

Niagara Irrigation Initiative Project

Technical Memorandum # 1 – Evaluation Factors and Criteria, Evaluation of Alternatives, and Preferred Solution Feasibility, Costing, and Preliminary Design Study August 2026



Possibility grows here.



Ontario
Tender Fruit
Growers



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Authors

Report Prepared By:



Nooshin Dadgar, P.Eng.
Water Resources Engineer



Rohan Hakimi, M.A.Sc., P.Eng.
Water Resources Engineer

Report Reviewed By:



Karl Grueneis, B.A.
Senior Environmental Planner



Pierre Roy
Irrigation Engineer

Report Approved By:



Pippy Warburton, P.Eng.
Project Manager

Prepared for:

Regional Municipality of Niagara

Prepared by:

AECOM Canada ULC
50 Sportsworld Crossing Road, Suite 290
Kitchener, ON N2P 0A4
Canada

T: 519.650.5313
aecom.com

Revision History

Rev #	Revision Date	Revised By:	Revision Description
01	Feb 2026	All	Initial Draft Revision
02	March 2026	All	2 nd Draft
03	August 2026	All	3 rd Draft
04	TBD	All	Final

Distribution List

PDF Required	Association / Company Name
✓	Regional Municipality of Niagara
✓	AECOM Canada ULC
	Town of Niagara-on-the-Lake

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1. Introduction

Niagara is one of only a few areas in Canada with climate and soil conditions suitable for high value crops such as grapes and tender fruit. However, the impacts of climate change, including drought conditions, have highlighted the need for improved irrigation infrastructure across Niagara. Previous studies have identified that there is significant room for increased yields of high value crops throughout the region. However, difficulties in accessing irrigation water and capital funding to build water delivery systems is preventing expansions.

Through these previous studies a need has been identified for a new piped system in the Lincoln/St. Catharines area below the Niagara Escarpment and for upgrades and enhancements to the existing open channel system in the Town of Niagara-on-the-Lake.

The overall Niagara Irrigation Initiative Project (“Project”) includes two separate components, both of which are being undertaken and managed concurrently by Niagara Region Staff on behalf of the Project Steering Committee:

- A Feasibility, Costing, and Preliminary Design Study for a new communal piped irrigation system in Lincoln/St. Catharines below the Niagara Escarpment
- Engineering work to support upgrades and enhancements to the existing irrigation system in the Town of Niagara-on-the-Lake

A Project Steering Committee (“Steering Committee”) was established in late 2024 to directly oversee the Project. The Steering Committee is undertaking the Project on behalf of the growers, producers, agricultural community, and others who will benefit from new and upgraded irrigation systems in the Region. The Steering Committee includes Regional Staff, grower and municipal representative from Niagara-on-the-Lake, Lincoln, and St. Catharines, as well as a representative from Grape and Tender Fruit Ontario Limited (GTFOL) and Regional Council. The Ontario Ministry of Agriculture, Food, and Agribusiness (OMAFRA) and Canada Infrastructure Bank (CIB) are also participating on the Steering Committee.

In addition to being a member of the Steering Committee and a project funder, Niagara Region Staff is undertaking project management and technical support for the overall Project on behalf of the Steering Committee.

1.1 Purpose and Overview of the Study

The purpose of the Feasibility, Costing, and Preliminary Design Study (“Study”) is to advance the previous irrigation planning work completed in Niagara by providing the

following information in support of a potential new communal piped irrigation system in Niagara below the Niagara Escarpment between Beamsville and St. Catharines:

1. A recommendation for the most efficient, environmentally sound and cost-effective irrigation system. It has been confirmed that the undertaking does not require an environmental assessment in accordance with the Ontario Environmental Assessment Act. However, an EA like evaluation of Source Water and Watermain Alignment Options is being undertaken. The evaluation will include considerations of impacts on water quantity and water quality among the full range of environmental considerations.
2. A preliminary design (10% engineering design) of the preferred alternative. This would include a preliminary pipe network and pipe sizes, as well as a preliminary design of source water option(s) including pumping station locations/requirements, draft intake design, property requirements, etc. The preliminary design will be supported by hydraulic modelling.
3. Cost estimate study including capital, operation, life cycle, and design costs.
4. Comprehensive consultation and engagement program including growers, stakeholders, public, government and regulatory agencies, and Indigenous Groups and organizations.
5. A consideration of next steps and implementation, for example, next steps in the design and construction process and a possible phasing strategy which considers logical buildout of the system and anticipated demand.

Deliverables for the Study will include a series of technical memorandums and other documents at each project phase. These individual documents will then be combined into a Final Project Report.

Table 1: List of Deliverables

Tasks	Deliverable
Evaluation of Alternatives	Technical Memorandum # 1 – Evaluation Factors and Criteria, Evaluation of Alternatives, and Preferred Solution & Risk Assessment Matrix
Preliminary Engineering	Technical Memorandum # 2 – Preliminary Design Summary Report including Hydraulic Modelling Report & 10% Engineering Design Drawings
Cost Estimate	Technical Memorandum # 3 – Cost Estimate Study
Consultation and Engagement	Technical Memorandum # 4 – Consultation and Engagement Summary Report
Considerations for Implementation	Technical Memorandum # 5 – Considerations for Implementation
Project Completion	Final Project Report

1.2 Purpose of this Technical Memorandum

The purpose of this Technical Memorandum (“Tech Memo #1”) is to document the identification and evaluation of source water and alignment options and the identification of the recommended solution. Tech Memo #1 also includes an overview of the water demand, risk assessment, and consultation activities that were completed during this phase of the project.

The information and conclusions presented in Tech Memo #1 forms the basis for moving the Study forward into subsequent stages, including preliminary design, cost estimates, and considerations for implementation.

1.3 Problem/Opportunity Statement

Niagara’s agricultural sector is a key economic driver, supported by unique climatic and soil conditions that enable the production of high-value crops. However, evolving environmental and infrastructure challenges are limiting the Region’s ability to fully realize this potential. The following outlines the key problem and corresponding opportunity that this Study seeks to address.

1.3.1 Problem

Niagara is one of only a few areas in Canada with climate and soil conditions suitable for high value crops such as grapes and tender fruit. However, the impacts of climate change, including drought conditions, have highlighted the need for improved irrigation infrastructure across Niagara. Previous studies have identified that there is significant room for increased yields of high value crops throughout the Region. However, difficulties in accessing irrigation water and capital funding to build water delivery systems is preventing expansions.

1.3.2 Opportunity

This Study will advance previous irrigation work, recommend the most efficient, environmentally sound, and cost-effective design of a piped, communal irrigation system between Beamsville and St. Catharines below the escarpment, and provide the foundational technical, financial and engagement work needed to move toward detailed design and implementation.

2. Background

2.1 Study Area

The Study Area (**Figure 1**) is situated within the north central part of the Niagara Peninsula, a unique geographic landform bounded by Lake Ontario to the north, Lake Erie to the south, and the Niagara River to the east. The Study Area primarily includes lands immediately above the Niagara Escarpment and along Lake Ontario, stretching from the community of Beamsville eastern urban boundary through the Town of Lincoln including lands within the City of St. Catharines lying outside of its west urban boundary. The Study Area is organized into three proposed districts: St. Catharines (SCS), Jordan–Ninth Street (JNS), and Vineland–Beamsville (VBS). The topography is defined by a gradual northward slope from the base of the Escarpment (the "Bench" and "Lowlands") down to the shores of Lake Ontario.

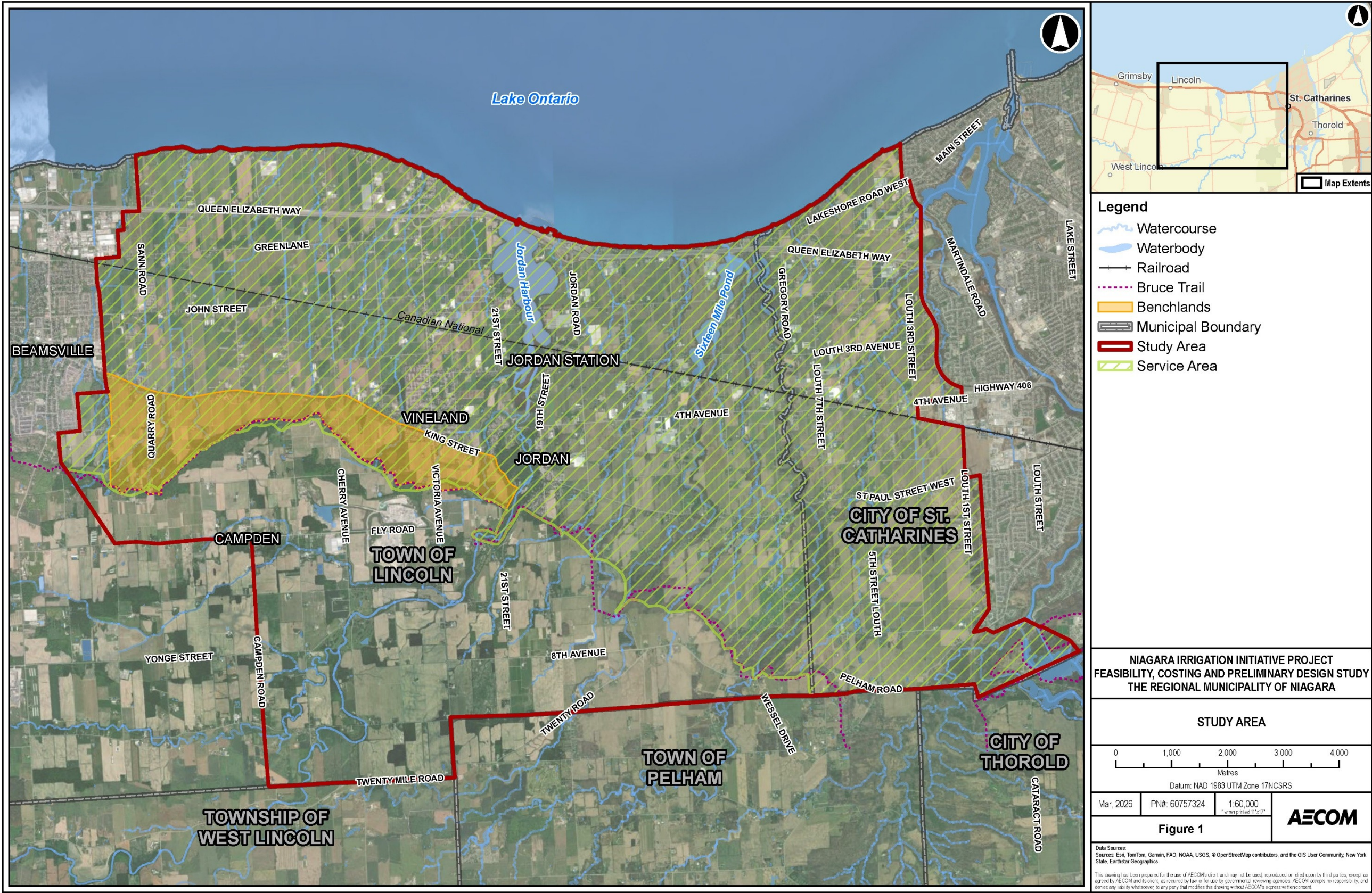
2.1.1 Quaternary Geology and Historical Glacier Activity

The surficial landscape of northern Niagara is a direct result of Quaternary glacial activity, specifically the recession of the Laurentide Ice Sheet approximately 12,000 years ago. A primary geological feature in the southern portion of the Study Area is the Fonthill Kame-Delta Complex. This landform consists of massive, thick deposits of sand and gravel transported and deposited by glacial meltwater. While historical studies have identified the Eriqan bedrock channel as a significant pre-glacial buried valley, recent local assessments do not consider it a primary hydrogeological driver for current irrigation supply. The areas below the Escarpment are characterized by glaciolacustrine deposits. This has resulted in a distinct soil distribution where sandy soils (often preferred for tender fruits) and heavier clay-based soils (often utilized for vineyards) form a complex mosaic across the landscape.

2.1.2 Surficial Geology and Soil Classification

The region's "specialty crop lands" are defined by their unique soil and climate conditions, which are among the only such areas in Canada suitable for high-value viticulture and horticulture. The Study Area proposed service area (refer to **Figure 1**) encompasses Canada Land Inventory Classes 1 through 3 generally extending from the toe of the Niagara Escarpment to Lake Ontario. Classes 1 and 2 are primarily associated with tender fruit production due to their superior drainage and texture, while Class 3 lands are traditionally suited to grapes. The underlying bedrock consists primarily of the Lockport Formation (dolostone) and the Guelph Formation. It should be noted that in the south-western portion of the study area there is an area with bedrock as shallow as 2.5 metres (see **Figure 2**).

Figure 1: Study Area





In certain zones, the upper portions of this dolostone bedrock serve as secondary aquifers, though they often exhibit high concentrations of total dissolved solids, iron, and magnesium, making them less ideal for irrigation compared to surface water. While not part of the proposed service area, Study Area lands on top of the escarpment generally include Canada Land Inventory Classes 2 and 3.

2.1.3 Hydrology and Surface Water Framework

The Study Area's hydrological framework is dominated by three major boundaries: Lake Ontario, the Welland Canal, and the Ontario Power Generation (OPG) reservoirs. The local hydrology is defined by a series of north-south flowing watercourses that carry water from the Escarpment headwaters to Lake Ontario. Key watercourses include Twenty Mile Creek, Sixteen Mile Creek, and Fifteen Creek. While the region receives significant annual precipitation, summer water deficits during 1-in-10-year drought events can reach between 135 millimetres and 297 millimetres, far exceeding the natural soil-water holding capacity.

2.1.4 Hydrogeological Constraints

Previous investigations have considered groundwater as a potential irrigation source within the Study Area. However, it is largely considered unfeasible for large-scale communal use due to variable yields and water quality challenges. Based on previous studies the probability of establishing high-yielding bedrock wells is often less than 10% (The Canadian Geotechnical Society, Raw Water for Agricultural Irrigation Study Phase 2, Hydrogeological Assessment of West District Zone B and South District, Stantec, 2007) Existing groundwater demand already accounts for a significant portion of the sustainable recharge rate in areas like the Fonthill Kame-Delta Complex. Elevated levels of chloride and manganese in the bedrock aquifers often exceed the Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses.

2.1.5 Physical and Multi-Jurisdictional Characteristics of the Study Area

The proposed service area extends northerly from the Escarpment toe to Lake Ontario. This area is accordingly home to high-value agricultural specialty crop lands and a dense cluster of farms, producing grapes, tender fruit, and greenhouse products, that would benefit significantly from supplemental irrigation during dry periods to maintain predictable annual production and crop quality.

Key geographic and hydrological features of the Study Area include:

- **The Niagara Escarpment:** A significant topographic barrier that dictates infrastructure alignment but could also offer strategic gravity flow opportunities for moving water from source reservoirs at higher elevations to farmland below.
- **Diverse Raw Water Sources:**
 - Lake Ontario, via potential new intake locations in VBS, JNS and SCS districts (refer to **Figure 7**):
 - Lake Gibson and Lake Moodie, which are managed by Ontario Power Generation (OPG).
 - The DeCew Water Treatment Plant (WTP) reservoirs, part of the Regional drinking water supply system. This includes opportunities to potentially rehabilitate an existing historic gravity-fed municipal water pipeline (dating from 1875-1920) adjacent to the DeCew lower reservoir (see yellow pipe as part of Option C in **Figure 8**).
 - The Welland Canal and related feeder channels, managed by the St. Lawrence Seaway Management Corporation (SLSMC).
 - Local intermittent watercourses, such as Fifteen Mile and Sixteen Mile Creeks, which may provide small-scale or seasonal supply opportunities.
- **Multiple Municipal Jurisdictions:** The Study Area encompasses the local area municipalities of the Town of Lincoln and City St. Catharines, both which are in the Regional municipality of Niagara each presenting unique land use, regulatory, permitting, and infrastructure considerations.
- **Environmentally Sensitive Areas:** The Study Area includes Areas of Natural Scientific Interest (ANSIs), Provincially Significant Wetlands (PSWs), and significant woodlands, all of which require rigorous environmental planning policy compliance (see **Figure 3** to **Figure 7** below).

2.1.6 Agricultural Context

Niagara is one of Canada's most valuable specialty crop areas, producing grapes, tender fruit, and other high-value crops, also including a mature greenhouse sector. These crops are uniquely suited to the Region's soils and climate, and agriculture continues to be a cornerstone of the local economy. The sector contributes over \$1.4 billion annually to Niagara's Gross Domestic Product (GDP), with the grape and wine industry alone generating \$5.49 billion in provincial economic activity and supporting more than 22,000 full-time jobs. Sustaining these industries during drought periods depends on the availability of reliable irrigation to maintain yields and crop quality.

