Master Environmental Servicing Plan

Clair-Maltby
Guelph, ON
Project # TPB168050

Prepared for:

City of Guelph
1 Carden Street, Guelph, Ontario N1H 3A1

4/22/2024

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LICENSED PROFESSIONAL ENGINEER
04/22/2024
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Prepared for:

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4/22/2024

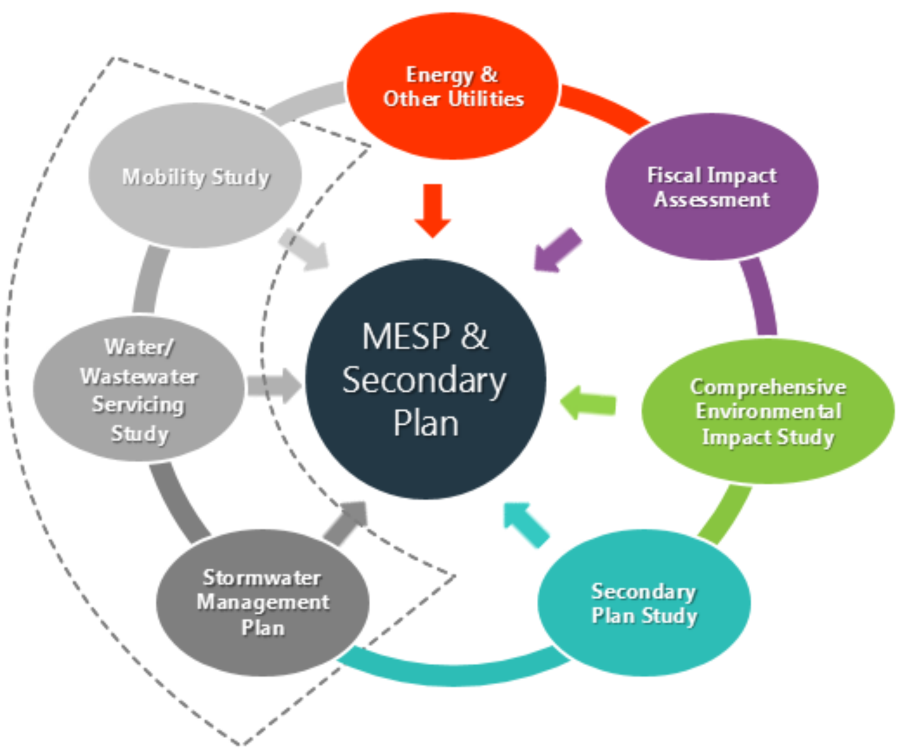
Executive Summary

1. Introduction

The City of Guelph initiated the process of preparing the Clair Maltby Secondary Plan in 2016. As part of this process, the City also prepared a Comprehensive Environmental Impact Study (CEIS), which established the existing environmental conditions within the Secondary Plan Area (SPA), determined the environmental impacts from the proposed land use (Community Structure) and then recommended mitigative and management measures to prevent and/or manage impacts (ref. Figure EX 1). The CEIS was prepared by the Wood Team, comprised of Wood Environment & Infrastructure Solutions, Matrix Solutions, Beacon Environmental and Daryl Cowell.

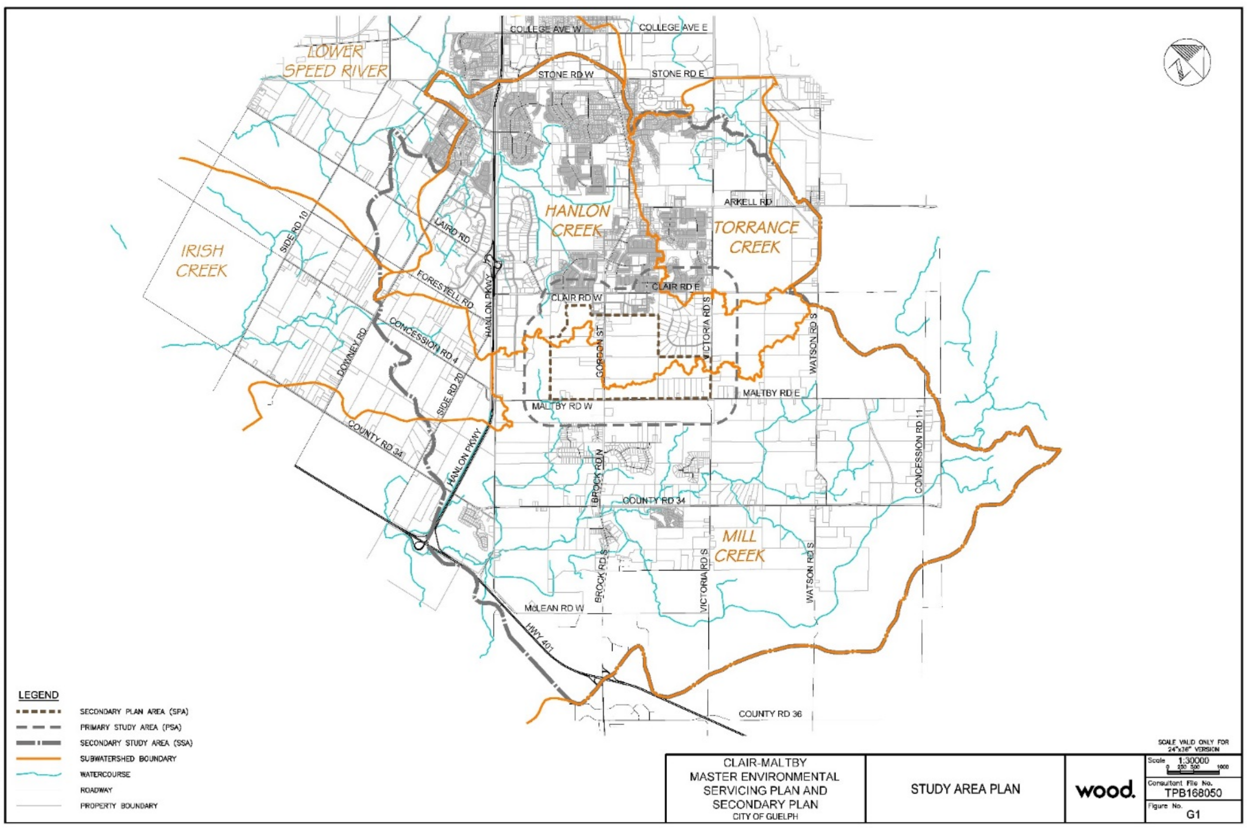
The Master Environmental Servicing Plan (MESP) was also prepared concurrently with the Secondary Plan. The MESP is intended to satisfy the requirements of the Environmental Assessment Act and the Planning Act. The MESP determined the preferred servicing strategies (water, wastewater, stormwater and mobility) required for the Clair-Maltby SPA. The Secondary Plan, CEIS and MESP along with the Energy & Other Utilities study as well as the Fiscal Impact Assessment are all integrated components as part of this study (ref. Figure EX 1).

Figure EX.1. Clair Maltby Study Components



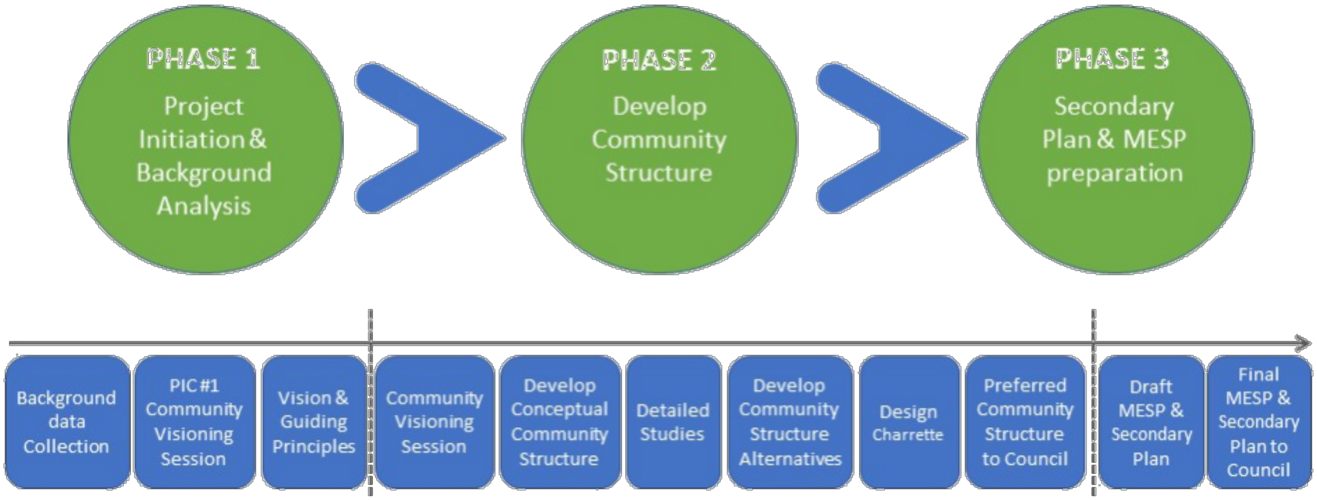
The Secondary Plan Area: (ref. Figure EX.2) constitutes the lands within which land use change is proposed to occur in accordance with an approved Secondary Plan. The SPA includes the lands south of Clair Road East, north of Maltby Road East, approximately 1 km east of the Hanlon Expressway and west of Victoria Road South, excluding the Rolling Hills Community at the corner of Victoria Road and Clair Road East. Notably, the Rolling Hills Community was originally included in the SPA for this project at its outset and was considered under the Phase 1 and 2 Characterization reporting. However, based on feedback from the community and other planning considerations, it was removed by decision of Council in June 2018 (ref. Figure Ex.2). The Secondary Study Area (SSA) refers to the assessment area under study being considered either partially or in its entirety (e.g. regional groundwater movement).

Figure EX.2. Study Area Plan



The purpose of the CEIS is to serve as a comprehensive and strategic document to address natural heritage and water resource protection and management based on a subwatershed scale assessment to inform environmental, land use and infrastructure planning and associated decision-making, as part of a broader integrated development framework for informing the Secondary Plan and its policies.

Figure EX.3. Clair-Maltby Secondary Plan Process



1.1 Process

The process and timing for developing the Secondary Plan is outlined in Figure EX.3. As part of the overall land use planning process, a preferred Conceptual Community Structure for the Clair-Maltby SPA had been developed by the City through a highly consultative process, with input from government agencies, stakeholder groups, the public and the CEIS/MESP Team. The process for developing the initial Community Structure is discussed further in Section 1.3.

The MESP has been conducted in accordance with the Master Plan Approach #2 requirements of the Municipal Engineers Association Class Environmental Assessment (EA) process (Section A.2.7 of the Municipal Class EA document, October 2000, as amended in 2007, 2011 and 2015). The MESP has followed Phases 1 and 2 of the Class EA process and identifies a series of servicing projects that will be required to service the Clair-Maltby SPA.

1.2 Problem and Opportunity Statement

The conversion of the Clair-Maltby SPA to urban uses, from its current largely natural and agricultural state, brings forward the need for municipal services including potable water and transmission, wastewater collection/treatment, stormwater management and transportation/mobility facilities.

The Class EA master planning process adopted for the MESP, with support from the CEIS, ultimately establishes the preferred servicing and transportation solutions for the preferred Community Structure Plan (land use plan), which are to be compatible, and integrate with, the existing and recommended natural systems, existing adjacent urban land uses and associated transportation and municipal servicing infrastructure.

1.3 Development of Preferred Community Structure/Public Consultation

The process of establishing the preferred land use for Clair-Maltby involved a number of concurrent studies and investigations. The initial preferred Conceptual Community Structure (urban land use plan) for Clair-Maltby was developed by the City through a highly consultative process, with input from government agencies, stakeholder groups, the public and the CEIS/MESP Team. Through the consultative process and the CEIS Impact Assessment results, the Updated Preferred Community Structure Plan was developed (ref. Figure EX.4). Subsequently the City finalized the location of the Community Park within the context of the updated Preferred Community Structure Plan in May 2020. In May 2021, a Final Preferred Community Structure Plan was provided by the City. The assessment has been conducted using the May 2021 Final Preferred Community Structure Plan, however due to timing of the plan's development and provision to the CEIS/MESP Team, the figures and drawings reflect the Updated Preferred Community Structure from May 2019.

Figure EX.4. Updated Preferred Community Structure, May 13, 2019

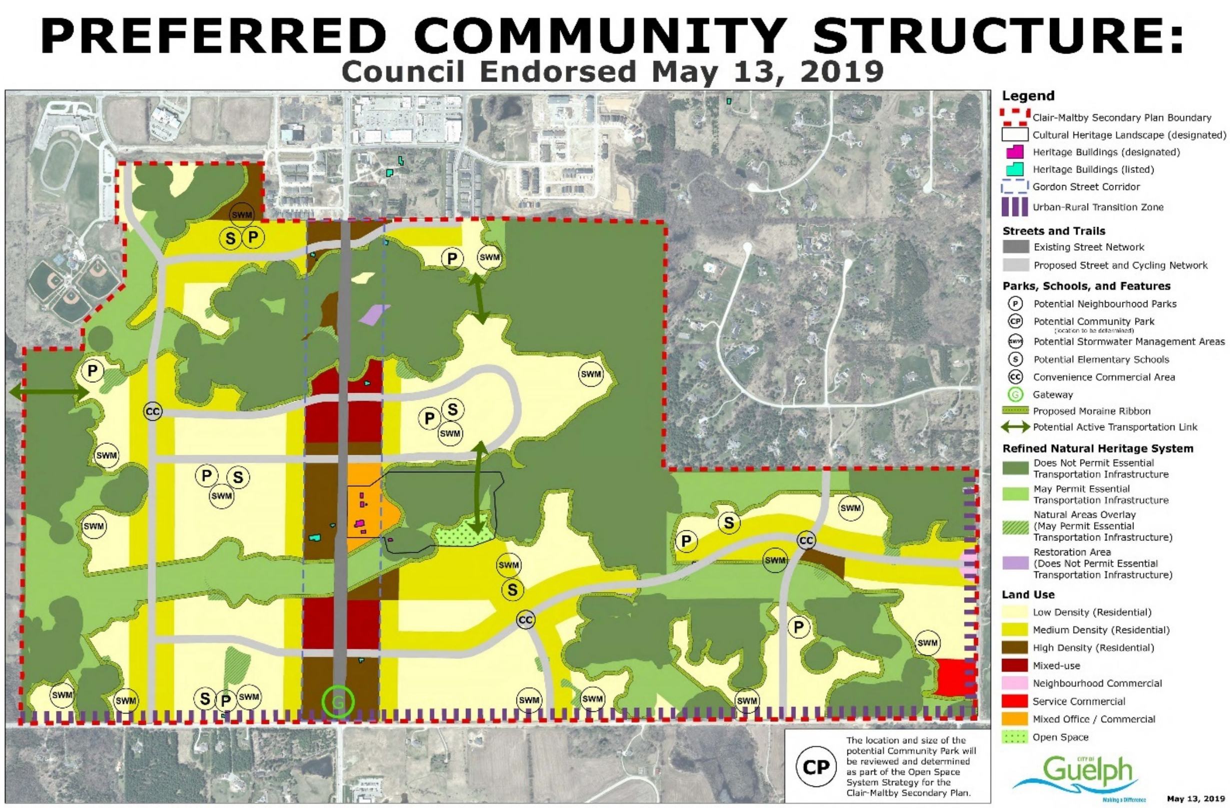
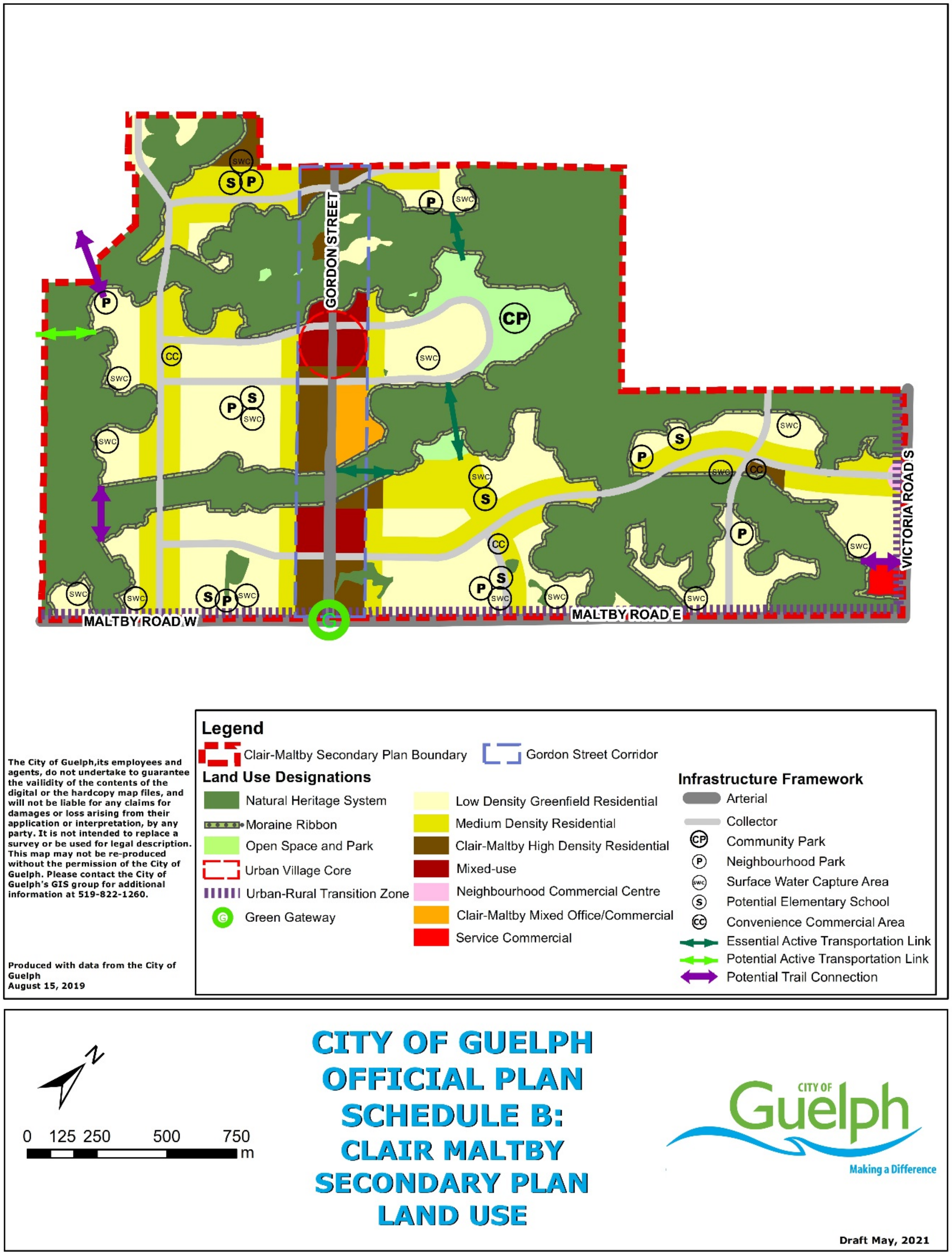


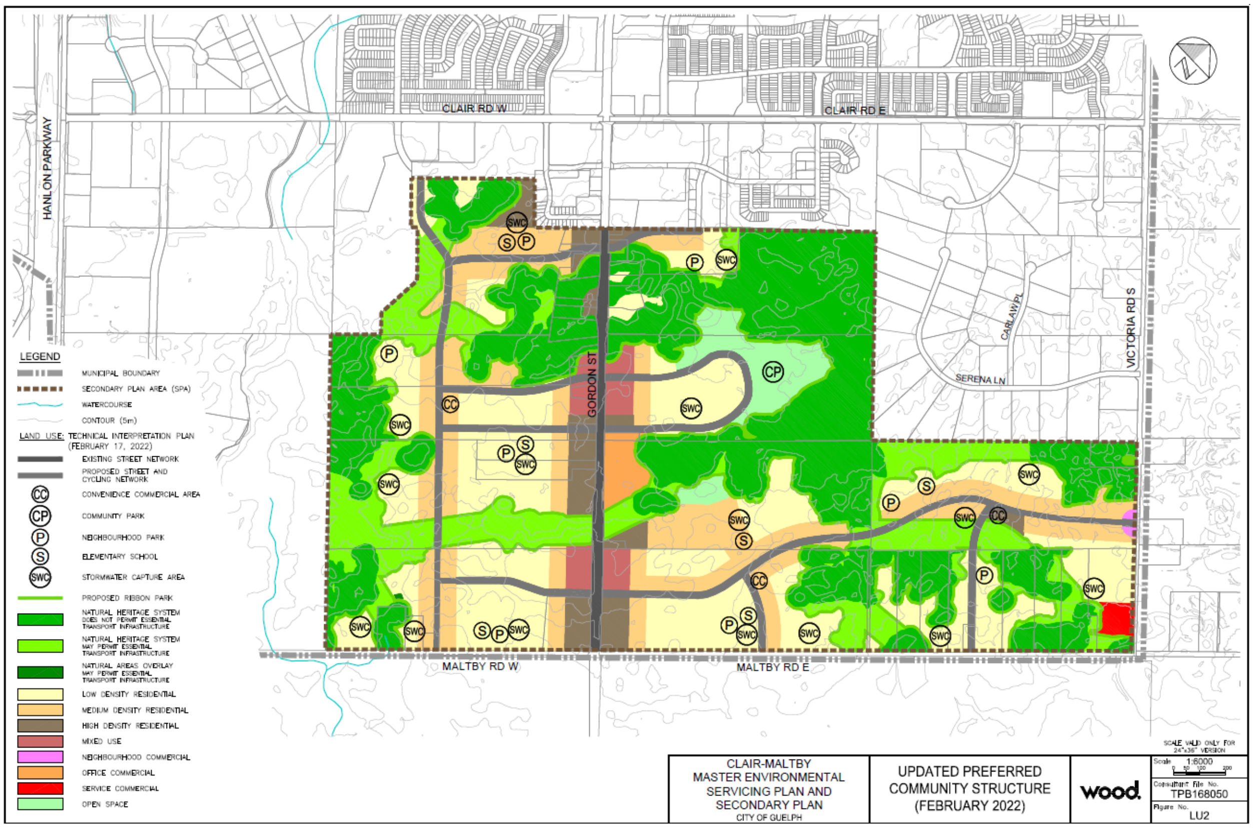
Figure EX.5. Final Preferred Community Structure, May 2021



The Clair-Maltby SPA is approximately 415 ha and will have various residential land uses, as well as schools, parks and office and commercial areas. The Clair-Maltby SPA is intended to have a population of approximately 16,300 people and provide 1,250 jobs.

The Final Preferred Community Structure, May 2021, (ref. EX-5) has been updated with minimal changes, primarily the NHS boundaries, which have incurred minimal revisions and one (1) north-south collector road alignment (road east of Gordon Road), which has been slightly adjusted. Figure EX-6 presents the updated February 2022 Final Preferred Community Structure.

Figure EX.6. Updated Final Preferred Community Structure, February 2022



2. Natural Environment

The CEIS provides the details associated with the natural systems in the Clair-Maltby SPA and surrounding areas based on existing conditions. Key information from the CEIS Characterization assessment of the natural environment has served as a basis for evaluating the respective servicing alternatives related to the water, wastewater, stormwater and mobility servicing.

The Clair-Maltby SPA includes portions of the Hanlon Creek, Mill Creek and Torrance Creek watersheds. It contains a well-defined natural heritage system (NHS). The Hanlon Creek Watershed and the Mill Creek Watershed each cover almost half of the SPA, with the northeastern corner captured by the Torrance Creek Watershed. The SPA contains a mix of cultural vegetation communities, natural forests and wetlands that support a range of significant species. This diversity of natural features and areas sits above the generally well-drained, hummocky topography of the Paris Moraine, which lacks open watercourse features, and instead drains to depressional features including Significant Wetlands, other Wetlands, Significant Woodlands and Cultural Woodlands.

Within the SPA, wetlands are the predominant surface water feature, collecting surface runoff, groundwater discharge, and/or recharging the groundwater system. There are no watercourses in the SPA. However, the CEIS identifies the linkage of the water resource system to areas outside the SPA, including portions of the City of Guelph and Township of Puslinch. Groundwater flow originating in the SPA and areas to the east of the SPA, support, in part, the residential well supplies and groundwater discharge/baseflow to the headwaters of Mill Creek, Torrance Creek and Hanlon Creek.

A Water Resource System has been defined in OPA 80 as follows:

> "A system consisting of groundwater features and areas and surface water features, and hydrologic functions, which provide the water resources necessary to sustain healthy aquatic and terrestrial ecosystems and human water consumption. The water resource system is comprised of key hydrologic features and key hydrologic areas."

3. Servicing

The objective of the MESP, as outlined in the earlier Problem Statement is to establish water, wastewater and storm servicing and transportation solutions for the preferred Community Structure Plan, with consideration to the existing and recommended NHS, existing adjacent urban land uses and associated existing transportation and municipal servicing infrastructure. The following sections provide details of the respective water, wastewater and storm servicing and transportation assessments conducted in accordance with the provisions of the MEA Class EA process (ref. Municipal Engineers Association Municipal Class Environmental Assessment document October 2000, as amended 2007, 2011 and 2015). Each section has been largely structured in a common approach providing details of the existing system, governing policies, and criteria, outlining future needs and demands, per the preferred Clair-Maltby Community Structure and offering a suite of alternatives, assessment criteria and ultimately the preferred servicing solutions.

3.1 Water

The City's water distribution system is being expanded in the southern portion of Guelph through a new pressure zone (Zone 3) that will operate at pressures suitable to supply the water demands for the CMSP Lands. Zone 3 is now live with pumping into the zone from the Clair Road Booster Pumping Station, however as demand increases in its service area, Zone 3 will require storage to meet mandated operating requirements.

