FOTENN

Barrhaven South Phase 3 - S1 Area

ENVIRONMENTAL IMPACT STUDY

Submitted to: Minto Communities Canada
Prepared for Catherine Tremblay,
Land Development Manager
200-180 Kent Street, Ottawa, ON K1P 0B6

April 10, 2026

Prepared for Minto Communities

Prepared by Fotenn Planning + Design
420 O'Connor Street,
Ottawa, ON, K2P 1W4

April 2026

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Catherine Tremblay

Minto Communities Canada

200 – 180 Kent Street

Ottawa ON K1P 0B6

RE: Barrhaven South Phase 3 – S1 Urban Expansion Area
Environmental Impact Study

Dear Ms. Tremblay,

Fotenn is pleased to submit the *Environmental Impact St (EIS)* for the proposed development of the Barrhaven South Phase 3 – S1 Urban Expansion Area, located at 3882 Barnsdale Road in the City of Ottawa. This assessment documents the existing natural heritage conditions within the Study Area and evaluates the potential impacts associated with the planned residential development and supporting infrastructure.

The report identifies natural heritage features present on the Site, including Significant Woodlands, Significant Wildlife Habitat, and roadside drainage features that contribute to downstream fish habitat. It provides an analysis of how the proposed construction and long-term development activities may interact with these features and applies a structured impact assessment to establish potential effects. Consistent with provincial and municipal policy requirements, the EIS outlines appropriate avoidance, minimization, and mitigation approaches informed by the mitigation hierarchy and current City of Ottawa guidelines.

We trust that this report provides the necessary information to support the ongoing development review process. Should you have any questions or require clarification, please do not hesitate to contact the undersigned.

Sincerely,

Alex Zeller

Principal, Natural Systems

Ottawa
420 O'Connor Street
Ottawa, ON K2P 1W4
613.730.5709

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Executive Summary

Minto Communities Canada (Minto) is proposing the development of the Barrhaven South Phase 3 – S1 Urban Expansion Area at 3882 Barnsdale Road. The Subject Site lies between an unnamed future residential road to the north and Barnsdale Road to the south and includes lands designated as Industrial and Logistics and Category 1 – Future Neighbourhoods under the City of Ottawa Official Plan. This Environmental Impact Study (EIS) has been prepared to evaluate existing natural heritage features within the Study Area and assess potential impacts of the proposed low-rise residential development, consistent with municipal, provincial, and federal policy requirements.

Natural Heritage Features and Existing Conditions

Field investigations conducted between 2021 and 2024 identified several natural heritage features requiring assessment. A surface water feature located along Barnsdale Road contains ephemeral flow and provides contributing (indirect) fish habitat. In accordance with the Headwater Drainage Feature (HDF) Guidelines, this feature was assigned a "Mitigation" management recommendation, indicating that its hydrologic conveyance function should be maintained through and after development.

Two Significant Woodlands—Woodland A (mixed forest) and Woodland B (deciduous forest)—occur on the Subject Site. Both woodlands meet the City of Ottawa's criteria for significance based on size and age. Detailed woodland evaluation concluded that approximately 59% of the total woodland area can be retained under the preferred development concept, preserving key ecological and community functions.

The Site also contains Significant Wildlife Habitat (SWH), including Candidate Bat Maternity Colony Habitat within both woodlands and Confirmed Woodland Raptor Nesting Habitat (Barred Owl) within Woodland A. Two Species of Conservation Concern—Monarch and Eastern Wood-pewee—were recorded. No wetlands, Provincially Significant Wetlands, ANSIs, or Valleylands were identified, and no Endangered or Threatened Species were observed on-Site, although suitable SAR bat roosting habitat is present.

Anticipated Impacts

Development of the S1 lands will require clearing, grading, and installation of services, resulting in the loss of meadow habitat, removal of portions of both significant woodlands, and localized disturbance or displacement of wildlife. Indirect impacts such as erosion, sedimentation, construction noise, and the spread of invasive species may also occur if not properly managed. However, due to the Site's disturbed agricultural condition and limited ecological sensitivity, impacts are expected to be localized and manageable with appropriate mitigation.

Mitigation and Management Measures

The EIS recommends a suite of mitigation measures aligned with municipal and provincial guidance, including erosion and sediment control, protection fencing around retained natural features, adherence to bird and bat timing windows, habitat-enhancing landscaping, and implementation of Low Impact Development drainage practices. A Tree Conservation Report (TCR) will be required at the detailed design stage and must be coordinated with landscape architecture and grading design to reflect the recommendations of this EIS and maximize tree retention opportunities.

Conclusion

From an environmental perspective, the Subject Site is considered a suitable candidate for development, provided the recommended mitigation measures are implemented and required approvals are obtained. The retention of significant woodland features, maintenance of hydrologic functions, and integration of ecological considerations into the subdivision and landscape design will ensure that natural heritage functions are appropriately protected while supporting planned growth within the Barrhaven South Urban Expansion Area.

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Acronyms and Abbreviations

City	The City of Ottawa
DBH	Diameter at breast height
DFO	The Department of Fisheries and Oceans Canada
EASR	Environmental Activity and Sector Registry
ECCC	Environment and Climate Change Canada
ECR	*Existing Conditions Report*
ELC	Ecological Land Classification
ESA	*Endangered Species Act, 2007*
FWCA	*Fish and Wildlife Conservation Act, 1997*
HDF	Headwater Drainage Feature
ISA	International Society of Arboriculture
J.L. Richards	J.L. Richards & Associates Limited
MBCA	*Migratory Birds Convention Act, 1994*
MBR	*Migratory Birds Regulations, 2022*
MNRF	Ministry of Natural Resources and Forestry
NHIC	Natural Heritage Information Centre
NHRM	*Natural Heritage Reference Manual* (MNR 2010)
NHS	Natural Heritage System
PPS	*Provincial Planning Statement, 2024*
PTTW	Permit To Take Water
RVCA	Rideau Valley Conservation Authority
SAR	Species at Risk
SARA	*Species at Risk Act, 2002*
SARO	Species at Risk in Ontario
Study Area	The Site and the area within 120 m of the Site
SWG	“Significant Woodlands Guidelines” (City of Ottawa 2022d)
SWH	Significant Wildlife Habitat
SWMP	Stormwater Management Pond

1. Introduction

Fotenn was retained by Minto Communities Canada to finalize this Environmental Impact Study (EIS) for the proposed Barrhaven South Phase 3 – S1 Urban Expansion Area (the "Project"), located at 3882 Barnsdale Road (Concession 3, Part Lot 6 and 7), in the City of Ottawa (the "Site"). The Site is approximately 77 ha total and generally irregular in shape. The property is situated between an unnamed service / future residential road to the north (parallel to Haiku Street, being the next street north) and Barnsdale Road to the south.

Urban Expansion Area

The Site involves two types of Urban Expansion Areas: Industrial and Logistics, and Category 1 – Future Neighbourhoods, as designated in the City of Ottawa Official Plan (City OP). The portion of property designated Industrial and Logistics encompasses and is bounded by Highway 416 to the west and the entire adjacent area to the east within approximately 410 m of the highway. The adjacent portion designated as Category 1 – Future Neighbourhoods extends approximately 445 to 480 m east from the Industrial and Logistics portion and is located between the unnamed service / future residential road to the north and Barnsdale Road to the south (Figure 1).

1.1. Study Area

This report describes the natural heritage features within the Site (3882 Barnsdale Road) and the area within 120 m of the Site (collectively referred to as the Study Area), to account for policy requirements and setback distances outlined in the Provincial Planning Statement (2024) and the accompanying Natural Heritage Reference Manual (MNR 2010). As necessary, consideration has been given to wildlife occurrences (including SAR) reported up to 10 km away, due to the nature of desktop resources (i.e., online databases and atlases) with data presented in a 10 km x 10 km grid.

1.2. Background and Purpose

Minto Communities Canada has proposed the construction of low-rise residential dwellings with associated asphalt-paved local roads, driveways, a park, and stormwater management pond, with two areas in the western extents zoned for Industrial Lands.

The purpose of this EIS is to collect and evaluate all the appropriate and necessary information to develop an understanding of the boundaries, attributes, connectivity, and functions of relevant environmental features within the Study Area (i.e., Site + 120 m). This EIS provides a summary of the available information from review of background documents and site visits conducted by Arcadis Ecologists (two site visits in 2023 and a single site visit in August 2024). Using this data, the functions and values of the natural heritage features within the Site boundary, and adjacent lands, as well as an evaluation of their significance as per applicable guidelines (i.e., City OP, provincial and/or federal policies) will be documented. This report will conclude with general recommendations on avoidance and mitigation measures to protect natural heritage features from impacts.

1.3. Property Information

The following table summarizes the key property information relevant to the Subject Site.

Table 1: Subject Site Property Information

Owner:	Minto Communities Canada
Address:	3882 Barnsdale Road (Concession 3, Part Lots 6 and 7), City of Ottawa, Ontario
Official Plan Designation:	Urban Expansion Area (Industrial and Logistics, and Category 1 – Future Neighbourhood Overlay)
Zoning:	DR – Development Reserve
Existing Land Use:	Rural / Agricultural
Traditional Territory:	Haudenosaunee, Anishinabewaki, and Omàmìwininìwag (Algonquin)

1.4. First Nations Land Acknowledgement

Fotenn acknowledges that the Subject Site at 3882 Barnsdale Road is located on the unceded traditional territory of the Anishinabe Algonquin Nation. The Algonquin peoples have lived on this land since time immemorial, and their culture and presence have nurtured—and continue to nurture—the lands and waters of this region. We extend our respect to the Algonquin Nation and to all First Nations, Inuit, and Métis peoples for their valuable past and present contributions to this territory.

1.5. Environmental Impact Study Approach

The following approach has been developed to provide a clear methodological direction towards characterizing the natural environment and assessing the potential for significant species and habitats within the Study Area. This approach also identifies the potential for impacts to natural heritage features, provides avoidance and mitigation measures to lessen or negate those impacts, and recommends compensation measures when appropriate.

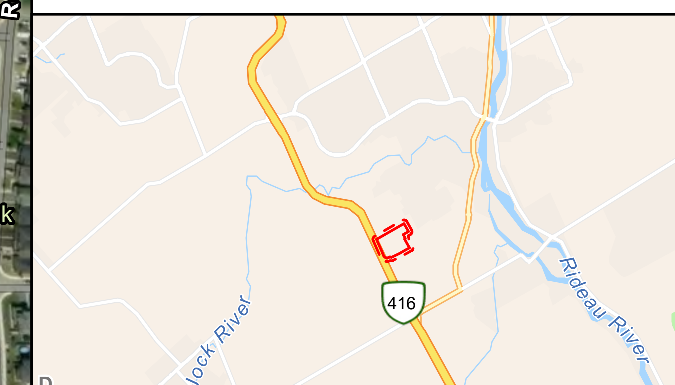
Throughout this EIS, common names of species are used, and binomial nomenclature (i.e., scientific names) are provided in the species lists in Appendix D. Both names of species (i.e., common and scientific) follow those used by the Ministry of Natural Resources (MNR) in the Natural Heritage Information Centre (NHIC 2025) Ontario Species Tables with the exception of scientific binomials of plant species which generally follow Newmaster et al. (2005) with updates taken from published volumes of the Flora of North America Editorial Committee (2000+ accessed 2015) and Michigan Flora Online (2015).

Legend

- Site
- Study Area (120m)

0 40 80 160 240 320 Meters

Scale: 1:5,000



Project Name:

Barrhaven South Phase 3 - S1 Area Environmental Impact Study

Title:

Site and Study Area

FOTENN

Date: 03/03/2026

Figure: 1

Table 2: Study approach

Relevant Policy and Legislative Framework:	**This section outlines the policies and legislation that apply to the protection of natural heritage features within the Study Area as it relates to the Project.**
Natural Heritage Screening / Background Review:	This section provides detailed background information collected from a variety of publicly accessible resource databases to describe the natural heritage features and significant features that may occur within the Study Area.
Field Methodology:	This section provides a summary of the specific protocols and methods used to evaluate potential natural heritage features and species identified within the natural heritage screening.
Field Survey Results:	This section provides the results from the field surveys. This also includes any incidental observations or notable observations made by the field ecologists.
Summary of Natural Features:	This section summarizes the natural heritage features confirmed present with respect to the relevant policies and legislation.
Description of the Development Proposal:	This section provides a summary of the Project, including the activities which may impact the natural environment.
Development Constraints and Opportunities Analysis	This section identifies areas or features that are ecologically sensitive, protected, or otherwise unsuitable for development, and portions of the site where low-impact development or restoration may be appropriate.
Impact Assessment and Mitigation Measures:	This section provides the assessment of the Project's potential impacts on the natural heritage system, including the natural heritage features and species confirmed present through this study. The mitigation measures proposed are aimed at reducing or eliminating potential impacts to natural heritage features. Where mitigation may not be possible, compensation may be proposed.
Summary and Conclusions:	This section provides a summary of the Study's findings, outlines general recommendations, and identifies any future permitting or agency authorizations that may be required before the Project may proceed.

2. Relevant Policy and Legislative Framework

This EIS references the regulatory agencies and legislative authorities mandated to protect different elements of natural heritage features and functions within Canada, Ontario, and the City of Ottawa, as applicable. The scope of this report evaluates the natural heritage features and SAR governed by the policies outlined in Table 3 below. The following subsections provide a high-level summary of the policies and legislation, noting their most recent date of amendment (at this time of preparation of this report). Each subsection also contains a short description of the policy's / legislation's applicability to this specific Project.

Table 3: Relevant environmental policies and legislation

Federal Government of Canada	
Environment and Climate Change Canada (ECCC)	
Migratory Birds Convention Act, 1994 (S.C. 1994, c. 22) (MBCA)	/ Guidelines to Avoid Harm to Migratory Birds (ECCC 2023a) / Migratory Birds Regulations, 2022 / Fact sheet: Nest Protection under the Migratory Birds Regulations, 2022 (ECCC 2023b) / Nesting Calendars (ECCC 2023c)
Species at Risk Act, 2002 (S.C. 2002, c. 29) (SARA)	/ Federal Species at Risk Public Registry / Distribution of aquatic Species at Risk mapping (DFO 2024) / ECCC Open Data: Range Map Extents, and Critical Habitat for Aquatic SAR, / National SAR (ECCC 2022)
Department of Fisheries and Oceans Canada (DFO)	
Fisheries Act, 1985 (R.S.C., 1985, c. F-14)	/ Projects Near Water online resources (DFO 2022) / The Fish and Fish Habitat Protection Program (FFHPP) Regulatory Review Process Map (DFO 2020)
Provincial Government of Ontario	
Ministry of Natural Resources (MNR)	
Fish and Wildlife Conservation Act, 1997 (S.O. 1997, c. 41) (FWCA)	/ Wildlife Schedules (*O. Reg. 669/98*)

Rideau Valley Conservation Authority (RVCA)	
Conservation Authorities Act, 1990 (R.S.O. 1990, c. C.27)	/ Prohibited Activities, Exemptions and Permits (O. Reg. 41/24) / RVCA Public GeoPortal (RVCA 2024)
Ministry of the Environment, Conservation and Parks (MECP)	
Endangered Species Act, 2007 (S.O. 2007, c. 6)	/ Species at Risk in Ontario List (O. Reg. 230.08)
Ministry of Municipal Affairs and Housing (MMAH)	
Planning Act, R.S.O. 1990, c. P.13	/ Provincial Planning Statement, 2024
Local Municipalities	
City of Ottawa	
City of Ottawa Official Plan	/ Environmental Impact Study Guidelines (City of Ottawa 2023) / Bird-Safe Design Guidelines (City of Ottawa 2022a) / Official Plan 2022, adopted by By-law 2021-386 (City of Ottawa 2022b) / Protocol for Wildlife Protection during Construction (City of Ottawa 2022c); / Significant Woodlands: Guidelines for Identification, Evaluation, and Impact Assessment (SWG; City of Ottawa 2022d) / Urban Expansion Areas (Official Plan Schedule C17) / Natural Heritage System (South) (Official Plan Schedule C11B)
Zoning By-law 2008-250	/ Section 69: Setback from watercourses and waterbodies
Tree Protection By-Law 2020-340	/ *By-law 2020-340* (City of Ottawa 2021)

2.1. Federal Policies and Legislation

This section summarizes the federal legislation and policy frameworks that govern the protection of wildlife, species at risk, and aquatic resources in Canada, outlining how these requirements apply to the proposed Project.

2.1.1. Migratory Birds Convention Act, 1994 (MBCA)

The federal MBCA was originally adopted in 1916, updated in June 1994 to strengthen the enforcement provisions and significantly increases the penalties. The MBCA was last amended in December 2017 and the associated *Migratory Birds Regulations* (MBR), were most recently updated in July 2022. Together the MBCA and the MBR protect migratory bird populations and individuals by regulating potentially harmful anthropogenic activities which may cause harm to the nests, eggs, and any part of a listed bird species.

Under the MBCA, protected species are listed under Article I. In general, birds not falling under federal jurisdiction within Canada include grouse, quail, pheasants, ptarmigan, hawks, owls, eagles, falcons, cormorants, pelicans, crows, jays, kingfishers, and some species of blackbirds. However, if the species identified is protected under Ontario's *Endangered Species Act, 2007* or Canada's *Species at Risk Act, 2002*, additional restrictions may apply.

The changes in the *MBR* altered the protection for nests of MBCA-listed birds. With the exception of 18 species listed under Schedule 1 of the MBR, which have year-round protection, instead of safeguarding *all* nests of MBCA-listed birds at *all* time, the new MBR protect *most* nests only when they are "active"; i.e., when they contain a live bird or a viable egg - generally during the breeding window (Late March – Late August with some regional variation, in the southern half of Ontario).

The changes to the MBR support conservation benefits, as the nests of most MBCA-listed birds only have conservation value when they are active. The changes also provide flexibility and predictability for stakeholders to manage their compliance requirements as they undertake activities on the landscape that may affect migratory birds and/or their nests.

MBCA - Applicability to the Project

Within Canada, the MBCA applies to activities conducted by the public and all levels of government. The killing or harming of an MBCA-listed bird or destruction / disturbance of a nest and eggs is unlawful regardless of intent. Therefore, if a protected species or their nest is encountered during Project activities, the Project must comply with the prohibitions of the MBCA. All impacts to natural habitat (e.g., ground cover, trees, or any structure with a nest) should follow appropriate timing windows and Best Management Practices specified by ECCC.

With respect to species listed under Schedule 1, targeted surveys and mitigation measures may be required to ensure nests are not impacted. Regardless of the time of year, nests of these species may only be removed with a permit from the ECCC.

2.1.2. Species at Risk Act, 2002 (SARA)

The federal SARA was adopted in 2002 and last amended in February 2023. The purposes of SARA are to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are Extirpated, Endangered, or Threatened because of human activity, and to manage species of Special Concern to prevent them from becoming Endangered or Threatened. Those species listed as Threatened, Endangered, or Extirpated under Schedule 1 are afforded both individual and habitat protection under SARA on federal lands. Additionally, outside of federal land, Section 58 of SARA affords protection to critical habitat of:

- Species of migratory birds protected by the MBCA that fall under Schedule 1 of SARA; and
- Aquatic species that fall under Schedule 1 of SARA.

A permit, or authorization, for activities that would otherwise not be allowable under SARA can be obtained from ECCC.

SARA - Applicability to the Project

The Study Area is not on federal land. As such, SARA only applies to the protection of federal SAR critical habitat, as per Section 58 of SARA.

2.1.3. Fisheries Act, 1985

The federal Fisheries Act was established in 1985. On August 28, 2019, provisions of the new Fisheries Act came into force including new protections for fish and fish habitat in the form of standards, codes of practice, and guidelines for projects near water. The Fisheries Act provides protection to fish and fish habitat such that:

> "No person shall carry on any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish habitat" (Section 35 (1)).

Fish habitat is defined by the *Fisheries Act* as:

> *"Water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas" (Section 2 (1)).*

The *Fisheries Act* requires that any work, undertaking, or activity avoid harmful alteration, disruption, or destruction of fish habitat unless authorized.

Fisheries Act - Applicability to the Project

The Fisheries Act governs all fish habitat (as defined above) within Canada. The Fisheries Act applies to the Site and Study Area where watercourses / drainage features provide fish habitat (as defined above).

2.2. Provincial Policies and Legislation

2.2.1. Fish and Wildlife Conservation Act, 1997 (FWCA)

The Ontario *Fish and Wildlife Conservation Act* (FWCA) was established in 1997 and most recently amended in June 2023. The FWCA is managed by the MNRF and applies to 'wildlife' which is defined as:

> *"An animal that belongs to a species that is wild by nature and includes game wildlife and specially protected wildlife" (Section 1 (1))."*

Those species considered "specially protected wildlife" include those specially protected amphibians, birds, invertebrates, mammals, and reptiles, as identified within Schedules 6 to 11 under the FWCA.

Under the FWCA, it is also illegal to destroy, take, or possess the nests, eggs, or young of most native bird species in Ontario without a permit. This includes stick nests constructed by birds such as hawks, owls, ospreys, eagles, and herons.

A permit, or authorization, for activities that would otherwise not be allowable under the FWCA can be obtained from MNR.

FWCA - Applicability to the Project

During the wildlife active period (typically spring through autumn), the probability of wildlife being found in the Site and not leaving on their own accord is low. In the case that wildlife relocation is required, consultation with MNR would be required to obtain the necessary permits and approvals under the FWCA.

2.2.2. Endangered Species Act, 2007 (ESA)

The Ontario ESA first came into effect on June 30, 2007, and was last amended in January 2022. Section 9 of the ESA protects members of species listed as Endangered, Threatened, or Extirpated on the Species at Risk in Ontario (SARO) List. Section 10 of the ESA prohibits the damage or destruction of the habitat of species listed as Endangered or Threatened. Species listed as Special Concern provincially are not afforded protection under the ESA.

In July 2019, amendments to the ESA came into effect through the *More Homes, More Choice Act*, and changes implemented in December 2021 enabled the payment of species conservation charges to the Species at Risk Conservation Fund and streamlined certain conditional exemptions for activities impacting prescribed SAR.

In June 2025, interim amendments to the ESA came into effect through the introduction and Royal Assent of Bill 5, known as the *Protect Ontario by Unleashing Our Economy Act, 2025*. These interim changes were implemented on June 5, 2025, while the proposed *Species Conservation Act, 2025* (SCA) is expected to be implemented sometime in early 2026 and will repeal the ESA. The Environmental Registry of Ontario identifies amendments to the ESA that have taken effect since the Royal Assent of Bill 5. It further identifies that once the enabling regulations are ready and the SCA is proclaimed into force, further changes will apply. The compliance and enforcement model in the SCA will be the same as in the amended ESA (including the mitigation and compliance orders).At the time of preparation of this report, a permit, or authorization, for activities that would otherwise not be allowable under Sections 9 or 10 of the ESA can be obtained from MECP.

ESA - Applicability to the Project

Within Ontario, the ESA applies to activities conducted by the public and all levels of government. The killing or harming of a Threatened or Endangered SAR or destruction of its habitat (as defined by Bill 5) is unlawful, regardless of intent. As such, the ESA applies to the entire Study Area. Therefore, if a protected species or their critical habitat is encountered during Project activities, the Project must comply with the prohibitions of the ESA.

It is expected that the Endangered Species Act, 2007 (ESA) will be repealed by the Species Conservation Act, 2025 (SCA) prior to the commencement of Project activities. As such, review of the new legislation and requirements for registrations and approval shall be reviewed prior to impacts to protected species.

2.2.3. Planning Act, 1990

The *Planning Act* was passed into law in 1990 and was recently amended in April 2022 by the *More Homes for Everyone Act*, with the most recent amendment in 2023. The *Planning Act* is provincial legislation that sets out the ground rules for land use planning in Ontario. It describes how land uses may be controlled and who may control them.

The *Planning Act* is the foundation for creating plans that guide development at both regional and municipal levels.

Planning Act - Applicability to the Project

The Planning Act applies across the province to all projects outside of federal land. Project activities must be in compliance with and conducted under the appropriate permit(s) of, the Planning Act.

2.2.4. *Provincial Planning Statement, 2024* (PPS)

The *Provincial Planning Statement* (PPS) was issued under Section 3 of the *Planning Act* (1990). The current PPS came into effect on October 20, 2024. It replaces the *Provincial Policy Statement* that came into effect on May 1, 2020, and provides overall policy direction on matters of provincial interest related to land use planning and development in Ontario. Natural features are afforded protections under Section 4.1- Natural Heritage, of the PPS. Protections may include maintenance, restoration, and improved function of diversity, connectivity, ecological function, and biodiversity of natural heritage systems. These protections restrict development and site alteration in significant natural areas (e.g., woodlands, wetlands, wildlife habitat) unless it can be demonstrated that there will be no negative effects on the features and ecological functions of those natural areas.

Technical guidance for implementing the natural heritage policies of the PPS is found within the second edition of the *Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005*. This manual recommends the approach and technical criteria for protecting natural heritage features and areas in Ontario.

The PPS identifies seven natural heritage features and provides planning policies for each. These features are:

- Significant wetlands (including coastal wetlands);
- Significant woodlands;
- Significant valleylands;
- Significant wildlife habitat (SWH);
- Significant areas of natural and scientific interest;
- Significant habitat of Endangered and Threatened species; and
- Fish habitat (detailed above).

Each of these features is afforded varying levels of protection subject to guidelines and/or regulations. Municipalities are the primary lead for implementing provincial policies, such as the PPS and other planning-related policies, through their official plans. Generally, special buffers and studies are prescribed based on the natural heritage features present and the land use proposed.

PPS - Applicability to the Project

The PPS, issued under Section 3 of the Planning Act by the Ministry of Municipal Affairs and Housing (MMAH), applies across the province to all projects outside of federal land.

The PPS 2024 continues to encourage municipalities to undertake watershed planning, especially in large, fast-growing areas, to manage water and wastewater services more effectively.

2.2.5. Conservation Authorities Act, 1990

The Conservation Authorities Act was originally legislated in 1946 but has undergone many amendments since. Approved changes came into effect on April 1, 2024. These changes revoked the existing 36 conservation authority-specific regulations and the regulation governing their contents and replaced them with one new minister's regulation governing prohibited activities, exemptions, and permits under the Conservation Authorities Act (Ontario Regulation 41/24, Prohibited Activities, Exemptions and Permits). This minister's regulation applies to all conservation authorities resulting in a clear and streamlined permitting process that protects people and property from natural hazards across Ontario (Government of Ontario 2024).

Section 28 Part VI of the Conservation Authorities Act identifies the regulation of areas over which authorities have jurisdiction. These regulations include prohibited activities in watercourses, wetlands, etc. such as development in areas that could be unsafe due to natural processes associated with flooding or erosion, and interference with, or alterations to, watercourses, wetlands, or shorelines.

The Conservation Authorities Act defines watercourses as:

> *"Watercourse (means a) defined channel, having a bed and banks or sides, in which a flow of water regularly or continuously occurs."*

The *Conservation Authorities Act* defines wetlands as:

> *"Wetland means land that, (a) is seasonally or permanently covered by shallow water or has a water table close to or at its surface, (b) directly contributes to the hydrological function of a watershed through connection with a surface watercourse, (c) has hydric soils, the formation of which have been caused by the presence of abundant water, and (d) has vegetation dominated by hydrophytic plants or water tolerant plants, the dominance of which have been favoured by the presence of abundant water."*

Conservation Authorities Act - Applicability to the Project

The Study Area is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA) under which the Conservation Authorities Act is applied through O. Reg. 41/24 (Prohibited Activities, Exemptions and Permits) Regulation. Proposed Project activities within an RVCA regulated area will require authorization from RVCA.

2.3. Municipal Policies and Legislation

This section outlines the municipal policies, by-laws, and planning documents that guide the protection and management of natural heritage features within the City of Ottawa. These local frameworks provide the specific requirements that must be considered as part of the proposed development.

2.3.1. City of Ottawa *Official Plan*

An Official Plan is a land use planning document that guides and shapes development by identifying where and under what circumstances specific types of land uses can be located. It is used to ensure that future planning development appropriately balances social, economic, and environmental interests of the community. As per the City of Ottawa Official Plan, 2022 (City OP), a natural heritage assessment is required to determine if significant natural features are present in or adjacent to the Site, followed by an assessment of the potential impacts to any identified natural environment feature from the proposed development.

The City's natural heritage features are listed in the City OP Subsection 4.8.1 Policy 3. Natural heritage features that are within a Natural Heritage System (NHS) are assessed by the City as having greater significance compared to features that are outside of the NHS. The NHS includes both Core Natural Areas and Natural Linkage Areas, both of which are found on Schedule C11. It is important to note that, as per 5.6.4.1 Policy 2, the edge of the NHS boundary would need to be verified on-site, as the City OP only displays to a certain level of detail. Where identified, the boundaries of any significant natural heritage features are to be noted and the potential for the proposed development to cause negative impacts is assessed.

City of Ottawa Official Plan - Applicability to the Project

The City's OP requires assessment of multiple natural heritage features, some of which may be present within or adjacent to the Site and may be potentially impacted by this proposed development. The Natural Heritage Features identified in the City's OP include the following:

- Significant wetlands
- Habitat for Endangered and Threatened Species (SAR)
- Significant woodlands
- Significant valleylands
- Significant wildlife habitat
- Areas of Natural and Scientific Interest (ANSI)
- Urban natural features
- Natural Environment Areas
- Natural linkage features and corridors
- Groundwater Features
- Surface water features, including Fish Habitat; and
- Landform Features

2.3.2. Tree Protection By-law No. 2020-340

This City of Ottawa *Tree Protection By-law* is a by-law that is set out to respect the protection of municipal trees and municipal natural areas in the City of Ottawa and trees on private property in the urban area of the City of Ottawa. City approval is required to permit the injury or destruction of any tree protected under the by-law.

By-law No. 2020-340- Applicability to the Project

Under the Tree Protection By-law, the following protected trees cannot be injured or removed without a permit from the City:

- All City-owned trees throughout the urban and rural area.
- All trees 10 cm or more in diameter at breast height on private properties within the urban area that are subject to a Planning Act application for Site Plan, Plan of Subdivision, or Plan of Condominium.
- All trees 10 cm or more in diameter at breast height on private properties within the urban area that are over 1 hectare in size.
- All distinctive trees, which are trees 30 cm or more in diameter at breast height on private properties within the urban area that are 1 hectare or less in size.

3. Background Review

A desktop review of the existing natural heritage features identified within the Study Area was completed during preparation of this EIS (as well as the previous ECR – Arcadis 2025) to inform the studies required. Natural heritage features identified to require consideration in the City OP (as designated in City OP Schedules) were the primary focus. Further information collected from external sources was used to help inform of the functions of these features and to identify those not depicted on the City OP Schedules (e.g., endangered, and threatened species habitat).

Information gathered from government websites / resources, site-specific reports produced by other professionals and consulting firms, and professional knowledge / interpretation has been incorporated, as appropriate. Furthermore, consideration has been given to wildlife occurrences (including SAR) reported up to 10 km away, due to the nature of desktop resources (i.e., online databases and atlases) with data presented in a 10 km x 10 km grid.

Overall, a variety of secondary sources were reviewed, the primary of which included the following:

Reports pertaining to the Study Area and immediate surroundings

/ Quinn's Pointe, Ecological Existing Conditions Report (WSP 2021a);

/ Quinn's Pointe – Significant Woodland Review (WSP 2021b);

/ Existing Conditions Report, Barrhaven South Urban Expansion Study Area (Dillon Consulting Ltd. 2017);

/ Hydrogeological Study, Proposed Residential Development, Barrhaven South Phase 3 - S1 Area (Paterson Group 2025);

/ Water Balance, Master Servicing Study Barrhaven South Phase 3 – S1 Area (J.L. Richards 2026); and

/ Natural Heritage Existing Conditions Report (ECR; Arcadis 2025) – recently provided for this Project.

Ontario wildlife atlases and observation records:

/ Natural Heritage Information Centre (NHIC) Database (MNR 2024);

/ Ontario Breeding Bird Atlas (BSC et al. 2006);

/ Ontario Reptile and Amphibian Atlas (Ontario Nature 2019);

/ Ontario Butterfly Atlas (TEA 2023);

/ iNaturalist observation records (iNaturalist 2025);

/ eBird HotSpot species lists (eBird 2025);

/ Bat Conservation International Inc. Bat Profiles (BCI 2025); and

/ Atlas of the Mammals of Ontario (Dobbyn 1994).

Conservation Authority resources:

/ Rideau Valley Conservation Authority Public GeoPortal mapping (RVCA 2025).

City of Ottawa Resources:

- Environmental Impact Study Guidelines (City of Ottawa 2023)
- Bird-Safe Design Guidelines (City of Ottawa 2022a);
- City of Ottawa Official Plan (City of Ottawa 2022b);
- Protocol for Wildlife Protection during Construction (City of Ottawa 2022c);
- Significant Woodlands Guidelines (City of Ottawa 2022d); and
- *Tree Protection By-law No. 2020-340* (City of Ottawa 2021).

Other provincial resources:

- Species-specific resources (such as recovery strategies, etc.), as required; and
- Agency Consultation, as required.

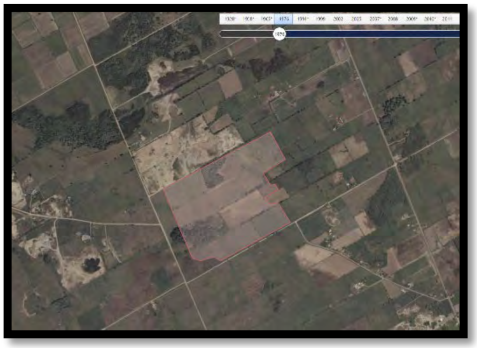
This section outlines the relevant natural heritage background from the recent ECR (Arcadis 2025) that was based on field surveys conducted by Arcadis in 2023 and 2024, as well as the previous Ecological Existing Conditions Report (WSP 2021a) produced for the development of the lands immediately adjacent (north) of the Site.

3.1. Historic Land Use

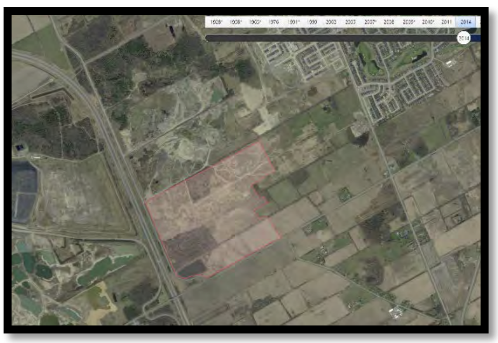
A desktop review of recent and historic aerial imagery highlights the land uses within and adjacent to the Study Area (Google 2024; Figure 2). From this review, residential developments within the city have been expanding since the late 1980's, while the landscape around the Study Area has been predominantly agricultural interspersed with wooded areas dating back to at least 1976. More recently, residential areas present to the northeast have continued expanding toward the Study Area, of which a recent residential development Project by Minto (Quinn's Point - Barrhaven South Urban Expansion Study Area) started construction around early 2021 and is located directly adjacent (east and north) to the Subject Site. The current proposed Project represents a continuation of this Barrhaven South Urban Expansion Study Area development.

Aerial imagery and background review of the Subject Site for the proposed Barrhaven South Phase 3 – S1 Area Project indicates that the property has experienced little change since at least 1976, likely due to historically being located outside of the City's Urban Boundary (City of Ottawa 2022b; Google 2024). In late 2022, with the approval of the new City OP (2022), new growth areas were identified to accommodate new housing, industry, businesses, parks, and cultural assets (City of Ottawa 2024), among which the Subject Site was designated Urban Expansion Area (Industrial and Logistics, and Category 1 – Future Neighbourhoods).

Figure 2: Aerial Imagery Showing Land Use Changes Over Time



1976 **1999**



2014 **2022**

3.2. Landform, Geology, and Soils

The landform, geology, and soils on the landscape are important factors that help determine natural heritage features on the landscape and provide the context for the understanding natural processes. Portions of the Study Area are situated within a Sand Plain Physiographic Landform, and an Eskers Physiographic Landform (OGS 2007).

The surficial geology of the Study Area is made up of “foreshore-basinal deposits” (coarse-textured glaciomarine deposits) composed of sand, gravel, minor silt, and clay, as well as “stone-poor, carbonate-derived silty to sandy till” on Paleozoic terrain (OGS 2010).

The underlying bedrock of the Study Area is part of the “dolostone, sandstone: Beekmantown Group (Unit 53)” dating back to the Lower Ordovician geologic period, approximately 485.4 to 470 million years ago (OGS 2011).

3.3. Aquatic Environment and Fish Habitat

Within the context of this report, the aquatic environment includes inland surface water and ground water, as well as the characteristics of the water and organisms / wildlife living within the water. The following subsections describe the aquatic features at a watershed and site-specific scale.

3.3.1. Surface Water

The Study Area is located within the Rideau Valley Conservation Authority (RVCA) jurisdiction and associated watersheds (RVCA 2024).

Mapping by RVCA and the City indicate the presence of a small waterbody at the southern extent of the Subject Site, adjacent to Borrisokane Road. There is also a watercourse (GeoOttawa, 2025) that flows westward along Barnsdale Road from the centre of the Subject Site, initially flowing along the northern side of Barnsdale (traversing Borrisokane via a culvert) before moving to the south side of Barnsdale via a second culvert and continuing flow westward. Upon reaching Highway 416, the flows then turn south for approximately 420 m along a farm field ditch on the east side of the highway before draining west through a third culvert under Highway 416 into the Thomas Baxter Drain.

3.3.2. Groundwater

The Kars Esker is located immediately west of Manotick and runs in a north-south direction bisecting the Study Area. This feature is approximately 21 km in length and has been identified as a Significant Groundwater Recharge Area (SGRA) in the various Mississippi-Rideau Source Protection Region documents (City of Ottawa, 2015).

The elevated hydraulic conductivity of the soils associated with this feature provides the opportunity to consider Low Impact Design alternatives to stormwater management within the property, depending on high seasonal groundwater elevations. The groundwater conditions of the Subject Site have been provided by Paterson Group, as reported in the Hydrogeological Study (Paterson Group 2025) report produced for the Project.

3.3.3. Floodplain and Regulated Limit

RVCA is the governing body that regulates zones with potential for flooding, protects associated natural features, and restores and enhances ecosystems within portions of the Jock River and Rideau River watersheds (location of the Subject Site). RVCA also maintains, monitors, and collects information related to water quality / quantity, fisheries resources, forestry, land use, and wetlands.

The RVCA Public GeoPortal mapping shows that although the property is within the RVCA jurisdiction, no portion of the Subject Site is located within the Regulated Limits (RVCA 2024).

3.3.4. Fishes and Fish Habitat

As shown in Figure 3 below, two (2) separate features providing fish habitat were identified within the Subject Site:

- Offline / Quarry Pond (Direct Fish Habitat); and
- Feature-1 (Indirect / Contributing Fish Habitat).

Offline / Quarry Pond

Information for the offline pond is available from the ArcGIS Aquatic Resource Area Survey Point feature layer provided by Land Information Ontario (LIO 2024). This single survey point is directly associated with the pond on the Subject Site and was conducted by Niblett Environmental Associates on May 4, 2012. Fisheries data associated with this survey point included the following:

- Description of the aquatic environment / fish habitat (offline pond):
    - Permanent waterbody;
    - Both submergent and emergent vegetation observed;

    - Moderate vegetation cover (shore and in-water); and
    - No watercress present.
- Description of the fish community / sampling conducted (May 2012):
    - Non-standard survey by Niblett Environmental Associates;
    - Mixed sampling gear: dip nets, hoop nets (2" x 2", 10' x 3'), seine nets (40' x 4'), and two (2) minnow traps;
    - Fish species observed / collected: rock bass, smallmouth bass;
    - Large smallmouth bass nest observed; and
    - Pond more suited to largemouth bass; smallmouth bass small and emaciated as no forage fishes were found.

Given the documented presence of fishes within the offline pond as noted in the Aquatic Resource Area Survey Point feature layer (LIO 2024), fishes are expected to continue to inhabit this pond. Therefore, direct fish habitat is expected to occur within the Subject Site, represented by the offline pond.

Based on the DFO Aquatic SAR and NHIC mapping resources, no aquatic SAR, Species of Conservation Concern, and/or their habitat have been reported within the Subject Site or surrounding Study Area (Appendix A).

Finally, based on the DFO Aquatic SAR and NHIC mapping resources, no aquatic SAR, Species of Conservation Concern, and/or their habitat have been reported within the Site or surrounding Study Area (DFO 2025; MNR 2024).

3.4. Terrestrial Environment

The Subject Site is mostly comprised of undeveloped and agricultural lands that are generally divided by mature hedgerows. The ground surface of the property is relatively flat, sloping gently from north to south (approximately 107 m to 99 m elevation, respectively). In the southwestern extent of the Subject Site, a densely treed area (Woodland A; approximately 10.1 ha ha) is located directly adjacent (approximately 15 m north) of the offline pond, just north of the Borrisokane and Barnsdale Road intersection. The northern extent of the Subject Site consists of a densely wooded area in the center (Woodland B; approximately 3.97 ha) and sparsely grassed area with some small trees (Figure 3).

Several specific natural heritage features require consideration for protection under the Ontario PPS. The protection of these features is generally administered by the City of Ottawa and the RVCA consistent with relevant provincial and federal legislation. These features are:

- Provincially Significant Wetlands;
- Significant Woodlands;
- Significant Valleylands;
- Areas of Natural and Scientific Interest;
- Significant Wildlife Habitat (SWH);
- Species at Risk habitat; and
- Fish habitat (detailed above).

The subsections below provide a review of available background records to determine the potential presence of these natural heritage features within the Study Area. Where possible, natural heritage features have been illustrated in Figure 3.

3.4.1. Wetlands

A review of the RVCA Public GeoPortal and provincial natural heritage mapping (NHIC) indicates the presence of two mapped, unevaluated wetlands within the Study Area. The larger wetland appears to encompass the entire area of Woodland B, while the smaller wetland appears to be located within / encompassed by Woodland A (Figure 3).

No Provincially Significant Wetlands are mapped within the Subject Site or surrounding Study Area.

3.4.2. Woodlands

Based on review of background documents and NHIC mapping, two woodlands (referred to as Woodland A and Woodland B; Figure 3) are present within the Study Area, situated north of Barnsdale Road, and immediately east of Highway 416. Recent and continuing residential developments are located north and east of these two woodlands (WSP 2021b).

The oldest available historic aerial imagery of the area (1976; GeoOttawa) was used to estimate the age and measure historic extent of the two woodlands.

3.4.3. Valleylands

The Site is flat and there are no Significant Valleylands present within the Study Area.

3.4.4. Area of Natural and Scientific Interest (ANSI)

No Areas of Natural and Scientific Interest (ANSIs) are present within the Study Area.

3.4.5. Significant Wildlife Habitat (SWH)

Four categories of SWH exist within the eastern Ontario ecoregion 6E (MNR 2015). These include:

- Seasonal Concentration Areas of Animals;
- Rare Vegetation Communities or Specialized Habitat for Wildlife;
- Habitat for Species of Conservation Concern (not including Threatened or Endangered Species); and
- Animal Movement Corridors.

The potential for the presence of habitats matching the description of these SWHs within the Study Area was reviewed using available background information and aerial imagery, and it was determined that there may be "Seasonal Concentration Areas of Animals", "Specialized Habitat for Wildlife" and presence of "Habitat for Species of Conservation Concern".

Seasonal Concentration Areas of Animals

Review of aerial imagery suggests that the Woodlands on Site may be suitable as a "Bat Maternity Colonies".

Specialized Habitat for Wildlife

Based on the criteria established for Candidate SWH, and the screening by WSP (2021) there is potential for "Woodland Raptor Nesting Habitat" to be found within the Study Area.

Habitat for Species of Conservation Concern

The Significant Wildlife Habitat Technical Guide (MNR 2000) defines Species of Conservation Concern as globally, nationally, provincially, regionally, or locally rare (S-Rank of S2 or S3). S-Ranks are an indicator of commonness within the province of Ontario, on a scale of 1 to 5. S2 represents a species that is considered imperilled within Ontario. S3 represents a species considered as vulnerable within Ontario. The classification of Species of Conservation Concern does not include SAR listed as Endangered or Threatened under the ESA or SARA but does include SAR listed as Special Concern as they do not receive protection under the ESA.

A review of background data (e.g., Ontario wildlife atlases and online databases; Appendix B) suggests that Barn Swallow, Wood Thrush, Monarch, and Short-eared Owl have been reported within the vicinity of the Study Area. Additionally, screening by WSP (2021) identified Eastern Wood-pewee as having moderate to high potential for occurrence within the Study Area.

Wildlife and Wildlife Habitat

A review of current and historic aerial photos of the Study Area were used to identify potential wildlife habitat. Several species of fauna common to the City of Ottawa rural and urban areas are known to live in the habitats present within the Study Area. These species may include, but are not limited to:

- **Mammals:** Northern Raccoon, White-tailed Deer, Coyote, Eastern Gray Squirrel, Eastern Cottontail, among others.
- **Reptiles & Amphibians:** Eastern Gartersnake, American Toad, among others.
- **Birds:** American Crow, American Robin, Northern Cardinal, American Goldfinch, Black-capped Chickadee, Blue Jay, Song Sparrow, among others.

3.5. Species at Risk and Species at Risk Habitat

In Ontario, SAR are protected under the federal SARA and the provincial ESA. Throughout this report, all references to SAR pertain specifically to species listed as Threatened or Endangered under the provincial ESA. As the Project site is located on non-federal lands, SARA only affords protection to the critical habitat of species of migratory birds protected by the MBCA that fall under Schedule 1 of SARA, and aquatic species that fall under Schedule 1 of SARA. Species listed as Special Concern are addressed in the context of their potential contribution to SWH.

The ESA affords protection to species listed as Endangered, Threatened, or Extirpated on the SARO List. Species listed as Special Concern provincially are not afforded protection under the ESA but may be protected under the PPS within SWH features and are discussed throughout this report under their respective SWH sections.

A desktop review was performed to search for potential SAR within or adjacent to the Study Area. A review of aerial imagery was used to identify general candidate habitat for these species based on the description of habitat provided. Species assessed to have a moderate to high potential for occurrence within our Study Area are discussed in the following sections. This desktop review identified 13 SAR occurring within proximity to the Study Area, listed in Appendix C.

3.5.1. Endangered and Threatened Species and Their Habitat

Under the ESA, all species listed as Threatened or Endangered in Ontario received immediate 'general habitat protection'. This included places that are used as dens, nests, hibernacula, or other residences. For some species, agencies have defined general habitat descriptions that provide science-based criteria for the habitat to be protected for some SAR species.

Through the recent introduction and Royal Assent of the Protect Ontario by Unleashing Our Economy Act (Bill 5) on June 5, 2025, interim changes to the ESA have since taken effect, including the narrowing of the definition of what is considered "habitat" (i.e., protections now focused on immediate species presence rather than considering long-term recovery needs or broader ecosystem health). Refer to Section 2.2.2 for more details.

The ESA is expected to be superseded by the new Species Conservation Act, 2025 (SCA) prior to the commencement of Project activities.

Beyond the limits of the Study Area, described above, wildlife and SAR occurrences are considered up to 10 km from the proposed development due to the nature of desktop resources (i.e., online databases and atlases) with data presented in a 10 km x 10 km grid.

Ten Endangered or Threatened species have been reported in the area and have a moderate to high potential for occurrence within the Study Area (Table 4). Refer to the SAR Screening table in Appendix C.

Table 4: Species at Risk with Occurrence Records and Suitable Habitat within the Study Area

Common Name	Scientific Name	S-Rank	ESA Status	SARA Status
BIRDS				
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	THR
Eastern Meadowlark	*Sturnella magna*	S4B	THR	THR
MAMMALS				
Little Brown Myotis	*Myotis lucifugus*	S4	END	END
Northern Myotis	*Myotis septentrionalis*	S3	END	END
Eastern Red Bat	*Lasiurus borealis*	S4	END	Under consideration
Hoary Bat	*Lasiurus cinereus*	S4	END	Under consideration
Silver-haired Bat	*Lasionycteris noctivagans*	S4	END	Under consideration
Tri-colored Bat	*Perimyotis subflavus*	S3?	END	END
TREES				
Black Ash	*Fraxinus nigra*	S4	END	No Status
Butternut	*Juglans cinerea*	S2?	END	END

Notes:

S-Rank is an indicator of commonness in the Province of Ontario. A scale between 1 and 5, with 5 being very common and 1 being the least common.

ESA = Endangered Species Act, 2007 Status, SARA = Species at Risk Act, 2002 Status, END: Endangered

Bat Species at Risk

Three bat species (Eastern Red Bat, Hoary Bat, and Silver-haired Bat) were recently uplisted to Endangered status under the ESA on January 27, 2025. As such, these species have been added as SAR having moderate to high probability of occurrence on the Site since Arcadis' previous ECR for this Project (Arcadis 2025a).

3.6. Summary of Natural Heritage Features

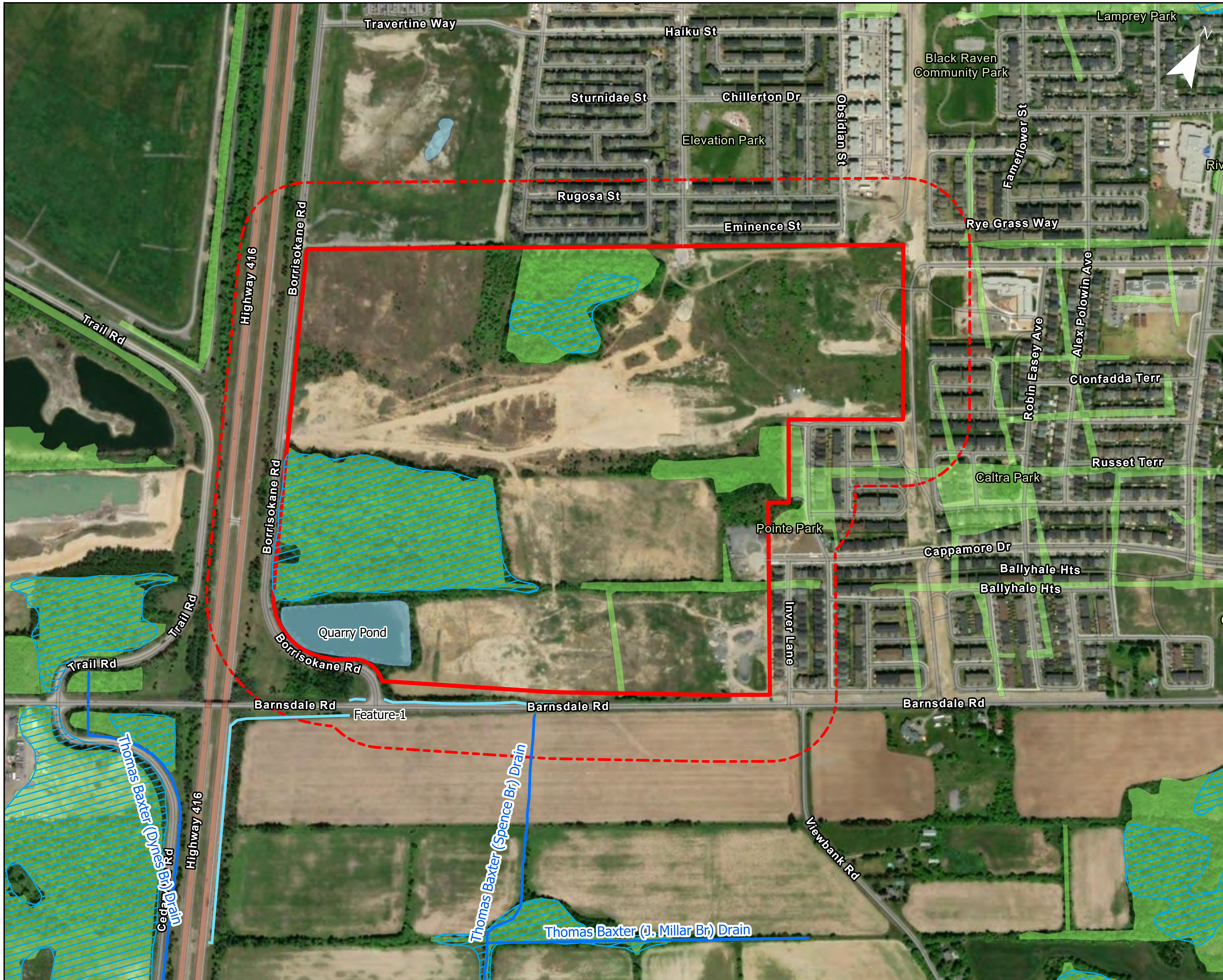
Based on a review of background documents / resources and aerial imagery, the majority of the Subject Site is comprised of undeveloped / agricultural lands, with two (2) woodlands (Woodland A and Woodland B) containing mapped wetland habitat, an offline / quarry pond (direct fish habitat) containing unmapped marginal wetland habitat, and an HDF (Feature-1; indirect / contributing fish habitat) present within the property.

A summary of the known natural heritage features identified within the Site boundaries during the background review are summarized below in Table 5 and are presented in Figure 3. It should also be noted that the PPS indicates that development and site alteration shall be restricted in or near sensitive water features (including both surface water and groundwater features) such that these features and their related hydrologic functions will be protected, improved or restored, which may require mitigative measures and/or alternative development approaches. The City OP also includes these as natural heritage features defined in Ottawa's Environmental Impact Study (EIS) Guidelines, seeking to improve long-term integrity and connectivity of these features through land use planning and associated processes (City of Ottawa 2022).

Further background data is presented in Appendix A and Appendix B.

Table 5: Known Natural Heritage Features within the Subject Site

Natural Heritage Feature	Present within Study Area	Comments	Further Assessment Required
Provincially Significant Wetlands (PSWs)	No	No PSWs identified during background review.	No
Significant Woodlands	Woodlands identified on Site	Two (2) large woodlands identified during review of satellite imagery.	**Yes Discussed in Section 4.5.1**
Significant Valleylands	No	No valleylands identified during review of satellite imagery.	No
Areas of Natural and Scientific Interest (ANSIs)	No	No ANSIs identified during background review.	No
Significant Wildlife Habitat	None identified in OP schedules	Potential for SWH / SAR needs to be determined following assessment of the suitable habitats on Site.	**Yes Discussed in Section 4.5.2**
Species at Risk Habitat	None identified in OP schedules		**Yes Discussed in Section 4.3**
Fish Habitat	Offline / Quarry Pond Feature-1	Direct (Pond) and indirect (Feature-1) fish habitat is confirmed for these features.	**Yes Discussed in Section 4.1.3**

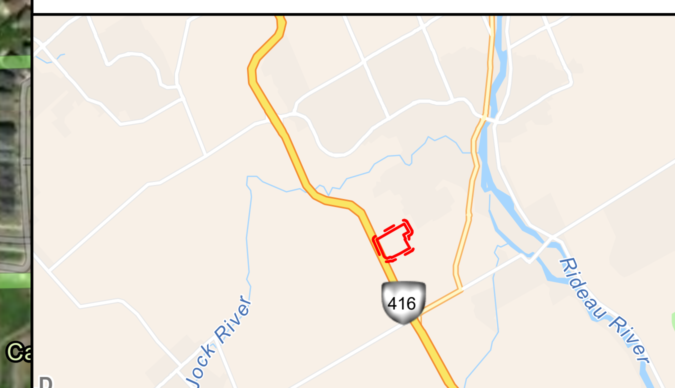


Legend

- Site
- Study Area (120m)
- Municipal Drains (geoOttawa, 2024)
- Watercourse (geoOttawa, 2024)
- Wetland (LIO, 2024)
- Woodland (LIO, 2024)
- Waterbody (geoOttawa, 2024)

0 60 120 240 360 480 Meters

Scale: 1:7,000



Project:

Barrhaven South Phase 3 - S1 Area Environmental Impact Study

Title:

Natural Heritage Background Information

FOTENN

Date: 03/03/2026

Figure: 3

4. Methodology

Based on the description of the existing natural environment outlined above, the natural heritage surveys outlined below have been completed to assess the impacts of the proposed development on the natural environment. Majority of the surveys were completed by WSP Canada Inc. (WSP) in 2021 for purposes of an Ecological Existing Conditions Report (ECR; WSP 2021a), supplemented by two (2) site visits by Arcadis Ecologists in 2023 to complete the HDF Assessments, and one (1) single site visit by Arcadis Ecologists in 2024 to confirm ELC and search for SAR plants. These surveys follow industry standard protocols and are intended to establish baseline conditions. Surveys were undertaken within the Subject Site and when possible, natural features within the larger Study Area were evaluated from a distance or via air-photo interpretation.

To evaluate potential natural heritage features within the Study Area and to establish baseline conditions, the following studies have been completed to date:

Aquatic Environment:

- High-level Fish Habitat Assessment – Offline Pond [Arcadis]
- Headwater Drainage Feature (HDF) Assessment – Feature-1 [Arcadis]
- Fish presence was also assessed using dipnets.
- Groundwater Assessment [Paterson Group]

Terrestrial Environment:

- Ecological Land Classification [WSP and Arcadis]
- Wetland Verification / Delineation [WSP and Arcadis]
- Amphibian Breeding Surveys [WSP]
- Breeding Bird Surveys [WSP]

Species at Risk:

- Identification of potential SAR and SAR habitat [WSP and Arcadis]
- Butternut and Black Ash Inventory [Arcadis]

Incidental Wildlife:

- Visual and auditory observations of wildlife during all field studies [WSP and Arcadis]

Natural Heritage Features Assessment:

- Significant Woodlands Assessments [WSP and Arcadis]
- Significant Wildlife Habitat Assessment [WSP and Arcadis]

Where applicable a depiction of field survey locations is included at the end of this section in Figure 4.