Figure 3: Environmentally Sensitive Areas – ANSI

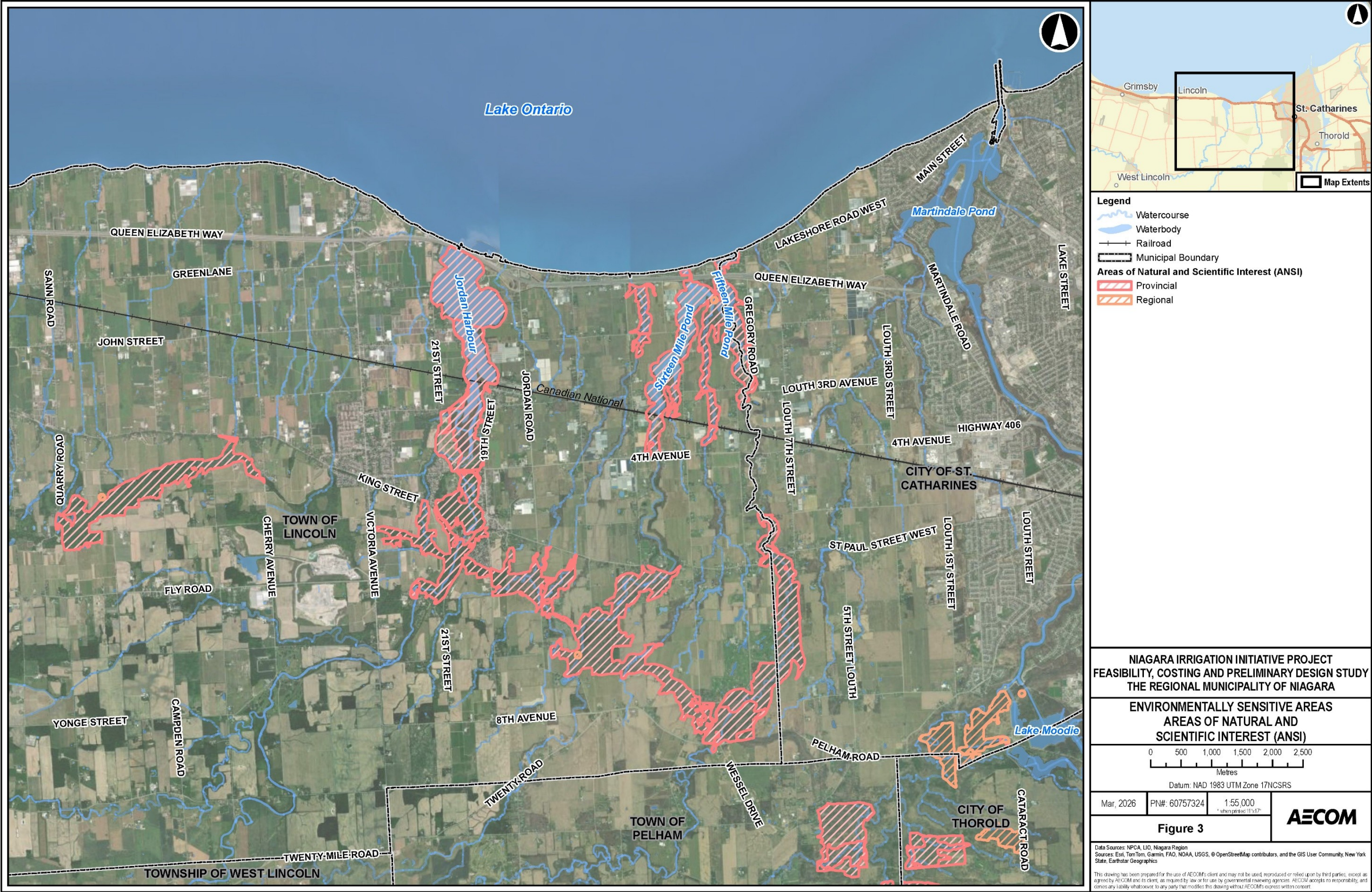


Figure 4: Environmentally Sensitive Areas – Policy Areas

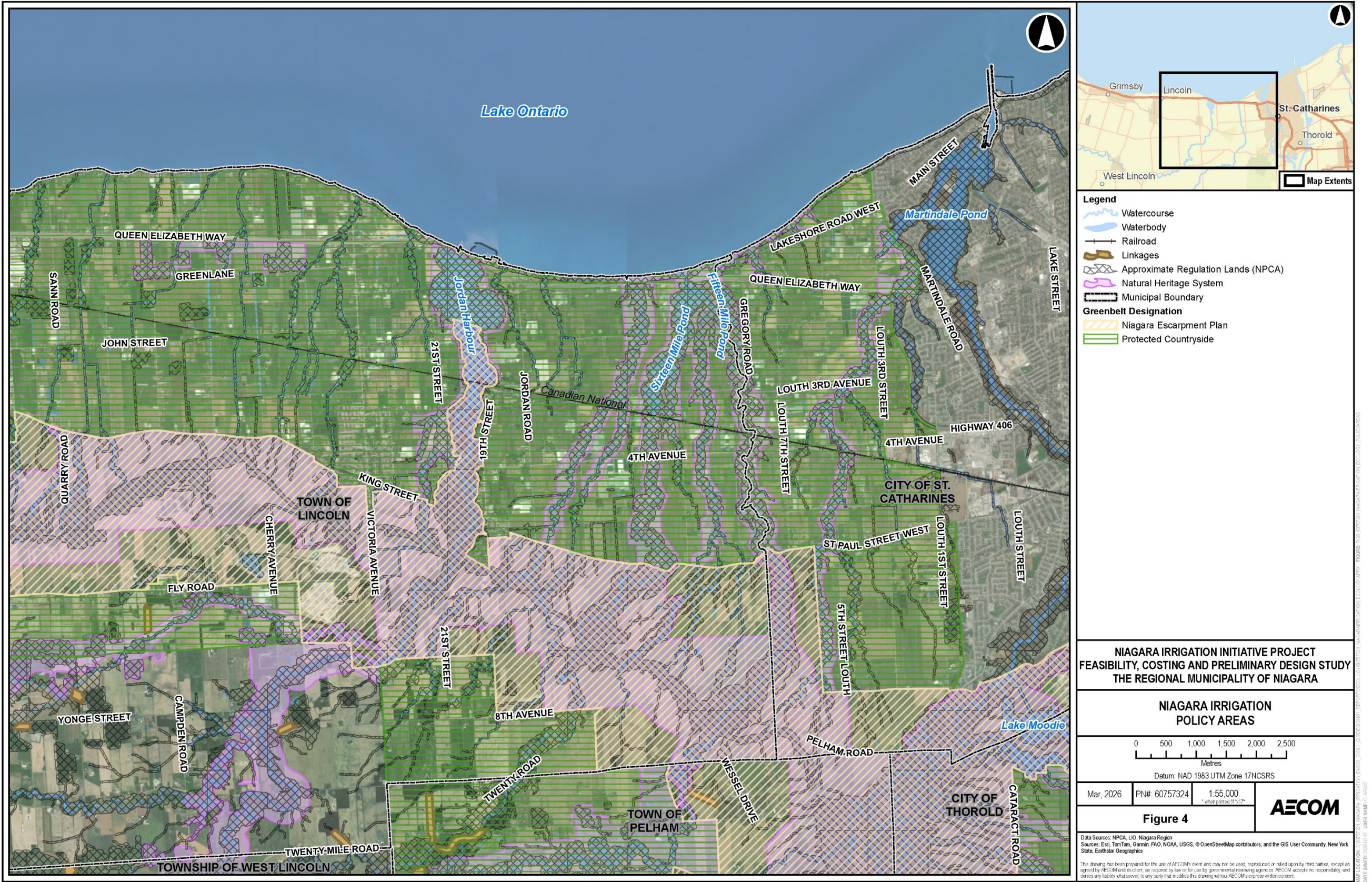


Figure 5: Environmentally Sensitive Areas – Specialty Agricultural Areas

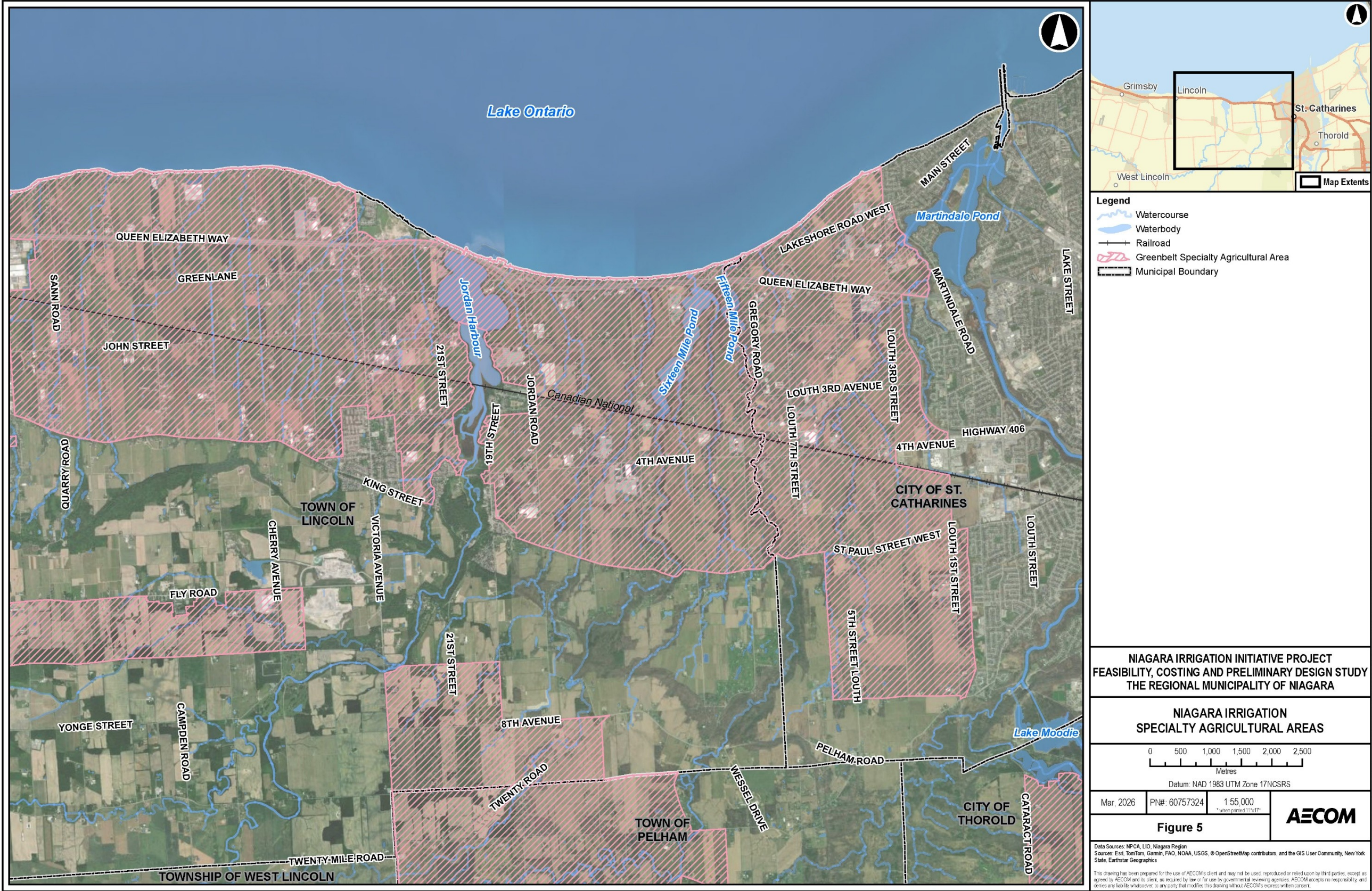


Figure 6: Environmentally Sensitive Areas – Wetlands

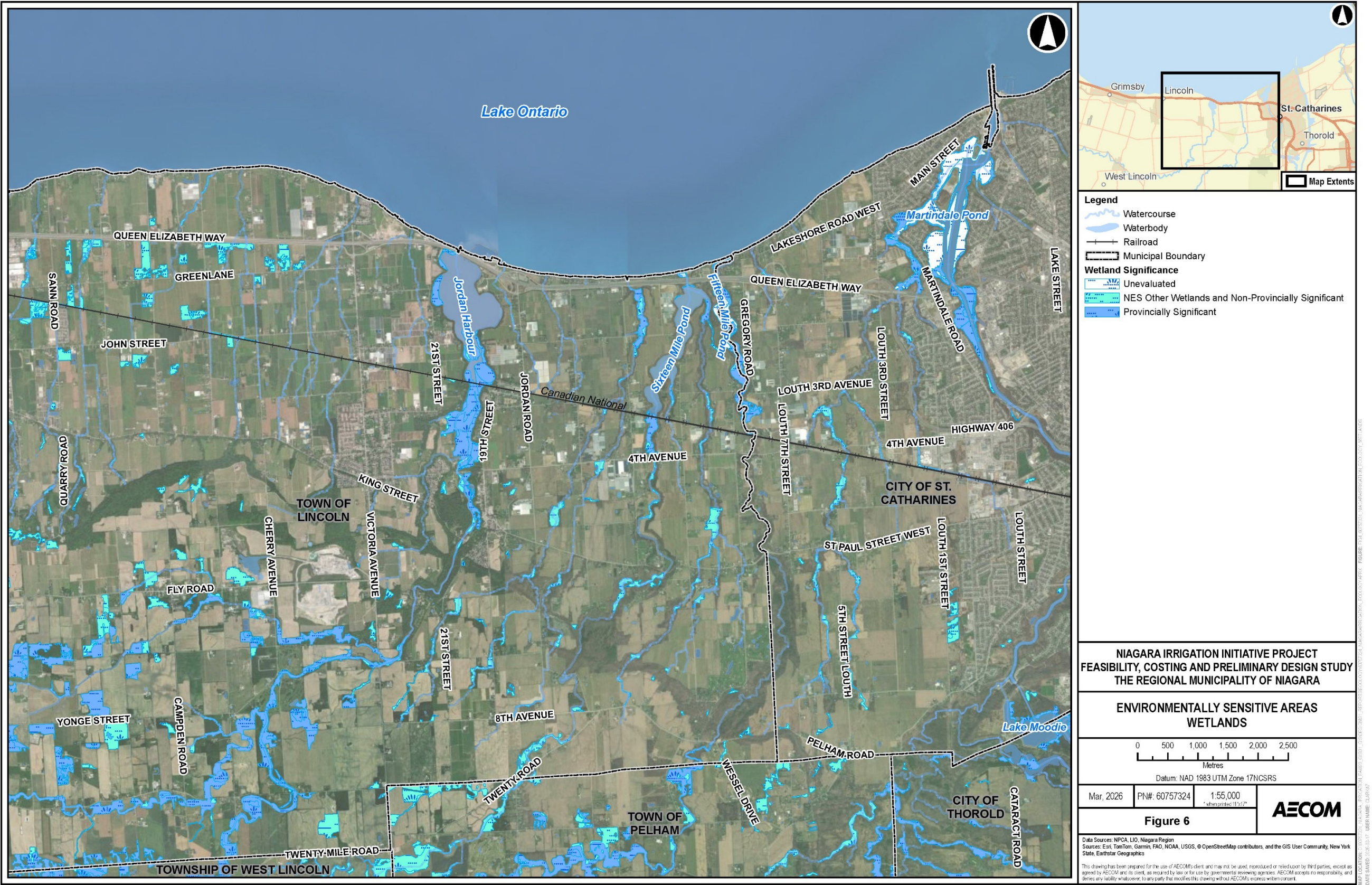
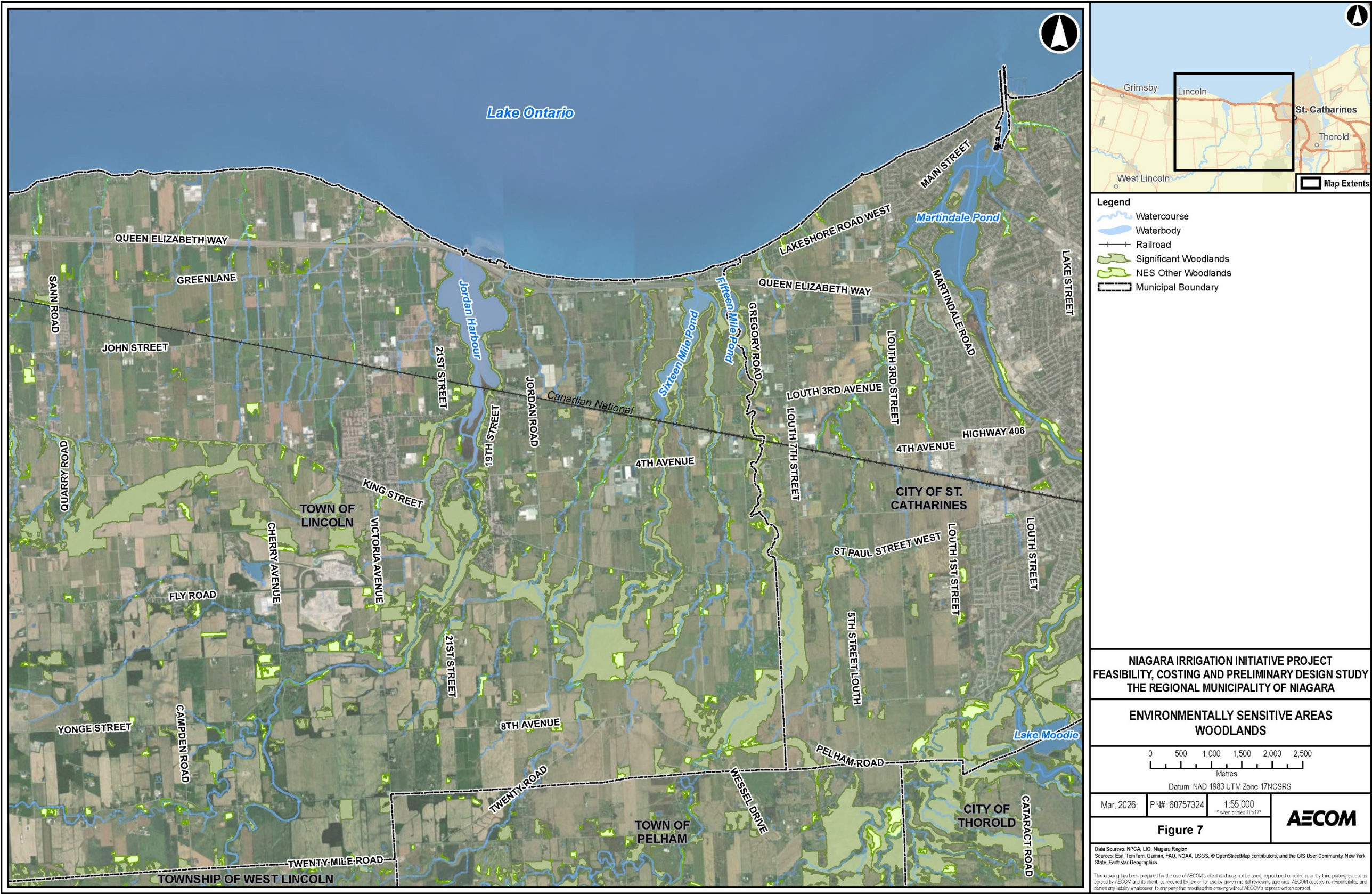


Figure 7: Environmentally Sensitive Areas – Woodlands



2.1.7 Climate Challenges and Water Demand

In recent years, climate change has intensified pressures on growers. Longer drought periods and unpredictable weather patterns have increased the vulnerability of tender fruit and grape production. The 2016 drought event, for example, resulted in an estimated \$14.5 million loss in farm output for tender fruit. Studies suggest that drought cycles can reduce marketable yields by up to 30%, while young orchards and vineyards may suffer complete loss without irrigation. This increasing risk has heightened the demand for a secure, long-term irrigation solution to safeguard both farm viability and regional food security.

2.2 Previous Investigations

Several studies have been conducted to assess the necessity, potential advantages, and most suitable governance system for the development of a communal irrigation system, including:

- [Raw Water for Agricultural Purposes Study](#) (mid-2000s): Identified technically feasible, financially responsible, and environmentally sustainable options for supplying raw water to Niagara’s agricultural community.
- [Niagara on The Lake Irrigation Master Plan \(2021\)](#): Provides a comprehensive assessment of existing irrigation practices, constraints, and future water demands within the Town. The plan also outlines phased implementation strategies, cost considerations, and governance models to support the development of a coordinated irrigation system.
- [Niagara Irrigation Strategic Action Plan](#) (2016): Addressed water security needs for Niagara growers and developed a strategic framework for irrigation infrastructure.
- [Niagara Irrigation Governance Report – Phase 1 & 2](#) (2021–2022): Researched and recommended governance models for a sustainable irrigation system in Niagara, including a “utility-style” governance model.
- Additionally, from 2020 to 2024, over 100 interviews were conducted with growers in St. Catharines, Jordan, and Vineland-Beamsville to understand grower needs and preferences for a communal irrigation system method.

2.2.1 Raw Water for Agricultural Purposes Study (mid-2000s)

The Raw Water for Agricultural Purposes Study (2005–2007) by Stantec and Weather Innovations provided the scientific basis for irrigation sizing in Niagara. They quantified

crop-specific irrigation requirements using evapotranspiration methods, field monitoring, and land use analysis:

- **Peak demands** ranged from 4.6 millimetres per day for tender fruits to 7.0 millimetres per for greenhouses.
- **Total daily demands** were estimated at 147,354 m³/day for the West District A (Lincoln/St. Catharines, below the escarpment). The total water demand was produced by applying the study's irrigation-depth assumptions to the crop areas in West District A, converting mm to m³ and converting to daily flow using the 2-day irrigation set / schedule and efficiency factors.
- Open channel conveyance increased water losses by ~33% compared to pipelines.

It should be noted that the water demand requirements and the estimated capital, operation and maintenance costs are being reassessed as part of this Study.

2.2.2 Niagara-on-the-Lake Irrigation Master Plan (2021)

The Niagara-on-the-Lake Irrigation Master Plan (2021) further demonstrated how communal irrigation systems can be designed around 2-day irrigation sets (51–76 mm every two weeks) to meet crop needs during both average and drought conditions. This specific methodology was dictated by a combination of technical requirements and local operational constraints.

- **Legislative Pumping Limits:** The Town of Lincoln handles noise control under By-Law No. 2019-44. Section 3.1 (j) states restrictions on noise do not apply to agricultural operations carried on as normal farm practices (including irrigation pumping) in accordance with the Farming and Food Production Protection Act. Similarly, under City of St Catharines Noise By-law No. 95-198 normal farm practices are also exempt from municipal noise restrictions. Application Requirements: To apply the target depth of 51 mm to 76 mm using standard equipment (such as guns or sprinklers), a field requires approximately 24 hours of total pumping time. There are no noise by-law compliance issues.
- **Temporal Sizing:** Consequently, providing the necessary volume within the restricted 12-hour daily window requires a two-day operational timeframe (or "set") per field to complete a single irrigation event. It is important to note that this 2-day "set" framework and its associated demand metrics belong to the modelling approaches of previous consultants.

While the current assessment utilizes updated scientific methodologies (such as CROPWAT 8.0 and climate data from 2003–2024), the historical figures will be

maintained as a primary referential baseline. By comparing the newly recalibrated requirements against these foundational data points, the Niagara Irrigation Initiative remains anchored in the long-term service objectives established by the Region while increasing the precision of the volumetric demands for modern infrastructure design.

2.2.3 Niagara Irrigation Strategic Action Plan (2016)

The Niagara Irrigation Strategic Action Plan (2016) was developed to address growing concerns around water security for agricultural producers across the Niagara Region. The plan assessed existing irrigation practices, water availability, and projected future demands under changing climatic conditions, particularly increased variability in precipitation and more frequent droughts. It identified key challenges, including limited access to reliable water sources, fragmented infrastructure, and the absence of a coordinated regional approach to irrigation. Building on this assessment, the Plan established a strategic framework to guide the development of irrigation infrastructure and management in Niagara. It outlined priority actions such as identifying viable water sources (e.g., surface water, groundwater, and Lake Ontario), evaluating conveyance and storage options, and promoting collaborative approaches among stakeholders. The Plan also emphasized the importance of governance, funding mechanisms, and policy support, laying the groundwork for subsequent studies and initiatives aimed at implementing a sustainable, region-wide irrigation system.

Building on this assessment, the Plan established a strategic framework to guide the development of irrigation infrastructure and management in Niagara. It outlined priority actions such as identifying viable water sources (e.g., surface water, groundwater, and Lake Ontario), evaluating conveyance and storage options, and promoting collaborative approaches among stakeholders. The Plan also emphasized the importance of governance, funding mechanisms, and policy support, laying the groundwork for subsequent studies, governance initiatives, and implementation planning aimed at developing a sustainable, region-wide communal irrigation system in Niagara.

2.2.4 Niagara Irrigation Governance Report – Phase 1 & 2 (2021–2022)

The Niagara Irrigation Governance Report (Phases 1 and 2) builds on earlier strategic work by examining how a regional irrigation system could be owned, operated, and managed in a sustainable and effective manner. Phase 1 focused on reviewing existing governance models from comparable jurisdictions, assessing their applicability to Niagara, and identifying key considerations such as accountability, financial sustainability, stakeholder representation, and regulatory requirements. It also included engagement with local stakeholders to understand governance preferences and concerns.

Phase 2 advanced this work by evaluating and refining preferred governance structures, ultimately recommending a “utility-style” model for Niagara. This model envisions a centralized entity responsible for the delivery and management of irrigation services, similar to municipal water or energy utilities, with a focus on cost recovery, operational efficiency, and long-term asset management. The report also outlines potential implementation pathways, including institutional setup, funding strategies, and transition considerations, providing a critical foundation for moving from planning to execution of a regional irrigation system.

2.2.5 Outside the Barn Solutions Study and Engagement (2020-2023)

The Outside the Barn Solutions Study and Engagement efforts (2020-2023), commissioned by the Niagara Irrigation Committee of the Whole, involved extensive grower engagement and technical scoping activities. More than 100 interviews were conducted with grape, tender fruit, nursery, greenhouse, and winery operators to establish demand assumptions and system preferences. The results of this work led to the preliminary assumptions outlined in the project scoping documents which are as follows:

- Most of the irrigation pipes should be routed along existing municipal, regional, or provincial road allowances.
- The preferred irrigation system should minimize property or easement acquisition requirements.
- The preferred irrigation system should minimize significant MTO, railway, or waterbody crossings.
- Preference is given to a looped system design.
- The irrigation pipes should be pressurized and provide a minimum of 40 PSI at all water taking locations to allow the potential for direct use of pipeline for drip irrigation with no on-farm pumping.
- Design should consider year-round, below frost, underground system to be designed for a 50-year lifecycle.
- Irrigation water is raw, untreated, and non-potable. However, intake water must be filtered/screened to the appropriate level, include zebra mussel control, and be circulated as much as possible to keep it fresh as possible. Intake design should also consider frazil ice, algae blooms and potential contaminants from the source water.
- All shares/taps end in a valve that controls flowrates and meters volumes used.

- Each of the three districts (St. Catharines [SCS], Jordan–Ninth Street [JNS], and Vineland–Beamsville [VBS]) has the same number of 240 water services at 25 US gallons per minute each, for a maximum of 6,000 gallons per minute being pumped at any time.
- All 240 services pump 24/7 at the maximum rate of 25 gallons per minute.

The above assumptions were considered as a starting point for this Study and are to be reviewed and validated by the study process.

2.3 Regulatory Framework

The Study Area is within a complex environment, intersecting municipal, provincial, federal, and railway jurisdictions, as well as areas regulated by the Niagara Escarpment Commission (NEC) and Niagara Peninsula Conservation Authority (NPCA).

The following provides an overview of the regulatory framework that would need to be considered in determining the feasibility of a communal irrigation system in the Study Area.

2.3.1 Permit to Take Water (PTTW) and Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement (SWRA)

The Study Area is located entirely within the Great Lakes–St. Lawrence River Basin and is therefore subject to Ontario's Permit to Take Water (PTTW) framework under the Ontario Water Resources Act, as well as the Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement (SWRA). Together, these frameworks establish the primary regulatory considerations governing the development of a communal irrigation system.

Under the Ontario Water Resources Act, a PTTW is required for any water taking exceeding 50,000 litres per day from surface water or groundwater sources. The Ministry of the Environment, Conservation and Parks (MECP) administers the program using a risk-based classification system, where water takings are categorized as Category 1, 2, or 3 based on withdrawal volume, consumptive use, duration, and potential environmental impacts.

Category 1 permits represent low-risk, small-scale takings, while Category 2 permits apply to moderate-risk or short-term takings requiring professional assessment and apply to water takings up to 19 million Litres per day. Consumptive water use exceeding 19 million Litres per day, averaged over any rolling 90-day period, triggers additional regulatory review requirements, which constitutes a Category 3 permit. Category 3 permits represent the highest level of regulatory oversight and apply to large-scale,

long-term, and consumptive water uses with the greatest potential to affect the environment or other users.

Based on preliminary demand estimates and consultation with MECP, the proposed communal irrigation system is expected to require a Category 3 PTTW. This reflects the anticipated high withdrawal volumes, long-term operation, and the consumptive nature of irrigation demands, where most water is not returned to the source. Category 3 applications require detailed technical studies, including environmental impact assessment, cumulative effects analysis, and the development of monitoring and mitigation plans. While this results in a more rigorous approval process, it is consistent with existing irrigation systems in Niagara-on-the-Lake and is not considered a barrier to project feasibility. Instead, it defines the level of technical rigor required for future design and permitting phases.

MECP has confirmed (**Appendix B**) that PTTW categorization and regulatory review are based on the total cumulative withdrawal and consumptive use at the project level, not on individual intakes. As such, dividing a system into multiple intakes or districts may not negate the Category 3 classification if the overall project serves a common purpose and exceeds the Category 2 regulatory threshold.

MECP has recommended that Category 3 PTTW applications include documentation of any consultation undertaken with Indigenous communities in relation to the proposed work. MECP has also advised that, as project plans become more refined, proponents may wish to request a pre-submission consultation meeting with the Ministry's Technical Support Section. Such meetings provide an opportunity to obtain technical direction and confirm study scope and permit expectations in advance of a formal application submission.

2.3.1.1 Key Permitting Considerations

Engagement with MECP was undertaken to confirm regulatory requirements and clarify key permitting considerations for the proposed system. The following points summarize the Ministry's guidance:

- **Monitoring and Reporting**

The SWRA requires all Great Lakes jurisdictions to submit annual water use information to the Great Lakes Regional Water Use Database. In Ontario, this reporting is largely based on information collected through the PTTW program.

- **Permitting Approach for Multiple Intakes**

If multiple intakes are part of the same system and serve a unified purpose (e.g., irrigation), MECP can issue a consolidated PTTW covering all sources, with individual intake limits and monitoring conditions.

■ **Demand and Capacity Assessment**

PTTWs are assessed based on maximum authorized takings, rather than average operational demand. Both individual intake capacities and total system withdrawals are considered.

■ **Staged Implementation**

Phased implementation does not eliminate the need for comprehensive permitting. Future stages can be incorporated through staged conditions within the original permit or through subsequent amendments.

■ **Use of Existing Infrastructure**

Repurposing existing infrastructure (e.g., pipelines or reservoir connections) does not eliminate the need for a valid PTTW if withdrawal thresholds are exceeded. Historical approvals or water rights may provide context but are not substitutes for current regulatory approval.

■ **Review Timelines**

The MECP service standard for PTTW review is approximately 180 days; however, timelines may be extended where complex technical review, consultation, or binational notification is required through the prior notice process (see **Appendix B**). Pre-submission consultation is recommended to support efficient review. Preliminary discussions with MECP (December 12, 2025) confirmed these expectations.

2.3.1.2 Implications for the Study

At this feasibility stage, no regulatory conditions have been identified that would preclude the development of a communal irrigation system within the Study Area. Based on preliminary demand estimates and agency consultation, it is expected that the future system will require a Category 3 Permit to Take Water and may trigger SWRA Prior Notice requirements depending on final consumptive use levels. These requirements are consistent with existing communal irrigation systems operating within Niagara Region.

Accordingly, the regulatory framework informs, but does not limit, the evaluation of source water options and system configurations presented in this Study. The anticipated permitting requirements reinforce the need for robust demand justification, efficient water use strategies, and phased implementation planning in subsequent project stages.

2.3.2 Other Regulatory Considerations

In addition to provincial water-taking requirements, the Study Area is subject to several land use and environmental legislative acts and regulations that influence the feasibility, costing, and preliminary design of a communal irrigation system.

2.3.2.1 Fisheries Act (Canada)

The *Fisheries Act* prohibits activities that cause the death of fish (Section 34.4) or the harmful alteration, disruption, or destruction (HADD) of fish habitat (Section 35). Where standard mitigation measures cannot adequately avoid these effects, a Request for Review must be submitted to Fisheries and Oceans Canada (DFO). If impacts can be avoided, DFO may issue a letter outlining required mitigation measures; where avoidance is not possible, an Authorization under subsection 35(2), including offsetting measures, may be required.

Relevance: Water withdrawals, intake structures, or construction near watercourses for the irrigation system may trigger compliance with fish habitat protection and require authorization under the Act.

2.3.2.2 Species Conservation Act (Ontario)

Ontario's *Species Conservation Act, 2025* (SCA) prohibits the killing, harming, capture, or possession of species listed on the *Protected Species in Ontario List*, except where activities are authorized through regulation, registration, or permits. In June 2025, the *Protecting Ontario by Unleashing our Economy Act, 2025* (Bill 5) was enacted, laying the groundwork for the SCA, which came into force on March 30, 2026, and repealed the *Endangered Species Act, 2007*.

Permits may be required for activities that may adversely affect species at risk (SAR).

Relevance: Field work and construction in areas with SAR occurrences may need assessment, avoidance, or permitting for habitat disturbance.

2.3.2.3 Species at Risk Act (Canada)

SARA monitors and protects federally listed species, provides recovery strategies for Extirpated, Endangered or Threatened species and manages species of Special Concern. For most terrestrial species, the general prohibitions under SARA apply primarily on federal lands for species listed as Extirpated, Endangered or Threatened. Aquatic species and migratory birds listed on Schedule 1 are protected wherever they occur in Canada. In certain circumstances, additional protections may apply on non federal lands through critical habitat orders, emergency orders, or safety net provisions.

Relevance: If the project interacts with federal lands, waterways, migratory birds or requires federal approvals, SARA screening will be necessary.

2.3.2.4 Migratory Birds Convention Act (Canada)

This Act prohibits the possession, destruction, and harm of migratory birds, their nests while there is a live bird or a viable egg in it for most migratory birds, and regulates activities during sensitive breeding periods.

Relevance: Vegetation clearing for pipelines, intakes, or distribution infrastructure must avoid nesting season or follow mitigation measures. Registration under the Abandoned Nest Registry and permits are required to remove potential or confirmed nests of the 18 species listed on Schedule 1 if removal is required before the end of designated wait periods for each respective species to confirm use of nest.

2.3.2.5 Navigable Waters Act / Canada Shipping Act

These acts regulate works that may interfere with navigation or vessel safety in navigable waters.

Relevance: Any irrigation infrastructure including the construction and operation of Lake Ontario intakes requires approvals to protect navigational use.

2.3.2.6 Ontario Heritage Act / Cemeteries Act

These acts protect cultural heritage resources, archaeological sites, and registered cemeteries.

Relevance: Ground-disturbing works (pipeline trenches, pumping stations) may require archaeological assessments and protocols for encountering burial sites.

2.3.2.7 Fish and Wildlife Conservation Act (Ontario)

This Act regulates the protection, possession, sale, transport, and management of wildlife in Ontario, including species not covered under the Migratory Birds Convention Act, 1994 (MBCA). Provides specific protections for raptors and other non-MBCA protected bird species, with nest removal only permitted through Ontario Ministry of Natural Resources (MNR) authorization. Also protects dens of most furbearing mammals (excluding fox and skunk) and beaver dams, which may only be damaged or destroyed by licensed trappers.

Relevance: Construction and land alteration must avoid harming wildlife and may require timing windows or relocation protocols.

2.3.2.8 Clean Water Act (Ontario)

The Clean Water Act (CWA) protects municipal drinking water sources through source protection plans and risk management measures. Under the CWA the Niagara Peninsula Source Protection Plan maps out vulnerable areas referred to as intake protection zones (IPZs) around municipal drinking water intakes. With respect to the Niagara Irrigation Initiative, the nearest municipal drinking water treatment plant intake is the Niagara Region DeCew Falls WTP located at 2700 DeCew Road (within the Study Area, on top of the escarpment). The second municipal drinking water treatment plant intake is the Niagara Region Grimsby Water Treatment Plant (WTP), located at 304 North Service Road (located approximately three km west of the Study Area, on Lake Ontario).

Relevance: Irrigation withdrawals or infrastructure near municipal supplies must be assessed for potential impacts on vulnerable areas, including IPZs. The design phase of the irrigation system must ensure that the proposed locations (including construction and operation) for new raw water intakes, pumping stations and pipe alignments do not interfere with or compromise the above noted WTP IPZs.

2.3.2.9 Public Lands Act (Ontario)

This Act governs the use and disposition of Crown land, including permitting for occupation or alteration.

Relevance: Any irrigation infrastructure proposed on or across Crown land will require review and potential authorization. This would include any new intakes on the Lake Ontario lake bottom.

2.3.2.10 Public Transportation and Highway Improvement Act

This Act regulates works occurring within or adjacent to provincial highway corridors.

Relevance: Pipeline crossings of provincial highways or access improvements will require MTO permits and design compliance. This particularly applies to irrigation pipes that cross the QEW.

2.3.2.11 Tree and Woodland By-laws

This municipal by-law governs the protection and preservation of woodlands in Niagara and regulates tree removal.

Relevance: Tree clearing for irrigation pipelines or facilities may require woodland assessments to determine if the project is exempt from the by-law.

In addition to the Regional Woodland Conservation By-law, local municipalities within Niagara Region have implemented tree protection by-laws:

■ **Town of Lincoln – Private Property Tree By-law (By-law No. 2025-40):**

This recently adopted by-law regulates the injury and removal of trees on private property within the Town's urban area. It requires landowners to obtain permits for removing trees above specified size thresholds and generally mandates tree replacement or compensation. The by-law is intended to prevent unnecessary tree loss and support long-term urban canopy growth.

■ **City of St. Catharines – Public Tree By-law (By-law No. 2017-326):**

This existing by-law regulates trees located on City property, including boulevards, parks, and other municipal lands. It requires municipal approval and permits for the removal or injury of City-owned or boundary trees and establishes protections to ensure public safety and preservation of the urban forest.

Relevance: If tree clearing or disturbance (e.g., irrigation pipelines, pumping stations, or access routes) is anticipated, the project planning should consider the need for permits, arborist assessments, and potential mitigation or compensation measures, depending on tree ownership, location, and woodland designation.

2.3.2.12 Noise and Vibration By-laws

Municipal by-laws limit allowable noise and vibration levels during construction and operation.

Relevance: Pump stations, construction activities, and equipment use must comply with local noise and vibration restrictions.

Local municipal noise by-laws were reviewed at a high level to understand their potential influence on system operation and design assumptions, particularly with respect to allowable pumping duration. Historically, irrigation operations in parts of Niagara have been constrained to approximately 12 hours per day, largely due to noise restrictions associated with diesel-powered on-farm pumping equipment and prevailing agricultural practices.

Previous studies and technical documentation including the Niagara Irrigation Strategic Plan and district-level assessments commonly assumed a 12-hour irrigation window when estimating instantaneous flow requirements. This assumption directly affects required pipe sizes and pumping capacities, as delivering the same daily volume over a shorter period necessitates higher flow rates.

However, more recent planning initiatives and stakeholder input indicate a shift toward continuous (24-hour) operation as a desired Level of Service for a modern communal irrigation system. This shift is primarily associated with the transition to electrified pumping infrastructure, which significantly reduces operational noise and improves compatibility with municipal noise regulations. Growers have identified 24/7 operation as critical for improving irrigation efficiency during peak drought conditions.

A high-level review of applicable noise by-laws across Niagara municipalities indicates variability in restrictions. Some by-laws focus on general prohibitions against unreasonable noise, with time-of-day limits primarily applicable to residential zones, while others include exemptions for municipal or regional infrastructure. Importantly, many of the historic constraints appear to relate to individual on-farm pumping practices, rather than centralized, purpose-built pump stations designed to modern acoustic standards.

It should be noted that under the Farming and Food Production Act (FFPPA) agricultural operations are protected from local noise by-law prosecutions and nuisance lawsuits if their activities are considered normal farm practices. Under the FFPPA normal farm practices are consistent with standards followed by similar agricultural operations. This would include farm machinery noise from tractors, harvest equipment and irrigation pumps as they are essential to the “expectation of gain or reward” for the farm.

For the purposes of this report, water demand calculations remain independent of delivery constraints and therefore assume that required daily irrigation volumes are unchanged regardless of pumping duration. The implications of delivering these volumes over 12 hours versus 24 hours, such as impacts to flow rates, pipe sizing, energy use, and compliance with municipal noise by-laws will be examined in more detail in Technical Memorandum #4 (Implementation Considerations). That memorandum will address operational strategies, pump station electrification, noise mitigation measures, and potential regulatory co-ordination required to support extended or continuous operation.

2.3.2.13 Niagara Escarpment Commission (NEC)

Portions of the Study Area, particularly infrastructure that may traverse the Niagara Escarpment or Escarpment Plan Area, are subject to the Niagara Escarpment Planning and Development Act and the Niagara Escarpment Plan (NEP), administered by the Niagara Escarpment Commission (NEC).

The Niagara Escarpment Plan (NEP) establishes land use designations intended to protect the ecological, geological, and scenic values of the Escarpment. Development within the Plan Area typically requires a Development Permit from the NEC, in addition to any municipal approvals. Linear infrastructure such as pipelines, pumping stations,

and access roads may be permitted, but routing, construction methods, and site restoration requirements must be clearly defined and agreed upon prior to receiving approvals.