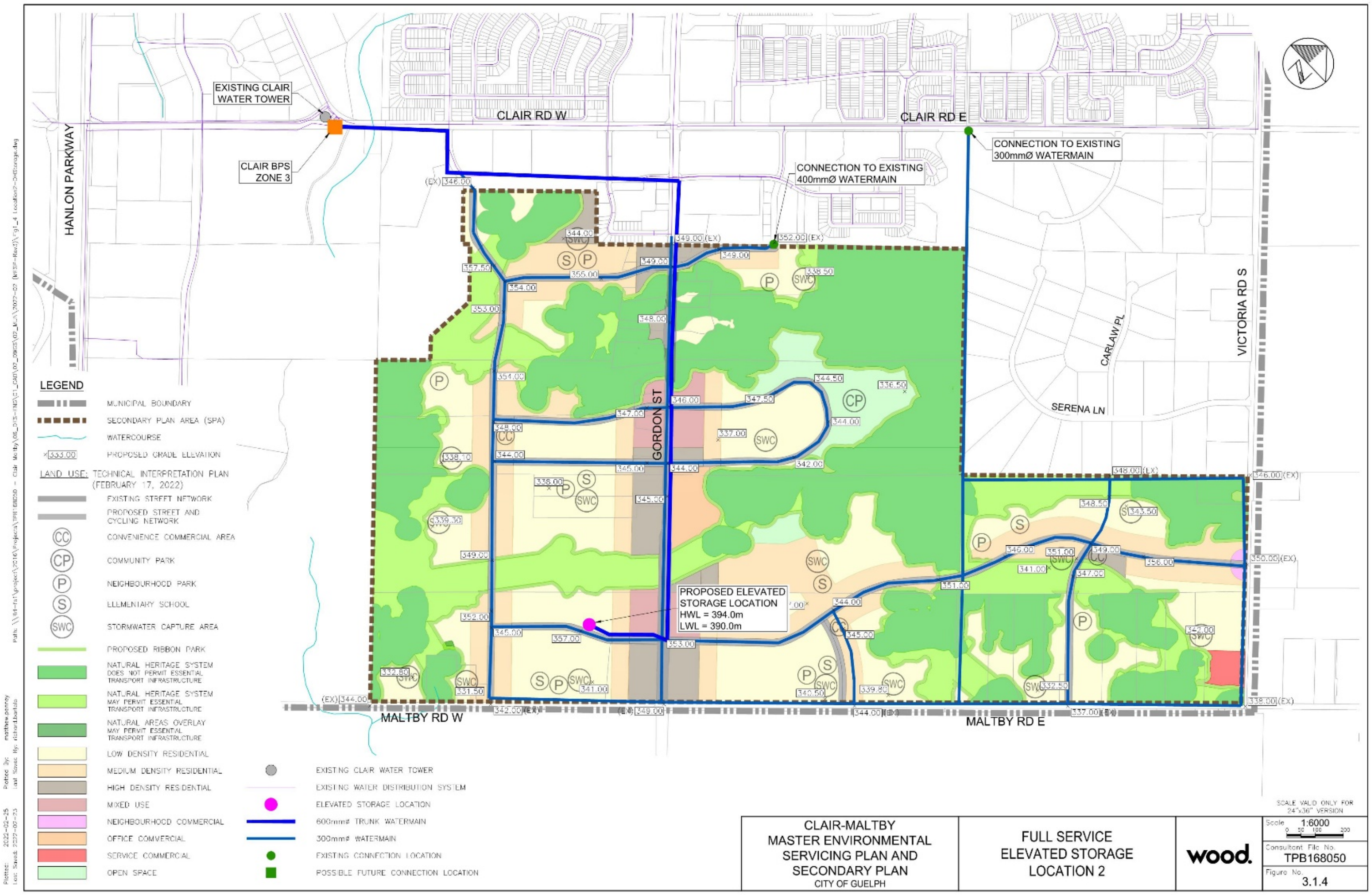
A 5ML storage reservoir will be required at one of the high points within the CMSP Lands. Three potential locations were reviewed for the water storage reservoir, Location 1 in the northern portion of the lands near Gordon Street, Location 2 in the

Southwest portion of the lands near Maltby Road, and Location 3 in the eastern portion of the lands adjacent Victoria Road.

The water storage options examined consisted of elevated storage which will be operated by gravity, and subsurface storage which will require a suitably sized pumping station. Elevated storage and underground storage with a pumping station were assessed for all three geographic locations including the water transmission mains and distribution piping required for each scenario. All scenarios were evaluated using various Social/Cultural Environment, Economic Environment, Natural Environment and Functional (Technical) Environment criteria.

The preferred alternative (ref. Figure EX.7) uses an elevated 5ML Storage reservoir at location 2, near the corner of Gordon Street and Maltby Roads, and requires approximately 17.35km of 300mm diameter watermain and 3.3km of 600mm watermain.

Figure EX.7 Water System Preferred Alternative



3.2 Wastewater

Wastewater flows will be conveyed to the Guelph Wastewater Treatment Plant (WWTP). Four main receiving branches were considered potentially available to receive all, or part of, the wastewater flow from the CMSP area and convey it to the WWTP. The receiving branches evaluated were the Clair Gordon Branch, the Southgate Hanlon Branch, Victoria Road Branch and the Valleyland Trunk. Up to three connection points along each branch were considered and evaluated. The topography of the CMSP Lands is such that flow by gravity alone is not possible and the use of sewage pumping stations is required. In all wastewater servicing scenarios, three sewage pumping stations are required to service the lands. Between each scenario the length, size and routing of the collection and conveyance piping and the size of the sewage pumping station differed.

The Clair Gordon Trunk alternative discharges immediately north of the lands and will require significant upgrades/twinning of existing sewers to provide capacity in the Clair Gordon Trunk system to accommodate CMSP wastewater flows.

The Southgate Hanlon alternative discharges to the west side of the development and provides a connection point which will not require upgrading of the existing sewer infrastructure. It does require a significant length of new gravity sewer in order to reach its connection point. It offers the lowest capital cost, reasonable operating costs and limited impact to businesses and communities, as well as limited impact to the natural environment.

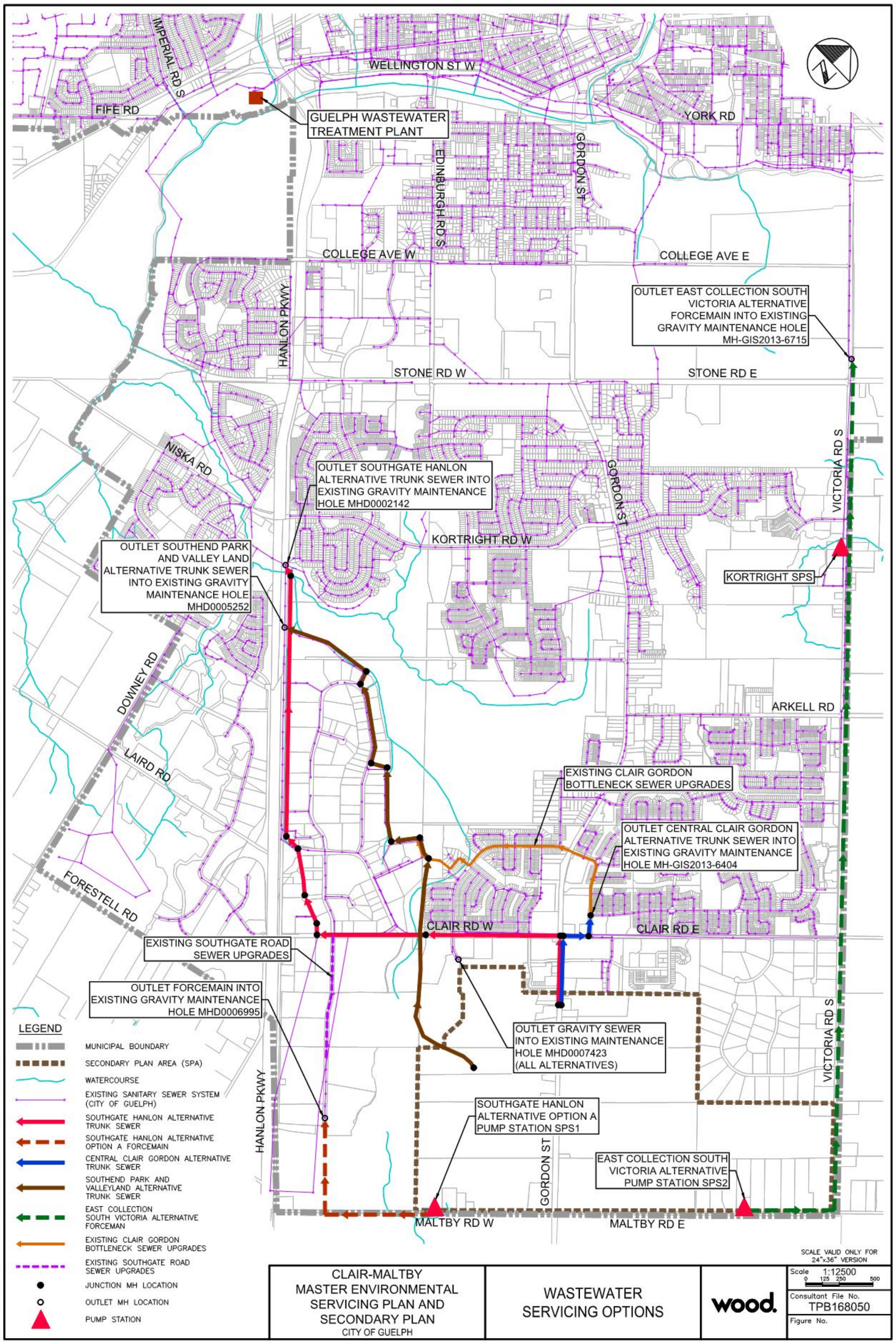
The Victoria Street alternative discharges to the east of the lands and requires an exceptionally long forcemain to avoid upgrading an existing downstream sewage pumping station, due to its lack of capacity to support the Clair Maltby Lands.

The Southend Park and Valleyland Trunk alternatives discharge to the west side of the lands. The advantage of this option is its heavy reliance on gravity flows resulting in smaller sewage pumping stations within the CMSP Lands. The disadvantage of this option is that the sewer depths are in excess of 10 m, as deep as 15 m to 18 m in some locations. As well, extensive sewer easements will be required for this option.

An Optimized Valley Lands / Southgate Hanlon alternative was developed which avoids the Valley Lands by cutting through recreational sports fields and connecting to Poppy Road. This alternative includes a new gravity trunk combining an updated forcemain and 3 pump stations, ultimately connecting to existing trunk system on Jean Anderson Crescent.

Lastly, the Gordon / Southgate Hanlon alternative was developed in an attempt to eliminate in-line pumping. This option utilizes a new gravity main gravity trunk sewer running north along Gordon Street and west along Clair Road and ultimately to the final outlet located northeast of Hanlon. This alternative eliminates double pumping of wastewater has some sections of deep sewer (approximately 250 m deeper than 10 m). Wastewater Servicing alternatives considered are shown in Figure EX 8.

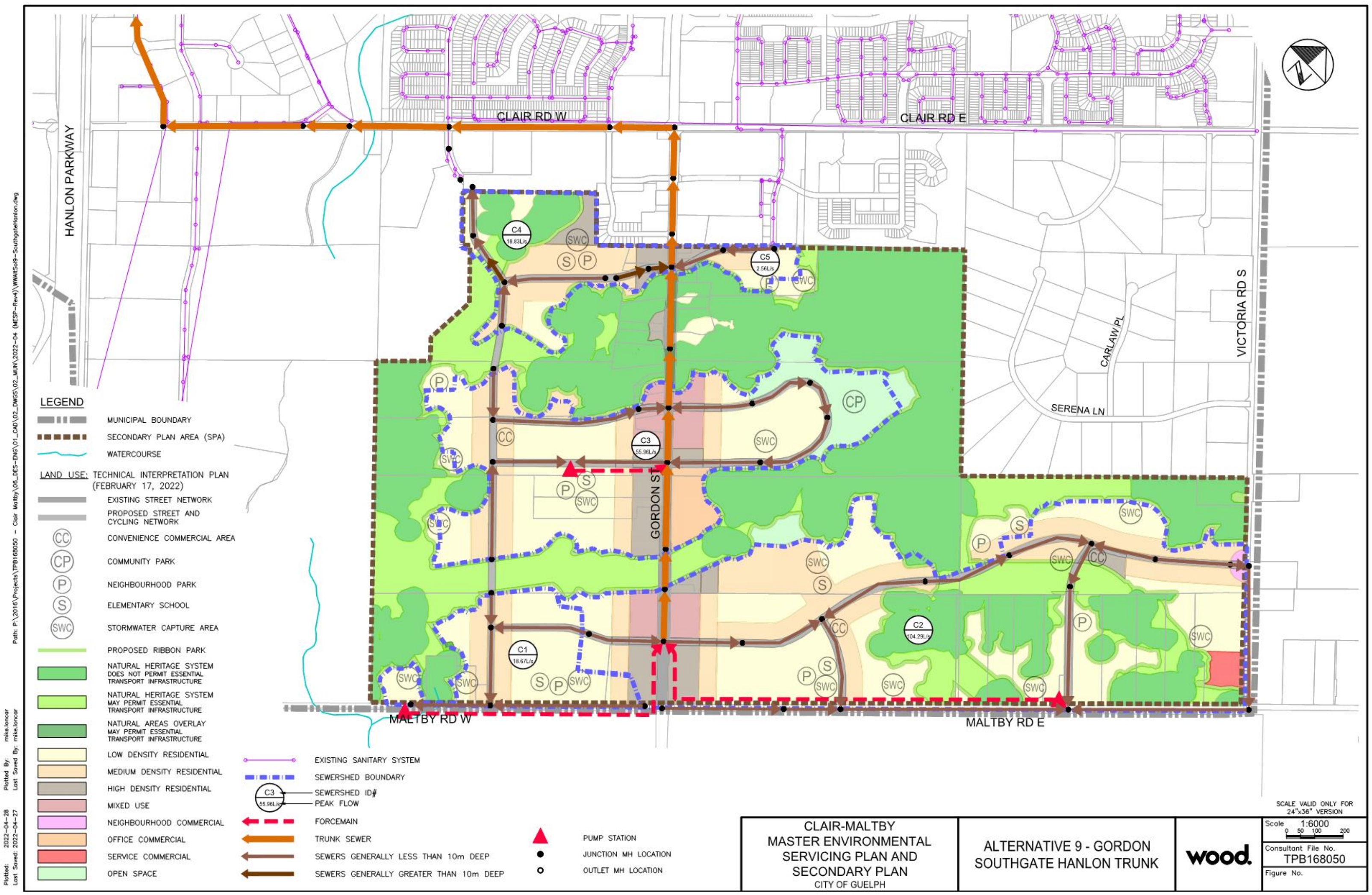
Figure EX.8. Wastewater Servicing Alternatives



All scenarios were evaluated using various Social/Cultural Environment, Economic Environment, Natural Environment and Functional (Technical) Environment criteria.

The preferred alternative is the Gordon / Southgate Hanlon Trunk Alternative (ref. Figure EX.9). This alternative offers the best combinations of economics (capital and operating costs), respect for the natural environment, and functionality in terms of operating and maintaining the system.

Figure EX.9. Preferred Wastewater Servicing Alternative



3.3 Stormwater

Stormwater management is required to address the drainage impacts resulting from the urbanization associated with the Final Preferred Community Structure (ref. Figure EX-6). Without mitigation, there would be impacts to peak flows, runoff volumes and surface water and groundwater quality. The CEIS developed preliminary targets for surface water and groundwater based on existing drainage conditions and the goals and objectives documented in Section 3.3.2. Given the hummocky terrain exhibited in the SPA, most surface water will either evaporate or infiltrate to the groundwater system, therefore groundwater targets are fully integrated and linked to surface water targets.

As part of Phase 2 of the Municipal Class EA process, a wide range, and types, of alternatives are typically developed and assessed to address the Problem Statement. Alternative stormwater management (SWM) solutions for Clair-Maltby have been advanced to consider all aspects of the environmental systems - natural, social/cultural, and economic (also referred to as the "Triple Bottom Line"). The approach to identifying alternative SWM quantity and quality solutions to address the goals, objectives and targets cited in Section 3.3.3, has considered the Subwatershed level protection strategies derived through the CEIS for the SPA and SSA. The SSA, as depicted on Figure EX.2, includes portions of the City and Township of Puslinch, based on the area's natural and water-based resources. The following recommendations have been prepared based on the SWM alternative assessment (ref. Figure EX.10).

1. It is recommended that distributed low impact development best management practices (LID BMPs) capturing 20 mm runoff be provided within both public and private lands, with the remaining drainage (i.e., in excess of 20 mm) being conveyed to stormwater capture areas (SWCA), sized to capture the Regional Storm runoff volume, with 10 per cent buffer (volume-based) to allow for maintenance access, trails, sediment removal and other detailed design requirements, including climate change resiliency. Stormwater capture areas are to have an emergency overflow relief to existing adjacent depression areas, which would essentially mimic existing conditions, should the stormwater capture area storage capacity be fully used, however in no case shall this exceed existing runoff rates for events up to, and including, the Regional Storm. The design of stormwater capture areas and associated emergency relief systems will be prepared at the time of site-specific development and will be informed by the recommendations of a site-specific Environmental Impact Study (EIS), Section 3.3.3 and Section 3.3.7 of the MESP, and Phase 3 of the CEIS.
2. For small development areas (typically less than 5 ha), unless draining to Maltby Road (see Note #3), 20 mm capture only will be required to provide water quality treatment and maintain water balance.
3. For small development areas (typically less than 5 ha), draining to Maltby Road, 20 mm capture within LID BMPs and Regional Storm (285 mm) capture and control within end-of-pipe stormwater management controls will be

required, to mitigate stormwater quantity, quality and water balance impacts to properties located south of Maltby Road.

4. For the proposed Community Park, located adjacent to Halls Pond, distributed LID BMPs are to be designed to capture the 100-year storm event. The distributed LID BMPs are to replace a 100-year stormwater capture area, which would have been required for the park draining to Halls Pond. The rationale for using LID BMPs versus a SWCA in this location is to prevent localized groundwater mounding resulting in ~~with~~ potential increases in the average Halls Pond water level.
5. The SWCAs for Subcatchments SW-42 and SW-61 should be located as per the recommendations of the Halls Pond Assessment (ref. Appendix F).
6. Sites with infiltrative LID BMPs that receive runoff from paved surfaces will require salt management plans and pretreatment focused on total suspended sediments (TSS) to protect groundwater quality. Pre-treatment may include various techniques including OGS, CB Shields, grassed swales and other suitable and approved BMPs. Pre-treatment measures will be used to address TSS and other contaminants consistent with provincial and City guidance including the City's recently completed Stormwater Management Master Plan (SWM MP) and the design criteria associated with the recently implemented Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA).
7. A treatment train approach should be used to protect the stormwater capture areas' function of infiltration and to protect groundwater quality.
8. Surface and groundwater quality monitoring as recommended per the CEIS and Section 3.3.7 of this report, will be required to validate the performance of the SWM which is intended to protect existing surface water and groundwater resources.
9. Development proposals will need to demonstrate that target infiltration volumes, as per existing conditions, will be achievable based on the application of LID BMPs and stormwater capture areas proposed as part of the development application.
10. Feature-based water budgets, including monthly water balance assessment should be prepared to demonstrate the mitigation of impacts from proposed land use conditions. The MIKE-SHE model for Clair Maltby should be used to numerically demonstrate mitigation of impacts by proposed developments.
11. As part of a development application, the City of Guelph will require a Salt Management Plan. These plans will include a site-specific salt mass loading calculation and associated monitoring plans that will be required to demonstrate that groundwater quality within the boundaries of the subject development not exceed relevant provincial and City guidelines at the time of development.
12. To achieve these management criteria the City will require salt reduction and management measures per the following:

i. The City of Guelph should consider any outstanding recommendations from the 2017 SMP.

ii. The City of Guelph should consider options for salt alternatives such as different types of chemical de-icers and agricultural by-products.

iii. Implement salt alternatives through financial incentives for independent contractors conducting snow removal and de-icing.

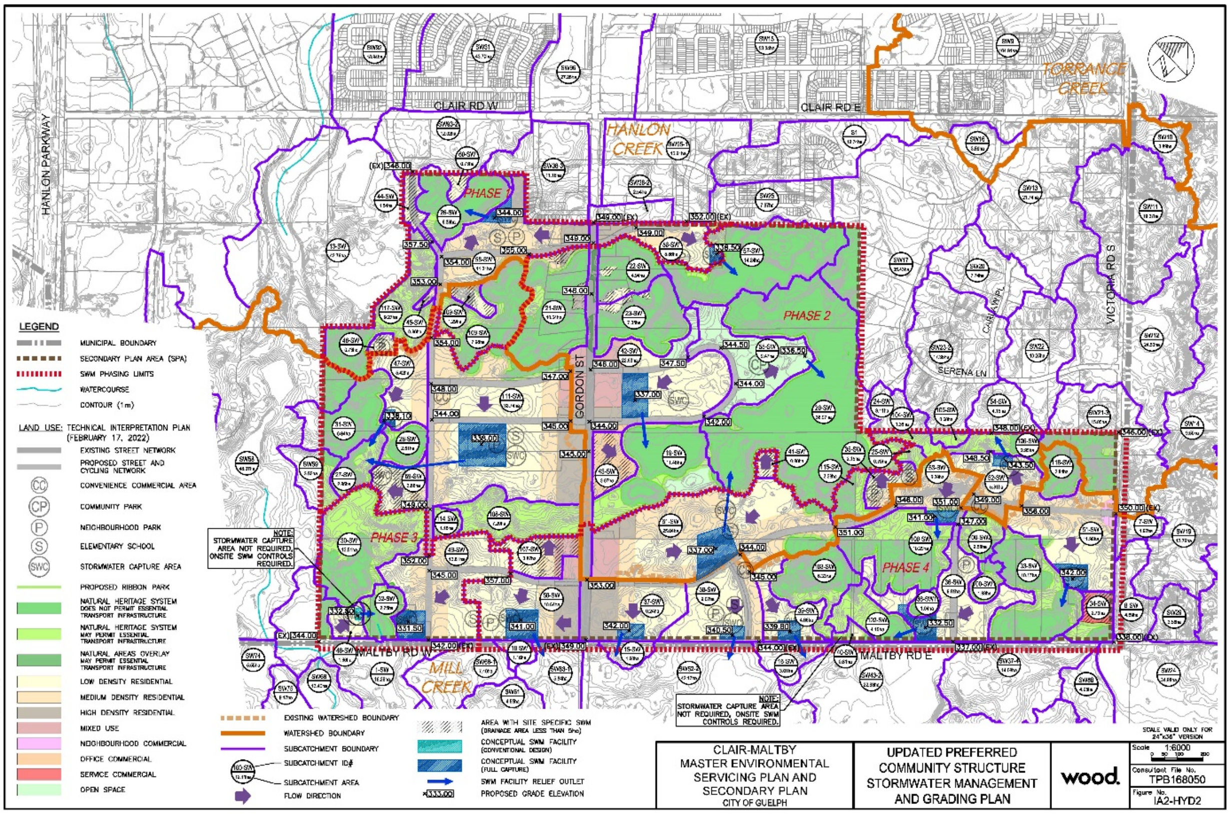
iv. Implement recommendations of the Snow and Ice Control for Parking Lots Platforms and Sidewalks (SICOPS) program as developed by the iTSS Lab at the University of Waterloo, to reduce salt application and improve salt management. The SICOPS program sets out various guidelines for salt management and anti-icing as outlined at http://www.sicops.ca/

v. Consider removal of snow in areas with low traffic loadings and the transportation/storage of this snow to established snow storage/melt areas that provide treatment prior to discharge to the Speed River.

vi. Seasonally closed or partially closed City owned parking lots could be considered by the City of Guelph. Closed parking lots could be used for snow storage and piling, to facilitate reduced salt use for paved areas.

vii. To control salt laden runoff from entering groundwater during the winter months, the City could consider bypasses of infiltrative LID BMPs that receive drainage from paved surfaces.

Figure EX.10. Stormwater Management Plan



3.4 Mobility

An assessment of background information including existing transportation conditions, design guidelines, policies and standards, and opportunities/challenges for the study area was conducted to inform the Preferred Conceptual Community Structure Plan, which was considered through a series of community and stakeholder engagements.

Community Structure options were assessed, and a "Preferred Community Structure" was developed as a planning objective for the future development of the Clair-Maltby Secondary Plan. The Preferred Community Structure Plan provides a general layout of land use, transportation linkages, community facilities, storm water management facilities, cultural heritage resources, and the NHS; and was used as the basis for technical multi-modal transportation analysis.

A system of connected arterial and collector streets are envisioned as part of the Preferred Community Structure Plan, to support development of the SPA, while respecting the Natural Heritage System and existing topography. As part of the Preferred Community Structure Plan, the Gordon Street corridor is a central element in the local transportation network and is intended to accommodate all street users through the delivery of multi-modal infrastructure. Limiting direct vehicular access to individual properties is recommended along Gordon Street. Streets throughout the Clair-Maltby Secondary Plan have been designed to be inclusive of bicycle and pedestrian amenities throughout the community. Travel demands for the Secondary Plan Area were developed based on the most conservative (highest density) assumptions outlined in the "Land Development Budget" and assumed a total of 10,125 residential units and 333 jobs[1]. Given the applicable "Land Development Budget", development within the Clair-Maltby Secondary Plan is anticipated to result in approximately 5,150 and 6,950 two-way person trips (all travel modes) during the weekday morning and weekday afternoon peak hours, respectively.

A future conditions traffic operations analysis was undertaken to understand the impacts of Secondary Plan development traffic on the planned road network (ref. Figure EX.11) with the following key findings:

- Overall, traffic operations within the Secondary Plan area are anticipated to be acceptable under future conditions given planned and recommended intersection traffic control measures and roadway improvements.
- Future traffic demands are anticipated to be accommodated by the Preferred Community Structure street network plan.
- A macro-model analysis undertaken in consultation with the City of Guelph and supported through the traffic analysis, supports the implementation of a 4-lane Gordon Street section within the Clair-Maltby Secondary Plan area. A typical 4-lane street section is anticipated to sufficiently accommodate forecast traffic demands along the Gordon Street corridor, understanding the need for ancillary turn lanes where appropriate.
- The transportation modelling undertaken indicates that a second north-south oriented street is required to connect to Clair Road to accommodate anticipated future traffic demands.
- The transportation modelling undertaken indicates that a third north-south oriented street connecting to Clair Road, initially considered during the planning process, is not required to accommodate anticipated future traffic demands.

Considerations were made in supporting the central high-density node and transit hub in the area of Gordon Street and Street C / Street D. The introduction of two east-west oriented collector streets in the central portion of the Secondary Plan Area supports the plan's transportation objectives of creating a fine-grain, robust street network to facilitate opportunities for site access, active transportation modes, provide opportunities for traffic signal control and associated controlled pedestrian and cycling crossing opportunities of Gordon Street, and access to transit service. Key in this regard is providing a modified grid of collector streets that allow for frequent occurrence of active transportation infrastructure connecting to key origins and destinations within the high-density node.