4.1. Aquatic Environment

The following methods describe how the aquatic environment was characterized, detailing the field assessments and desktop analyses completed to document surface water features, groundwater conditions, and aquatic habitat functions within the Study Area.

4.1.1. Surface Water Assessment

For purposes of this EIS, surface water associated with the aquatic environment within the Study Area is confined to the offline pond and Feature-1, both of which are located within the southern extent of the Subject Site. An assessment of Feature-1 (detailed below), and a high-level fish habitat assessment of the offline pond were conducted in 2023.

4.1.2. Headwater Drainage Feature Assessment

HDF assessments were based on the Toronto and Region Conservation Authority and Credit Valley Conservation protocol, outlined in the Evaluation, Classification and Management of Headwater Drainage Features Guidelines ("HDF Guidelines"; TRCA and CVC 2014). One site visit was conducted as part of this assessment to gather baseline data in spring freshet conditions, in 2023. This survey was carried out following the rapid assessment method, which utilizes the Unconstrained Headwater Sampling (Section 4, Module 11) methodology in the Ontario Stream Assessment Protocol (Stanfield 2017).

This assessment included a description of the channel morphology, channel width, wetted width, bankfull depth, water depth, substrate, and in-stream cover.

4.1.3. Groundwater Assessment

A hydrogeological study was undertaken by Paterson Group (2024) with the following objectives:

- Determine the subsoil and groundwater conditions at the Subject Site by means of test holes; and
- Provide hydrogeological recommendations for the design of the proposed development.

For purposes of the hydrogeological study report (Paterson 2025), Paterson Group measured groundwater levels through installed monitoring wells (manual water level measurements) and carried out a groundwater level monitoring program across the Subject Site from April 2022 to April 2023. The purpose of the monitoring program was to provide an overview of the variations in the monitoring well water levels based on seasonal fluctuations.

For further details regarding the hydrogeological study approach and methods, see Paterson Group (2025).

Water Budget, Master Servicing Study (J.L. Richards 2026)

The following section summarizes the water budget analysis completed as part of the 2025 Master Servicing Study, outlining existing and post-development hydrologic conditions for the S-1 Urban Expansion lands.

Characterization of Existing Conditions

A continuous hydrological model is often used to understand the water budget for a given area. As described in a previous ECR (refer to Appendix B in J.L. Richards 2026), the PCSWMM software platform was also used to assess the water budget as part of the ECR and MSS competed in 2017 and 2018, respectively by J.L Richards. Since the approach and methodology was adopted by both the City and RVCA, the PCSWMM platform and modelling approach was once again utilized for this analysis.

The water balance assessment completed for the S1 Area was based on PCSWMM's simplified groundwater and snowmelt modules that allow continuous simulation of the water budget including the elements of evapotranspiration, the groundwater table (lower saturated zone), snowfall, and snowmelt (J.L. Richards 2026).

Storm Servicing Strategy

A conceptual stormwater management strategy was developed based on residual capacities of the existing outlets which is consistent with the servicing solutions that were evaluated following the Class EA undertaken as part of the 2018 BSUEA MSS (J.L. Richards 2026).

4.2. Fishes and Fish Habitat Assessment

Arcadis Ecologists conducted two separate fish community / habitat assessments within the Study Area in 2023:

Offline / Quarry Pond

A high-level fish habitat assessment was conducted for the offline pond, including setting up a minnow trap and using a dip net around the pond's edge to identify any fish species within the feature.

Headwater Drainage Feature

Dip nets were utilized to assess the presence of fishes within Feature - 1.

4.3. Terrestrial Environment

The terrestrial environment section provides a brief overview of the vegetation communities and wildlife habitat within the Study Area. Field studies and desktop review inform the identification of key natural heritage features.

4.3.1. Vegetation Communities / Ecological Land Classification (ELC)

For purposes of the previous Ecological Existing Conditions Report (ECR) for the larger Barrhaven South Urban Expansion Area project (of which the current Project is a continuation), WSP conducted an ELC study (WSP 2021a). Arcadis Ecologists verified the results of this ELC assessment in August 2024.

Vegetation communities within the Study Area were characterized and mapped using the Ecological Land Classification for Southern Ontario (ELC) (Lee et al. 1988). The ecological community boundaries were determined through the review of aerial photography and then further refined through on-site vegetation surveys as specified by the protocol. Field studies were completed by systematically walking the Site. For areas where access was not granted, observations were conducted from either the road right-of-way or the property edge to the extent visible.

The ELC protocol recommends that a vegetation community be a minimum of 0.5 ha in size before they are defined as a discrete community. Unique communities less than 0.5 ha or disturbed/planted vegetation have been described to the community level only or have been described as an inclusion or complex to an existing vegetation community. In some instances, where an ecosite is less than 0.5 ha but appears relatively undisturbed and clearly fits within an ELC vegetation type, the more refined classification was used.

In 2007, the MNR refined their original vegetation type codes to encompass the vast range of natural and cultural communities more fully across Southern Ontario. Through this process, many new codes have been added while some have changed slightly. These new ELC codes have been used for reporting purposes in this study as they are more representative of the vegetation communities within the Study Area.

4.3.2. Wetland Verification / Delineation

In the previous Ecological ECR, WSP identified that they had also conducted a wetland delineation study as part of their ELC (WSP 2021a). Information pertaining to wetland delineation activities (e.g., field methodology) at the Subject Site was not provided in this report.

Wetland communities were mapped using satellite imagery and verified during the ELC field visit in 2024. The wetland verification process included a botanical inventory, and vegetation was characterized based on the Ontario Wetland Evaluation System, Southern Manual (OWES; MNRF 2022).

As per OWES, the outer boundaries of the wetlands within the Subject Site were delineated and mapped using the "50% wetland vegetation rule" which estimates the relative abundance of wetland and upland species in each layer. An OWES-qualified professional from Arcadis walked the outer limits of the wetlands, using a hand-held GPS to create boundary lines. As per OWES, the minimum community size to be delineated is 0.5 ha and the minimum wetland size to be assessed is 2 ha unless special functions or ecological importance is identified. In this case, smaller wetland communities or wetlands may be delineated.

4.3.3. Botanical Inventory

A botanical / vegetation inventory was compiled by WSP, as documented in the previous Ecological ECR (WSP 2021a). The following methodological information was provided:

Vegetation was inventoried in conjunction with ELC surveys, and a list of vascular plant species was compiled. This inventory was also used to screen for any SAR and/or provincially rare species not previously identified within the Study Area.

Scientific nomenclature, English colloquial names, and scientific binomials of plant species generally followed Newmaster et al. (2005) with updates taken from published volumes of the Flora of North America Editorial Committee (2000+ accessed 2015) and Michigan Flora Online (2015).

4.3.4. Amphibian Surveys

Amphibian Breeding Surveys were completed by WSP, as documented in the previous Ecological ECR (WSP 2021a). The following methodological information was provided:

Amphibian breeding surveys were conducted and followed the Marsh Monitoring Program - Participant's Handbook for Surveying Amphibians (Bird Studies Canada 2008). Two survey visits were conducted on April 24 and May 25, 2021, with at least two weeks between each visit. Surveys began at least one half-hour after sunset during evenings with a minimum night temperature of 14 ºC and 24 ºC for each of the respective surveys. One (1) survey location was situated within the woodland and/or wetland features within the Study Area.

Each amphibian survey involved standing at a predetermined station for three (3) minutes and listening for amphibian calls. The calling activity of individuals estimated to be within 100 m of the observation point was documented. All individuals beyond 100 m were recorded as outside the count semi-circle. Calling activity was then ranked using one of the three abundance code categories:

- **Code 1:** The number of individuals can be accurately counted.
- **Code 2:** Calls are distinguishable and some calls simultaneous, the number of individuals can be reliably estimated.
- **Code 3:** Full chorus; calls continuous and overlapping, the number of individuals cannot be estimated.

Refer to the Ecological ECR for more information and a depiction of wildlife survey locations (WSP 2021a).

4.3.5. Breeding Bird Surveys

Breeding bird surveys were conducted by WSP, as documented in the Ecological ECR (WSP 2021a):

Diurnal breeding bird surveys were conducted within the Study Area and followed methods outlined in the Ontario Breeding Bird Atlas Guide for Participants (Bird Studies Canada 2001). Two surveys were completed during the bird breeding season: June 4 and June 25, 2021.

Each survey consisted of visiting eight point-count locations for five minutes to establish quantitative estimates of bird abundance in different habitat types within the Study Area. To supplement the surveys, area searches of the habitats were completed by meandering throughout the Study Area on foot and using binoculars to observe species presence and breeding activity. Area searches involved noting all individual bird species and their corresponding breeding evidence.

Refer to the Ecological ECR for more information and for a depiction of wildlife survey locations (WSP 2021a).

4.3.6. Species at Risk

Preliminary screening for SAR was conducted and a list of potential SAR was compiled for the Subject Site through review of various resources. The desktop review identified the potential for ten SAR (Eastern Meadowlark, Bobolink, Little Brown Myotis, Eastern Red Bat, Hoary Bat, Silver-haired Bat, Northern Myotis, Tri-colored Bat, Butternut, Black Ash) to occur within the Study Area based on suitable habitat conditions (Appendix C).

Site visits completed by Arcadis in 2024 recorded the location for all observed plant and animal species that are listed provincially as Threatened and Endangered (Appendix C). Should any SAR or SAR habitat be identified within the Study Area during field surveys, appropriate measures will be proposed to reduce or eliminate the impact of the proposed development on the observed species or habitat. This may include further consultation with the Ministry of the Environment, Conservation and Parks (MECP) and/or additional species-specific surveys.

Butternut and Black Ash Inventory

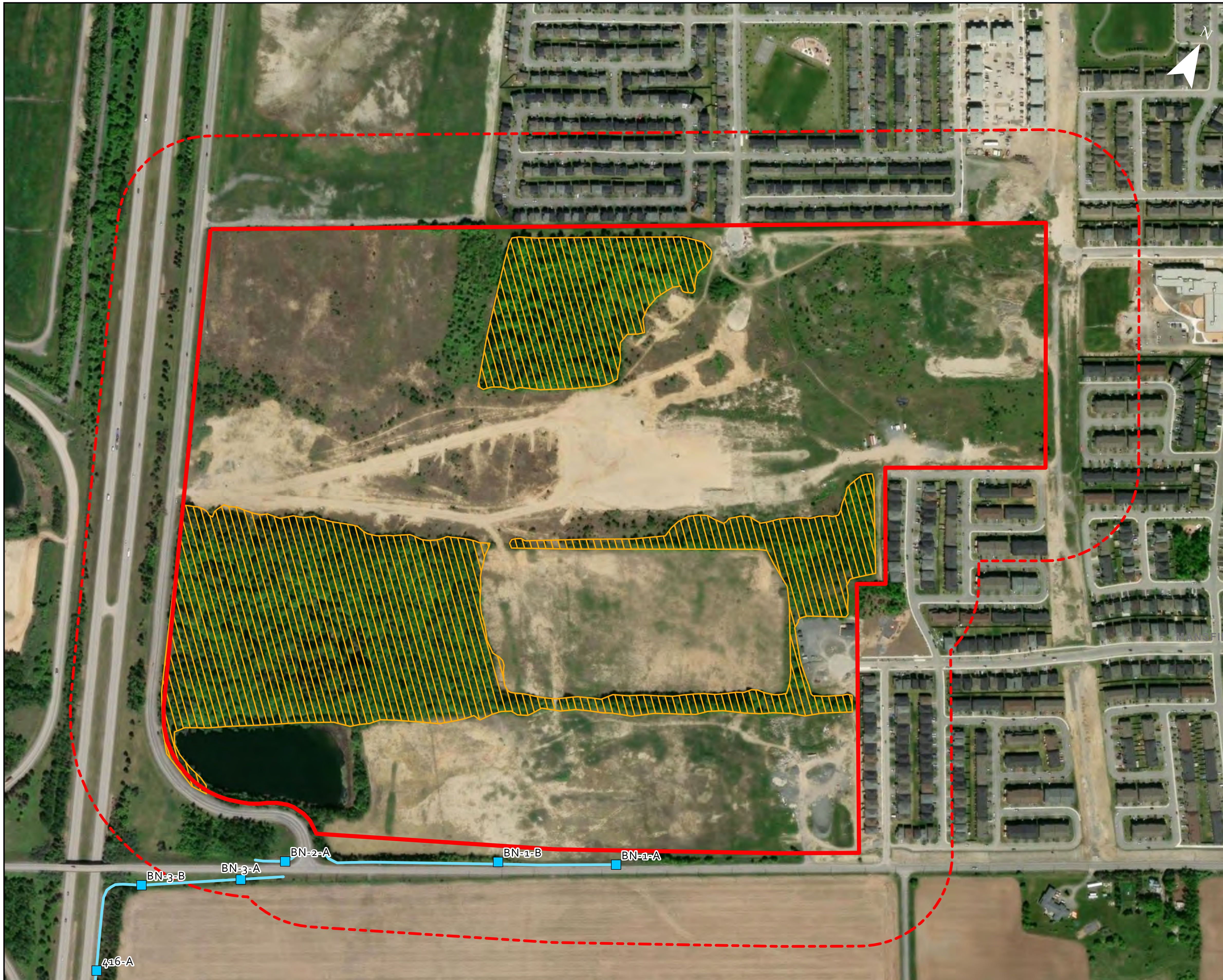
Specific attention was paid to locating SAR plants within the Study Area, specifically Butternut and Black Ash. If these species were observed, they were photographed, and their coordinates recorded. Each individual tree was assigned a number and flagged (e.g., flagging tape).

For this survey, the inventory included all treed areas on site and the 50 m surrounding area. Where the 50 m extended to neighbouring lands, inventory was assessed from a distance / over the fence.

4.4. Incidental Wildlife

Any incidental observations of wildlife, as well as other wildlife evidence such as vocalizations, dens, tracks, and scat, were documented by means of observational notes and photographs. Such observations help validate conclusions regarding the ecological function and wildlife use of the Study Area.

Incidental sightings are documented in Appendix D.

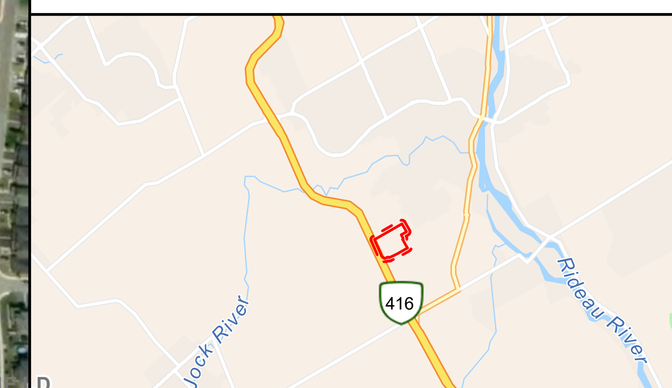


Legend

- Site
- Study Area (120m)
- Headwater Drainage Feature (2023)
- Headwater Drainage Feature Survey Location (2023)
- SAR Plant Search (5m transects)

0 40 80 160 240 320 Meters

Scale: 1:5,000



Project Name:

Barrhaven South Phase 3 - S1 Area Environmental Impact Study

Title:

Field Survey Locations

FOTENN

Date: 03/03/2026

Figure: 4

4.5. Natural Heritage Features Assessment

The Natural Heritage Reference Manual (MNR 2010) is the technical document used to define and set out the criteria for the determination and designation of provincially significant natural heritage features, as summarized in Table 5 above. Some of these significant natural heritage features have been designated by MNR (e.g., ANSIs), while others may be designated as regionally significant by the municipality having jurisdiction. For features that have not been identified as significant, site-specific findings are used for evaluation against criteria detailed by MNR.

Regionally significant features may provide important features to the local community and local environment but may not meet the threshold of significance at the provincial scale. These features are still important features to preserve on the landscape as they provide important benefits locally. If a feature is provincially significant then it will also be regionally significant, but not all regionally significant features will be provincially significant.

When projects are proposed, the identification of these features is essential to promote protection through the applicable guidelines, regulations, and policies. Referring to provincial and municipal resources, the following subsections evaluate the significance of the features present within the Study Area.

The natural heritage features identified as candidate features based on background review or confirmed present by others based on previous field investigations are brought forward for evaluation, as per the applicable municipal, provincial and/or federal guidelines for that feature. These methods are described in the sections below.

4.5.1. Significant Woodlands – Urban Criteria

This report makes use of the City of Ottawa's Significant Woodlands: Guidelines for Identification, Evaluation, and Impact Assessment (SWG; City of Ottawa 2022d) which notes that within the Urban Area, Ottawa defines all urban woodlands meeting minimum size and age thresholds (i.e., 0.8 ha and 60 years old, respectively) as significant under the Natural Heritage Reference Manual (NHRM) Criterion 4 – Economic and Social Functional Values (MNR 2010). This policy does not preclude the possibility that urban woodlands may also qualify as Significant under other NHRM criteria (City of Ottawa 2022d).

Section 4.3 of the guidelines notes that within Urban Expansion Areas, special policies exist for significant woodlands and other natural heritage features under City OP policies in Section 3.1 and 12.2. In these areas, development proponents are required to identify and to convey the natural heritage system and natural heritage features to the city at no cost. Significant woodlands, however, will be subject to further evaluation using these guidelines to determine if retention of the woodlot provides the greatest community benefit, or if modification or reduction of the woodlot is warranted prior to conveyance (City of Ottawa 2022d).

4.5.2. Significant Wildlife Habitat

The PPS indicates that no development or site alteration is permitted within SWH unless it has been demonstrated that there will be no negative impacts on the natural feature or its ecological functions. Wildlife habitat is defined as:

> *"Areas where plants, animals and other organisms live and find adequate amounts of food, water, shelter, and space needed to sustain their populations. Specific wildlife habitat of concern may include areas where species concentrate at a vulnerable point in their annual or life cycle; and areas which are important to migratory or non-migratory species".*

The ELC communities were compared to the MNR's Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (2015) and those that were deemed candidate SWH are discussed in Section 6.3 below. The full SWH assessment is in Appendix E.

5. Field Investigation Results

Fieldwork conducted for the Quinn's Pointe -Barrhaven South Urban Expansion Area development took place between April 2021 and July 2021 by WSP, and for the current Barrhaven South Phase 3 – S1 Area development between April 2023 and August 2024 by Arcadis when weather conditions and timing were deemed suitable based on the survey protocols being implemented. The following sections outline the findings from the field surveys and characterize the existing conditions within the Study Area.

5.1. Aquatic Habitat Assessment

The following subsection provides a summary of the findings from the aquatic field investigations completed within the Study Area, focusing on the offline/quarry pond and the headwater drainage features located along Barnsdale Road and Highway 416. These surveys were undertaken to characterize existing surface-water conditions, confirm the presence and function of fish habitat, and document hydrologic connectivity relevant to downstream systems. Together, these results establish the baseline aquatic conditions needed to assess potential impacts associated with the proposed development and to inform appropriate mitigation and management measures.

5.1.1. Offline / Quarry Pond

The offline / quarry pond is an approximately 2 ha offline pond located at the southern extent of the Subject Site, adjacent to Borrisokane Road in the northern corner where the road bends north of the intersection with Barnsdale Road. This offline pond is completely isolated from external flows, including BN-1, BN-2, and BN-3, located along Barnsdale Road, and was likely excavated for materials for the implementation of Highway 416 and Borrisokane Road. Over the years, water has likely percolated into the feature due to high groundwater and the surrounding permeable soils, as well as through inputs from precipitation / snow melt.

5.1.2. Headwater Drainage Feature Assessment

Field investigations of surface water Feature-1 resulted in the division of the feature into four distinct segments and the addition of a further HDF feature along the shoulder of Highway 416. A total of seven survey stations were assigned within these reaches. Most of the reaches appear to be groundwater-fed rather than fed by northern areas such as the Subject Site (J.L. Richards 2026). All features within the Study Area consist of roadside Drainage.

/ Three drainage features located along Barnsdale Road: Features BN-1, BN-2, and BN-3 (Previous segments of Feature-1)

/ One drainage feature located along Highway 416

Ephemeral waterflow associated with spring freshet was observed in all features during the first assessment. Subsequent visits resulted in surface damp to dry conditions within all reaches and are likely associated with sheet flow from precipitation events and roadside runoff. All four features resulted in a 'Mitigation' recommendation.

The management recommendations proposed herein are intended to provide a framework to guide future development while maintaining the ecological and hydrological function that these features have in the natural heritage system. The following provides a summary of the intent for each of the proposed management recommendations, as described in the HDF Guidelines (TRCA and CVC 2014):

- **Protection:** Protect and/or enhance the existing feature and its riparian corridor in-situ.
- **Conservation:** Maintain, relocate, and/or enhance drainage feature and its riparian zone corridor.
- **Mitigation:** Replicate or enhance functions through enhanced conveyance measures. Flows should be conveyed to the appropriate downstream receiver.
- **Maintain Recharge:** Maintain overall water balance by through measures to infiltrate clean stormwater.
- **Maintain/Replicate Terrestrial Linkage:** Maintain or replicate the terrestrial corridor between features.
- **No Management Required:** Incorporate flow conveyance into standard stormwater solutions.

Reach BN-1

This feature (previously referred to as a segment of "Feature-1") is located between the northern edge of Barnsdale Road and the southwestern extent of the Site. Review of background resources for feature S4-A indicated that this reach has operated as a roadside ditch as early as 1976 and underwent further construction during the development of Highway 416 in the late 1990's. BN-1 conveys surface runoff from Barnsdale Road beneath Borrisokane Road to BN-2, then under Barnsdale Road to BN-3, before continuing west toward Reach 416.

Ephemeral water flow was observed within feature BN-1 during the spring assessment, with the reach becoming surface damp to dry during the following summer assessment. Reach BN-1 provides limited riparian and terrestrial habitat on either side of the channel and offers contributing functions to downstream fish habitat. No fish or breeding amphibians were observed during field investigations.

Given these characteristics, this Reach BN-1 receives a management recommendation of "Mitigation".

Reach BN-2

This feature (previously referred to as a segment of "Feature-1") follows a small segment of Barnsdale Road west of Borrisokane Road. Flow enters this reach from a culvert under Borrisokane Road from BN-1. This reach has functioned as a roadside ditch since it's installment during the construction of Highway 416 in the late 1990's. Flow from BN-2 travels south through a culvert under Barnsdale Road to BN-3, then continues west toward Feature 416. Ephemeral water flow was observed within this feature's spring assessment, with the reach becoming surface damp to dry during the subsequent summer assessment. Reach BN-2 provides limited riparian and terrestrial habitat on either side of the channel and offers contributing functions to downstream fish habitat. No fish or breeding amphibians were observed during field investigations.

Given these characteristics, this Reach BN-2 receives a management recommendation of "Mitigation".

Reach BN-3

This feature (previously referred to as a segment of "Feature-1") follows a small segment of Barnsdale Road west of Borrisokane Road. Flow enters this reach from a culvert under Barnsdale Road from BN-2. This reach has functioned as a roadside ditch since it's installment during the construction of Highway 416 in the late 1990's. Flow from BN-3 travels west along Barnsdale Road before curving to flow southbound along Highway 416. Ephemeral water flow was observed within this feature's spring assessment, with the reach becoming surface damp to dry during the summer assessment. Reach BN-3 provides limited riparian and terrestrial habitat on either side of the channel and offers contributing functions to downstream fish habitat. No fish or breeding amphibians were observed during field investigations.

Given these characteristics, this Reach BN-3 receives a management recommendation of "Mitigation".

Reach 416

Located along the eastern shoulder of Highway 416's northbound lanes, this feature flows to the southeast. Flow enters from the northwest through HDF BN-3 before continuing along Highway 416. Ephemeral water flow was observed within this feature's spring assessment, with the reach becoming surface damp to dry during the summer assessment. Reach 416 provides limited riparian and terrestrial habitat on either side of the channel and offers contributing functions to downstream fish habitat. No fish or breeding amphibians were observed during field investigations.

Given these characteristics, this Reach BN-3 receives a management recommendation of "Mitigation".

A summary of the management recommendations for each feature is provided below in Table 6 and displayed in Figure 6. This detailed assessment highlights the management classification proposed by the HDF Guidelines (TRCA and CVC 2014).

Table 6: Headwater Drainage Feature Management Recommendations

Drainage Feature Segment	Step 1		Step 2	Step 3	Step 4	Management Recommendation
	Hydrology	Modifiers	Riparian Habitat	Fish Habitat	Terrestrial Habitat	
BN-1	Contributing functions: Contains ephemeral flows fed by snowmelt, precipitation, and drainage from adjacent meadows and likely some stormwater inputs from Barnsdale Road.	Flows within the defined ditch along Barnsdale Road, towards a culvert that conveys the channel under Borrisokane Road.	Limited function: meadow and Barnsdale Road.	Contributing functions: roadside ditch along Barnsdale Road. No fish present within the channel during assessment.	Limited functions: road and limited vegetation within defined ditch does not provide terrestrial habitat or movement corridor to valued habitat.	**Mitigation**
BN-2	Contributing functions: Contains ephemeral flows fed by snowmelt, precipitation, and drainage from adjacent meadows and likely some stormwater inputs from Barnsdale Road.	Flows within the defined ditch along Barnsdale Road, towards a culvert that conveys the channel to the southern edge of Barnsdale Road.	Limited function: meadow and Barnsdale Road.	Contributing functions: roadside ditch along Barnsdale Road. No fish present within the channel during assessment.	Limited functions: road and limited vegetation within defined ditch does not provide terrestrial habitat or movement corridor to valued habitat.	**Mitigation**
BN-3	Contributing functions: Contains ephemeral flows fed by snowmelt, precipitation, and drainage from agricultural features and likely some stormwater inputs from Barnsdale Road.	Flows within the defined ditch between Barnsdale Road and an agricultural field towards Highway 416.	Limited function: agricultural field and Barnsdale Road.	Contributing functions: roadside ditch along Barnsdale Road. No fish present within the channel during assessment.	Limited functions: road and limited vegetation within defined ditch does not provide terrestrial habitat or movement corridor to valued habitat.	**Mitigation**
416A	Contributing functions: Contains ephemeral flows fed by snowmelt, precipitation, and drainage from agricultural features and likely some stormwater inputs from Highway 416.	Flows adjacent to a windbreak, within the defined ditch between an agricultural field and Highway 416. Channel flows towards a culvert that conveys the channel west to Thomas Baxter Drain.	Limited function: agricultural field and Barnsdale Road.	Contributing functions: roadside ditch along Highway 416. No fish present within the channel during assessment.	Limited functions: road and limited vegetation within defined ditch does not provide terrestrial habitat or movement corridor to valued habitat.	**Mitigation**

5.1.3. Fish and Fish Habitat

This section provides a brief summary of the existing fish and fish habitat features within the Study Area, establishing the baseline conditions needed to evaluate potential project impacts.

Offline / Quarry Pond

A high-level fish habitat assessment was conducted for the offline pond. Fish species observed included brook stickleback and creek chub.

The offline pond meets DFO's definition of an artificial waterbody and does not require review.

Headwater Drainage Features BN-1, BN-2, BN-3, and Feature 416

No fishes or invertebrates were observed within the assessed reaches of BN-1, BN-2, BN-3, or Feature 416. However, as these features are associated with agricultural / roadside ditches that relay flows to Mud Creek and the Rideau River, these features may provide indirect fish habitat through the contribution of flow to direct fish habitat located within these watercourses further downstream.

Due to the presence of indirect fish habitat within the Study Area, Fish and Fish Habitat is being brought forward to evaluation.

5.1.4. Groundwater Assessment

Groundwater conditions form a critical component of the hydrogeological context for the Subject Site and directly inform the evaluation of potential impacts associated with the proposed development. As part of the supporting investigations for this EIS, Paterson Group (2024 and 2025) completed a geotechnical and hydrogeological assessment, including test-hole excavation, installation of monitoring wells, and a year-long groundwater monitoring program from April 2022 to April 2023. These data provide baseline information on subsurface stratigraphy, groundwater elevations, seasonal fluctuations, and infiltration characteristics. In parallel, a water budget analysis was completed through the Master Servicing Study by J.L. Richards (2026), providing a complementary assessment of existing and post-development hydrologic conditions using continuous modelling. Together, these studies establish the baseline hydrogeological context necessary to evaluate potential changes to local water balance and to inform natural heritage and servicing considerations for the Project.

5.2. Terrestrial Environment

The subsections below provide the results of surveys related to the terrestrial environment of the Study Area. Where applicable, survey results are illustrated in Figure 6 and Figure 7 below.

5.2.1. Ecological Land Classification (ELC)

The ELC survey identified a total of three upland vegetation communities (minimum size 0.5 ha, as per ELC protocol, unless a significant smaller community is identified).

The upland natural environment includes:

- **Mixed Meadow:** dominated by herbaceous species with no more than 25% cover provided by either shrub or tree species.
- **Mixed Forests:** communities with >60% canopy cover composed of >25% deciduous trees, and >25% coniferous tree species.
- **Deciduous Forest:** communities with >60% canopy cover composed of >75% deciduous trees.

All meadow communities surveyed within the Subject Site are impacted by land use activities occurring within the past 30 years. Both Woodlands A and B are mature and undisturbed. The native vegetation communities present are considered common within Ontario.

Overall, the ELC survey divided the Study Area into a total of 5 ELC polygons, plus an additional 3 ELC polygons associated with constructed lands (i.e., transportation and/or residential development).

The communities documented during ELC surveys, as well as the dominant vegetation cover is summarized below in Table 7 and displayed in Figure 5.

5.2.2. Wetland Verification

NHIC mapping indicated the presence of two (2) unevaluated wetlands within both woodlands in the Study Area. Wetland communities were mapped using satellite imagery and verified during the ELC field visits.

No wetlands were observed on the Subject Site, and a detailed description of the ELC communities can be found in Table 7 below.

It has been determined through field surveys that there are no wetland vegetation communities within the Study Area, despite mapping resources suggesting otherwise. As such, wetlands are not being brought forward to evaluation.

Table 7: Summary of Ecological Land Classification for the Study Area

ELC Type	Total Area (ha)	Community Description	Photo Record
UPLAND – Mixed Meadow (MEM)			
Dry-Fresh Mixed Meadow [MEMM3]	36.5	This extensive community occurs throughout the site, north of the woodlands along Borrisokane Rd to the northern edge and along Barnsdale Rd to the eastern edge. Vegetation species in this community are primarily regenerative, weedy, and/ or invasive species. This highly disturbed ecosite, particularly extensive in the northern portions, had a very little and scattered canopy (8-12m tall, 5% cover), almost entirely composed of trembling aspen, which was also true for the sub canopy (3-6m tall, 5% cover), and existed primarily in small patches in edge or transition areas. The understory (0.5-2 m tall, 10% cover) had native species such as sandbar willow and paper birch but also contained the invasive common buckthorn. The ground cover layer (40% cover) had various graminoid and broadleaf species, dominated by goldenrods. The southern portion of this ecosite was separated by a naturalized hedgerow that contains remnant soy crop plants with the above-mentioned species.	Looking east toward northern forest (FODM5-2) from north-west section. Photo taken 16.08.2024.  Looking south across field along Barnsdale Rd. Photo taken 16.08.2024. 

ELC Type	Total Area (ha)	Community Description	Photo Record
UPLAND - Mixed Forest (FOM)			
Dry-Fresh Hemlock - White Pine Mixed Forest [FOMM3-3]	10.1	This mature, mixed forest community (Woodland A) is located north of the offline pond in the south-west corner of the property. The canopy (15-25 m tall, 85% cover) was largely composed of sugar maple (avg dbh 15 cm, up to 119 cm) and white pine (avg dbh 16 cm, up to 102 cm). Eastern hemlock (avg dbh 17 cm, up to 50 cm) was abundant in the subcanopy (5-8 m tall, 25% cover) which also included American beech, white spruce, eastern white cedar, Freeman's maple, and basswood. The understory (0.5-2 m tall, 15% cover) was primarily comprised of glossy buckthorn, green ash, bitternut hickory, and elderberry. Ground vegetation (55% cover) included various fern species such as spreading wood fern, sensitive fern, and common bracken fern, as well as Canada mayflower, red raspberry, goldenrod, Canada fleabane, Virginia creeper, partridge berry, wild strawberry, star flower, and Virginia clematis.	View from inside Forest. Photo taken 16.08.2024.  View from inside Forest. Photo taken 16.08.2024. 

ELC Type	Total Area (ha)	Community Description	Photo Record
UPLAND – Coniferous Forest (FOC)			
Naturalized Coniferous Hedgerow [FOCM5]	0.6	Though one large White Pine is at the south-west corner of the pond, beside a small meadow opening (0.005 ha), planted white spruce comprise much of the canopy (15-25 m tall, 75% cover) along the western and southern borders of the pond. The sub canopy (5-8 m tall, 15% cover) was similar and included paper birch and white ash. They continue into the understory (0.5-2 m tall, 5% cover) along with trembling aspen, honeysuckle spp., and riverbank grape.	Google image (2021) 
UPLAND – Deciduous Forest (FOD)			
Dry-Fresh Sugar Maple-Beech Deciduous Forest [FODM5-2]	4.1	This deciduous forest (Woodland B) is in the north-central area of the property. The canopy (15-25 m tall, 85% cover) is largely sugar maple (avg dbh 15cm) and American beech (avg dbh 16cm). The subcanopy (5-8 m tall, 25% cover) was comprised of the above species along with eastern hemlock, black cherry, and bitternut hickory. The understory (0.5-2 m tall, 10% cover) had the previous species and purple sandcherry, bitternut hickory, glossy buckthorn, honeysuckle spp., and white ash. Ground vegetation (30% cover) included bloodroot, sharp-lobed hepatica, false Solomon's-seal, purple flowering raspberry, geranium spp. and beechdrops.	View from inside the forest. Photo taken 16.08.2024. 

ELC Type	Total Area (ha)	Community Description	Photo Record
Dry-Fresh Upland Deciduous Forest [FODM4]	2.8	This younger forest community is located along the eastern side of the Site, midway between Barnsdale Road and the developing community to the north. White ash is the dominant species present in the canopy (15-25 m tall, 75% cover). The sub canopy (5-8 m tall, 20% cover) has Manitoba maple, American elm, and American basswood. The understory (0.5-2 m tall, 10% cover) featured black cherry and bitternut hickory. Ground vegetation (15% cover) was dominated by prickly gooseberry and tartarian honeysuckle with self-heal, red baneberry, common buckthorn, wild lily-of-the-valley, violet species, broad-leaved Enchanter's nightshade, and false Solomon's-seal associates.	*-photo not available-*
Naturalized Deciduous Hedgerow [FODM11]	1.9	Two hedgerows extend from the eastern property to the mixed forest, running parallel with Barnsdale Rd. These hedge-rows are dominated by basswood and trembling aspen, with a mix of Manitoba maple, bitternut hickory, and staghorn sumac through the sub canopy and understory.	Looking east along the hedgerow bordering the middle and southern fields. Photo taken 16.08.2024. 

ELC Type	Total Area (ha)	Community Description	Photo Record
AQUATIC ENVIRONMENT – Open Water (OA)			
Open Aquatic [OAO]	2.0	Offline pond in the southwest corner of the Site. Surrounded on the western and southern sides by a naturalized coniferous hedgerow, on the east by a naturalized deciduous hedgerow, and a mixed forest to the north. The northeast corner contains cattails as well as patches along other parts of the shoreline.	From the northeast corner looking west. Photo taken 16.08.2024. 
CULTURAL – Agriculture (AG)			
Open Agriculture [OAG]	8.0	Agricultural practices occur south of the Study Area, south of Barnsdale Rd. Some areas have been left fallow or as open pasture lands.	*-photo not available-*
CULTURAL – Constructed (CV)			
Constructed Lands [CV]	10.4	These areas within the Study Area are comprised of active construction lands and construction access roads.	-photo not available-
Transportation and Utilities [CVI_1]	13.6	These areas consist of major roads, right of ways, and hydro corridors.	-photo not available-
Low Density Residential [CVR_1]	14.9	These areas consist of single-family homes north and east of the Site.	-photo not available-

Legend

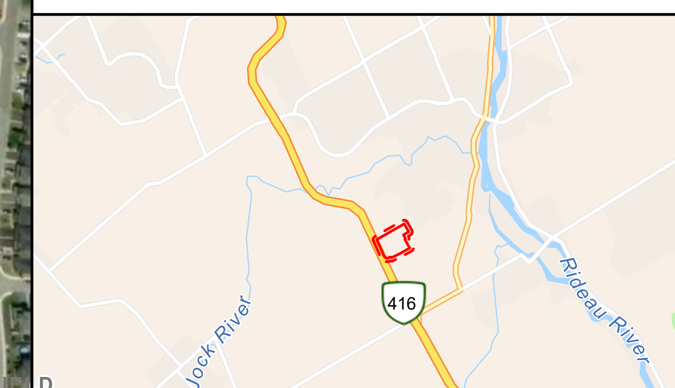
- Site
- Study Area (120m)

Ecological Land Classification

- 1 - Dry - Fresh Hemlock Pine Forest (FOMM3-3)
- 2 - Dry - Fresh Sugar Maple – Beech Deciduous Forest (FODM5-2)
- 3 - Naturalized Coniferous Hedge-row (FOCM5)
- 4 - Dry – Fresh Upland Deciduous Forest (FODM4)
- 5 - Naturalized Deciduous Hedge-row (FODM11)
- 6 - Dry - Fresh Mixed Meadow (MEMM3)
- 7 - Open Water (OA)
- 8 - Open Agriculture (OAG)
- 9 - Constructed (CV)
- 10 - Transportation (CVI_1)
- 11 - Low Density Residential (CVR_1)

0 40 80 160 240 320 Meters

Scale: 1:5,000



Project Name:

Barrhaven South Phase 3 - S1 Area Environmental Impact Study

Title:

Ecological Land Classification

FOTENN

Date: 03/03/2026

Figure: 5

5.2.3. Botanical Inventory

The botanical inventory identified 90 vegetation species within the Site (Appendix D). Majority of the vascular plants inventoried are considered common throughout Ontario and are native species.

Floristic Quality Assessment

A Floristic Quality Assessment (FQA) was conducted to determine the Site's level of ecological integrity based on plant species composition. A coefficient of conservatism (CC) value is assigned to each species, ranging from 0 to 10, with 10 having a lower tolerance to disturbance and restricted to undisturbed habitats.

Seven vascular plants had CC values ranging from 7-10 (high to highest sensitivity). These included Common Oak Fern, Eastern Hemlock, New York Fern, Royal Fern, Field Wormwood, Red Pine, and Sharp-lobed Hepatica. However, the average CC value was three, indicating that majority of the vascular plants within the Subject Site have a moderate tolerance to disturbance and, if given the opportunity, could recover in adjacent suitable habitat.

Vascular plant species observed within the Study Area are listed in the Ecological ECR (WSP 2021a), in addition to the 2024 field observations. No SAR plants were encountered during field surveys.

5.2.4. Amphibian Call Surveys

A total of three (3) amphibian species were observed within the Study Area during the 2021 field program (WSP 2021a), outlined in Table 8 below.

Table 8: Amphibian Survey Results

Common Name	Scientific Name	Number of Observations	Meets SWH Criteria
American Toad	*Anaxyrus americanus*	1 (Call Code 1)	**No**
Gray Treefrog	*Hyla versicolor*	2 (Call Code 1 & 2)	**No**
Spring Peeper	*Pseudacris crucifer*	2 (Call Code 2 & 1)	**No**

Though breeding amphibians were observed during surveys, they do not meet the quantity or species diversity requirements to support Candidate Amphibian Breeding Habitat (Woodland) SWH.

5.2.5. Breeding Bird Surveys

A total of 33 bird species were recorded during the breeding bird surveys (refer to survey methodology in Section 4.3.5). Evidence of breeding birds occurred as the following:

- **Possible Breeders:** Singing males being present within suitable nesting habitat
- **Probable Breeders:** Pairs of a species and territorial behaviour observed in suitable nesting habitat
- **Confirmed Breeders:** Active / used nests and fledged young observed in suitable nesting habitat

Majority of the birds recorded are common within the City of Ottawa and generally have secure populations within Ontario. No Endangered or Threatened species were observed during field surveys. One (1) species of special concern was observed during field surveys: **Eastern Wood-pewee.**

A record of the bird species observed within the Study Area, including their conservation status, can be found in the Ecological ECR (WSP 2021a). Additionally, six (6) common species not included in WSP's report were observed during site visit in 2024 (Appendix D) outside the breeding window.

Based on the field surveys conducted, the Study Area contains suitable habitat conditions to support breeding birds common to Ottawa and Eastern Ontario.

The results indicate that the Study Area is considered SWH for breeding birds due to the observation of a Species of Special Concern: Eastern Wood-pewee.

5.3. Species at Risk and Species at Risk Habitat

This section presents the results of field surveys and desktop screening for Species at Risk and their habitats within the Study Area, identifying any protected species or suitable habitat features that may be affected by the proposed development.

5.3.1. Bobolink and Eastern Meadowlark

Preliminary findings (Dillon 2017) suggested that the Study Area may provide marginal habitat for Bobolink and Eastern Meadowlark. However, during the ELC surveys in 2021 and 2024, it was determined that areas identified as potential Bobolink and Eastern Meadowlark habitat by previous studies are no longer suitable for these species. Meadow and pasture habitat present in 2013 have been converted to tilled agricultural fields with no vegetation growth during the breeding bird season.

In 2021 and 2024, suitable habitat was not identified within the Study Area for these grassland SAR birds, therefore, targeted surveys for Bobolink and Eastern Meadowlark were not completed. Species presence would be confirmed in conjunction with breeding bird surveys completed on the Subject Site. No Bobolink or Eastern Meadowlark were observed during these surveys.

It has been determined that there is no suitable Bobolink or Eastern Meadowlark habitat present within the Study Area. For this reason, these species are not being carried forward to evaluation.

5.3.2. SAR Bats

Little Brown Myotis, Eastern Red Bat, Hoary Bat, Silver-haired Bat, Northern Myotis, Tri-colored Bat, are all listed as Endangered species provincially signifying that they are at risk of becoming extinct or extirpated in Ontario. There are three types of habitats required by bats: hibernation, maternity sites, and day-roost sites. The latter is not considered significant habitat.

These six bat species prefer to hibernate in caves or mines, and rarely hibernate in buildings (COSEWIC, 2013). Additionally, three of the six species (i.e., Eastern Red Bat, Hoary Bat, Silver-haired Bat) do not hibernate locally but instead migrate south for the winter. No caves or mines were present within the Study Area, as such, it is assumed that no suitable overwintering habitat will be impacted.

SAR bats can use tall, large cavity trees that are in the early to mid-stages of decay as maternity roosts, as well as loose/raised tree bark. These bat species occur in higher densities in mature deciduous and/or mixed forests due to increased opportunities for large snags. Both Woodland A and Woodland B within the Study Area have suitable habitat characteristics to support SAR bat maternity roosting.

It has been determined that there is suitable habitat for bats within the Study Area. For this reason, these species are being carried forward to evaluation.

5.3.3. Butternut

Butternut was searched for within the forested areas in the Subject Site. Both Woodlands within the Study Area may provide suitable conditions for Butternut; however, this species was not observed within the Subject Site during field surveys completed in 2024.

It has been determined that there are no known butternut trees present within the Study Area. Note that butternut inventories have a validity period of 2 years (in this case until August 31, 2026). For this reason, this species is not being carried forward to evaluation.

5.3.4. Black Ash

Black ash was searched for in tandem with Butternut searches. There were no observations of Black Ash or suitable habitat for this species within the Study Area.

It has been determined that there are no known black ash trees or suitable habitat present within the Study Area. For this reason, this species is not being carried forward to evaluation.

5.4. Incidental Wildlife

Incidental wildlife species and general wildlife observations were documented during the field survey program completed by WSP in 2021, and included: Eastern Chipmunk, Eastern Gray Squirrel, Gray Catbird, American Robin, Great Blue Heron, Northern Flicker, and Monarch butterfly.

Most species observed are common in Ontario and the City of Ottawa and appeared as residents of the Study Area, except for the Monarch butterfly representing a SAR designated as Special Concern. However, as the Study Area is not within 5 km of Lake Ontario, it is not considered a Migratory Butterfly Stopover Area as per the SWH Criteria Schedules for Ecoregion 6E (Appendix E).

6. Evaluation of Significance

In conjunction with findings of the background review, field survey data was evaluated for significance with respect to the provincially designated significant natural heritage features, and the potential for negative impacts, which may occur as a result of the Project. The provincially designated significant natural heritage features listed under the Provincial Planning Statement, 2024, identified as candidate features based on background review or confirmed present based on field investigations are brought forward for evaluation, as per the applicable municipal, provincial and/or federal guidelines for that feature. The features identified within the Study Area are as follows:

- Fish Habitat;
- Significant Woodlands;
- Significant Wildlife Habitat (SWH); and
- Habitat of Endangered and Threatened Species.

6.1. Fish Habitat

Fish habitat occurs within the Site, associated with the offline pond. A high-level fish habitat assessment was conducted for the offline pond and fish species were observed. However, as the offline pond meets DFO's definition of an artificial waterbody this feature does not require review.

Features BN-1, BN-2, BN-3, and Feature 416 are associated with agricultural / roadside ditches that relay flows to Mud Creek and Rideau River, as such, these features may provide indirect fish habitat through the contribution of flow to direct fish habitat located within these watercourses further downstream.

Importantly, no fish habitat occurs within the Urban Expansion Area limits of the Site where development is proposed as the surface water / drainage features in this area (i.e., run along Barnsdale Road) are not connected to any upstream / downstream features.

6.2. Significant Woodlands Assessment

The woodlands were assessed for significance using both desktop and field components, in relation to both the urban and rural criteria and guidelines within the City's **Significant Woodland Policy**. The two woodlands were assessed for significance using desktop tools (e.g., geoOttawa) in relation to the guidelines for 'peri-urban woodlots', as outlined in the City's SWG (2022) document.

Peri-urban woodlands are described in the City's SWG as being woodlands located within areas that have been identified for urban expansion demonstrated in the City's OP Schedule C17 – Urban Expansion Areas. Woodlands within the peri-urban boundary are considered significant if they are a minimum of 60 years old and 0.8 ha or larger in area. Within larger woodlands, only portions that can be identified as older than 60 years old through aerial imagery interpretation count towards this 0.8 ha size threshold and are identified as significant.

Woodland A

Woodland A (Dry-Fresh Hemlock - White Pine Mixed Forest; approximately 10.7 ha in its current state) is located within the southwestern extent of the Study Area approximately 15 m north of the offline pond, just north of the Borrisokane and Barnsdale Road intersection, and is bounded by Borrisokane Road to the west. The majority of this feature occurs within the Urban Expansion Area designated for future Industrial and Logistics, while a smaller portion of the woodland is within the Category 1 - Future Neighbourhoods designation in the City OP.

From the 1976 imagery, the historical area of Woodland A is approximately 9 ha; approximately 7 ha (78%) of the historic 9 ha woodland is within the Urban Expansion Area as identified within the City's OP Schedule C-17. The remaining 2 ha of historic woodland was removed for the construction of Highway 416 and Borrisokane Road.

Given that most of Woodland A is within the Industrial and Logistics Urban Expansion Area, it is reasonable to assume that it would be considered a peri-urban woodland.

Based on the evaluation of peri-urban criteria, the majority of *Woodland A is considered significant*.

Woodland B

Woodland B (Dry-Fresh Sugar Maple - Beech Deciduous Forest; approximately 4.1 ha in its current state) is in the center of the northern extent of the Subject Site, within the Urban Expansion Area designated as Category 1 – Future Neighbourhoods in the City OP.

From the 1976 imagery, the historical area of Woodland B is approximately 4 ha, corresponding with current conditions. Based on the evaluation of peri-urban criteria, Woodland B is considered Significant as it is larger than 0.8 ha and approximately 3.78 ha (95%) of the present-day woodland is older than 60 years old.

The Dry-Fresh Upland Deciduous Forest (FODM4; 2.8 ha present day) would meet the size criteria for significance currently; however, review of aerial imagery (Photo 1) reveals that only 0.6 ha of this woodland was present in 1976. The majority of the woodland is much younger. Therefore, no part of this woodland meets the minimum criteria for significance.

Photo 1: Aerial Image of Woodlands in 1976

Based on the evaluation of peri-urban criteria, the majority of both Woodland A and Woodland B are considered significant as they are a minimum of 60 years old and 0.8 ha or larger in area.

A full assessment of the Significant Woodlands on Site is provided in Appendix F. This analysis includes an evaluation of proposed development options relative to the baseline conditions of both woodlots as outlined in Appendix C of the City's SWG (City of Ottawa 2022d). Through this evaluation process the extent of Woodland A and Woodland B to be retained has been established. Based on the current design, it is assumed that 59% of both woodlands shall be retained to preserve the ecological and social functions of the woodlots.

6.3. Significant Wildlife Habitat

The ELC communities within the Study Area were compared to the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (MNR 2015) and those that were deemed candidate SWH are discussed below.

The full SWH assessment can be found in Appendix E.

Seasonal Concentration Areas of Animals

Based on the results of the ELC assessment, ***Candidate Bat Maternity Colony Habitat is present*** within the Dry-Fresh Hemlock - White Pine Mixed Forest and the Dry-Fresh Sugar Maple – Beech Deciduous Forest (Woodland A and Woodland B).

Specialized Habitat for Wildlife

Based on the results of the breeding bird surveys and general field observations by WSP (2021), the presence of two (2) juvenile/fledged young Barred Owls in the Dry-Fresh Hemlock - White Pine Mixed Forest (Woodland A) indicates this woodland is ***Confirmed Woodland Raptor Nesting Habitat***.

Habitat for Species of Conservation Concern

Eastern Wood-pewee were observed incidentally within the Study Area. As such, ***Special Concern species are Confirmed*** within the Study Area.

Based on the results of the field surveys completed in 2021, and 2024, Significant Wildlife Habitat is present within the Study Area and is being brought forward to evaluation.

6.4. Habitat of Endangered and Threatened Species

No SAR were confirmed present within the Site; however, suitable habitat is present for SAR Bats within the Study Area. Refer to **Section 5.3** for a full description of results from the 2021, and 2024 targeted surveys in search of SAR.

Summary of Natural Heritage Features

Following the background review and site investigations, the following have been confirmed absent from the Site:

- ✓ *Provincially Significant Wetlands;*
- ✓ *Significant Valleylands; and*
- ✓ *Areas of Natural and Scientific Interest.*

Furthermore, the vegetation communities and landscape within the Site have been confirmed to provide the following:

- ✓ *Fish Habitat;*
- ✓ *Significant Woodlands;*
- ✓ *Significant Wildlife Habitat; and*
- ✓ *Endangered or threatened species and their habitat (i.e., SAR Bats).*

Figure 6 *below displays the notable results of the field surveys, and* ***Table 9*** *provides a summary of the work completed for this study and the existing conditions for the proposed Barrhaven South Phase 3 – S1 Urban Expansion.*

Legend

- Site
- Study Area (120m)

Significant Widlife Habitat

- Confirmed Woodland Raptor Nesting / Candidate Bat Maternity Colony

Significant Woodlands

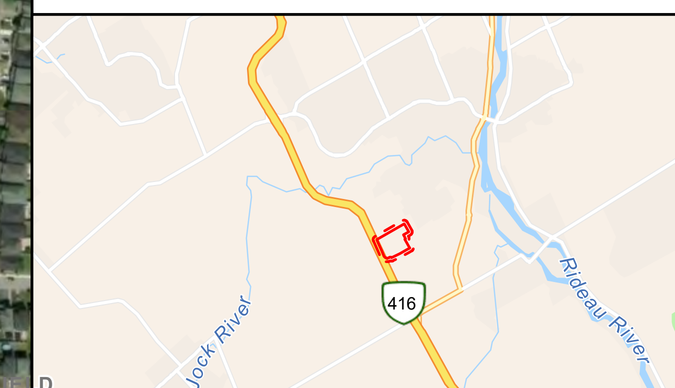
- Significant Woodlands

Headwater Drainage Feature Management Assessment

- Mitigation

0 40 80 160 240 320 Meters

Scale: 1:5,000



Project Name:

Barrhaven South Phase 3 - S1 Area Environmental Impact Study

Title:

Field Survey Results

FOTENN

Date: 03/03/2026

Figure: 6

Table 9: Evaluation of Significance and Summary of Presence of Natural Heritage Features as per the Provincial Planning Statement

Designated Natural Heritage Feature	Criteria for Significance	Field Surveys Completed	Existing Conditions	Feature Confirmed Present within Study Area?	Regulatory Agency
Fish Habitat	As defined by the *Fisheries Act* (see Section 2.1.3).	Fish Habitat Assessment (Pond) HDF Assessments	Features BN-1, BN-2, BN-3, and Feature 416 Indirect / contributing fish habitat present. Downstream receivers of flows from the Study Area likely contain direct fish habitat (e.g., Mud Creek, Rideau River). Pond Although the Quarry / Pond contains fish habitat, since the pond is a man-made feature, it is not regulated by DFO.	**Yes**	DFO
Significant Wetlands	Wetlands are evaluated through the *Ontario Wetland Evaluation System* (OWES) (MNR 2022).	ELC Wetland Delineation	No Significant or Unevaluated Wetlands occur within the Study Area.	No	–
Significant Woodlands	Woodlands were assessed using the City's *Significant Woodlands Guidelines* (SWG) for Peri-urban woodlands (City of Ottawa 2022).	ELC	Woodland A and Woodland B Both woodlands are >60 years old and meet the size requirement (>0.8 ha) dating back to 1974.	**Yes**	City of Ottawa
Significant Valleylands	Valleylands are evaluated through the *Natural Heritage Reference Manual* (MNR 2010).	–	No Significant Valleylands occur within the Study Area.	No	–
Significant Areas of Natural and Scientific Interest	As identified by MNR's NHIC (MNR 2025) and available on Geospatial Ontario (GEO; formerly, Land Information Ontario) mapping.	–	No Significant Areas of Natural and Scientific Interest occur within the Study Area.	No	–

Designated Natural Heritage Feature	Criteria for Significance	Field Surveys Completed	Existing Conditions	Feature Confirmed Present within Study Area?	Regulatory Agency
Significant Wildlife Habitat	In accordance with the Ecoregion 6E Criterion Schedule (MNR 2015) for the four categories of SWH.	Amphibian Breeding Surveys Breeding Bird Surveys Incidental Wildlife Observations Significant Wildlife Habitat Assessment	Seasonal Concentration Areas of Animals *Candidate Bat Maternity Colony Habitat* is present within Woodland A and Woodland B. Specialized Habitat for Wildlife The presence of two (2) juvenile/fledged young Barred Owls in Woodland A indicates this woodland is *Confirmed Woodland Raptor Nesting Habitat*. Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species) Two *Species of Conservation Concern* observed on Site (i.e., Eastern Wood-Pewee, and Monarch).	**Yes**	City of Ottawa
Habitat of Endangered and Threatened Species	As defined by the *Endangered Species Act (see Section 2.2.2)*.	Breeding Bird Surveys SAR Plant Searches Incidental Wildlife Observations	Bats SAR habitat is represented by Candidate Bat SAR roosting trees within Woodland A and Woodland B.	**Yes**	MECP

7. Description of Development Proposal

Minto is proposing a low-rise residential subdivision within the Barrhaven South S1 Urban Expansion lands at 3882 Barnsdale Road in the City of Ottawa. The project will establish new neighbourhood streets, municipal services, and a stormwater management pond, together with local amenities such as a park, in a form consistent with adjacent recent growth areas in Barrhaven South (e.g., Quinn's Pointe). The S-1 lands span an area between an unnamed future road to the north and Barnsdale Road to the south and include designations for Category 1 – Future Neighbourhoods and Industrial and Logistics in the City's Official Plan, situating the subdivision as a direct continuation of urban expansion in this part of Ottawa.

7.1. Construction Activities

The proposed works will prepare the S-1 Urban Expansion lands for low-rise residential development, municipal roads, underground services, and a stormwater management pond (SWMP). The principal activities anticipated through site preparation and servicing—and their relevance to ecological receptors—are summarized below. Based on the most recent draft Concept Plan provided by Minto (dated February 10, 2026; **Figure 7**), development of this property may include the following project components:

Pre-Construction Setup

- Establishing construction access points and temporary haul routes.
- Installing temporary site offices, laydown/staging areas, and equipment storage zones.
- Surveying and staking property boundaries, clearing limits, road alignments, and utility corridors.
- Installing perimeter controls and defining areas required for clearing and grading.

Vegetation Clearing and Grubbing

- Removing trees and vegetation within approved development limits to accommodate grading, infrastructure installation, and building footprints.
- Tree clearing, chipping or hauling woody debris, and removing brush.
- Grubbing stumps and root mats to prepare the subgrade for earthworks.
- Clearing field edges, hedgerows, and shrubs where roads, services, or lot grading require.

Site Grading

- Stripping and stockpiling topsoil for later reuse in landscaping and final stabilization.
- Undertaking cut-and-fill operations to achieve design grades for roads, building pads, the stormwater management pond, and public parks/blocks.
- Shaping the land to establish stormwater overland flow routes and subdivision drainage patterns.
- Constructing embankments, fills, or depressions required for the site's engineered grading plan.