Relevance: At the feasibility stage, the presence of the NEP introduces the following considerations:

- Constraints on alignment options crossing or paralleling the Escarpment
- Potential need for alternative routing to minimize impacts
- Additional approval timelines and co-ordination requirements
- Enhanced environmental protection and restoration obligations

Early identification of NEC-regulated areas is therefore important for evaluating source-water options and conveyance corridors, particularly where gravity-fed systems from higher elevations are being considered.

2.3.2.14 Conservation Authority Regulation

The Study Area falls within the jurisdiction of the Niagara Peninsula Conservation Authority (NPCA). Conservation Authorities regulate development in and around:

- watercourses and valleys
- floodplains
- wetlands
- shoreline hazard areas

Relevance: Under Ontario Regulation (e.g., O. Reg. 41/24), permits may be required for construction, grading, and infrastructure placement within NPCA regulated areas. While irrigation infrastructure is not prohibited, Conservation Authorities typically require demonstration that works will not increase flood risk, erosion, or environmental degradation.

At a conceptual level, Conservation Authority involvement may affect:

- intake locations near shorelines or watercourses, for example Lake Ontario pumping infrastructure will need to be located outside of the Lake Ontario hazard lands
- pipeline crossings of regulated features
- pump station siting in flood-prone or erosion-sensitive areas
- construction timing and methods

These considerations reinforce the need to integrate regulatory mapping into option screening and to recognize potential permitting complexity during later design phases.

2.3.2.15 Municipal Planning and Approvals

Municipal approvals may also be required, including:

- conformity with Official Plans and zoning with respect to new pumping stations
- road occupancy and crossing permits
- site plan approval for surface infrastructure

With respect to Official Plans and zoning it is important to note most of the Study Area falls within the provincial Greenbelt Specialty Agricultural Area in addition to Protected Countryside and Natural Heritage System (refer to **Figure 4**). Both the Town of Lincoln and City of St Catharines are responsible for ensuring Greenbelt conformity.

Because the governance and ownership model for the irrigation system has not yet been defined, the precise approval pathway remains uncertain. The Town of Lincoln is currently finalizing its “Shape Lincoln 2051” Official Plan Update that reinforces its vision as a Centre of Excellence for Agriculture which includes modernizing infrastructure to support high intensity farming as per this Niagara Irrigation Initiative. The Official Plan includes policies to support the expansion of infrastructure to provide a reliable water supply to wineries, greenhouses and orchards.

2.3.3 Co-ordination Among Regulatory Agencies

A key characteristic of the regulatory environment in the Study Area is the overlap of multiple approval authorities. For major linear infrastructure, approvals may be required from:

- MECP – PTTW and environmental review
- Niagara Escarpment Commission - development permit for watermain within Area of Development Control
- Niagara Peninsula Conservation Authority (NPCA) - Permit as per Ontario Regulation 41/24 applies to works (new intakes and pipe water crossings) within NPCA regulated floodplain considering core natural hazard management
- Municipalities - Road Occupancy Permit for works in municipal road allowances and Site Plan Approval for pumping stations
- Ministry of Transportation Ontario (MTO) – encroachment permit related to trenchless QEW pipe crossings

- Canadian National Railway(CNR) – work permit related to trenchless CN Rail corridor pipe crossings
- Ministry of Natural Resources (MNR)- Crown easements under the Lakes and Rivers Improvement Act related to intakes extending into Lake Ontario, and Indigenous communities)

As the project moves forward from the feasibility stage to the design phase, early agency co-ordination will be undertaken to align expectations, avoid rework and successfully secure approvals and Indigenous community endorsement.

2.3.4 Implications for Existing Conditions Assessment

From an existing conditions perspective, the regulatory environment governing land use and environmental protection is complex but navigable. No single agency approval precludes the development of a communal irrigation system; however, the presence of the Niagara Escarpment Plan Area and regulated natural features will influence infrastructure siting, routing, and implementation strategy.

These regulatory considerations inform option development and screening but are not determinative at the conceptual stage. They will become increasingly important as the project advances into detailed design and permitting.

3. Water Demand

A key objective of the Niagara Irrigation Initiative is to establish a reliable water supply for specialty crop producers within the St. Catharines (SCS), Jordan-Ninth Street (JNS), and Vineland-Beamsville (VBS) districts. Accurate determination of water demand is fundamental to the feasibility and preliminary design of the proposed communal irrigation system, as it directly influences source water requirements, pumping station sizing, transmission and distribution infrastructure, operational strategies, and regulatory approvals.

Niagara's agricultural sector supports some of Canada's most valuable specialty crops, including grapes, tender fruit, greenhouse products, and nursery operations. Recent climate trends and increasing drought frequency have heightened irrigation requirements across the Region, with previous studies reporting that drought conditions can reduce marketable crop yields by up to 30% and significantly affect long-term agricultural viability (Regional Municipality of Niagara. (2025). Request for Proposals No. 2025-RFP-80). Reliable access to irrigation water is therefore increasingly important to support crop productivity, economic resilience, and future agricultural investment.

The water demand assessment completed for this Study builds on previous irrigation investigations undertaken in Niagara while incorporating updated climate records, current land-use information, GIS-based irrigable acreage estimates, and modern irrigation efficiency assumptions.

This section summarizes the methodology used to estimate irrigation demand, presents the updated peak water requirements, and outlines the resulting volumetric demands that form the foundation of subsequent system planning and evaluation.

Peak water demand is based on the peak depth of irrigation water required (based on crop type and historical climate data) and the area requiring irrigation; this is the amount of water that needs to be applied during the driest time of year (typically July) across all of the land requiring irrigation. The gross peak water demand is also dependent on the type of irrigation used; an irrigation efficiency factor of 85% was used based on the predominant use of drip irrigation.

For the peak water demand calculations, a 1-in-10 year drought condition was used. A 1-in-10 year drought is considered a severe drought by Agriculture and AgriFood Canada and statistically occurs every 10 years. Conventional irrigation systems are typically designed for the 1-in-5 year drought (considered a moderate drought), but since high-value crops are involved, a 1-in-10 year drought design condition is recommended.

Recent climate change effects to-date are reflected in the underlying dataset and design criteria used for the water-demand analysis. The climate dataset employed represents the most recent 20-year period, which includes three notably dry years, resulting in lower average precipitation values and a more realistic representation of recent climatic variability.

The estimated land requiring irrigation, based the Region's *vineyard and orchard* GIS layer, is approximately 3,000 ha. Based on further analysis of land use data (MPAC parcel data), there is 7,300 ha of agricultural land within the Study Area, 5,050 ha of this could be cultivated (use irrigation). Through consultation with the Steering Committee the preference is to assume that a significant portion of this 5,500 ha of cultivated area could switch to higher value crops if irrigation becomes available.

Furthermore, through engagement with growers, 40% of survey participants indicated that they think 50 to 75% of agricultural area would use the communal irrigation system if / when it was available. An additional 28% of survey participants indicated that 75 to 100% of agricultural area would use the system. The statistical estimate based on this feedback is ~62% 'uptake' or estimated usage of the system. We also note that currently in the Niagara-on-the-Lake (NOTL) area, approximately 54% of all agricultural land are currently using the system.

Therefore, based on technical analysis and informed by stakeholder and grower engagement, it is recommended the study proceeds with the following assumptions to determine a design water demand value:

- **All agricultural properties should be considered vineyards or tender fruit**, with a representative portion of greenhouses and nurseries, to accommodate potential future changes once irrigation is available (total peak demand)
- **Up to 60% of all agricultural properties will use the communal irrigation system** when built.
- The water demand calculation based on the above should be **increased by 10% to account for growth and contingent capacity**.
- **Irrigation water should be available year-round.**
- **The peak demand is used in Section 6 to calculate pipe sizes for each alignment option. For each option, the peak demand is prorated based on the proportion of agricultural properties with frontage along a roadway containing a proposed irrigation pipeline. Accordingly, each option is sized to serve the assumed demand associated with the properties reached by that alignment.**

Further details are provided below and the detailed water demand assessment is provided in Appendix A.

3.1 Approach and Design Basis

The water demand analysis was undertaken using the **CROPWAT 8.0 model** and **FAO-56 methodology**, supported by historical climate data from 2003 to 2024 and updated crop parameters. The key design assumptions include:

- **Design Drought Condition:** 1-in-10-year summer drought (**based on 2003–2024 data to reflect recent climate change impacts**)
- **Level of Service:** peak July irrigation requirement based on climate data and crop type
- **System Efficiency:** 85%, representative of modern pressurized drip irrigation systems
- **Crop Categories:** vineyards, orchards (tender fruit), greenhouses, nurseries, and golf courses
- **GIS-based Analysis:** parcel-level mapping used to determine irrigated acreage and spatial distribution of demand

3.2 Peak Irrigation Requirements

Under the 10-year drought scenario, the gross irrigation requirements (GIR) at the system level are:

- **Vineyards:** 3.2 millimetres per day
- **Orchards:** 4.3 millimetres per day
- **Greenhouses:** 6.6 millimetres per day
- **Nurseries:** 13.9 millimetres per day
- **Golf courses:** 7.9 millimetres per day

These values reflect peak-day demands, which drive infrastructure sizing and system capacity requirements.

It should be noted that during the July 7th Grower's Workshop multiple growers reported their irrigation volume or flow rate over a specified period of time and the area being irrigated during peak irrigation time. Based on that, the daily irrigation depth was calculated (see **Table 2** below) to compare their values to the above calculated values. The reported amounts align well with the calculated values above.

Table 2: Reported Irrigation Amounts

Grower Data Entry	Water Use (m ³ /day)	Agricultural Area (m ²)	Irrigation Depth (millimetres per day)	Crop Type
1	3,785	242,800	15.6	Greenhouse
2	850	283,300	3.0	Unspecified – assumed vineyard/orchard
3	200	64,750	3.1	Unspecified – assumed vineyard/orchard
4	1,050	300,000	3.5	Unspecified – assumed vineyard/orchard
5	12	4,050	3.0	Unspecified – assumed vineyard/orchard
6	50	60,70	8.24	Unspecified – assumed greenhouse

3.3 Updated Irrigated Area and Volumetric Demands

Refined GIS analysis shows a substantial increase in irrigable area compared to earlier studies. The below table shows how irrigated area and peak irrigation depth are converted to a peak flow rate based on 24-hour irrigation schedule.

Table 3: Peak Flow Rate based on 24-hour Irrigation Schedule

District	Irrigated Area (ha)	Peak Daily Demand (m ³ /day)	Peak Flow (m ³ /s)
VBS (Vineland–Beamsville)	2,947.7	113,708	1.316
JNS (Jordan–Ninth Street)	1,973.3	78,730	0.911
SCS (St. Catharines)	1,939.2	76,600	0.887

To reflect realistic uptake, as described above, a peak demand assuming a **70% adoption scenario** was evaluated. The peak demand within each district would thus be:

- **VBS:** 79,596 m³/day (0.921 m³/s)
- **JNS:** 55,111 m³/day (0.638 m³/s)
- **SCS:** 53,620 m³/day (0.621 m³/s)

The peak demand is used in **Section 6** to calculate pipe sizes for each alignment option. For each option, the peak demand is prorated based on the proportion of agricultural properties with frontage along a roadway containing a proposed irrigation pipeline. Accordingly, each option is sized to serve the assumed demand associated with the properties reached by that alignment.

3.4 Key Finding

The analysis confirms that:

- The proposed design capacity (6,000 US gallons per minute per district $\approx 0.379 \text{ m}^3/\text{s}$) is significantly lower than peak demand in all districts
- Under a 70% participation design basis, total peak flow requirements were determined. For each alignment option, the peak demand is prorated based on the proportion of agricultural properties with frontage along a roadway containing a proposed irrigation pipeline. Accordingly, each option is sized to serve the assumed demand associated with the properties reached by that alignment.

4. Risk Management

A structured and proactive risk management process was undertaken to support the evaluation of source water and alignment alternatives presented in this Technical Memorandum. The objective of this process is to identify and assess risks that may influence the feasibility, constructability, regulatory approvals, and long-term operation of the proposed communal irrigation system.

At this stage of the Study, the focus of the risk assessment is on high-level risks that differentiate alternatives, rather than detailed design or construction risks. The results of the risk assessment directly inform the evaluation framework and multi-criteria analysis (MCA) by identifying key uncertainties, constraints, and implementation considerations associated with each option.

4.1 Risk Management Approach

The risk management approach follows the principles of ISO 31000 – Risk Management and is integrated with the overall evaluation methodology for the Study. The approach includes the following components:

- **Risk Identification:** Identification of potential risks through review of previous studies, technical assessments, and stakeholder input.
- **Risk Analysis:** Qualitative assessment of each risk based on its likelihood and potential consequence (e.g., impact on cost, schedule, or system performance).
- **Risk Evaluation:** Assignment of a relative risk rating to support comparison across alternatives.
- **Risk Treatment (High-Level):** Identification of potential mitigation measures or design considerations that may reduce or manage identified risks.

A preliminary risk register has been developed and is provided in **Table 4** below, summarizing key risks, relative ratings, and mitigation considerations.

4.2 Integration with Alternatives Evaluation

Risk considerations are integrated into the evaluation of alternatives through the defined evaluation criteria, particularly within the following categories:

- Economic
- Engineering (Constructability and Technical Risk)

- Permits and Approvals Considerations
- Operational Performance and Ability to Meet Water Demand
- Environmental and Socio-Economic Considerations

By incorporating risk into these criteria, the evaluation framework captures not only the technical and economic performance of each alternative, but also the degree of uncertainty and implementation complexity associated with each option.

Alternatives that reduce exposure to key risks – such as regulatory constraints, constructability challenges, and operational complexity – are considered more favourable within the evaluation process.

At the feasibility stage, risk assessment supports decision-making by:

- Identifying constraints and uncertainties that may influence system design and implementation;
- Highlighting areas where additional studies or mitigation measures may be required in future phases; and
- Supporting the selection of alternatives that provide a balanced, practical, and implementable solution.

The risk assessment does not preclude any alternatives at this stage but ensures that risks are clearly understood and incorporated into the comparative evaluation.

The assessment considered a wide range of potential risks, including contractual, social, economic, operational, compliance and environmental/site condition risks. Each identified risk was evaluated in terms of its likelihood (high, medium, low) and impact (high, medium, low) and assigned a combined risk score (likelihood × consequence).

All identified risks and related mitigation strategies are documented in a preliminary risk register, presented in matrix format (**Table 4**). The register was validated through a risk workshop and is reviewed and updated regularly throughout the study to reflect new information, evolving project conditions, and the implementation status of mitigation measures.

Table 4: Preliminary Risk Register Matrix

Risk Category	Risk	Risk Description	Likelihood (1-5)	Consequence (1-5)	Risk Rating (1-25) (L x C)	Mitigation Measures
Operational Constraints	Water Source Uncertainty	Uncertainty regarding the availability or quality of suitable water source.	2	4	8	Confirm suitability of adequate supply.
Operational Constraints	Technical Feasibility of Alignment	Existing conditions (topography, other infrastructure) impact on the feasibility of pipeline or reservoir locations.	3	3	9	Multiple alignment options will be explored to mitigate this risk.
Operational Constraints	Design/Construction Feasibility	Challenges during detailed design or construction due to utilities, access, unforeseen issues.	3	3	9	These can be mitigated during detailed design through proper utility investigations and careful planning/design.
Operational Constraints	Supply Capacity	Inadequate water supply capacity for irrigation requirements in Study Area	2	3	6	Study team to review existing and future conditions water demand.
Compliance	Regulatory Approvals	Delays/changes in obtaining permits (PTTW, NEC, CEAA, etc.) affecting project schedule.	3	4	12	Early consultation with regulatory agencies
Social	Governance Structure	Uncertainty regarding the governance model (e.g., utility, public, or partnership structure) could affect long-term ownership, operations, cost recovery, and key audiences support.	3	4	12	Establish a clear governance framework early, defining roles, responsibilities, and decision-making authority. Engage stakeholders through formal agreements and regular communication to ensure alignment and accountability.
Social	Misaligned Expectations with Key Audiences	Lack of consensus among growers, agencies, and partners as to the quantity or cost of water, thus delaying progress.	3	3	9	Early and ongoing consultation with stakeholders
Economic	Funding and Financing Risk	Uncertainty around provincial/federal cost-sharing or private contributions.	3	4	12	Funding for existing study is confirmed. Funding for future construction to be confirmed following study. Early and ongoing engagement of funding agencies.
Economic	Cost Uncertainties	Fluctuating Costs and / or Availability of Materials Due to Tariffs and Supply Chain Volatility	4	5	20	Study team to develop costs based on most recent costing data and to include contingency to account for future uncertainties.
Economic	Cost Overruns	Study stage assumptions underestimated leading to budget increases during detailed design stage of project	4	4	16	Careful consideration of project requirements and thorough engagement with stakeholders to best anticipate actual design requirements
Environmental/Site Conditions	Land Access Constraints	Inability to access land parcels for site investigation	3	3	9	Careful planning and engagement with landowners ahead of access
Environmental/Site Conditions	Land Acquisition Constraints	Inability to acquire land for construction	3	3	9	Careful planning and development of alternatives where land acquisition not possible
Environmental/Site Conditions	Environmental Impact Risks	Unexpected impacts to PSWs, fish habitat or species-at-risk triggering additional mitigation requirements.	3	3	9	Careful review of environmental/habitat constraints during study phase
Environmental/Site Conditions	Climate Change Impacts	Drought frequency, freeze-thaw or extreme precipitation affects system performance.	3	3	9	Careful planning for possible future conditions
Contractual	Study/Design Scope Inadequate	Design scope inadequate due to unforeseen circumstances during RFP/Proposal phase	2	4	8	Open communication between AECOM and the Region/Steering Committee on project scope and out of scope items



The risk management process includes the following stages:

1. **Study Context and Preparation** – Confirming project understanding through review of background study documents and past engagement feedback.
2. **Risk Identification** – Identifying risks through review of historical project data and engagement workshops.
3. **Risk Analysis** – Qualifying and quantifying risks to assess their likelihood and consequence.
4. **Risk Treatment** – Developing mitigation strategies, assigning risk and response owners, and documenting actions (for future project stage).
5. **Monitoring and Review** – Continuously updating the risk register, monitoring the effectiveness of mitigation measures, and communicating progress through dashboards and reporting (for future project stage).

Outputs from the risk management process are integrated into the **Multi-Criteria Analysis (MCA)** and overall evaluation framework to ensure that risk considerations are fully embedded in the decision-making process.

4.3 Risk Workshop

As part of the Study, a Risk Assessment Workshop was held on October 30, 2025, to identify and evaluate key risks that could influence option development, evaluation, and implementation of the Niagara Irrigation Initiative. The full methodology, input summaries, polling results, and risk register are provided in the Risk Assessment Workshop Summary Memo, attached as **Appendix D** to this Technical Memorandum. The summary below highlights the outcomes.

Participants used a standardized likelihood–consequence approach to score identified risks. The results indicated that cost-related risks, notably cost overruns and cost uncertainty, ranked highest. Additional risks identified as moderate to high included regulatory approvals, funding and financing, land acquisition and access constraints, environmental impacts, and constructability challenges. These results reinforced the emphasis placed on capital/operating cost, permitting complexity, constructability, environmental effects, and land constraints in the evaluation framework and weighting applied to source water options in **Section 7**.

Representation at the workshop included the following organizations and agencies:

- Niagara Region
- Ontario Power Generation (OPG)

- Ministry of the Environment, Conservation and Parks (MECP)
- Ministry of Agriculture, Food and Agribusiness
- Fisheries and Oceans Canada (DFO)
- Canada Infrastructure Bank (CIB)
- Canadian National Railway (CN)
- Town of Lincoln
- City of St. Catharines
- Town of Niagara-on-the-Lake
- Project Steering Committee
- Project Working Committee

As part of this Study, the project team will continue to update the Risk Register Matrix which includes to serve as a dynamic tool for informed decision-making throughout the remainder of the Study.

5. Source Water Options

5.1 Identification of Source Water Options

This section presents the identification and screening of alternative source water options, drawing upon previous studies, technical investigations, and recent data collection conducted under this Study. A long list of potential raw water supply approaches was initially developed based on previous Niagara irrigation studies, discussions with the Steering Committee and Region staff, and the preliminary design assumptions outlined in the Request for Proposal (RFP). This long list identified a range of potential water sources and intake approaches that could theoretically supply raw water to the three service districts within the Study Area, including:

- Direct intake from Lake Ontario at multiple shoreline locations
- Supply from above the escarpment from Lake Moodie, Lake Gibson, or the Regional reservoir at the DeCew Water Treatment Plant (WTP).
- Hybrid systems combining Lake Ontario supply with escarpment reservoir storage
- Use of existing canals or conveyance infrastructure associated with hydroelectric operations
- Withdrawal from smaller local watercourses or ponds within the Study Area

These potential options were reviewed at a high level to determine whether they could meet the irrigation system requirements identified through the Study assumptions. In particular, the preliminary screening considered the following factors:

- Ability to provide sufficient water quantity to meet irrigation demand
- Reliability of supply during drought conditions
- Feasibility of intake construction and operation
- Regulatory and permitting considerations
- Compatibility with the proposed district-based irrigation system
- Potential operational constraints associated with existing infrastructure

Based on this initial screening, several potential sources were determined to be unsuitable for further detailed evaluation.

Local watercourses and small surface water bodies were screened out primarily due to limitations in available flow during dry periods and potential environmental constraints.

These sources were not considered capable of reliably supplying the irrigation demand required for a regional communal irrigation system.

Similarly, smaller lakes and ponds within the Study Area were not carried forward due to their limited storage volumes, potential environmental sensitivity, and the significant regulatory challenges associated with large consumptive withdrawals from smaller water bodies.

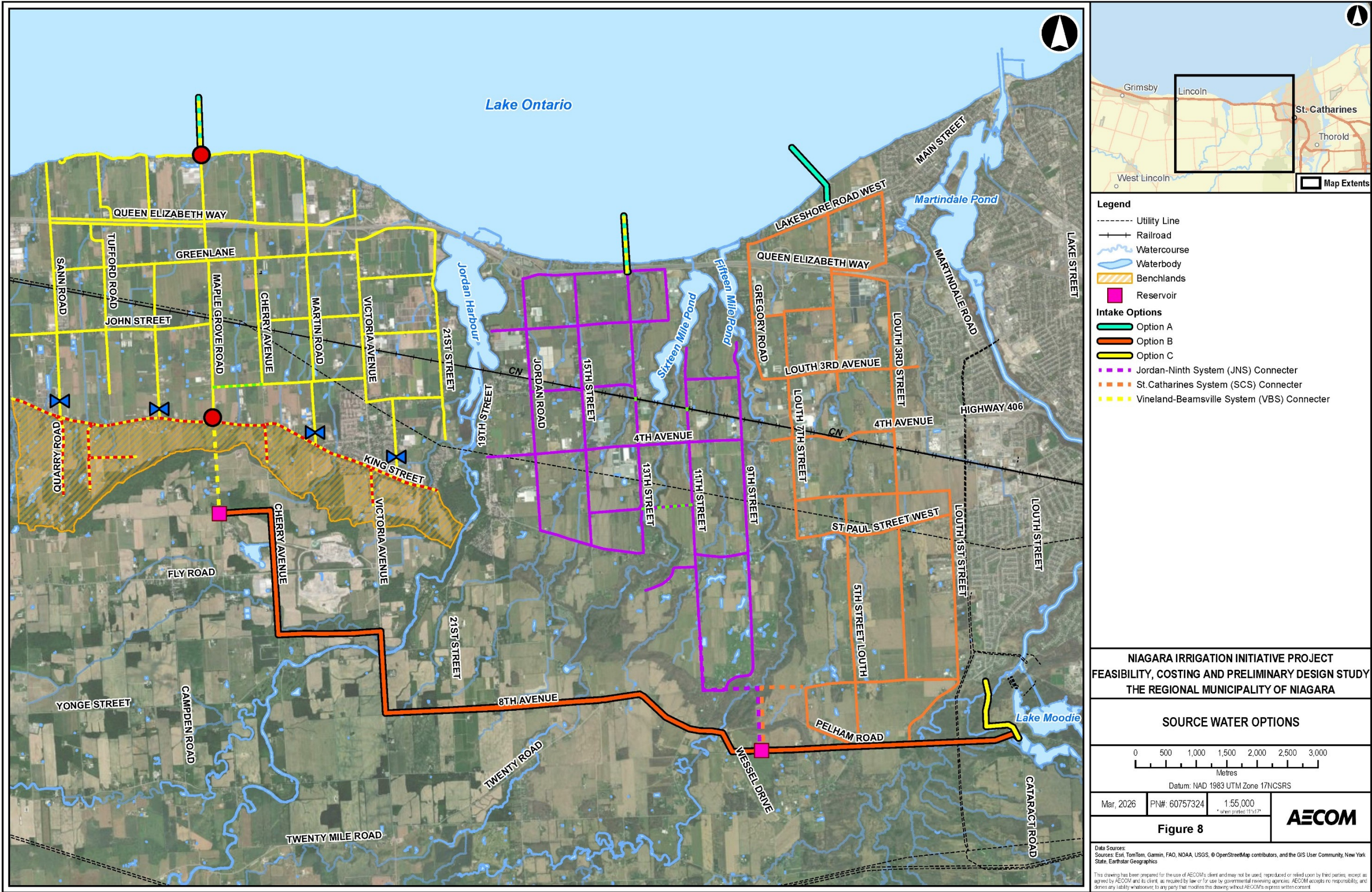
During the early stages of option development, the study team considered Lake Moodie and Lake Gibson as potential above-escarpment sources because they form part of the same Ontario Power Generation (OPG) cascade system connected to the DeCew generating stations. At that time, the hydraulic behaviour and operational constraints of the reservoirs were not fully differentiated from those of the DeCew WTP lower reservoir.

As further technical information was gathered, including workshop discussions with OPG and review of historical water quality and sediment assessments, it became clear that Lake Moodie and Lake Gibson are not suitable sources for a communal irrigation system. Past studies documented heavy metal and polychlorinated biphenyls (PCBs) contamination in their sediments, with some values exceeding provincial Severe Effect Level thresholds and longstanding provincial guidance advising against dredging or direct water use ([Environmental assessment of Lake Gibson sediments, water quality, and soils of the Niagara Region](#), Placko, 1999; OPG & MECP follow-up reports, 2007–2010). Although the contamination is considered stable if sediments remain undisturbed, it introduces significant risk and renders these lakes inappropriate as a raw water irrigation source.

Additionally, operational constraints associated with OPG's hydroelectric system mean these lakes are managed primarily for power production and are not reliably available to support large new consumptive uses such as the proposed irrigation project. During discussions with OPG regarding the feasibility of taking water from Lake Moodie, it was noted there is historical heavy metals contamination ([Environmental assessment of Lake Gibson sediments, water quality, and soils of the Niagara Region](#), Placko, 1999; OPG & MECP follow-up reports, 2007–2010) of the sediment and operational limitations which led to Lake Moodie being screened out. As a result of this screening process, three primary source water (see **Figure 8**) supply approaches were identified as having sufficient potential to support the irrigation system and were therefore carried forward for full evaluation in this Study.

Options such as rainwater harvesting, groundwater, or stormwater reuse are not considered viable, consistent supply options at the scale of this project due to the crucial need for water availability during drought periods.

Figure 8: Source Water Options



Following completion of the screening process, three primary source water supply approaches were identified as having sufficient potential to support the proposed irrigation system and were therefore carried forward for detailed evaluation:

- **Option 1:** Three Intakes from Lake Ontario.
- **Option 2:** Full System Supply from DeCew WTP Supply Reservoir. Use of the Regional Drinking Water Lower Reservoir (DeCew WTP) located beyond the escarpment to provide gravity fed water via a siphon to all three agricultural districts.
- **Option 3:** Hybrid System combining Lake Ontario intakes (for the VBS and JNS districts) with the escarpment reservoir supply (for the SCS district).

The following subsections describe each option in greater detail, summarizing the technical configuration, operational considerations, permitting implications, and relative advantages and disadvantages based on multi-criteria evaluation results.

5.1.1 Option 1 – Three intakes from Lake Ontario

This intake option involves constructing three raw water intakes from Lake Ontario (see **Figure 8**).

Raw water would be pumped from the lake directly to each of the irrigation distribution districts (VBS, JNS and SCS districts). For each district, an intake pipe would be required within the easement at the intake point which would extend approximately 1,000 metres offshore to a point with a minimum depth of approximately 7 metres. The pumping stations would be situated nearby; the potential location and approximate areas are shown on **Figure 9 to Figure 11**. This option requires pumping water from the northern to the southern extent of each district. Given the elevation increase (approximately 30 to 45 metres depending on the district) from north to south, booster stations may be required.

The intake system would likely consist of intake screens installed at a suitable depth to ensure adequate raw water quality and hydraulic reliability. The intake screens would be constructed of 90/10 copper–nickel to prevent zebra or quagga mussel attachment to screen surfaces. Intake screens shall be designed and sized in accordance with Fisheries and Oceans Canada’s interim standard for Water intake end-of-pipe fish screens (DFO, 2026) to minimize the risk of fish impingement and entrainment at the intake structure. An air-burst cleaning system would also be provided on each intake screen to periodically dislodge accumulated debris through the rapid release of high-pressure air.