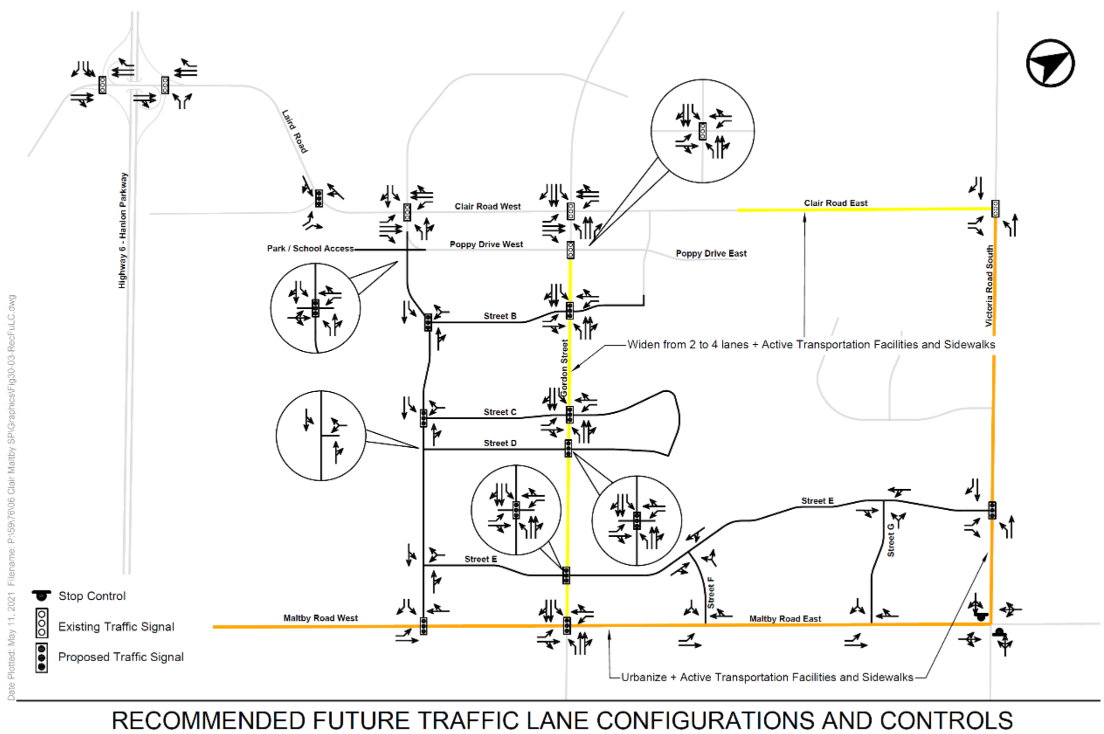
1 Based on August 2018 Area Population and Employment of 24,495 population and 564 jobs. 333 jobs related to commercial and office uses. Remaining jobs related to Service Commercial and Neighbourhood assumed to be small, dispersed, and partly off-peak.

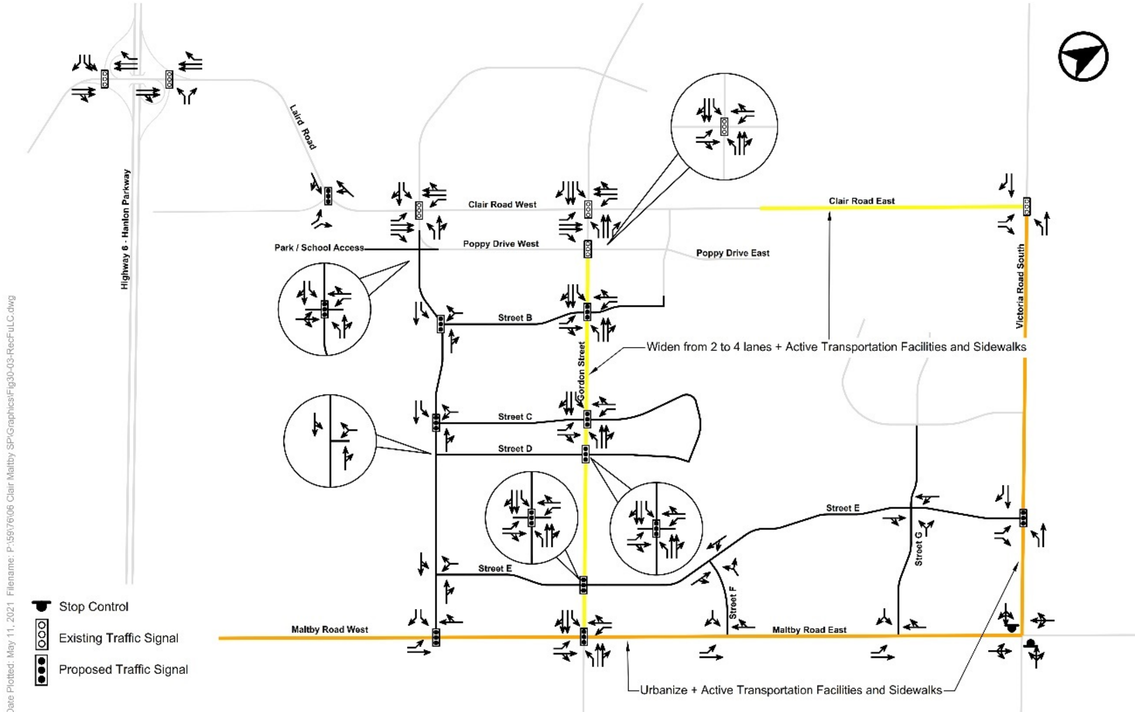
A future conditions transit assessment was also undertaken considering expected transit ridership demands. Development contemplated as part of the Clair-Maltby Secondary Plan is anticipated to be accommodated by the introduction of new transit routes or the expansion of existing services.

Parking demands and supply can be managed through a combination of strategies to guide overall development through the Clair-Maltby Secondary Plan Area. A number of policies can be implemented in support of reducing parking demands, which would provide a positive contribution towards the City's approach to parking management.

A Transportation Demand Management (TDM) framework can be pursued to establish a foundation for managing future travel demands upon development of the SPA. It is recommended that the SPA incorporate a robust TDM framework requiring future development to pursue TDM measures.

Figure EX.11. Proposed Road and Existing Road Network





RECOMMENDED FUTURE TRAFFIC LANE CONFIGURATIONS AND CONTROLS

4. Implementation and Costing

Implementation of water, wastewater, stormwater, and mobility infrastructure must consider phasing / staging requirements and costing. The following outlines current phasing considerations and preliminary costing for each of the infrastructure components, with Figures EX.12-EX.16 indicating the recommended four (4) implementation phases.

4.1 Water

Order of magnitude cost estimates were developed for the various water supply, storage, and distribution elements for each of the alternatives. Cost estimates included the local distribution system (watermains, valves hydrants, etc.), transmission main from the Clair Road Booster Pumping Station, a 5ML water storage reservoir, and the pumping systems required for the subsurface storage alternatives. The capital costs for all alternatives are relatively closely grouped and range from $31.8M to $37.9M. The Preferred Alternative, Elevated 5ML Storage Reservoir at Location 2, is on the lower end of the range at $34.5M. Phasing of the Transmission Main from the Clair Road Booster Pumping Station to new Water Storage reservoir will proceed with partial construction of the transmission main in phases 1 and 2 and completion of the Transmission Main and Water Storage Reservoir in Phase 2.

4.2 Wastewater

Order of magnitude cost estimates were developed for the various wastewater collection, pumping and conveyance alternatives. Cost estimates included the local gravity sewers, sewage pumping stations (3 in all scenarios), forcemains (3), and upgrades to existing downstream infrastructure. Service easement costs were not evaluated.

The capital costs for all alternatives range from $28.6 to $35.7M. The Preferred Alternative, Gordon / Southgate Hanlon Trunk, has the lowest capital cost at $28.6M and is expected to have reasonable operating and maintenance costs.

Phasing is heavily driven by the sanitary catchment areas and must proceed from downstream to upstream (North to South) to ensure infrastructure is in place to support upstream development. Phase 1 can be constructed and connected to the existing wastewater system by gravity. Development of Phase 2 will require the construction of the Trunk sewer to the receiving branch, as well as construction of Sewage Pumping Station 3 (SPS3). Phases 3 and 4 will each require pumping stations which will discharge to a new gravity main gravity trunk sewer running north along Gordon Street and west along Clair Road and ultimately to the final outlet located northeast of Hanlon.

4.3 Stormwater

Stormwater management measures are typically constructed for the locally contributing development area, as development precedes, with stormwater management measures implemented at various stages of construction. End-of-pipe stormwater management facilities, in the case of Clair-Maltby, stormwater capture areas (SWCA), are proposed to be constructed near the commencement of construction of each development phase tributary to that SWCA, therefore providing runoff capture from the disturbed lands. All public source and conveyance stormwater management measures would be constructed during right-of-way construction and for LID BMPs located on private lands, during the finishing construction of private lot grading and sodding.

Preliminary cost estimates for stormwater management measures have been determined for the 15 SWCAs and for low impact development best management practices (ref. Appendix C). SWCAs have been estimated at approximately $26,607,705, with the SWCA costs to be covered through development agreements, based on the contributing development impervious area to each SWCA. Costing for low impact development best management practices has been estimated at a cost of $4,324,419, of which $1,226,018 would be for collector and arterial roadways, which would be covered by Development Charges as part of the road work, as stormwater management measures, with the remaining costs to be distributed between various land uses, including local roads; the total LID BMP storage volume of public versus private LID BMPs, would be based on land use impervious coverages. As per the City of Guelph's DC Local Service Policy, storm sewers up to, and including, 900 mm diameter are a direct developer responsibility. For the purpose of the MESP preliminary stormwater costing, storm sewers have been assumed to be covered by the City's DC Local Service Policy. The LID BMP capture of 20 mm will also provide a measure of climate change resiliency for sizing of the storm sewer system, as long as the benefit of the LID BMP capture is not considered in the base sizing of the pipes.

4.4 Mobility

It is anticipated that new streets and transportation infrastructure will be pursued through development of the SPA, either through direct development contributions and/or Development Charges. New collector streets will be required to undergo detailed design through an Environmental Assessment, specifically phases 3 / 4, or in support of prospective Draft Plan processes.

Transportation infrastructure costs have been estimated for the Clair-Maltby Preferred Community Structure land use plan. General cost estimates, where available, were derived from the February 2019 Development Charges Background Study – Consolidated Report, prepared by Watson and Associates Economists Ltd. for the City of Guelph. This document provides the basis for understanding the unit cost of identified infrastructure. General costs account for the extent of new collector streets reflected in the "Preferred Community Structure Plan", as identified in the City of Guelph Official Plan Schedule C: Clair-Maltby Secondary Plan Mobility Plan.

Mobility infrastructure preliminary costs are forecast in the order of $45,000,000 to $50,000,000. Estimated transportation infrastructure costs are not exhaustive, and generally reflect the extent of details derived from the Secondary Plan structure.

As is typically the case, a contingency is often included. A contingency of 20 per cent may be appropriate given the early stages of planning.

The following recommended roads projects are anticipated to be required to support the Preferred Community Structure. These improvements are also illustrated in Section 3.4 Mobility:

- Widening of Clair Road from 2 to 4 lanes (east of Beaver Meadows Road to Victoria Road) including active transportation and sidewalks
- Widening of Gordon Road from 2 to 4 lanes (south of Poppy Drive to Maltby Road) and urbanizing to include cycle tracks and sidewalks
- Urbanizing of Maltby Road (from Highway 6 to Victoria Road), including introduction of active transportation facilities
- Urbanizing of Victoria Road (from Clair Road to Maltby Road), including introduction of active transportation facilities
- A new Collector Road network that establishes an additional N-S link between Clair and Maltby and an east-west link from west of Gordon (Street A) and Victoria Road.
- 11 new traffic signals (1 on Laird/Clair, 1 on Victoria Road, 2 on Maltby, 4 on Gordon internal to SP, and 3 internal to Collector Road network)
- Intersections Improvements (additional turning lanes) across the Secondary Plan area.

The following roads projects are anticipated to require Schedule C EAs as part of Phases 3 & 4 of the MCEA:

- Widening of Clair Road from 2 to 4 lanes (east of Beaver Meadows Road to Victoria Road)
- Widening of Gordon Road from 2 to 4 lanes (south of Poppy Drive to Maltby Road) – EA Update
- Street A (north-south) Collector Road (from Clair Road to Maltby Road) that will exceed Schedule B requirements (>$2.4m) and have crossings within the NHS.
- Street E (east-west) Collector Road (from Gordon Road to Victoria Road) that will exceed Schedule B requirements (>$2.4m) and have a crossing within the NHS.

There are also numerous ways in which the roads could be phased and built out within the Clair-Maltby SPA, given:

- there are a number of landowners in the SPA:,
- phasing of development can happen in a number of ways; and
- there are a number of amendments in progress for the MCEA process that can influence whether roads >$2.4m proceed to Schedule C or instead to schedule A.

Given the above, it is noted that each road project's classification under the MCEA process should be discussed between the City and developers as draft plans of subdivision come forward.

Figure EX.12. Phase 1

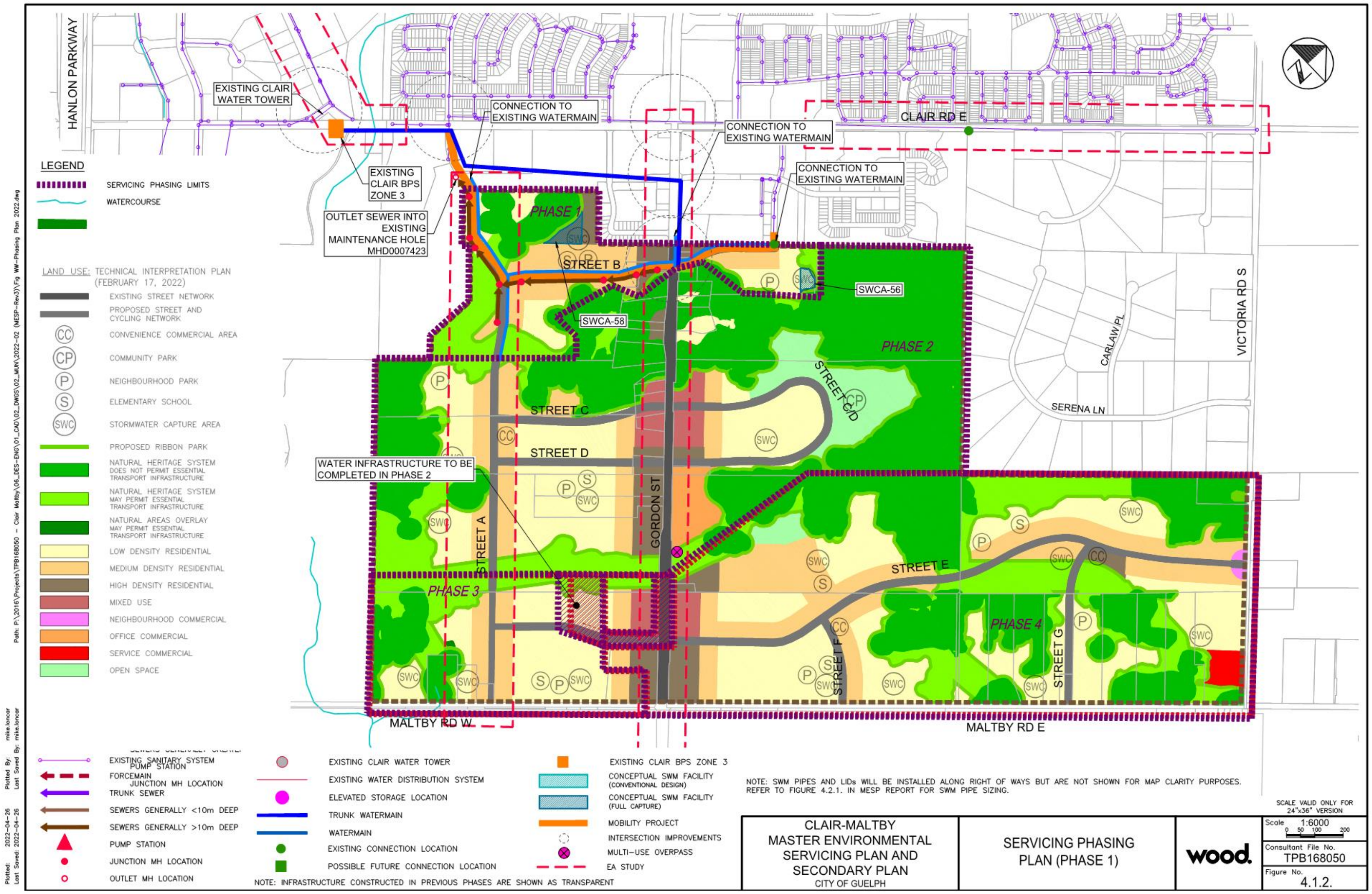


Figure EX.13. Phase 2

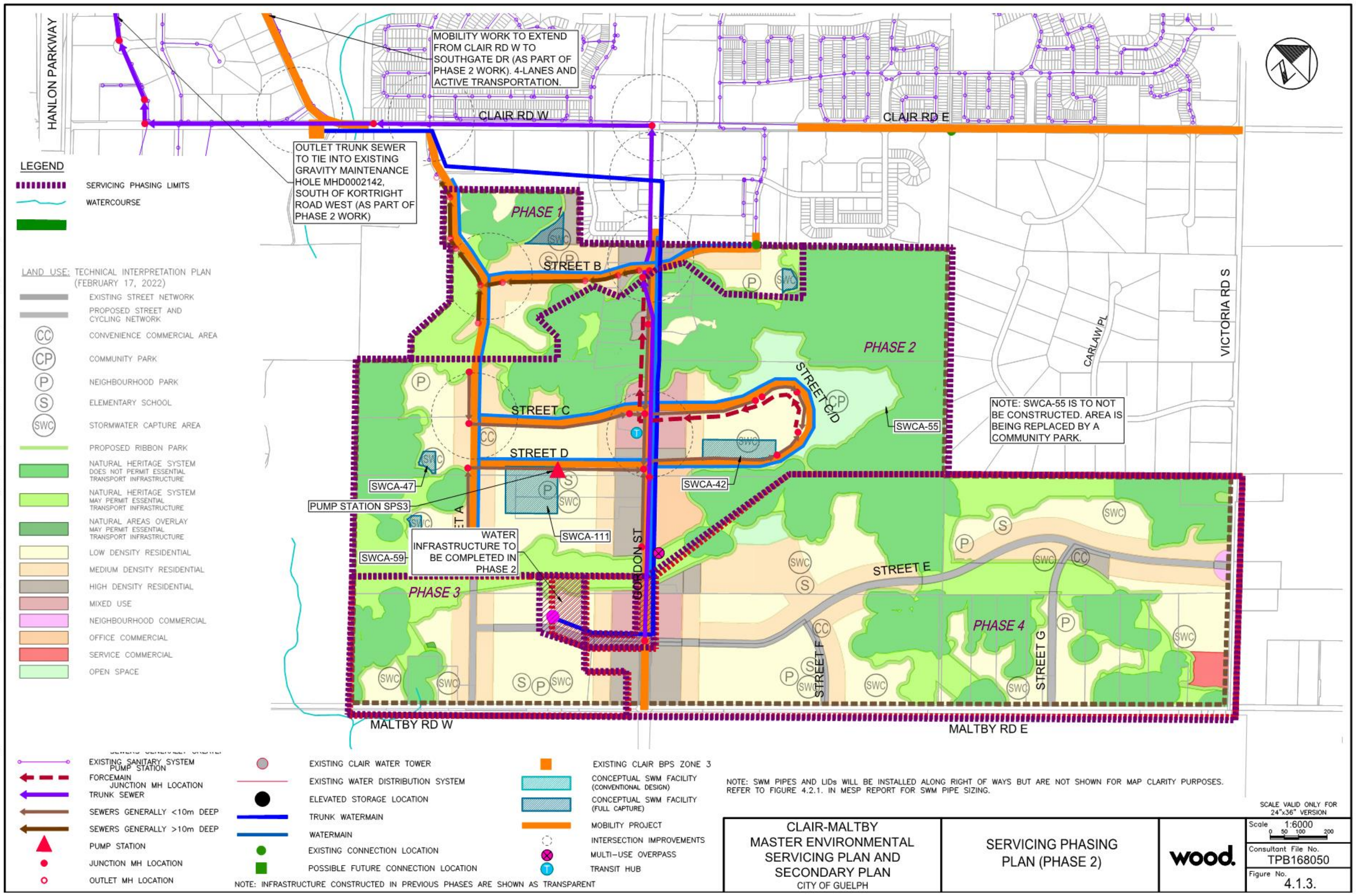


Figure EX.14. Phase 3

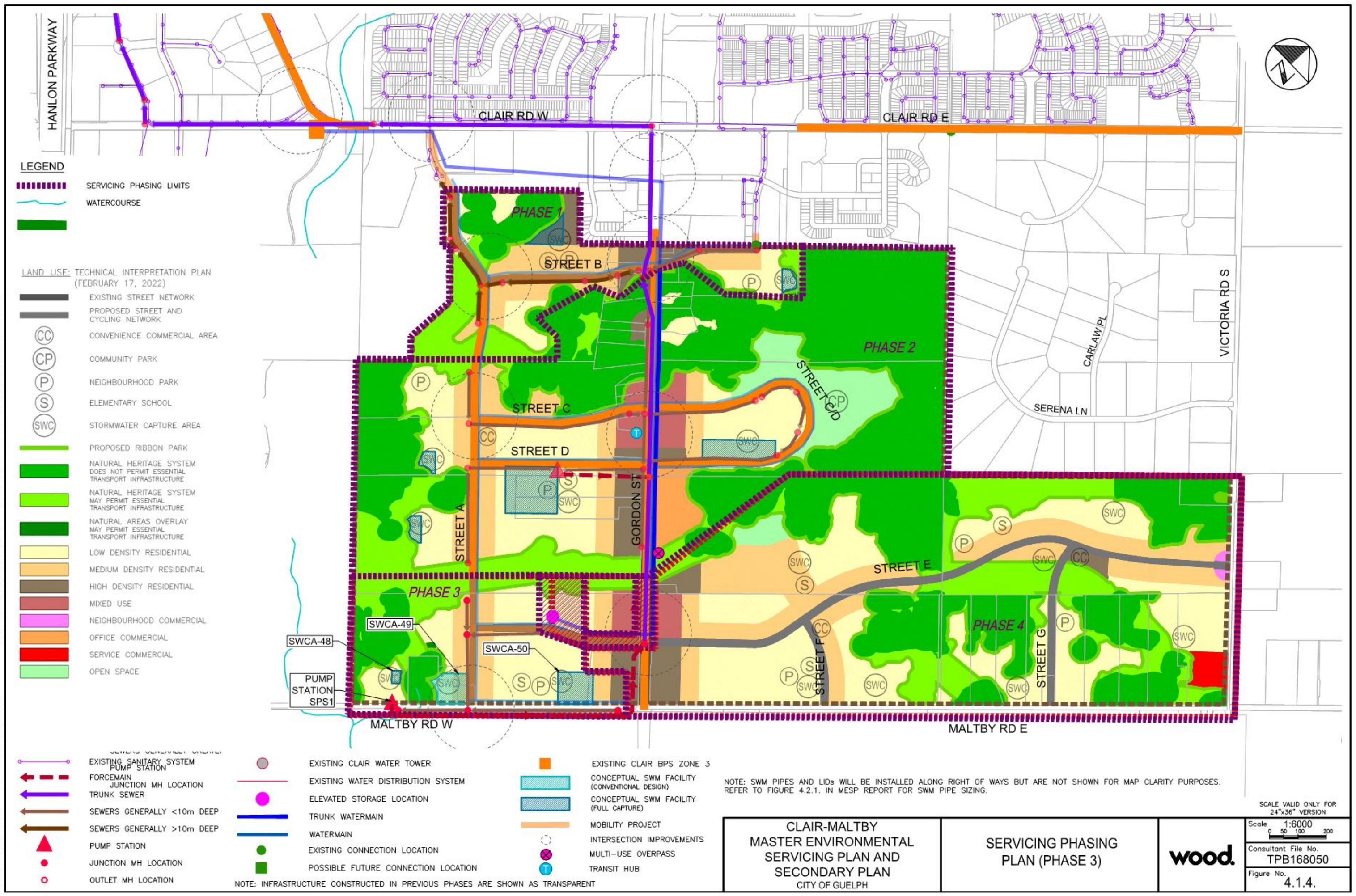
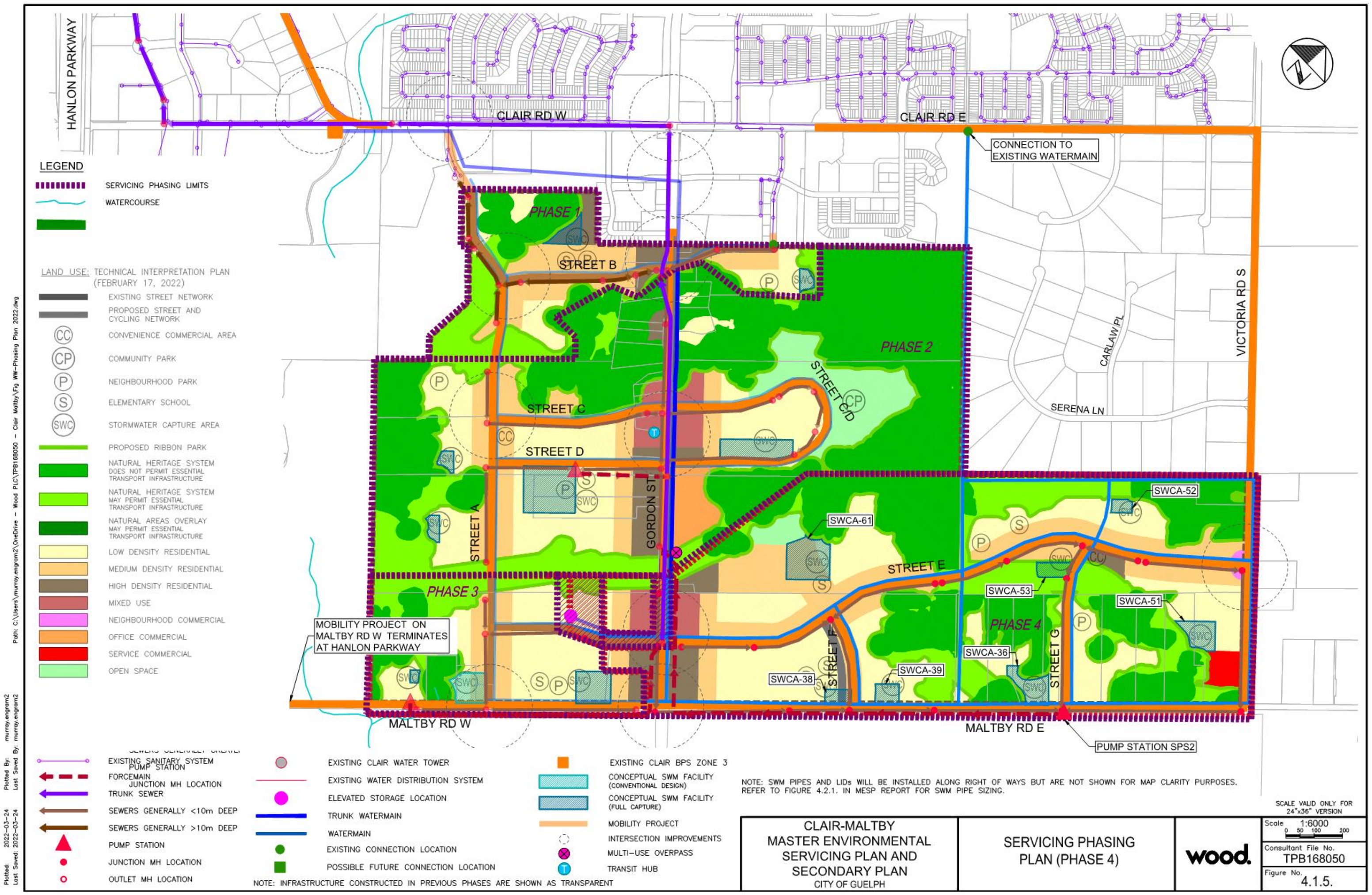