Installation of Underground Services

- Trenching for and installing municipal watermains, sanitary sewers, and storm sewers throughout the subdivision.
- Installing utility infrastructure such as gas, hydro, telecommunications, and street-lighting conduits.
- Backfilling trenches, compacting subgrades, and preparing road corridors for base construction.

- Connecting new services to existing municipal networks at designated tie-in points.

Road Construction and Surface Works

- Preparing roadbeds with granular materials and compacted sub-base.
- Installing concrete curbs, gutters, sidewalks, and driveway aprons.
- Paving local streets in lifts (base course followed by surface course).
- Constructing subdivision intersections with existing roadways and internal connections between phases.

Stormwater Management System Construction

- Excavating and shaping the stormwater management pond, including forebay, permanent pool, and outlet structures.
- Installing stormwater inlet pipes, major/minor conveyance systems, and outlet control features.
- Constructing spillways, access routes, and pond embankments as designed.
- Implementing site drainage features such as swales, culverts, and catch basins that form part of the neighbourhood's long-term drainage network.

Homebuilding and Above-Grade Construction

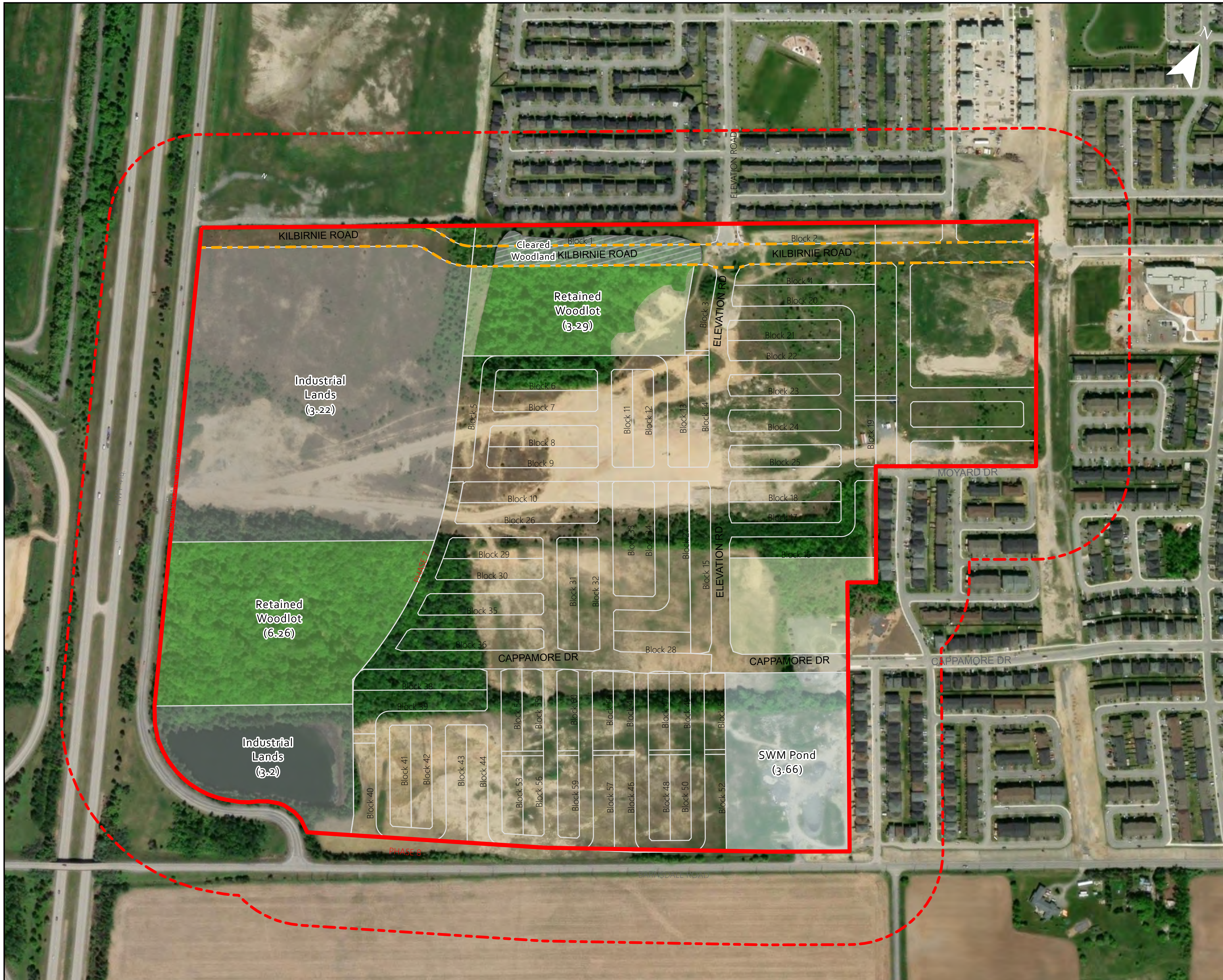
- Constructing building foundations, basements, and structural framing for single-detached homes and townhouses.
- Installing roofing, exterior cladding, windows, doors, and building systems (HVAC, plumbing, electrical).
- Pouring driveways, building porches, steps, and private walkways.
- Completing internal home finishes and lot-specific grading.

Final Grading, Landscaping, and Community Features

- Replacing stockpiled topsoil across lots, parks, and boulevard areas.
- Sodding or seeding all disturbed soils.
- Planting subdivision trees and landscape features in accordance with approved plans.
- Constructing park blocks, pathways, fencing, and streetscape elements.
- Completing final road paving (top lift), signage, and street-lighting installation.

Occupancy and Post-Construction Activities

- Homeowners begin occupying completed units as phases are finished.
- Minor touch-ups to boulevards, landscaping, road surfaces, and sidewalks continue as needed.
- Final inspections, certification of municipal infrastructure, and assumption by the City occur once subdivision construction is fully complete.



Legend

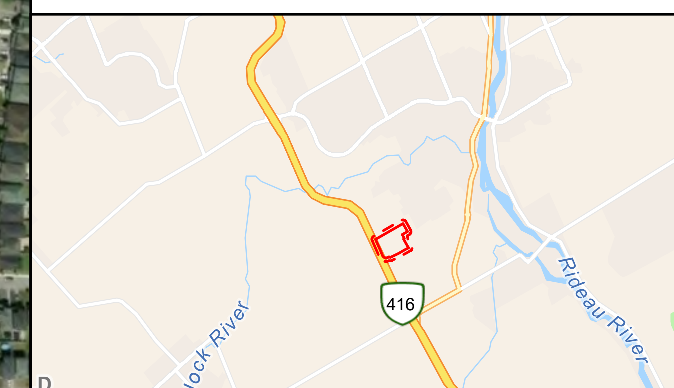
- Site
- Study Area (120m)
- Concept Plan (Oct, 2025)
- EA Approved Kilbirnie Drive Extention

LandType

- Retained Woodlot
- Industrial Lands
- Park
- SWM Pond
- Approved Woodland Removal (Kilbirnie Extension)

0 40 80 160 240 320 Meters

Scale: 1:5,000



Project Name:

Barrhaven South Phase 3 - S1 Area Natural Heritage Existing Conditions Report

Title:

Concept Plan

FOTENN

Date: 4/10/2026

Figure: 7

7.2. Addendum to Extend the Master Servicing Study (2018)

The stormwater management solutions developed by J.L. Richards (2026) are designed to manage both groundwater resources (through infiltration-focused practices and maintenance of the existing water balance) and surface-water runoff (via conveyance, on-site detention, and controlled discharge). Together, these solutions form the basis of the Master Servicing Study's stormwater design criteria for the S-1 lands—supporting the objective to maintain the existing infiltration proportion and to control post-development peak flows and volumes through the subdivision's integrated drainage system.

7.2.1. Storm Servicing Strategy

The proposed conceptual storm servicing strategy was determined to consist of the following elements:

- **Etobicoke Exfiltration System (EES):** An EES will be incorporated along local roads to the maximum extent, based on measured groundwater levels, in accordance with the guidance described below.
- **Other Infiltration practices:** Infiltration practices should be implemented in both Industrial Blocks to capture and infiltrate rooftop flows.

Overall, J.L. Richards (2025) demonstrates that the development depicted on the Concept Plan can be serviced by extending existing municipal water and wastewater infrastructure as well as constructing an expanded SWM facility.

7.2.2. Post-Development Water Budget

The post-development water budget described by J.L. Richards (2026) was prepared using Paterson Group's unfactored infiltration rates, corresponding to an average infiltration rate of approximately 36.65 mm/hr, with a comparison to existing conditions provided in Table 10. The existing condition water budget analysis indicates that infiltration across the S1 Area accounts for approximately 34% of total annual precipitation, and the MSS confirms that this proportion is maintained under post-development conditions through the proposed infiltration strategy.

Table 10: Water Budget Comparison (J.L. Richards 2026)

Annual Water Budget Component	Annual Average Depth to Jock River (mm)	Annual Average Depth to Mud Creek (mm)	Annual Average Depth to Rideau River (mm)	Area Weighted Total (mm)	Budget %
Precipitation	864 [864]	864 [864]	864 [864]	864 [864]	100% [100%]
Evapotranspiration	248 [509]	262 [531]	252 [509]	249 [513]	29% [59%]
Infiltration	301 [296]	214 [314]	274 [286]	297 [297]	34% [34%]
Surface Runoff	316 [83]	389 [60]	339 [0]	319 [61]	37% [7%]

Analysis and comparison of existing and post-development water budgets by J.L. Richards (2026) determined that the proposed stormwater servicing strategy is capable of maintaining the existing condition infiltration rate (i.e., 34%; Table 10), provided that the infiltration requirements of the CLI-ECA (Appendix A of J.L. Richards 2026) are achieved through the implementation and ongoing maintenance of the proposed infiltration measures (see Section 8.1).

7.2.3. Off-Site Peak Flow Management

The storm servicing strategy described by J.L. Richards (2026) has been designed so that no off-site peak flows increase at any discharge point. Given the limited capacity and shallow invert of the Thomas Baxter

Municipal Drain, most S-1 post-development runoff will be captured by a storm sewer system and routed to a new on-site end-of-pipe facility, which will then discharge to the existing Quinn's Pointe storm sewer at a rate at or below the Quinn's Pointe build-out flow allowance.

This approach, referred to as a "disconnection", also supports approvals under the Ontario Drainage Act by minimizing new discharges to the Thomas Baxter Municipal Drain. A prior disconnection to the Baxter system was approved in the 2018 BSUEA Master Servicing Study and later formalized in Robinson's Engineer's Report for the Subsequent Disconnection, Thomas R. Baxter Municipal Drain (October 2021).

According to the J.L. Richards (2026) Master Servicing Study, the previously approved disconnection area of 10.7 ha is combined with a proposed additional disconnection of 59.8 ha for the S-1 lands. This 59.8 ha value is lower than the earlier MSS estimate (65.8 ha), reflecting a conservative approach whereby runoff from the retained woodlot continues to discharge to the Borrisokane Road open ditch system under both existing and post-development conditions.

Hydrological Analysis and Simulation Results

In addition to the upstream check at the Quinn's Pointe 900 mm storm sewer, the hydrologic analysis was refined to evaluate peak flows and runoff volumes at two locations along the Borrisokane Road/Barnsdale Road open-ditch system and at the boundary culvert to the Thomas Baxter Municipal Drain. This refinement reflects the drainage reconfiguration proposed for the S-1 lands under the Master Servicing approach.

The event set included the 4-hour Chicago 25 mm storm (industry water-quality event) and return periods from 1:2-year through 1:100-year, with the modeled catchments incorporating one-half of the Barnsdale Road right-of-way and the eastern half of the Borrisokane Road right-of-way, consistent with the J.L. Richards (2026) Master Servicing update.

Because the 2017 SWMHYMO platform is no longer compatible, the pre-development model was rebuilt in PCSWMM to align with the current Master Servicing methodology. The resulting pre-development and post-development model schematics that support this analysis are illustrated below in the *Pre-Development Model Schematic* and the *Post-Development Model Schematic*, showing the modeled drainage areas, flow pathways, and discharge locations used in the assessment.

For clarity, the location checks summarized in the 2026 J.L. Richards work included: the Quinn's Pointe 900 mm storm sewer, two nodes along the Borrisokane/Barnsdale open-ditch system, and the culvert at the Thomas Baxter Municipal Drain immediately downstream of the confluence of the roadside ditches. (Detailed tabular outputs remain in the J.L. Richards 2026 documentation.

Pre-Development Model Schematic (J.L.Richards 2025)

Post-Development Model Schematic (J.L.Richards 2025)

The J.L. Richards (2026) Master Servicing Study evaluated hydrologic conditions at the Borrisokane Road culvert under both existing and post-development scenarios. As part of this analysis, the modelling framework assessed flows at the Quinn's Pointe 900 mm storm sewer, two locations along the Borrisokane Road/Barnsdale Road open-ditch system, and the culvert leading to the Thomas Baxter Municipal Drain. A consistent event set was applied across all scenarios using updated PCSWMM modelling, and readers are referred to the 2026 J.L. Richards report for detailed tabular summaries of peak flows and runoff volumes.

- Peak flows discharged to the Quinn's Pointe 900 mm storm sewer are maintained at levels consistent with Quinn's Pointe build-out conditions, thereby maintaining the integrity of the existing downstream storm sewer system under events up to and including the 1:100-year storm.
- At the Borrisokane Road culvert, post-development peak flows are reduced relative to existing conditions. These reductions are primarily attributable to a substantial decrease in the contributing drainage area following the redirection of runoff from the S-1 lands. Across the modeled event set, post-development peak flows are approximately 35%–60% lower than existing conditions, depending on storm magnitude, reflecting the reduced extent of contributing catchment rather than changes in per-unit runoff response.
- Post-development runoff volumes are similarly reduced when compared to existing conditions. For the 4-hour, 25 mm water-quality event, runoff volumes from the previously contributing drainage area are reduced by approximately 11%–14%. This reduction is consistent with the overall servicing strategy and reflects the redistribution of runoff away from the Borrisokane Road/Thomas Baxter drainage system.

Collectively, these reductions are consistent with the proposed servicing approach, which redirects the majority of S-1 runoff toward the Quinn's Pointe stormwater system while maintaining appropriate conveyance to downstream receivers. Accordingly, the lower peak flows and runoff volumes observed within the Borrisokane Road and Thomas Baxter systems reflect the reduced contributing drainage area under post-development conditions, and no increases in off-site peak flows are anticipated.

The 2026 J.L. Richards analysis demonstrates that post-development drainage from the S-1 lands is effectively controlled, with the majority of runoff redirected to the Quinn's Pointe stormwater system rather than the Thomas Baxter Municipal Drain. As a result of the reduced contributing drainage area, peak flows and runoff volumes at downstream locations decrease under post-development conditions, and no increases in off-site peak flows are anticipated.

7.3. Establishing Impact Pathways for Assessment

Taken together, the construction and build-out activities for the S-1 Urban Expansion lands are evaluated against the natural heritage features confirmed within the Study Area—namely the Significant Woodlands (Woodlands A and B), Significant Wildlife Habitat (including candidate bat maternity habitat and confirmed woodland raptor nesting), and contributing fish habitat within roadside drainage features—to establish potential pathways of impact associated with clearing, grading, servicing, road construction, and homebuilding. Building on this impact identification, the EIS then applies a mitigation hierarchy that prioritizes **avoidance** first, followed by **minimization**, **mitigation**, and, where necessary, **compensation/restoration**, to compare and refine measures appropriate to the site's features and functions.

8. Impact Assessment and Mitigation

The following sections describe the anticipated environmental impacts associated with the proposed development and the mitigation measures that should be implemented.

This impact assessment and associated mitigation measures consider both temporary (i.e., construction-related) impacts and permanent impacts associated with the occupation of the development. Opportunities and Constraints are depicted in Figure 8 below.

8.1. Groundwater and Hydrologic / Hydrogeologic

According to the Hydrogeological Study report, Paterson Group (2025) identified that a temporary Permit to Take Water (PTTW) or water taking Environmental Activity and Sector Registry (EASR) will be required if water taking volumes exceed 50,000 L/day. Permitting requirements will be determined at the detailed design phase.

From a geotechnical and hydrogeological perspective, Paterson Group (2024 and 2025) concluded that the Subject Site is suitable for the proposed development.

8.2. Aquatic Environment

Due to proximity of aquatic features to the Site, Project activities associated with the construction of the proposed low-rise residential development have the potential to impact these features if appropriate measures are not taken to avoid and mitigate against impacts.

8.2.1. Offline / Quarry Pond

The offline pond meets DFO's definition of an artificial waterbody and is therefore not regulated under the Fisheries Act. Because it is not a naturally occurring feature, the MNRF also does not regulate the feature itself; however, the Ministry does retain authority to protect the wildlife that use the pond, including fish, amphibians, and other aquatic species.

Under Section 28 of the Conservation Authorities Act, the pond does not qualify as a regulated feature such as a watercourse, wetland, or shoreline subject to flooding or erosion. In contrast, under Section 13 of the City's Official Plan, the pond qualifies as a surface water feature, as it can reasonably be described as an inland lake. As such, it is recognized as providing natural heritage functions and values and falls within the City's mandate for natural heritage management.

Habitat loss, displacement, and potential injury or mortality may occur for wildlife residing within the pond or relying on it to complete essential life processes. These impacts may result not only from the direct removal or alteration of habitat, but also from increased noise, vibration, and human activity during construction, which can temporarily or permanently disrupt wildlife behaviour. In addition, changes to vegetation structure, hydrology, and microhabitat conditions can reduce habitat suitability for species that depend on this feature, contributing to both immediate and longer-term ecological effects.

Proposed Mitigation Measures – Planning and Design Stage

- ✓ If removal or alteration of this feature is proposed a ***License to Collect Fish for Scientific Purposes*** will need to be obtained from MNRF.
  - o Upon receipt of a License to Collect Fish for Scientific Purposes from MNRF and within 48 hrs prior to construction activities, a fish / amphibian salvage should be conducted to remove / relocate wildlife within the offline pond.
- ✓ If removal or alteration of this feature is proposed, consultation with the city and the RVCA is recommended.

8.2.2. Watercourses & Drainage Features

Multiple simulations, as summarized in the J.L. Richards (2026) Master Servicing Study, demonstrate that the proposed drainage disconnection reduces both peak flows and runoff volumes at several discharge points across the receiving system. This section therefore focuses on two key locations—the Borrisokane Road open-ditch system and the headwaters of the Thomas Baxter Municipal Drain—to illustrate how the servicing strategy redistributes drainage and maintains effective system performance under post-development conditions.

Consistent with the Headwater Drainage Feature (HDF) Assessment, Features BN-1, BN-2, BN-3, and Feature 416 received a "Mitigation" management recommendation, indicating that their contributing hydrologic functions are expected to be maintained and that they do not pose a substantive natural heritage constraint to the proposed development. In accordance with the TRCA/CVC (2014) HDF Guidelines, a "Mitigation" outcome directs that these features continue to convey flows toward appropriate downstream receivers—principally the Thomas Baxter Municipal Drain, and ultimately Mud Creek and the Rideau River, where direct fish habitat occurs.

Expected impacts associated with project activities include:

- Changes to drainage patterns on the property; and
- Localized habitat loss, displacement, or the potential for accidental injury or mortality of wildlife that may reside in or use these drainage features to complete life processes.

However, no direct impacts to the drainage features located within the road rights-of-way are anticipated. These features are expected to remain in their current locations and continue functioning as roadside drainage ditches along Barnsdale Road (BN-1, BN-2, BN-3) and Highway 416 (Feature 416) under post-development conditions.

Borrisokane Road Open Ditch System (MTO ROW)

The Borrisokane Road open ditch forms part of the Highway 416 right-of-way and functions as a roadside conveyance channel receiving runoff from the adjacent road network. As summarized in the J.L. Richards (2026) Master Servicing Study, the drainage-limit modifications for the S-1 lands redirect a substantial proportion of post-development flows away from this system, resulting in lower post-development peak flows and runoff volumes entering the ditch—particularly under the more frequent 4-hour, 25 mm storm event. These reductions are consistent with the "Mitigation" recommendation of the HDF Assessment and indicate that the servicing approach will lessen hydraulic loading on the Borrisokane ditch relative to existing conditions. As a result, no adverse effects to the ditch's functionality are anticipated, and the feature is expected to continue operating as a roadside drainage conveyance with no meaningful change to its ecological or hydrologic role.

Headwaters of the Thomas Baxter Municipal Drain (Barnsdale Road)

Hydrologic simulations presented in the J.L. Richards (2026) Master Servicing Study indicate that, under post-development conditions, both peak flows and runoff volumes will also decrease at the headwaters of the Thomas Baxter Municipal Drain. From a fisheries and aquatic habitat perspective, the 4-hour, 25 mm storm event is the most relevant check because it occurs several times annually. For this event, the post-development runoff volume at the headwaters is approximately 1,293 m^3, representing a reduction of about 335 m^3 (approximately 21%) relative to existing conditions. Because no fish habitat occurs at the Barnsdale Road headwaters, this reduction is not expected to adversely affect fish or aquatic communities.

Furthermore, given the large intervening drainage area between Barnsdale Road and the Thomas Baxter–Mud Creek confluence (with the S-1 lands contributing only a small portion of the approximately 883 ha total), the relative effect of these changes diminishes downstream. As a result, conditions near Mud Creek fish communities are expected to remain virtually unchanged, consistent with the Headwater Drainage Feature Assessment's "Mitigation" direction to maintain or replicate conveyance functions toward appropriate receivers.

Proposed Mitigation Measures – Planning and Design Stage

- ✓ Grading and drainage shall be designed to ensure proper management of drainage off the site during construction activities.
- ✓ The proposed stormwater servicing strategy shall be designed to focus on capturing and redirecting storm flows from the Thomas Baxter Municipal Drain to the Jock River for the majority of the S1 Area (J.L. Richards 2026).
- ✓ A site-specific erosion and sediment control plan shall be implemented to prevent sedimentation outside of the Subject Site.
- ✓ Due to their classification as indirect fish habitat, any work below the high-water mark of Features BN-1, BN-2, BN-3, and Feature 416 will require authorization from DFO through the submission of a Request for Review.
- ✓ A Fish and Wildlife Salvage should be conducted for these features 48 hours prior to Project activities.

Proposed Mitigation Measures – Construction Implementation

- ✓ Features BN-1, BN-2, BN-3, and Feature 416 with a recommendation of "Mitigation", must be replicated and/or enhanced. Construction near these features should incorporate shallow groundwater and base flow conveyance measures, as well as Low Impact Development construction practices. Flow within these features should be conveyed to the appropriate downstream receiver.
- ✓ Orange snow fencing or other suitable fencing should be used to delineate the construction limits from the drainage features.
- ✓ This will prevent encroachment of construction activities into the features. This fencing should be monitored weekly to ensure it is functioning properly. Any deficiency in the fencing should be dealt with within 48 hours of notification.
- ✓ A site-specific erosion and sediment control plan should be implemented to prevent on-site erosion and sedimentation / siltation outside of work areas.
- ✓ Fish timing window (July 1 to March 14, inclusive) – no work within the highwater mark of Features BN-1, BN 2, BN-3, and Feature 416 outside of this period, and high risk of negative impacts if accidents or malfunctions affecting water quality occur outside of this period.

With the successful implementation of the mitigation measures outlined above, the drainage features within the Study Area are expected to be "Maintained" with minimal impacts to surrounding natural features.

8.2.3. Fishes and Fish Habitat

Based on field observations and background review, the offline/quarry pond provides direct fish habitat, while the roadside drainage features BN-1, BN-2, BN-3, and Feature 416 function as indirect/contributing fish habitat by conveying flows to downstream systems (e.g., Mud Creek and the Rideau River). Because the offline pond meets DFO's definition of an artificial waterbody, its removal would not require Fisheries Act authorization; however, a Fish and Wildlife Salvage would be required. The salvage operation would need to be authorized under a provincial licence.

Hydrologic simulation results compiled in the J.L. Richards (2026) Master Servicing Study (Section 3.13.5.5) indicate reductions in both peak flows and runoff volumes at the headwaters of the Thomas Baxter Municipal Drain under post-development conditions. From a fisheries perspective, the 4-hour, 25 mm storm is the most informative check because it recurs several times annually, whereas

1:2-year and 1:100-year events occur less frequently. For the 4-hour, 25 mm event, the post-development runoff volume at the headwaters is approximately 1,293 m^3, representing a reduction of about 335 m^3 (approximately 21%) from pre-development conditions. Since no fish habitat is present at the Barnsdale Road headwaters, this reduction is not expected to adversely affect downstream fish communities. Moreover, LiDAR indicates a total drainage area of approximately 883 ha at the Thomas Baxter–Mud Creek confluence; with the S-1 lands representing only a small portion of this drainage area and substantial intervening catchment between Barnsdale Road and Mud Creek, the drainage regime near downstream fish communities is expected to remain effectively unchanged.

Potential project-related effects on fish and fish habitat primarily relate to water quality and flow conveyance. If erosion and sediment controls are inadequate during construction, sedimentation or siltation could reach downstream habitats (e.g., Mud Creek and the Rideau River). Similarly, if drainage patterns are altered or conveyance features are disturbed, there is a risk of permanent alteration or inadvertent degradation of downstream fish habitat. As described below, these risks are readily managed through robust erosion and sediment control measures, maintaining established flow pathways, and adhering to recommended in-water timing windows, ensuring that downstream aquatic environments remain protected while the headwater drainage features continue to serve their contributing role.

Proposed Mitigation Measures – Planning and Design Stage

- A Fish and Wildlife Salvage should be conducted for these features 48 hours prior to Project activities.
- DFO Request for Review submission to determine if the Project will result in serious harm to fish or fish habitat associated with the roadside drainage features.

Proposed Mitigation Measures – Construction Implementation

- ✓ Orange snow fencing or other suitable fencing should be used to delineate the construction limits from adjacent lands / areas.
    - This will prevent encroachment of construction activities into the non-developable / more naturalized areas. This fencing should be monitored weekly to ensure it is functioning properly. Any deficiency in the fencing should be dealt with within 48 hours of notification.
- ✓ A site-specific erosion and sediment control plan should be implemented to prevent on-site erosion and sedimentation / siltation outside of work areas, particularly toward downstream fish habitat present (e.g., Mud Creek and Rideau River).
- ✓ Any in-water works in the surface water features on-Site (Features BN-1, BN-2, BN-3, and Feature 416) should be undertaken outside of the in-water works timing restriction period for fish habitats (July 1 to March 14, inclusive).

Based on the results of the hydrologic modelling and the characterization of existing drainage features, the proposed development is not expected to adversely affect fishes or downstream fish habitat. The roadside headwater features will continue to function under post-development conditions due to ongoing groundwater input and ROW runoff, and projected reductions in peak flows and runoff volumes further support this conclusion. With these conditions in place, only minimal impacts to fishes and fish habitat are anticipated.

8.3. Terrestrial Environment

To accommodate construction of the proposed development, the removal of vegetation communities consisting of meadow, mixed and deciduous forest habitat will be required. The Subject Site will be cleared as necessary, and the property will be graded.

8.3.1. Woodlands

As the majority of both Woodland A and Woodland B are confirmed significant, their partial retention is recommended in accordance with the City's policies and the detailed Significant Woodland Assessment provided in Appendix F. Under the preferred Concept Plan illustrated in Figure 7, the majority of both woodlands are retained, with approximately 57% of Woodland A and 59% of Woodland B preserved to maintain their core ecological functions. However, removals are still required in both features to accommodate the proposed development, including approximately 0.13 ha of Woodland A for an easement and a small portion of Woodland B, as documented in Appendix F. These removals represent a localized loss of woodland area, but based on grading requirements and the high-permeability esker-related soils, indirect effects to the retained woodland blocks are expected to be limited, provided the mitigation measures outlined in this EIS—such as forest-edge management, coordinated grading refinements, and integration with the landscape architecture plan—are implemented to support the long-term health and function of the remaining woodland.

Significant Woodlands Assessment

The Significant Woodland Assessment provided in Appendix F presents a comparative evaluation of three concept plan scenarios, each exploring different configurations of woodland retention and development limits. This assessment applies the City of Ottawa's guideline-based criteria to examine how each scenario performs relative to woodland size, function, connectivity, and feasibility of long-term retention. It should be noted that all three of the proposed options include the necessary removal of the northern part of Woodland B for the Kilbirnie Road extension. Together, these comparisons establish a clear basis for identifying the preferred concept and understanding the implications of woodland removal and preservation across the Site.

- **Concept Plan 1**: This plan proposes the near-full retention of both Woodlands A and B, aside from the removal of some border areas to accommodate adjacent land parcels and approved extension of Kilbirnie Road. This plan likely provides the highest benefit to the community through the incorporation of two parklands (2.2 ha total parkland area, representing the highest), as well as open spaces with direct connectivity to the retained significant woodlands; however, Concept Plan 1 provides only the second largest total canopy cover.
- **Concept Plan 2:** This plan is similar to Concept Plan 1 but proposes the removal of 3.5 ha of significant woodland total, represented by 2.4 ha of Woodland A and 1.1 ha of Woodland B removed. Compared to Concept Plan 1, this plan likely provides less benefit to the community through incorporation of only one parkland (1.8 ha total parkland area) and less open space, as well as providing the lowest total canopy cover.
- **Concept Plan 3:** This plan proposes the removal of 4.7 ha of significant woodland total, represented by 4.5 ha of Woodland A and 0.2 ha of Woodland B. Compared to Concept Plan 2, this plan also proposes only one parkland and of similar size (1.9 ha total parkland area). Concept Plan 3 proposes the highest total canopy cover, and, importantly, represents the only concept plan to achieve the City of Ottawa's 40% urban canopy coverage target (City of Ottawa 2022a).

The evaluation completed in accordance with the screening and comparative criteria outlined in Appendix F was undertaken to assess the relative effects across the three concept and woodland-retention scenarios. The Concept Plan 3 is the preferred plan based on broader planning and design considerations. Although it requires the removal of approximately 4.7 ha of 'significant' woodland (4.5 ha from Woodland A and 0.2 ha from Woodland B**)** the majority of both features are retained, and the remaining woodland patches are not constrained by hazard lands, represent common habitat types in the region, and provide limited ecological connectivity.

Relative to the other proposed concept plans, Concept Plan 3 delivers meaningful community benefits by achieving the highest publicly accessible canopy cover (43.7%) and providing intermediate public access through an easement. However, the concept performs lowest in pollution removal, runoff abatement, and carbon storage/sequestration due to the increased woodland removal and additional impermeable surfaces. Despite these trade-offs, the iTree results confirm that key woodland functions can be maintained within the development limits when supported by the mitigation measures identified described below. The findings indicate that Concept Plan 3 provides a balanced scenario between woodland retention and neighbourhood development objectives.

Management Recommendations

Concept Plan 3 is the preferred option, and the plan carried forward in this EIS, based on a wide range of considerations, including community form, open-space structure, servicing efficiency, and implementation. However, it also performs well from a natural heritage perspective by protecting the features and functions of the Significant Woodlands to be retained. It achieves the highest projected public canopy coverage among the scenarios (43.7%), exceeding the City's 40% target. This enhanced canopy outcome provides long-term ecological and community benefits and reflects a balanced approach to neighbourhood design.

To reach these canopy gains, Concept Plan 3 combines preservation with the required tree replanting. Tree plantings within housing blocks, parks, boulevards, and around the stormwater management pond contribute substantially to canopy at maturity and help integrate natural features throughout the community. Although overall greenspace access is slightly lower than the full-retention scenario, the superior canopy performance demonstrates efficient use of available space to support the City's canopy objectives.

Where feasible, the plan emphasizes retention of mature trees within parks, open spaces, and residential blocks, recognizing their immediate canopy benefits and ecological functions that cannot be quickly replicated through replanting. Because long-term canopy depends on ongoing care, the plan prioritizes public-realm plantings (parks, boulevards, and open spaces) where maintenance and monitoring can sustain canopy performance over time.

The extent of woodland retention has been established: approximately 57% of Woodland A and 59% of Woodland B will be retained to preserve the ecological and social functions of these features. In accordance with Urban Expansion Area policies, these lands are intended to be conveyed to the City as natural heritage features at the appropriate stage.

Proposed Mitigation Measures – Planning and Design Stage

- ✓ A forest edge management plan and restoration objectives shall be developed at the Detail Design stage to manage impacts associated with the removal of native trees and shrubs along the edges of Woodland A and Woodland B. No setbacks are proposed.
- ✓ Landscaping plans shall incorporate native vegetation and tree plantings in accordance with the City's Urban Forest Management Plan to increase the abundance of native vegetation species on the site and to offset any loss of species from vegetation removals. Re-naturalization of east and west extent of Woodland B should be considered in the Landscape Plan.
- ✓ Woodland management and maintenance of hazard trees shall be required in Woodland A and Woodland B prior to occupancy of the community. Directed by a qualified arborist, the detailed plan shall be included in the landscape plan, designed for the safety of the community.
- ✓ **A Tree Conservation Report (TCR) will be required** to facilitate proposed tree removals and shall be prepared in accordance with the City of Ottawa's Tree Conservation Report Guidelines at the detailed design (Site Plan) stage; the TCR should be coordinated with the Landscape Architect and municipal engineering/grading design to ensure tree retention and compensation accurately reflect the requirements and mitigation outlined in this EIS, and to confirm that grading is refined on a case-by-case basis to maximize feasible tree retention.

Proposed Mitigation Measures – Construction Implementation

- ✓ Orange snow fencing or other suitable fencing should be installed around the perimeter of the retained woodland features to prevent erosion and sedimentation into adjacent habitats.
  - o This will prevent encroachment of construction activities into non-developable / more naturalized areas. This fencing should be monitored weekly to ensure it is functioning properly. Any deficiency in the fencing should be dealt with within 48 hours of notification.

With the successful implementation of the mitigation measures outlined above, an approximate 4.7 ha decrease in woodlands (43% of Woodland A and 41% of Woodland B) on-site is anticipated due to the proposed development. Despite this loss of Woodland area, the Project proposes to retain the two most significant ecological features on the property which will retain a significant portion of native vegetation on the property.

8.3.2. Vegetation Communities

To accommodate the construction of the proposed development, the Subject Site will be further cleared as necessary, and the property will be graded. These activities will result in the permanent removal and modification of existing vegetation communities, with associated loss of local habitat structure and biodiversity (e.g., reduced species richness and abundance in cleared areas). However, it is also recognized that much of the Site has been previously disturbed by historic land clearing and ongoing agricultural use, which already altered native community composition and ecological integrity relative to an undisturbed, native, condition. Consequently, while additional effects on biodiversity are anticipated within the development limits, they occur in a landscape partly characterized by prior vegetation removal and habitat simplification and fragmentation.

The approximate area of vegetation communities proposed for removal are shown below in Table 11.

Table 11: Vegetation Communities Impacted

ELC Type	Total Area Proposed for Removal (ha)
Dry - Fresh Hemlock – White Pine Mixed Forest (FOMM3-3)	4.4
Dry - Fresh Sugar Maple – Beech Deciduous Forest (FOCM5-2)	1.7
Naturalized Coniferous Hedge-row (FOCM5)	0
Dry – Fresh Upland Deciduous Forest (FODM4)	2.0
Naturalized Deciduous Hedge-row (FODM11)	1.9
Open Water (OA)	2.0

The clearing required to accommodate the proposed development is expected to result in several direct and indirect impacts on existing vegetation communities. These impacts include the permanent loss or disturbance of trees and other vegetation, as well as localized increases in heat retention where vegetated areas are replaced with roads, buildings, and other infrastructure. Vegetation removal and soil disturbance may also facilitate the spread of invasive species, and construction activities introduce the potential for accidental damage or loss of additional trees beyond planned clearing limits. Changes in grading and surface conditions may alter natural drainage patterns, contributing to shifts in soil moisture regimes and vegetation composition. Together, these effects may lead to a decrease in biodiversity and overall species abundance, and if erosion and sediment controls are not properly implemented, there is potential for on-site erosion and the deposition of sediment into adjacent vegetation communities, further degrading habitat quality.

Proposed Mitigation Measures – Planning and Design Stage

- Landscaping plans shall incorporate native vegetation and plantings to increase the abundance of native vegetation species on the site and to offset any loss of species from vegetation removals.
- Replanting of trees on site to offset the loss of trees due to the development (or compensation plantings off site, if appropriate).
- **A Tree Conservation Report (TCR) will be required** to facilitate proposed tree removals and shall be prepared in accordance with the City of Ottawa's Tree Conservation Report Guidelines at the detailed design (Site Plan) stage; the TCR should be coordinated with the Landscape Architect and municipal engineering/grading design to ensure tree retention and compensation accurately reflect the requirements and mitigation outlined in this EIS, and to confirm that grading is refined on a case-by-case basis to maximize feasible tree retention.

Proposed Mitigation Measures – Construction Implementation

- ✓ Orange snow fencing or other suitable fencing should be used to delineate the construction limits from adjacent areas.
  - This will prevent encroachment of construction activities into adjacent natural areas. This fencing should be monitored weekly to ensure it is functioning properly. Any deficiency in the fencing should be dealt with within 48 hours of notification.
- ✓ A site-specific erosion and sediment control plan should be implemented to prevent on-site erosion and sedimentation / siltation outside of work areas.
- ✓ Invasive species to be removed shall be done so using species-appropriate methods (following best management practices outlined on the Ontario Invasive Plant Council [OIPC 2024] website) to prevent further contamination.
- ✓ Machinery will arrive on site in a clean condition and will be free of fluid leaks, invasive species, and noxious weeds.

Proposed Mitigation Measures – Post-Construction

- ✓ All waste construction material shall be removed from the Subject Site and impacted areas shall be reinstated in accordance with the proposed landscape plans upon Project completion.

While the proposed development will reduce the extent of native terrestrial vegetation on the Subject Site, the overall magnitude of this impact is moderated by the retention of the two Significant Woodlands, which preserve the core ecological features and functions present on the property.

8.3.3. Significant Wildlife Habitat

This section summarizes potential impacts the proposed project may have on Significant Wildlife Habitat confirmed within the Study Area, specifically: candidate bat maternity habitat and confirmed woodland raptor nesting within Woodlands A and B, as well as Species of Conservation Concern recorded on-site.

- **Candidate Bat Maternity Colony Habitat:** Construction activities (including, clearing, grading, and equipment operation) may result in the loss or disturbance of roosting and foraging habitat where trees are removed or woodland edges are modified. Short-term impacts may also occur through noise, vibration, and temporary increases in human activity that disrupt bat use of adjacent forest stands – especially during construction and clearing activities.
- **Confirmed Woodland Raptor Nesting Habitat:** Vegetation removal and site-disturbance activities near Woodland A may temporarily disrupt nesting individuals and reduce the availability of suitable nesting and foraging habitat. Additional effects may arise from increased noise,

machinery movement, and general construction activity, which can displace raptors from previously used nesting areas within the woodland interface.

- **Species of Conservation Concern (e.g., Eastern Wood-pewee):** Clearing of vegetation communities may remove or alter breeding, foraging, and general wildlife habitat used by SCC species. Construction may also cause short-term disturbance or accidental harm to nests or dens, while long-term changes—including increased human presence, traffic, and building windows—can contribute to displacement or elevated mortality risks (e.g., collisions).

Overall, these impacts are expected to be localized and limited in magnitude, as a substantial portion of the Significant Woodlands is being retained, and much of the Site has already experienced habitat alteration due to historic land clearing and agricultural use. This retained woodland area helps preserve the core ecological functions that support these habitat types, moderating the scale of anticipated effects.

Proposed Mitigation Measures – Planning and Design Stage

- ✓ Building and community design should consider the City of Ottawa's Bird-Safe Design Guidelines where practical (City of Ottawa, 2022a).
- ✓ Where possible, retain large mature trees (including cavity trees) to maintain available roosting habitat. At the Detail Design stage, consideration should also be given to the retention of standing dead wildlife trees if they have been assessed as safe.
- ✓ Tree planting and landscape design trees should consider bat roosting opportunities upon reaching maturity specifically surrounding the edges of stormwater management facility blocks (Oak, Maple, Hickory, etc.).
- ✓ The installation of bat boxes (i.e., constructed roosting habitat), should be considered at the Detail Design phase to offset habitat loss. Boxes should be in association with parkland or within the edges of stormwater management facility blocks, meeting the design criteria provided by Bat Conservation International (BCI 2025).
- ✓ Native plants should be incorporated into the Landscape Architecture design for the community (including park blocks, open spaces, and other landscaped areas) to provide host plants and foraging resources for Species of Conservation Concern birds.

Proposed Mitigation Measures – Construction Implementation

- ✓ Orange snow fencing or other suitable fencing should be used to delineate the construction limits from adjacent naturalized areas.
  - This will prevent encroachment of construction activities into adjacent areas / habitats. This fencing should be monitored weekly to ensure it is functioning properly. Any deficiency in the fencing should be dealt with within 48 hours of notification.
- ✓ A site-specific erosion and sediment control plan should be implemented to prevent on-site erosion and sedimentation / siltation outside of work areas.
- ✓ Clearing of vegetation should be avoided during the breeding bird / bat roosting season, between March 15 and November 30, inclusive.
  - Should any clearing be required during the breeding bird season, a qualified ecologist should be contacted to determine if a nest search is possible to facilitate clearing. No work will be permitted within this setback until the nest is no longer active, in accordance with the federal MBCA.
- ✓ Mitigation measures outlined in the Protocol for Wildlife Protection during Construction (City of Ottawa 2022c) should be considered prior to construction of the proposed development.

Following implementation of the measures described above, Significant Wildlife Habitat is not anticipated to experience residual adverse effects.

8.3.4. Wildlife and Wildlife Habitat

Construction and build-out activities (clearing, grading, servicing, road and home construction) will remove or modify portions of existing vegetation communities, resulting in direct habitat loss and temporary disturbance to wildlife that currently use the Site for nesting, foraging, movement, or shelter. Potential impacts may include removal of nesting/foraging substrates, disturbance from noise/vibration during active construction, and increased human activity and vehicle traffic during and after build-out.

Most disturbance (e.g., noise, vibrations, temporary displacement) will be short-term (construction phase), whereas the habitat impacts associated with subdivision build-out is long-term/permanent within the development footprint. Post-construction occupation introduces ongoing effects typical of residential areas (lighting, traffic, people/pets); however, these are expected to stabilize as the community matures.

Given the agricultural and suburban context within and around the Site, potential effects are expected to remain localized to the development footprint and its immediately adjacent lands. The area is already highly modified, largely former agricultural land with hedgerows and two woodlands in an expanding urban setting. After decades of clearance and agricultural use, broader system-level effects are limited, and impacts are localized to construction and build-out areas. In this context and given the Site's disturbed history and lower ecological value, in several areas, the magnitude of effects on common urban/rural wildlife is expected to be low to moderate.

Ecological Connectivity

Habitat on-Site is relatively isolated and fragmented, dominated by fields/meadows with hedgerows and two discrete woodlands, and located within an area of active and recent residential expansion (e.g., Quinn's Pointe), which limits broader connectivity and movement corridors. Accordingly, effects on the broader natural heritage system is expected to be minor.

Biodiversity

General biodiversity on the Site reflects a mix of common native and disturbance-tolerant species typical of previously cleared/agricultural landscapes. Surveys documented common birds, amphibians, and plants with moderate tolerance to disturbance. Accordingly, anticipated changes are expected to primarily affect common and widespread taxa, rather than species with high conservation sensitivity.

Retention of Key Features

A substantial portion of Significant Woodlands (A and B) will be retained, preserving core habitat functions within the Site and maintaining native canopy structure at build-out. In addition, subdivision landscaping and street tree planting will establish new, planted habitats that support common urban wildlife and birds over time, integrating retained features with parks, boulevards, and yards.

Given the disturbed baseline, limited connectivity, retention of significant woodlands, and the introduction of extensive landscaping at build-out, the anticipated extent and magnitude of impacts to general wildlife and wildlife habitat are expected to be localized and low to moderate, with long-term conditions shifting toward habitats typical of suburban neighbourhoods that support common urban species.

Proposed Mitigation Measures – Planning and Design Stage

- ✓ Building and community design should consider the City of Ottawa's Bird-Safe Design Guidelines where practical (City of Ottawa, 2022a).
- ✓ Vegetation planting should consider bird breeding, wildlife shelter, and foraging habitat within the Subject Site.

Proposed Mitigation Measures – Construction Implementation

- ✓ Impacts to natural vegetation should be minimized to the extent possible.
- ✓ Clearing of trees / snags that have potential to provide bat roosting habitat should be avoided during the active bat season, i.e., March 15 to November 30, inclusive.
- ✓ Clearing of vegetation should be avoided during the breeding bird season, i.e., between April 15 and August 15.
    - o Should any clearing be required during the breeding bird season, a qualified ecologist should be contacted to determine if a nest search is possible to facilitate clearing. No work will be permitted within this setback until the nest is no longer active, in accordance with the federal MBCA.
- ✓ Idling of construction machinery should be limited to reduce disturbance to resident wildlife.
- ✓ Should wildlife enter the work area, activities in that area shall cease and the wildlife shall be allowed to vacate the site under its own power.
- ✓ A qualified wildlife rehabilitation centre should be contacted if any wildlife is injured or found injured during construction. Injured wildlife should be transported to a qualified facility for care with a small donation of money to help pay for their care.

Given the disturbed baseline, limited connectivity, retention of significant woodlands, and the introduction of extensive landscaping at build-out, the anticipated extent and magnitude of impacts to general wildlife and wildlife habitat are expected to be localized and low to moderate, with long-term conditions shifting toward habitats typical of suburban neighbourhoods that support common urban species.

With the successful implementation of the recommended mitigation, a site-wide decrease of wildlife habitat is expected due to the proposed development.

8.3.5. Species at Risk

According to background resources and field investigations, six SAR (provincially Endangered) have been reported in the area of the Subject Site and have a moderate to high potential of occurrence: Eastern Red Bat, Hoary Bat, Little Brown Myotis, Northern Myotis, Tri coloured Bat, and Silver-haired Bat.

SAR Bats

Mature trees within Woodlands A and B provide suitable roosting opportunities for SAR bats. However, in the Ottawa area, roost availability is not considered a limiting factor in their decline. As a result, potential effects from the proposed development are expected to arise primarily from construction-phase activities, such as tree removal, where bats could be present in individual trees or nearby stands. Longer-term effects may be associated with the localized loss or modification of foraging and day-roost habitat where vegetation is cleared, or woodland edges are altered to accommodate roads, residential lots, and services.

The extent of these impacts is expected to remain localized because a substantial portion of the Significant Woodlands will be retained, allowing core canopy structure and roost potential to persist. Disturbance during construction will be temporary, habitat modification in areas that are fully developed will be permanent. However, considering the Site's already disturbed condition and the availability of suitable roosting habitat elsewhere in the surrounding landscape, the overall magnitude of potential bat-related effects is expected to be low to moderate.

The offline quarry pond currently provides open-water habitat that may provide suitable bat foraging. Its removal would represent a localized loss of candidate foraging habitat. However, it is understood that residential lighting typically increases insect abundance at night, which can provide alternative foraging opportunities for bats in suburban settings. As such, while some changes to site-specific foraging conditions will occur, alternatives will remain available within and adjacent to the Site.

Overall, the potential impacts to SAR bats are expected to be limited in extent, short-term during active construction, and long-term only where habitat is permanently removed. Given the retention of significant woodland areas and the broader availability of suitable roosting and foraging resources in the surrounding landscape, these impacts are anticipated to be low to moderate in magnitude.

The following mitigation measures have been proposed for SAR Bats:

Proposed Mitigation Measures – Planning and Design Stage

- ✓ The landscape plan (including planting and landscape design) should consider planting opportunities for larger tree species (Oak, Maple, Hickory, etc.) for the provision of suitable bat habitat within the community upon reaching maturity, which may require appropriate planning and greater setbacks from infrastructure. This could include the edges of stormwater management facility blocks, park blocks, schools, or other large open spaces.
- ✓ Where possible, retain large mature trees (including cavity trees) to maintain available roosting habitat, specifically within parkland dedication and/or along the retained woodland edges.
- ✓ The installation of bat boxes (i.e., constructed roosting habitat), should be considered at the Detail Design phase to offset habitat loss. Boxes should be in association with parkland or within the edges of stormwater management facility blocks, meeting the design criteria provided by Bat Conservation International (BCI 2025).
- ✓ **MECP SAR permitting may be required** -- Review requirements for registration / permitting based on applicable provincial legislation / policies at the time of planning / design.

Proposed Mitigation Measures – Construction Implementation

- ✓ Tree removal should be avoided during the general active period for bats (i.e., March 15 to November 30, inclusive).
- ✓ If this is not possible, conduct exit survey prior to cutting them down. If the exit survey identifies bats, contact MECP or biologist for additional guidance.

With the successful implementation of the mitigation measures outlined above, it is anticipated that there will be a temporary, minor loss of roosting and foraging habitat for SAR Bats. This loss is expected to lessen over time as planted trees reach maturity and provide appropriate roosting opportunities.

8.4. Indirect Impacts

Beyond direct impacts associated with the proposed development, a number of indirect impacts can affect the natural heritage system as the subject lands transition from largely agricultural/undeveloped uses to an urban neighbourhood. Because the area is already highly modified and habitat diversity is limited, these existing conditions shape how indirect impacts affect the habitats and features in the lands around the subject site.

- **Air, Light, and Noise:** Localized increases in dust and exhaust during active works, followed by routine traffic emissions after build-out, can influence adjacent features. New residential lighting and streetlights introduces a net increase in nighttime illumination that may negatively affect adjacent habitats. In addition, typical neighbourhood noise may alter wildlife behaviour in adjacent habitats.
- **Forest Edge Effects:** Where encroachment into woodland/forest habitat occurs, a reduction in interior habitat and loss of an established forest edge can allow deeper penetration of light and wind. This can change moisture, temperature, and understory composition at the edge. Given the Site's isolated woodland blocks in a growing urban setting, these edge-related changes are expected to be localized and not dissimilar to the existing condition.
- **Invasive Species:** Construction traffic, disturbed soils, and future landscaping are all factors that can introduce or spread, non-native, invasive plants. Natural habitats, including the woodlands found onsite, may be suspectable to these impacts. Over time, this may shift understory composition and reduce the representation of native species if not actively mitigated (as noted above). The potential risk is greatest in recently disturbed areas and along linear features such as paths and roadways.
- **Hydrologic Effects:** Establishing new drainage patterns for the subdivision may influence how stormwater flows along edges and roadside ditches. Because the headwater drainage features mainly serve as roadside conduits, their overall role is expected to remain largely the same, with only small changes to local moisture regimes. No substantial negative impacts to the natural heritage systems are anticipated.
- **Climate Change:** In the short term, construction equipment and trucks will add noise and exhaust, and freshly exposed soils and pavement can make the area feel hotter and drier. As the neighbourhood opens, higher traffic volumes will increase localized emissions and heat. Over time, new street trees and park plantings will help shade surfaces and cool the microclimate, partially (but likely not fully) offsetting these effects.
- **Woodland Retention:** Retention of the Site's Significant Woodlands preserves core canopy structure and ecological function within an otherwise fragmented setting. As subdivision landscaping and street-tree plantings mature, it is expected that they will create additional habitat that supports common urban wildlife and birds, improving ecological diversity within the suburban community. These elements help lessen indirect effects by maintaining cover, moderating edge microclimate, and offering foraging and nesting opportunities typical of suburban environments.

Indirect impacts associated with the proposed development are expected to remain limited with proper mitigation in place. Retention of Significant Woodlands and strategic landscaping throughout parks, streetscapes, and open spaces will help moderate edge effects and support ecological function. With appropriate construction controls, invasive species management, and thoughtful community design, long-term indirect impacts can be effectively minimized. Overall, the development is anticipated to integrate into the surrounding landscape with minimal residual indirect effects.

8.5. Cumulative Impacts

The proposed development is situated within a landscape already characterized by substantial urban expansion and historical agricultural use. In this context, most system-level changes to the broader natural heritage network have occurred incrementally over past decades, as surrounding lands transitioned from agricultural and rural uses to residential neighbourhoods and supporting infrastructure. Consequently, while cumulative effects must be considered, the additional contribution from this Project is expected to be modest relative to the larger pattern of change already present in the area.

Within this regional backdrop, the principal cumulative concerns associated with build-out include a general loss of biodiversity and available habitat, reduction of urban tree canopy, and increased impervious coverage leading to higher runoff potential. These pressures are common in suburbanizing environments and can compound over time if not actively mitigated through site design, strategic retention, and targeted restoration.

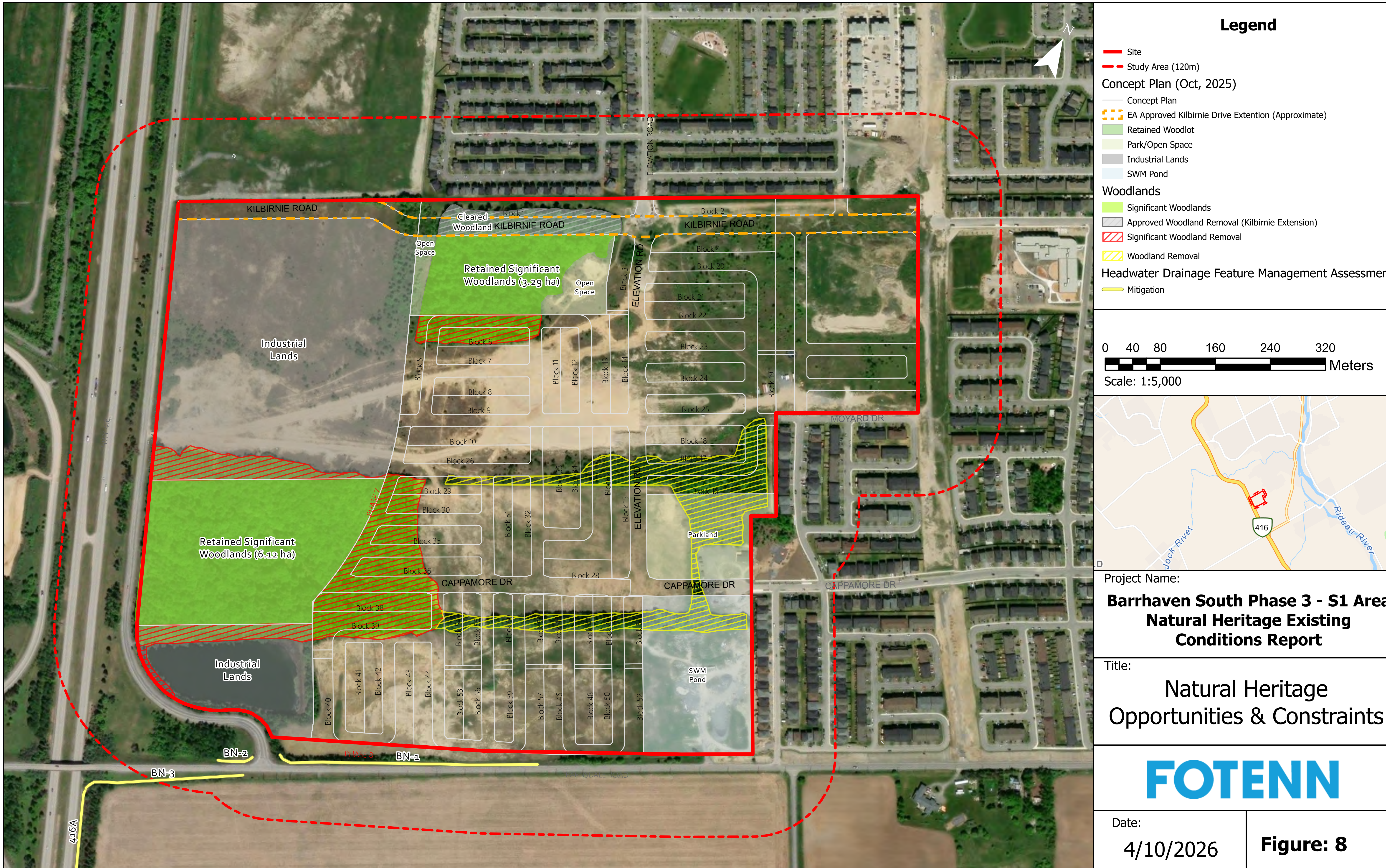
Overall, with the implementation of the proposed mitigation measures, the residual cumulative effects of the proposed development on biodiversity, canopy cover, and runoff are expected to be limited and consistent with the scale of change already accommodated within the surrounding urban expansion area.

Proposed Mitigation Measures – Planning and Design Stage

In addition to the mitigation measures listed above, the following mitigation should be considered to address the cumulative impacts resulting from the proposed development:

- ✓ Landscaping plans should compensate for the removal of woodlands and vegetation.
- ✓ Landscaping plans should include tree plantings to enhance canopy cover across the site, including replacement of any lost canopy cover due to tree removals, contributing toward the goal of 40% coverage in accordance with City Official Plan policies and associated guidelines; and
- ✓ Project design should promote the use of permeable landscaping materials and rain capture systems like rain gardens and permeable pavers.

Refer to Figure 8 below to view the Opportunities and Constraints within the Site.



