



Revised Wignell Drain Subwatershed Study

City of Port Colborne, Niagara Region, Ontario

Elite Cap Inds. Holdings Inc.; Elite Cap PC Holdings Inc.; Elite P.C.M. Holdings Inc.; Elite P.C.V. Holdings Inc.; 705 Main P.C. Holdings Inc.; Elite Capital P.C. Developments Inc.; Elite 869 Killaly Holdings Inc.

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Statement of Limitations

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Executive Summary

SLR (formerly Palmer) has been retained by Elite Cap Inds. Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., and Elite 869 Killaly Holdings Inc. (the 'Client') to complete a Subwatershed Study (SWS) as part of a development plan application for the lands located east of the City of Port Colborne, Niagara Region (the Study Area).

SLR (under the name of Palmer) prepared an SWS report for the Client dated May 8, 2024. This Subwatershed Study report was reviewed and commented on by the City of Port Colborne (the City), the Niagara Region, and the Niagara Peninsula Conservation Authority (NPCA). The City and Niagara Region comments were compiled by MHBC in April 2025 and the NPCA comments were dated May 15, 2025. This (February 2025) SWS has been updated to reflect comments received from the aforementioned agencies.

The Study Area, which is approximately 1,276 ha in size, is roughly situated between Chippawa Road and Lake Erie, and between Elizabeth Street on the west and Miller Road on the east. Client-owned lands (the "Subject Lands") have undergone an Environmental Impact Study (EIS) as part of a Site Plan Approval application for the proposed development of these properties. The Subject Lands are approximately 142 ha in size and are primarily situated between Elizabeth Street, Main Street East, Lorraine Road, and Killaly Street East. Snider Road, which is an infrequently used dirt road, subdivides the Subject Lands.

The Study Area is mostly surrounded by rural agricultural lands, with Lake Erie to the south and residential neighbourhoods from the City of Port of Colborne to the west. The Study Area is partially regulated by the NPCA. Natural features including wetlands (Non-Provincially Significant, Provincially Significant, and unevaluated), woodlands, a provincially significant Earth Science Area of Natural and Scientific Interest, linkages, fish habitat (Wignell Drain West Tributary), Significant Wildlife Habitat, a Natural Heritage System, and numerous watercourses/waterbodies within and adjacent to the Study Area were identified through SLR's background review and EIS for the Subject Lands.

Field investigations were conducted to collect existing conditions data for flora, fauna, and natural features and their hydrological and ecological functions in and adjacent to the Wignell Drain Subwatershed Study Area. Thus, ecological, hydrogeological, and fluvial morphology field investigations were conducted by SLR in 2021, 2022, and 2023. A desktop floodplain analysis was also conducted and summarized for the Study Area as part of this Subwatershed Study. Due to the scale of a subwatershed study, as well as the lack of access to private lands in the Study Area, knowledge gaps are present and noted within this study.

The vegetation communities of the Study Area are moderately diverse, with much of the landscape composed of humanly altered lands. Two 'Natural Areas' as described in the Natural Areas Inventory (NAI, Vol 1.) (Niagara Peninsula Conservation Authority, 2006-2009) occur in the Wignell Drain Subwatershed Study Area (Study Site PC-04 Nickel Beach Woods and Study Site PC-16 Dann Dunes).

A total of 129 plant species were recorded based on surveys within the Subject Lands and the greater Study Area. Of the identified species, about 35 (27%) are non-native, which is consistent to the percentage of non-native found in Ontario (approximately 25%) (Oldham, Bakowsky, & Sutherland, 1995). No provincially or regionally rare species were identified within the Study Area (Oldham M., 2010; Oldham & Brinker, 2009).



A total of 66 breeding bird species were observed within the Wignell Drain Subwatershed Study Area. Savannah Sparrow (*Passerculus sandwichensis*) and Bobolink (*Dolichonyx oryzivorus*) were the two area-sensitive grassland/open-land species observed within the Study Area. Three breeding Species at Risk (SAR) birds were observed on the Subject Lands. These were the Eastern Wood-Pewee (*Contopus virens*), the Barn Swallow (*Hirundo rustica*), and Bobolink. A fourth SAR, Chimney Swift, was observed aerial foraging. Two regionally rare species, the Green-winged Teal and the Tufted Titmouse, were recorded within the Study Area. Additionally, 23 species listed as regionally uncommon were observed.

Five species of calling amphibians were recorded in 22 locations. Generally, Spring Peepers were heard in choruses throughout the subwatershed area, whereas the remaining frog species were heard in smaller numbers.

No salamander or snake species have been observed within the Study Area by SLR to date. No Species at Risk turtle species have been observed within the Study Area by SLR to date. Monarch Butterfly (*Danaus Plexippus*), listed as Special Concern, was confirmed to be present within the Study Area.

A Rare Vegetation Community (Southern Arrow-wood Mineral Thicket Swamp), Amphibian Breeding Habitat (Woodland), and Special Concern and Rare Wildlife Species Significant Wildlife Habitat were identified within the Study Area.

There are relatively few natural connections between natural features in the Study Area, and there are no naturally vegetated valleys that serve as connectors, as in many other parts of southern Ontario. Thus, the natural features within the Study Area are considered to have low / weak connectivity in a landscape context with existing connections mainly between disjointed patches of wetland or woodland.

Notable watercourses identified within the Study Area includes the Port Colborne Drain, the Wignell Drain, and the Michener Drain. It should be noted that additional watercourses regulated by the NPCA may be present within the Study Area that were not captured during in-field assessments. In general, the surveyed drains across the Study Area were noted as severely altered, channelized, and/or greatly impacted from adjacent anthropogenic activity (e.g., agriculture, industries). Several reaches were also noted to be dominated by invasive herbaceous species such as European Reed (*Phragmites australis*), with minimal naturalized riparian zones. As defined by the Provincial Water Quality Objectives, the Study Area regularly exceeded the recommended limit for copper, iron, nickel, zinc, and phosphorus. The entirety of the subwatershed is considered to be a warmwater environment (MNRF, 2024), with both intermittent and permanent systems present. Mostly warmwater species were captured from the lower reaches of the subwatershed; permanent baseflow was only documented within the lower reaches, groundwater indicators were minimal, and little to no canopy cover (e.g., herbaceous or woody plant species) was noted. The primary surface water inputs are provided through surface runoff from surrounding agricultural fields. Benthic invertebrates sampling across the Study Area indicated a range in pollution-tolerant species however, poor quality and polluted habitats were predominant.

Headwater drainage feature assessments were not conducted outside of the Subject Lands. Most headwater drainage features were determined to lack a significant ecological or hydrologic benefit to the Port Colborne subwatershed. A few features were identified as providing more important ecological benefit due to their position within wetland or woodland communities, permanence on the landscape (i.e., standing water in late spring), and their potential ability to aid or support wildlife.



The hydrogeological conditions of the Study Area consist of shallow to moderately shallow groundwater levels, low permeability overburden soils with shallow bedrock, good groundwater quality, potential karst conditions, and a low infiltration rate. The interaction between groundwater and surface water features is not well known; however, the limited data available suggests that groundwater recharging conditions exist. This; however, is limited by low infiltration through the overburden soils. The Study Area currently receives an infiltration quantity of 2,551,185 m³/year and generate a runoff quantity of 4,353,571 m³/year, corresponding to 198 mm/year in infiltration and 337 mm/year in runoff.

Future development within the Study Area may trigger major hydrogeological impacts including decreased infiltration due to increased impervious area, which would result in reduced groundwater recharge, lowered groundwater level, and reduced groundwater discharge. However, it is likely that major impacts such as this can be mitigated for through appropriate engineering design, environmental planning, and/or further hydrogeological study and monitoring. Future hydrogeological studies should focus on site water balance, feature-based water balance assessment, and karst screenings. To maintain infiltration and post- to pre-development, water balance should be the major target of stormwater management design.

A hydrologic/hydraulic stormwater management (SWM) analysis has been completed for the Study Area. The results of the analysis have confirmed that all SWM criteria (quantity, quality, water balance, erosion) can be met and will not have any negative impact on the existing drains within the Study Area. These criteria will largely be achieved through the implementation of six stormwater management ponds (Ponds A–F) which are proposed within the Subject Lands. These SWM facilities are provided to achieve quantity control targets as well as provide enhanced level 1 quality control protection (80% TSS removal). Quality control will be provided via a treatment-train approach incorporating wet ponds (primary quality treatment), Oil/grit separators at outlets, and Low Impact Development (LID) measures.

In accordance with NPCA and MECP criteria, post-development water balance analysis identified an annual infiltration deficit. This deficit will be addressed primarily through infiltration galleries designed in accordance with MECP design criteria.

The Study Area has been evaluated using hydrodynamic modelling which provides the following confirmations:

- Post-development peak flows match pre-development targets.
- Floodplain limits and hydraulic grade lines remain essentially unchanged.
- Erosion risk is not increased.
- Emergency access and public safety criteria are satisfied.
- Enhanced water quality (80% TSS removal) will be achieved.
- Water balance requirements can be fully addressed through infiltration and LID strategies.
- High lake level scenarios do not materially affect upstream conditions.

The Study Area is in a continental climate region with a warm, humid summer and a cold winter, as well as a wet spring, dry summer, and moderately wet autumn precipitation wise. In general, studies suggest the Niagara Region will be subject to warmer and wetter conditions as a result of climate change. This expected climatic change within Niagara Region, and thus the Study Area, will likely have serious implications on agricultural success (i.e., pests), wildlife migration patterns, and land development (i.e., flooding, erosion), among others. However, all future



climate projections carry a level of uncertainty. Interdisciplinary initiatives will help to better define how climate change will affect the systems of both the Study Area and the Niagara Region.

In the scenario of agricultural lands changing to urbanized land uses within the Study Area, an impact assessment of the Study Area's sensitivity to ecological and hydrological changes has been considered. Developing a management strategy provides a set of goals and objectives within the context of future land uses within the watershed. This Subwatershed Study's management strategy has considered the Natural Heritage System (terrestrial, wetland, aquatic systems), hydrogeological elements, stormwater management, and climate change scenarios. To establish a fulsome and detailed management strategy for future development within the Study Area, EIS protocols have also been recommended for future site-specific development.

Mitigation, enhancement, and monitoring measures for future development applications within the Study Area have been considered. Mitigation measures for the Study Area include the protection of natural features and their ecological functions through prescribed buffers, as well as the implementation of Low Impact Development measures to maintain baseflow. Potential enhancement opportunities within the Study Area include management of invasive species, as well as buffer, restoration, and/or riparian plantings of native species. Wildlife eco-passages, as part of road upgrading, may offer additional landscape connectivity enhancement opportunities. Interdisciplinary pre-, during, and post-construction monitoring programs, as part of future development applications, are recommended to protect, and enhance where possible, the health of the subwatershed.



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Acronyms and Abbreviations

AEMP	Adaptive Environmental Monitoring Program
ANSI	Areas of Natural and Scientific Interest
CMIP	Coupled Model Intercomparison Project
COSSARO	Committee on the Status of Species at Risk in Ontario
CSP	Corrugated Steel Pipe
CTE	Coefficient of Thermal Expansion
CUM	Cultural Meadow
CUP	Coniferous Plantation
CUT	Cultural Thicket
CUW	Cultural Woodland
CVC	Credit Valley Conservation
DFO	Department of Fisheries and Oceans
ECA	Environmental Conservation Areas
EIR	Environmental Implementation Report
EIS	Environmental Impact Study
ELC	Ecological Land Classification
EPA	Environmental Protection Agency
EPA	Environmental Protection Areas
EPT	Ephemeroptera, Plecoptera and Trichoptera
ESA	Endangered Species Act
EWA	EWA Engineering Inc.
FFS	Functional Servicing Study
FOD	Deciduous Forest
FOM	Mixed Forest
GGH	Greater Golden Horseshoe
GHG	Greenhouse Gas
GIS	Geographic Information Systems
Ha	Hectare
HBI	The Hilsenhoff's Family Biotic Index
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HGL	Hydraulic Grade Line
HVA	Highly Vulnerable Aquifer



ICI	Industrial, Commercial and Institutional
IPCC	Intergovernmental Panel on Climate Change
LIDs	Low Impact Developments
M	meter
MA/SA	Marsh/Shallow Aquatic
MAM	Meadow Marsh
MAS	Meadow Shallow Marsh
mASL	Metres above sea level
mbgs	Metre below ground surface
MECP	Ministry of Environment, Conservation and Parks
mg/L	Milligrams per litre
Mm	Millimetres
MMAH	Ministry of Municipal Affairs and Housing
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of the Environment
MP	Mini-piezometres
MW	Monitoring Wells
NA	Not Applicable
NAI	Natural Areas Inventory
NHF	Natural Heritage Features
NHIC	Natural Heritage Information Centre
NHS	Natural Heritage System
NPCA	Niagara Peninsula Conservation Authority
OBBA	Ontario Breeding Bird Atlas
ODWS	Ontario Drinking Water Standards
OGS	Ontario Geological Survey
OP	Official Plan
ORAA	Ontario Reptile and Amphibian Atlas
OWES	Ontario Wetland Evaluation System
Pa	Permissible Unit Shear Stress
PCSWMM	Personal Computer Stormwater Management Model
PGMN	Provincial Groundwater Monitoring Network
PPS	Provincial Planning Statement
PSW	Provincially Significant Wetlands
PWQO	Provincial Water Quality Objectives



ROW	Right-of-Way
RTK	Real Time Kinematics
S	Seconds
SAR	Species at Risk
SGRA	Significant Groundwater Recharge Area
SWD	Deciduous Swamp
SWH	Significant Wildlife Habitat
SWP	Stormwater Management Ponds
SWS	Subwatershed Study
SWT	Thicket Swamp
TSS	Total Suspended Solids
WBU	Water Balance Unit
WHPA	Wellhead Protection Area
WWIS	Well Water Information System



1.0 Introduction

SLR (formerly Palmer) has been retained by Elite Cap Inds. Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., and Elite 869 Killaly Holdings Inc. (the 'Client') to complete a Subwatershed Study (SWS) as part of a development plan application for the lands located east of the City of Port Colborne, Niagara Region (the Study Area – **Figure 1**). SLR (under the name of Palmer) prepared an SWS report for the Client dated May 8, 2024. This Subwatershed Study report was reviewed and commented on by the City of Port Colborne (the City), the Niagara Region, and the Niagara Peninsula Conservation Authority (NPCA).

The City and Niagara Region comments were compiled by MHBC in April 2025 and the NPCA comments were dated May 15, 2025. This SWS has been updated to reflect comments received from the aforementioned agencies.

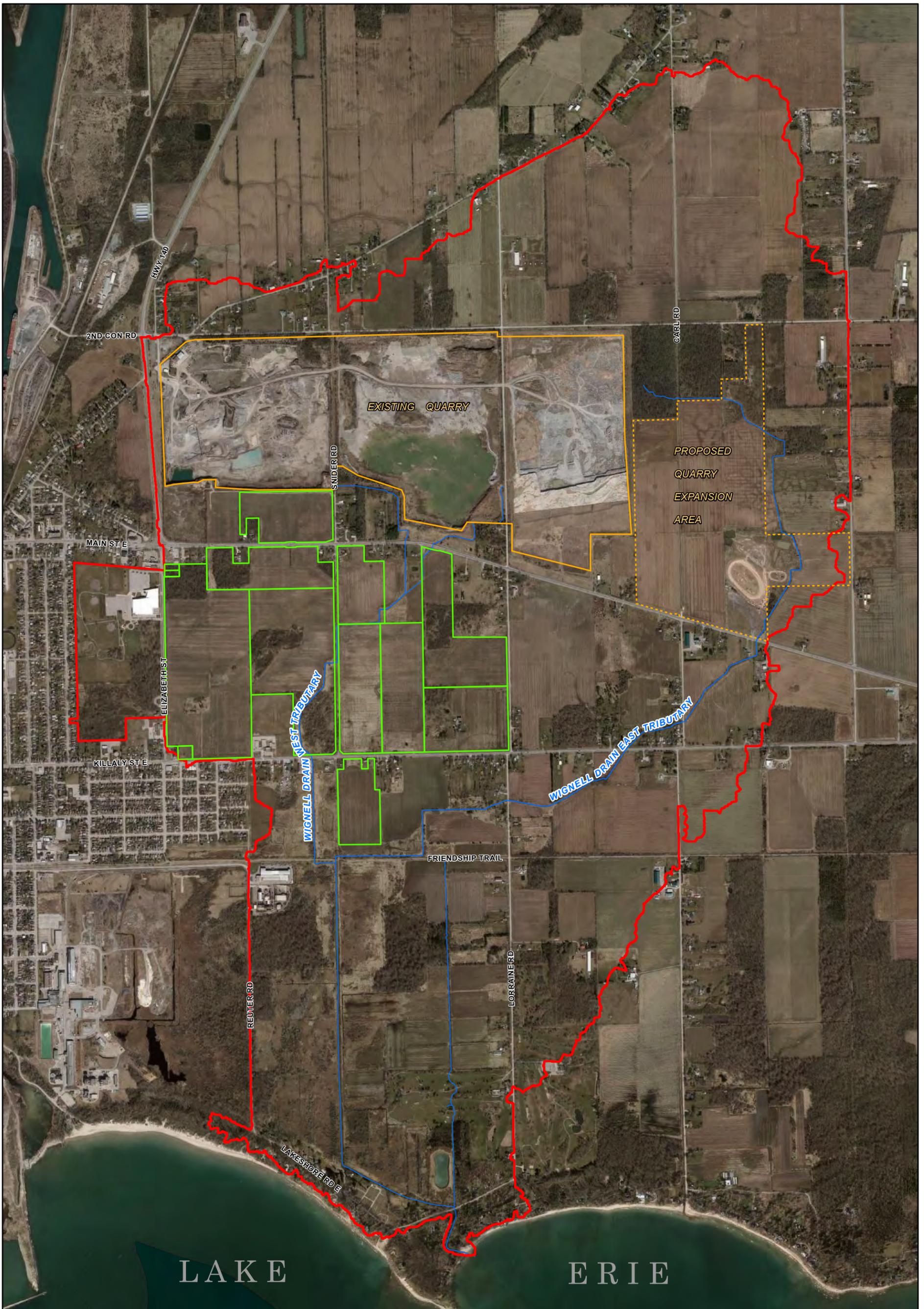
The Study Area, which is approximately 1,276 ha in size, is roughly situated between Chippawa Road and Lake Erie, and between Elizabeth Street and Miller Road (**Figure 1**). Client-owned lands (the "Subject Lands" – seen on **Figure 1**) have undergone an Environmental Impact Study (EIS) as part of a Site Plan Approval application for the proposed development of these properties. The Subject Lands are approximately 142 ha in size and are primarily situated between Elizabeth Street, Main Street East, Lorraine Road, and Killaly Street East. Snider Road, which is an infrequently used dirt road, subdivides the Subject Lands. The proposed development for these Subject Lands includes the construction of single-family dwellings and townhouses.

The Study Area comprises the Lens Wignell Drain subwatershed and a small southeast portion of the CWR Welland Canal South subwatershed. The approximate Study Area has also been further subdivided into the Port Colborne Drain, the Wignell Drain, and the Michener Drain (EWA Engineering Inc., 2022). For the purposes of this SWS the Study Area will be referred to as the Wignell Drain Subwatershed to avoid confusion. Watercourse reaches within the Wignell Drain Subwatershed will be named according to the subwatershed.

The Wignell Drain Subwatershed Study Area currently supports quarries, agricultural fields, woodland features, wetlands, and drainage features. The Study Area is mostly surrounded by rural agricultural lands, with Lake Erie to the south and residential neighbourhoods from the City of Port of Colborne to the west. The Study Area is partially regulated by the Niagara Peninsula Conservation Authority (NPCA).

The intent of this SWS is multi-purpose. The first is to characterize the Study Area through the delineation, inventorying, and evaluation of ecological and geomorphic data in which the sensitivities and significance of existing natural heritage features will be determined through assessment. The second is to integrate SLR's ecological and geomorphic data with hydrogeological and civil engineering data to inform development potential within the Study Area, in part through constraints mapping. The last is to use the comprehensive data to develop monitoring and mitigation measures, as well as discuss potential enhancement and management recommendations for the Wignell Drain Subwatershed Study Area overall.





<p>LEGEND</p> <ul style="list-style-type: none"> — Watercourse ¹ Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area <p><small>1 - Contains data sourced from Geospatial Ontario (GEO)</small></p>	<p>Key Map</p> <p style="text-align: center; color: red;">Site Location</p>	<p>0 100 200 300 400 500 METRE SCALE</p> <p>North American Datum 1983 Universal Transverse Mercator Projection Zone 17</p> <p>Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches)</p> <p>Drawn: SM Checked: RC Date: Feb 26, 2026</p> <p>Source Notes: Imagery (2020) provided by Brock University GIS services. Contains information licensed under the Open Government Licence - Ontario.</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: small;">CLIENT</td> <td>Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc</td> </tr> <tr> <td style="font-size: small;">PROJECT</td> <td>Wignell Drain Subwatershed Study</td> </tr> <tr> <td style="font-size: small;">TITLE</td> <td>Wignell Subwatershed Study Area</td> </tr> <tr> <td style="font-size: small;">REF. NO.</td> <td>2007708-1-2</td> </tr> <tr> <td colspan="2" style="text-align: center;">Figure 1</td> </tr> </table>	CLIENT	Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc	PROJECT	Wignell Drain Subwatershed Study	TITLE	Wignell Subwatershed Study Area	REF. NO.	2007708-1-2	Figure 1	
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TITLE	Wignell Subwatershed Study Area												
REF. NO.	2007708-1-2												
Figure 1													

2.0 Policy Review

2.1 Provincial Planning Statement (2024)

The Provincial Planning Statement, 2024 (PPS) provides direction to regional and local municipalities regarding planning policies for the protection and management of natural heritage features and resources (Ontario Ministry of Municipal Affairs and Housing, 2024). The Provincial Planning Statement (PPS) defines eight types of Natural Heritage Features (NHF) and adjacent areas and provides planning policies for each. Of these NHF, development is not permitted in:

- Significant Coastal Wetlands.
- Significant Wetlands in Ecoregions 5E, 6E and 7E.
- Fish Habitat, except in accordance with provincial and federal requirements; or
- Habitat of species designated as Endangered and Threatened, except in accordance with provincial and federal requirements.

Additionally, unless it can be demonstrated through an Environmental Impact Study (EIS) or similar document, that there will be no negative impacts on the natural features or their ecological functions, development and site alteration are also not permitted in:

- Significant Wetlands in the Canadian Shield north of Ecoregions 5E, 6E and 7E.
- Significant Woodlands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Mary's River).
- Significant Valleylands in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Mary's River).
- Significant Wildlife Habitat.
- Significant Areas of Natural and Scientific Interest (ANSI).
- Other Coastal Wetlands in Ecoregions 5E, 6E and 7E.
- Lands defined as Adjacent Lands to all the above natural heritage features.

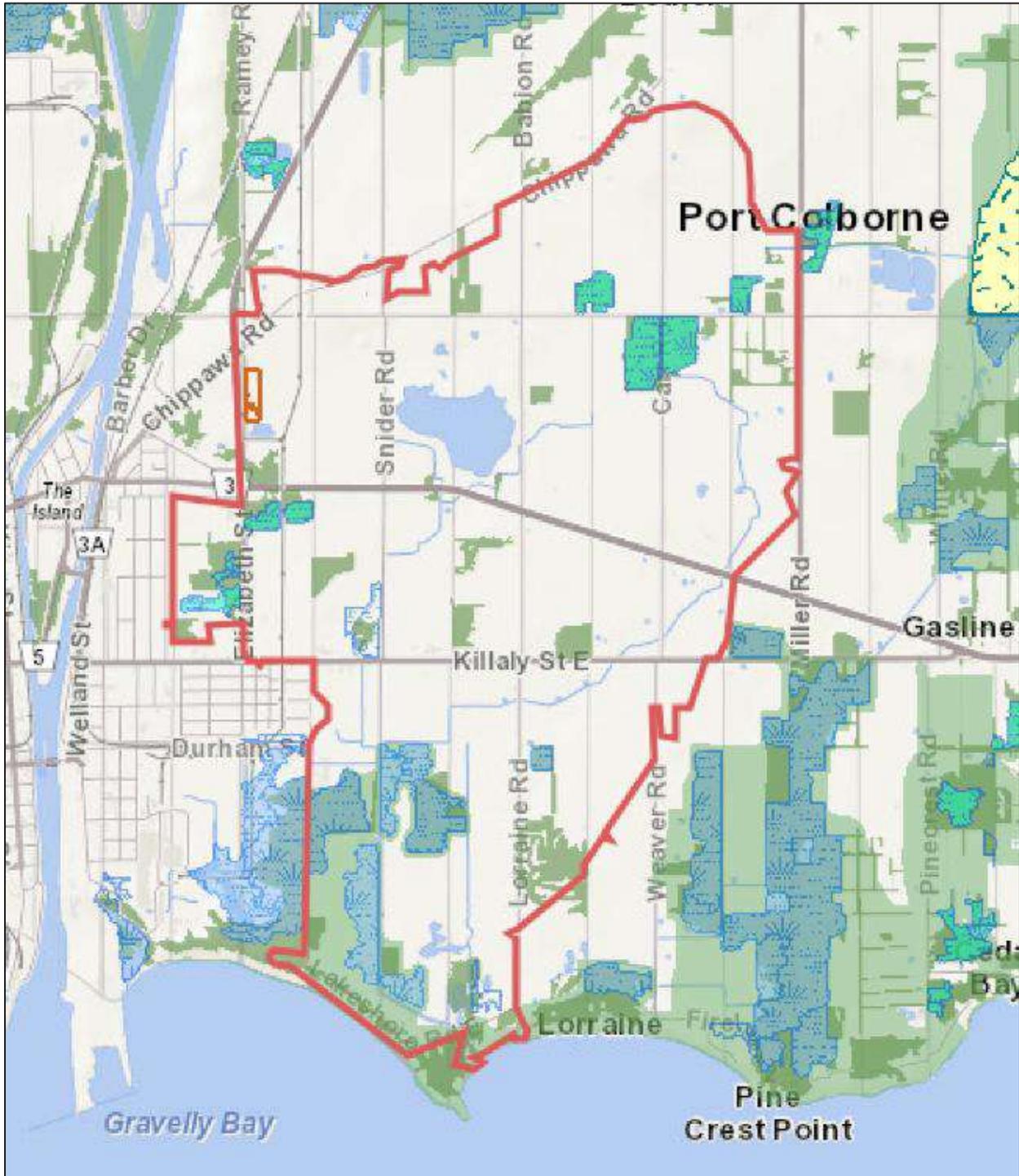
Each of these natural heritage features is afforded varying levels of protection subject to guidelines, and in some cases, regulations.

Site-specific Relevance to the PPS

The Study Area is located within Ecoregion 7E (Crins, Gray, Uhlig, & Wester, 2009). As depicted on the Ministry of Natural Resources and Forestry (MNR) Natural Heritage Information Centre (NHIC) mapping, there are wetlands (Non-Provincially Significant, Provincially Significant, and unevaluated), woodlands, a provincially significant Earth Science Area of Natural and Scientific Interest (ANSI, Earth Science), a Natural Heritage System (NHS), and numerous watercourses/waterbodies within and adjacent to the Study Area (**Map A**).



Map A: MNRF NHIC mapping depicts Non-Provincially Significant Wetlands (turquoise patterned layer), unevaluated wetlands (bright green patterned layer), PSWs (blue patterned layer), woodlands (dark green layer), watercourses and waterbodies (blue lines/blue layer), an NHS (light green layer), and an Earth Science ANSI (orange patterned layer) within and adjacent to the Study Area (approximate boundaries in red).



2.2 The Growth Plan for the Greater Golden Horseshoe

The *Growth Plan for the Greater Golden Horseshoe* (GGH) 2019 was approved by the Council in 2019 and underwent office consolidation in 2020. The GGH directs growth and the development to ensure economic prosperity, environmental protection, and community support (Ministry of Municipal Affairs and Housing, 2020). This is intended to direct municipalities towards the establishment of appropriate policies to maintain, restore, or enhance biodiversity and connectivity of the system and long-term ecological function (MMAH, 2020).

The GGH was developed as a supplement to the PPS, and “*builds upon the policy foundation provided by the PPS and provides additional and more specific land use planning policies to address issues facing specific geographic areas in Ontario. This Plan is to be read in conjunction with the PPS. The policies of this Plan take precedence over the policies of the PPS to the extent of any conflict, except where the relevant legislation provides otherwise.*”

The following proposed development guidelines of the Growth Plan are applicable:

4.2.2 Natural Heritage System

Within the Natural Heritage System:

- i. *new development or site alteration will demonstrate that:*
 - i. *there are no negative impacts on key natural heritage features or key hydrologic features or their functions;*
 - ii. *connectivity along the system and between key natural heritage features and key hydrologic features located within 240 metres of each other will be maintained or, where possible, enhanced for the movement of native plants and animals across the landscape;*
 - iii. *the removal of other natural features not identified as key natural heritage features and key hydrologic features is avoided, where possible. Such features should be incorporated into the planning and design of the proposed use wherever possible.*

4.2.3.1 Key Hydrologic Features, Key Hydrologic Areas and Key Natural Heritage Features of the Growth Plan prohibits the development or site alteration, outside of settlement areas, of key natural heritage features within the Natural Heritage System or within key hydrologic features. Exceptions to this guideline are provided in Section 4.2.3.1 a)-g).

4.2.4 Lands Adjacent to Key Hydrologic Features and Key Natural Heritage Features:

1. *Outside settlement areas, a proposal for new development or site alteration within 120 metres of a key natural heritage feature within the Natural Heritage System for the Growth Plan or a key hydrologic feature will require a natural heritage evaluation or hydrologic evaluation that identifies a vegetation protection zone, which:*
 - a) *is of sufficient width to protect the key natural heritage feature or key hydrologic feature and its functions from the impacts of the proposed change;*
 - b) *is established to achieve and be maintained as natural self-sustaining vegetation; and*
 - c) *for key hydrologic features, fish habitat, and significant woodlands, is no less than 30 metres measured from the outside boundary of the key natural heritage feature or key hydrologic feature.*



Site-Specific Relevance to the GGH

The Wignell Drain Subwatershed Study Area is within the GGH Growth Plan Area. The Study Area contain portions of the Natural Heritage System associated with the Nickel Beach Marsh Wetland PSW (**Map A**). Key Natural Heritage Features and Key Hydrologic Features (i.e., wetlands, significant woodlands, permanent / intermittent streams, lakes) within this Natural Heritage System are protected to ensure that there are no negative impacts to the features and their functions.

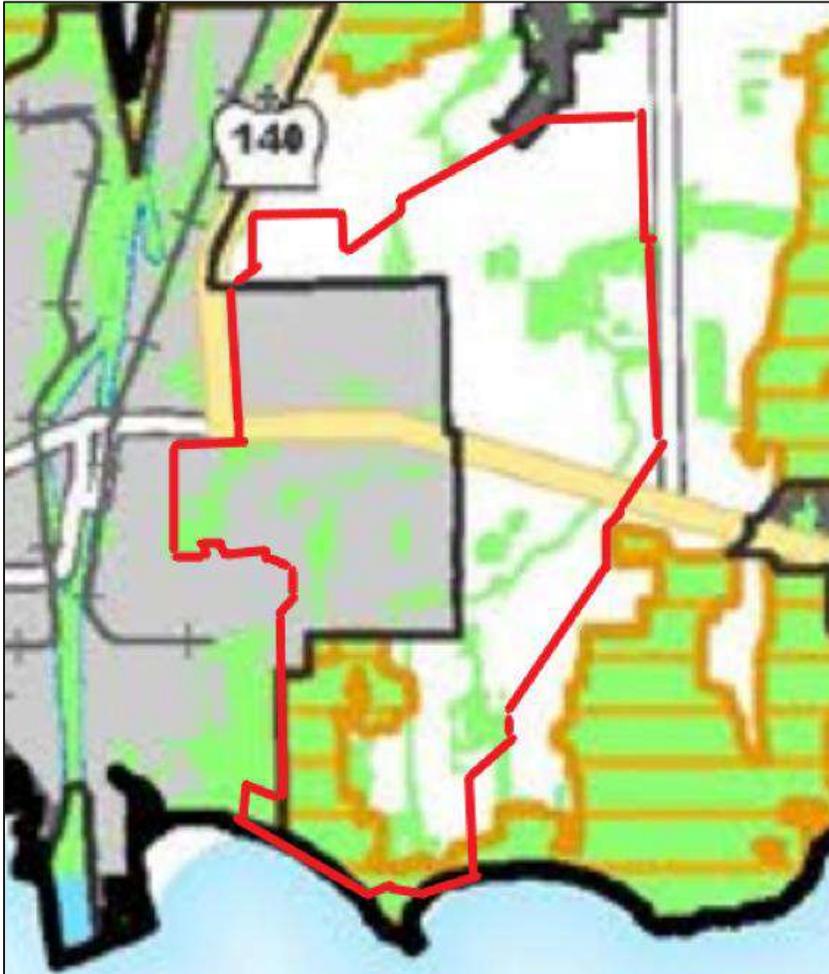
2.3 Niagara Region Official Plan

The Niagara Region Official Plan (OP) was recently adopted by the Regional Council in June 2022 and approved by the province in November 2022 (Niagara Region, 2022). As a result of Bill 23: *More Homes Built Faster Act*, on March 31, 2025 the Niagara Region OP became a planning document for the 12 municipalities of Niagara, rather than a Regional Plan (Niagara Region, n.d.). This Subwatershed Study will still refer to the Niagara Region OP for environmental policy.

The Region's OP sets out Natural Heritage policies in Chapter 3 – Sustainable Region. Section 3.1 outlines the objective and policies of the Regional Natural Heritage System and Water Resource System. These two systems have been integrated in the OP and are known together as the Region's Natural Environmental System (Schedule C) (**Map B**).



Map B: The Region’s OP Schedule C1 depicts the Study Area (approximate boundaries in red) partially within an Urban Settlement Area (light grey layer) and a Rural Settlement Area (dark grey layer). The Region’s Natural Environment System (green layer) is found throughout the Study Area, with the south portion also containing part of the Growth Plan Natural Heritage System (orange hashed layer).



As defined in the Niagara Region OP:

Natural Heritage Features and Areas – means features and areas, including significant wetlands, significant coastal wetlands, other coastal wetlands, fish habitat, significant woodlands, significant valleylands, habitat of endangered species and threatened species, significant wildlife habitat, and significant areas of natural and scientific interest, which are important for their environmental and social values as a legacy of the natural landscapes of an area (modified from PPS, 2020). For the purposes of this definition, natural heritage features and areas includes other woodlands, earth science areas of natural and scientific interest (provincial and regional), and life science areas of natural and scientific interest (provincial and regional).

Natural Heritage System – is made up of natural heritage features and areas, wetlands, and linkages intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species, and ecosystems. These systems can include key natural heritage features, key hydrologic features, federal and provincial parks and conservation reserves, other natural heritage features and areas, lands that have been restored or have the potential to be restored to a natural state, associated areas that support hydrologic functions, and working landscapes that enable ecological functions to continue.

Water Resource System – means a system consisting of groundwater features/areas and surface water features (including shoreline areas), and their hydrologic functions, which provide the water resources necessary to sustain healthy aquatic and terrestrial ecosystems and human water consumption (see lists of features below).

- Groundwater Features
 - Recharge/discharge areas
 - Water tables
 - Aquifers and unsaturated zones
- Surface Water Features
 - Headwater Drainage Features (HDFs)
 - Recharge/discharge areas
 - Associated riparian lands that can be defined by their soil moisture, soil type, vegetation, or topographic characteristics.

2.3.1 Development and Site Alteration

As per OP Section 3.1.9.5.1, development and site alteration shall not be permitted in the following natural heritage features and areas:

- a) Provincially Significant Wetlands (PSWs)
- b) Significant Coastal Wetlands
- c) Significant Woodlands

Additionally, as per OP Section 3.1.9.5.2, development and site alteration shall not be permitted in the following natural heritage features and areas unless it has been demonstrated through an EIS that there will be no negative impacts to the natural features or their ecological functions:

- d) Other woodlands



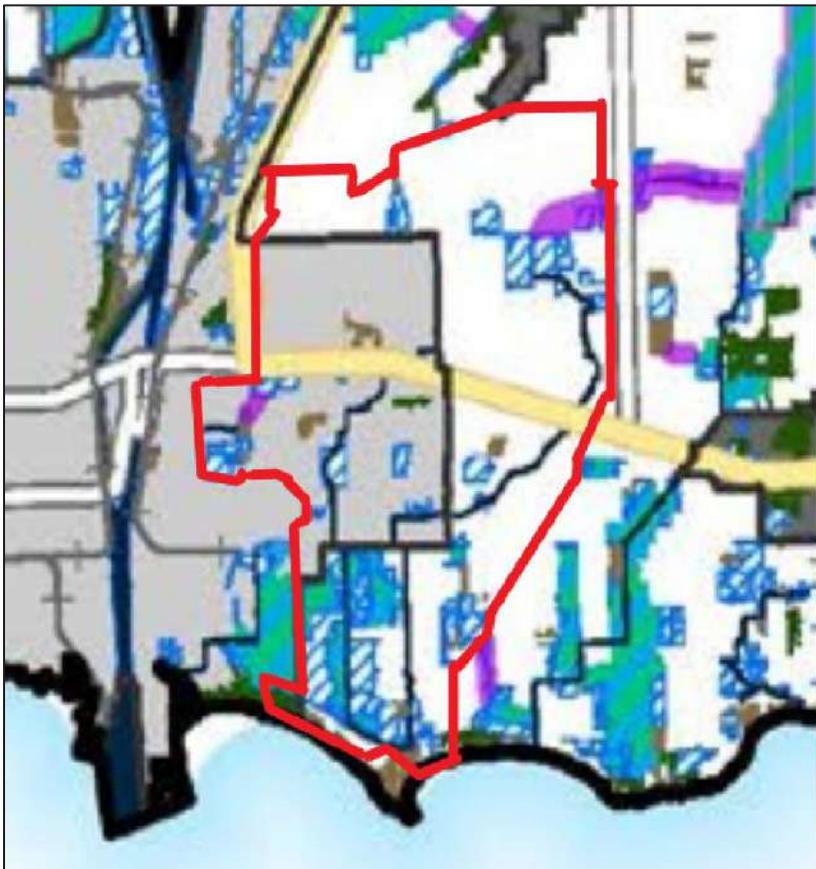
- e) Significant valleylands
- f) Significant Wildlife Habitat
- g) ANSIs

Furthermore, OP Section 3.1.9.5.4 states:

Notwithstanding any other policies of this Plan, development and site alteration in, and adjacent to watercourses, provincially significant wetlands, and other wetlands that are regulated by the Conservation Authority, may also be subject to the regulations and land use planning policies of the Conservation Authority. When development or site alteration is proposed in or adjacent to any watercourse, provincially significant wetland, significant valleyland, or other wetland the applicant shall contact the Conservation Authority, at which time Conservation Authority staff will advise the applicant and the Region of the land use or regulatory policies that will apply.

Schedule C2 from the OP indicates mapped natural heritage features (**Map C**).

Map C: The Region's OP Schedule C2 depicts the Study Area (approximate boundaries in red) within and adjacent to PSWs (light green layer), Other Wetlands and Non-Provincially Significant Wetlands (blue hatched layer), Significant Woodlands (dark green layer), Other Woodlands (brown layer), Linkages (purple layer), and Permanent and Intermittent Streams (thin black lines).



2.3.2 Buffers in Settlement Areas

Section 3.1.9.9.1 of the OP states that within settlement areas, mandatory buffers from natural heritage features and areas are required. The width of an ecological appropriate buffer would be determined through an EIS (or SWS) and/or hydrologic evaluation, or through the completion of a subwatershed study in support of a secondary plan or other large-scale development.

2.3.3 Linkages

Section 3.1.17.3 of the OP states that when a SWS is being undertaken, or when development or site alteration is proposed within 30 metres of a linkage shown on Schedule C2 (**Map C**), an evaluation shall be completed that:

- a) *Assesses the ecological features and functions of a linkage, including its vegetative, wildlife, and/or landscape features or functions.*
- b) *Identifies appropriate boundaries/widths that permit the movement of wildlife between nearby key natural heritage features, key hydrological features, and/or natural heritage feature and areas.*
- c) *Describes the ecological functions the linkage is intended to provide and identifies how these ecological functions can be maintained or enhanced within a development proposal.*
- d) *Assesses the potential for compatible uses including, but not limited to, stormwater management ponds, passive recreational uses, and trails within the linkage to determine how the intended ecological functions of the linkage can be maintained or enhanced.*
- e) *Assesses potential impacts on the linkage as a result of the development.*
- f) *Makes recommendations on how to protect, enhance, or mitigate impacts on the linkage and its ecological functions through avoidance and planning, design, and construction practices.*

2.3.4 Significant Woodlands

According to Table 4-1 of the OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Significant Woodlands must meet the definition of an ELC forest and meet one or more of the following criteria:

- 1 *2 ha or greater in size*
- 2 *1 ha or greater in size meeting at least one of the following criteria:*
 - a) *Naturally occurring (i.e., not planted) trees (as defined in the species list of Appendix D in the Greenbelt Technical Paper)*
 - b) *Treed areas planted with the intention of restoring woodland*
 - c) *10 or more trees per ha greater than 100 years old or 50 cm or more in diameter*
 - d) *Wholly or partially within 30 m of a provincially significant wetland or habitat of an endangered or threatened species*
 - e) *Overlapping or abutting one or more of the following features:*
 - i. *Permanent streams or intermittent streams*
 - ii. *Fish habitat*



iii. Significant valleylands

- 3) *0.5 ha or greater in size meeting at least one of the following criteria:*
- a) *A provincially rare, treed vegetation community with an S1, S2, or S3 in its ranking by the MNRF's NHIC.*
 - b) *Habitat of a woodland plant species with an S1, S2, or S3 in its ranking or an 8, 9, or 10 in its Southern Ontario Coefficient of Conservatism by the NHIC, consisting of 10 or more individual stems or 100 or more square meters of leaf coverage.*
 - c) *Any woodland overlapping or abutting one or more of the following features:*
 - i. Significant wildlife habitat*
 - ii. Habitat of threatened species and endangered species*
 - iii. Non-Provincially Significant Wetlands*
- 4) *Any size overlapping or abutting one or more of the following features:*
- a) *PSW*
 - b) *Life Science ANSI*

2.3.5 Other Woodlands

According to Table 4-1 of the OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Other Woodlands are a terrestrial treed area that must have $\geq 25\%$ tree cover and meet one or more of the following criteria:

- 1 *An average minimum width of 40 m and is ≥ 0.3 ha, measured to crown edges; or*
- 2 *Any size abutting a significant woodland, wetland, or permanent stream.*

Treed areas that "abut" a significant woodland, wetland, or permanent stream are considered adjacent when located within 20 m of each other. Other woodlands are identified based on the Ecological Land Classification (ELC) methodology.

2.3.6 Other Wetlands

According to Table 4-1 of the OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Other Wetlands include:

- All wetlands that meet an ELC wetland system classification and have not been evaluated as a PSW;
- Both evaluated non-PSWs and wetlands that have not been evaluated. These include wetlands that are regulated and wetlands that are not regulated by the Conservation Authority; and,
- Wetlands with ecological and hydrological functions and wetlands that have only have a hydrological function.

In settlement areas, Other Wetlands, which are not regulated by the Conservation Authority, require further evaluation to determine the appropriate protection or management of the feature. Within settlement areas, Other Wetlands which are not regulated by the Conservation Authority are considered to be a required component of the water resource system and are protected or managed in accordance with the policies of the Regional OP.



2.3.7 Fish Habitat

According to Table 4-1 of the OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Fish Habitat is identified as any watercourse or waterbody identified by the MNRF or provided / approved by the Federal Department of Fisheries and Oceans (DFO) or a delegated authority of DFO (including Conservation Authorities, as appropriate).

For screening purposes, and until such time appropriate studies are completed to assess watercourses and waterbodies, Fish Habitat will be presumed to be:

- Any permanent or intermittent stream or waterbody excluding constructed and actively managed offline ponds (e.g., stormwater ponds, active farm irrigation ponds, etc.);
- Intermittent or ephemeral watercourses, or HDFs that provide contributions in terms of baseflow, material (e.g., substrates, etc.), or allochthonous inputs that are important to the maintenance of downstream fish habitat; or
- Shoreline features that provide contributions in terms of material (e.g., substrates, etc.) or allochthonous inputs that are important to the maintenance of fish habitat in the Great Lakes.

Site-specific Relevance to Region's OP

According to the Region's OP Schedule C1 (Natural Environment System Overlay and Provincial Natural Heritage Systems), the Study Area is partially within urban and rural settlement areas and contains portions of the Region's Natural Environment System and Growth Plan Natural Heritage System (**Map B**). As per the OP's policies (Section 3.1.9.9.1), within settlement areas, these natural features are to be protected with an ecological buffer. The width of an appropriate buffer for each feature will be determined through an EIS or SWS. Additionally, PSWs, Other Wetlands and Non-Provincially Significant Wetlands, Significant Woodlands, Other Woodlands, Linkages, and Permanent and Intermittent Streams are found within and/or adjacent to the Study Area (**Map C**). Furthermore, though not mapped in the Region's Schedules, Fish Habitat (Wignell Drain West Tributary) and Significant Wildlife Habitat (SWH) were noted within the Subject Lands (during the 2021/2022 field investigations) and the Study Area (during 2023 field investigations).

2.4 City of Port Colborne Official Plan

The City of Port Colborne OP was approved by the Ontario Land Tribunal on November 25, 2013 (City of Port Colborne, 2013), and was updated in September 2017. The City of Port Colborne (the "City") promotes the protection, conservation, restoration, and enhancement of Natural Heritage Features within and adjacent to its boundaries. The City's Natural Heritage is shown on Schedule B of the OP, as Environmental Protection Areas (EPAs), Environmental Conservation Areas (ECAs), Streams, and Fish Habitat.

EPAs are lands that are classified as PSWs, Provincially Significant ANSIs, Significant Habitat of Threatened and Endangered Species, and Natural Hazards. ECAs are lands that are classified as Regionally Significant ANSIs, Non-Provincially Significant Wetlands, SWH, Habitats of Species of Concern, Significant Woodlands, Environmental Corridors and Linkages, Significant Valleylands, Stream Corridors, and Fish Habitat Areas.

As part of the City's OP Section 4.1.1 policies, development should maintain, enhance, or restore ecosystem health and integrity. Priority is to be given to development avoiding negative environmental impacts. If negative impacts cannot be avoided, mitigation measures will be required.



2.4.1 Woodlands

The City's OP Section 4.3.5.1 b) states that woodlands are treed areas, woodlots, or forest areas that provide environmental and economic benefits to private landowners and the public that vary in levels of significance. To be classified as significant, a woodland must:

- Contain a threatened or endangered species or species of concern,
- Be equal or greater than 2 hectares in size,
- Overlap or contain one or more significant natural heritage features, or
- Abut or be crossed by a water body greater than 2 hectares in area.

2.4.2 Fish Habitat

According to the City's OP Section 4.3.7.1 g), a naturally vegetated buffer areas of at least 30 m in width from the stable top of bank will be required adjacent to a Critical Fish Habitat. A minimum 15 m vegetative buffer from the stable top of bank will be required adjacent to Important or Marginal Fish Habitat. A buffer narrower than 15 m may be considered for Important or Marginal Fish Habitat where the EIS (or SWS) has demonstrated that there will be no harmful destruction of fish habitat.

Although types of fish habitat are not differentiated on City mapping, The 2010 Lake Erie North Shore Watershed Plan identifies that the entirety of the Wignell Drain Subwatershed Study Area is considered Important (Type 2) Fish Habitat (NPCA, 2010). No Critical (Type 1) Habitat is identified within the 2010 Lake Erie North Shore Watershed Plan (NPCA, 2010).

Regarding Municipal Drains, Section 4.3.7.1 h) states that where development, site alteration, or construction is proposed adjacent to a Municipal Drain a minimum buffer zone of 15 m in width measured from stable top of bank shall be required to provide access for drain maintenance.

Site-specific Relevance to the City's OP

According to the OP's Schedule B (Natural Heritage) the Study Area contain EPAs, ECAs, streams, and fish habitat (**Map D**). Additionally, as depicted on the OP's Schedule B1 (Environmental Protection Area), Natural Hazard Lands and EPAs are found within and adjacent to the Study Area (**Map E**). Furthermore, the OP's Schedule B2 (Environmental Conservation Area), depicts the Study Area containing Significant Woodlands, Non-Provincially Significant Wetlands, Environmental Corridors, Fish Habitat, and Streams (**Map F**).

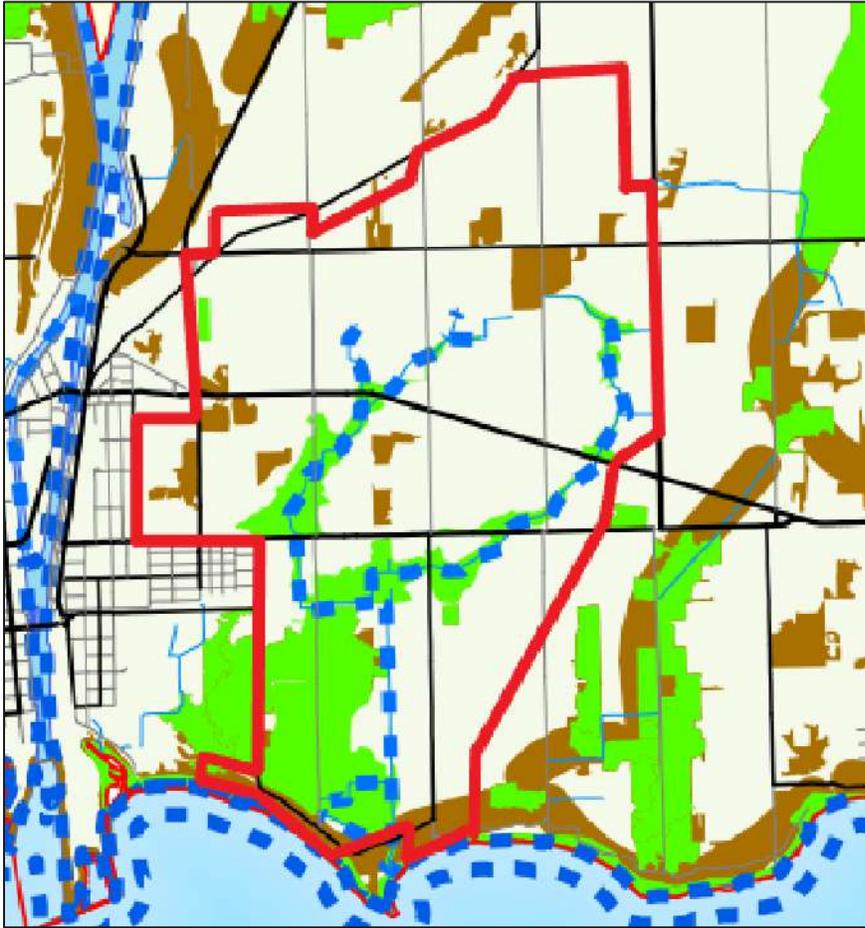
As per Section 4.1.1 (j) of the OP, undisturbed, vegetated buffers will be required between Natural Heritage Features and any proposed buildings or structures of adjacent development and, unless reduced buffers are determined by an EIS (or SWS), the size of the buffers shall be:

- Provincially Significant Wetlands: 120 m
- Non-Provincially Significant Wetlands: 50 m
- Fish Habitat: a) Critical: 30 m; b) Important or Marginal: 15 m
- Significant Woodlands: 50 m
- Significant Wildlife Habitat: 50 m

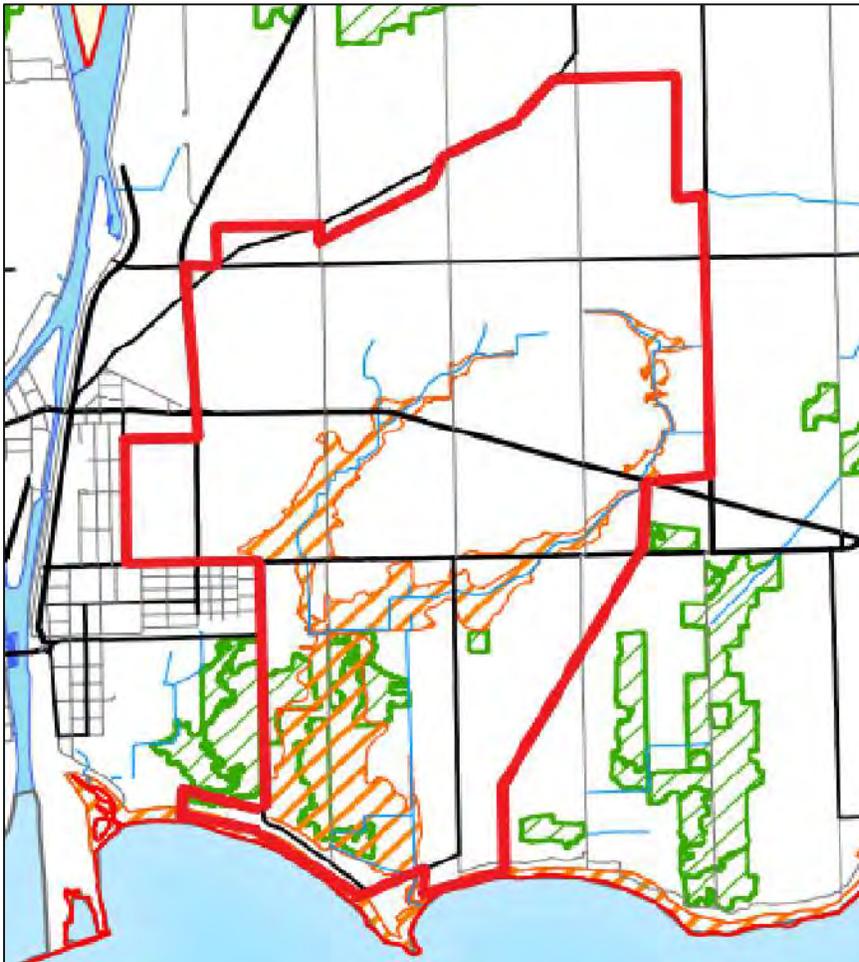
Map D: The City's OP Schedule B depicts the Study Area (approximate boundaries in red) containing and/or being adjacent to EPAs (green layer), ECAs (brown layer), streams (blue lines), Lake Erie (light blue layer), and fish habitat (linear



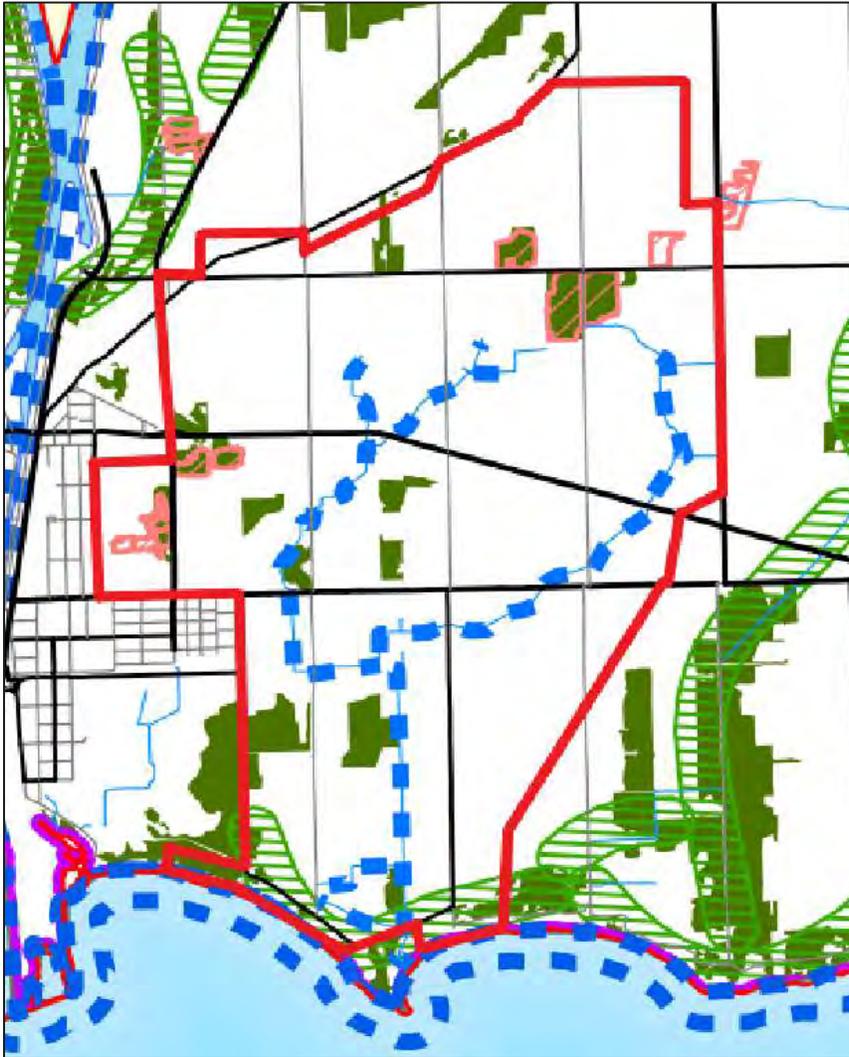
blue squares). Much of the green layer is reflective of the regulated floodplain (see Map G).



Map E: The City's OP Schedule B1 depicts Natural Hazard Lands (orange hashed layer), EPAs (green hashed layer), and streams (blue lines) within and adjacent to the Study Area (approximate boundaries in red).



Map F: The City's OP Schedule B2 depicts the Study Area (approximate boundaries in red) containing and/or being adjacent to Significant Woodlands (dark green layer), Non-Provincially Significant Wetlands (pink hashed layer), Environmental Corridors (green hashed layer), Streams (blue lines), and Fish Habitat (linear blue squares).

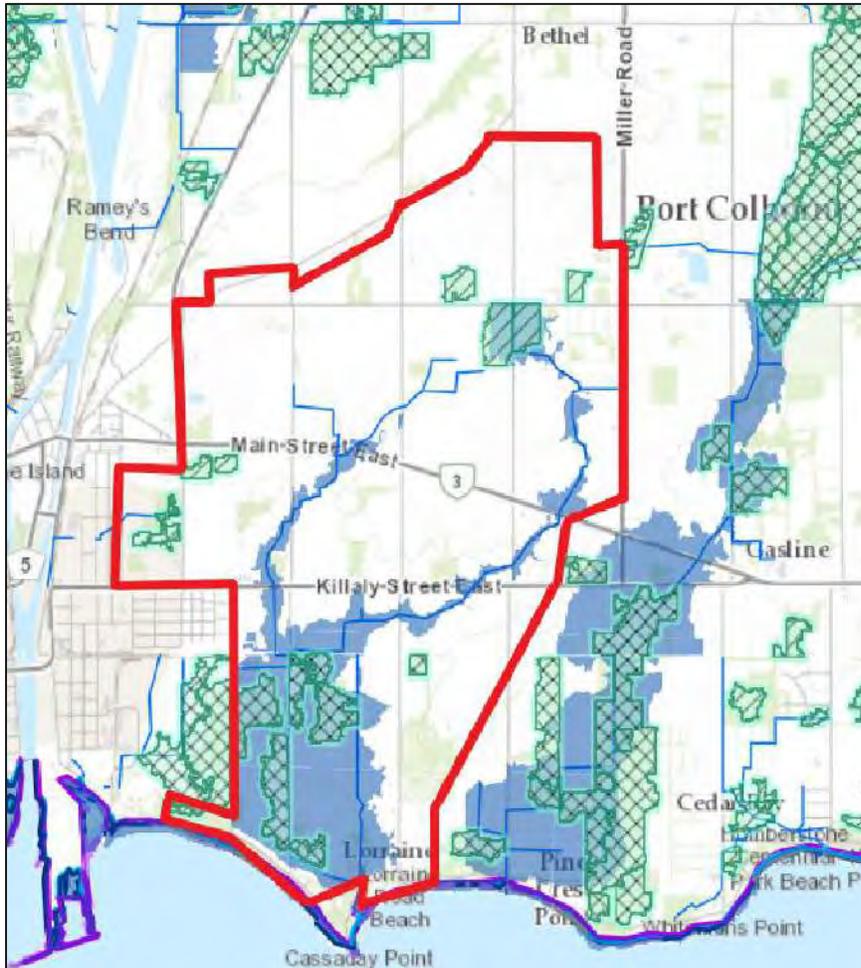


2.5 Niagara Peninsula Conservation Authority (NPCA)

The Conservation Authorities Act directs all Conservation Authorities to produce local regulations to streamline development approvals under Ontario Regulation (O. Reg.) 41/24. Within the Study Area, areas associated with the wetland features, watercourses (as defined under the Conservation Authorities Act), and the floodplain are considered NPCA's regulated lands (**Map G**). As such, should development be proposed in these areas and within adjacent lands, they will require authorization and a work permit from the NPCA under O. Reg. 41/24.



Map G: NPCA’s Regulated Lands within and adjacent to the Study Area (approximate boundaries in red) which include floodplains (dark blue layer), PSWs (green cross hashed layer), Non-Provincially Significant Wetlands (green hashed layer), and Shorelines (dark blue and purple line).



Implementation of O. Reg. 41/24 is supported by the NPCA Policy Document: Policies for Planning and Development in the Watersheds of the Niagara Peninsula Conservation Authority (NPCA, 2024). Through regulation, as expressed above, the NPCA has jurisdiction within and adjacent to wetlands, watercourses, and other hazard lands (e.g., floodplains). Applicable NPCA regulations for the Study Area are listed below:

2.5.1 Wetlands

The NPCA document *Policies for Planning and Development in the Watersheds of the NPCA* states that:

8.2.2.1 - *Unless exempt by Section 3.5.4, no development and/or interference shall be permitted within any wetland.*

And,

8.1.2.3 - *Some wetlands within the watershed have not been evaluated and delineated under the OWES [i.e., unevaluated wetlands]. In those instances, the following policies apply:*



- a) *Prior to development activity or site alteration on a property with an unevaluated wetland, a wetland evaluation shall be required prior to completion of an EIS (if required) or the approval process.*
- b) *Exceptions to (a) may be considered in cases where an appropriate natural buffer (as determined by the NPCA) is proposed between the NPCA staked wetland boundary and all site alteration and development (including grading), or small scale non-permanent development (such as small backyard sheds not requiring planning approval) which in the opinion of NPCA will have no negative impact on the ecological and hydrologic function of the wetland. These cases will only be considered for small-scale development through the work permit process and where an appropriate buffer is maintained.*

2.5.2 Buffers

Wetland Buffers

Section 8.2.3.1 of the NPCA Policy Document states:

Wetland Buffers

- 1 *Where development is proposed adjacent to a wetland, a minimum 30 m buffer shall be provided.*
- 2 *Notwithstanding Section 8.2.3.1 1), a reduction to a non-PSW buffer shall only be considered where:*
 - a) *There is no other reasonable alternative; and*
 - b) *Where supported by an EIS in accordance with NPCA Procedural Manual.*

Watercourse Buffers

According to Section 9.2.5.1 of the NPCA Policy Document, the following buffer requirements apply to development and site alteration adjacent to a watercourse:

- a) *A 30 m buffer shall be provided where the watercourse contains permanent flow. Notwithstanding this requirement, the buffer may be reduced where supported by a technical study in accordance with the NPCA Procedural Manual, but in no case shall the buffer be reduced below 15 m.*
- b) *A 15 m buffer shall be provided for watercourses containing intermittent flow. Notwithstanding this requirement, the buffer may be reduced where supported by a technical study in accordance with the NPCA Procedural Manual.*

2.5.3 Fish Habitat Classification

Based on other Watershed Plans completed by the NPCA, such as the Twenty Mile Creek Watershed Plan (located north of Port Colborne), fish habitat is classified based on the MNRF's 2000 protocol (NPCA, 2006). Fish habitat falls into one of three categories in Niagara:

Type 1 – 'Critical': This is the most sensitive habitat and requires the highest level of protection. It includes critical spawning and rearing areas, migration routes, over-wintering areas, productive feeding areas, and habitat occupied by sensitive species.

Type 2 – 'Important': This habitat is less sensitive and requires a moderate level of protection. These areas are considered "ideal for enhancement or restoration projects" and include feeding areas for adult fish and unspecialised spawning habitat.



Type 3 – ‘Marginal’: This habitat type is considered marginal or highly degraded and does not contribute directly to fish productivity. Examples of Type 3 habitat include channelized stream and artificially created watercourses.

The 2010 Lake Erie North Shore Watershed Plan identifies that the entirety of the Wignell Drain Subwatershed Study Area is considered Important (Type 2) Fish Habitat (NPCA, 2010). No Critical (Type 1) Habitat is identified within the 2010 Lake Erie North Shore Watershed Plan (NPCA, 2010).

As outlined below, background review of previous watershed level assessment for the Wignell Drain characterize the majority of the watershed as being Important (Type 2) Fish Habitat; however, through site-specific habitat assessment, it is more likely that the watershed is composed of both Important Fish Habitat areas and Marginal (Type 3) Fish Habitat areas due to historical anthropogenic impacts and alterations and continuing organic inputs.

2.6 Endangered Species Act (2007)

Species designated as Endangered or Threatened by the Committee on the Status of Species at Risk in Ontario (COSSARO) are listed as Species at Risk (SAR) in Ontario (Government of Ontario, 2007). These SAR and their habitats (e.g., areas essential for breeding, rearing, feeding, hibernation, and migration) are afforded legal protection under the Endangered Species Act, 2007 (ESA). This Act is administered by the Ministry of Environment, Conservation and Parks (MECP).

The protection provisions for species and their habitat within the ESA apply only to those species listed as Endangered or Threatened on the SARO list, being Ontario Regulation 230/08 of the ESA. Species listed as Special Concern may be afforded protection through policy instruments respecting significant wildlife habitat (e.g., the PPS) as defined by the Province or other relevant authority, or other protections contained in Official Plans.

Please note that this Act was amended in 2025 and is currently under review and it is expected that the *Species Conservation Act* (SCA) will replace the ESA in 2026. Currently, the SCA is not yet in force, as such the amended ESA applies until further notice (Government of Ontario, 2025).

2.7 Federal Species at Risk Act

The purpose of the *Species at Risk Act* (SARA, SC 2002, c 29) is to prevent species in Canada from disappearing, to provide for their recovery, and to manage species of special concern to prevent them from becoming endangered or threatened (Government of Canada, 2002). Fisheries and Oceans Canada (DFO) administers the SARA for aquatic SAR, while Environment and Climate Change Canada (ECCC) administers the SARA for all other federally listed SAR including SAR migratory birds. Except in the case of migratory birds and aquatic species, SARA applies to federal lands, and not to provincially or privately held property. SARA can apply to these other lands if provincial laws do not effectively protect species at risk or their residences through an Order in Council. Protections for aquatic and migratory birds apply to all lands (federal, provincial, Indigenous, and private) in Canada.

For species listed under Schedule 1 of SARA, listed as endangered, threatened, or extirpated, the Act prohibits:

- Killing, harming, or harassing an individual;
- Damaging or destroying a residence (e.g., nest or den); and



- Damaging or destroying designated Critical Habitat.

For aquatic SAR, review under the SARA is typically undertaken in conjunction with requirements under the *Fisheries Act*. A permit is required for activities that may affect species listed on Schedule 1 and/or that have the potential to contravene the SARA's general or Critical Habitat prohibitions.

2.8 Climate Projections for the Niagara Region (2007)

Climate Projections for Niagara Region, prepared by the Toronto and Region Conservation Authority in collaboration with the Ontario Climate Consortium, is designed to provide Niagara Region with localized climate projections to inform policy development and climate adaptation planning. The report responds to the growing need for municipalities to integrate climate change considerations into official plans, asset management strategies, and risk assessments. Its primary purpose is to establish a consistent, science-based approach for generating regional climate data that supports decision-making across sectors such as infrastructure, agriculture, public health, and natural systems.

The report focuses on projecting future temperature and precipitation trends under high-emission scenarios and translating these into actionable climate parameters relevant to planning and adaptation. Beyond presenting projections, the report aims to guide municipalities in understanding potential impacts, identifying vulnerabilities, and developing strategies to enhance resilience. It also outlines recommendations for ongoing updates, integration of climate data into planning tools, and capacity building to ensure that adaptation initiatives remain aligned with evolving climate science. Its findings are discussed in Section 9.2.

3.0 Study Approach

3.1 Background Review

SLR has reviewed relevant background material to provide a focus on field investigations and ensure compliance with applicable regulations and policy. Background information collection is guided by the *Natural Heritage Information Request Guide* (Ministry of Natural Resources and Forestry, 2018). Current direction from the MNR and MECP is to gather natural heritage information and species occurrence records from available sources; the NHIC Make-a-Map application being the main source of information and records from the Ministry itself (Ministry of Natural Resources and Forestry, 2021). Information gathered is recommended to be balanced and supplemented by a professional ecological review of potential habitats and characteristics of a project site.

Background review included the collection and review of relevant mapping and reports, including regulations and policies, Official Plans, and zoning by-laws; and the NHIC Make-a-Map application for species occurrences and designated area mapping. In addition to these sources, the following data sources were reviewed for the project:

- Google Earth mapping (covering approximately the last 20 years, as well as 1934)
- Lands Information Ontario base mapping and associated Ministry of Natural Resources and Forestry Make a Map: Natural Heritage Areas
- Port Colborne EIS materials (EIS, Palmer September 2023, and SLR, EIS Addendum January 2026)
- Natural Areas Inventory 2006 - 2009, Volume 1 and 2 (NPCA, 2010)



- Lake Erie North Shore Watershed Plan (NPCA, 2010)
- Nature for Niagara's Future (NPCA 2010-2011)
- Online citizen science databases (e.g., eBird, iNaturalist, etc.),
- DFO Aquatic SAR Map (2020)
- NHIC database for tracked species, plant communities, and wildlife concentration areas
- Lower Welland River Characterization Report (2011)
- MNDMNRF fisheries data from Fisheries Database Sites and from MNDMNRF at Vineland
- MNRF Ontario Wetland Evaluations

Following the *Information Request Guide* (MNRF, 2018), MECP advice and direction should be solicited once SAR interactions or potential interactions are identified via field investigations and analysis.

Note that while eBird and iNaturalist databases are 'citizen science' databases, they both have different type of vetting and checking process for data submitted. Thus, while it is possible that there are errors in this data, at the same time there is a level of quality control.

3.2 Agency Liaison

A Terms of Reference (TOR) was prepared for the requested SWS and was submitted to the reviewing agencies on April 13, 2022. Comments were received and multiple discussions were had between the consultants and the reviewing agencies to adequately characterize the required scope of work. A revised TOR was sent to the reviewing agencies on March 10, 2023. This TOR was accepted by the Niagara Region on May 18, 2023, with the condition that if SLR is granted access to private lands that breeding bird surveys are to be conducted as per protocols (where applicable). On June 2, 2023, the NPCA also accepted this TOR under the condition that SLR completes surveys and assessments as per the provided protocols. The latest TOR and correspondence related to the TOR's acceptance can be found in **Appendix A**.