Figure EX.15. Phase 4



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1 Introduction

The City of Guelph initiated preparation of the Clair Maltby Secondary Plan in 2015 to establish preferred land uses and servicing for this new community in the City's south-central area. As part of this process, the City conducted an integrated process for the Clair-Maltby Secondary Plan which included a Master Environmental Servicing Plan (MESP) building from the Comprehensive Environmental Impact Study (CEIS), specifically the Phase 3 Impact Assessment – Second Iteration, March 31, 2020. The CEIS established the existing environmental conditions within the Secondary Plan Area (SPA) and surrounding lands (ref. Figure 1.4) and assessed the environmental impacts from the proposed land use (Community Structure) and ultimately recommended mitigative/management measures to prevent and/or manage potential impacts associated with urbanization of the SPA. The CEIS has been prepared by the Wood Team, comprised of Wood Environment & Infrastructure Solutions (Wood), Matrix Solutions (Matrix), Beacon Environmental (Beacon), BA Group, and Daryl Cowell (Cowell). The CEIS was prepared in a multi-phased approach including:

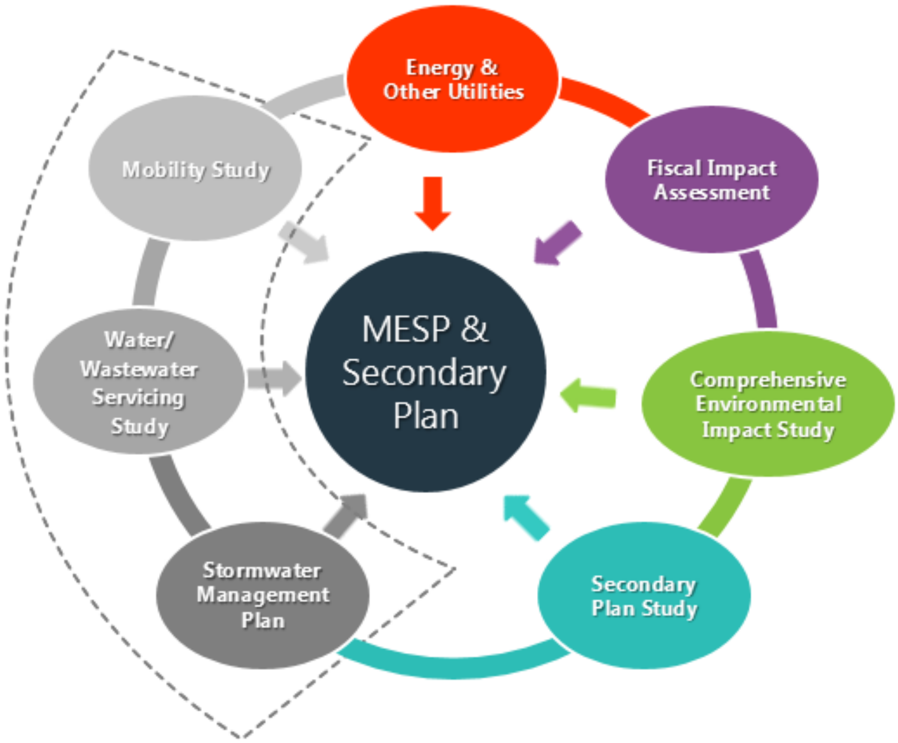
> Phase 1 and 2: Clair-Maltby Secondary Plan and Master Environmental Servicing Plan (CMSP / MESP) Comprehensive Environmental Impact Study (CEIS) Phase 1 and Phase 2: Characterization Report, September 5, 2018.
>
> Phase 3: Clair-Maltby Secondary Plan and Master Environmental Servicing Plan (CMSP/ MESP) Comprehensive Environmental Impact Study (CEIS) Phase 3 Impact Assessment – First Iteration, March 6, 2019, and Second Iteration, March 31, 2020.

The CEIS sets the environmental framework for the assessment of land use in the SPA and servicing alternatives (MESP), by providing guidance specific to the protection and enhancement of the natural heritage system and the water resource system (surface and ground), and their associated functions.

The CEIS identifies the linkage of the water resource system to areas within and outside the SPA, that include portions of the City of Guelph and Township of Puslinch. Groundwater flow originating in the SPA and areas to the east of the SPA, support, in part, the residential well supplies and groundwater discharge/baseflow to headwaters of the Mill Creek south of the SPA.

To plan for servicing this new urban community, the City requires that a Master Environmental Servicing Plan (MESP) be prepared to support the Clair-Maltby Secondary Plan. As a Master Plan, the MESP is intended to satisfy the requirements of the Provincial Environmental Assessment Act through the Municipal Engineers Association (MEA) Environmental Assessment process (ref. Municipal Engineers Association Municipal Class Environmental Assessment document October 2000, as amended 2007, 2011 and 2015) and the Planning Act. The MESP sets out the preferred servicing strategies for water, wastewater, stormwater, and mobility required for the Clair-Maltby Secondary Plan Area. The integrated process is depicted on Figure 1.1.

Figure 1.1. Clair-Maltby Study Components



1.1 Process

The process and steps for developing the Secondary Plan are outlined in Figure 1.3. As part of the overall land use planning process, a preferred Conceptual Community Structure for the Clair-Maltby SPA has been developed by the City through a highly consultative process, with input from government agencies, stakeholder groups, the public and the CEIS/MESP Team. The process for developing the initial Community Structure is discussed further in Section 1.3.

The MESP has been conducted in accordance with the Master Plan Approach #2 requirements of the Municipal Engineers Association Cass Environmental Assessment (EA) process (Section A.2.7 of the Municipal Class EA document, October 2000, as amended in 2007, 2011 and 2015). The MESP has followed Phases 1 and 2 of the Class EA Schedule B process and identifies a series of servicing projects that will be required to service the Clair-Maltby SPA. The MESP addresses Phases 1 and 2 of the MEA Class EA Process (ref. Figure 1.2), with the servicing needs for the Preferred Community Structure determined in Phase 1 and servicing alternatives identified and selected in Phase 2.

Figure 1.2. MEA Class EA Process

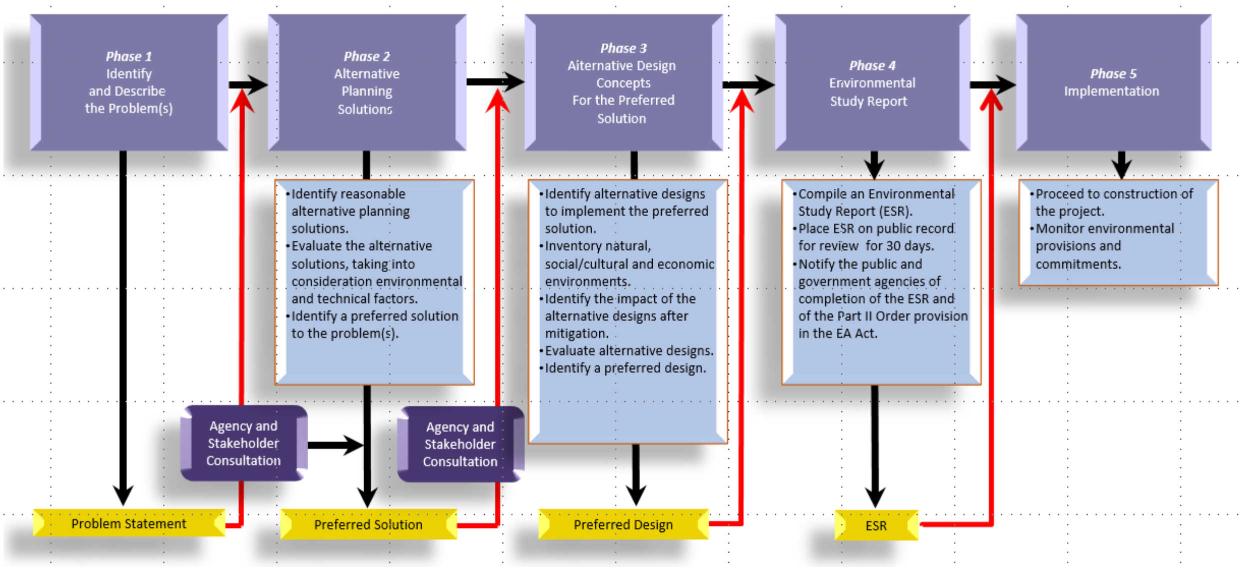
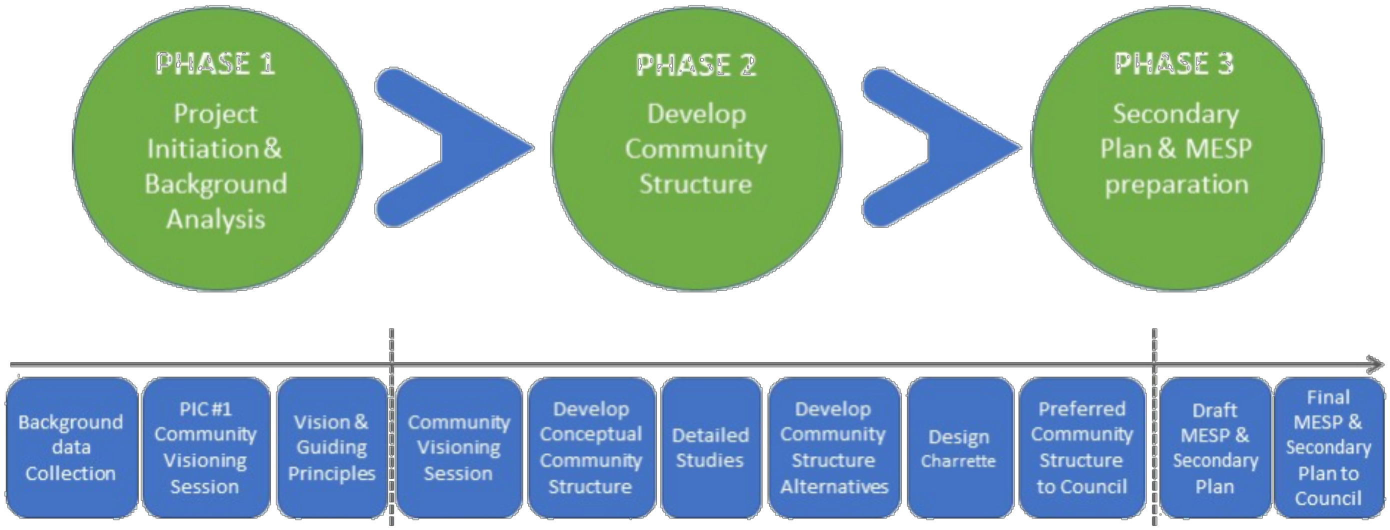


Figure 1.3. Clair-Maltby Secondary Plan Process

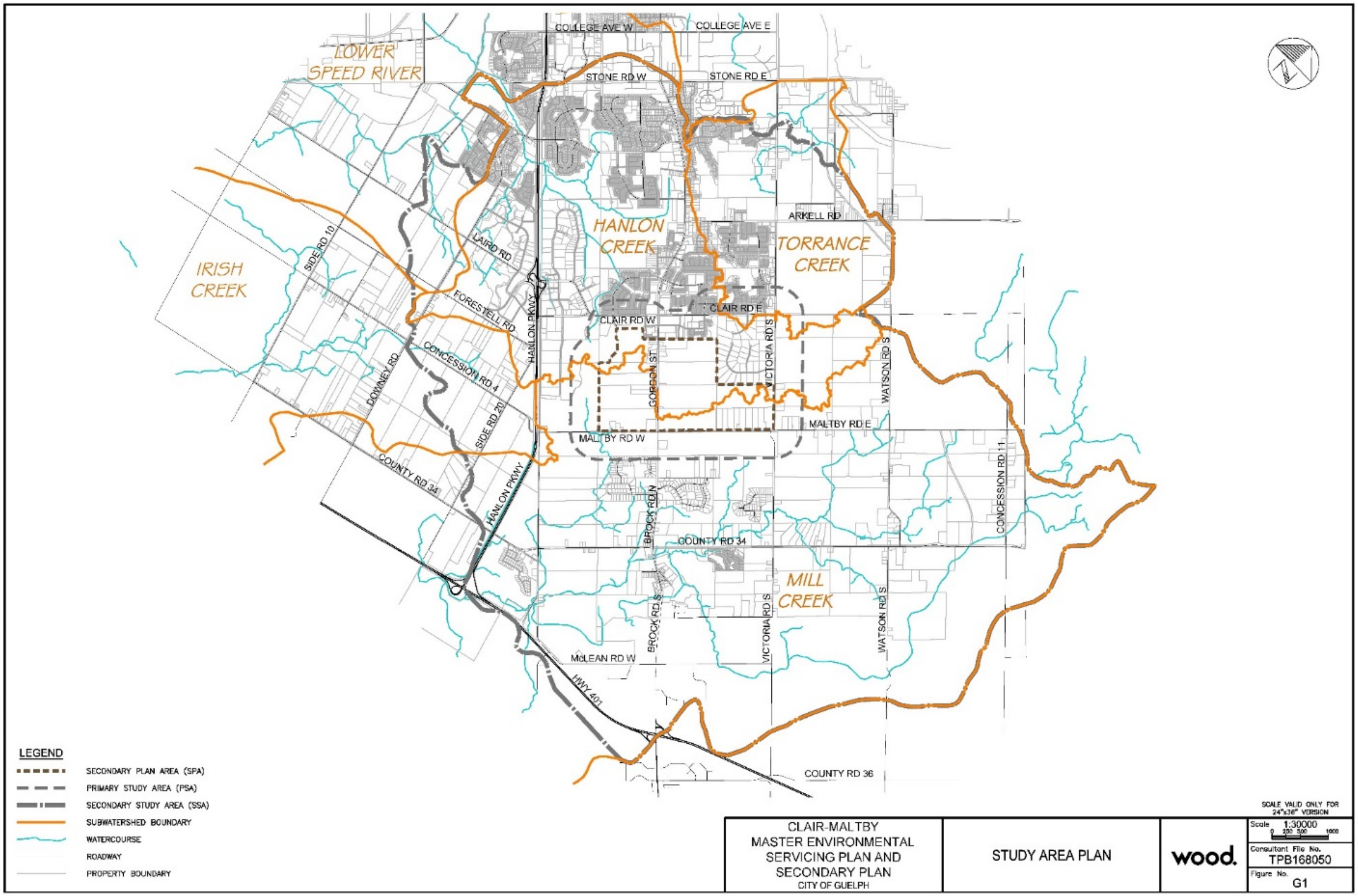


1.2 Study Area

Three scales of study area (ref. Figure 1.4) have been identified for the CEIS which inherently consider the core area (direct land base proposed to be urbanized – SPA), and the immediate surrounding area (Primary Study Area-PSA) and the broader watershed areas (Secondary Study Area-SSA) given the environmental focus of the CEIS. Notably, given that the MESP also needs to consider the existing system of infrastructure associated with water, wastewater, mobility and to a lesser degree stormwater, each infrastructure system has its own spatial domain which is described under each servicing section. The following describes the study limits for the environment, as outlined in the CEIS:

i. The Secondary Plan Area (SPA): The SPA is the area within which land use change is proposed to occur in accordance with the approved Secondary Plan. The SPA includes the lands south of Clair Road East, north of Maltby Road East, west of Victoria Road South, and approximately 1 km east of the Hanlon Expressway in the City of Guelph.
ii. The Primary Study Area (PSA): The PSA includes the SPA plus a 500 m (+/-) zone beyond this boundary, including adjacent communities, to allow for consideration of natural heritage and water resource functions and connectivity in the landscape.
iii. The Secondary Study Area (SSA): The SSA includes the PSA plus the surface water / groundwater receiving systems beyond the Clair-Maltby SPA. This area has been defined based on the area's hydrology and hydrogeology to ensure that landscape scale connectivity is considered from a groundwater and surface water perspective. The SSA is based on appropriate groundwater and surface water model boundaries, which inherently consider subwatershed boundaries (Mill Creek, Hanlon Creek, Torrance Creek, Irish Creek, and Lower Speed River), as well as groundwater flow divides.

Figure 1.4. Study Area Plan



1.3 Problem and Opportunity Statement

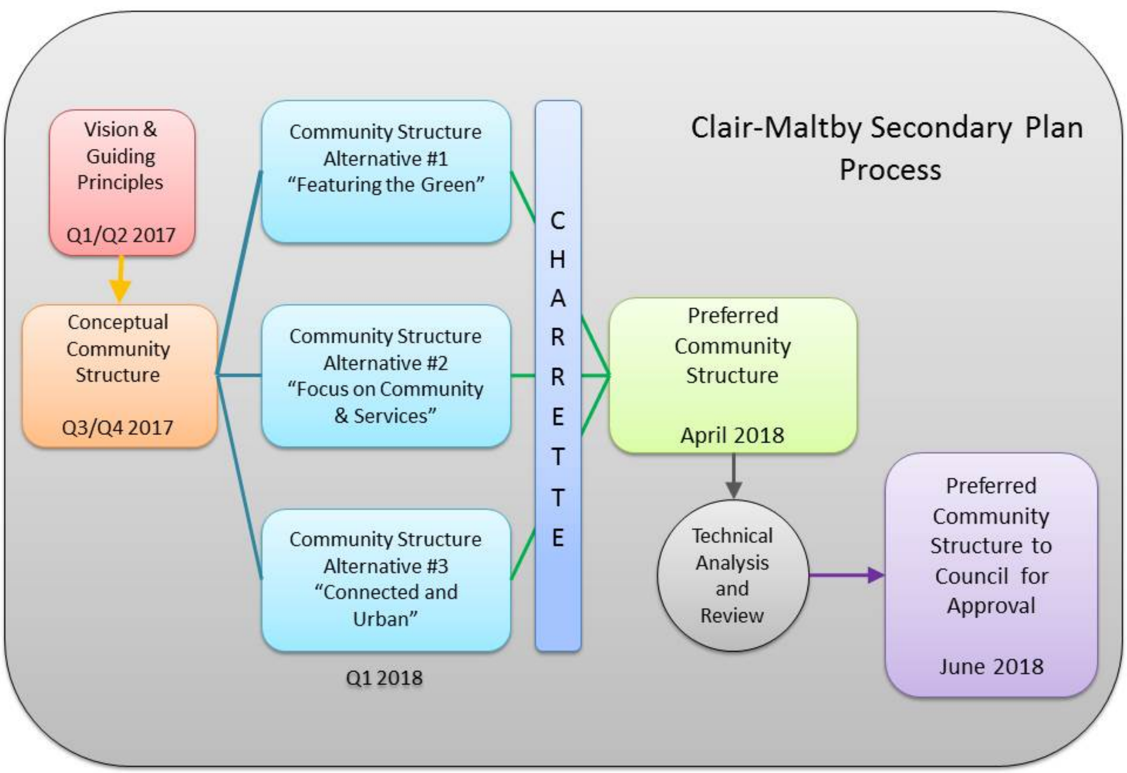
The conversion of the Clair-Maltby SPA to urban uses, from its current largely natural and agricultural state, brings forward the need for municipal services including potable water, wastewater collection/treatment, stormwater management and transportation facilities.

The Class EA master planning process adopted for the MESP, with support from the CEIS, ultimately establishes the preferred servicing and transportation solutions for the preferred Community Structure Plan (urban land use plan), which are to be compatible, and integrate with, the existing and refined natural heritage system, existing adjacent urban land uses and associated transportation and municipal servicing infrastructure.

1.4 Development of Preferred Community Structure/Public Consultation

As outlined in Figure 1.1, the process of establishing the preferred land uses for Clair-Maltby involved a number of concurrent studies and investigations. The initial preferred Conceptual Community Structure (urban land use plan) for Clair-Maltby was developed by the City through a highly consultative process, with input from government agencies, stakeholder groups, the public and the CEIS Team (ref. Figure 1.5). The following provides an overview of the steps taken to prepare the initial preferred Community Structure Plan.

Figure 1.5. Clair-Maltby Preferred Community Structure Development Process



In July 2017 the City established a *vision* and *guiding principles* for the Clair-Maltby community, as per the following:

Vision

Clair-Maltby will be a vibrant, urban community that is integrated with Guelph's southern neighbourhoods, as well as having strong connections to Downtown, employment areas and the rest of the City. The NHS and the Paris Moraine provide the framework for the balanced development of interconnected and sustainable neighbourhoods. This area will be primarily residential in character with a full range and mix of housing types and a variety of other uses that meet the needs of all residents. A system of parks, open spaces and trails will be interwoven throughout to provide opportunities for active and passive recreation.

Guiding Principles

Vibrant and Urban: Create identifiable urban neighbourhoods that are pedestrian oriented and human-scaled. Promote forward-thinking and innovative design that integrates new development into the rolling topography, while conserving significant cultural heritage resources.

Green and Resilient: Protect, maintain, restore, and where possible, improve water resources and the Natural Heritage System. Support resiliency and environmental sustainability through measures such as energy efficiency, water conservation and green infrastructure.

Healthy and Sustainable: Design the community for healthy, active living. Provide a mix of land uses including a diversity of housing choices at appropriate densities with appropriate municipal services to ensure long-term sustainable development which is fiscally responsible.

Interconnected and Interwoven: Establish a multi-modal mobility network that provides choice and connects neighbourhoods to each other and the rest of the City. Create a network of parks, open spaces, and trails to provide opportunities for active and passive recreation, as well as active transportation choices.

Balanced and Liveable: A valued and livable community which reflects the right balance between protecting the environment and fostering a healthy, equitable and complete community.

Conceptual Community Structure and Community Alternative Plans

The Conceptual Community Structure was developed and approved by Council December 2017 based on the Vision and Guiding Principles and was further developed into three Alternative Plans in early 2018 based on a focus of various community aspects and themes.

The first land use alternative (Featuring the Green), generally reflected the land uses with the high density and mixed uses focused on Gordon Street, medium density located along proposed collector and/or arterial roads and low density in the interior parts of the neighbourhoods. The roads were to be located beside the NHS in some locations with the right-of-way boulevard providing additional buffer to the NHS, and fewer connections through the NHS.

The second land use alternative (Focus on Community and Services) increased the area of medium density residential by reducing the areas of lower density residential and moved the southern east/west collector roadway to the south to allow for development on each side of the right-of-way. The Proposed Trail Network, east of Gordon Street was replaced with a Potential Active Transportation Link, increasing the width of the link through the NHS. The land use along the Gordon Street corridor was revised compared to the first Alternative to include additional mixed use.

The third land use alternative (Connected and Urban) provided additional connectivity by using south/north roadways through the NHS in two locations east of Gordon Street. In addition, high density residential land uses, replaced medium density in select locations compared to the second Alternative. The Gordon Street corridor land use was also revised to provide mixed use land uses centred around roadway intersections. The three initial land use alternatives are depicted in Figures 1.6 to 1.8.