Project Name:

Barrhaven South Phase 3 - S1 Area Natural Heritage Existing Conditions Report

Title:

Natural Heritage Opportunities & Constraints

FOTENN

Date: 4/10/2026

Figure: 8

9. Summary and Conclusion

Fotenn was retained by Minto Communities Canada to finalize this Environmental Impact Study (EIS) for the proposed Barrhaven South S1 Area at 3882 Barnsdale Road. The Study Area is surrounded by fully developed residential lands to the north and east, Highway 416 to the west, and agricultural lands to the south, and the proposed development will require clearing and grading that will remove existing vegetation and result in a general loss of natural wildlife habitat.

- **Drainage Features:** A headwater drainage feature system composed of Reaches BN-1, BN-2, BN-3, and Feature 416A occurs along the southern boundary of the Urban Expansion Area. These roadside and agricultural ditches drain toward Mud Creek and the Rideau River and therefore contribute indirectly to downstream fish habitat. Based on the HDF Assessment, the feature received a **"Mitigation"** management recommendation, meaning its contributing hydrologic functions should be maintained through and after construction.
- **Vegetation Communities:** Based on the most recent Concept Plan, development is expected to impact three vegetation community types present on the Site: Mixed Meadow, Deciduous Forest, and Mixed Forest.
- **Significant Woodlands:** Two Significant Woodlands occur within the Study Area. A detailed woodland assessment (Appendix F) evaluated potential development scenarios relative to baseline woodland conditions. Through this analysis, approximately 59% of both Woodland A and Woodland B will be retained to preserve their ecological and community functions.
- **Species at Risk (SAR):** Suitable habitat for SAR bats is present within both woodlands. To avoid impacts to individuals that may be roosting or using these features, Tree removal should be avoided during the general active period for bats (i.e., **March 15 to November 30**, inclusive).
- **Basis of Assessment:** This EIS integrates desktop screening, background documents prepared by others (e.g., WSP 2021 *Ecological ECR*), and three site visits in 2023 and 2024. Together, these sources informed the analysis of existing natural heritage conditions, evaluation of potential impacts, and identification of appropriate mitigation and compensation measures.

Despite the natural heritage considerations identified in this report, the S1 Urban Expansion Area remains a good candidate for residential development from both an environmental and geotechnical perspective. With implementation of recommended mitigation and adherence to applicable policy and regulatory requirements, the Project can proceed while maintaining the ecological functions of key natural features.

9.1. Policy Conformity and Next Steps

Project-specific details and next steps, to help ensure adherence to the applicable policies and legislation:

Migratory Birds Convention Act, 1994

- ✓ No vegetation removal should occur between April 1 and August 15, to reduce the potential for incidental take of active bird nests.

Fish and Wildlife Conservation Act, 1997

- ✓ In the case that wildlife is observed within the work area, all work in the area shall stop until the animal has left the area on its own. In the case that wildlife relocation is required, consultation with MNR would be required to obtain the necessary permits and approvals under the FWCA.
- ✓ If removal or alteration of the Offline Pond feature is proposed a License to Collect Fish for Scientific Purposes will need to be obtained from MNRF.

Endangered Species Act, 2007

- ✓ Tree removal should be avoided during the general active period for bats (i.e., March 15 to November 30, inclusive).

NOTE: It is expected that the Endangered Species Act, 2007 (ESA) will be repealed by the Species Conservation Act, 2025 (SCA) prior to the commencement of Project activities. As such, review of the new legislation and requirements for registrations and approval shall be reviewed prior to impacts to protected species.

Tree By-law 2020-340

- ✓ Tree removals and other activities prohibited under By-law 2020-340 will require prior review and approval by the City, which can be achieved through the development application process and/or a permit under the by-law.
- ✓ **A Tree Conservation Report (TCR) will be required** to facilitate proposed tree removals and shall be prepared in accordance with the City of Ottawa's Tree Conservation Report Guidelines at the detailed design (Site Plan) stage; the TCR should be coordinated with the Landscape Architect and municipal engineering/grading design to ensure tree retention and compensation accurately reflect the requirements and mitigation outlined in this EIS, and to confirm that grading is refined on a case-by-case basis to maximize feasible tree retention.

9.2. Standard of Care and Limitations

Field investigations were carried out using investigation techniques and ecological methods consistent with those ordinarily exercised by the qualified biologists who performed the fieldwork and other scientific practitioners, working under similar conditions and subject to the time, financial, and physical constraints applicable to these investigations. The field investigation results presented in this report are based on work undertaken by trained professionals and technical staff and the reasonable and professional interpretation using acceptable scientific practices current at the time the work was performed. The findings and conclusions presented in this report are generally considered valid for a period of up to five (5) years from the date of issuance, subject to unchanged site conditions, environmental circumstances, and applicable policy or legislative requirements

The results and findings of this study have been reported without bias or prejudice. Thus, conclusions have been based on our own professional opinion, substantiated by the results of this study, and have not been influenced in any way.

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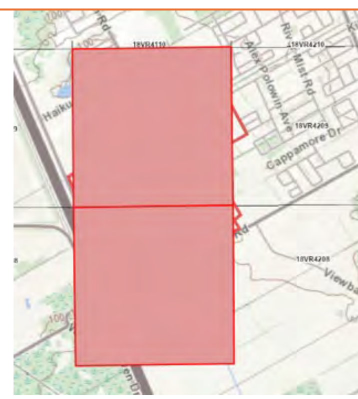
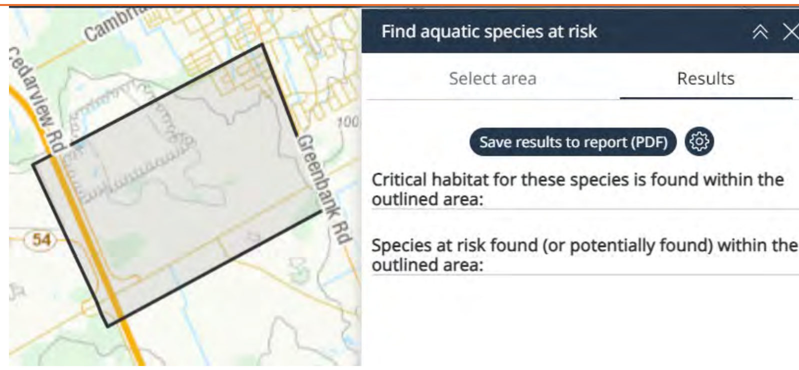
Appendix A

Aquatic Background Data

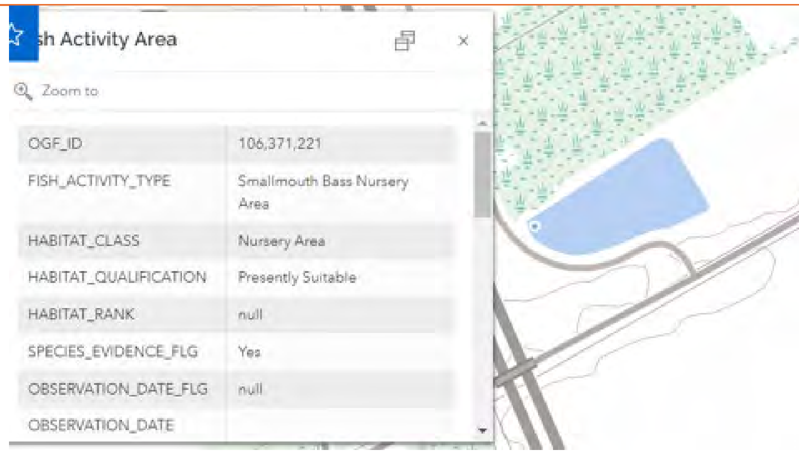
Table A1: Summary of Aquatic Background Data Collection

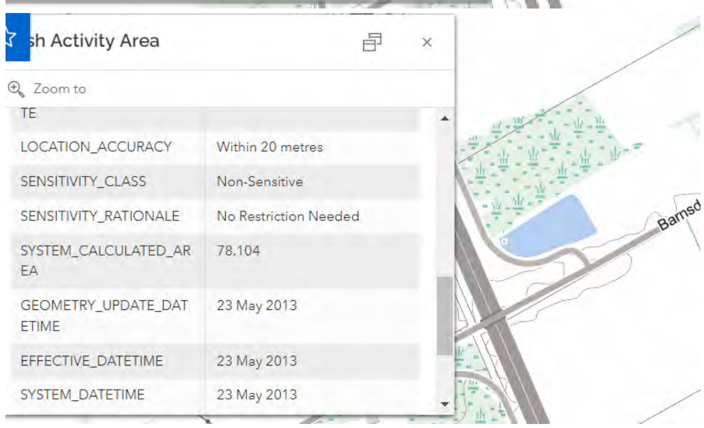
Aquatic Resources Background Information	
General NHIC map showing unevaluated wetland and woodlands within the Study Area.	
	
NHIC Species map does not indicate any aquatic species for the highlighted squares: 18VR4108, 18VR4109	 

The DFO species at risk map does not indicate species or critical habitat present within the study area.

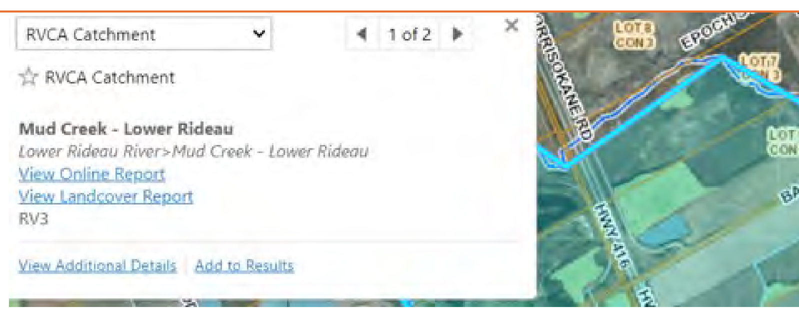


There is a presently suitable smallmouth bass nursery, however, it is non-sensitive, and no restriction is needed.





The property falls within the RVCA and is just south of the Jock River-Barrhaven catchment but is within the Mud Creek - Lower Rideau River catchment.

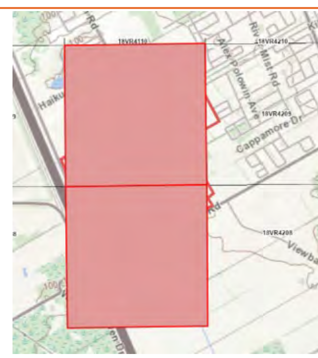


The Thomas Baxter Drain runs south to the east of the property and along its southern edge where it connects with the Mud Creek Drain.

Appendix B

Terrestrial Background Data

Table B1: Summary of Terrestrial Background Data Collection

Terrestrial Resources Background	
Comments	
General NHIC map showing unevaluated wetland and woodland just north of the pond along Borrisokane Rd and south of Appalachian Cir.	
	
NHIC Species map indicates bank swallow, eastern meadowlark, bobolink, and wood thrush within highlighted squares: 18VR4108, 18VR4109	 

NHIC data for the corresponding squares noted above.

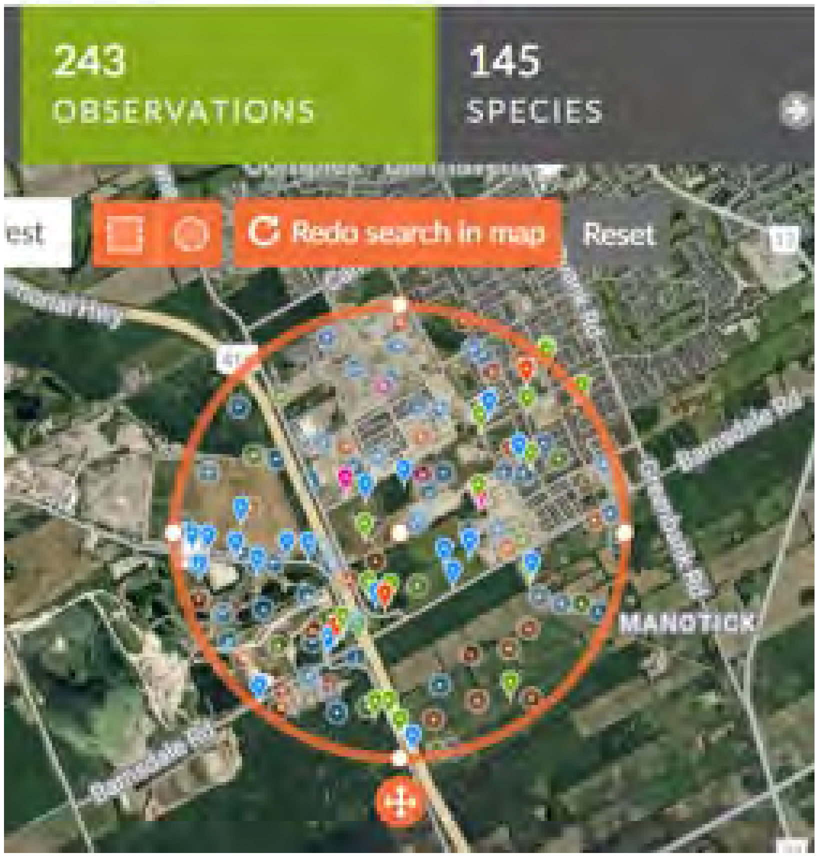
NHIC Data

To work further with this data select the content and copy it into your own word or excel document.

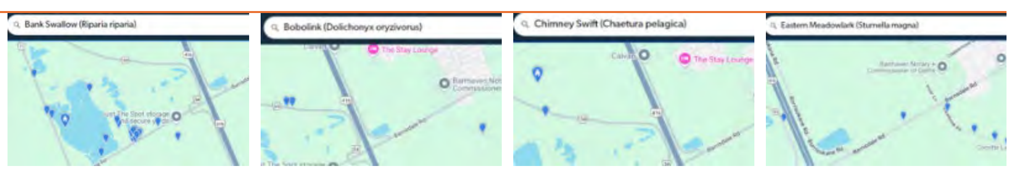
OGF ID	Element Type	Common Name	Scientific Name	SRank	SARO Status	COSEWIC Status	ATLAS NAD83 IDENT	COMMENTS
1107785	SPECIES	Upland Sandpiper	Bartramia longicauda	S2B			18VR4109	
1107785	SPECIES	Grasshopper Sparrow	Ammodramus savannarum	S4B	SC	SC	18VR4109	
1107785	SPECIES	Wood Thrush	Hylocichla mustelina	S4B	SC	THR	18VR4109	
1107785	SPECIES	Eastern Wood-pewee	Contopus virens	S4B	SC	SC	18VR4109	
1107785	SPECIES	Eastern Meadowlark	Sturnella magna	S4B,S3N	THR	THR	18VR4109	
1107785	SPECIES	Bank Swallow	Riparia riparia	S4B	THR	THR	18VR4109	
1107785	SPECIES	Bobolink	Dolichonyx oryzivorus	S4B	THR	SC	18VR4109	
1107784	SPECIES	Upland Sandpiper	Bartramia longicauda	S2B			18VR4108	
1107784	SPECIES	Grasshopper Sparrow	Ammodramus savannarum	S4B	SC	SC	18VR4108	
1107784	SPECIES	Eastern Wood-pewee	Contopus virens	S4B	SC	SC	18VR4108	
1107784	SPECIES	Eastern Meadowlark	Sturnella magna	S4B,S3N	THR	THR	18VR4108	
1107784	SPECIES	Bank Swallow	Riparia riparia	S4B	THR	THR	18VR4108	
1107784	SPECIES	Bobolink	Dolichonyx oryzivorus	S4B	THR	SC	18VR4108	

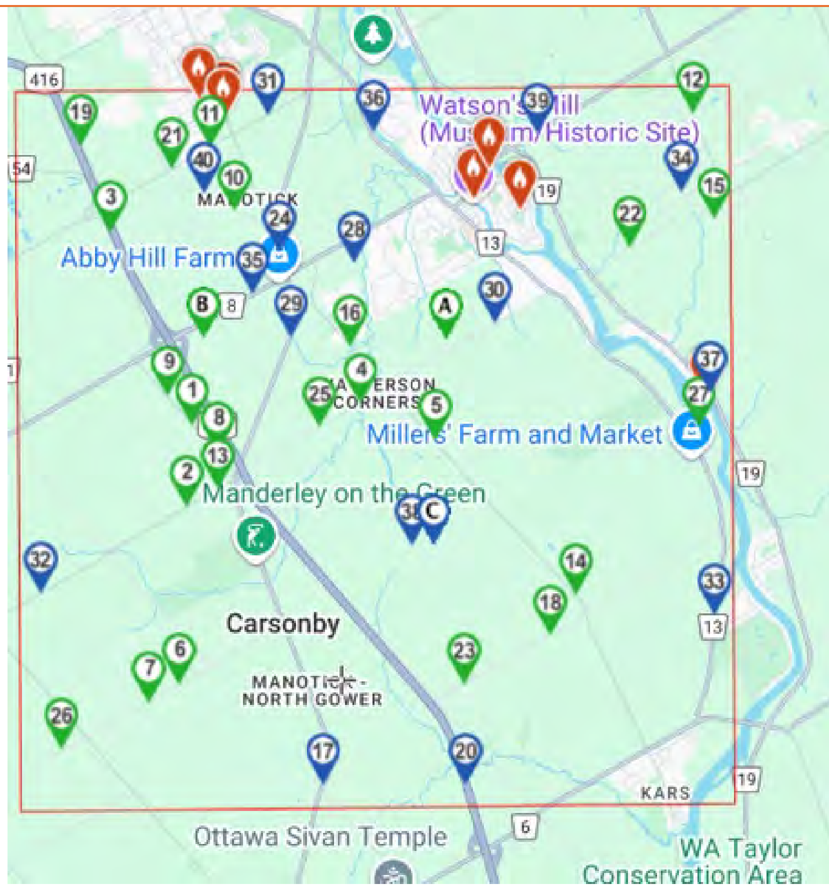
An iNaturalist search for research grade observations with an approximate 2km buffer from the center of the study area shows 145 species have been identified, with many outside the study area.

Notable SAR: 3 observations of Blanding's turtle and multiple monarch sightings.

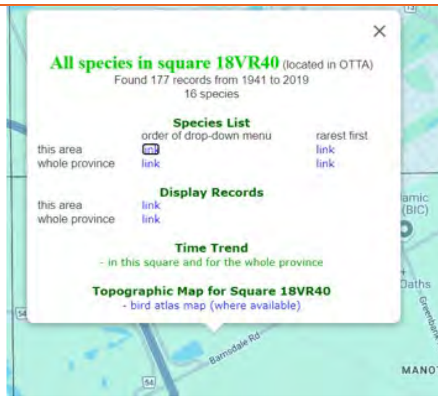


Exploring nearby eBird reports for SAR shows 7 notables species reported: bank swallow, bobolink,



chimney swift, eastern meadowlark, least bittern, lesser yellowlegs, and short-eared owl.	
	  
The study area falls within square 18VR40 of the OBBA. The list shows 94 species with strong breeding evidence. Notable SAR: bank swallow, least bittern, bobolink, eastern meadowlark, and wood thrush.	

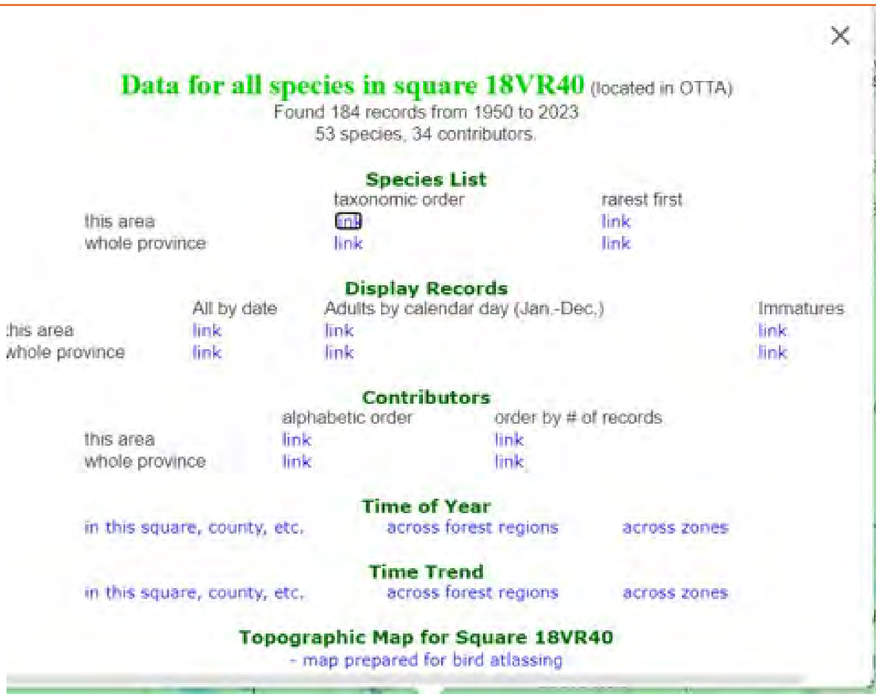
The ORAA produced 16 species for the square (18VR40) the study area is within. One notable SAR, Blanding's turtle, was last recorded in 2018.



Number of rows of data displayed below: 16.

Species #	Common Name	# of Records	Earliest Yr	Latest Yr
1	Blanding's Turtle	2	1974	2018
2	Eastern Musk Turtle	1	1980	1980
3	Midland Painted Turtle	16	1976	2018
8	Snapping Turtle	15	1995	2019
12	Eastern Gartersnake	4	1976	2017
25	American Bullfrog	14	1941	2008
28	Gray Treefrog	18	1986	2018
29	Green Frog	21	1954	2018
31	Northern Leopard Frog	31	1962	2018
33	Spring Peeper	15	1987	2009
34	Western Chorus Frog	6	1995	1997
35	Wood Frog	11	1976	2002
36	American Toad	18	1961	2018
44	Eastern Red-backed Salamander	2	1976	1992
48	Mudpuppy	1	1948	1948
50	Northern Two-lined Salamander	2	1954	1992

The OBA for research square 18VR40 produced 53 species, with the monarch, a species of special concern, being noted.



Appendix C

Species at Risk Screening

Common Name	Scientific Name	Habitat Description[1]	Conservation Status[2]				Source of Occurrence Record[3]	Habitat within Study Area?	Rationale for Determination of Habitat Presence
			Federal SARA	Federal COSEWIC	Provincial ESA	Provincial S-Rank			
Birds									
Bank Swallow	*Riparia riparia*	This species nests within vertical banks, with a preference for sand-silt substrate. Nesting sites more likely near open upland habitats. (COSEWIC 2013). Provincially, the species protected habitat is the 50 m in front of a breeding colony's bank face and all suitable foraging habitat within 500 m (MECP, 2015).	THR	THR	THR	S4B	eBird	No	Insufficient vertical banks exist on the property, including the stream banks that cut through the west end of property.
Bobolink	*Dolichonyx oryzivorus*	Primarily in forage crops, and grassland habitat. It is sensitive to edge effects, size of habitat and areas with dense shrub vegetation or a litter layer deeper than a few centimeters (COSEWIC, 2010). Provincially, this species' protected habitat is the area extending 60 m from the nest as well as the 300 m of suitable habitat around the nest (MECP, 2013).	THR	THR	THR	S4B	NHIC, eBird, OBBA	**Yes**	Agricultural fields and open meadow habitats within Study Area. .
Chimney Swift	*Chaetura pelagica*	Cities, towns, villages, rural, and wooded areas. This species rarely utilizes trees; they prefer trees greater than 50 cm in diameter and that are within 1 km of waterbodies (COSEWIC 2007). Provincially, this species' protected habitat consists of Category 1 habitat, which is a human-made nesting/roosting feature or natural nesting/roosting tree cavity, as well as the area within 90 m of the natural tree cavity (MECP, 2017). No Category 2 or 3 habitats are outlined for this species (MECP, 2017).	THR	THR	THR	S3B	eBird	No	Property does not contain wooded areas with large trees to serve as a nest sites, and there are no large waterbodies within 1 km.
Eastern Meadowlark	*Sturnella magna*	Open fields and pastures, meadows, prairies. Breeds in natural grasslands, meadows, weedy pastures, also in hayfields and sometimes in fields of other crops. Winters in many kinds of natural and cultivated fields. In the Midwest, it tends to prefer taller and lusher grass than Western Meadowlark, but in the Southwest, it lives in very arid desert grasslands.	THR	THR	THR	S4B, S3N	NHIC, eBird, OBBA	**Yes**	Agricultural fields and open meadow habitats within Study Area.
Least Bittern	*Ixobrychus exilis*	Fresh marshes, reedy ponds. Mostly freshwater marsh but also brackish marsh, in areas with tall, dense vegetation in standing in water. May be over deep water, because it mostly climbs in reeds rather than wading. Sometimes in salt marsh or in mangroves.	THR	THR	THR	S4B	eBird, OBBA	No	No areas of dense vegetation in standing water.
Lesser Yellowlegs	*Tringa flavipes*	Marshes, mudflats, shores, ponds; in summer, open boreal woods. Occurs widely in migration, including coastal estuaries, salt and fresh marshes, edges of lakes and ponds, typically more common on freshwater habitats. Often in same places as Greater Yellowlegs but may be less frequent on tidal flats. Breeds in large clearings, such as burned areas, near ponds in northern forest.	-	THR	THR	S3S4B, S5M	EBird, iNaturalist	No	Breeds in northern boreal forests. May be on site during migration if large mudflats, puddles exist, but only temporarily.
Herpetozoa									
Blanding's Turtle	*Emydoidea blandingii*	Shallow water marshes, bogs, ponds or swamps, or coves in larger lakes with soft, muddy bottoms and aquatic vegetation; basks on logs, stumps, or banks; surrounding natural habitat is important in summer as they frequently move from aquatic habitat to terrestrial habitats.	THR	THR	THR	S3	iNaturalist, ORAA	No	The study site does not contain sufficient marshes, bogs, ponds, or swamps for Blanding's to inhabit.
Mammals									
Little Brown Myotis	*Myotis lucifugus*	Females establish summer maternity colonies, often in buildings or large-diameter trees. Foraging occurs over water, along waterways, and forest edges. Overwinter in cold and humid hibernacula (caves/mines) (COSEWIC 2013).	END	END	END	S3	AMO	**Yes**	Study Area contains deciduous woodlands that could provide cavities and loose bark suitable for roosting.
Northern Myotis	*Myotis septentrionalis*	Older (late successional or primary forests) with large interior habitat and snags that are in the mid-stage of decay. They prefer intact interior habitat and are sensitive to edge habitats (Menzel et al., 2002; Broders et al., 2006; SWH 6E Ecoregion Criterion Schedule). Critical habitat has not yet been defined by the province.	END	END	END	S3	AMO	**Yes**	Study Area contains deciduous woodlands that could provide cavities and loose bark suitable for roosting.
Eastern Red Bat	*Lasiurus borealis*	Roosts among the foliage of both deciduous and coniferous trees, of any age class, and occasionally shrubs. Maternity roosts tend to be large in diameter	Not listed	END	END	S4	AMO	**Yes**	Study Area contains deciduous and coniferous trees that could

Common Name	Scientific Name	Habitat Description[1]	Conservation Status[2]				Source of Occurrence Record[3]	Habitat within Study Area?	Rationale for Determination of Habitat Presence
			Federal SARA	Federal COSEWIC	Provincial ESA	Provincial S-Rank			
		and tall, reaching or exceeding the height of the surrounding canopy. Forage in both forested and non-forested habitats, in both open and semi-cluttered habitats, both above and below forest canopies, and in both early and later stage forests. They overwinter in the southern United States.							provide cavities and loose bark suitable for roosting.
Hoary Bat	*Lasiurus cinereus*	Roosts among the foliage of both deciduous and coniferous trees, of any age class, and occasionally shrubs. Maternity roosts tend to be large in diameter and tall, reaching or exceeding the height of the surrounding canopy. Forage in the open, including wetlands, grasslands and open fields with patchily distributed trees. They overwinter in the southern United States.	Not listed	END	END	S4	AMO	**Yes**	Study Area contains deciduous and coniferous trees that could provide cavities and loose bark suitable for roosting.
Silver-haired Bat	*Lasionycteris noctivagans*	Roosting by Silver-haired Bats occurs primarily under bark and in the cavities of large, decaying, coniferous and deciduous trees. They may occasionally roost in or on buildings, especially during migration when natural roosting sites may be scarce. Forage in young and old forests, as well as forest openings (canopy gaps), but are concentrated along forest edges. Overwinter in the United States, southeastern British Columbia, and sometimes the Great Lakes region in mines, rock crevices, trees, and snags.	Not listed	END	END	S4	AMO	**Yes**	Study Area contains deciduous and coniferous trees that could provide cavities and loose bark suitable for roosting.
Tricolored Bat	*Perimyotis subflavus*	Females establish summer maternity colonies, often in buildings or large-diameter trees. Foraging occurs over water, along waterways, and forest edges. Overwinter in cold and humid hibernacula (caves/mines) (COSEWIC, 2013). Critical habitat has not yet been defined by the province.	END	END	END	S3?	AMO	**Yes**	Study Area contains deciduous woodlands that could provide cavities and loose bark suitable for roosting.
Plants									
Butternut	*Juglans cineara*	Found in a variety of habitat types but grows best on well-drained fertile soils in shallow valleys and on gradual slopes (COSEWIC, 2017). Provincially, butternuts are assessed and categorized based on the amount of canker. These categories are 1-3 with Category 1 trees as those that are heavily infected to the point that they are not expected to survive.	END	END	END	S2	NHIC	**Yes**	Sunny openings near forest edges with moist soils are present within the Study Area.
Black Ash	*Fraxinus nigra*	Predominantly a wetland species of swamps, floodplains, and fens. It has an intermediate light requirement and a tendency toward greater abundance in more alkaline sites. Most sites in which it is dominant are flood prone, where its high tolerance of seasonal flooding appears to offer a competitive advantage. Black Ash also occurs widely in moist upland forests, but generally at lower densities than in wet areas.	THR	THR	END	S4	-	**Yes**	Wetland habitat and drainage features may provide suitable habitat for Black Ash within the Subject Site.

Legend

Blue highlighted species are protected and/or have protected critical habitat within the Study Area and the species is confirmed present or has a Moderate to High probability of occurrence in the Study Area (i.e., the species is Threated, Endangered under the ESA, and/or the Threatened or Endangered species' critical habitat is present – including ferally listed migratory birds and fish). Only those SAR protected in the Study Area have been included in this table. Fish and molluscs have been excluded from this table as fish habitat is not present in the Study Area. No amphibian SAR occurrences have been reported in the vicinity of the Study Area.

Unhighlighted species are not expected to occur in the Study Area.

** Under consideration for status change*

1 Habitat description is sourced from the OMNR (2000) Significant Wildlife Habitat Technical Guide or from the Species at Risk in Ontario list provided in O. Reg. 230/08, unless otherwise cited.

2 Conservation Status: SC = Special Concern; THR = Threatened; END = Endangered; NAR = Not at Risk; Extirpated species have been excluded from the table.

***Federal SARA:** Species at Risk Act, 2002 Schedule 1 unless otherwise noted. The protection and/or conservation measures afforded by SARA apply only to species listed under Schedule 1.*

***Federal COSEWIC:** In the case that a species is not listed under Schedule 1 of SARA, but has a status recommended by the Committee on the Status of Endangered Wildlife in Canada, the uplisting of the species to Schedule 1 of SARA may be imminent.*

***Provincial ESA:** Endangered Species Act, 2007.*

***Provincial (or Subnational) S-Rank:** Subnational ranks are assigned and maintained by state or provincial NatureServe network programs.*

- *S1 – Critically Imperiled; S2 – Imperiled; S3 - Vulnerable; S4 Apparently Secure; S5 - Secure; B - Breeding; N - Non-breeding; ? - Uncertainty,*

3 Sources:

- *AMO = Atlas of the Mammals of Ontario*
- *iNat = iNaturalist observations*
- *OBA = Ontario Butterfly Atlas*
- *ECCC = Environment and Climate Change Canada Open Data*
- *ORAA = Ontario Reptile and Amphibian Atlas*
- *OBBA = Ontario Breeding Bird Atlas*
- *NHIC = Natural Heritage Information Centre Database.*
- *BCI = Bat Conservation International Inc. 2025. Bat Profiles.*
- *Colville = 2020 Field Survey results as reported by Colville Consulting Inc.'s 2024 Environmental Impact Statement0 Thompson Road, Town of Fort Erie*

Probability of Occurrence in the Study Area:

- ***Confirmed:** Species and/or preferred habitat has been observed in the Study Area (i.e., confirmed by recent field investigations, consultation with MECP, or reliable secondary source).*
- ***High:** Species has been reported in the vicinity of the Study Area during field investigations by others or within 10 km atlas square. The species' preferred habitat is abundant within the Study Area. Species with a high probability of occurrence would be expected to breed within or frequently use the habitats available within the Study Area and would be known to have a high relative abundance within the region (i.e., compared to other regions in Ontario).*
- ***Moderate:** Species' preferred habitat is present but limited or uncommon in the Study Area and breeding in the area is rare. Species with Moderate probability of occurrence may intermittently use the area for foraging, migration, or movement to other parts of their home range and therefore may have been documented in secondary sources or field investigations.*
- ***Low:** Species has been recorded in the vicinity of the Study Area during field investigations by others or within 10 km atlas square. The species' preferred habitat does not occur or is extremely limited within the Study Area. These species may intermittently move through the Study Area but are unlikely to become permanent residents. Reports of this species may be historical records.*

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Appendix D

On-Site Species Observations

Table D1: Breeding Bird List

Common Name	Scientific Name	Conservation Status1		
		Federal (SARA, 2002)	Provincial (ESA, 2007)	S-Rank
American Goldfinch	*Spinus tristis*	-	-	S5
American Redstart	*Setophaga ruticilla*	-	-	S5B
American Robin	*Turdus migratorius*	-	-	S5
Barred Owl	*Strix varia*	-	-	S5
Belted Kingfisher	*Megaceryle alcyon*	-	-	S5B,S4N
Black-capped Chickadee	*Poecile atricapillus*	-	-	S5
Blue Jay	*Cyanocitta cristata*	-	-	S5
Canada Goose	*Branta canadensis*	-	-	S5
Cedar Waxwing	*Bombycilla cedrorum*	-	-	S5
Common Yellowthroat	*Geothlypis trichas*	-	-	S5B,S3N
Eastern Phoebe	*Sayornis phoebe*	-	-	S5B
Eastern Wood-pewee	*Contopus virens*	SC	SC	S4B
European Starling	*Sturnus vulgaris*	-	-	SNA
Fox Sparrow	*Passerella iliaca*	-	-	S5B,S3N
Gray Catbird	*Dumetella carolinensis*	-	-	S5B,S3N
Great Blue Heron	*Ardea herodias*	-	-	S4
Great Crested Flycatcher	*Myiarchus crinitus*	-	-	S5B
Killdeer	*Charadrius vociferus*	-	-	S4B
Least Flycatcher	*Empidonax minimus*	-	-	S5B
Mallard	*Anas platyrhynchos*	-	-	S5
Northern Cardinal	*Cardinalis cardinalis*	-	-	S5
Northern Parula	*Setophaga americana*	-	-	S5B
Ovenbird	*Seiurus aurocapilla*	-	-	S5B
Red-eyed Vireo	*Vireo olivaceus*	-	-	S5B
Red-winged Blackbird	*Agelaius phoeniceus*	-	-	S5
Ring-billed Gull	*Larus delawarensis*	-	-	S5
Savannah Sparrow	*Passerculus sandwichensis*	-	-	S5B,S3N
Song Sparrow	*Melospiza melodia*	-	-	S5
Turkey Vulture	*Cathartes aura*	-	-	S5B,S3N
Vesper Sparrow	*Pooecetes gramineus*	-	-	S4B
Warbling Vireo	*Vireo gilvus*	-	-	S5B
White-breasted Nuthatch	*Sitta carolinensis*	-	-	S5
Yellow Warbler	*Setophaga petechia*	-	-	S5B

1 - Conservation Status:

SC = Special Concern; THR = Threatened; END = Endangered; NA = Not at Risk

Federal SARA = Species at Risk Act, 2002 Schedule 1 unless otherwise noted. The protection and/or conservation measures afforded by SARA apply only to species listed under Schedule 1.

Federal COSEWIC = In the case that a species is not listed under Schedule 1 of SARA, but has a status recommended by the Committee on the Status of Endangered Wildlife in Canada, the uplisting of the species to Schedule 1 of SARA may be imminent.

Provincial ESA = Endangered Species Act, 2007.

Provincial (or Subnational) S-Rank: Subnational ranks are assigned and maintained by state or provincial NatureServe network programs.

S1 – Critically Imperiled; S2 – Imperiled; S3 - Vulnerable; S4 - Apparently Secure; S5 - Secure; B - Breeding; N - Non-breeding; ? - Uncertainty

Table D2 Incidental Bird List

Common Name	Scientific Name	Conservation Status1		
		Federal (SARA, 2002)	Provincial (ESA, 2007)	S-Rank
American Crow	*Corvus brachyrhynchos*	-	-	S5
American Goldfinch	*Spinus tristis*	-	-	S5
Black-capped Chickadee	*Poecile atricapillus*	-	-	S5
Common Grackle	*Quiscalus quiscula*	-	-	S5
Double-crested Cormorant	*Nannopterum auritum*	-	NAR	S5B,S4N
Eastern Wood-pewee	*Contopus virens*	SC	SC	S4B
Killdeer	*Charadrius vociferus*	-	-	S4B
Mourning dove	*Zenaida macroura*	-	-	S5
Red-tailed Hawk	*Buteo jamaicensis*	-	NAR	S5
Red-winged Blackbird	*Agelaius phoeniceus*	-	-	S5
Song Sparrow	*Melospiza melodia*	-	-	S5
Wild Turkey	*Meleagris gallopavo*	-	-	S5

1 - Conservation Status:

SC = Special Concern; THR = Threatened; END = Endangered; NA = Not at Risk

Federal SARA = Species at Risk Act, 2002 Schedule 1 unless otherwise noted. The protection and/or conservation measures afforded by SARA apply only to species listed under Schedule 1.

Federal COSEWIC = In the case that a species is not listed under Schedule 1 of SARA, but has a status recommended by the Committee on the Status of Endangered Wildlife in Canada, the uplisting of the species to Schedule 1 of SARA may be imminent.

Provincial ESA = Endangered Species Act, 2007.

Provincial (or Subnational) S-Rank: Subnational ranks are assigned and maintained by state or provincial NatureServe network programs.

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Table D3: Other Incidental Species List

Common Name	Scientific Name	Conservation Status1		
		Federal (SARA, 2002)	Provincial (ESA, 2007)	S-Rank
Herpetofauna				
American Toad	Anaxyrus americanus	-	-	S5
Gray Treefrog	Dryophytes versicolor	-	-	S5
Green Frog	Lithobates clamitans	-	-	S5
Northern Leopard Frog	Lithobates pipiens	-	NAR	S5
Mammals				
Eastern Gray Squirrel	Sciurus carolinensis	-	-	S5
Insects				
Black Swallowtail	Papilio polyxenes	-	-	S5
Fish				
Creek chub	Semotilus atromaculatus	-	-	-
Brook Stickleback	Culaea inconstans	-	-	-

1 - Conservation Status:

SC = Special Concern; THR = Threatened; END = Endangered; NA = Not at Risk

Federal SARA = *Species at Risk Act, 2002* Schedule 1 unless otherwise noted. The protection and/or conservation measures afforded by SARA apply only to species listed under Schedule 1.

Federal COSEWIC = In the case that a species is not listed under Schedule 1 of SARA, but has a status recommended by the Committee on the Status of Endangered Wildlife in Canada, the uplisting of the species to Schedule 1 of SARA may be imminent.

Provincial ESA = *Endangered Species Act, 2007*.

Provincial (or Subnational) S-Rank: Subnational ranks are assigned and maintained by state or provincial NatureServe network programs.

S1 – Critically Imperiled; S2 – Imperiled; S3 - Vulnerable; S4 - Apparently Secure; S5 - Secure; B - Breeding; N - Non-breeding; ? – Uncertainty

Table D4: Plant List

Common Name	Scientific Name	Conservation Status1			Coefficient of Conservation	Coefficient of Wetness
		SARA	SARO	S-Rank		
American Beech	*Fagus grandifolia*	-	-	S4	6	3
Basswood	*Tilia americana*	-	-	S5	4	3
Bebb's Willow	*Salix bebbiana*	-	-	S5	4	-3
Beechdrops	*Epifagus virginiana*	-	-	S5	6	5
Bitternut Hickory	*Carya cordiformis*	-	-	S5	6	0
Black Cherry	*Prunus serotina*	-	-	S5	3	3
Black Raspberry	*Rubus occidentalis*	-	-	S5	2	5
Black-eyed Susan	*Rudbeckia hirta*	-	-	S5	0	3
Bladder Campion	*Silene vulgaris*	-	-	SNA	0	5
Bloodroot	*Sanguinaria canadensis*	-	-	S5	5	3

Common Name	Scientific Name	Conservation Status1			Coefficient of Conservation	Coefficient of Wetness
		SARA	SARO	S-Rank		
Bracken Fern	*Pteridium aquilinum*	-	-	S5	2	3
Bull Thistle	*Cirsium vulgare*	-	-	SNA	0	3
Canada Horseweed	*Erigeron canadensis*	-	-	S5	0	3
Canada Mint	*Mentha canadensis*	-	-	S5	3	-3
Clubmoss Spp.	*Lycopodiopsida spp.*	-	-	-	-	-
Common Elderberry	*Sambucus canadensis*	-	-	S5	5	-3
Common Hemp-nettle	*Galeopsis tetrahit*	-	-	SNA	0	3
Common Juniper	*Juniperus communis*	-	-	S5	4	3
Common Lamb's-quarters	*Chenopodium album*	-	-	SNA	0	3
Common Milkweed	*Asclepias syriaca*	-	-	S5	0	5
Common Mullein	*Verbascum thapsus*	-	-	SNA	0	5
Common Oak Fern	*Gymnocarpium dryopteris*	-	-	S5	7	3
Common Plantain	*Plantago major*	-	-	SNA	0	3
Common Vetch	*Vicia sativa*	-	-	SNA	0	3
Common Viper's Bugloss	*Echium vulgare*	-	-	SNA	0	5
Eastern Hemlock	*Tsuga canadensis*	-	-	S5	7	3
Eastern Prickly Gooseberry	*Ribes cynosbati*	-	-	S5	4	3
Eastern White Cedar	*Thuja occidentalis*	-	-	S5	4	-3
Eastern White Pine	*Pinus strobus*	-	-	S5	4	3
European Honeysuckle	*Lonicera periclymenum*	-	-	SNA	0	0
Field Wormwood	*Artemisia campestris*	-	-	S5	8	5
Freeman's Maple	*Acer x freemanii*	-	-	SNA	6	-5
Garden Bird's-foot Trefoil	*Lotus corniculatus*	-	-	SNA	0	3
Geranium Spp.	*Geranium spp.*	-	-	-	-	-
Glossy Buckthorn	*Frangula alnus*	-	-	SNA	0	0
Green Ash	*Fraxinus pennsylvanica*	-	-	S4	3	-3
Hemp Dogbane	*Apocynum cannabinum*	-	-	S5	3	0
Herb-Robert	*Geranium robertianum*	-	-	S5	2	3
Ironwood	*Ostrya virginiana*	-	-	S5	4	3
Kentucky Bluegrass	*Poa pratensis*	-	-	S5	0	3
Large False Solomon's Seal	*Maianthemum racemosum*	-	-	S5	4	3
Lopseed	*Phryma leptostachya*	-	-	S4S5	6	3
Manitoba Maple	*Acer negundo*	-	-	S5	0	0
New England Aster	*Symphyotrichum novae-angliae*	-	-	S5	2	-3
New York Fern	*Parathelypteris noveboracensis*	-	-	S4S5	7	0
Northeastern Lady Fern	*Athyrium filix-femina var. angustum*	-	-	S5	4	0

Common Name	Scientific Name	Conservation Status1			Coefficient of Conservation	Coefficient of Wetness
		SARA	SARO	S-Rank		
Northern Starflower	*Lysimachia borealis*	-	-	S5	6	0
Ostrich Fern	*Matteuccia struthiopteris*	-	-	S5	5	0
Paper Birch	*Betula papyrifera*	-	-	S5	2	3
Partridgeberry	*Mitchella repens*	-	-	S5	6	3
Poison Ivy	*Toxicodendron radicans*	-	-	S5	2	0
Purple Leaf Sand Cherry	*Prunus x cistena*	-	-	SNA	0	0
Purple Loosestrife	*Lythrum salicaria*	-	-	SNA	0	-5
Purple-flowering Raspberry	*Rubus odoratus*	-	-	S5	3	5
Red Clover	*Trifolium pratense*	-	-	SNA	0	3
Red Maple	*Acer rubrum*	-	-	S5	4	0
Red Pine	*Pinus resinosa*	-	-	S5	8	3
Red Raspberry	*Rubus idaeus*	-	-	S5	2	3
Red-osier Dogwood	*Cornus sericea*	-	-	S5	2	-3
Riverbank Grape	*Vitis riparia*	-	-	S5	0	0
Royal Fern	*Osmunda regalis*	-	-	S5	7	-5
Running Clubmoss	*Lycopodium clavatum*	-	-	S5	6	0
Sandbar Willow	*Salix interior*	-	-	S5	1	-3
Sedge Spp.	*Cyperaceae spp.*	-	-	-	-	-
Sensitive Fern	*Onoclea sensibilis*	-	-	S5	4	-3
Sharp-lobed Hepatica	*Hepatica acutiloba*	-	-	S5	8	5
Small Enchanter's Nightshade	*Circaea alpina*	-	-	S5	6	-3
Smooth Brome	*Bromus inermis*	-	-	SNA	0	5
Staghorn Sumac	*Rhus typhina*	-	-	S5	1	3
Sugar Maple	*Acer saccharum*	-	-	S5	4	3
Sulphur Cinquefoil	*Potentilla recta*	-	-	SNA	0	5
Sunchoke	*Helianthus tuberosus*	-	-	SU	1	0
Tall Blue Lettuce	*Lactuca biennis*	-	-	S5	6	0
Tall Goldenrod	*Solidago altissima*	-	-	S5	1	3
Trembling Aspen	*Populus tremuloides*	-	-	S5	2	0
Virginia Clematis	*Clematis virginiana*	-	-	S5	3	0
Virginia Creeper	*Parthenocissus quinquefolia*	-	-	S4?	6	3
White Ash	*Fraxinus americana*	-	-	S4	4	3
White Baneberry	*Actaea pachypoda*	-	-	S5	6	5
White Elm	*Ulmus americana*	-	-	S5	3	-3
White Meadowsweet	*Spiraea alba*	-	-	S5	3	-3
White Oak	*Quercus alba*	-	-	S5	6	3
White Spruce	*Picea glauca*	-	-	S5	6	3
White Trillium	*Trillium grandiflorum*	-	-	S5	5	3

Common Name	Scientific Name	Conservation Status1			Coefficient of Conservation	Coefficient of Wetness
		SARA	SARO	S-Rank		
Wild Carrot	*Daucus carota*	-	-	SNA	0	5
Wild Lily-of-the-valley	*Maianthemum canadense*	-	-	S5	5	3
Wild Sarsaparilla	*Aralia nudicaulis*	-	-	S5	4	3
Wild Strawberry	*Fragaria virginiana*	-	-	S5	2	3
Willow Spp.	*Salix spp.*	-	-	-	-	-
Yellow Birch	*Betula alleghaniensis*	-	-	S5	6	0

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Appendix E

Significant Wildlife Habitat Assessment

Table E1: Candidate Significant Wildlife Assessment (Ecoregion 6E) – Barrhaven South Phase 3 – S1 Urban Expansion Area

Significant Wildlife Habitat	Candidate SWH		Confirmed SWH		Comments
	ELC Codes	Additional Criteria Summary	In Site	In Adjacent Lands	
Seasonal Concentration Areas of Animals					
Waterfowl Stopover and Staging Areas (terrestrial)	Certain cultural meadow or thicket <u>Plus,</u> evidence of annual spring flooding	Fields flooded from mid-March to May	No spring flooding observed. No large flocks of waterfowl observed during surveys.		Not discussed further
Waterfowl Stopover and Staging Areas (aquatic)	Specific aquatic habitat types (marsh, swamps)	Ponds, marshes, lakes, bays, coastal inlets, and watercourses used for migration. Stormwater and sewage management facilities are not included.	No suitable habitat features present. No large flocks of waterfowl observed during surveys.		Not Present; Not discussed further
Shorebird Migratory Stopover Area	Beach/Bar Sand Dunes Meadow marsh	Shorelines used in May to mid-June and early July to October. Stormwater and sewage management facilities are not included.	No shallow shorelines, beaches, bars, dunes, or meadow marshes. No shorebirds observed during surveys.		Not Present; Not discussed further
Raptor Wintering Area	Requires combination of forest (deciduous, mixed, or coniferous) and upland (cultural meadow, cultural thickets, cultural savannahs, or cultural woodlands)	Combination of habitats must >20 ha and the field portion must be wind swept with little accumulation of snow. Where site is for eagles, open water and large trees and snags must be available.	The combination of woodland and meadow habitat on Site are not large enough. No large trees suitable for eagles were noted.		Not Present; Not discussed further
Bat Hibernacula	Crevices and caves	Active mines are not to be included. Buildings are not included.	No crevices or caves present		Not Present; Not discussed further
Bat Maternity Colonies	Deciduous, or mixed forests Deciduous or mixed Swamps (>5m tall)	>10/ha large diameter (>25 cm diameter at breast height) Snag trees in the decay classes 1-3 are preferred.	Suitable bat maternity habitat is present in the upland forest ecosites. Timing windows for SAR bats will protect for general bats.		Discussed under SWH section.
Turtle Wintering Areas	Swamps, marshes, open water, shallow water, open fen, or open bog	Water that is deep enough not to freeze solid with soft bottoms. Must be permanent waterbody (or wetlands with adequate dissolved oxygen)	Man-made ponds such as sewage lagoons or storm water ponds should not be considered SWH.		Not discussed further
Reptile Hibernaculum	Any habitat except very wetlands Talus, rock barren, cave and alvar	For snakes – needs to be below frost lines.	No rocky outcroppings present. No snakes encountered during the site investigations.		Not Present; Not discussed further
Colonially – Nesting Bird Breeding Habitat (Bank and Cliff Swallow)	Exposed sandy slopes of banks or piles. Cliff faces or structures (bridges, silos etc....)	Does not include licensed aggregate areas. Does not include man-made structures or recently (within 2 years) disturbed soil	No suitable habitat features present. No bank or cliff swallows observed during surveys.		Not Present; Not discussed further
Colonially – Nesting Bird Breeding Habitat (Trees/Shrubs)	Swamps – deciduous or mixed (trees >5m) Treed fen	Typically requires tall trees as nests are usually 11-15m from ground but shrubs and emergent vegetation could be used.	Breeding bird surveys were completed, and no colonial nesting species were observed.		Not Present; Not discussed further
Colonially – Nesting Bird Breeding Habitat (Ground)	Any rocky island or peninsula on lake or large river. For Brewer's Blackbird – near watercourses in open fields, pastures		No rocky islands, or peninsulas were present. Breeding bird surveys were completed, and no colonial nesting species were observed.		Not Present; Not discussed further
Migratory Butterfly Stopover Area	***Not applicable to Ottawa Area – must be within 5 km of Lake Ontario***				
Landbird Migratory Stopover Area					
Deer Yarding Areas	Mixed or coniferous forests or swamps (>5m tall trees) Can include plantations, cultural thickets, or dry-fresh poplar-white birch deciduous forest	These are mapped by OMNRF	None mapped by OMNRF for this area		Not Present; Not discussed further

Significant Wildlife Habitat	Candidate SWH		Confirmed SWH		Comments
	ELC Codes	Additional Criteria Summary	In Site	In Adjacent Lands	
Deer Winter Congregation Area	All forest and wetland habitats and small conifer plantations	These are mapped by OMNRF (typically, >100ha in size)	None mapped by OMNRF for this area		Not Present; Not discussed further
Rare Vegetation Communities or Specialized Habitat for Wildlife					
Cliffs and Talus Slopes	Near vertical face that is >3m in height (cliff or talus)	Typically, in Niagara Escarpment	Cliffs and talus slope habitat were not present		Not Present; Not discussed further
Sand Barren	Sand barrens various types but tree cover is always ≤ 60%	Must be >0.5ha	Sand barrens not present.		Not Present; Not discussed further
Alvar	Alvar, Coniferous Forest, cultural meadow, cultural savannah, cultural thickets, and cultural woodlands	Must have at least 4 indicator species with substantial cover (must not have large amounts of exotic or introduced species) Must be >0.5ha	Alvar habitat is typically flat and mostly unfractured calcareous bedrock. Not present		Not Present; Not discussed further
Old Growth Forest	Any forest or treed (>5 m) swamp	Must be at least 30 ha with at least 10 ha of interior habitat (edge considered 100 m) Have specific characteristics (snags, mosaic of gaps, multi-layered canopy)	Woodland A and Woodland B did not meet the requirements for old growth.		Not Present; Not discussed further
Savannah	Tallgrass prairie savannah and cultural savannah	Must have indicator species	No savannah present		Not Present; Not discussed further
Tallgrass Prairie	Tallgrass prairie (open prairie - <25% tree cover)	No minimum size	No tallgrass prairie was present.		Not Present; Not discussed further
Other Rare Vegetation Communities	Provincially rare S1-S3 communities as described in Appendix M of the SWHTG		None of the communities listed for the Ottawa-Carleton Area in Appendix M were present.		Not Present; Not discussed further
Specialized Habitat for Wildlife					
Waterfowl Nesting Area	Shallow marsh, meadow marsh, thicket swamp or deciduous (treed >5 m tall) swamps	Wetland must be 0.5 ha or consist of up to 3 smaller wetlands within 120 m of each other if known nesting is occurring.	The Site did not meet the minimum requirements of 3 or more nesting pairs of species, or 10 or more pairs of Mallards.		Not Present; Not discussed further
Bald Eagle and Osprey Nesting, Foraging, and Perching Habitat	Any forest or swamp (trees >5m) type of habitat that is immediately next to rivers, lakes, ponds, or wetlands	Nests on man-made structures are not included.	Some active in general area but none observed during survey, no nests present on or near site.		Not Present; Not discussed further
Woodland Raptor Nesting Habitat	Any forest habitat or treed swamp (>5m tall) or coniferous plantation	Stand must be > 30 ha with >10 ha of interior habitat (edge is 200 m)	Presence of two (2) juvenile/fledged young of barred owl in the Dry-Fresh Hemlock – White Pine Mixed Forest observed by WSP in 2021.		Discussed under SWH section.
Turtle Nesting Areas	Shallow marsh, shallow water, open bog	Close to water but away from roads. It must provide sand and gravel that turtles can dig through and be in open sunny areas. Areas on the sides of municipal or provincial roads are not included.	The only potential habitat noted were the ploughed agricultural fields however, these are actively cropped and not suitable for nesting turtles.		Not Present; Not discussed further.
Seeps and Springs	Any forested community could have a seep/spring	Forest area with <25% meadow/pasture in the headwaters of a stream.	Candidate habitat not present.		Not Present; Not discussed further
Amphibian Breeding Habitat (woodland)	Any forest or treed swamp (>5m tall trees)	Wetland, pond, or vernal pool must be > 500 m^2 Those with water until mid-July (during most years) are better candidates	Woodland breeding habitat is present. However, the vernal pools do not meet size requirement, and the amphibian breeding quantity or species diversity do not meet the requirements.		Not discussed further
Amphibian Breeding Habitat (wetlands)	Swamps, marsh, fen, bog, open water, or shallow water	Unless it is a larger wetland, must be >120 m from woodlands. Must be > 500 m^2	Candidate habitat not present.		Not Present; Not discussed further
Woodland Area-Sensitive Bird Breeding Habitat	Any forest or treed swamp (>5 m tall)	Interior habitat (200 m edge used) in mature (>60 years) large (>30 ha) stand	Candidate habitat not present.		Not Present; Not discussed further

Significant Wildlife Habitat	Candidate SWH		Confirmed SWH		Comments
	ELC Codes	Additional Criteria Summary	In Site	In Adjacent Lands	
Habitat for Species of Conservation Concern (not including Endangered or Threatened Species)					
Marsh Bird Breeding Habitat	Meadow marsh, shallow water, fen, or open bog		Does not meet the minimum requirements.		Not Present; Not discussed further
Open Country Bird Breeding Habitat	Cultural meadows	Must be large grasslands (>30 ha) Agricultural class 1 and 2 are not included Agricultural lands planted in row crop or intensive hay, or pastures (within past 5 years) not included.	Candidate habitat not present.		Not Present; Not discussed further
Shrub/Early Successional Bird Breeding Habitat	Cultural thickets or woodlands	Must be > 10 ha. Agricultural class 1 and 2 are not included. Agricultural lands planted in row crop or intensive hay, or pastures (within past 5 years) not included.	Candidate habitat and species present. However, the cultural thickets on Site to not meet the size requirements.		Not discussed further
Terrestrial crayfish	Not present in Ottawa Area				
Special Concern and Rare Wildlife Species	All special concern or species ranked as S1-S3, SH (plants or animals)	Habitat depends on the species. Of those listed in SWHCS there is a potential for Snapping Turtle.	Eastern wood-pewee, and Monarch present on site.		Discussed under SWH section.
Animal Movement Corridors					
Amphibian Movement Corridor	Any habitat but amphibian breeding wetland habitat must be identified		The criterion indicates that amphibian movement corridors are to have a minimum of 15 m of native vegetation on both sides of the waterway. This is not present at this location.		Not Present; Not discussed further
Deer Movement Corridor	All forests but project must be in Stratum II Deer Wintering Area and Deer Wintering Habitat must be confirmed.		Not applicable – no Deer Wintering Areas or Habitat identified by OMNRF for area.		Not Present; Not discussed further

Appendix F

Significant Woodlands Assessment

Barrhaven South Phase 3 – S1 Expansion Lands

Significant Woodlands Assessment

1. Introduction

Fotenn was retained by Minto Communities Canada to finalize the *Significant Woodlands Assessment* for the proposed Barrhaven South S1 Urban Expansion Lands development. This assessment was guided by the City of Ottawa's SWG (2022b) which outline criteria for identifying and preserving woodlands that contribute to ecological, social, and cultural values. Special policies exist for significant woodlands and other natural heritage features in urban expansion areas under Official Plan policies in Section 3.1 and 12.2. In these areas, development proponents are required to identify and to convey the natural heritage system and natural heritage features to the City. Significant woodlands, however, are subject to further evaluation using these guidelines to determine if retention of the woodlot provides the greatest community benefit, or if modification or reduction of the woodlot is warranted prior to conveyance (City of Ottawa 2022b).