Figure 9: Lake Ontario Intake- VBS District

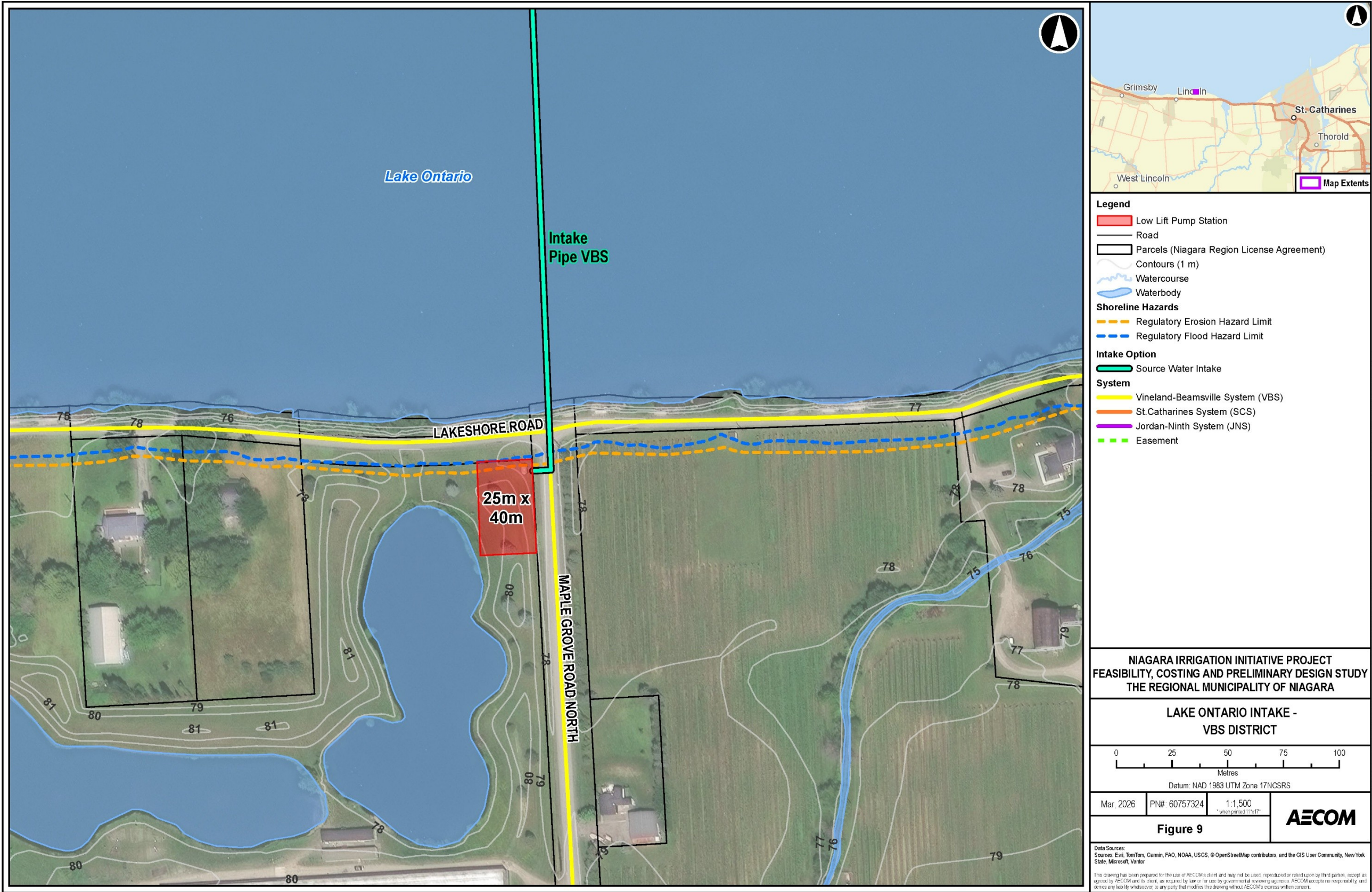


Figure 10: Lake Ontario Intake- JNS District

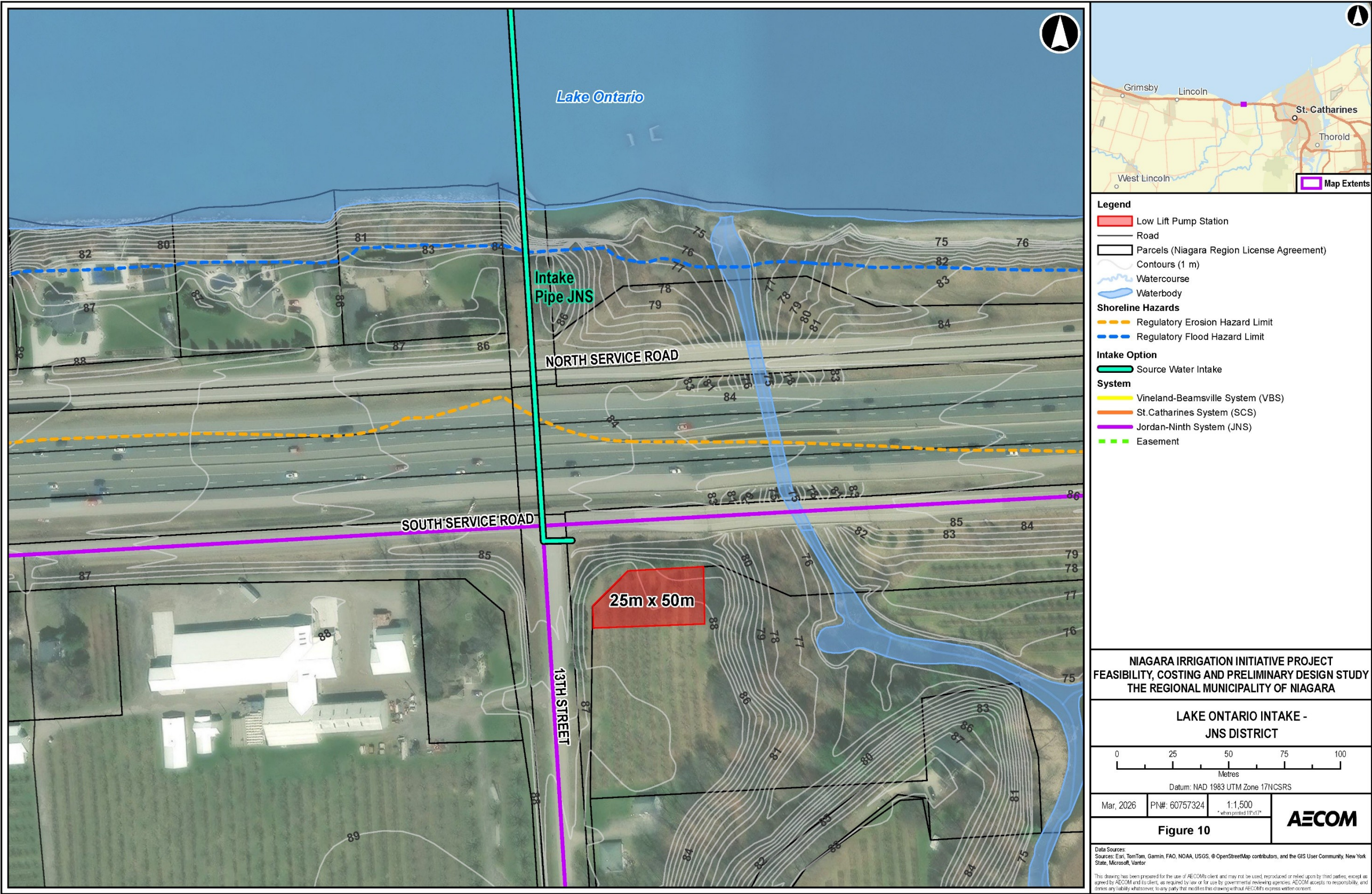
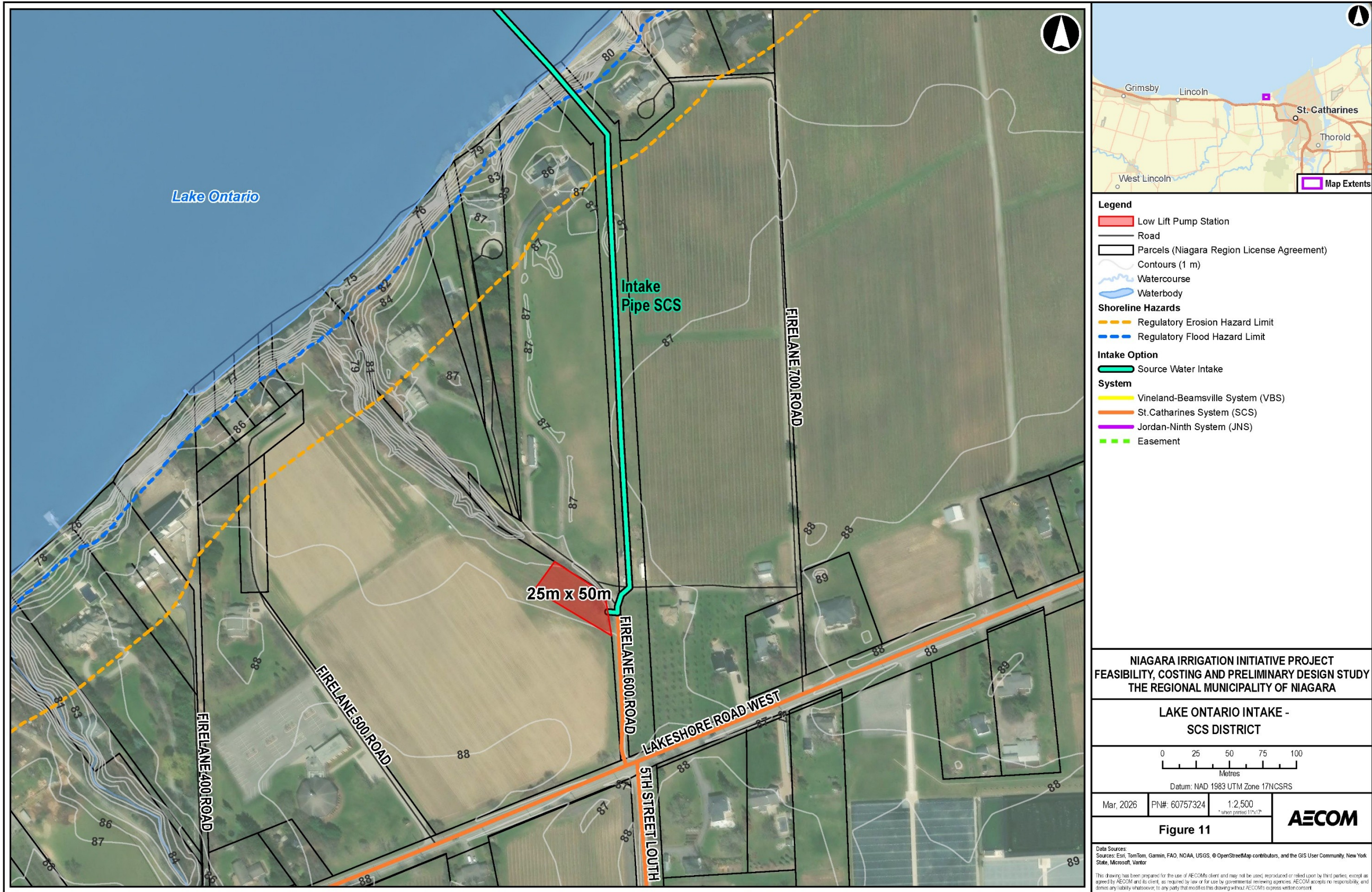


Figure 11: Lake Ontario Intake- SCS District



Intake pipelines would be routed within available shoreline easements and connected to a nearby pumping station with any sensitive components located above the regulatory flood elevations.

The onshore pumping stations would house electrically driven pumps, suitable to draw lake water in a large-volume, low-head pressure capacity. The pump station would also accommodate the air-burst system. Limitations on the allowable distance between the air-burst equipment and the intake structure would need to be considered when selecting the final pump station location as air-burst systems are typically not recommended for distances greater than approximately 305 metres, with an absolute maximum of 762 metres based on air-burst system sizing and performance considerations.

A vacuum priming system would be required to keep the suction piping and pumps primed.

Water would be conveyed via intake pipelines extending from each pumping station to the southern extents of the respective districts. These details are further discussed in the alignment options **Section 6**.

All pumping and conveyance infrastructure would be designed for year-round operation.

The intake location for the St. Cathrines area is currently shown within the Fifth Street Louth road allowance (see **Figure 11**) which appears to remain under City of St. Catharines ownership. However, existing informal use by adjacent landowners and limited physical access to the shoreline may constrain immediate access. As a result, limited site investigations were undertaken at this stage. This intake location may need to be further investigated during subsequent design stages. Other potential intake locations for the St. Cathrines area include:

■ **Seventh Street Area**

The road allowance opposite Seventh Street is understood to be under municipal or regional ownership and provides potential public access to the shoreline in this area. Adjacent parcels to the east and west, including properties at 1226 and 1228 Lakeshore Road, are in private ownership. Any future field investigations or works in this area would need to remain within public rights-of-way or be subject to separate landowner permissions.

■ **Courtleigh Road Area**

A narrow public access path is understood to exist at the end of Courtleigh Road, providing potential proximity to the waterfront. This access point allowed limited shoreline observation; however, its suitability for construction staging or permanent intake infrastructure would require further confirmation during subsequent design phases.

Overall, these access considerations were incorporated into the evaluation of intake locations from a constructability and land use perspective. No assumptions were made regarding access to private lands, and all evaluations were based on publicly accessible areas only. Any future advancement of intake infrastructure would require detailed property review, landowner co-ordination, and confirmation of municipal or regional approvals.

5.1.1.1 Key Considerations

The specific shoreline locations illustrated in this report represent conceptual locations used for hydraulic modelling, preliminary conveyance routing, and order-of-magnitude cost estimation. They should therefore be interpreted as representative locations rather than confirmed intake sites.

The evaluation of this option focuses on the feasibility of the Lake Ontario supply approach, rather than the suitability of any single shoreline parcel. The Lake Ontario shoreline between Beamsville and St. Catharines contains numerous potential access points where intake infrastructure could be located while still maintaining similar hydraulic conditions and conveyance distances to the irrigation districts. As a result, the viability of this option does not depend on any one conceptual intake location. If a specific site were determined to be unsuitable due to land use, environmental constraints, or constructability considerations, an alternative shoreline location within the same general district could be selected with minimal effect on the overall system concept.

Potential constraints that may influence intake siting have been considered qualitatively as part of this evaluation. These include shoreline topography, access from municipal or regional road allowances, proximity to environmentally sensitive areas, aquatic habitat considerations, potential erosion hazards, and compatibility with existing land uses. Cultural heritage and archaeological potential were also recognized as factors that may influence the suitability of individual sites.

Because these factors are highly site-specific, detailed evaluation of individual intake parcels has not been undertaken as part of this feasibility-level study. Instead, these considerations have been incorporated at a screening level within the environmental, constructability, and permitting criteria used in the multi-criteria evaluation. Confirmation of final intake siting would occur during the preliminary design phase through site-specific environmental investigations, geotechnical assessment, and consultation with relevant regulatory agencies.

For this reason, the evaluation presented in this report reflects the relative feasibility of the Lake Ontario supply approach rather than the confirmation of a specific intake location.

Other key considerations include:

- Lake Ontario provides a stable, year-round water source with minimal limitations and seasonal variability.
- Would involve substantial new infrastructure including three water intake pipes (from Lake to pumping stations), pumping stations, booster stations, vacuum priming systems, and water distribution pipeline from the pumping stations to service areas.
- Would require compliance with Category 3 PTTW requirements
- Offers long-term scalability and resilience.
- Permanent above-ground facilities would include pumping station buildings, electrical and control systems, and standby power provisions, as well as parking and turnarounds
- Intake and pumping station footprints would be approximately 20 metres x 10 metres, with need for shoreline maintenance, easements, and land acquisition considerations.
- System would be energy-intensive due to long pumping distances and elevation gain.
- Operational complexity associated with managing pressure zones, seasonal demand, and co-ordinated pump operation.
- Modular pumping systems and water distribution pipeline could be sized to allow future expansion.
- Provides long-term resilience by relying on a large, stable surface water source.

5.1.2 Option 2 – Full System Supply from DeCew WTP Reservoir

Several above-escarpment supply alternatives were initially considered during the screening process. Based on discussions with OPG and Niagara Region staff, the lower reservoir associated with the DeCew Water Treatment Plant (WTP) was identified as the most practical above-escarpment source and was therefore carried forward for detailed evaluation, subject to confirmation of available canal capacity and protection of municipal drinking water requirements

This intake would require new infrastructure at the DeCew Water Treatment Plant lower reservoir. It would involve taking raw water from the reservoir, upstream of the treatment plant. Due to the significant elevation difference between the source (on the escarpment) and the service area (below the escarpment) a pressure reducing control system would be used. The pressure reducing control system would deliver water into

the service areas with reduced pressures / hydraulic gradelines to prevent over-pressurizing the raw water distribution network (see **Figure 8**).

The intake system would likely consist of intake screens installed at a suitable depth in the reservoir to ensure adequate raw water quality and hydraulic reliability. The intake screens would be constructed of 90/10 copper–nickel to prevent zebra or quagga mussel attachment to screen surfaces. An air-burst cleaning system would also be provided to periodically remove accumulated debris through the rapid release of high-pressure air.

The system would be designed as a gravity-driven conveyance system with pressure reducing capability for preventing over-pressurizing in the raw water distribution network. A metering station would be located along the reservoir bank. The water will enter a large-diameter water distribution main aligned generally along the top of the escarpment.

From this escarpment-top water distribution main, water would be delivered to each of the three irrigation districts via dedicated drop structures, consisting of vertical or steeply inclined pipelines descending the escarpment face. These drop structures would likely require energy dissipation features, pressure-reducing valves, and air-release systems to safely manage hydraulic head and prevent pipe overstressing. The downstream portions of the system would transition into gravity-fed distribution networks within each district. However, due to localized elevation increases within the VBS, one booster pump is required within this distribution district to maintain adequate system pressures.

The overall system would require robust hydraulic control and isolation, including flow control structures at the intake, metering, and emergency shut-off capability to ensure that raw water withdrawals do not compromise the WTP reservoir operations, downstream flow obligations, or municipal supply reliability.

5.1.2.1 Key Considerations

This option considers supplying irrigation water from the reservoir system associated with the DeCew Water Treatment Plant located above the Niagara Escarpment. Water would be conveyed from the reservoir system to the irrigation districts through gravity or controlled conveyance infrastructure.

The evaluation of this option is based on the feasibility of utilizing excess water within the reservoir and conveyance system rather than the confirmation of a specific outlet or conveyance location. Like the Lake Ontario option, the locations illustrated in this report represent conceptual connection points used for hydraulic evaluation and cost estimation purposes.

Key considerations associated with this option relate primarily to operational constraints within the existing reservoir system, the availability of excess water beyond municipal

drinking water requirements, and the ability to convey water from the escarpment elevation down to the irrigation districts. Because the DeCew system is integrated with Niagara Region's drinking water infrastructure and is influenced by upstream water management operations, the available capacity for irrigation withdrawals remains uncertain at this stage of the Study. Physical and environmental constraints that may influence potential outlet or conveyance locations were considered qualitatively as part of the evaluation. These include escarpment topography, land ownership, environmental designations associated with the Niagara Escarpment, and potential impacts to natural heritage features. Regulatory approvals related to water taking, infrastructure construction, and land use compatibility would also be required. Given these uncertainties, the feasibility of this option is influenced more by operational and regulatory considerations associated with the reservoir system than by the suitability of individual connection points. Detailed confirmation of feasible outlet locations and conveyance infrastructure would require further co-ordination with the relevant water system operators and additional technical investigation during subsequent design stages. Other key considerations include:

- Water source is managed by the Regional Municipality of Niagara - spare capacity still unknown. Water would be diverted prior to entering the treatment plant (bypassing the WTP). Existing channel and reservoir infrastructure may be leveraged. There may be a cost associated with obtaining bulk water from the Regional water supply system, subject to future discussions regarding water allocation, ownership, and operational arrangements
- Requires assessment of raw water channel capacity and operational constraints -this still needs to be confirmed.
- Would require compliance with Category 3 PTTW requirements
- Distribution pipe across the escarpment and down to each district would provide the advantage of gravity feed, however additional cost and sensitive environmental feature removals and disruptions required to install pipes above the escarpment.
- Large-diameter gravity transmission main conveying water from the DeCew reservoir to the irrigation system. The pipeline would operate under pressure and remain full during normal operation.
- Water distribution main routed along the top of the escarpment, potentially requiring:
 - Easements or right-of-way acquisition
 - Environmental approval and protection measures within the Niagara Escarpment Plan Area

- Above-ground appurtenances are limited but may include air-vacuum valves, control chambers, and access points.
- Steep-slope or vertical pipelines descending the escarpment to serve each district would require careful geotechnical design, anchoring, and slope stabilization. Also, energy dissipation and pressure management systems required at lower elevations.
- Construction would represent a significant visual and environmental footprint on a natural heritage feature which is part of a UNESCO Biosphere Reserve.

5.1.3 Option 3 – Hybrid System

This option involves two Lake Ontario intakes (VBS and JNS districts) and the DeCew WTP reservoir intake (SCS district). The lake intakes would have an intake pipe in the lake and pump house situated nearby, as described in Option 1 above. The SCS district would include the construction of raw water intake above the escarpment at the lower reservoir (DeCew Water Treatment Plant), as described in Option 2 above. From the reservoir intake water would be conveyed to the SCS irrigation district via an existing abandoned raw water supply pipe, shown in yellow on **Figure 8**. This pipe would require substantial rehabilitation or replacement to address structural integrity, hydraulic capacity, and pressure management requirements.

Given the north-to-south elevation gain across VBS and JNS district, the system would require multiple pressure zones, with inline booster pumping stations strategically located (two in VBS and one in JNS) to maintain adequate operating pressures throughout the irrigation network.

5.1.3.1 Key Considerations

This option considers a hybrid supply approach that combines Lake Ontario intake infrastructure with supply from the escarpment reservoir system. Under this concept, each district would be supplied by a dedicated source, with Lake Ontario serving the VBS and JNS districts and the DeCew reservoir serving the SCS district.

As with the previous options, the locations illustrated in this report represent conceptual intake and connection points used for hydraulic modelling and cost estimation. The purpose of this evaluation is to assess the feasibility of a hybrid supply approach rather than to confirm specific intake or connection sites.

The hybrid approach combines two different source water strategies within the overall project, with Lake Ontario supplying the VBS and JNS districts and the DeCew reservoir supplying the SCS district. While this approach allows the source water strategy to be tailored to each district, it also requires the implementation of two different intake and conveyance approaches within a single project.

It introduces additional complexity in terms of infrastructure requirements, system operations, and regulatory approvals. Infrastructure associated with both shoreline intakes and escarpment conveyance would be required, and the system would need to be designed to manage water supply from two different sources. Potential constraints associated with shoreline intake locations, including environmental sensitivity, land use compatibility, shoreline stability, and archaeological considerations, would apply similarly to those described for the Lake Ontario option. Likewise, the operational and regulatory considerations associated with the escarpment reservoir system described under Option 2 would also apply. Because this option combines the infrastructure and regulatory considerations associated with both supply approaches, it introduces additional complexity without necessarily providing significant advantages relative to the other alternatives. Confirmation of feasible intake and connection locations would therefore require further investigation during subsequent design phases if this option were to be advanced. Other key considerations include:

- Lake Ontario provides a stable, year-round water source with minimal seasonal variability.
- Existing channel and reservoir infrastructure as well as an abandoned municipal water supply line down the escarpment for the SCS district may be leveraged.
- Offers long-term scalability and resilience.
- WTP water source (Lower Reservoir) managed by the Regional Municipality of Niagara - spare capacity still unknown but it will be less than Option 2.
- Water would be diverted prior to entering the treatment plant (bypassing the WTP).
- Requires assessment of raw water channel capacity and operational constraints.
- Would require compliance with Category 3 PTTW requirements.

5.2 Evaluation Criteria for Source Water Options

To ensure an objective and transparent comparison of the alternative source water options, a weighted multi-criteria evaluation framework was developed. This framework incorporates technical, environmental, economic, regulatory, and operational considerations relevant to the feasibility and long-term sustainability of irrigation water supply infrastructure.

The evaluation criteria fall into three main categories: economic, engineering and environmental / social-economic. The evaluation criteria and their associated weight are presented below (**Table 5**).

Table 5: Source Water Options Evaluation Criteria

Criteria Category	Criterion	Weight (%)
Economic	Capital Cost	20%
Economic	Operational Cost (length of system, # of pumps)	6%
Engineering	Ability to Meet Water Demand	20%
Engineering	Construct-ability / Technical Risk	10%
Engineering	PTTW Considerations	10%
Environmental / Socio-Economic	Water Quality / Algae / Sediment / Ice Resistant	2%
Environmental / Socio-Economic	Environmental Impact	10%
Environmental / Socio-Economic	Permits / Approval Consideration	10%
Environmental / Socio-Economic	Climate Change Impact	2%
Environmental / Socio-Economic	Land Use & Property Constraints	10%

The weighting of the evaluation criteria was informed by a combination of stakeholder input, risk-based technical assessment, and AECOM's professional experience.

The process began with the Risk Assessment Workshop held on October 30, 2025, where participants from Niagara Region, OPG, MECP, DFO, local municipalities, agricultural organizations, and members of the Steering and Working Committees evaluated identified project risks using a likelihood–consequence scoring exercise. The highest-rated risks identified through this process, cost overruns, cost uncertainties, regulatory approvals, funding and financing, land acquisition constraints, environmental impacts, and constructability challenges, provided an early, signal of which project factors carry the greatest potential influence on the study. These priorities directly informed the initial distribution of weights across economic, permitting, constructability, and environmental criteria.

Following this, Growers Workshop #2 offered a complementary user-focused perspective. Through live polling, growers ranked capital cost, operational cost, and ability to meet water demand as the most important considerations, with constructability and ease of implementation also scoring highly. This community feedback aligned closely with the risk-based results, reinforcing the decision to assign higher weightings to economic and engineering performance criteria.

Finally, the weighting approach also reflects AECOM's experience designing and permitting large linear water systems, based on these past projects, the AECOM team recognized that economic feasibility, permitting complexity, constructability risks, and land access constraints typically have disproportionate influence on whether a project can move successfully from feasibility to construction. This internal expertise, combined with the stakeholder and risk-based evidence above, informed the final balanced weighting structure applied in the evaluation.

Each criterion is described below, along with indicators and relative weightings reflecting its importance to decision-making. The evaluation process is summarized in **Table 7**.

5.2.1 Economic – Capital Cost

This criterion reflects the estimated construction cost associated with each option, including intakes, mains, storage, pumping infrastructure, distribution piping and other system components. Although this evaluation is focused on source options, since there are associated distribution system costs based on the intake option, preliminary distribution system costs were also included, based on the preliminary alignment layout. The alignment options are further considered in **Section 6**.

Engagement participants ranked capital cost as the most important evaluation criterion during the workshops, and many emphasized the importance of reducing costs wherever possible so long as it does not reduce the overall effectiveness of the system. Since cost is a significant factor in the feasibility of the proposed system and was identified as a key factor by the public, it was assigned a relatively high weighting of 20%.

Please note costs developed during evaluation of source water options have been brought forward and further developed as part of the alignment options, **Section 6**.

5.2.2 Cost Estimation Approach

For each intake and associated alignment / distribution system, the estimates account for pipelines and associated crossings, including highway and railway crossings. Cost estimates were developed using a combination of supplier quotations, historical local project costs and internal cost databases to support reliable and up-to-date pricing for each of the system components. Recent local construction costs were used to inform our cost estimates to bring the costs to 2025 levels, the Building Construction Price Index (BCPI) from Statistics Canada was also incorporated.

5.2.3 Economic – Operational Cost

This criterion evaluates long-term costs for energy, labour, and routine maintenance to keep the system functioning over time. It is expected that the buildings and equipment will last over thirty years without any major overhaul or upgrade. The siphon and control valve building requires less energy and less maintenance and has lower overhaul costs than a pumping station.

- **Indicators:** Estimated annual O&M costs per connection; energy use, number of pumping stations, expected maintenance cycles.

Workshop participants placed a high emphasis on operational costs as an evaluation criterion, and many growers expressed support for more cost-effective solutions. This preference partially overlaps with the capital cost evaluation criterion – which was a heavily weighted criterion. Consequently, this criterion was given a weighting of 6% since operational cost is expected to be much less than capital costs and thus easier to manage over time.

5.2.4 Engineering – Ability to Meet Water Demand

The required amount of water would clearly be available from Lake Ontario, and the only limit would be from any constraints placed by the Permit To Take Water. The amount of water that can be supplied by the DeCew WTP Reservoir is dependant on any excess capacity in the inlet channel; consultations have taken place with OPG (who maintain the channel) however no clear information has been received on the capacity of the channel (a record of consultation with OPG can be found in **Appendix C**). As such the ability of the channel to supply the required water demand is unclear. Furthermore, the consultations made clear that the WTP will have priority in terms of water rights, and the irrigation system would only be able to draw any excess water.

For evaluation of source water options, the ability to provide the full water demand amount has been considered. The PTTW triggers are also affected by the overall water demand, which is discussed below in the PTTW criteria. Since the ability to meet water demand is the central aim of the proposed system, this criterion has a high relative weighting of 20%.

- **Indicators:** Water quantity availability

5.2.5 Engineering – Constructability / Technical Risk

This criterion reflects the engineering and construction complexity associated with each intake or conveyance option. Engineering and construction complexity relate to topography, environment and natural heritage area crossings, road crossings, utility conflicts and access. Since constructability is a significant factor, this criterion is weighted at 10%.