As part of the ecological surveys for the Subject Lands EIS, a senior SLR ecologist met with staff from both the Niagara Region and the NPCA to discuss, delineate, and stake natural features. Site staking occurred on November 18, 2021 (woodland staking with the Niagara Region) and September 14, 2022 (wetland and woodland staking with the NPCA and the Niagara Region). The remaining areas outside of the Subject Lands (including watercourses and drains) were delineated and classified via a desktop analysis of aerial imagery and a review of the Natural Areas Inventory (NPCA, 2010) for the Niagara Region (**Appendix B**), with some areas being verified during ecological and geomorphic surveys.

Features within the Subject Lands are described in **Appendix C** and mapped later in the report; however, the following methods were used to delineate the numbered features:

- A1/B1 (wetland/woodland) – used existing evaluated wetland mapping with agreement from the NPCA and the Region
- A2 (SWH/wetland) – staked (NPCA)
- B2 (woodland) – staked (Region)
- B2 (interior wetland) - used air photo delineation/field observations with agreement from the NPCA and the Region



- B3 (wetland/woodland) – partly staked (NPCA) and partly used air photo delineation with agreement from the NPCA and the Region
- A3 (woodland) – staked (Region)
- A4 (woodland) – staked (Region)
- A4 (wetland) – partly staked (NPCA) and partly used air photo delineation with agreement from the NPCA and the Region

3.3 Indigenous Group, Naturalist Club, and Landowner Consultation

At the request of the reviewing agencies during the TOR process, Indigenous groups, naturalist clubs, and key landowners were contacted via letters to inform them of the SWS being conducted in the area.

The letters to six Indigenous communities requesting input were emailed by SLR on May 4, 2023. Letters to two local naturalist groups were sent in November 2023 by SLR. One response from an Indigenous group was received, requesting a copy of the SWS report once completed. No other responses have been received by SLR to date from Indigenous Groups nor naturalists' groups.

Letters (jointly written by SLR and the City) to selected landowners were sent by the City of Colborne in the last week of May 2023, requesting access to private lands within Wignell Drain Subwatershed Study Area. Letters were sent to selected landowners were those that appeared to have the larger natural features on their properties or which had watercourse reaches that would be useful to sample. One property owner responded granting access; this was a small property which allowed aquatic survey sampling, but not further terrestrial information could be gathered from this property. No other landowners responded.

3.4 Terrestrial Surveys

Field investigations were conducted to collect existing conditions data for flora, fauna, and natural features and their hydrological and ecological functions in and adjacent to the Wignell Drain Subwatershed Study Area. Field investigations were conducted by SLR in 2021, 2022, and 2023. Completed surveys and their associated dates are provided in **Table 1**. See **Figure 2** for bird, amphibian, and aquatic survey locations.

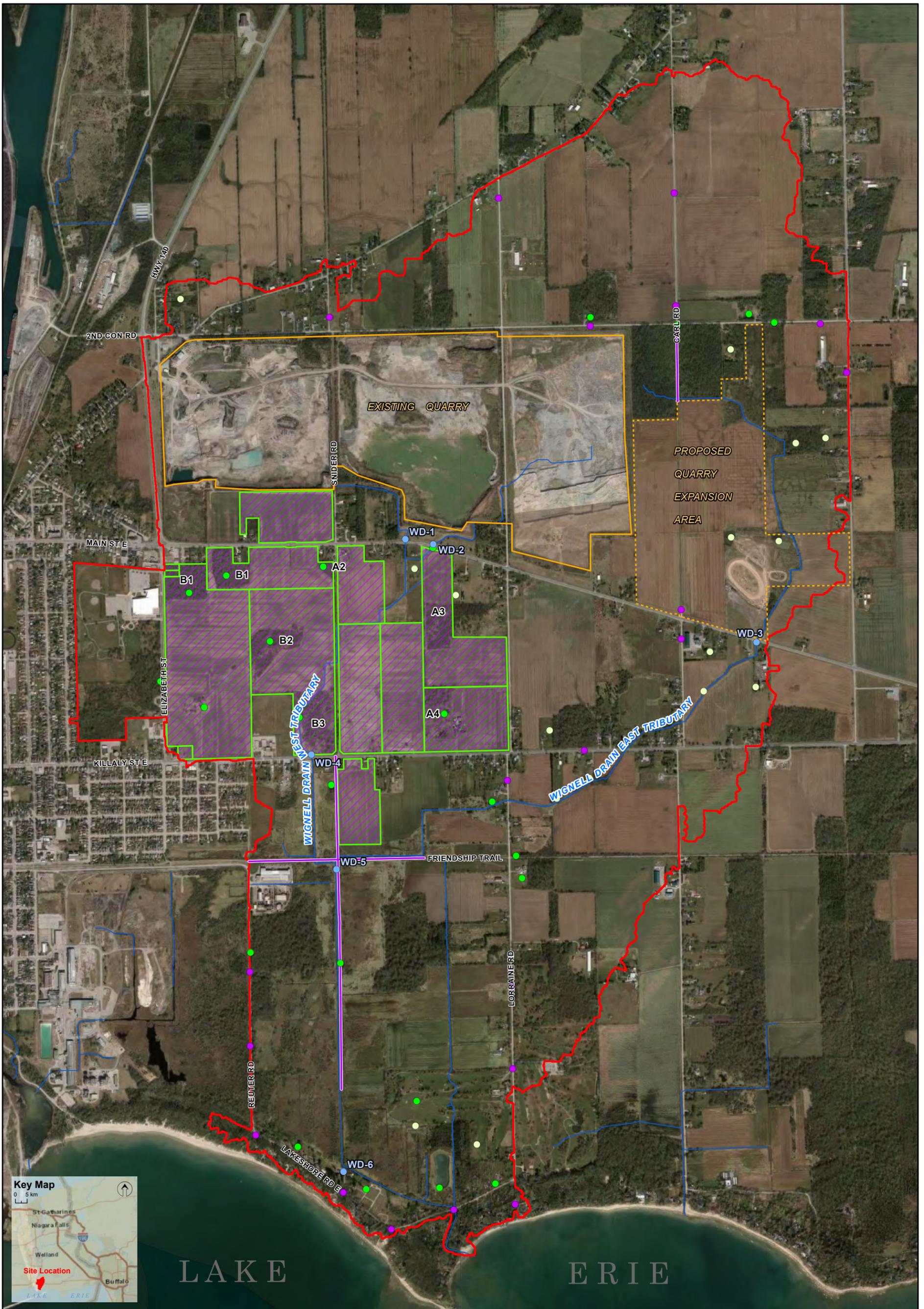
Table 1: Summary of Ecological Surveys (2021 - 2023)

Survey Type	Date		
	2021	2022	2023
Amphibian Breeding Surveys	-	March 18, April 12, May 18, and June 23 (on Subject Lands) April 12 and May 18 (within the Study Area outside of Subject Lands)	-
Breeding Bird Surveys	June 17 and July 5 (on most of Subject Lands)	May 31, and June 22 (areas on Subject Lands not surveyed in 2021)	June 9 (roadside and trails in areas outside Subject Lands)



Survey Type	Date		
	2021	2022	2023
Vegetation Communities and Flora	June 17, July 5, and October 19 (on Subject Lands)	March 1, April 27, August 30, August 31 (on Subject Lands)	Not conducted outside Subject Lands due to access constraints to privately owned lands.
Aquatic Assessment	June 17 and July 5 (on Subject Lands)	March 18 and May 24 (on Subject Lands)	June 12 and 14 (initial surveys). Additional habitat condition details recorded from June through October. Completed concurrently during surface water quality sampling events.
Salamander Habitat Assessment	-	March 18, and May 24 (with additional observations March 31) (on Subject Lands)	-
Snake Surveys	-	May 18, May 31, June 23, July 28, and August 30 (on Subject Lands)	-
Soil Sampling (hand-held Dutch auger)	-	August 31, September 14, and October 27 (on Subject Lands)	-
Wetland and Woodland Staking	November 18 (most woodlands completed on Subject Lands)	September 14 (wetlands and remaining woodlands on Subject Lands)	-
Surface Water Quality Sampling	-	-	June 14, July 7 and 31, August 16 and 31, September 27, October 24
Electrofishing	-	-	September 27
Benthic Sampling	-	-	June 12 and October 25





LEGEND Aquatic, Benthic, and Fishing Sampling Location ● Logger & Field Sampling Location Breeding Bird Survey Location ● Roadside Point Survey — Roadside Line Survey ▨ Completed Survey Amphibian Survey Location ● Surveyed Point ● Not Surveyed - potential amphibian habitat		Watercourse 1 Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area 1 - Contains data sourced from Geospatial Ontario (GEO)		0 100 200 300 400 500 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: KT Date: Feb 26, 2026		CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 889 Killaly Holdings Inc. PROJECT Welland S - Wignell SWS TITLE Bird, Amphibian, Fish Sampling, Benthic Invertebrate, and Aquatic Survey Sampling Locations REF. NO. 2007708-2-1	
						Figure 2	

3.4.1 Vegetation Communities, Flora, and Soil Sampling

Vegetation communities within the Subject Lands were mapped and described following the ELC System for Southern Ontario protocols (Lee, et al., 1998). Vegetation community boundaries were delineated on field maps through the interpretation of recent aerial photographs and refined in the field. Information collected during ELC includes dominant species cover, community structure, as well as level of disturbance, presence of indicator species, and other notable features. Botanical surveys for these vegetation communities were completed by traversing the site and recording species observed in each vegetation community, as access allowed (private properties were not entered as not permission was granted). Provincial plant status was based on the *Rare Flora of Ontario* (Oldham & Brinker, 2009) and the Natural Heritage Information Centre (Ministry of Natural Resources and Forestry, 2023). Regional plant status was based on the *Checklist of the Vascular Plants of Niagara Regional Municipality Ontario* (Oldham M., 2010).

Access was not granted by private landowners within the Study Area. Therefore, vegetation communities outside of the Subject Lands were delineated and described to the ELC Community Class level (e.g., FOD, SWD, etc.) following a desktop review of aerial photography in combination with roadside observations. These SLR interpretations have been shown on the mapping, however at NPCA's request, the NPCA wetland mapping has been overlain on SLR's mapping. Thus, some polygons will appear to be both an upland and a wetland, as it is unknown. It should be noted that on the Client's Subject Lands fewer wetlands were found than are mapped by NPCA. That is, the NPCA mapping is likely overly conservative, however SLR has taken the conservative approach and applied constraints to these units as if NPCA has a unit mapped as a wetland (with a few exceptions noted later). Future surveys on other lands may be needed to confirm presence/absence of NPCA mapped wetlands.

Soil sampling (with hand-held Dutch auger) occurred on several dates in 2022 at each of the main ELC polygons in the Subject Lands, totalling 14 soil samples. Using a standard-sized soil auger, soil samples were dug to a depth which would enable the sampler to determine the soil texture and moisture regime. In some instances, it was not possible to achieve a suitable depth as resistance was encountered. This was likely due to heavy clay soils or bedrock. The following characteristics were recorded: depth of sample; presence of litter; depth and characteristics of organic layer and lower mineral layers; texture of mineral layer(s), depth of distinct mottles and gleys (if present); depth to water table (if present), and the subsequent resulting moisture regime. Soil identification and characteristics were described using Section 10 within Lee et al. (1998). Where depth of bedrock was not known, depth to bedrock was assumed to be >120 cm. Wetland community identification was ultimately based on wetland plants as per Ontario Wetland Evaluation System (OWES) and ELC (Lee et al., 1998), and the soil information was considered supplementary, further confirming the wetland evaluation. Within this SWS report, this soil information is provided as part of the ELC description of the associated vegetation community within **Appendix C**.

For lands within the Study Area, but outside the Subject Lands, soil sampling and characterization was not conducted, as this was not possible.

3.4.2 Breeding Amphibian Surveys

Amphibian breeding surveys were conducted across the Wignell Drain Subwatershed Study Area (including the Subject Lands) on April 12 and May 18, 2022, at twenty-four survey locations. A third survey was completed for one station within the Subject Lands (pond at A4 – see **Figure 2**) on June 23, 2022. Additionally, incidental observations of amphibians, amphibian calls, and egg masses were recorded, where applicable. Air photo analysis was also used to



indicate areas outside of the Subject Lands which might contain breeding amphibian habitat but were not accessible due to private land ownership.

These breeding amphibian surveys were conducted in accordance with standard Marsh Monitoring Program protocols (Bird Studies Canada, 2009). Surveys were completed in the evenings between 20:30 and 23:50 h. Weather conditions were between 5°C and 20°C, with few clouds, no precipitation, and light wind. Species were identified by call, and an abundance code for each species heard calling was assessed by the following the Marsh Monitoring Program protocol:

- Code 0: No calls heard.
- Code 1: Calls not overlapping or simultaneous, number of individual frogs can be counted.
- Code 2: Calls overlapping or simultaneous, number of individuals can still be distinguished, number of individual frogs cannot be counted, but a reliable estimate of numbers can be made based on location and call voices.
- Code 3: Full chorus, calls simultaneous and overlapping, numbers of calling males cannot be reasonably counted or estimated.

3.4.3 Breeding Bird Surveys

Breeding bird surveys were conducted on the Subject Lands using a roving survey method whereby the entirety of site was covered. The site was walked in such a way that the observer came within 50 m (or less) of all parts of the site at one point during the survey. SLR conducted two breeding bird surveys, more than one week apart within the peak breeding season, on June 17 and July 5 of 2021. These surveys were conducted between 5:30 a.m. and 10:00 a.m. to coincide with the dawn chorus and were completed under suitable weather conditions when wind speeds were less than 20 km/h and there was no precipitation. The surveyor used a site map to record all bird species and individuals seen/heard, as well as the approximate locations that the individuals were observed/heard. Any flyovers or migrants were excluded from the species list.

Additional breeding bird surveys were conducted by SLR ecologists on June 9 of 2023 within the Study Area, outside of the Subject Lands. These surveys included point observations from public roads and walking observations from the Friendship Trail and the Snider Road allowance in the southern third of the Study Area.

3.4.4 Salamander Habitat Assessment

Within the Subject Lands, in areas where potential salamander breeding habitat (i.e., vernal pools) was noted, the presence/absence of salamander eggs was documented. Surveys included flipping logs, rocks, or other objects in suitable woodland habitat in search of individuals. The location of the areas that were surveyed were recorded and includes areas A1, B1, and A4. Suitable habitat was also recorded onsite, if observed, while conducting other field activities.

For lands within the Study Area but outside the Subject Lands, salamander habitat assessments were not possible and therefore not conducted.



3.4.5 Turtle Habitat Assessment

Within the Subject Lands, in areas where potential turtle habitat was noted, the presence/absence of turtles was documented. Ecologists looked for deep, open standing water habitats that had basking opportunities and potential overwintering capabilities.

For lands within the Study Area, but outside the Subject Lands, turtle habitat assessments were not possible and therefore not conducted; however, any incidental observations of turtle species were recorded.

3.4.6 Snake Surveys

Snake surveys, conducted within the Subject Lands, involved creating artificial habitat (wood cover boards) in potentially suitable habitat areas. Snake boards were approximately 1 m by 1 m or 1 m by 2 m and about half the boards were pre-weathered. A total of 12 snake boards were placed in dry, flat, and open/semi-open areas within the forest/swamp/thicket communities of the Subject Lands. Snake boards were placed in the early spring and were subsequently checked during the 2022 spring and summer field season (see **Table 1**). Additionally, while onsite conducting other field activities, any incidental snake observations were recorded.

For lands within the Study Area, but outside the Subject Lands, snake surveys were not possible and therefore not conducted; however, any incidental observations of snake species were recorded.

3.4.7 Species at Risk

For the purposes of this report, SAR include species listed as *Endangered*, *Threatened*, or *Special Concern* under Ontario's ESA. Prior to conducting field work on the Subject Lands and the Study Area, existing SAR records were queried through the NHIC database. Habitat opportunities for SAR on the Subject Lands and in the Study Area were then assessed by comparing habitat preferences of species deemed to have potential to occur to current site conditions. The species noted during the NHIC search and others known through professional experience to have potential to occur, along with field survey results, were considered in the assessment.

3.4.8 Significant Wildlife Habitat

Prior to conducting field investigations within the Subject Lands, a *Significant Wildlife Habitat Screening Table for Niagara Region* was submitted to and accepted by the Niagara Region at their request. This screening table was completed to ensure that the Niagara Region approved the direction of future SWH studies within the Subject Lands. Following acceptance of this screening table, SLR completed a fulsome SWH assessment on the Subject Lands using vegetation community information, as well as information gathered during field investigations. For lands within the Wignell Drain Subwatershed Study Area, but outside the Subject Lands, a similar SWH assessment was completed.

3.4.9 Roadside Mortality Observations

Observations of any road-killed wildlife (mainly reptiles and mammals) were noted and have had their locations documented. Findings of road-killed wildlife for the Subject Lands and the remaining Study Area are incorporated into this report.



3.4.10 Incidental Observations

Incidental observations of wildlife (primarily mammals and herptiles) were recorded during field investigations within the Subject Lands and the Study Area. These observations included direct sightings and indirect evidence such as nests, tracks, scat, and browse.

3.5 Aquatic Surveys

3.5.1 Aquatic Habitat

Aquatic habitat, within both the Subject Lands and the Study Area, consist of surface water features that function, ecologically, as watercourses, but are also identified as a municipal drains, and are subject to conditions under the Drainage Act. The details of the Drainage Act are not discussed in detail within this Study report, but it is understood that most, if not all, watercourses within the Study Area may be subject to periodic maintenance, including activities such as dredging or sediment removal, to ensure that the conveyance of overland drainage towards Lake Erie is maintained, and the protection of public and private lands from flooding is maintained.

Aquatic habitat assessments were initially carried out by SLR on March 18 and May 24 of 2022 on watercourses that traverse the Subject Lands (i.e., the main portions of the Wignell Drain). In December 2022, an initial review of all watercourses within the Study Area was completed. In 2023, all accessible watercourses (i.e., drains) flowing across the Study Area were surveyed in detail on June 12 and 14. Watercourses were continually surveyed across the 2023 monitoring season (June to October) for the water quality sampling program instituted as part of the SWS. The following characteristics of these watercourses were recorded when possible:

- Channel width and depth profile, bank height, bank stability;
- Substrate types and distribution;
- Presence of potential fish barriers;
- Riparian vegetation type and cover; and
- In-stream cover type and extent.

The characterization of watercourses within the Study Area, but outside the Subject Lands, was conducted at aquatic monitoring survey locations, where the watercourses are observable from the roadside, and at locations where SLR has been granted access to private properties (this applies to a single property only). It should be noted that additional watercourses regulated by the NPCA may be present within the Study Area, outside of those lands where field survey access was possible, that were not captured during in-field assessments. This may especially be the case for private, non-participating lands in which site access was not granted. A conservative approach was taken with respect to assessing the presence and significance of potential, but inaccessible, watercourses within the Study Area. All drainage features shown on NPCA mapping are mapped on relevant figures, and constraints were applied as appropriate. Where applicable, subsequent field work for other properties may be needed to confirm presence/absence.

3.5.2 Surface Water Quality

Surface water quality sampling and monitoring was completed at six key locations within the Wignell Drain Subwatershed Study Area during 2023 (**Figure 2**). Monitoring consisted of a combination of continuous logging and discrete grab sampling at each location.



3.5.2.1 Surface Water Quality

For discrete grab sampling, surface water samples were collected at each sample station location, packaged, and sent to an accredited lab for analysis. Discrete water sample parameters included nutrients (phosphorus and nitrogen), a comprehensive metals analysis (copper, zinc, chloride, and nickel), and physical characteristics (total suspended solids). Additional parameters including temperature, dissolved oxygen, pH, and conductivity were also gathered during discrete sampling events using a handheld multi-meter probe (YSI 556). As outlined in Section 3.5.1 above, during these surface water quality sampling events, general aquatic habitat conditions were noted visually to identify potential land use influences on the Wignell Drain Subwatershed Study Area (e.g., sedimentation from adjacent fields), as well as potential impacts to aquatic and semi-aquatic wildlife as a result of these influences.

Surface water quality results were summarized and compared to the Provincial Water Quality Objectives (PWQO). Results are summarized in Section 4.3.3 of this report.

3.5.2.2 Continuous Water Temperature

Continuous data logging of water temperatures was completed through the installation of six (6) Solinst Leveloggers, one for each monitoring station location (**Figure 2**). Alongside water temperature data, air temperature was also recorded by a Solinst Barologger at Station WD-1 for comparative purposes. The purpose of the continuous temperature monitoring was to record baseline surface water temperature fluctuations and seasonal gradients across the Wignell Subwatershed from late spring to late fall. All data logging instrumentation was installed on June 12, 2023, and continuously measured air and water temperatures at 15-minute intervals until their removal on November 2, 2023.

3.5.3 Surface Water Levels

In addition to continuous logging of water and air temperatures the Leveloggers also recorded continuous water levels at the six sample station locations (**Figure 2**). Recorded results from the pressure transducers were verified with *in situ* manual flow monitoring. Manual flow measurements were recorded along a watercourse transect while using a HACH handheld flow meter. Water pressure readings, collected by the Leveloggers, were compensated for by using air pressure measurements gathered by the Solinst Barologger installed next to Station WD-1 (**Figure 2**). Like the water temperature monitoring, water levels were also recorded from late spring to late fall (June to November). Elevations of the pressure transducers were recorded, in metres above sea level (MASL), using a mobile RTK (Real Time Kinematics) unit. Elevation levels are included in the data analysis for each station's water level.

Flow monitoring was summarized following the 2023 monitoring season to evaluate the volume of water present throughout the drainage network from season to season.

3.5.4 Fish Community Sampling

Fish community sampling (i.e., electrofishing) was conducted at the six sampling locations on September 27, 2023. Fish community sampling was completed in accordance with the Ontario Stream Assessment Protocol single-pass field procedures (Stanfield, 2017). Prior to the completion of sampling, fish collection permits were obtained from the MNR (License No. 1104495), and sampling was completed in accordance with permit requirements.



3.5.5 Benthic Invertebrates

To accompany general water chemistry sampling and provide a more fulsome sense of water quality within the Wignell Drain Subwatershed Study Area, benthic invertebrate sampling was completed at the six sample stations on June 14 (spring event) and October 25 (fall event), 2023. Three subsamples from each station were collected in order to capture different habitat types (i.e., riffle versus pools). Samples were then sent to a qualified taxonomist to be tabulated and sorted to at least the family level.

Sample collection utilized standard methods as outlined within the OBBN Protocol Manual (Jones et al., 2005). A 500 µm mesh kick net was used to collect standardized three-minute timed 'travelling kick and sweep' samples. Care was taken to scrub coarse materials present within the sample area to remove potentially attached benthic macroinvertebrates.

Samples were subsampled using the teaspoon method until at least 100 specimens were found (or until no other specimen could be found within the sample). Specimens from each sample were identified to family level. Sample results were summarized into the following biological metrics: total number of organisms, taxa diversity, taxa richness, Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa richness, percent EPT, and Hilsenhoff's biotic index (HBI).

3.6 Landscape Connectivity

Landscape connectivity is a concept that considers the degree of connectedness of natural features and habitats when a landscape has been subject to some degree of human development. This is especially relevant to southern Ontario, south of the Canadian Shield, where most land has been altered through agricultural practices or the construction of manmade structures (including roads). A highly connected landscape is one where there is generally a higher percentage of natural cover, and which has numerous natural corridors (such as river valleys) that link larger natural areas together. Highly connected landscapes enable higher biodiversity and higher genetic diversity due to the increased species mobility, while also enabling the movement of plants (by seeds) more readily. On the contrary, landscapes with low connectivity result in lower biodiversity and genetic diversity. It is worth remembering that the science of landscape connectivity is somewhat imprecise, and it is not always clear which species use or require corridors, and under which circumstances.

A landscape connectivity analysis was undertaken in the Study Area using:

- General knowledge of the area from:
 - EIS studies (Subject Lands)
 - Study Area on-site observations and studies
 - Extensive professional experience of southern Ontario
- Examination of Google Earth air photography

From this was drawn an approximation of the landscape connectivity and linkage conditions of the Study Area.

3.7 Channel Morphology

3.7.1 Desktop Assessment

Initial drainage feature characterization was completed through a desktop assessment of available background reporting (EWA Engineering Inc., 2022), LiDAR-derived topographic



hillshade and associated contours (LiDAR-derived Ontario Digital Terrain Model Mosaic, 2018), historical aerial imagery, and surficial geology mapping (Ontario Geological Survey, 2007). Geomorphic reaches (i.e., lengths of channel that exhibit similar characteristics with respect to parameters that influence channel form) were delineated based on the desktop assessment to guide the field assessments.

3.7.1.1 Headwater Drainage Feature Assessment

In 2022, HDFs within the Subject Lands were evaluated in accordance with the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (Toronto and Region Conservation Authority and Credit Valley Conservation, 2014). These guidelines use an integrated approach for the evaluation of key attributes of drainage features including flow and feature form, riparian vegetation, fish and fish habitat, and terrestrial habitat. The evaluation divides HDFs into segments, with breaks between segments occurring where key attributes change.

Due to the ubiquity of potential HDFs and other small municipal drainage features within the larger Study Area and lack of property access throughout the Study Area, these features were reviewed using a desktop approach in 2023 and 2024.

3.7.2 Field Surveys

Fluvial geomorphic field assessments were completed in 2023 to 'ground-truth' desktop characterization of existing drainage features and collect detailed channel information (bankfull geometry, bed and bank materials, indicators of instability or erosion) at representative locations within the Study Area. Characterization focused on publicly accessible areas, roadside observations, and the Subject Lands (**Figure 2**). Access was requested for specific, targeted locations on private lands that would provide the most benefit to the SWS; however, access was not granted. Detailed channel information collected during the field investigations supports erosion threshold analysis and erosion hazard limit delineation.

3.7.3 Erosion Hazard Limit Delineation

The erosion hazard limit was delineated (where appropriate) for the main branches of the Wignell Drain within the Subject Lands and Study Area, in accordance with accepted procedures (Parish Geomorphic, 2004). Channel configurations in georeferenced historic and recent aerial photographs were reviewed as a basis for identifying trends in channel form and adjustment. Geomorphic form and function of the drainage features in the Study Area are a reflection of historic alterations and maintenance under the *Drainage Act*. Empirical estimates of meander belt widths were employed to account for the history of disturbance and unnatural character of the existing drainage features (municipal drains).

3.7.4 Erosion Threshold Analysis

A representative erosion threshold for the Study Area was determined based on the results of the 2023 field investigation. Erosion thresholds are determined as part of subwatershed studies to provide guidance for stormwater management planning as a target for outlet flows. Ideally, they are determined for reaches located downstream of proposed stormwater management ponds. Due to limited property access in the broader Study Area, one reach in the Subject Lands was selected for erosion threshold analysis. The reach flows permanently and exhibits a well-defined cross-section. An erosion threshold was estimated based on accepted empirical formula from applicable literature, with field observations and measurements as the necessary inputs.



3.8 Floodplain Analysis

The Floodplain Analysis work, in brief, included the following tasks:

- 1 Review of the City's "Wignell Watershed Hydrology and Hydraulics Report", EWA Engineers Inc., August 31, 2021.
- 2 Review of "NIAGARA PENINSULA CONSERVATION AUTHORITY FLOOD PLAIN MAPPING WIGNELL DRAIN CITY OF PORT COLBORNE", NIAGARA PENINSULA CONSERVATION AUTHORITY, August 2011.
- 3 Comparing Province DEM (Lidar derived) to MTE Surveyors Ltd. and adjusting the Province DEM to the MTE topographic data. The adjusted Lidar DEM was used as the base line.
- 4 Requesting and obtaining from City the PCSWMM hydraulic models used by EWA in preparing the Wignell Watershed Hydrology and Hydraulics Report.
- 5 Reviewing the PCSWMM model.
- 6 Creating a 1D/2D model (XPSWMM 2D).
- 7 Comparing existing conditions to that of the Subject Lands.

The following items were evaluated via the XPSWMM 1D/2D model:

- Flood elevations (Regulatory);
- Hydraulic Grade Line (HGL) at the subject areas;
- Bed shear calculations; and,
- Velocity and depth calculations (Hazard).

3.8.1 Hydraulic Analysis

XPSWMM 1D/2D Model

The model that was used for hydraulic analysis was XPSWMM as many items were transferable. The boundary conditions and 1D nodes were copied and pasted from PCSWMM to XPSWMM.

XPSWMM was run with the following scenarios:

- 1 Existing 0 (Base) - The existing scenario was simulated using the hydrology in the "Wignell Watershed Hydrology and Hydraulics Report", EWA Engineers Inc., August 31, 2021. The storms run were SCS 24 hr -100, 50, 25, 10, 5, 2-year events and AES 12 hr – 100-year event. The Lake Erie boundary condition was considered as free flow.
- 2 Subject Lands Developed 1 - The existing scenario was modified to simulate (add) 6 urban areas flowing to 6 SWM ponds (Subject Lands Developed). The storms run was SCS 24 hr -100, 50, 25, 10, 5, 2-year events and AES 12 hr – 100-year event. The Lake Erie boundary condition was considered as free flow.
- 3 Existing 3 Lake boundary modified - The existing scenario was simulated using the hydrology in the "Wignell Watershed Hydrology and Hydraulics Report", EWA Engineers Inc., August 31, 2021. The Lake Erie boundary condition was 100-year Lake level + 10-year surface runoff event.



- 4 Subject Lands Developed 1 Lake boundary modified - The existing scenario was modified to simulate (add) 6 urban areas flowing to 6 SWM ponds (Subject Lands Developed). The Lake Erie boundary condition was 100-year Lake level + 10-year surface runoff event.

Model:

The Hydrodynamic 2D model utilized is XP2D by Innovyze. XPSWMM 1D is similar to and has the modified EPA SWMM 5 engine. SWMM 5 models can be imported and exported into XPSWMM. XP2D is a computer program for simulating depth-averaged, two and one-dimensional free-surface flows such as occurs from floods and tides. XP2D is based on the computational engine TUFLOW which was originally developed for modelling two-dimensional (2D) flows and stands for Two-dimensional Unsteady FLOW. XP2D has been dynamically linked (fully integrated) with the XPSWMM 1D solution engine.

2D: TUFLOW HPC's 2D explicit formulation assures unconditional stability. Thus, a reasonable initial time step is 1 to 5 seconds. The program will use the initial time step and divide it by 10 to start the simulation. From that point on the program will adjust.

1D: Finite difference Runge-Kutta explicit scheme. Scheme solves all terms of the St. Venant equations.

1D and 2D schemes automatically switch between upstream and downstream controlled flow regimes to represent shocks.

Prior to embarking on a 2D model routine it is customary practice to create a well-planned workflow so that major items are not missed. The pillar of this workflow is a well conceived Quality Control Check List (**Table 2**). This is only checked after the modelling takes place to ensure that the report and models are in sync.

Table 2: Control Checklist

Item	Description	Checked
Modeling Log	A modeling log is highly recommended and should be a requirement on all projects. The log may be in Excel, Word, or other suitable software. A review of the modeling log is to be made by an experienced modeler. It should contain sufficient information to record model versions during development and calibration, along with observations from simulations. A model version naming and numbering system needs to be designed prior to the modeling. The version numbering system should be reflected in input data filenames to allow traceability and the ability to reproduce an old simulation if needed.	√
File Naming, Structure and Management	A review of the data file management should check: Files are named using a logical and appropriate system that allows easy interpretation of file purpose and content; A logical and appropriate system of folders is used that manages the files; Relative path names to be used for input files (e.g. ".\model\geometry.tgc") so that models are easily moved from one folder to another. Documentation of the above in, for example, the projects Quality Control Document and/or Modeling Log.	√
2D Cell Size	Check whether the 2D cell size is appropriate to reproduce the topography needed to satisfactorily meet the objectives of the study.	√
Topography	The topography review should focus on:	



Item	Description	Checked
	<p>Correct interrogation of DTM; Correct datum; Modifications to the base data (e.g. breaklines) have been checked. Regarding the latter, this is effectively carried out by producing a _zpt GIS check file using Write Check Files. The _zpt layer contains all modifications including any flow constriction adjustments. A DTM can be created from the Zpts using Global Mapper, or other 3D surface software, to aid in the review. Note: Reviewing the elevations in the .2dm file is not appropriate as only the ZH Zpt is represented in the .2dm file (the ZH elevation is not used in the hydrodynamic calculations).</p>	√
Bed Resistance Values	<p>Bed resistance values are to be reviewed by an experienced modeler. The review should focus on checking at least one of: Roughness Categories in the Global Database; The grid “Mat” or “Manning_n” values in the grd GIS check file; or Specifying weir output using the weir approach. The reviewer should be looking for: Relative consistency between different land-use (material) types; and Values are within accepted calibration values.</p>	√
Calibration / Validation	<p>Check that the model calibration or validation is satisfactory in regard to the study objectives. Identify any limitations or areas of potential uncertainty that should be noted when interpreting the study outcomes.</p>	√
Mass Conservation	<p>Standard practice is to place PO flow lines at a minimum of several locations through the model. They are typically aligned roughly perpendicular to the flow direction. The locations should include lines just inside each of the boundaries. Other suitable locations are upstream and downstream of key structures, through structures and areas of particular interest. The flows are graphed, and conservation of mass checked (i.e., the amount of water entering the model equals the amount leaving allowing for any retention of water in the model). Check that any 1D flow paths crossed by a PO line are also included in the mass check. In dynamic simulations, an exact match between upstream and downstream will not occur due to retention of water; however, examination of the flow lines should reflect this phenomenon. For steady-state simulations, demonstration of reaching steady flow conditions is demonstrated when the flow entering the model equals the flow leaving the model.</p>	√
Free-Over fall & Weir Flow	<p>Especially if Supercritical is set to OFF, the percentage of free-over fall and weir flow velocity points should be checked. The review should seek to check that excessive number of points are not free-overfalling, and if so, that this is in accordance with the expected flow (e.g. weir flow over a levee) – check that the weir option is on if significant weir flow exists; and/or the effect on the overall flow patterns is minimal. The review is best carried out by: Monitoring the numbers after “CS” or “FO” on the screen or in the .tlf file</p>	√



Item	Description	Checked
	<p>Specifying flow regime output to generate the _R.dat file. This file shows the flow regime.</p> <p>The presence of significant areas of supercritical and/or weirs can be acceptable in large areas of sheet flow. However, care should be taken in interpreting the flow behavior in these areas, particularly if the flow is supercritical as complex hydraulic processes (e.g. hydraulic jumps, surcharging against buildings) can occur.</p> <p>Typically, most supercritical and weir flow occurs:</p> <p>Around the edge of a model where it is wetting and drying and has little influence over the general flow behavior; or</p> <p>Down steep slopes or over significant drops (e.g. over a levee).</p>	
Hydraulic Structures	<p>Head losses through a structure need to be validated through:</p> <p>Calibration to recorded information (if available).</p> <p>Crosschecked using desktop calculations based on theory and/or standard publications (eg. Hydraulics of Bridge Waterways).</p> <p>Crosschecked with results using other hydraulic software (e.g. HEC-RAS).</p> <p>Simple checks can be made by calculating the number of dynamic head losses that occur and checking that this is in accordance with that expected. It is important to note that contraction and expansion losses associated with structures are modeled very differently in 1D and 2D schemes. 1D schemes rely on applying form loss coefficients, as they cannot simulate the horizontal or vertical changes in velocity direction and speed. 2D schemes model these horizontal changes and, therefore, do not require the introduction of form losses to the same extent as that required for 1D schemes. However, 2D schemes do not model losses in the vertical or fine-scale horizontal effects (such as around a bridge pier) and, therefore, may require the introduction of additional form losses. See Syme 2001b for further details.</p>	√
Eddy Viscosity	Check that the eddy viscosity formulation and coefficient is appropriate.	√

Graphic 1 and **Graphic 2** contain the existing condition XPSWMM model. The XPSWMM model was built from the Provinces 2018 DEM, which is Lidar derived. The raw data was imported into Global Mapper (Geospatial software) where it was reviewed and edited if necessary. A digital terrain model was created in Global Mapper. Through Global Mapper a grid file (XYZ) file was created and sent to XPSWMM. XPSWMM then creates the DTM. The DTM still satisfies the theory that a good 2D model should contain for each 2D cell at least 2 vertices on average.

Graphic 3 is the post development XPSWMM model showing additional nodes added to the model representing the post development drainage areas shown in **Graphic 4**. **Graphic 5** is a close-up view of the nodes at Pond A and Pond C that have outlets crossing Elizabeth Street and Killaly Street East respectively.

Time Step:

As a rule, the time step is typically half the cell size. For steep models with high Froude numbers and supercritical flow, smaller time steps may be required. For this Study Area, this was not an issue as the Study Area is relatively flat.



If the model is operating at high Courant numbers (>10), sensitivity testing with smaller time steps to demonstrate no measurable change in results should be carried out. The occurrence of high mass errors is also an indicator of using too high a time step. It is recommended that the time step of the 2D engine be equal to or an integer multiple of the time step of the 1D calculations.

Odan Detech have adapted the following time steps to start:

1D model 1.0 sec

2D model 1.0 sec

XP2D is finite volume based, explicit formulation. As mentioned above, the program will use the initial time step and divide it by 10 to start the simulation. From that point on the program will adjust. The above noted criteria are met and there are no stability issues with the model.

Cell Size:

The cell sizes of 2D domains need to be sufficiently small to reproduce the hydraulic behavior. Based on review of benchmark studies, experience, and consultation with Innovyze, the chosen Grid size of 2.5 m is adequate. This provides enough resolution to capture local ditches and space between buildings.

Cell Roughness:

The grid roughness was set to a Manning n of 0.050 for the existing natural areas and residential lawns, as noted in Graphic 1. There are no urban areas where the 2D grid is provided. Therefore, a single manning n is provided. The Subject Lands were modelled as a 1D system (hydrology nodes, to storage node, with control structure) out letting to a node linked to a 2D cell.

Hydrology Parameters:

The existing XPSWMM hydrology model is the same as the PCSWMM model. Refer to **Table 3** for the post developed (Subject Lands Developed) hydrology parameters. The Post Developed model has urban runoff, and the existing tributaries are subdivided.



Table 3: Post Development Hydrology Parameters

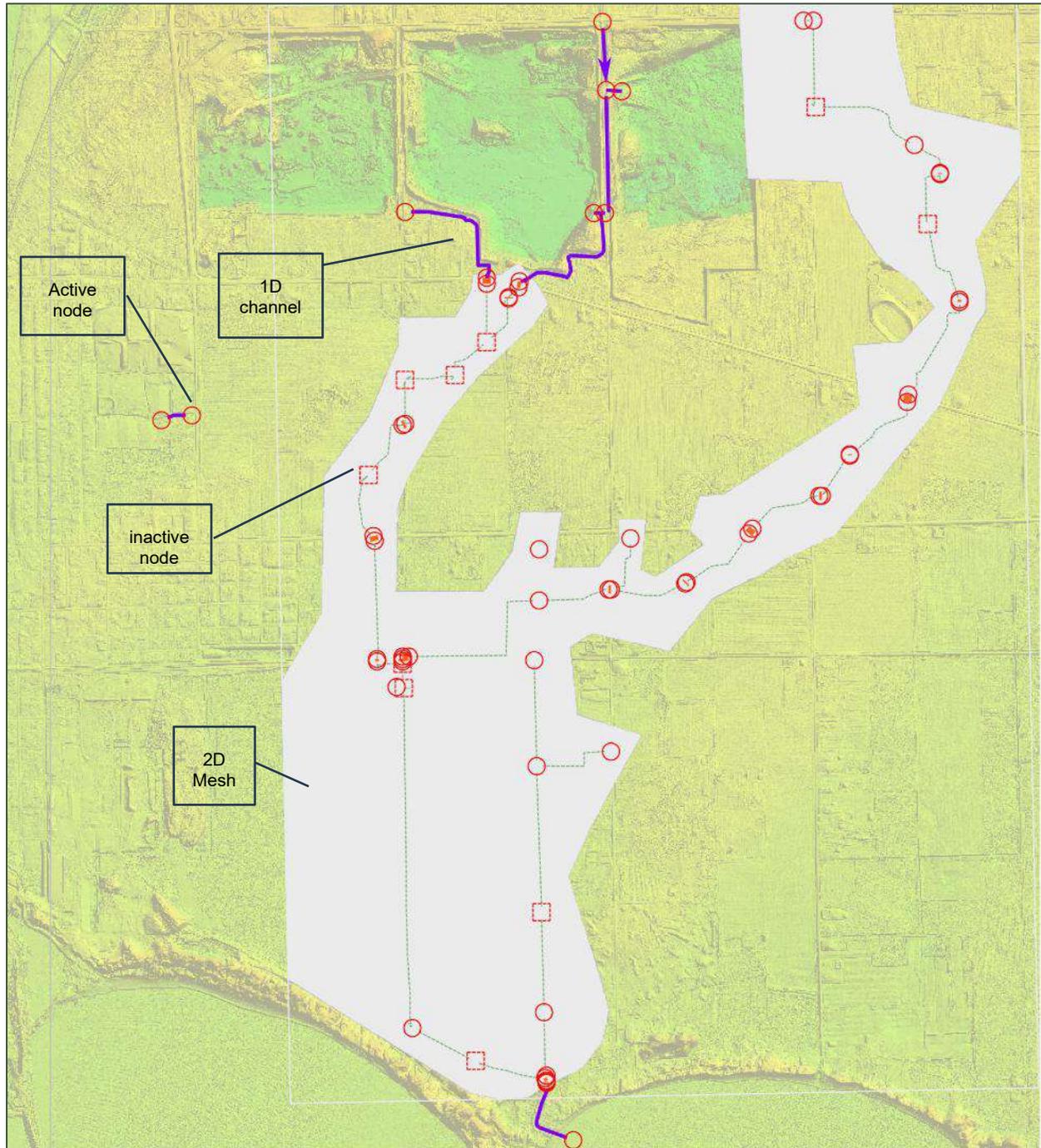
Name	Subcatchment	Impervious Area depression storage (mm)	Pervious Area depression storage (mm)	Area ha	Width m	Slope m/m	Impervious Percentage %	Infiltration Reference	Hydrology Methods
J1	1	10	5	28.746	288.0	0.002	4.5	M1	SWMM
J10	1	10	5	5.441	60.0	0.007	85	PC9_4	SWMM
J12	1	10	5	100.6	680.0	0.01	4.5	W10	SWMM
J15	1	10	5	15.657	137.5	0.001	3	PC7	SWMM
J15	2	10	5	4.66	64.5	0.001	0	PC7	SWMM
J16	1	10	5	7.463	50.0	0.001	1	PC8	SWMM
J17	1	10	5	7.7	153.0	0.004	4.5	PC5	SWMM
J18	1	10	5	1.98	40.0	0.004	55	PC10	SWMM
J19	1	10	5	63.43	906.0	0.001	0	PC4-QE1	SWMM
J2	1	10	5	26.526	420.0	0.004	4.5	M2	SWMM
J20	1	10	5	66.06	660.0	0.001	0	PC3-QW1	SWMM
J21	1	10	5	19.343	198.0	0.005	4.5	PC1	SWMM
J21	2	10	5	36.597	374.0	0.002	4.7	PC2	SWMM
J22	1	10	5	58.295	511.0	0.008	4.5	W1	SWMM
J23	1	10	5	77.959	488.0	0.005	4.5	W2	SWMM
J24	1	10	5	18.36	275.0	0.002	4.5	W12	SWMM
J24	2	10	5	41.66	495.0	0.001	4.5	W7	SWMM
J24	3	10	5	10.022	250.0	0.002	4.5	WB2	SWMM
J25	1	10	5	82.306	986.0	0.001	4.5	W6	SWMM
J26	1	10	5	22.3	354.0	0.002	4.5	W5	SWMM
J27	1	10	5	34.15	491.0	0.003	4.5	W14	SWMM
J28	1	10	5	41.21	330.0	0.002	4.5	W3	SWMM
J29	1	10	5	6.607	185.6	0.003	4.5	W8	SWMM
J29	2	10	5	5.167	260.0	0.004	4.5	WB1	SWMM
J30	1	10	5	12.037	502.0	0.008	4.5	W9	SWMM
J32	1	10	5	8.87	239.0	0.007	4.5	PC9_3	SWMM
J4	1	10	5	18.79	469.8	0.01	4.5	M4	SWMM
J5	1	10	5	16.705	597.0	0.01	4.5	M5	SWMM
J6	1	10	5	8.32	201.0	0.003	5	B1	SWMM
J7	1	10	5	41.95	411.0	0.01	4.5	M3	SWMM
J8	1	10	5	26.23	1380.0	0.03	4.5	W11	SWMM
J88	1	10	5	3.65	36.5	0.004	45	PC11	SWMM
J15.1.1	1	10	5	20.839	279.5	0.002	4.5	PC6	SWMM
Node 56-1	1	2	5	2	86.6	0.02	60	urban	SWMM
J87	1	10	5	28.715	342.0	0.004	4.5	W13	SWMM
Node84	1	2	5	24.426	302.7	0.01	54	urban	SWMM
Node88	1	2	5	50.173	433.8	0.01	43	urban	SWMM
Node92	1	2	5	31.92	346.0	0.01	66	urban	SWMM
Node96	1	2	5	7.866	170.0	0.01	70	urban	SWMM
Node100	1	2	5	33.047	347.3	0.01	62	urban	SWMM
Node108	1	2	5	12.722	218.4	0.01	70	urban	SWMM
Node109	1	10	5	11.537	208.0	0.01	4	PC7	SWMM



Note the two quarry areas (J19 and J20) are included in the above parameters; however, these areas were turned off in the simulation. The CN curve number of 83 was used in the urban infiltration model. The area = 1143.13 is very close to the Wignell Drain area of 1089.58 ha + 51.83 ha (flow area to south Welland, node88) = 1141.41 ha (existing conditions).



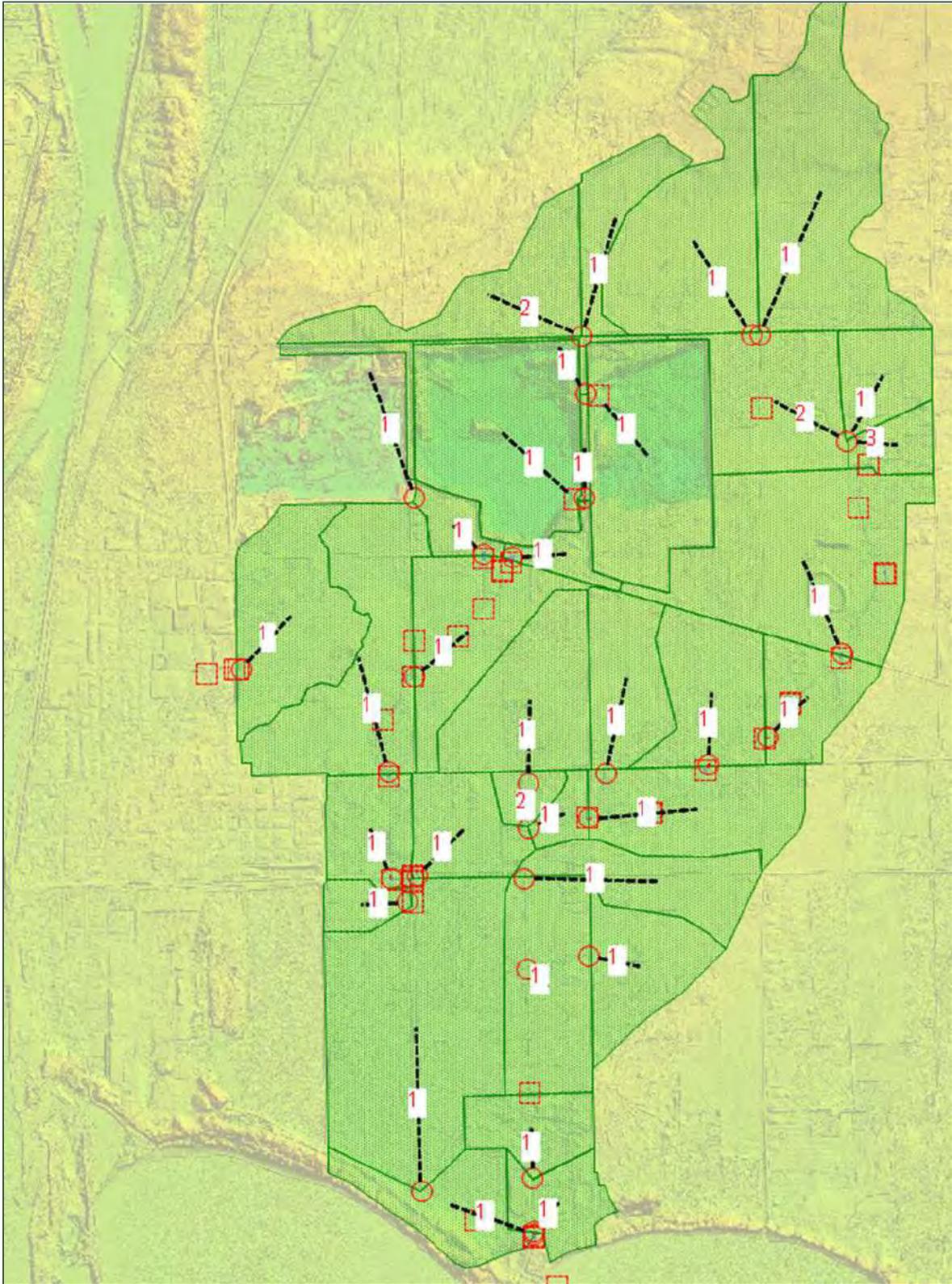
Graphic 1: XPSWMM Global Existing Model



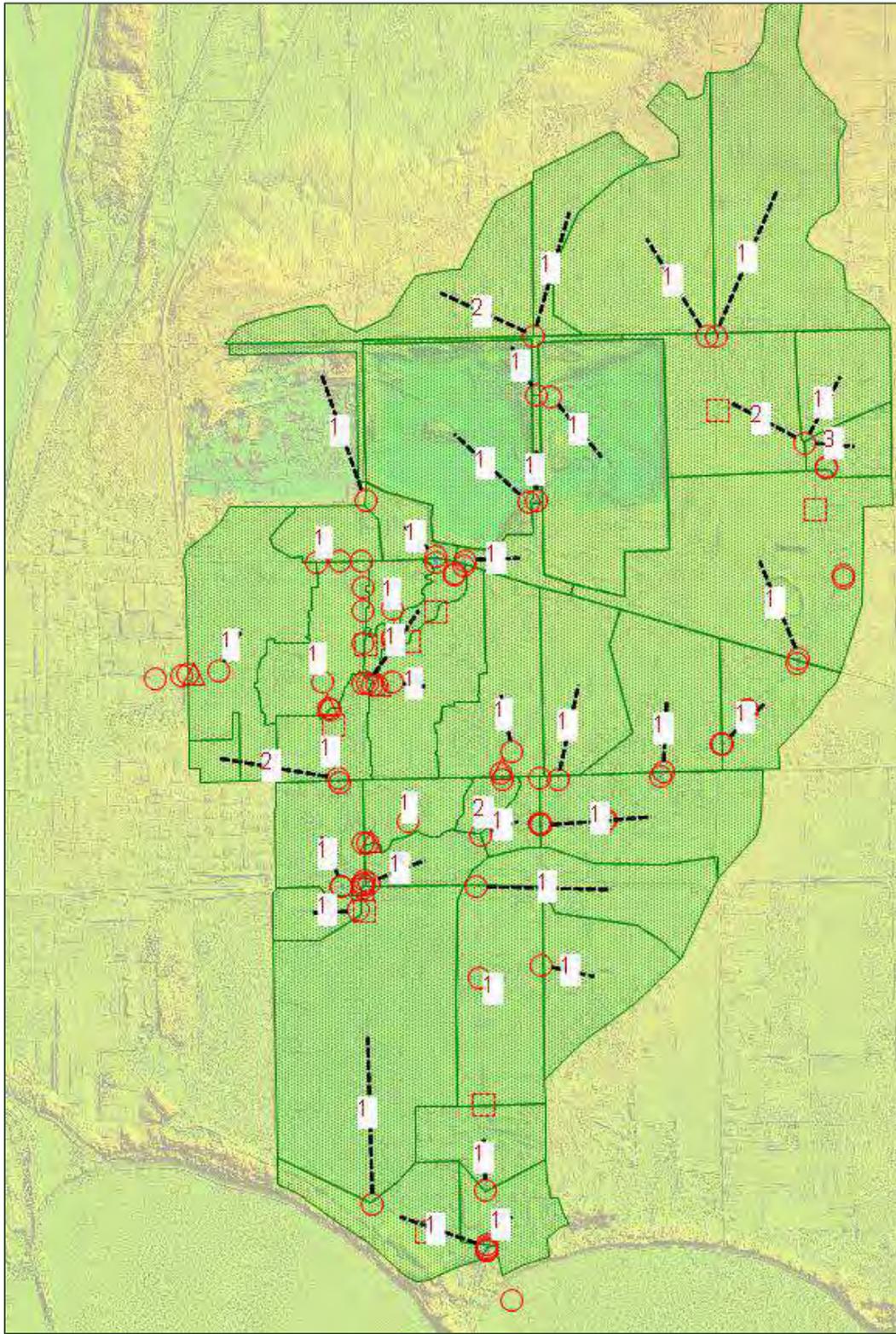
Legend: Δ - storage node, node \circ -node/MH, \blacktriangleright Link (pipe) \blacktriangleright dummy link \square inactive node
 \blacktriangleright Link culvert \blacktriangleright Link open channel $\cdots\blacktriangleright$ Link orifice and or weir
 Grid Manning n = 0.05



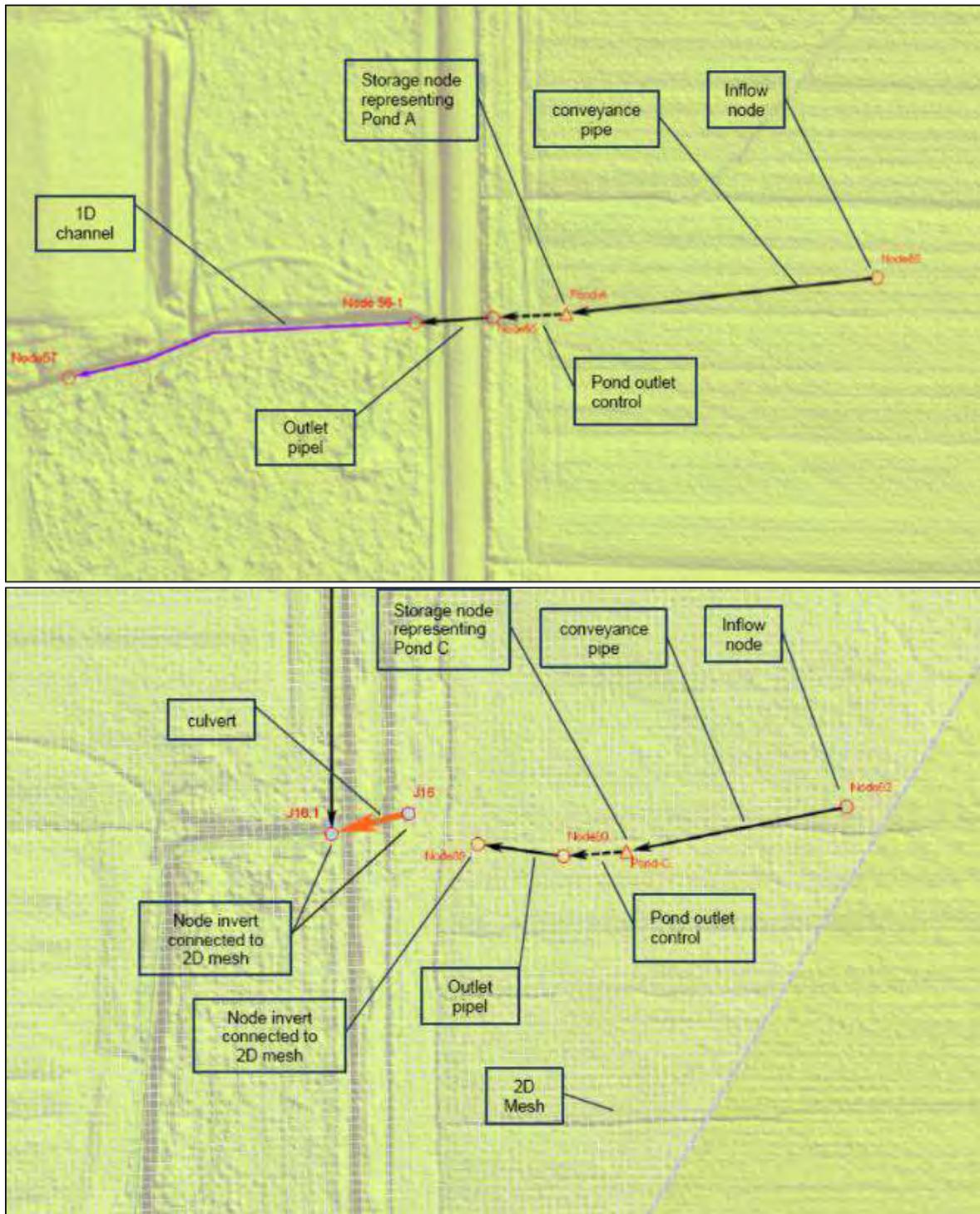
Graphic 2: XPSWMM Existing Model Showing Tributary Areas and Node Links



Graphic 4: XPSWMM Subject Lands Developed Model Showing Tributary Areas and Node Links



Graphic 5: Close Up of Urbanized XPSWMM Subject Lands Developed Model



3.8.2 Discussion of XP2D Model

The following items are (in no particular order):

1. The PCSWMM model by EWA was utilized in the XPSWMM model. The red square nodes shown in Graphic 1 above are nodes from PCSWMM representing the nodes at the end of the links. In XPSWMM Odan Detech replaced the Wignell Drain links with a 2D mesh. Thus, the red squares are the XPSWMM nodes turned off. In addition, the links were turned off. Only select channels and culvert crossings were modelled.
2. The hydrology nodes (where run-off is directed) are linked to 2D mesh if the runoff is in the valley area (Wignell Drain). If connected to pipes, they are not linked to 2D mesh.
3. The pond outlet nodes for ponds B to F are linked to the 2D mesh at the creek outfall. Pond A has no 2D mesh.
4. To accept flow from a 1D domain to a 2D domain or vice versa the nodes must be linked to the 2D mesh.
5. Culvert crossings utilize entrance loss of 0.5 and exist loss of 1.0.
6. Culvert crossing utilize manning n as per the NPCA HEC-RAS model (variable with depth)
7. HGL levels at select locations are retrieved via points 1 to 13. The points are in identical locations in the existing and post models.
8. There are no celerity issues with the model.
9. The continuity error is excellent.
10. There were no error messages from the analysis.
11. The HGL maximum at any given point in the system is the most useful result. The animation of the flow with time, best shows how the upper flows are attenuated through the system and the effect of downstream tail water if it exists.
12. Hydro-dynamic models provide the most accurate, reliable, and defensible representation of flows in the collection system. These account for varying inflows, non-coincident peak flows, in system storage, hydrograph attenuation, and tail and backwater effects. In addition, the integration with a 2D model allows accurate spill over calculations of the Flood plain along with the attenuation effects of the spill.
13. The following are the key items affecting HGL in dynamic models:
 - Pipe and or channel volume,
 - Length of flow, spill, and volume in the spill area,
 - Runoff hydrograph (length in time and volume),
 - Timing of peaks which are controlled by the above.
14. The analysis is based on clean channels. No percentage blocked.

Refer to Section 8.1 for modeling results.



3.9 Hydrogeology

3.9.1 Background Record Review

A detailed background and record review was conducted for the Study Area to delineate the regional physical setting and environmental setting. The understanding of the regional setting assists in the delineation of subwatershed conditions, data interpretation, and impact assessment. The major sources of records reviewed included, but were not limited to the Ontario Geological Survey database (physiography, geology and boreholes), the MECP database (well record, natural heritage, hydrology, source protection and environmental instruments), documents from the NPCA (watershed plan, subwatershed studies, source protection plan, stormwater criteria and etc.), and documents from the City of Port Colborne (official plan, zoning plan, permit application, well head protection policies, sewer use bylaw, etc.).

One previous study report was provided by the client, titled “*Preliminary Hydrogeological and Water Balance Investigation, Killaly Street East, Port Colborne, ON*” (EXP, 2023). The Study Area (i.e., the Subject Lands) is located within the subwatershed between Killaly Street East and the Main Street East. The study was based on:

- Sixteen (16) monitoring wells (MWs) with depths ranging from 3.05 to 6.25 m, including thirteen (13) wells screened in bedrock, one (1) well screened in overburden, and two (2) wells with the screen straddling bedrock and overburden;
- Eight (8) pairs of mini-piezometers (MPs) (one shallow and one deep) with depths ranging from 0.79 to 1.25 m;
- Hydraulic conductivity tests for fifteen (15) monitoring wells and infiltration test for three hand augured shallow holes;
- Three groundwater samples from two monitoring wells. One (1) sample was analyzed for Niagara Sewer-use By-law parameters and routine comprehensive analytical package (RCAP) parameters. A second sample was analyzed for Niagara Sewer-use By-law parameters and a third sample was analyzed for metal parameters.

The following are the major findings of the study:

- Groundwater levels measured ranged from 0.33 to 4.84 meter below ground surface (mbgs);
- The recorded groundwater and surface water levels from the MPs suggested that during the monitoring period from June to August 2021 and from March to November 2023 groundwater recharging conditions existed at MP1, MP6, MP7 and MP8, while water level data for other MPs were erratic;
- Bedrock hydraulic conductivity values (k-values) ranged from 1.0×10^{-8} to 1.6×10^{-5} m/s, while monitoring wells screened across the bedrock and overburden interface had k-values from 4.2×10^{-8} to 3.0×10^{-7} m/s. The overall geometric mean k-value was 7.5×10^{-7} m/s;
- Infiltration tests within four hand-augured, shallow holes resulted in k-values from 7.5×10^{-7} to 1.7×10^{-6} m/s with corresponding infiltrate rates from 5 to 6 mm/hour;
- Groundwater sample analytical results indicated no exceedances to sewer-use bylaw limits, but three exceedances to the Ontario Provincial Water Quality Objectives (PWQO) including sulphide, total cobalt, and dissolved cobalt were documented.



The above factual data and information will be used or referred to for the current study. The borehole and well logs and the groundwater analysis certificates are provided later in this report.

3.9.2 Remote Sensing Interpretation and Terrain Analysis

Available historic aerial images were interpreted to delineate surficial features that may provide insight into groundwater recharge, discharge features, and karst development within the Study Area. Terrain Analysis (Surface Analysis) was conducted by interpreting topographic features using geographic information systems (GIS). As part of terrain analysis, a Lidar Derived Digital Terrain Model from provincial sources was used to create topographic contours for the area within 500 m from the Study Area. The topographic contours data from NPCA were also used. The topographic contours, in addition to the satellite imagery, provided a general view of terrain characteristics and formed the base of the micro-topographic analysis.

Ground-truthing, as part of the remote sensing interpretation, and terrain analysis were conducted during the study and involved walking through key areas to validate results of remote-sensing interpretation and terrain analysis, and to detect surficial and shallow features that may directly and indirectly indicate the existence of recharge and discharge features, as well as karst features under the overburden. The key areas include major watercourses, quarries, culverts, lake beaches, slopes, bedrock outcrops, and bedrock escarpment.

3.9.3 WWIS Well Record Inventory

Ontario Regulation 903, under the Ontario Water Sources Act, has required all well contractors to report drilled and bored well construction operations to the well owner and to the Ontario Government since the late 1940s. Since the late 1980s, all persons constructing dug wells were also required to complete well records. Presently, well records are required to be submitted to the Ministry to document any well construction, alteration, or abandonment of wells in Ontario. Over 790,000 well records have been submitted to the Ministry over the years with approximately 15,000 to 24,000 new well records received each year. The government has well record data from 1899 to present. Due to the long history of records and seamless coverage, the geology, material properties, and groundwater information contained in well records have become a major source of data for regional groundwater conditions.

Well records within 1000 m of the Study Area boundary were queried from the MECP database of the Water Well Information System (WWIS) for the following fields: well ID, completion date, well depth, static groundwater levels, aquifer type (bedrock or overburden well), water use, pumping test result and stratigraphy. The information and data contained in these well records were used to delineate stratigraphy, bedrock topography, and general groundwater conditions within the Study Area. Results of the inventory from the MECP well records and their locations are discussed in Section 7 of this report.

3.9.4 PGMN Well and NPCA Well Inventory

The Provincial Groundwater Monitoring Network (PGMN), initiated in 2001, is a partnership program with all 36 Ontario conservation authorities and 10 municipalities (in areas not covered by a conservation authority) to collect and manage ambient (baseline) groundwater levels and quality information from key aquifers located across Ontario. The PGMN program uses a standardized approach to monitor the 474 wells in the province-wide system. The NPCA has 15 PGMN wells located throughout the NPCA watershed in locally significant hydrogeological areas. The PGMN well closest to the Study Area is W0000289, which is located side-gradient approximately 6 km to the west of the Study Area.



In addition to PGMN wells, NPCA has its own Groundwater Monitoring Network which consists of 31 monitoring wells installed at 23 different locations across the NPCA watershed through a joint project between the NPCA and the Ontario Geological Survey (OGS). Each of the 23 locations has a groundwater monitoring well installed at the top of the bedrock in an aquifer zone commonly known as the Contact-Zone Aquifer. Three (3) of the 23 locations have a set of nested monitoring wells installed at various depths within the overburden sediments. The NPCA wells closest to the Study Area include Buchner Well and Townline Well, which are located up-gradient approximately 5.3 and 6.7 km to the northwest and the north of the Study Area respectively. **Table 4** provides a summary of the PGMN Well and NPCA Well logs. Well logs and well locations are discussed in Section 7 of this report.

Table 4: Summary of the PGMN Well and NPCA Wells

Well ID	W0000289	Buchner	Townline
Depth (m)	4.9	43.0	42.5
Screened Interval (m)	2.0-4.9	40.0-43.0	35.0-39.6 39.6-42.5
Screened Aquifer	Limestone	Limestone	Silt Limestone

3.10 Knowledge Gaps

Given the broad-scale nature of a subwatershed study, and its dependence on private landowner participation, knowledge gaps are expected.

Due to lack of private landowner participation within the subwatershed, fulsome in-situ assessment of the entire Study Area was not possible. Where possible, roadside surveys were completed for non-participating lands. For example, visual assessments were conducted for lands adjacent to Friendship Trail within the Study Area. In cases where lands were entirely inaccessible, a desktop study was conducted through review of aerial imagery, provincial and municipal records, and NPCA ELC mapping. In these instances, existing site conditions could not be confirmed thus, a number of assumptions were made in relation to potential development constraints and opportunities. These assumptions included, but are not limited to:

- Available aerial imagery is both up to date and accurate;
- Available provincial and municipal records are both up to date and representative of site conditions;
- Existing conditions determined through roadside surveys apply to the entire unit; and
- The most conservative constraint is applied to existing natural features unless otherwise stated.

Subwatershed studies offer a foundational but high-level understanding of current environmental conditions. This report has taken a conservative approach with respect to feature significance and development constraints, with few exceptions. In general, site-specific surveys are both recommended and expected for future development applications within the Study Area.



4.0 Ecological Existing Conditions

4.1 Physiography

The Subject Lands and Study Area are located within the Lake Erie – Lake Ontario Ecoregion 7E (Crins, Gray, Uhlig, & Wester, 2009). This region extends from Windsor and Sarnia east to the Niagara Peninsula and Toronto, and contains shorelines of Lakes Huron, Erie, and Ontario. The Study Area lies within the physiographic region of the Haldimand Clay Plain (Chapman & Putnam, 1984), consisting of several physiographic landforms including Beaches, Sand Plains, and Limestone Plains. The underlying bedrock consists of Silurian and Devonian limestone. Unlike the majority of the Study Area, which is underlain by limestone bedrock close to ground surface, along the edge of Lake Erie there is a narrow band of sandy soils created by historical beach material.

4.1.1 Port Colborne Quarry ANSI

In the northwestern portion of the Study Area there is a provincially significant Earth Science ANSI called the Port Colborne Quarry ES ANSI (**Figure 3**). This Earth Science ANSI is wholly within the existing quarry and in an area that still sees activity, based on recent Google Earth imagery. It appears that the ANSI was originally identified in 1980 (Niagara Region, 2020).

4.2 Terrestrial Observations

4.2.1 Vegetation Communities

The vegetation communities of the Wignell Drain Subwatershed Study Area are moderately diverse, with much of the landscape composed of humanly altered lands. **Figure 3** indicates ELC communities within the Study Area. Much of the landscape is flat agricultural lands, often planted with soybeans. A small portion of these lands are old fields or pastures (green cross on **Figure 3**), while the remaining fields are croplands. There are also some residential properties within the Study Area. Agricultural lands and associated hedgerows, houses, gardens, and other anthropogenic lands are not marked on the Existing Environmental Conditions mapping (**Figure 3**). Another large component of the Wignell Drain Subwatershed Study Area are the active quarry lands in the northern portion of the Study Area (Port Colborne Quarries Inc.). This area has been shown on the ELC figure (**Figure 3**), along with an adjacent area that is proposed for quarry development. In addition to this, in the southeast portion of the Study Area, a golf course (Whiskey Run Golf Club) is present, which has also been shown in **Figure 3**.

Vegetation communities within the Subject Lands are shown in more detail because access was available to these lands. The ELC descriptions of these communities are provided in **Appendix C**. Elsewhere ELC communities are high-level as observations and descriptions were made from the roadside and/or through air photography interpretation. Apart from the extensive wetland area in the southwest portion of the Study Area, natural vegetation communities are generally small and isolated.

Two 'Natural Areas' as described in the Natural Areas Inventory (NAI, Vol 1.) (Niagara Peninsula Conservation Authority, 2006-2009) occur in the Wignell Drain Subwatershed Study Area (Study Site PC-04 Nickel Beach Woods and Study Site PC-16 Dann Dunes; **Appendix B**). These areas are not necessarily areas of significance but were inventoried to understand the region better. Unfortunately, the natural areas are relatively large and, while the natural areas are mapped, each individual ELC community was not. Thus, it is generally not possible to determine which listed vegetation communities are located within the SWS Study Area and



which are not. Some information; however, can be gathered from this source including that the Dann Dunes site is in a large part outside of the Wignell Drain Subwatershed Study Area.