1.1. Purpose of Assessment

The purpose of this assessment is to support land-use planning for this Future Neighbourhood under the City's Urban Expansion Areas to make an informed decision as to whether the proposed works will have a negative impact on the Significant Woodlands identified and/or its ecological functions which are present on the Site. Overall, the City aims to maintain the amount of green space and associated benefits for the community.

This report provides a summary of the available information from background review and site investigations. Using this data, an assessment of the functions and values of these features within the Site, as well as an evaluation of its significance as per applicable guidelines (i.e., Official Plan, Provincial Planning Statement) has been completed. The report concludes with general recommendations on avoidance and mitigation measures to protect these significant natural features from impacts.

Legend

- Study Area (120m)
- Site
- Significant Woodlands
- Approved Woodland Removal (Kilbirnie Extension)

0 40 80 160 240 320 Meters

Scale: 1:5,000

Project Name:

Barrhaven South Phase 3 - S1 Area Natural Heritage Existing Conditions Report

Title:

Site and Study Area

FOTENN

Date: 4/9/2026

Figure: F-1

2. Existing Conditions

Peri-urban woodlands are described in the City's SWG (2022b) as being woodlands located within areas that have been identified for urban expansion demonstrated in the City's OP Schedule C17 – Urban Expansion Areas. Woodlands within the peri-urban boundary are considered significant if they are a minimum of 60 years old and 0.8 ha or larger in area. Within larger woodlands, only portions that can be identified as older than 60 years old through aerial imagery interpretation count towards this 0.8 ha size threshold and are identified as significant.

Three woodlands on the Site were assessed for significance using desktop tools (e.g., geoOttawa) in relation to the guidelines for 'peri-urban woodlots', as outlined in the City's SWG (2022b) document.

Woodland A

Woodland A (Dry-Fresh Hemlock - White Pine Mixed Forest; approximately 10.1 ha) is located within the southwestern extent of the Site approximately 15 m north of the offline pond, just north of the Borrisokane and Barnsdale Road intersection, and is bounded by Borrisokane Road to the west. The majority of this feature occurs within the Urban Expansion Area designated for future *Industrial and Logistics*, while a smaller portion of the woodland is within the *Category 1 - Future Neighbourhoods* designation in the City OP.

Sixty years ago, Woodland A was historically approximately 9.0 ha. Approximately 7.0 ha (78%) of this woodland was identified within the Urban Expansion Area as identified within the City's OP *Schedule C-17*. The remaining 2.8 ha of historic woodland was removed for the construction of Highway 416 and Borrisokane Road.

Given that most of Woodland A is within the Industrial and Logistics Urban Expansion Area, it is reasonable to assume that it would be considered a peri-urban woodland. Based on the evaluation of peri-urban criteria, the majority of ***Woodland A is considered significant***.

Woodland B

Woodland B (Dry-Fresh Sugar Maple - Beech Deciduous Forest; approximately 4.0 ha) is in the center of the northern extent of the Site, within the Urban Expansion Area designated as Category 1 – Future Neighbourhoods in the City OP.

From the 1976 imagery, the historical area of Woodland B is approximately 4.0 ha, corresponding with current conditions. Based on the evaluation of peri-urban criteria, ***Woodland B is considered Significant*** as it is larger than 0.8 ha and approximately 3.78 ha (95%) of the present-day woodland is older than 60 years old.

Based on the evaluation of peri-urban criteria, the majority of both Woodland A and Woodland B are considered significant as they are a minimum of 60 years old and 0.8 ha or larger in area.

Based on this cursory review of aerial imagery which confirmed that both Woodland A and Woodland B on Site are considered significant, the following assessment techniques have been undertaken to assess these woodlands.

Photo 1: Aerial Image of Woodlands in 1976

3. Assessment Approach

Both Significant Woodlands were assessed through the City of Ottawa's Policy on Significant Woodlands Guidelines for Identification, Evaluation, and Impacts, following the Urban Expansion Area / Future Neighbourhood Process – C Protocol. Comparative concept plans prepared by Minto and Fotenn were utilized in this evaluation to establish three possible scenarios that propose the full or near-full retention of the Significant Woodlands, partial retention of both Significant Woodlands, and a preferred development solution that best integrates Significant Woodland A and Significant Woodland B within the Project site. Area calculations, tree planting estimates, and evaluations were conducted alongside policy descriptions to determine accessible greenspace between Street-oriented Residential and Multi-unit Residential blocks.

The Significant Woodland Policy outlines four key areas of assessment: Total Accessible Greenspace, Residential Greenspace Access, Canopy Coverage, and an iTree V.6 analysis. The policy provides clear criteria for evaluating greenspace within the neighbourhood.

A plot-based tree inventory was derived from ELC survey and field investigation to assess species diversity and structural composition of both Significant Woodlands. The inventory data was further analyzed using iTree V.6, providing additional conservation-related statistics such as carbon sequestration and avoided stormwater runoff.

3.1. Concept Plans

Three Concept Plans have been prepared, two by Minto and one by Fotenn, which represent different approaches to the treatment of the two Significant Woodlands situated within the Site:

- **Concept Plan 1** proposes the near-full retention of both Woodlands A and B, aside from the removal of some border areas to accommodate adjacent land parcels and approved extension of Kilbirnie Road.
- **Concept Plan 2** is similar to Concept Plan 1, but proposes the removal of 3.5 ha of significant woodland total, represented by 2.4 ha of Woodland A and 1.1 ha of Woodland B removed.
- **Concept Plan 3** proposes an intermediate removal of 4.7 ha of significant woodland total, represented by 4.5 ha of Woodland A and 0.2 ha of Woodland B.

See **Section 4** below.

3.2. Evaluation of Significance

The criteria for urban Significant Woodlands falls into two types: *Screening Criteria*, and *Comparative Criteria*.

Screening Criteria represent important ecosystem functions and services that cannot be replaced or substituted, or for which impacts cannot be adequately mitigated. Areas of Significant Woodland providing these services should be conserved and protected from negative impact (City of Ottawa 2022).

Comparative Criteria represent those ecosystem services that can be replaced, substituted, or adequately mitigated through urban design or engineering. These criteria will be used to evaluate the nature and magnitude of the impacts and to evaluate development options (City of Ottawa 2022).

The following table, provided in the City's SWG (City of Ottawa 2022b), summarizes the criteria for urban Significant Woodlands and identifies the measures and indicators used to represent them (**Table 1**).

3.3. Evaluation Criteria

Green spaces of high importance include Significant Woodlands, parks, and open areas that connect to Significant Woodlands and parks. Areas of moderate importance encompass the proposed stormwater management pond and any open spaces not directly linked to high-quality green areas.

The projected canopy coverage for the neighbourhood at maturity was estimated using assumptions based on landscape planting data from adjacent developments and with guidance from suggested plantings from the City of Ottawa.

- Some statistics of interest used for comparing the Concept Plans include the following:
- Street-oriented Residential with Greenspace Access (%);
- Multi-unit Residential with Greenspace Access (%);
- Public Canopy Cover (%);
- Pollution Removal (kilograms per year);
- Carbon Storage (thousand metric tons per year); and
- Avoided Run-off (cubic metres per year).

Refer to Section 5 below for a summary of the comparison of the above listed statistics / parameters between the Concept Plans.

Assumptions

The following tables illustrate the assumptions used in the running of the iTree software. These assumptions inform the calculation of the criteria outlined above. Refer to the iTree assessment results in Appendix F-A.

Multi-unit Residential	20 large trees / ha	3 small trees / ha
Street-oriented Residential	18 large trees / ha	1 small trees / ha
Urban Natural Features	N/A large trees	N/A small trees
Parks and Stormwater Management Facilities	10 large trees / ha	N/A small trees
Schools and Institutions	5 large trees / ha	N/A small trees

Notes:

Multi-unit Residential = townhomes on shared lots, low-rise apartments, mid-to-high-rise apartments, residences in mixed-use developments.

Street-oriented Residential = detached dwellings, doubles, and townhomes on individual lots.

Large trees = 115m2 canopy, Small trees = 78 m2 canopy

Access Categories

The following table illustrates the access categories used in the iTree assessment. See **Appendix F-A**.

High:	Programmed parks, wooded parks, urban natural areas or open space with internal accessible paths or facilities.
Moderate:	Stormwater facilities, urban natural areas or open spaces with peripheral, accessible paths or facilities.
Low:	Urban natural features or open spaces with no accessible paths or facilities.

Table 12: Representation of Urban Criteria by Measures and Indicators (City of Ottawa 2022b)

Urban Criteria	Category of Services	Hazard Lands	Habitat and Landscape Connectivity		Social Values				iTree Eco Analysis (or equivalent)						Accessibility and Equity				LID
		Constrained Areas	Adjacency and Connectivity	Uncommon Characteristics (NHRM)	Unusual Recreational, Educational, Cultural Opportunities	Qualifying Cultural Heritage or Historical Features	Indigenous Values Established Through Consultation	Existing Public Use	Total Canopy Cover at maturity	Pollutants Removed	Run-off Averted	Carbon Storage	Carbon Sequestration	Structural Value	Residents Within 250m, by Housing Type	Residents Within 250m by Quality of Access	Total Accessible Greenspace	Sensitive Populations within 250 m	Run-off Captured
		Screening Criteria						Comparative Criteria											
Air pollution	Air, Water Cycle, Climate								■	■								■	
Air temperature								■	■						■	■	■	■	
Climate regulation - energy									■		■								
Carbon storage									■			■	■						
Water-flow regulation: cumulative									■		■								■
Water-flow regulation: green infrastructure	Green infrastructure	■																	■
Erosion regulation		■																	■
Water purification and waste treatment		■									■								■
Disease regulation (exposure)	Disease Regulation							■								■			
Pollination	Pollination		■						■						■		■		
Cultural identity social relations cohesion	Socio-cultural				■	■	■	■							■	■	■		
Spirituality/religion					■	■	■	■							■	■	■		
Knowledge systems and education					■	■	■	■							■	■	■		
Cognitive, physical, psychological benefits					■	■	■	■	■						■	■	■	■	
Aesthetic experience					■	■	■	■	■						■	■	■		
Inspiration - creative					■	■	■	■	■						■	■	■		
Recreation and tourism	Recreation, heritage, tourism		■		■	■	■	■	■						■	■	■		
Sense of place and heritage			■			■	■	■	■						■	■	■		
Habitat	Habitat	■	■	■					■										

4. Woodland Assessment

The following Sections provide a summary of the woodland retention scenarios for the three Concept Plans produced for the future S1 development area.

The following baseline assumptions represent external conditions and fixed constraints that apply consistently across all concept plans:

- ***Significant Woodland A:*** *The southern / southeastern portion of Significant Woodland A is proposed for impacts / removal due to the requirement for a utility easement and transportation access.*
- ***Significant Woodland B:*** *The northern portion of Significant Woodland B is proposed for impacts / removal due to the approved extension of Kilbirnie Road in this area. This road extension is represented in all three woodlot retention scenarios provided below.*

The following analysis presents the results of the significant woodland evaluation undertaken for Woodlands A and B in accordance with the City of Ottawa's *Significant Woodlands: Guidelines for Identification, Evaluation, and Impact Assessment*. These results apply the City's required assessment framework—examining age, size, composition, ecological function, and broader landscape context—to determine the significance of each woodland and to identify the extent to which their features and functions can be retained under the proposed development scenarios.

4.1. Concept 1 – Retained Woodland (Default)

Description

This concept plan demonstrates the near-full retention of Significant Woodland A and Significant Woodland B. Select border areas of Significant Woodland A have been removed to facilitate the squaring off of adjacent land parcels, while the northern portion of Significant Woodland B has been modified to accommodate the extension of Kilbirnie Road.

In addition to preserving the majority of the Significant Woodlands, the proposed plan incorporates two parklands, open spaces with direct connectivity to the retained Significant Woodlands, and a stormwater management (SWM) pond.

Proposed Mitigation

None.

Proposed Compensation

Removals within Significant Woodland A required for parcel alignment will be compensated through street tree plantings and additional plantings associated with the stormwater pond (SWP).

Statistics

Plan Area: 71.1 ha

Total Accessible Greenspace: 19.2 ha (27%)

- High Accessibility: 15.6 ha (81.3%)
- Moderate Accessibility: 3.6 ha (18.7%)
- Low Accessibility: 0 ha (0%)

Residential Greenspace Access

Multi-unit

Total Multi-unit Residential Area: 9.3 ha

Total Area with Greenspace Access: 9.3 ha (100%)

Woodland Access Categories	Area	Percentage
Residential Area with High Access	9.3 ha	100%
Residential Area with Moderate Access	4.0 ha	43%
Residential Area with Low Access	0 ha	0%

Street-oriented

Total Street-oriented Residential Area: 11.4 ha

Total Area with Greenspace Access: 11.4 ha (100%)

Woodland Access Categories	Area	Percentage
Residential Area with High Access	11.4 ha	100%
Residential Area with Moderate Access	5.0	43.9%
Residential Area with Low Access	0 ha	0%

Canopy Cover

- Total Woodland Area: 11.7 ha (Woodland A&B)
- Large Tree Crowns: 27.8 ha
- Small Tree Crowns: 0.3 ha
- Total Public Urban Canopy Cover: 28.1 ha (39.5%)

iTree Eco 6 Analysis

- Number of Trees: 5,339
- Dominant Species: White Pine (Pinus strobus), Sugar Maple (Acer saccharum), Eastern Hemlock (Tsuga canadensis).
- Pollution Removal: 87.72 kilograms/year (CAD $7.3/year).
- Carbon Storage: 2.71 thousand metric tons (CAD $311 thousand)
- Carbon Sequestration: 34.17 metric tons (CAD $3.93 thousand/year)
- Avoided Run-off: 250.5 cubic meters/year (CAD $582/year)
- Structural Value: N/A

Habitat Values

Mature stands of Eastern Hemlock, Sugar Maple, and White Pine are located within both Significant Woodland A and Significant Woodland B.

Historical and Cultural Values

None identified.

4.2. Concept 2 – Modified Woodland

Description

This design results in the removal of 3.5 hectares of Significant Woodland total, combined between Significant Woodland A and Significant Woodland B. More specifically, Concept 2 proposes the removal of 2.4 ha of Woodland A and 1.1 ha of Significant Woodland B. Similar to Concept 1, portions of Significant Woodland A are removed to square off adjacent industrial land parcels; however, a larger area along the eastern edge is cleared to accommodate street-oriented residential blocks, multi-unit residential blocks, and a new public road. Significant Woodland B is reduced along both its northern and southern extents. To the north, a portion of the Significant Woodland is removed to accommodate the planned extension of Kilbirnie Road. Along the southern edge, additional areas are cleared to support residential development and the associated road infrastructure required to service these new blocks.

Compared to Concept 1, high-quality greenspace is reduced due to the removal of 2.4 hectares from Significant Woodland A and 1.1 hectares from Significant Woodland B. Despite this reduction, the plan continues to provide meaningful accessible greenspace through the proposed parklands and the stormwater management (SWM) pond, which together maintain functional community greenspace within the development.

Proposed Mitigation

Retention of mature trees within blocks of open space to the extent possible. Exact area and number of trees will be determined through the design of the parkland and SWMP placement. Tree retention may not be possible given the grading constraints on the Project site.

Proposed Compensation

New tree plantings will be incorporated into high-quality green spaces, such as the proposed park in Block 73 (1.82 ha), and various open spaces. As well as within moderate-quality green spaces including the proposed stormwater management pond (SWMP).

Statistics

Plan Area: 71.1 ha

Total Accessible Greenspace: 14.5 ha

- High Accessibility: 10.8 ha (74.5%)
- Moderate Accessibility: 3.7 ha (25.5%)
- Low Accessibility: 0 ha (0%)

Residential Greenspace Access

Muti-unit

Total Multi-unit Residential Area: 12.3 ha

Total Area with Greenspace Access: 12.3 ha

Woodland Access Categories	Area	Percentage
Residential Area with High Access	12.3 ha	100%
Residential Area with Moderate Access	4.6 ha	37.4%
Residential Area with Low Access	0 ha	0%

Street-oriented

Total Street-oriented Residential Area: 12.7 ha

Total Area with Greenspace Access: 12.7 ha

Woodland Access Categories	Area	Percentage
Residential Area with High Access	12.7 ha	100%
Residential Area with Moderate Access	4.7 ha	37.0%
Residential Area with Low Access	0	0

Canopy Cover

- Total Woodland Area: 8.2 ha
- Large Tree Crowns: 23.0 ha
- Small Tree Crowns: 0.0 ha
- Total Public Urban Canopy Cover: 23.0 ha (32.4%)

iTree Eco 6 Analysis

- Number of Trees: 3,531
- Dominant Species: Sugar Maple (Acer saccharum), White Pine (Pinus Strobus), Eastern Hemlock (Tsuga canadensis)
- Pollution Removal: 60.3 kilograms/year (CAD $4.94/year)
- Carbon Storage: 1.916 thousand metric tons (CAD $220 thousand)
- Carbon Sequestration: 22.8 metric tons (CAD $2.62 thousand/year)
- Avoided Run-off: 166.2 cubic meters/year (CAD $386/year)
- Structural Value: N/A

Habitat Values

Stands of mature Sugar Maple, White Pine, and Eastern Hemlock are present within both Significant Woodland A and Significant Woodland B.

Historical and Cultural Values

None identified.

4.3. Concept 3 – Modified Woodland (Improved Access)

Description

This design results in the removal of 4.7 hectares of Significant Woodland (combined Significant Woodland A and Significant Woodland B). In Significant Woodland A, a northern section is removed to align the boundaries of the adjacent industrial area, while additional removals occur along the eastern edge to accommodate street-oriented residential blocks, multi-unit residential development, and a new public road. Significant Woodland B is reduced at both its northern and southern extents: the northern portion is removed to facilitate the extension of Kilbirnie Road, and the southern portion is cleared to support single-family residential development and associated easement and road infrastructure. The plan also incorporates a single 1.9-hectare park, dedicated open spaces, and open-space walking corridors that provide residents with direct access to high-quality greenspace. In addition, the stormwater management pond (SWP) contributes moderate-quality greenspace accessible to residents in the southwestern area of the development.

Proposed Mitigation

Retention of mature trees within blocks of open space to the extent possible. Exact area and number of trees will be determined through the design of the parkland and SWMP placement. Tree retention may not be possible given the grading constraints on the Project site.

Proposed Compensation

New tree plantings will be incorporated into high-quality green spaces, such as the proposed park (1.9 ha), and various open spaces. As well as within moderate-quality green spaces including the proposed stormwater management pond (SWMP).

Statistics

Plan Area: 71.1 ha

Total Accessible Greenspace: 15.5 ha

- High Accessibility: 11.8 ha (76.1%)
- Moderate Accessibility: 3.37 ha (23.9%)
- Low Accessibility: 0 ha (0%)

Residential Greenspace Access

Muti-unit

Total Multi-unit Residential Area: 11.5 ha

Total Area with Greenspace Access: 8.2 ha

Woodland Access Categories	Area	Percentage
Residential Area with High Access	8.2 ha	71.3%
Residential Area with Moderate Access	0.0 ha	0%
Residential Area with Low Access	0.0 ha	0%

Street-oriented

Total Street-oriented Residential Area: 14.5 ha

Total Area with Greenspace Access: 14.5 ha

Woodland Access Categories	Area	Percentage
Residential Area with High Access	12.0 ha	82.7%
Residential Area with Moderate Access	2.5 ha	17.2%
Residential Area with Low Access	0.0	0%

Canopy Cover

- Total Woodland Area: 8.7 ha
- Large Tree Crowns: 43.7 ha
- Small Tree Crowns: 0.0 ha
- Total Public Urban Canopy Cover: 43.7 ha (61.5%)

iTree Eco 6 Analysis

- Number of Trees: 3,557
- Dominant Species: White Pine (Pinus strobus), Sugar Maple (Acer saccharum), Eastern Hemlock (Tsuga canadensis).
- Pollution Removal: 58.52 kg/year (CAD $4.87/year)
- Carbon Storage: 1.805 thousand metric tons (CAD $207 thousand)
- Carbon Sequestration: 22.77 metric tons (CAD $2.62 thousand/year)
- Avoided Run-off: 167.3 cubic meters/year (CAD $389/year)
- Structural Value: N/A

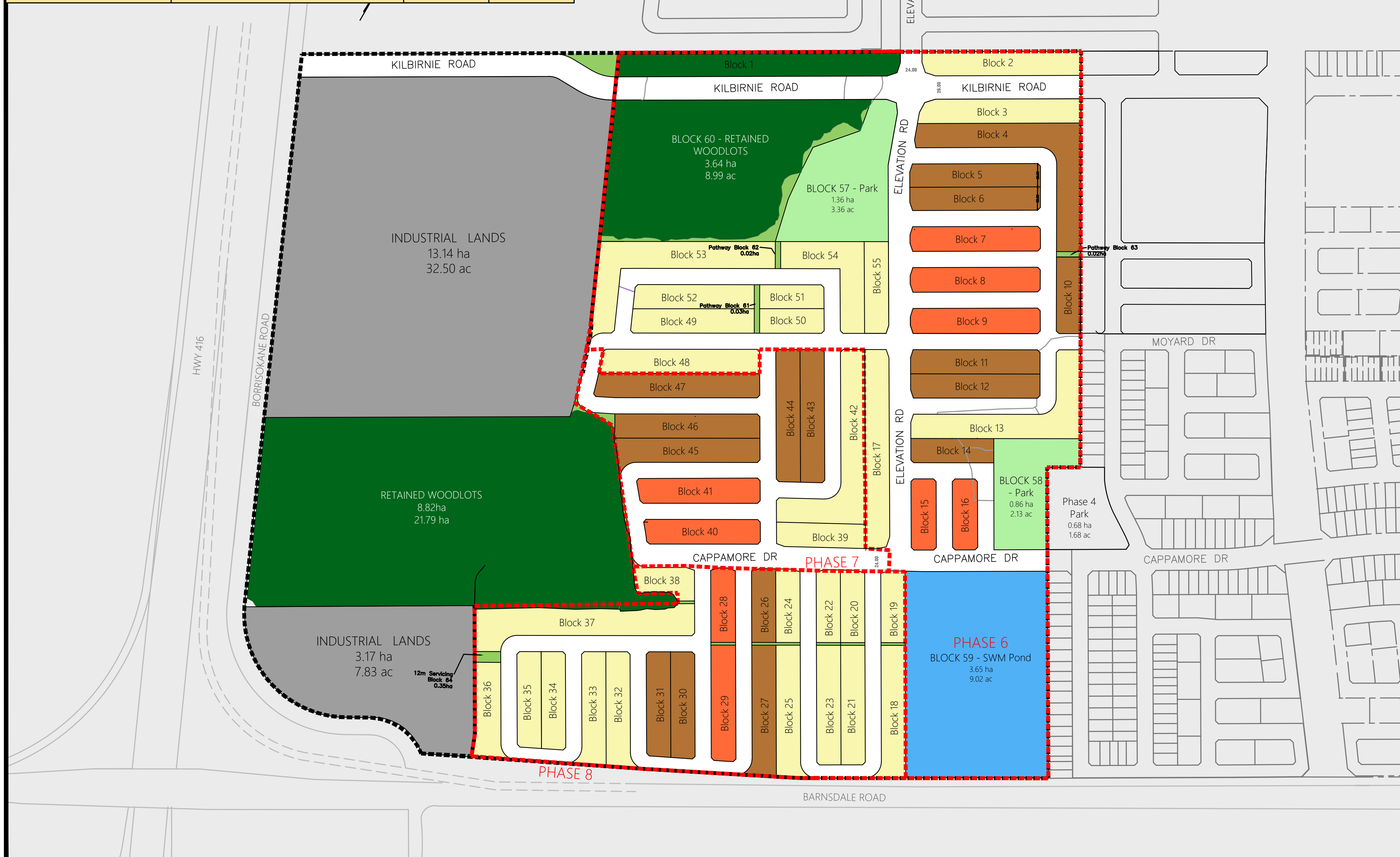
Habitat Values

Mature stands of Eastern Hemlock, Sugar Maple, and White Pine are located within both Significant Woodland A and B.

Historical and Cultural Values

None identified.

Unit Type	Phase 6	Phase 7	Phase 8	Total	
36' Single	107	57	691	**855**	59.92%
Executive Towns	113	63	110	**286**	20.04%
Avenue Towns	158	58	70	**286**	20.04%
Total	**378**	**178**	**871**	**1427**	100.00%
Parkland Required	= Total Units / 600 units per ha			2.38 ha	5.88 ac
Parkland Dedicated	= Parkland Provided on plan			2.22 ha	5.49 ac
Over Dedicated By				-0.16 ha	-0.39 ac



Title: **Concept Plan 1**

Project: **S-1 - Barrhaven Urban Expansion**

Legend

- Site Boundary
- Phase Line
- Singles
- Executive Towns
- Avenue Towns (Back to Backs)
- Rear Lane Towns
- Condos
- SWM Pond
- Parkland
- Open Space
- Industrial
- Woodlot

*Notes:
- All roads are 18m ROW unless indicated on the plan.
- All singles and executive towns are 27m in depth
- All avenues are 27.5m in depth
- The unit count for Metro Town Condos is estimated at a rate of 70 units per 1.00 ha.
- Stage 5 unit count is not included in the park dedication.

No.	Description	Date	By
2	Revised Woodlot Area	2025-11-13	E.H

Revisions

minto

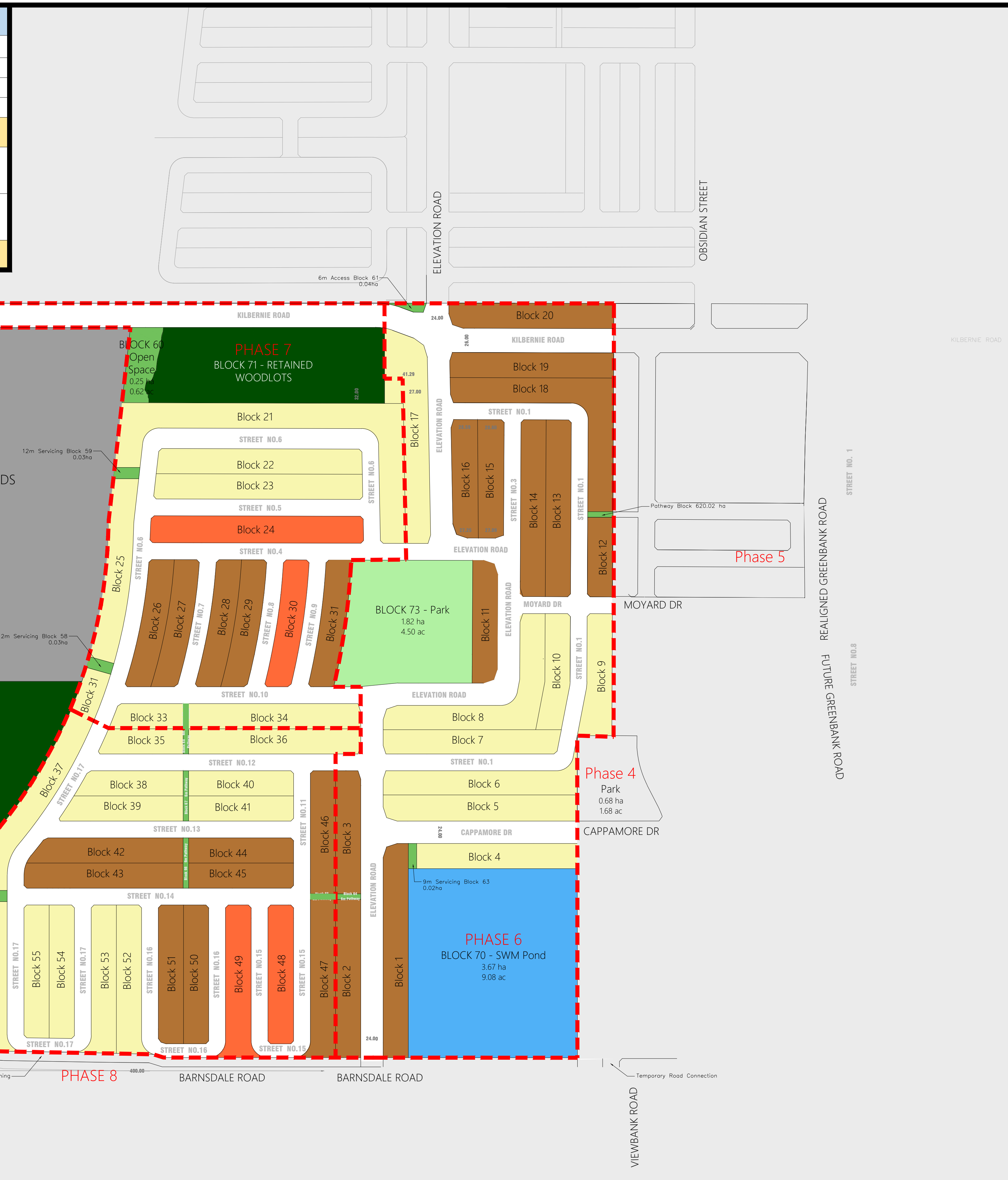
Drawn By: G.T
Checked By: C.T

Minto Communities Inc
180 Kent Street,
Ottawa, ON
K1P 0B6

North

Scale: **NTS**

Unit Type	Stage 6	Stage 7	Stage 8	Total
Singles	127	118	144	**389**
Executive Towns	278	95	162	**535**
Avenue Towns	0	102	88	**190**
Metro Towns	0	0	0	**0**
Total	**405**	**315**	**394**	**1114**
Parkland Required	= Total Units / 600 units per ha		1.86 ha	4.59 ac
Parkland Dedicated	= Parkland Provided on plan		1.82 ha	4.50 ac
Over Dedicated By			-0.03 ha	-0.09 ac



Title: Concept Plan 2

Project: S-1 - Barrhaven Urban Expansion

Legend

- Site Boundary
- Phase Line
- Singles
- Executive Towns
- Avenue Towns (Back to Backs)
- Rear Lane Towns
- Condos
- SWM Pond
- Parkland
- Open Space
- Industrial
- Woodlot

*Notes:
- All roads are 18m ROW unless indicated on the plan.
- All singles and executive towns are 27m in depth
- All avenues are 27.5m in depth
- The unit count for Metro Town Condos is estimated at a rate of 70 units per 1.00 ha.
- Stage 5 unit count is not included in the park dedication.

No.	Description	Date	By
0	Submitted for review	2025-02-28	G.T

Revisions

minto Communities

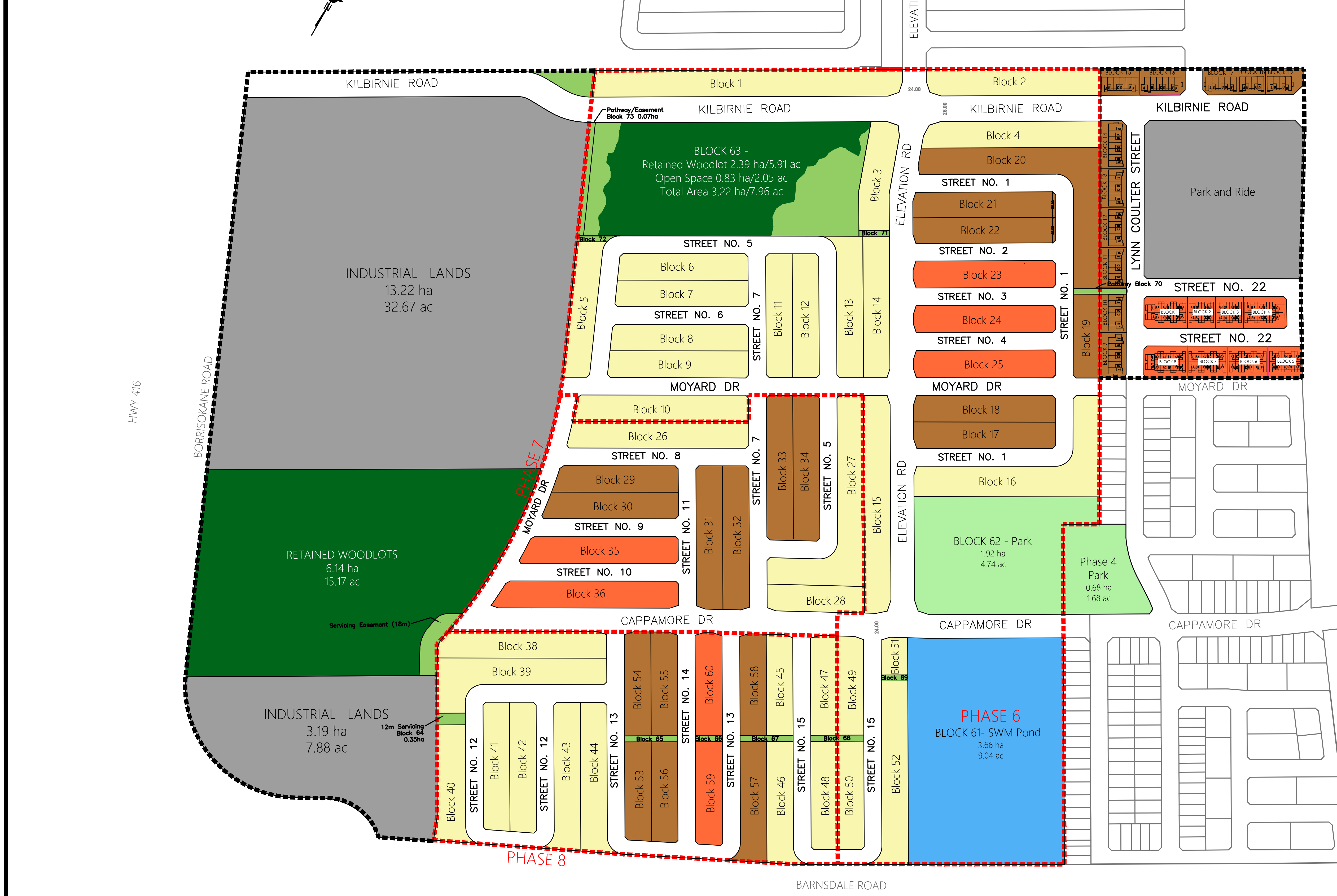
Drawn By: G.T.
Checked By: C.S.

Minto Communities Inc
180 Kent Street,
Ottawa, ON
K1P 0B6

North

Scale: NTS

Unit Type	Phase 6	Phase 7	Phase 8	Total	
Single - 36'	146	27	87	**260**	25.59%
Single - 43'	104	15	35	**154**	15.16%
Executive Towns	130	118	90	**338**	33.27%
Avenue Towns	118	90	56	**264**	25.98%
Total	**498**	**250**	**268**	**1016**	100.00%
Parkland Required	= Total Units / 600 units per ha			1.69 ha	4.18 ac
Parkland Dedicated	= Parkland Provided on plan			1.92 ha	4.74 ac



Title:
Concept Plan 3

Project:
S-1 - Barrhaven Urban Expansion

Legend

- Site Boundary
- Phase Line
- Singles
- Executive Towns
- Avenue Towns (Back to Backs)
- Rear Lane Towns
- Condos
- SWM Pond
- Parkland
- Open Space
- Industrial
- Woodlot

*Notes:
- All roads are 18m ROW unless indicated on the plan.
- All singles and executive towns are 27m in depth
- All avenues are 27.5m in depth
- The unit count for Metro Town Condos is estimated at a rate of 70 units per 1.00 ha.
- Stage 5 unit count is not included in the park dedication.

No.	Description	Date	By
13	Woodlot Easement/SWMP Easement	2.10.2026	E.H
12	Phasing Limits/Easements	1.30.2026	E.H

Revisions

minto

Drawn By: G.T
Checked By: C.S

Minto Communities Inc
180 Kent Street,
Ottawa, ON
K1P 0B6

North

Scale: **NTS**

5. Summary of Findings

The following section provides a comparison summary of the three concept plans / development scenarios evaluated for the Site, developed to assess alternative approaches to development layout, woodland retention, and integration of natural heritage features. A detailed comparative assessment of the three scenarios is provided in Section 5.4 below.

5.1. Concept 1: Evaluation Summary

This concept proposes the near-full retention of both Woodlands A and B, aside from the removal of some border areas to accommodate adjacent land parcels and approved extension of Kilbirnie Road. The following provides a summary of the Urban Criteria for Concept 1.

Screening Criteria

- **Constrained Areas:** No hazard lands constrain the site
- **Connectivity:** Ecological connectivity is limited due with no meaningful connection to the broader natural heritage system.
- **Uncommon Characteristics:** The woodlands represent common habitats in the Ottawa area.
- **Social Values:** Retention of the woodlands in this scenario represents the greatest opportunity for outdoor recreation, educational and cultural opportunities.

Comparative Criteria

- **Existing Public use:** Given that public are not currently permitted access to the woodlands, this concept provides the greatest opportunity for public access.
- **Total Canopy Cover at Maturity:** Despite full retention of Significant Woodlands, Concept Plan 1 provides only the second largest total canopy cover.
- **Pollutants Removed:** This concept plan provides the highest pollution removal function of all concepts proposed.
- **Run-off Averted:** This concept provides the greatest runoff abatement function of all concepts due to the reduction of impermeable services and the greatest access to the highly permeable esker for the absorption of rainwater and snow melt.
- **Carbon Storage/Sequestration:** This concept provides the greatest opportunity for carbon storage/ sequestration.
- **Accessibility and Equity:** Retention of the woodlands represents the greatest opportunity for outdoor recreation, educational and cultural opportunities.

5.2. Concept 2: Evaluation Summary

Concept Plan 2 is similar to Concept Plan 1 but proposes the removal of 3.5 ha of significant woodland total, represented by 2.4 ha of Woodland A and 1.1 ha of Woodland B removed. The following provides a summary of the Urban Criteria for Concept 2.

Screening Criteria

- C**onstrained Areas:** No hazard lands constrain the site
- **Connectivity:** Ecological connectivity is limited due with no meaningful connection to the broader natural heritage system.
- **Uncommon Characteristics:** The woodlands represent common habitats in the Ottawa area.

- **Social Values:** Compared to Concept Plan 1, this plan likely provides less benefit to the community through incorporation of only one parkland (1.8 ha total parkland area) and less open space.

Comparative Criteria

- **Existing Public use:** This concept provides the lowest opportunity for public access as it does not include an access easement like Concept Plan 3.
- **Total Canopy Cover at Maturity:** Concept Plan 2 provides the lowest total canopy cover despite proposing to remove less woodland area compared to Concept Plan 3.
- **Pollutants Removed:** This concept plan provides an intermediate pollution removal function of all concepts proposed.
- **Run-off Averted:** This concept provides an intermediate runoff abatement function of all concepts as it retains more woodland area compared to Concept Plan 3 but proposes more impermeable surface area compared to Concept Plan 1.
- **Carbon Storage/Sequestration:** This concept provides an intermediate opportunity for carbon storage/ sequestration as it proposes more woodland removal compared to Concept Plan 1 and less woodland removal compared to Concept Plan 3. Concept Plan 3 also proposed an access easement which further removes treed / woodland area.
- **Accessibility and Equity**: This concept plan provides the least accessibility as it does not propose full retention of the woodlands like Concept Plan 1 or an access easement like Concept Plan 3

5.3. Concept 3: Evaluation Summary

This concept proposes the removal of 4.7 ha of significant woodland total, represented by 4.5 ha of Woodland A and 0.2 ha of Woodland B. Importantly, this concept plan represents the only plan of the three to achieve the City of Ottawa's 40% urban canopy coverage target (City of Ottawa 2022a).

Screening Criteria

- C**onstrained Areas:** No hazard lands constrain the site.
- **Connectivity:** Ecological connectivity is limited due with no meaningful connection to the broader natural heritage system.
- **Uncommon Characteristics:** The woodlands represent common habitats in the Ottawa area.
- **Social Values:** Compared to Concept Plan 2, this plan also proposes only one parkland and of similar size (1.9 ha total parkland area). Concept Plan 3 also offers the highest total publicly accessible canopy cover which would provide a significant public benefit.

Comparative Criteria

- **Existing Public use:** This concept provides excellent public access by incorporating single-loaded roads adjacent to the woodlots, allowing the woodlots to be viewed and experienced from publicly accessible areas.
- **Total Canopy Cover at Maturity:** Concept Plan 3 provides the highest total canopy cover despite proposing to remove more woodland area compared to Concept Plan 2.
- **Pollutants Removed:** This concept plan provides the lowest pollution removal function of all concepts proposed.

- **Run-off Averted:** This concept provides the lowest runoff abatement function of all concepts as it retains less woodland area compared to Concept Plan 2 and proposes more impermeable surface area compared to both Concept Plan 1 and Concept Plan 2.
- **Carbon Storage/Sequestration:** This concept provides the lowest opportunity for carbon storage/ sequestration as it proposes more woodland removal compared to both Concept Plan 1 and Concept Plan 2. Concept Plan 3 also proposes an access easement which further removes treed / woodland area.
- **Accessibility and Equity**: This concept plan provides high accessibility as it does not propose full retention of the woodlands like Concept Plan 1 and incorporates a single-loaded roads adjacent to the woodlots for ease of public access.

5.4. Comparative Summary of iTree Results

The table below provides a comparative summary of the iTree results for all three concepts:

Statistic	Concept Plan 1	Concept Plan 2	Concept Plan 3 (preferred)
Public Canopy Cover	39.5%	32.4%	43.7%
Pollution Removal	87.72 kilograms/year	60.3 kilograms/year	58.48 tons/year
Avoided Run-off	250.5 cubic meters/year	166.2 cubic meters/year	167.3 cubic meters/year
Carbon Storage/ Sequestration	2.71 thousand metric tons/year	1.916 thousand metric tons/year	1.805 thousand tons/year
Street-oriented Residential with Greenspace Access (Total/High/Moderate/Low)	100% (100%*, 43.9%, 0%)[1]	100% (100%, 37.0%, 0%)[1]	100% (82.7%, 17.3%, 0%)
Multi-unit Residential with Greenspace Access (Total/High/Moderate/Low)	100% (100%, 43%, 0%)1	100% (100%, 37.4%, 0%)	71.3% (71.3%, 0%, 0%)

Notes:

1 All Residential areas have access to high quality greenspace, but not all Residential areas have access to moderate quality greenspace.

6. Closure

Overall, the evaluation of Woodlands A and B demonstrates that meaningful woodland retention is achievable across the development scenarios, with Concept Plan 3 offering a balanced approach that preserves core ecological functions while supporting community design objectives. The mitigation measures outlined in this EIS—including forest-edge management, coordinated grading refinements, and the preparation of a Tree Conservation Report at the detailed design stage—will be essential to protecting the long-term health and integrity of the retained woodland areas. Complementary landscape architecture plans for parks, open spaces, and streetscapes will further reinforce woodland function by incorporating native tree plantings and restoration treatments consistent with the City's guidance, ensuring that canopy cover is maintained and enhanced as the community matures.

7. References

City of Ottawa. 2022a. City of Ottawa Official Plan. Retrieved from https://ottawa.ca/en/planning-development-and-construction/official-plan-and-master-plans/official-plan. Last accessed April 2025.

City of Ottawa. 2022b. Significant Woodlands Guidelines for Identification, Evaluation, and Impact Assessment. Retrieved from https://documents.ottawa.ca/sites/default/files/significant_woodlands_en.pdf. Last accessed January 2026.

City of Ottawa. 2026. geoOttawa. Retrieved from https://maps.ottawa.ca/geoottawa/. Last accessed January 2026.

Google. 2026. Aerial imagery centred around the Subject Site. Retrieved from Google Earth Pro software. Last accessed January 2026.

Appendix F-1

iTree Results

i-Tree
Ecosystem Analysis

S1-Significant Woodlands A&B

Urban Forest Effects and Values
January 2026

Summary

Understanding an urban forest's structure, function and value can promote management decisions that will improve human health and environmental quality. An assessment of the vegetation structure, function, and value of the S1-Significant Woodlands A&B urban forest was conducted during 2026. Data from 10 field plots located throughout S1-Significant Woodlands A&B were analyzed using the i-Tree Eco model developed by the U.S. Forest Service, Northern Research Station.

- Number of trees: 5,339
- Tree Cover: 94.5 %
- Most common species of trees: Pinus strobus, Acer saccharum, Tsuga canadensis
- Percentage of trees less than 6" (15.2 cm) diameter: 16.3%
- Pollution Removal: 87.72 kilograms/year (Can$7.3/year)
- Carbon Storage: 2.71 thousand metric tons (Can$311 thousand)
- Carbon Sequestration: 34.17 metric tons (Can$3.93 thousand/year)
- Oxygen Production: 77.28 metric tons/year
- Avoided Runoff: 250.5 cubic meters/year (Can$582/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Replacement values: Can$5.3 million

Metric ton: 1000 kilograms
Monetary values Can$ are reported in Canadian Dollars throughout the report except where noted.
Ecosystem service estimates are reported for trees.
With Complete Inventory Projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition. Oxygen production in Plot Inventory Projects is estimated from net carbon sequestration.

The estimate of Tree Cover is derived from user estimations of percent tree cover over plots and extrapolated to the whole study area. For more precise tree cover estimates please use i-Tree Canopy or i-Tree Landscape.

For an overview of i-Tree Eco methodology, see Appendix I. Data collection quality is determined by the local data collectors, over which i-Tree has no control. Additionally, some of the plot and tree information may not have been collected, so not all of the analyses may have been conducted for this report.

Table of Contents

I. Tree Characteristics of the Urban Forest

The urban forest of S1-Significant Woodlands A&B has an estimated 5,339 trees with a tree cover of 94.5 percent. The three most common species are Pinus strobus (20.5 percent), Acer saccharum (18.7 percent), and Tsuga canadensis (16.9 percent).

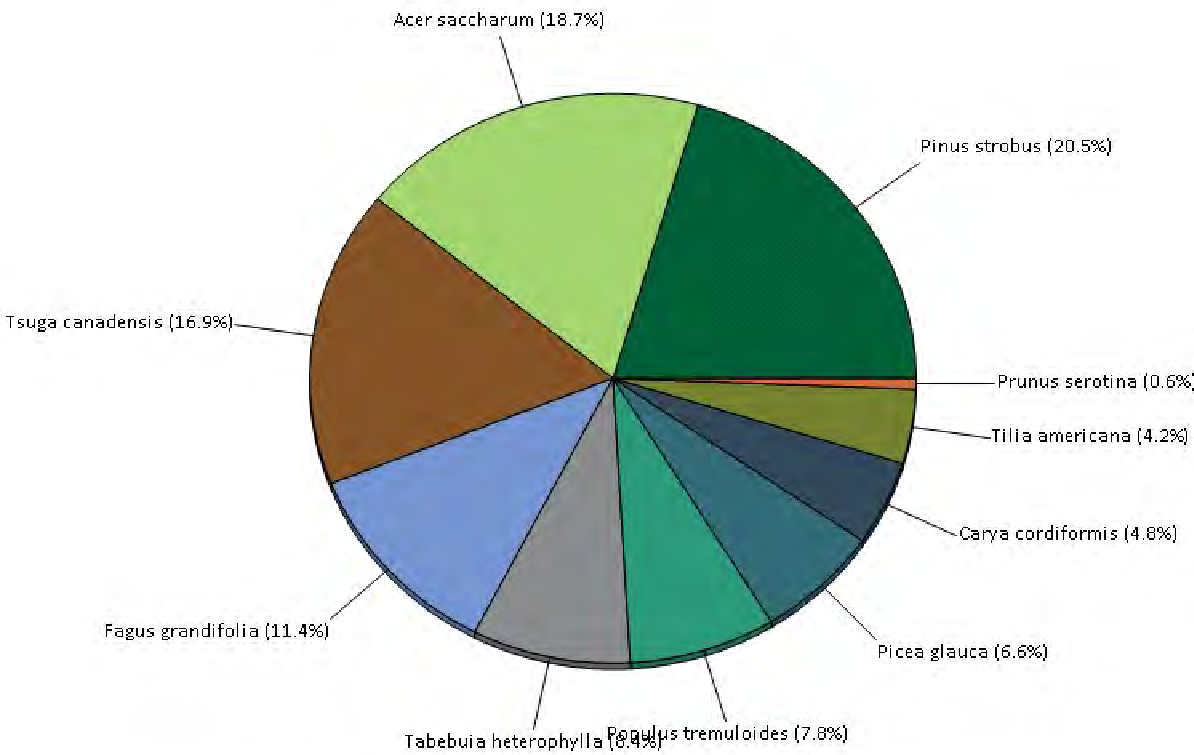


Figure 1. Tree species composition in S1-Significant Woodlands A&B

The overall tree density in S1-Significant Woodlands A&B is 410 trees/hectare (see Appendix III for comparable values from other cities).

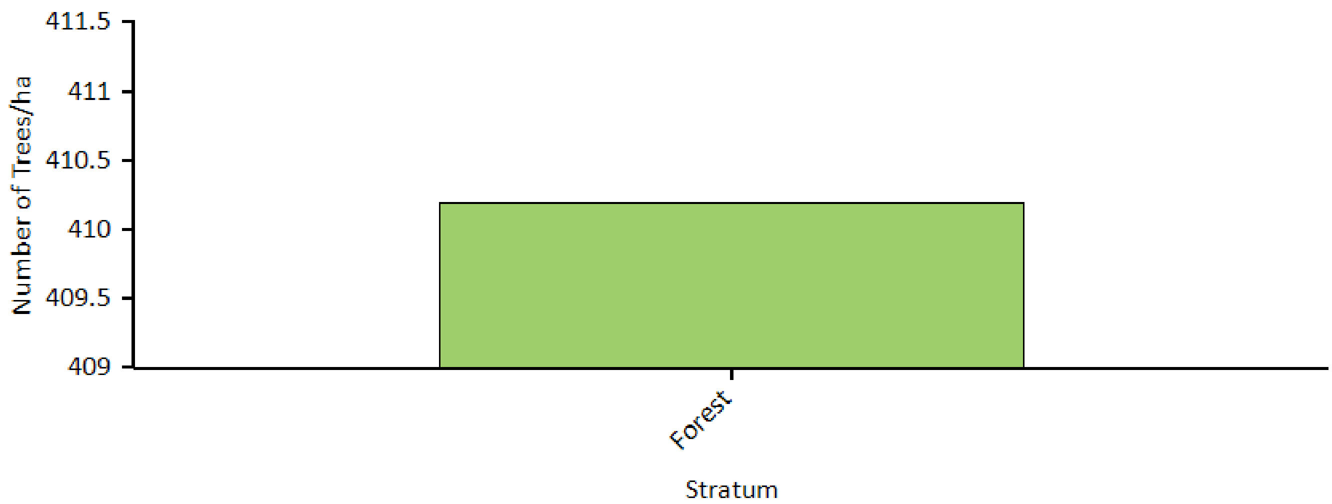


Figure 2. Number of trees/ha in S1-Significant Woodlands A&B by stratum

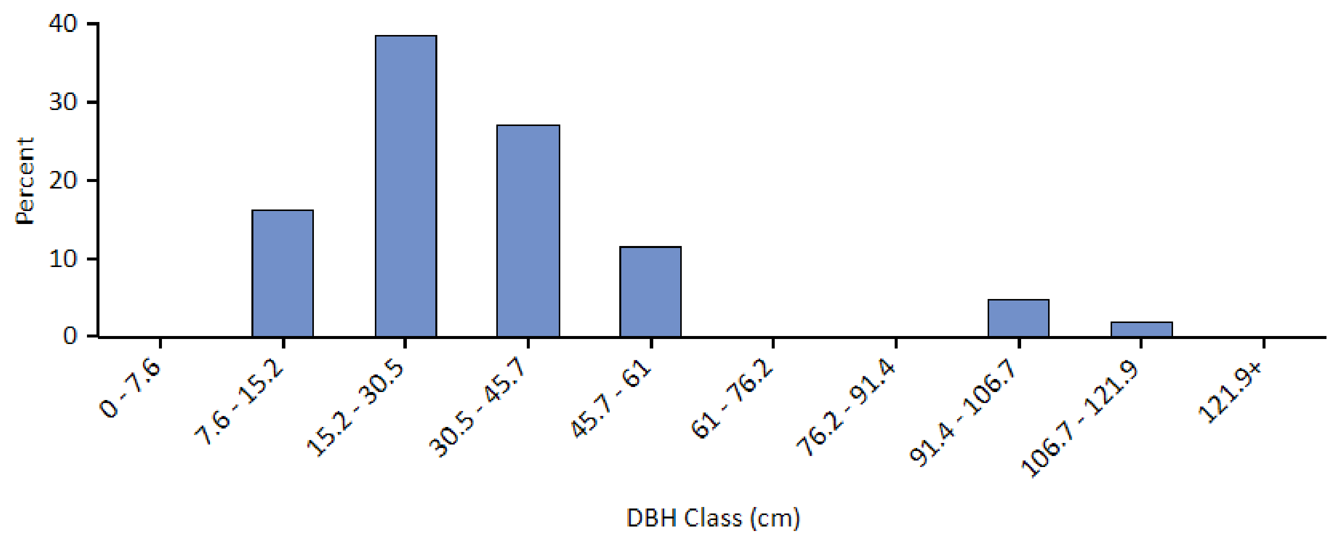


Figure 3. Percent of tree population by diameter class (DBH - stem diameter at 1.37 meters)

Urban forests are composed of a mix of native and exotic tree species. Thus, urban forests often have a tree diversity that is higher than surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but it can also pose a risk to native plants if some of the exotic species are invasive plants that can potentially out-compete and displace native species. In S1-Significant Woodlands A&B, about 92 percent of the trees are species native to North America. Most trees have an origin from COUNTRY (92 percent of the trees).

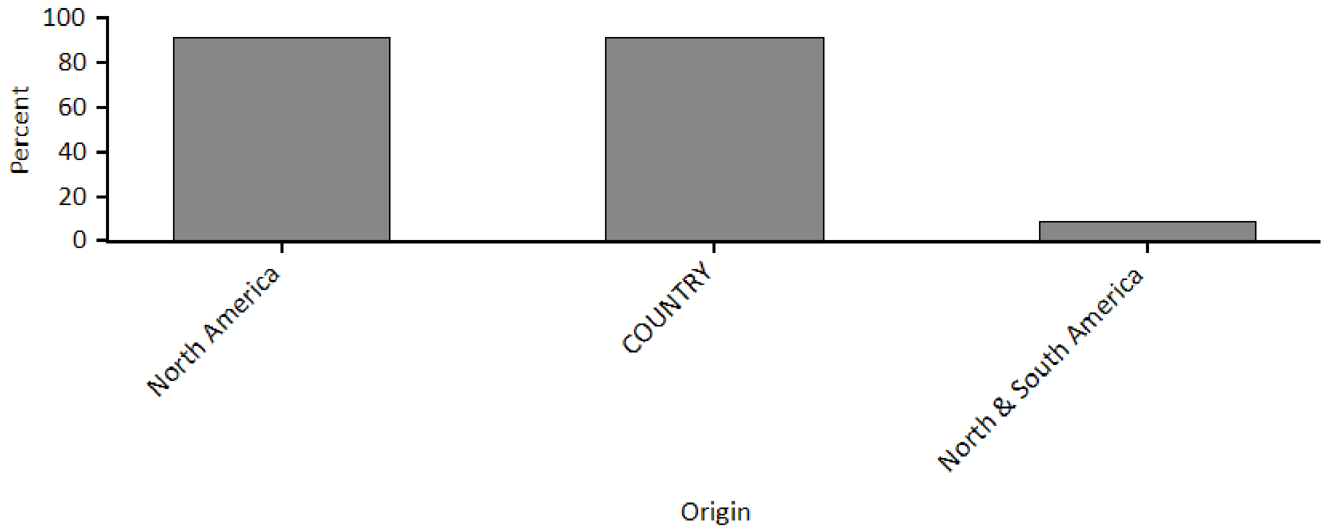


Figure 4. Percent of live tree population by area of native origin, S1-Significant Woodlands A&B

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and general lack of natural enemies. These abilities enable them to displace native plants and make them a threat to natural areas.

II. Urban Forest Cover and Leaf Area

Many tree benefits equate directly to the amount of healthy leaf surface area of the plant. Trees cover about 94 percent of S1-Significant Woodlands A&B and provide 208.6 hectares of leaf area. Total leaf area is greatest in Forest.