Figure 1.6. Alternative 1: Featuring the Green

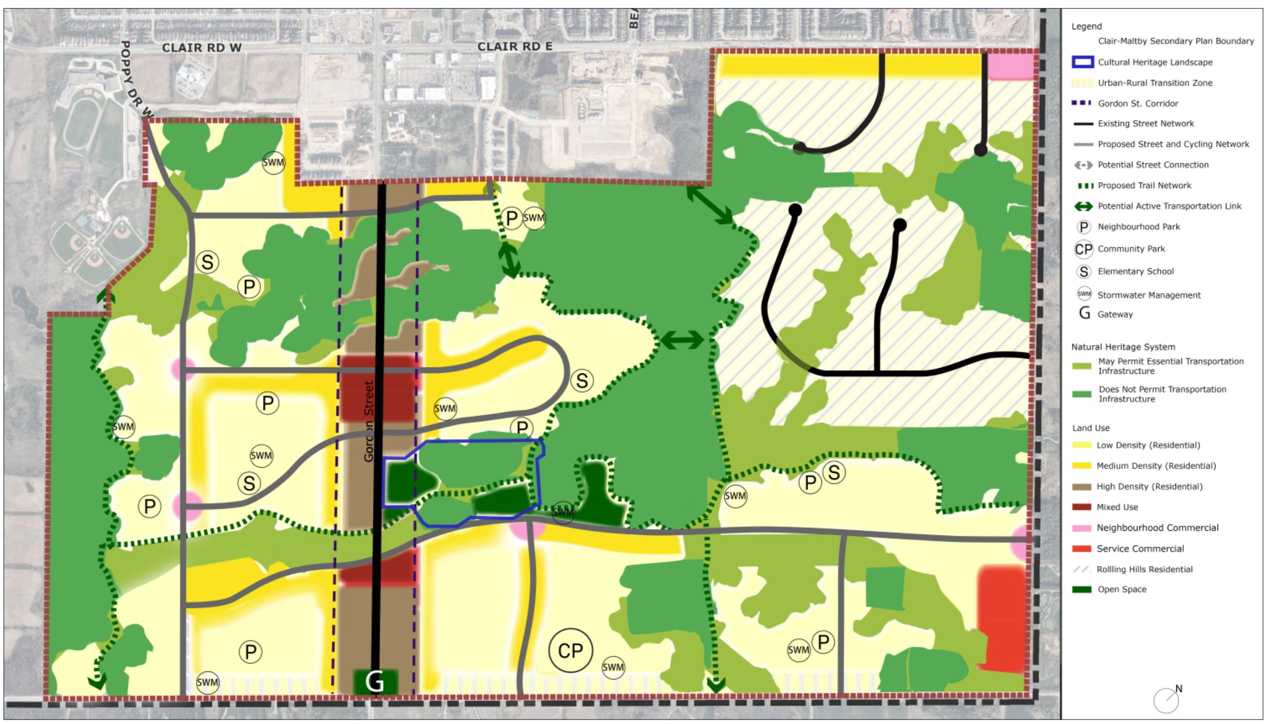


Figure 1.7. Alternative 2: Focus on Community and Services

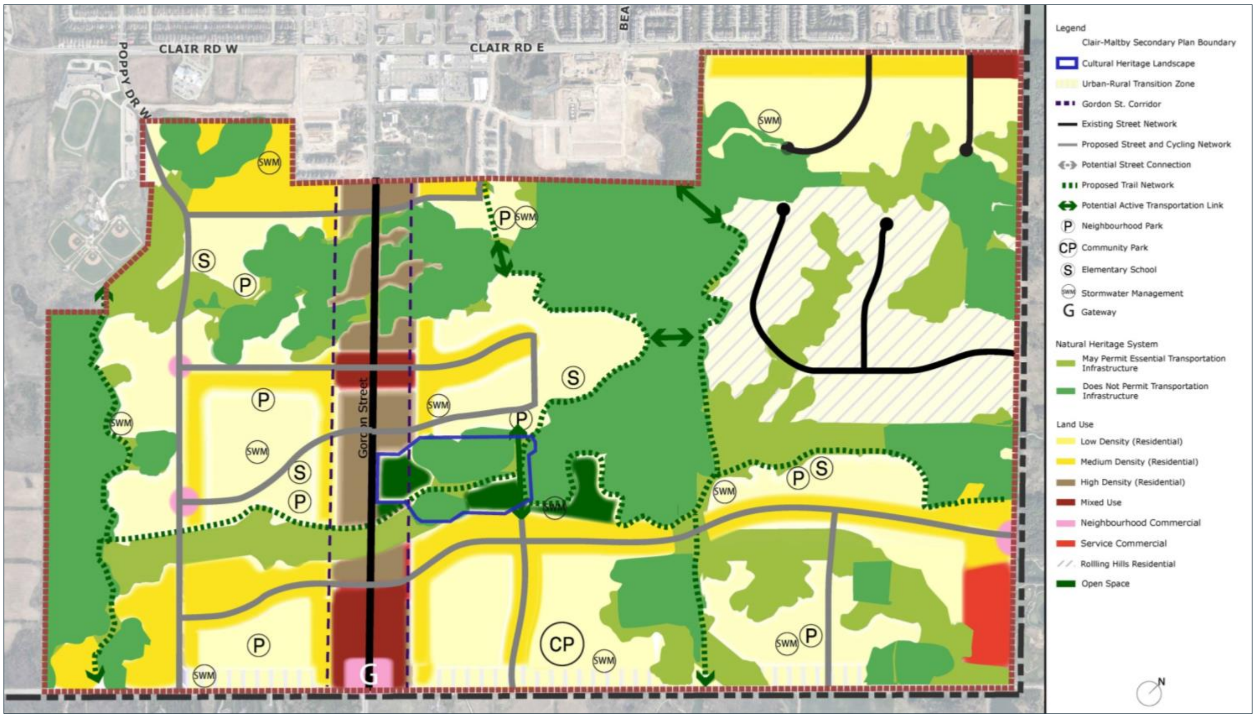
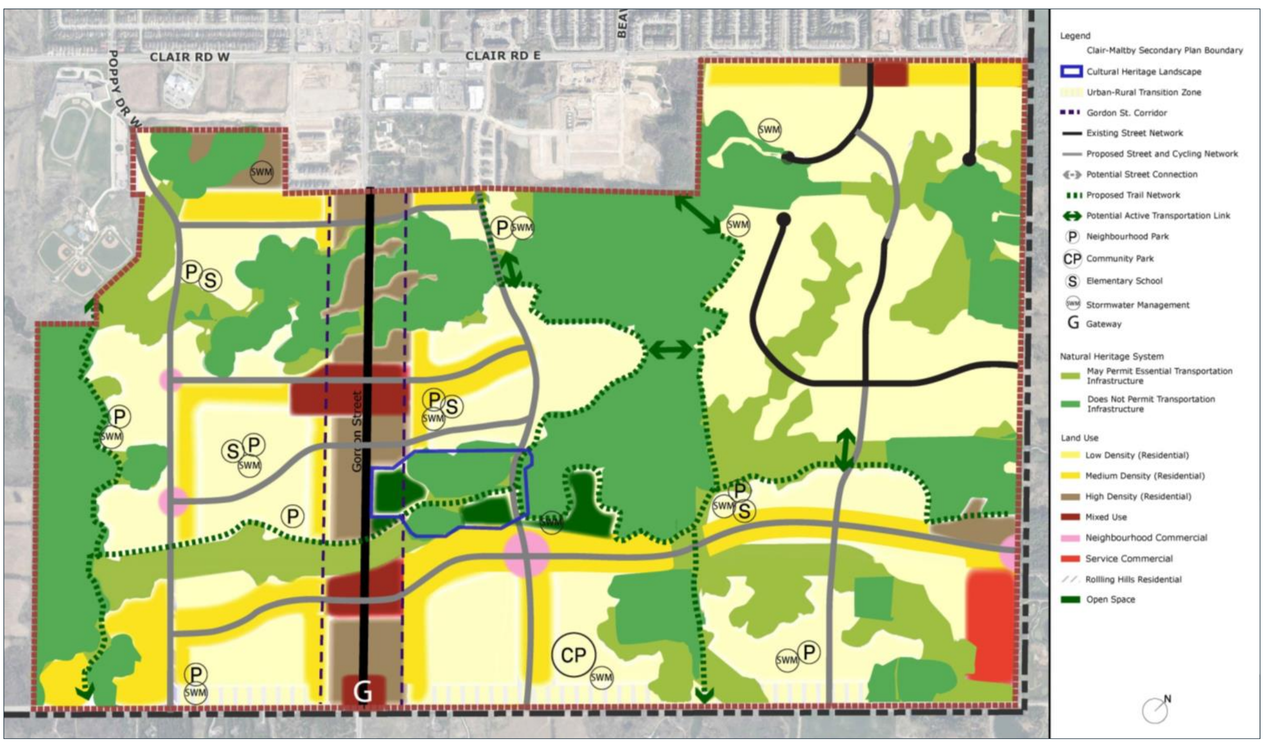


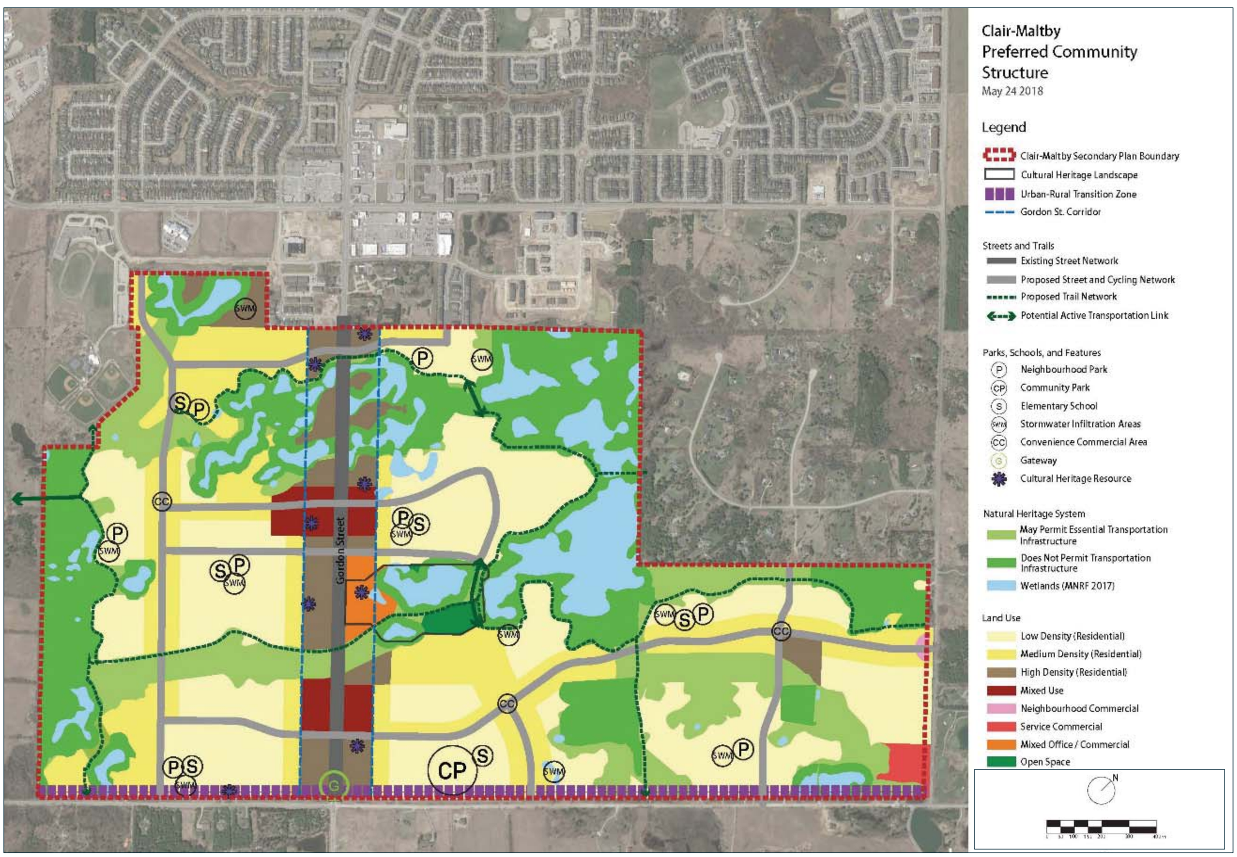
Figure 1.8. Alternative 3: Connected and Urban



Public Consultation

In April 2018, the City held a five-day planning and design charrette, which used collaborative design and planning workshops with stakeholders and the public to evaluate the three initial land use alternatives, known as the Community Structure Alternatives, leading to the Preliminary Preferred Community Structure for the SPA. At these sessions, the CEIS/MESP Team provided information from the CEIS on the environmental systems and also outlined preliminary concepts and principles for servicing, while the BA Group added insights associated with transportation needs. Subsequent to the design charrette, modifications were made to the Preliminary Preferred Community Structure, including removal of the Rolling Hills area from the SPA and other land use revisions, resulting in an initial Preferred Community Structure approved by Council in June 2018. The initial Preferred Community Structure which resulted from that process is depicted in Figure 1.9.

Figure 1.9. Initial Preferred Community Structure



Refinement of Preferred Community Structure

The initial Preferred Community Structure plan was then assessed at a high level in terms of its potential impacts on the social, natural, and economic environments. Based on the technical feedback from this integrated assessment (ref. March 2019 Preferred Community Structure Impact Assessment), and in response to comments from the public and stakeholders the City updated the initial Preferred Clair-Maltby

Community Structure. The Policy Directions Document, May 2019, provided several high-level directions for the revised Community Structure, which included the notable addition of the Moraine Ribbon.

The Updated Preferred Community Structure approved by Council in May 2019 conforms to the approved Vision and Guiding Principles for the Clair-Maltby Secondary Plan (CMSP) project; the updated plan is considered:

- Green and Resilient
- Healthy and Sustainable
- Vibrant and Urban
- Interconnected and Interwoven
- Balanced and Liveable

The Updated Preferred Community Structure continues to be primarily residential in character, with the ability to accommodate a full range and mix of housing types, as well as a mix of uses at key locations. A multi-modal mobility network, including major roads, bicycle infrastructure and trails, is planned to provide strong connectivity throughout the Clair-Maltby area and to the rest of the city. A connected system of parks, open spaces and trails are proposed to provide both active and passive recreation opportunities. The updated Preferred Community Structure creates a framework to enable carbon neutral policies to be developed for this area in line with the City's goal of being a Net Zero Carbon Community by 2050.

The Updated Preferred Community Structure also continues to put protection of the Paris Moraine and the city's natural heritage and water resources first.

As noted above, the updates to the Preferred Community Structure have been informed by detailed technical work, including data analysis and numerical modelling. The technical work and modelling completed as part of the CEIS has concluded that urban development, with appropriate and contemporary management practices in place, can occur in this area without negatively impacting the moraine, the NHS or the water resources system in the City or the Township of Puslinch. Further, the modelling confirms the City's previous understanding that the Paris Moraine is not a significant recharge area for the City's drinking water supply, however, it is an important recharge area for the local wetlands and headwaters of Hanlon Creek and Mill Creek, as noted in the Comprehensive Environmental Impact Study (CEIS) Phase 1 and Phase 2: Characterization Report, September 5, 2018.

The Updated Preferred Community Structure illustrates the conceptual location of the proposed Moraine Ribbon as part of the Open Space System in the CMSP area.

It was proposed that the Community Park be moved so that it nestles beside the southerly edge of Halls Pond and the surrounding NHS, although this location was again revised through the Open Space System Strategy (refer to Components of the Recommended Open Space System map approved by Council in May 2020). Figure 1.11 represents the Final Preferred Community Structure Plan.

In addition, the amount of medium density residential has been decreased in order to increase the amount of low-density residential areas. This has been done to improve the balanced mix of unit types to be provided within the CMSP area. The low-density residential land use is proposed to accommodate a range of 20 to 60 units per hectare. This range allows for most low-rise housing types and, therefore creates flexibility for development to respond to the changing needs of the community over the next 20 years and beyond. Notably, as it relates to water management, low density residential areas will have more pervious areas, allowing for more balanced opportunities for source infiltration, which will further assist in ensuring that development in this area will not impact the moraine, natural heritage or water resources.

The other changes within the Updated and Final Preferred Community Structures (ref. Figure 1.10 and Figure 1.11) include the following:

- The urban-rural transition zone has been extended along both Maltby Road and Victoria Road. The urban-rural transition will ensure that low-rise buildings are located in proximity to the surrounding rural area including the area shown as high density along Gordon Street at the entrance to the City;
- A high-density residential area just south of Poppy Drive has been changed to low density residential in order to assist with the mitigation of potential impacts to the wetland in that area;
- Stormwater capture areas have been shifted and modified as a result of more detailed analysis completed in the CEIS. The stormwater capture areas continue to be proposed to be co-located with parks and schools in most instances subject to detailed site-specific analysis at the time of development;
- Potential school and park locations have been shifted to remain co-located with stormwater capture areas; and,
- Conceptual road alignments have been modified in response to refinements to the NHS and stormwater capture area locations.

The Final Preferred Community Structure, May 2021, has been updated with minor changes, primarily the NHS boundaries have incurred minimal revisions, and one (1) north-south collector road alignment (road east of Gordon Road) has been slightly adjusted. Figure EX-6 presents the updated February 2022 Final Preferred Community Structure.

Assessment of each municipal service has been conducted using the updated Final Preferred Community Structure.

Figure 1.10. Updated Preferred Community Structure, May 2019

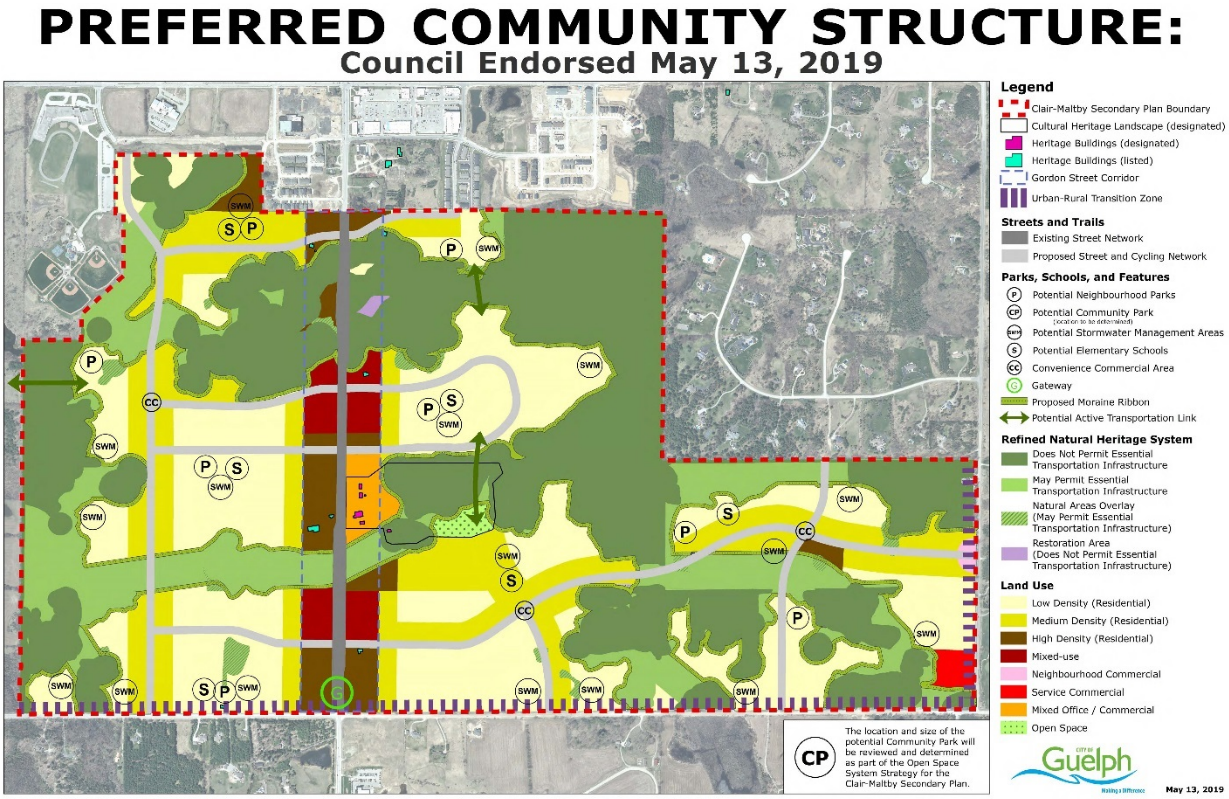


Figure 1.11. Final Preferred Community Structure, May 2021

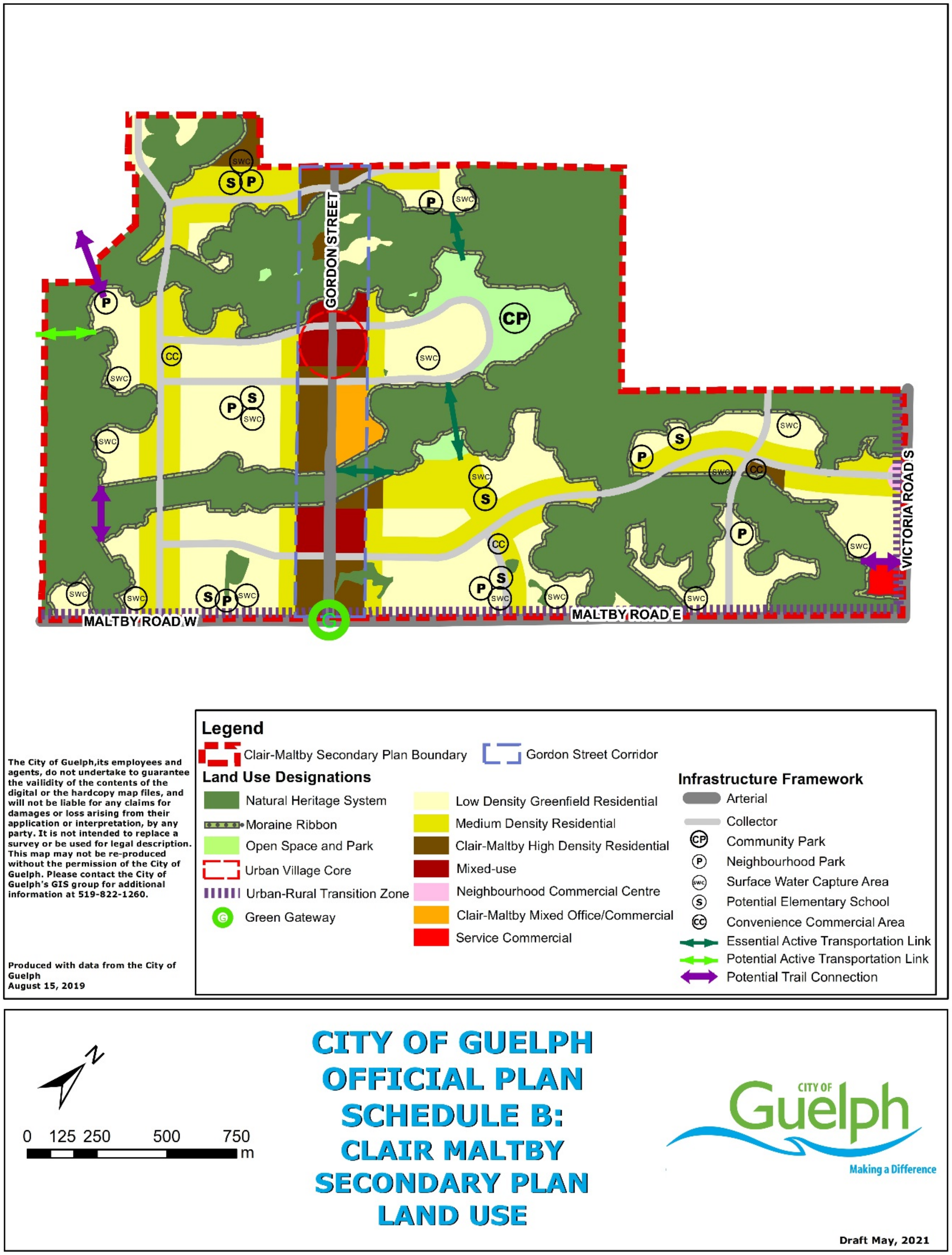
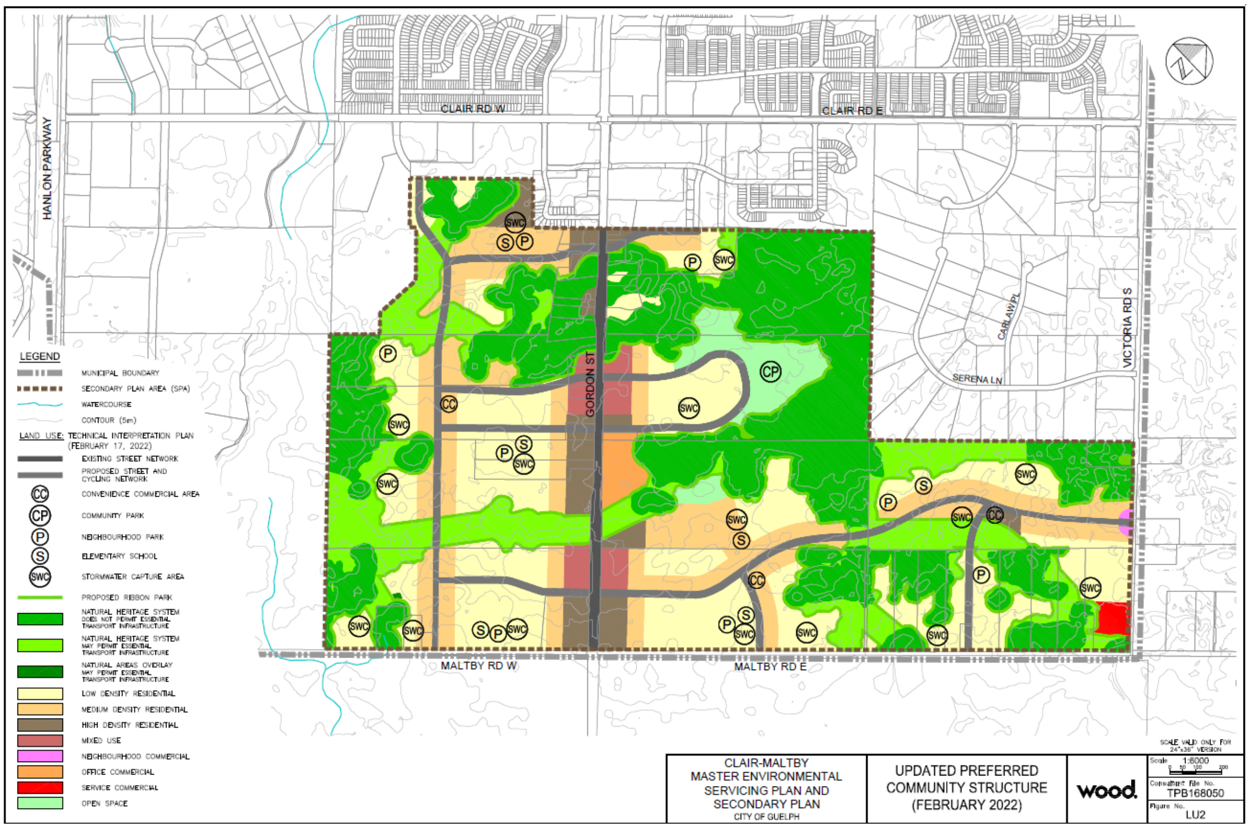


Figure 1.12. Updated Final Preferred Community Structure, February 2022



1.5 Consultation

1.5.1 Public Consultation

The City of Guelph has conducted a comprehensive public consultation process for the CMSP, which went beyond the April 2018, design charrette process, as outlined in Section 1.4 and consultation materials in Appendix E. The following provides a summary of the public engagement conducted for the future Clair-Maltby Community.

- August 2015: Open House held providing the process for developing and assessing the Clair-Maltby Secondary Plan. The open house also provided a high-level summary of existing conditions.
- May 2016: Meeting with property owners to establish access for monitoring and field work. Wood provided an overview of the CEIS Team, scope, including field monitoring requirements that could require property owner's permission.
- April 2017: Notice of Study Commencement and Public Information Centre (PIC) No.1 held to present initial existing condition findings of the CEIS and the MESP, Secondary Planning Process, and future Visioning Workshop. The Wood Team presented material to the public regarding the CEIS scope including assessments of the NHS, stormwater management alternatives and water and wastewater alternatives.