ELC Legend

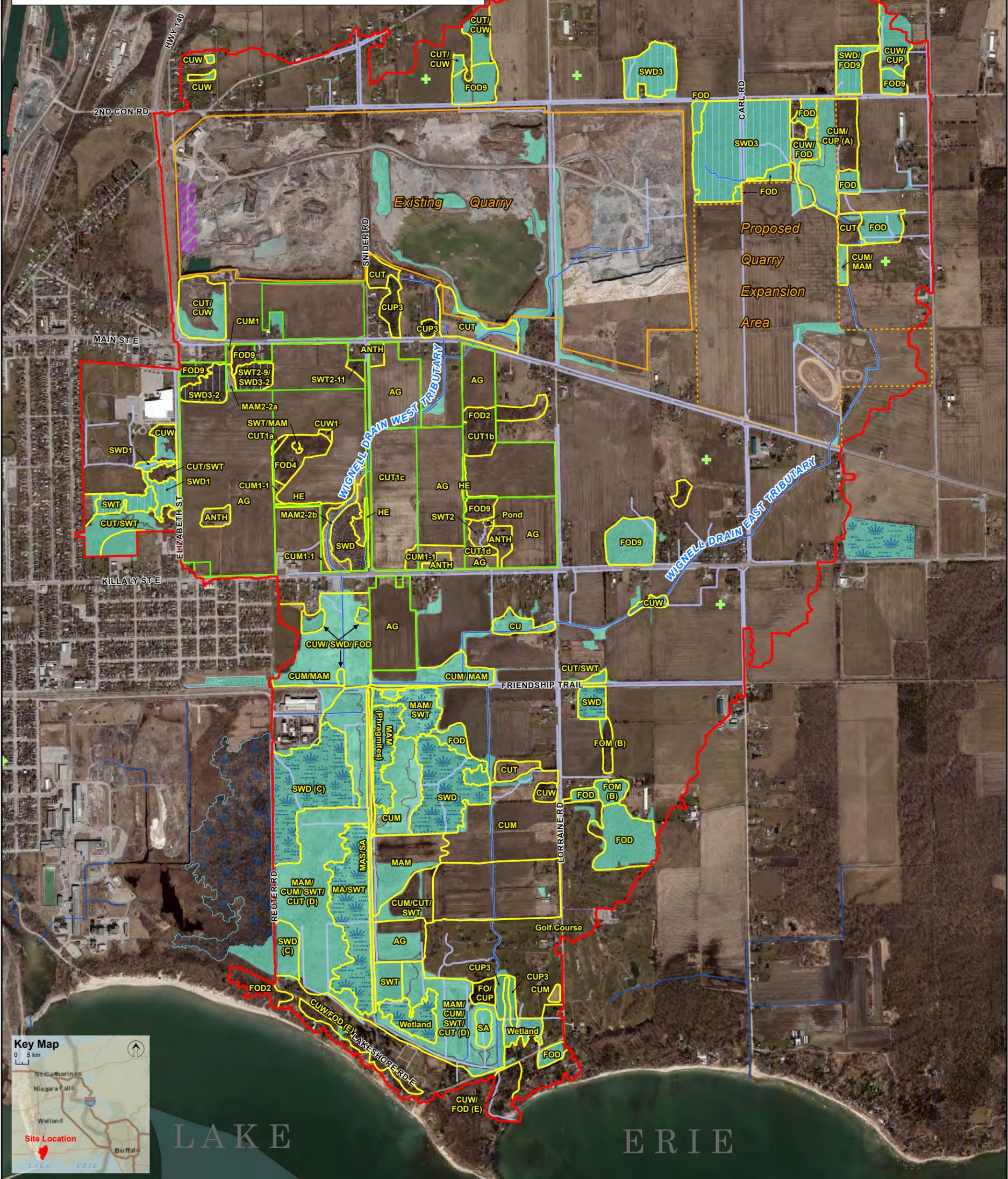
Cultural Communities
 ANTH: Anthropogenic
 AG: Agricultural
 HE: Hedgerow
 CU – Cultural
 CUM1-1: Dry-Moist Old Field Meadow
 CUT1: Mineral Cultural Thicket
 CUW1: Mineral Cultural Woodland
 CUP3 – Pine Plantation

Wetland Communities
 MAM – Meadow Marsh
 MAM2-2: Reed Canary Grass Mineral Meadow Marsh
 SWD: Deciduous Swamp
 SWD3 – Maple Deciduous Swamp
 SWD3-2: Silver Maple Mineral Deciduous Swamp
 SWT2: Mineral Thicket Swamp
 SWT2-9: Gray Dogwood Mineral Thicket Swamp
 SWT2-11: Southern Arrow-wood Mineral Thicket Swamp

Forest Communities
 FOD2: Dry – Fresh Oak – Maple – Hickory Deciduous Forest
 FOD9: Fresh – Moist Oak – Maple – Hickory Deciduous Forest
 FOM – Mixed Forest

1 - Geospatial Ontario (GEO)
 2 - Niagara Peninsula Conservation Authority (NPCA)

Note: Outside of the Subject Lands, all anthropogenic areas (buildings, gardens, hedges), all agricultural fields, and most cultural communities (e.g. thickets, small CUW) not mapped. Yellow ELC polygons are communities as identified by SLR through a variety of means but are overlaid by NPCA wetland mapping. Where NPCA identifies a wetland (with a few exceptions) we have considered it a wetland for the purposes of development constraints.



<p>LEGEND</p> <ul style="list-style-type: none"> + Old Field or Hayfield (as of 2022) ~ Watercourse¹ ~ Flowlines² Wetland¹ Evaluated - Provincially Significant Evaluated - Other Unevaluated NPCA Wetland (November, 2022)² Ecological Land Classification (ELC) ANSI Earth Science (Port Colborne Quarry) Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area <p>Source notes located in upper text box.</p>		<p>0 100 200 300 400 500 METRE SCALE</p> <p>North American Datum 1983 Universal Transverse Mercator Projection Zone 17</p> <p>Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches)</p> <p>Drawn: SM Checked: RC Date: Feb 26, 2026</p> <p>Source Notes: Imagery (2019) provided by ESRI basemapping. Contains information licensed under the Open Government Licence – Ontario.</p>	<p>CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc</p> <p>PROJECT Welland S - Wignell SWS</p> <p>TITLE Existing Environmental Conditions</p> <p>REF. NO. 2007708-3-4</p> <p>Figure 3</p>
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4.2.1.1 Forests and Swamps

Virtually all the forests and treed swamps with the Wignell Drain Subwatershed Study Area are composed of deciduous trees. Forests and swamps are discussed together because the differences between these communities (i.e., a moist treed upland and a treed swamp with short-term spring-time water) are often very subtle, even when access to lands is available and soil samples are taken. Tree species composition is often similar as well. The flat terrain and generally small-grained silty clay soils of the Wignell Drain Subwatershed Study Area play a role in this difficulty of differentiating forests and swamps. Communities that fall into this situation (i.e., may or may not be wetlands) are discussed in Section 5.2. As mentioned in the methodology, the NPCA 2020 ELC mapping, which includes wetlands, was also considered in this assessment specifically for areas which were inaccessible for SLR ecologists (**Figure 3**). Thus, some polygons will appear to be both an upland and a wetland, as it is unknown. It should be noted that on the Client's Subject Lands fewer wetlands were found than are mapped by NPCA. That is, the NPCA mapping is likely overly conservative.

Tree species found in both (moist) forests and (drier) swamps include oaks (Red *Quercus rubra*, White *Q. alba*, Swamp White *Q. bicolor*, Bur *Q. macrocarpa*, and Swamp Pin *Q. palustris*), maples (Silver *Acer saccharinum*, Red *A. rubrum*, and Freeman's *A. freemanii*), Shagbark Hickory (*Carya ovata*), and Eastern White Elm (*Ulmus americana*). Many forests and swamps in the Study Area contain some component of oak, while fewer are maple dominated, with the SWD3 south of Second Concession Road as one example (**Photo 1**).

Photo 1: Maple Swamp (SWD3) south of Second Concession Road (Sept 21, 2022)



One swamp forest (SWD C on **Figure 3, Photo 2**) of the type described above is noteworthy as it appears to be mature based on roadside observations. It includes mature oak and Eastern Cottonwood (*Populus deltoides*). Northern Spicebush (*Lindera benzoin*) is among the species present in the understory.

Photo 2: Mature oak mix deciduous swamp (SWD C) east of Reuter Road (Oct. 22, 2022)



4.2.1.2 Other Forests

This section describes some woodland types which are not prevalent and thus potentially more unusual within the Study Area.

There is only one mixed deciduous – coniferous forest in the Wignell Drain Subwatershed Study Area, excluding small areas of conifer plantation. The Mixed Forest (FOM B; **Figure 3**) is east of Lorraine Road. The conifers are pines, but due to lack of access it was not possible to determine if these are naturally occurring or planted pines.

One of the more unusual communities is the forest situated on the historical sand dune along the south edge of the Wignell Drain Subwatershed Study Area and backing onto Lake Erie (CUW/FOD E; **Figure 3**). The south side of the sand dunes is technically outside of the Study Area and is very disturbed by homes and gardens. The north side is disturbed with driveways but remains more naturalized. Unlike most of the Wignell Drain Subwatershed Study Area, sloped terrain and a different substrate (sand) are present. Thus, this community may contain native species that differ from other communities within the subwatershed. Unfortunately, invasives species are also present within this community (including Japanese Knotweed (*Fallopia japonica*) and English Ivy (*Hedera helix*)).

The Dry–Fresh Oak–Maple–Hickory Deciduous Forest (FOD2; **Figure 3**) on the mainly north-facing slope in the southwestern corner of the Study Area is less disturbed and contains Sugar Maple and Red Oak, as well as some American Beech (*Fagus grandifolia*) and Eastern Hemlock (*Tsuga canadensis*). This is the only known community of this kind in the Wignell Drain



Subwatershed Study Area. A larger portion of this community continues westward offsite. The Natural Area PC-04 Nickel Beach Woods has records that indicates that the dune-associated forests and other communities are noteworthy and are part of ‘*the third largest extant of dune ecosystem in the entire NPCA watershed jurisdiction*’.

The PC-16 Dann Dunes NAI description indicates that there is some old growth in PC-16; however, based on an examination of Google Earth aerial photography it appears that these old growth areas are outside of the Wignell Drain Subwatershed Study Area, likely in sub-area PC-16-07 and not within the onsite portion of PC-16-07. PC-16 reporting also describes the sand-dune forest habitats as being of interest, but within PC-16 these are outside the Wignell Drain Subwatershed Study Area.

There is a Dry-Fresh Forest (FOD4 = B2; **Figure 3**) west of Snider Road and south of Main Street East that contains numerous Black Walnuts (*Juglans nigra*) that are thought to have spread from former plantings, as well as Bitternut Hickory (*Carya cordiformis*) and other tree species. This community contains both native species (such as Bladdernut (*Staphylea trifolia*)), as well as evidence of past habitation (Common Privet (*Ligustrum vulgare*), dug wells, etc.).

4.2.1.3 Swamp Thickets and Marshes

Marshes and swamp thickets are numerous in the Study Area south of Killaly Street East (**Figure 3**). Many of the vegetation communities south of the Friendship Trail, on both sides of the Snider Road allowance that are not mapped already as PSW, are believed to either be wetland, possible wetland, or transition communities. Communities that may or may not be wetlands are discussed in Section 5.2 (e.g., Potential Wetland -CUM/CUT/SWT ELC community).

Four types of wetland designations (1. Evaluated Wetland - PSW, 2. Evaluated Wetland - not PSW, 3. Unevaluated – SLR Identified Wetland, and 4. Potential Wetland) are discussed and mapped in Section 5.2 of this report.

Community MAM/CUM/SWT/SWT (D, **Figure 3**) is a large unit that is likely a wetland or a transition community between wetland and upland. Based on aerial photography and access along the Snider Road allowance, it is thought to primarily be a marsh, perhaps in part dominated by the invasive Common Reed – *Phragmites australis* (**Photo 3**), with scattered trees and shrubs. Aerial photography of the area shows the vegetation structure of the known and probable wetlands. The uniform blue-green areas on **Photos 4 and 5** (2018 Google Earth) are thought to be *Phragmites* dominated.



Photo 3: Phragmites dominated marsh along Snider Road allowance (Sept 21, 2022).



Photos 4 and 5: Left: Snider Road allowance south of Friendship Trail. Right: Snider Road allowance north of Lakeshore Road East (i.e. south of previous photo). The area in both photos is primarily wetlands, with blue-green uniform vegetation thought to be *Phragmites australis* and open water shown as light green.



The straightened Wignell Drain situated on the west side of the Snider Road allowance, south of the Friendship Trail, is one of the few open wetlands within the Wignell Drain Subwatershed Study Area. It is shown on **Photo 5** above as a light green colour, in **Photo 6** below, and as a Marsh/Shallow Aquatic (MA/SA) community on **Figure 3**. Herbaceous vegetation associated with this wetland includes Flowering Rush (*Butomus umbellatus* - a non-native invasive), *Phragmites australis*, cattail species (*Typha* sp.), and Duckweed species (*Lemna* sp).

Photo 6: Open wetland (MAS/SA) strip west of Snider Road allowance (Sept 21, 2022).



Very small areas of meadow marsh and swamp thicket may be present north of Killaly Street East in the Study Area outside of the Subject Lands. These small areas are unmapped partly due to lack of access, but also because small vegetation communities would be expected to be mapped at an EIS-level of study and not at the subwatershed level of study.

4.2.1.4 Cultural Communities

Most Cultural Thicket (CUT) and Cultural Meadow (CUM1 or old field) communities within the Wignell Drain Subwatershed Study Area are not mapped; however, these habitats are thought to cover only a small portion of the Study Area. Most of the old fields or hayfields observed are



marked on **Figure 3** with a green plus sign. There are also a few small areas of planted pines. There appears to be only one large area of planted trees: Unit CUM/CUP (**Figure 3**), situated south of Second Concession Road. This community is comprised of meadow with young, planted pine and deciduous trees, in addition to naturally regenerating poplar.

4.2.1.5 Unusual or Atypical Vegetation Communities

Vegetation communities of interest have been described above under the Forest/Swamps (Section 4.2.1.1); however, one additional atypical vegetation community is the Southern Arrowwood Mineral Thicket Swamp (SWT2-11) community situated southwest of Main Street East and Snider Road (**Figure 3**). The small swamp thicket community was dominated by Southern Arrowwood (*Viburnum recognitum*) with abundant Red-osier Dogwood and occasional European Buckhorn, Silver Maple, and Green Ash saplings. The soils in this thicket swamp were assessed to be 6 (very moist) following the methods described in Section 3.4.1. This vegetation community is considered Significant Wildlife Habitat (under the Other Rare Vegetation Community category) and is further discussed in Section 5.4.

4.2.2 Flora

A total of 129 species were recorded based on surveys within the Subject Lands and the greater Study Area. Of the identified species, about 35 (27%) are non-native, which is consistent to the percentage of non-native found in Ontario (approximately 25%) (Oldham, Bakowsky, & Sutherland, 1995). A total of 67 (52%) of species were identified as native species. At the Study Area level, a high percentage of non-native species is indicative of higher levels of disturbance. Non-native species were recorded from all vegetation community types with the highest number found in Dry-Moist Old Field Meadow (CUM1-1) and areas surrounding active agricultural lands. Highly invasive species are present in the Study Area; with perhaps the most widespread and abundant being Common Reed. A compiled plant list for the Study Area is provided in **Appendix D**. No provincially or regionally rare species were identified within the Study Area (Oldham M., 2010; Oldham & Brinker, 2009).

Additional vascular plant species were recorded within the Study Area via iNaturalist and are included in **Appendix E**.

4.2.3 Breeding Birds

A total of 66 breeding bird species were observed (**Appendix F**) within the Wignell Drain Subwatershed Study Area. Of these bird species, seven were not confirmed to be breeding in the subwatershed (shown as F in **Appendix F**).

Of these seven species, Canada Goose (*Branta canadensis*), Chimney Swift (*Chaetura pelagica*), and Turkey Vulture (*Cathartes aura*) may have been breeding, although no definitive nesting was observed. It is thought that another two of the species (Belted Kingfisher (*Ceryle alcyon*) and Rough-winged Swallow (*Stelgidopteryx serripennis*)) were likely not nesting, due to lack of observed nesting habitat within the Wignell Drain Subwatershed Study Area. It is possible; however, that both these species nest nearby and forage within the subwatershed. In the case of Great Blue Heron (*Ardea herodias*), no colonies are thought to be present in the subwatershed. Lastly, a single male Green-winged Teal (*Anas crecca*) observed may or may not have been a nesting species.

Regardless of the lack of access to many privately-owned properties, the results of the bird surveys are thought to give a reasonably accurate representation of the breeding birds within the subwatershed. Although a few forest birds, raptors, and interior wetland species were likely



missed, it is thought that a large percentage of the breeding birds found in the Wignell Drain Subwatershed Study Area were observed.

Many of the bird species observed were disturbance-tolerant species that are frequently found in rural areas (hedgerows, edges, gardens, fields, etc.) and are common and widespread in southern Ontario. The four most abundant species that were notably more abundant in the subwatershed than other species were Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), Yellow Warbler (*Setophaga petechia*), and American Robin (*Turdus americanus*). These species are all very common species across south and central Ontario. Also observed frequently were European Starling (*Sturnus vulgaris*), Willow Flycatcher (*Empidonax traillii*), Gray Catbird (*Dumetella carolinensis*), Common Grackle (*Quiscalus quiscula*), Brown-headed Cowbird (*Molothrus ater*), and American Goldfinch (*Carduelis tristis*). Again, these species are either 'edge' species and/or shrubland birds, common in southern Ontario. The only similarly abundant species that was not either an edge or shrub species was Common Yellowthroat (*Geothlypis trichas*), a marshland bird that was primarily observed in the southern Nickel Beach PSW and associated wetlands units.

Despite the extensive wetlands in the southern portion of the Wignell Drain Subwatershed Study Area (south of Friendship Trail), the wetland bird diversity appeared to be low. Wetland species observed included small numbers of a few waterfowl, a few herons, Tree Swallow (*Tachycineta bicolor*), Willow Flycatcher, Yellow Warbler, Red-winged Blackbird, Marsh Wren (*Cistothorus palustris* - one individual), Common Yellowthroat, and Swamp Sparrow (*Melospiza georgiana*). It is thought that although a few species were likely missed due to lack of access, that this is reflective and representative of a low diversity of wetland birds within the subwatershed. The relatively small amount of both open water (primarily along Wignell Drain itself) and cattail marshlands, as well as a high percentage of Common Reed are thought to be part of the reason for this. Un-recorded birds are expected to be common shrubland species and species of small woodlands.

Relatively few forest birds were recorded given the size of the Wignell Drain Subwatershed Study Area. This is not surprising as most woodlands within the subwatershed are small and isolated. Even typically common woodland species such as Black-capped Chickadee and Red-eyed Vireo were observed in very low numbers. In addition, few area-sensitive species, which are species that either require larger patches of habitat (whether grassland or forest) in which to breed or are generally more productive in larger patches of habitat, for the reason given above, were documented within the subwatershed (see **Appendix F** for species).

Savannah Sparrow (*Passerculus sandwichensis*) and Bobolink (*Dolichonyx oryzivorus*) were the two area-sensitive grassland/open-land species observed within the Study Area. Despite being area-sensitive, Savannah Sparrow is a very common species in southern Ontario in both active and abandoned agricultural fields. Bobolink is discussed further in the SAR section (Section 5.3) below.

Four SAR and two regionally rare species were recorded during SLR's surveys. These are discussed in Sections 4.2.3.1 and 4.2.3.2 below.

All SAR, area-sensitive, and regionally rare species are mapped on **Figure 4**, except area-sensitive Savannah Sparrow which is not mapped due to its abundance, as noted above. It should also be noted that Marsh Wren, which is not considered a SAR, area-sensitive species, nor a regionally rare species is mapped on **Figure 4**. Based on professional experience this is a somewhat localized species that tends to breed in higher quality, larger wetlands. Only one Marsh Wren was recorded in the subwatershed. Typically, Marsh Wrens are observed in 'colonies'. As such, SLR thought this species was worth noting.



4.2.3.1 Avian Species at Risk

Three breeding SAR birds were observed on the Subject Lands (**Figure 4**). These were the Eastern Wood-Pewee (*Contopus virens*), the Barn Swallow (*Hirundo rustica*), and the Bobolink. A fourth SAR, Chimney Swift, was observed aerial foraging; however, no nesting was observed.

Several Eastern Wood-pewee territories were recorded. This species is designated as Special Concern due to declining populations. Despite this, it is still one of the most common bird species in mid-aged to mature deciduous and mixed woodlands (of many types and sizes), and thus the observations of this species within the subwatershed are not surprising.

Barn Swallow, another Special Concern species, was also observed in a few locations within the Wignell Drain Subwatershed Study Area. This species has recently been downgraded from Threatened to Special Concern and is often found in rural landscapes, usually nesting on or in buildings and foraging over wetlands, meadows, and fields. Locations where observations were made within the subwatershed, and where suitable nesting habitat was also present, are shown on **Figure 4**. A few other locations where foraging individuals were observed, but where no nearby nesting habitat was present, were not mapped.

Two locations of Bobolink, a Threatened Species under the *ESA* (2007), in suitable nesting habitat were documented. Additionally, there were a few other fields, primarily north of 2nd Concession Road, that provided potential nesting habitat. This species is still moderately common across southern Ontario in large, old fields / hayfields.

4.2.3.2 Regionally Rare Species

Regionally rare species are based on the NPCA's Natural Areas Inventory 2006-2009 (**Appendix B**) and are ranked as Rare, Occasional or Extremely Rare. There are only two species in this category which were recorded within the Wignell Drain Subwatershed Study Area during SLR's breeding bird surveys: the Green-winged Teal and the Tufted Titmouse.

The documented Green-winged Teal, a small species of waterfowl, may not have been a breeding individual. The Ontario Breeding Bird Atlas (2007) states that '*the presence of a lone drake in suitable habitat in late June or July does not necessarily constitute evidence of local breeding*'. This species was observed feeding in the wetland channel of Wignell Drain in the southern third of the subwatershed, along the Snider Road allowance.

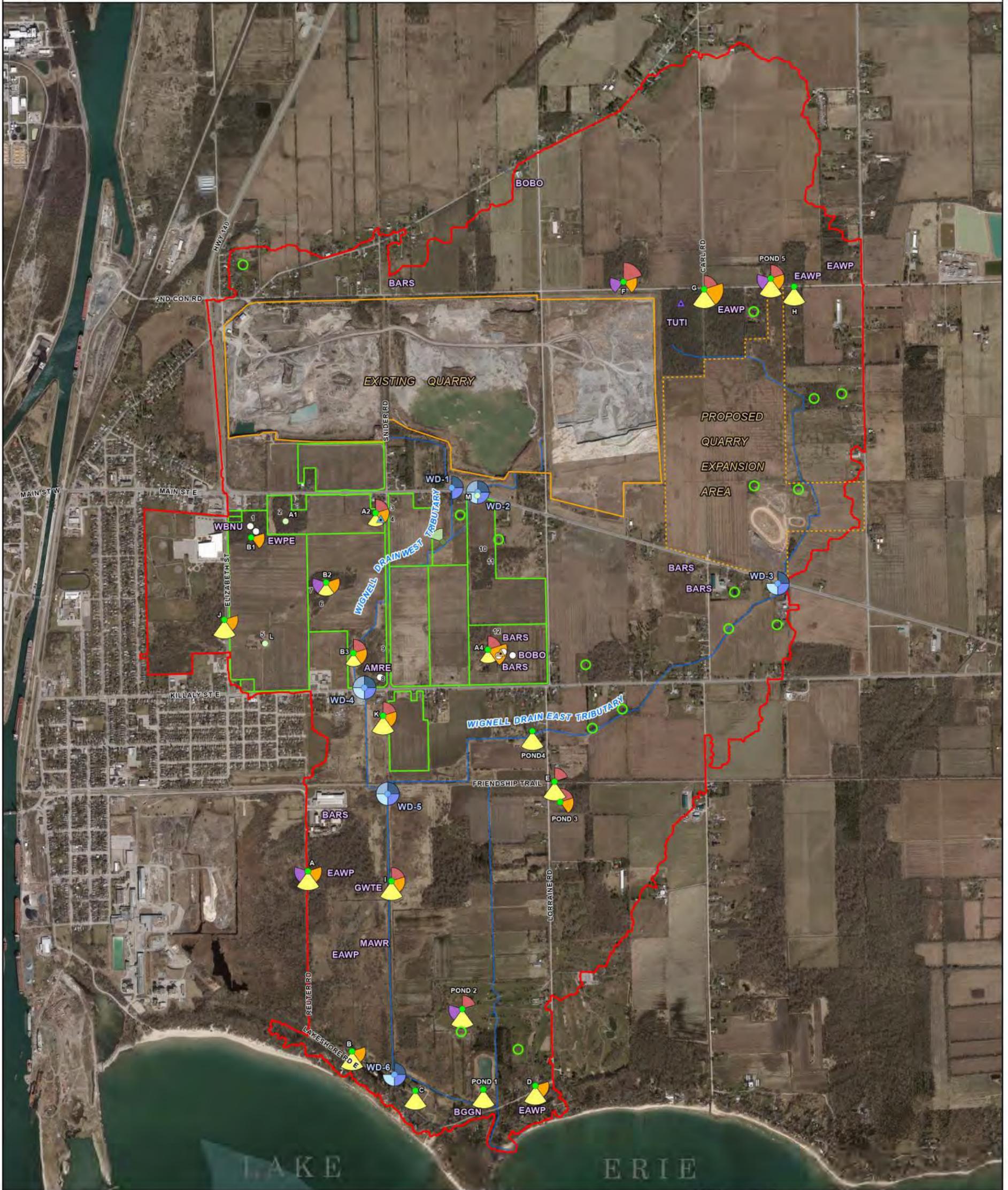
The Tufted Titmouse, on the other hand, is a southern songbird of deciduous woodlands which only occurs in Ontario in some parts of the Carolinian Forest Zone (Ecoregion 7E). One of its strongholds in Ontario is the Niagara Region.

Additionally, 23 species listed as regionally uncommon were observed (**Appendix F**). The definition of Uncommon is '*observed annually on many days at a few locations in small numbers*'.

4.2.4 Non-Breeding Birds

Data from eBird indicated that there was information from the very southeast corner of the Study Area at the south end of Lorraine Road at Lake Erie. This was the only location within the Study Area with data on the eBird database. Fifty-eight species of birds have been recorded at that location between 1987 and 2022 (**Appendix E**). These include primarily non-breeding birds, such as waterfowl observed on the lake or migrating species which were likely either using the woodlands at the edge of the lake or passing along the shoreline.





<p>Breeding Bird Key:</p> <p>Species At Risk BARS: Barn Swallow BOBO: Bobolink EAWP: Eastern Wood-Pewee</p> <p>Regional Interest Species GWTE: Green-winged Teal MAWR: Marsh Wren TUTI: Tufted Titmouse</p>	<p>Forest Area-Sensitive Species AMRE: American Redstart BGGN: Blue-gray Gnatcatcher WBNU: White-breasted Nuthatch</p>	<p>Key Map</p>	<p>0 100 200 300 400 500 METRE SCALE</p> <p>North American Datum 1983 Universal Transverse Mercator Projection Zone 17</p> <p>Scale: 1:20,000 Page Size: Tabloid (11 x 17 inches)</p> <p>Drawn: SM Checked: KT Date: Feb 26, 2026</p> <p>Source Notes: Imagery (2015) provided by South Western Orthophotography Project (SWOOP). Contains information licensed under the Open Government Licence - Ontario.</p>	<p>CLIENT: Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc.</p> <p>PROJECT: Welland S - Wignell SWS</p> <p>TITLE: Select Wildlife Observations</p> <p>REF. NO.: 2007708-4-3</p> <p style="text-align: right; font-weight: bold;">Figure 4</p>
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4.2.5 Breeding Amphibians

Five amphibian species were heard at the time of SLR's 2022 calling surveys or incidentally: Spring Peeper (*Pseudacris crucifer*), Western Chorus Frog (*Pseudacris triseriata*), American Toad (*Anaxyrus americanus*), Northern Leopard Frog (*Lithobates pipiens*), and Green Frog (*Lithobates clamitans*). The latter two species were observed within the Subject Lands and are also expected to be present along the straightened southward portion of Wignell Drain.

Calling survey results are summarized in **Appendix G**. Additionally, some amphibian calls were heard during daytime surveys conducted by SLR. On March 18, 2022, SLR ecologists heard the calls of Northern Leopard Frogs (code: 2-2) and Western Chorus Frogs (code: 2-10) in wetland B2, and on the same date a chorus of Western Chorus Frogs in the A4 pond (**Figure 4**). SLR ecologists incidentally heard Green Frogs (Code: 1-4) calling on May 31, 2022, and observed three Green Frog individuals, and egg masses, on June 22, 2022 within a small pond along the Wignell Drain within the Subject Lands (**Figure 4**).

Thus, calling amphibians were recorded in 22 locations (**Figure 4**). Generally, Spring Peepers were heard in choruses throughout the subwatershed area, whereas the remaining frog species were heard in smaller numbers. Higher concentrations of both frog species and numbers were recorded in larger, naturalized areas such as SWD3 (south of 2nd Concession Rd), Nickel Beach Marsh Wetland PSW, Pond 2, and Pond 5 (**Figure 4**).

4.2.6 Salamander Habitat Assessment

No salamanders (eggs or individuals) were noted within the Subject Lands during the 2022 field investigations. Additionally, no vernal pools were observed in any part of the Subject Lands on any occasion. Furthermore, no salamanders have been observed by SLR to date within the Study Area.

4.2.7 Turtle Habitat Assessment

Only one observation of turtles was made during all of the site visits to the Subject Lands, or the remaining Study Area. Two Painted Turtles (*Chrysemys picta*) were observed in the Wignell Drain on June 9, 2023, just above the water control structure on Lakeshore Road East.

No high-quality turtle habitat was observed. That is, no sufficiently deep, open, standing water has been documented. The exceptions to this could be the Wignell Drain itself, which provides a small potential to be a movement corridor, and the pond in the A4 wetland (**Figure 2**). The latter; however, is very small and is a relatively isolated feature. Regarding nesting, turtles generally choose areas with loose substrates that are relatively close to suitable living habitat. The soils of the Subject Lands are mostly heavy clay-based soils and are therefore not considered loose. As such, no potential nesting habitat was noted within the subwatershed either.

At least one observation of Snapping Turtle (*Chelydra serpentina*) within the Study Area was recorded via iNaturalist (**Appendix E**).

4.2.8 Snakes

No evidence of snake activity was observed at any of the 12 snake board survey locations across the Subject Lands during the 2022 field investigations. Additionally, no snakes have been observed by SLR to date within the Study Area. At least one observation of DeKay's Brownsnake (*Storeria dekayi*) was recorded via iNaturalist (**Appendix E**).



4.2.9 Roadside Mortality Observations

Minimal roadside mortality observations were made by SLR staff during field investigations. One deceased raccoon (*Procyon lotor*) was observed along the south side of Lakeshore Road East at the water control structure.

4.2.10 Incidental Observations

The following incidental wildlife were identified in the Study Area through SLR's background review (iNaturalist, **Appendix E**) or during SLR's 2021, 2022, and 2023 field investigations (excluding amphibians and birds identified during breeding surveys):

Herptiles

- Painted Turtle – two individuals were observed on June 9, 2023, above the water control structure on Lakeshore Road East
- Snapping Turtle – iNaturalist
- Dekay's Brownsnake - iNaturalist

Mammals

- White-tailed Deer (*Odocoileus virginianus*) – tracks and adults observed (along Reuter Road)
- Red Squirrel (*Sciurus vulgaris*) – individuals heard calling
- Coyote (*Canis latrans*) – several individuals heard calling
- Eastern Grey Squirrel (*Sciurus carolinensis*) – black and grey individuals observed
- Northern Short-tailed Shrew (*Blarina brevicauda*) – nest observed under Snake Board #4
- Weasel (*Mustela* sp.) – along Friendship Trail on June 9, 2023
- Muskrat (*Ondatra zibethicus*) – in Wignell Drain, below Friendship Trail, on June 9, 2023
- Eastern Cottontail (*Sylvilagus floridanus*) – observed along Reuter Road
- Groundhog (*Marmota monax*) – iNaturalist

Insects

- Spicebush Swallowtail (*Papilio Troilus*) – Larvae on Spicebush in A4 wetland (northwest of Killaly Street East and Lorraine Road) on September 14, 2022
- Io Moth (*Automeris io*) - iNaturalist
- Cecropia Moth (*Hyalophora cecropia*) - iNaturalist
- Polyphemus Moth (*Antheraea polyphemus*) - iNaturalist
- Monarch (*Danaus plexippus*) - iNaturalist
- Banded Tussock Moth (*Halysidota tessellaris*) - iNaturalist
- Lesser Maple Spanworm Moth (*Macaria pustularia*) - iNaturalist
- Spongey Moth (*Lymantria dispar*) - iNaturalist



- Seven-spotted Lady Beetle (*Coccinella septempunctata*) - iNaturalist
- Black Firefly (*Lucidota atra*) - iNaturalist
- Small Engrailed (*Ectropis crepuscularia*) - iNaturalist
- Common Eastern Bumble Bee (*Bombus impatiens*) - iNaturalist
- Snowberry Clearwing (*Hemaris diffinis*) - iNaturalist
- Two-striped Grasshopper (*Melanoplus bivittatus*) - iNaturalist
- Question Mark (*Polygonia interrogationis*) - iNaturalist
- White-marked Tussock Moth (*Orgyia leucostigma*) - iNaturalist
- Red Admiral (*Vanessa atalanta*) - iNaturalist
- Hickory Tussock Moth (*Lophocampa caryae*) - iNaturalist
- Acadian Hairstreak (*Satyrium acadica*) - iNaturalist

4.3 Aquatic Observations

In general, all aquatic surveys (detailed in the following 4.3 subsections) were carried out at the six (6) sampling stations outlined on **Figure 2**. These sampling stations are detailed in Section 4.3.1 below. The positioning of the six stations provided a fulsome spatial review of the general aquatic habitat and water quality characteristics across the Wignell Drain Subwatershed Study Area and were either accessible by road rights-of-way or private access was granted (WD-6). Aquatic habitat quality is demonstrated in **Figure 5**. It should be noted that additional watercourses regulated by the NPCA may be present within the Study Area that were not captured during in-field assessments (**Figure 3**). This is especially be the case for private, non-participating lands in which site access was not granted.

4.3.1 Aquatic Habitat Survey

WD-1

The WD-1 station is located along the Main Street East corridor, approximately 340 m east of Snider Road. The station area is heavily influenced from historical road construction and drainage activities. From aerial image interpretation, the station area drains a landscape to the north, which is heavily altered from ongoing aggregate quarry activities. It is unknown to what degree the historical upstream drainage catchment was changed due to the construction of the upstream quarry pits. The WD-1 station comprises a portion of the western upstream branch of the Wignell Drain West Tributary (**Figure 2**).

Within the Study Area, the WD-1 channel enters the road right-of-way through dense vegetation (mostly *Phragmites* with interspersed cattails) before entering an existing corrugated steel pipe (CSP) culvert. Downstream of the Main Street East roadway, flow exits the culvert into dense vegetation and is then focused into a channel next to a private property. This portion of the channel appears to have localized bank hardening along the right bank. Riparian habitat is altered upstream and downstream of the culvert, with mowed ditch lines and manicured lawn that contain the occasional mature tree. The substrate within the road right-of way is mainly silts with occasional pea gravel and other introduced road materials. On both sides of the road the channel area includes graded road embankments meant to gather stormwater. Refuse and general debris were noted along the roadway. During most site visits this channel area was observed to be dry, with standing water present in the CSP culvert beneath the roadway.



Overall, the presence of dense vegetation and lack of sustained flow likely precludes this reach of Wignell Drain as being considered fish habitat.

WD-2

The WD-2 station is located approximately 115 m to the east of WD-1, along the Main Street East road corridor. Like the WD-1 station, the WD-2 station represents an upstream extent of the Wignell Drain West Tributary, being the eastern upstream branch (**Figure 2**). Like the WD-1 channel, the WD-2 channel drains an upstream landscape that is heavily altered by ongoing aggregate quarry activities. Following further review of aerial imagery, the WD-2 channel appears to be channelized upstream of the Main Street East roadway.

Within the road right-of-way, the WD-2 channel is primarily rock-lined with the presence of angular stone (i.e., rip-rap) upstream of the existing concrete box culvert. Downstream of the box culvert exists a long stagnant pool (approximately 0.3-0.4 m deep). Riparian vegetation consists mostly of *Phragmites*, with interspersed cattails. The WD-2 channel was found to be flowing during most site visits (>0.5 L/s). As outlined in Section 4.3.5. below, a single fish specimen (a Banded Killifish - *Fundulus diaphanus*) was captured during SLR's spring benthic sampling. Combined with the relative permanency of flows observed during the 2022 and 2023 monitoring, it likely that the WD-2 channel provides direct fish habitat during most times of the year.

WD-3

The WD-3 station, located along the Main Street East road corridor, represents the Wignell Drain East Tributary, and is located approximately 1.6 km to the east of WD-2 (**Figure 2**). Using the Ontario Watershed Information Tool (OWIT; MNRF 2023), the WD-3 channel gathers drainage from an upstream catchment of approximately 264 ha (MNRF, 2023), extending north of 2nd Concession Road. Unlike other stations located along Main Street East, the WD-3 channel drains an upstream landscape that is predominantly agricultural, with interspersed woodland and wetland areas (refer to **Figure 3** for ELC units located east of open quarry areas).

Within the road right-of-way, the WD-3 is highly altered, as it traverses next to an existing parking lot upstream of Main Street East. Two manicured lawns were noted south of the roadway. Within the channel an abundance of fine sediments was observed. Several times during the 2023 monitoring year, the WD-3 channel was observed to contain turbid or cloudy flows, likely resulting from the upstream of agricultural lands. Instream vegetation consisted mostly of *Phragmites* (both upstream and downstream of the roadway), creating high channel roughness conditions. The feature itself resembles a constructed swale (i.e., a low-lying depressional feature), with gently sloped banks.

WD-4

The WD-4 channel area is located along the southern limit of the Subject Lands, along Killaly Street East, approximately 125 m west of Snider Road (**Figure 2**). The catchment area associated with the WD-4 station is comprised of agricultural lands, as well as lands influenced by ongoing quarry activities.

Like other upstream monitoring stations, the WD-4 channel exhibits high channel roughness; however, instream vegetation is predominantly composed of cattails species (*Typha* sp.). Channel substrates are predominantly silts with some sand and gravel likely deposited from the adjacent roadway. The feature itself resembles a swale with moderately sloped banks.

WD-5



The WD-5 channel area is located south of the Friendship Trail, immediately to the west of the Snider Road allowance (**Figure 2**). The WD-5 channel area is generally located downstream of the confluence between the Wignell Drain West Tributary and the Wignell Drain East Tributary. The WD-5 channel area drains an upstream catchment that is predominantly composed of agricultural lands, with residential and industrial influences from residential subdivisions and active quarry activities respectively.

The habitat along the WD-5 station is highly altered and is consistent with large, constructed agricultural drains with uniform morphology and banks. Instream conditions generally consist of turbid, slow-flowing waters that eventually diffuse through dense vegetation approximately 35 m downstream of the Friendship Trail alignment. The watercourse here, like most sections of the Wignell Drain Subwatershed Study Area, contains instream vegetation, but little canopy cover, and thus is subject to thermal loading from direct sunlight. The riparian corridor consists of a thin, linear wetland community (ELC unit MAS/SA), flanked by wetland or cultural meadow areas (refer to **Figure 3**).

WD-6

The furthest downstream monitoring location in the Wignell Drain Subwatershed Study Area is station WD-6, located approximately 120 m north of Lakeshore Road East, at the end of the Snider Road cul-de-sac (next to Mount Saint Joseph Cemetery; see **Figure 2**). The monitoring station is located approximately 900 m upstream of the outlet into Lake Erie. Between the WD-6 station location and the Lake Erie outlet is a flow control structure, located immediately south of the Lakeshore Road East alignment.

The aquatic habitat at the WD-6 location is a relatively stagnant environment with some inflows noted at the upstream extent of the monitoring reach following rainfall activity. During the summer and fall seasons considerable instream vegetation is present, with high levels of algae also noted. The WD-6 channel area is highly altered and features a uniformed morphology and straightened alignment. The left bank of the channel is completely lined with large concrete blocks, likely to restrict any erosion along the private lands located at the northern extent of the Snider Road cul-de-sac. Visual water clarity was generally cloudy to turbid during most 2022 and 2023 site visits. From accessing the channel area during benthic invertebrate and fish community sampling visits, the substrate was found to consist of thick (up to 0.5 m) organic and silt materials. Unlike other monitoring stations located throughout the subwatershed, the riparian area did include some mature trees that provided shading to the channel area.

4.3.2 Surface Water Quality

Sample results from surface water quality sampling completed throughout the 2023 monitoring season, were compared to the Provincial Water Quality Objectives (PWQO), the standard guidelines for management of the province's water resources. If a reading is above this standard, it is considered an 'exceedance'. In general, the limits outlined in the PWQO standards are set to ensure that water quality is satisfactory for aquatic life and recreation, and that water uses which require more stringent water quality be protected on a site-specific basis. Comprehensive water quality sampling results for all parameters are provided in **Appendix H**.

From review of the surface water sample results, in the context of the PWQO limits, the following exceedances were identified:

pH

Lab-provided pH results indicated that three occurrences of pH levels that were outside of the PWQO-prescribed acceptable range of 6.5 to 8.5. The first occurrence registered a reading of



0.28 at station WD-4 during the July 6 visit. This is a highly acidic reading and is likely to be an artifact or error as no other downstream reading from the same sampling event registered a similar reading, and no subsequent readings at this station replicated these extremely acidic conditions. Two other, separate occurrences (different locations and sample dates) registered pH levels outside of the PWQO-prescribed range; however, these were both measured between 6.4 and 6.5 and would be considered anomalous, and not the result of a chronic adverse effects from a particular source, as prior and subsequent samples did not replicate these readings. All remaining measurements of pH gathered during the 2023 monitoring period were within a range deemed acceptable by PWQO.

Copper

PWQO prescribes an upper limit threshold for copper in surface water at 0.005 mg/L. Several occurrences of copper levels in excess of the PWQO limit were recorded during the 2023 monitoring period. Elevated levels of copper were recorded throughout the Wignell Drain Subwatershed Study Area but were most commonly found to be elevated at station WD-3. Natural sources of copper in aquatic systems include geological deposits, volcanic activity, and weathering and erosion of rocks and soils. Anthropogenic sources of copper include mining activities, agricultural activities, metal and electrical manufacturing, sludge from wastewater treatment works, and pesticide use (EPA, 2023). As many of these anthropogenic sources, notably mining, agriculture, and metal manufacturing are present within the subwatershed, it is likely that man-made sources have led to an elevated presence of copper in the subwatershed's aquatic environments.

Iron

PWQO prescribes an upper limit threshold for iron in surface water at 0.3 mg/L. During the 2023 monitoring period, iron was registered at levels above the PWQO prescribed limit across the subwatershed on a frequent basis (refer to **Appendix H**). Iron was measured at its highest reading of 7.78 mg/L at station WD-3 during the September 27, 2023 sampling event and was commonly found above 1.0 mg/L at different monitoring locations on different sampling dates. The presence of iron in natural waters can be attributed to *the weathering of rocks and minerals, acidic mine water drainage, landfill leachates, sewage effluents, and iron-related industries* (Government of Canada, 2009).

Nickel

PWQO prescribes an upper limit threshold for nickel in surface water at 0.025 mg/L. During the 2023 monitoring period, nickel was registered above the PWQO-prescribed limit several times, most commonly at stations WD-3, WD-5, and WD-6 (refer to **Appendix H**). The highest instance of nickel was measured at 0.46 mg/L on August 16, 2023 at station WD-5. Many natural processes, including weathering of soil materials and bedrock, forest fires, and exudates from vegetation, release nickel into the environment (Environment Canada, 1994). Many anthropogenic sources; however, can also release nickel into the environment, most frequently through mining, smelting, and refining of base materials. Fossil fuel combustion is also a major contributor to the release of nickel into the natural environment (Environment Canada, 1994). As it relates to the Study Area, it is SLR's understanding that nickel was historically refined at the Inco refinery (which was to the immediate west of the Study Area) for approximately 60 years, with operations ending in the 1980's (Mines and Communities, 2010). Nickel is understood to be an element that can persist in terrestrial and aquatic environments (Chau, 1995).

Zinc



PWQO prescribes an upper limit threshold for zinc in surface water at 0.03 mg/L. During the 2023 monitoring period, zinc was registered above the PWQO prescribed limit several times, almost exclusively at station WD-1, and once at station WD-3 (refer to **Appendix H**). Zinc generally occurs in association with copper and lead and is commonly recovered near mining or milling operations (Canadian Council of Ministers of the Environment, 2018).

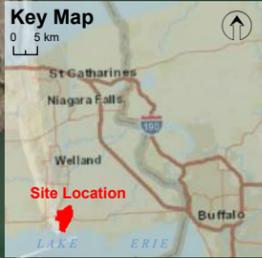
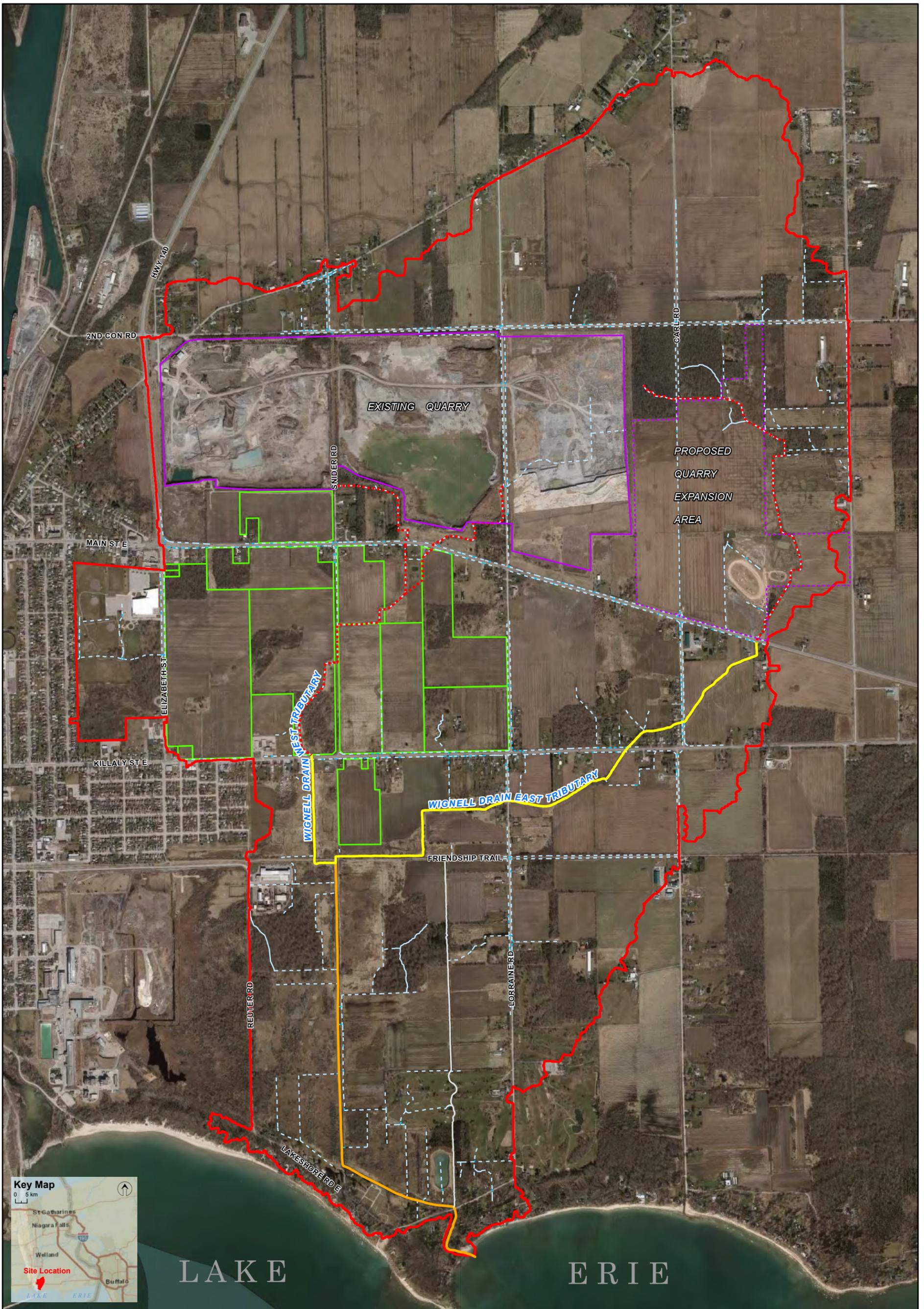
Nutrient Considerations – Phosphorus and Nitrogen

Outside of the pH and metal exceedances discussed above, all other parameters were found to be within prescribed PWQO limits. Despite this, PWQO does not assign specific upper threshold limits for all sampled water quality parameters, including phosphorus or nitrogen, the main parameters linked to excessive algae growth and associated decreases in other water quality metrics such as dissolved oxygen (NPCA, 2021).

PWQO does provide guidance on levels of phosphorus within lotic (i.e., flowing) and lentic (i.e., lakes) systems. To avoid excessive plant matter growth in rivers and streams, PWQO indicates that phosphorus levels should be maintained below 0.03 mg/L. As outlined in **Appendix H**, this limit is commonly exceeded throughout the Wignell Drain Subwatershed Study Area, and potentially high levels of phosphorus were visually evident as excessive algae growth was noted at various points, especially at station WD-6 in the southern extent of the Study Area.

PWQO does not provide specific guidance on acceptable levels of nitrogen.





LEGEND

Watercourse Habitat Assessment ¹

- Permanent, Poor - *Very substantial pollution likely*
- Permanent, Fairly Poor - *Substantial pollution likely*
- Intermittent, Very Poor - *Severe organic pollution likely*
- Not Sampled due to property access restrictions

¹ - Contains data sourced from Geospatial Ontario (GEO)
² - Niagara Peninsula Conservation Authority (NPCA), reaches not sampled

NPCA Flowline ²

- Natural
- Constructed - open
- Constructed - closed
- Study Area
- Subject Lands (Owned by Elite Developments)
- Proposed Quarry Expansion Lands
- Existing Quarry Footprint



North American Datum 1983
 Universal Transverse Mercator Projection Zone 17

Scale: 1:17,000
 Page Size: Tabloid (11 x 17 inches)

Drawn: SM
 Checked: RC
 Date: Feb 26, 2026

Source Notes:
 Imagery (2020) provided by Brock University GIS services.
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CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc.,
 Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc.,
 Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc

PROJECT Wignell Drain Subwatershed Study

TITLE **Flow Regime & Aquatic Habitat Quality**

	REF. NO. 2007708-5-1
	Figure 5

4.3.2.1 Continuous Water Temperature

As shown in **Appendix I**, the continuous water and air temperature results provide insight into general flow permanency where dry stream segments mirror air temperature fluctuations, and those with longer hydroperiods are buffered from diurnal temperatures fluctuations. The following summaries detail each monitoring stations water and air temperature results for the 2023 monitoring period.

WD-1

Water level records indicated minimal flow or standing water at the WD-1 monitoring station during most of the 2023 monitoring period. These observations are reflected within the continuous water temperature data where water temperature data generally mirrors air temperature data, and both are subject to the regular diurnal temperature increases during the day and decreases during evening and nighttime. Differences between air and water temperature appear similar even after significant rainfall events, likely indicating that either the WD-1 segment's upstream catchment does not capture much water, or the system conveys surface flows quickly and then quickly returns to low water level conditions.

During the summer months (July and August), daytime highs for water temperature regularly exceeded 25°C, with several records exceeding 30°C.

WD-2

From recorded water level data, it was noted that the WD-2 monitoring station stream segment contained flowing or standing water during most of the 2023 monitoring period. This is reflected in the continuous data, where water temperature swings are significantly smaller compared to the recorded changes in air temperature.

During the summer months, daily temperature peaks commonly exceed 25°C, with very few exceeding 30°C.

WD-3

Water levels within the WD-3 stream segment fluctuated significantly during the 2023 monitoring period, with dry conditions being noted often in June and early July, and again in late September. Several large increases in water level were noted from mid-July to early September, with most occurring after significant rainfall, or several smaller rainfall events. Due to the presence of water in mid-summer, the water temperature graph for WD-3 changes during the 2023 monitoring period with strong fluctuations in water and air temperature in early summer, and early fall, and relatively stable water temperatures in mid-summer.

Like monitoring station WD-2, the overall water temperatures during the summer months commonly exceed 25°C, with very few records exceeding 30°C.

WD-4

Water level data for monitoring station WD-4 indicated that at least minimal levels of flowing or standing water were present during most of the 2023 monitoring period. This is reflected in the overall temperature data, where water temperatures were more stable compared to the recorded air temperature data.

During the summer months, many daytime peak water temperatures were between 20 to 25°C, with only one occurrence exceeding 30°C.



WD-5

Water level data for monitoring station WD-5 indicated that moderate levels of flowing or standing water were present during most of the 2023 monitoring period. This is reflected in the overall temperature data, where water temperatures were considerably more stable compared to recorded air temperature data.

During the summer months, many daytime peak water temperatures were below 25°C, with very few records exceeding 25°C. No water temperature records for WD-5 exceeded 30°C.

WD-6

Water level data for monitoring station WD-6 indicated that moderate levels of flowing or standing water were present during most of the 2023 monitoring period. This is reflected in the overall temperature data, where water temperatures were considerably more stable compared to the recorded air temperature data. Minimal water temperature fluctuations are noted during the summer months.

During the summer months, many daytime peak water temperatures stabilized slightly above 20°C. No water temperature records for WD-6 exceeded 25°C.

4.3.3 Surface Water Levels

Continuous water level data was recorded within the Wignell Subwatershed Study Area from mid-June until early November at the six monitoring stations. Graphs detailing water level information are included in **Appendix I**. Water levels were determined through compensation of water level pressure information, with air pressure information gathered at monitoring station WD-1. Water levels are referenced to elevation data collected using a mobile RTK unit and are expressed in metres above sea level (mASL). Water level data was also referenced alongside local rainfall data gathered from Environment Canada weather stations located in Port Colborne and Welland.

WD-1

Water level data recorded at the WD-1 monitoring station indicated a system that was commonly dry with no flowing or standing water present. From review of the recorded information, it appears that most increases in water level were preceded by significant rainfall or several smaller rainfall events.

WD-2

Water level data recorded at the WD-2 monitoring station reflected a stream segment that maintained a constant baseline water level (~0.1 m in depth), but also experienced consistent increases in water level to approximately 0.4 m in depth, regardless of the occurrence of precipitation events. This regular and consistent increase in water levels across the 2023 monitoring period is likely linked to regular upstream anthropogenic inputs (e.g. pumping inputs). Conversely, from review of the WD-2 data, occurrences of significant rainfall did not trigger a responding increase in water levels within the localized stream segment.

WD-3

Water level data recorded at the WD-3 monitoring station reflected a stream segment that was mostly dry during the 2023 monitoring period but had significant increases in stream flow following significant rainfall events. For increases in water level that were not preceded by significant rainfall (i.e., August 25, 2023), it is possible that other upstream surface water inputs may have been directed into the drainage network (e.g. upstream pumping), or local rainfall



events may have been isolated to the WD-3 upstream catchment and did not register on the local rainfall data being recorded in Port Colborne and Welland.

WD-4

Water level data recorded at the WD-4 monitoring station maintained a constant base water level (<0.05 m in depth), but also experienced consistent increases in water level of approximately 0.4 m or greater, regardless of the occurrence of precipitation events. This regular and consistent increase in water levels across the 2023 monitoring period is likely reflective of the upstream surface water inputs observed in flow data from the WD-2 monitoring station. However, unlike WD-2, increases in stream flow were also observed following significant rainfall events, reflecting the increases in stream flow observed from monitoring stations WD-1 and WD-3.

WD-5

Water level data recorded at the WD-5 monitoring station maintained a constant base water level (generally >0.1 m in depth). Water levels rose in response to significant rainfall events, but also exhibited ‘peaks and valleys’ within the data that reflected the regular increases that were observed upstream at monitoring station WD-2.

WD-6

Water levels data recorded at the WD-6 monitoring station maintained a constant base water level (approximately 0.7 m in depth on average). Water levels increased following significant rainfall events, but also exhibited some evidence of ‘peaks and valleys’ within the data that reflected the regular increases that were observed upstream at monitoring station WD-2. The ‘peaks and valleys’ observed at this station were more subtle relative to other upstream monitoring stations due to the deeper base water levels.

4.3.4 Fish Community Sampling

Fish community sampling was completed on September 27, 2023. Sampling was not completed at all stations, as some stations were found to be dry or containing excessive algae growth, which restricted the ability of to effectively sample the reach. Sampling stations that were found to be dry or containing excessive algae during one or more sampling events included stations WD-1, WD-2, WD-3, and WD-6. Fish were retrieved from stations WD-4 and WD-5 and are documented in **Table 5** below. All of these are identified as being native species to southern Ontario, except Goldfish (*Carassius auratus*) which was historically introduced from Asia and is considered invasive in Ontario (MNR, 2022).

Fish were not captured from the WD-1, WD-2, or WD-3 stations, as outlined in **Table 5**. As outlined in the aquatic habitat survey observations detailed in Section 4.3.1, several factors including lack of baseflow and the presence of dense vegetation likely precluded fish access to these stations during fish community sampling.

Table 5: Fish Sampling Summary (September 27, 2023)

Scientific Name	Common Name	Tolerance	Thermal Preference	Stations					
				WD-1	WD-2	WD-3	WD-4	WD-5	WD-6
<i>Fundulus diaphanus</i>	Banded Killifish	Tolerant	Cool				3		



Scientific Name	Common Name	Tolerance	Thermal Preference	Stations					
				WD-1	WD-2	WD-3	WD-4	WD-5	WD-6
<i>(Ameiurus melas)</i>	Black Bullhead	Intermediate	Warm					1	
<i>(Amia calva)</i>	Bowfin	Intermediate	Warm					1	
<i>(Umbra limi)</i>	Central Mudminnow	Tolerant	Cool					10	
<i>(Carassius auratus)</i>	Goldfish	Tolerant	Warm					23	
<i>(Micropterus nigricans)</i>	Largemouth Bass	Tolerant	Warm					16	
<i>(Lepomis gibbosus)</i>	Pumpkinseed	Intermediate	Warm					16	

Three (3) specimens, identified as Banded Killifish (a member of the top minnow (*fundulidae*) family) following the field survey, were captured at station WD-4. As noted in Section 4.3.1 above, another Banded Killifish individual was incidentally captured during the spring benthic sampling event on June 14, 2023, at station WD-2.

As outlined in **Table 5** above, most fish were captured at station WD-5 during the 2023 fish sampling event. In addition to the various native species captured and listed above, twenty-three (23) specimens of invasive Goldfish were also captured at station WD-5.

Despite generally suitable aquatic conditions for fish habitat at station WD-6 (presence of deeper waters with instream cover), no fish were captured during the 2023 fish community sampling. The two main reasons why fish were not captured during 2023 was firstly the presence of abundant fine sediments, which when the stream segment was accessed by field staff was stirred up rendering the backpack electrofishing unit ineffective, the second was the abundant presence of in-stream algae which limited the ability to use seine nets and dip nets. The presence of abundant fine sediments within the bed of the WD-6 station segment also significantly limited field staff ability to move through the water limiting sampling capabilities.

Overall, the fish species captured throughout the Wignell Drain Subwatershed Study Area are those indicative of warmwater aquatic environments. All captured fish species are considered tolerant, or at least intermediately tolerant, to environmental perturbations and changes in water temperature and turbidity.

4.3.5 Benthic Invertebrates

The metrics calculated for the benthic invertebrates collected at each monitoring station are summarized below. Detailed benthic data is included for each monitoring station in **Appendix J**. It should be noted that benthic sampling was not completed at all stations due to dry conditions. Detailed information about each sampling station is provided below. Given that it is difficult to determine specific thresholds for the number, or percentage, of organisms for each metric that should be found in an unimpaired or impaired stream sample, sampled sites were compared to



each other. The following measures were used in the tables below, to describe benthic invertebrate communities:

Taxa Richness: Indicates diversity of taxa. The number of taxa generally increases with habitat quality and water quality. Although Taxa Richness is a commonly referenced metric, it is considered a coarse indicator of stream health, and should be considered alongside other metrics to fully evaluate long-term water quality and habitat conditions.

% EPT: Percent composition of Ephemeroptera, Plecoptera, and Trichoptera (EPT). Reflects the composition of the benthic community within Families that are considered to be sensitive to water quality (i.e., a higher percentage indicates more sensitive species).

Simpson's Diversity and Equitability: The Simpson's Diversity index and equitability are related to the proportion of total organisms contributed by each taxon. Diversity and evenness are low when the benthic community is dominated by a few taxa, and higher when the number of organisms is more evenly distributed across numerous taxa. High diversity and low equitability indicate better environmental conditions, while the opposite can indicate stresses on the system.

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

n = the total number of organisms of a particular species

N = the total number of organisms of all species

Hilsenhoff's Family Biotic Index: The Hilsenhoff's Family Biotic Index (HBI) uses the pollution tolerances of organisms to determine the level of stream impairment. For pollution, HBI generally considers organic pollution from anthropogenic sources such as wastewater, or agricultural sources such as fertilizer, and other organic herbicides, pesticides, and insecticides. Each organism is assigned a tolerance value of 0 to 10, with a value of 0 indicating that the organism has a very low tolerance to pollution and a value of 10 indicating that the organism has a very high tolerance to pollution. The index is calculated using the following formula:

$$HBI = \sum(x_i)(t_i) / n$$

Where x_i is the number of organisms in the i^{th} taxon, t_i is the tolerance value of the i^{th} taxon, and n is the total number of organisms in the sample. Interpretation of the HBI Value is as shown in **Table 6**.



Table 6: Hilsenhoff's Family Biotic Index

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very Good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probably
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly Poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very Poor	Severe organic pollution likely

There are known differences in the way the indices respond to human disturbance/habitat degradation (Jones C. C., 2007). For Taxa Richness, % EPT, and the Simpson's Diversity Index, a larger value implies a healthy biological community, and low values imply reduced health (Jones C. C., 2007). For HBI, a lower value implies a healthier community (Jones C. C., 2007); however, there is no "target value" since there are no reference stations in this SWS. Consequently, it can only be determined which monitoring stations have higher or lower values.

Tables 7 & 8 provide the spring and fall 2023 benthic invertebrate analysis results within the Wignell Drain Subwatershed Study Area. It should be noted that no benthic invertebrate sampling was carried out at station WD-1 during either sampling event as no water was present in the channel area. Station WD-3 was not sampled during the fall event, as the station area was found to be dry.

Table 7: Benthic Invertebrate Monitoring Results – Spring 2023

Metric	WD-2	WD-3	WD-4	WD-5	WD-6
Total Number of Organisms	868	1098	347	251	511
Taxa Richness	8	8	7	14	11
%EPT	0.00	0.00	0.00	0.01	0.01
Simpson Diversity Index	0.21	0.12	0.61	0.69	0.50
HBI	7.68	7.95	7.31	6.78	6.64

Table 8: Benthic Invertebrate Monitoring Results – Fall 2023

Metric	WD-2	WD-3	WD-4	WD-5	WD-6
Total Number of Organisms	345	N/A	380	325	95
Taxa Richness	7	N/A	5	10	8
%EPT	0	N/A	0	0.36	0.07
Simpson Diversity Index	0.49	N/A	0.75	0.72	0.58
HBI	7.33	N/A	6.85	6.29	6.26



WD-2

Overall, the analytical results for station WD-2 represents an aquatic system that is in very poor condition. Taxa richness was found to be generally low compared to other monitoring stations results, with no EPT taxa being identified in the spring or fall. In terms of diversity station WD-2 scores relatively low, with a benthic community that is dominated by a few taxa. The HBI score for the system was measured at 7.68 in the spring and 7.33 in the fall, representing a benthic community composed of mostly pollution-tolerant invertebrates. This suggests the presence of severe organic pollution.

WD-3

Overall, the analytical results for station WD-3 represents an aquatic system that in very poor condition. The analytical results reflect springtime sampling conditions only. Like WD-2, taxa richness was found to be generally low compared to other monitoring stations results, with no EPT taxa being identified in the spring. Station WD-3 presented the lowest diversity score of 0.12, highlighting the highest total number of organisms, while representing a very small number of taxa. The HBI score was the highest of any sampled area within the Wignell Drain Subwatershed Study Area, indicating a strong likelihood of severe organic pollution.

WD-4

Overall, the analytical results for station WD-4 represents an aquatic system that is in very poor condition. Taxa richness was found to be the lowest compared to other monitoring stations results, with no EPT taxa being identified during the spring or the fall. Despite a lack of taxa richness and EPT, overall diversity at WD-4 was identified as being amongst the highest of all monitoring stations. In general, this indicates that although there was a low number of total taxa, the individual species of one taxon did not dominate the proportion of total organisms, with isopods (i.e., sow bugs), mollusks (i.e., pelecypoda), and amphipoda (i.e., scuds) representing a significant share of the total organisms. Habitat quality was identified as being poor to very poor, with spring HBI values being measured worse than the fall values.

WD-5

The analytical results for station WD-5 represent a benthic community that, relative to other monitoring stations, is somewhat healthy, but overall is representative of a fairly poor system when compared to the standard benthic metrics. Taxa richness was measured at its highest during both the spring and fall sampling events at station WD-5. The percentage of the benthic invertebrate community representing EPT species was measured at 1% during the spring, and up to 36% during the fall, with high numbers of *Ephemeroptera* (i.e., Mayfly) being counted. Diversity levels were also measured highest at station WD-5, registering some of the lowest HBI (besides station WD-6). This is representative of more sensitive, pollution-intolerant benthic invertebrate communities within the Wignell Drain Subwatershed Study Area.

WD-6

Overall, the analytical results for station WD-6 are representative of an aquatic system that is in poor condition. Relative to other stations, station WD-6 registered the second highest taxa richness values during both the spring and fall sampling events, only trailing values measured at station WD-5. Furthermore, station WD-6 was the only other station besides WD-5 to register counts for EPT with 1% of documented species being identified as EPT during the spring event and 7% during the fall event. Like station WD-5, EPT species counts were represented solely by *Ephemeroptera*. Diversity values at WD-6 registered lower than the WD-4 and WD-5 stations during both the spring and fall sampling events. Station WD-6 registered the lowest HBI values for any station within the Wignell Drain Subwatershed Study Area, reflecting a relatively



sensitive benthic invertebrate community; however, still falling within the Fairly Poor to Poor categories.

4.4 Landscape Connectivity/Linkage Analysis

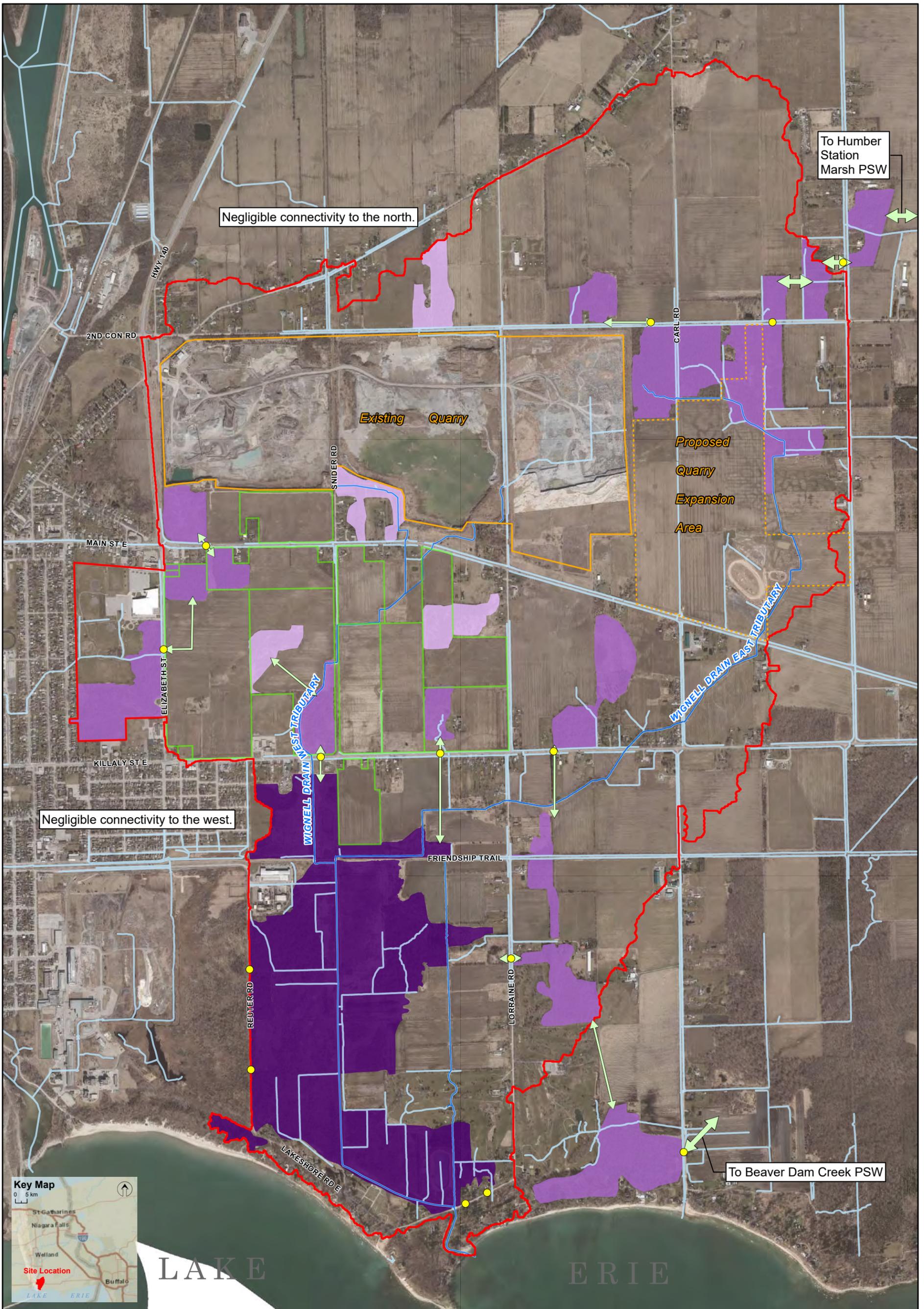
Landscape connectivity is a concept that considers the degree of connectedness of natural features and habitats when a landscape has been subject to some degree of human development. This is especially relevant to southern Ontario, south of the Canadian Shield, where most land has been altered through agricultural practices or the construction of manmade structures (including roads). A highly connected landscape is one where there is generally a higher percentage of natural cover, and which has numerous natural corridors (such as river valleys) that link larger natural areas together. Highly connected landscapes enable higher biodiversity and higher genetic diversity due to the increased species mobility, while also enabling the movement of plants (by seeds) more readily. On the contrary, landscapes with low connectivity result in lower biodiversity and genetic diversity. It is worth remembering that the science of landscape connectivity is somewhat imprecise, and it is not always clear which species use or require corridors, and under which circumstances.

Within the Wignell Drain Subwatershed Study Area, there are small to mid-sized wetlands and woodlands, as described throughout this report, as well as the larger Nickel Beach Marsh Wetland PSW in the southern region of the subwatershed. Watercourses are mainly straightened and there are no river valleys.

The ecological connectivity within and to adjacent areas of the Subwatershed is shown on **Figure 6**. To the west of the Wignell Drain Subwatershed Study Area is the developed City of Port Colborne and thus there is very little scope for connectivity in that direction. To the north and east there are primarily agricultural lands interspersed with some natural habitats consisting of wetlands and woodlands. Northwards, although not urbanized, there is little opportunity for ecological connectivity in part due to the presence of the quarry, which spreads across most of the Study Area width, and in part due to large agricultural fields and small natural features to the immediate north of the Study Area. Larger areas of natural or semi-natural areas outside the Study Area are Beaver Dam Creek Wetland PSW (about 2 km to the southeast) and Humberstone Muck Basin Swamp Forest Provincial Life Science Area of Natural and Scientific Interest / Humberstone Marsh PSW (about 3.5 km to the northeast).