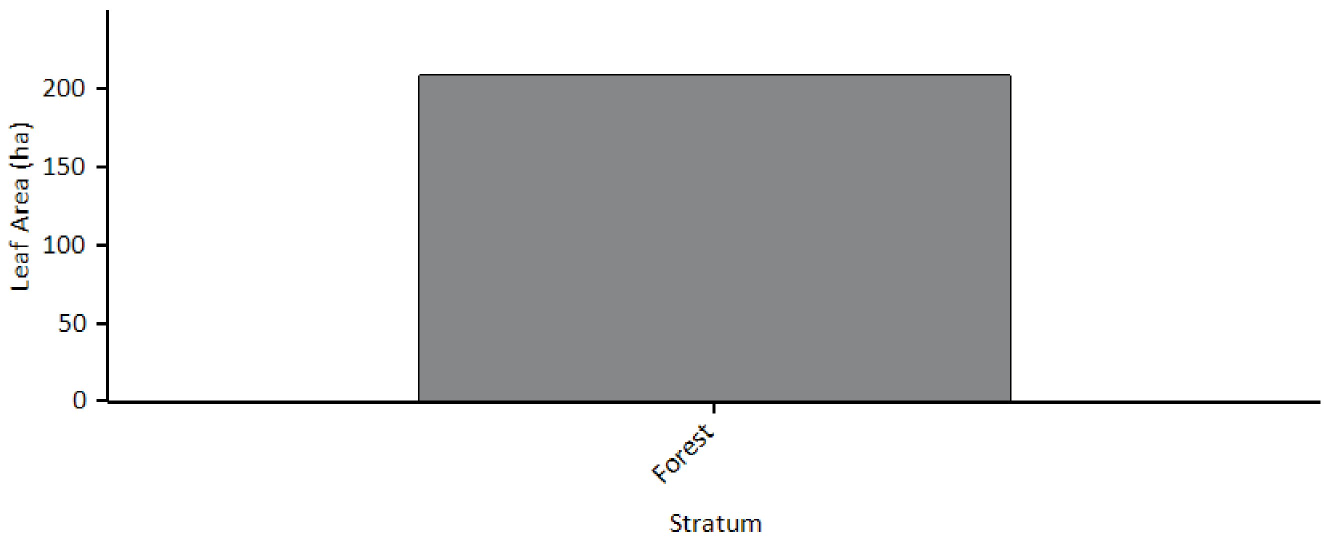


Figure 5. Leaf area by stratum, S1-Significant Woodlands A&B

In S1-Significant Woodlands A&B, the most dominant species in terms of leaf area are Fagus grandifolia, Pinus strobus, and Acer saccharum. The 10 species with the greatest importance values are listed in Table 1. Importance values (IV) are calculated as the sum of percent population and percent leaf area. High importance values do not mean that these trees should necessarily be encouraged in the future; rather these species currently dominate the urban forest structure.

Table 1. Most important species in S1-Significant Woodlands A&B

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Pinus strobus	20.5	21.0	41.4
Fagus grandifolia	11.4	27.5	38.9
Acer saccharum	18.7	18.5	37.1
Tsuga canadensis	16.9	15.9	32.8
Tabebuia heterophylla	8.4	5.5	13.9
Picea glauca	6.6	6.9	13.5
Populus tremuloides	7.8	1.1	9.0
Tilia americana	4.2	2.8	7.0
Carya cordiformis	4.8	0.9	5.7
Prunus serotina	0.6	0.1	0.7

Common ground cover classes (including cover types beneath trees and shrubs) in S1-Significant Woodlands A&B are not available since they are configured not to be collected.

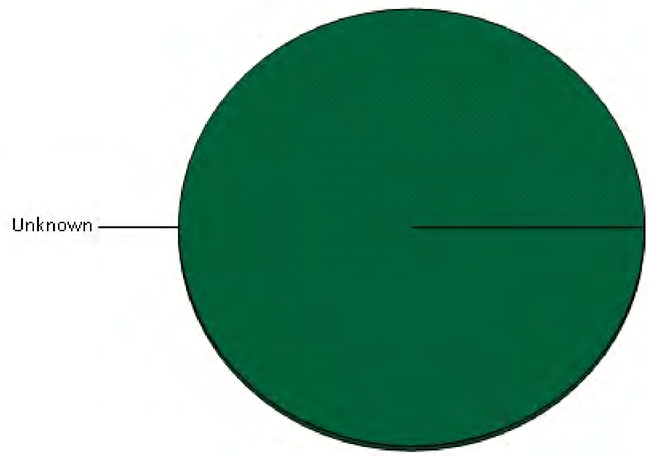


Figure 6. Percent of land by ground cover classes, S1-Significant Woodlands A&B

III. Air Pollution Removal by Urban Trees

Poor air quality is a common problem in many urban areas. It can lead to decreased human health, damage to landscape materials and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power sources. Trees also emit volatile organic compounds that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation (Nowak and Dwyer 2000).

Pollution removal[1] by trees in S1-Significant Woodlands A&B was estimated using field data and recent available pollution and weather data available. Pollution removal was greatest for sulfur dioxide (Figure 7). It is estimated that trees remove 87.72 kilograms of air pollution (ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter less than 2.5 microns (PM2.5), particulate matter less than 10 microns and greater than 2.5 microns (PM10*)[2], and sulfur dioxide (SO2)) per year with an associated value of Can$7.3 (see Appendix I for more details).

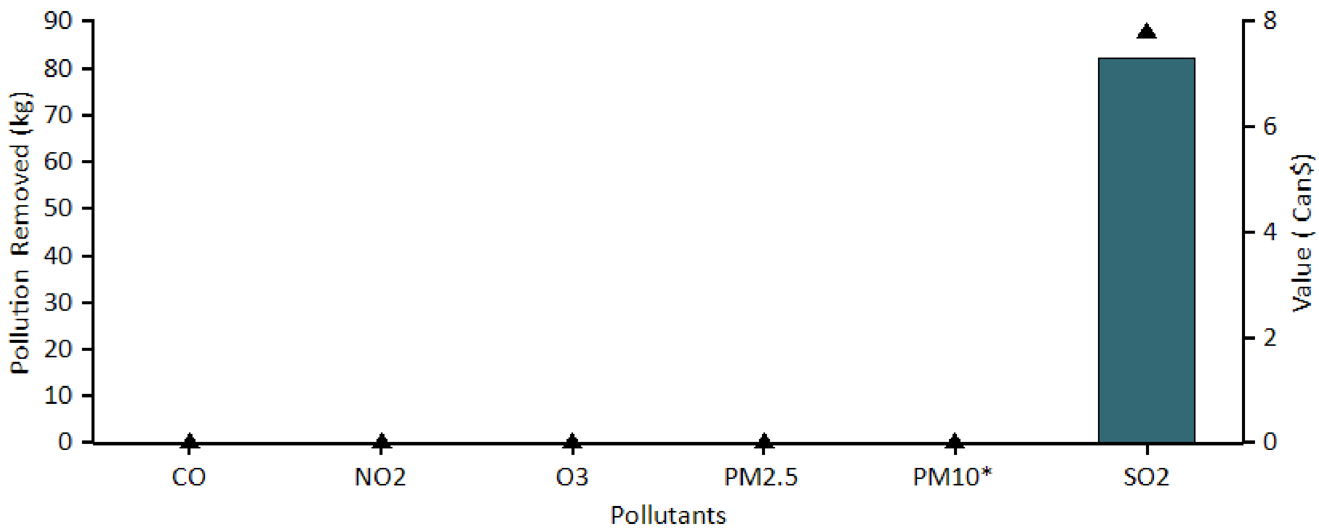


Figure 7. Annual pollution removal (points) and value (bars) by urban trees, S1-Significant Woodlands A&B

[1] PM10* is particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is particulate matter less than 2.5 microns. If PM2.5 is not monitored, PM10* represents particulate matter less than 10 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

[2] Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces. This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors (see Appendix I for more details).

In 2026, trees in S1-Significant Woodlands A&B emitted an estimated 468.5 kilograms of volatile organic compounds (VOCs) (29.44 kilograms of isoprene and 439.1 kilograms of monoterpenes). Emissions vary among species based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Seventy-nine percent of the urban forest's VOC emissions were from Pinus strobus and Picea glauca. These VOCs are precursor chemicals to ozone formation.[3]

General recommendations for improving air quality with trees are given in Appendix VIII.

[3] Some economic studies have estimated VOC emission costs. These costs are not included here as there is a tendency to add positive dollar estimates of ozone removal effects with negative dollar values of VOC emission effects to determine whether tree effects are positive or negative in relation to ozone. This combining of dollar values to determine tree effects should not be done, rather estimates of VOC effects on ozone formation (e.g., via photochemical models) should be conducted and directly contrasted with ozone removal by trees (i.e., ozone effects should be directly compared, not dollar estimates). In addition, air temperature reductions by trees have been shown to significantly reduce ozone concentrations (Cardelino and Chameides 1990; Nowak et al 2000), but are not considered in this analysis. Photochemical modeling that integrates tree effects on air temperature, pollution removal, VOC emissions, and emissions from power plants can be used to determine the overall effect of trees on ozone concentrations.

IV. Carbon Storage and Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by altering energy use in buildings, and consequently altering carbon dioxide emissions from fossil-fuel based power sources (Abdollahi et al 2000).

Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is increased with the size and health of the trees. The gross sequestration of S1-Significant Woodlands A&B trees is about 34.17 metric tons of carbon per year with an associated value of Can$3.93 thousand. Net carbon sequestration in the urban forest is about 28.98 metric tons. See Appendix I for more details on methods.

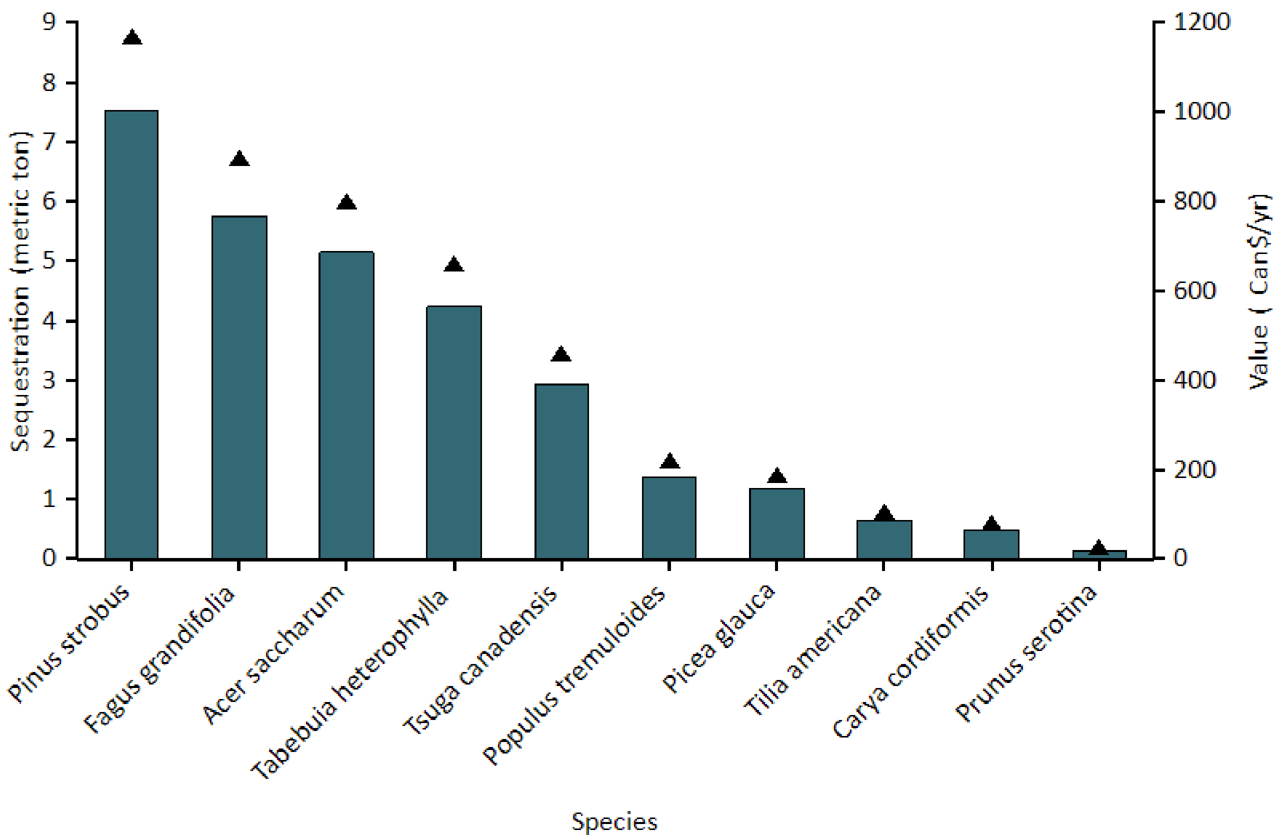


Figure 8. Estimated annual gross carbon sequestration (points) and value (bars) for urban tree species with the greatest sequestration, S1-Significant Woodlands A&B

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions (Nowak et al 2002c). When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants.

Trees in S1-Significant Woodlands A&B are estimated to store 2710 metric tons of carbon (Can$311 thousand). Of the species sampled, Acer saccharum stores the most carbon (approximately 31.5% of the total carbon stored) and Pinus strobus sequesters the most (approximately 25.5% of all sequestered carbon.)

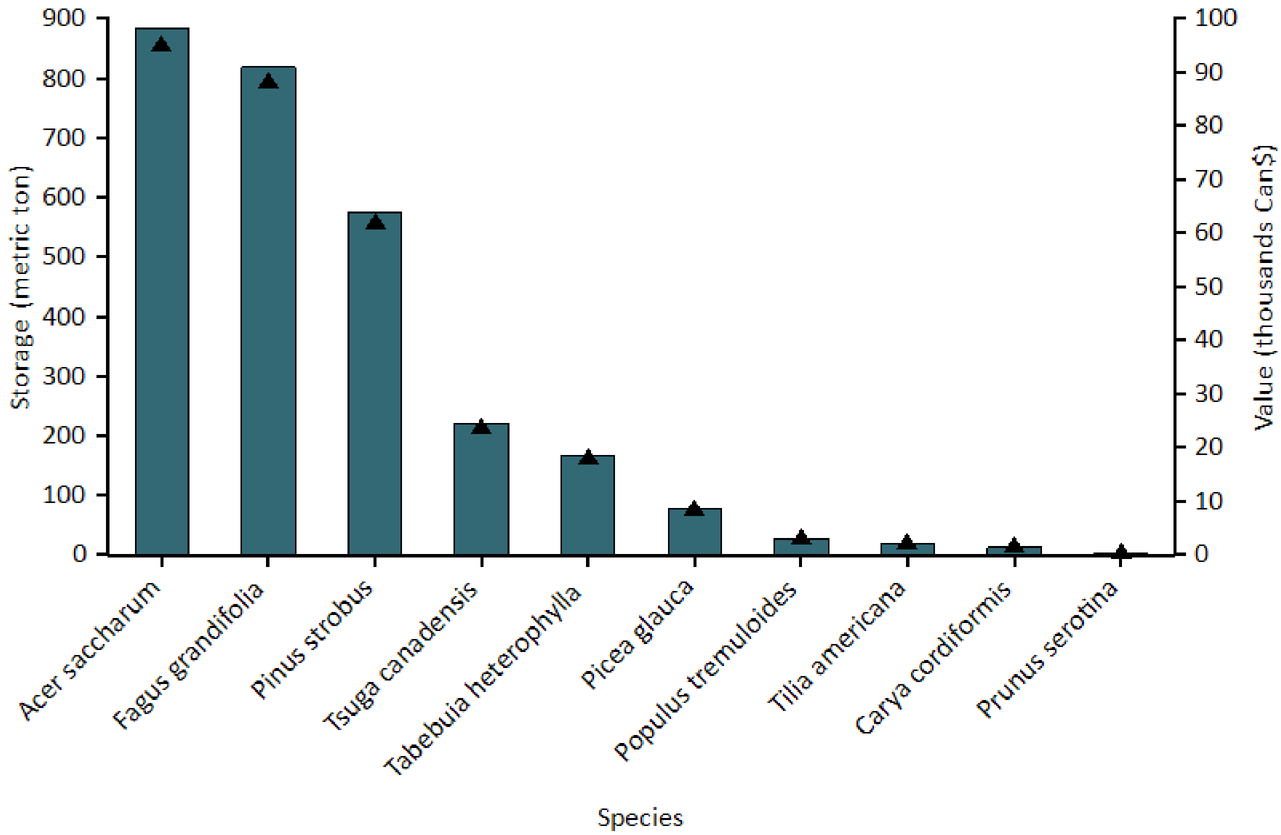


Figure 9. Estimated carbon storage (points) and values (bars) for urban tree species with the greatest storage, S1-Significant Woodlands A&B

V. Oxygen Production

Oxygen production is one of the most commonly cited benefits of urban trees. The net annual oxygen production of a tree is directly related to the amount of carbon sequestered by the tree, which is tied to the accumulation of tree biomass.

Trees in S1-Significant Woodlands A&B are estimated to produce 77.28 metric tons of oxygen per year.[4] However, this tree benefit is relatively insignificant because of the large and relatively stable amount of oxygen in the atmosphere and extensive production by aquatic systems. Our atmosphere has an enormous reserve of oxygen. If all fossil fuel reserves, all trees, and all organic matter in soils were burned, atmospheric oxygen would only drop a few percent (Broecker 1970).

Table 2. The top 10 oxygen production species.

Species	*Oxygen (metric ton)*	*Net Carbon Sequestration (metric ton/yr)*	*Number of Trees*	*Leaf Area (hectare)*
Pinus strobus	18.60	6.98	1,094	43.73
Acer saccharum	14.38	5.39	997	38.52
Tabebuia heterophylla	12.63	4.74	450	11.44
Fagus grandifolia	11.32	4.25	611	57.28
Tsuga canadensis	8.68	3.26	901	33.13
Populus tremuloides	4.20	1.58	418	2.34
Picea glauca	3.52	1.32	354	14.32
Tilia americana	2.00	0.75	225	5.75
Carya cordiformis	1.50	0.56	257	1.78
Prunus serotina	0.44	0.17	32	0.28

[4] A negative estimate, or oxygen deficit, indicates that trees are decomposing faster than they are producing oxygen. This would be the case in an area that has a large proportion of dead trees.

VI. Avoided Runoff

Surface runoff can be a cause for concern in many urban areas as it can contribute pollution to streams, wetlands, rivers, lakes, and oceans. During precipitation events, some portion of the precipitation is intercepted by vegetation (trees and shrubs) while the other portion reaches the ground. The portion of the precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff (Hirabayashi 2012). In urban areas, the large extent of impervious surfaces increases the amount of surface runoff.

Urban trees and shrubs, however, are beneficial in reducing surface runoff. Trees and shrubs intercept precipitation, while their root systems promote infiltration and storage in the soil. The trees and shrubs of S1-Significant Woodlands A&B help to reduce runoff by an estimated 250 cubic meters a year with an associated value of Can$580 (see Appendix I for more details). Avoided runoff is estimated based on local weather from the user-designated weather station. In S1-Significant Woodlands A&B, the total annual precipitation in 2024 was 87.7 centimeters.

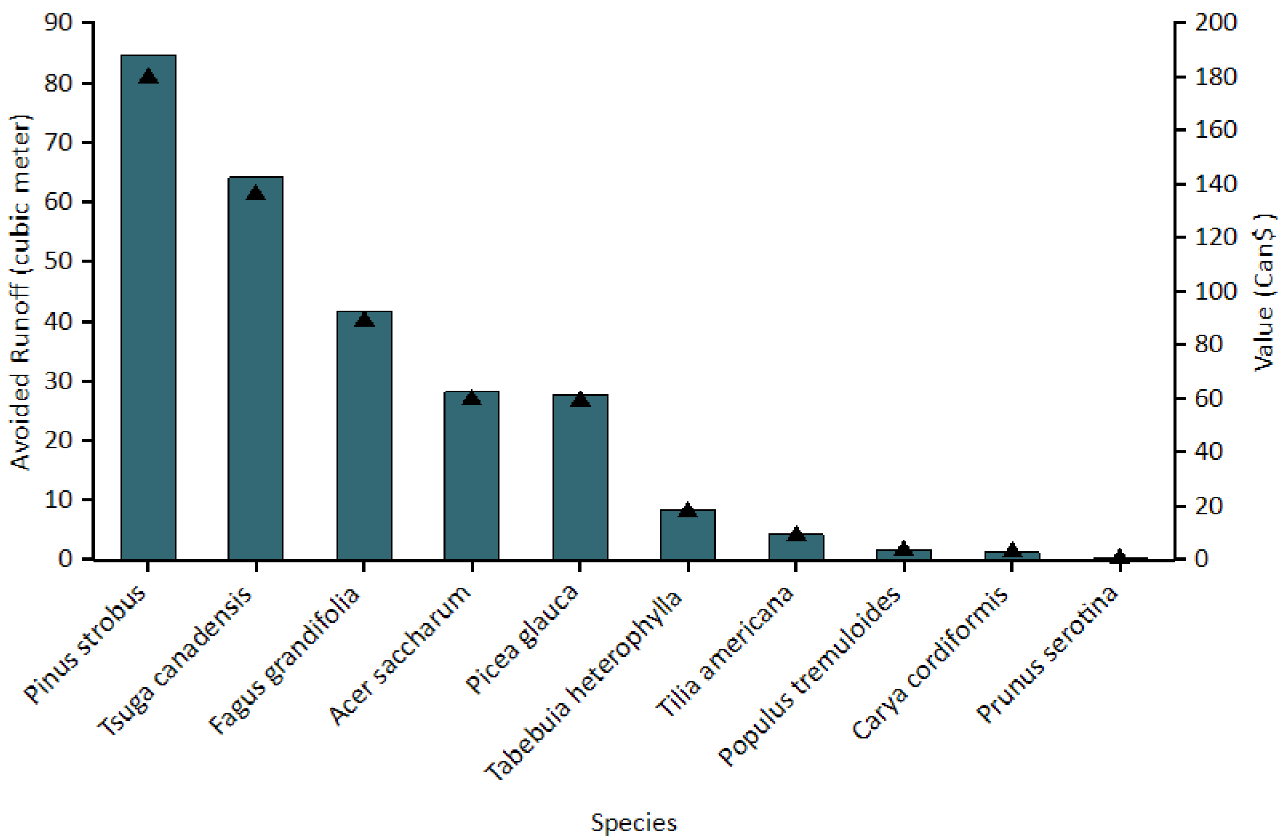


Figure 10. Avoided runoff (points) and value (bars) for species with greatest overall impact on runoff, S1-Significant Woodlands A&B

VII. Trees and Building Energy Use

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space conditioned residential buildings (McPherson and Simpson 1999).

Because energy-related data were not collected, energy savings and carbon avoided cannot be calculated.

Table 3. Annual energy savings due to trees near residential buildings, S1-Significant Woodlands A&B

	Heating	*Cooling*	*Total*
MBTU[a]	0	N/A	0
MWH[b]	0	0	0
Carbon Avoided (kilograms)	0	0	0

[a]MBTU - one million British Thermal Units

[b]MWH - megawatt-hour

Table 4. Annual savings [a](Can$) in residential energy expenditure during heating and cooling seasons, S1-Significant Woodlands A&B

	Heating	*Cooling*	*Total*
MBTU[b]	0	N/A	0
MWH[c]	0	0	0
Carbon Avoided	0	0	0

[b]Based on the prices of Can$75 per MWH and Can$10.4544285106757 per MBTU (see Appendix I for more details)

[c]MBTU - one million British Thermal Units

[c]MWH - megawatt-hour

[5] Trees modify climate, produce shade, and reduce wind speeds. Increased energy use or costs are likely due to these tree-building interactions creating a cooling effect during the winter season. For example, a tree (particularly evergreen species) located on the southern side of a residential building may produce a shading effect that causes increases in heating requirements.

VIII. Replacement and Functional Values

Urban forests have a replacement value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); they also have functional values (either positive or negative) based on the functions the trees perform.

The replacement value of an urban forest tends to increase with a rise in the number and size of healthy trees (Nowak et al 2002a). Annual functional values also tend to increase with increased number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in S1-Significant Woodlands A&B have the following replacement values:

- Replacement value: Can$5.3 million
- Carbon storage: Can$311 thousand

Urban trees in S1-Significant Woodlands A&B have the following annual functional values:

- Carbon sequestration: Can$3.93 thousand
- Avoided runoff: Can$582
- Pollution removal: Can$7.3
- Energy costs and carbon emission values: Can$0

(Note: negative value indicates increased energy cost and carbon emission value)

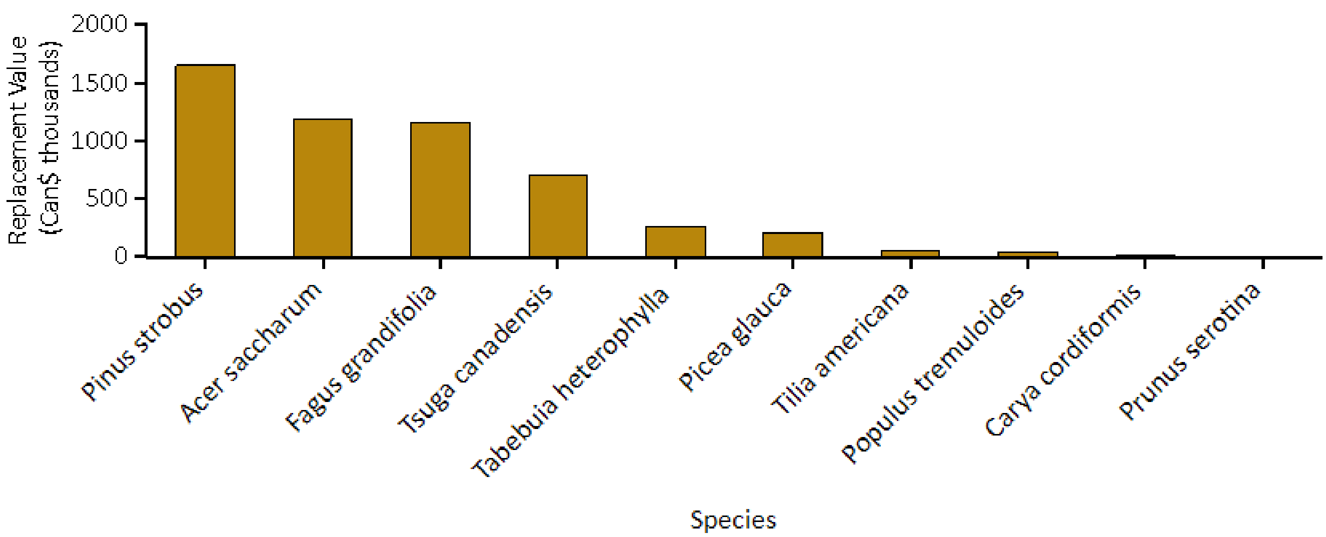


Figure 11. Tree species with the greatest replacement value, S1-Significant Woodlands A&B

[1] Replacement value in Canada is calculated using the same procedure as the U.S. (Nowak et al 2002a). Base costs and species values are derived from the International Society of Arboriculture Ontario Chapter and applied to all Canadian provinces and territories.

IX. Potential Pest Impacts

Various insects and diseases can infest urban forests, potentially killing trees and reducing the health, replacement value and sustainability of the urban forest. As pests tend to have differing tree hosts, the potential damage or risk of each pest will differ among cities.Fifty-three pests were analyzed for their potential impact.

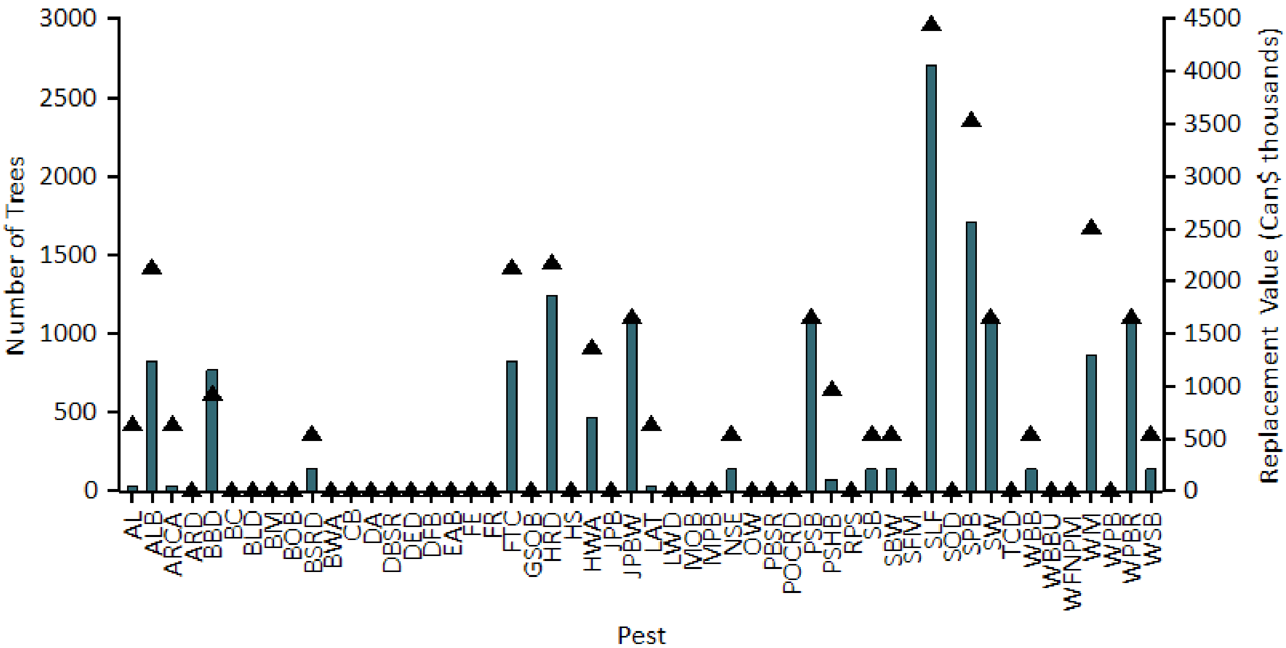


Figure 12. Number of trees at risk (points) and associated compensatory value (bars) by potential pests, S1-Significant Woodlands A&B

Aspen leafminer (AL) (Kruse et al 2007) is an insect that causes damage primarily to trembling or small tooth aspen by larval feeding of leaf tissue. AL has the potential to affect 7.8 percent of the population (Can$48.1 thousand in replacement value).

Asian longhorned beetle (ALB) (Animal and Plant Health Inspection Service 2010) is an insect that bores into and kills a wide range of hardwood species. ALB poses a threat to 26.5 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$1.23 million in replacement value.

Aspen Running Canker (ARCA) poses a threat to 7.8 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$48.1 thousand in replacement value.

Armillaria Root Disease (ARD) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Beech bark disease (BBD) (Houston and O'Brien 1983) is an insect-disease complex that primarily impacts American beech. This disease threatens 11.4 percent of the population, which represents a potential loss of Can$1.16 million in replacement value.

Butternut canker (BC) (Ostry et al 1996) is caused by a fungus that infects butternut trees. The disease has since caused significant declines in butternut populations in the United States. Potential loss of trees from BC is 0.0 percent (Can$0 in replacement value).

Beech Leaf Disease (BLD) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Browntail Moth (BM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Bur Oak Blight (BOB) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Black Stain Root Disease (BSRD) poses a threat to 6.6 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$206 thousand in replacement value.

Balsam woolly adelgid (BWA) (Ragenovich and Mitchell 2006) is an insect that has caused significant damage to the true firs of North America. S1-Significant Woodlands A&B could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

The most common hosts of the fungus that cause chestnut blight (CB) (Diller 1965) are American and European chestnut. CB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Dogwood anthracnose (DA) (Mielke and Daughtrey) is a disease that affects dogwood species, specifically flowering and Pacific dogwood. This disease threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Douglas-fir black stain root disease (DBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks Douglas-firs. S1-Significant Woodlands A&B could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

American elm, one of the most important street trees in the twentieth century, has been devastated by the Dutch elm disease (DED) (Northeastern Area State and Private Forestry 1998). Since first reported in the 1930s, it has killed over 50 percent of the native elm population in the United States. Although some elm species have shown varying degrees of resistance, S1-Significant Woodlands A&B could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Douglas-fir beetle (DFB) (Schmitz and Gibson 1996) is a bark beetle that infests Douglas-fir trees throughout the western United States, British Columbia, and Mexico. Potential loss of trees from DFB is 0.0 percent (Can$0 in replacement value).

Emerald ash borer (EAB) (Michigan State University 2010) has killed thousands of ash trees in parts of the United States. EAB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

One common pest of white fir, grand fir, and red fir trees is the fir engraver (FE) (Ferrell 1986). FE poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Fusiform rust (FR) (Phelps and Czabator 1978) is a fungal disease that is distributed in the southern United States. It is particularly damaging to slash pine and loblolly pine. FR has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Forest Tent Caterpillar (FTC) poses a threat to 26.5 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$1.23 million in replacement value.

Infestations of the goldspotted oak borer (GSOB) (Society of American Foresters 2011) have been a growing problem in southern California. Potential loss of trees from GSOB is 0.0 percent (Can$0 in replacement value).

Heterobasidion Root Disease (HRD) poses a threat to 27.1 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$1.86 million in replacement value.

Hemlock Sawfly (HS) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

As one of the most damaging pests to eastern hemlock and Carolina hemlock, hemlock woolly adelgid (HWA) (U.S. Forest Service 2005) has played a large role in hemlock mortality in the United States. HWA has the potential to affect 16.9 percent of the population (Can$704 thousand in replacement value).

The Jeffrey pine beetle (JPB) (Smith et al 2009) is native to North America and is distributed across California, Nevada, and Oregon where its only host, Jeffrey pine, also occurs. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Jack Pine Budworm (JPBW) poses a threat to 20.5 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$1.65 million in replacement value.

Quaking aspen is a principal host for the defoliator, large aspen tortrix (LAT) (Ciesla and Kruse 2009). LAT poses a threat to 7.8 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$48.1 thousand in replacement value.

Laurel wilt (LWD) (U.S. Forest Service 2011) is a fungal disease that is introduced to host trees by the redbay ambrosia beetle. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Mediterranean Oak Borer (MOB) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Mountain pine beetle (MPB) (Gibson et al 2009) is a bark beetle that primarily attacks pine species in the western United States. MPB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

The northern spruce engraver (NSE) (Burnside et al 2011) has had a significant impact on the boreal and sub-boreal forests of North America where the pest's distribution overlaps with the range of its major hosts. Potential loss of trees from NSE is 6.6 percent (Can$206 thousand in replacement value).

Oak wilt (OW) (Rexrode and Brown 1983), which is caused by a fungus, is a prominent disease among oak trees. OW poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Pine black stain root disease (PBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks hard pines, including lodgepole pine, Jeffrey pine, and ponderosa pine. S1-Significant Woodlands A&B could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Port-Orford-cedar root disease (POCRD) (Liebhold 2010) is a root disease that is caused by a fungus. POCRD threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

The pine shoot beetle (PSB) (Ciesla 2001) is a wood borer that attacks various pine species, though Scotch pine is the preferred host in North America. PSB has the potential to affect 20.5 percent of the population (Can$1.65 million in replacement value).

Polyphagous shot hole borer (PSHB) (University of California 2014) is a boring beetle that was first detected in California. S1-Significant Woodlands A&B could possibly lose 12.0 percent of its trees to this pest (Can$109 thousand in replacement value).

Red Pine Scale (RPS) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Spruce beetle (SB) (Holsten et al 1999) is a bark beetle that causes significant mortality to spruce species within its range. Potential loss of trees from SB is 6.6 percent (Can$206 thousand in replacement value).

Spruce budworm (SBW) (Kucera and Orr 1981) is an insect that causes severe damage to balsam fir. SBW poses a threat to 6.6 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$206 thousand in replacement value.

Subalpine Fir Mortality (SFM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Spotted Lanternfly (SLF) poses a threat to 55.4 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$4.06 million in replacement value.

Sudden oak death (SOD) (Kliejunas 2005) is a disease that is caused by a fungus. Potential loss of trees from SOD is 0.0 percent (Can$0 in replacement value).

Although the southern pine beetle (SPB) (Clarke and Nowak 2009) will attack most pine species, its preferred hosts are loblolly, Virginia, pond, spruce, shortleaf, and sand pines. This pest threatens 44.0 percent of the population, which represents a potential loss of Can$2.56 million in replacement value.

The sirex woodwasp (SW) (Haugen and Hoebeke 2005) is a wood borer that primarily attacks pine species. SW poses a threat to 20.5 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$1.65 million in replacement value.

Thousand canker disease (TCD) (Cranshaw and Tisserat 2009; Seybold et al 2010) is an insect-disease complex that kills several species of walnuts, including black walnut. Potential loss of trees from TCD is 0.0 percent (Can$0 in replacement value).

Western Balsam Bark Beetle (WBB) poses a threat to 6.6 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$206 thousand in replacement value.

Western Blackheaded Budworm (WBBU) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Western Five-Needle Pine Mortality (WFNPM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B urban forest, which represents a potential loss of Can$0 in replacement value.

Winter moth (WM) (Childs 2011) is a pest with a wide range of host species. WM causes the highest levels of injury to its hosts when it is in its caterpillar stage. S1-Significant Woodlands A&B could possibly lose 31.3 percent of its trees to this pest (Can$1.3 million in replacement value).

The western pine beetle (WPB) (DeMars and Roettgering 1982) is a bark beetle and aggressive attacker of ponderosa and Coulter pines. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Since its introduction to the United States in 1900, white pine blister rust (Eastern U.S.) (WPBR) (Nicholls and Anderson 1977) has had a detrimental effect on white pines, particularly in the Lake States. WPBR has the potential to affect 20.5 percent of the population (Can$1.65 million in replacement value).

Western spruce budworm (WSB) (Fellin and Dewey 1986) is an insect that causes defoliation in western conifers. This pest threatens 6.6 percent of the population, which represents a potential loss of Can$206 thousand in replacement value.

Appendix I. i-Tree Eco Model and Field Measurements

i-Tree Eco is designed to use standardized field data from randomly located plots and local hourly air pollution and meteorological data to quantify urban forest structure and its numerous effects (Nowak and Crane 2000), including:

- Urban forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year.
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources.
- Replacement value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian longhorned beetle, emerald ash borer, spongy moth, and Dutch elm disease.

Typically, all field data are collected during the leaf-on season to properly assess tree canopies. Typical data collection (actual data collection may vary depending upon the user) includes land use, ground and tree cover, individual tree attributes of species, stem diameter, height, crown width, crown canopy missing and dieback, and distance and direction to residential buildings (Nowak et al 2005; Nowak et al 2008).

During data collection, trees are identified to the most specific taxonomic classification possible. Trees that are not classified to the species level may be classified by genus (e.g., ash) or species groups (e.g., hardwood). In this report, tree species, genera, or species groups are collectively referred to as tree species.

Tree Characteristics:

Leaf area of trees was assessed using measurements of crown dimensions and percentage of crown canopy missing. In the event that these data variables were not collected, they are estimated by the model.

An analysis of invasive species is not available for studies outside of the United States. For the U.S., invasive species are identified using an invasive species list for the state in which the urban forest is located. These lists are not exhaustive and they cover invasive species of varying degrees of invasiveness and distribution. In instances where a state did not have an invasive species list, a list was created based on the lists of the adjacent states. Tree species that are identified as invasive by the state invasive species list are cross-referenced with native range data. This helps eliminate species that are on the state invasive species list, but are native to the study area.

Air Pollution Removal:

Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter less than 2.5 microns, and particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models (Baldocchi 1988; Baldocchi et al 1987). As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature (Bidwell and Fraser 1972; Lovett 1994) that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere (Zinke 1967). Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values (Hirabayashi et al 2011; Hirabayashi et al 2012; Hirabayashi 2011).

Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces (Nowak et al 2013). This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors. Generally, PM2.5 and PM10* removal is positive with positive benefits. However, there are some cases when net removal is negative or resuspended particles lead to increased pollution concentrations and negative values. During some months (e.g., with no rain), trees resuspend more particles than they remove. Resuspension can also lead to increased overall PM2.5 and PM10* concentrations if the boundary layer conditions are lower during net resuspension periods than during net removal periods. Since the pollution removal value is based on the change in pollution concentration, it is possible to have situations when trees remove PM2.5 and PM10* but increase concentrations and thus have negative values during periods of positive overall removal. These events are not common, but can happen.

For reports in the United States, default air pollution removal value is calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter less than 2.5 microns using data from the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP) (Nowak et al 2014). The model uses a damage-function approach that is based on the local change in pollution concentration and population. National median externality costs were used to calculate the value of carbon monoxide removal (Murray et al 1994).

For international reports, user-defined local pollution values are used. For international reports that do not have local values, estimates are based on either European median externality values (van Essen et al 2011) or BenMAP regression equations (Nowak et al 2014) that incorporate user-defined population estimates. Values are then converted to local currency with user-defined exchange rates.

For this analysis, pollution removal value is calculated based on the prices of Can$0 per metric ton (carbon monoxide), Can$0 per metric ton (ozone), Can$0 per metric ton (nitrogen dioxide), Can$83 per metric ton (sulfur dioxide), Can$0 per metric ton (particulate matter less than 2.5 microns), Can$0 per metric ton (particulate matter less than 10 microns and greater than 2.5 microns).

Carbon Storage and Sequestration:

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations (Nowak 1994). To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

Carbon sequestration is the removal of carbon dioxide from the air by plants. To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States (U.S. Environmental Protection Agency 2015, Interagency Working Group on Social Cost of Carbon 2015) and converted to local currency with user-defined exchange rates.

For this analysis, carbon storage and carbon sequestration values are calculated based on Can$115 per metric ton.

Oxygen Production:

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O_2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of the urban forest account for decomposition (Nowak et al 2007). For complete inventory projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition.

Avoided Runoff:

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis.

The value of avoided runoff is based on estimated or user-defined local values. For international reports that do not have local values, the national average value for the United States is utilized and converted to local currency with user-defined exchange rates. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

For this analysis, avoided runoff value is calculated based on the price of Can$2.32 per cubic meter.

Building Energy Use:

If appropriate field data were collected, seasonal effects of trees on residential building energy use were calculated based on procedures described in the literature (McPherson and Simpson 1999) using distance and direction of trees from residential structures, tree height and tree condition data. To calculate the monetary value of energy savings, local or custom prices per MWH or MBTU are utilized.

For this analysis, energy saving value is calculated based on the prices of Can$75.00 per MWH and Can$10.45 per MBTU.

Replacement Values:

Replacement value is the value of a tree based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Replacement values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b). Replacement value may not be included for international projects if there is insufficient local data to complete the valuation procedures.

Potential Pest Impacts:

The complete potential pest risk analysis is not available for studies outside of the United States. The number of trees at risk to the pests analyzed is reported, though the list of pests is based on known insects and disease in the United States.

For the U.S., potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to the county in which the urban forest is located. For the county, it was established whether the insect/disease occurs within the county, is within 400 kilometers of the county edge, is between 400 and 1210 kilometers away, or is greater than 1210 kilometers away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007).

Relative Tree Effects:

The relative value of tree benefits reported in Appendix II is calculated to show what carbon storage and sequestration, and air pollutant removal equate to in amounts of municipal carbon emissions, passenger automobile emissions, and house emissions.

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM10, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM10 emission per kWh from Layton 2004.
- CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Appendix II. Relative Tree Effects

The urban forest in S1-Significant Woodlands A&B provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average municipal carbon emissions, average passenger automobile emissions, and average household emissions. See Appendix I for methodology.

Carbon storage is equivalent to:

- Amount of carbon emitted in S1-Significant Woodlands A&B in 0 days
- Annual carbon (C) emissions from 2,110 automobiles
- Annual C emissions from 866 single-family houses

Carbon monoxide removal is equivalent to:

- Annual carbon monoxide emissions from 0 automobiles
- Annual carbon monoxide emissions from 0 single-family houses

Nitrogen dioxide removal is equivalent to:

- Annual nitrogen dioxide emissions from 0 automobiles
- Annual nitrogen dioxide emissions from 0 single-family houses

Sulfur dioxide removal is equivalent to:

- Annual sulfur dioxide emissions from 1,040 automobiles
- Annual sulfur dioxide emissions from 3 single-family houses

Annual carbon sequestration is equivalent to:

- Amount of carbon emitted in S1-Significant Woodlands A&B in 0.0 days
- Annual C emissions from 27 automobiles
- Annual C emissions from 11 single-family houses

Appendix III. Comparison of Urban Forests

A common question asked is, "How does this city compare to other cities?" Although comparison among cities should be made with caution as there are many attributes of a city that affect urban forest structure and functions, summary data are provided from other cities analyzed using the i-Tree Eco model.

I. City totals for trees

City	*% Tree Cover*	*Number of Trees*	*Carbon Storage (metric tons)*	*Carbon Sequestration (metric tons/yr)*	*Pollution Removal (metric tons/yr)*
Toronto, ON, Canada	26.6	10,220,000	1,108,000	46,700	1,905
Atlanta, GA	36.7	9,415,000	1,220,000	42,100	1,509
Los Angeles, CA	11.1	5,993,000	1,151,000	69,800	1,792
New York, NY	20.9	5,212,000	1,225,000	38,400	1,521
London, ON, Canada	24.7	4,376,000	360,000	12,500	370
Chicago, IL	17.2	3,585,000	649,000	22,800	806
Phoenix, AZ	9.0	3,166,000	286,000	29,800	511
Baltimore, MD	21.0	2,479,000	517,000	16,700	390
Philadelphia, PA	15.7	2,113,000	481,000	14,600	522
Washington, DC	28.6	1,928,000	477,000	14,700	379
Oakville, ON , Canada	29.1	1,908,000	133,000	6,000	172
Albuquerque, NM	14.3	1,846,000	301,000	9,600	225
Boston, MA	22.3	1,183,000	290,000	9,500	257
Syracuse, NY	26.9	1,088,000	166,000	5,300	99
Woodbridge, NJ	29.5	986,000	145,000	5,000	191
Minneapolis, MN	26.4	979,000	227,000	8,100	277
San Francisco, CA	11.9	668,000	176,000	4,600	128
Morgantown, WV	35.5	658,000	84,000	2,600	65
Moorestown, NJ	28.0	583,000	106,000	3,400	107
Hartford, CT	25.9	568,000	130,000	3,900	52
Jersey City, NJ	11.5	136,000	19,000	800	37
Casper, WY	8.9	123,000	34,000	1,100	34
Freehold, NJ	34.4	48,000	18,000	500	20

II. Totals per hectare of land area

City	*Number of Trees/ha*	*Carbon Storage (metric tons/ha)*	*Carbon Sequestration (metric tons/ha/yr)*	*Pollution Removal (kg/ha/yr)*
Toronto, ON, Canada	160.4	17.4	0.73	29.9
Atlanta, GA	275.8	35.7	1.23	44.2
Los Angeles, CA	48.4	9.4	0.36	14.7
New York, NY	65.2	15.3	0.48	19.0
London, ON, Canada	185.5	15.3	0.53	15.7
Chicago, IL	59.9	10.9	0.38	13.5
Phoenix, AZ	31.8	2.9	0.30	5.1
Baltimore, MD	118.5	25.0	0.80	18.6
Philadelphia, PA	61.9	14.1	0.43	15.3
Washington, DC	121.1	29.8	0.92	23.8
Oakville, ON , Canada	192.9	13.4	0.61	12.4
Albuquerque, NM	53.9	8.8	0.28	6.6
Boston, MA	82.9	20.3	0.67	18.0
Syracuse, NY	167.4	23.1	0.77	15.2
Woodbridge, NJ	164.4	24.2	0.84	31.9
Minneapolis, MN	64.8	15.0	0.53	18.3
San Francisco, CA	55.7	14.7	0.39	10.7
Morgantown, WV	294.5	37.7	1.17	29.2
Moorestown, NJ	153.4	27.9	0.90	28.1
Hartford, CT	124.6	28.5	0.86	11.5
Jersey City, NJ	35.5	5.0	0.21	9.6
Casper, WY	22.5	6.2	0.20	6.2
Freehold, NJ	94.6	35.9	0.98	39.6

Appendix IV. General Recommendations for Air Quality Improvement

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmosphere environment. Four main ways that urban trees affect air quality are (Nowak 1995):

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Emission of volatile organic compounds (VOC) and tree maintenance emissions
- Energy effects on buildings

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities (Nowak 2000). Local urban management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include (Nowak 2000):

Strategy	*Result*
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

Appendix V. Invasive Species of the Urban Forest

Invasive species data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

Appendix VI. Potential Risk of Pests

Pest range data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

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i-Tree
Ecosystem Analysis

1-Significant Woodlands: Partial

Urban Forest Effects and Values
January 2026

Summary

Understanding an urban forest's structure, function and value can promote management decisions that will improve human health and environmental quality. An assessment of the vegetation structure, function, and value of the S1-Significant Woodlands: Partial urban forest was conducted during 2026. Data from 6 field plots located throughout S1-Significant Woodlands: Partial were analyzed using the i-Tree Eco model developed by the U.S. Forest Service, Northern Research Station.

- Number of trees: 3,531
- Tree Cover: 93.7 %
- Most common species of trees: Acer saccharum, Pinus strobus, Tsuga canadensis
- Percentage of trees less than 6" (15.2 cm) diameter: 17.1%
- Pollution Removal: 60.3 kilograms/year (Can$4.94/year)
- Carbon Storage: 1.916 thousand metric tons (Can$220 thousand)
- Carbon Sequestration: 22.8 metric tons (Can$2.62 thousand/year)
- Oxygen Production: 53.17 metric tons/year
- Avoided Runoff: 166.2 cubic meters/year (Can$386/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Replacement values: Can$3.71 million

Metric ton: 1000 kilograms
Monetary values Can$ are reported in Canadian Dollars throughout the report except where noted.
Ecosystem service estimates are reported for trees.
With Complete Inventory Projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition. Oxygen production in Plot Inventory Projects is estimated from net carbon sequestration.

The estimate of Tree Cover is derived from user estimations of percent tree cover over plots and extrapolated to the whole study area. For more precise tree cover estimates please use i-Tree Canopy or i-Tree Landscape.

For an overview of i-Tree Eco methodology, see Appendix I. Data collection quality is determined by the local data collectors, over which i-Tree has no control. Additionally, some of the plot and tree information may not have been collected, so not all of the analyses may have been conducted for this report.

Table of Contents

I. Tree Characteristics of the Urban Forest

The urban forest of S1-Significant Woodlands: Partial has an estimated 3,531 trees with a tree cover of 93.7 percent. The three most common species are Acer saccharum (22.9 percent), Pinus strobus (22.9 percent), and Tsuga canadensis (19.0 percent).

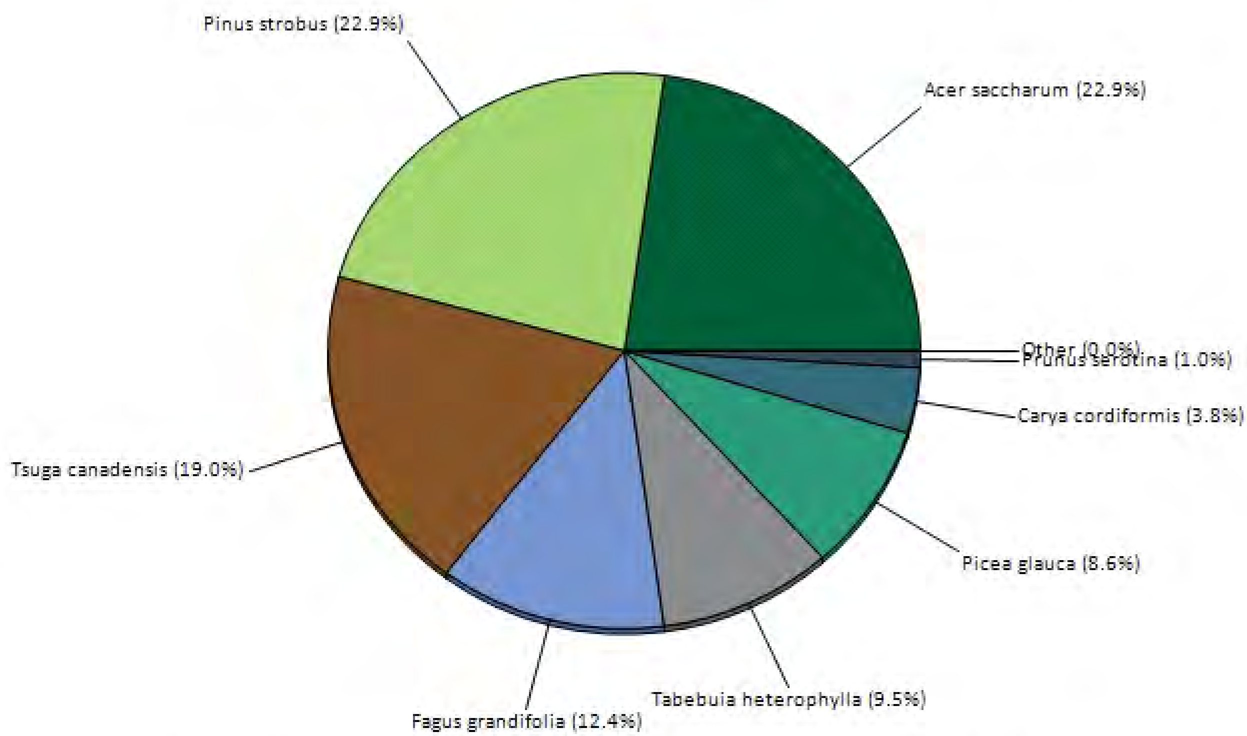

Figure 1. Tree species composition in S1-Significant Woodlands: Partial

The overall tree density in S1-Significant Woodlands: Partial is 432 trees/hectare (see Appendix III for comparable values from other cities).

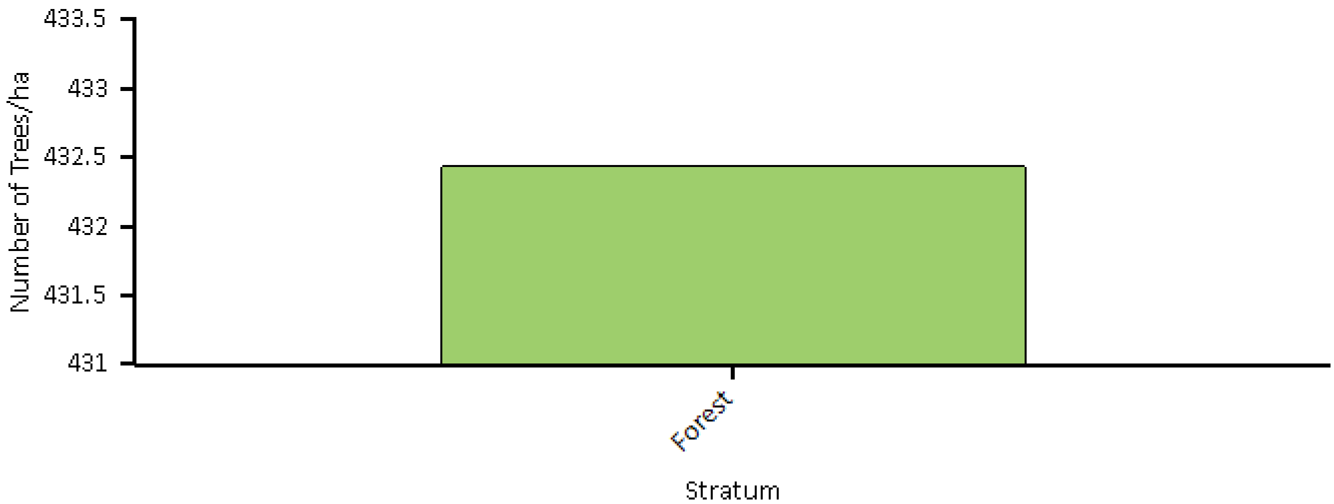

Figure 2. Number of trees/ha in S1-Significant Woodlands: Partial by stratum

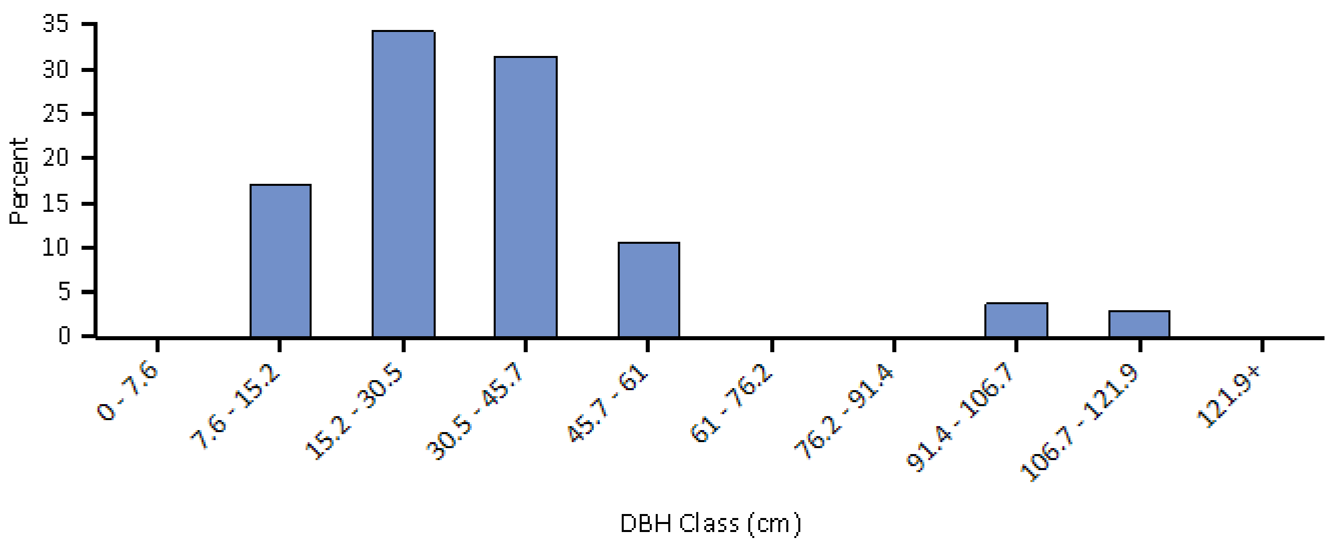

Figure 3. Percent of tree population by diameter class (DBH - stem diameter at 1.37 meters)

Urban forests are composed of a mix of native and exotic tree species. Thus, urban forests often have a tree diversity that is higher than surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but it can also pose a risk to native plants if some of the exotic species are invasive plants that can potentially out-compete and displace native species. In S1-Significant Woodlands: Partial, about 90 percent of the trees are species native to North America. Most trees have an origin from COUNTRY (90 percent of the trees).