- April 2018: Community Structure Design Charrette held with the public. The Wood Team assisted the City during the Charette to provide insight into constraints and opportunities of each land use specifically related to the NHS, surface and groundwater systems and servicing requirements.
- September 2018: CEIS Characterization Report released. The Wood Team provided the existing conditions characterization of the Clair-Maltby SPA including surface water, groundwater and the NHS.
- September 2018: CEIS Characterization Presentation: A presentation was made to the public providing the findings of the Clair-Maltby SPA characterization.
- November 2018: Draft Direction Consultation Report released
- December 2018: Public Workshop held to discuss Secondary Plan Policy Directions
- March 2019: Public Information Session held to discuss protection of the moraine, water resources, and natural heritage resources
- May 2019: Policy Directions: Framework for Clair-Maltby Secondary Plan approved by Council
- September 2019: Workshop held to discuss parks and open spaces
- November 2019: Second workshop held to discuss parks and open spaces
- May 2020: Council approved the Parks and Open Space Strategy
- June 2021: release of draft Secondary Plan and supporting documents for public comment prior to the public open house and statutory public meeting
- June 2021: Public Information Session #3 was held to present the draft documents and collect feedback
- September 2021: Statutory Public Meeting
- May 2022: Council Decision Meeting

A detailed record of consultation with the public and private groups has been published within the Council Report and can be found here https://pub-guelph.escribemeetings.com/filestream.ashx?DocumentId=24690 (ref. Appendix E1).

1.5.2 Indigenous Engagement

The City has engaged with Indigenous Nations consistently throughout the process. Engagement occurred in the form of e-mail notifications, project updates, requests for comments, and meetings. The City of Guelph recognizes the Mississaugas of the Credit First Nation (MCFN) as the City's treaty partner. Guelph is located in Between the Lakes Treaty No. 3 Territory signed between the Crown and MCFN in 1792. The lands Guelph is located on are also directly adjacent to the Haldimand Tract. Six Nations of the Grand River Elected Council (SNGREC) also asserts treaty rights under the historic 1701 Nanfan Deed.

MCFN expressed interest in the wetlands and waterbodies on the site, protection of groundwater recharge systems, access to daycares, and support for Indigenous culture and heritage. Through written exchanges and meetings, the City was able to provide information to and answer questions by MCFN. A detailed record of consultation opportunities, discussions, questions and answers, meeting notes, and emails between the City and MCFN is included in Appendix E.2. The City is committed to engaging MCFN during future study and detailed design of specific projects in the MESP.

Engagement with the Six Nations of the Grand River was carried out through consultation with SNGREC Land and Resources department in recognition of SNGREC's sovereign, governmental representation of the Six Nations under Canada's Indian Act. Notably, given the City's location outside of the Haldimand Tract, Guelph is not in the catchment area of other notification and consultation protocols that are specific to the Haldimand Tract. SNGREC expressed interest in the Natural Heritage System, archaeological assessment, water features and groundwater, and future environmental study. They were also specifically interested in the Gordon Street Connection and how to remain involved in that study. The City committed to involving SNGREC in further study and detailed design works for this area, which will include the Schedule C EA required for Gordon Street and the overpass/underpass/at-grade connection. A detailed record of engagement opportunities, discussions, questions and answers, meeting notes, and emails between the City and SNGREC is included in Appendix E.2.

The Métis Nation of Ontario Region 9 Consultation Committee (MNO) expressed interest in how the Natural Heritage System, water system, and archaeological resources were being studied and protected during future development. Further detail on the ecological monitoring program, stormwater management system, and the mix of housing was provided during a meeting held on November 10, 2021. A detailed record of engagement opportunities, discussions, questions and answers, meeting notes, and emails between the City and MNO is included in Appendix E.2. The City is committed to keeping MNO informed during future study and detailed design of specific projects in the MESP.

1.5.3 Municipal Consultation

The City has consulted with the neighbouring Township of Puslinch regularly throughout the study. A record of presentations to Puslinch Council and letters between professional consultants can be found in Appendix E.3.

2 Natural Environment

The CEIS provides a detailed description of the NHS and water resources in the Clair-Maltby SPA and surrounding areas based on existing conditions. Key information from the CEIS Characterization assessment of the natural environment is summarized as follows to serve as a basis for evaluating the respective servicing alternatives related to the water, wastewater, stormwater, and mobility servicing.

2.1 General

The Clair-Maltby SPA includes portions of the Hanlon Creek, Mill Creek and Torrance Creek watersheds. The Hanlon Creek Watershed and the Mill Creek Watershed each cover almost half of the SPA, with the northeastern corner captured by the

Torrance Creek Watershed. The SPA contains a mix of cultural vegetation communities, natural forests and wetlands that support a range of significant species. This diversity of natural features and areas sits above the generally well-drained, hummocky topography of the Paris Moraine, which lacks open watercourse features, and instead drains to depressional features including Significant Wetlands, other Wetlands, Significant Woodlands and Cultural Woodlands.

2.2 Natural Heritage System

As part of Guelph's Natural Heritage Strategy, NHS mapping and policies were developed for the entire city, including the Clair-Maltby SPA. These NHS policies and maps were included in the City's updated Official Plan in 2010, refined through the Ontario Municipal Board process, and finalized in June 2014.

From a natural heritage perspective, the Clair-Maltby SPA is unique in the City because it is dominated by the Paris Moraine which has no watercourses and has highly hummocky topography that supports woodlands, wetlands and transitional habitats scattered amongst lands that are currently being farmed, as well as a few scattered residences and commercial buildings.

As part of the natural heritage work for the CEIS (as documented in annual Monitoring Reports (2016, 2017, 2018 and 2019) a Refined NHS has been determined consisting of the following components:

> Significant Natural Areas (including Significant habitat for Provincially Endangered and Threatened species; Surface Water Features and Fish Habitat (warm water) plus a 15 m minimum buffer; Provincially Significant Wetlands (PSWs) plus minimum 30 m buffer); Significant Woodlands plus minimum 10 m buffers; Significant Landform; Ecological Linkages; Confirmed Significant Wildlife Habitat (SWH); Restoration Areas; andNatural Areas (mapped as an Overlay) (including Other Wetlands plus a 15 m buffer; Candidate SWH; Cultural Woodlands plus minimum 10 m buffers; and Habitat of Significant Species)

The Phase 1 and 2 Characterization Reports prepared as part of the overall CEIS included a "Draft 1" refined NHS based on information collected through to the end of 2017 which was presented to the stakeholders in the spring of 2018. The first iteration of the Phase 3 CEIS reporting included the "Draft 2" refined NHS based on information collected through to the end of 2018. The Phase 3 CEIS included the final refined NHS being used as the primary development constraint for the Secondary Plan. The final refined NHS builds on the two Draft versions and includes some additional minor modifications based on input on the Draft 2 mapping from the City, GRCA, Technical Advisory Group, Technical Steering Committee, local landowners, and the community. The refined NHS for the Clair-Maltby SPA is indicated in Figure 2.1, with a comparison of the refined NHS to the OPA 42 Approved NHS in Figure 2.2.

Figure 2.1. Refined Natural Heritage System for Secondary Plan Area

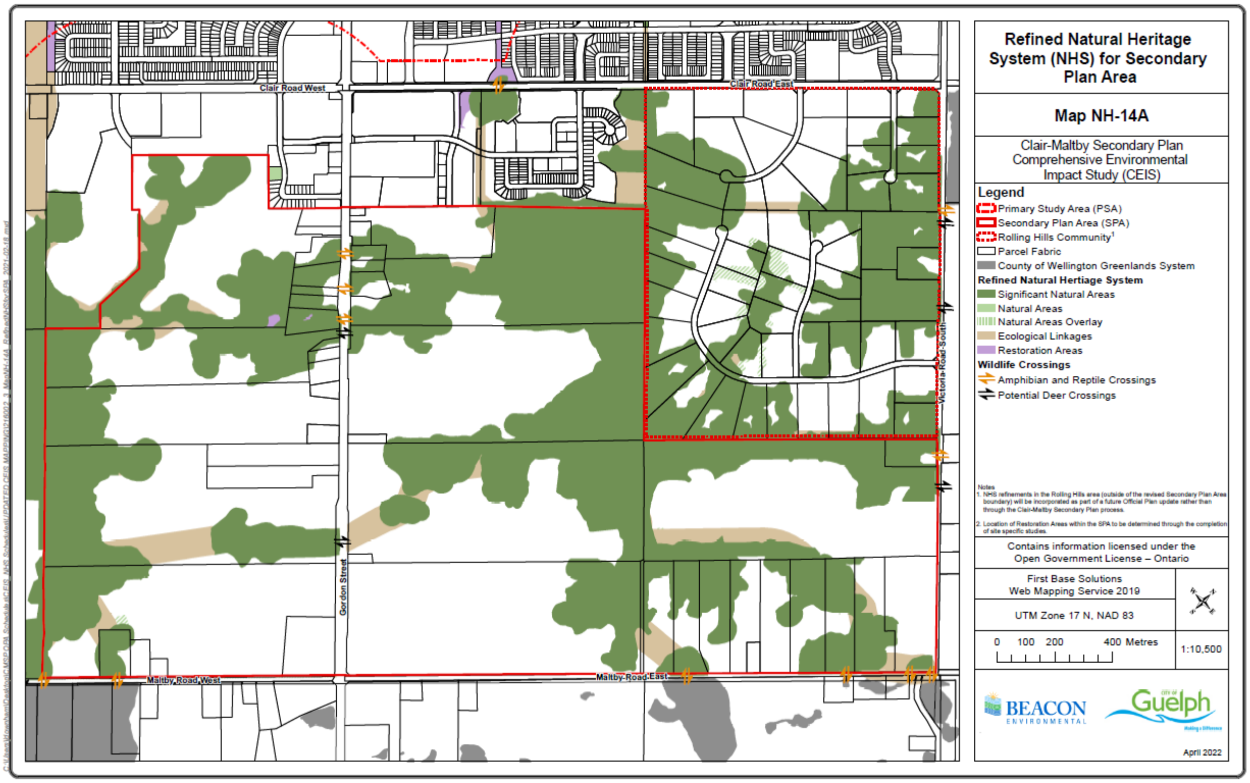
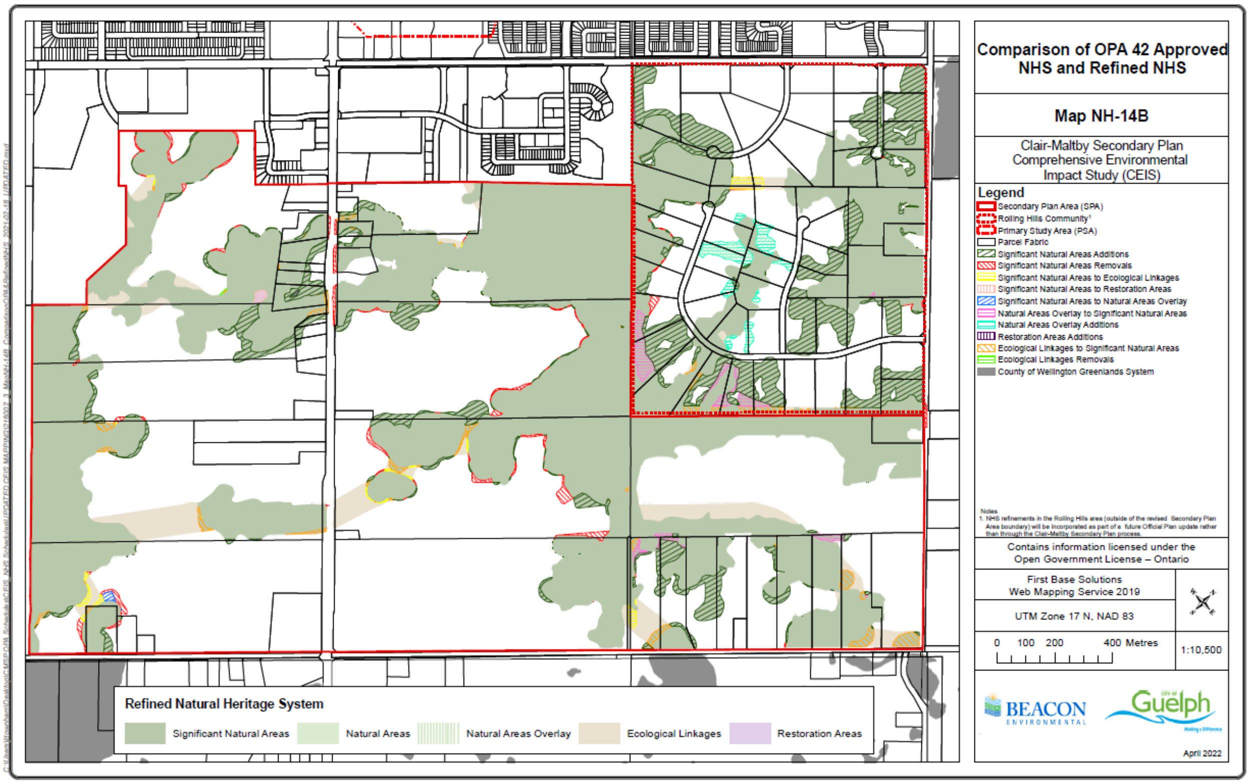


Figure 2.2. Comparison of OPA 42 to Refined Natural Heritage System for Secondary Plan Area



2.3 Water Resource System

As defined within City's OPA 80, water resource system means: "a system consisting of groundwater features and surface water features, and hydrologic functions, which provide the water resources to sustain healthy aquatic and terrestrial ecosystems and human water consumption. The water resource system is comprised of key hydrologic features and key hydrologic areas." As such, the water resource system is not confined to the PSA and extends into and beyond the SSA (ref. Figure 1.4).

The Secondary Plan Area (SPA) is predominantly within the Horseshoe Moraine physiographic region and transitions into the Guelph Drumlin Field to the north in proximity to Clair Road (Chapman and Putnam 1984). The physiographic region consists of rough, hummocky terrain and often steep, irregular slopes. Therefore, as noted earlier, streams and creeks are largely absent in the SPA reflecting the high infiltration capacity of the area (ref. Figure 2.3). The headwaters of Hanlon, Mill and Torrance Creek form on the north and south slopes of the moraine.

Surface Water:

Surface runoff is predominantly infiltrated or evaporated. The permeable nature of the surficial sediments, as well as the interconnected permeable properties of the overburden, allows for significant infiltration, subsequent recharge to the water table (overburden aquifer) and shallow and deep bedrock aquifers. Groundwater flow tends to radiate out from the SPA to contribute groundwater to the Mill Creek and Hanlon Creek subwatersheds (ref. Figure 2.3). In the broader SSA, each creek system annually infiltrates and evaporates 93 per cent to 98 per cent of the total precipitation, with Torrance Creek infiltrating the least, due to some existing development within its limits. The remaining surface water (not infiltrated or evaporated) ends up as limited discharge/ runoff from the system to each creek system.

Figure 2.3. Existing Drainage Boundaries

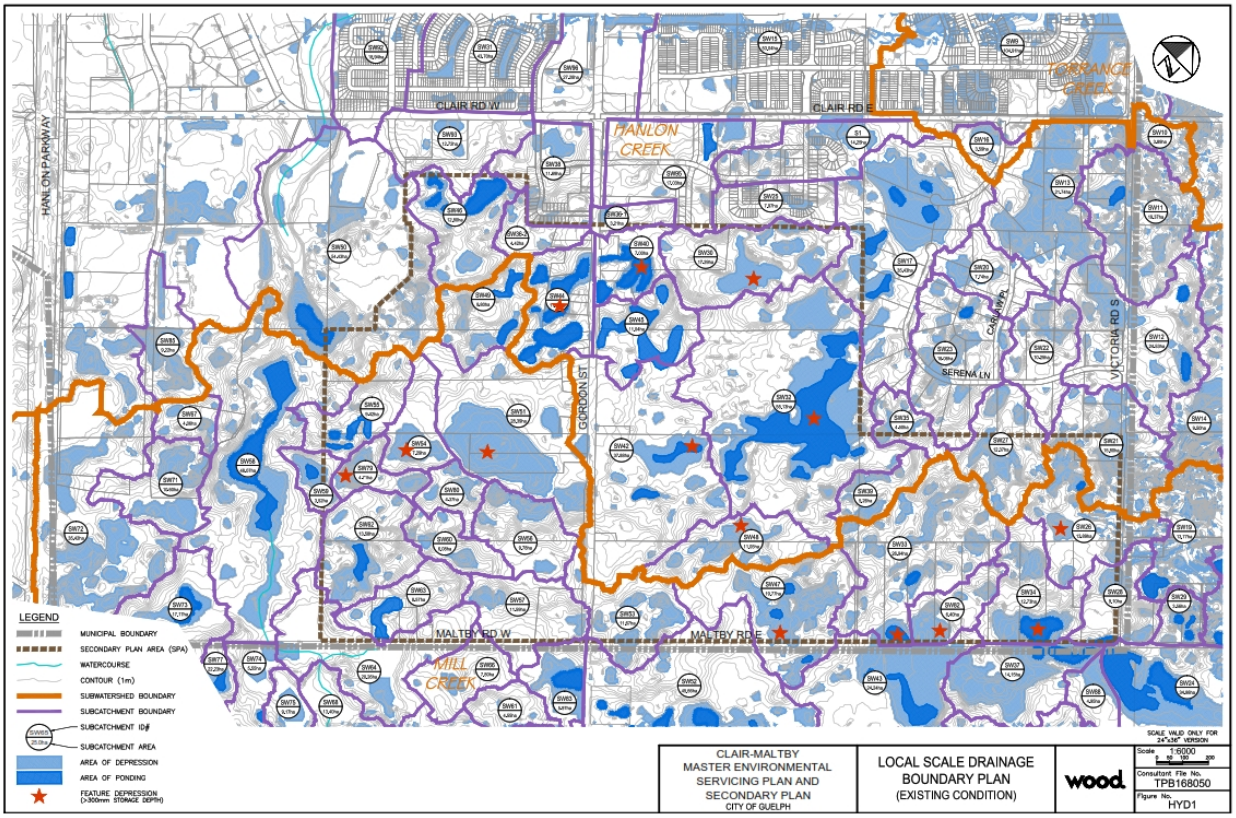
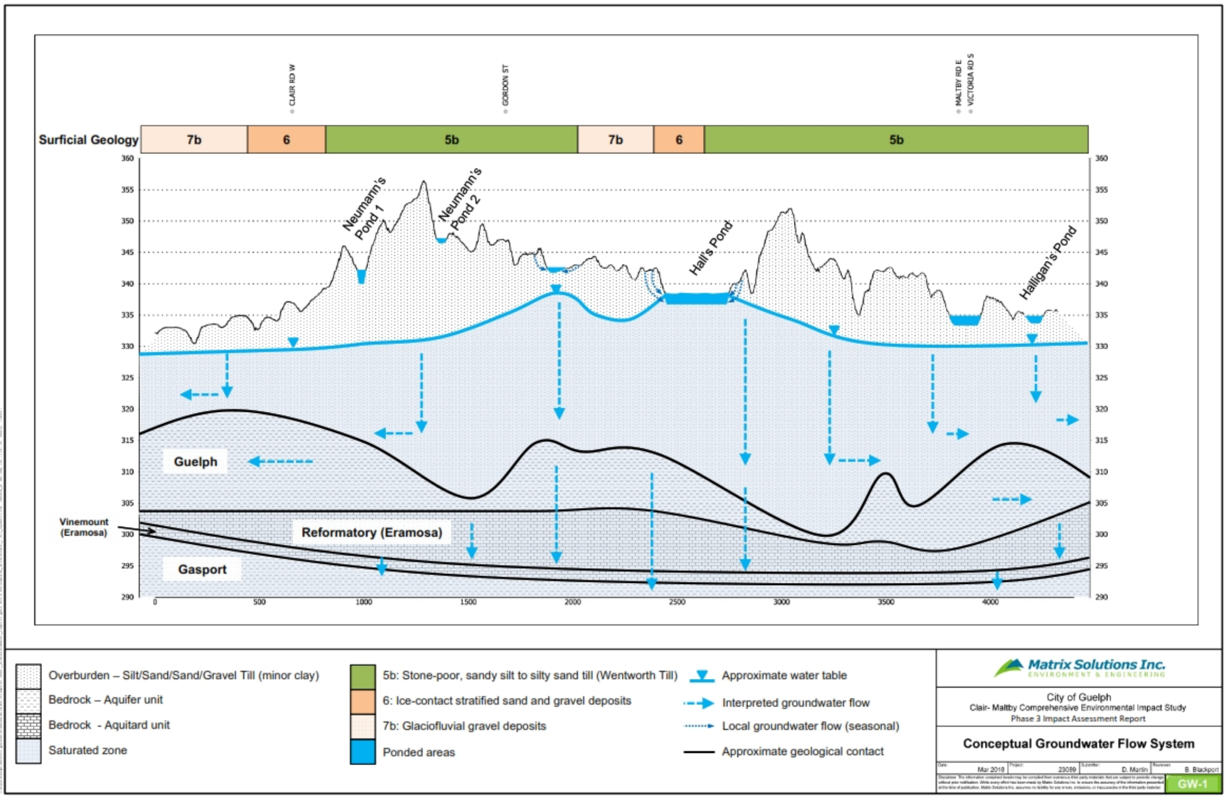


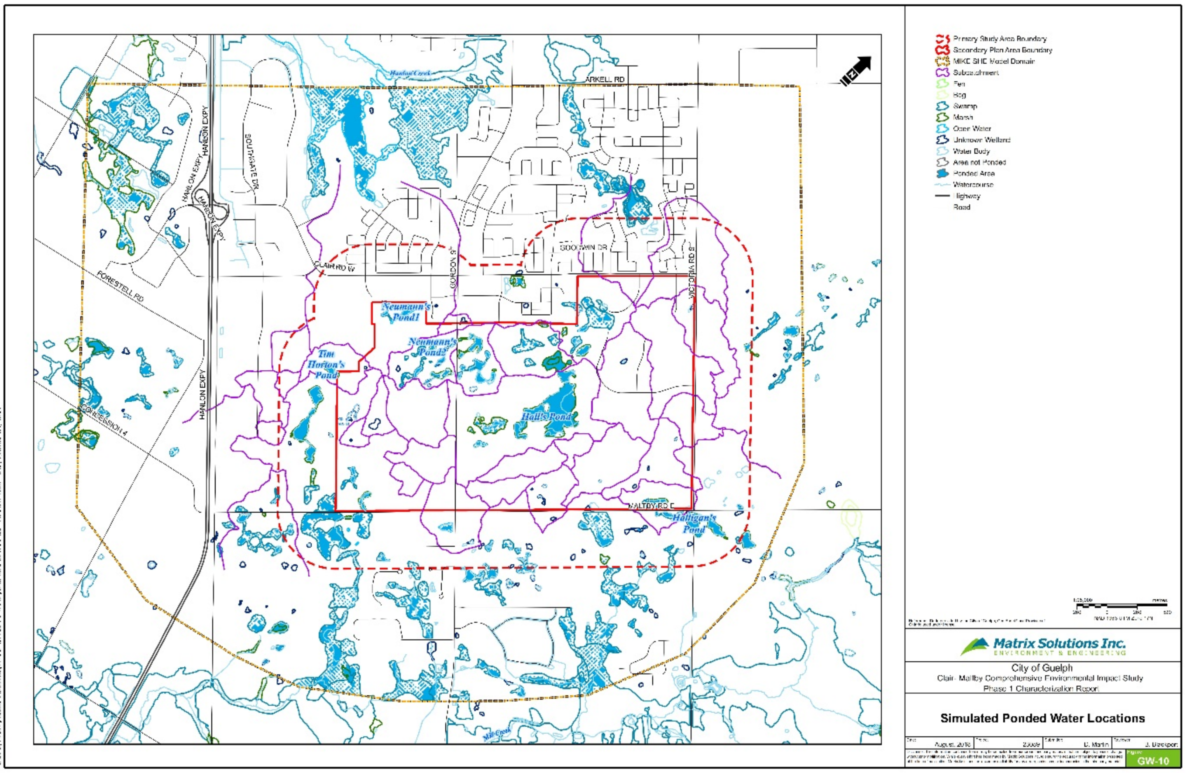
Figure 2.4. Existing Groundwater Flow System



Groundwater:

Groundwater flow radiates out from the SPA contributing groundwater to the Mill Creek, Torrance Creek and Hanlon Creek subwatersheds (ref. Figure 2.4). Water budget analyses of Neumann's Pond, Halls Pond and Halligan's Pond (ref. Figure 2.5) indicate that these features are predominantly maintained by direct precipitation and minor overland flow contributions which reflect the lower groundwater levels near these wetland features. Other perennial ponds in the area are typically perched and are predominantly surface runoff fed. Groundwater discharge to wetlands appears to be derived locally and during spring melt or longer-term precipitation events. Per Figure 2.4, wetlands within the SPA can exhibit perched conditions such as Neumann's Pond (i.e. unsaturated zone beneath the pond) or be connected to the water table such as Halls Pond, Halligan's Pond (i.e. saturated zone beneath the pond) and other wetland/pond features within the SPA (i.e. northwestern portion of SPA).

Figure 2.5.Existing Ponded Locations



Groundwater quality analyses have indicated that the overburden water consistently represents a calcium-magnesium carbonate system with no significant difference in most basic anions and cations between the shallow and deeper groundwater in the overburden monitoring wells. In addition, the basic anions and cations within the two Provincial Groundwater Monitoring Network (PGMN) bedrock wells appear to be like the overburden monitoring wells. Localized elevated levels of chloride and nitrate reflect potential quality degradation related to winter de-icing or agricultural applications.

Under existing conditions, there is limited groundwater quality protection within the overburden and shallow bedrock aquifers from potential contaminant sources, particularly related to those elements that are considered conservative (i.e. those that do not biodegrade or are not adsorbed such as chloride). The thick overburden and Vinemount bedrock aquitard provide greater protection for the deep bedrock aquifer (main source of municipal groundwater) by limiting the flux from the shallow to deep bedrock aquifer in the SPA).