There are relatively few natural connections either between the small and mid-sized natural features onsite or the larger features listed above, and there are no naturally vegetated valleys that serve as connectors, as in many other parts of southern Ontario. Most of the wildlife present can cross agricultural fields and are generally also able to make their way through residential environments (e.g., Northern Raccoon, Striped Skunk, Grey Squirrel, etc.). Breeding birds can for the most part fly across non-connected landscapes. Thus, the natural features within the Wignell Drain Subwatershed Study Area are considered to have low / weak connectivity in a landscape context with existing connections mainly between disjointed patches of wetland or woodland. General connection arrows on **Figure 6** indicate where there may be some ecological connection currently; most of these connections are across agricultural lands or over roads. At the same time, these arrows indicate where connection could be improved at a time of development.





LEGEND Watercourse 1 Watercourse 2 Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area		Potential Locations to Improve Ecological Connectivity Consider 60 m-wide linkage (Connection more important, natural areas often larger) Consider 20 m-wide linkage or SWMF connection (Connection less important, natural areas often smaller) Eco Passage - Construct eco-passage & wildlife fencing when/if road is rebuilt		Natural Areas Currently Isolated Mid-sized Large		 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: RC Date: Feb 26, 2026 NORTH		CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc. PROJECT Welland S - Wignell SWS TITLE Ecological Landscape Level Connectivity REF. NO. 2007708-6-1 Figure 6	
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5.0 Natural Heritage Feature Analysis & Assessment of Significance

Based on the assessment of significance that is included below and the natural heritage feature delineation process that was confirmed through the TOR process with the Niagara Region, the City of Port Colborne, and the NPCA, natural heritage features (including new wildlife corridor/linkages) were identified and mapped for the Wignell Drain Subwatershed Study Area. **Figures 7 and 8** indicate features that were either designated (through the EIS or SWS process on the Subject Lands) or identified through this subwatershed study. Woodlands, wetlands, and watercourses were identified within the Study Area. No valleylands have been documented to date from roadside surveys or lands where landowners have provided access.

5.1 Woodlands

Table 9 provides an assessment of the woodlands within the Wignell Drain Subwatershed Study Area, indicating which woodland meets Regional or City criteria for significance. Based on this assessment, there are 14 Significant Woodlands in the subwatershed in addition to the five Significant Woodlands identified on the Subject Lands, totaling 19 Significant Woodlands overall (**Table 9, Figure 7**). Subject Land woodlands, which were identified and delineated on-the-ground, are labelled A and B, while those identified through the subwatershed process are labelled C woodlands. Additional details of the five Significant Woodlands identified through the Subject Lands EIS, can be found in **Appendix C**.

Three additional woodlands have been identified as *Potential Significant Woodlands* on **Figure 7**. These *Potential Significant Woodlands* have been treated as Significant Woodlands until field verification can be completed. It should be noted that a preliminary designation is associated with this assessment of woodland significance as at the subwatershed level many of these woodlands were either not accessible (i.e., on privately-owned lands where access was not permitted) or only observable from roadways / trails (did not allow for interior habitat to be examined). Site-specific, or EIS-level, surveys would need to be conducted to confirm woodland significance within individual properties at the time of proposed development.

The definition of a woodland and the criteria for woodland significance, both at the Regional and Municipal level, are described below.

Niagara Region

According to Table 4-1 of the Regional OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Significant Woodlands *must meet the definition of ELC forest and meet one or more of the following criteria:*

- 1 2 ha or greater in size
- 2 1 ha or greater in size meeting at least one of the following criteria:
 - a) Naturally occurring (i.e., not planted) trees (as defined in the species list of Appendix D in the Greenbelt Technical Paper)
 - b) Treed areas planted with the intention of restoring woodland
 - c) 10 or more trees per ha greater than 100 years old or 50 cm or more in diameter
 - d) Wholly or partially within 30 m of a provincially significant wetland or habitat of an endangered or threatened species
 - e) Overlapping or abutting one or more of the following features:



- i. *Permanent streams or intermittent streams*
 - ii. *Fish habitat*
 - iii. *Significant valleylands*
- 3 *0.5 ha or greater in size meeting at least one of the following criteria:*
- a) *A provincially rare, treed vegetation community with an S1, S2 or S3 in its ranking by the MNR's N.H.I.C.*
 - b) *Habitat of a woodland plant species with an S1, S2 or S3 in its ranking or an 8, 9, or 10 in its Southern Ontario Coefficient of Conservatism by the NHIC, consisting of 10 or more individual stems or 100 or more sqm of leaf coverage.*
 - c) *Any woodland overlapping or abutting one or more of the following features:*
 - i. *Significant wildlife habitat*
 - ii. *Habitat of threatened species and endangered species*
 - iii. *Non-Provincially Significant Wetlands*
- 4 *Any size overlapping or abutting one or more of the following features:*
- a) *Provincially significant wetland*
 - b) *Life Science area of natural and scientific interest*

Other Woodlands:

According to Table 4-1 of the OP's Schedule L (Natural Environment System: Components, Definitions, & Criteria), Other Woodlands are a *terrestrial treed area must have $\geq 25\%$ tree cover and meet one or more of the following criteria:*

- 1 *an average minimum width of 40 m and is ≥ 0.3 ha, measured to crown edges; or*
- 2 *any size abutting a significant woodland, wetland, or permanent stream.*

Treed areas that "abut" a significant woodland, wetland or permanent stream are considered adjacent when located within 20 m of each other. Other woodlands are identified based on the Ecological Land Classification (ELC) methodology.

City of Port Colborne

The City's OP defines 'woodland' as the following:

Treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance at the local, regional, and provincial levels. They do not include cultivated fruit or nut orchards or plantations used for the purpose of producing Christmas trees.

The City's OP Section 4.3.5.1 b) defines 'significant woodlands' as the following:

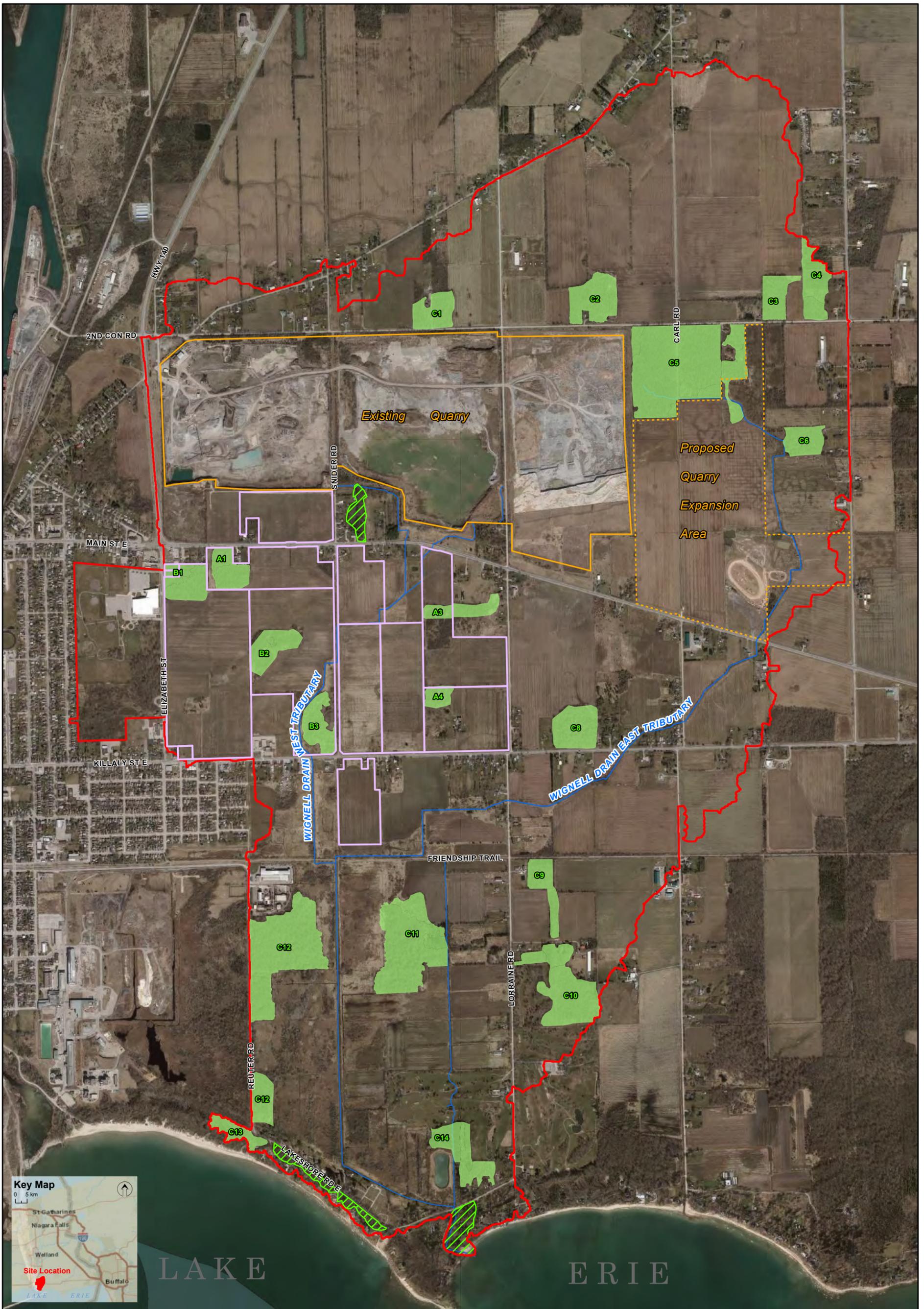
...treed areas, woodlots or forest areas that provide environmental and economic benefits to private landowners and the public that vary in levels of significance. To be classified as significant, a woodland must:

- *Contain a threatened or endangered species or species of concern,*



- *Be equal or greater than 2 hectares in size,*
- *Overlap or contain one or more significant natural heritage features or abut or be crossed by a water body greater than 2 hectares in area.*





LEGEND Watercourse ¹ Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area	Significant_Woodland Potential Significant Woodland Significant Woodland 1 - Contains data sourced from Land Information Ontario (LIO) Note: Outside of the Subject Lands, all anthropogenic areas (buildings, gardens, hedges), all agricultural fields, and most cultural communities (e.g. thickets, small CUW) not mapped.	 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: RC Date: Feb 26, 2026 Source Notes: Imagery (2019) provided by ESRI basemapping. Contains information licensed under the Open Government Licence - Ontario.	CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc.
			PROJECT Welland S - Wignell SWS TITLE Significant Woodlands
			REF. NO. 2007708-7-2 Figure 7

Table 9: Significant Woodland Assessment

Natural Feature Code	ELC	Size (ha)	Region Significant Woodland Policies	City Significant Woodland Policies
A4	Fresh – Moist Oak – Maple – Hickory Deciduous Forest (Oak Dominant) (FOD9a)	1.3	<u>Meets Criteria:</u> Woodland is > 1 ha and of ‘naturally occurring’ mid-late successional trees	<u>Does not meet Criteria</u> Mapped as Environmental Conservation Area
A1 + B1 (included together since only 20 m apart in one location)	Fresh – Moist Oak – Maple – Hickory Deciduous Forest (Oak Dominant) (FOD9) / Silver Maple Mineral Deciduous Swamp (SWD3-2) / Grey Dogwood Mineral Thicket Swamp (SWT2-9)	3.5 + 2.9 = 6.4	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Woodland is > 1 ha and of ‘naturally occurring’ mid-late successional trees Woodland is > 0.5 ha and overlapping with Non-Provincially Significant Wetland 	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Mapped as Environmental Conservation Area
A3	Dry – Fresh Oak – Maple – Hickory Deciduous Forest (FOD2)	2.2 (including off-site area)	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Woodland > 1 ha and of ‘naturally occurring’ mid-late successional trees 	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Mapped as Environmental Conservation Area
B2	Dry - Fresh Deciduous Forest (FOD4)	3.1	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Woodland is > 1 ha and of ‘naturally occurring’ mid-late successional trees had a lower tree canopy cover and was excluded from woodland by Region	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Mapped as Environmental Conservation Area



Natural Feature Code	ELC	Size (ha)	Region Significant Woodland Policies	City Significant Woodland Policies
B3	Deciduous Swamp (SWD)	3.1	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Woodland is > 1 ha and abutting a permanent/intermittent watercourse 	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Mapped as Environmental Protection Area due to being Hazard Lands
C1	FOD9: Fresh – Moist Oak – Maple – Hickory Deciduous Forest	2.99	<u>Meets Criteria:</u> <p>Woodland is > 2 ha</p> May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <p>Woodland is > 2 ha</p> May meet additional <i>Significant Woodland</i> criteria.
C2	SWD3: Maple Deciduous Swamp	4.45	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with Non-Provincially Significant Wetlands May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C3	SWD/FOD9: Deciduous Swamp / Fresh – Moist Oak – Maple –Hickory Deciduous Forest	2.64	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with Non-Provincially Significant Wetlands May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C4	CUW/CUP: Cultural Woodland / Cultural Plantation; FOD9: Deciduous Swamp / Fresh – Moist Oak – Maple – Hickory	3.82	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.



Natural Feature Code	ELC	Size (ha)	Region Significant Woodland Policies	City Significant Woodland Policies
	Deciduous Forest			
C5	SWD3: Maple Deciduous Swamp; FOD: Deciduous Forest; CUW/FOD: Cultural Woodland / Deciduous Forest	19.71	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with Non-Provincially Significant Wetlands May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C6	FOD: Deciduous Forest	2.52	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.
C7	SWD1: Oak Mineral Deciduous Swamp; FOD9: Fresh – Moist Oak – Maple – Hickory Deciduous Forest	2.68	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with Non-Provincially Significant Wetlands May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C8	FOD9: Fresh – Moist Oak – Maple – Hickory Deciduous Forest	4.13	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.
C9	SWD: Deciduous Swamp; FOM: Mixed Forest	2.75	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Provincially Significant Wetland 	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature



Natural Feature Code	ELC	Size (ha)	Region Significant Woodland Policies	City Significant Woodland Policies
			May meet additional <i>Significant Woodland</i> criteria.	May meet additional <i>Significant Woodland</i> criteria.
C10	FOD: Deciduous Forest; FOM: Mixed Forest	8.11	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha May meet additional <i>Significant Woodland</i> criteria.
C11	FOD: Deciduous Forest; SWD: Deciduous Swamp	11.3	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Provincially Significant Wetland May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C12	SWD: Deciduous Swamp	12.74	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Provincially Significant Wetland May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C13	FOD: Dry – Fresh Oak – Maple – Hickory Deciduous Forest; SWD: Deciduous Swamp	> 4	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping/abutting with a Provincially Significant Wetland May meet additional <i>Significant Woodland</i> criteria.	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha Overlapping/abutting with a Significant Natural Feature May meet additional <i>Significant Woodland</i> criteria.
C14	FO/CUP: Forest / Cultural Plantation;	5.33	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha 	<u>Meets Criteria:</u> <ul style="list-style-type: none"> Woodland is > 2 ha



Natural Feature Code	ELC	Size (ha)	Region Significant Woodland Policies	City Significant Woodland Policies
	CUP3: Pine Plantation; wetland		May meet additional <i>Significant Woodland</i> criteria.	May meet additional <i>Significant Woodland</i> criteria.



Potential Significant Woodlands

It should be noted that additional potentially Significant Woodlands may be present within the Wignell Drain Subwatershed Study Area but were unable to be site-verified through field work and assessed as part of this subwatershed study (**Figure 8**). For example, a vegetation community at the northeastern corner of Elizabeth Street and Main Street East was mapped as Significant Woodland on the City's OP Schedule B2; however, SLR was unable to verify whether the community met the criteria for Significant Woodland. Other, similar scenarios may exist within the subwatershed landscape. Future site-specific surveys completed through an EIS will be required to determine whether these woodlands meet the necessary criteria to qualify as significant.

5.2 Wetlands

There are four types of wetlands identified in the Wignell Drain Subwatershed Study Area:

- Provincially Significant Wetlands (PSWs) – evaluated
- Evaluated Non-Provincially Significant Wetlands – evaluated
- Unevaluated wetlands - identified or confirmed by SLR during field investigations, and
- Potential wetlands - assumed wetlands based on aerial imagery and/or NPCA 2020 ELC mapping but could not be confirmed through field investigations

The abovementioned wetlands are mapped in **Figure 8**. Five wetlands were identified and assessed within the Subject Lands and are included in **Table 10**. Due to lack of field confirmation, potential wetlands are mapped in **Figure 8** but are not included in **Table 10**.

Figure 3 shows all wetlands as mapped by NPCA 2020, however on **Figure 8**, ELC mapping of wetlands has been modified by SLR in a few locations where wetlands are very unlikely to be present. There are two types of NPCA 2020 wetlands not shown on Figure 8: 1) those within active quarry lands that are assumed to be areas of standing water within the quarry; and 2) about five narrow wetland "fingers" that appear to be an ephemeral/intermittent drainage feature.

The policies regarding wetland protection are given below.

Provincially significant wetlands are protected under the Provincial Policy Statement.

The Region states in Section 3.1.9.5.4 of its OP:

When development or site alteration is proposed in or adjacent to any watercourse, provincially significant wetland, significant valleyland, or other wetland the applicant shall contact the Conservation Authority, at which time Conservation Authority staff will advise the applicant and the Region of the land use or regulatory policies that will apply.

The Region generally defers to the NPCA for the protection of unevaluated and non-provincially significant wetlands.

The City of Port Colborne '*promotes the protection and/or conservation and where appropriate, the restoration and enhancement of Natural Heritage Features (including wetlands) within and adjacent to its boundaries*' and its OP Section 4.1.1 policies state that:

Development should maintain, enhance, or restore ecosystem health and integrity. First priority is to be given to avoiding negative environmental impacts. If negative impacts cannot be avoided, mitigation measures will be required.

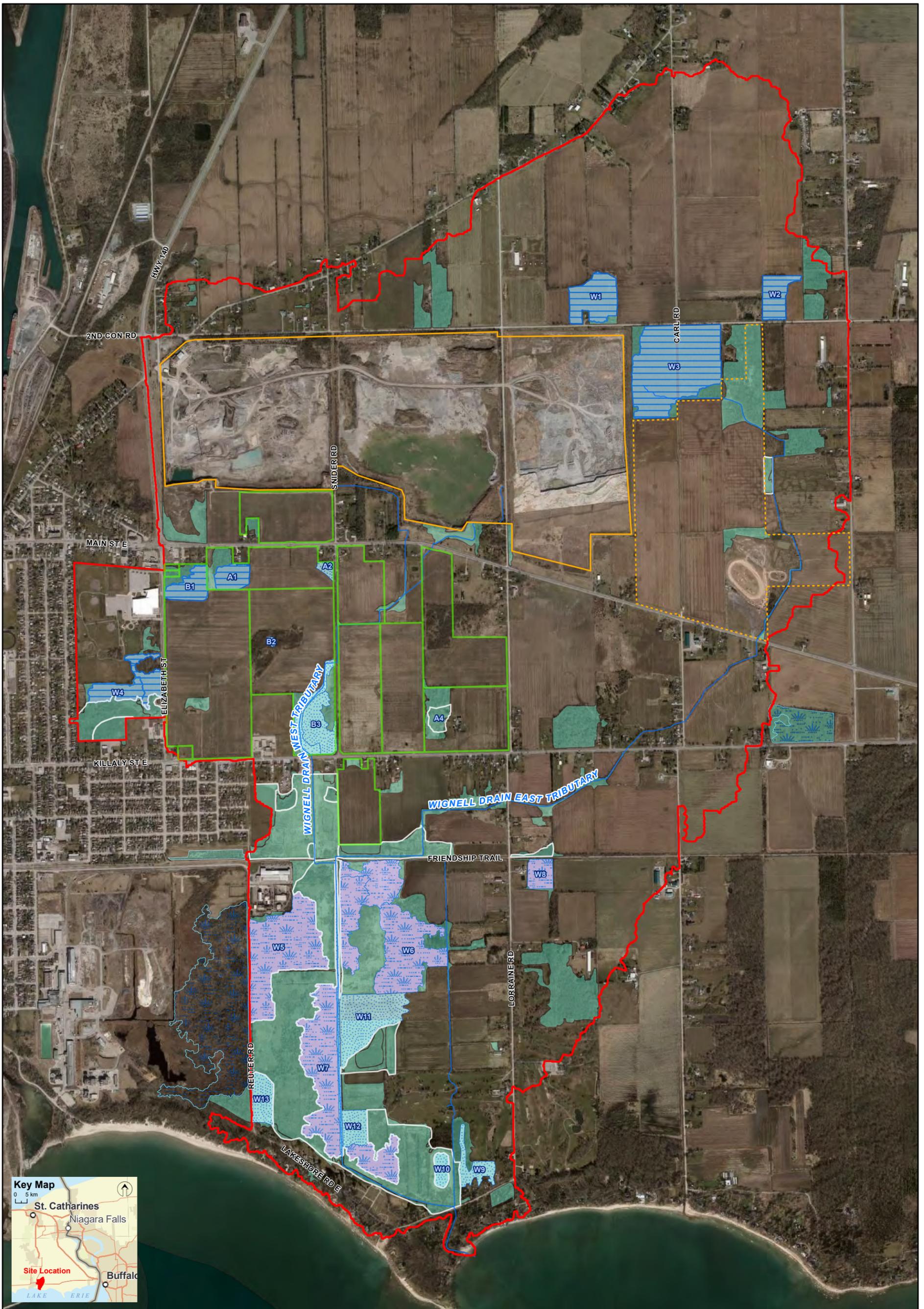


The NPCA document, *Policies for Planning and Development in the Watersheds of the NPCA* (NPCA, 2024), states in Section 8.2.2.1 that “unless otherwise stated in this Document, no development and/or site alteration shall be permitted within a wetland.”

Based on the aforementioned policies and onsite discussions with the Niagara Region and the NPCA during field investigations on the Subject Lands, all other wetlands including non-provincially significant wetlands are protected primarily under the City and NPCA’s jurisdiction.

An assessment of the basic characteristics of the wetlands (PSWs, evaluated (other) wetlands (non-provincially significant), unevaluated wetlands (confirmed by SLR) within the Wignell Drain Subwatershed Study Area is provided below in **Table 10** and on **Figure 8**.





LEGEND Watercourse ¹ Wetland Provincially Significant Wetland Evaluated - Other Unevaluated Wetland Potential Wetland ²		Existing Quarry Footprint Proposed Quarry Expansion Lands Subject Lands (Owned by Elite Developments) Study Area		 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: RC Date: Feb 26, 2026 Source Notes: Imagery (2019) provided by ESRI basemapping. Contains information licensed under the Open Government Licence - Ontario.		CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc. PROJECT Welland S - Wignell SWS TITLE Subwatershed Wetlands REF. NO. 2007708-8-1 Figure 8	
1 - Contains data sourced from both Niagara Peninsula Conservation Authority (NPCA) and Land Information Ontario (LIO) 2 - Contains data sourced from NPCA and added to by SLR except as per removals shown on Figure 20 and within the quarry.							

Table 10: Wetland Characteristics and Delineation

Natural Feature Code	Wetland Feature	Size (ha)	Delineation Method
A1 + B1 wetlands + marsh in between	Contiguous: Silver Maple Mineral Deciduous Swamp (SWD3-2) + Gray Dogwood Mineral Thicket Swamp + Reed Canary Grass Mineral Meadow Marsh (MAM2-2a)	4.8	Used existing mapping of Evaluated Non-Provincially Significant Wetlands, plus added meadow marsh situated in between.
A2	Southern Arrow-wood Mineral Thicket Swamp (SWT2-11)	0.5	Wetland staked by the NPCA with Region, and SLR on September 14, 2022 (is also a SWH)
B3	Poplar Deciduous Swamp (SWD) + Reed Canary Grass Mineral Meadow Marsh (MAM2-2b)	5.0	Wetland partly staked by the NPCA with Region and SLR on September 14, 2022 and remaining delineation discussed and agreed upon with SLR, NPCA and Region using field observations and air photography
Within B2	Mineral Thicket Swamp and Mineral Meadow Marsh (SWT/MAM)	0.1	SLR delineated using air photos (is situated wholly within a woodland feature)
A4 wetland	Mineral Thicket Swamp (SWT2) (including pond)	1.1	Delineation discussed and agreed upon with SLR, NPCA and Region using field observations and air photography.
W1	SWD3: Maple Deciduous Swamp	4.5	Used existing mapping of Evaluated Non-Provincially Significant Wetlands.
W2	SWD/FOD9: Deciduous Swamp / Fresh – Moist Oak –Maple – Hickory Deciduous Forest	2.6	Used existing mapping of Evaluated Non-Provincially Significant Wetlands.
W3	SWD3: Maple Deciduous Swamp	15.4	Used existing mapping of Evaluated Non-Provincially Significant Wetlands.
W4	SWD1: Oak Mineral Deciduous Swamp; SWT: Swamp Thicket	3.5	Used existing mapping of Evaluated Non-Provincially Significant Wetlands.
W5 + W13	SWD: Deciduous Swamp	> 14.5	Used existing mapping of Evaluated Provincially Significant Wetlands (W5). Delineated via in-field surveys and desktop aerial imagery (W13).



Natural Feature Code	Wetland Feature	Size (ha)	Delineation Method
W6 + W7 + W11 + W12	SWD: Deciduous Swamp; MAM/SWT: Meadow Marsh / Swamp Thicket; MAS/SA: Shallow Marsh / Shallow Aquatic; Wetland: undetermined	44.8	Used existing mapping of Evaluated Provincially Significant Wetlands (W6, W7). Delineated via in-field surveys and desktop aerial imagery (W11, W12).
W8	SWD: Deciduous Swamp	1.7	Used existing mapping of Evaluated Provincially Significant Wetlands.
W9	SWD: Deciduous Swamp	1.9	Used existing mapping of Unevaluated Wetlands.
W10	SA: Shallow Aquatic	1.1	Delineated via in-field surveys and desktop aerial imagery.

Like the woodlands, it should be noted that a degree of error is associated with this assessment of wetlands as at the subwatershed level many of these wetlands were either inaccessible (i.e., on privately-owned lands where access was not permitted) or only observable from roadways / trails (preventing soil testing from occurring). Site-specific, or EIS-level, surveys would need to be conducted at the time of proposed development to confirm the presence / absence of wetlands and if present determine the significance of these features.

Note that part of one evaluated, non-provincially significant wetland on the west side of Elizabeth Street was observed to be an upland Cultural Woodland (CUW) community during 2022 field investigations (hence CUW ELC code) but the provincial mapping has still been shown on **Figure 3**.

Potential Wetlands

Several potential wetland communities exist within the Wignell Drain Subwatershed Study Area but were unable to be verified in the field due to site access constraints. These communities are differentiated on **Figure 8**. Delineation and classification of wetland landscapes using aerial photography alone can prove to be challenging. Thus, these *Potential Wetlands* have been treated as wetlands at this stage of the SWS. Field verification would have to be completed outside of the subwatershed study process such as through a site-specific EIS.

5.3 Aquatic Habitat

The entirety of the subwatershed is considered to be a warmwater environment (MNR, 2024), with the upstream portions (WD-1, WD-2, WD-3, and WD-4) functioning as intermittent systems, and the downstream portions (WD-5, WD-6) functioning as permanent systems with perennially flowing water (**Figure 9**). Results of the 2023 fish community sampling were consistent with thermal classification information, with mostly warmwater species be captured from the lower reaches of the subwatershed. Physical aquatic habitat observations were consistent as well with the warmwater thermal classification, as permanent baseflow was only documented within the lower reaches, groundwater indicators were minimal, and little to no lower or upper canopy is present throughout the subwatershed to provide shading and cooling effects and reduce thermal loading from sun exposure. The primary surface water inputs are provided through surface runoff from surrounding agricultural fields.



Consistent with NPCA Policy, a 15 m setback is assigned to stream segments located north of the Friendship Trail, as these monitoring stations were observed as being intermittent. South, or downstream of the Friendship Trail, a 30 m setback is assigned to stream segments as flow was generally observed to be flowing on a permanent basis, even during summer baseflow conditions, as described in Section 4.3.2. Comprehensive ecological constraints are detailed in Section 9 of this report.

It should be noted that additional watercourses regulated by the NPCA may be present within the Study Area that were not captured within this SWS. This may be the case on private, non-participating lands in which site access was not granted. A conservative approach was taken with respect to assessing the presence and significance of potential, but inaccessible, watercourses within the Study Area. For example, in **Figure 3** all Land Information Ontario and NPCA drainage features are mapped. However, all constructed flowlines (open or closed) are not considered significant nor to require a buffer. These features are often ditches, including many that are along roads, or are straightened drainage features within fields that are disturbed and often contain low quality water. They are still shown on the Aquatic Constraints figure. The presence/absence of all drainage features, including these constructed flowlines, as well as their significance, should be confirmed through site-specific surveys and as required through the development application process.

It is SLR's understanding that "Constructed – closed" indicates the potential watercourse segment is piped.

5.4 Species at Risk

Prior to field investigations, a background review was completed for potential SAR habitat opportunities. The NHIC database, the Ontario Breeding Bird Atlas (OBBA), and the Ontario Reptile and Amphibian Atlas (ORAA) were screened for SAR records. Also, based on professional experience, it was determined that larger trees may present habitat opportunities for SAR bat species.

Based on available background information and the 2021, 2022, and 2023 field investigations, the Study Area was assessed for potential SAR habitat opportunities. The assessment was conducted by comparing habitat preferences of species deemed to have potential to occur against current site conditions, as well as integrating field survey results. This SAR habitat assessment can be found in **Appendix K**, providing a detailed description of each species' habitat (including those deemed to not have potential habitat), as well as a discussion of habitat suitability within the Study Area, potential impacts, and mitigation, where applicable. Based on the rationale provided in **Appendix K** and field observations, a total of six (6) SAR have been confirmed and a total of 22 species have been identified as having the potential to occur within the Study Area. SLR's observations of three, confirmed SAR species are shown on **Figure 4**.

The following six SAR have been identified as confirmed within the Study Area, assuming eBird and iNaturalist records are accurate:

Birds

- Chimney Swift (*Chaetura pelagica*) – Threatened - observed foraging only
- Red-headed Woodpecker (*Melanerpes erythrocephalus*) – Endangered – from eBird (2021) and iNaturalist (2023) records
- Eastern Wood-Pewee (*Contopus virens*) – Special Concern - Confirmed
- Barn Swallow (*Hirundo rustica*) – Special Concern - Confirmed



- Bobolink (*Dolichonyx oryzivorus*) – Threatened – Confirmed

Insects

- Monarch Butterfly (*Danaus Plexippus*) – Special Concern - Confirmed

5.5 Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) can be difficult to appropriately determine at the site-specific level, as the assessment must incorporate information from a wide geographic area and consider other factors such as regional resource patterns and landscape effects. To help with site level assessments, the MNR has developed the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E* (Ontario Ministry of Natural Resources, 2015). With the exception of wintering deer yards, which could be, and often are, considered SWH, the detailed identification and designation of SWH has not been completed in Niagara Region or the Town of Port Colborne.

SWH is defined by the MNR in the Significant Wildlife Habitat Technical Guide (Ontario Ministry of Natural Resources, 2000) and Natural Heritage Reference Manual (Ontario Ministry of Natural Resources, 2010), and the abovementioned Schedules and includes the following categories:

- Seasonal Concentration Areas of Animals;
- Rare Vegetation Communities or Specialized Habitats for Wildlife;
- Habitats of Species of Conservation Concern; and
- Animal Movement Corridors.

Criteria for the identification of these features are also provided in the *Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E*. These criteria were used to provide a screening for wildlife habitat within the Study Area for potential SWH as detailed in **Appendix L**.

The Confirmed or Candidate SWH within the Study Area are summarized in **Table 11** and mapped on **Figure 4**. Potential SWH (16 categories), within the Study Area, are not mapped as part of this study, due to lack of definitive information and spatial extent.

Table 11: Candidate and Confirmed SWH

SWH Category	Candidate / Confirmed	Description
Other Rare Vegetation Communities	Confirmed	Rare vegetation communities (i.e., Southern Arrow-wood Mineral Thicket Swamp) were identified within the EIS Subject Lands and are not known, but may be, present within the Study Area. Mapped on Figure 4 .
Amphibian Breeding Habitat (Woodland)	Confirmed	One location meets the criteria. Chorus of both Spring Peeper and Western Chorus Frog recorded in April 2022 in the SWD3 community south of Carl Road and 2 nd Concession Road. Mapped on Figure 4 .
Special Concern and Rare Wildlife Species	Candidate	Two Special Concern avian species were recorded; Eastern Wood-Pewee and Barn Swallow. Three Barn Swallow nests



SWH Category	Candidate / Confirmed	Description
		<p>were observed in two buildings in the active farm area at 896 Killlaly Street East. This is the only area where three or more Barn Swallow nests were observed and thus, is the only SWH for Barn Swallow (mapped on Figure 4). All records of Eastern Wood-Pewee are of single territories in a treed area. Single territories are not considered SWH. One record of Green-winged Teal (Occasional), with uncertain breeding status, is not SWH. A single breeding record of Tufted Titmouse (Rare) is similarly not considered SWH. Other SWH under this category have the potential to occur.</p>



6.0 Channel Morphology

The Wignell Drain subwatershed Study Area consists of three subwatersheds: the Port Colborne Drain, the Wignell Drain, and the Michener Drain. The Port Colborne Drain originally outletted into Lake Erie but was diverted to the Wignell Drain (south of Friendship Trail) and renamed as part of Wignell Drain in the 1970s (EWA Engineering Inc., 2022). For the purposes of this study, the historical subwatershed names are used.

The drainage features within the Wignell Drain subwatershed are primarily managed as municipal drains (**Figure 9**). Municipal drains were historically constructed to improve drainage of agricultural land by serving as the discharge point for agricultural tile drainage systems. Under the *Drainage Act*, municipalities are legislated to maintain and repair drains (Ministry of Natural Resources and Forestry, 2012). From a morphological perspective, municipal drains are considered watercourses and regulated under the *Conservation Authorities Act* (Ministry of Natural Resources and Forestry, 2012); however these features do not function as natural watercourses. Morphology is primarily dictated by original engineered design and ongoing maintenance to ensure adequate conveyance. The regulation of municipal drains as watercourses by Conservation Authorities necessitates their assessment and protection in association with proposed development.

The *Lake Erie North Shore Watershed Plan* classified the Wignell subwatershed based on fish habitat to facilitate better management of the features. The upper branches of the watershed (north of Snider Road allowance) are considered Class F Drains (intermittent systems that are dry at least 3 months of the year), and the lower branches (south of Snider Road allowance) are considered Class B Drains (permanent systems that restrict in-water work during spring months).

6.1 Drainage Feature Characterization

6.1.1 Port Colborne Drain

The Port Colborne Drain has seven reaches, beginning upstream in the existing quarry and continuing downstream to the confluence with the Wignell Drain, south of the Friendship Trail. Only reaches PC-5 and PC-6 were accessible based on property access. Characterization for the remaining reaches was completed based on road crossings observations and aerial imagery review. Reach photos are found in **Appendix M**.

Reaches PC-1 and PC-2 are located in the existing Port Colborne quarry. Access was not provided to assess the existing conditions of these reaches. Historical imagery indicates that the quarry west of Snider Road was operational as early as 1965 and expanded to the east of Snider Road, where PC-1 and PC-2 are located, between 1972 and 2002. The reaches appeared to be channelized prior to the quarry expansion and were further impacted by the expansion. Both reaches were truncated and realigned to their current alignments. The quarry occupies much of the upstream drainage area and impacts the flows to the reaches through runoff capture, water taking, and eventual discharge (EWA Engineering Inc., 2022).

Reach PC-3 is located to the west of PC-4 downstream of the quarry and Main Street East and corresponds to aquatic habitat survey location WD-1. PC-3 was not identified as part of the City of Port Colborne maintenance in 2016 (EWA Engineering Inc., 2022), and it is assumed that it is not maintained. The reach is located on private property and was only assessed at the roadside culvert and through review of aerial imagery. The channel was generally dry, with only standing water observed at the culvert itself. Historical aerial imagery indicates the channel has limited



fluvial processes and a minimal riparian corridor. The feature appears to have been straightened prior to 1934, with no subsequent observable channel change to date, although the channel is generally obscured by dense grasses in the imagery.

Reaches PC-4 through PC-7 were cleaned and realigned by the City of Port Colborne in 2016 (EWA Engineering Inc., 2022). This would have included removal of vegetation from top-of-bank to top-of-bank, targeting tree and shrub growth that partly or fully obstructed primary flow paths. Efforts were made to retain trees and understory growth, where possible, to reduce environmental impacts. Removal of sediment accumulation that impedes flow within the channel cross-section may also be completed as part of this maintenance (EWA Engineering Inc., 2022). Reach characterizations are summarized in **Table 12**.

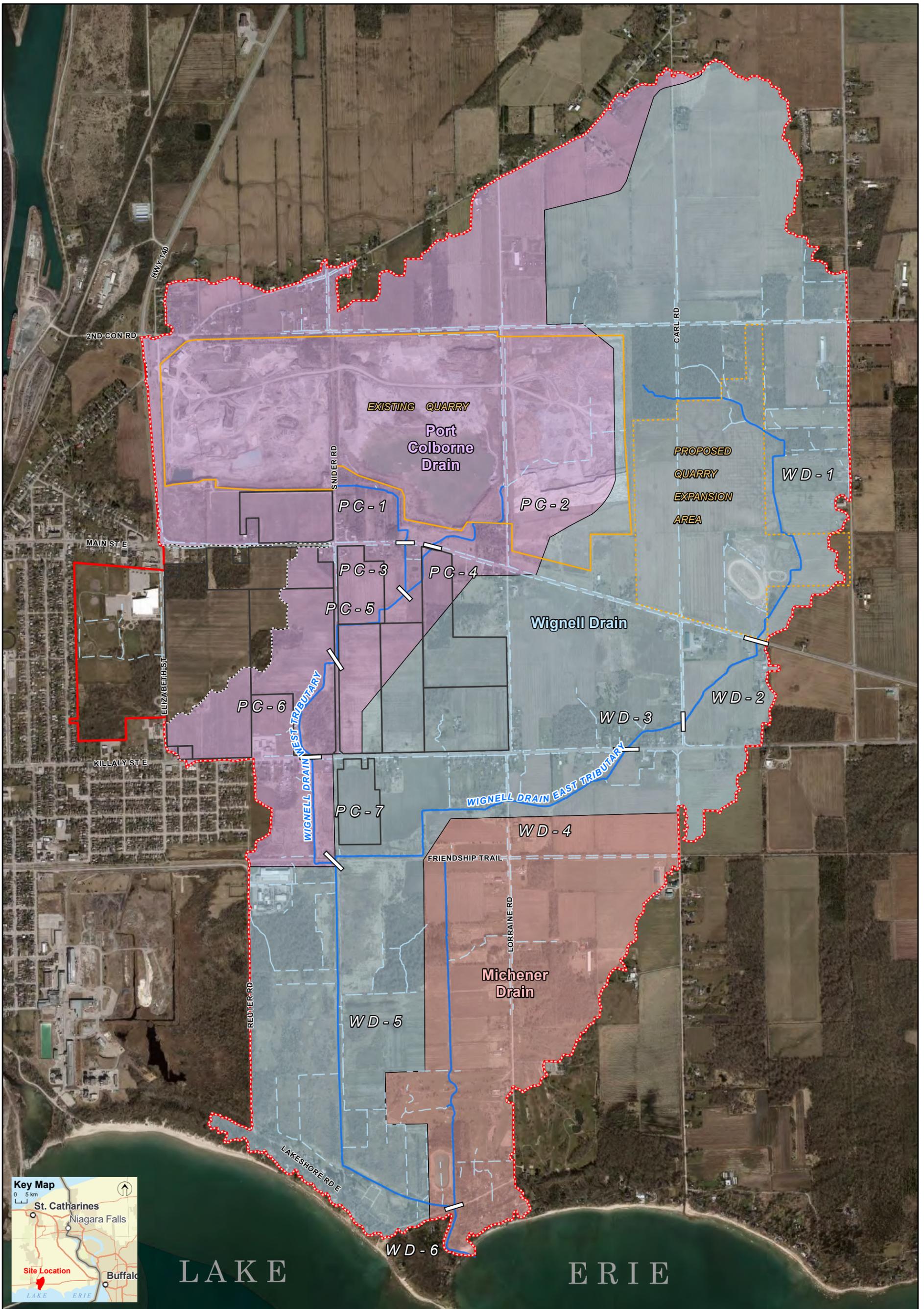
Table 12: Port Colborne Reach Characterization (PC-4 through PC-7)

Reach	Channel Geometry and Flow Condition	Description	Access
PC-4	Channel width approximately 3.5-4 m (measured from LiDAR). A stagnant pool approximately 0.3-0.4 m deep is located at the road culvert. Aquatic habitat sampling in the right of way (ROW) indicates the reach is generally wet throughout the spring and summer, suggesting permanency of flow.	Limited riparian vegetation or riparian corridor. Aerial imagery indicates some rock placement along a small bend to help direct the channel. Potential minor HDF features are visible on aerial imagery draining towards the reach from the east (agricultural field).	No access to reach (private property). Observations made from ROW.
PC-5	Both bankfull width and bankfull depth were measured in the field. Bankfull width ranged from 2.1-4.8 m. Bankfull depth ranged from 0.5-1.3 m. The channel significantly narrows and shallows as it approaches the Snider Road allowance, flowing through cropped fields. The channel is wider through meadow vegetation in the upstream half of the reach. The reach appears to be permanently flowing, with a wetted depth of 0.70 m during an October field visit.	The channel flows through meadow vegetation in the upstream portion of the reach and through active agricultural fields approaching Snider Road. Limited geomorphic processes. Channel substrates consist of sand and silt with some fine gravel. The reach parallels the Snider Road allowance for approximately 185 m.	Partial – access to downstream half of reach only.



Reach	Channel Geometry and Flow Condition	Description	Access
PC-6	Both bankfull width and bankfull depth were measured in the field. Bankfull width ranged from 4.9-5.75 m. Bankfull depth ranged from 1.06-1.12 m. Channel appears to be permanently flowing based on field visits in July and October.	Channel flows through meadow and forested vegetation. Review of the historical aerial imagery indicates some planform development and adjustment of the channel between maintenance years. A small drainage feature from the adjacent elementary school joins the channel near the downstream end, approaching Killaly Street East. Channel substrates consisted of sand and silt with fine gravels. The channel cross-section was well-defined; however, it was frequently populated by cattails.	Full access.
PC-7	Both bankfull width and bankfull depth were measured in the field. Bankfull width ranged from 2.5-4.1 m. Bankfull depth ranged from 0.4-0.65 m. Reach was permanently flowing. Channel dimensions were wider at the Friendship Trail culvert.	The channel planform is straight and well-maintained, and there are no visible planform adjustments in the historical aerial imagery. The surrounding vegetation is primarily meadow vegetation. Substrates consisted primarily of silt and sands.	No access to reach (private property). Observations made within 75 m of Friendship Trail.





LEGEND Reach Break ¹ Watercourse ² NPCA Flowline³ Natural Constructed - open Constructed - closed Wignell Subwatershed		Description Michener Drain Port Colborne Drain Wignell Drain Existing Quarry Footprint Proposed Quarry Expansion Lands	Subject Lands (Owned by Elite Developments) Study Area 1 - WD = Wignell Drain, PC = Port Colborne 2 - Geospatial Ontario (GEO) 3 - Niagara Peninsula Conservation Authority (NPCA)	 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: RC Date: Feb 26, 2026 NORTH Source Notes: Imagery (2020) provided by Brock University GIS services. Contains information licensed under the Open Government Licence - Ontario.	CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc. PROJECT Wignell Drain Subwatershed Study TITLE Wignell Drainage Areas REF. NO. 2007708-9-1 Figure 9
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6.1.2 Wignell Drain and Michener Drain

Wignell Drain has five reaches beginning upstream in the proposed quarry expansion area and draining into Lake Erie. The confluence of Port Colborne Drain and Wignell Drain is located just south of the Friendship Trail. Access was not granted to any reaches of the Wignell Drain and as such all assessments were completed at ROWs and through desktop approaches (i.e., review of historical aerial imagery and LiDAR). Michener Drain is located to the east of Wignell Drain, south of the Friendship Trail. Similarly, no access was granted to these lands. Michener Drain converges with the Wignell Drain at Lakeshore Road East, at the dam structure that mitigates backwater effects from Lake Erie. Reach characterizations are summarized in **Table 13**.

Table 13: Wignell Drain and Michener Drain Reach Conditions

Reach	Channel Geometry	Description	Access
WD-1	Bankfull width 4-5 m based on roadside and LiDAR measurements.	The reach generally flows through agricultural fields with limited to no riparian buffer. There is no visible evidence of planform adjustment based on the historical aerial imagery.	No access to reach (private property). Observations made from ROW.
WD-2	Bankfull width 4-5.5 m based on roadside and LiDAR measurements.	The reach flows behind a residential property and through an active agricultural field. There is a limited riparian buffer, approximately 2 m on either side of the channel. There is no visible evidence of planform adjustment based on the historical aerial imagery.	No access to reach (private property). Observations made from ROW.
WD-3	Bankfull width 4-5 m based on roadside and LiDAR measurements.	The reach flows behind several residential properties with a minimal riparian buffer, approximately 1-2 m on either side of the channel. The channel narrows approaching the downstream end of the reach and culvert at Killaly Street East. There is no visible evidence of planform adjustment based on the historical aerial imagery.	No access to reach (private property). Observations made from ROW.
WD-4	Bankfull width 3-6 m and bankfull depth of 0.50 m based on roadside and LiDAR measurements.	The reach flows primarily through agricultural fields with a minimal riparian buffer, approximately 1-2 m on either side of the channel. Some wetland vegetation was documented in the channel and along the margins. Two small ponds are seen adjacent to the channel. There is no visible evidence of planform adjustment based on the historical aerial imagery.	No access to reach (private property). Observations made from ROW.



Reach	Channel Geometry	Description	Access
WD-5	Bankfull width is 10-15 m and bankfull depth is 0.80-1.25 m based on roadside and LiDAR measurements.	The reach is backwatered, slow flowing, and has significant unconsolidated silt deposition downstream of the culvert at Friendship Trail. Wetland and aquatic vegetation populate the margins of the channel. Dense aquatic vegetation is visible in aerial imagery indicating limited flow velocity. The reach exhibits limited fluvial processes.	No access to reach (private property). Observations made from Friendship Trail.
Michener Drain	Bankfull width is 2-4 m as measured from LiDAR. No bankfull depth measurement.	Michener drain is straightened through its entire length, except for the reach through Whisky Run Golf Club, where there is some sinuosity. Prior to the golf course development, the reach was straight and ditched. It is assumed the golf course operations altered the planform alignment. The surrounding manicured lawn also provides the opportunity for some natural planform adjustment. A large pond is located on the west side of the channel, downstream of the golf course. There is less evidence of backwatering visible on the aerial imagery compared to in the Wignell Drain reach WD-5.	No access to reach (private property).

6.1.3 HDF Characterization

In 2022, HDFs within the Subject Lands were evaluated in accordance with *the Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (Toronto and Region Conservation Authority and Credit Valley Conservation, 2014) (**Table 14** and **Figure 10**). These guidelines use an integrated approach for the evaluation of key attributes of drainage features including flow and feature form, riparian vegetation, fish and fish habitat, and terrestrial habitat. The evaluation divides HDFs into segments, with breaks between segments occurring where key attributes change.

Table 14: HDF Functional Classification and Management

Drainage Feature	Step 1		Step 2	Step 3	Step 4	Management Recommendation
	Hydrology	Modifiers	Riparian	Fish Habitat	Terrestrial Habitat	
HDF-1	Valued	Agriculture	Limited	Contributing Function	Valued	Mitigation
HDF-2	Valued	Agriculture	Important	Contributing Function	Important	Conservation
HDF-3	Valued	Agriculture	Limited	Contributing Function	Limited	Mitigation
HDF-4	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required



Drainage Feature	Step 1		Step 2	Step 3	Step 4	Management Recommendation
	Hydrology	Modifiers	Riparian	Fish Habitat	Terrestrial Habitat	
HDF-5	Valued	Agriculture	Limited	Contributing Function	Limited	Mitigation
HDF-6	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required
HDF-7	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required
HDF-8	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required
HDF-9	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required
HDF-10	Valued	Agriculture	Limited	Contributing Function	Limited	Mitigation
HDF-11a	Valued	None	Important	Contributing Function	Important	Conservation
HDF-11b	Valued	Agriculture	Limited	Contributing Function	Limited	Mitigation
HDF-12	Limited	Agriculture	Limited	Contributing Function	Limited	No Management Required

As outlined in **Table 14**, the majority of the HDFs identified within the Subject Lands do not provide a significant ecological or hydrologic benefit to the Port Colborne subwatershed; as such, these features are identified by a management recommendation of either *Mitigation*, where some hydrologic function may need to be replicated, or *No Management* where no significant function was identified and these features may be removed from the landscape with no future consideration. A few other features, notably HDF-2 and the HDF-11a segments, were identified as providing more important ecological benefit due to their position within wetland or woodland communities, permanence on the landscape (i.e., standing water in late spring), and their potential ability to aid or support wildlife, in this case, amphibian species, resulting in these features receiving *Conservation* status.

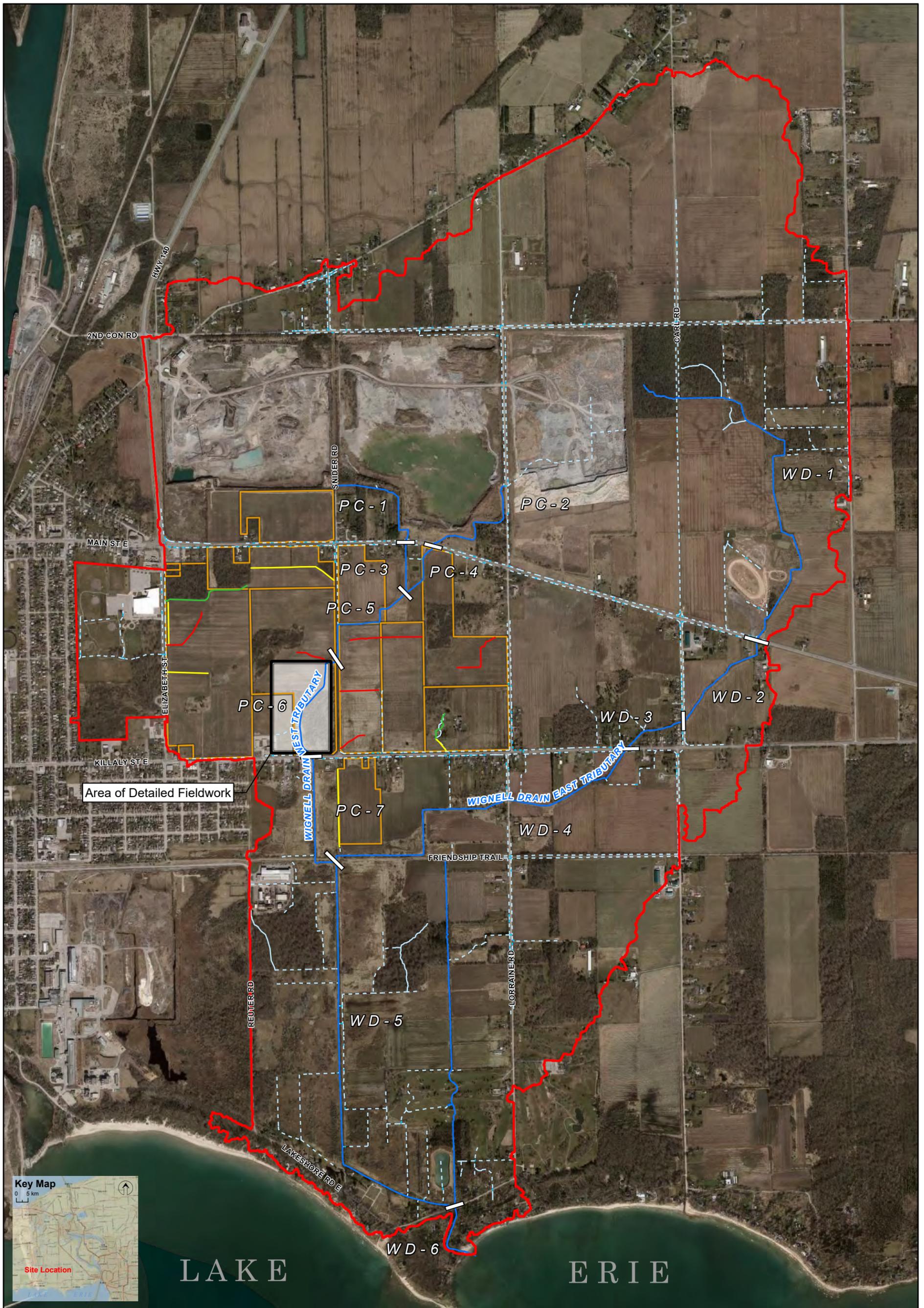
As highlighted above, HDFs identified for *Mitigation* should be considered during future detailed design phases of any development project, with hydrologic function being maintained to benefit downstream systems within the Wignell Drain subwatershed. HDFs identified as *Conservation*, should be maintained on the landscape, preferably in their current location, or in a re-aligned form that maintains the ecological function they provide to the surrounding natural landscape (e.g. HDF-2's proximity to woodlands may support Western Chorus Frog populations that utilize the saturated spring woodland for breeding purposes).

The remainder of the potential HDFs and other small municipal drainage features within the larger Wignell Drain Subwatershed (as shown in **Figure 10**), were reviewed using a desktop approach. The NPCA mapping (NPCA, 2023) identifies the features as *natural*, *constructed open*, or *constructed closed*. Most of the drainage features are classified as *constructed open* and flow adjacent to roadways in the upper watershed. Along reach WD-3 and WD-4 there are several *constructed open* features that flow across the landscape and should be evaluated for potential HDF functions at subsequent planning stages should development of those properties



occur. Due to constructed nature of these features, they were frequently visible on the LiDAR mapping, further confirming ongoing maintenance of channel geometry. Similarly, there are several *constructed open* features near the downstream end of reach WD-5 and the Michener Drain. Repeated maintenance limits the geomorphic function and aquatic habitat of these features. The value of these features would primarily be based on potential connections and linkages with existing ecological features, such as a number of wetlands identified surrounding reach WD-5 (**Figure 9**). Subsequent studies should focus on identifying these linkages and the functionality of the constructed drains as potential habitat corridors. There are a very limited number of features classified as *natural* throughout the watershed. These features should be prioritized for additional study should development proceed in these areas.





LEGEND Reach Break ¹ Watercourse ² NPCA Flowline³ Natural Constructed - open Constructed - closed <small>1 - WD = Wignell Drain, PC = Port Colborne 2 - Contains data sourced from Geospatial Ontario 3 - Contains data sourced from both Niagara Peninsula Conservation Authority (NPCA)</small>		Headwater Drainage Feature <i>Conservation Type</i> Conservation Mitigation No Management		Subject Lands (Owned by Elite Developments) Study Area		0 100 200 300 400 500 METRE SCALE North American Datum 1983 Universal Transverse Mercator Projection Zone 17 Scale: 1:17,000 Page Size: Tabloid (11 x 17 inches) Drawn: SM Checked: RC Date: Feb 26, 2026 NORTH		CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 889 Killaly Holdings Inc. PROJECT Wignell Drain Subwatershed Study TITLE Fluvial Features	
						REF. NO. 2007708-10-1 Figure 10			

6.2 Meander Belt Delineation

To support constraint delineation for the subwatershed Study Area, meander belt width corridors were delineated for the main watercourse branches. Based on limited access to the majority of the Study Area, the meander belt corridors were primarily delineated based on high-level desktop information. Meander belt corridors should be reviewed and refined as appropriate through subsequent studies, particularly for reaches that were not accessible during field assessments.

The meander belt is a designated corridor intended to contain natural meander migration tendencies based on historical planform alignments and potential future planform alignments. The meander belt is determined based on background information, historical data (aerial imagery), topographic mapping (LiDAR), and field observations of existing channel conditions. Empirical methods may be used when the channel planform has been historically altered and is not representative of natural channel geometry or processes.

The drainage features in the Study Area are managed as engineered, municipal drain features (i.e., dimensions and alignments are maintained through anthropogenic intervention to ensure adequate flow conveyance). Historical aerial imagery revealed that the drainage features have been straightened and maintained since at least the earliest available aerial photography (1934).

Empirical meander belt width equations rely on various channel parameters indicative of hydraulic capacity (drainage area, channel area, discharge, cross-section width) to determine an appropriate corridor width. For the Wignell Subwatershed cross-sectional dimensions are imposed and not reflective of channel processes. Heavily altered features typically rely on drainage areas or discharge as inputs for empirical equations and representation of the potential for erosion and channel migration. Due to the scale of the current study, reliable discharge data were not available on a reach-by-reach basis. Thus, meander belt corridors were derived based on drainage area (**Table 15**). The existing meander belt width was derived based on the NRCS (2007) equation. A 20% factor of safety was added (10% on either side) to establish the final meander belt width (**Table 16**).

Table 15: Empirical Meander Belt Width Equation

Source	Equation
NRCS (2007)	$120A_w^{0.43}$

Table 16: Meander Belt Width Results

Reach	Drainage Area (Ha)	Existing Meander Belt Width (m)	Factor of Safety (20%) (m)	Final Meander Belt Width (m)
PC3	79	22	4.4	26
PC4	221	34	6.8	41
PC5	379	43	8.6	52
PC6	428	45	9.0	54
PC7	447	46	9.2	55



Reach	Drainage Area (Ha)	Existing Meander Belt Width (m)	Factor of Safety (20%) (m)	Final Meander Belt Width (m)
WD-2	289	38	7.6	46
WD-3	310	39	8.0	48
WD-4	498	48	9.6	58

6.3 Channel Morphology and Hydraulics – Reach PC-6

An erosion threshold analysis was completed for Reach PC-6 based on the detailed field data collected on July 18, 2023, to inform future stormwater management planning in the Wignell Drain Subwatershed. Detailed field data collection included measurements of bankfull cross-sections, longitudinal profiles, and visual inspections of the grain size distribution of alluvial bed material. The field data were analyzed to determine the average bankfull channel geometry (**Table 17**) and hydraulics (**Table 18**). Bankfull discharge is estimated to be 1.04 m³/s based on channel geometry.

Reach PC-6, located in the Subject Lands west of the Snider Road allowance (**Figure 10**). The surrounding land use transitions from active agricultural (PC-5) to natural meadow and woodland vegetation (PC-6). Riparian vegetation consisted of dense, tall grasses, which overhung the channel, but did not obscuring flow. Cattail stands were sporadically present in the channel through the reach. Bed material is primarily fine-grained, ranging from silt to coarse sands. Root strength from the riparian vegetation stabilizes bank material and reduces erosion potential. Shear stress during high flows is primarily concentrated on the finer bed material, resulting in a narrow, deep cross-section as indicated by the width-depth ratio (8.15).

Table 17: Reach PC-6 Averaged Bankfull Channel Dimensions

Parameter	Value
Width (m)	5.45
Average Depth (m)	0.67
Maximum Depth (m)	1.09
Width:Average Depth	8.15
Cross-sectional Area (m ²)	2.95

Table 18: Reach PC-6 Averaged Bankfull Channel Hydraulics

Parameter	Value
Energy Gradient (m/m)	0.0011
Discharge (m ³ /s)	1.04
Average Velocity (m/s)	0.30
Froude Number	0.12
Average Shear Stress (N/m ²)	5.24

Erosion thresholds define a theoretical hydraulic condition at which sediment of specific size is entrained and transported by a watercourse. The threshold represents a depth, velocity, or



discharge rate at which the material may be entrained based on the cross-sectional geometry. The erosion threshold does not indicate that erosion will occur if this flow is exceeded; it simply indicates the flow conditions at which sediment/bed material is likely to be mobilized.

The bed material within reach PC-6 is fine-grained and does not have a typical gravel-bed distribution, for which most sediment transport relations were developed. As a result, the threshold value is based on empirically-derived data for fine-grained and vegetation-controlled channels (Fischenich, 2001; **Table 19**).

Table 19: Reach PC-6 Permissible Shear and Velocity for Fine Gravels (from Fischenich, 2001)

Boundary Type	Permissible Shear Stress (N/m ²)	Permissible Velocity (m/s)	Citation
Fine gravels	1.92	0.53	Chang, H.H. (1988); Data from Fischenich (2001).

Based on the field-measured cross-sections, the critical discharge (erosion threshold) required to produce the critical shear stress is 0.12 m³/s, approximately 10% of the bankfull discharge (**Table 20**).

Table 20: Reach PC-6 Critical Hydraulic Conditions

Parameter	Value
Energy Gradient (m/m)	0.0011
Critical Shear Stress (N/m ²)	1.92
Critical Discharge (m ³ /s)	0.12
Bankfull Discharge (m ³ /s)	1.04

7.0 Hydrogeological Characterization

Monitoring well and mini-piezometer locations used to inform the hydrogeological characterization are shown on **Figure 11**, as discussed in Section 3 (Study Approach).

7.1 Physiography

7.1.1 Climate Conditions

The Study Area is in a continental climate region with a warm, humid summer and a cold winter, as well as a wet spring, dry summer, and moderately wet autumn precipitation wise. The region is generally affected by warm, moist air masses from the south and cold, dry air masses from the north, and experiences a wide range of weather conditions throughout the course of an average year. The closest climate station is Port Colborne Station located 1.6 km west of the boundary of the Study Area. **Table 21** lists the average and daily values of major climate parameters collected at this station for the period between 1981 and 2010.

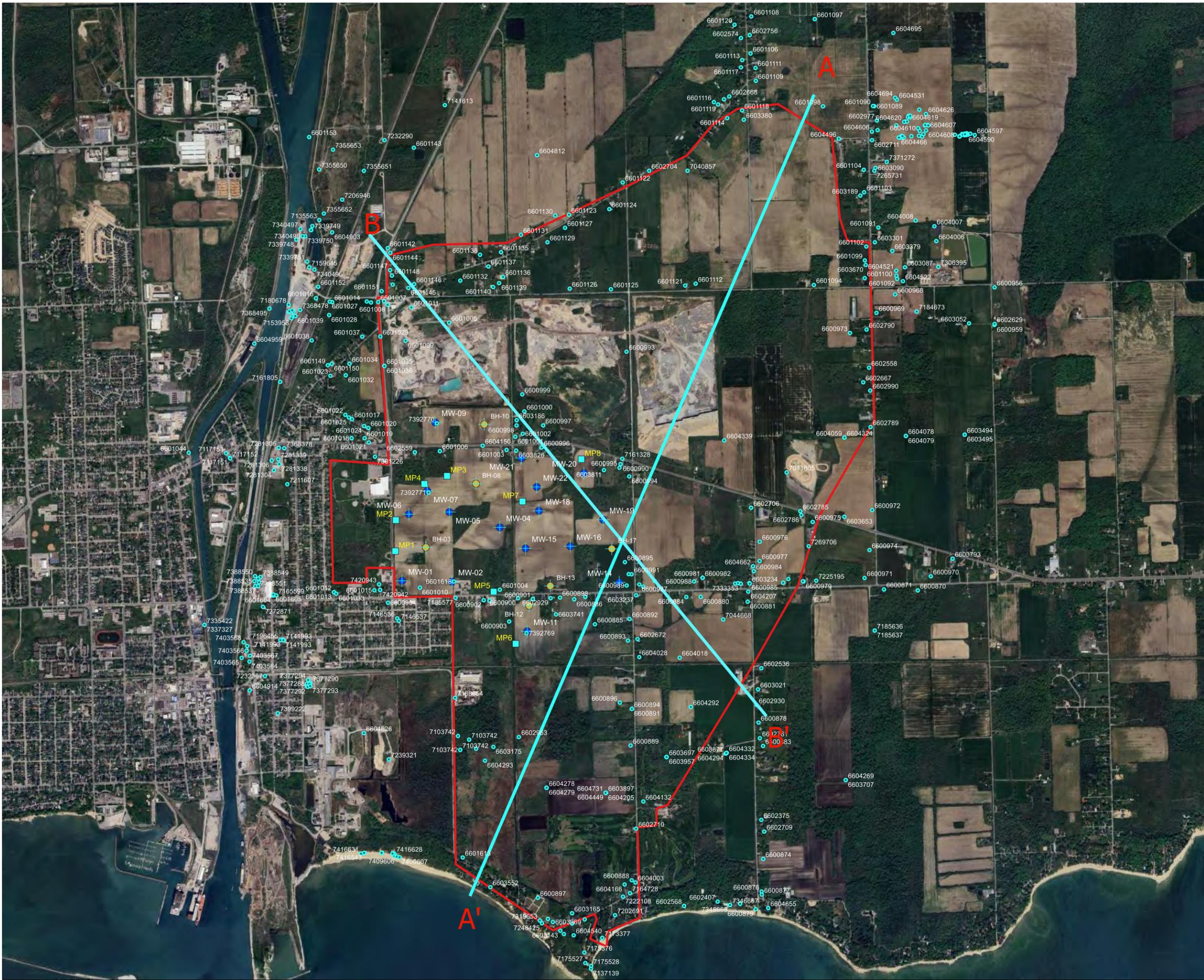


Table 21: Monthly Averaged Climate Data (1981 – 2010)

Average Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Air T (°C)	-3.7	-2.9	0.8	7	13.2	18.7	21.9	21.3	17.4	11	5.5	-0.4
Rainfall (mm)	32.5	26.9	46.6	71.9	89.1	78.9	82.2	82.5	98	89.7	95.2	53.2
Snowfall (cm)	40.5	30.1	20.2	4.2	0.6	0	0	0	0	0.8	5.8	35.6
Precipitation (mm)	73.1	57	66.8	76.1	89.7	78.9	82.2	82.5	98	90.4	100.9	88.8
Extreme Daily Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Extreme Daily Rainfall (mm)	46.5	29.5	34.8	39	41	108.7	74	102	96	72.6	78.2	38.6
Extreme Daily Snowfall (cm)	35	12	32	17	0	0	0	0	0	20	7	15

It should be noted that the Lake Effect of the Great Lake System of Ontario can moderate air temperatures and snowfalls up to 5 to 10 km inland. The Study Area is on the north shore of Lake Erie, and as such, the weather in the Study Area can be affected by the Lake Effect significantly, which could result in slight moderation of air temperatures and higher than normal snowfalls in the early winter (as shown in **Table 21**).





Legend

- Study Area
- MECP Well Record
- NPCA Wells
- PGMN Well
- + Exp Monitoring Well
- Exp Mini-Piezometer
- Exp Borehole

Cross Section

- A-A'
- B-B'



North American Datum 1983
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Project Wignell Drain Subwatershed Study

TITLE Hydrogeological Investigation Plan



REF. NO 2007708

Figure 11

7.1.2 Geomorphology and Drainage

The Study Area is located in the Haldimand Clay Plain, which was deposited during the era of glacial Lake Warren (12,700 years before present) and lies between the Niagara Escarpment and Lake Erie (**Figure 12**). The topography of the Haldimand Clay Plain is basically flat with streams meandering sluggishly across it.

The ground surface of the Study Area has elevations ranging from 194 mASL at the north end to 178 mASL at the south end of, which is a few meters above the average water level of Lake Erie. Natural drainage channels are not well developed and have been modified by channelization to facilitate farmland drainage (**Figure 13**). Based on the results of remote sensing interpretation and regional information interpretation by SLR, the Study Area is further divided into three geomorphological units:

- Bedrock Escarpment;
- Quarry; and
- Lake plain.

Table 22 list the major properties of the three geomorphological units of the Study Area, as defined by SLR, while **Figure 13** shows the demarcation of these geomorphological features. The Bedrock Escarpment is located on the north end of the Study Area and forms the north divide of the Wignell Drain subwatershed. This unit is characterized by shallow bedrock and apparent relief. Land use is primarily farmland, woodlands and residential. The large quarry within this area is operated by Port Colborne Quarries Inc. and consists of three pits (Pit 1, Pit 2, and Pit 3); however, an application for an extension to Pit 3 is ongoing. Geomorphologically, the quarry pits serve as catch basins for both surface water and groundwater. The Lake Plain unit covers a majority of the Study Area and is characterized by a relatively flat ground surface. Its major land use is farmlands and woodlands.

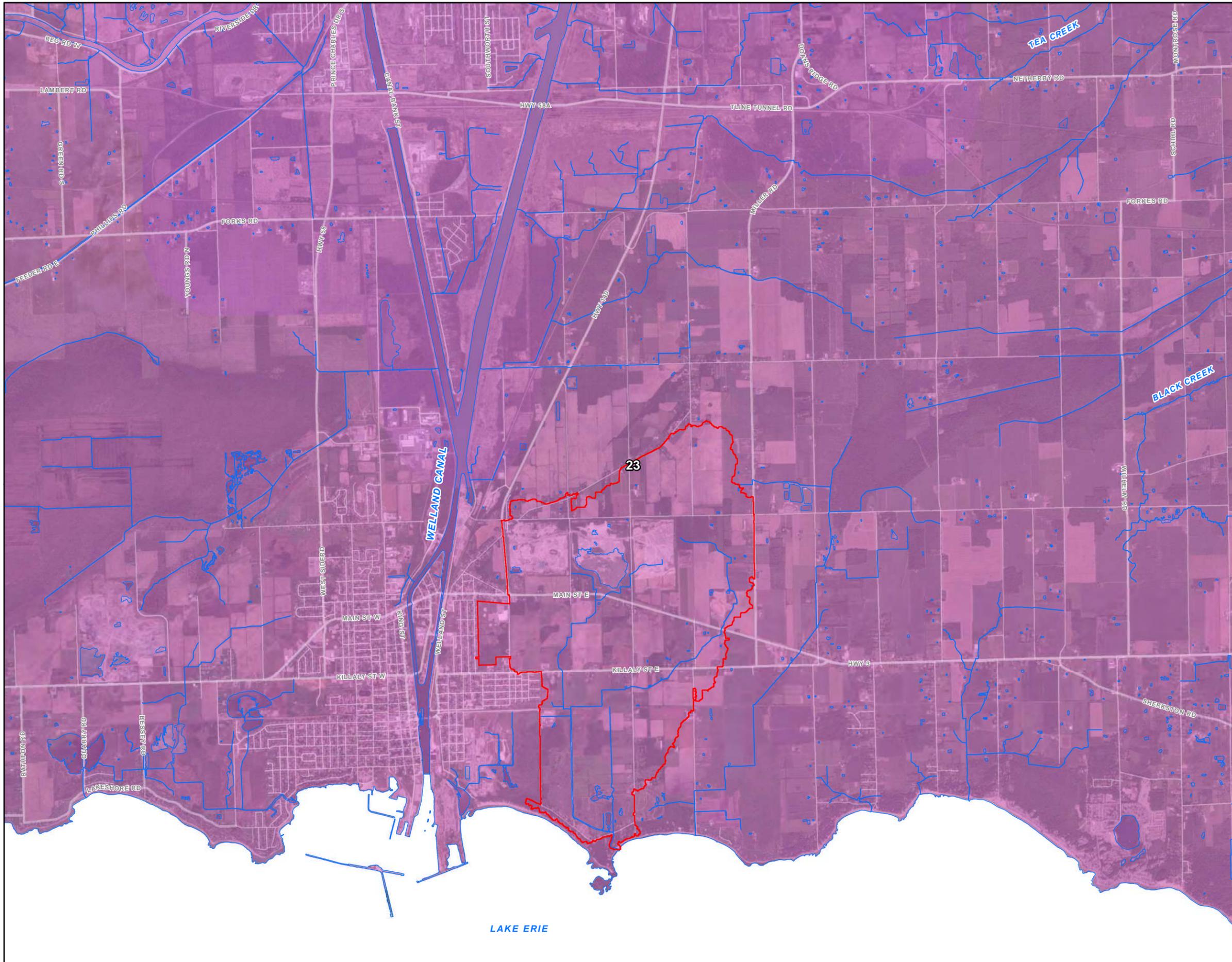
Table 22: Properties of Geomorphological Units

Unit	Elevation (mASL)	Area (ha)	Relief (m)	Gradient	Land Use
Bedrock Escarpment	183-194	148.18	9	0.8-1.2%	Farmlands, woodlands and residential
Quarry	165-187	206.83	12	-	Quarry operation
Lake Plain	178-184	954.59	6	0.3-0.6%	Farmlands and woodlands

The Study Area is part of the Northeast Lake Erie Shoreline watershed, which is a Tertiary Watershed based on the Ontario Watershed Boundaries (OWB) map. The Welland Canal is the major flow channel adjacent to the Study Area. It flows from Lake Erie to the south to Lake Ontario to the north and is controlled by locks to permit marine vessels to traverse the vertical difference in elevation between the two lakes.