- **Indicators:** Number of major (road, environmental, natural heritage) crossings; site accessibility; topographical challenges such as need to traverse the escarpment. Construction duration is also an associated indicator of this criteria.

5.2.6 Engineering – Permit to Take Water (PTTW) Considerations

One consolidated PTTW application for the project would be allowed, thus streamlining administrative requirements. Water taking above 19 million Litres per day (averaged over 90 days) and/or the relative risk and complexity of the project triggers a Category 3 permit requirement. Since the water taking is within the Great Lakes basin, the Great Lakes-St. Lawrence River Basin Sustainable Water Resources Agreement is triggered. Since all intake options would require greater than 19 million Litres per day, a Category 3 permit would be required for each. The difference in relative complexity between the 3 options will be due to the complexity of the supporting hydrological and hydraulic studies required for permitting. Since the PTTW is a significant factor in being able to advance this project to implementation, it was given a weighting of 10%.

- **Indicators:** Duration / Complexity of PTTW process, including complexity of required hydrological/hydrogeological studies.

5.2.7 Environmental / Socio-Economic – Water Quality

This criterion assesses the susceptibility of intakes to performance degradation due to biological or physical accumulation, which can increase maintenance needs and reduce efficiency.

- **Indicators:** Historical turbidity/algae data; depth and location of intakes; presence of frazil ice; need for specialized cleaning/screening systems.
- **Evaluation Criteria:** Algae / Sediment / Ice Formation

Since this factor can be easily mitigated, this criteria were given a low weighting of 2%.

5.2.8 Environmental / Socio-Economic – Environmental Impact

This criterion considers potential environmental impacts and constraints, particularly where infrastructure may interact with sensitive ecosystems or regulated features. Few workshop participants expressed concern about environmental impacts, however, since this factor can add significant complexity to the construction process, it was given a rating of 10%.

- **Indicators:** Potential impacts to the natural environment due to the construction and operation of new infrastructure. These include:
 - Impacts to the Aquatic Environment (aquatic habitat and Species at Risk (SAR)).

- Impacts to the Terrestrial Environment (terrestrial habitat and SAR).
- Proximity to wetlands including Provincially Significant Wetlands (PSWs), woodlands, valleylands, watercourses, and ANSIs.

5.2.9 Environmental / Socio-Economic – Permits and Approval Considerations

This criterion covers all regulatory and environmental approvals beyond PTTW that could affect project feasibility or timelines.

When evaluating source water options, a range of permits and approvals beyond the Permit to Take Water (PTTW) will likely be required. These vary depending on the intake location (e.g., above the escarpment options vs Lake Ontario), ownership (e.g., OPG, municipal, or private), infrastructure alignments, and environmental features affected.

This section provides a breakdown of key permitting and approval considerations beyond the PTTW as presented below:

Environmental and Regulatory Approvals

a) Canadian Environmental Protection Act (CEPA) / Impact Assessment Act (IAA)

- If the intake or alignment triggers federal thresholds (e.g., near fish habitat, on federal land, significant water withdrawals), an **Impact Assessment** may be required, this would be subject to further review to confirm applicability of federal requirements as the design advances.
- **Transport Canada** may also be involved if navigable waters are crossed or affected (particularly Lake Ontario).

b) Ministry of the Environment, Conservation and Parks (MECP)

- **Environmental Compliance Approval (ECA)**: Required for any new sewage works, stormwater management facilities, or waterworks infrastructure (including pumping stations, reservoirs).
- **Drinking Water Source Protection**: Any intake near an existing or planned municipal drinking water source may require review under the **Clean Water Act** source protection policies.

Conservation Authority Permits

a) Ontario Regulation 41/24 (under the Conservation Authorities Act)

- Work within regulated areas (floodplains, wetlands, watercourses, valley slopes) will require a permit from the local **Conservation Authority** (NPCA).
- This includes any construction of intakes, crossings, or alterations to watercourses.
- Lake Ontario Hazard lines were reviewed and are shown on the figures the pump stations are outside of the hazard limits. Works within the hazard limits are to be avoided where possible.

b) Potential OPCA Considerations

- The Province has signaled ongoing reform to the Conservation Authority system, including the establishment of the Ontario Provincial Conservation Agency (OPCA) to provide centralized oversight and direction.
- While Conservation Authorities currently remain the permitting authority under O. Reg. 41/24, the OPCA may influence:
 - Greater standardization of permit review criteria and documentation requirements
 - Potential changes to review timelines and approval processes
 - Increased emphasis on provincial policy alignment and hazard-based decision-making
- As these reforms continue to evolve, there is potential for transition-related uncertainty during the permitting process, including procedural changes or additional co-ordination requirements.
- Ongoing engagement with NPCA and monitoring of provincial guidance will be required to ensure regulatory compliance and to account for any OPCA-related changes affecting permit issuance.

Federal and Provincial Species and Habitat Protection

a) Fisheries Act (DFO)

- Any works in or near water (intake structures, sediment disturbance) may require **authorization under the Fisheries Act** if fish habitat could be impacted.
- Includes a requirement for mitigation measures or compensation if habitat loss occurs.

b) Species Conservation Act (SCA)

- Avoidance of impacts to **species-at-risk (SAR)** and their habitats will be prioritized and implemented through design refinement, alternative siting, and timing restrictions. If residual impacts cannot be avoided, applicable **permits or screening** may be required, including for turtle nesting sites, birds, bats, or aquatic SAR.
- Applies to both intake locations and alignment routes.

Land and Utility Approvals

a) Landowner Agreements

- If the intake, pipeline, or pumping infrastructure crosses private land, formal **easements, access agreements, or expropriation proceedings** may be necessary.
- Includes Ontario Power Generation (OPG), Seaway Authority, or private farms.

b) Infrastructure Crossings

- **Ministry of Transportation Ontario (MTO)**: For QEW or other major highway crossings.
- **CN/CP Rail**: For crossings of rail corridors.
- **Municipal road ROWs**: Road occupancy permits or agreements.
- **Utility Locates/Permissions**: Enbridge, Hydro One, Bell, etc.

Operational and Jurisdictional Permissions

a) Ontario Power Generation (OPG)

- **OPG approval is required** for any intake on Lake Gibson or Moodie, or use of existing OPG-owned infrastructure.
- May require operational agreements, cost-sharing, or risk-sharing arrangements.

b) St. Lawrence Seaway Management Corporation

- If water is drawn from or conveyed through Seaway-regulated areas, **permissions and fees apply**.

c) Regional/Municipal Authorities

- **Niagara Region** and associated municipalities will need to issue internal approvals, particularly if facilities are tied into their water systems or reservoirs.

Table 6: Summary Table of Key Non-PTTW Approvals

Type	Agency	Triggered By
ECA	MECP	Pump stations, intakes, pipes, waterworks
DFO Authorization	Fisheries and Oceans Canada	Intake in fish habitat
Conservation Authority Permit	NPCA	Work within or near wetlands or floodplains
SCA Permit / Screening	MECP	Species-at-risk
Transport Canada Approval	Transport Canada	Navigable water (Lake Ontario)
OPG Agreement	Ontario Power Generation	Lake Gibson/Moodie use
CN/CP Crossing Work Permit	CN Rail / CP Rail	Rail corridor crossings
Encroachment Permit	MTO	QEW Pipe crossings
Road Occupancy Permit	Region / Municipality	ROW or road crossing
Source Water Protection	MECP / Source Protection Authority	Near DW intake protection zones
Land Agreements	OPG, Seaway, private landowners	Access, alignment routing

- **Indicators:** Number and type of permits (e.g., ECAs, Conservation Authority, OPG, DFO); lead times; sensitivity of receiving environments; level of multi-jurisdictional co-ordination required; history of delays for similar projects in the Region.

This framework will be used to score and compare each of the shortlisted source water intake options. Since permitting is a significant factor in being able to advance this project to implementation, it was given a weighting of 10%.

5.2.10 Environmental / Socio-Economic – Climate Change Impact

The Ministry of Environment, Conservation and Parks' guide "Consideration of Climate Change in Environmental Assessments in Ontario" was finalized in October 2017 and requires that all Municipal Class Environmental Assessments (MCEA) consider this within the scope of the project. While this study is not formally following the MCEA process two approaches for consideration and addressing climate change in project planning include:

- Reducing a project's effect on climate change (climate change mitigation).
- Increasing the projects and local ecosystem's resilience to climate change (climate change adaptation).

Under this framework impacts to and from climate change including drought protection, infrastructure protection against extreme weather, construction activities and energy use will be used to evaluate each option. Since the overall aim of the project is to mitigate drought impacts, the project's goal relative to climate change was considered even for all 3 options. This criterion was thus used to assess each option's impact on climate change factors such as carbon footprint of construction and energy use. Since this factor does directly impact feasibility of each option, it was weighted at 2%.

5.2.11 Environmental / Socio-Economic – Land Use & Property Constraints

This criterion assesses the degree to which an option impacts existing agricultural operations or requires use / purchase of private land. Since being able to access all the required land to implement the system is crucial to its feasibility, this criterion was given a weighting of 10%.

- **Indicators:** Number of agricultural parcels crossed; access to road allowances or field edges; and potential to require easement or property acquisition.

5.3 Evaluation of Source Water Options

The Study began by identifying all potentially feasible raw-water sources within and adjacent to the project area. The high level evaluation of the long list of options supported the decision to advance only with **Options 1, 2, and 3** to evaluation phase.

Each option was assessed against a set of twelve evaluation criteria, weighted to reflect their relative importance. These criteria encompassed capital cost, operational cost, ability to meet water demand, constructability, ease of implementation, permitting complexity, environmental impact, climate change impact, land use and property constraints and impact to residents. The results of this evaluation are summarized in the table at the end of this section (see **Table 7 – Evaluation of Source Water Options**).

5.3.1 Option 1 – Three Intakes from Lake Ontario

This option ranked higher across several key categories including ability to meet water demand, constructability, ease of implementation, environmental impact and permitting complexity, as Lake Ontario represents a year-round, high-volume source and no construction is required within the environmentally sensitive escarpment area with this option. Relative to Options 2 and 3, the capital cost for Option 1 is considered as “moderate” because it falls between the highest cost option (Option 2) and the lowest cost option (Option 3). However, energy costs are high due to the long pumping

distances and elevation increase from the lake to the southern end of the service area, the intakes would have virtually no limit in access to water, thus being less vulnerable to drought conditions.

Constructability and ease of implementation are higher and permitting complexity and environmental impact are lower given there is no need to cross above the escarpment and the associated significant environmental and natural heritage areas. Like the other two options, this option would require a Category 3 permit and would trigger the Great Lakes – St. Lawrence River Basin Sustainable Water Resources Agreement but the supporting studies would be simpler since impacts to the water source would be minimal.

Considering the preliminary RFP alignment, four booster pumps are required for Option 1, therefore this option is expected to have the highest energy costs among the options.

Strengths:

- **Economic:** Moderate capital cost including the intake, airburst cleaning system, pumps and pumping station building, as well as alignment piping, crossings, and required booster pumps.
- **Engineering:**
 - Ample water quantity
 - Moderate construction period
 - Category 3 PPTW; potentially simpler supporting hydrological study compared to other two options
- **Environment:**
 - Fewest woodlands and wetlands impacted
 - Fewest amount of SARs present
 - Fewest environmental permitting requirements

Challenges:

- **Economic:** Higher operating costs due to regular maintenance, pumping uphill and energy usage.
- **Engineering:** Water must be pumped from Lake Ontario to the upper portions of the service area, requiring additional pumping and pressure management infrastructure to overcome elevation differences across the districts
- **Environmental / Socio Economic:**
 - Moderate impacts from water quality/algae/sediment/ice formation
 - Moderate climate change impact

- Moderate land acquisition required for three pump houses at each intake location
- Moderate impacts to neighbouring residents due to construction and operation
- Potential Property Impacts (see **Section 5.2**)

Overall Scoring:

This option was rated the highest, at an overall score of 4.1 out of 5.0. The scoring for each criterion can be seen in **Table 7**.

5.3.2 Option 2 – Full System Supply from DeCew WTP Reservoir

This option benefits from the use of existing Regional water infrastructure and the elevation advantage of the DeCew reservoir system, which may reduce pumping requirements. Key uncertainties include available source capacity, operational constraints associated with the Regional water system, and conveyance requirements from above the escarpment

For this option constructability and ease of implementation are ranked lowest and permitting complexity, land impacts, environmental impact and impacts to residents are ranked highest. Furthermore, the extent of spare capacity in the inlet channel to the reservoir and operational compatibility with the municipal system remains uncertain and thus the ability to meet water demand is rated the lowest of all options. This option is also the most expensive. Like the other two options, this option would require a Category 3 permit and would trigger the Great Lakes - St. Lawrence River Basin Sustainable Water Resources Agreement but the supporting study may be the most complex, as the full water demand would come from the DeCew WTP reservoir and inlet channel, thus hydrological impacts on these would need to be assessed.

Considering the preliminary alignment, one booster pump is required for Option 2, therefore this option is expected to have the lowest energy cost among the three options. In addition, given that some of the proposed infrastructure is located within the Niagara Escarpment Plan including Escarpment Natural Area and Escarpment Protection Area there are multiple policy compliance and approvals areas which can translate to longer permitting paths.

Strengths:

- **Economic:** Low operating costs
- **Engineering:**
 - Ties into an existing, well-maintained water supply reservoir operated by the Region. Potential intake location has adequate space and is clear adjacent to

the treatment plant, however would be dependent on property access discussions with Region.

- Water quality/algae/sediment/ice resistant impacts are anticipated to be lower.

■ **Environment / Socio Economic:**

- No intake pump station is required, as water is conveyed from the DeCew reservoir primarily through gravity flow. However, a booster pumping station may be required in localized areas (e.g., portions of the VBS district) to maintain adequate system pressures.

Challenges:

- **Economic:** Highest capital cost including the intake, airburst cleaning system, pumps and pumping station building, as well as alignment piping, crossings, and required booster pumps. The alignment options are further developed in **Section 6**.

■ **Engineering:**

- Full water demand would need to pass through reservoir inlet channel, whose excess capacity remains unknown
- Category 3 PPTW, supporting studies may be most complex due to full water demand coming from reservoir and inlet channel
- Irrigation withdrawals must not interfere with municipal supply priorities.
- Pipe alignment above the escarpment will require numerous additional utility, road, property and environmental and natural heritage area crossings.
- Longest construction period

■ **Environment / Socio Economic:**

- Highest number of woodlands and wetlands impacted
- Highest amount of SARs present
- Highest number of Areas of Natural and Scientific Interest impacted
- Highest impacts to residents along pipeline route during construction
- Most environmental permits required

Overall Scoring:

This option was rated the lowest, at an overall score of 2.1 out of 5.0. The scoring for each criterion can be seen in **Table 7**.

5.3.3 Option 3 – Hybrid System

This option combines the reliability of Lake Ontario for the VBS and JNS areas with an above-escarpment siphon supply to SCS. The potential use of the existing abandoned

short pipe to deliver to the St. Catharines area via gravity helps reduce energy costs in that zone. This option shares many of the same benefits as Option 1 for the VBC and JNS areas but shares similar challenges to Option 2 for the SCS area. This option is the lowest cost of all three options, has a lower operational cost, climate change and land impact than Option 1 but given the unknown capacity of the DeCew WTP reservoir inlet channel the ability to meet water demand is rated lower than Option 1. Given the need to rehabilitate the existing short pipe through the escarpment, constructability is more challenging, and environmental impacts are higher than Option 1.

Based on the preliminary alignment, Option 3 would require three booster pumping stations to maintain service pressures within the VBS and JNS districts. As a result, this option would incur ongoing energy and maintenance costs associated with operation of the pumping infrastructure.

Strengths:

- **Economic:** Lowest capital cost (including the intake, airburst cleaning system, pumps and pumping station building, as well as alignment piping, crossings, and required booster pumps. The alignment options are further developed in **Section 6**).
- **Engineering:**
 - Conceptual intake locations have been identified for the VBS and JNS districts along the Lake Ontario shoreline, while the SCS district would be supplied from the DeCew reservoir system. Final intake and connection locations would be confirmed during subsequent design stages
 - One less pump house compared to Option 1
 - Moderate construction period
 - Category 3 PPTW, supporting studies for intakes from Lake Ontario would be straightforward, some complexity for the hydrological study due to one intake at the DeCew WTP reservoir and inlet channel
- **Environment / Socio Economic:**
 - Moderate number of significant wetlands and woodlots impacted
 - Moderate impacts to residents during construction
 - Potential Property Impacts (see **Section 5.2**)

Challenges:

- **Economic:** Moderate to high operating costs due to regular maintenance, pumping uphill and energy usage.

■ Engineering:

- SCS water demand would need to pass through reservoir inlet channel, whose excess capacity remains unknown
- Irrigation withdrawals must not interfere with municipal supply priorities.
- There is an elevation increase from the lake to the southern extent of the irrigation district; thus, booster pumps are required for two districts
- Higher constructability challenge than Option 1 due to need to rehabilitate existing pipe running down the escarpment

■ Environment / Socio Economic:

- Moderate impacts from water quality/algae/sediment/ice formation
- Moderate to high impact due to the number of SARs
- Land acquisition required for two new pump houses at the intakes

Overall Scoring:

This option was rated in the middle, at an overall score of 3.8 out of 5.0. The scoring for each criterion can be seen in **Table 7**.

Table 7: Evaluation of Source Water Options

Evaluation 1 – 5 (5 = best, 1 = worst)

Options / Evaluation Criteria					Option 1	Option 2	Option 3
Criteria Category	Criterion	Description	Indicators	Weight (%)	Three Intakes from Lake Ontario	Above the Escarpment Only Supply to All Areas via Full System Supply Line from DeCew WTP Reservoir (Long Pipe)	Hybrid - Lake Ontario & Above the Escarpment Supply to St Catharines System via Existing Supply Line from DeCew WTP Reservoir (Short Pipe)
Economic	Capital Cost	This criterion reflects the initial construction cost associated with each option, including intakes, mains, storage, pumping infrastructure, and other system components. Cost estimates were developed using a combination of supplier quotations and internal cost databases to support reliable and up-to-date pricing.	1. The estimated cost encompasses the following components: *Intake and Airburst Cleaning System *Pumps and Pumping Station Building *Booster Pumps and Booster Pumping Station Building 2. Additionally, the cost includes the long and short pipelines for Options 2 and 3 respectively, where the intake is sourced from the Regional Drinking Water Lower Reservoir. 3. Since there are associated distribution system costs based on the intake option, preliminary distribution system costs were also included, based on the pipe layout from the RFP. For each distribution system, the estimate accounts for pipelines and associated crossings, including highway and railway crossings.	20.0%	■ Pumping Station (including Intake and Airburst, Pumps and Pumping Station Building): \$10,970,000 ■ Booster Pump Stations(including Booster Pumps and Booster Pumping Station Building): \$4,860,000 ■ Alignment Options Crossings Cost: \$34,245,000 ■ Alignment Options Piping Cost (including Material, Excavation and Backfill): \$ 139,109,000 ■ Estimated TOTAL = \$190M	■ Metering Station (Includes vacuum pump priming system, and control valves): \$5,400,000 ■ Booster Pump Stations(including Booster Pumps and Booster Pumping Station Building): \$ 500,000 ■ Full System Supply Line from DeCew WTP Reservoir Cost: \$60,385,000 ■ Alignment Options Crossings Cost: \$32,145,000 ■ Alignment Options Piping Cost (including Material, Excavation and Backfill): \$140,600,000 ■ Estimated TOTAL = \$240M	■ Pumping Station (including Intake and Airburst, Pumps and Pumping Station Building): \$ 7,500,000 ■ Metering Station for intake from the above escarpment (Includes vacuum pump priming system, and control valves): \$1,621,000 ■ Booster Pump Stations(including Booster Pumps and Booster Pumping Station Building): \$3,980,000 ■ St Catharines System Supply Line from DeCew WTP Reservoir Rehabilitation Cost:\$ 3,200,000 ■ Alignment Options Crossings Cost: \$34,900,000 ■ Alignment Options Piping Cost (including Material, Excavation and Backfill): \$ 124,500,000 ■ Estimated TOTAL = \$176M
					3	1	4
	Operational Cost (length of system, # of pumps)	Long-term energy, labour, and maintenance costs	Annual O&M cost per connection; energy use (kWh/year); anticipated maintenance cycles	6.0%	■ Pumping stations would require regular maintenance. Requires pumping uphill. ■ Energy Cost (based on the number of the Booster Pumps): High	■ Siphon would require some maintenance ■ Energy Cost (based on the number of the Booster Pumps): Low	■ Pumping stations would require regular maintenance ■ Siphon would require some maintenance ■ Energy Cost (based on the number of the Booster Pumps): Medium
Engineering	Ability to Meet Water Demand	Ability to provide peak water demand for all agricultural parcels	Availability of water to meet demand.	20.0%	■ Ample water quantity available from Lake Ontario	■ Water quantity availability in OPG channel ("spare" capacity after WTP usage) still unknown and may have limitations	■ Ample water quantity available from Lake Ontario for 2 districts. ■ Water quantity availability in OPG channel ("spare" capacity after WTP usage) still unknown for supply to St. Catharines district and may have limitations
					5	3	4

Options / Evaluation Criteria					Option 1	Option 2	Option 3
Criteria Category	Criterion	Description	Indicators	Weight (%)	Three Intakes from Lake Ontario	Above the Escarpment Only Supply to All Areas via Full System Supply Line from DeCew WTP Reservoir (Long Pipe)	Hybrid - Lake Ontario & Above the Escarpment Supply to St Catherines System via Existing Supply Line from DeCew WTP Reservoir (Short Pipe)
Engineering	Construct-ability / Technical Risk	Challenges related to topography, access, road crossings, environmental and natural heritage crossings and utility conflicts	Number of road crossings, environment/natural heritage area crossings, utility conflicts, site accessibility; geotechnical risks; shoreline stability/erosion	10.0%	■ Conceptual intake locations have been identified and seem to be clear. Final intake and connection locations would be confirmed during subsequent design stages. ■ Proximity to alignment options is advantage.	■ Conceptual intake locations have been identified and seem to be clear. Final intake and connection locations would be confirmed during subsequent design stages. ■ Source pipe alignment would require numerous utility, road, property and environmental and natural heritage area crossings	■ Conceptual intake locations have been identified and seem to be clear. Final intake and connection locations would be confirmed during subsequent design stages. ■ Pipe alignment existing but would need full rehabilitation.
					5	2	4
	PTTW Considerations	For any water taking over 19 million Litres per day, a Category 3 permit is required. Significant water taking from anywhere in the Great Lakes Basin triggers the SWRA. Category 3 permits necessitate robust technical justification and monitoring in later phases but are considered feasible for the proposed irrigation system.	One consolidated PTTW application for the project would be allowed, thus streamlining administrative requirements. Given the anticipated water requirements at each intake (> 19 million Litres per day), a Category 3 permit with reviews via the Great Lakes-St Lawrence River Basin Sustainable Water Resource Agreement is required for each option.	10.0%	■ This option would require a Category 3 permit and would trigger the Great Lakes - St. Lawrence River Basin Sustainable Water Resources Agreement. Since the water availability from the Great Lakes is high and hydrological impacts would be low, the supporting studies required for a Category 3 permit should be simpler to complete.	■ This option would require a Category 3 permit and would trigger the Great Lakes - St. Lawrence River Basin Sustainable Water Resources Agreement. ■ Since the intake takes water from the DeCew WTP reservoir, a detailed hydraulic study would be required for the Category 3 permit. This study would need to determine if there is sufficient surplus capacity to provide the required flow for irrigation while maintaining the allocated flows for the WTP and Morningstar Mill.	■ This option would require a Category 3 permit and would trigger the Great Lakes - St. Lawrence River Basin Sustainable Water Resources Agreement. Since the water availability from the Great Lakes is high and hydrological impacts would be low for the Lake Ontario intakes, the supporting studies required for a Category 3 permit should be simpler to complete for 2/3 intakes. ■ Since the third intake takes water from the DeCew WTP reservoir, a detailed hydraulic study would be required for the Category 3 permit. This study would need to determine if there is sufficient surplus capacity to provide the required flow for irrigation while maintaining the allocated flows for the WTP and Morningstar Mill.
Environmental / Socio-Economic	Water Quality / Algae / Sediment / Ice Resistant	Susceptibility of intake to algae, mussels, frazil ice and sediment buildup	Historical algae and turbidity data; intake depth/location vs. risk zones; need for specialized screens or cleaning systems	2.0%	■ Exposure to seasonal ice and benthic algae (e.g., Cladophora) due to shallow nearshore conditions. Intakes would be designed with appropriate mitigation measures.	■ Less exposure to ice formation processes. Potential impacts from algal formation. Intake would be designed with appropriate mitigation measures.	■ Exposure to seasonal ice and benthic algae (e.g., Cladophora) due to shallow nearshore conditions at the lake intakes, and potential algal growth formation at reservoir intake. Intakes would be designed with appropriate mitigation measures.
					3	4	3

Options / Evaluation Criteria					Option 1	Option 2	Option 3
Criteria Category	Criterion	Description	Indicators	Weight (%)	Three Intakes from Lake Ontario	Above the Escarpment Only Supply to All Areas via Full System Supply Line from DeCew WTP Reservoir (Long Pipe)	Hybrid - Lake Ontario & Above the Escarpment Supply to St Catharines System via Existing Supply Line from DeCew WTP Reservoir (Short Pipe)
Environmental / Socio- Economic	Environmental Impact	Footprint construction method (bore, open cut, lay on riverbed) Presence of SAR Anticipated permitting complexity	Sensitive feature proximity; need for CEAA / NEC / PTTW / DFO; fish habitat or PSW impacts	10.0%	Designated Natural Areas: ■ One Woodland ■ One Provincially Significant Wetland (Sunset Barrier Beach Wetland Complex) Policy Areas: ■ Green Belt Act Protected Countryside ■ Niagara Escarpment Planning and Development Act ■ Niagara Natural Environment System Shoreline Area ■ Groundwater Protection Area ■ Niagara Peninsula Conservation Authority Regulated Area Aquatic Habitat: ■ Lake Ontario ■ outlet of Eighteen Mile Creek to Lake Ontario ■ unnamed pond with potential connection to Lake Ontario Species at Risk: ■ Aquatic: American Eel (Lake Ontario), Shortnose Cisco (Lake Ontario) ■ Terrestrial: Pumpkin Ash, Bobolink, Downy Yellow False Foxglove, Gray Ratsnake, Loggerhead Shrike, Least Bittern, Blanding's Turtle, Chimney Swift, Bank Swallow, and Eastern Meadowlark	Designated Natural Areas: ■ 19 Significant Woodlands ■ 17 Woodlands ■ One Provincially Significant Wetland (Twelve Mile Creek Wetland Complex) ■ 21 unevaluated wetlands ■ Six Areas of Natural and Scientific Interest (DeCew Falls, DeCew Gorge, Twelve Mile Creek Bottomlands, Fifteen- and Sixteen-Mile Creek Valleys, Rockway Falls, Beamsville Escarpment) ■ Candidate Significant Wildlife Habitat: Colonially Nesting Bird Breeding Habitat (Trees/Shrubs) Policy Areas: ■ Green Belt Act Protected Countryside ■ Niagara Escarpment Planning and Development Act ■ Niagara Natural Environment System Shoreline Area ■ Groundwater Protection Area ■ Niagara Peninsula Conservation Authority Regulated Area Aquatic Habitat: ■ 31 watercourses ■ Three pond features Species at Risk: ■ Aquatic: American Eel (Twelve Mile Creek), Liliput ■ Terrestrial: Cerulean Warbler, Eastern Flowering Dogwood, Acadian Flycatcher, American Chestnut, American Columbo, Red-headed Woodpecker, Eastern Meadowlark, Bobolink, Transverse Lady Beetle, Cucumber Tree, Butternut, Red Mulberry, Gray Ratsnake, Five-lined Skink, Chimney Swift, and Bank Swallow	Designated Natural Areas: ■ Two Significant Woodlands ■ Two Woodlands ■ Three Provincially Significant Wetlands (Twelve Mile Creek Wetland Complex, Lower Twenty Mile Creek Wetland Complex, Fifteen Mile Creek Above Escarpment Wetland Complex) ■ Two Areas of Natural and Scientific Interest (DeCew Falls and DeCew Gorge) Policy Areas: ■ Green Belt Act Protected Countryside ■ Niagara Escarpment Planning and Development Act ■ Niagara Natural Environment System Shoreline Area ■ Groundwater Protection Area ■ Niagara Peninsula Conservation Authority Regulated Area Aquatic Habitat: ■ Two watercourses ■ Lake Ontario ■ outlet of Eighteen Mile Creek to Lake Ontario ■ unnamed pond with potential connection to Lake Ontario Species at Risk: ■ Aquatic: American Eel (Lake Ontario, Twelve Mile Creek), Shortnose Cisco (Lake Ontario) ■ Terrestrial: Cerulean Warbler, Eastern Flowering Dogwood, Acadian Flycatcher, American Chestnut, American Columbo, Red-headed Woodpecker, Eastern Meadowlark, Bobolink, Transverse Lady Beetle, Cucumber Tree, Five-lined Skink, Chimney Swift, Bank Swallow, Blanding's Turtle, Downy Yellow False Foxglove, Gray Ratsnake, Least Bittern, Loggerhead Shrike, and Pumpkin Ash
					5	2	4

Options / Evaluation Criteria					Option 1	Option 2	Option 3
Criteria Category	Criterion	Description	Indicators	Weight (%)	Three Intakes from Lake Ontario	Above the Escarpment Only Supply to All Areas via Full System Supply Line from DeCew WTP Reservoir (Long Pipe)	Hybrid - Lake Ontario & Above the Escarpment Supply to St Catherines System via Existing Supply Line from DeCew WTP Reservoir (Short Pipe)
	Permits / Approval Consideration	The risk that delays or challenges in obtaining necessary environmental, regulatory, and land use approvals (beyond PTTW) will impact project schedule, costs, or feasibility. This includes Conservation Authority permits, ECAs, Class EA requirements, OPG access, DFO approvals, NEC, rail and road crossing permits, etc.	Number and complexity of permits required Lead times for each regulatory agency Presence of sensitive areas (e.g., species-at-risk, floodplains, wetlands, source protection zones) Level of jurisdictional co-ordination needed (e.g., OPG, Region, NPCA, MTO, Transport Canada, NEC) History of delays or concerns for similar past projects in the region Potential need for design changes or realignment due to permitting constraints	10.0%	■ Environmental permitting requirements. (Species at Risk Act, Fisheries Act, Migratory Birds Convention Act, Species Conservation Act, Conservation Authorities Act Section 28 (NPCA)) ■ NPCA Application for Development, Interference with Wetlands and Alterations to shorelines and Watercourse. ■ Update to Source Water Protection Program ■ Transport Canada Approval under the Navigable Water Act for in water work.	■ Additional Environmental permitting requirements for the "long pipe". (Species at Risk Act, Fisheries Act, Migratory Birds Convention Act, Species Conservation Act, Conservation Authorities Act Section 28 (NPCA)) ■ NPCA Application for Development, Interference with Wetlands and Alterations to shorelines and Watercourse. ■ Update to Source Water Protection Program ■ Niagara Escarpment Plan and Development Permit	■ Environmental permitting requirements. (Species at Risk Act, Fisheries Act, Migratory Birds Convention Act, Species Conservation Act, Conservation Authorities Act Section 28 (NPCA)) ■ NPCA Application for Development, Interference with Wetlands and Alterations to shorelines and Watercourse. ■ Update to Source Water Protection Program ■ Transport Canada Approval under the Navigable Water Act for in water work. ■ Niagara Escarpment Plan and Development Permit
					5	2	4
	Climate Change Impact	Impact to/from climate change	Carbon footprint of construction, resilience of pump houses/water supply, how construction and operations impact climate change	2.0%	■ Smaller construction footprint ■ Continuous operation of the pump house at all 3 intake locations.	■ Larger construction footprint ■ No pump house operation	■ Smaller construction footprint ■ Continuous operation of the pump house at 2 out of 3 locations.
					4	2	5
	Land Use & Property Constraints	Land Use & Property Constraints	Number of private parcels crossed; conflict with specialty crops; access to road allowances	10.0%	■ Land acquisition required for a pump house at each intake ■ Easements already in place for each intake location	■ No pump house required as system will be gravity fed. DeCew WTP is owned by Region; property acquisition or an agreement with the Region would be required. ■ Significant properties impacted for long pipe.	■ Land Acquisition required for two new pump houses at the intakes ■ Easements already in place for each intake location ■ Although there is already an abandoned pipe in place, an easement or permission may be required at this location
					3	1	4
TOTALS (sum of evaluation scores x weightings)				100%	4.1	2.1	3.8

5.4 Recommended Source Water Option

Based on the multi-criteria evaluation process undertaken, **Option 1 – Three Intakes from Lake Ontario** is identified as the preferred source water option.