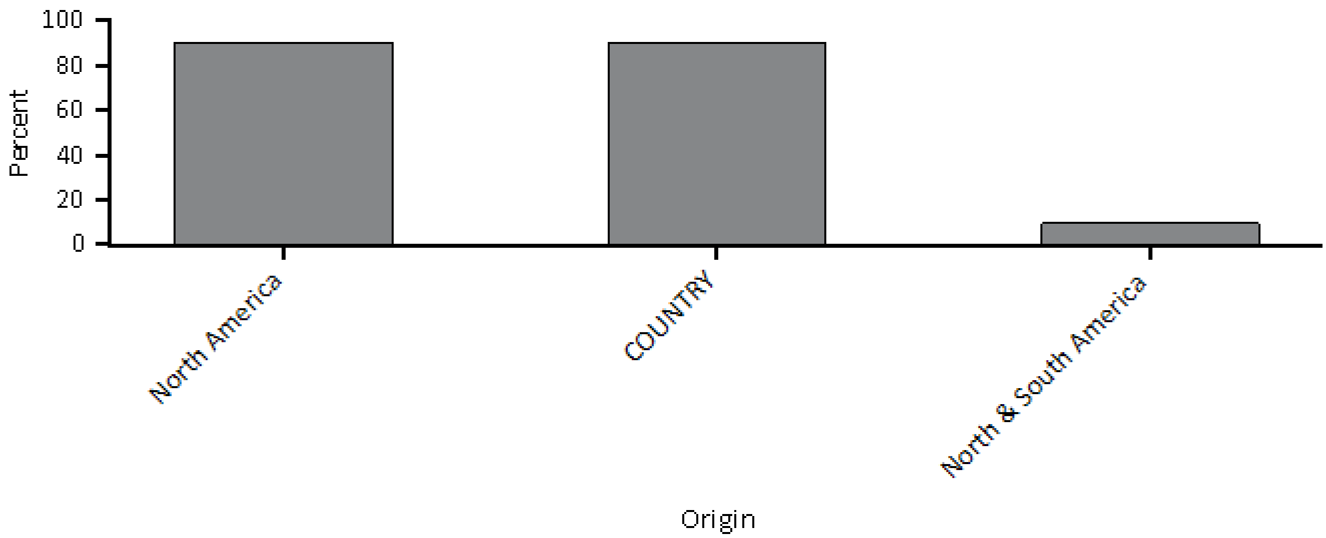

Figure 4. Percent of live tree population by area of native origin, S1-Significant Woodlands: Partial

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and general lack of natural enemies. These abilities enable them to displace native plants and make them a threat to natural areas.

II. Urban Forest Cover and Leaf Area

Many tree benefits equate directly to the amount of healthy leaf surface area of the plant. Trees cover about 94 percent of S1-Significant Woodlands: Partial and provide 144.2 hectares of leaf area. Total leaf area is greatest in Forest.

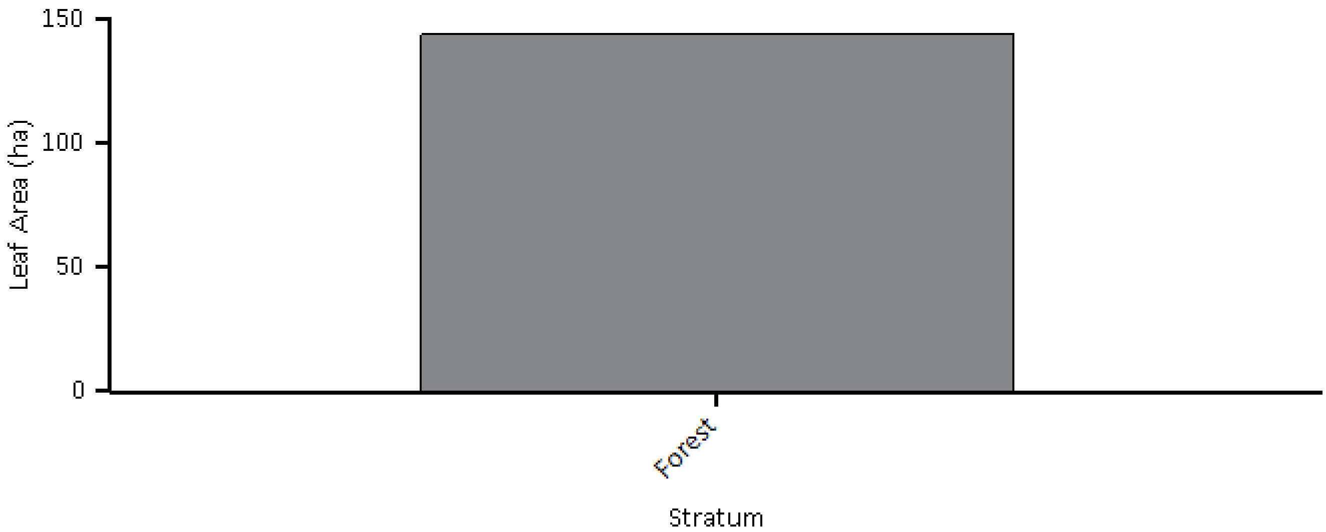

Figure 5. Leaf area by stratum, S1-Significant Woodlands: Partial

In S1-Significant Woodlands: Partial, the most dominant species in terms of leaf area are Fagus grandifolia, Acer saccharum, and Pinus strobus. The 8 species with the greatest importance values are listed in Table 1. Importance values (IV) are calculated as the sum of percent population and percent leaf area. High importance values do not mean that these trees should necessarily be encouraged in the future; rather these species currently dominate the urban forest structure.

Table 1. Most important species in S1-Significant Woodlands: Partial

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Acer saccharum	22.9	22.9	45.7
Pinus strobus	22.9	20.6	43.4
Fagus grandifolia	12.4	25.1	37.5
Tsuga canadensis	19.0	16.6	35.6
Picea glauca	8.6	8.4	17.0
Tabebuia heterophylla	9.5	5.9	15.4
Carya cordiformis	3.8	0.4	4.2
Prunus serotina	1.0	0.2	1.2

Common ground cover classes (including cover types beneath trees and shrubs) in S1-Significant Woodlands: Partial are not available since they are configured not to be collected.

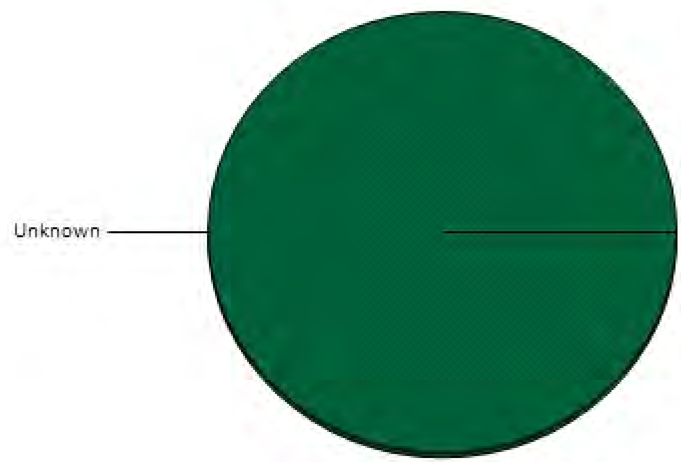

Figure 6. Percent of land by ground cover classes, S1-Significant Woodlands: Partial

III. Air Pollution Removal by Urban Trees

Poor air quality is a common problem in many urban areas. It can lead to decreased human health, damage to landscape materials and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power sources. Trees also emit volatile organic compounds that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation (Nowak and Dwyer 2000).

Pollution removal[1] by trees in S1-Significant Woodlands: Partial was estimated using field data and recent available pollution and weather data available. Pollution removal was greatest for sulfur dioxide (Figure 7). It is estimated that trees remove 60.3 kilograms of air pollution (ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter less than 2.5 microns (PM2.5), particulate matter less than 10 microns and greater than 2.5 microns (PM10*)[2], and sulfur dioxide (SO2)) per year with an associated value of Can$4.94 (see Appendix I for more details).

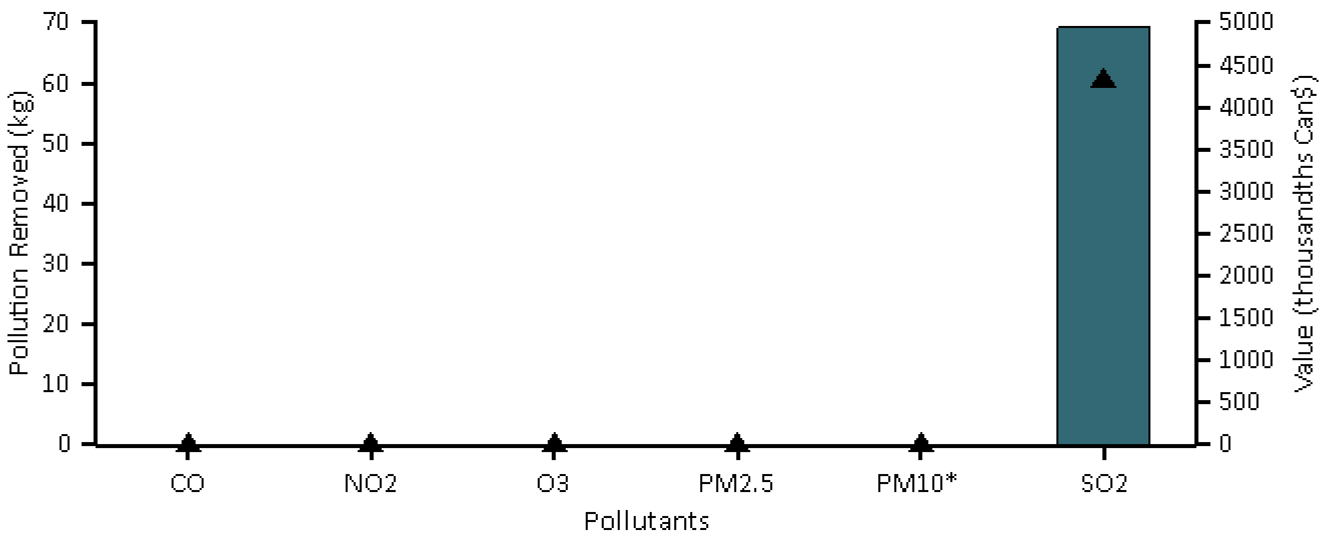

Figure 7. Annual pollution removal (points) and value (bars) by urban trees, S1-Significant Woodlands: Partial

[1] PM10* is particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is particulate matter less than 2.5 microns. If PM2.5 is not monitored, PM10* represents particulate matter less than 10 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

[2] Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces. This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors (see Appendix I for more details).

In 2026, trees in S1-Significant Woodlands: Partial emitted an estimated 342.6 kilograms of volatile organic compounds (VOCs) (14.16 kilograms of isoprene and 328.4 kilograms of monoterpenes). Emissions vary among species based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Eighty- one percent of the urban forest's VOC emissions were from Pinus strobus and Picea glauca. These VOCs are precursor chemicals to ozone formation.[3]

General recommendations for improving air quality with trees are given in Appendix VIII.

[3] Some economic studies have estimated VOC emission costs. These costs are not included here as there is a tendency to add positive dollar estimates of ozone removal effects with negative dollar values of VOC emission effects to determine whether tree effects are positive or negative in relation to ozone. This combining of dollar values to determine tree effects should not be done, rather estimates of VOC effects on ozone formation (e.g., via photochemical models) should be conducted and directly contrasted with ozone removal by trees (i.e., ozone effects should be directly compared, not dollar estimates). In addition, air temperature reductions by trees have been shown to significantly reduce ozone concentrations (Cardelino and Chameides 1990; Nowak et al 2000), but are not considered in this analysis. Photochemical modeling that integrates tree effects on air temperature, pollution removal, VOC emissions, and emissions from power plants can be used to determine the overall effect of trees on ozone concentrations.

IV. Carbon Storage and Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by altering energy use in buildings, and consequently altering carbon dioxide emissions from fossil-fuel based power sources (Abdollahi et al 2000).

Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is increased with the size and health of the trees. The gross sequestration of S1-Significant Woodlands: Partial trees is about 22.8 metric tons of carbon per year with an associated value of Can$2.62 thousand. Net carbon sequestration in the urban forest is about 19.94 metric tons. See Appendix I for more details on methods.

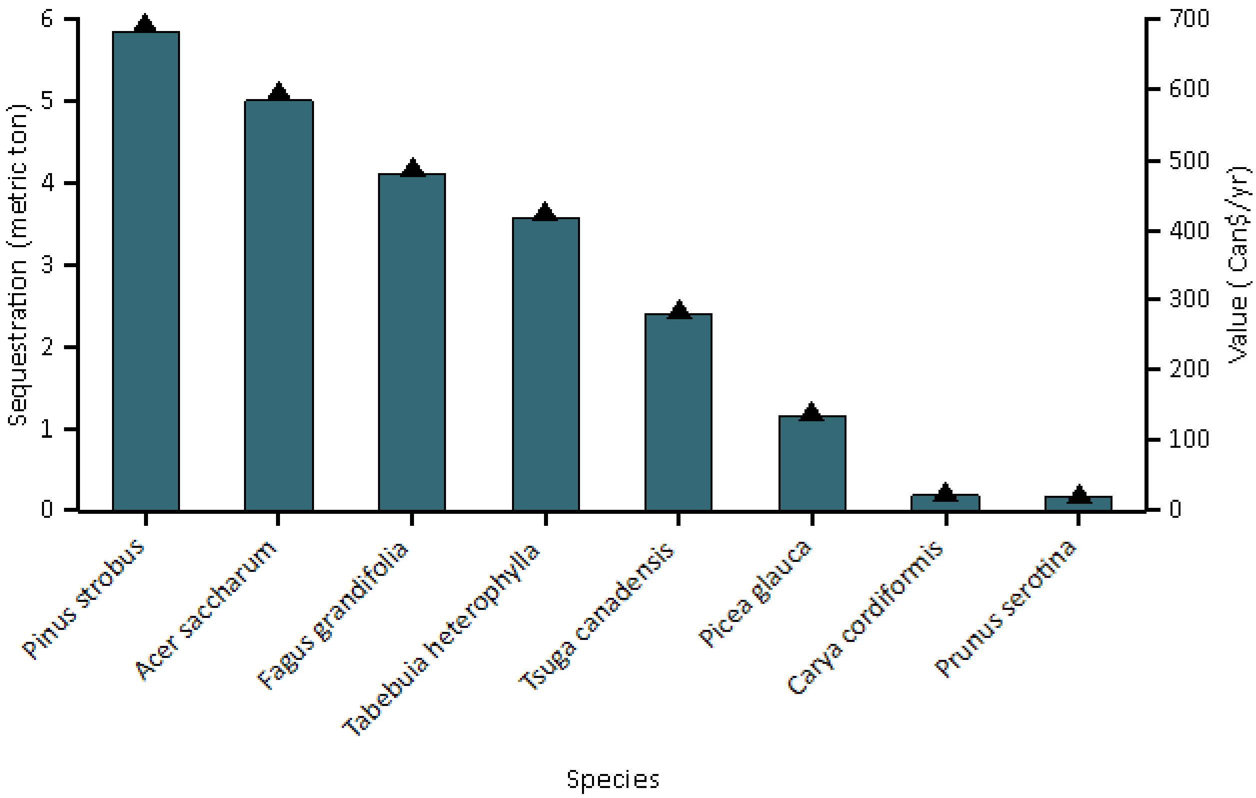

Figure 8. Estimated annual gross carbon sequestration (points) and value (bars) for urban tree species with the greatest sequestration, S1-Significant Woodlands: Partial

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions (Nowak et al 2002c). When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants.

Trees in S1-Significant Woodlands: Partial are estimated to store 1920 metric tons of carbon (Can$220 thousand). Of the species sampled, Acer saccharum stores the most carbon (approximately 44.3% of the total carbon stored) and Pinus strobus sequesters the most (approximately 26% of all sequestered carbon.)

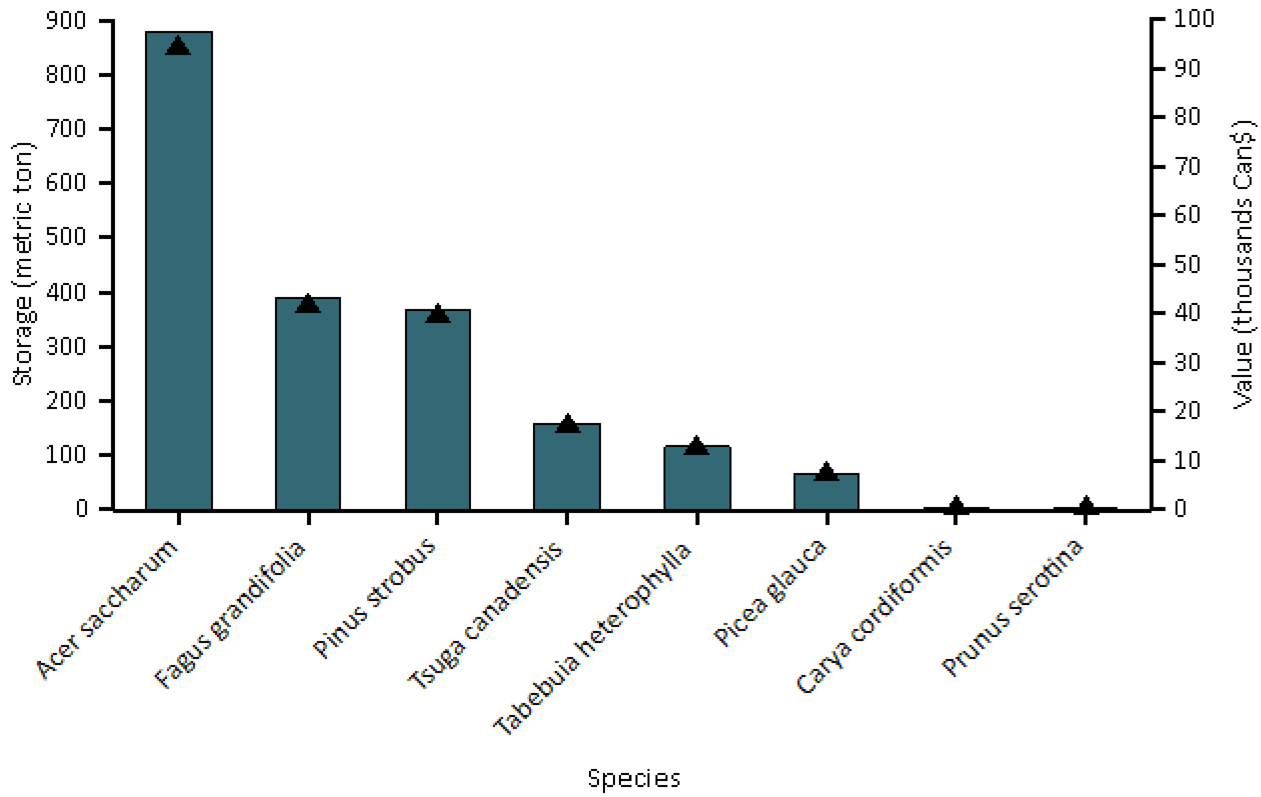

Figure 9. Estimated carbon storage (points) and values (bars) for urban tree species with the greatest storage, S1-Significant Woodlands: Partial

V. Oxygen Production

Oxygen production is one of the most commonly cited benefits of urban trees. The net annual oxygen production of a tree is directly related to the amount of carbon sequestered by the tree, which is tied to the accumulation of tree biomass.

Trees in S1-Significant Woodlands: Partial are estimated to produce 53.17 metric tons of oxygen per year.[4] However, this tree benefit is relatively insignificant because of the large and relatively stable amount of oxygen in the atmosphere and extensive production by aquatic systems. Our atmosphere has an enormous reserve of oxygen. If all fossil fuel reserves, all trees, and all organic matter in soils were burned, atmospheric oxygen would only drop a few percent (Broecker 1970).

Table 2. The top 8 oxygen production species.

Species	*Oxygen (metric ton)*	*Net Carbon Sequestration (metric ton/yr)*	*Number of Trees*	*Leaf Area (hectare)*
Pinus strobus	12.90	4.84	807	29.66
Acer saccharum	12.04	4.51	807	32.98
Tabebuia heterophylla	9.35	3.51	336	8.53
Fagus grandifolia	8.68	3.25	437	36.24
Tsuga canadensis	6.21	2.33	672	23.87
Picea glauca	3.01	1.13	303	12.10
Carya cordiformis	0.51	0.19	134	0.52
Prunus serotina	0.47	0.17	34	0.29

[4] A negative estimate, or oxygen deficit, indicates that trees are decomposing faster than they are producing oxygen. This would be the case in an area that has a large proportion of dead trees.

VI. Avoided Runoff

Surface runoff can be a cause for concern in many urban areas as it can contribute pollution to streams, wetlands, rivers, lakes, and oceans. During precipitation events, some portion of the precipitation is intercepted by vegetation (trees and shrubs) while the other portion reaches the ground. The portion of the precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff (Hirabayashi 2012). In urban areas, the large extent of impervious surfaces increases the amount of surface runoff.

Urban trees and shrubs, however, are beneficial in reducing surface runoff. Trees and shrubs intercept precipitation, while their root systems promote infiltration and storage in the soil. The trees and shrubs of S1-Significant Woodlands: Partial help to reduce runoff by an estimated 166 cubic meters a year with an associated value of Can$390 (see Appendix I for more details). Avoided runoff is estimated based on local weather from the user-designated weather station. In S1-Significant Woodlands: Partial, the total annual precipitation in 2024 was 87.7 centimeters.

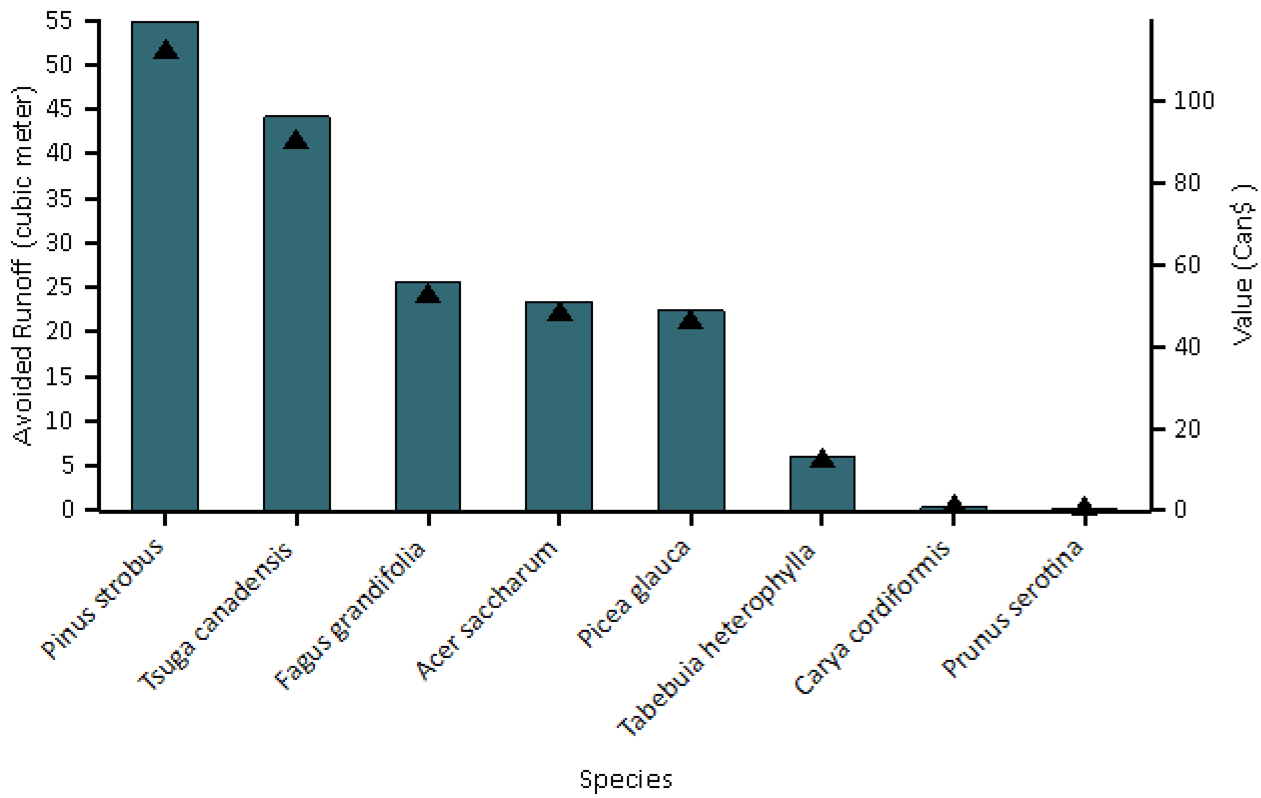

Figure 10. Avoided runoff (points) and value (bars) for species with greatest overall impact on runoff, S1-Significant Woodlands: Partial

VII. Trees and Building Energy Use

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space conditioned residential buildings (McPherson and Simpson 1999).

Because energy-related data were not collected, energy savings and carbon avoided cannot be calculated.

Table 3. Annual energy savings due to trees near residential buildings, S1-Significant Woodlands: Partial

	Heating	*Cooling*	*Total*
MBTU[a]	0	N/A	0
MWH[b]	0	0	0
Carbon Avoided (kilograms)	0	0	0

[a]MBTU - one million British Thermal Units
[b]MWH - megawatt-hour

Table 4. Annual savings [a](Can$) in residential energy expenditure during heating and cooling seasons, S1-Significant Woodlands: Partial

	Heating	*Cooling*	*Total*
MBTU[b]	0	N/A	0
MWH[c]	0	0	0
Carbon Avoided	0	0	0

[b]Based on the prices of Can$75 per MWH and Can$10.4544285106757 per MBTU (see Appendix I for more details)
[c]MBTU - one million British Thermal Units
[c]MWH - megawatt-hour

[5] Trees modify climate, produce shade, and reduce wind speeds. Increased energy use or costs are likely due to these tree-building interactions creating a cooling effect during the winter season. For example, a tree (particularly evergreen species) located on the southern side of a residential building may produce a shading effect that causes increases in heating requirements.

VIII. Replacement and Functional Values

Urban forests have a replacement value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); they also have functional values (either positive or negative) based on the functions the trees perform.

The replacement value of an urban forest tends to increase with a rise in the number and size of healthy trees (Nowak et al 2002a). Annual functional values also tend to increase with increased number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in S1-Significant Woodlands: Partial have the following replacement values:

- Replacement value: Can$3.71 million
- Carbon storage: Can$220 thousand

Urban trees in S1-Significant Woodlands: Partial have the following annual functional values:

- Carbon sequestration: Can$2.62 thousand
- Avoided runoff: Can$386
- Pollution removal: Can$4.94
- Energy costs and carbon emission values: Can$0

(Note: negative value indicates increased energy cost and carbon emission value)

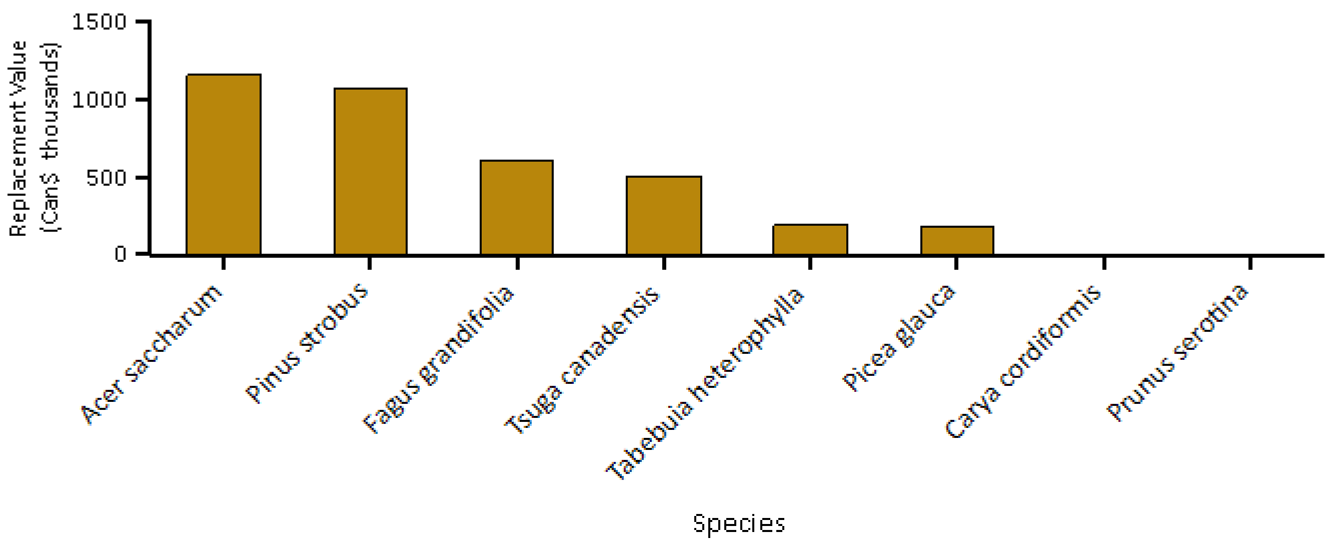

Figure 11. Tree species with the greatest replacement value, S1-Significant Woodlands: Partial

[1] Replacement value in Canada is calculated using the same procedure as the U.S. (Nowak et al 2002a). Base costs and species values are derived from the International Society of Arboriculture Ontario Chapter and applied to all Canadian provinces and territories.

IX. Potential Pest Impacts

Various insects and diseases can infest urban forests, potentially killing trees and reducing the health, replacement value and sustainability of the urban forest. As pests tend to have differing tree hosts, the potential damage or risk of each pest will differ among cities.Fifty-three pests were analyzed for their potential impact.

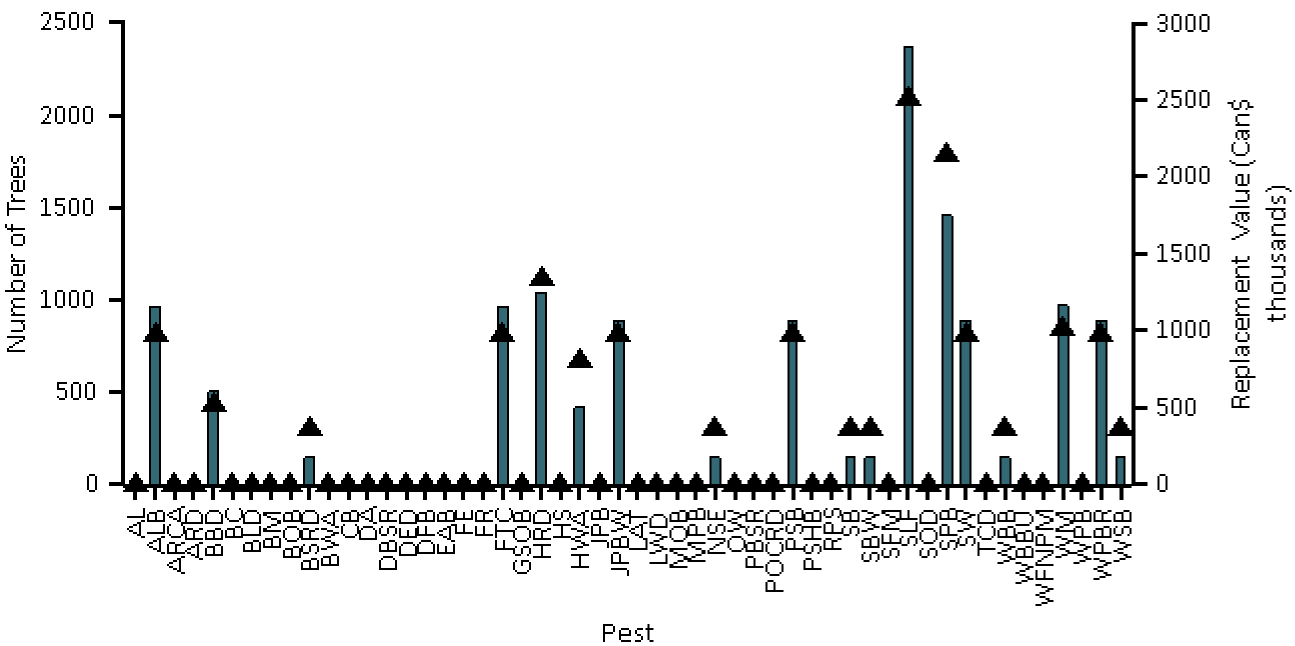

Figure 12. Number of trees at risk (points) and associated compensatory value (bars) by potential pests, S1-Significant Woodlands: Partial

Aspen leafminer (AL) (Kruse et al 2007) is an insect that causes damage primarily to trembling or small tooth aspen by larval feeding of leaf tissue. AL has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Asian longhorned beetle (ALB) (Animal and Plant Health Inspection Service 2010) is an insect that bores into and kills a wide range of hardwood species. ALB poses a threat to 22.9 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$1.16 million in replacement value.

Aspen Running Canker (ARCA) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Armillaria Root Disease (ARD) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Beech bark disease (BBD) (Houston and O'Brien 1983) is an insect-disease complex that primarily impacts American beech. This disease threatens 12.4 percent of the population, which represents a potential loss of Can$606 thousand in replacement value.

Butternut canker (BC) (Ostry et al 1996) is caused by a fungus that infects butternut trees. The disease has since caused significant declines in butternut populations in the United States. Potential loss of trees from BC is 0.0 percent

(Can$0 in replacement value).

Beech Leaf Disease (BLD) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Browntail Moth (BM) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Bur Oak Blight (BOB) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Black Stain Root Disease (BSRD) poses a threat to 8.6 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$177 thousand in replacement value.

Balsam woolly adelgid (BWA) (Ragenovich and Mitchell 2006) is an insect that has caused significant damage to the true firs of North America. S1-Significant Woodlands: Partial could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

The most common hosts of the fungus that cause chestnut blight (CB) (Diller 1965) are American and European chestnut. CB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Dogwood anthracnose (DA) (Mielke and Daughtrey) is a disease that affects dogwood species, specifically flowering and Pacific dogwood. This disease threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Douglas-fir black stain root disease (DBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks Douglas-firs. S1-Significant Woodlands: Partial could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

American elm, one of the most important street trees in the twentieth century, has been devastated by the Dutch elm disease (DED) (Northeastern Area State and Private Forestry 1998). Since first reported in the 1930s, it has killed over 50 percent of the native elm population in the United States. Although some elm species have shown varying degrees of resistance, S1-Significant Woodlands: Partial could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Douglas-fir beetle (DFB) (Schmitz and Gibson 1996) is a bark beetle that infests Douglas-fir trees throughout the western United States, British Columbia, and Mexico. Potential loss of trees from DFB is 0.0 percent (Can$0 in replacement value).

Emerald ash borer (EAB) (Michigan State University 2010) has killed thousands of ash trees in parts of the United States. EAB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

One common pest of white fir, grand fir, and red fir trees is the fir engraver (FE) (Ferrell 1986). FE poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Fusiform rust (FR) (Phelps and Czabator 1978) is a fungal disease that is distributed in the southern United States. It is particularly damaging to slash pine and loblolly pine. FR has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Forest Tent Caterpillar (FTC) poses a threat to 22.9 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$1.16 million in replacement value.

Infestations of the goldspotted oak borer (GSOB) (Society of American Foresters 2011) have been a growing problem in southern California. Potential loss of trees from GSOB is 0.0 percent (Can$0 in replacement value).

Heterobasidion Root Disease (HRD) poses a threat to 31.4 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$1.25 million in replacement value.

Hemlock Sawfly (HS) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

As one of the most damaging pests to eastern hemlock and Carolina hemlock, hemlock woolly adelgid (HWA) (U.S. Forest Service 2005) has played a large role in hemlock mortality in the United States. HWA has the potential to affect 19.0 percent of the population (Can$503 thousand in replacement value).

The Jeffrey pine beetle (JPB) (Smith et al 2009) is native to North America and is distributed across California, Nevada, and Oregon where its only host, Jeffrey pine, also occurs. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Jack Pine Budworm (JPBW) poses a threat to 22.9 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$1.07 million in replacement value.

Quaking aspen is a principal host for the defoliator, large aspen tortrix (LAT) (Ciesla and Kruse 2009). LAT poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Laurel wilt (LWD) (U.S. Forest Service 2011) is a fungal disease that is introduced to host trees by the redbay ambrosia beetle. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Mediterranean Oak Borer (MOB) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Mountain pine beetle (MPB) (Gibson et al 2009) is a bark beetle that primarily attacks pine species in the western United States. MPB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

The northern spruce engraver (NSE) (Burnside et al 2011) has had a significant impact on the boreal and sub-boreal forests of North America where the pest's distribution overlaps with the range of its major hosts. Potential loss of trees from NSE is 8.6 percent (Can$177 thousand in replacement value).

Oak wilt (OW) (Rexrode and Brown 1983), which is caused by a fungus, is a prominent disease among oak trees. OW poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Pine black stain root disease (PBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks hard pines, including lodgepole pine, Jeffrey pine, and ponderosa pine. S1-Significant Woodlands: Partial could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Port-Orford-cedar root disease (POCRD) (Liebhold 2010) is a root disease that is caused by a fungus. POCRD threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

The pine shoot beetle (PSB) (Ciesla 2001) is a wood borer that attacks various pine species, though Scotch pine is the preferred host in North America. PSB has the potential to affect 22.9 percent of the population (Can$1.07 million in replacement value).

Polyphagous shot hole borer (PSHB) (University of California 2014) is a boring beetle that was first detected in California. S1-Significant Woodlands: Partial could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Red Pine Scale (RPS) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Spruce beetle (SB) (Holsten et al 1999) is a bark beetle that causes significant mortality to spruce species within its range. Potential loss of trees from SB is 8.6 percent (Can$177 thousand in replacement value).

Spruce budworm (SBW) (Kucera and Orr 1981) is an insect that causes severe damage to balsam fir. SBW poses a threat to 8.6 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$177 thousand in replacement value.

Subalpine Fir Mortality (SFM) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Spotted Lanternfly (SLF) poses a threat to 59.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$2.84 million in replacement value.

Sudden oak death (SOD) (Kliejunas 2005) is a disease that is caused by a fungus. Potential loss of trees from SOD is 0.0 percent (Can$0 in replacement value).

Although the southern pine beetle (SPB) (Clarke and Nowak 2009) will attack most pine species, its preferred hosts are loblolly, Virginia, pond, spruce, shortleaf, and sand pines. This pest threatens 50.5 percent of the population, which represents a potential loss of Can$1.75 million in replacement value.

The sirex woodwasp (SW) (Haugen and Hoebeke 2005) is a wood borer that primarily attacks pine species. SW poses a threat to 22.9 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$1.07 million in replacement value.

Thousand canker disease (TCD) (Cranshaw and Tisserat 2009; Seybold et al 2010) is an insect-disease complex that kills several species of walnuts, including black walnut. Potential loss of trees from TCD is 0.0 percent (Can$0 in replacement value).

Western Balsam Bark Beetle (WBB) poses a threat to 8.6 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$177 thousand in replacement value.

Western Blackheaded Budworm (WBBU) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Western Five-Needle Pine Mortality (WFNPM) poses a threat to 0.0 percent of the S1-Significant Woodlands: Partial urban forest, which represents a potential loss of Can$0 in replacement value.

Winter moth (WM) (Childs 2011) is a pest with a wide range of host species. WM causes the highest levels of injury to its hosts when it is in its caterpillar stage. S1-Significant Woodlands: Partial could possibly lose 23.8 percent of its trees to this pest (Can$1.16 million in replacement value).

The western pine beetle (WPB) (DeMars and Roettgering 1982) is a bark beetle and aggressive attacker of ponderosa and Coulter pines. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Since its introduction to the United States in 1900, white pine blister rust (Eastern U.S.) (WPBR) (Nicholls and Anderson 1977) has had a detrimental effect on white pines, particularly in the Lake States. WPBR has the potential to affect 22.9 percent of the population (Can$1.07 million in replacement value).

Western spruce budworm (WSB) (Fellin and Dewey 1986) is an insect that causes defoliation in western conifers. This pest threatens 8.6 percent of the population, which represents a potential loss of Can$177 thousand in replacement value.

Appendix I. i-Tree Eco Model and Field Measurements

i-Tree Eco is designed to use standardized field data from randomly located plots and local hourly air pollution and meteorological data to quantify urban forest structure and its numerous effects (Nowak and Crane 2000), including:

- Urban forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year.
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources.
- Replacement value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian longhorned beetle, emerald ash borer, spongy moth, and Dutch elm disease.

Typically, all field data are collected during the leaf-on season to properly assess tree canopies. Typical data collection (actual data collection may vary depending upon the user) includes land use, ground and tree cover, individual tree attributes of species, stem diameter, height, crown width, crown canopy missing and dieback, and distance and direction to residential buildings (Nowak et al 2005; Nowak et al 2008).

During data collection, trees are identified to the most specific taxonomic classification possible. Trees that are not classified to the species level may be classified by genus (e.g., ash) or species groups (e.g., hardwood). In this report, tree species, genera, or species groups are collectively referred to as tree species.

<u>Tree Characteristics:</u>

Leaf area of trees was assessed using measurements of crown dimensions and percentage of crown canopy missing. In the event that these data variables were not collected, they are estimated by the model.

An analysis of invasive species is not available for studies outside of the United States. For the U.S., invasive species are identified using an invasive species list for the state in which the urban forest is located. These lists are not exhaustive and they cover invasive species of varying degrees of invasiveness and distribution. In instances where a state did not have an invasive species list, a list was created based on the lists of the adjacent states. Tree species that are identified as invasive by the state invasive species list are cross-referenced with native range data. This helps eliminate species that are on the state invasive species list, but are native to the study area.

<u>Air Pollution Removal:</u>

Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter less than 2.5 microns, and particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models (Baldocchi 1988; Baldocchi et al 1987). As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature (Bidwell and Fraser 1972; Lovett 1994) that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere (Zinke 1967). Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values (Hirabayashi et al 2011; Hirabayashi et al 2012; Hirabayashi 2011).

Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces (Nowak et al 2013). This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors. Generally, PM2.5 and PM10* removal is positive with positive benefits. However, there are some cases when net removal is negative or resuspended particles lead to increased pollution concentrations and negative values. During some months (e.g., with no rain), trees resuspend more particles than they remove. Resuspension can also lead to increased overall PM2.5 and PM10* concentrations if the boundary layer conditions are lower during net resuspension periods than during net removal periods. Since the pollution removal value is based on the change in pollution concentration, it is possible to have situations when trees remove PM2.5 and PM10* but increase concentrations and thus have negative values during periods of positive overall removal. These events are not common, but can happen.

For reports in the United States, default air pollution removal value is calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter less than 2.5 microns using data from the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP) (Nowak et al 2014). The model uses a damage-function approach that is based on the local change in pollution concentration and population. National median externality costs were used to calculate the value of carbon monoxide removal (Murray et al 1994).

For international reports, user-defined local pollution values are used. For international reports that do not have local values, estimates are based on either European median externality values (van Essen et al 2011) or BenMAP regression equations (Nowak et al 2014) that incorporate user-defined population estimates. Values are then converted to local currency with user-defined exchange rates.

For this analysis, pollution removal value is calculated based on the prices of Can$0 per metric ton (carbon monoxide), Can$0 per metric ton (ozone), Can$0 per metric ton (nitrogen dioxide), Can$82 per metric ton (sulfur dioxide), Can$0 per metric ton (particulate matter less than 2.5 microns), Can$0 per metric ton (particulate matter less than 10 microns and greater than 2.5 microns).

Carbon Storage and Sequestration:

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations (Nowak 1994). To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

Carbon sequestration is the removal of carbon dioxide from the air by plants. To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States (U.S. Environmental Protection Agency 2015, Interagency Working Group on Social Cost of Carbon 2015) and converted to local currency with user-defined exchange rates.

For this analysis, carbon storage and carbon sequestration values are calculated based on Can$115 per metric ton.

Oxygen Production:

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of the urban forest account for decomposition (Nowak et al 2007). For complete inventory projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition.

Avoided Runoff:

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis.

The value of avoided runoff is based on estimated or user-defined local values. For international reports that do not have local values, the national average value for the United States is utilized and converted to local currency with user-defined exchange rates. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

For this analysis, avoided runoff value is calculated based on the price of Can$2.32 per cubic meter.

Building Energy Use:

If appropriate field data were collected, seasonal effects of trees on residential building energy use were calculated based on procedures described in the literature (McPherson and Simpson 1999) using distance and direction of trees from residential structures, tree height and tree condition data. To calculate the monetary value of energy savings, local or custom prices per MWH or MBTU are utilized.

For this analysis, energy saving value is calculated based on the prices of Can$75.00 per MWH and Can$10.45 per MBTU.

Replacement Values:

Replacement value is the value of a tree based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Replacement values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b). Replacement value may not be included for international projects if there is insufficient local data to complete the valuation procedures.

Potential Pest Impacts:

The complete potential pest risk analysis is not available for studies outside of the United States. The number of trees at risk to the pests analyzed is reported, though the list of pests is based on known insects and disease in the United States.

For the U.S., potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest

Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to the county in which the urban forest is located. For the county, it was established whether the insect/disease occurs within the county, is within 400 kilometers of the county edge, is between 400 and 1210 kilometers away, or is greater than 1210 kilometers away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007).

Relative Tree Effects:

The relative value of tree benefits reported in Appendix II is calculated to show what carbon storage and sequestration, and air pollutant removal equate to in amounts of municipal carbon emissions, passenger automobile emissions, and house emissions.

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM10, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM10 emission per kWh from Layton 2004.
- CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Appendix II. Relative Tree Effects

The urban forest in S1-Significant Woodlands: Partial provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average municipal carbon emissions, average passenger automobile emissions, and average household emissions. See Appendix I for methodology.

Carbon storage is equivalent to:
- Amount of carbon emitted in S1-Significant Woodlands: Partial in 0 days
- Annual carbon (C) emissions from 1,490 automobiles
- Annual C emissions from 612 single-family houses

Carbon monoxide removal is equivalent to:
- Annual carbon monoxide emissions from 0 automobiles
- Annual carbon monoxide emissions from 0 single-family houses

Nitrogen dioxide removal is equivalent to:
- Annual nitrogen dioxide emissions from 0 automobiles
- Annual nitrogen dioxide emissions from 0 single-family houses

Sulfur dioxide removal is equivalent to:
- Annual sulfur dioxide emissions from 715 automobiles
- Annual sulfur dioxide emissions from 2 single-family houses

Annual carbon sequestration is equivalent to:
- Amount of carbon emitted in S1-Significant Woodlands: Partial in 0.0 days
- Annual C emissions from 18 automobiles
- Annual C emissions from 7 single-family houses

Appendix III. Comparison of Urban Forests

A common question asked is, "How does this city compare to other cities?" Although comparison among cities should be made with caution as there are many attributes of a city that affect urban forest structure and functions, summary data are provided from other cities analyzed using the i-Tree Eco model.

I. City totals for trees

City	*% Tree Cover*	*Number of Trees*	*Carbon Storage (metric tons)*	*Carbon Sequestration (metric tons/yr)*	*Pollution Removal (metric tons/yr)*
Toronto, ON, Canada	26.6	10,220,000	1,108,000	46,700	1,905
Atlanta, GA	36.7	9,415,000	1,220,000	42,100	1,509
Los Angeles, CA	11.1	5,993,000	1,151,000	69,800	1,792
New York, NY	20.9	5,212,000	1,225,000	38,400	1,521
London, ON, Canada	24.7	4,376,000	360,000	12,500	370
Chicago, IL	17.2	3,585,000	649,000	22,800	806
Phoenix, AZ	9.0	3,166,000	286,000	29,800	511
Baltimore, MD	21.0	2,479,000	517,000	16,700	390
Philadelphia, PA	15.7	2,113,000	481,000	14,600	522
Washington, DC	28.6	1,928,000	477,000	14,700	379
Oakville, ON , Canada	29.1	1,908,000	133,000	6,000	172
Albuquerque, NM	14.3	1,846,000	301,000	9,600	225
Boston, MA	22.3	1,183,000	290,000	9,500	257
Syracuse, NY	26.9	1,088,000	166,000	5,300	99
Woodbridge, NJ	29.5	986,000	145,000	5,000	191
Minneapolis, MN	26.4	979,000	227,000	8,100	277
San Francisco, CA	11.9	668,000	176,000	4,600	128
Morgantown, WV	35.5	658,000	84,000	2,600	65
Moorestown, NJ	28.0	583,000	106,000	3,400	107
Hartford, CT	25.9	568,000	130,000	3,900	52
Jersey City, NJ	11.5	136,000	19,000	800	37
Casper, WY	8.9	123,000	34,000	1,100	34
Freehold, NJ	34.4	48,000	18,000	500	20

II. Totals per hectare of land area

City	*Number of Trees/ha*	*Carbon Storage (metric tons/ha)*	*Carbon Sequestration (metric tons/ha/yr)*	*Pollution Removal (kg/ha/yr)*
Toronto, ON, Canada	160.4	17.4	0.73	29.9
Atlanta, GA	275.8	35.7	1.23	44.2
Los Angeles, CA	48.4	9.4	0.36	14.7
New York, NY	65.2	15.3	0.48	19.0
London, ON, Canada	185.5	15.3	0.53	15.7
Chicago, IL	59.9	10.9	0.38	13.5
Phoenix, AZ	31.8	2.9	0.30	5.1
Baltimore, MD	118.5	25.0	0.80	18.6
Philadelphia, PA	61.9	14.1	0.43	15.3
Washington, DC	121.1	29.8	0.92	23.8
Oakville, ON , Canada	192.9	13.4	0.61	12.4
Albuquerque, NM	53.9	8.8	0.28	6.6
Boston, MA	82.9	20.3	0.67	18.0
Syracuse, NY	167.4	23.1	0.77	15.2
Woodbridge, NJ	164.4	24.2	0.84	31.9
Minneapolis, MN	64.8	15.0	0.53	18.3
San Francisco, CA	55.7	14.7	0.39	10.7
Morgantown, WV	294.5	37.7	1.17	29.2
Moorestown, NJ	153.4	27.9	0.90	28.1
Hartford, CT	124.6	28.5	0.86	11.5
Jersey City, NJ	35.5	5.0	0.21	9.6
Casper, WY	22.5	6.2	0.20	6.2
Freehold, NJ	94.6	35.9	0.98	39.6

Appendix IV. General Recommendations for Air Quality Improvement

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmosphere environment. Four main ways that urban trees affect air quality are (Nowak 1995):

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Emission of volatile organic compounds (VOC) and tree maintenance emissions
- Energy effects on buildings

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities (Nowak 2000). Local urban management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include (Nowak 2000):

Strategy	*Result*
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

Appendix V. Invasive Species of the Urban Forest

Invasive species data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

Appendix VI. Potential Risk of Pests

Pest range data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

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i-Tree
Ecosystem Analysis

S1-Significant Woodlands A&B: Preferred

Urban Forest Effects and Values
January 2026

Summary

Understanding an urban forest's structure, function and value can promote management decisions that will improve human health and environmental quality. An assessment of the vegetation structure, function, and value of the S1-Significant Woodlands A&B: Perfered urban forest was conducted during 2026. Data from 10 field plots located throughout S1-Significant Woodlands A&B: Perfered were analyzed using the i-Tree Eco model developed by the U.S. Forest Service, Northern Research Station.

- Number of trees: 3,557
- Tree Cover: 95.0 %
- Most common species of trees: Pinus strobus, Acer saccharum, Tsuga canadensis
- Percentage of trees less than 6" (15.2 cm) diameter: 16.3%
- Pollution Removal: 58.52 kilograms/year (Can$4.87/year)
- Carbon Storage: 1.805 thousand metric tons (Can$207 thousand)
- Carbon Sequestration: 22.77 metric tons (Can$2.62 thousand/year)
- Oxygen Production: 51.48 metric tons/year
- Avoided Runoff: 167.3 cubic meters/year (Can$389/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Replacement values: Can$3.53 million

Metric ton: 1000 kilograms
Monetary values Can$ are reported in Canadian Dollars throughout the report except where noted.
Ecosystem service estimates are reported for trees.
With Complete Inventory Projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition. Oxygen production in Plot Inventory Projects is estimated from net carbon sequestration.

The estimate of Tree Cover is derived from user estimations of percent tree cover over plots and extrapolated to the whole study area. For more precise tree cover estimates please use i-Tree Canopy or i-Tree Landscape.

For an overview of i-Tree Eco methodology, see Appendix I. Data collection quality is determined by the local data collectors, over which i-Tree has no control. Additionally, some of the plot and tree information may not have been collected, so not all of the analyses may have been conducted for this report.

Table of Contents

I. Tree Characteristics of the Urban Forest

The urban forest of S1-Significant Woodlands A&B: Perfered has an estimated 3,557 trees with a tree cover of 95.0 percent. The three most common species are Pinus strobus (20.5 percent), Acer saccharum (18.7 percent), and Tsuga canadensis (16.9 percent).

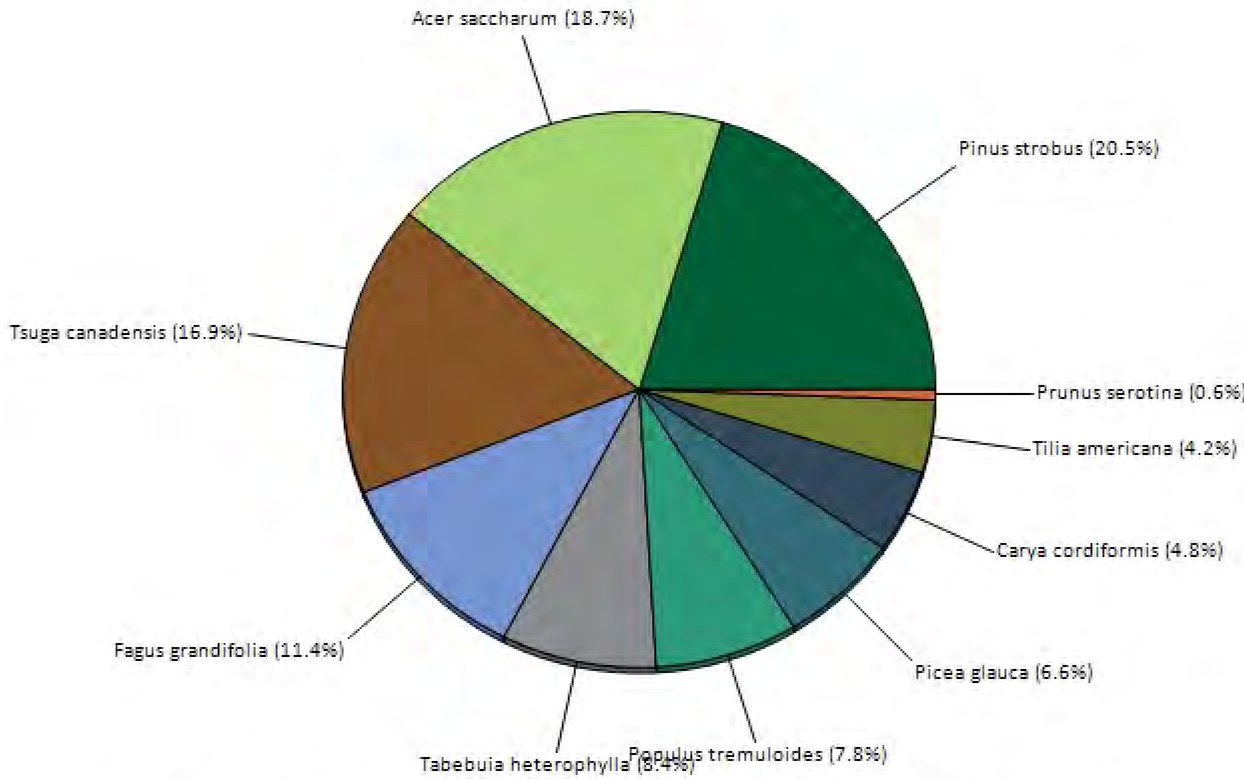

Figure 1. Tree species composition in S1-Significant Woodlands A&B: Perfered

The overall tree density in S1-Significant Woodlands A&B: Perfered is 410 trees/hectare (see Appendix III for comparable values from other cities).