The watercourses identified within the Study Area includes the Port Colborne Drain, the Wignell Drain, and the Michener Drain. Port Colborne Drain and Wignell Drain controls the majority of the subwatershed, while the Michener Drain controls southeast corner of the subwatershed. Both Wignell Drain and Michener Drain have a long history of channelization and alignment and contains NPCA regulated area of different widths along the drains.





- LEGEND
- Watercourse¹
 - Study Area
- Physiographic Region²**
- 23: Haldimand Clay Plain

1. LIO/MNRF
 2. Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228

0 1 2
km

North American Datum 1983
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NORTH

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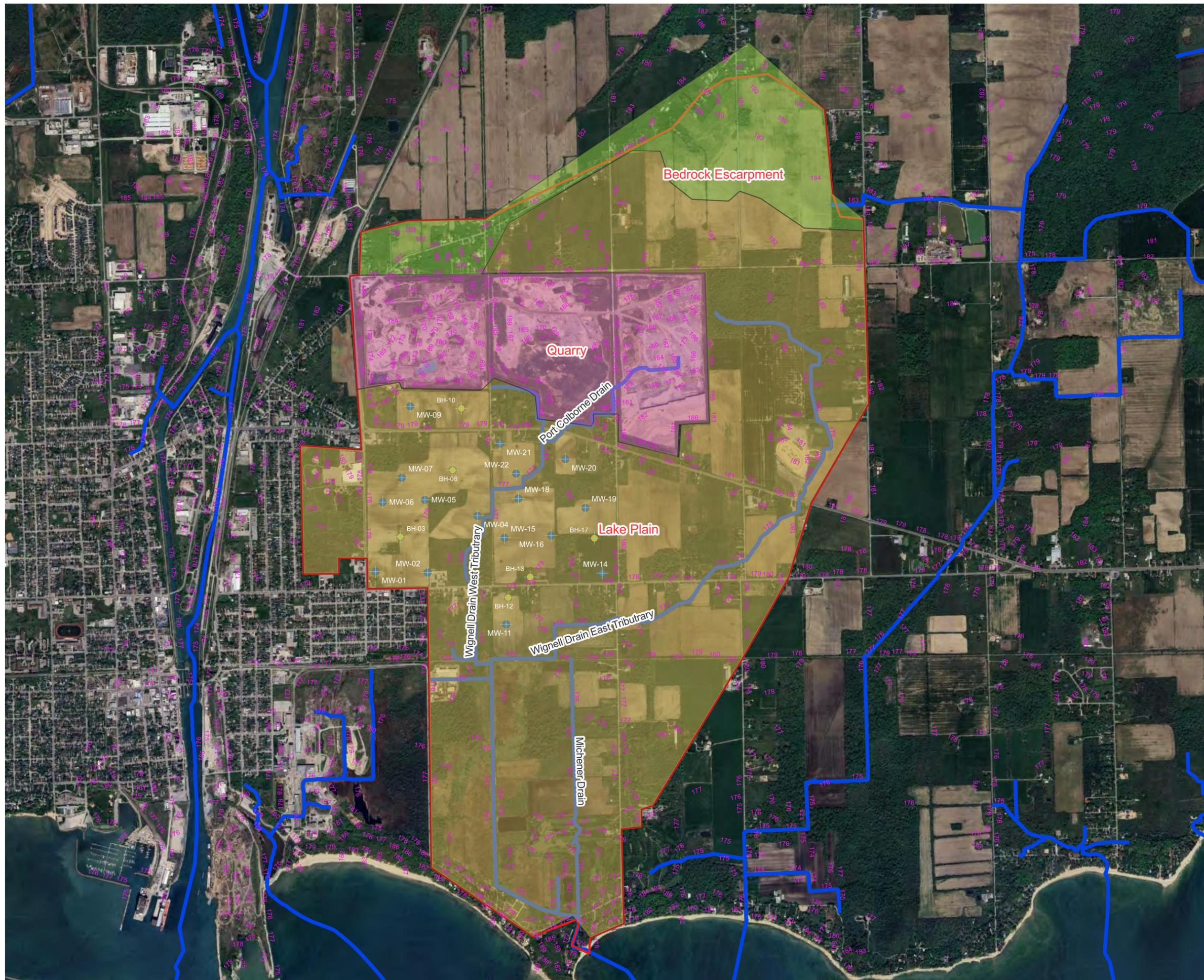
PROJECT Welland S - Wignell SWS

TITLE

Physiography

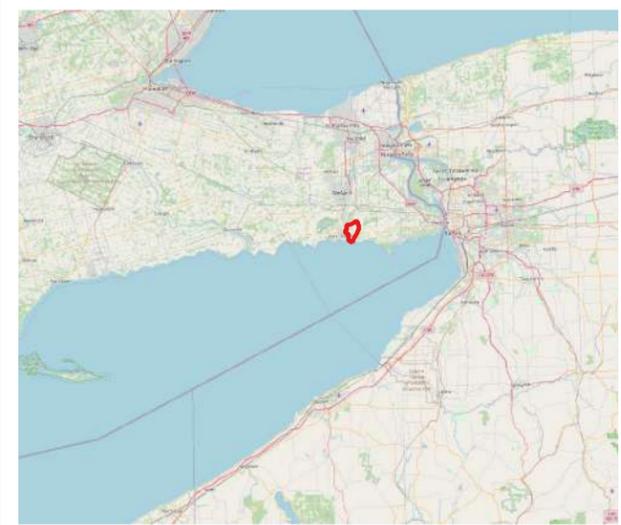
REF. NO. 2007708-1-1

Figure 12



Legend

- Study Area
- Geomorphological Units**
- Lake Plain
- Bedrock Escarpment
- Quarry
- Water Course**
- Topo Contours-1m



1 2 km

North American Datum 1983
 Universal Transverse Mercator Projection Zone 17

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Project Wignell Drain Subwatershed Study

TITLE Geomorphology, Topography and Drainage System



REF. NO 2007708

Figure 13

7.1.3 Karstification

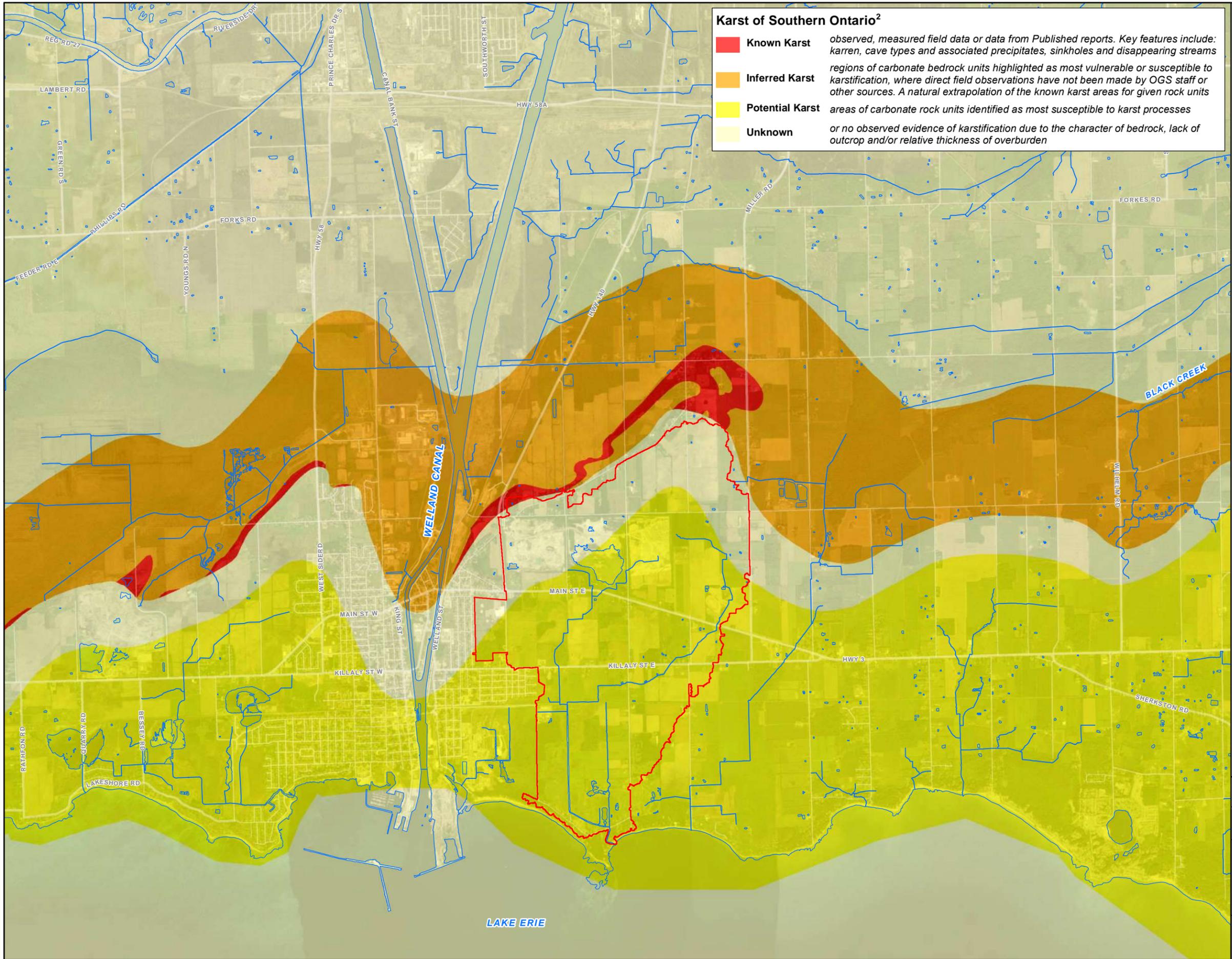
Karstification refers to the process where carbonate or other soluble rocks, either at surface or under a shallow overburden cover, are exposed to leaching and dissolution by acidic or aggressive atmospheric water to produce a series of landform features, or karst, including sinkholes, caves, natural bridges, sinking streams, dry valleys, karren, stalactites, stalagmites, and/or tufa. The Study Area is located in the Guelph-Smithville Karst Region based on the Karst of Southern Ontario and Manitoulin Island (OGS, 2008). Most of the Study Area was mapped by OGS as Potential Karst Area (**Figure 14**). Only a small area in the northwest corner of the Study Area is in Known Karst area. The area between the Potential Karst Area and the Known Karst Area within the Study Area is the Unknown Karst Area. An area of Inferred Karst is located just north of the northern Study Area boundary. **Table 23** provides a summary of the characteristics of the three types of karst areas identified within the Study Area.

Table 23: Karst Classification

Class	Formation	Lithology	Drift Cover	Karst Features	Area (ha)
Known Karst	Bertie	Dolostone; argillaceous, laminated, bituminous or burrowed	None	Unknown	13
Unknown Karst	Bois Blanc	Limestone, dolostone; cherty, argillaceous; local glauconitic sandstone	Yes	Unknown	358
Potential Karst	Onondaga	Limestone; variably cherty, fossiliferous, argillaceous, biohermal	Yes	Unknown	889

Site reconnaissance did not identify any surficial karst features. Karst investigation is beyond the scope of work for this subwatershed study. Site specific karst investigation is recommended for major development projects located in the Known and Potential Karst Areas.





Karst of Southern Ontario²

- **Known Karst** *observed, measured field data or data from Published reports. Key features include: karren, cave types and associated precipitates, sinkholes and disappearing streams*
- **Inferred Karst** *regions of carbonate bedrock units highlighted as most vulnerable or susceptible to karstification, where direct field observations have not been made by OGS staff or other sources. A natural extrapolation of the known karst areas for given rock units*
- **Potential Karst** *areas of carbonate rock units identified as most susceptible to karst processes*
- **Unknown** *or no observed evidence of karstification due to the character of bedrock, lack of outcrop and/or relative thickness of overburden*

KEY MAP

- Watercourse¹
- Study Area

1. LIO/MNRF
 2. Brunton, F.R. and Dodge, J.E.P. (2008). Karst map of Southern Ontario, including Manitoulin Island; Ontario Geological Survey, Groundwater Resource Study 5



North American Datum 1983
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PROJECT Welland S - Wignell SWS

TITLE Karst



REF. NO. 2007708-4-1

Figure 14

7.2 Land Use and Natural Heritage

Based on image interpretation and site reconnaissance, major land use types within the Study Area include farmlands, quarry pits, golf courses, commercial properties, roads, and residential properties.

Based on the provincial dataset, image interpretation, site reconnaissance, and the ecological characterization of the study area as part of the SWS, the primary natural heritage features identified within the Study Area include wetlands, woodlands, and drainage channels. PSWs and other significant features within the Study Area are designated as part of a larger Natural Heritage System in the provincial natural heritage mapping. The types of wetlands as identified by SLR's ELC for the Study Area include both marsh wetland and swamp wetland.

Table 24 summarises the major attributes of the land use units and natural heritage features.

Table 24: Attributes of Major Land Use Units and Natural Heritage Features

Land Use Unit	Area (m ²)	Surface Gradient
Farmland	5,765,118	0.2% - 0.5%
Quarry Pits	1,755,411	0.5%
Golf Courses	289,625	0.6%
Wetland	896,041	0.4%
Woodland	986,341	0.5%
Residential	1,269,453	<0.3%
Grassland	977,369	0.4%
Commercial and Institutional	544,842	<0.3%
Roads	371,453	-

As mentioned above, three drains including the Port Colborne Drain, the Wignell Drain and the Michener Drain exist within the Study Area. Based on channel form, all three drains have been channelized and realigned in some capacity.

7.3 Geology and Stratigraphy

7.3.1 Geotectonic Setting

Geotectonically the Study Area is located in the north edge of the foreland basin of the Appalachian Fold Belt, south of the Algonquin Arch. Ultimately there are three large suites of geological formations underlain the study area including Quaternary overburden deposits, Paleozoic platform sedimentary formations, and Proterozoic basement gneiss formations, as shown in **Table 25**.

Table 25: Geotectonic Setting

Geological Age	Formations	Geotectonic Environment
Quaternary	Overburden	Glacial to glaciolacustrine
Paleozoic	Clastic to limestone	Foreland basin of Appalachian Orogen



Geological Age	Formations	Geotectonic Environment
Precambrian	Gneiss	Grenville Orogen

7.3.2 Overburden Geology

Surficial geology as mapped by OGS (**Figure 15**) includes four units within and surrounding the Study Area:

- Fine-textured glaciolacustrine deposits of massive to laminated silt and clay, minor sand, and gravel;
- Organic deposits of peat, muck, and marl;
- Coarse-textured glaciolacustrine deposits of sand, gravel, minor silt, and clay; and,
- Outcropped Paleozoic bedrock.

The first unit covers most of the Study Area and forms the major farmland soils. Organic deposits occur in the southwest corner of the Study Area and the sand and gravel deposits occur in the northeast corner.

Bedrock outcrops occur at the surface in a substantial part of the Study Area, and almost half of the bedrock outcrop area has been developed into quarry.

7.3.3 Bedrock Geology

Bedrock within the Study Area was mapped by OGS (**Figure 16**) to consist of the following three units underlying the overburden from south to north:

- Onondaga Formation (D2) – limestone; variably cherty, fossiliferous, argillaceous, biohermal;
- Bois Blanc Formation (D1) – limestone, dolostone; cherty, argillaceous; local glauconitic sandstone (Springvale Member); and,
- Bertie Formation (S3) – dolostone; argillaceous, laminated, bituminous or burrowed.

The whole Study Area is underlain by Onondaga Formation and Bois Blanc Formation, with only a small area in the northwest corner of the Study Area being underlain by Bertie Formation. The following details were based on *OGS Special Volume 4, Part 1 and Part 2* (C., Williams, Sutcliffe, & Thurston, 1991), and the occurrence of bedrock units in the Study Area.

Onondaga Formation occupies approximately 70% of the Study Area. This formation was deposited in the Middle Devonian Period (D2) in a reef forming environment. The lithology of the formation includes limestone, cherty to interbeds of chert, fossiliferous, locally argillaceous, biohermal, and has an average thickness of 30 m.

Bois Blanc Formation, underlying the Onondaga Formation, occupies the north part of the Study Area and is composed primarily of glauconitic cherty carbonate, known as Springvale Member, which was deposited in a shallow marine environment during the Early Devonian Period (D1) and has an average thickness of 3 m. The bottom of the Bois Blanc Formation is known to have paleokarst features.

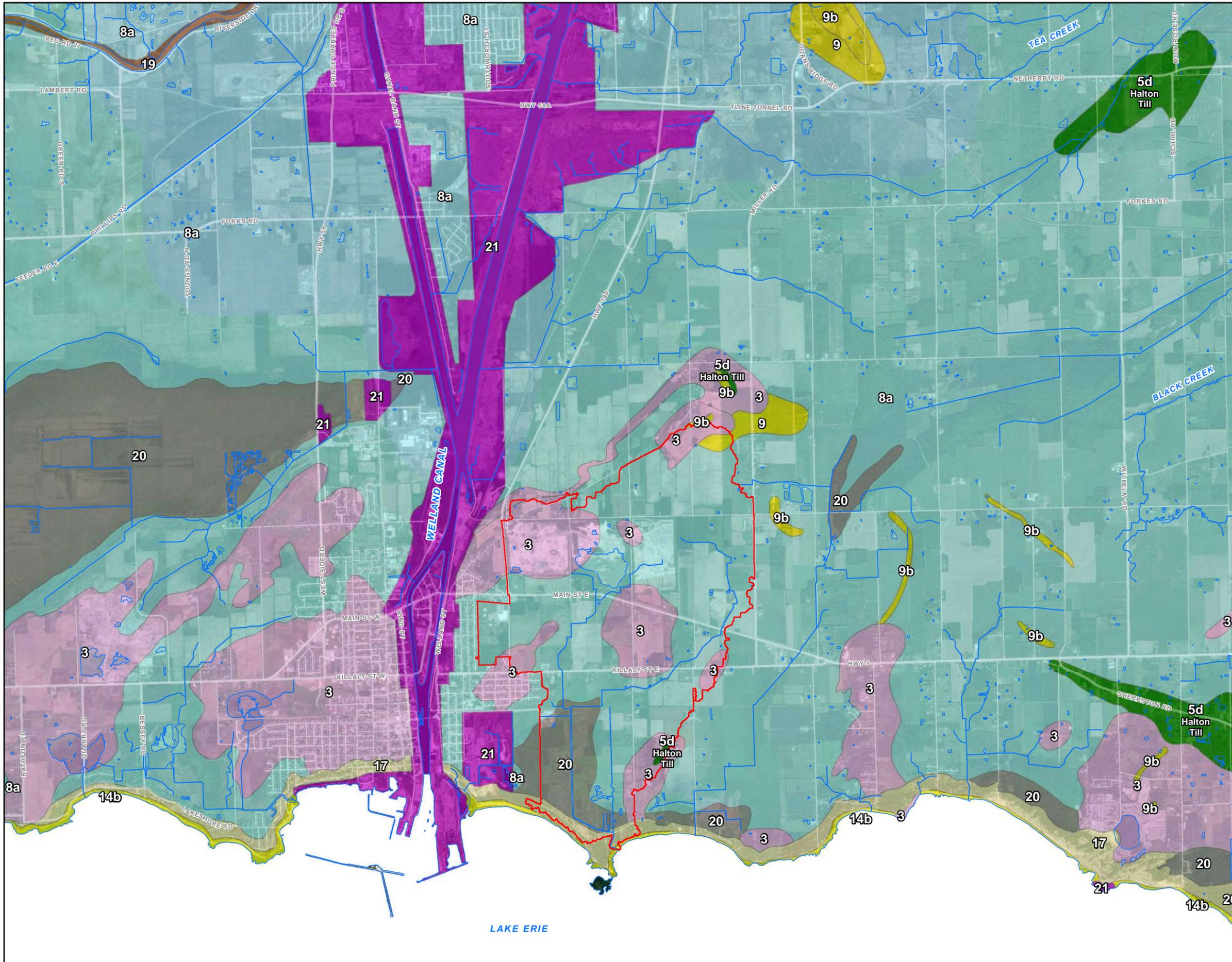
Bertie Formation underlays the Bois Blanc Formation and outcrops along the northwest edge of the subwatershed. This formation was deposited during the Late Silurian Period (S3) in an intertidal to supertidal environment. The lithology consists of dark brown to buff microcrystalline



dolostone with oolitic dolostone seams and is lightly fossiliferous. The thickness of the formation reaches 14 m.

Based on the orientation and distribution of the exposed strips of formations as shown in **Figure 16**, the Study Area is located in the core area of a syncline, which plunges gently to the south.





KEY MAP

- Watercourse¹
- Study Area

Surficial Geology²

Phanerozoic / Cenozoic / Quaternary / Recent

- 21: Man-made deposits (fill, sewage lagoon, landfill, urban development)
- 20: Organic deposits (peat, muck, marl)
- 19: Modern alluvial deposits (clay, silt, sand, gravel, may contain organic remains)
- 17: Eolian deposits (fine to very fine sand and silt)
- 14b: Coarse-textured lacustrine (Littoral deposits)

Phanerozoic / Cenozoic / Quaternary / Pleistocene

- 9: Coarse-textured glaciolacustrine deposits (sand, gravel, minor silt and clay)
- 9b: Coarse-textured glaciolacustrine deposits (Littoral deposits)
- 8a: Fine-textured glaciolacustrine deposits (Massive-well laminated)
- 5d: Till (Clay to silt-textured till [derived from glaciolacustrine deposits or shale])

Phanerozoic / Paleozoic

- 3: Paleozoic bedrock

1. LIO/MNRF
 2. Ontario Geological Survey 2010 (Mapped at 1:50,000). Surficial geology of southern Ontario; Ontario Geological Survey. Miscellaneous Release- Data 128 - Revised

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km

North American Datum 1983
 Universal Transverse Mercator Projection Zone 17

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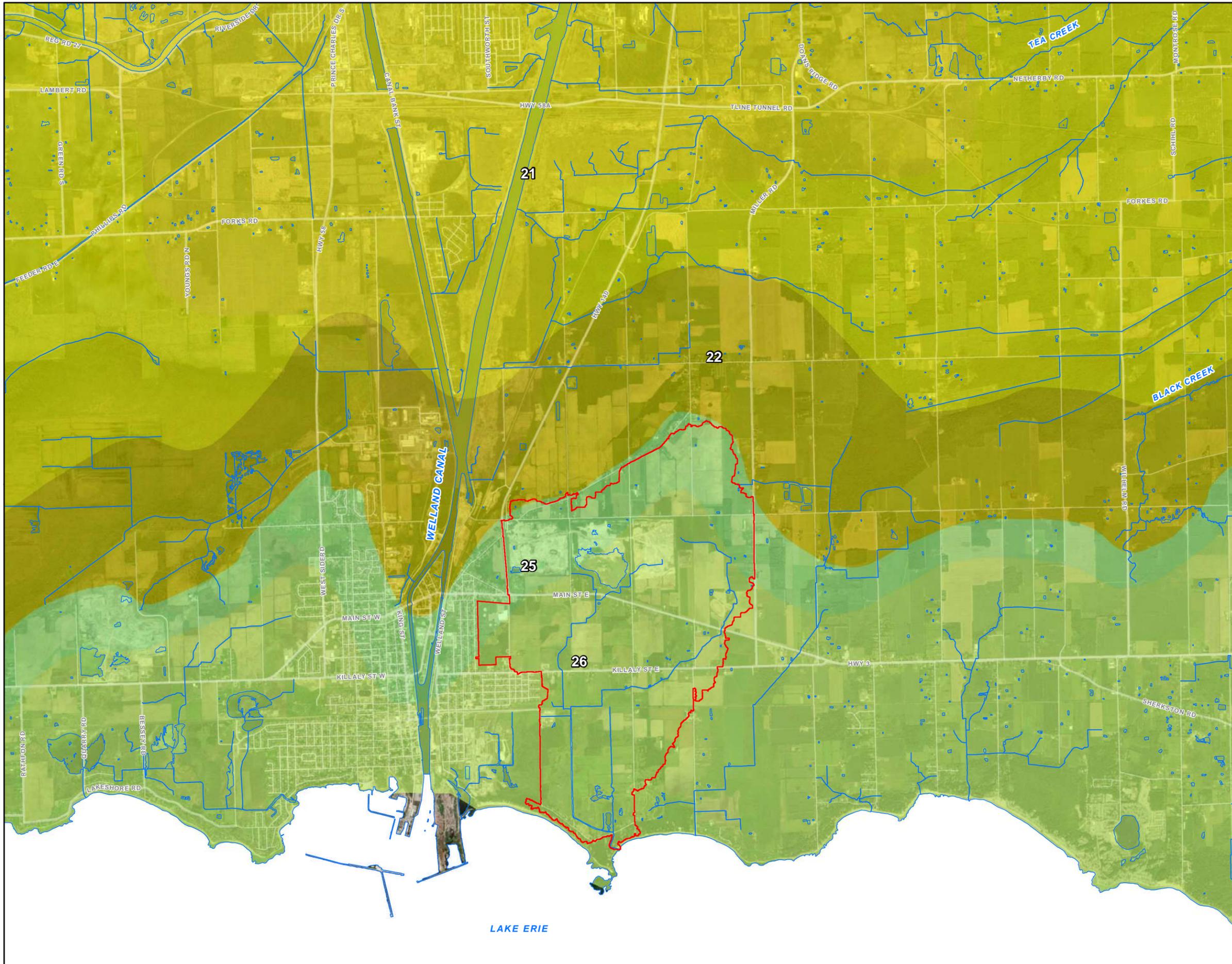
PROJECT Welland S - Wignell SWS

TITLE

Surficial Geology

REF. NO. 2007708-2-1

Figure 15



KEY MAP

-  Watercourse¹
-  Study Area

Paleozoic Bedrock Geology²

Middle Devonian - Detroit River Group

 26: Onondaga (limestone; variably cherty, fossiliferous, argillaceous, biohermal)

Lower Devonian

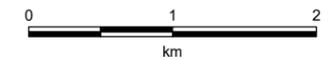
 25: Bois Blanc (limestone, dolostone; cherty, argillaceous; local glauconitic sandstone [Springvale Member])

Upper Silurian

 22: Bertie (dolostone; argillaceous, laminated, bituminous or burrowed)

 21: Salina (argillaceous dolostone, shale, gypsum, salt [at depth])

1. LIO/MNRF
2. Armstrong, D.K. and Dodge, J.E.P. Paleozoic Geology Map of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219



North American Datum 1983
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PROJECT Welland S - Wignell SWS

TITLE **Bedrock Geology**



REF. NO. 2007708-3-1

Figure 16

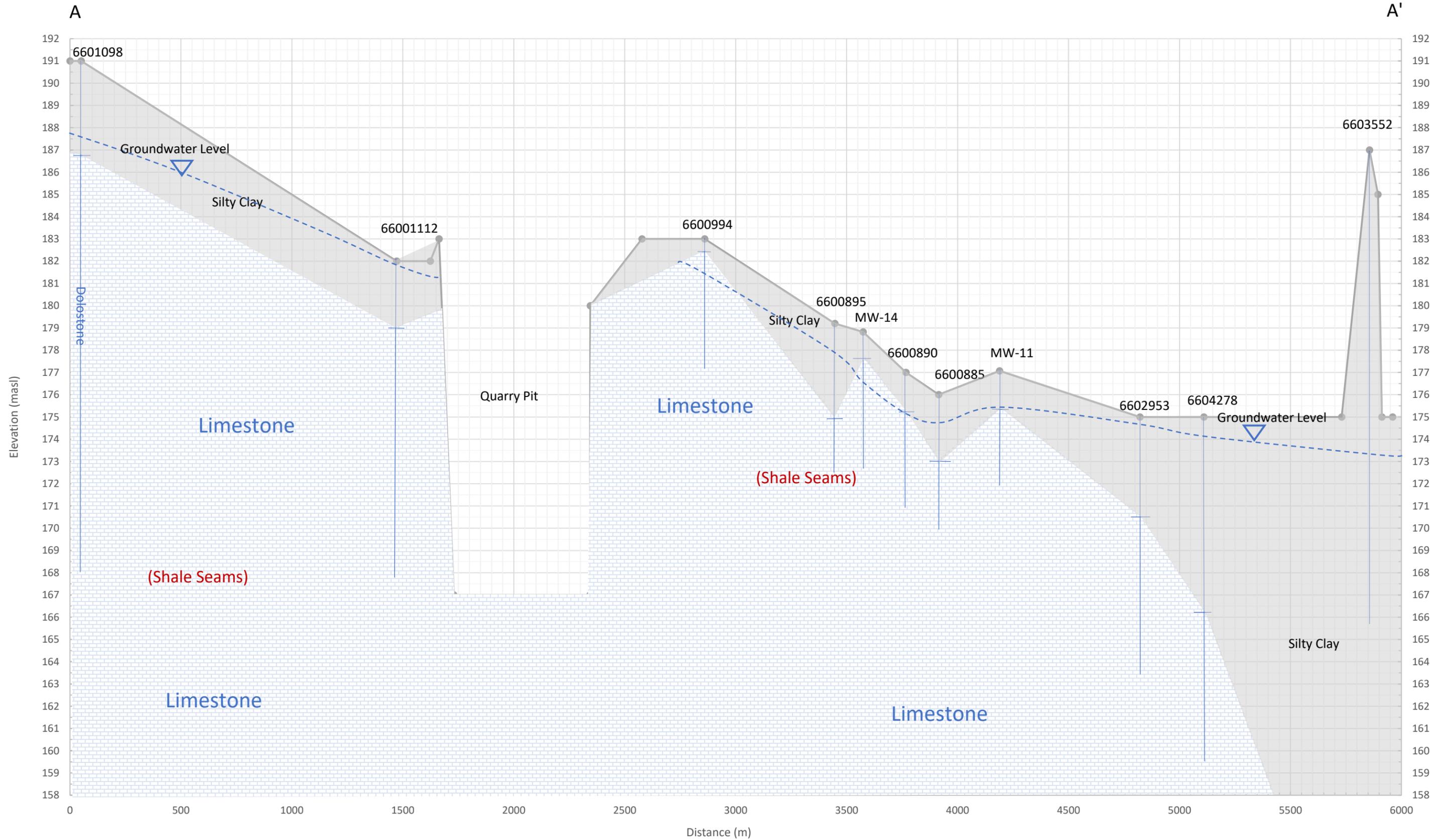
7.3.4 Stratigraphy

Stratigraphy for the Study Area was delineated with MECP well records (**Appendix N**). Due to lack of details and accuracy, detailed classification and correlation of stratigraphic units for both overburden and bedrock is infeasible. To display patterns and trends of stratigraphy under the Study Area, two cross-sections cutting through the Study Area were created and are presented as in **Figure 17**, and all information on the cross-sections are adapted from the MECP well records. Well logs of EXP (**Appendix N**) were also incorporated in the cross-sections. Based on the information from the MECP well records, EXP well logs, and observations during site reconnaissance, the stratigraphy within the Study Area is characterized as below:

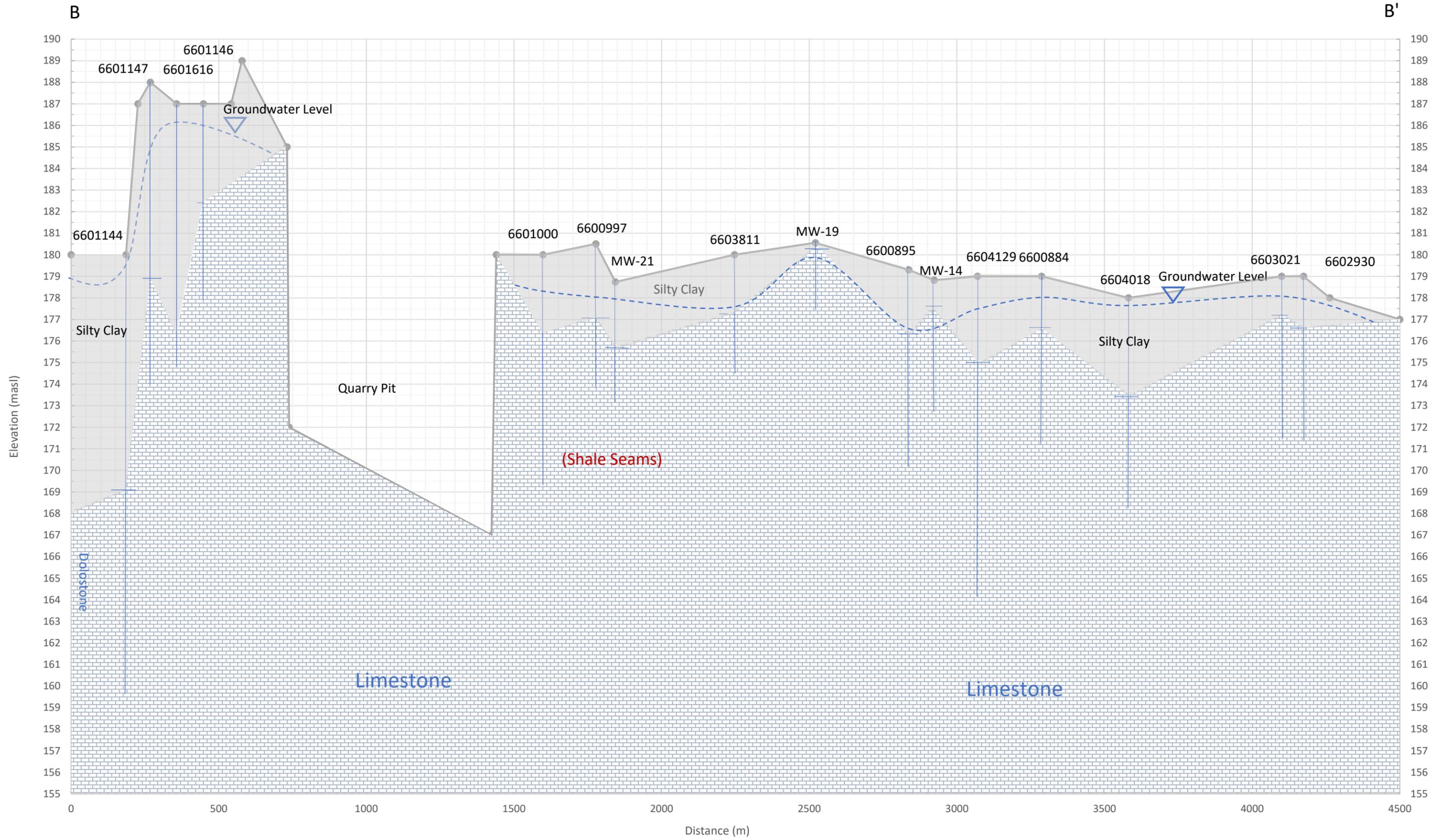
- The lithology of overburden deposits includes brown and blue clay, and black clayey silt with occasional sand lenses. The thickness of overburden deposits ranges from 0.5 to 30 m, and increases from north to south; and,
- The lithology of bedrock consists of microcrystalline limestone with interbedded chert and occasionally gray to black shale seams. Based on observations of lithology, structure, and weathering characteristics of the exposed bedrock, the bedrock in shallow depth has experienced a high degree of physical weathering, which disintegrates rock into pebbles. This may be due to the drastic difference in coefficient of thermal expansion (CTE) of limestone and chert. Rock pebbles are widespread on the bedrock outcrops within the Study Area. The pebbles accumulate on the ground surface and have formed the pebble beaches along the shoreline area of Lake Erie. The physical weathering may also facilitate water infiltration, water storage, and flow.



Cross-Section A-A'



Cross-Section B-B'



7.4 Groundwater Conditions

7.4.1 Source Protection, Water Supply, Sewerage System, and Groundwater Resources

The Study Area is located within the Niagara Peninsula Source Protection Area (NPSPA) under the Source Protection Plan approved on October 1, 2014 (NPCA, 2014). The Source Protection Plan has designated the following 10 types of vulnerable areas:

- Wellhead Protection Area (WHPA)- Quality;
- Wellhead Protection Area E-(GUDI);
- Intake Protection Zone-Quality;
- Intake Protection Zone-Quantity;
- Issue Contributing Area;
- Significant Groundwater Recharge Area (SGRA);
- Highly Vulnerable Aquifer (HVA);
- Event Based Area;
- Wellhead Protection Area (WHPA) Q1-Quantity;
- Wellhead Protection Area Q2-Quantity.

Based on the provincial source protection mapping, the City of Port Colborne Official Plan, and the abovementioned Source Protection Plan, the following source protection designations were identified within the Study Area (City of Port Colborne, 2013; NPCA, 2014; Ontario Geohub, 2015)

- A Significant Groundwater Recharge Area (SGRA) with a score of 6 for the north, east, and south portions of the Study Area;
- A SGRA with a score of 4 for the east corner of the Study Area; and
- A Highly Vulnerable Aquifer (HVA) with a default score of 6 for entirety of the Study Area.

Based on information from the City of Port Colborne, municipal services do not currently extend to the undeveloped areas of the Study Area. Municipal drinking water supply for Port Colborne is provided by the Regional Municipality of Niagara through the Port Colborne Water Treatment plant. Wastewater is collected by the City's wastewater collection system and treated by the Region through its Seaway Wastewater Treatment Plant.

Stormwater management is a shared responsibility between the City of Port Colborne, the Regional Municipality of Niagara, and residents, businesses, and developers. Homeowners are responsible for stormwater on their properties. The City and Region operate and maintain the municipal stormwater drainage systems to collect, control, and transport stormwater from properties.

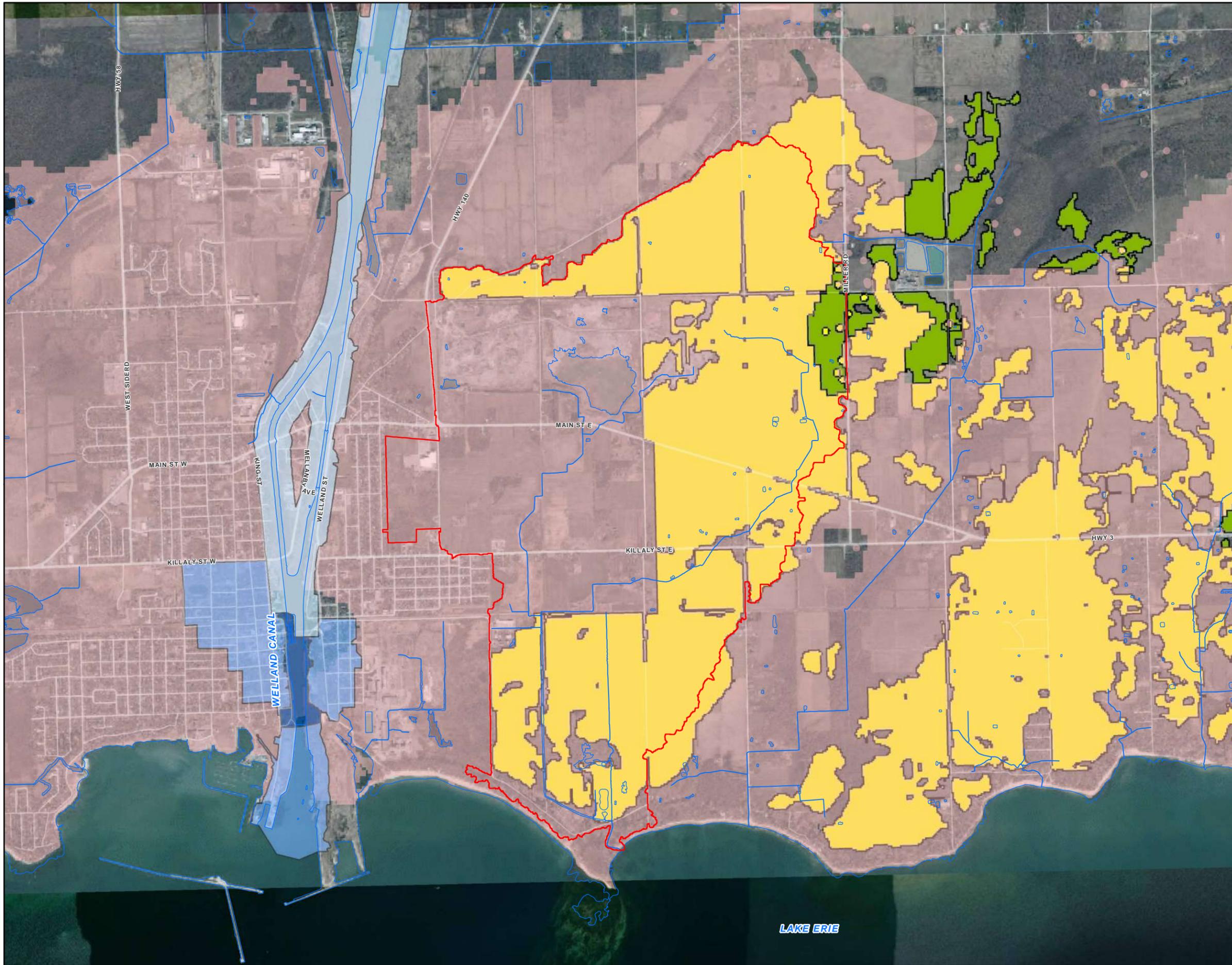
The results of the MECP well records inventory query are summarized in **Table 26** and displayed in **Figure 11**. In total, 499 water well records were found within 1000 m of the Study Area. The water well records have been broken down to provide well use, water quality, and aquifer information. Most of the wells are domestic / livestock, have freshwater quality, and are completed in bedrock. A majority of the supply wells were built from 1967 to 2000, reflecting a long history of private water supply prior to the year 2000.



Table 26: Summary of MECP Well Records

Classification		Record Number
Water Use	Domestic/Livestock	279
	Commercial	8
	Industrial	4
	Municipal/Public	7
	Monitoring and Test Hole	57
	Irrigation	3
	Decommissioned	-
	Unknown/Not used/Other	138
Water Quality	Fresh	302
	Gas	1
	Mineral	4
	Sulfur	56
	Unknown/Untested	135
Aquifer	Overburden	125
	Bedrock	374
	Unknown	-





KEY MAP

 Watercourse¹

 Study Area

Source Water Protection²

 Intake Protection Zone 1

 Intake Protection Zone 2

 Intake Protection Zone 3

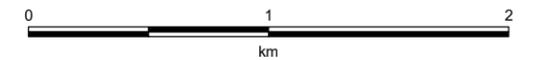
 Highly Vulnerable Aquifer

Significant Groundwater Recharge Area

 Score 6

 Score 4

1. LIO/MNRF
2. NPCA & Source Protection Information Atlas MECP © King's Printer for Ontario 2023



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PROJECT Welland S - Wignell SWS

TITLE
Source Water Protection



REF. NO. 2007708-5-1

Figure 18

7.4.2 Groundwater Levels, Flow Direction and Gradient

Based on MECP well record data and the EXP well logs (**Appendix N**), groundwater levels range from 0.3 to 24 m below ground surface (mbgs) and show a moderate degree of correlation in well depths. The moderate correlation degree shows that vertical groundwater gradients should be downward for most wells and upward for some wells.

As shown in **Figure 17**, groundwater flow direction is affected by local topography, aquifer structure, and well structures; however, the dominant flow direction is from north to south.

7.4.3 Groundwater Quality

MECP well records show that groundwater quality from most of the supply wells is fresh, but wells with gas, minerals, and sulfur were identified, indicating that groundwater quality becomes deteriorated locally due to natural reasons.

The groundwater quality monitoring for Buchner and Townline wells (**Table 4**), as found in the Summary Reports of NPCA Water Quality Monitoring Program (NPCA, 2009) (NPCA, 2022a) identified only one exceedance (sodium) over Ontario Drinking Water Standards (ODWS). The groundwater quality monitoring for well W0000289 has not identified any exceedances over ODWS.

Groundwater sampling completed by EXP identified two exceedances over PWQO, including sulphide and cobalt, which are listed in **Table 27**. The exceedance for sulphide is in line with the regional pattern, as reflected in MECP well records. The exceedance for cobalt may be caused by localized mineralization of groundwater in carbonate rock or due to sample contamination.

Table 27: Exceedances Over PWQO (EXP)

Parameter	Unit	PWQO	MW2	MW21
Sulphide	mg/L	0.002	0.037	0.33
Total Cobalt	ug/L	0.9	2.3	1.6
Dissolved Cobalt	ug/L	0.9	2.3	<0.5

7.4.4 Groundwater Recharge

Groundwater recharge is a hydrologic process in which water (i.e., rain, melt snow, or other surface water) moves downward from ground surface to groundwater. The three steps in this process include:

- Infiltration – Rain or melted snow migrate through shallow zones (fertile soil zone, root zone, evaporation zone, burrow zone, etc.) into unsaturated zones. This is accompanied with a series of physical, chemical, and biological processes in shallow zones such as dissolution, precipitation, redox reactions, and evapotranspiration;
- Percolation – Infiltrating water migrates through the unsaturated zone, accompanied with relatively simple physical and chemical processes; and,
- Percolating water reaches saturated zone joining the groundwater system.

Groundwater recharge is divided into the following six types based on the recharge mechanisms and tempo-spatial characteristics in Southern Ontario:



- 1 Direct or diffuse recharge (areal) – water added to groundwater after satisfying soil moisture deficit and evapotranspiration by direct infiltration of precipitation through the unsaturated zone. Direct recharge is impulsive following the subdued pattern of precipitation and accounts for a majority of groundwater reserves;
- 2 Indirect recharge (localized) – recharge from surface water features such as stream, wetlands, and lakes. Indirect recharge is continuous. This may result in the drying up of reaches in a stream, wetlands, and lakes when groundwater levels are lower than the water stages;
- 3 Depression focused recharge (localized or areal) – hummocky area recharge in glaciated regions and mountain front recharge (MFR) in arid region. This type of recharge is controlled by landforms. It can be intermittent or continuous depending on the supply of water sources;
- 4 Pathway recharge/preferential recharge (localized) – recharge through preferential flow paths (faults, joints, solution voids, cracks, root hole, burrow holes, geostrata boundaries, and even man-made structures);
- 5 Incidental recharge (localized or areal) – recharge that results from artificial structures and activities that have prolonged water flow and storage, such as leakage from reservoirs, canals, sewers, stormwater ponds, as well as quarries and pits and irrigation facilities. This type of recharge can be intermittent or continuous, and can be localized or areal; and,
- 6 Recharge from neighbouring aquifer – recharge across aquitard from neighbouring aquifers above or under the subject aquifer.

Based on the conditions of the Study Area, the overburden thickness ranges from 0 to 30 m, with most of the Study Area having overburden thickness of greater than 1.5 m. Therefore, the groundwater recharge within the Study Area will go through all the steps as presented above.

The natural drainage system within the Study Area is not well developed, and most of the watercourses had been channelized to facilitate agricultural drainage. Thus, direct or diffuse recharge occurs in a majority of the Study Area. Indirect recharge occurs mostly within wetland areas.

The rate of groundwater recharge will be estimated through a water balance assessment, which is provided in Section 7.5 below.

7.4.5 Groundwater Discharge

Groundwater discharge is a hydrological process in which groundwater from aquifers flow out of the feature to become surface water. Groundwater discharge can occur diffusely across a landscape, such as when deep rooted vegetation relies on groundwater, and can also occur in concentrated areas where the ground surface cuts through aquifer. In general groundwater discharge is referred to as the discharge along concentrated areas, and is classified into natural and induced groundwater:

- Natural groundwater discharge:
 - Stream discharge;
 - Springs and wet area;
 - Depression discharge;



- Lake discharge.
- Induced groundwater discharge:
 - Basement flooding;
 - Infiltration into sewer system;
 - Passive dewatering;
 - Supply wells;
 - Flowing wells.

Site reconnaissance and background review of the Study Area did not identify natural groundwater discharge features such as springs, wet areas along streams, and low lying areas. Stream flow was observed within the Study Area; however, further studies would be needed in these areas to determine if the flow was baseflow derived from groundwater discharge. Based on terrain analysis, the potential places of groundwater discharge within the Study Area include:

- Streams or drainage channels – especially in southerly reaches of the Study Area as groundwater levels become shallower downstream, as shown in the cross-sections (Figure 17);
- Wetland – the wetland may be supported partly by groundwater discharge, especially for the wetland located in southerly reaches of the Study Area;
- Lake Erie – as the final sink for both surface water and groundwater in the Lake Erie North Shore watershed, most of the groundwater discharge should occur along the shoreline area of the lake. The water edge of Lake Erie is at about 174.5 mASL. This elevation corresponds to the elevation of the predominant aquifer, as shown by the MECP well records of the supply wells (Figure 17). Consequently, a groundwater discharge zone is anticipated along the shoreline of Lake Erie.

Post-development, induced groundwater recharge such as infiltration into sewer systems and passive dewatering is anticipated.

7.5 Water Balance Analysis

Water balance analysis for the pre-development condition, as part of the hydrogeological characterization, was conducted to fulfill several purposes including providing a baseline condition of water balance to assess the impact of the future development, quantifying groundwater recharge rates, addressing concerns from agencies regarding stormwater management, and providing inputs to stormwater management design. The water balance assessment was conducted in general accordance with the *Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications* (Conservation Authorities Geoscience, 2013) and the *Stormwater Management Planning and Design Manual* (Ministry of the Environment, Conservation and Parks, 2003) and consists of the following steps:

- Water balance unit delineation and infiltration factor determination for pre-development scenario;
- Water surplus determination; and,
- Pre-development water balance analysis.



7.5.1 Water Balance Unit Delineation and Infiltration Factor Determination

A Water Balance Unit (WBU) is defined as a land unit with uniform land cover, soil type, and ground surface slope gradient (surface gradient), and has distinctive hydrological properties in comparison to the surrounding land units. A WBU was delineated for the Study Area through three steps of GIS classification and GIS area measurement. The three steps of classification include land use and natural coverage classification, surficial/overburden soil classification, and surface gradient classification. **Table 24** summarizes the major attributes of the land use units and natural heritage feature, while **Table 28** summarizes the details of each type of WBU. **Figure 19** shows the distribution of WBUs.

Table 28: Details of Water Balance Units

WBU	Land Cover	Surficial Geology	Surface Gradient	Area (m ²)	Infiltration Factor	Impervious Factor
Farmland-clay	Farmland	Clay	0.4%	5760179	0.5	0
Farmland-sand	Farmland	Sand	0.4%	4939	0.7	0
Wetland-clay	Wetland	Clay	0.4%	641300	0.5	0
Wetland-org	Wetland	Organic soil	0.4%	254741	0.6	0
Woodland-clay	Woodland	Clay	0.5%	830191	0.6	0
Woodland-org	Woodland	Organic soil	0.5%	116172	0.7	0
Woodland-sand	Woodland	Sand	0.5%	39978	0.8	0
Grassland-clay	Grassland	Clay	0.4%	392321	0.5	0
Grassland-org	Grassland	Organic soil	0.4%	585048	0.6	0
Golf Courses-clay	Golf Courses	Clay	0.6%	289625	0.6	0
Residential-clay	Residential	Clay	<0.3%	1148306	0.6	0.2
Residential-sand	Residential	Sand	<0.3%	121147	0.7	0.2
Commercial-clay	Commercial	Clay	<0.3%	508907	0.5	0.4
Commercial-sand	Commercial	sand	<0.3%	35917	0.7	0.4
Industrial-clay	Industrial	Clay	<0.3%	31423	0.6	0.9
Industrial-org	Industrial	Organic soil	<0.3%	23363	0.7	0.9
Quarry Pits	Quarry Pits	Bedrock	0.5%	1755411	0.3	0.95
Roads-paved	Roads	-	<0.5%	266516	0.3*	0.5
Roads-gravel	Road	-	<0.5%	104937	0.3*	0

*applied to ROW.

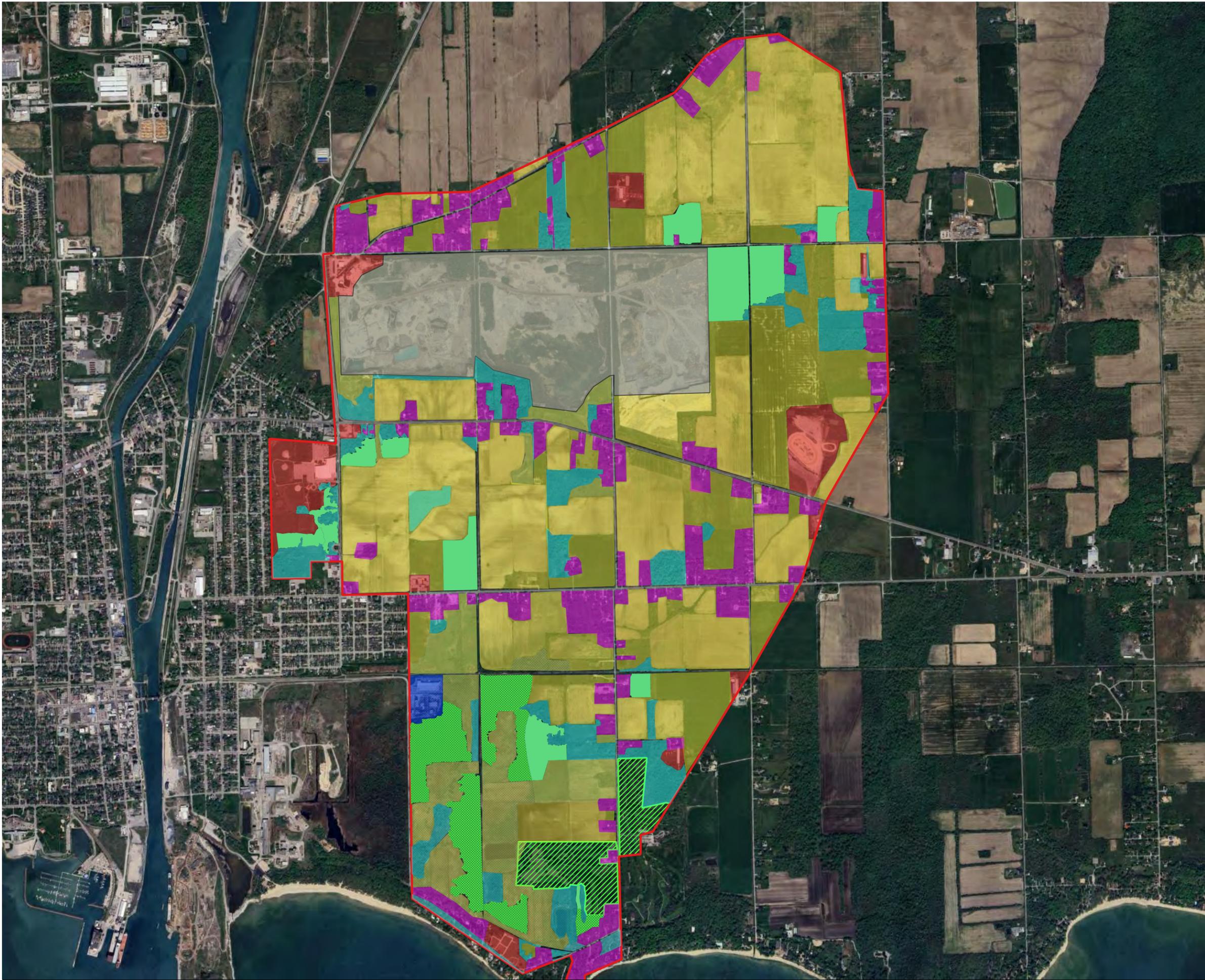


It should be noted that many of the areas that were mapped as bedrock have been developed into farmland, indicating the overburden soil has a thickness of over 1 m, as 1 m of overburden soil is considered to be the minimum amount required for agricultural purposes. For the purposes of the water balance analysis, where the OGS has mapped bedrock at surface but was confirmed to have overburden soils for agricultural purposes, it is reasonable to treat these mapped bedrock areas as areas covered with the type of soil that surrounds the mapped bedrock areas.

The roads within the Study Area include paved roads and gravel roads. Drainage corridors were not modeled separately and were combined with adjacent WBUs as most of these corridors are narrow and merged well with neighbouring land uses.

Infiltration factors for each land use unit was determined based on the scoring table presented in the Stormwater Management Planning and Design Manual (Ministry of the Environment, Conservation and Parks, 2003) and in the MECP Hydrogeological Technical Information Requirements for Land Development Applications (Ministry of Environment and Energy, 1995). Impervious factors were based on empirical values that are accepted in Ontario.





Legend

- Study Area
- Farmland**
- Farmland-clay
- Farmland-sand
- Commercial/Institutional**
- Commercial-clay
- Commercial-sand
- Golf Course-clay
- Grass Area**
- Grassland-clay
- Grassland-org
- Quarry Pits
- Residential**
- Residential-clay
- Residential-sand
- Wetland**
- Wetland-clay
- Wetland-org
- WoodLand**
- Woodland-clay
- Woodland-org
- Woodland-sand
- Industrial**
- Industrial-clay
- Industrial-org

0.9 1.8 km

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:22000
Page Size: Tabloid (11 x 17 inches)

Drawn: FL
Checked: NS

Date: April 2024

Source Notes:
Basemap: Google satellite imagery (2020)
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Client Elite Cap Inds. Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc.

Project Wignell Drain Subwatershed Study

TITLE Water Balance Units



REF. NO 2007708

Figure 19

7.5.2 Water Surplus Determination

Water surplus for pervious vegetated areas is estimated with the Thornthwaite and Mather water balance method (Thornthwaite, 1957). This method is an accounting procedure that is based on the reasonable principle to quantify components of the hydrologic cycle, as expressed in the following equation:

$$P = ET + R + I + \Delta S$$

P= Precipitation (mm/year)

ET= Evapotranspiration (mm/year)

R= Runoff (mm/year)

I= Infiltration (mm/year)

ΔS = Change in groundwater storage (mm/year)

And where:

$R+I$ =Water surplus (mm/year)

SLR developed an in-house spreadsheet program to execute the Thornthwaite and Mather water balance analysis. The input data includes:

- Long term (30 years) monthly average precipitation and temperatures, collected from the closest climate station (Port Colborne Station) between 1981 and 2010 (Table 211);
- Degrees of altitude = 42.87 to 42.92o; and,
- Soil moisture storage capacity for major WBUs within the Study Area:
 - Farmland-clay = 100 mm;
 - Farmland-sand = 50 mm;
 - Wetland-clay = 250 mm;
 - Wetland-org = 250 mm;
 - Woodland-clay = 250 mm;
 - Woodland-org = 300 mm;
 - Woodland-sand = 150 mm;
 - Grassland-clay = 100 mm;
 - Grassland-org = 200 mm;
 - Golf Courses-clay = 125 mm;
 - Residential-clay = 100 mm;
 - Residential-sand = 50 mm;
 - Commercial-clay = 100 mm;
 - Commercial-sand = 50 mm;
 - Industrial-clay = 100 mm;
 - Industrial-org = 150 mm



- Roads = 125 mm.

Table 29 summarizes the average water surplus for each WBU every month of the year.

Table 29: Water Surplus (mm/year) for Each Water Balance Unit

WBU	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Farmland-clay	73.1	57.0	64.5	43.8	13.3	-16.0	-7.0	4.0	11.1	44.1	83.4	88.8	460.0
Farmland-sand	73.1	57.0	64.5	43.8	13.3	-6.0	-1.0	1.0	11.1	44.1	83.4	88.8	473.0
Wetland-clay	73.1	57.0	64.5	43.8	13.3	-17.0	-16.0	9.0	11.1	44.1	83.4	88.8	455.0
Wetland-org	73.1	57.0	64.5	43.8	13.3	-17.0	-16.0	9.0	11.1	44.1	83.4	88.8	455.0
Woodland-clay	73.1	57.0	64.5	43.8	13.3	-27.0	-16.0	9.0	11.1	44.1	83.4	88.8	445.0
Woodland-org	73.1	57.0	64.5	43.8	13.3	-29.0	-17.0	10.0	11.1	44.1	83.4	88.8	443.0
Woodland-sand	73.1	57.0	64.5	43.8	13.3	-21.0	-11.0	6.0	11.1	44.1	83.4	88.8	453.0
Grassland-clay	73.1	57.0	64.5	43.8	13.3	-16.0	-7.0	4.0	11.1	44.1	83.4	88.8	460.0
Grassland-org	73.1	57.0	64.5	43.8	13.3	-25.0	-14.0	8.0	11.1	44.1	83.4	88.8	448.0
Golf Courses-clay	73.1	57.0	64.5	43.8	13.3	-18.0	-10.0	5.0	11.1	44.1	83.4	88.8	456.0
Residential-clay	73.1	57.0	64.5	43.8	13.3	-16.0	-7.0	4.0	11.1	44.1	83.4	88.8	460.0
Residential-sand	73.1	57.0	64.5	43.8	13.3	-6.0	-1.0	1.0	11.1	44.1	83.4	88.8	473.0
Commercial-clay	73.1	57.0	64.5	43.8	13.3	-16.0	-7.0	4.0	11.1	44.1	83.4	88.8	460.0
Commercial-sand	73.1	57.0	64.5	43.8	13.3	-6.0	-1.0	1.0	11.1	44.1	83.4	88.8	473.0
Industrial-clay	73.1	57.0	64.5	43.8	13.3	-16.0	-7.0	4.0	11.1	44.1	83.4	88.8	460.0
Industrial-org	73.1	57.0	64.5	43.8	13.3	-21.0	-11.0	6.0	11.1	44.1	83.4	88.8	453.0
Roads	73.1	57.0	64.5	43.8	13.3	-18.0	-10.0	5.0	11.1	44.1	83.4	88.8	456.0

Water surplus for impervious areas (paved roads, industrial areas, and quarry pits) was calculated based on the assumption that 10% of total precipitation will evaporate off impervious surfaces (acceptable range is 10% to 20%). The total precipitation, based on Table 211, is 984.4 mm/year. Consequently, the water surplus for impervious areas is 886 mm/year.



Quarry pits have certain levels of infiltration owing to fractures and cracks. The water surplus for the pervious parts of the quarry pits is assumed to be 500 mm/year, which is greater than the water surplus in vegetated area as no transpiration takes place on the quarry floor.

Wetlands are assumed to receive surface water infiltration or groundwater recharge for the purpose of water balance analysis. The surface water and groundwater interaction in the wetland is currently unknown and should be delineated through monitoring and future studies, as recommended in Section 10.3 below.

7.5.3 Pre-Development Water Balance Analysis

The pre-development water balance, or water balance for the current conditions, was calculated based the results of the WBU delineation and water surplus analysis. **Table 30** presents the water balance results for the Study Area, which shows that the Study Area currently receives an infiltration quantity of 2,551,185 m³/year and generate a runoff quantity of 4,353,571 m³/year, corresponding to 198 mm/year in infiltration and 337 mm/year in runoff.

Table 30: Pre-Development Water Balance Analysis Results

WBU	Total (ha)	Total Runoff Volume (m ³ /year)	Total Infiltration Volume (m ³ /year)	Runoff Rate (mm/year)	Infiltration Rate (mm/year)
Farmland-clay	576.02	1,324,841	1,324,841	230	230
Farmland-sand	0.49	701	1,635	142	331
Wetland-clay	64.13	145,896	145,896	228	228
Wetland-org	25.47	46,363	69,544	182	273
Woodland-clay	83.02	147,774	221,661	178	267
Woodland-org	11.62	15,439	36,025	133	310
Woodland-sand	4.00	3,622	14,488	91	362
Grassland-clay	39.23	90,234	90,234	230	230
Grassland-org	58.50	104,841	157,261	179	269
Golf Courses-clay	28.96	52,828	79,241	182	274
Residential-clay	114.83	372,510	253,546	324	221
Residential-sand	12.11	35,220	32,089	291	265
Commercial-clay	50.89	250,586	70,229	492	138
Commercial-sand	3.59	15,787	7,135	440	199
Industrial-clay	3.14	25,635	867	816	28
Industrial-org	2.34	18,947	741	811	32
Quarry Pits	175.54	1,508,249	13,166	859	8
Roads-paved	26.65	160,603	18,230	603	68
Roads-gravel	10.49	33,496	14,355	319	137
Total	1291.04	4,353,571	2,551,185	337	198
Percentage of Total Precipitation %				34	20



8.0 Floodplain Analysis

8.1 Modelling Results

Flood Scenario (Peak Flows)

Table 31 provides a summary of the storage volumes required in Stormwater Management Ponds (SWPs) to control the 100-year storm volumes to pre-development levels within the Subject Lands.

Table 31: Required Storage Volumes: Subject Lands – Developed

Block ID	Upstream Contributing Area (ha)	100 Year Storage Required (m ³)	100 Year HGL - in pond (m)	100 Year Storage Provided at 2.0 m depth (m ³)	Top of Pond elevation (m)	Pond Freeboard (m)
Pond A	50.173	27,224	178.21	46,716	178.80	0.59
Pond B	24.43	14,424	178.99	19,039	179.30	0.31
Pond C	31.92	18,556	179.37	23,932	179.66	0.30
Pond D	33.05	18,974	178.25	32,063	178.85	0.60
Pond E	12.72	8,119	178.75	12,994	179.07	0.32
Pond F	7.87	6,292	179.45	9,732	179.80	0.35

Table 32 provides a comparison of peak outflows for the ponds (existing target flows vs. developed target flows). Note, existing target flows have been inferred from the XPSWMM existing model, while the developed target flows have been inferred from the XPSWMM post model results for the ponds.



Table 32: Comparison of Pre-Development and Developed Site Pond Flows

Storm Event	Storm Type	Peak Flow Rate (m ³ /s)											
		Pond A		Pond B		Pond C		Pond D		Pond E		Pond F	
		Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed
2 Year	24Hr SCS	0.085	0.083	0.118	0.075	0.154	0.136	0.159	0.102	0.061	0.038	0.038	0.005
5 Year	24Hr SCS	0.192	0.113	0.224	0.109	0.293	0.277	0.304	0.165	0.117	0.103	0.072	0.007
10 Year	24Hr SCS	0.299	0.196	0.314	0.155	0.411	0.353	0.425	0.268	0.164	0.130	0.101	0.020
25 Year	24Hr SCS	0.467	0.374	0.451	0.237	0.589	0.438	0.610	0.424	0.235	0.162	0.145	0.022
50 Year	24Hr SCS	0.603	0.526	0.567	0.281	0.741	0.489	0.768	0.525	0.296	0.184	0.183	0.058
100 Year	24Hr SCS	0.751	0.661	0.611	0.317	0.798	0.532	0.827	0.626	0.318	0.204	0.197	0.043
100 Year	12Hr AES	0.728	0.712	0.510	0.331	0.666	0.532	0.689	0.628	0.265	0.203	0.164	0.043



8.1.1 Scenario 1 & 2

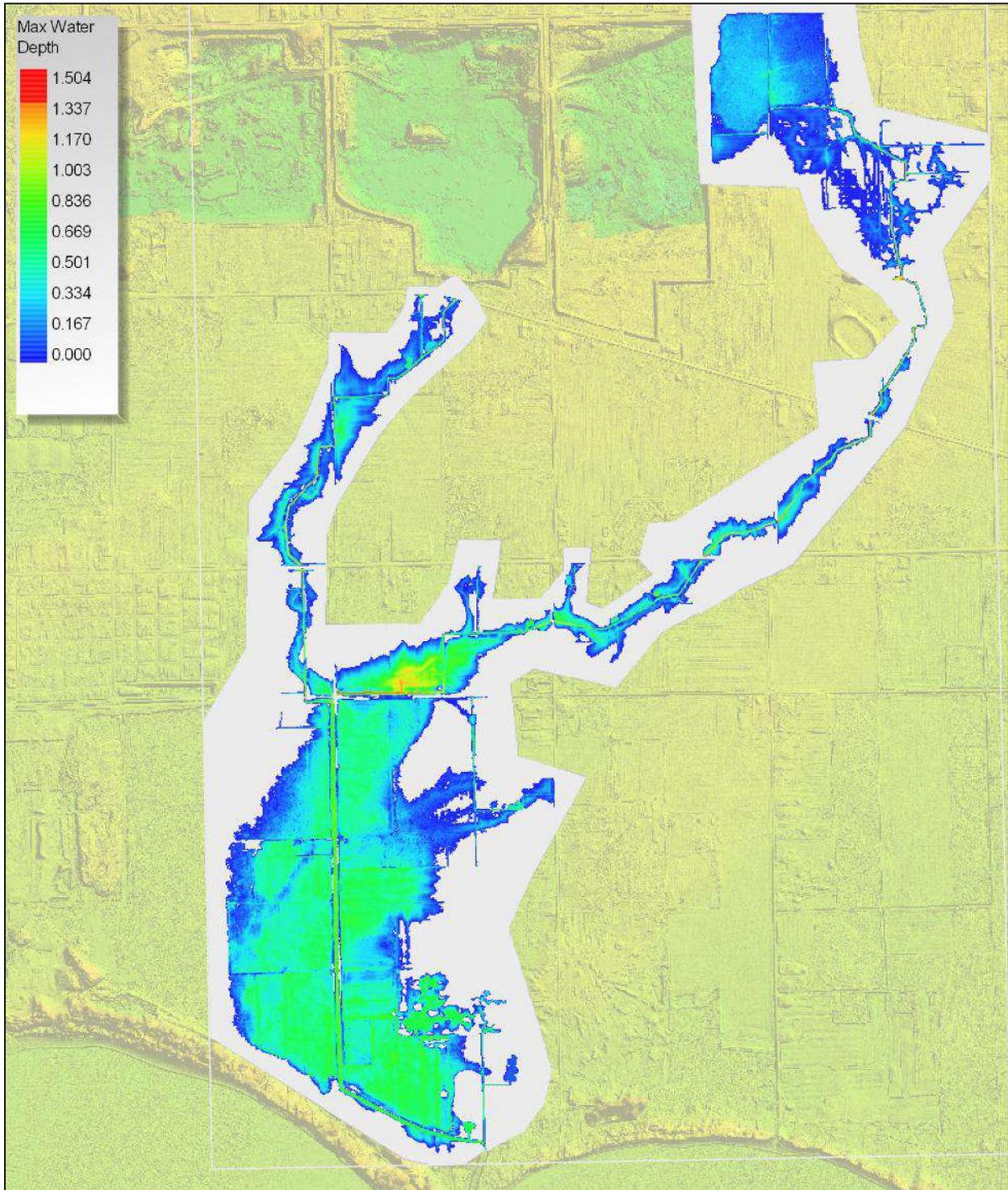
Graphics 6 - 14 are from the *Functional Servicing & Stormwater Management Report* (The Odan/Detech Group Inc., 2023), which depict the modeling and mapping for Scenario 1 – Existing Undeveloped (base). **Graphics 15- 23** are from the *Functional Servicing & Stormwater Management Report* (The Odan/Detech Group Inc., 2023), which depict the modeling and mapping for Scenario 2 – Subject Lands Developed.