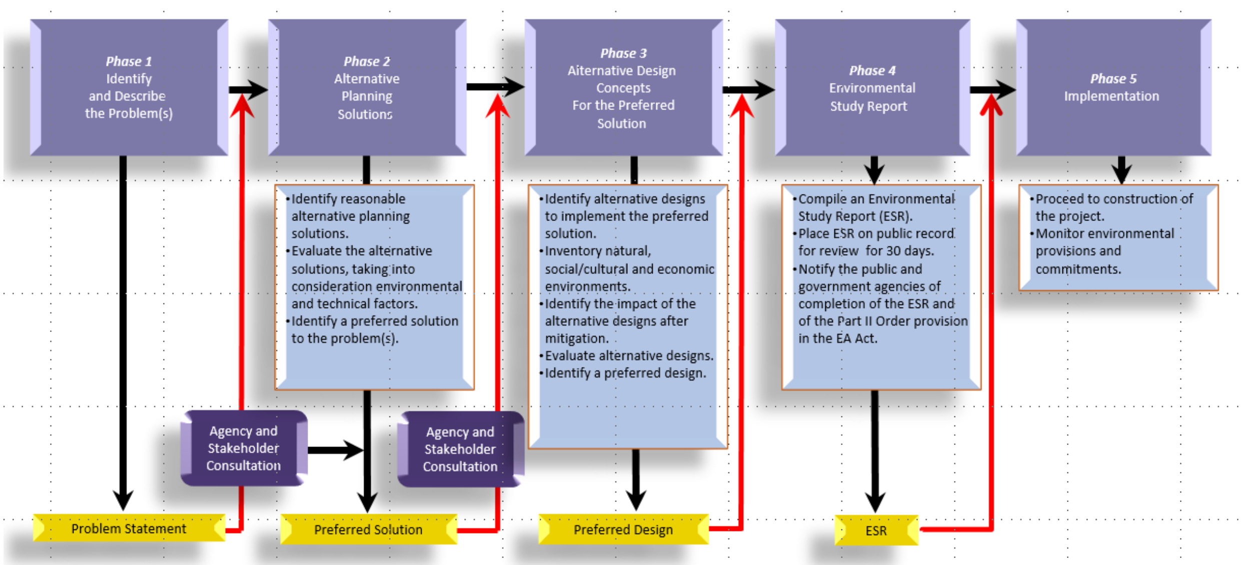
In addition, a portion of groundwater flow from the SPA within the City, flows south into the SSA (i.e. Mill Creek headwaters) in the Township of Puslinch. Shallow flow paths through the overburden and shallow bedrock aquifers contribute to the groundwater discharge and baseflow to the headwaters of Mill Creek. A number of private residential wells use these same aquifers as their source of water.

The recommended management practices, and monitoring and implementation requirements, set out in this MESP, consider the potential for impacts to the water resource system. Site-specific management practices, monitoring and implementation requirements will be further defined through future planning approval processes.

3 Servicing

The objective of the MESP, as outlined in the earlier Problem Statement is to establish water, wastewater and storm servicing and transportation solutions for the preferred Community Structure Plan, with consideration to the existing and recommended natural heritage systems, existing adjacent urban land uses and associated existing transportation and municipal servicing infrastructure. The following sections provide details of the respective water, wastewater and storm servicing and transportation assessments conducted in accordance with the provisions of the MEA Class EA process (ref. Municipal Engineers Association Municipal Class Environmental Assessment document October 2000, as amended 2007, 2011 and 2015). The MESP addresses Phases 1 and 2 of the MEA Class EA Process (ref. Figure 3.1), with the servicing needs for the Preferred Community Structure determined in Phase 1 and servicing alternatives identified and selected in Phase 2.

Figure 3.1. MEA Class EA Process



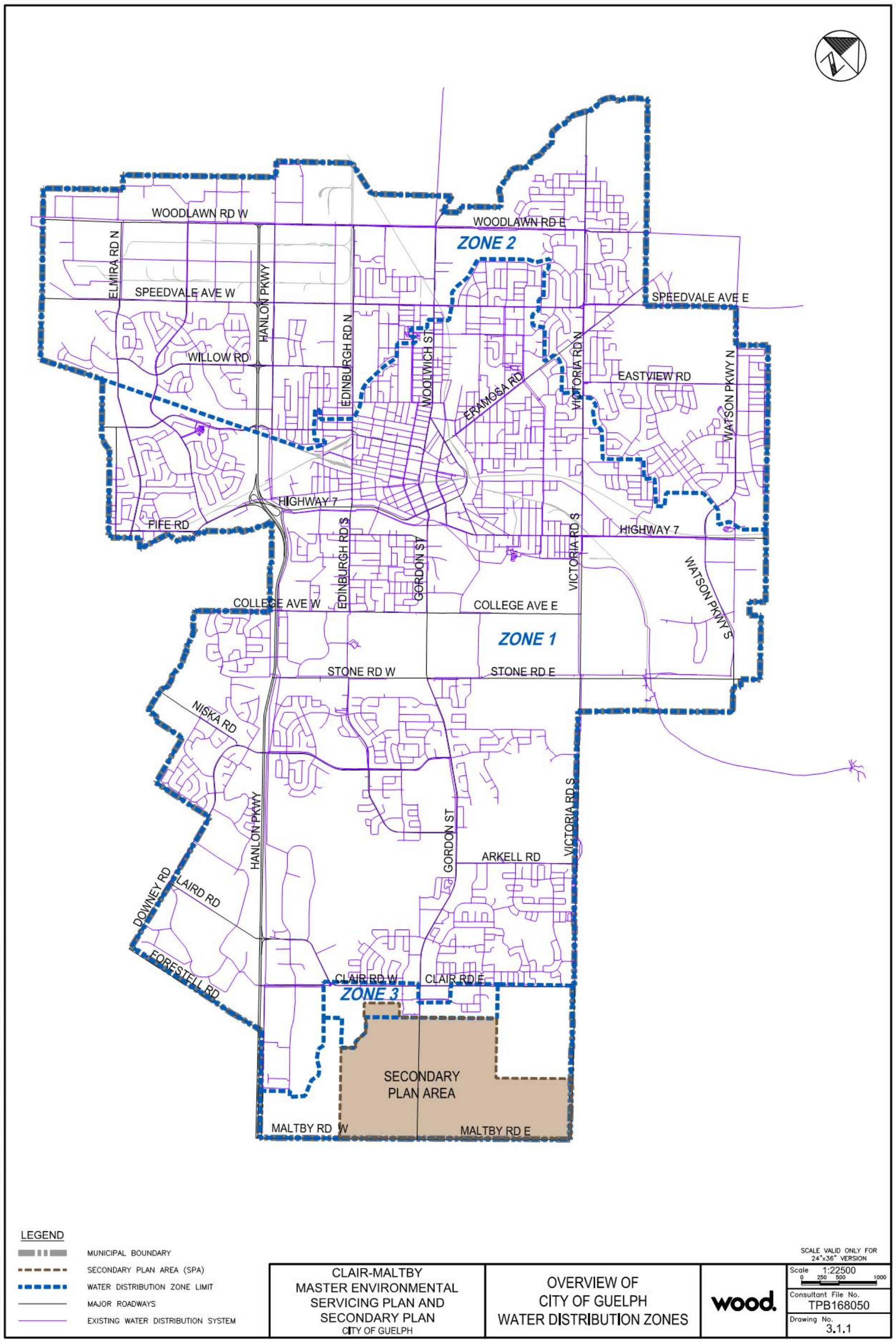
Each servicing section has been largely structured in a common approach providing details of the existing system, governing policies and criteria, outlining future needs and demands, per the Clair-Maltby Community Structure and offering a suite of alternatives, assessment criteria and ultimately the preferred solutions.

3.1 Water

3.1.1 Existing Conditions

The City of Guelph's water distribution system is shown in Figure 3.1.1.

Figure 3.1.1. Overview of City of Guelph Water Distribution System



To establish the preliminary servicing requirements for the CMSP lands, and to aid with the hydraulic analysis, the City provided a working water model for the entire City. This water model was used to size the servicing infrastructure at a planning level and establish the pressures for various servicing scenarios. The City's water model was also used to estimate available fire flows at various locations. The City's hydraulic water model is deemed to be sufficiently calibrated to determine the boundary conditions for the existing and baseline network.

The CMSP lands are primarily rural and agricultural in nature and according to Ministry of Environment Well Records, the lands contain in excess of 60 private water wells.

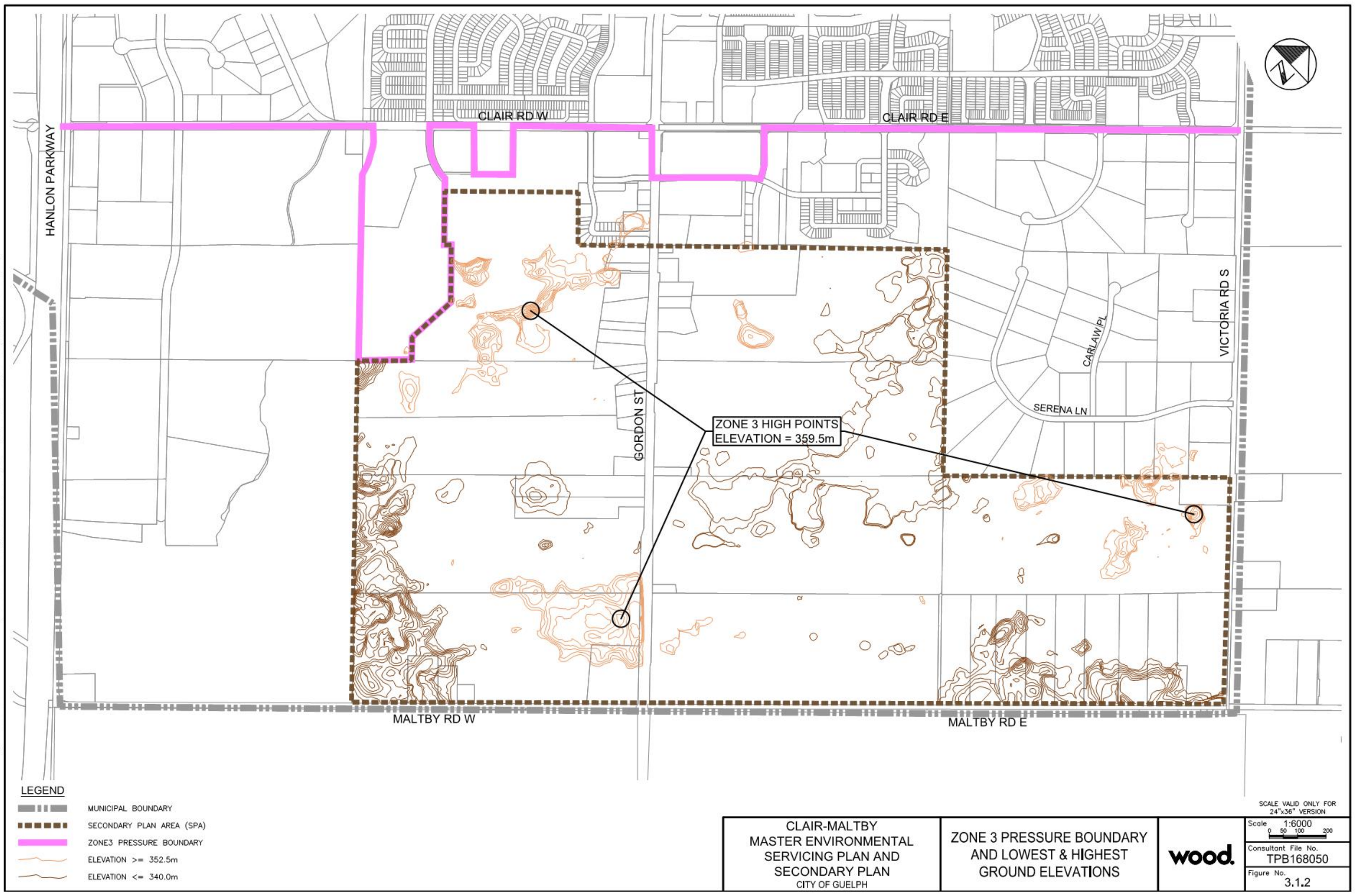
The CMSP lands are higher in elevation than much of the rest of the City. The City's water distribution system is currently being expanded in the south side of Guelph through a new pressure zone (Zone 3) that will operate at elevations that are suitable for the CMSP Lands. Zone 3 is now live with pumping into the zone, however as demand increases in its service area, it will require storage to meet mandated operating requirements. As such, a new storage tank must be considered to meet the water distribution demands for Zone 3. An evaluation of the pros and cons of an elevated tank versus an in-ground storage tank must be also carried out in order to make a recommendation on the most suitable storage system to meet the needs of the CMSP lands.

The Clair Road Booster Pumping Station (BPS) was constructed in 2012 to service new development areas consistent with the CMSP lands, as a part of Zone 3 development. The Clair Road BPS increases water pressures from a Zone 1 Hydraulic Grade Line (HGL) of approximately 377 m to the proposed Zone 3 HGL of approximately 400 m (Zone 3 Commissioning Plan). The Zone 3 boundary is shown in Figure 3.1.2. This proposed HGL for Zone 3 will provide customers in that area with pressures between 40 - 100 psi (275 - 690 KPa) consistent with Ministry of the Environment, Conservation and Parks (MECP) guidelines.

As the CMSP lands are expected to have planned growth in phases over an extended period of time, consideration should be provided to adjusting the hydraulic grade line (HGL) as the growth progresses. During the initial stages of development, when the hydraulic head loss is relatively low, a Top Water Level (TWL) of the elevated Zone 3 Reservoir can be less than 400 m to provide adequate residual pressure to the area's residents. The TWL of the Zone 3 reservoir could be brought up as development in CMSP lands progresses to account for additional hydraulic head loss, over time. This approach could result in savings in pumping costs until full buildout, as presented in the energy efficiency study as part of the Clair Booster Pumping Station and Zone 3 Commissioning Plan carried out by the City in 2016. See Appendix A- Water, for Water Model output.

Currently, if the existing Clair Rd Booster Station is offline for any prolonged time for maintenance or other needs, the Zone 3 system is reliant on watermains from Zone 1 via three (3) check valves on the Zone 1/ Zone 3 border. This circumstance has been shown to result in limited pressures (20-40 psi) and poses a fire flow/service risk for the area. Regardless of the water servicing alternative selected, an inline booster station to provide system redundancy is recommended until the Zone 3 storage can be constructed.

Figure 3.1.2. Zone 3 Pressure Boundary and Highest Ground Elevations



Based on current planning level information, the proposed CMSP developable lands are expected to be graded between 331.5 to 357.5 m, which is considered suitable for this area. These grades are consistent with the proposed grading to provide stormwater servicing (ref. Section 3.3). Note that low areas below 340 mASL may require pressure reducing components and associated plumbing systems. An assessment of the pressures and elevations within Zone 3 is presented in Table 3.1.1.

Table 3.1.1. Zone 3 Pressures/Elevations

Descriptor	Required (MECP)	Preferred
Minimum Operating Pressure	40 psi / 275 kPa / 28.0 m	50 psi / 340 kPa /35.0 m
Maximum Operating Pressure	100 psi / 690 kPa / 70.0 m	80 psi / 550 kPa / 56.0 m
Minimum Suitable Ground Service Elevation	330.0 mASL	344.0 mASL
Maximum Suitable Ground Service Elevation	360.0 mASL	353.0 mASL
Minimum HGL	388 mASL	388 mASL
Maximum HGL	400 mASL	400 mASL

3.1.2 Criteria/Standards/Policy

A review of the policies, standards, and criteria as it relates to the water supply and distribution systems was undertaken and is presented in the following. This would serve as the basis for further analysis, hydraulic modelling, and preliminary sizing of the water infrastructure for the CMSP lands.

3.1.2.1 Water Demand Estimates

The water demands in this planning process are described as "Average Day Demand", "Maximum Day Demand", "Peak Hour Demand", and "Fire Demand".

Average Day Demand (ADD): refers to the average daily demand observed in a system in a given year. The City of Guelph has a modelled average day demand for an existing condition (2018 scenario) and a projected future 2032 scenario. The 2032 average day demand scenario has been modified in Section 3.1.3 to reflect the planning framework for the Clair-Maltby Secondary Plan Lands as described in Section 1.

Maximum Day Demand (MDD): refers to the highest daily demand observed in a system in a given year. City of Guelph has a modelled max day demand for an existing condition (2018 scenario) and a projected future 2032 scenario. The 2032 Max Day Demand scenario has been modified in Section 3.1.3 to reflect the planning framework for the Clair-Maltby Secondary Plan Lands as described in Section 1. In the previous studies undertaken by the City, specifically, the 2016 Water Efficiency Study and the 2014 Water Supply Master Plan update, a Max Day Demand (MDD) factor of 1.5 was used. In order to be consistent and as discussed with the City, a MDD factor of 1.5 has been applied in the current analysis.

Peak Hour Demand (PHD): refers to the highest hourly demand observed in a system in a given day. The City of Guelph has a modelled peak hour demand for an existing condition (2018 scenario) and a projected future 2032 scenario. The 2032 Peak Hour Demand scenario has been modified in Section 3.1.3 to reflect the planning framework for the Clair-Maltby Secondary Plan Lands as described in Section 1.

Fire Demand and Available Fire Flow: The fire demand criterion can be described in two ways, *building-specific* fire demand criterion, and *urban network* fire demand criterion. In the building specific context, the fire demand typically refers to the protection needs of a given building, as estimated by the Fire Underwriters' Survey (FUS) method. In the urban network context, fire demand is typically estimated based on the service population of a given distribution system or pressure zone. The MECP guidelines (ref. MECP Design Guidelines for Drinking-Water Systems, Chapter 8) have a population-based fire demand. Available fire flow refers to the amount of flow a network can deliver to a single point in the network without going below 140 KPa (X psi). The available fire flow typically does not consider the restrictions through a hydrant, (i.e. in order to draw the available fire flow at a given point), as there may need to be multiple hydrants.

3.1.2.2 Water Operating Pressures

Normal Operating Pressures

The MECP guidelines require water distribution systems to operate, under normal operating conditions (Peak Hourly, Average Day, and Max Day), within the following pressure range:

- 275 - 690 KPa (40 -100 psi)

Typically, municipalities operate pressure zones within a preferred operating range per the following:

- 350 - 550 KPa (50 - 80 psi)

Fire Flow Conditions

Under fire flow conditions, the MECP guidelines require system pressure to be greater than 140 KPa (20 psi) in the vicinity of the point in the network where fire flow is drawn. Fire flow conditions are evaluated with Max Day Demand background demands in the system.

3.1.2.3 Pipe Network

Head losses in the piped system are a function of the network conditions, specifically related to pipe inside diameters, pipe lengths, inside wall smoothness, network configuration, valving, bends, and restrictions. The Hazen Williams friction loss method is the basis commonly used for determining and solving pressure conditions within the network.

For the new water servicing for the future Clair-Maltby area, the pipe servicing has been connected to the City model. For these new pipes, it has been assumed that nominal diameter is equal to inside diameter, and Hazen-Williams C factors used were dependent on diameters as stipulated in MECP guidelines as indicated below:

Diameter – Nominal	C-Factor
150 mm (6 in)	100
200 mm 250 mm (8 to 10 in)	110
300 mm 600 mm (12 to 24 in)	120
Over 600 mm (over 24 in)	130

Pumping Stations

Water pumping systems are designed with multiple pumps to meet a firm capacity. The firm capacity of a pumping station which supplies a pressure zone with adequate floating[2] storage available for fire protection and balancing, is defined as the system flow rate with the largest capacity pump out-of-service. For a pump station which serves a pressure zone that does not have adequate floating storage, the firm capacity is defined by two of the largest capacity pumps out-of-service.

The use of firm capacity introduces a safety/redundancy factor in the case of a pump needing to be taken out for maintenance or if a pump breaks down.

3.1.2.4 Zone Storage Requirements

Every municipality needs a ready source of water and a means to store this water for future use. Water supply flow rates never exactly match water usage rates. During periods of excess inflow, unused water needs to be conveniently and safely stored for use during peak demand times or for emergencies such as fires. Storage tanks and reservoirs are used to provide potable water storage capacity to meet fluctuations in demand, to provide reserve supply for firefighting use and emergency needs, to stabilize pressures in the distribution system, to increase operating convenience and provide flexibility in pumping, to provide water during source or pump failures, and to blend different water sources.

Water storage planning needs to consider the MECP's Design Guidelines for Drinking Water Systems (ref. Section 8.4.2), where:

Total Treated Water Storage Requirement = A + B + C, where:

- A = Fire Storage:
  - Evaluated as the volume from MECP Table 8-1: Fire Flow Requirements via suggested flow rate x duration.
- B = Equalization Storage (25 per cent of maximum day demand):
  - Max Day Demand, per capita consumption rates, and Max Day demand factors will be evaluated based on historical demands and updated on an annual basis to determine system requirements. Growth will be evaluated based on per capita unit consumption rates observed in the Clair-Maltby distribution system.
- C = Emergency Storage (25 per cent of A + B):
  - Emergency storage is evaluated as a function of the needs identified in A and B.

[2] Floating Storage refers to water that is stored at an elevation range that coincides with the pressure requirements of a distribution zone and does not require pumping to be distributed to the zone

The fire flow requirements can be based on:

- the MECP guidelines, which are based on a combination of the equivalent population, as well as suggested fire flow requirements;
- Fire Underwriters Survey (FUS);
- City's specific guidelines in the Guelph Master Servicing Plan, 2008, mentioned below.

Fire flow guidelines are provided in the Guelph Master Servicing Plan, 2008. This document is understood (based on consultation with City staff) to be approved as a guideline for planning the water infrastructure within the City. Based on the proposed development within the CMSP lands, the maximum fire flow is to be determined based on the commercial building guideline, which is 267 L/s for 3.5 hours. While the lands will be primarily residential in nature, the highest fire flow demand will be the commercial development.

3.1.2.5 Demand Estimation

Based on the land use information provided August 2019, the total CMSP population is estimated to be 23,759. This includes a projected residential population of 23,135, and an employment equivalent of 624. This population projection is exclusively for the CMSP lands and does not include any additional lands outside the CMSP boundary, which may develop or intensify.

Typically, storage needs are calculated to meet the requirements of the entire distribution zone, rather than for a single development area. At this time, the ultimate planning population for entire Zone 3, is not known. Based on discussions with the City, it is also understood that the Zone 3 requirements can be met in part by the Zone 1 pumps, at Clair Rd if required. Currently, the spare capacity of Zone 1 pumps to meet Zone 3 requirements is not known. As such, to account for the potential for development outside of the CMSP lands, 15 per cent of the projected population for CMSP lands, (i.e., a total population equivalent of 3,565) has been included for planning purposes, over and above the estimated population of 23,759. A similar ratio between residential and non-residential population has been assumed for the additional population of 3,565 (Residential population = 3,471, and non-residential population equivalent =94). This would provide a total planning population of 27,324, for the servicing assessment.

The per capital demand factors utilized in this study are as follows:

- Residential 180 L/ca/d
- Non-residential 286 L/ca/d
- Non-revenue Water 43 L/ca/d

In addition, a Max Day Demand (MDD) factor of 1.5 has been applied. These are based on the 2016 Water Efficiency Study and the 2014 Water Supply Master Plan update.

For the Clair-Maltby SPA, the total projected population equivalent of 27,324, includes a residential population of 26,606 persons and a non-residential population equivalent of 718 persons, the average day and max day demands are as follows:

- Average Day Demand (ADD) 6.2 ML/d
  - (180 L/ca/d X 26,606 + 286 L/ca/d X 718 + 43 L/ca/d X 27,324)/10^6
- Max Day Demand (MDD) 9.3 ML/d
  - ADD x PF (1.5)

3.1.2.6 Zone 3 Fire Flow and Storage Requirements

The MECP fire flow guidelines reference the latest edition of the "Water Supply for Public Fire Protection" published by the Fire Underwriters Survey and provide a suggested fire flow requirement for small municipalities of 318L/s for 5 hours for an equivalent population of 27,000.

The application of the suggested requirements results in higher volumes than are typically implemented, especially when a zone relies on elevated tank storage. The reduced storage can be rationalized in combination with often redundant supply elements, including multiple supply sources, backup power, and pump capacities.

Fire flow guidelines are provided in the Guelph Master Servicing Plan, 2008. As noted earlier, this document is approved as a guideline for planning the water infrastructure within the City. Based on the proposed development within the CMSP lands, the maximum fire flow is determined based on the commercial building guideline, which is 267 L/s for 3.5 hours.

Based on an assumed Zone 3 total population of 27,324 (Residential and Non-Residential), and an elevated storage component sized for a fire flow of 267 L/s for 3.5 hours, the elevated storage requirement is established as approximately 7.1 ML. This calculation assumes that 100 per cent of the volume would be supplied by the distribution system feeding Zone 3. However as previously discussed, based on discussions with the City, Zone 3 demands can be provided in part by Zone 1. It is understood from City staff that 50 percent of the fire flows for Zone 3 can be met by Zone 1. This assumption will be confirmed through the City's overall Water and Wastewater Servicing Master Plan, where it can be examined as part of a holistic assessment of needs across the whole City. Therefore, if 50 percent of the Zone 3 demands are assumed to be provided by Zone 1, the elevated storage requirement for Zone 3 would be approximately 5.0 ML.

Table 3.1.2. Estimated Storage Requirements

Descriptor	Storage (50 per cent $Q_{fireMECP}$)	Storage (100 per cent $Q_{fireMECP}$)
Residential Population	26,606	26,606
Non-residential Population Equivalent	718	718
Average Day Demand Factor (Residential)	180 L/ca/d	180 L/ca/d
Average Day Demand Factor (Non-Residential)	286 L/ca/d	286 L/ca/d
Non-Revenue Water	43 L/ca/d	43 L/ca/d
Average Day Demand (ADD)	6.2 ML/day	6.2 ML/day

Descriptor	Storage (50 per cent $Q_{fireMECP}$)	Storage (100 per cent $Q_{fireMECP}$)
Maximum Day Demand (MDD) Peaking Factor	1.5	1.5
Maximum Day Demand (MDD)	9.3 ML/day	9.3 ML/day
Fire Storage	1.7 ML	3.4 ML
Equalization Storage	2.3 ML	2.3 ML
Emergency Storage	1.0 ML	1.4 ML
Total	5.0 ML	7.1 ML

In the 50 per cent storage scenario, it has been assumed that all of the equalization storage for Zone 3 will be provided by its own reservoir. However, 50 per cent of the fire storage and corresponding emergency storage will be provided by Zone 1.

Table 3.1.2a. Existing Storage Capacities

Storage	Type	Zone	Volume (m^3)
F.M. Woods	Reservoir	1	29,270
University	Reservoir	1	2,287
Clair	Elevated Tank	1/3	4,500
Verney	Elevated Tank	1	3,790
Paisley	Reservoir	2	11,750
Clythe	Reservoir	2	650
Speedvale	Elevated Tank	2	2,258
Zone 1 Total			39,847
Zone 2 Total			14,658
System Total			54,505

3.1.3 Alternatives

The following general servicing approach has been considered to service the proposed development. This approach is a practical method of ensuring that the pipe network is not a limiting factor in achieving the required levels of service (pressure, flow etc.) while facilitating operations from a water quality / aging / chlorination perspective. It is also expected that further opportunities for refining/optimizing the pipe sizing for the transmission, as well distribution mains will present themselves during the subsequent stages of the planning and design process, as land use details are established including local roads and lotting.