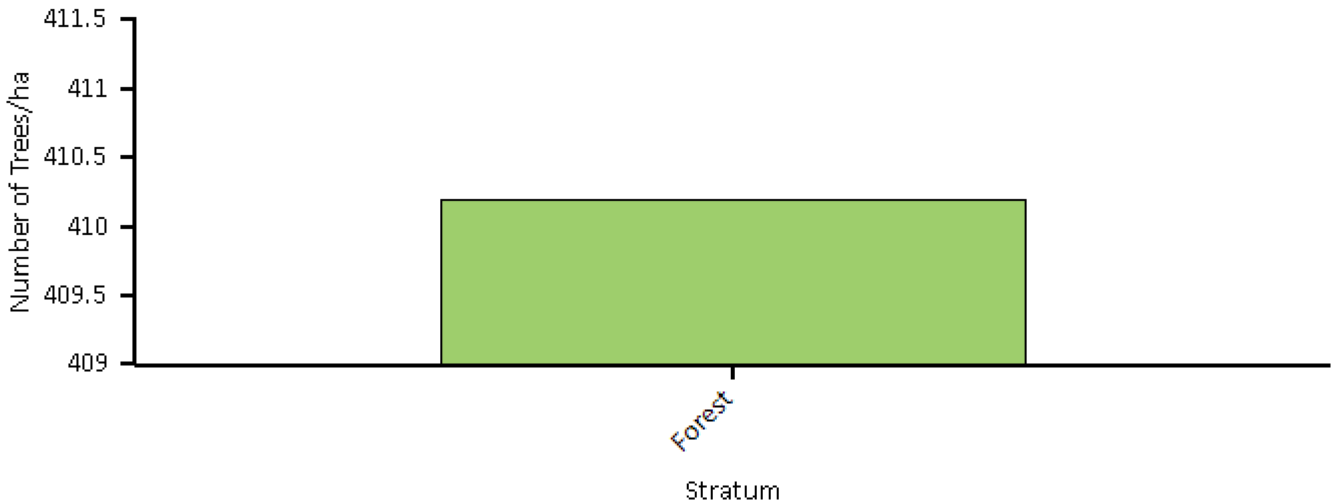

Figure 2. Number of trees/ha in S1-Significant Woodlands A&B: Perfered by stratum

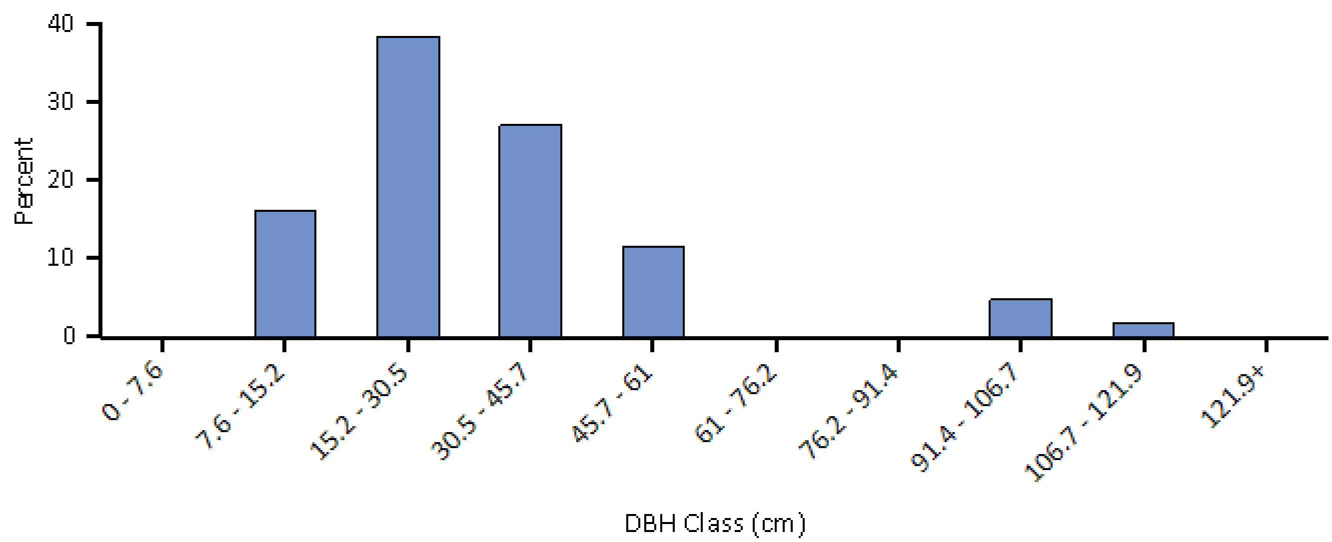

Figure 3. Percent of tree population by diameter class (DBH - stem diameter at 1.37 meters)

Urban forests are composed of a mix of native and exotic tree species. Thus, urban forests often have a tree diversity that is higher than surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but it can also pose a risk to native plants if some of the exotic species are invasive plants that can potentially out-compete and displace native species. In S1-Significant Woodlands A&B: Perfered, about 92 percent of the trees are species native to North America. Most trees have an origin from COUNTRY (92 percent of the trees).

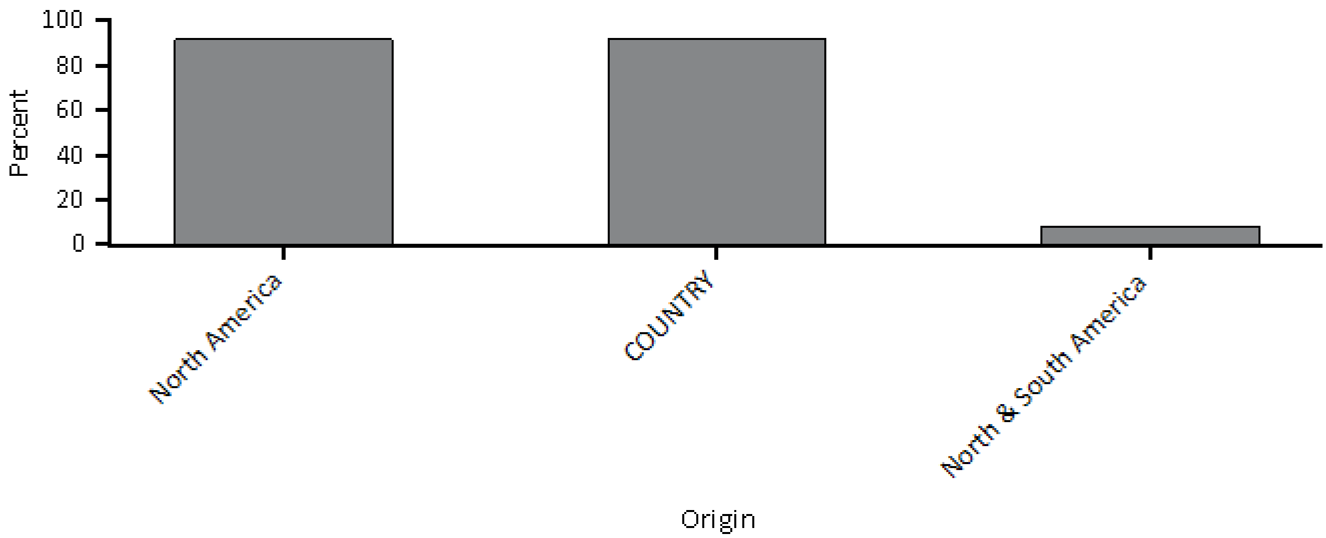

Figure 4. Percent of live tree population by area of native origin, S1-Significant Woodlands A&B: Perfered

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and general lack of natural enemies. These abilities enable them to displace native plants and make them a threat to natural areas.

II. Urban Forest Cover and Leaf Area

Many tree benefits equate directly to the amount of healthy leaf surface area of the plant. Trees cover about 95 percent of S1-Significant Woodlands A&B: Perfered and provide 139 hectares of leaf area. Total leaf area is greatest in Forest.

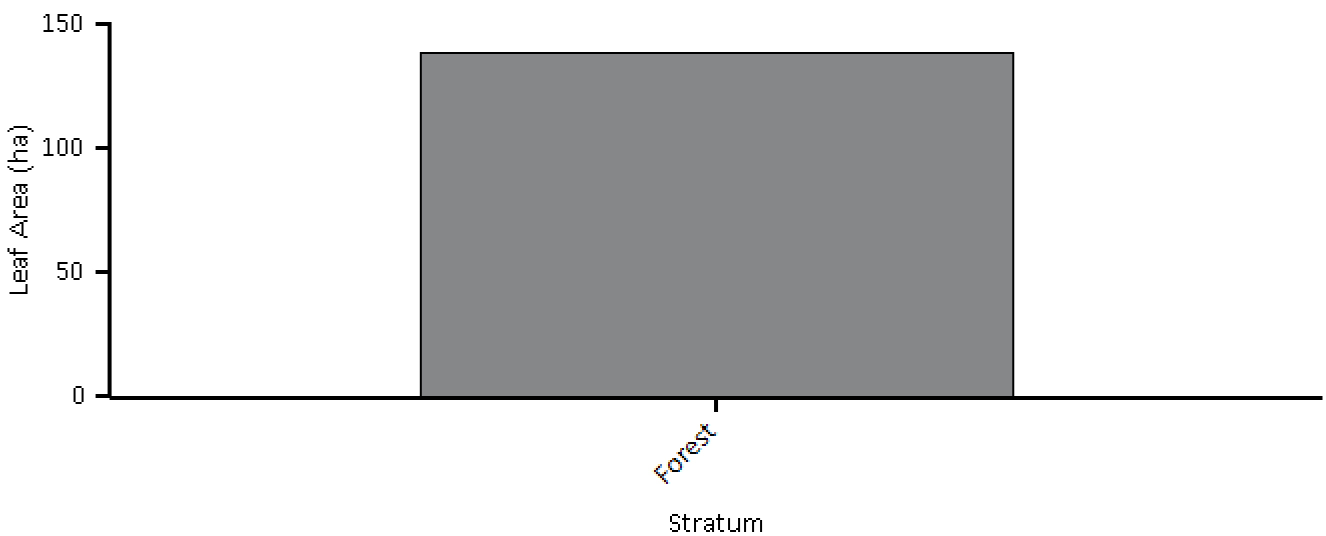

Figure 5. Leaf area by stratum, S1-Significant Woodlands A&B: Perfered

In S1-Significant Woodlands A&B: Perfered, the most dominant species in terms of leaf area are Fagus grandifolia, Pinus strobus, and Acer saccharum. The 10 species with the greatest importance values are listed in Table 1. Importance values (IV) are calculated as the sum of percent population and percent leaf area. High importance values do not mean that these trees should necessarily be encouraged in the future; rather these species currently dominate the urban forest structure.

Table 1. Most important species in S1-Significant Woodlands A&B: Perfered

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Pinus strobus	20.5	21.0	41.4
Fagus grandifolia	11.4	27.5	38.9
Acer saccharum	18.7	18.5	37.1
Tsuga canadensis	16.9	15.9	32.8
Tabebuia heterophylla	8.4	5.5	13.9
Picea glauca	6.6	6.9	13.5
Populus tremuloides	7.8	1.1	9.0
Tilia americana	4.2	2.8	7.0
Carya cordiformis	4.8	0.9	5.7
Prunus serotina	0.6	0.1	0.7

Common ground cover classes (including cover types beneath trees and shrubs) in S1-Significant Woodlands A&B: Perfered are not available since they are configured not to be collected.

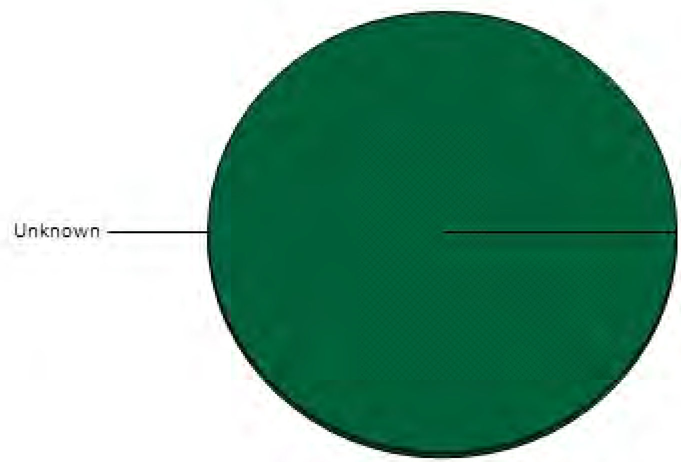

Figure 6. Percent of land by ground cover classes, S1-Significant Woodlands A&B: Perfered

III. Air Pollution Removal by Urban Trees

Poor air quality is a common problem in many urban areas. It can lead to decreased human health, damage to landscape materials and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power sources. Trees also emit volatile organic compounds that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation (Nowak and Dwyer 2000).

Pollution removal[1] by trees in S1-Significant Woodlands A&B: Perfered was estimated using field data and recent available pollution and weather data available. Pollution removal was greatest for sulfur dioxide (Figure 7). It is estimated that trees remove 58.52 kilograms of air pollution (ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter less than 2.5 microns (PM2.5), particulate matter less than 10 microns and greater than 2.5 microns (PM10*)[2], and sulfur dioxide (SO2)) per year with an associated value of Can$4.87 (see Appendix I for more details).

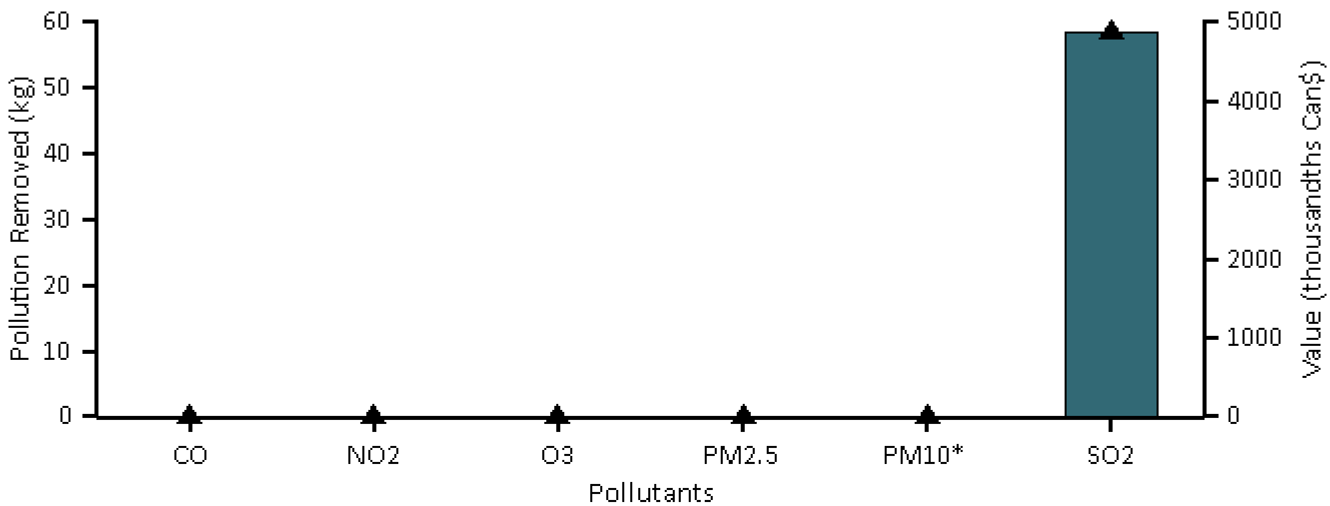

Figure 7. Annual pollution removal (points) and value (bars) by urban trees, S1-Significant Woodlands A&B: Perfered

[1] PM10* is particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is particulate matter less than 2.5 microns. If PM2.5 is not monitored, PM10* represents particulate matter less than 10 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

[2] Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces. This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors (see Appendix I for more details).

In 2026, trees in S1-Significant Woodlands A&B: Perfered emitted an estimated 312.3 kilograms of volatile organic compounds (VOCs) (19.71 kilograms of isoprene and 292.5 kilograms of monoterpenes). Emissions vary among species based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Seventy- nine percent of the urban forest's VOC emissions were from Pinus strobus and Picea glauca. These VOCs are precursor chemicals to ozone formation.[3]

General recommendations for improving air quality with trees are given in Appendix VIII.

[3] Some economic studies have estimated VOC emission costs. These costs are not included here as there is a tendency to add positive dollar estimates of ozone removal effects with negative dollar values of VOC emission effects to determine whether tree effects are positive or negative in relation to ozone. This combining of dollar values to determine tree effects should not be done, rather estimates of VOC effects on ozone formation (e.g., via photochemical models) should be conducted and directly contrasted with ozone removal by trees (i.e., ozone effects should be directly compared, not dollar estimates). In addition, air temperature reductions by trees have been shown to significantly reduce ozone concentrations (Cardelino and Chameides 1990; Nowak et al 2000), but are not considered in this analysis. Photochemical modeling that integrates tree effects on air temperature, pollution removal, VOC emissions, and emissions from power plants can be used to determine the overall effect of trees on ozone concentrations.

IV. Carbon Storage and Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by altering energy use in buildings, and consequently altering carbon dioxide emissions from fossil-fuel based power sources (Abdollahi et al 2000).

Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is increased with the size and health of the trees. The gross sequestration of S1-Significant Woodlands A&B: Perfered trees is about 22.77 metric tons of carbon per year with an associated value of Can$2.62 thousand. Net carbon sequestration in the urban forest is about 19.31 metric tons. See Appendix I for more details on methods.

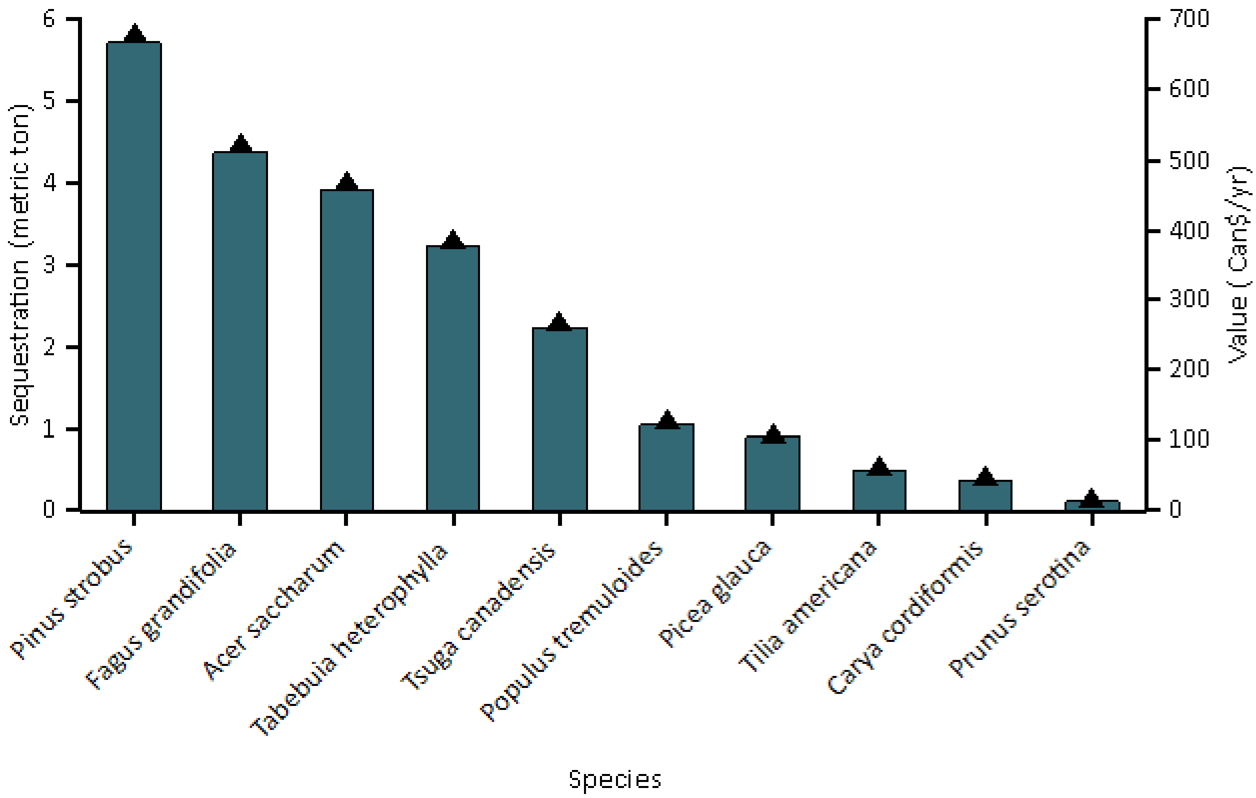

Figure 8. Estimated annual gross carbon sequestration (points) and value (bars) for urban tree species with the greatest sequestration, S1-Significant Woodlands A&B: Perfered

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions (Nowak et al 2002c). When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants.

Trees in S1-Significant Woodlands A&B: Perfered are estimated to store 1810 metric tons of carbon (Can$207 thousand). Of the species sampled, Acer saccharum stores the most carbon (approximately 31.5% of the total carbon stored) and Pinus strobus sequesters the most (approximately 25.5% of all sequestered carbon.)

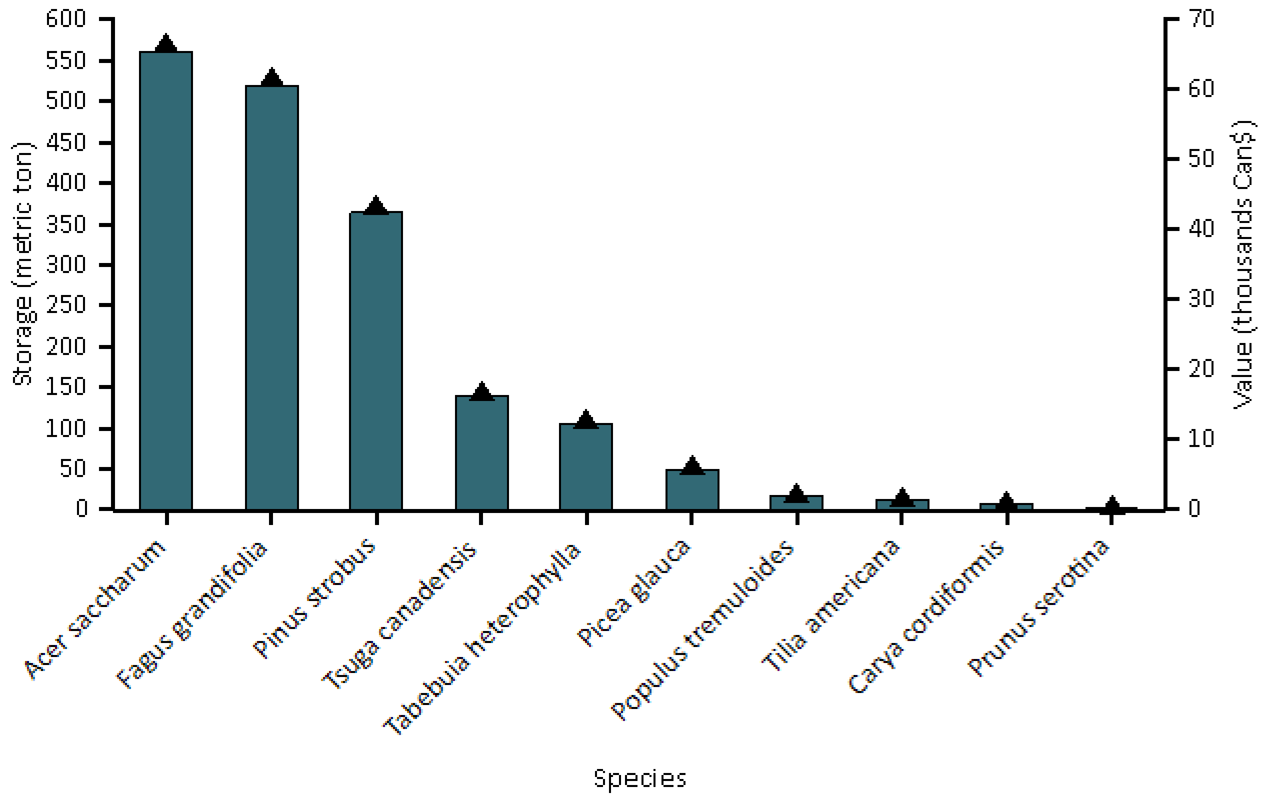

Figure 9. Estimated carbon storage (points) and values (bars) for urban tree species with the greatest storage, S1-Significant Woodlands A&B: Perfered

V. Oxygen Production

Oxygen production is one of the most commonly cited benefits of urban trees. The net annual oxygen production of a tree is directly related to the amount of carbon sequestered by the tree, which is tied to the accumulation of tree biomass.

Trees in S1-Significant Woodlands A&B: Perfered are estimated to produce 51.48 metric tons of oxygen per year.[4] However, this tree benefit is relatively insignificant because of the large and relatively stable amount of oxygen in the atmosphere and extensive production by aquatic systems. Our atmosphere has an enormous reserve of oxygen. If all fossil fuel reserves, all trees, and all organic matter in soils were burned, atmospheric oxygen would only drop a few percent (Broecker 1970).

Table 2. The top 10 oxygen production species.

Species	*Oxygen (metric ton)*	*Net Carbon Sequestration (metric ton/yr)*	*Number of Trees*	*Leaf Area (hectare)*
Pinus strobus	12.39	4.65	729	29.13
Acer saccharum	9.58	3.59	664	25.66
Tabebuia heterophylla	8.41	3.15	300	7.62
Fagus grandifolia	7.54	2.83	407	38.16
Tsuga canadensis	5.78	2.17	600	22.07
Populus tremuloides	2.80	1.05	279	1.56
Picea glauca	2.34	0.88	236	9.54
Tilia americana	1.33	0.50	150	3.83
Carya cordiformis	1.00	0.38	171	1.19
Prunus serotina	0.30	0.11	21	0.19

[4] A negative estimate, or oxygen deficit, indicates that trees are decomposing faster than they are producing oxygen. This would be the case in an area that has a large proportion of dead trees.

VI. Avoided Runoff

Surface runoff can be a cause for concern in many urban areas as it can contribute pollution to streams, wetlands, rivers, lakes, and oceans. During precipitation events, some portion of the precipitation is intercepted by vegetation (trees and shrubs) while the other portion reaches the ground. The portion of the precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff (Hirabayashi 2012). In urban areas, the large extent of impervious surfaces increases the amount of surface runoff.

Urban trees and shrubs, however, are beneficial in reducing surface runoff. Trees and shrubs intercept precipitation, while their root systems promote infiltration and storage in the soil. The trees and shrubs of S1-Significant Woodlands A&B: Perfered help to reduce runoff by an estimated 167 cubic meters a year with an associated value of Can$390 (see Appendix I for more details). Avoided runoff is estimated based on local weather from the user-designated weather station. In S1-Significant Woodlands A&B: Perfered, the total annual precipitation in 2024 was 87.7 centimeters.

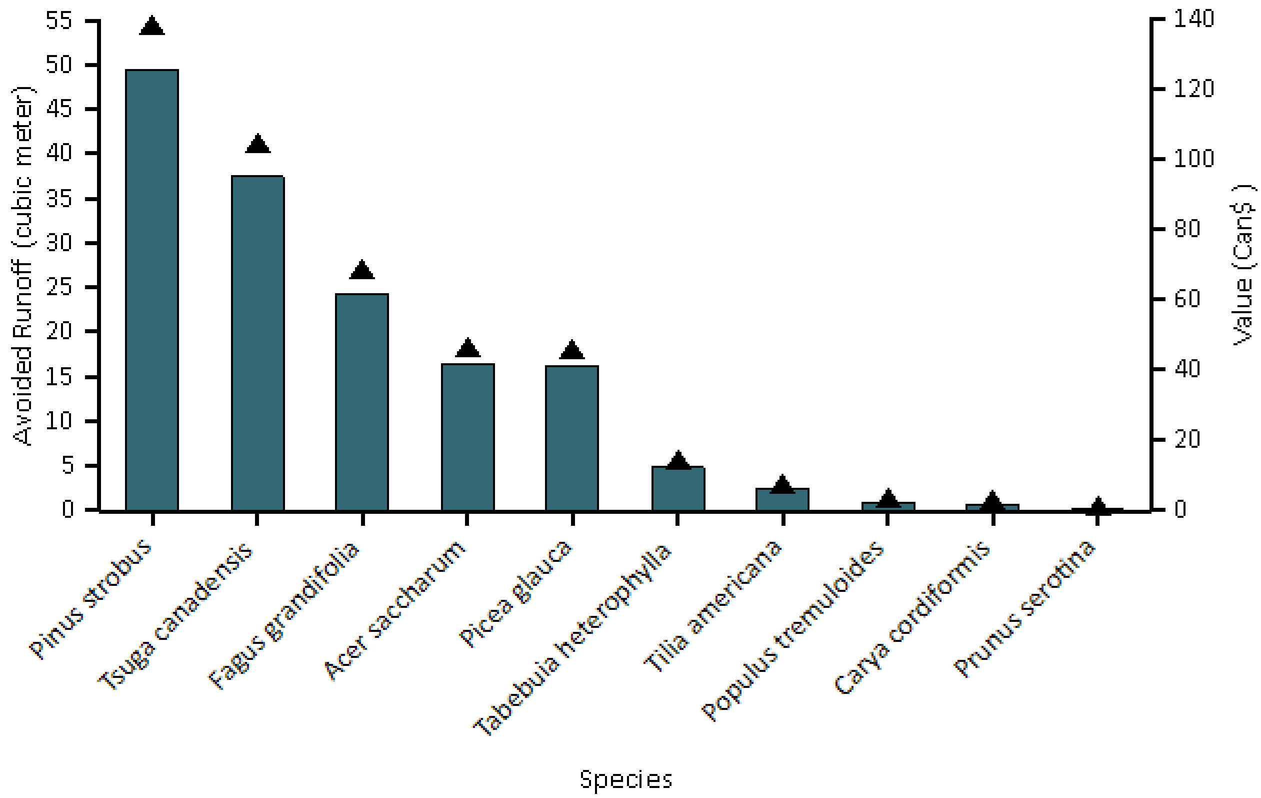

Figure 10. Avoided runoff (points) and value (bars) for species with greatest overall impact on runoff, S1-Significant Woodlands A&B: Perfered

VII. Trees and Building Energy Use

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space conditioned residential buildings (McPherson and Simpson 1999).

Because energy-related data were not collected, energy savings and carbon avoided cannot be calculated.

Table 3. Annual energy savings due to trees near residential buildings, S1-Significant Woodlands A&B: Perfered

	Heating	*Cooling*	*Total*
MBTU[a]	0	N/A	0
MWH[b]	0	0	0
Carbon Avoided (kilograms)	0	0	0

[a]MBTU - one million British Thermal Units

[b]MWH - megawatt-hour

Table 4. Annual savings [a](Can$) in residential energy expenditure during heating and cooling seasons, S1-Significant Woodlands A&B: Perfered

	Heating	*Cooling*	*Total*
MBTU[b]	0	N/A	0
MWH[c]	0	0	0
Carbon Avoided	0	0	0

[b]Based on the prices of Can$75 per MWH and Can$10.4544285106757 per MBTU (see Appendix I for more details)

[c]MBTU - one million British Thermal Units

[c]MWH - megawatt-hour

[5] Trees modify climate, produce shade, and reduce wind speeds. Increased energy use or costs are likely due to these tree-building interactions creating a cooling effect during the winter season. For example, a tree (particularly evergreen species) located on the southern side of a residential building may produce a shading effect that causes increases in heating requirements.

VIII. Replacement and Functional Values

Urban forests have a replacement value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); they also have functional values (either positive or negative) based on the functions the trees perform.

The replacement value of an urban forest tends to increase with a rise in the number and size of healthy trees (Nowak et al 2002a). Annual functional values also tend to increase with increased number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in S1-Significant Woodlands A&B: Perfered have the following replacement values:

- Replacement value: Can$3.53 million
- Carbon storage: Can$207 thousand

Urban trees in S1-Significant Woodlands A&B: Perfered have the following annual functional values:

- Carbon sequestration: Can$2.62 thousand
- Avoided runoff: Can$389
- Pollution removal: Can$4.87
- Energy costs and carbon emission values: Can$0

(Note: negative value indicates increased energy cost and carbon emission value)

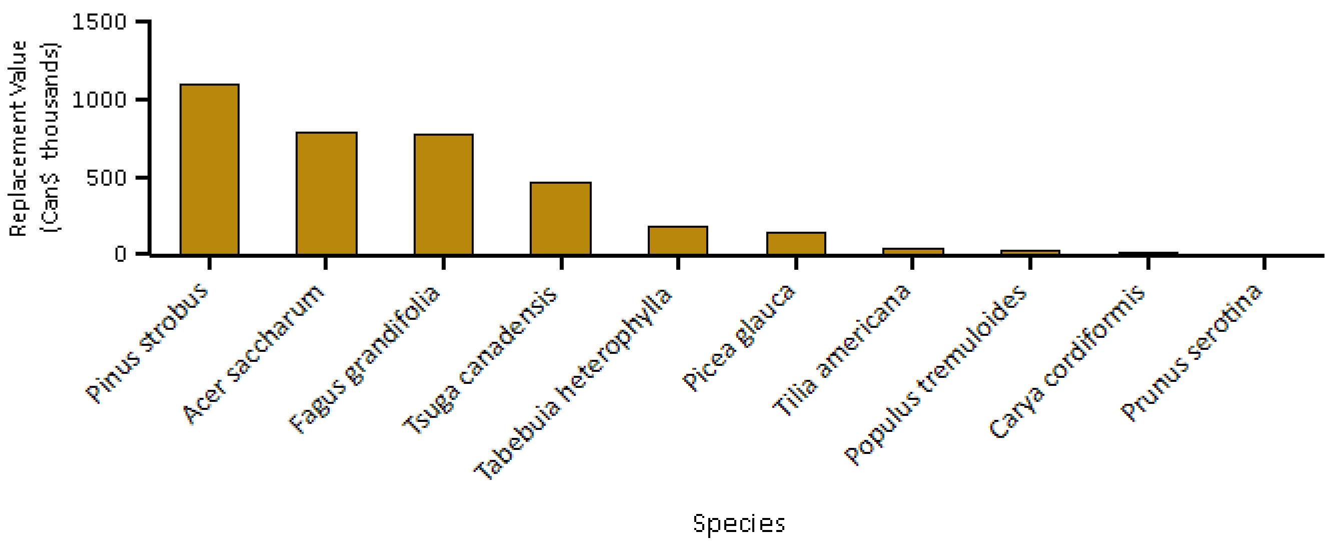

Figure 11. Tree species with the greatest replacement value, S1-Significant Woodlands A&B: Perfered

[1] Replacement value in Canada is calculated using the same procedure as the U.S. (Nowak et al 2002a). Base costs and species values are derived from the International Society of Arboriculture Ontario Chapter and applied to all Canadian provinces and territories.

IX. Potential Pest Impacts

Various insects and diseases can infest urban forests, potentially killing trees and reducing the health, replacement value and sustainability of the urban forest. As pests tend to have differing tree hosts, the potential damage or risk of each pest will differ among cities.Fifty-three pests were analyzed for their potential impact.

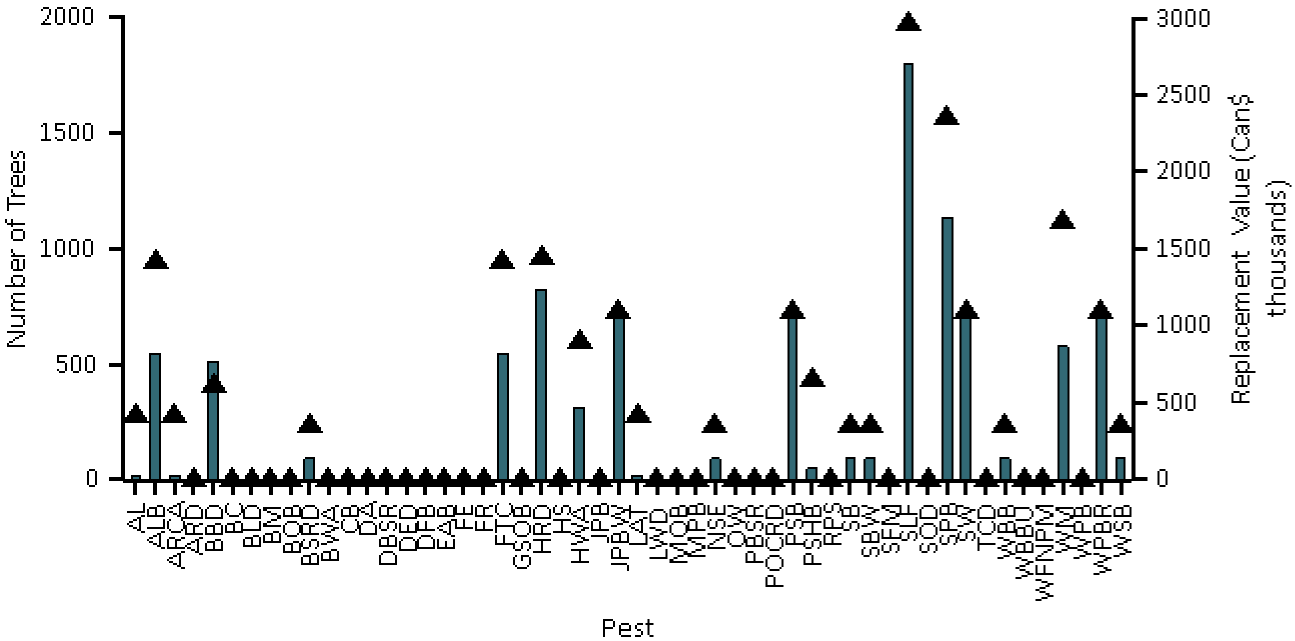

Figure 12. Number of trees at risk (points) and associated compensatory value (bars) by potential pests, S1-Significant Woodlands A&B: Perfered

Aspen leafminer (AL) (Kruse et al 2007) is an insect that causes damage primarily to trembling or small tooth aspen by larval feeding of leaf tissue. AL has the potential to affect 7.8 percent of the population (Can$32.1 thousand in replacement value).

Asian longhorned beetle (ALB) (Animal and Plant Health Inspection Service 2010) is an insect that bores into and kills a wide range of hardwood species. ALB poses a threat to 26.5 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$821 thousand in replacement value.

Aspen Running Canker (ARCA) poses a threat to 7.8 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$32.1 thousand in replacement value.

Armillaria Root Disease (ARD) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Beech bark disease (BBD) (Houston and O'Brien 1983) is an insect-disease complex that primarily impacts American beech. This disease threatens 11.4 percent of the population, which represents a potential loss of Can$772 thousand in replacement value.

Butternut canker (BC) (Ostry et al 1996) is caused by a fungus that infects butternut trees. The disease has since caused significant declines in butternut populations in the United States. Potential loss of trees from BC is 0.0 percent (Can$0 in replacement value).

Beech Leaf Disease (BLD) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Browntail Moth (BM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Bur Oak Blight (BOB) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Black Stain Root Disease (BSRD) poses a threat to 6.6 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$137 thousand in replacement value.

Balsam woolly adelgid (BWA) (Ragenovich and Mitchell 2006) is an insect that has caused significant damage to the true firs of North America. S1-Significant Woodlands A&B: Perfered could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

The most common hosts of the fungus that cause chestnut blight (CB) (Diller 1965) are American and European chestnut. CB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Dogwood anthracnose (DA) (Mielke and Daughtrey) is a disease that affects dogwood species, specifically flowering and Pacific dogwood. This disease threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Douglas-fir black stain root disease (DBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks Douglas-firs. S1-Significant Woodlands A&B: Perfered could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

American elm, one of the most important street trees in the twentieth century, has been devastated by the Dutch elm disease (DED) (Northeastern Area State and Private Forestry 1998). Since first reported in the 1930s, it has killed over 50 percent of the native elm population in the United States. Although some elm species have shown varying degrees of resistance, S1-Significant Woodlands A&B: Perfered could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Douglas-fir beetle (DFB) (Schmitz and Gibson 1996) is a bark beetle that infests Douglas-fir trees throughout the western United States, British Columbia, and Mexico. Potential loss of trees from DFB is 0.0 percent (Can$0 in replacement value).

Emerald ash borer (EAB) (Michigan State University 2010) has killed thousands of ash trees in parts of the United States. EAB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

One common pest of white fir, grand fir, and red fir trees is the fir engraver (FE) (Ferrell 1986). FE poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Fusiform rust (FR) (Phelps and Czabator 1978) is a fungal disease that is distributed in the southern United States. It is particularly damaging to slash pine and loblolly pine. FR has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

Forest Tent Caterpillar (FTC) poses a threat to 26.5 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$821 thousand in replacement value.

Infestations of the goldspotted oak borer (GSOB) (Society of American Foresters 2011) have been a growing problem in southern California. Potential loss of trees from GSOB is 0.0 percent (Can$0 in replacement value).

Heterobasidion Root Disease (HRD) poses a threat to 27.1 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$1.24 million in replacement value.

Hemlock Sawfly (HS) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

As one of the most damaging pests to eastern hemlock and Carolina hemlock, hemlock woolly adelgid (HWA) (U.S. Forest Service 2005) has played a large role in hemlock mortality in the United States. HWA has the potential to affect 16.9 percent of the population (Can$469 thousand in replacement value).

The Jeffrey pine beetle (JPB) (Smith et al 2009) is native to North America and is distributed across California, Nevada, and Oregon where its only host, Jeffrey pine, also occurs. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Jack Pine Budworm (JPBW) poses a threat to 20.5 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$1.1 million in replacement value.

Quaking aspen is a principal host for the defoliator, large aspen tortrix (LAT) (Ciesla and Kruse 2009). LAT poses a threat to 7.8 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$32.1 thousand in replacement value.

Laurel wilt (LWD) (U.S. Forest Service 2011) is a fungal disease that is introduced to host trees by the redbay ambrosia beetle. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Mediterranean Oak Borer (MOB) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Mountain pine beetle (MPB) (Gibson et al 2009) is a bark beetle that primarily attacks pine species in the western United States. MPB has the potential to affect 0.0 percent of the population (Can$0 in replacement value).

The northern spruce engraver (NSE) (Burnside et al 2011) has had a significant impact on the boreal and sub-boreal forests of North America where the pest's distribution overlaps with the range of its major hosts. Potential loss of trees from NSE is 6.6 percent (Can$137 thousand in replacement value).

Oak wilt (OW) (Rexrode and Brown 1983), which is caused by a fungus, is a prominent disease among oak trees. OW poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Pine black stain root disease (PBSR) (Hessburg et al 1995) is a variety of the black stain fungus that attacks hard pines, including lodgepole pine, Jeffrey pine, and ponderosa pine. S1-Significant Woodlands A&B: Perfered could possibly lose 0.0 percent of its trees to this pest (Can$0 in replacement value).

Port-Orford-cedar root disease (POCRD) (Liebhold 2010) is a root disease that is caused by a fungus. POCRD threatens

0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

The pine shoot beetle (PSB) (Ciesla 2001) is a wood borer that attacks various pine species, though Scotch pine is the preferred host in North America. PSB has the potential to affect 20.5 percent of the population (Can$1.1 million in replacement value).

Polyphagous shot hole borer (PSHB) (University of California 2014) is a boring beetle that was first detected in California. S1-Significant Woodlands A&B: Perfered could possibly lose 12.0 percent of its trees to this pest (Can$72.5 thousand in replacement value).

Red Pine Scale (RPS) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Spruce beetle (SB) (Holsten et al 1999) is a bark beetle that causes significant mortality to spruce species within its range. Potential loss of trees from SB is 6.6 percent (Can$137 thousand in replacement value).

Spruce budworm (SBW) (Kucera and Orr 1981) is an insect that causes severe damage to balsam fir. SBW poses a threat to 6.6 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$137 thousand in replacement value.

Subalpine Fir Mortality (SFM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Spotted Lanternfly (SLF) poses a threat to 55.4 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$2.7 million in replacement value.

Sudden oak death (SOD) (Kliejunas 2005) is a disease that is caused by a fungus. Potential loss of trees from SOD is 0.0 percent (Can$0 in replacement value).

Although the southern pine beetle (SPB) (Clarke and Nowak 2009) will attack most pine species, its preferred hosts are loblolly, Virginia, pond, spruce, shortleaf, and sand pines. This pest threatens 44.0 percent of the population, which represents a potential loss of Can$1.7 million in replacement value.

The sirex woodwasp (SW) (Haugen and Hoebeke 2005) is a wood borer that primarily attacks pine species. SW poses a threat to 20.5 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$1.1 million in replacement value.

Thousand canker disease (TCD) (Cranshaw and Tisserat 2009; Seybold et al 2010) is an insect-disease complex that kills several species of walnuts, including black walnut. Potential loss of trees from TCD is 0.0 percent (Can$0 in replacement value).

Western Balsam Bark Beetle (WBB) poses a threat to 6.6 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$137 thousand in replacement value.

Western Blackheaded Budworm (WBBU) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Western Five-Needle Pine Mortality (WFNPM) poses a threat to 0.0 percent of the S1-Significant Woodlands A&B: Perfered urban forest, which represents a potential loss of Can$0 in replacement value.

Winter moth (WM) (Childs 2011) is a pest with a wide range of host species. WM causes the highest levels of injury to its hosts when it is in its caterpillar stage. S1-Significant Woodlands A&B: Perfered could possibly lose 31.3 percent of its trees to this pest (Can$864 thousand in replacement value).

The western pine beetle (WPB) (DeMars and Roettgering 1982) is a bark beetle and aggressive attacker of ponderosa and Coulter pines. This pest threatens 0.0 percent of the population, which represents a potential loss of Can$0 in replacement value.

Since its introduction to the United States in 1900, white pine blister rust (Eastern U.S.) (WPBR) (Nicholls and Anderson 1977) has had a detrimental effect on white pines, particularly in the Lake States. WPBR has the potential to affect 20.5 percent of the population (Can$1.1 million in replacement value).

Western spruce budworm (WSB) (Fellin and Dewey 1986) is an insect that causes defoliation in western conifers. This pest threatens 6.6 percent of the population, which represents a potential loss of Can$137 thousand in replacement value.

Appendix I. i-Tree Eco Model and Field Measurements

i-Tree Eco is designed to use standardized field data from randomly located plots and local hourly air pollution and meteorological data to quantify urban forest structure and its numerous effects (Nowak and Crane 2000), including:

- Urban forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year.
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources.
- Replacement value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian longhorned beetle, emerald ash borer, spongy moth, and Dutch elm disease.

Typically, all field data are collected during the leaf-on season to properly assess tree canopies. Typical data collection (actual data collection may vary depending upon the user) includes land use, ground and tree cover, individual tree attributes of species, stem diameter, height, crown width, crown canopy missing and dieback, and distance and direction to residential buildings (Nowak et al 2005; Nowak et al 2008).

During data collection, trees are identified to the most specific taxonomic classification possible. Trees that are not classified to the species level may be classified by genus (e.g., ash) or species groups (e.g., hardwood). In this report, tree species, genera, or species groups are collectively referred to as tree species.

Tree Characteristics:

Leaf area of trees was assessed using measurements of crown dimensions and percentage of crown canopy missing. In the event that these data variables were not collected, they are estimated by the model.

An analysis of invasive species is not available for studies outside of the United States. For the U.S., invasive species are identified using an invasive species list for the state in which the urban forest is located. These lists are not exhaustive and they cover invasive species of varying degrees of invasiveness and distribution. In instances where a state did not have an invasive species list, a list was created based on the lists of the adjacent states. Tree species that are identified as invasive by the state invasive species list are cross-referenced with native range data. This helps eliminate species that are on the state invasive species list, but are native to the study area.

Air Pollution Removal:

Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter less than 2.5 microns, and particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models (Baldocchi 1988; Baldocchi et al 1987). As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature (Bidwell and Fraser 1972; Lovett 1994) that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere (Zinke 1967). Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values (Hirabayashi et al 2011; Hirabayashi et al 2012; Hirabayashi 2011).

Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces (Nowak et al 2013). This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors. Generally, PM2.5 and PM10* removal is positive with positive benefits. However, there are some cases when net removal is negative or resuspended particles lead to increased pollution concentrations and negative values. During some months (e.g., with no rain), trees resuspend more particles than they remove. Resuspension can also lead to increased overall PM2.5 and PM10* concentrations if the boundary layer conditions are lower during net resuspension periods than during net removal periods. Since the pollution removal value is based on the change in pollution concentration, it is possible to have situations when trees remove PM2.5 and PM10* but increase concentrations and thus have negative values during periods of positive overall removal. These events are not common, but can happen.

For reports in the United States, default air pollution removal value is calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter less than 2.5 microns using data from the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP) (Nowak et al 2014). The model uses a damage-function approach that is based on the local change in pollution concentration and population. National median externality costs were used to calculate the value of carbon monoxide removal (Murray et al 1994).

For international reports, user-defined local pollution values are used. For international reports that do not have local values, estimates are based on either European median externality values (van Essen et al 2011) or BenMAP regression equations (Nowak et al 2014) that incorporate user-defined population estimates. Values are then converted to local currency with user-defined exchange rates.

For this analysis, pollution removal value is calculated based on the prices of Can$0 per metric ton (carbon monoxide), Can$0 per metric ton (ozone), Can$0 per metric ton (nitrogen dioxide), Can$83 per metric ton (sulfur dioxide), Can$0 per metric ton (particulate matter less than 2.5 microns), Can$0 per metric ton (particulate matter less than 10 microns and greater than 2.5 microns).

<u>Carbon Storage and Sequestration:</u>

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations (Nowak 1994). To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

Carbon sequestration is the removal of carbon dioxide from the air by plants. To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States (U.S. Environmental Protection Agency 2015, Interagency Working Group on Social Cost of Carbon 2015) and converted to local currency with user-defined exchange rates.

For this analysis, carbon storage and carbon sequestration values are calculated based on Can$115 per metric ton.

Oxygen Production:

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O_2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of the urban forest account for decomposition (Nowak et al 2007). For complete inventory projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition.

Avoided Runoff:

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis.

The value of avoided runoff is based on estimated or user-defined local values. For international reports that do not have local values, the national average value for the United States is utilized and converted to local currency with user-defined exchange rates. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

For this analysis, avoided runoff value is calculated based on the price of Can$2.32 per cubic meter.

Building Energy Use:

If appropriate field data were collected, seasonal effects of trees on residential building energy use were calculated based on procedures described in the literature (McPherson and Simpson 1999) using distance and direction of trees from residential structures, tree height and tree condition data. To calculate the monetary value of energy savings, local or custom prices per MWH or MBTU are utilized.

For this analysis, energy saving value is calculated based on the prices of Can$75.00 per MWH and Can$10.45 per MBTU.

Replacement Values:

Replacement value is the value of a tree based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Replacement values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b). Replacement value may not be included for international projects if there is insufficient local data to complete the valuation procedures.

Potential Pest Impacts:

The complete potential pest risk analysis is not available for studies outside of the United States. The number of trees at risk to the pests analyzed is reported, though the list of pests is based on known insects and disease in the United States.

For the U.S., potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest

Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to the county in which the urban forest is located. For the county, it was established whether the insect/disease occurs within the county, is within 400 kilometers of the county edge, is between 400 and 1210 kilometers away, or is greater than 1210 kilometers away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007).

Relative Tree Effects:

The relative value of tree benefits reported in Appendix II is calculated to show what carbon storage and sequestration, and air pollutant removal equate to in amounts of municipal carbon emissions, passenger automobile emissions, and house emissions.

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM10, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM10 emission per kWh from Layton 2004.
- CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Appendix II. Relative Tree Effects

The urban forest in S1-Significant Woodlands A&B: Perfered provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average municipal carbon emissions, average passenger automobile emissions, and average household emissions. See Appendix I for methodology.

<u>Carbon storage is equivalent to:</u>

- Amount of carbon emitted in S1-Significant Woodlands A&B: Perfered in 0 days
- Annual carbon (C) emissions from 1,410 automobiles
- Annual C emissions from 577 single-family houses

<u>Carbon monoxide removal is equivalent to:</u>

- Annual carbon monoxide emissions from 0 automobiles
- Annual carbon monoxide emissions from 0 single-family houses

<u>Nitrogen dioxide removal is equivalent to:</u>

- Annual nitrogen dioxide emissions from 0 automobiles
- Annual nitrogen dioxide emissions from 0 single-family houses

<u>Sulfur dioxide removal is equivalent to:</u>

- Annual sulfur dioxide emissions from 694 automobiles
- Annual sulfur dioxide emissions from 2 single-family houses

<u>Annual carbon sequestration is equivalent to:</u>

- Amount of carbon emitted in S1-Significant Woodlands A&B: Perfered in 0.0 days
- Annual C emissions from 18 automobiles
- Annual C emissions from 7 single-family houses

Appendix III. Comparison of Urban Forests

A common question asked is, "How does this city compare to other cities?" Although comparison among cities should be made with caution as there are many attributes of a city that affect urban forest structure and functions, summary data are provided from other cities analyzed using the i-Tree Eco model.

I. City totals for trees

City	*% Tree Cover*	*Number of Trees*	*Carbon Storage (metric tons)*	*Carbon Sequestration (metric tons/yr)*	*Pollution Removal (metric tons/yr)*
Toronto, ON, Canada	26.6	10,220,000	1,108,000	46,700	1,905
Atlanta, GA	36.7	9,415,000	1,220,000	42,100	1,509
Los Angeles, CA	11.1	5,993,000	1,151,000	69,800	1,792
New York, NY	20.9	5,212,000	1,225,000	38,400	1,521
London, ON, Canada	24.7	4,376,000	360,000	12,500	370
Chicago, IL	17.2	3,585,000	649,000	22,800	806
Phoenix, AZ	9.0	3,166,000	286,000	29,800	511
Baltimore, MD	21.0	2,479,000	517,000	16,700	390
Philadelphia, PA	15.7	2,113,000	481,000	14,600	522
Washington, DC	28.6	1,928,000	477,000	14,700	379
Oakville, ON , Canada	29.1	1,908,000	133,000	6,000	172
Albuquerque, NM	14.3	1,846,000	301,000	9,600	225
Boston, MA	22.3	1,183,000	290,000	9,500	257
Syracuse, NY	26.9	1,088,000	166,000	5,300	99
Woodbridge, NJ	29.5	986,000	145,000	5,000	191
Minneapolis, MN	26.4	979,000	227,000	8,100	277
San Francisco, CA	11.9	668,000	176,000	4,600	128
Morgantown, WV	35.5	658,000	84,000	2,600	65
Moorestown, NJ	28.0	583,000	106,000	3,400	107
Hartford, CT	25.9	568,000	130,000	3,900	52
Jersey City, NJ	11.5	136,000	19,000	800	37
Casper, WY	8.9	123,000	34,000	1,100	34
Freehold, NJ	34.4	48,000	18,000	500	20

II. Totals per hectare of land area

City	*Number of Trees/ha*	*Carbon Storage (metric tons/ha)*	*Carbon Sequestration (metric tons/ha/yr)*	*Pollution Removal (kg/ha/yr)*
Toronto, ON, Canada	160.4	17.4	0.73	29.9
Atlanta, GA	275.8	35.7	1.23	44.2
Los Angeles, CA	48.4	9.4	0.36	14.7
New York, NY	65.2	15.3	0.48	19.0
London, ON, Canada	185.5	15.3	0.53	15.7
Chicago, IL	59.9	10.9	0.38	13.5
Phoenix, AZ	31.8	2.9	0.30	5.1
Baltimore, MD	118.5	25.0	0.80	18.6
Philadelphia, PA	61.9	14.1	0.43	15.3
Washington, DC	121.1	29.8	0.92	23.8
Oakville, ON , Canada	192.9	13.4	0.61	12.4
Albuquerque, NM	53.9	8.8	0.28	6.6
Boston, MA	82.9	20.3	0.67	18.0
Syracuse, NY	167.4	23.1	0.77	15.2
Woodbridge, NJ	164.4	24.2	0.84	31.9
Minneapolis, MN	64.8	15.0	0.53	18.3
San Francisco, CA	55.7	14.7	0.39	10.7
Morgantown, WV	294.5	37.7	1.17	29.2
Moorestown, NJ	153.4	27.9	0.90	28.1
Hartford, CT	124.6	28.5	0.86	11.5
Jersey City, NJ	35.5	5.0	0.21	9.6
Casper, WY	22.5	6.2	0.20	6.2
Freehold, NJ	94.6	35.9	0.98	39.6

Appendix IV. General Recommendations for Air Quality Improvement

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmosphere environment. Four main ways that urban trees affect air quality are (Nowak 1995):

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Emission of volatile organic compounds (VOC) and tree maintenance emissions
- Energy effects on buildings

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities (Nowak 2000). Local urban management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include (Nowak 2000):

Strategy	*Result*
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

Appendix V. Invasive Species of the Urban Forest

Invasive species data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

Appendix VI. Potential Risk of Pests

Pest range data is only available for the United States. This analysis cannot be completed for international studies because of a lack of necessary data.

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