The hazard maps shown on **Graphic 12** and **Graphic 21** are a visualization of hazards, which are a quotient of velocity and depth for each grid cell used to assess risk. Please note that all hazard areas are outside the proposed urban boundary and are contained within the floodplain areas.

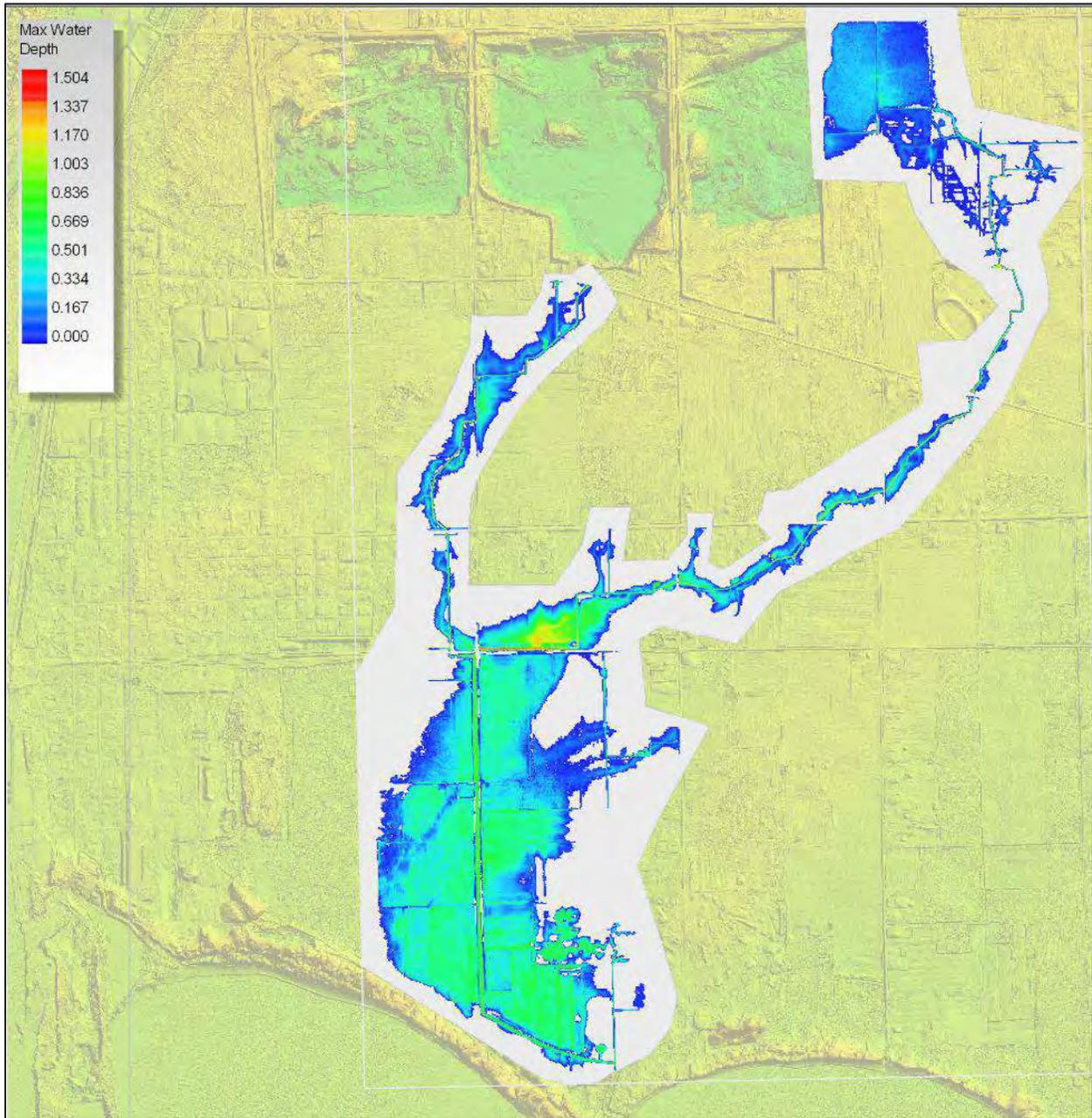
The bed shear maps shown on **Graphic 13**, **Graphic 14**, **Graphic 22**, and **Graphic 23** illustrate the erosion potential for frequently occurring storms. Note that **Graphic 13** and **Graphic 22** show a 100-year shear bed map, which is less than the allowable for the vegetation in situ. See Section 8.2 for further information on bed shear and erosion.



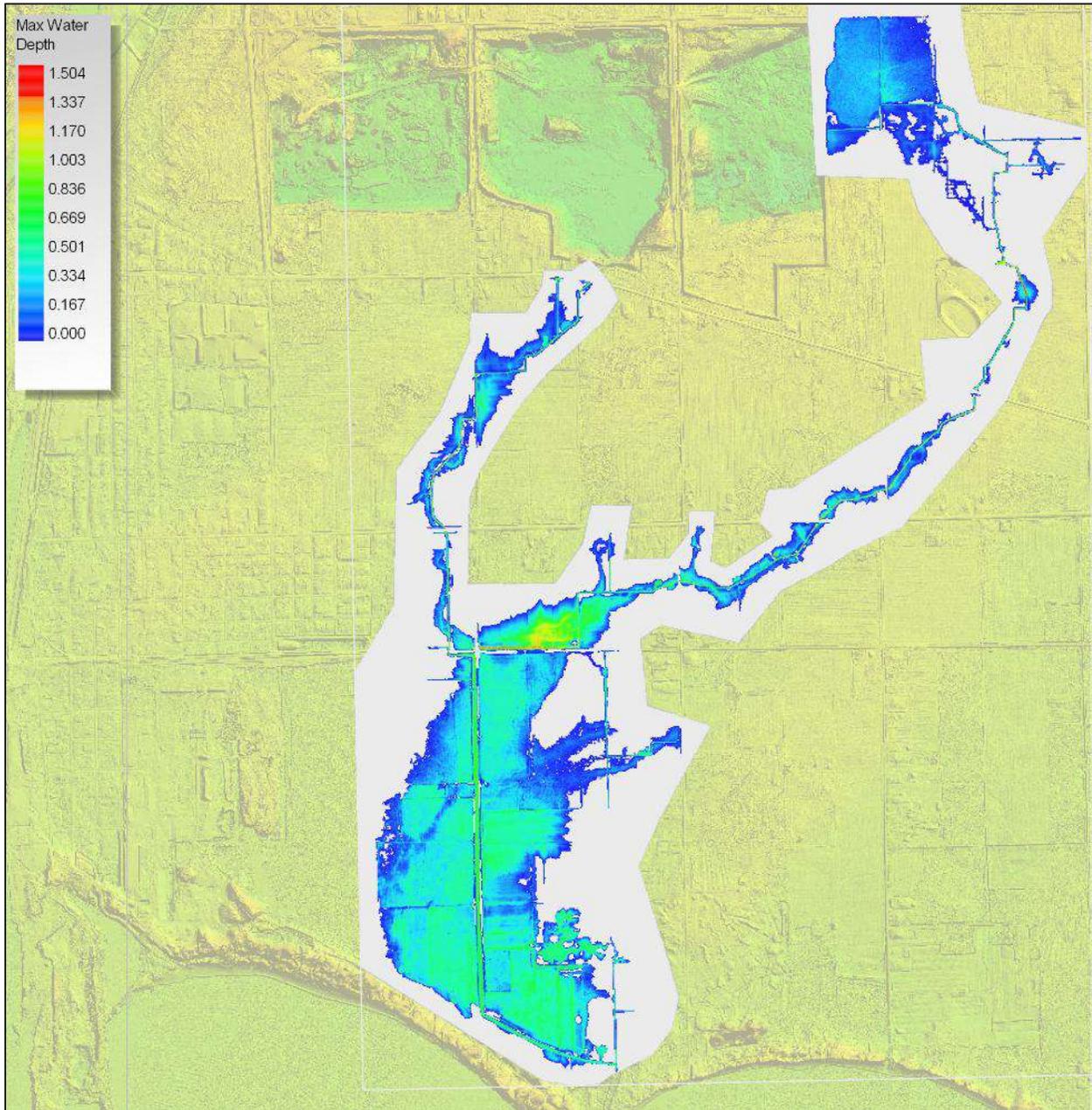
Graphic 6: XPSWMM Depth MAP (100 year) – Site Undeveloped Existing Flows



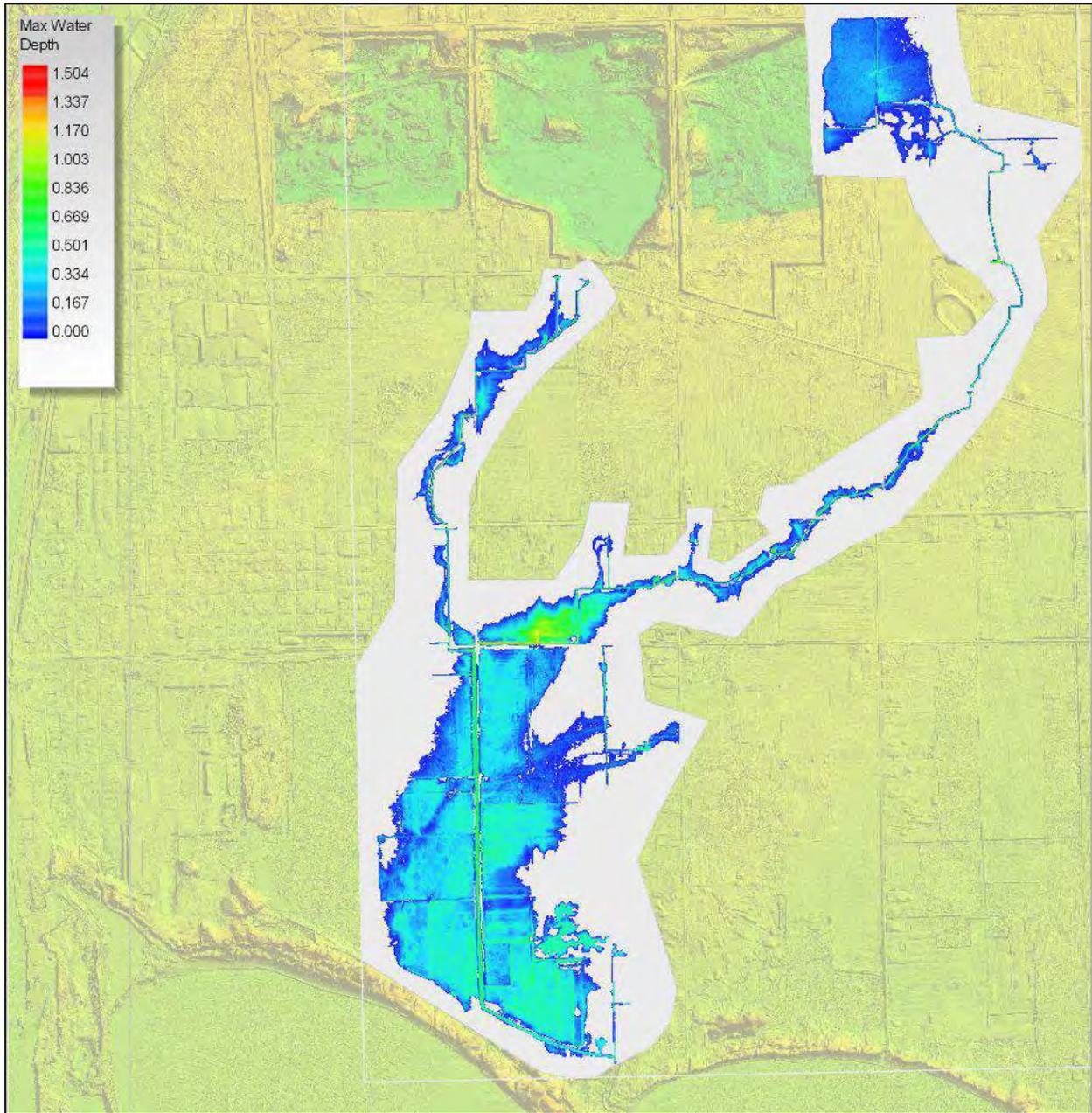
Graphic 7: XPSWMM Depth MAP (50 year) - Site Undeveloped Existing Flows



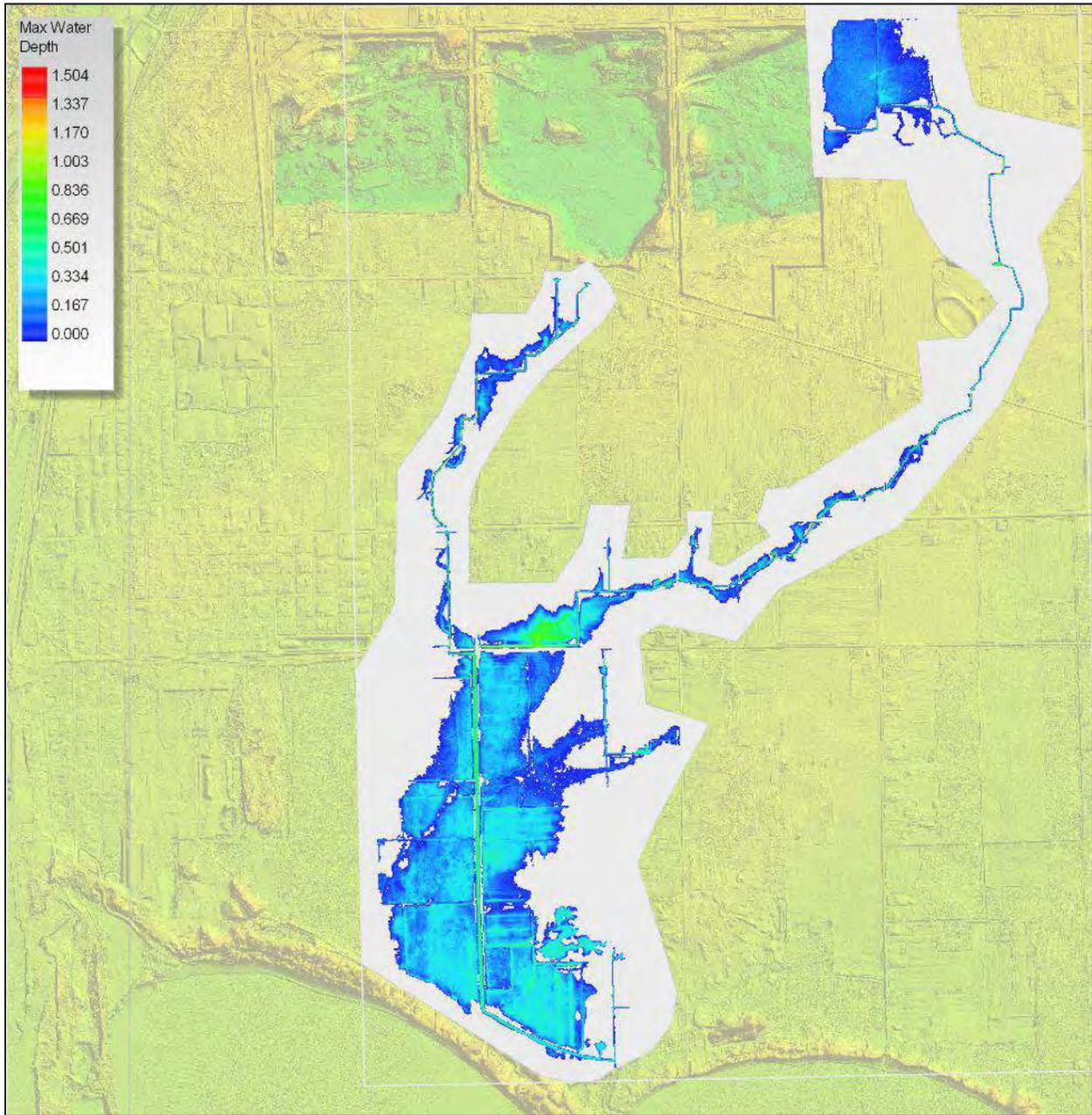
Graphic 8: XPSWMM Depth MAP (25 year) – Site Undeveloped Existing Flows



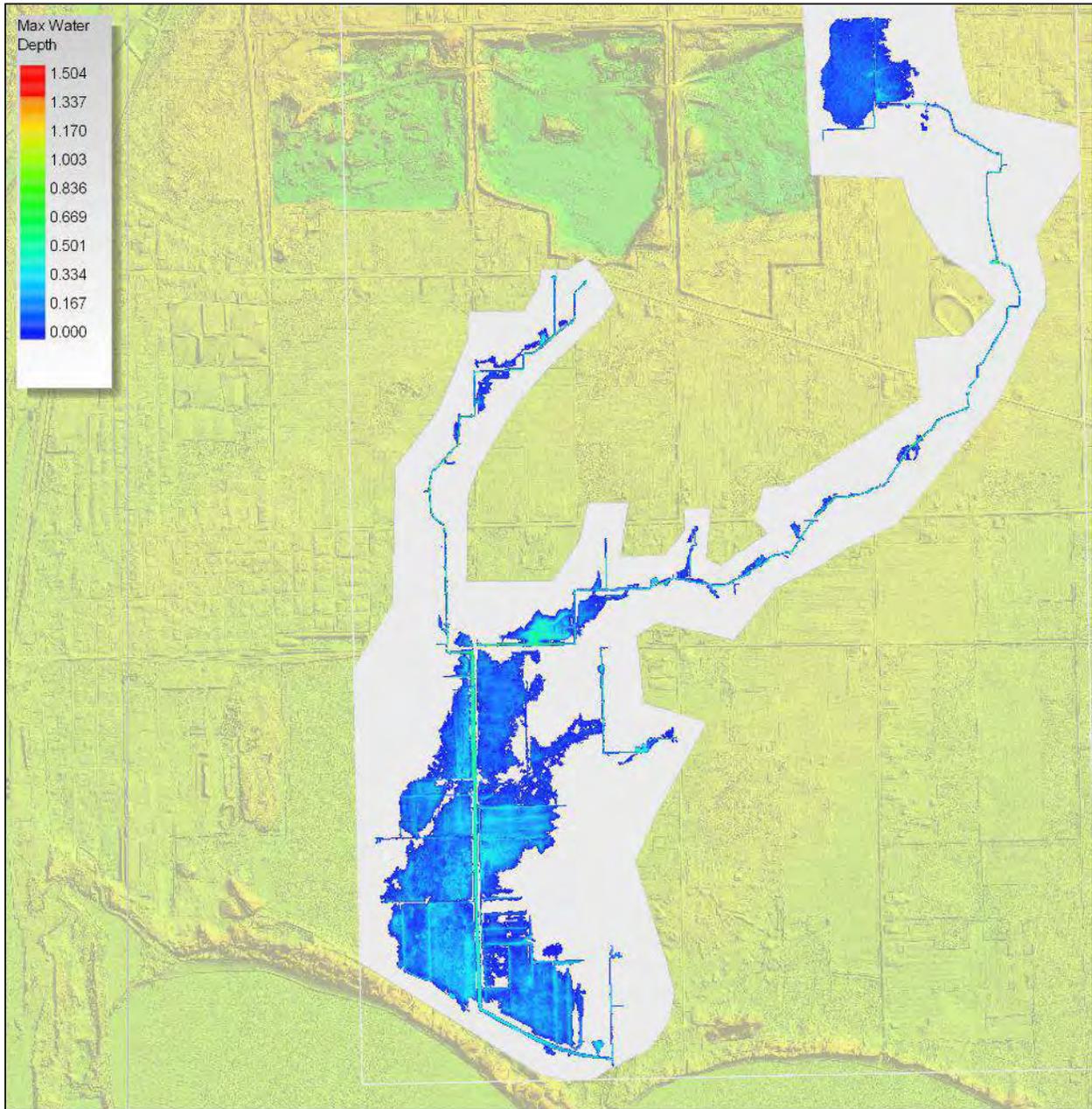
Graphic 9: XPSWMM Depth MAP (10 year) – Site Undeveloped Existing Flows



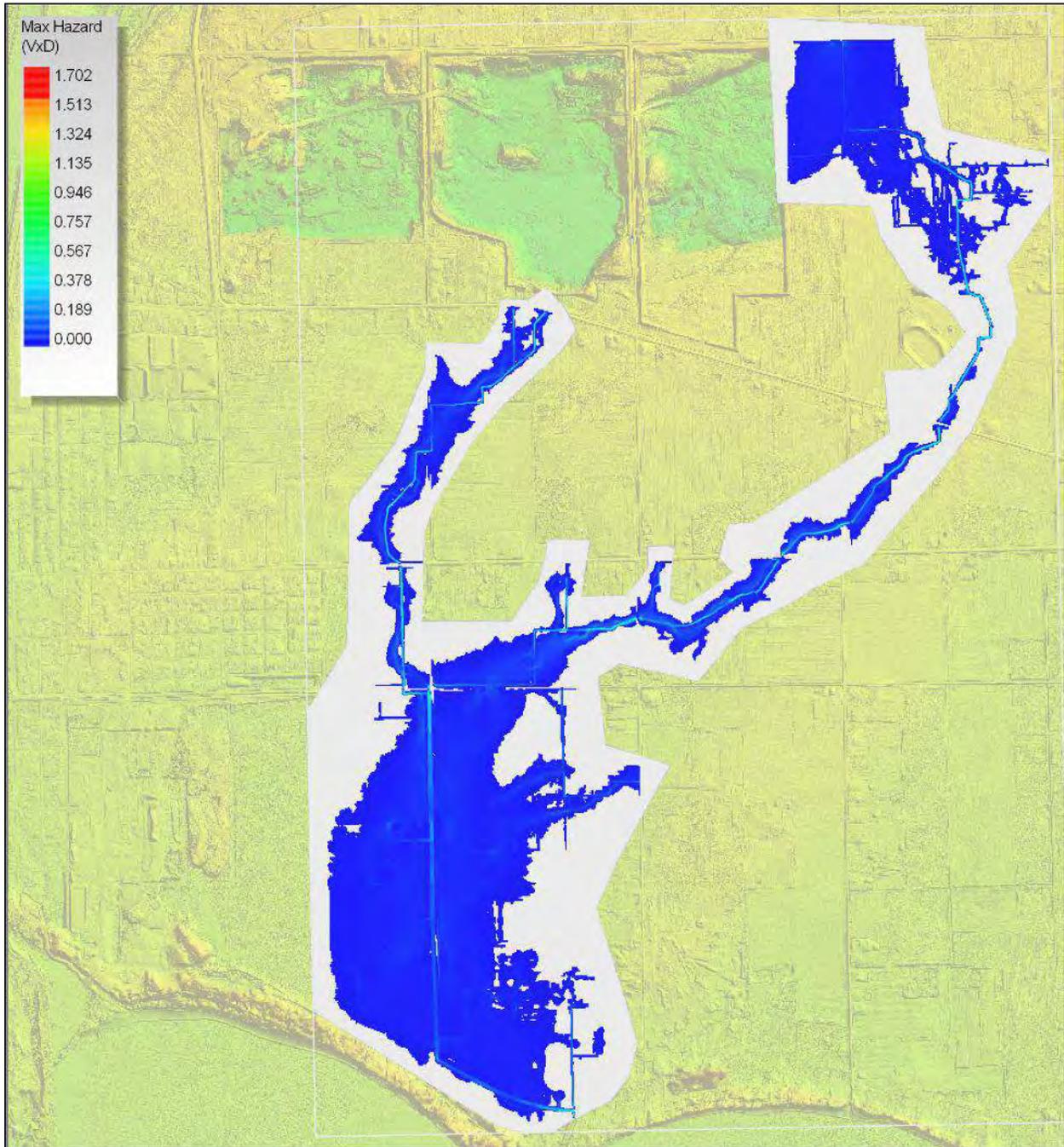
Graphic 10: XPSWMM Depth MAP (5 year) – Site Undeveloped Existing Flows



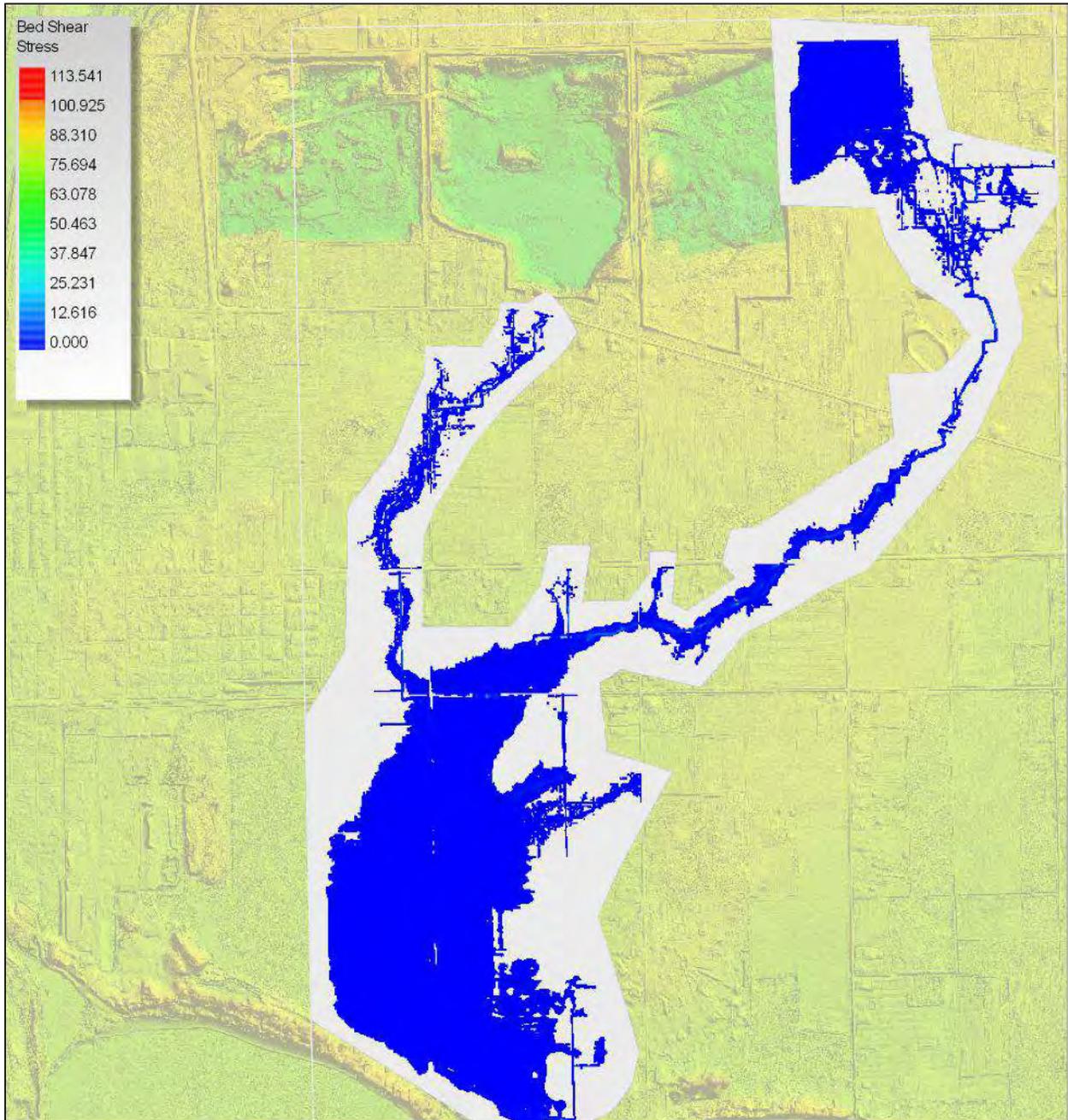
Graphic 11: XPSWMM Depth MAP (2 year) - Site Undeveloped Existing Flows



Graphic 12: XPSWMM Hazard MAP (100 year) – Site Undeveloped Existing Flows



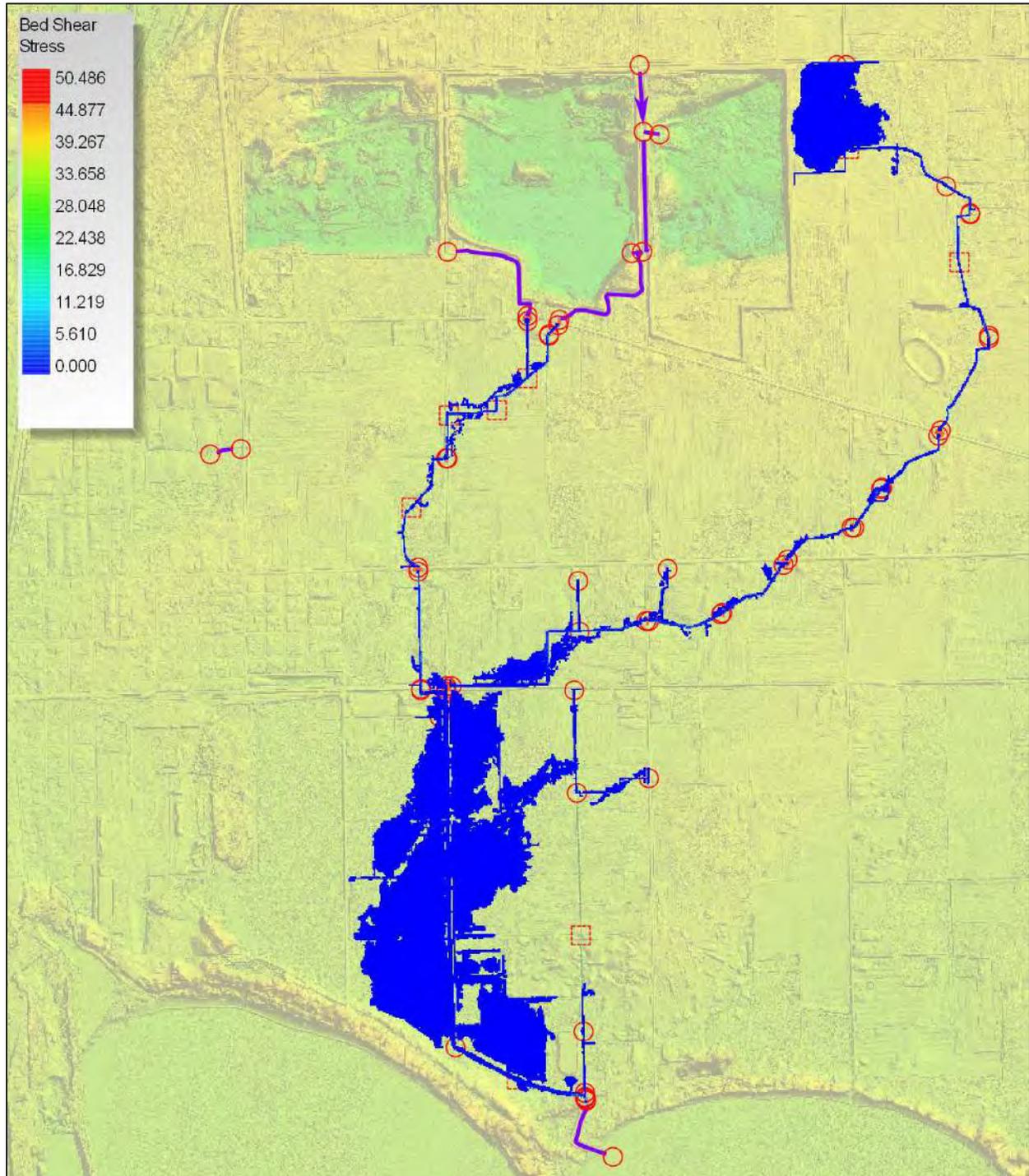
Graphic 13: XPSWMM Bed Shear MAP (100 year) - Site Undeveloped Existing Flows



The above map is the 100-year bed shear. The maximum is 114 Pa anywhere in the system.



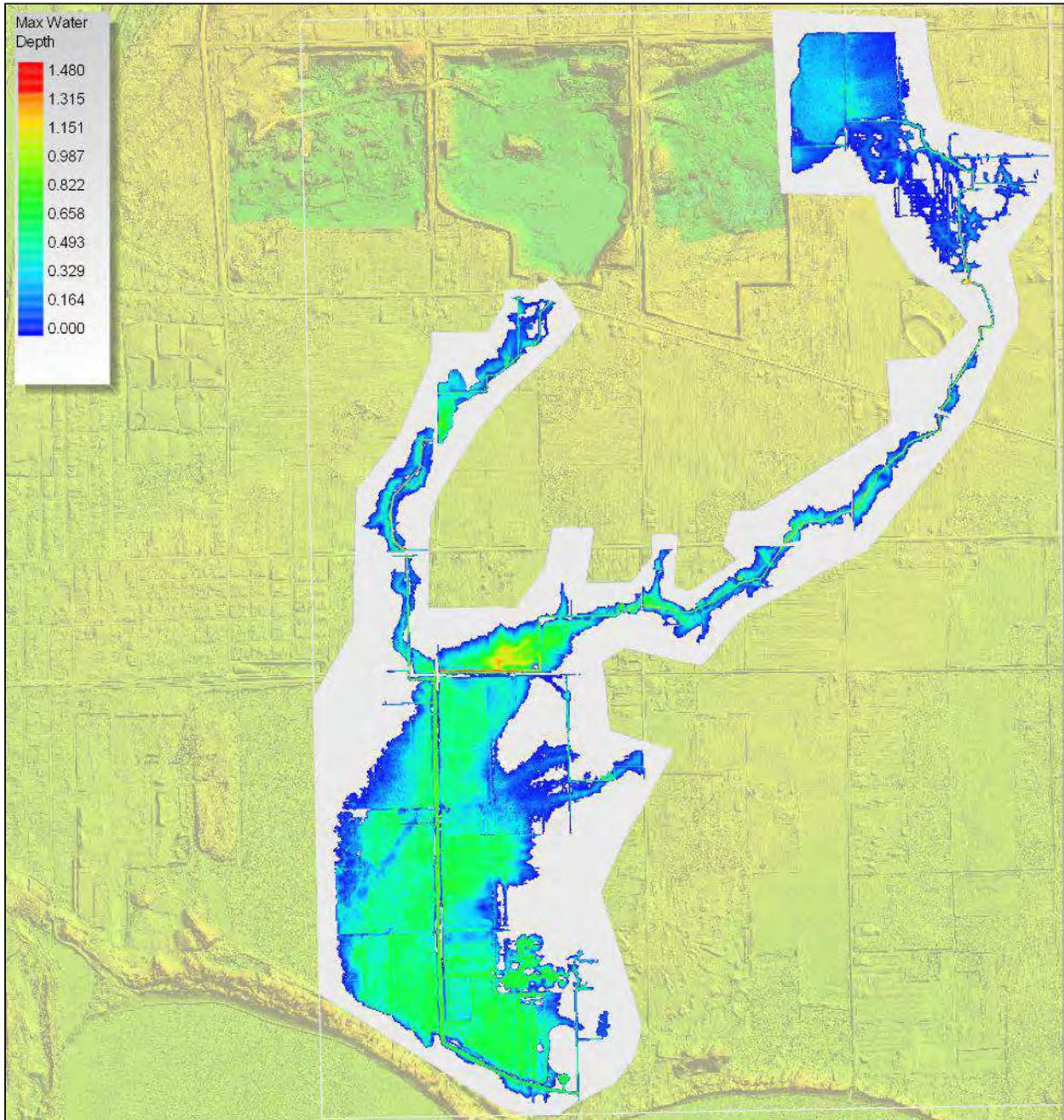
Graphic 14: XPSWMM Bed Shear MAP (2 year) - Site Undeveloped Existing Flows



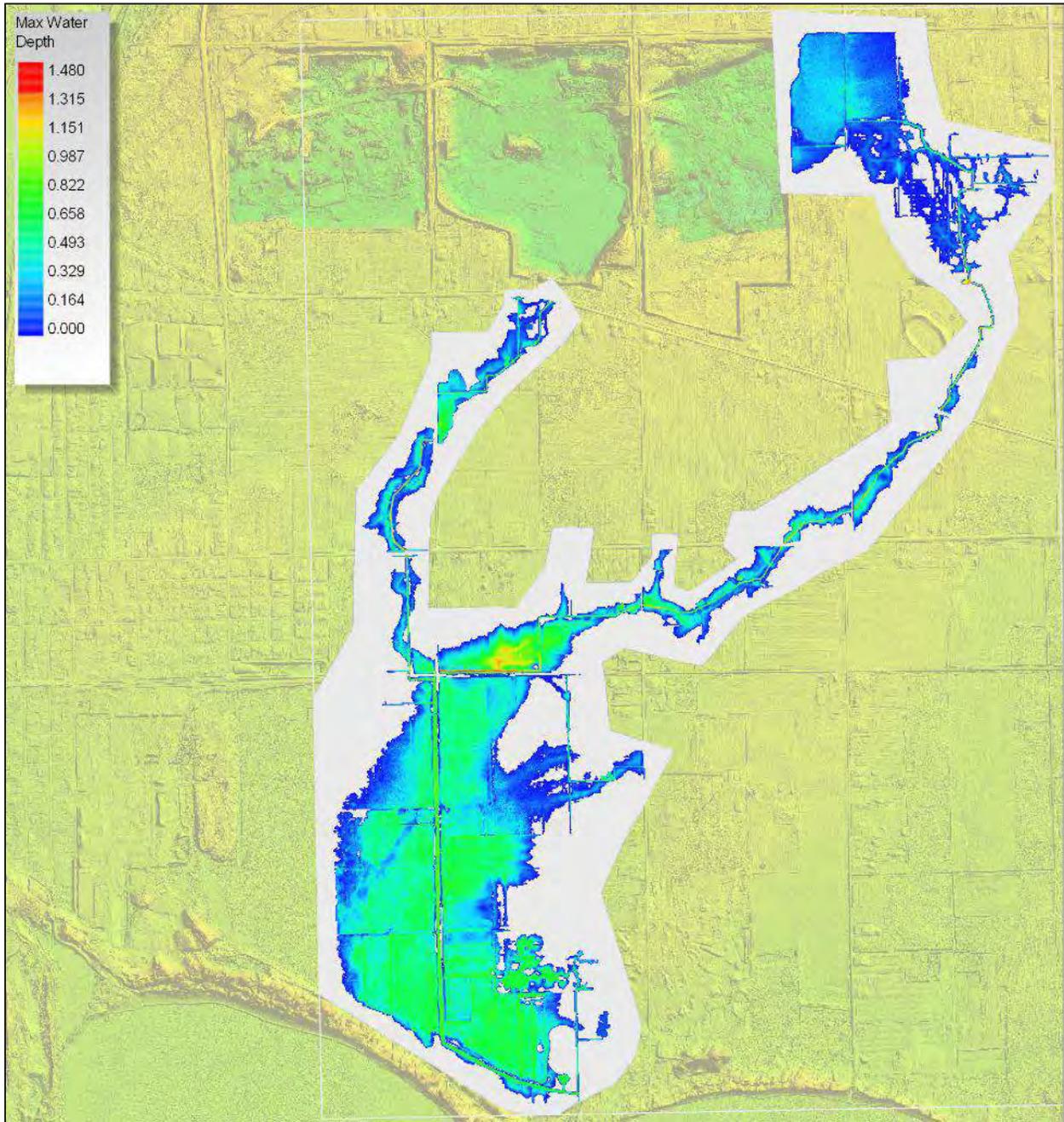
The above map is the 2-year bed shear. The maximum is 50 Pa anywhere in the system.



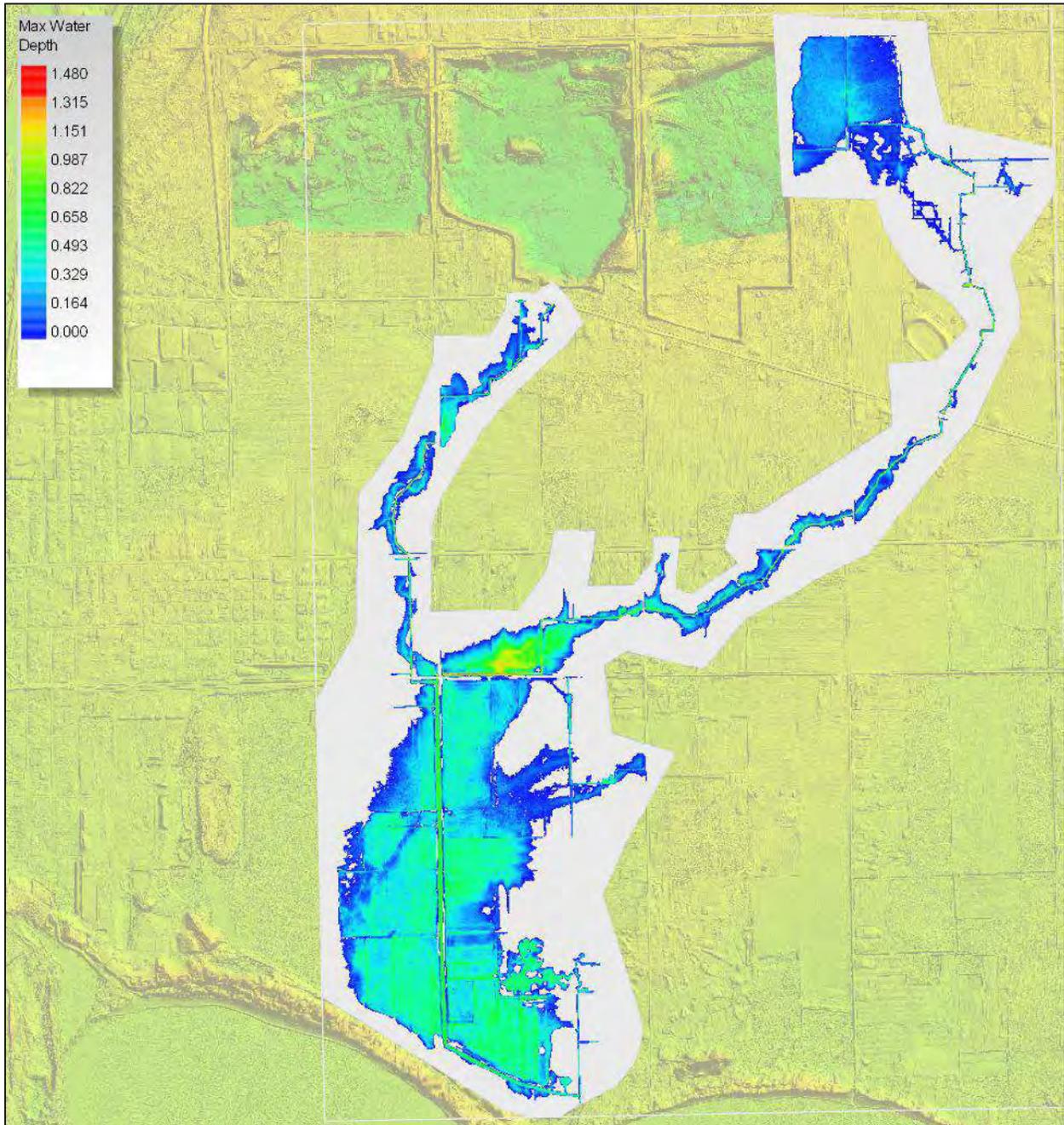
Graphic 15: XPSWMM Depth MAP (100 year) – Subject Lands Developed



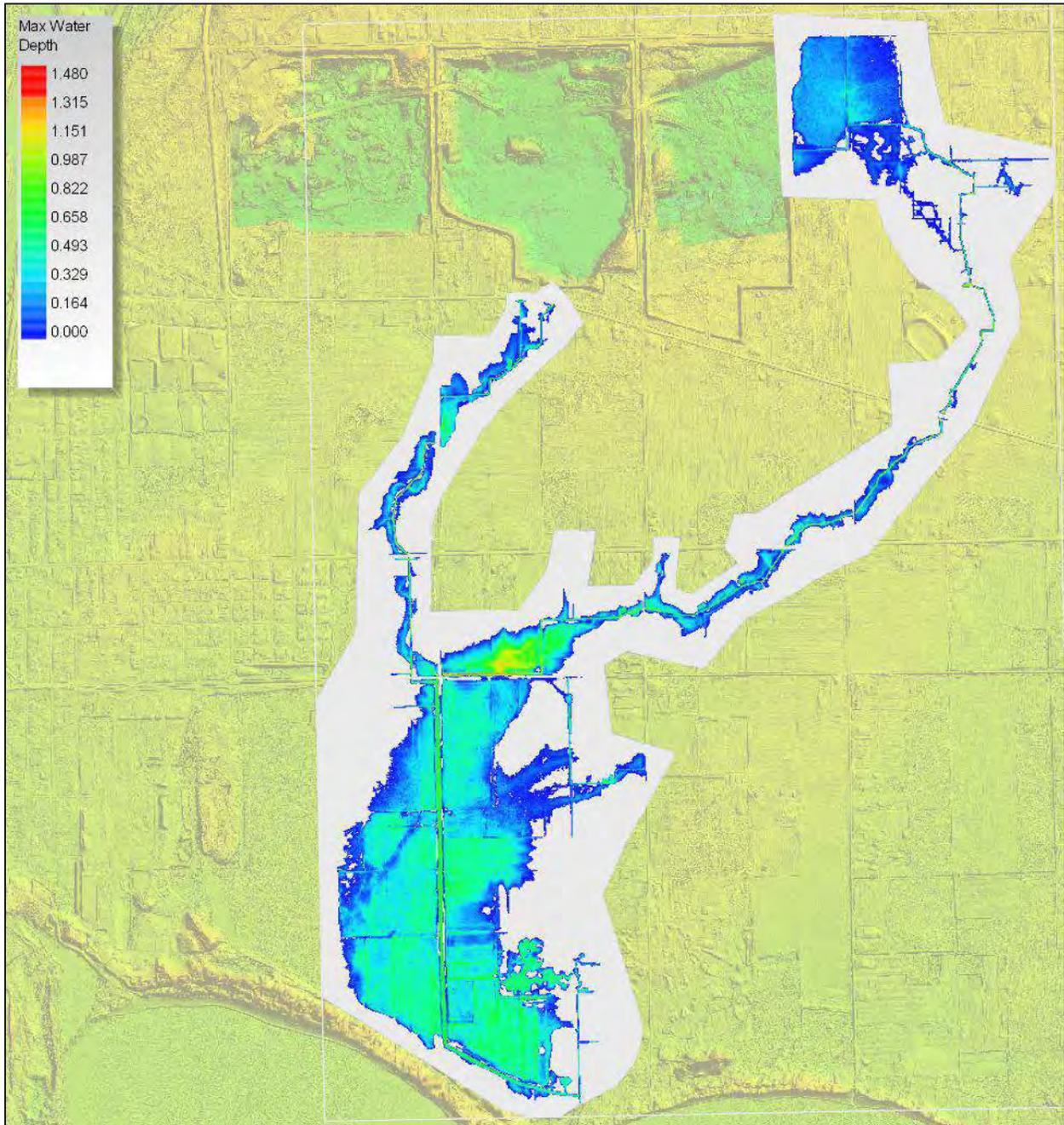
Graphic 16: XPSWMM Depth MAP (50 year) - Subject Lands Developed



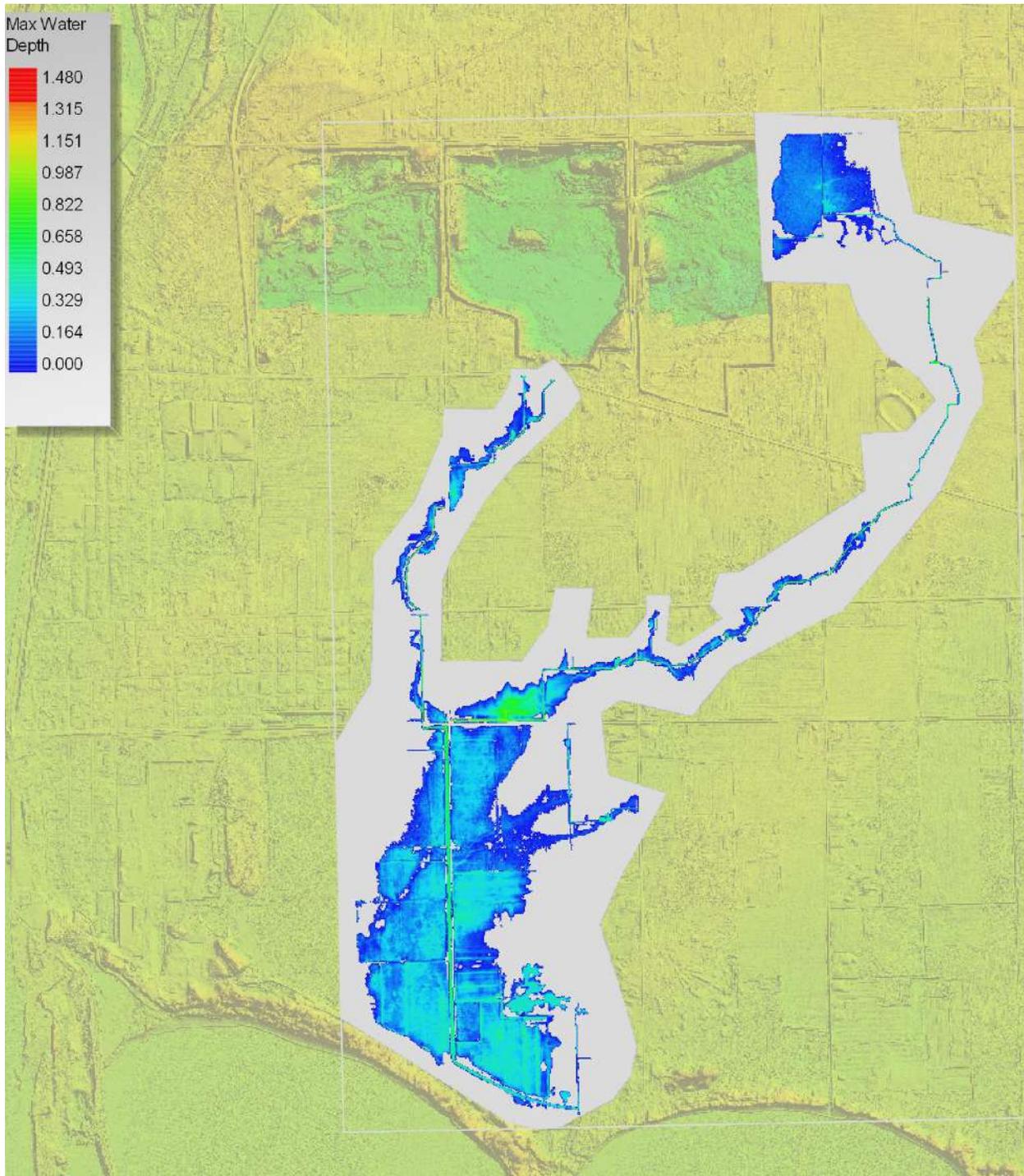
Graphic 17: XPSWMM Depth MAP (25 year) - Subject Lands Developed



Graphic 18: XPSWMM Depth MAP (10 year) - Subject Lands Developed

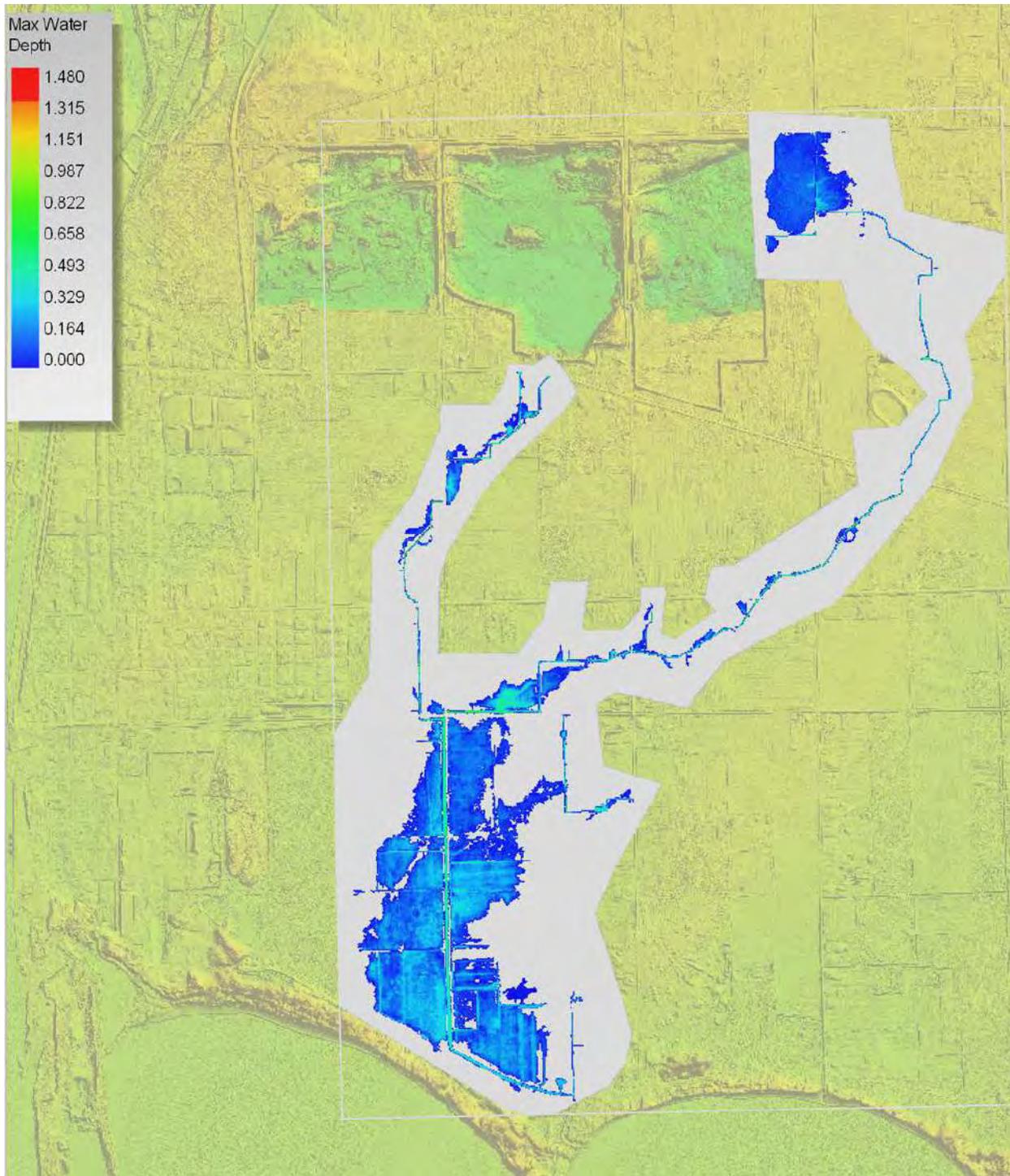


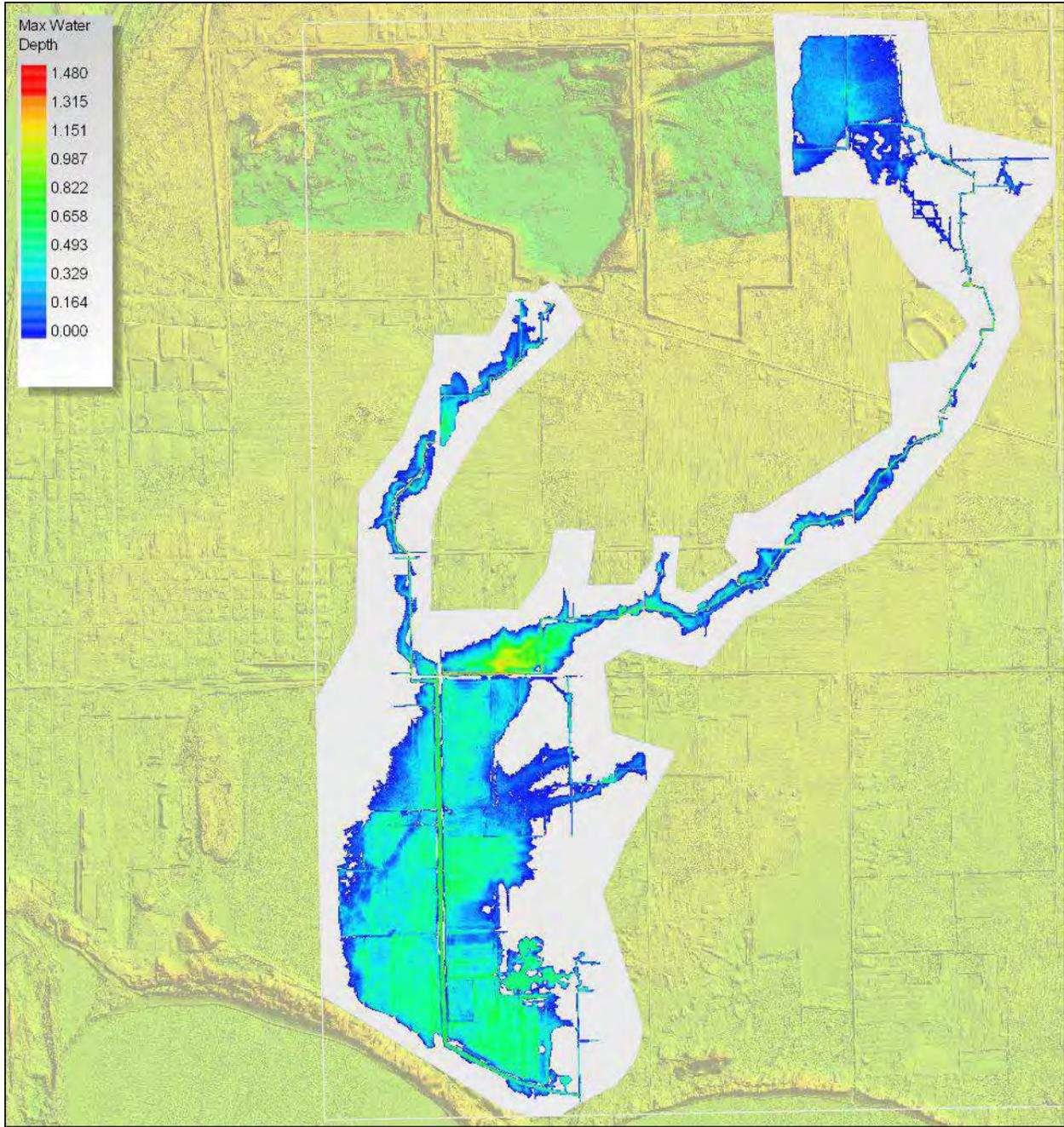
Graphic 19: XPSWMM Depth MAP (5 year) - Subject Lands Developed



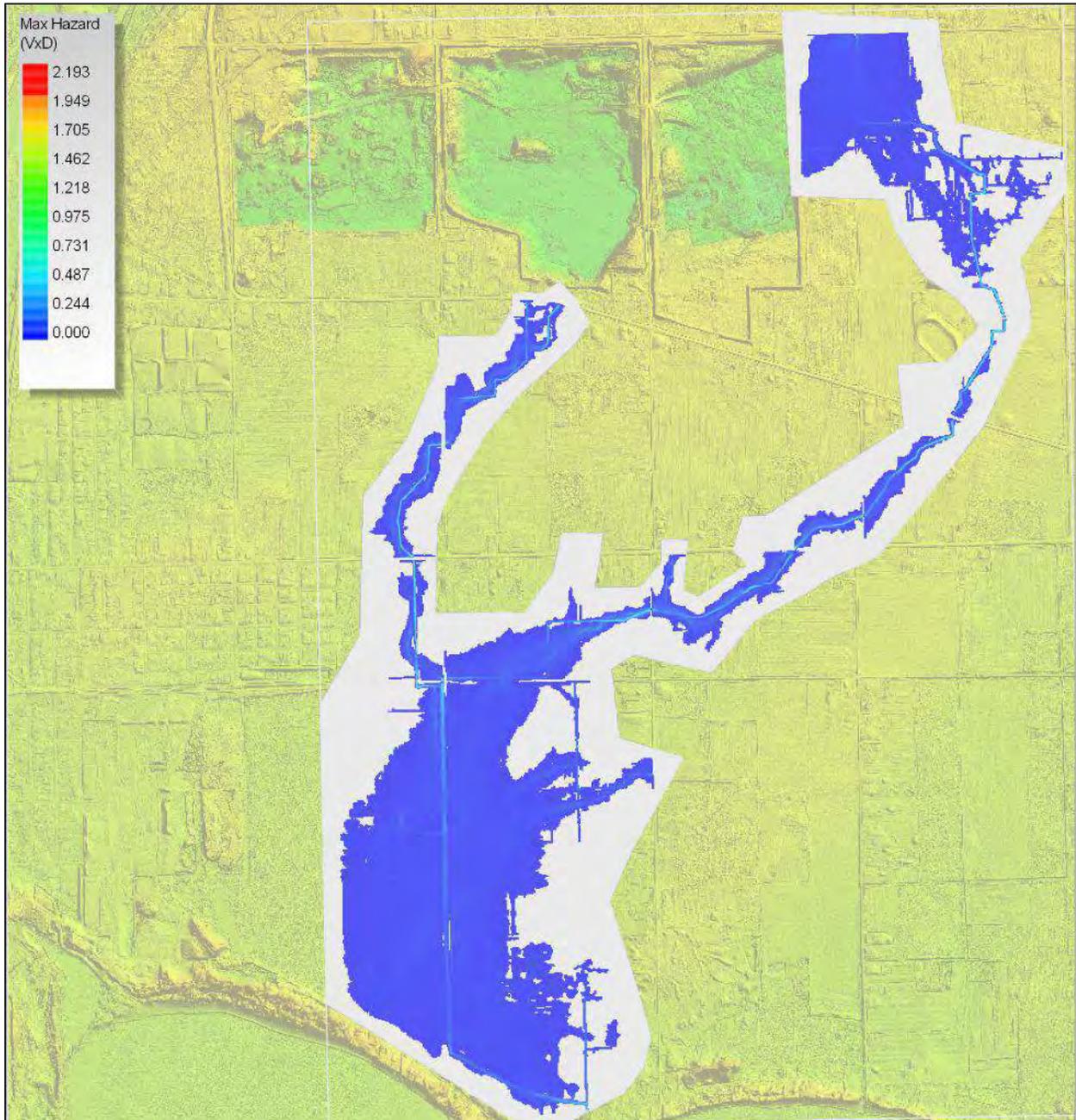
Graphic 20: XPSWMM Depth MAP (2 year) - Subject Lands Developed



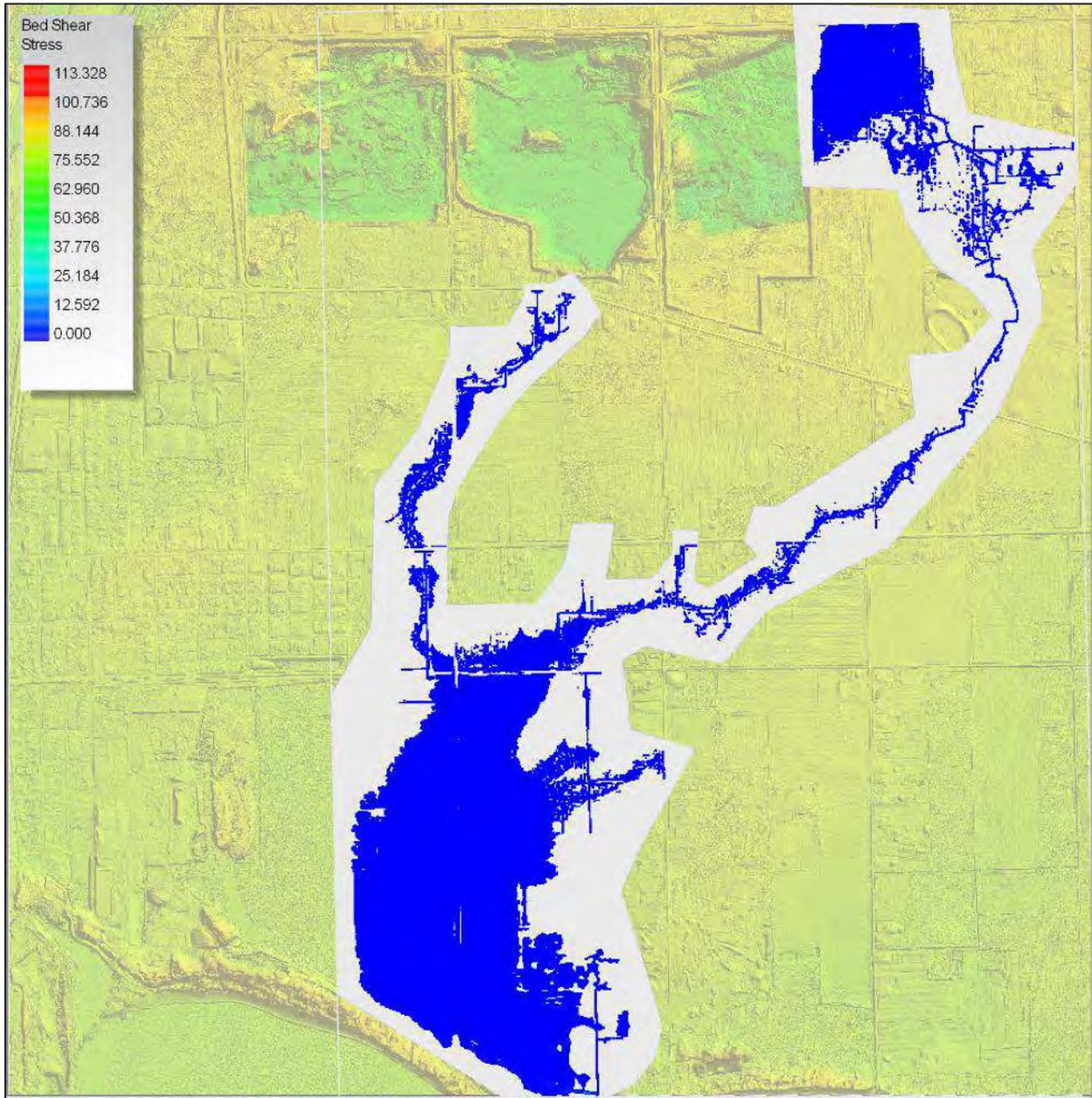




Graphic 21: XPSWMM Hazard MAP (100 year) - Subject Lands Developed



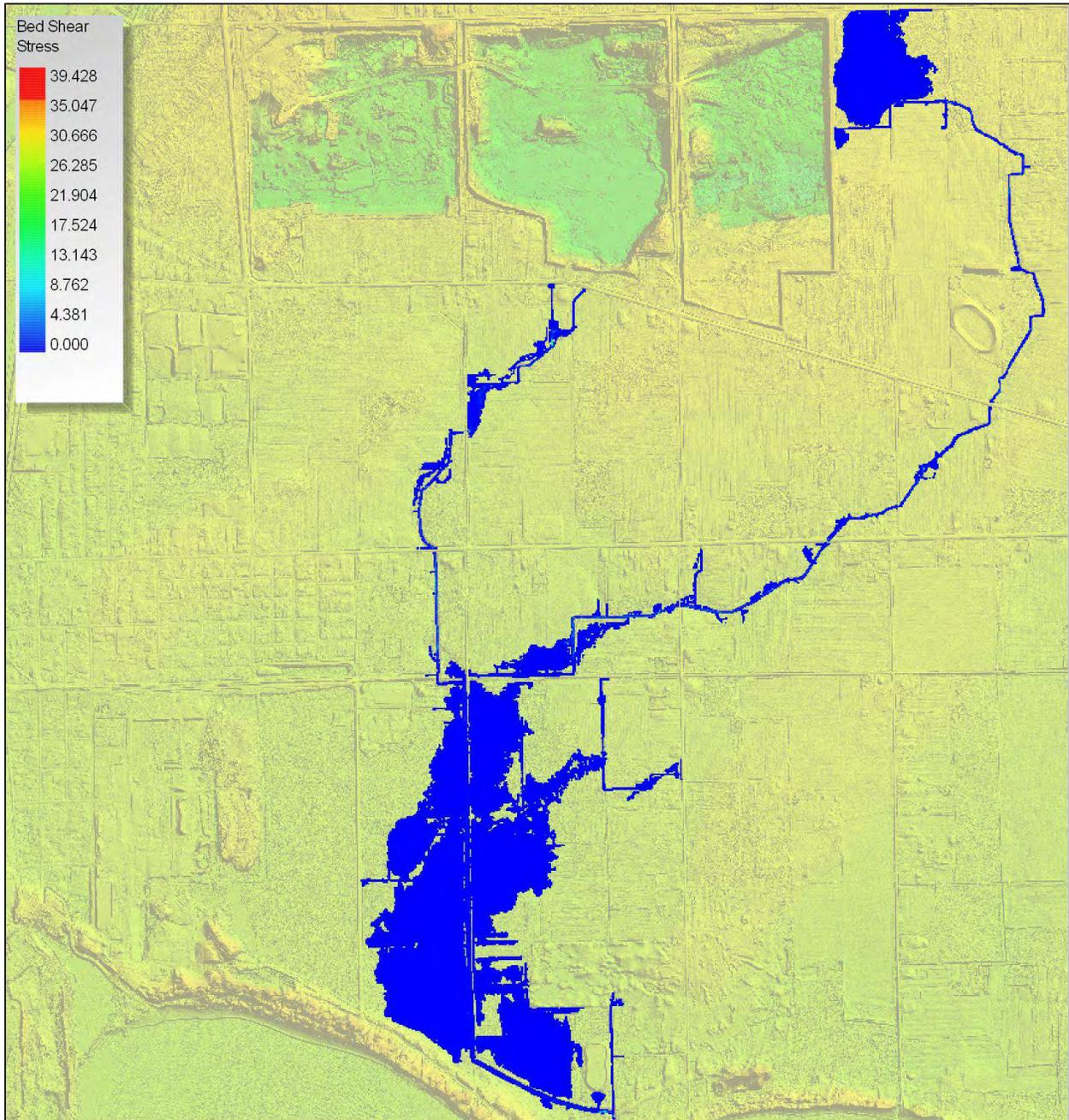
Graphic 22: XPSWMM Bed Shear MAP (100 year) - Subject Lands Developed



Note, the 100-year maximum in the Subject Lands is less than the existing conditions.



Graphic 23: XPSWMM Bed Shear MAP (2 year) - Subject Lands Developed



Note, the 2-year maximum in the Subject Lands is less than the existing conditions.



Point Head Plot

In addition to the modeling and mapping, **Graphic 24** below provides the points from which the HGLs were retrieved, as well as the locations of profile plots (sections plots) for the existing and proposed models. **Table 33** provides a summary of these points HGLs, with the section plots graphed below. It should be noted that the geospatial locations of these points and sections are identical for the existing conditions scenario and the Subject Lands scenario.