This option offers the best overall combination of:

- Ability to meet water demand
- Moderate Cost
- Minimal
 - Risk associated with water availability
 - Constructability challenges
 - Environmental impact
 - Land use impacts
 - Permitting complexity

Option 1 was identified as the preferred solution due to its superior reliability, scalability, and overall ease of implementation, despite not being the lowest cost option.

Engagement participants in Growers Workshop #2 were also broadly supportive of this option. More information on public feedback is available in **Section 7**.

Lake Ontario provides a virtually unlimited and drought-resilient water supply with minimal seasonal variability, ensuring that peak agricultural irrigation demands can be consistently met. In comparison, Options 2 and 3 are constrained by the availability and operation of the DeCew system, including limitations in the inlet channel and reliance on existing escarpment infrastructure, which introduce uncertainty in long-term supply.

Option 1 also reduces environmental, constructability, and land use challenges. By avoiding the Niagara Escarpment, it limits impacts to sensitive natural heritage features and eliminates the need for complex infrastructure within highly regulated areas. From a permitting standpoint, Option 1 represents the lowest overall risk. While coordination with multiple agencies is required, the approval pathway for Great Lakes withdrawals is generally more straightforward than for the reservoir-based alternatives. Options 2 and 3 involve additional complexity due to works within the Niagara Escarpment Plan Area and dependencies on infrastructure governed by external operational requirements. A key advantage of Option 1 is that it provides an independent water source that is not constrained by competing demands such as municipal drinking water supply or hydroelectric generation. This significantly reduces risks related to long-term availability and operational flexibility.

Although Option 1 has higher capital and operating costs, its strong performance across reliability, environmental considerations, implementation feasibility, and regulatory risk resulted in the highest overall evaluation score. As such, it represents the most robust and future-resilient solution under the current planning assumptions.

6. Alignment Options

6.1 Identification of Alignment Options

This Study has considered a range levels of services and user uptake assumptions to understand how system scale, participation, and phasing influence technical feasibility, cost, and regulatory complexity. The study team has also engaged growers to collect feedback on preferred system reach and public priorities for system accessibility and water capacity. Given that governance, funding, and detailed grower participation levels have not yet been confirmed, multiple scenarios were developed to reflect plausible implementation pathways rather than a single “all-or-nothing” system.

With the consideration of the end-user locations, infrastructure locations, preferred water source, supply security / operating resiliency, overall capital investment and topography of each system, the following three alignment options were developed for evaluation:

- Option A: Basic Branch System
- Option B: Basic Looped System
- Option C: Full Coverage Looped System

These alignment options vary primarily by:

- extent of trunk and lateral pipeline infrastructure (number of agricultural properties reached)
- assumed percentage of properties connecting to the system
- ability to phase construction over time

In addition to pipe extent and uptake, the options were developed also considering the following:

- compatibility with multiple governance models
- scalability to respond to future climate and agricultural change
- consistency with regulatory and land use constraints

All three alignment options assume the recommended source water option, with conveyance to the agricultural service areas through a series of trunk mains and distribution laterals.

The sizing of pumps and watermain for each option is based on the irrigation demand associated with the properties serviced by that option as well as maintaining the minimum pressures (40 PSI) in the system.

Although the minimum pressure requirement at each on farm supply point is 40 PSI, in a typical pressurized pipe system, the operating pressures in the pipe are around 100 PSI (70 metres of water). Given the water level of the supply source (Lake Ontario) is about 75 metres above sea level (ASL) and the anticipated energy losses (head loss) due to roughness in the pressurized pipe, the maximum service elevation in the system is approximately between 130 to 135 meters ASL. The service elevation could be increased by oversizing the watermains or installing multiple watermains in the system for minimizing the head losses in the system. For participants that are located at the elevation higher than the approximated elevation range of 130 metres to 135 metres ASL (e.g. Benchlands in Vineland-Beamsville System), a booster pumping station would be required to achieve adequate water pressures. For participants that are located at the lower elevation and the water pressures are higher than 100 PSI, localized pressure reducing valves would be needed to deliver water at the required 40 PSI pressure.

The sizing of pumps and watermains for each option is based on the irrigation demand associated with the properties serviced by that option. As outlined in **Section 3** above and **Appendix A**, the peak demand requirement assumes 70% of all agricultural properties in the study area can be reached by the distribution system; however, based on the different alignment options, a subset of all agricultural properties are able to be reached. As such, for each alignment option, the proportion of agricultural properties with frontage along a proposed pipe corridor was quantified. This proportion was then applied to the corresponding service area demand to determine the effective design flow for that option, as outlined in **Table 8** below.

Table 8: System Design Flow

District	Design Flow (m ³ /s) Option A	Design Flow (m ³ /s) Option B	Design Flow (m ³ /s) Option C
VBS	0.44	0.60	0.79
SCS	0.41	0.51	0.58
JNS	0.36	0.54	0.57

6.1.1 Option A – Basic Branched System

Option A (refer to **Figure 12**) represents a branched communal irrigation system capable of delivering water from the Lake Ontario intake to the primary agricultural areas within the Study Area. A looped system is not required for a raw water system and this alignment option follows a branched or tree-style configuration, where a series of trunk mains (ranging in diameter from 250 mm to 1050 mm) convey water inland from the lakeshore and individual laterals extend outward to serve groups of agricultural parcels.

In this configuration, the trunk mains function as the primary conveyance corridors, while lateral pipelines branch from these trunks to reach individual agricultural areas. Each lateral is supplied from a single direction, meaning that water reaches each portion of the network through one supply path only. As a result, the system has limited redundancy, and service interruptions may occur in downstream areas if maintenance or failures occur on upstream sections of the network.

Under this option, the system focuses on serving the highest-demand agricultural corridors first, particularly areas with significant vineyard, orchard, and greenhouse operations. Additional pipeline extensions are included along the shoreline in the areas identified during the alignment development process (yellow areas in the **Figure 12**) to ensure that agricultural parcels located closer to Lake Ontario are not bypassed by the primary trunk corridors.

Because this configuration minimizes the number of parallel routes and avoids extensive looping, Option A represents the lowest capital cost distribution system among the options considered. Pipe lengths, crossings, and control infrastructure are minimized, resulting in a relatively straightforward construction approach. However, the reduced network redundancy means that system reliability is lower compared to looped configurations, and operational flexibility is limited.

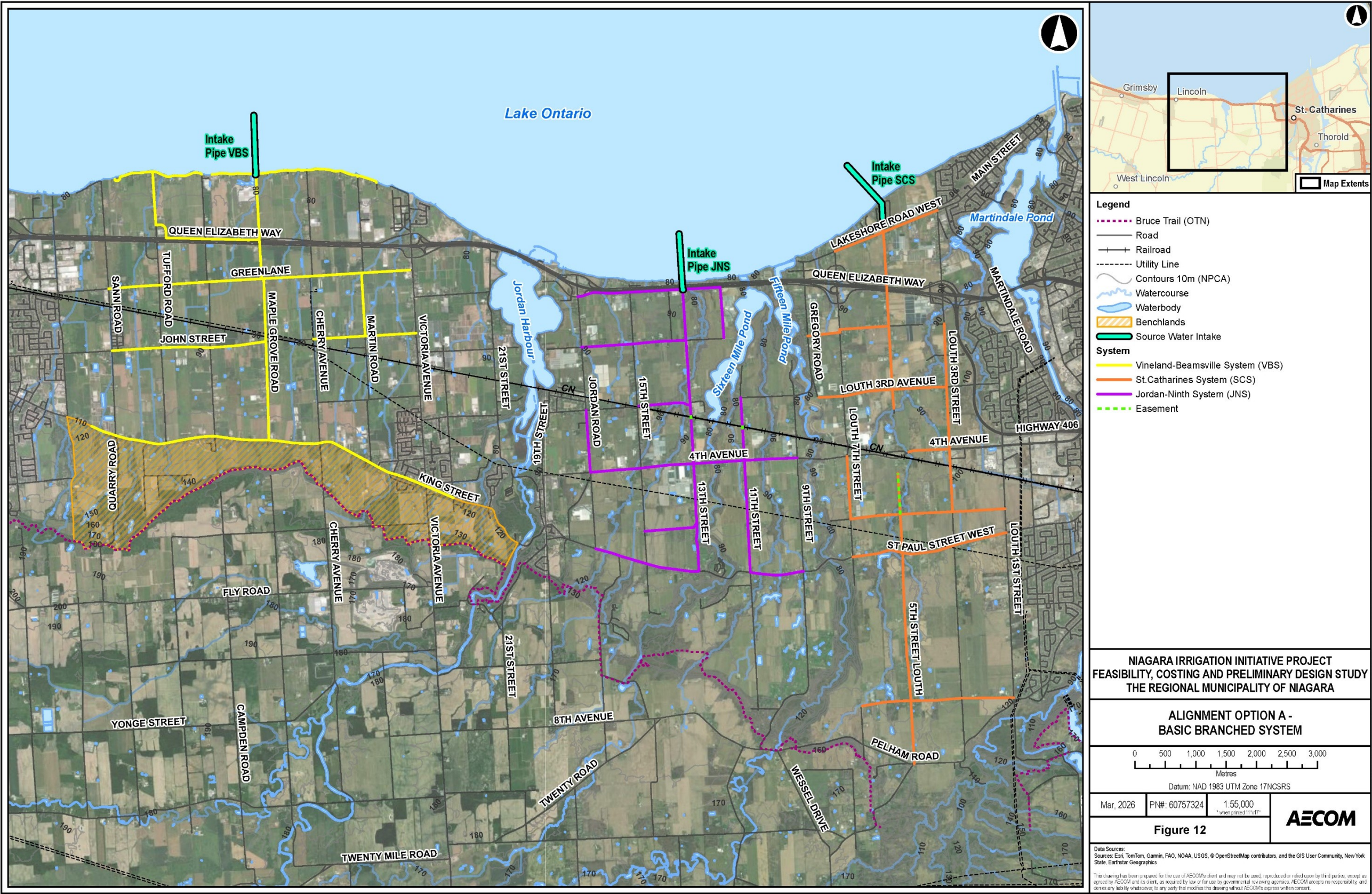
Specifically for the Vineland-Beamsville System, a booster station will not be required for this alignment option as the water service area for this option is located on the north side of King Street (does not service the Benchlands, located on the south side of King Street).

Hydraulic modelling analysis was conducted for this option for evaluating the infrastructure requirements to achieve the minimum pressure of 40 PSI. The following table summarizes the infrastructure requirements for Option A for each system.

Table 9: Infrastructure Requirements for Option A

Infrastructure Type	Size	JNS System	SCS System	VBS System
Watermain	250 mm	10,473 m	16,219 m	12,749 m
Watermain	300 mm	1,678 m	-	6,905 m
Watermain	400 mm	5,370 m	-	4,602 m
Watermain	500 mm	-	-	1,837 m
Watermain	600 mm	839 m	3,068 m	1,064 m
Watermain	750 mm	3,172 m	5,188 m	1,728 m
Watermain	900 mm	744 m	2,628 m	18 m
Watermain	1050 mm	30 m	-	363 m
Watermain	Total Length	22,306 m	27,102 m	29,265 m
Intake Pump Station	Flow / Head	365 L/s @ 75 m	410 L/s @ 85 m	437 L/s @ 75 m

Figure 12: Alignment Option A – Basic Branched System



From an operational perspective, maintenance activities or emergency repairs on a trunk main may require temporary shutdown of downstream laterals. Additionally, because the system is branched, hydraulic balancing must be carefully managed to maintain adequate pressure and flow at the extremities of the network during peak irrigation periods.

6.1.2 Option B – Basic Looped System

Option B (refer to **Figure 13**) introduces a degree of network redundancy while maintaining a relatively controlled system footprint. In this configuration, the primary trunk mains and major laterals (ranging in diameter from 250 mm to 1050 mm) are arranged to form closed loops, allowing water to reach key portions of the network through multiple paths.

This configuration is broadly similar to the distribution system concept presented in the original Request for Proposal (RFP), although some refinements have been made to improve hydraulic performance and system connectivity. The looped trunk backbone provides improved operational flexibility compared with the branched configuration in Option A.

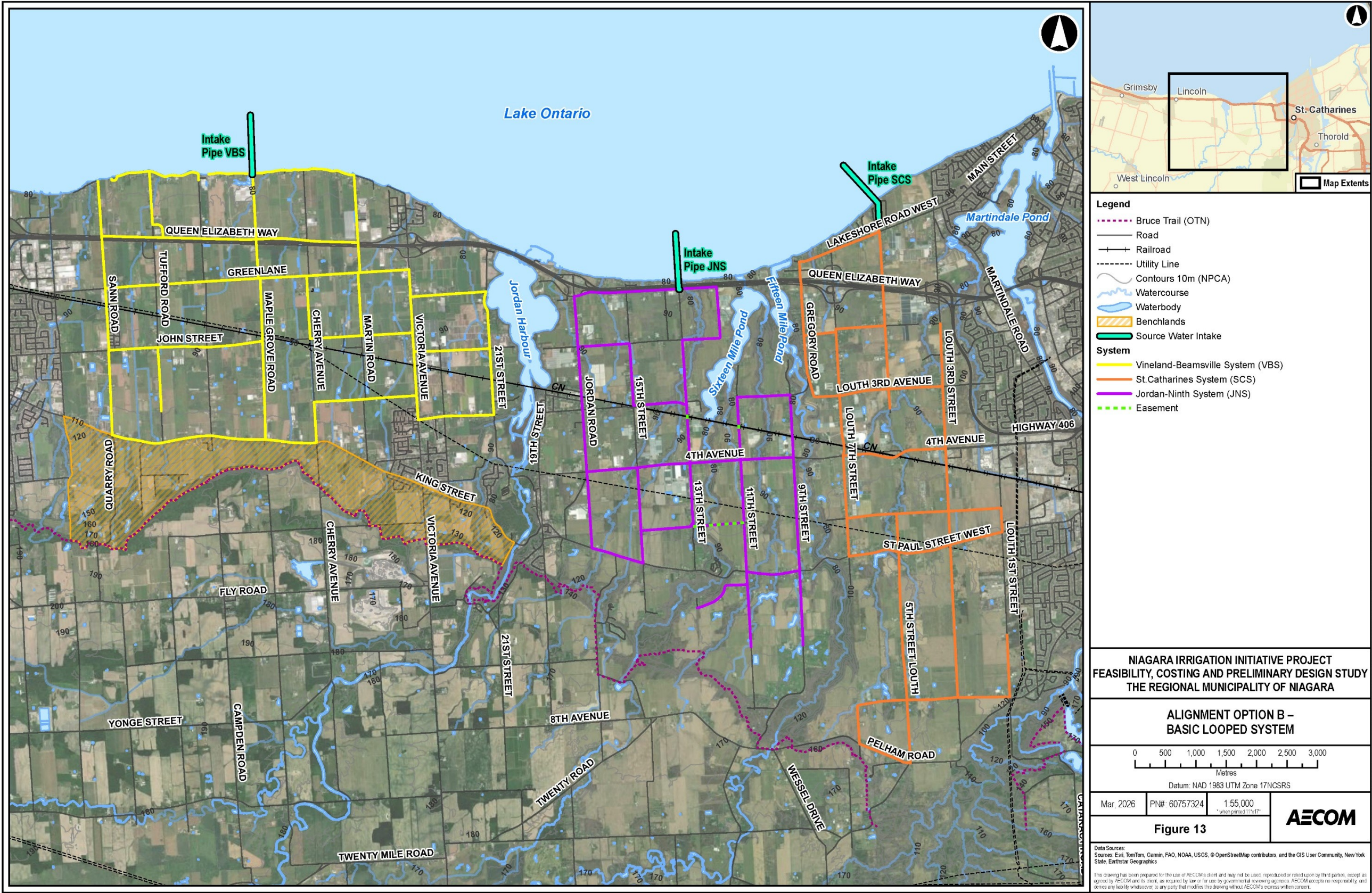
Within this alignment option, the main trunk pipelines form interconnected loops across the major agricultural districts. From these trunk loops, secondary laterals extend outward. These laterals are generally branched in nature but connect to a looped backbone, meaning that disruptions on the main trunks can be bypassed through alternative flow paths.

Hydraulic modelling analysis was conducted for this option for evaluating the infrastructure requirements to achieve the minimum pressure of 40 PSI. **Table 10** summarizes the infrastructure requirements for Option B for each system.

Table 10: Infrastructure Requirements for Option B

Infrastructure Type	Size	JNS System	SCS System	VBS System
Watermain	250 mm	3,927 m	5,779 m	14,620 m
Watermain	300 mm	7,910 m	8,267 m	15,944 m
Watermain	400 mm	8,327 m	4,657 m	12,124 m
Watermain	500 mm	3,405 m	5,380 m	1,618 m
Watermain	600 mm	4,624 m	9,841 m	1,064 m
Watermain	750 mm	4,412 m	2,327 m	1,728 m
Watermain	900 mm	744 m	1,548 m	381 m
Watermain	1050 mm	30 m	143 m	-
Watermain	Total Length	33,379 m	37,942 m	47,478 m
Intake Pump Station	Flow / Head	539 L/s @ 80 m	510 L/s @ 90 m	599 L/s @ 74 m

Figure 13: Alignment Option B – Basic Looped System



The looped backbone improves system resilience by allowing operators to isolate sections of pipeline for maintenance while maintaining service to other portions of the network. It also improves hydraulic performance by enabling flow to redistribute through the network during periods of high demand.

Because the system backbone is looped while most smaller laterals remain branched. Pipe lengths are greater than in Option A, but significantly less than in a full coverage looped network.

Option B will provide greater water servicing coverage than Option A. However, similar to Option A, the water service area located at the southside of King Street (i.e. the Benchlands) in the Vineland-Beamville system will be excluded and therefore a booster pumping station will not be required.

6.1.3 Option C – Full Coverage Looped System

Option C (refer to **Figure 14**) represents the most comprehensive communal irrigation system considered in this study. In this configuration, both the trunk mains and a large proportion of the lateral distribution network (ranging in diameter from 250 mm to 1050 mm) are designed as fully looped systems, providing multiple supply paths throughout the service area.

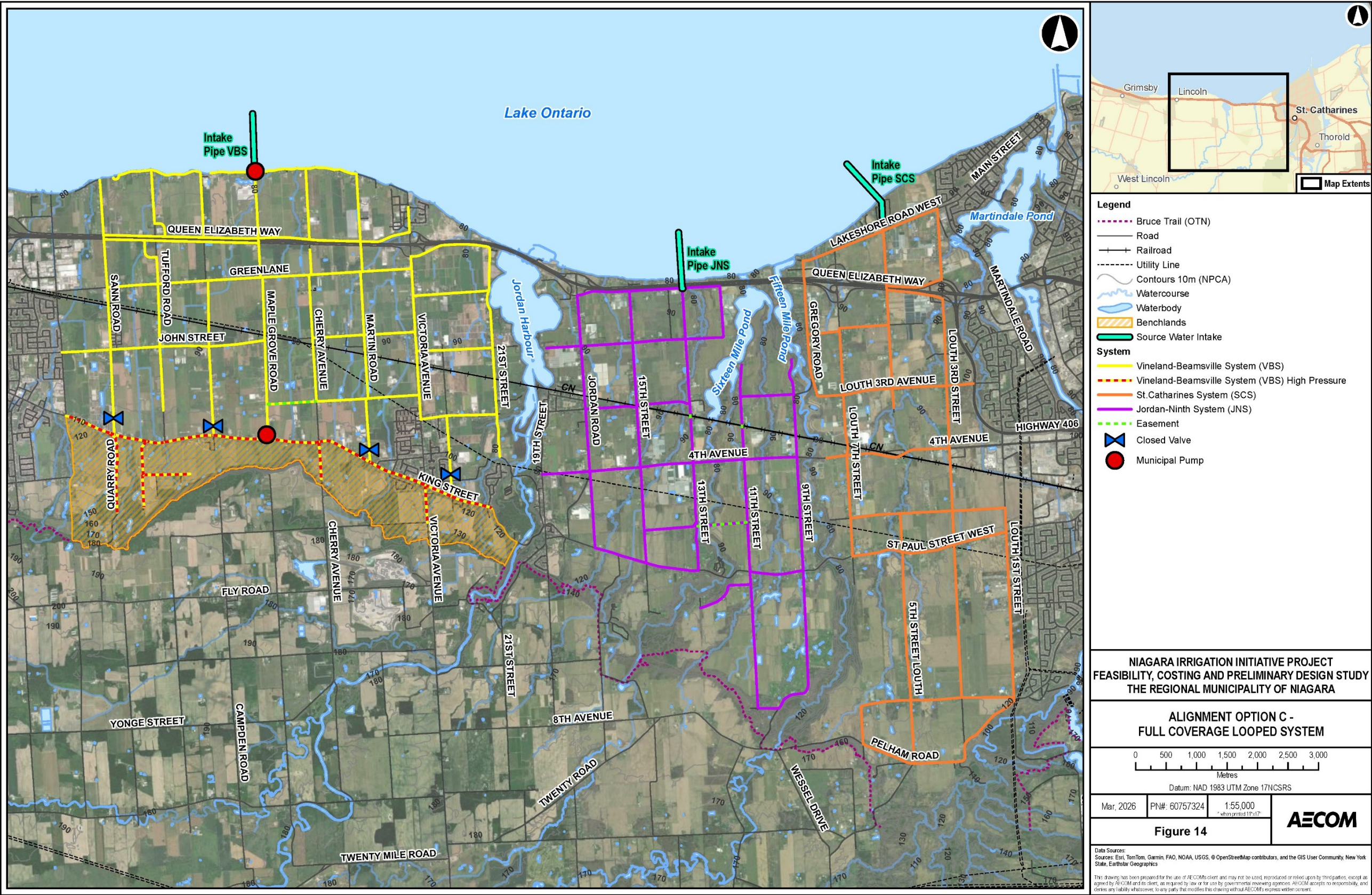
This option builds upon the concept presented in the Request for Proposal (RFP) but expands the network extent and connectivity to provide almost 90% service coverage to agricultural parcels within the Study Area. Under this configuration, trunk pipelines extend across all primary agricultural corridors, with numerous interconnected laterals designed to reach most farms and agricultural operations.

Hydraulic modelling analysis was conducted for this option for evaluating the infrastructure requirements to achieve the minimum pressure of 40 PSI. **Table 11** summarizes the infrastructure requirements for Option C for each system.

Table 11: Infrastructure Requirements for Option C

Infrastructure Type	Size	JNS System Pipe Length (m)	SCS System Pipe Length (m)	VBS System Pipe Length (m)
Watermain	250 mm	2,841	4,140	26,161
Watermain	300 mm	22,558	11,417	16,044
Watermain	400 mm	2,928	11,157	12,528
Watermain	500 mm	3,642	6,273	0
Watermain	600 mm	8,683	5,775	15,574
Watermain	750 mm	0	5,340	1,064
Watermain	900 mm	3,884	2,590	1,728
Watermain	1050 mm	62	143	381
Watermain	Total Length	44,598	46,835	73,480
Intake Pump Station	Flow / Head	571 L/s @ 85 metres	580 L/s @ 90 metres	790 L/s @ 65 metres
Booster Pumping Station	Flow / Head	-	-	140 L/s @ 47 metres

Figure 14: Alignment Option C- Full Coverage Looped System



The primary objective of this option is to establish a communal irrigation system capable of supporting widespread participation. Because the network is extensively looped, water can circulate through multiple pathways, allowing operators to maintain service even if sections of the network are temporarily taken offline for maintenance or repair.

The looped structure also improves hydraulic stability by distributing flows more evenly across the network and reducing pressure fluctuations during peak irrigation demand. This configuration is particularly advantageous under scenarios where irrigation demand is relatively constant or where greenhouse operations require reliable year-round supply.

Option C provides the greatest water servicing coverage of all options including water service to the Benchlands. To maintain adequate pressures in the Benchlands area a new pressure zone in the Vineland-Beamsville system will be developed. The new pressure zone will require a booster pumping station and pressure isolation valves to service the benchlands at their higher elevation.

From an operational perspective, the fully looped system provides the highest level of system resilience, flexibility, and long-term expandability. However, achieving this level of coverage requires significantly more pipeline infrastructure, additional pipe crossings (e.g. QEW, CN Rail and road intersections) and greater co-ordination with landowners and regulatory agencies.

As a result, Option C represents the highest capital cost alignment option, reflecting the larger extent of pipeline construction and supporting infrastructure required to reach nearly all agricultural parcels.

6.2 Evaluation Criteria for Alignment Options

To ensure an objective and transparent comparison of alternative alignment options, a weighted multi-criteria evaluation framework was developed. This framework incorporates economic, engineering, environmental, and socio-economic considerations relevant to the feasibility, constructability, and long-term performance of the irrigation distribution system.

The evaluation criteria fall into three main categories: economic, engineering, and environmental / socio-economic. Each criterion is described below, along with indicators and relative weightings reflecting its importance to decision-making. These are summarized in **Table 12**.

Throughout engagement, participants emphasized the importance of a cost-effective alignment configuration that maximizes system reach and that is well positioned for future growth. Consequently, capital cost and ability to reach agricultural properties are the most heavily weighted criteria.

Table 12: Alignment Option Evaluation Criteria

Criteria Category	Criterion	Weight (%)
Economic	Capital Cost	20%
Economic	Operational Cost (length of system, # of pumps)	10%
Engineering	Ability to Reach Agricultural Properties	35%
Engineering	Construct-ability / Technical Risk	10%
Engineering	Traffic Impacts during construction	5%
Environmental / Socio-Economic	Environmental Impact	5%
Environmental / Socio-Economic	Permits / Approval Consideration	10%
Environmental / Socio-Economic	Land Use & Property Constraints	5%

6.2.1 Economic – Capital Cost

This criterion reflects the initial construction cost associated with the distribution infrastructure required for each alignment option, including water mains, booster pumping stations, storage or pressure management infrastructure, and associated system components. The capital cost varies depending on the total length of pipeline required, pipe diameters, number and capacity of pumping facilities, and the number and complexity of infrastructure crossings.