Graphic 24: Point Head Plot

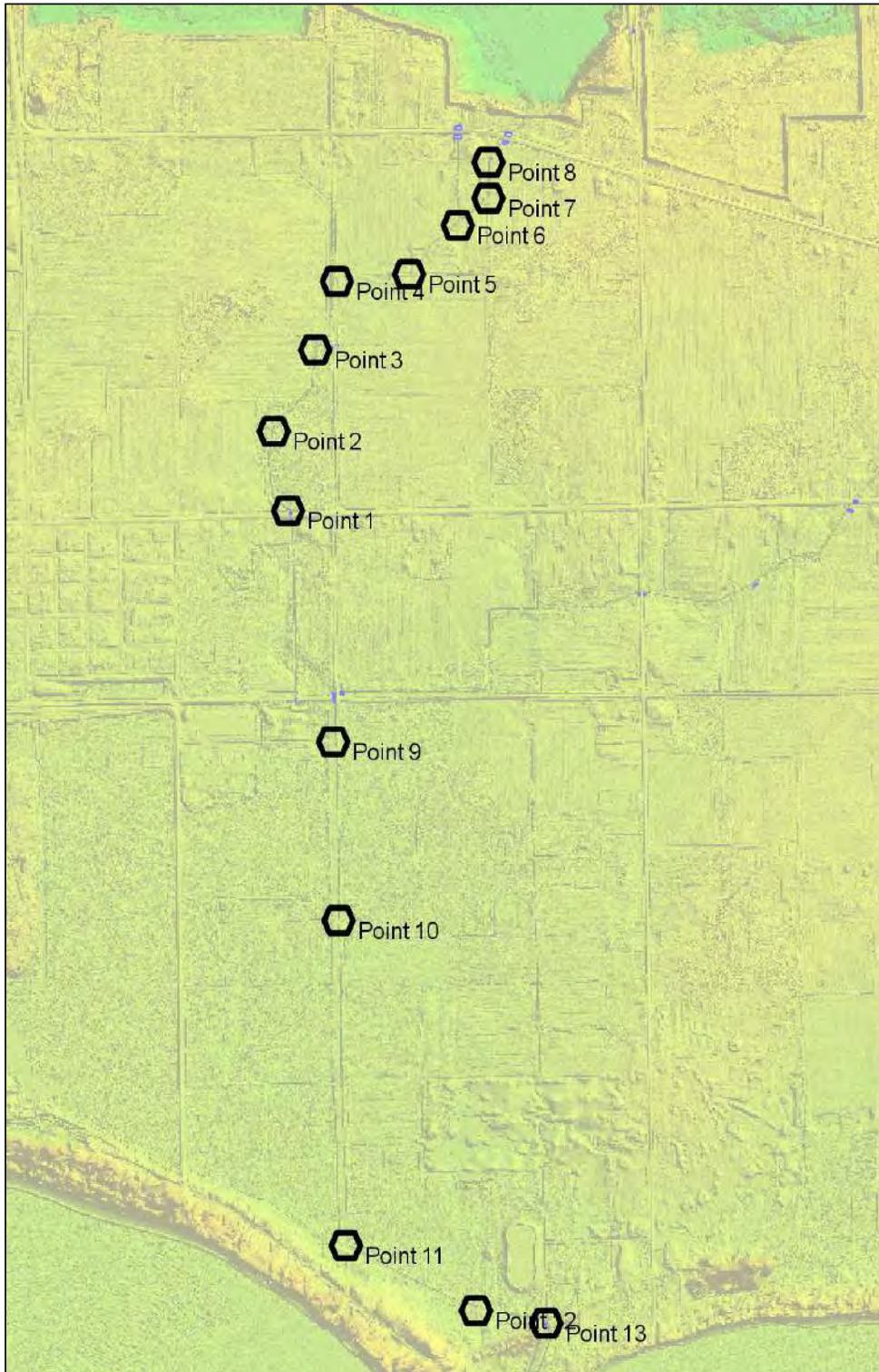


Table 33: Summary of Hydraulic Effects - Existing and Subject Lands Developed

Location	100-year 24 hr SCS		50-year 24 hr SCS		25-year 24 hr SCS		10-year 24 hr SCS		5-year 24 hr SCS		2-year 24 hr SCS	
	HGL (m)											
	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed	Existing	Developed
Point 1	177.08	177.06	176.94	176.96	176.80	176.82	176.60	176.61	176.50	176.51	176.35	176.37
Point 2	177.20	177.19	177.10	177.13	177.03	177.07	176.96	177.00	176.88	176.92	176.74	176.76
Point 3	177.44	177.45	177.40	177.43	177.36	177.40	177.30	177.34	177.24	177.27	177.08	177.11
Point 4	177.77	177.74	177.74	177.70	177.68	177.65	177.58	177.58	177.50	177.54	177.40	177.49
Point 5	177.96	178.00	177.94	177.98	177.92	177.95	177.90	177.91	177.85	177.86	177.78	177.78
Point 6	177.44	178.43	178.41	178.42	178.40	178.40	178.38	178.38	178.32	178.33	178.22	178.22
Point 7	178.69	178.69	178.66	178.67	178.62	178.64	178.57	178.60	178.54	178.56	178.44	178.50
Point 8	179.05	179.04	178.98	178.98	178.90	178.91	178.78	178.78	178.68	178.69	178.54	178.57
Point 9	175.74	175.74	175.69	175.69	175.67	175.67	175.64	175.63	175.60	175.59	175.49	175.50
Point 10	175.73	175.73	175.68	175.68	175.63	175.63	175.55	175.55	175.47	175.48	175.40	175.40
Point 11	175.73	175.73	175.68	175.68	175.63	175.62	175.54	175.54	175.45	175.46	175.36	175.35
Point 12	175.69	175.69	175.62	175.61	175.54	175.52	175.43	175.42	175.35	175.35	175.27	175.27
Point 13	175.53	175.50	175.45	175.44	175.38	175.38	175.25	175.26	175.16	175.16	175.00	175.00

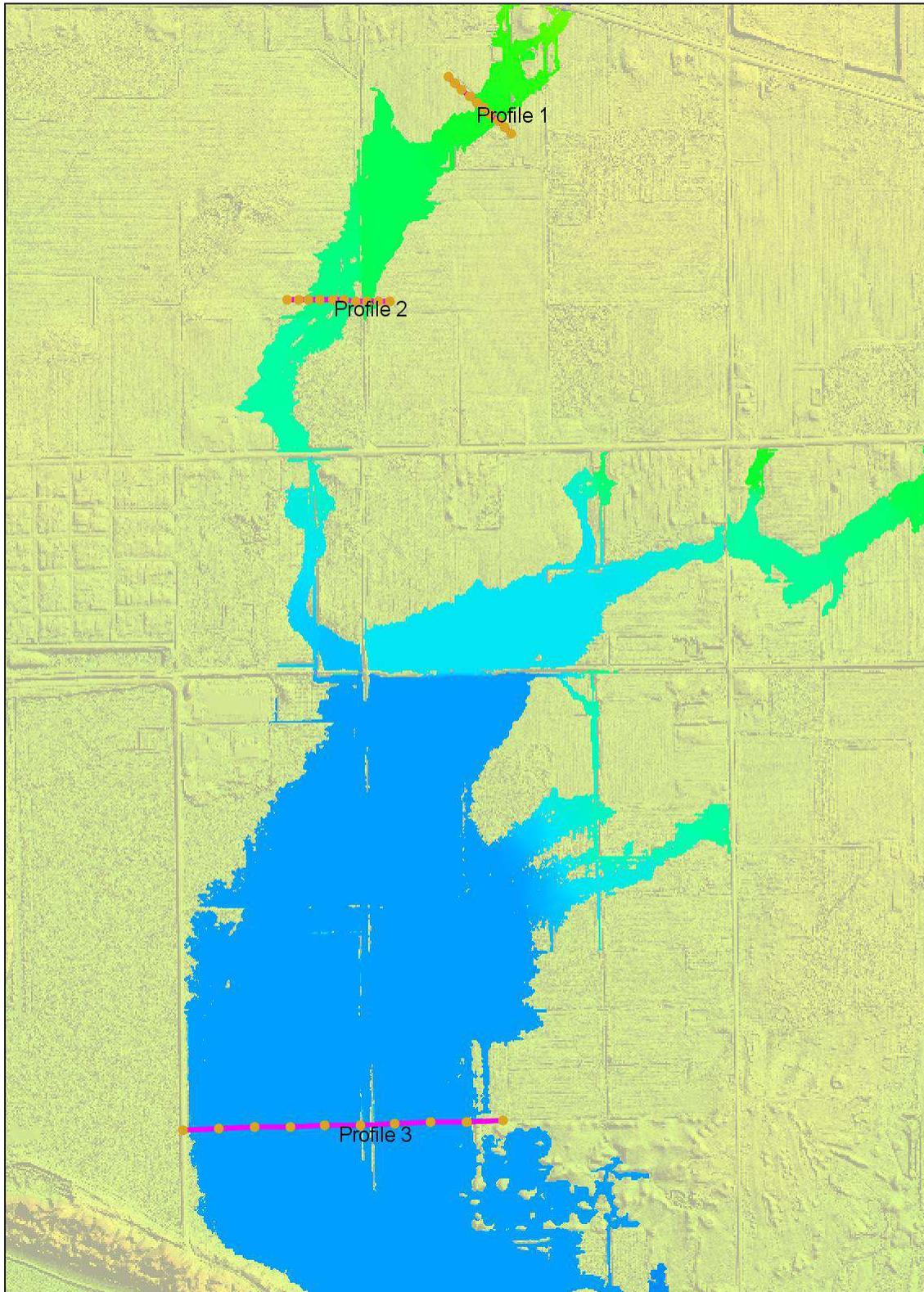
Note, essentially the existing and Subject Lands HGL are the same.

Section Plots

Graphic 25 shows the locations of profile plots for existing and proposed models.

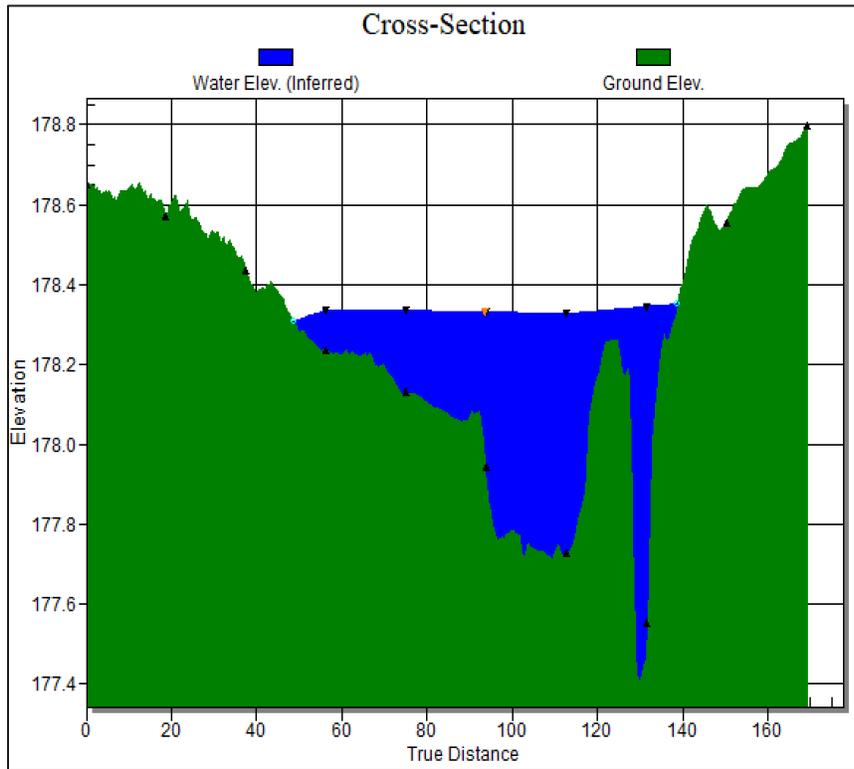


Graphic 25: Section Plots

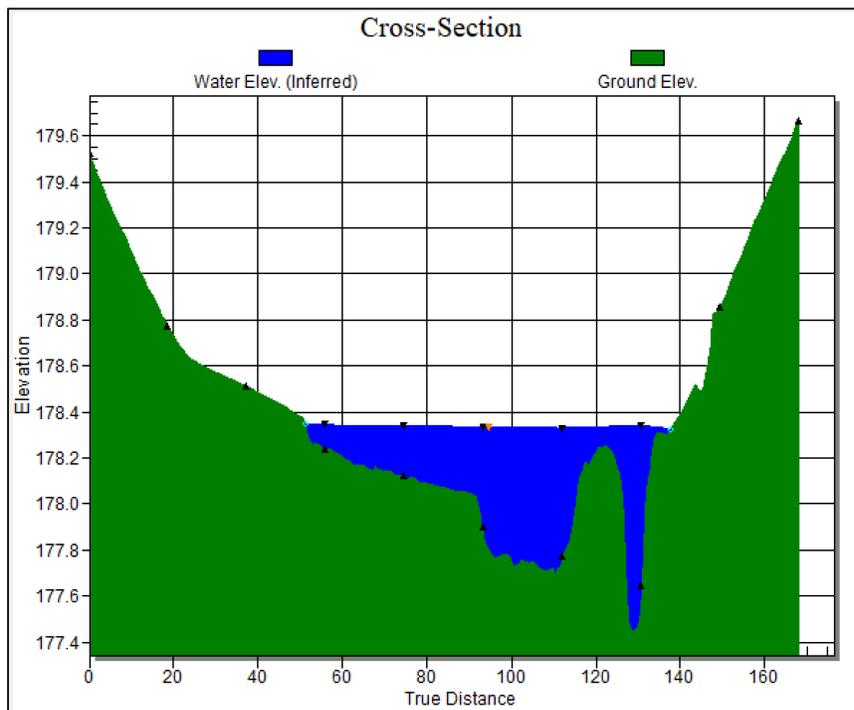


Profile 1: 100-year 24 hr SCS

Existing

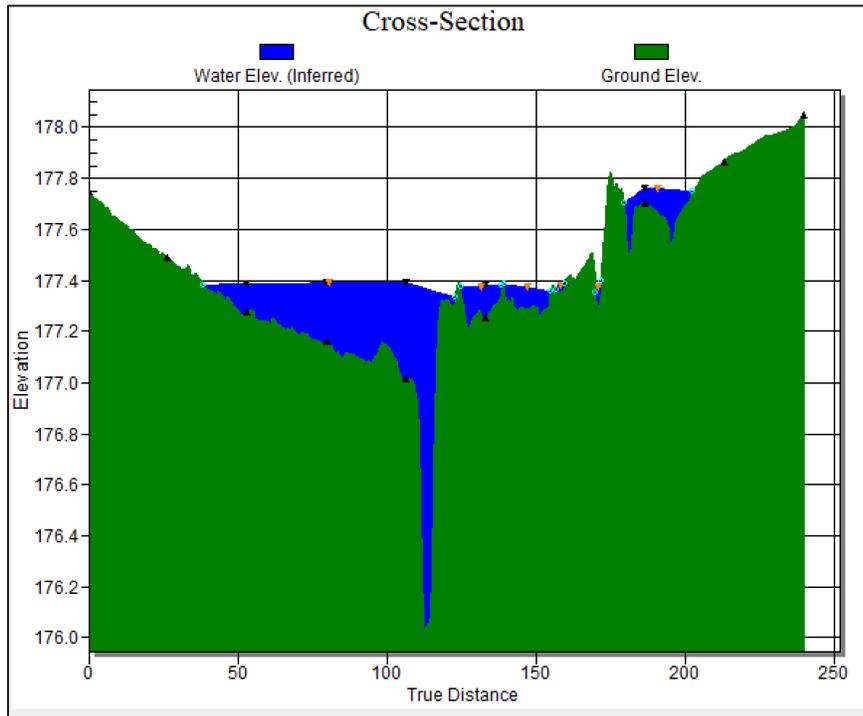


Subject Lands Developed

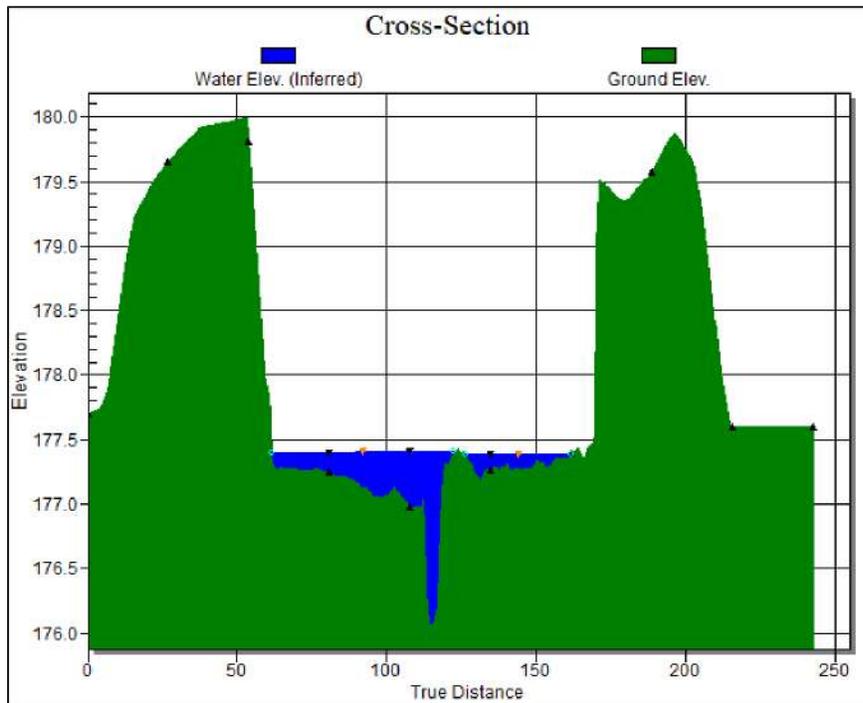


Profile 2: 100-year 24 hr SCS

Existing

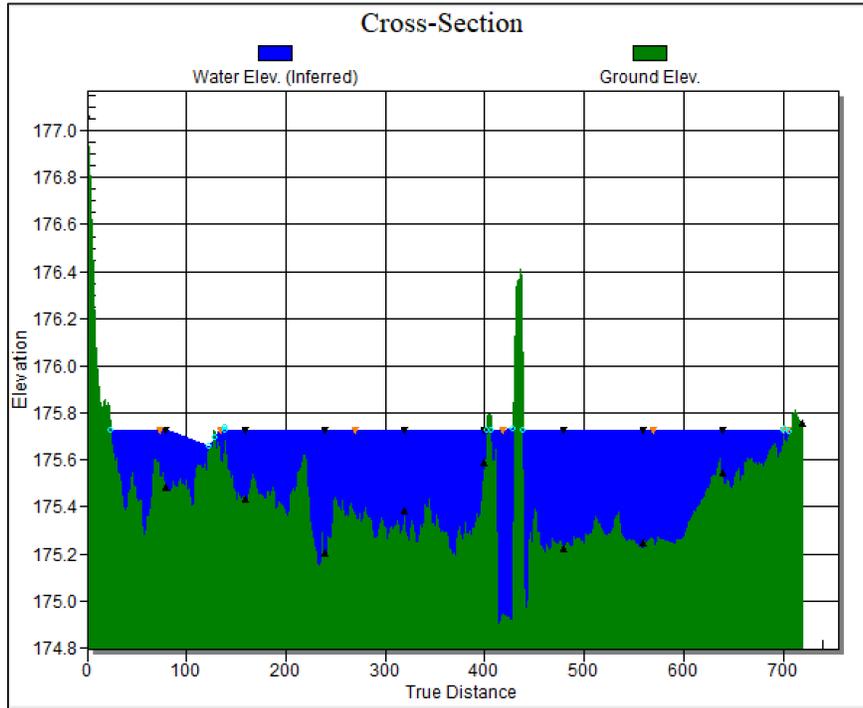


Subject Lands Developed

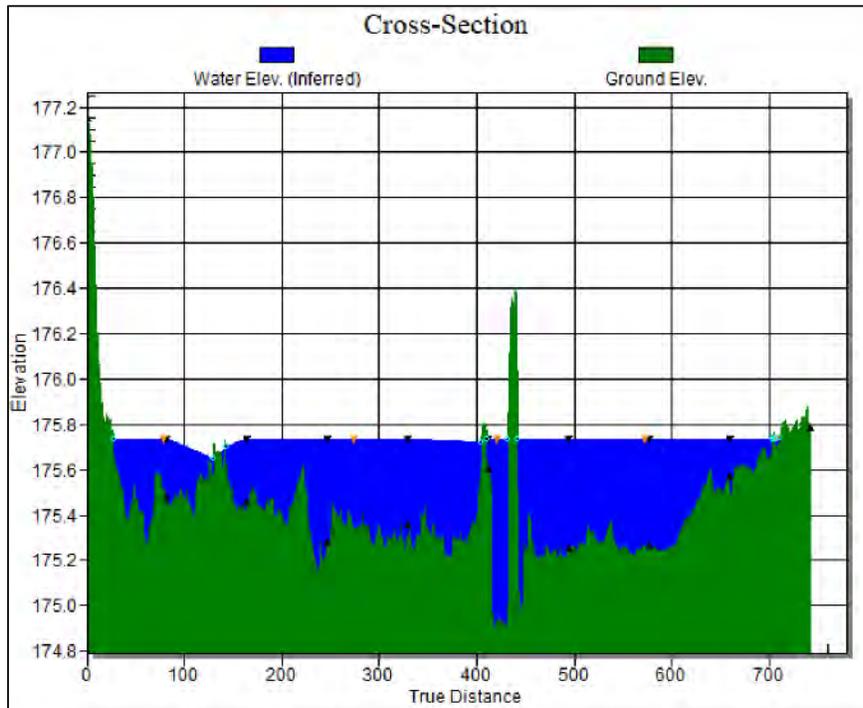


Profile 3: 100-year 24 hr SCS

Existing



Subject Lands Developed



8.2 Erosion Review

The bed shear stress is calculated as follows in XP2D:

$$\tau_{bed(metric)} = \frac{\rho g v^2 n^2}{y^{1/3}}$$

where:

ρ = Density

g = Gravity

v = Velocity

n = Manning's n

y = Depth

Units are in N/m²

Reproduced from the HEC-15, FHWA-NHI-01-021 Urban Drainage Design Manual (2001), the following are the recommended shear stresses as per vegetative cover.

Lining Category	Type	Permissible Unit Shear Stress (Pa)
Vegetative	Class A	177.2
	Class B	100.6
	Class C	47.9
	Class D	28.7
	Class E	16.8

Using the formula and graphs provided above, a majority of the cells in the landscaped areas and the drain areas have a bed shear stress of less than 114 N/m². Note this is calculated using the 100-year storm scenario. The 2-year storm bed shear graphs and formula calculations indicate a bed shear of 50 N/m² in the existing condition scenario and 39 N/m² in the developed condition (maximum) scenario. This is well within the permissible range for well vegetated areas.

The objective of the floodplain analysis is to not increase the erosion forces in the receiving natural streams. The Ministry of Environment (MOE) outlined an interim approach in 1994 and updated it in the Stormwater Management Planning and Design Manual (Ministry of the Environment, Conservation and Parks, 2003). This updated approach consists of either a detailed design approach or a simplified design approach that is currently being improved to address inadequacies. Accordingly, it is recommended that the general approach be followed as outlined in the Stormwater Management Planning and Design Manual (Ministry of the Environment, Conservation and Parks, 2003). This consists of designing SWM ponds to include active storage for the runoff from a 25 mm storm, followed by a check on erosion velocities in the downstream receiver. Quantity control to detain and release the 25 mm, 4-hour Chicago design storm over a 24-hour period shall be provided for all receiving systems that are



demonstrated to be stable watercourses or for proposed development that comprise less than 10% of the total area that drains to the receiving system.

Note, the shear bed method in 2D modelling is quickly becoming the method of choice due to testing that shows shear stress is a better indicator of erosion than velocity.

Table 34 provides a comparison of existing to developed flows (target flows).



Table 34: WMM Comparison of Outflow – Existing (target) and Redeveloped

Storm Event Storm Type	Target Peak Flow Rate (m ³ /s)																				
	S-1			S-2			S-3			S-4			S-5			S-6			S7		
	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM	Existing	Developed	PCSWMM
2 Year 24Hr SCS	0.439	0.439	0.406	0.730	0.728	0.764	1.092	1.098	1.169	0.685	0.690	1.184	1.025	0.989	1.803	1.026	1.024	2.923	0.480	0.469	2.908
5 Year 24Hr SCS	0.794	0.794	0.750	1.215	1.214	1.256	1.815	1.783	2.156	1.554	1.546	2.806	1.948	1.854	4.266	1.956	1.922	6.375	1.049	1.033	6.580
10 Year 24Hr SCS	1.054	1.054	1.009	1.592	1.595	1.671	2.413	2.461	2.975	2.325	2.320	4.276	2.515	2.404	5.189	2.541	2.502	7.933	1.475	1.413	8.521
25 Year 24Hr SCS	1.402	1.403	1.370	2.164	2.167	2.328	3.225	3.364	4.220	3.415	3.419	5.018	2.654	2.623	5.719	3.374	3.226	7.933	1.770	1.753	9.380
50 Year 24Hr SCS	1.651	1.651	1.655	2.656	2.656	2.906	3.937	4.032	5.273	4.230	4.243	5.294	2.684	2.643	6.081	3.886	3.820	7.933	1.955	1.919	9.791
100 Year 24Hr SCS	1.916	1.916	1.951	3.159	3.158	3.557	4.689	4.574	5.719	4.979	5.002	5.629	2.687	2.645	6.481	4.374	4.311	7.933	2.164	2.145	10.00
100 Year 12Hr AES	0.606	0.606	-	1.976	1.978	-	4.105	3.948	-	4.619	4.637	-	2.694	2.657	-	4.048	4.070	-	1.766	1.738	-

Note, PCSWMM had approximately 0.53 m³/sec from the quarry area which should not be included.



8.2.1 Scenario 3: Existing Conditions - Lake Boundary Modified

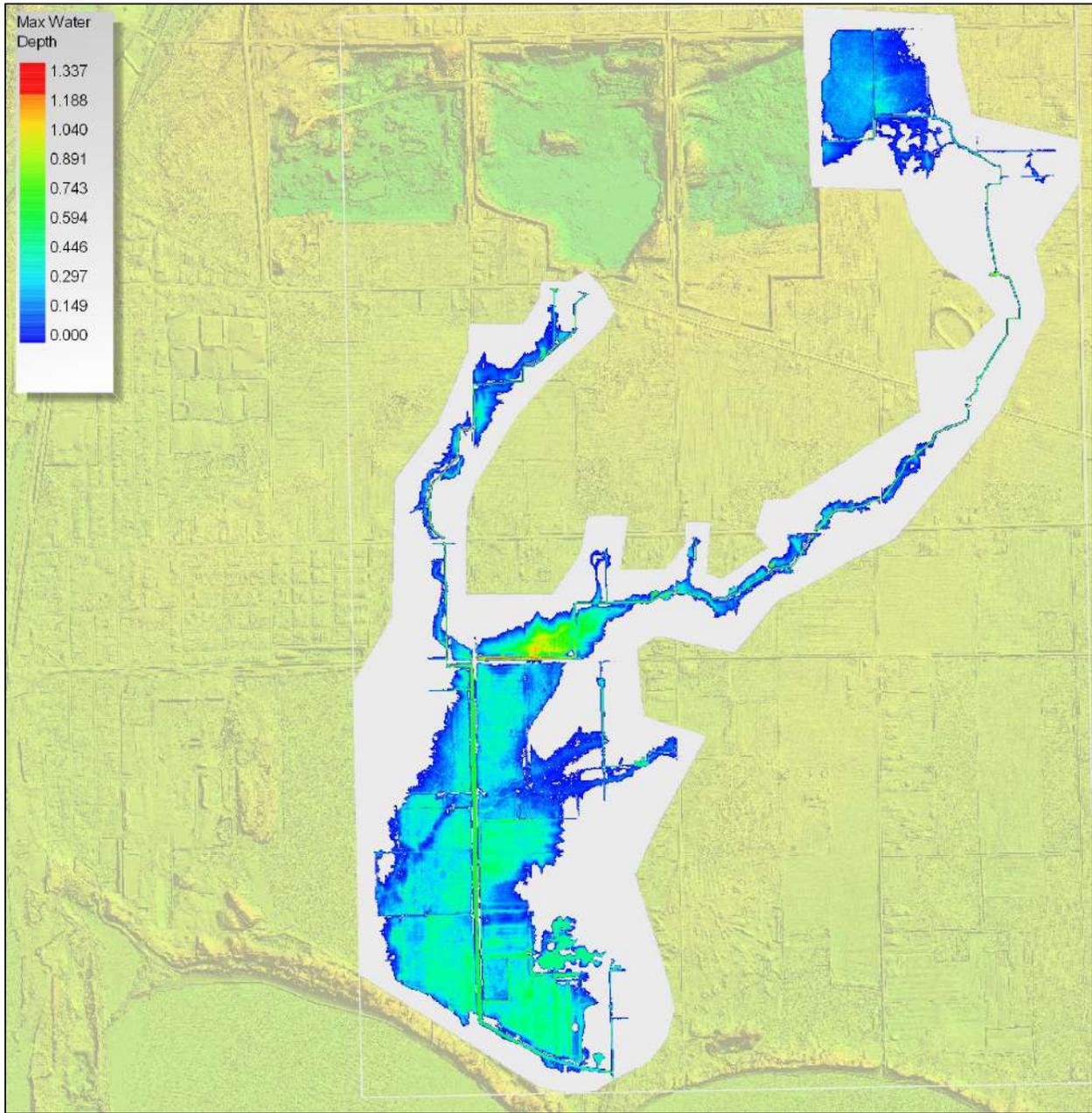
In this scenario the existing condition were used, and the Lake Erie boundary condition was 100-year lake level + 10-year surface runoff event (**Graphic 26**). The outfall was raised to 75.10 m to represent the 100-year lake level + wave setup. At the control structure a flap gate was added since the control structure has sluice gates. Only the 10-year storm scenario was run.

In order to keep probabilities of lake levels and surface runoff real, the scenarios were as follows:

- 10-year surface and 100-year Lake Level and vice versa. Many Conservation Authorities and the MNR use this criterion.



Graphic 26: XPSWMM Depth MAP- Existing – 100 Year Lake – 10 Year Storm



8.2.2 Scenario 4: Subject Lands Developed – Lake Boundary Modified

In this scenario the developed Subject Lands conditions were used, and the Lake Erie boundary condition was 100-year lake level + 10-year surface runoff event (**Graphic 27**). The outfall was raised to 75.10 m to represent the 100-year level + wave setup. At the control structure a flap gate was added since the control structure has sluice gates. Only the 10-year storm was run.

Table 35 below summarizes the effect of Lake Erie water levels on the drain system for the 10-year storm under free flow conditions, as well the effect of Lake Erie water levels on the drain system for the 100-year storm.



Graphic 27: XPSWMM Depth MAP- Subject Lands – 100 Year Lake – 10 Year Storm

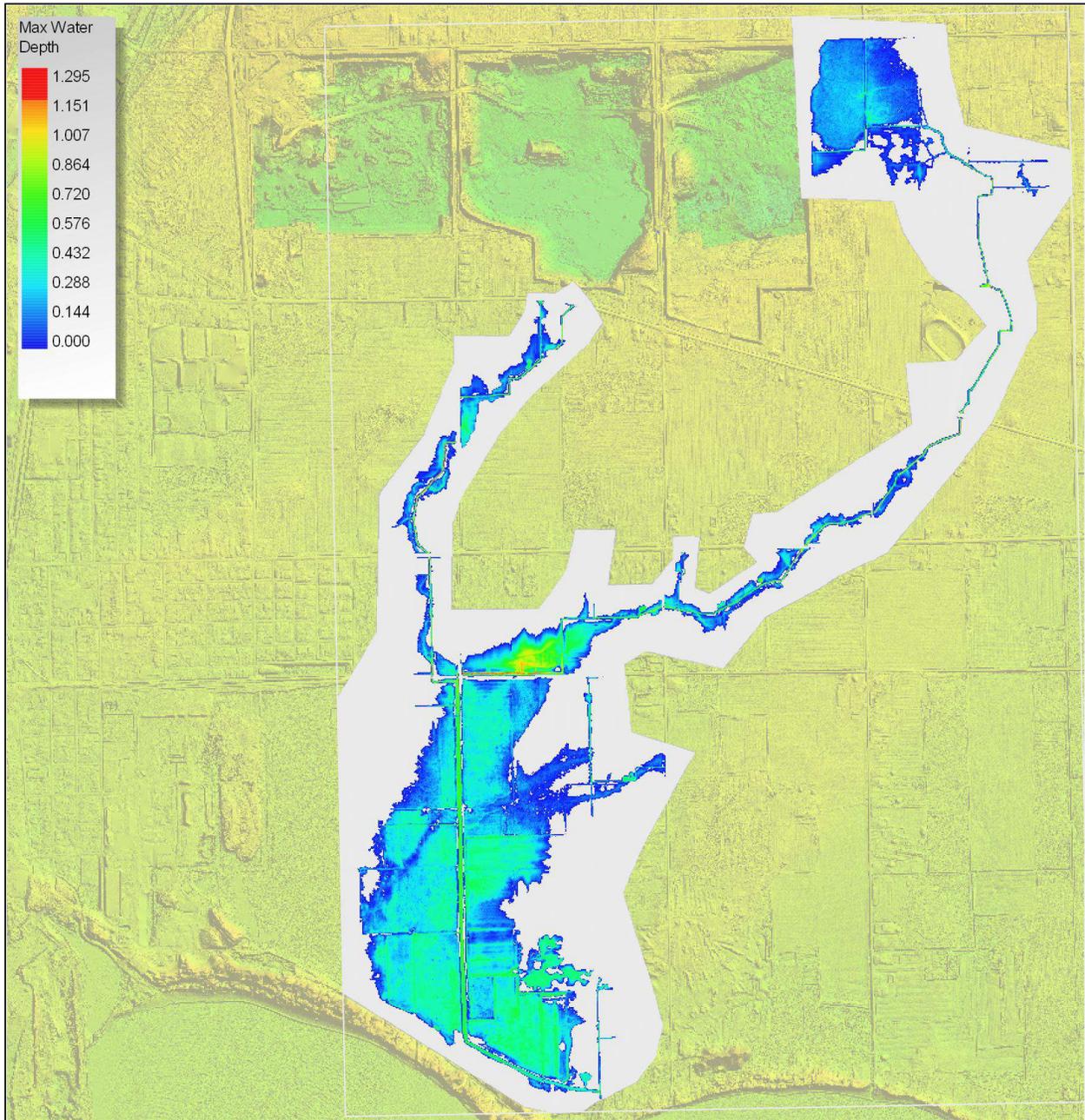


Table 35: Summary of Lake Effects - Hydraulic Effects Existing and Subject Lands Developed

Location	10-year 24 hr SCS 100 year Lake		10-year 24 hr SCS Free flow	
	HGL (m)			
	Existing	Developed	Existing	Developed
Point 1	176.61	176.61	176.60	176.61
Point 2	176.96	177.00	176.96	177.00
Point 3	177.30	177.34	177.30	177.34
Point 4	177.57	177.58	177.58	177.58
Point 5	177.89	177.91	177.90	177.91
Point 6	178.37	178.38	178.38	178.38
Point 7	178.58	178.60	178.57	178.60
Point 8	178.78	178.78	178.78	178.78
Point 9	175.64	175.63	175.64	175.63
Point 10	175.55	175.55	175.55	175.55
Point 11	175.54	175.54	175.54	175.54
Point 12	175.42	175.42	175.43	175.42
Point 13	175.31	175.31	175.25	175.26

Notes:

1. Based on **Table 35** the only area affected by the high lake water is Point 13, near Lake Erie.
2. The Subject Lands not appreciably affect the area when the Lake is high.
3. The probability of lake levels and surface runoff rare events concurring are unlikely, thus the scenario of 10-year surface and 100-year lake level is more realistic.



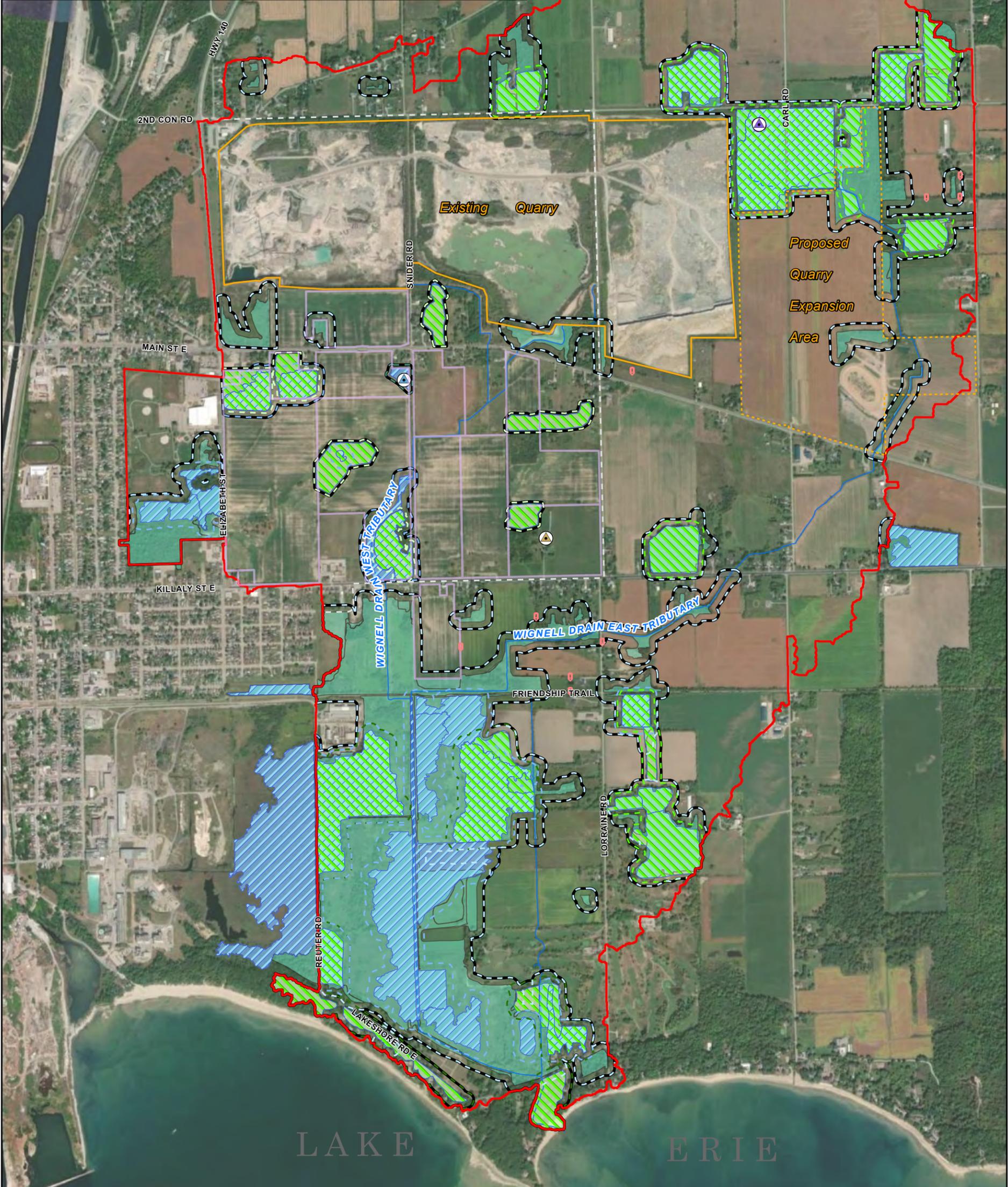
9.0 Development Constraints and Opportunities

9.1 Ecological Constraints

Ecological constraints for the Wignell Subwatershed Study Area are detailed in **Table 36** and illustrated on **Figure 20** (Terrestrial Constraints) and **Figure 21** (Aquatic Constraints). The recommended development limit (i.e., outermost constraints) for the Study Area is highlighted on **Figure 22**. Final meander belts from **Table 16** are included in **Figure 21**. The development may be subject to refinement for areas where site-level field work could not be completed. Other areas may still require feature staking with the appropriate agencies.



LEGEND		OTHER FEATURES:	
CONSTRAINT FEATURES:			
Significant Wildlife Habitat (SWH)			
	Amphibian Breeding Habitat (Woodland)		Arrowroot Thicket Setback (15 m)
	Other Rare Vegetation Communities		Significant Woodland Setback - Urban Settlement Area (10 m)
	Special Concern and Rare Wildlife Species		Significant Woodland Setback (20 m)
Woodland and Wetland Features			
	Significant Woodland		Confirmed Wetland Setback (30 m)
	Confirmed Wetland		Wetland Setback (15 m)
	Potential Wetland ¹		Potential Wetland Setback (30 m)
Constraint Setbacks			
	Amphibian SWH Setback (30 m)		NPCA Wetland Finger Removed
			Watercourse ²
			Existing Quarry Footprint
			Proposed Quarry Expansion Lands
			Subject Lands (Owned by Elite Developments)
			Urban Settlement Area
			Study Area
			Outer Terrestrial Constraint
			1 - Contains data sourced from both Niagara Peninsula Conservation Authority (NPCA)
			2 - Contains data sourced from Geospatial Ontario



Note: Outside of the Subject Lands, all anthropogenic areas (buildings, gardens, hedges), all agricultural fields, and most cultural communities (e.g. thickets, small CUW) have not been mapped. Significant woodland and wetland polygons are communities as identified by SLR through a variety of means but are overlaid by NPCA wetland mapping. Where NPCA identifies a wetland (with a few exceptions) we have considered it a wetland for the purposes of development constraints.

Potential Wetland setbacks were not applied to NPCA Potential Wetlands within the active quarry or in areas where the NPCA wetland fingers have been removed (as shown on this figure).



0 100 200 300 400 500
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

Scale: 1:17,000
Page Size: Tabloid (11 x 17 inches)

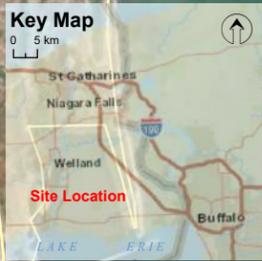
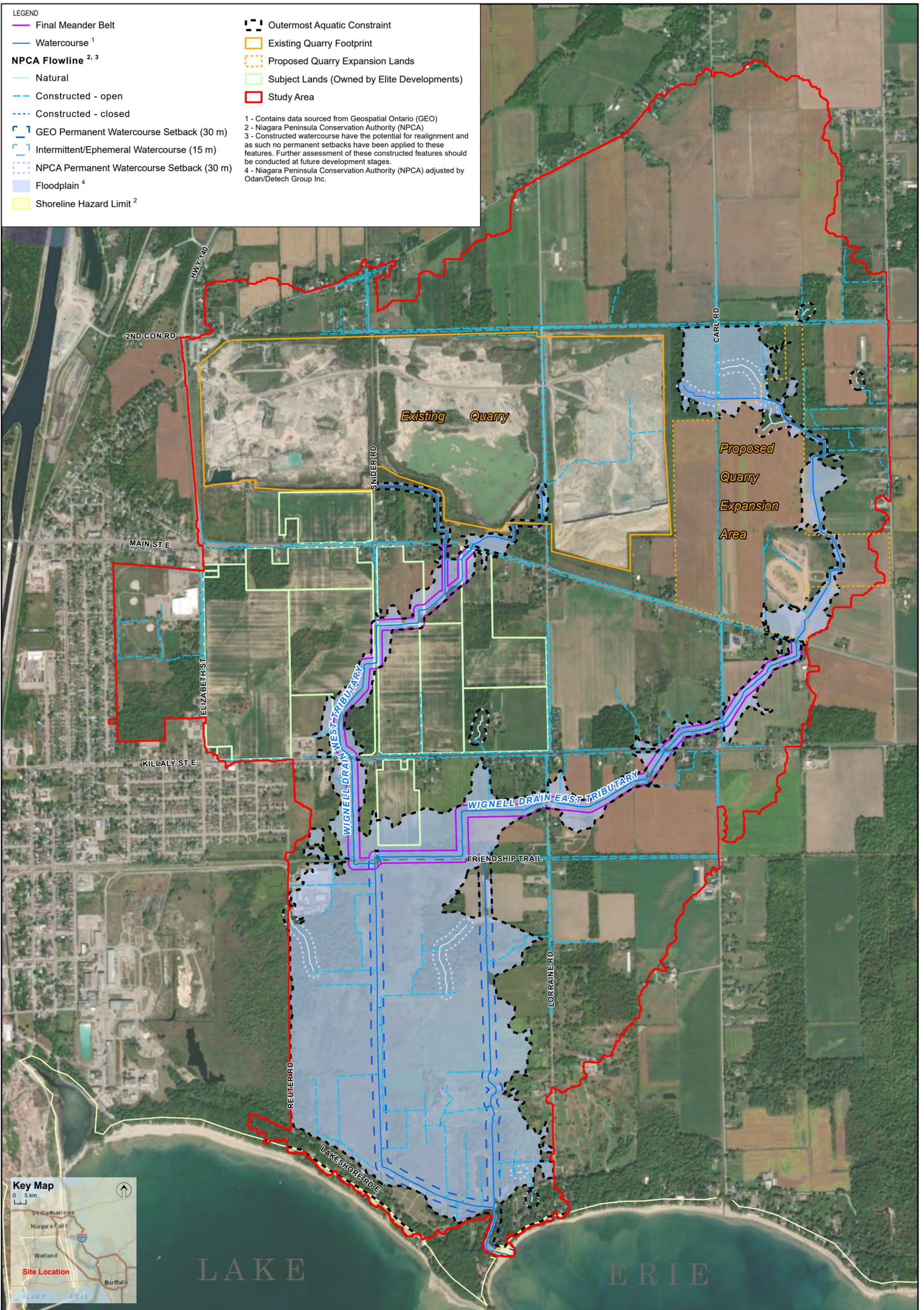
Drawn: SM
Checked: RC
Date: Feb 26, 2026

Source Notes:
Imagery (2019) provided by ESRI basemapping. Contains information licensed under the Open Government Licence - Ontario.

CLIENT	Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc
PROJECT	Welland S - Wignell SWS
TITLE	Terrestrial Constraints
REF. NO.	2007708-20-2
Figure 20	



- LEGEND**
- Final Meander Belt
 - Watercourse ¹
 - NPCA Flowline ^{2, 3}**
 - Natural
 - Constructed - open
 - - - Constructed - closed
 - - - GEO Permanent Watercourse Setback (30 m)
 - - - Intermittent/Ephemeral Watercourse (15 m)
 - - - NPCA Permanent Watercourse Setback (30 m)
 - Floodplain ⁴
 - Shoreline Hazard Limit ²
 - Outermost Aquatic Constraint
 - Existing Quarry Footprint
 - Proposed Quarry Expansion Lands
 - Subject Lands (Owned by Elite Developments)
 - Study Area
- 1 - Contains data sourced from Geospatial Ontario (GEO)
 2 - Niagara Peninsula Conservation Authority (NPCA)
 3 - Constructed watercourse have the potential for realignment and as such no permanent setbacks have been applied to these features. Further assessment of these constructed features should be conducted at future development stages.
 4 - Niagara Peninsula Conservation Authority (NPCA) adjusted by Odan/Detech Group Inc.



North American Datum 1983
 Universal Transverse Mercator Projection Zone 17

Scale: 1:17,000
 Page Size: Tabloid (11 x 17 inches)

Drawn: SM
 Checked: RC
 Date: Feb 26, 2026



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CLIENT Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc.,
 Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc.,
 Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc

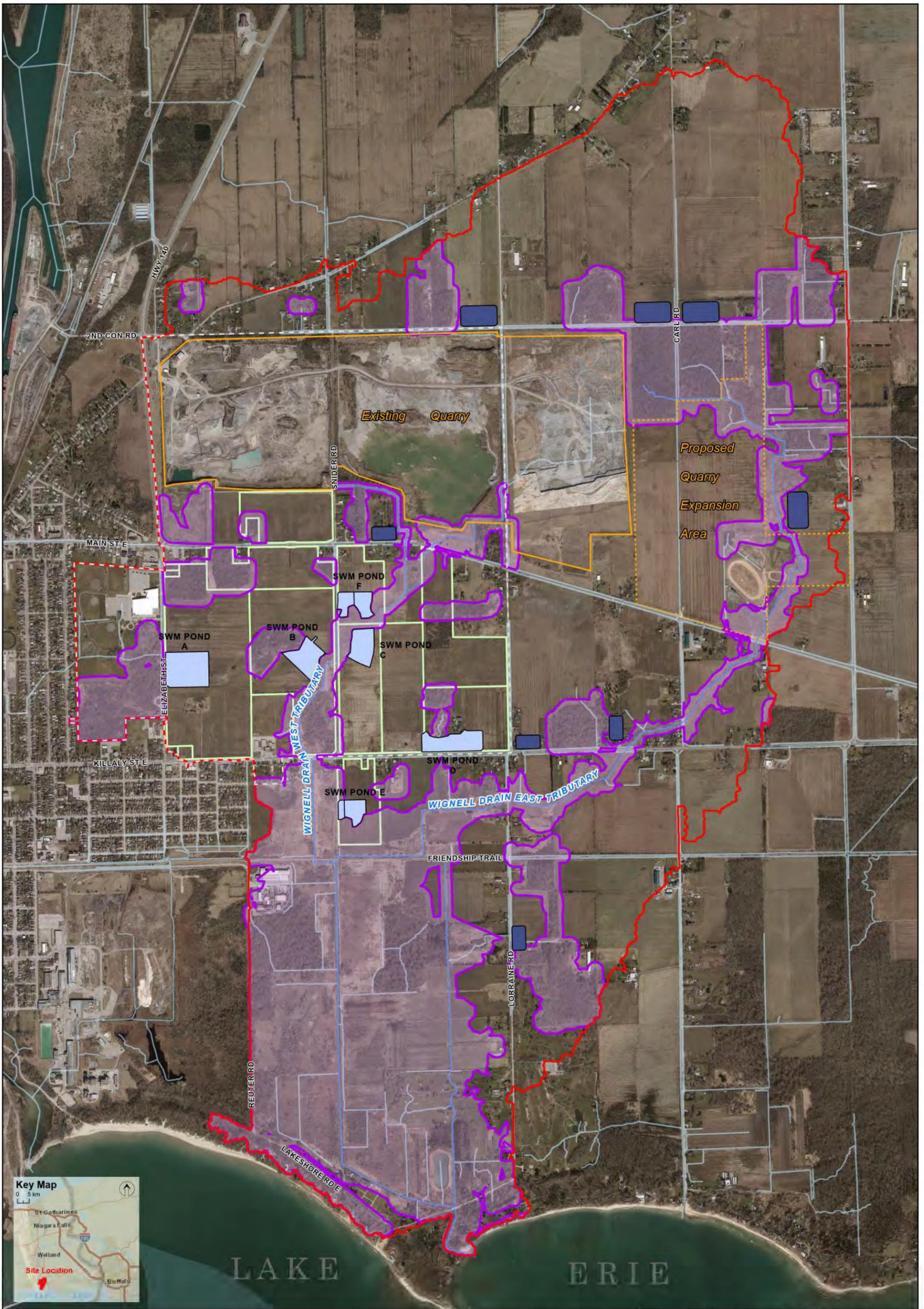
PROJECT Welland S - Wignell SWS

TITLE Aquatic Constraints



REF. NO. 2007708-21-1

Figure 21



LEGEND	
	Watercourse ¹
	Watercourse ²
	Existing Quarry Footprint
	Proposed Quarry Expansion Lands
	Subject Lands (Owned by Elite Developments)
	Urban Settlement Area
	Confirmed SWM Pond
	Proposed SWM Pond
	Study Area
	Outermost Constraint

1 - Contains data sourced from Land Information Ontario (LIO)
 2 - Contains data sourced from Niagara Peninsula Conservation Authority (NPCA)

Notes:
 *SWM Pond locations to be updated to reflect most recent Development Plan for the Killaly Lands (waiting on input from Elite/Planners)
 **Proposed SWM Pond locations subject to change (waiting on input from Odan Detech)

0 100 200 300 400 500
 METRE SCALE

North American Datum 1983
 Universal Transverse Mercator Projection Zone 17

Scale: 1:17,000
 Page Size: Tabloid (11 x 17 inches)

Drawn: SM
 Checked: RC
 Date: Feb 26, 2026

Source Notes:
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CLIENT	Elite Cap Inds Holdings Inc., Elite Cap PC Holdings Inc., Elite P.C.M. Holdings Inc., Elite P.C.V. Holdings Inc., 705 Main P.C. Holdings Inc., Elite Capital P.C. Developments Inc., Elite 869 Killaly Holdings Inc.
PROJECT	Welland S - Wignell SWS
TITLE	Proposed Development Limit
REF. NO.	2007708-18-3
Figure 22	

Table 36: Required and Recommended Buffers for Natural Heritage Features and Key Hydrological Features

Natural Feature Type	Niagara Region OP	City of Port Colborne OP	NPCA Policy Document	Required or Recommended Buffers
<i>Wetland (Evaluated - Other, Other Wetland, Potential Wetland)</i>	Outside of settlement areas: Not defined for non-PSW	50 m, unless reduced buffers are determined by an EIS or SWS (Section 4.1.1 j) of the OP).	Not defined for non-PSW.	Proposed: <ul style="list-style-type: none"> • 30 m for all except • 15 m for A2 (reduced through site-specific EIS) • (excludes NPCA-mapped wetland units within active quarry lands and a few other locations were believed to be drainage feature only, see Figure 22)
	Within settlement areas: The width of an ecological appropriate buffer would be determined though an EIS (or SWS) and/or hydrologic evaluation at the time of an application for development or site alteration is made (Section 3.1.9.10.1 of the OP).			
<i>Wetland (Provincially Significant Wetland)</i>	Outside of settlement areas and the Provincial Natural Heritage System: 30 m (Table 3-2 of the OP)	120 m, unless reduced buffers are determined by an EIS or SWS (Section 4.1.1 j) of the OP).	30 m	Proposed: <ul style="list-style-type: none"> • 30 m for all
	Within the Provincial Natural Heritage System: 30 m (Section 3.1.5.3 of the OP)			
	Within settlement areas: The width of an ecological appropriate buffer would be determined though an EIS (or SWS) and/or hydrologic evaluation at the time of an application for development or site alteration is made			



	(Section 3.1.9.10.1 of the OP).			
<i>Watercourse/Municipal Drain (Stream)/Fish Habitat</i>	The width of an ecological appropriate buffer would be determined through an EIS (or SWS) and/or hydrologic evaluation at the time of an application for development or site alteration is made.	15 m from stable top of bank of Municipal drain (Section 4.3.7.1 h) of the OP).	15 m if the watercourse is warmwater, intermittent or permanent and Fish Habitat is Important or Marginal - reductions of these buffer requirements will only be considered in special circumstances based on a site-specific evaluation by NPCA staff (Section 9.2.5.1 b) of the policy document). A 30 m setback is required from stream areas with permanent flow (NPCA Section 9.2.5.1).	Proposed: <ul style="list-style-type: none"> • 15 m from drain edge north of Friendship Trail (as no valley or permanent flow is present) • 30 m from drain edge south of Friendship Trail (as permanent flow is present) • 30 m from all 'Natural Flowline' from NPCA-mapped watercourses
<i>Floodplain</i>	NA	NA	None given.	0 m
<i>Lake Erie Shoreline</i>	NA	NA (however, the City's OP Schedule B1 was used to estimate the 100-year flood line)	15 m setback from the 100-year flood line (NPCA Section 4.1.2.7, page 82).	15 m (from 100-year flood line)
<i>Significant Woodland</i>	Outside of settlement areas and the Provincial Natural Heritage System: 20 m (Table 3-2 of the OP)	50 m, unless reduced buffers are determined by an EIS or SWS (Section 4.1.1 j) of the OP).	NA	Proposed: <ul style="list-style-type: none"> • 20 m (outside of settlement areas) • 30 m (within the Provincial Natural Heritage System)
	Within the Provincial Natural Heritage System: 30 m (Section 3.1.5.3 of the OP)			



	<p>Within settlement areas: The width of an ecological appropriate buffer would be determined through an EIS (or SWS) and/or hydrologic evaluation at the time of an application for development or site alteration is made (Section 3.1.9.10.1 of the OP).</p>			<ul style="list-style-type: none"> • 10 m (within settlement areas)
<p><i>Significant Wildlife Habitat</i></p>	<p>The width of an ecological appropriate buffer would be determined through an EIS (or SWS) and/or hydrologic evaluation at the time of an application for development or site alteration is made (Section 3.1.9.9.2 of the OP).</p>	<p>50 metres unless reduced buffers are determined by an EIS or SWS (Section 4.1.1 j) of the OP).</p>	<p>NA</p>	<p>Proposed:</p> <ul style="list-style-type: none"> • 15 m for A2 (Sufficient to protect uncommon/rare shrub and small numbers of breeding amphibians). See Figure 20. <p>Proposed:</p> <ul style="list-style-type: none"> • 30 m for Amphibian SWH (Sufficient given that the SWH is within a larger woodland / wetland complex). See Figure 20. <p>Proposed: No buffer is proposed for Special Concern and Rare Wildlife Species SWH.</p>

It is important to note that, as mentioned in Section 7, a majority of the Study Area is considered ‘potential karst’ (Brunton & Dodge, 2008) and may cause additional environmental constraints if a surface karst feature is found.

9.2 Climate Change Discussion

As part of this SWS, SLR reviewed a report entitled Climate Projections for Niagara Region (Toronto and Region Conservation Authority, 2022). Key findings indicate a warmer and wetter climate for the Niagara Region, as shown more specifically in **Table 37**, with:



- Mean annual temperature projected to rise by 2°C in the short term and 3.6°C in the long term.
- Increased frequency of extreme heat events (e.g., days above 30°C and tropical nights) and a decline in extreme cold days.
- Annual precipitation expected to increase, alongside higher intensity rainfall events.
- Longer growing seasons and more growing degree days, which may benefit agriculture but also increase pest risks.
- Reduced freeze-thaw cycles and ice potential, impacting winter conditions and infrastructure.

Table 37: Climate Change Projections (Niagara Region)

Climate Parameter	Projections (RCP8.5)			
	Baseline (1971-2000)	Short Term (2021-2050)	Long Term (2051-2080)	Climate Trend
Mean Annual Temperature (°C)	8.7	10.7	12.3	↑ Increasing
Annual Average Number of Days above 35°C	0.3	2.1	7.1	↑ Increasing
Annual Average Number of Days above 25°C	53.5	77.7	95.08	↑ Increasing
Tropical Nights	9.4	24.5	46.2	↑ Increasing
Annual Average Number of Days below -15°C	12.3	6.5	1	↓ Decreasing
Total Average Annual Precipitation (mm)	1080.6	1135	1192	↑ Increasing
Annual Average Maximum Amount of Precipitation Falling in 1 Day (mm)	70.7	72.7	78.1	↑ Increasing
Annual Average Maximum Amount of Precipitation Falling in 3 Days (mm)	112.4	109.3	119.5	↑ Increasing



Climate Parameter	Projections (RCP8.5)			
	Baseline (1971-2000)	Short Term (2021-2050)	Long Term (2051-2080)	Climate Trend
Annual Average Simple Daily Intensity Index (SDII) (mm/day)	5.2	5.4	5.7	↑ Increasing
Average Growing Season Length for Climate Period (days)	186	194	201	↑ Increasing

The future climate depends on gravitational interactions within our solar system as well as the cumulative effects of global greenhouse gas (GHG) emissions in Earth's atmosphere. Therefore, GHG emission choices made today will affect tomorrow's climate. The Intergovernmental Panel on Climate Change (IPCC) was commissioned in 1988 by the World Meteorological Organization and the United Nations Environment Program to provide policymakers with regular assessments of the scientific basis of climate change, including its impacts and future risks, as well as options for climate change adaptation and mitigation (Bush and Lemmen, 2019). The IPCC issues regular updates as assessment reports that present the results of climate change models developed by the Coupled Model Intercomparison Project (CMIP). CMIP5 was presented in the IPCC's Fifth Assessment Report and presented the use of Representative Concentration Pathways (RCP).

Although CMIP6 was presented in the IPCC's Sixth Assessment Report and presented the use of Shared Socioeconomic Pathways GHG scenarios to project future climates, RCP emission scenarios are still accepted, and there are currently more data for RCP scenarios at the local level. Data in this report uses the RCP 8.5 emissions scenario.

Employing a high-emission scenario such as RCP 8.5 in climate risk assessments is considered best practice for evaluating the upper bound of potential impacts. This scenario represents one of the most severe modelled trajectories of GHG emissions and associated climate change, assuming limited global mitigation efforts. By using a high emissions scenario, planners and decision-makers can examine the most extreme plausible outcomes, ensuring that adaptation strategies are designed to withstand the highest level of risk. This approach reduces the likelihood of underestimating vulnerabilities and supports the development of robust, long-term resilience measures across infrastructure, ecosystems, and communities.

Assuming a 'high emissions' scenario (a Representative Concentration Pathway of 8.5) where GHG emissions continue to increase beyond the end of the century, the Niagara Region is projected to experience similar climate-related impacts to that of the overarching Great Lakes Basin (Toronto and Region Conservation Authority, 2022) in that it will experience a wetter and warmer climate in the future.

In the short-term, air temperatures are expected to rise on average by 2°C (**Table 37**) (Toronto and Region Conservation Authority, 2022).

Consequently, this will lead winter precipitation to increasingly occur as rain instead of snow. With the less pervious (i.e., frozen) soils during the winter months, additional runoff and flooding within the Region's aquatic systems may occur. Contrastingly, an increase in rain during the



winter months (Toronto and Region Conservation Authority, 2022) may reduce snow accumulation and therefore, spring freshet. Increased temperatures will lead to warming waters and heat stress on the aquatic systems. Moreover, due to the increased winter precipitation and the maintenance of total summer precipitation, the total annual precipitation is expected to increase (Toronto and Region Conservation Authority, 2022). Lastly, the growing season is expected to increase in length; however, as a result of the projected temperature fluctuations, pests are expected to thrive, resulting in the crops needing to be hardier to both temperatures and pests (Toronto and Region Conservation Authority, 2022).

In the long-term (2015-2080), assuming a Representative Concentration Pathway of 8.5, air temperatures are predicted to rise on average by 3.6°C relative to baseline numbers (1971-2000) (Toronto and Region Conservation Authority, 2022).

The anticipated warmer and wetter climate within the Niagara Region, and thus the Study Area (Toronto and Region Conservation Authority, 2022), will likely have serious implications on agricultural success (i.e., pests), wildlife migration patterns, and land development (i.e., flooding, erosion), among others. Some examples of factors to consider based on climate change are given in **Table 38**.

Table 38: Climate Considerations

<u>Natural Heritage Systems and Wildlife</u>	<u>Climate Considerations (TRCA, 2022)</u>
<u>Woodlands</u>	Forested areas are expected to expand beyond their current extent to support carbon sequestration efforts. However, longer growing seasons combined with the risk of sudden cold snaps may increase plant mortality and crop failure risks.
Wetlands	Climate-driven changes can disrupt land-water interactions, leading to altered precipitation patterns, increased flooding, shoreline erosion, and shifts in aquatic and terrestrial habitats. (Toronto and Region Conservation Authority, 2022).
Aquatic Habitat	
Species at Risk and Significant Wildlife Habitat	Rising temperatures are expected to affect both resident and migratory wildlife species, reducing habitat suitability and connectivity. (Toronto and Region Conservation Authority, 2022). SLR notes however, that changes in weather would be anticipated to benefit some wildlife species (e.g. more northerly habitat becomes available for southerly species, and connections could open up if waters rise and agricultural lands are abandoned)
Channel Morphology	Warmer and wetter winters will likely result in more rainfall than snowfall, producing rapid runoff over frozen ground. This can increase urban flooding,
Hydrogeological Characterization (The Hydrogeological	



<u>Natural Heritage Systems and Wildlife</u>	<u>Climate Considerations (TRCA, 2022)</u>
Characterization section of the report uses historical (1981-2010) data from the Port Colbourne weather station).	riverbank erosion, and infrastructure damage. (Toronto and Region Conservation Authority, 2022).
Geology and Stratigraphy	Local climate station data used (Port Colborne) (1981-2010)
Groundwater Conditions	Hydrogeological modelling should incorporate climate change scenarios to better understand future risks.
Flood Plain Analysis	
Hydrogeological Constraints and Impacts	Hydrogeological modeling should incorporate climate change scenarios to better understand future risks (Toronto and Region Conservation Authority, 2022).

All projections are based on assumptions for future scenarios and are subject to some degree of uncertainty. Levels of confidence provide a qualitative explanation of the validity of findings (level of agreement). While levels of confidence are not assigned for individual climate events, the “Tier” system, as described by Cannon et al. (2020), can be used for the relative consideration of confidence for the climate data presented. SLR has not assigned any weighting to climate hazards based on the relative confidence tiers presented in **Table 39**.

Table 39: Confidence Tier Descriptions

<u>Confidence Tier</u>	<u>Description</u>	<u>Example(s)</u>
<u>Tier 1</u>	<u>Variables are those for which there is generally high or very high confidence in the future projections for a given level of global warming.</u>	<ul style="list-style-type: none"> • <u>Mean Annual Temperature (°C)</u> • <u>Annual Average Number of Days above 35°C</u> • <u>Annual Average Number of Days above 25°C</u> • <u>Tropical Nights</u>



<u>Confidence Tier</u>	<u>Description</u>	<u>Example(s)</u>
		<ul style="list-style-type: none"> • <u>Annual Average Number of Days below -15°C</u> •
<u>Tier 2</u>	<u>Variables are those for which there is generally medium confidence in the future projections for a given level of global warming.</u>	<ul style="list-style-type: none"> • <u>Total Average Annual Precipitation (mm)</u> • <u>Annual Average Maximum Amount of Precipitation Falling in 1 Day (mm)</u> • <u>Annual Average Maximum Amount of Precipitation Falling in 3 Days (mm)</u> • <u>Annual Average Simple Daily Intensity Index (SDII) (mm/day)</u> • <u>Average Growing Season Length for Climate Period (days)</u>
<u>Tier 3</u>	<u>Variables are those for which there is low or very low confidence in the future projections for a given level of global warming.</u>	<ul style="list-style-type: none"> • <u>NA</u>
<u>Source: Cannon et al. 2020</u>		

Interdisciplinary initiatives, such as those listed below in Section 10, will help to better define how climate change will affect the systems of both the Subwatershed Study Area and the Niagara Region as a whole.

9.3 Hydrogeological Constraints and Impacts

9.3.1 Hydrogeological Constraints and Impacts

The hydrogeological constraints to the development in the Study Area were assessed based on the above hydrogeological characterization (Section 7). The hydrogeological conditions of the Study Area can be summarized as shallow to moderately shallow groundwater levels, low permeability overburden soils with shallow bedrock, good groundwater quality, potential karst conditions, and a low infiltration rate. The interaction between groundwater and surface water features is not well known; however, the limited data available suggests that groundwater recharging conditions exist. This; however, is limited by low infiltration through the overburden soils. Depending on the types of developments, hydrogeological constraints and issues may include:

- Locally shallow groundwater levels and bedrock top;



- Karst risk;
- Challenge in stormwater management through infiltration;
- Impact of development to natural heritage features supported partly or wholly by groundwater discharge.

Shallow groundwater levels occur in the areas around MW-19 and 6604018 (**Figure 17**) and other areas. Shallow bedrock is usually associated with shallow groundwater levels and karst risk. A majority of the Study Area is underlain with varved silty clay with low hydraulic conductivity (7.5×10^{-7} to 1.7×10^{-6} m/s). Based on the shallow overburden soil, stormwater management through infiltration may be difficult to implement due to the large space that would be required to infiltrate sufficient volumes of water.

Major hydrogeological impact as a result of development is the decreased infiltration due to increased impervious area, which will result in reduced groundwater recharge and lowered groundwater level, as well as reduced groundwater discharge. Lowered groundwater levels will reduce the yield of supply wells and increase the energy consumption of water taking. The reduced groundwater discharge may have a negative effect on the groundwater-supported natural features.

9.3.2 Impact of Cease of Pumping for Quarry Dewatering and Climate Change

Site reconnaissance conducted by SLR hydrogeologist on February 19, 2023, did not see water pumps and pumping operation in quarry pits, and did not identify sign of groundwater seepage from quarry walls. Based on EXP Services Inc. (EXP) report, the bedrock aquifer has a geometric mean k-value of 7.9×10^{-7} m/s. Assuming the possible maximal dewatering height of 17.0 m, which is the averaged depths of the quarry pits, the influence zone of the dewatering is approximately 45.0 m based on Sichardt and Kryieleis formula ($R0 = C(H-hw)K^{1/2}$, $C=3000$). The influence zone is measured from the excavation boundary of the quarry pits. The cease of pumping will cause groundwater recovery within 45.0 m buffer from the quarry boundary only.

The closest monitoring wells adjacent to the quarry installed by EXP include MW-9, MW-20, and MW-21, and they recorded groundwater depth of 3.5, 1.7 and 0.5 mbgs respectively. As these three wells are all located away from the influence zone, the groundwater levels recorded from these monitoring wells can be viewed as background groundwater levels. It is reasonable to assume that the groundwater levels under the west pit will recover to the groundwater levels in MW-9, groundwater levels under the middle pit will recover to the groundwater levels in MW-21 and groundwater levels under the east pit will recover to the groundwater levels in MW-20. Consequently, the cease of pumping will not have significant effect to the groundwater system and futural development.

9.4 Stormwater Management Recommendations

9.4.1 Target Flow

The City PCSWMM model was used to establish pre-development hydrology target values to compare to the post development conditions within the Subject Lands added (**Table 40**).

Table 40: Target Flow Locations for the Wignell Drain

No.	Location description or crossing	Notes
S-1	Hwy # 3 culvert crossing west branch	Should be similar to PCSWMM



No.	Location description or crossing	Notes
S-2	Hwy # 3 culvert crossing east branch	Should be similar to PCSWMM
S-3	Killaly culvert crossing west of Snider Road	Should be similar to PCSWMM
S-4	Killaly culvert crossing east of Lorraine Road	
S-5	Snider road culvert crossing just north of Friendship Trail (former CNR)	
S-6	Friendship trail culvert crossing adjacent to Snider Road west side	
S-7	Outlet to Lake	

Table 41 summarizes the allowable (target flows) for the existing outlets per storm event.

The comparison will be made with XPSWMM (2D) existing conditions and XPSWMM (2D) with the Subject Lands development added. It is the only honest way to compare because the PCSWMM model is not 2D and does not include the culverts in real time. The NPCA HEC-RAS model maintains continuity of flow and thus has no attenuation at culverts. We will include the flows of PCSWMM at the above locations for comparison only.

Table 41: Pre-Development Existing Flow Targets

Storm Event	Storm Type	Target Peak Flow Rate (m ³ /s)						
		S-1	S-2	S-3	S-4	S-5	S-6	S7
		Existing	Existing	Existing	Existing	Existing	Existing	Existing
2 Year	24Hr SCS	0.439	0.730	1.092	0.685	1.025	1.026	0.480
5 Year	24Hr SCS	0.794	1.215	1.815	1.554	1.948	1.956	1.049
10 Year	24Hr SCS	1.054	1.592	2.413	2.325	2.515	2.541	1.475
25 Year	24Hr SCS	1.402	2.164	3.225	3.415	2.654	3.374	1.770
50 Year	24Hr SCS	1.651	2.656	3.937	4.230	2.684	3.886	1.955
100 Year	24Hr SCS	1.916	3.159	4.689	4.979	2.687	4.374	2.164
100 Year	12Hr AES	0.606	1.976	4.105	4.619	2.694	4.048	1.766

A development, such as the one proposed on the Subject Lands, requires a team approach with many disciplines including but not limited to Planners, Environmental Consultants, Hydrogeologist/Soil Consultants, and Civil Engineering Consultants.