Capital cost is also expressed as cost per acre, which takes the capital cost of each alignment option and compares it to the amount of area serviced. Each alignment option services progressively more area based on the area of agricultural land fronting the proposed pipe.

Cost estimates were developed using a combination of supplier quotations and AECOM internal cost databases. This approach supports the development of estimates that reflect reliable and up-to-date construction pricing representative of the region.

For each distribution system, the cost estimate accounts for the installation of water mains and associated infrastructure, including crossings of watercourses, highways, and railway corridors. Alignment options with longer pipelines, larger pipe diameters, or greater numbers of crossings generally result in higher capital costs.

Since capital cost is a key determinant of overall system feasibility and affordability and since many workshop participants emphasized the importance of reducing overall system costs, this criterion was assigned a relatively high weighting of 20%.

- **Indicators:** Estimated capital cost of the distribution system including water mains, booster pumps and pumping station buildings, and the number and type of major infrastructure crossings.

6.2.2 Economic – Operational Cost

This criterion evaluates the long-term operational and maintenance costs associated with each alignment option. Operational costs include energy consumption required for pumping, labour associated with operating and maintaining the system, and routine maintenance of mechanical and electrical equipment.

Operational costs are influenced by several factors including the overall length of the distribution system, the number of pumping stations required to maintain pressure within the network, and the overall hydraulic efficiency of the system. Alignment options requiring additional pumping stations or greater pumping head will typically result in higher annual operating costs due to increased energy consumption and maintenance requirements. This criterion was assigned a moderate weighting of 10%

- **Indicators:** Estimated annual operating and maintenance costs per connection, energy consumption measured in kilowatt-hours per year, and anticipated maintenance cycles for major infrastructure components.

6.2.3 Engineering – Ability to Reach Agricultural Properties

The ability of the irrigation system to reach agricultural properties is a key engineering and planning criterion. This criterion was assessed based on the percentage of agricultural parcels that front onto a roadway containing an irrigation distribution pipeline, as well as the ability of the system configuration to provide redundancy and maintain service during outages or unforeseen events

Accessibility to the irrigation system was evaluated by determining the percentage of agricultural parcels located along a roadway containing irrigation distribution infrastructure or within a reasonable connection distance of a distribution pipeline. Agricultural parcels with direct frontage on roads containing irrigation pipelines are considered to have the most direct opportunity to connect to the system.

Alignment options that provide access to a greater proportion of agricultural properties are considered more favourable, as they increase the potential utilization of the communal irrigation system and improve the ability of the system to support agricultural operations throughout the Study Area.

Most engagement participants noted that they believe more than half of the Study Area's agricultural properties will be interested in using the communal system and many participants indicated that ensuring access to all agricultural properties was a key priority for the system alignment. Numerous participants also noted the importance of building a system that can easily scale up as interest grows.

Since the primary purpose of the irrigation system is to serve agricultural lands, and because this was identified as a key system goal by the public, this criterion was assigned a relatively high weighting of 35%.

Indicators: Percentage of agricultural parcels with frontage along a roadway containing an irrigation distribution pipeline and ability of the system to provide redundancy

6.2.4 Engineering – Constructability / Technical Risk

This criterion evaluates the relative constructability and technical risk associated with each alignment option, with a focus on challenges related to infrastructure implementation. Consideration is given to the extent of linear infrastructure required, the associated construction footprint, and the number of major highway and rail crossings along each alignment.

Constructability and technical risk are influenced by the complexity and intensity of construction activities required to implement the irrigation distribution network. In particular, crossings of major highways and rail corridors introduce additional design, permitting, staging, and safety requirements, and may necessitate specialized construction methods, thereby increasing cost, schedule, and delivery risk.

Alignment options with fewer major crossings, fewer utility conflicts, and better site accessibility generally present lower construction risk and are therefore considered more favourable. This criterion was assigned a weighting of 10%.

- **Indicators:** Space in existing ROW requirements and construction footprint and number of major highway and rail crossings.

6.2.5 Engineering – Traffic Impacts During Construction

This criterion assesses the potential impacts to vehicular and cycling traffic associated with construction of the irrigation distribution infrastructure. As the majority of the proposed pipeline installation is anticipated to occur within existing road right-of-ways, construction activities may temporarily affect roadway operations through lane closures, or localized detours.

Alignment options that require construction along major regional roads or higher-traffic corridors are expected to result in greater disruption to traffic operations when compared to options located primarily along lower-volume rural roadways. Construction methods such as open-cut trenching may necessitate temporary lane closures or traffic control measures, potentially reduce the level of service and affect road users during construction.

Public and stakeholder engagement indicated that traffic impacts during construction were not a primary concern, with few participants raising this issue explicitly. Nonetheless, minimizing traffic disruption remains an important consideration from an engineering and implementation perspective.

Options that limit the extent of work on high-traffic roads, reduce the duration and frequency of lane closures, and allow for effective traffic management are considered more favourable under this criterion. This criterion was assigned a weighting of 5%.

- **Indicators:** Estimated number and duration of vehicular or cycling lane closures and the anticipated reduction in level of service on roads with higher traffic volumes during construction.

6.2.6 Environmental / Socio-Economic – Environmental Impact

This criterion considers the potential environmental impacts associated with construction and operation of the irrigation distribution system. Potential impacts include direct, indirect, and cumulative effects on natural heritage features, ecological functions, and environmentally sensitive areas.

Environmental considerations include the presence and type of natural heritage features along the alignment corridor, including woodlands, wetlands, Areas of Natural and Scientific Interest (ANSIs), valleylands, watercourses, and SAR habitat. Construction activities may result in temporary or permanent disturbance to these features depending on the installation method and the sensitivity of the receiving environment.

Few engagement participants voiced concern about impacts to natural heritage features or the local environment. However, several participants enquired about the overall size and extent of the system. This criterion was assigned a weighting of 5%.

Indicators: Applicable environmental or land use designations such as Provincially Significant Wetlands or Conservation Authority regulated areas, presence and sensitivity of fish habitat, SAR habitat or occurrence records, proximity to sensitive ecological features and designated areas, number and type of watercourse crossings, and anticipated construction methods such as open-cut or trenchless installation.

6.2.7 Environmental / Socio-Economic – Permits and Approval Considerations

This criterion evaluates the potential complexity and risk associated with obtaining the regulatory approvals required to construct the distribution system. Delays or challenges

in obtaining environmental, regulatory, or land use approvals may affect the project schedule, cost, or feasibility.

Approvals that may be required include Conservation Authority permits, Environmental Compliance Approvals (ECAs), Fisheries Act authorizations from Fisheries and Oceans Canada, SCA screening, Niagara Escarpment Commission approvals, and permits associated with road and railway crossings.

Alignment options that require fewer permits or involve less complex regulatory processes are considered more favourable.

Several engagement participants expressed a general preference for options that could expediate construction timelines by reducing the number of required permits. However, this criterion was not a key factor for most participants. This criterion was assigned a weighting of 10%.

- **Indicators:** Number and type of permits required, complexity and duration of the approval process, anticipated lead times for regulatory agencies, and presence of sensitive environmental features such as species at risk habitat, wetlands, floodplains, or source protection zones.

6.2.8 Environmental / Socio-Economic – Land Use and Property Constraints

This criterion evaluates the extent to which each alignment option affects private properties, agricultural operations, and existing land uses. While pipeline installation within road allowances can reduce impacts to private lands, some options may require permanent easements across agricultural parcels.

The evaluation considers the number of private properties crossed by each alignment, land requirements for infrastructure such as pumping stations, and potential impacts to specialty crops including vineyards and orchards. This criterion was assigned a weighting of 5%.

- **Indicators:** Number of private parcels crossed; land requirements, permitting permanent easements, conflict with specialty crops; and potential disruption to businesses.

6.3 Evaluation of Alignment Options

The evaluation is summarized in the below sections and shown in **Table 13**. These options vary in terms of system coverage, network configuration, and the degree of redundancy provided within the distribution network.

To support the evaluation of alignment options, the distribution systems were sized to convey sufficient capacity to meet the irrigation demand associated with agricultural parcels that have frontage along roads containing irrigation pipelines. This approach reflects the practical assumption that parcels directly fronting serviced roads are the most likely to connect to the communal irrigation system. By sizing the system based on these properties, the evaluation focuses on realistic service uptake while avoiding oversizing infrastructure for parcels that would require significant private distribution works to connect.

6.3.1 Option A – Basic Branched System

This option ranked third overall, with a total weighted score of 2.9 out of 5.0. This option represents a simplified branched irrigation network with a single supply path, resulting in a straightforward system layout with reduced infrastructure requirements. Due to its limited network extent and concentration within existing road corridors, interactions with environmentally sensitive areas are minimized, contributing to lower environmental impact and permitting complexity relative to the other options.

Relative to Options B and C, the capital cost for Option A is considered the lowest, with an estimated total cost of approximately \$137.3M, reflecting the shortest pipe length, fewest crossings, and minimal system infrastructure. In addition, operational costs are also favourable compared to the other options, as no booster pumping is required, resulting in lower energy consumption, reduced maintenance requirements, and simpler system operation.

Constructability and ease of implementation are highest for this option, as the system represents the least complex alignment, with fewer major crossings (approximately 3 QEW and 4 CN rail crossings) and a smaller construction footprint. As a result, construction staging, coordination, and overall implementation risk are minimized. Similarly, traffic impacts during construction are expected to be lowest, with approximately 122 local road intersections affected, and impacts that are localized and manageable.

Environmental impacts and permitting complexity are also lowest among the three options, as the shorter alignment reduces the likelihood of interactions with watercourses, wetlands, woodlands, and species at risk (SAR) habitat. Fewer regulated

crossings and limited ecological disturbance requirements contribute to a more streamlined approvals process, with fewer agency coordination requirements and reduced schedule risk.

However, Option A performs less favourably in terms of system coverage and resilience. The branched configuration provides access to approximately 55% of agricultural parcels, which is the lowest among the options. Many properties located away from the primary trunk corridors would not be serviced, limiting overall system effectiveness and potential uptake. In addition, the absence of looped infrastructure means there is no redundancy, reducing the system's ability to respond to outages or maintenance requirements. Also, this option has a limited opportunity for future phased expansion without constructing additional trunk infrastructure, as the initial network is generally sized only for immediate servicing needs.

Strengths:

■ **Economic:**

- Lowest capital cost (~\$137.3M) due to reduced pipe length, fewer crossings, and minimal infrastructure
- Lower cost per acre (\$14,600/acre), same as Option B but lower than Option C
- Lower operational costs with no booster pumping requirements, reduced energy consumption, and simplified maintenance

■ **Engineering**

- Simplest system configuration with the lowest constructability and technical risk
- Shortest and least complex alignment with fewer major crossings
- Minimal construction duration and lowest traffic impacts during implementation
- Straightforward operation with limited infrastructure requirements
- Moderate land acquisition required for a pump house at each intake location

■ **Environmental**

- Lowest potential for impacts to natural heritage features (e.g., wetlands, woodlands, watercourses)
- Reduced likelihood of encountering SAR habitat
- Lowest permitting complexity and reduced regulatory coordination

Challenges

■ **Economic:**

- Limited service coverage may reduce overall system uptake and cost efficiency per connection

■ Engineering:

- Serves only approximately 55% of agricultural parcels, limiting overall effectiveness of the system
- No redundancy due to branched configuration, reducing reliability during outages or maintenance
- Limited flexibility for future expansion or system upgrades

■ Environmental / Socio-Economic:

- While impacts are generally low, localized construction impacts to roads and nearby properties will occur
- Limited service coverage may restrict broader agricultural and economic benefits across the study area
- Minor property easements and temporary disruptions to businesses may be required in select locations

Overall Scoring

- This option was rated the **lowest among the three alternatives**, with an overall score of **2.9 out of 5.0**. The scoring for each criterion can be seen in the evaluation table.

6.3.2 Option B – Basic Looped System

This option ranked second overall, with a total weighted score of 3.1 out of 5.0. This option introduces a looped trunk backbone with branched laterals, improving system reliability and flexibility compared to Option A while maintaining a moderate level of infrastructure expansion. The looped configuration allows water to reach portions of the network through more than one supply path, improving operational resilience.

Relative to Options A and C, the capital cost for Option B is considered moderate, with an estimated total cost of approximately \$185.5M, reflecting increased pipe length, additional crossings, and expanded infrastructure compared to Option A, but still significantly lower than Option C. Operational costs remain relatively favourable, as no booster pumps are required, resulting in lower energy consumption, moderate maintenance requirements, and manageable operational complexity.

Constructability and ease of implementation are considered moderate, as the alignment is more extensive and complex than Option A, with an increased number of major crossings (approximately 6 QEW and 8 CN rail crossings). While this introduces additional coordination and staging requirements, the overall construction risks remain manageable using standard municipal construction practices. Traffic impacts during construction are also moderate, with approximately 156 local road intersections affected, resulting in broader but still manageable disruptions compared to Option A.

Environmental impacts and permitting complexity are also moderate, as the expanded alignment increases the likelihood of interaction with watercourses, wetlands, woodlands, and potential SAR habitat. Additional regulatory approvals will be required compared to Option A, including increased coordination with multiple agencies; however, the level of impact and permitting complexity remains typical for municipal linear infrastructure projects.

Option B performs moderately in terms of system coverage and reliability, providing access to approximately 77% of agricultural parcels, a substantial improvement over Option A. The looped configuration introduces system redundancy, improving reliability during outages and enhancing operational flexibility. This option represents a balanced approach between cost, coverage, and system resilience, aligning well with stakeholder preferences for broader access without incurring the highest capital cost.

Strengths:

■ Economic:

- Moderate capital cost (**~\$185.5M**) balancing expanded coverage with infrastructure efficiency
- Lower cost per acre (\$14,600/acre), same as Option A but lower than Option C
- No booster pumping required, resulting in lower energy consumption and manageable operational costs

■ Engineering:

- Improved service coverage (**~77% of agricultural parcels**) compared to Option A
- Looped trunk network provides redundancy and enhances system reliability
- Moderate constructability risk with feasible construction methods
- Balanced system design allowing for some potential for a staged expansion over time, but not enough capacity in the main branches to service the Benchlands in the future

■ Environmental:

- Moderate environmental impact relative to the extent of the system
- Impacts generally manageable within typical mitigation and permitting frameworks
- Acceptable level of permitting complexity compared to more extensive alternatives

Challenges

■ Economic:

- Higher capital cost than Option A due to increased pipe length and infrastructure requirements

■ Engineering:

- Increased alignment length and number of crossings introduce greater complexity compared to Option A
- Does not achieve full system coverage, leaving approximately 23% of agricultural parcels without direct access
- While improved, redundancy is not as extensive as in Option C

■ Environmental / Socio-Economic:

- Increased interaction with natural heritage features compared to Option A
- Moderate traffic disruptions during construction across a wider area
- Additional permitting requirements and coordination with multiple agencies

Overall Scoring

- This option was rated **second among the three alternatives**, with an overall score of **3.1 out of 5.0**. The scoring for each criterion can be seen in the evaluation table.

6.3.3 Option C – Full Coverage Looped System

This option ranked first overall, with a total weighted score of 3.3 out of 5.0. This option represents a fully looped and comprehensive irrigation network, providing multiple supply pathways throughout the system and enabling the highest level of reliability, redundancy, and long-term expandability.

Relative to Options A and B, the capital cost for Option C is considered the highest, with an estimated total cost of approximately \$262M, driven by the longest pipe length, greatest number of crossings, and most extensive infrastructure requirements. Operational costs are also the highest among the three options, as the system requires booster pumping infrastructure, resulting in increased energy consumption, more complex operations, and higher maintenance requirements.

Constructability and ease of implementation are considered the most complex, as this option includes the longest alignment and the highest number of major crossings (approximately 8 QEW and 14 CN rail crossings). The increased infrastructure footprint introduces additional coordination, staging challenges, and potential schedule and cost uncertainty. Traffic impacts during construction are also the highest, with approximately 219 local road intersections affected, leading to more widespread and longer-duration disruptions.

Environmental impacts and permitting complexity are highest for this option, as the extensive network increases interaction with watercourses, wetlands, woodlands, escarpment-adjacent areas, and potential SAR habitat. The larger number of crossings and broader geographic footprint result in more complex regulatory approvals, increased coordination with multiple agencies, and longer permitting timelines.

Despite these challenges, Option C performs best in terms of system coverage and resilience, providing access to approximately 89% of agricultural parcels, the highest among the options. This option also allows for optimal phasing and ultimate reach; if the main trunks are constructed with the full extent in mind, the full alignment coverage does not need to be built from the beginning. The system can be phased based on demand, thus spreading costs out over time with the highest ultimate coverage. The fully looped configuration provides maximum redundancy, ensuring high operational reliability and flexibility during maintenance or outage conditions. This option best supports long-term agricultural needs and aligns with stakeholder feedback emphasizing broad access and system scalability.

Strengths

■ Economic:

- Provides maximum service coverage and long-term system value despite higher upfront cost

■ Engineering:

- Highest service coverage (**~89% of agricultural parcels**)
- Fully looped system provides maximum redundancy and operational flexibility
- Most adaptable configuration for phasing in of the system over time, main branches could be built first with sufficient capacity to build out full alignment in the future, including the Benchlands.
- Strong system resilience during outages or maintenance

■ Environmental:

- Enables comprehensive servicing of the study area, maximizing overall agricultural benefit
- Supports long-term sustainability through system reliability and expandability

Challenges

■ Economic:

- Highest capital cost (**~\$238M**) due to extensive infrastructure requirements
- Highest cost per acre (\$15,800/acre) due to more extensive pipe network. When going from Option B to C, the incremental amount of additional agricultural land reached proportional to the extent of pipe added is smaller than when going from Option A to B, thus the cost per acre increases.
- Highest operational cost due to booster pumping, energy consumption, and maintenance

■ **Engineering:**

- Most complex system to construct with the longest alignment and highest number of crossings
- Greater technical risk and construction coordination requirements
- Significant traffic impacts during construction across multiple corridors

■ **Environmental / Socio-Economic:**

- Highest potential for impacts to natural heritage features and sensitive areas
- Most complex permitting and approvals process with longer timelines
- Greater number of property interactions, easements, and construction-related disruptions

Overall Scoring

- This option was rated **highest among the three alternatives**, with an overall score of **3.2 out of 5.0**. The scoring for each criterion can be seen in the evaluation table.

Table 13: Alignment Evaluation Matrix

Criteria Category	Criterion	Description	Indicators	Weight (%)	Option A – Basic Branched System	Option B – Basic Looped System	Option C – Full Coverage Looped System
Economic	Capital Cost	This criterion reflects the initial construction cost associated with linear infrastructure for each option, including water mains, storage, pumping infrastructure, and other system components. Cost estimates were developed using a combination of supplier quotations and internal cost databases to support reliable and up-to-date pricing.	1. The estimated cost encompasses the following components: ■ Water main ■ Booster Pumps and Booster Pumping Station Building ■ For each distribution system, the estimate accounts for water mains and associated crossings, including watercourses, highway and railway crossings. ■ Consideration of Engagement Feedback: Many engagement participants emphasized the importance of reducing overall cost wherever possible as long as it does not reduce the overall effectiveness of the system.	20	■ The branched system provides limited-service coverage	■ Expanded service coverage compared to Option A	■ Maximum service coverage across the study area
					■ Shortest total pipe length, resulting in reduced piping costs	■ Increased pipe length, leading to higher material and installation costs	■ Longest total pipe length, resulting in highest piping costs
					■ Minimal redundancy; limited to parcels along main trunk pipelines.	■ Moderate level of redundancy with some looped sections	■ High level of redundancy with fully looped network
					■ Lowest number of crossings and associated structures cost	■ Additional crossings and associated structures cost	■ Greatest number of crossings and associated structures cost
Economic	Capital Cost	This criterion reflects the initial construction cost associated with linear infrastructure for each option, including water mains, storage, pumping infrastructure, and other system components. Cost estimates were developed using a combination of supplier quotations and internal cost databases to support reliable and up-to-date pricing.	1. The estimated cost encompasses the following components: ■ Water main ■ Booster Pumps and Booster Pumping Station Building ■ For each distribution system, the estimate accounts for water mains and associated crossings, including watercourses, highway and railway crossings. ■ Consideration of Engagement Feedback: Many engagement participants emphasized the importance of reducing overall cost wherever possible as long as it does not reduce the overall effectiveness of the system.	20	■ Pumping Station (Including Intake pipe, screen, airburst, installation to shoreline, pumps, pumping station building and pump station land acquisitions): \$ 37 M	■ Balanced cost relative to increased reliability	■ Pumping Station (Including Intake pipe, screen, airburst, installation to shoreline, pumps, booster pump, pumping station building and pump station land acquisitions): \$ 38.1 M
					■ Alignment Crossings Cost (Including creek crossings, CN Railway crossings, highway crossings, major utility lines, and regional intersections): \$ 10.5 M	■ Pumping Station (Including Intake pipe, screen, airburst, installation to shoreline, pumps, pumping station building and pump station land acquisitions): \$ 37.3 M	■ Alignment Crossings Cost (Including creek crossings, CN Railway crossings, highway crossings, major utility lines, and regional intersections): \$ 20.7 M
					■ Alignment Piping Cost (including pipe material, installation, trenching, and road restoration): \$ 56.5 M	■ Alignment Crossings Cost (Including creek crossings, CN Railway crossings, highway crossings, major utility lines, and regional intersections): \$ 17.2 M	■ Alignment Piping Cost (including pipe material, installation, trenching, and road restoration): \$ 139.7 M
					■ Estimated Cost = \$ 104 M	■ Alignment Piping Cost (including pipe material, installation, trenching, and road restoration): \$ 86 M	■ Alignment Piping Cost (including pipe material, installation, trenching, and road restoration): \$ 139.7 M
Economic	Capital Cost	This criterion reflects the initial construction cost associated with linear infrastructure for each option, including water mains, storage, pumping infrastructure, and other system components. Cost estimates were developed using a combination of supplier quotations and internal cost databases to support reliable and up-to-date pricing.	1. The estimated cost encompasses the following components: ■ Water main ■ Booster Pumps and Booster Pumping Station Building ■ For each distribution system, the estimate accounts for water mains and associated crossings, including watercourses, highway and railway crossings. ■ Consideration of Engagement Feedback: Many engagement participants emphasized the importance of reducing overall cost wherever possible as long as it does not reduce the overall effectiveness of the system.	20	■ General Conditions 12% (Includes - Mob/demob, Tree protection, Relocation of existing utilities (if any), Rock blasting (if any), etc.): \$ 12.5 M	■ Estimated Cost = \$ 140.5 M	■ Estimated Cost = \$ 198.5 M
					■ Detailed Design 10%: \$ 10.4 M	■ General Conditions 12% (Includes - Mob/demob, Tree protection, Relocation of existing utilities (if any), Rock blasting (if any), etc.): \$ 17 M	■ General Conditions 12% (Includes - Mob/demob, Tree protection, Relocation of existing utilities (if any), Rock blasting (if any), etc.): \$ 23.8 M
					■ Construction Contingency 10% (cost fluctuations includes UTE, permitting) :10.4 M	■ Detailed Design 10%: \$ 14 M	■ Detailed Design 10%: \$ 19.8 M
					■ Total Cost for Option A = 137.3 M	■ Construction Contingency 10% (cost fluctuations includes UTE, permitting) :14 M	■ Construction Contingency 10% (cost fluctuations includes UTE, permitting) :19.8 M
Economic	Capital Cost	This criterion reflects the initial construction cost associated with linear infrastructure for each option, including water mains, storage, pumping infrastructure, and other system components. Cost estimates were developed using a combination of supplier quotations and internal cost databases to support reliable and up-to-date pricing.	1. The estimated cost encompasses the following components: ■ Water main ■ Booster Pumps and Booster Pumping Station Building ■ For each distribution system, the estimate accounts for water mains and associated crossings, including watercourses, highway and railway crossings. ■ Consideration of Engagement Feedback: Many engagement participants emphasized the importance of reducing overall cost wherever possible as long as it does not reduce the overall effectiveness of the system.	20	■ Total Cost per Acre Serviced = \$14,600	■ Total Cost for Option B = 185.5 M	■ Total Cost for Option C = 238 M
					■ Total Cost per Acre Serviced = \$14,600	■ Total Cost per Acre Serviced = \$14,600	■ Total Cost per Acre Serviced = \$15,800
					4	3.5	2.5
					4	3	2.5
Economic	Operational Cost (length of system, # of pumps)	Long-term energy, labour, and maintenance costs	■ Annual O&M cost per connection; energy use (kWh/year); anticipated maintenance cycles	10	■ No Booster Pump is needed for this option	■ No Booster Pump is needed for this option	■ One Booster Pump is needed for this option
					■ Lower energy consumption	■ Lower energy consumption	■ Additional pumping and control infrastructure compared to option A and B
					■ Simpler maintenance program	■ Simpler maintenance program	■ Highest ongoing maintenance requirement
					■ Less operational infrastructure	■ Moderate operational infrastructure	■ Large-sized pumps is needed for this option
Economic	Operational Cost (length of system, # of pumps)	Long-term energy, labour, and maintenance costs	■ Annual O&M cost per connection; energy use (kWh/year); anticipated maintenance cycles	10	■ Small-sized pumps is needed for this option	■ Medium-sized pumps is needed for this option	■ Large-sized pumps is needed for this option
					4	3	2.5
					4	3	2.5
					4	3	2.5

Criteria Category	Criterion	Description	Indicators	Weight (%)	Option A – Basic Branched System	Option B – Basic Looped System	Option C – Full Coverage Looped System
Engineering	Ability to Reach Agricultural Properties	Percentage of agricultural parcels with frontage along a roadway containing an irrigation distribution pipeline and ability of the system to provide redundancy and ability to accommodate a phased implementation approach	- Percentage of Agricultural Properties fronting onto a roadway containing an irrigation distribution pipeline which in turn addresses potential drought conditions. Redundancy and ability of the system to respond to outage and unforeseen events (watermain break). - Consideration of Engagement Feedback: A majority of participants indicated that more than half of agricultural properties within the Study Area would be interested in connecting to a communal irrigation system, with further uptake anticipated following system implementation. While some participants did support providing connections to properties approaching or above the escarpment, most did not explicitly mention servicing the benchlands as a key requirement for the system.	35	55 % of all agricultural parcels (9,400 out of 16,945 acres) in the study area. - The branched system provides limited-service coverage, primarily constrained to parcels located along the main trunk pipelines. - Many agricultural parcels, particularly those set back from primary corridors, would not front onto a distribution route, limiting their ability to connect. - This configuration does not provide redundancy or lateral reach, reducing flexibility of the system during unforeseen events - Option A offers the lowest proportion of agricultural parcels with direct roadway frontage to irrigation infrastructure, which may limit system uptake. - Limited opportunity for phasing without constructing additional trunk infrastructure, as the initial network is generally sized only for immediate servicing needs.	77 % of all agricultural parcels (12,800 out of 16,945 acres) in the study area. - The looped configuration significantly expands the trunk network, improving access to agricultural parcels across most of the study area. - While benchlands are excluded, the alignment reaches a majority of agricultural parcels, supporting broader participation relative to Option A. - Looping provides multiple access points enhancing the practicality of farm connections. - Overall, Option B achieves a strong balance between service reach and infrastructure efficiency, aligning well with stakeholder preferences for improved access. - Looped configuration improves redundancy including operational reliability and maintenance flexibility - Provides reasonable opportunities for phasing through selected oversized trunk mains; however, additional distribution infrastructure would still be required to service the Benchlands.	89 % of all agricultural parcels (15,100 out of 16,945 acres) in the study area. - This option provides maximum service coverage, extending distribution mains to include benchlands and peripheral agricultural areas. - Nearly all agricultural parcels would front onto a roadway containing irrigation infrastructure, enabling universal connectivity. - Option C best responds to engagement feedback emphasizing full agricultural access and system scalability. - This option provides greater redundancy while maintaining operational reliability and maintenance flexibility - Offers the greatest flexibility for phased implementation by allowing strategically oversized trunk and distribution mains to be constructed initially, enabling future service expansion and additional farm connections with minimal upgrades to the primary backbone infrastructure.
					1.5	3	4.5
	Constructability / Technical Risk	Challenges related infrastructure implementation	Space in existing ROW requirements and construction footprint and number of major highway and rail crossings	10	- Option A represents the shortest and least complex alignment, resulting in the lowest construction risk. - The system includes 3 QEW, and 4 CN rail major crossings. Fewer crossings compared to other 2 options minimizes coordination and technical challenges. - Limited construction footprint simplifies staging, access, and sequencing. - Overall, Option A presents the lowest constructability and technical risk among the three alternatives.	- The looped configuration increases network length and introduces additional construction complexity. - Option B includes 6 QEW, and 8 CN rail major crossings a moderate increase compared to Option A. - While additional crossings require more coordination and design mitigation, risks remain manageable using standard municipal construction practices. - Overall, Option B results in moderate constructability and technical risk, balancing expanded service coverage with feasible construction.	- Option C requires the most extensive infrastructure, resulting in the longest alignment length. - The system includes the most amount of major crossings, 8 at QEW, and at 14 CN rail. - While additional crossings require more coordination and design mitigation, risks remain manageable using standard municipal construction practices. - Construction staging and access management would be more complex, increasing the potential for schedule and cost uncertainty. - Overall, Option C presents the highest constructability and technical risk of the evaluated alternatives. - Highest adaptability and long-term system resilience.
					3.5	3	2.5
	Traffic Impacts during construction	Expected numbers of the vehicular and bicycling lane closures during construction	- Resulting reduction in level of service on roads with high traffic volumes. - Consideration of Engagement Feedback :Few engagement participants explicitly raised concerns about traffic impacts during construction.	5	- Construction is limited to a small number of corridors, resulting in minimal traffic disruption. - Approximately 122 local road intersections are anticipated to experience temporary lane closures or traffic control during construction. Avoids work within Regional Road 24 (Victoria Av) which has high traffic volumes. - Includes work on Regional Road 81 (King St) which has high traffic volumes and is part of the Regional Wine Route. - Shorter construction duration reduces the overall impact on vehicular, cycling, and pedestrian movement. - Traffic impacts would be localized, temporary, and readily manageable. - Option A results in the lowest traffic impacts during construction.	- Expanded network coverage increases the number of streets affected during construction. - Approximately 156 local road intersections may experience temporary lane closures, detours, or reduced level of service. Moderate work within Regional Road 24 (Victoria Av) which has high traffic volumes. - Includes less work on Regional Road 81 (King St) which has high traffic volumes and is part of the Regional Wine Route. - Traffic impacts would be distributed across multiple corridors but generally limited in duration. - Standard traffic management measures would be required to maintain safety and access. - Option B results in moderate traffic impacts, reflecting the broader construction footprint.	- Extensive construction across multiple corridors generates the highest level of traffic disruption. - Approximately 219 local road intersections are anticipated to require lane closures, detours, or partial closures during construction. Slightly higher work within Regional Road 24 (Victoria Av) which has high traffic volumes. - Includes slightly more work on Regional Road 81 (King St), compared to option A, which has high traffic volumes and is part of the Regional Wine Route. - The duration and geographic extent of construction would increase cumulative impacts on traffic flow. - More complex traffic staging and coordination would be required. - Option C results in the greatest traffic impacts during construction among the alternatives.
					3.5	3	2.5

Criteria Category	Criterion	Description	Indicators	Weight (%)	Option A – Basic Branched System	Option B – Basic Looped System	Option C – Full Coverage Looped System
Environmental / Socio-Economic	Environmental Impact	Potential direct, indirect, and cumulative impacts to natural heritage features, ecological functions, and environmentally sensitive areas. Presence and type of natural heritage features (e.g., woodlands, wetlands, ANSIs, valleylands, watercourses)	■ Applicable environmental or land use designations (e.g., PSWs, conservation authority regulated areas, protected countryside), fish habitat presence and sensitivity, SAR habitat or occurrence records, proximity to sensitive ecological features and designated areas, anticipated number and type of watercourse or feature crossings, type and level of construction impact (e.g., open cut, trenchless methods). ■ Consideration of Engagement Feedback :Few engagement participants expressed concern about impacts to natural heritage or local ecosystems.	5	■ Site conditions suggest Option A has the lowest likelihood of interacting with regulated natural features due to its shorter overall alignment and concentration within established road corridors. The reduced number of watercourse, woodlands, and wetland crossings indicates low potential for disturbance to SAR habitat or valleylands systems. Trenchless methods would only be required at a limited number of crossings, lowering ecological disruption and construction-timing constraints.	■ Option B's moderate expansion of the alignment footprint increases the likelihood of interacting with woodlands, wetlands, and watercourses. The looped configuration reduces reliance on single corridors but introduces moderate potential for SAR habitat proximity and valleylands constraints. Some segments may require trenchless crossings to avoid ecological features.	■ Option C has the highest probability of interacting with natural heritage features due to its extensive looping and expansion into benchlands and peripheral rural corridors. Increased frequency of watercourse, woodland, and wetland crossings raises the likelihood of encountering SAR habitat and requiring trenchless methods. Wider ground disturbance and interactions with escarpment-adjacent valleylands elevate ecological sensitivity compared to other options.
					3.5	3	2.5
	Permits / Approval Consideration	The risk that delays or challenges in obtaining necessary environmental, regulatory, and land use approvals will impact project schedule, costs, or feasibility. This includes Conservation Authority permits, ECAs, DFO approvals, NEC, rail and road crossing permits, etc.	■ Number of permits required including complexity and duration to obtain Consider lead times for each regulatory agency and presence of sensitive areas (e.g., SAR, floodplains, wetlands, source protection zones). ■ Consideration of Engagement Feedback : Several participants expressed a preference for options that could expediate construction timelines by reducing the number of required permits.	10	■ Option A is likely to require the fewest permits, given the smaller number of regulated crossings. NPCA s.28 review needs are limited, Fisheries Act interaction is unlikely, except at isolated minor watercourse crossings, and SCA screening where SAR habitat potential is reduced compared to other options. Fewer utility, road, and rail interfaces reduce multi-agency coordination. Evidence indicates Option A carries the lowest schedule sensitivity among the alternatives.	■ Option B will require more approvals than Option A, including additional NPCA s.28 permits, moderate potential for Fisheries Act review where watercourses support fish habitat, and SCA screening where SAR habitat potential is high. The broader alignment envelope introduces additional rail/road/utility crossing coordination. Permit-related schedule sensitivity is moderate, consistent with typical multi-corridor municipal linear infrastructure.	■ Option C will require the most extensive permitting, including numerous NPCA s.28 permits, a higher likelihood of Fisheries Act review, and SCA screening where SAR habitat potential is high. Multiple road, rail, and utility crossings create elevated coordination requirements, resulting in the longest anticipated permitting timeline among the options.
					3.5	3	3
	Land Use & Property Constraints	Land Use & Property Constraints	■ Number of private parcels crossed; land requirements, permitting permanent easements, conflict with specialty crops; and potential disruption to businesses ■ Consideration of Engagement Feedback : Few engagement participants reported any specific concerns related to land use.	5	■ All pipelines are located within road allowances, with the exception of a small permanent easement within Specialty Crop Lands along 5th Street Louth, between 5th Avenue Louth and the CN Rail corridor. ■ Temporary disruption to businesses along the King St and surrounding area within the community of Vineland	■ All proposed pipelines are located within existing road allowances, with the exception of a small permanent easements within Specialty Crop Lands along Horton Avenue between 13th Street and 11th Street, ■ Avoids disruption to businesses along the King St and surrounding area within the community of Vineland	■ All proposed pipelines are located within existing road allowances, with the exception of two small permanent easements within Specialty Crop Lands: one along Horton Avenue between 13th Street and 11th Street, and one along Claus Road between Maple Grove Road and Cherry Avenue ■ Temporary disruption to businesses along the King St and surrounding area within the community of Vineland, similar to Options A
					3	3.5	2.5
TOTALS	(sum of evaluation scores x weightings)			100%	2.9	3.1	3.3

6.4 Recommended Alignment Option

Based on the multi-criteria evaluation presented in **Section 6.3.3, Option C – Full Coverage Looped System** is recommended and is the preferred alignment option. The evaluation indicates that each alignment option presents a different balance between cost, system coverage, and operational resilience.

Option A provides the lowest capital and operational costs and minimizes construction and environmental impacts. However, it provides the least redundancy and the lowest level of service coverage.

Option B provides improved system reliability and greater service coverage, however significant areas remain unserved. Capital and operational costs are moderate.

Option C provides the highest level of service coverage, including the Benchlands, while maximizing network redundancy. Since Option C has the greatest ultimate coverage and thus has main trunks sized for the maximum coverage scenario, it is the option that is best suited to being built in phases to achieve the maximum coverage scenario over time. This option requires a higher capital investment and introduces greater construction and environmental complexity.

Although this option is the most expensive it also provides the potential for a phased approach, where the intakes and main branches could be built first, with some laterals based on the highest demand areas. Further laterals can be added over time. Alternatively, the system can be built one district at a time implementation can be incremental as demand, funding availability, or governance arrangements support further system growth. Implementation can be incremental as demand, funding availability, or governance arrangements support further system growth. Further detail on the approach to phasing will be included in the implementation plan, to be developed later in the project.

Accordingly, Option C is considered to represent the most practical and implementable alignment that meets the project objectives while supporting long-term system scalability. Despite the higher initial investment, this option offers advantages in terms of long-term system utilization, reliability, and agricultural participation, particularly if communal irrigation becomes widely adopted across the Study Area. Most participants in Workshop #3 also supported this alignment option (see **Section 7.2**).

7. Consultation and Engagement

The success of the Study depends on early and meaningful collaboration with all interested and affected parties. Engagement supports a better understanding of community priorities, technical constraints, permitting requirements and operational considerations. The engagement approach includes targeted consultation with growers, agencies as well as co-ordination with relevant regulatory bodies.

7.1 Grower Engagement

Engaging with growers, producers, greenhouse operators, agricultural landowners and the broader public was, and will continue to be, a key part of the Study's engagement strategy. To support this, the Study hosted regular events throughout 2025 and 2026 to provide study updates, maximize transparency and collect community feedback. Activities included:

- Growers Workshop #1 (July 23, 2025). This workshop served as a Study kick-off session and it overviewed the Niagara Irrigation Initiative, the Study's objectives, the Study area and the Study timeline.
- A water demand survey for growers (November 2025). This survey collected information from growers to support the development of the Study's water demand estimate.
- Growers Workshop #2 (December 3, 2025; January 8, 2026). This workshop provided a Study update to growers, shared the results of the water demand survey, sought feedback on the Study's problem and opportunity statement and solicited feedback on water intake and alignment options. This workshop included a virtual option on January 8, 2026 in addition to the in-person session on December 3, 2025. Both options presented the same material.
- Public Information Centre (PIC) (December 3, 2026). This event was co-located with Growers Workshop #2, with the PIC occurring directly following the workshop. The PIC provided a Study overview to the public and shared key details to a wider audience.
- Ontario Fruit and Vegetable Convention (February 17-18, 2026). The Study Team staffed an exhibit at the Ontario Fruit and Vegetable Convention to increase Study visibility and provide quality information to the public.
- Growers Workshop #3 (July 7, 2026). This event provided a Study update, presented the preferred source water option (see **Section 5.4**) and sought final feedback on the preliminary preferred alignment option (see **Section 6.4**). The Study Team also explained and sought feedback on additional design options and discussed next steps.

The Study workshops all included live polling questions to streamline feedback collection in addition to open discussion breaks.

7.2 Key Feedback from Growers

The Study Team should expect high system usage once built.

During Growers Workshop #2, participants were asked to estimate what percentage of agricultural properties would use a communal irrigation system if built. A notable 62% of attendees expected that more than half of all properties would use the communal system – and many attendees expected interest in the system to build over time. This informed the 60% uptake value used in the peak demand calculations.

44% of attendees at Workshop #2 suggested that the Study Team should anticipate growth in crop area and expect crop changes. This input supported the creation of a public-informed water demand value.

The preferred design should prioritize reducing capital and operation costs while still meeting anticipated water demand.

During Growers Workshop #2, attendees were invited to rank evaluation criteria in order of importance. The following list shows the most important criteria to least important, based on public feedback:

1. Capital Cost
2. Operation cost
3. Ability to Meet Water Demand
4. Ease of Implementation
5. Constructability / Technical risk
6. Permit-to-Take-Water Considerations
7. Permits/Approvals
8. Water Quality/Algae/Sediment/Ice Resistant
9. Land Use and Property Constraints
10. Environmental Impact
11. Impact to Residents
12. Climate Change Impact

Public input on the evaluation criteria was considered as the different criteria were weighted and used to score the three alternatives.

Furthermore, when asked at Growers Workshop #3, 56% of participants stated that “reliable water delivery” was the most important factor to them for the new system. An

additional 20% of participants noted that “access to the greatest number of farms” was the most important factor. Only 13% of participants ranked “lowest possible cost” as their most important factor, suggesting that while cost reduction measures are important, the system needs to be built to a standard worth using.

Lake Ontario was the most preferred source water option among participants.

When asked during the live polling at Workshop #2, approximately 43% of attendees indicated that they preferred using Lake Ontario for the irrigation water source (Option 1), 16% of attendees preferred using the water treatment plant with a feeder main (Option 2) and 41% of attendees preferred using a hybrid system (Option 3).

Growers broadly supported Alignment Option C (Full Coverage Looped System).

81% of participants at Growers Workshop #3 supported or strongly supported the preliminary preferred alignment option as outlined in the presentation. 15% were neutral or unsure and only one participant explicitly opposed the preferred option.

7.3 Regulatory and Agency Co-ordination

Engagement with agencies was designed to ensure early awareness of regulatory pathways, permitting requirements and data needs. Key activities included:

- Meeting with MECP to clarify PTTW requirements.
- Meeting with OPG and the Region staff at the DeCew WTP to determine potential impacts on infrastructure.
- Working Committee Meetings that served a technical advisory role and included a wide variety of agencies and stakeholders

7.4 Utility Consultation

Utility operators (OPG, Regional water supply staff) were also consulted regarding existing assets (DeCew WTP reservoir and supply channel and existing abandoned pipeline down the escarpment) and water system operations.

7.5 Steering Committee Engagement

The Study Team provided the Steering Committee regular updates via email and met periodically throughout 2025 and 2026. Steering Committee meetings were hosted on:

- September 15, 2025. This meeting introduced the consultant team and provided an overview of the Study’s scope and objectives.

- November 15, 2025. This meeting outlined the format, promotional strategy and the materials to be presented at Growers Workshop #2.
- January 15, 2026. This meeting recapped the feedback received at Growers Workshop #2 and the PIC. The Study team also provided an update on the water demand analysis, the source water option evaluations and the alignment options.
- March 3, 2026. This meeting presented the recommended source water option, provided a water demand analysis update and reviewed the preliminary alignment options and evaluation criteria.
- June 18, 2026. This meeting provided an update on the alignment evaluation, introduced several additional design options and discussed the materials to be presented at Growers Workshop #3.

Steering Committee members also attended key community events to represent and support the Study, including all three Study Workshops and the December 2025 PIC.

7.6 Working Committee Engagement

A Working Committee was also formed to serve as a collaborative forum for bringing together agency representatives, members of the Steering Committee, interested Indigenous groups and organizations and grower representatives. The Working Committee provides an opportunity for a range of groups and organizations to stay informed about project progress, share perspectives and provide input on planning and engagement activities. Niagara Region staff Chair the Working Committee meetings.

Several meetings have been held since the Study commenced, including meetings on:

- May 30, 2025. This meeting served as an introduction to the Niagara Irrigation Initiative, the Study and the Committee's purpose.
- October 7, 2025. This meeting introduced the consultant team and included an overview of ongoing activities, upcoming milestones and preliminary findings.
- January 6, 2026. The third meeting provided a progress update, highlighting completed activities like the risk assessment workshop and work completed on the water demand analysis.
- March 31, 2026. This meeting shared the preliminary source water evaluation and outlined the various alignment options and alignment evaluation criteria.
- June 23, 2026. This meeting shared the final source water evaluation, information about the preliminary preferred alignment option and overviewed additional design options.

Committee members were encouraged ask questions and offer feedback to guide future work at each of the meetings outlined above.

7.7 Engagement Summary and Outcomes

Key outcomes of the engagement process include:

- Development of a public-informed water demand value.
- Informing the weighting of the evaluation criteria for the source water and alignment options.
- Confirmation of grower support for source water Option 1 (Lake Ontario) and alignment Option C (Full Coverage Looped System).
- Confirmation of priority irrigation zones and crop types.
- Identification of community partner concerns (e.g., permitting complexity, environmental protection, land access).
- Refinement of design assumptions related to risks, water demand, scheduling and system layout.
- Clarification of agency permitting triggers and co-ordination expectations.
- Strong interest from growers in moving forward to implementation, with a desire for transparent, inclusive next steps.

8. Additional Scenarios Analysis

Following completion of the initial evaluation of source water and alignment options, the Steering Committee directed the study team to consider and analyze some additional alternative scenarios. The purpose of this exercise was to investigate opportunities to improve the affordability and practicality of the proposed communal irrigation system.

The set of assumptions used in this Study were developed based on previous visioning work, the project Terms of Reference and stakeholder engagement outcomes. These assumptions were based on a high level of service for the communal irrigation system, and that it would be capable of delivering water continuously in all seasons at a minimum pressure sufficient to allow direct connection to on-farm drip irrigation systems without supplemental pumping. While this approach provides a highly resilient and future-ready irrigation system, the resulting infrastructure requirements and capital costs prompted further investigation into whether alternative servicing approaches could provide meaningful cost reductions while maintaining acceptable levels of service.

8.1 Evaluation Approach

The additional scenarios analysis utilized the preferred source water strategy (Option 1: Three Intakes from Lake Ontario – see **Section 5**) and preferred alignment configuration (Option C: Full Coverage Looped System – see **Section 6**) identified moving forward as the “base case”. Alternative scenarios were developed by modifying key assumptions that directly influence system sizing, pumping requirements, water distribution infrastructure, and overall project costs.

The objective of the analysis was not to replace the preferred communal irrigation system concept, but rather to identify possible opportunities to optimize the system while continuing to achieve the project's primary objectives of agricultural drought resilience and long-term water security.

8.2 Scenarios Evaluated

A range of supplementary servicing scenarios were developed and evaluated to investigate opportunities to reduce capital costs, improve implementation feasibility, and better understand the relationship between level of service and infrastructure requirements. The scenarios focused on modifying key design assumptions that directly influence system sizing, pumping requirements, operational complexity, and long-term affordability. The scenarios evaluated are summarized in **Appendix F**. For each scenario, the analysis considered the potential impact on water demand, water

distribution infrastructure, pumping requirements, constructability, operational considerations, and overall system cost.

8.2.1 Isolation of Benchlands

The benchland areas within the Vineland-Beamsville System require additional pumping infrastructure due to the significant elevation difference between the lower service areas and the benchlands. To better understand the cost implications of servicing these higher elevation areas, a separate analysis was undertaken to isolate the incremental costs associated with providing irrigation service to the benchlands. Primarily, these costs include the incremental pipe size increase required to convey the required flow from Lake Ontario to the benchlands and the booster station and additional piping to reach the benchland area.

The analysis determined that removal of benchland servicing would reduce total system capital costs from approximately \$238.3 million to \$233.8 million, representing an overall reduction of approximately 2%. Within the Vineland-Beamsville System specifically, costs were reduced from approximately \$99.0 million to \$94.4 million, representing a reduction of approximately 6%. The cost per acre serviced increases from \$15,800 to \$16,200.

These results indicate that while benchland servicing requires additional infrastructure, the overall cost savings associated with eliminating service to these areas is relatively modest when considered at a system-wide scale.

Key findings:

- Minor reduction in overall system costs
- The cost per acre increases as less land is serviced while overall cost is not reduced significantly
- Removing the benchlands prevents this portion of agricultural land from having irrigation system access, while increasing the cost per acre for all users

8.2.2 Moderate Drought Design Basis

Under the base case, irrigation demand was calculated for a severe drought (1-in-10 year) event (see **Section 3** above). A supplementary analysis was undertaken to determine whether reducing the design basis to a more moderate (1-in-5 year) drought event would result in meaningful reductions in system sizing and associated infrastructure costs.

Updated irrigation demand calculations were completed using local climate data representative of a 1-in-5 year drought condition. The analysis demonstrated that peak irrigation demand decreased by approximately 8% relative to the 1-in-10 year drought design basis.

Although some reduction in pipe sizing and pumping requirements may be achievable, the reduction in demand was significantly smaller than originally anticipated. As a result, the corresponding reduction in overall capital cost is expected to be modest.

It should be noted that analysis of recent historical data found that 2016 was a 1-in-33 year drought, 2020 was a 1-in-26 year drought 2025 was a 1-in-5 year drought. As such, designing only for the 1-in-5 year drought would provide significantly less resilience.

Key findings:

- Demand reduction approximately 8% while reducing the resilience of the system Infrastructure reduction less significant than initially anticipated
- Most system costs remain associated with the extent of the system, including water distribution infrastructure length and major crossings

8.2.3 Reduced Demand (Request For Proposal) Scenario

The water demand scenario that was initially outlined in this project's Request for Proposal (RFP) was 6000 gallons per minute (379 L/S) per district. This demand was based on an early assumption that this would be the maximum available through a PTTW. After it was confirmed by the study team that this would not be the upper limit a more detailed water demand was completed which determined a much higher water demand was expected. For the sake of comparison an analysis was completed to compare the RFP demand to the calculated demand. This option represents the following percentage (%) of the base case demand:

- VBS = 790 L/s --> 379 L/s (48%)
- JNS = 571 L/s --> 379 L/s (66%)
- SCS = 580 L/s --> 379 L/s (65%)

For this scenario the pipe extents from the base case were maintained as it assumes there will be demand across the extents of each district. The cost savings from this scenario were calculated from a detailed assessment of the reduced pipe sizes; the resulting decrease is 11%.

Key findings:

- This scenario assumes significantly less demand (48% for VBS, 66% for JNS and 65% for SCS) compared to the base case
- This scenario would significantly reduce the level of service of the system and service proportionally less agricultural area (i.e. only the following percentages of land, compared to the base case, would have full irrigation supply during the design drought: 48% for VBS, 66% for JNS and 65% for SCS)
- The associated system cost reduction is 11% due to smaller pumping and pipe size requirements
- The level of service reduction (48-66%) is disproportionate to the cost savings (11%)

8.2.4 Reduced Pressure System

The base case assumed a minimum service pressure of approximately 40 PSI at all connection points, sufficient to allow direct operation of drip irrigation systems without additional pumping.

This scenario was to evaluate lower pressure scenarios, including minimum pressures of approximately 30 PSI and 20 PSI.

Reducing system pressure requirements has the potential to reduce pumping requirements, reduce pipe sizes for water distribution mains, and potentially reduce overall infrastructure costs. However, lower pressure systems may require supplemental on-farm pumping or storage infrastructure and may reduce the level of service provided to agricultural users.

As proxy for this scenario, all the pipe sizes were reduced by one size to determine if the cost savings were meaningful and if this scenario was worth pursuing further. The cost savings were found to be only 3% when reducing all pipe sizes.

Key findings:

- A minor reduction in pipe sizes provides minimal costs savings
- Most system costs remain associated with the extent of the system, including water distribution infrastructure length and major crossings
- Lower pressures may require additional infrastructure or operational responsibilities at individual farms

8.2.5 Irrigation Scheduling (Rotational Supply)

A rotational supply scenario was explored to determine whether managed irrigation scheduling could reduce peak demands and associated infrastructure sizing.

The analysis determined that the reference case already assumes irrigation demand is distributed over a continuous 24-hour operating period during peak irrigation conditions. As a result, further rotational scheduling does not reduce peak instantaneous demands and therefore does not provide meaningful opportunities for reducing water distribution infrastructure sizing.

The analysis concluded that rotational scheduling is not a practical cost reduction measure for the proposed system under the current demand assumptions.

Key findings:

- System already operates on a 24-hour irrigation cycle as such, further rotational scheduling would not significantly reduce pipe sizing requirements
- Rotational scheduling would introduce additional operational complexity and governance requirements
- No further evaluation of this option is recommended

8.2.6 Seasonal/Non-Winter System

A seasonal-only system was explored to determine whether construction costs could be reduced by eliminating winter operation requirements and allowing shallower pipe installation (less than 1.2 metres).

The analysis found that potential cost savings associated with reduced burial depth are limited. In many locations, minimum burial depths are controlled by roadway requirements, utility crossings, and structural loading considerations rather than frost protection requirements.

Furthermore, seasonal systems require additional infrastructure to facilitate draining and winterization, including low-point drains, air release valves, isolation valves, and operational procedures.

The analysis concluded that a seasonal system is not a practical.

Key findings:

- Significant reductions in burial depth are generally not feasible
- Additional winterization infrastructure would be required

- Operational complexity increases due to annual startup and shutdown requirements
- Capital cost savings are expected to be limited
- No further evaluation of this option is recommended

8.2.7 On-Farm Storage System

A supplementary analysis was undertaken to evaluate the potential benefits of utilizing existing on-farm storage facilities to reduce peak instantaneous demand on the communal irrigation network.

Under this approach, the communal system would partially operate as a recharge network, delivering water continuously at lower rates to those properties with ponds, reservoirs, cisterns, or other storage facilities. Peak irrigation demands would then be reduced as these properties would then be supplied from local storage rather than directly from the communal system.

This scenario used the same parameters as the base case but used an estimate of existing on-farm storage to buffer / reduce peak demand. Using 2020 SWOOP imagery, Normalized Difference Water Index (NDWI) was calculated and used to estimate the surface area of existing on-farm storage. Any area with an NDWI above 0.1 was considered water. A land cover classification using the High Resolution Land Cover Classification – USA Model was then run using the same 2020 SWOOP aerial imagery to determine areas that are classified as structures, impervious surfaces, and impervious roads. Any area that was assigned to one of these three classes and had an NDWI above 0.1 was removed from consideration. This was done to remove any false positives that could occur. To prevent including ornamental ponds, the minimum pond size was set to 200 sq metres. An assumed pond depth of 1.5 metres was used to estimate the volume of each pond in cubic metres. The resulting reduction in peak flow inclusion of these ponds is as follows:

- VBS = 790.0 L/s → 631.8 L/s = 20% reduction
- JNS = 570.9 L/s → 439.8 L/s = 23% reduction
- SCS = 580.0 L/s → 538.8 L/s = 7% reduction

The associated reduction in cost from this reduction in peak demand, and thus reduced pumping and pipe size requirements, was calculated to be 7% across the entire system.

Although this option could reduce water distribution and pumping infrastructure requirements significantly, the analysis and engagement with the Steering Committee confirmed that reservoirs cannot be considered a reliable source of water to reduce the system capacity permanently; during periods of extended drought, when the system is

needed most, storage ponds and reservoirs may run dry. However, at the lot level, should individual landowners have storage and wish to rely on that storage during a drought period, they can decide to purchase less shares (or flow) from the system accordingly, understanding they would not have access to their peak irrigation requirement should their storage run out during a drought.

Key findings:

- Existing storage can provide meaningful opportunities to reduce peak demand during short term droughts
- Reduced peak demand could significantly reduce water distribution infrastructure requirements
- Costs can be reduced by 7%
- Storage cannot be relied on to permanently reduce the system capacity as storage can run dry during extended periods of drought, when the communal irrigation system is needed most; as such this option proved unfeasible and no further evaluation of this option is recommended
- Individual landowners can decide to factor in their storage capacity should they wish to purchase less shares of the system, understanding they would not have access to their peak irrigation requirement should their storage run out during a drought.

8.3 Summary of Findings

- The supplementary analysis demonstrated that several commonly thought-of cost-reduction measures provide relatively limited savings when applied to a communal irrigation system of this scale.
- Isolation of benchlands provides a 2% overall cost savings.
- Moderate drought design provides an 8% reduction in water demand.
- RFP demand scenario reduces the system cost by 11% but reduces the amount of area that can be irrigated by 48-66%.
- Reducing pipe size by one size reduces the system cost by 3%.
- Irrigation scheduling is not feasible due to irrigation demand already being considered over a 24-hour period.
- Seasonal system is not feasible due to need to bury system below existing utilities.
- Accounting for on-farm storage, although it can reduce the system cost by 7%, cannot be considered reliable during periods of prolonged drought.

- Across all additional scenarios evaluated, capital cost savings were relatively modest compared to the level of service reductions. While reducing peak demand can lower pipe diameters and pumping requirements, most project costs are associated with the overall extent of the system, including water distribution mains, road and utility crossings, pumping stations, permitting, and construction. As a result, significant reductions in peak demand generally translate into only limited reductions in total capital cost.
- Reducing the extent of the system was considered during the alignment option evaluation process, however having a system with maximum potential reach is preferred, as the ultimate aim of the system is to support agricultural production on as much land as feasibly possible. As such, alignment Option C without any of the above additional options included is the preferred option.
- To help manage costs, a phased approach to Option C is recommended. Phasing implementation of Option C can spread the costs out over time without reducing the potential of the system to reach the maximum amount of agricultural land. The system could be implemented in phases, prioritizing areas where there is strong stakeholder support and readiness for adoption. These opportunities would be identified and evaluated in a later stage of the project.

8.4 Conclusions

The additional options analysis confirmed that the preferred communal irrigation system alignment option (Option C) remains technically feasible and continues to provide the highest level of service, resiliency, and long-term flexibility. While opportunities exist to reduce system costs, the associated reduction in level of service was disproportionately high. What is recommended to support the financial feasibility of implementation is a phased approach to Option C implementation, based on a detailed assessment of stakeholder commitment to implementing the system.

The findings of this analysis provide additional insight into the relationship between level of service, infrastructure requirements, and project affordability, and will support future discussions regarding implementation strategy, funding opportunities, phasing, and progression into preliminary design.

9. Next Steps

The conclusions and recommendations presented above were presented and validated at the Grower's Workshop #2 (in-person session hosted on December 3, 2025; virtual session hosted on January 8, 2026), which primarily covered the source water options evaluation, and at Grower's Workshop #3 hosted on July 7, 2026, which primarily covered the alignment options and additional scenarios. Following review of Technical Memorandum #1 by Niagara Region staff and the Project Steering Committee, and confirmation of the key assumptions and recommendations presented herein, the project will advance to the next stage of work.

The next phase of the project will focus on preliminary design and refinement of the preferred system configuration, including further development of the intake concept, refinement of the distribution network layout, and confirmation of the hydraulic capacity required to serve agricultural parcels with frontage along roads containing irrigation infrastructure. Updated capital and operational cost estimates will also be prepared based on the refined system design.

This work will provide the technical basis required to support subsequent project planning, funding considerations, and future implementation activities.