In the case of the Subject Lands, the development fabric was determined based on a Survey/Topographical Plan, Provincial Lidar derived DEM, and the natural heritage features. Weston was the Planner (now Armstrong), SLR was the Environmental Consultant, EXP was the Hydrogeologist/Soil Consultant for the Subject Lands, SLR was the Hydrogeologist Consultant for the Wignell Drain Subwatershed Study Area, and Odan/Detech Group Inc. was the Civil Consultant. The revised Draft Plan of Sub-Division was assembled by Armstrong



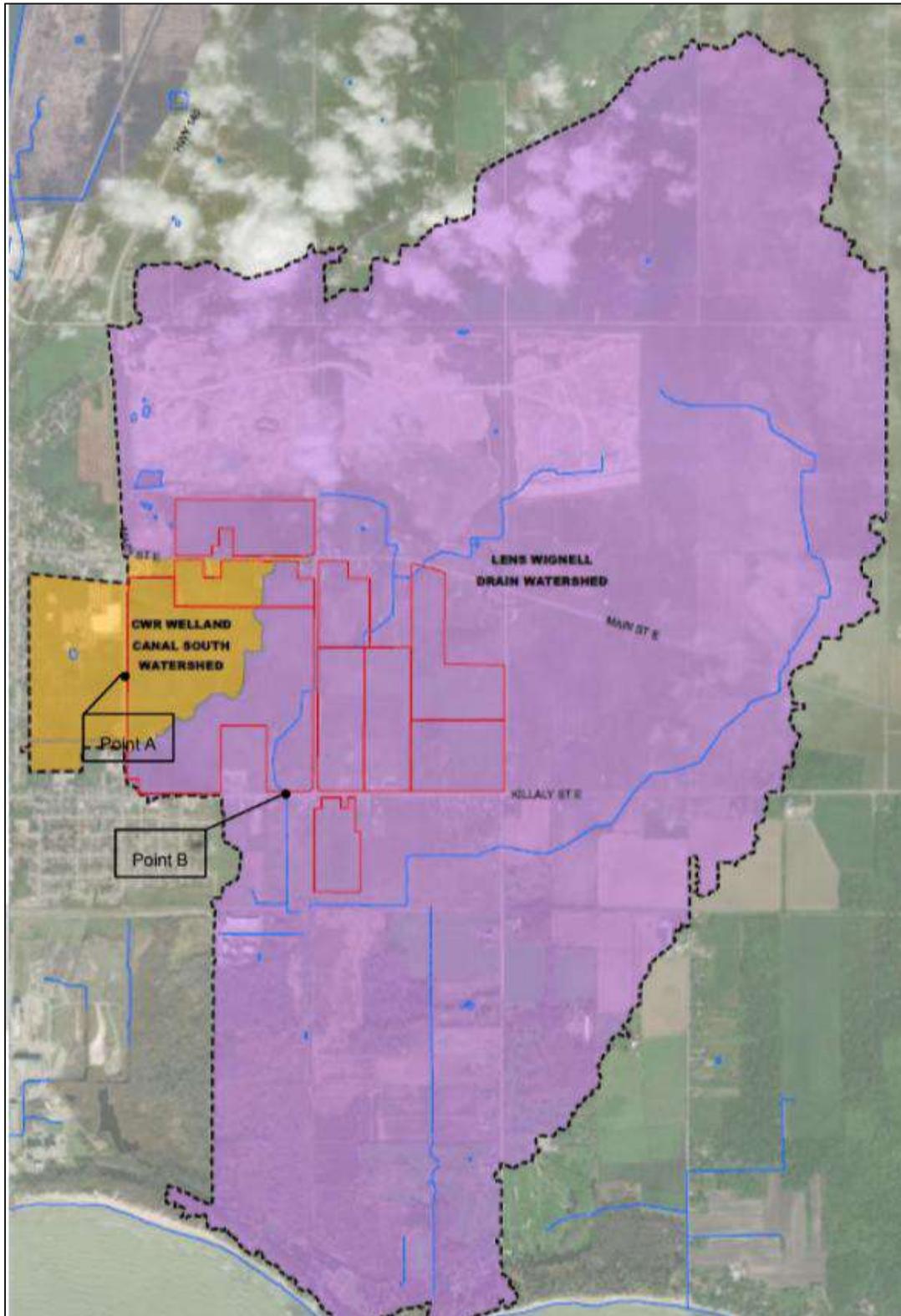
through input by the Developer, SLR, EXP, and Odan/Detech Group Inc. and can be found in the document entitled EIS Addendum for Elite Development Lands East of Port Colborne (SLR 2026). It is recommended to utilize six SWM ponds for the development of the Subject Lands. Refer to **Figure 22** for locations. The ponds within the Subject Lands outlet to the Wignell Drain at various locations. The preferred method to determine an allowable (target flow) is to use the predevelopment unit runoff rates. The following is the procedure:

- 1 Pick a point in the drainage system where there is a known flow from PCSWMM model. The Subject Lands as mentioned above has two drainage areas as follows:
 - o Welland Canal South Watershed - Point A - ditch at Elizabeth Street (see **Graphic 28**)
 - o Wignell Drain Watershed - Point B - culvert crossing Killaly Street, west of Snider Road (see **Graphic 28**).
- 2 For the Welland Canal South Watershed (Point A) - the calculated flows are based on hydrology information shown above (**Table 38**).
- 3 For the Wignell Drain Watershed (Point B) – **Graphic 29** summarizes the procedure used to derive the target flow at Point B using tributary areas in the original PCSWMM and unit flow rates per hectare for the 2-year storm to the 100-year storm. The target flows were determined for each pond (Pond A – Pond F) as shown in **Graphic 29**. Catchment G at the southwest corner of the site will not drain to any of the stormwater management ponds and will be required to provide site level stormwater management to meet the target flows for this catchment.

Notes: The quarry areas were removed because they do not contribute runoff flow.



Graphic 28: Wignell Drain Subwatershed Drainage Areas



Graphic 29: Procedure to Derive Target Flows & Summary of Target Flows Using Procedure

From PCSWMM model				Point B	Point B	unit rate
Name	Area (ha)			area (ha)	flow (m3/sec)	m3/s/ha
W10	8.32			274.24	6.86	0.025
W6	28.7457					
W2	26.526	Flow area to point B				
PC3-QW1	41.95					
PC4-QE1	18.79			Pond Trib	100 year	
W1	16.7049	19.3425		area (ha)	allowable flow	
PC7	19.3425	63.43				
W4	1.98	7.7		Outlet A	52.28	0.921
M3	3.65	18.3597				
W7	36.5969	42.97				
W3	66.06	82.3056				
PC8	63.43	23.23		Outlet B	274.24	6.86
PC2	7.7	6.88				
W14	20.8394	10.0218				
M1	54.0114			Pond A		0.921
W13	39.1345	274.24 ha				
M2	8.8715			Pond B	23.33	0.584
W11	5.4412					
W9	58.2949			Pond C	31.354	0.784
W5	100.6					
PC6	26.23			Pond D	33.849	0.847
PC1	18.3597					
M4	28.7148			Pond E	11.827	0.296
W12	34.15					
M5	77.959			Pond F	8.004	0.200
WB2	41.21					
PC9_3	42.97					
B1	22.3			example : 100 year allowable flow pond B = 23.33 x 0.025		
PC5	82.3056					= 0.584
WB1	41.66			for Outlet A - the flows are based on existing hydrology		
W8	6.61					
PC9_4	23.23					
PC11	6.88					
PC10	10.0218					
	1089.59					



Summary of Pond Target Flows:

Pond	Pond Trib area (ha)	24 hr SCS	24 hr SCS	24 hr SCS	24 hr SCS	24 hr SCS	24 hr SCS	12 hr AES
		100 year Target flow m3/sec	50 year Target flow m3/sec	25 year Target flow m3/sec	10 year Target flow m3/sec	5 year Target flow m3/sec	2 year Target flow m3/sec	100 year Target flow m3/sec
Pond A	50.17	0.751	0.603	0.467	0.299	0.192	0.085	0.728
Pond B	24.43	0.611	0.567	0.451	0.314	0.224	0.118	0.510
Pond C	31.92	0.798	0.741	0.589	0.411	0.293	0.154	0.666
Pond D	33.05	0.827	0.768	0.610	0.425	0.304	0.159	0.689
Pond E	12.72	0.318	0.296	0.235	0.164	0.117	0.061	0.265
Pond F	7.87	0.197	0.183	0.145	0.101	0.072	0.038	0.164
Catchment G	4.66	0.117	0.108	0.086	0.060	0.043	0.022	0.097

9.4.2 Water Quality

This SWS and the Stormwater Management Plan (SWMP) Implementation Document establishes the required guidelines for implementing stormwater quality for the future development. The requirements for water quality are as follows.

“Control pollutant loadings in accordance with current MOE guidelines. Enhanced Level 1 protection as defined in the 2003 Stormwater Management Planning & Design Manual – reduce average long term annual load of suspended sediment by 80% or better. Accomplish through the use of LID source and conveyance controls.”

Stormwater Source Control Policy for Industrial, Commercial, and Institutional (ICI) Land Uses by NPCA is also to be used as a guide.

In order to achieve water quality for any proposed development, each site will be required to implement the above measures to achieve an Enhanced Level 1 Protection of 80% removal of total suspended solids prior to discharge into downstream outlets. **Table 42** provides values established and generally accepted throughout the province for use of various total suspended solids removal techniques.

Table 42: Total Suspended Solid Removal Method & Removal Efficiency

Removal Method	Removal Efficiency
Rooftop	80%
Grassed Swale (with Perforated Pipe)	80%
Grass Swale (no perforated Pipe)	50%
Soakaway & Infiltration Systems	70-90%
Chambers (with Infiltration)	70-90%
Bio retention	80%
Dry Swale	80%



Removal Method	Removal Efficiency
Permeable Pavers (with Storage Bed)	80%
OGS (Oil/Grit Separator)	50%-80%
CB Shield	* 50%
Wet Pond	** up to 90% total suspended solid removal if extended detention is used

* - Based on Table provided by Manufacturer.

** - New Jersey Department of Environmental Protection

The above methods can be considered at the detailed design stage. Removal methods will largely be dependent on constraints, such as limited landscape space available throughout the Study Area for implementing Low Impact Developments (LIDs), underlying soils conditions and conductivity to LIDs, groundwater conditions, and other factors that can limit the use of LIDs. All reasonable attempts should be made during the detailed design stage to provide for the use of LIDs to enhance water quality measures.

The efficiencies of LID strategies are variable and dependent on the maintenance and loading from the Study Area usage. **Table 42** values are based on the generally accepted removal.

In order to ensure the removal of oils, each outlet will require an oil grit separator or method of removing oil spills prior to discharging to the downstream outlet and receiving watercourse.

Volume Control and Water Balance

As per City, Region, and NPCA criteria, Enhanced (Level 1) classification must be achieved, improving the quality of drainage discharging to each outlet from that of existing conditions. Reduction of the Total Suspended Solids (TSS) released to an Enhanced (Level 1) system must result in 80% TSS removal, based on the MOECC 2003 criterion. This will be attained using a train treatment approach, in which a series of LIDs will be implemented.

LIDs

The following LID methods are possible:

- Imbrium Filterra Bioretention System
- Silva Cells
- Soak Away Pits
- Bio Swales
- Others

It is believed the following can be adapted for the SWM quality/water balance component:

- 1 Wet ponds as detailed in this report
- 2 Silva Cells or Imbrium Filterra Bioretention System on the roads if City will accept.
- 3 Soak away pits in the park area.
- 4 Bioswales if landscaped areas can accept.
- 5 Irrigation reuse.



- 6 Roof flow capture via barrels for reuse.

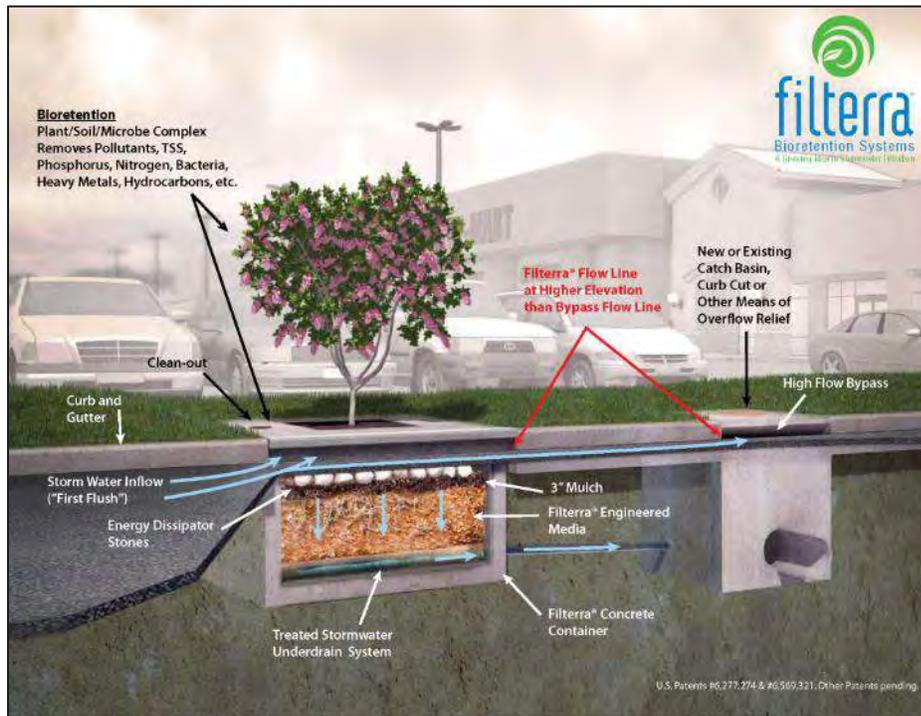
Imbrium Filterra Bio-retention System

This is an appropriate method for water quality treatment in a train treatment environment. Stormwater runoff enters the Filterra system through a curb-inlet opening and flows through a specially designed filter media mixture contained in a landscaped modular container. The following photos (**Photo 7** and **8**) show the installed Filterra unit and a section through the unit.

Photo 7: Filterra System: External View.



Photo 8: Filterra System: Internal View.



Silva Cells

The Silva Cell is a modular, suspended pavement system that uses soil volumes to support large tree growth and provide powerful on-site storm water management through absorption, evapotranspiration, and interception. The system is typically installed under pavement applications and can be configured in several different ways:

Streetscapes

Adjacent to or under sidewalks, between buildings and streets.

Parking Areas

Under parking stalls adjacent to medians or islands.

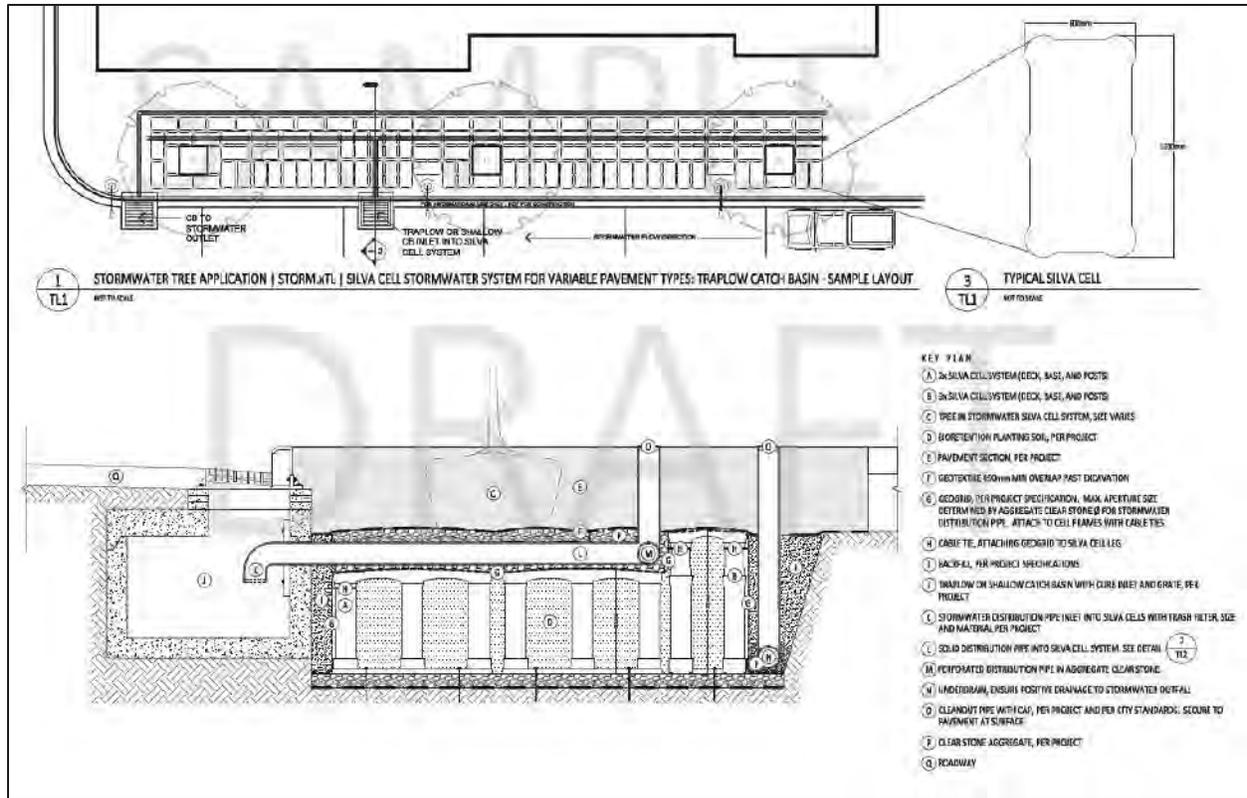
Public Spaces

Under plazas, promenades, courtyards, or other public spaces at office buildings, museums, schools, and transit centers.

The Region of York is using Silva Cells on the widening and reconstruction of Yonge Street.

The following detail is a typical Silva Cell application.





9.4.3 Water Balance / Groundwater

Refer to report by EXP Hydrogeologist “*Preliminary Hydrogeological and Water Balance Investigation, Killaly Street East, Port Colborne, Ontario.*”

The following is the summary from that report. Note, there is 33,161 m³ deficient in the infiltration rate from pre to post conditions. The Subject Lands will require to infiltrate 33,161 m³ of rainfall on an annual basis.

Killaly Street East, Port Colborne, ON
BRM-21000726-A0

Appendix E-4
Summary of Pre and Post-Development Water Balance (Unmitigated)

6. Comparison of Pre-Development and Post-Development Un-Mitigated

	Precipitation (cu.m.)	Actual Evapotranspiration (cu.m.)	Run-off (cu.m.)	Corrected Infiltration Rate for Areas with Shallow Groundwater Table (cu.m.)
Pre-Development	1,490,625	868,758	423,299	198,568
Post Development	1,490,625	579,183	748,057	165,406
			Pre-development Infiltration Rate	133.3
			Post-development Infiltration Rate Un-Mitigated	111.1
			Deficit Post Development Un-Mitigated	33,161

Criteria

Criteria for stormwater balance, retention, and low-impact-development (LID) is provided for the City of Port Colborne and by NPCA. The NPCA provides criteria in their manual *Niagara Peninsula Conservation Authority Stormwater Management Guidelines* (March 17, 2010).

Stormwater Volume Control Requirements in the NPCA manual provides criteria. The criteria applying to this development is generally described as follows:



- Any major development or disturbance that reconstructs 0.5 ha of impervious surfaces are subject to storm water volume control criteria.
- Stormwater volume reduction (stormwater retention) may include such techniques as infiltration, reuse, rainwater harvesting, canopy interception, evapotranspiration and/or additional techniques.
- Redevelopment volume control – nonlinear redevelopment projects meeting the foregoing criteria shall capture and retain/treat on-site the runoff from a pre to post water balance analysis event from the new and/or fully reconstructed impervious surfaces.
- The retained runoff is to be dispersed on-site by the acceptable measures (above) in 48 hours.

The proposed development which comprises approximately 148.93 ha of which 53.94 ha of impervious surface, is subject to the storm water balance/retention requirements. It is demonstrated as follows that the criteria can be addressed in the proposed development principally by infiltration, with additional retention provided by irrigation (evapotranspiration) and rainwater harvesting.

Based on the EXP report the deficit is 22.3 mm/a rainfall event, falling on the proposed new and reconstructed impervious surfaces, will generate the following storm water retention volume requirement.

$$\text{Area of impervious surfaces} = 53.94 \times 10000 = 539,400 \text{ m}^2$$

$$\text{Required Stormwater Retention Volume} = 539,400 \text{ m}^2 \times 22.3 \text{ mm} = 12,029 \text{ m}^3$$

Retention Strategy

It is proposed to principally retain the foregoing 12,029 m³ by infiltration galleries whereby the foregoing volume of water will percolate into the underlying soil.

The locations and footprint available for infiltration galleries have been functionally considered in potential locations for infiltration galleries with a total footprint of 4.20 ha. The infiltration footprint identified is located within lands planned to be allocated for parks such that all infiltration galleries will be controlled. The footprints will need to be sized such that there is a minimum 5 m setback (OBC latest edition) from the potential location of any buildings (above- or below-ground) on the adjacent development blocks.

The design criteria for infiltration galleries comprises the following factors. The province of Ontario's Stormwater Management Planning & Design Manual (2003) provides design criteria for infiltration galleries. The criteria are identified and addressed as follows:

- Underlying groundwater table elevation
- Criteria: the MECP states that the groundwater table or bedrock elevation should be 1.0 m below the bottom of infiltration galleries.
- Design: A Hydrogeological Investigation was prepared by EXP, Dated September 15, 2021. Table 3.1: Summary of measured groundwater elevations in Monitoring Wells from 14 wells. The observed groundwater is typically 0.4 to 3 m below existing grade. This is sufficient depth below-grade in which to install an infiltration gallery with 1m clear above the groundwater/bedrock. If necessary, the landscaped space in which the infiltration galleries will be installed can be graded such that there is sufficient cover above the stable groundwater table in which to install an infiltration gallery.



- Percolation rate of underlying soils. The MECP states that infiltration galleries should only be proposed where the percolation rate of receiving soils is greater than 15 mm. Infiltration gallery footprints are to be designed considering percolation rates.
- EXP has not provided infiltration rate. We are assuming the MOE 2003 minimum of 15mm/hr in the following analysis – this has been applied in the following infiltration gallery design calculations.
- Drain down time of infiltration galleries.
- Criteria: The MECP and NCPA manuals state that infiltration galleries should drain-down in 48 hours following the design storm event.
- Design: A drain-down time of 48 hours has been applied in the following infiltration gallery calculations.

Shown below is a sample infiltration gallery sizing calculation (**Graphic 30**) showing that the infiltration gallery footprint required to drain-down a retention volume of 12,029 m³ (above) within 48 hours is 41,766 m², which aligns with the potential infiltration gallery areas within the site mentioned above (42,000 m²). This is less than the required footprint, therefore this is preliminarily a feasible means of addressing the storm water retention requirement in-full.

It is possible that in the future design refinement of the infiltration galleries' placements may yield small available footprints than has been preliminarily identified above. In such a case, the water balance volume can be made up by other forms such as irrigation and other forms of greywater reuse such as roof capture barrels.



Graphic 30: Sample Infiltration Gallery Sizing Calculation

INFILTRATION GALLERY CALCULATION					
PROJECT: Elite - Killaly Street East - Port Colborne					
PROJECT No. : 21247					
Location of infiltration gallery: TBD					
					DESCRIPTION
					$A = 1,000V / (Pn\Delta t)$
					UNIT
$d = P\Delta t/1000$		P=	15	mm/hr	Where:
d = 0.72 m		$\Delta t =$	48	hr	A = Filter bed surface area (m ²)
		n=	0.40	-	V = Water volume (m ³)
V= 12029 m ³		Atrib runoff	539400	m ²	$\Delta t =$ time to drain (hr)
			22.3	mm	n = void space ratio for aggregate used (note: void space ratio of 0.4 to be used)
					P = soil percolation rate mm/hr
					$d = P\Delta t/1000$
					Atrib = pervious area contributing runoff
					Where:
A = 1,000V / (Pn Δt)					d = maximum soak-away depth (m)
Af= 41766 m ²					P= infiltration rate for native soils (mm/hr)
Af provided = 42000 m ²					$\Delta t =$ time to drain (hr)
Vpit req'd = 30072 m ³					Af = Filter bed surface area provided (m ²)
Vpit provided = 42000 m ³					Vpit req'd = V/n
		Af =	42000	m	Vpit provided = L x W x d
		d =	1	m	L = length of pit (m)
					W = width of pit (m)
					d = depth of pit (m)
NOTE: 10 SOAK-AWAY PITS WILL BE PROVIDED THAT TOTAL THE ABOVE VOLUME					

9.4.4 Special Servicing Requirements Due to Rock and Groundwater

Groundwater levels in the monitoring wells on site ranged from 0.4 to 3.0 m below grade (elevation 175.2 to 180.3 m).

In the event the base of the pond is to be constructed below the recorded, static groundwater table, dewatering will be required to allow the excavation of the pond and the construction of the clay liner. Due to this site being in a well head protected zone a liner would be required.

9.4.5 Discussion/Commentary and Observations

The following are in no particular order:

- 1 The 1D/2D model approach is more realistic. The EWA model does not capture the culverts interacting with the channels in real time. The NPCA HEC-RAS has no respect to the attenuation effect behind the culverts.



- 2 The proposed infill development will not have a negative effect on the properties adjacent to the Site when developed.
- 3 Erosion is not a concern for the Subject Lands. Refer to section on erosion review. Erosion control can be implemented as per MOE 2003 in the proposed wet ponds. Quantity control to detain and release the 25mm, 4-hour Chicago design storm over a 24-hour period.
- 4 Snider Road will be raised in the post developed Subject Lands. It must be taken out of the flood plain.
- 5 Raising Snider Road creates a stacking effect on the flood waters on the east side. This can be seen in the HGL point 4. In the pre scenario the flood waters flow over Snider Road in the post they do not. Compare figure 23 to 31. This can be rectified in the final design by provided a ditch at point 4 to the new outlet culvert crossing on Snider Road.
- 6 There is a difference in the topography of the drain area through the developed area. This will create small differences in the sections (pre to post). Refer to 3D view of post-developed graded Site.
- 7 The aquatic, wetland and terrestrial resources as identified by SLR and shown on the draft plan by Weston are to be protected.
- 8 All wet ponds will have bottom draw outlets to control temperature.
- 9 All pond outfall structures will be above the 100-year flood plain.
- 10 All ponds are outside the 100-year flood plain.

Refer to **Graphic 31** for the summary of SWM for the Wignell Drain Subwatershed Study Area, which depicts the following:

- 1 The global locations for the entire Subwatershed SWM facilities.
- 2 The potential future quarry and the existing quarries.
- 3 The NPCA 100-year flood extents.
- 4 The pond location for the Subject Lands' developed area depicted as solid blue hatch areas.
- 5 Approximate pond location for other areas within the watershed depicted as rectangular blue hatches.
- 6 Major roads in the Wignell Drain Subwatershed Study Area.

Development within the Subject Lands has been advanced such that the SWM facilities have known locations. The remaining portion of the Wignell Drain Subwatershed Study Area has not had potential future development advanced, thus the SWM facility locations depicted in the **Graphic 31** and **Figure 22** are approximate and will require refinement as development applications are advanced.

All SWM facilities will be designed as per the MOECP 2003 design manual. Quality control will be Level 1. Quantity control will be post-development to pre-development flows for each storm event as outlined above.

Refer to Sections 10 and 11 below for future SWS requirements.



10.0 Subwatershed Management Strategy, Mitigation, and Monitoring Recommendations

10.1 Impact Assessment

As part of the impact analysis process, the project team has considered the scenario of the development of lands within the Study Area changing from mostly agricultural uses (as well as vegetated areas) to urbanized residential and associated land uses. Based on this proposed land use scenario, an assessment of the Wignell Drain Subwatershed's (and its catchment areas) sensitivity to ecological and hydrological changes has been considered. This scenario was assessed from a hydrologic perspective in consideration of surface water conditions, water balance, and the potential impacts on stream and drainage conditions. Consideration of terrestrial, wetland, and aquatic conditions (and associated management requirements) was also included in order to manage the preservation and enhancement of environmental conditions.

Based on this assessment, a management strategy has been developed that includes elements of protection, mitigation, and enhancement of the hydrological and environmental conditions of the Study Area.

Due to the range of processes that influence subwatershed conditions, the following components were considered as part of the management strategy:

- SWM measures for the maintenance and protection of flow regime conditions, which include baseflow, flood flows, and water quality.
- The protection of terrestrial features with an approach that identifies preservation, restoration, and enhancement of the Study Area's existing conditions.
- The preservation and enhancement of linkages to ensure that a sustainable natural heritage system is maintained.
- The characterization, functional understanding, and protection of watercourse corridors for aquatic habitat, hydrologic processes, and water quality.
- The identification, preservation, and restoration of key landscape elements that are important to the watercourse corridor functions including the hydrologic, geomorphologic, hydrogeologic, aquatic, and terrestrial attributes.
- The identification of rehabilitation opportunities to maintain and improve the stream system.

10.2 Management Strategy and Recommendations

The development of a management strategy provides guidance for the future management of the Wignell Subwatershed in order to meet the goals and objectives within the context of future land uses within the watershed.

The characterization of the existing conditions within the Wignell Drain Subwatershed has been completed to provide the context of current conditions. This includes ecological and significant features (Sections 4 and 5), watercourse and HDF channel morphology (Section 6), hydrogeological conditions (Section 7), and understanding of the floodplain (Section 8). The identification of current conditions allows for the SWS-related goals and objectives to be established.



The management strategy for a SWS must be broad enough to include all of the technical and administrative tools that are involved in land use and resource management measures. Thus, the scope of the management strategy should currently or in the future include:

- Land Use Management Measures – That guide land use in a manner that recognizes the natural environment which includes terrestrial resources, wildlife, wildlife habitat, ecological linkages and associated environmental corridors, stream and riparian corridors, and the subwatershed processes that influence these resources;
- SWM Measures – To preserve or enhance hydrologic functions/flow conditions related to surface water and groundwater flows and water quality;
- Terrestrial and Wetland Resource Management – To protect and enhance terrestrial and wetland resources;
- Riparian Corridor Management Plans – To protect and enhance riparian systems;
- Rehabilitation and Remediation Plans – For environmental (terrestrial and aquatic) features to increase the resiliency of the catchments and stream system;
- Monitoring Plan – Must be practical and focused to measure the environmental health of the catchments and to track the effectiveness of the watershed management strategy; and
- Implementation Plan – That describes how the strategy is to be put into place, based on the mandates of the various agencies and stakeholders, as well as identify the specific roles and responsibilities for each group.

10.2.1 Management Strategy

To adhere to the overall approach that protects and enhances the natural environment in a sustainable fashion, the management strategy should address all of the key components and processes of the watershed. These components should at a minimum include:

- Natural Heritage System:
 - Terrestrial and Wetland – The development of a management approach for terrestrial and wetland features that will protect and enhance overall biodiversity, including the flora and fauna associated with terrestrial and wetland features, in an environmentally sustainable fashion. This includes the provision of a corridor system to provide necessary linkages for wildlife and plant movement, such as eco-passages beneath roadways.
 - Streams – The provision of a corridor system for streams that have been identified as having environmental characteristics or watershed functions that require protection and/or enhancement to meet the watershed goals and objectives. A riparian corridor approach is to be applied which will consider all the stream functions including:
 - hydrologic;
 - hydrogeologic;
 - geomorphologic; and
 - environmental.



- SWM – The development of an approach that will protect and enhance environmental characteristics through managing related stormwater response and conveyance processes.

10.2.2 Natural Heritage System – Terrestrial and Wetland

The current landscape pattern of terrestrial and wetland habitats throughout the Study Area is the result of a number of human and natural influences. The resulting landscape pattern largely centers around patches of often disconnected woodland and wetland of a variety of sizes, with the main watercourses and drainage channels providing lesser terrestrial connections due to the lack of natural vegetation along these features.

The functional contributions and connections between natural areas are an integral part of the management strategy for individual components of and the overall NHS. The overall goal relates to the sustainability of the natural heritage features and resources of the NHS, which is based on the maintenance and the restoration of biodiversity at a series of levels (species and habitats). For the terrestrial environment (i.e., vegetation communities within aquatic, wetland and terrestrial systems), the goals and objectives of the SWS is to focus on the protection of important naturally vegetated features in both terms of structure and function. The objectives of a sustainable NHS are to follow a systems-based approach that protects and maintains the identified ecological features (e.g., woodlands, wetlands, significant wildlife habitat), the ecological functions (breeding amphibian habitat, riparian/wetland water attenuation and control), and a range of ecological interactions (wildlife movement through linkages).

Woodlands

The overall goal of protecting woodlands within the Study Area is identified through the natural environmental policies at the provincial, regional, and local levels. This has been completed through a detailed characterization of woodlands and the applicable policies and criteria that defines significant woodlands. These are mapped for the Study Area with the management strategy objective of maintaining the woodlands despite urbanization.

Targets:

Based on the character of the woodlands in the Study Area, the following targets were identified:

- Woodlands are not to be fragmented;
- Maintain and enhance, wherever possible, the function of all woodlands that supports the overall NHS;
- Maintain and enhance, wherever possible, the function of woodlands associated with wetlands and watercourses;
- Provide enhancement of the woodland quality (e.g., managing invasive species) and shape (i.e. to reduce edge habitat) wherever possible; and,
- Maintain and enhance woodland size where there are opportunities to do so.

Wetlands

The overall goal of protecting wetlands within the Study Area is identified through the natural environmental policies at the provincial, regional, and local levels. This goal is reflected in the objective of maintaining the roles of the wetlands despite urbanization.



The approach used here focuses on the identification of the types of wetlands, their functions and the hydrologic benefits and requirements. These features provide supporting functions to the NHS (both terrestrial and aquatic). The wetlands in the Study Area are also known to provide habitats for a number of plant and wildlife species and play an important role in the hydrology of the Wignell Drain Subwatershed.

Wetlands in the Study Area consist of the following types:

- 1 Wetlands with no permanent inflow or outflow of water (isolated wetlands, as defined in the Ontario Wetland Evaluation System) – These are represented by small pockets of wetlands that are a result of accumulation of runoff in low-lying areas with less permeable soils (eg. Fig 8. A2). Some of these are found as vernal components of woodland blocks, and in other areas.
- 2 Wetlands with a direct outflow (palustrine wetlands, as defined in the Ontario Wetland Evaluation System) – These wetlands are associated with a watercourse or other wetland feature and may play an important hydrological role in addition to their ecological role (eg. Fig. W 8, W3) (i.e., water attenuation and conveyance to downstream features).
- 3 Wetlands associated with the channels and riparian areas of watercourses (riverine wetlands, as defined in the Ontario Wetland Evaluation System) – These wetlands are generally online features that have established as a result of flow patterns in the channels (e.g., low gradient systems and areas with impeded flows) (eg. Fig 8 W5/6/7).

Targets:

Based on the character of the wetlands in the Study Area, the following targets were identified:

- Avoid the fragmentation and hydrological interference of wetlands;
- Maintain the function of all wetlands associated with watercourses; and
- Maintain the function and structure of wetlands within woodlands.

Terrestrial Feature Buffers

The identification of buffers around wetlands and woodlands are driven by the natural environmental policies at the regional, local, and watershed (i.e., conservation authorities) levels. There are a number of similarities in the approaches typically used to determine buffers for situations where specific buffers can be determined through a SWS or an EIS. From review of numerous past studies on buffers, general components/approaches have been used to identify the extent of buffers:

- 1 Cases where the immediate protection of the edge of the natural habitat is considered (i.e., for the protection of wetland vegetation and control of runoff to wetlands), these dimensions are typically larger (a dimension of 30 m is in common usage for provincially significant wetlands)
- 2 In some cases, the protection of woodlands considers arboricultural approaches in which the focus is on the physical protection of the outer trees based on root zone protection. This type of approach results in a modest buffer normally in the range of 10 to 15 m from the dripline.
- 3 Buffers around natural habitats may be based on specific species' habitat requirements.

The targets associated with buffers are based on the overall objectives of maintaining the biodiversity of the habitats in the area. The identification and use of appropriate buffers and



consideration of edge effects and the ecological needs of species within the natural areas is recommended.

Targets:

- Establish appropriate feature-specific buffers for protection of natural habitats that contributes to the function of these areas.
- Use of variable buffers where appropriate and where the function of the buffer can be maintained.

Plants and Wildlife

For the most part, the goals for plants and wildlife species overlap with those noted above for wetlands, woodlands, and other habitat types. The key objective for plants and wildlife is the preservation of biodiversity. Given the character of the habitats and species known from the Study Area and the relationship of these habitats to others outside the Study Area, the management of plants and wildlife species must be considered at the metapopulation level. The defined NHS is key to maintaining biodiversity. Many wildlife species use a range of habitat types for different aspects of their life history, and therefore this range of habitats must be considered.

Amphibians provide a prime example on why metapopulations must be managed. Depending on their life cycle stage and season, amphibians require different habitats. Spring peepers, for example, use wetland habitats (i.e., vernal pools, flooded swamps) for breeding, but then migrate to upland areas once breeding is complete or once tadpoles have transformed. In winter, this species hibernates under logs, bark, or fallen leaves. The overwintering habitat needs to be protected and location in proximity to the breeding habitat.

The targets for the maintenance of plant and wildlife biodiversity are for the most part reflected in those cited for wetlands and woodlands discussed above. Linkages are an important consideration for the maintenance of sustainable populations and are therefore discussed separately below.

Targets:

- Set targets listed for wetlands, woodlands, and other vegetation community types.
- Provide for linkages and buffers.
- Remove invasive species and replace with native species or manage invasive species when not feasible.

Linkages

A range of linkages and opportunities currently exist within the Study Area. Linkages are an integral part of the objectives of maintaining sustainable woodlands, wetlands, watercourse corridors, and wildlife populations within subwatersheds. Improved landscape connectivity in this case has the potential to have the largest impact on the movement of smaller organisms such as insects, herptiles, and plants.

Linear habitats, either associated with riparian habitats or other upland features, may provide an intrinsic habitat function (Riley and Mohr, 1994). Ecological linkages must be designed with an understanding of the species that will use the connection. For example, the design of eco-passages recommended for the Study Area are often targeted towards specific species (see Section 10.3.2.1.1).



To improve connectivity of features within the Study Area, some linkage opportunities exist along watercourses between isolated woodland and wetland areas.

Targets:

- Minimize the discontinuities in linkages
- Larger linkages to be generally a minimum of 60 m wide (these are more likely to be between very large natural features, potentially outside the Study Area)
- Local linkages to be generally a minimum 20 m wide
- Consider use of stormwater management facilities areas as a method of allowing some terrestrial movement
- Crossing structures (eco-passages) such as culverts should take into account terrestrial and aquatic wildlife passage where feasible.
- When roads are rebuilt or widened consider eco-passage use both where there are drainage features under roads and also where there are not (to allow for upland species movement). The feasibility of eco-passages are still subject to the environmental assessments for road upgrades and improvements.
- Allow for linkages to habitats or other linkages located outside the Study Area

10.2.3 Aquatic Environment and Surface Water Quality and Quantity

Upstream of the Friendship Trail, two main tributaries anchor the Wignell Subwatershed surface water network and aquatic environment (**Figure 22**). The tributaries serve as conduits for surface water drainage, provide aquatic habitat for fish and other aquatic wildlife and invertebrates, and provide ecosystem services such as providing 'stepping stone', hydration, and refuge habitat for various wildlife including amphibians, reptiles, and urban-tolerant mammals. Downstream of the Friendship Trail, the Wignell Drain Subwatershed's drainage network provides similar services and is primarily contained in one channel area; however, the expansive adjacent wetlands and the un-surveyed drainage channel located immediately west of Lorraine Road, also anchor the natural heritage system. It should be noted that additional watercourses regulated by the NPCA may be present within the Study Area that were not captured during this subwatershed study. This may be the case for private, non-participating lands in which site access was not granted. The below strategies should also be considered for such features.

Protection of the stream corridors and the associated aquatic ecological functions can be achieved by:

- Prohibiting development and site alteration within or adjacent to the municipal drains or associated drainage features, including HDFs identified as requiring protection or conservation, as part of future studies;
- Maintaining existing water balances of the surface water features by implementing various recommendations outlined in future SWM Management Plans and LID Management Plans;
- Consistent with NPCA policies, applying a 15 m buffer to the top of slope of intermittent, warmwater surface water features, as identified upstream of the Friendship Trail (**Figure 21**); and, applying a 30 m buffer to the top of slope limits of permanent, warmwater surface water features, as identified downstream of the Friendship Trail. To accurately delimit the top of slope boundaries, completion of a top of bank assessment, or where



necessary a stable top of slope analysis, should be completed in consultation with the NPCA and other regulatory agencies.

- Placing the surface water features and their associated buffers within an EPA or NHS designation.

Maintenance and enhancement of the ecological integrity of the surface water features and their associated ecological functions, including surface water quality and quantity, can be achieved by:

- Removing foreign waste and debris;
- Controlling populations of invasive species present within surface water features or their buffers;
- Restoring native species diversity to riparian habitats by planting appropriate native vegetation;
- Enhancing wildlife habitat opportunities through strategic plantings and artificial habitat creation, while respecting localized drainage requirements;
- Enhancing fish habitat and stream stabilization by providing more diverse riparian cover and removing barriers to fish passage, while respecting localized drainage requirements;
- Naturalizing surface water feature corridors with dense, native shrub planting to create a living fence barrier between future development and surface water areas;
- Incorporating LIDs within buffers to improve inflowing water quality by promoting infiltration and reducing overland runoff;
- Installing comprehensive ESC measures (ex. Silt fencing) at the limits of all future development and ensuring removal occurs post-development;
- Posting educational signage in feature buffers to discourage encroachment into surface water corridors;
- Monitoring the health and condition of surface water features and the performance of environmental protection and management plans developed as part of future development applications; and,
- Monitoring and identifying areas of groundwater recharge and discharge and ensuring areas of significant groundwater recharge are protected and maintained.

10.2.4 Potential EIS Protocols for Future Development

Considering the number and complexity of natural elements of the Study Area, each future development project should be accompanied with a detailed, site-specific EIS, or equivalent study, completed in accordance with relevant policies and protocols at the time. The following ecology-focused protocols are recommended to be followed as part of future development applications within the Study Area. Please note that this list may not be fully exhaustive, and at the same time may overestimate what is required. The field surveys completed for the current SWS are relatively detailed and can also be used to supplement future studies, recognizing that field data typically needs to be updated after five years. Additionally, the protocols and guidelines referenced below may or may not be in force at the time of a future development application.

- General



- Federal, provincial, regional and/or municipal policy overview;
- Background review of applicable mapping, wildlife atlases & records, and relevant studies (e.g., subwatershed study, secondary plan);
- Assessment of feature significance as per federal, provincial, regional, and/or municipal criteria;
- Terms of Reference submission to relevant agencies with planning authority;
- Natural feature staking exercise in consultation with relevant agencies with planning authority;
- Impact assessment of the proposed development on natural features;
- Consideration for natural feature linkages and/or corridors;
- Mitigation, monitoring, and/or restoration strategies as they relate to the identified impacts of the proposed development on natural features; and
- Summary of how the proposed development conforms to applicable federal, provincial, regional and/or municipal policies.
- Terrestrial Ecology Surveys
 - Ecological Land Classification as per the Ecological Land Classification (ELC) System for Southern Ontario protocol (Lee, et al., 1998);
 - Three season floral inventory
 - Breeding Birds as per Bird Studies Canada protocols (2001) and MNR protocols (2013);
 - Breeding Amphibians as per Bird Studies Canada protocols (2009);
 - Maternity Roosting Habitat for Bats (e.g., snag density, acoustic monitoring) as per MNR protocols (2022);
 - Turtle basking as per the Survey Protocol for Blanding's Turtle (*Emydoidea blandingii*) in Ontario (OMNRF, 2015);
 - Snake hibernacula as per the Survey Protocol for Ontario's Species at Risk Snakes (OMNRF, 2016)
 - SAR screening based on desktop, habitat based screening and standard protocols as appropriate.
 - SWH screening as per criteria outlined in the MNR's ecoregion schedules (2015) and Significant Wildlife Habitat Technical Guide (2000).
- Aquatic Ecology
 - Aquatic habitat assessment as per the Ontario Stream Assessment Protocol single-pass field procedures (Stanfield, 2017).
 - Surface water quality as per the Ontario Stream Assessment Protocol single-pass field procedures (Stanfield, 2017).
 - Fish community sampling as per the Ontario Stream Assessment Protocol single-pass field procedures (Stanfield, 2017).
 - Benthic invertebrates as per the OBBN Protocol Manual (Jones et al., 2005).



- Headwater drainage feature assessment as per the Ontario Stream Assessment Protocol Headwater Drainage Feature Module (Stanfield, 2017).

With respect to aquatic ecology, it is recommended that any future development application considers and field-verifies watercourse features identified within NPCA watercourse mapping. If it is determined that the reach(es) does not meet the Conservation Authorities' definition of a watercourse, it is recommended that a headwater drainage feature assessment be considered.

10.2.5 Climate Change

A climate change vulnerability and risk assessment is recommended to gain a better understanding of potential climate change impacts on the Wignell Drain Subwatershed. These assessments (i.e., ecosystem impact analyses, neighbourhood-scale vulnerability assessments, etc.) will provide a better understanding of the climatic, biophysical, and human factors that contribute to the effects of climate change on various systems (e.g., natural systems, infrastructure, etc.) and will support better adaptive management and planning for the Study Area. In addition, these assessments will allow the Region and the City to identify and map highly vulnerable locations within the Study Area.

Additionally, the updated MECP approach to stormwater management requires the use of the municipal Consolidated Linear Infrastructure Environmental Compliance Approval process which includes climate change considerations. The Consolidated Linear Infrastructure Environmental Compliance Approval process will be used when designing stormwater ponds.

10.2.6 Hydrogeology

Hydrogeological constraints and impacts can be overcome through appropriate engineering designs and environmental planning and further hydrogeological study and monitoring.

Considering the complexity of forms and function of the natural elements of the Study Area, each development project within the Study Area should be accompanied with a detailed, site-specific hydrogeological study completed following the guide of Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications (2013), and with reference to the NPCA Policy Document (Policies for the Administration of Ontario Regulation 155/06 and the Planning Act, Niagara Peninsular Conservation Authority, 2020). The hydrogeological studies should focus on site water balance and feature-based water balance assessment. To maintain infiltration and post- to pre-development, water balance should be the major target of stormwater management design.

Karst screenings should also be conducted as part of each hydrogeological study. Karst (Unstable Bedrock) Investigation Guidelines of Quinte Conservation (2023) can be referred to when screening for karst.

10.3 Mitigation, Enhancement, and Monitoring Recommendations

Monitoring and adaptive management plans are generally developed as part of Subwatershed Impact Studies. The information collected as part of these plans is intended to verify the performance of the environmental and stormwater management systems advanced in the Subwatershed Impact Study, as well as to provide guidance for potential modifications to the management plan to satisfy the objectives of the Subwatershed Study. Additional details regarding various components of the monitoring and adaptive management plans are provided below.



10.3.1 Mitigation

A primary goal of the management strategy is to ensure that there are no negative impacts to natural heritage features and the aquatic environments and their associated hydrological functions. Key objectives for mitigation measures to be implemented in order avoid potential negative impacts are listed below.

- Develop and implement appropriate mitigation measures that are necessary to avoid negative impacts to natural features that may result from new development, including infrastructure.
- Watercourse crossings, including bridges and culverts, are designed appropriately to address and mitigate for potential channel migration.
- Utilize the analysis and recommendations of the multi-disciplinary classification forms of watercourses and drainage features to manage for the protection and conservation of fish habitat.
- To mitigate for the potential reduction in baseflow consider that LID measures be employed to minimize the potential reduction in groundwater recharge/discharge where applicable and appropriate. Opportunities for infiltration may require further analysis on a site-specific level for the identification of suitable infiltration opportunities.
- High constraint areas are to be excluded from development with the establishment of appropriate buffers that mitigate potential impacts from development to natural features and maintain the ecological functions.

10.3.2 Natural Environment

Given the current developed and disturbed nature of the Wignell Drain Subwatershed, several actions should be considered by the City and Region to better understand the subwatershed or to improve the health of the subwatershed.

The 2024 Port Colborne Urban Forest Management Plan evaluated changes in the city's canopy cover both spatially and temporally (Williams & Associates and McNeil Urban Forestry, 2024). As per the urban forest management plan's definition, canopy cover includes both tree and shrub cover across urban, rural, and natural areas. As of 2018, within the Port Colborne municipal boundary, canopy cover accounted for approximately 37% of the landscape (Williams & Associates and McNeil Urban Forestry, 2024). Canopy cover was greatest within woodlands (26% of the overall 37%) found in rural areas of Port Colborne, including those within the Study Area, and lower within urban areas. Conversely, the Niagara Region's 2024 Tree and Forest Canopy Summary Report indicated the City of Port Colborne exhibited a tree and forest canopy cover of 28% between 2020 and 2021. However, it is important to note that this percent cover did not include shrub cover whereas the Urban Forest Management Plan had.

Scientific literature suggests that a tree canopy cover of 30%, in urban areas, is the minimum threshold for ensuring mental, physical, and social health of its residents (Konijnendijk, 2025; Astell-Burt & Feng, 2020). Globally, a number of cities have set a target of 30% canopy cover including Barcelona and Seattle (Konijnendijk, 2021). Recommendations outlined within this report for setting a forest cover target within the City of Port Colborne assumes the most recent estimation (28%) to be representative of existing canopy cover. Given the relatively high, existing tree canopy cover within the City of Port Colborne, it is our opinion that a target of > 30% tree canopy cover is more than reasonable. Niagara Parks has set a target of reaching 35% canopy cover as part of its Urban Forestry Management Strategy (Niagara Parks, n.d.). As development pressures increase for the rural areas of the subwatershed, it is critical to prioritize



woodland retention and native tree planting programs to ensure targets are being met, or ideally surpassed.

Maintaining and/or increasing the forest cover of the Study Area; this might be undertaken through:

- Buffer and floodplain plantings during development;
- Selective municipal or conservation authority purchase and restoration of private properties when they are for sale;
- Development and implementation of native tree planting and maintenance programs for private landowners;
- Prioritization of planting programs for municipal road allowances, parks, and facilities;
- Identification and protection of enhancement areas;
- Planting of riparian corridors that are apparently unused/abandoned or have become part of the Natural Heritage System assuming they are safe to access and with landowner permission; and
- Ensuring that, when Port Colborne Quarry lands are exhausted, restoration and enhancement plans are in place that include re-forestation.

10.3.2.1 Invasive Species Management

Invasive species not only have direct impacts on Niagara's natural areas, but they also have consequences for human health (e.g., toxic plants), the economy, and recreational opportunities (Niagara Parks, 2018). It is SLR's understanding that the NPCA does not currently have an invasive species strategy in place (Brown, 2019). A regional invasive species management plan would help shape future site-specific strategies in terms of responsibilities, priorities, methods, and accountability. More specifically, the development of a project prioritization tool could help scope site-specific initiatives (Credit Valley Conservation, 2020).

Given the prevalence of non-native, invasive species within the Study Area (e.g., European Common Reed), as reported within this SWS, it is recommended that an invasive species management plan be considered for all future development applications. In the absence of a regional invasive species management plan, SLR has provided some general strategies that may be applicable for the Study Area:

- Employ a site-specific plan that aligns with the federal, provincial, and municipal strategies (CVC, 2020);
- In consultation with the NPCA, implement a site-specific plan that targets invasive species and that will have the greatest impact;
- Use a science-based approach to determine on-the-ground management (e.g., removal, disposal, and restoration planting) (CVC, 2020);
- Develop and implement Best Management Practices to ensure the overall objective of the management plan is accomplished (CVC, 2020); and
- Provide recommendations for future monitoring efforts onsite to reduce the risk of reestablishment of invasive species.



10.3.2.2 Enhancement Areas

With the predominantly anthropogenic nature, as well as the increasing development pressures, of the Study Area and adjacent lands, potential enhancement areas should be considered. Enhancement areas may include the expansion or creation of natural features within the Study Area, including wetlands, woodlands, and surface water features. Floodplains and hedgerows are also suitable candidates for enhancement initiatives, especially within the Study Area where agricultural activity is widespread. Similarly, enhancement and restoration of natural areas within the existing quarry lands, once operations are terminated, would greatly increase natural cover within the Study Area. Enhancement of areas connecting, or linking, multiple natural features should be considered within future development projects within the Study Area. Under a future development scenario within the Study Area, the following areas should be considered for future enhancement:

- Existing agricultural lands protected from future development (e.g., within the floodplain seen on **Figure 21**);
- Anthropogenic landscapes wedged between two or more natural features (see **Figure 6** for potential linkages); or
- Vegetation communities dominated by invasive species (e.g., European Reed).

The following criteria can be used, as part of site-specific studies (e.g., EIS), to determine potential areas for enhancement within the Study Area:

- Improves connectivity of existing natural features;
- Provides greater protection of natural features (e.g., watercourses);
- Increases the size of an existing natural feature (e.g., woodland); and/or
- Improves the quality (e.g., floristic diversity, wildlife habitat) of the natural feature.

It is important to note that the above is not an exhaustive list of all possible enhancement areas within the Study Area. Potential enhancement areas are subject to confirmation through site-specific studies such as an EIS.

10.3.2.2.1 Landscape Connectivity Enhancement Opportunities

The ecological connectivity of almost every southern Ontario landscape can be improved through a combination of creating larger natural areas or widening connections in a variety of directions between existing natural areas. Within the low connectivity landscape context of the Wignell Drain Subwatershed, some of the recommended areas to enhance connectivity are depicted in **Figure 6**. The areas where it is more important to improve connectivity (where feasible) are shown as wider arrows; these are often to large wetlands outside the Study Area. Narrower arrows are less important areas of potential enhancement. All watercourses are also areas of potential future natural connection if naturalized and restored. The Niagara Region Official Plan (2022) also indicates areas of potential linkage on Schedule C2.

Wildlife Eco-passages

Wildlife passage should be accounted for in development projects within the Study Area, specifically when road upgrading is required. Any time a) a new road is built, b) a road is widened or c) watercourse crossings are replaced, consideration should be given to wildlife passage. Attention should be given to the following: which wildlife species might use a passage and if they are aquatic or terrestrial; whether a dryland passage should be added; whether a culvert should be increased in size; whether a dryland passage should be added to a passage



that is primarily aquatic; and if it is feasible to add wildlife funnel fencing along either side of the road. Generally eco-passages have been found to be more effective with the associated use of wildlife fencing, however the use of it may depend on the presumed extent of wildlife usage, type of wildlife, etc.

At the direction of municipal agencies, opportunities for the installation of wildlife eco-passages as part of future development projects have been explored within the Study Area. Due to the generally flat landscape across the Study Area, and lack of physically large and sensitive species, it is not feasible to implement eco-passages that cater to large, terrestrial mammals. Rather, considerations to enhance the ability for smaller wildlife (e.g., herptiles) to move from one side of a roadway to the other should be implemented. For example, culvert crossings with an appropriate 'Openness Ratio' (OR) is important to facilitate herptile movement. OR refers to the amount of light visible at the end of a structure and in the study of Road Ecology is used as a measure of the permeability or attractiveness of the crossing structure to wildlife. It is calculated as the cross-sectional area of the structure entrance divided by its length (all measurements in meters) (Conservation Halton, 2018). For box culverts, the following calculation is used for OR:

$$\text{Openness Ratio for a Box Culvert} = (\text{Height} \times \text{Width}) / \text{Length}$$

A general openness ratio (OR) of 0.1 is typically used to accommodate amphibians and reptiles (Conservation Halton, 2018). SLR utilized the Conservation Halton guideline for OR as the NPCA does not provide specific values. Additional site-level design components should be incorporated to increase the likelihood that wildlife will utilize the crossing (e.g., use of natural substrates and incorporation of habitat structures such as woody debris).

10.3.3 Surface Water Quantity

To better understand localized water quantity conditions across multiple seasons, it is recommended that continuous flow monitoring be completed as part of future development applications, particularly in catchments that were not accessible as part of this SWS (**Figure 2**). More detailed stream flow monitoring will better inform baseline hydrologic conditions, identify natural and anthropogenic inputs, and will inform if future stormwater management facilities are functioning as intended. Flow monitoring should be paired with future water quality monitoring efforts.

As part of future development proposals, mitigations for surface water quantity may be achieved through approaches such as reducing impacts associated with runoff from agricultural and rural areas, reducing impacts of runoff from new development, and maintaining the baseline hydrologic regime. Incorporation of development features such as LIDs may alleviate water quantity impacts and promote improved water quality conditions through increased infiltration and surface runoff attenuation. Other improvements to water quantity may also be achieved through enhancement or retrofits to existing stormwater infrastructure, and completion of functional servicing and stormwater management designs for new development that reduce runoff and implement effective water quantity controls.

10.3.4 Surface Water Quality and Temperature

As a general requirement for future development and associated monitoring, surface water quality within the Wignell Drain Subwatershed should maintain or surpass general baseline conditions outlined in this report and should not exceed parameter targets outlined in the



PWQO, where feasible. For instance, where baseline water quality does not meet the PWQOs as identified in this report, the water quality should not be degraded further, and all practical measures should be taken to upgrade the water quality to PWQO targets.

Areas with relatively higher water quality (i.e., downstream reaches of the subwatershed including monitoring stations WD-5 and WD-6) should be protected and enhanced, where feasible. This includes protecting and enhancing upstream surface water corridors, which supply flow to downstream surface water environments. Proponents of future development within the Wignell Drain Subwatershed should be required to prepare appropriate hydrologic, hydrogeological, and/or environmental studies to ensure that adjacent and downstream surface water environments are protected and enhanced, from a surface water quality perspective.

As part of future development proposals, additional surface water quality enhancement may be achieved through items such as streambank stabilization and rehabilitation, reducing impacts associated with runoff from agricultural and rural areas, reducing impacts of runoff from new development, and maintaining the baseline hydrologic regime.

To capture the degree of potential impacts and rehabilitation the following monitoring approaches may be incorporated into monitoring programs including, but not limited to, surface water chemistry and nutrient sampling, benthic invertebrate sampling, fish community sampling, and aquatic habitat monitoring. Future surface water quality monitoring should span from spring to fall and include dry and wet weather conditions to provide a more fulsome understanding of subwatershed under varying conditions. Comprehensive baseline water quality conditions should be completed for catchments that were not accessible as part of this SWS.

For future development proposals, surface water temperature monitoring should be completed on a continuous basis for pre-, during-, and post-development basis to monitor changes in baseline conditions and incorporate background atmospheric parameters including precipitation levels and daily air temperature. During-, and post-construction monitoring should capture upstream and downstream conditions for major development outlet points.

10.3.5 Groundwater

Groundwater flows and resides underground and has complicated interactions with other natural resources and environmental elements. In view of the complex nature of the groundwater system, an adaptive environmental monitoring program (AEMP) is recommended as part of the ongoing development planning for the Study Area. The AEMP is to achieve three objectives including:

- Provide further knowledge and understanding of the groundwater conditions and its interactions with other environmental elements;
- Establish baseline hydrogeological conditions such as groundwater levels, quality, recharge and discharge, and their patterns and trends;
- Monitor the impact of the development to groundwater conditions and related environmental elements; and
- Monitor the effectiveness of various best practices and mitigation measures adopted by the proponents.

AEMP is a key component of adaptive environmental management. AEMP is usually adopted to monitor convoluted impact-receiver systems such as mining sites, quarries, and large developments. Because these systems, in general, cannot be recognized thoroughly at the beginning of a program, AEMP takes a form of cycling steps: study-monitoring-adjustment-



study-monitoring. Through multiple cycles, the system becomes better understood and the monitoring becomes more precise. AEMP is realized through setting up a clear matrix of actions, locations, duration, triggers, thresholds, and mitigation measures, and all these elements in the matrix are executed in a systematic (feedback and action) way. AEMP has proved to be the most cost-effective way of monitoring complicated environmental systems. The AEMP recommended should include the following monitoring points or stations:

- Monitoring wells in strategic locations to monitor patterns, trends, and stability of groundwater levels and groundwater quality;
- Mini-piezometer and surface water stage stations for major wetlands and certain spots of drainage channels to delineate hydroperiods of wetlands and the interaction of groundwater and surface water;
- Baseflow measurement or observation stations along drainage channels to characterize baseflow conditions and groundwater discharge.

10.3.6 Stream Morphology

The collection of field data from similar sites over an extended period of time can provide great insight on channel processes and function. Monitoring is critical to determining a channel's response to surrounding land use changes. Typically land use changes without mitigation will result in alteration to hydrologic regimes (increased flow volumes) and sediment regimes (initially more sediment being supplied to the channel followed by an overall decrease). These alterations can result in changes in the channel planform, bank erosion, cross-sectional area, and substrate composition, which, in turn, may locally impact aquatic habitat and water quality.

From a geomorphic perspective, monitoring and pre-construction baseline surveys should be established 1-2 years prior to land alteration. Preferably monitoring should be installed in relevant or sensitive reaches prior to stormwater being released into the system. Monitoring would subsequently take place annually during- and post- construction to fulfill performance evaluation requirements. The post-construction monitoring period should extend for 3-years following completed build out.

11.0 Implementation of Subwatershed Plan

The implementation of the Subwatershed Plan should follow a process of addressing the components outlined in the management strategy. This includes a process that involves technical components of the SWS analysis and specific planning steps guided by the Provincial Policy Statement and Regional and Local Official Plans.

The implementation process for a SWS fits within an environmental planning and municipal land use planning process with agency stakeholders and associated review and approval process.

Graphic 31 provides an illustration of this process with a summary of the major planning process steps provided below:

- Official Plan (OP);
- Secondary Plan;
- Draft Plan;
- Subdivision Design Plan; and
- Registered Plan.

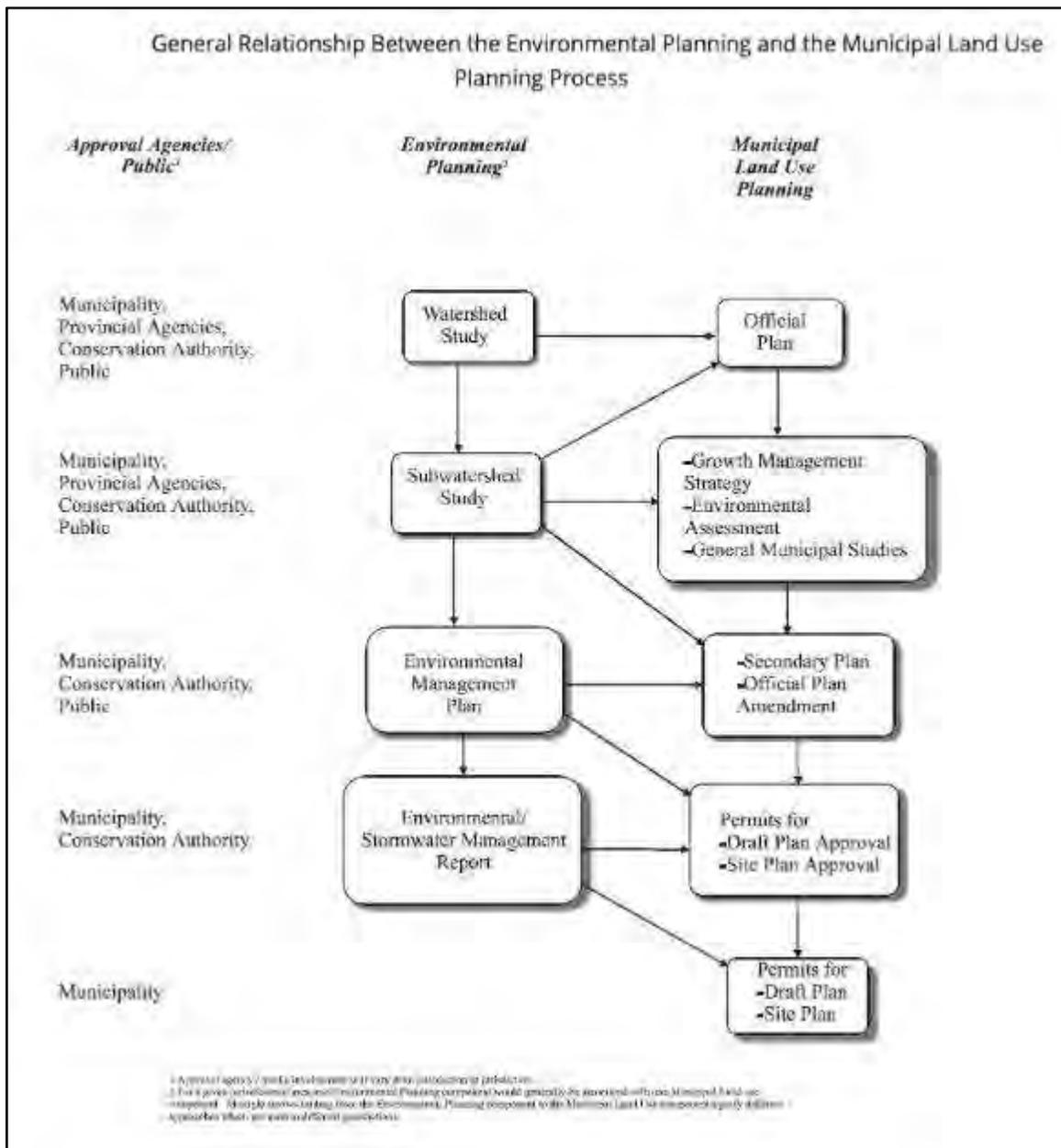


The supporting studies that may be necessary include a(n):

- Subwatershed Study;
- Environmental Implementation Report (EIR);
- Functional Servicing Study (FSS);
- Preferred Servicing Plan;
- Draft Plan or Site Plan;
- Environmental Impact Study;
- Restoration and Enhancement Plan;
- Tree Preservation and Protection Plan;
- Grading Plan;
- Erosion and Sediment Control Plan;
- Servicing Plan;
- Stormwater Management Design Plan; and/or,
- Approvals and permits as required by agencies and the municipalities.



Graphic 31: Example Overview of Planning Process for Implementation of a SWS



Additional Requirements and Future SWS Updates

Regulated areas (i.e. hazard limits and wetlands) and stormwater management pond design will need to be further revised at the site specific and watershed level as part of the ongoing implementation of the SWS and the site-specific EIS'. The following requirements are provided:

- 1 Future studies must follow the TOR approved by all agencies.
- 2 Refinement of flooding (including spill) and erosion hazards.
- 3 There are no known valleylands in the Wignell Drain Subwatershed; however, if determined to be present a site visit with NPCA staff to determine whether there is a top



of bank associated with the Wignell Tributary. If confirmed, top of bank staking will be required.

- 4 Further site visits with NPCA staff to determine the presence of any wetlands. If confirmed, wetland staking will be required during the appropriate staking season (June – September).
- 5 A refined SWM review/design which maintains the NPCA setbacks and requirements.

12.0 Closure

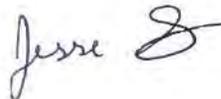
This report was prepared, reviewed and approved by the undersigned.

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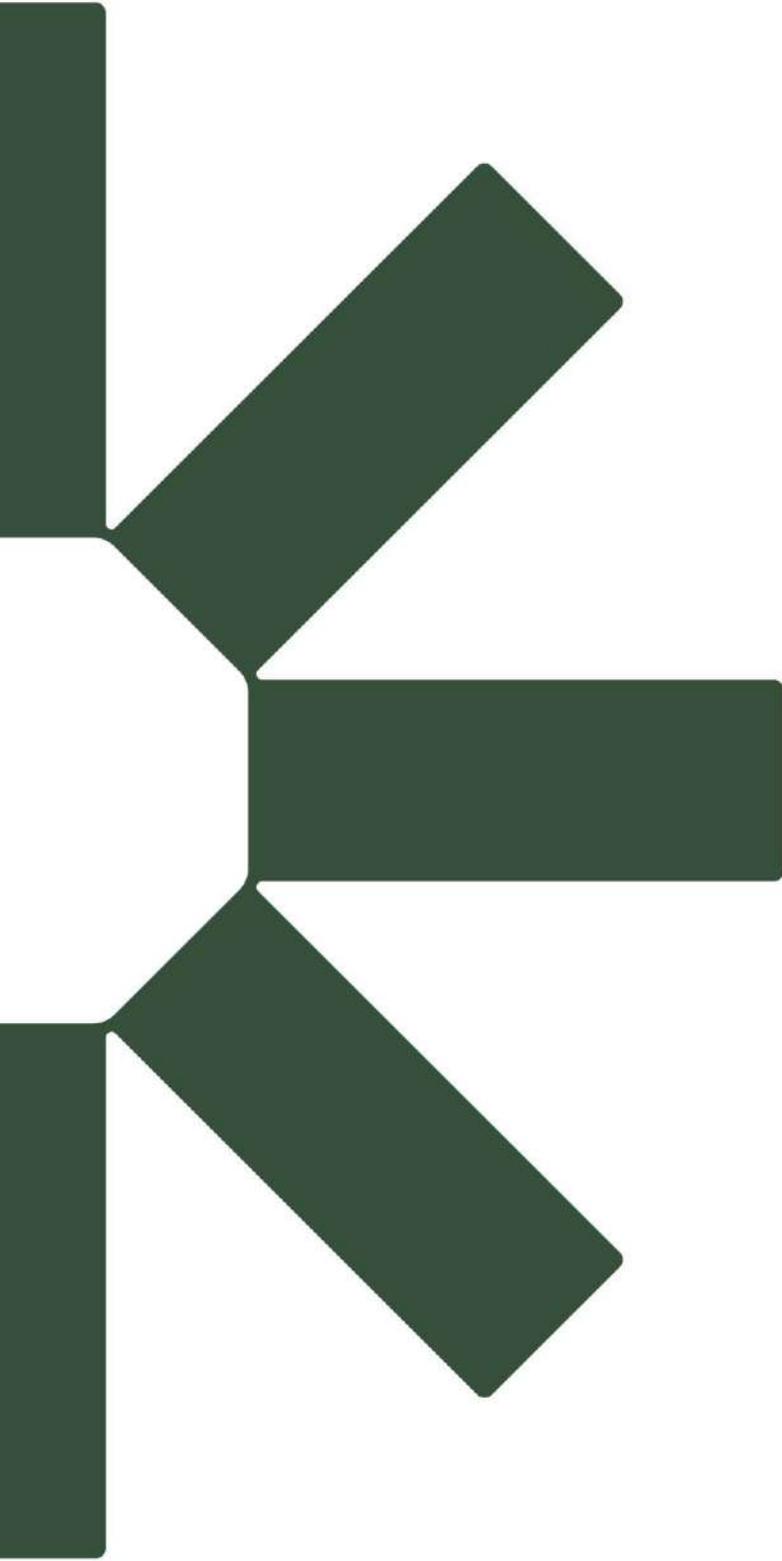
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