1. All new collector and arterial roads shown in the land use plan will be serviced with 300 mm distribution mains;

2. Distribution mains will be looped, and where there are any dead-ends a looped solution will be envisaged (via easement or other opportunity);
3. Transmission mains will be constructed along major system connections (Pump to Storage) and distribution mains will be connected to the transmission mains at suitable locations. Transmission mains will be distributed sufficiently around the pressure zone to provide sufficient boundary pressure for the distribution mains.

It is also acknowledged that the City's Development Engineering Manual provides a minimum pipe size of 150 mm for local roads, and pipe diameters on local roads could be as small as 150 mm. For the level of resolution of this study (planning-level), local roads are not included in the analysis as the local road patterns and alignments, and associated lotting, are not yet established.

3.1.3.1 Alternative 1 – Do Nothing

This alternative would not implement any infrastructure to service the CMSP lands. As such there would be no municipal water services for the planned growth. This alternative does not present a viable solution to service the CMSP lands, nor does it address the problem/opportunity statement. The alternative is listed here, only for the purpose of benchmarking against the other alternatives being considered.

3.1.3.2 Alternative 2 – Limit Community Growth

This alternative will generally involve limiting growth to below the levels identified in the current Secondary Plan. The limitation in growth could be due to limiting the geographical area of development, reduction in population density, or both. Limiting community growth would result in not achieving the growth targets identified in the secondary plan and Provincial forecasts and would therefore not meet the planned growth targets. As such, limiting community growth to minimize/eliminate infrastructure upgrades, is not considered a viable solution to service the CMSP lands.

3.1.3.3 Alternative 3 – Elevated Storage

This alternative addresses the storage and transmission requirements for the projected growth in land use. As noted, the total projected population equivalent for pressure Zone 3 includes an additional 27,324 people.

The primary system components required are:

1. Zone 3 Functional Storage: Storage volume requirements are a function of the overall needs in Zone 3, (i.e. not simply the CMSP lands). Functional Storage will support a normal operating HGL of 382-394 masl.
2. Transmission Main to Storage: A 600 mm transmission main from the Clair Road Booster Pumping Station to the new storage facility will be required at the same time as the storage is implemented.
3. Internal Distribution System: A 300 mm looped distribution system.

This alternative is subdivided into two sub alternatives based on the approach to functional storage. Specific storage facility design configurations will need to be determined through detailed design.

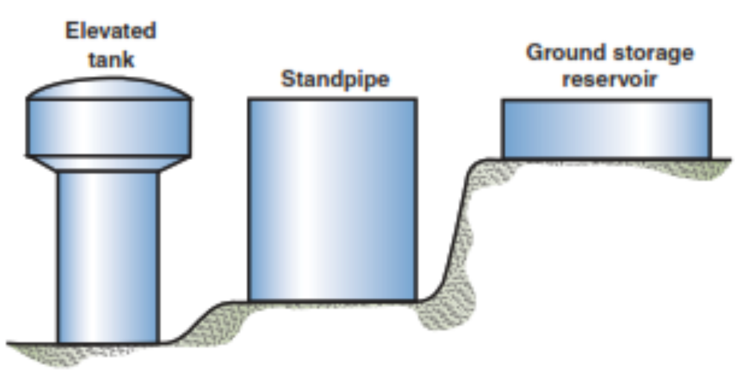
Alternative 3 - Zone 3 Storage and Transmission using Elevated Storage

The Elevated Storage option for Zone 3 has the specific advantage of being configured as floating storage, where the free surface of the water in the storage facility establishes the HGL in the pressure zone. Where ground elevations permit, it is desirable to locate storage facilities on higher ground and use ground level storage tanks or standpipes. Water storage can be most economically provided by constructing ground storage reservoirs on high ground. Floating storage from an operational, economic, and practical perspective, is a much simpler option to implement than a system which relies on pumping, to utilize the storage to its full potential.

Instrumentation is required in storage facilities to control water levels. Level indicating devices will provide readings at a central location and overflow and low-level alarms will be sent to locations which will be monitored 24 hours a day. For subsurface storage, level indicators would be provided by a pressure gauge on the tank piping, a level indicating transmitter or other means. For elevated tanks, level control instrumentation should be sufficiently precise to prevent wasting storage or tank overflows. Subsurface storage is designed with two or more cells which can be operated independently. Through valving, it is possible to isolate one of the two cells without affecting the operation of the other cell. This is imperative for routine inspection, maintenance, and cleaning of the tank.

Elevated Storage eliminates the need for electrical systems and backup power, and thereby makes the entire storage potential available to the pressure zone in an emergency situation. Figure 3.1.3 illustrates the typical configurations for floating storage.

Figure 3.1.3. Types of Floating Storage



This alternative has also considered three sub-options (a), (b) and (c), based on three possible locations for the elevated storage. The locations were selected based on elevation; the three locations represent the three highest elevations within the CMSP, as illustrated in Figure 3.1.2. Elevated storage volume requirements have been estimated as 5.0 ML, assuming that 50 per cent of the Zone 3 storage requirement for fire and the corresponding emergency storage will be provided from Zone 1. The storage elevation has been assumed to be 12 m, resulting in a total required storage area of approximately 419 m^2. On this basis the tank diameter has been estimated to be 23.1 m. The facility footprint, including the elevated tank, parking, and roadways would result in a conservative spatial footprint of 50 m x 50 m for the total facility area.

The diameters, elevations, and lengths of new and existing watermains and transmission mains for Alternatives 3 (a), 3 (b), and 3 (c) are based on the demand estimation and per capita factors discussed in the foregoing, premised on the conceptual grading for stormwater servicing, and the hydraulic modelling carried out for the CMSP lands.

Elevated Storage Location 1

Alternative 3 (a) Elevated Storage – Location 1

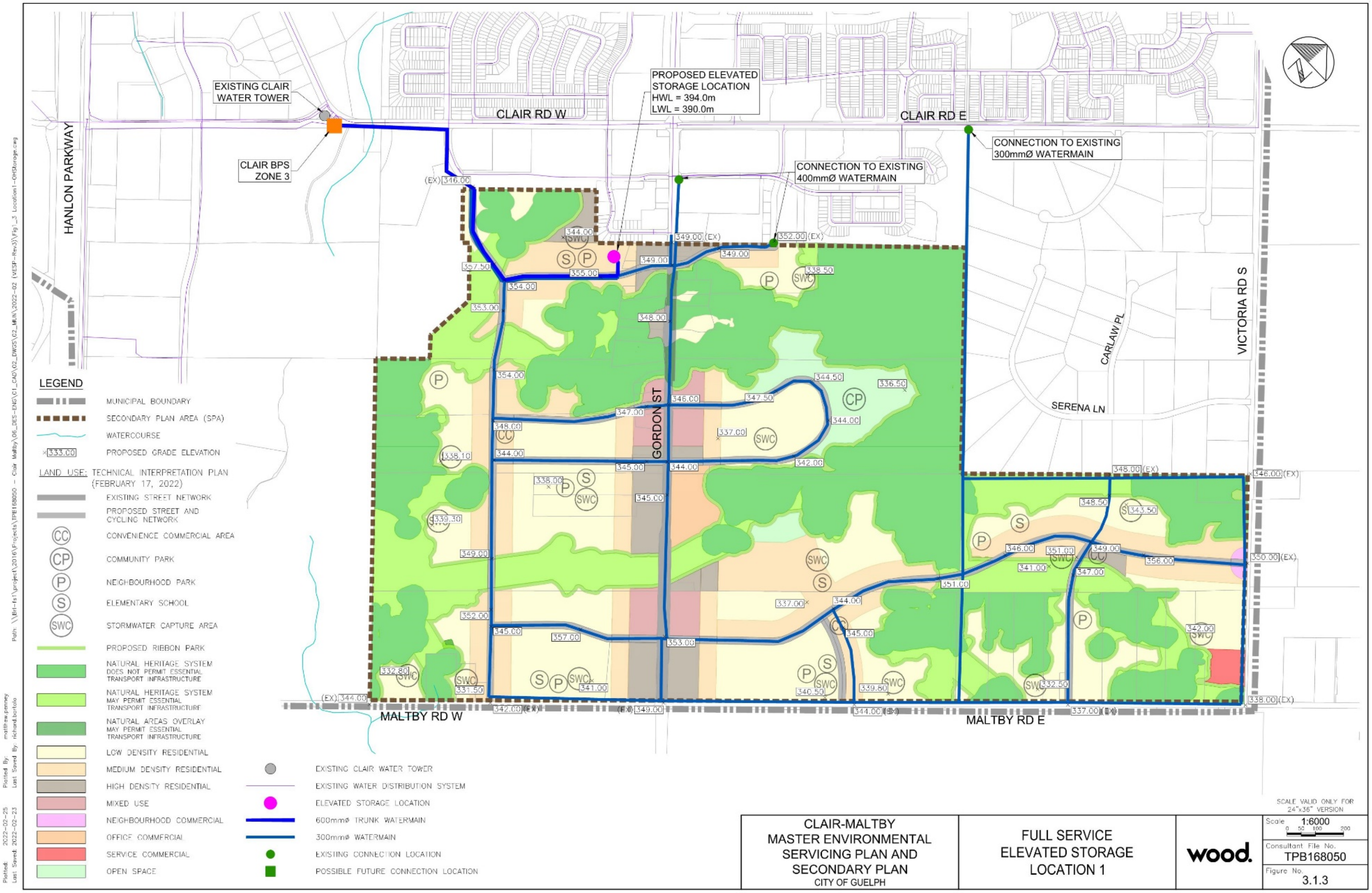
Figure 3.1.4 shows the location of the Elevated Storage within the northwest portion of the CMSP lands. This location is closest to the Clair Booster Pump Station, as well as the Zone 1 Clair Rd elevated storage tank and therefore, will require the shortest length of the transmission main from the Clair Booster Pump Station to the Elevated Reservoir. Its proposed location is close to existing and proposed residences and proposed schools. As such, the visual appearance and acceptability may pose an issue.

Table 3.1.3 presents a summary of the infrastructure required for this alternative.

Table 3.1.3. Watermain and Storage Information for Reservoir Location 1

Infrastructure Required	Amount
Length of 200 mm Diameter Watermain	300 m
Length of 300 mm Diameter Watermain	17,800 m
Length of 400 mm Diameter Watermain	540 m
Length of 600 mm Diameter Watermain	2,200 m
Capacity of Above Ground Storage Reservoir	5 ML

Figure 3.1.4. Elevated Storage – Location 1



Elevated Storage Location 2

Alternative 3 (b) Elevated Storage – Location 2

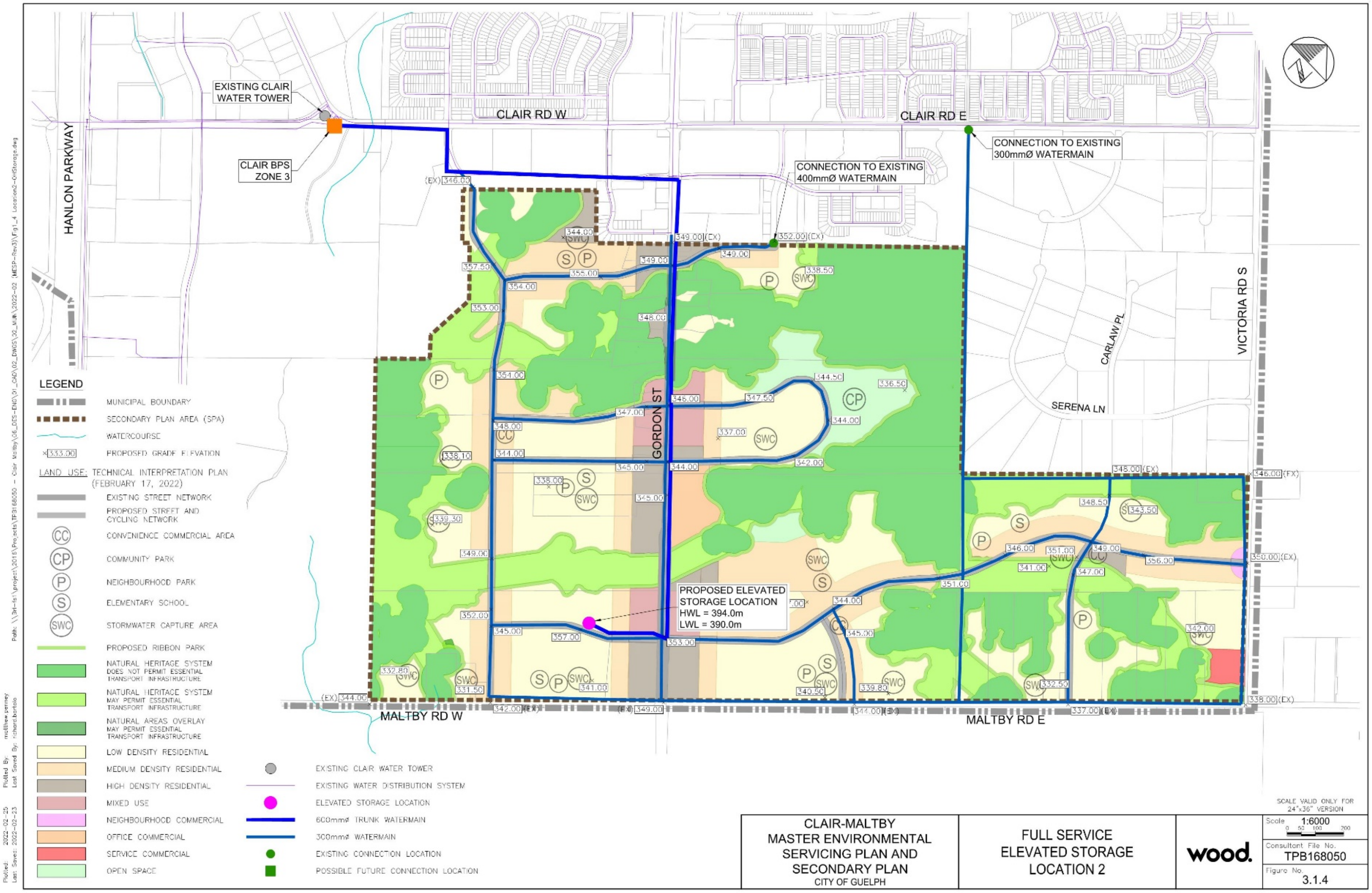
Figure 3.1.5 shows the location of the Elevated Storage within the southern portion of the CMSP lands. This location is in a more centralized location than the other two proposed locations, which is generally considered a better location than those that are to one side/corner of the service area. Another advantage of this location is that it is close to a proposed commercial designation, which is associated with the largest fire flow demand for the CMSP lands. As such, it has the potential to provide more reliable fire flow to the largest fire flow demand area.

Table 3.1.4 presents a summary of the infrastructure required for this alternative.

Table 3.1.4. Watermain and Storage Information for Reservoir Location 2

Infrastructure Required	Amount
Length of 300 mm Diameter Watermain	17,550 m
Length of 600 mm Diameter Watermain	3,300 m
Capacity of Above Ground Storage Reservoir	5 ML

Figure 3.1.5. Elevated Storage – Location 2



Elevated Storage Location 3 for Projected Future Community Growth

Alternative 3 (c) Elevated Storage – Location 3

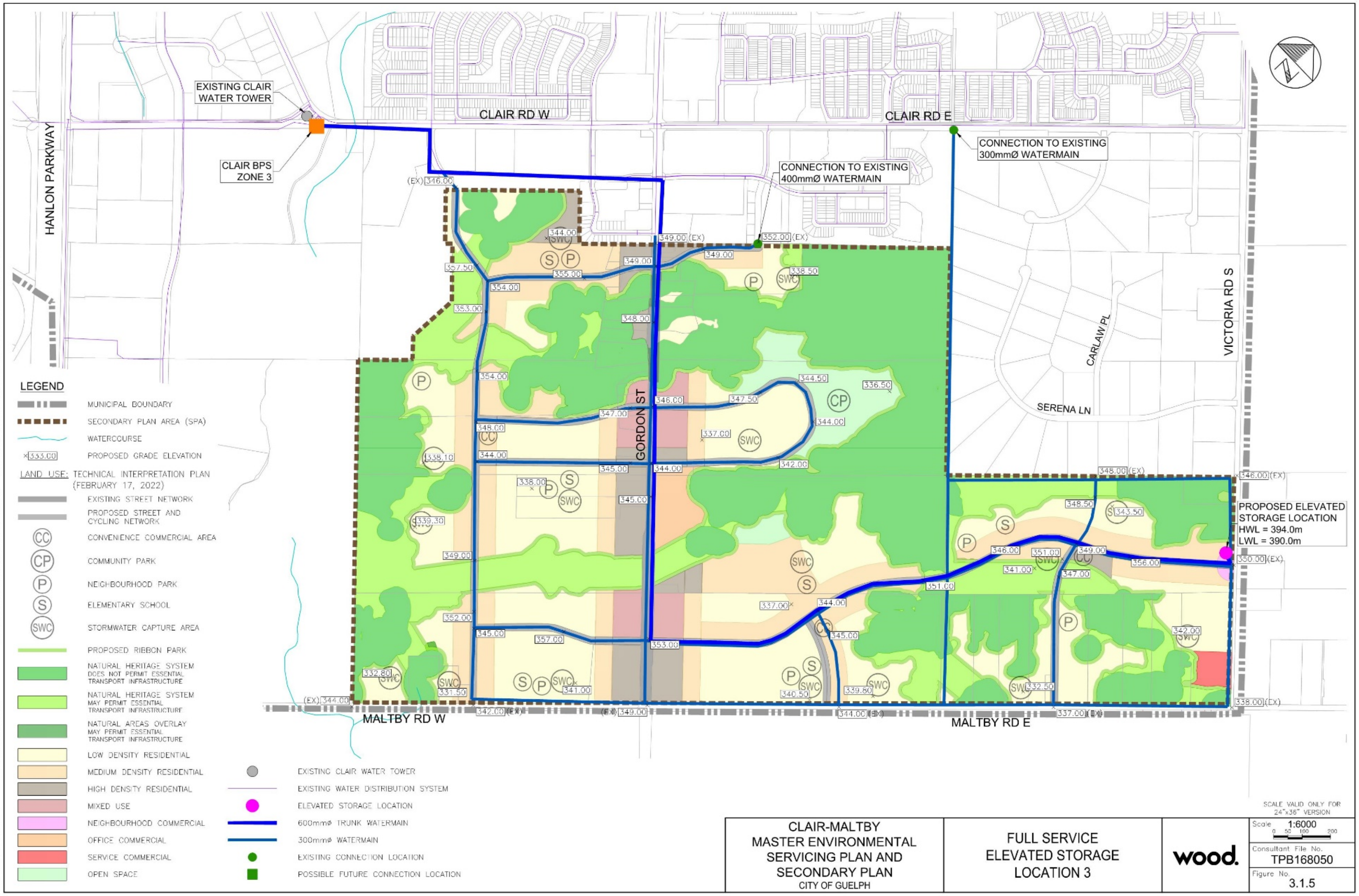
Figure 3.1.6 shows the location of the Elevated Storage within the southeastern portion of the CMSP lands. This location will require the longest transmission main from the Clair Booster Pump Station to the Elevated Storage Tank. It is toward the southeast corner of the subject lands and is close to proposed residential areas, where it will impact the visual appearance/skyline of the neighbourhood.

Table 3.1.5 presents a summary of the infrastructure required for this alternative.

Table 3.1.5. Watermain and Storage Information for Reservoir Location 3

Infrastructure Required	Amount
Length of 300 mm Diameter Watermain	17,550 m
Length of 600 mm Diameter Watermain	5,200 m
Capacity of Above Ground Storage Reservoir	5 ML

Figure 3.1.6. Elevated Storage – Location 3



3.1.3.4 Alternative 4 – Zone 3 Storage and Transmission using Below Ground Storage and Pumping

"Floating" underground storage is commonly used in Ontario Systems in areas where topography is suitable. Integrated Urban Systems with multiple zones, progressing in elevation, tend to lend themselves to the use of underground floating storage. In such situations, underground floating storage reservoirs are located in ground that is higher than the pressure zone they service, connected via transmission mains, and often used as the launch point for pumping into the next zone.

The CMSP lands are located at a topographic high point, as such, there is no nearby ground that is at a suitable elevation for providing floating underground storage. Underground storage in this case will need to be combined with a pumping system located at the storage reservoir to replicate what a floating storage reservoir would achieve. This pumping system will need to be equipped with back-up power generation, typically natural gas or diesel generator, to ensure the ability to use the storage in the event of an emergency.

The storage is configured with a pumping station that pressurizes water to Zone 3 operating levels. The pumping station will thereby be able to meet max day demands and max day plus fire flow demands in combination with other booster pumping stations (i.e. Clair Road BPS). The pumping station will need to have a firm capacity of 160 L/s, as well as backup power.

This alternative similarly has three sub-options (i – iii) based on three possible locations for the underground storage. Underground storage volume requirements are the same as above ground storage requirements. The storage requirements were established in Section 3.1.2.7. A subsurface storage of 5.0 ML has been considered. The estimated total storage area required is approximately 1,100 m^2 for this amount of storage. Based on preliminary sizing, the area would be divided into 3 cells, and assuming a 1:1 grading slope of 5 m, as well as space for the pumping facility, parking, and roadways, resulting in a conservative footprint of 100 m x 60 m (6000 m^2) for facility sizing.

Underground Storage Location 1

Alternative 4 (a) Underground Storage – Location 1

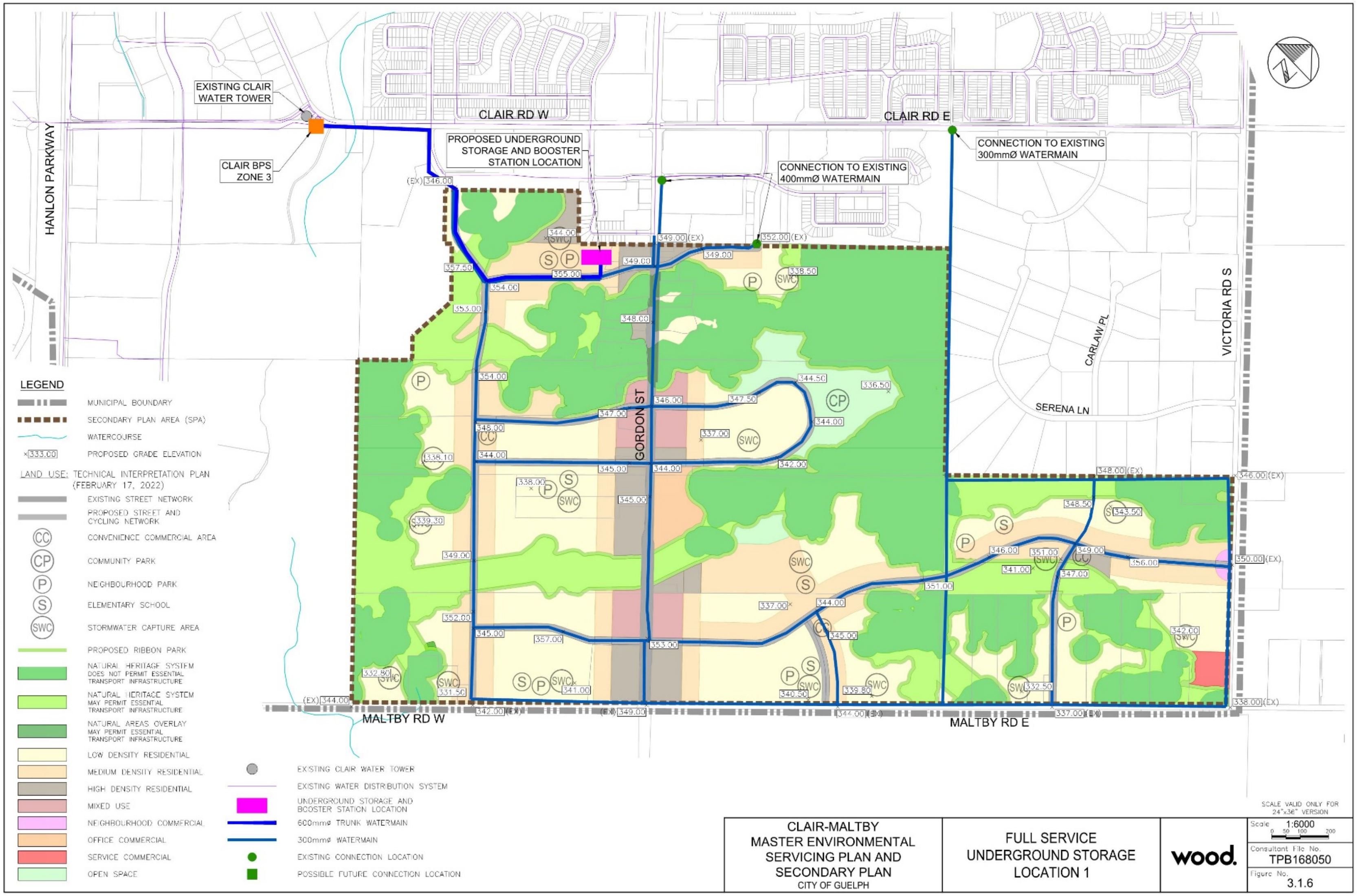
Alternative 4 (a) (i) (Figure 3.1.7) shows the location of the underground storage reservoir within the northwest portion of the CMSP lands. The approximate mean elevation of the underground storage reservoir at this location is 355.5 masl (meters above sea level).

Table 3.1.6 presents a summary of the infrastructure required for this alternative.

Table 3.1.6. Watermain, Storage and Pumping Information for Reservoir Location 1

Infrastructure Required	Amount
Length of 150 mm Diameter Watermain	11 m
Length of 200 mm Diameter Watermain	300 m
Length of 300 mm Diameter Watermain	17,800 m
Length of 400 mm Diameter Watermain	540 m
Length of 600 mm Diameter Watermain	2,200 m
Capacity of Below Ground Storage Reservoir	5 ML
Capacity of the Booster Pumping Station	160 L/s

Figure 3.1.7. Underground Storage – Location 1



Underground Storage Location 2

Alternative 2 (b) Underground Storage – Location 2

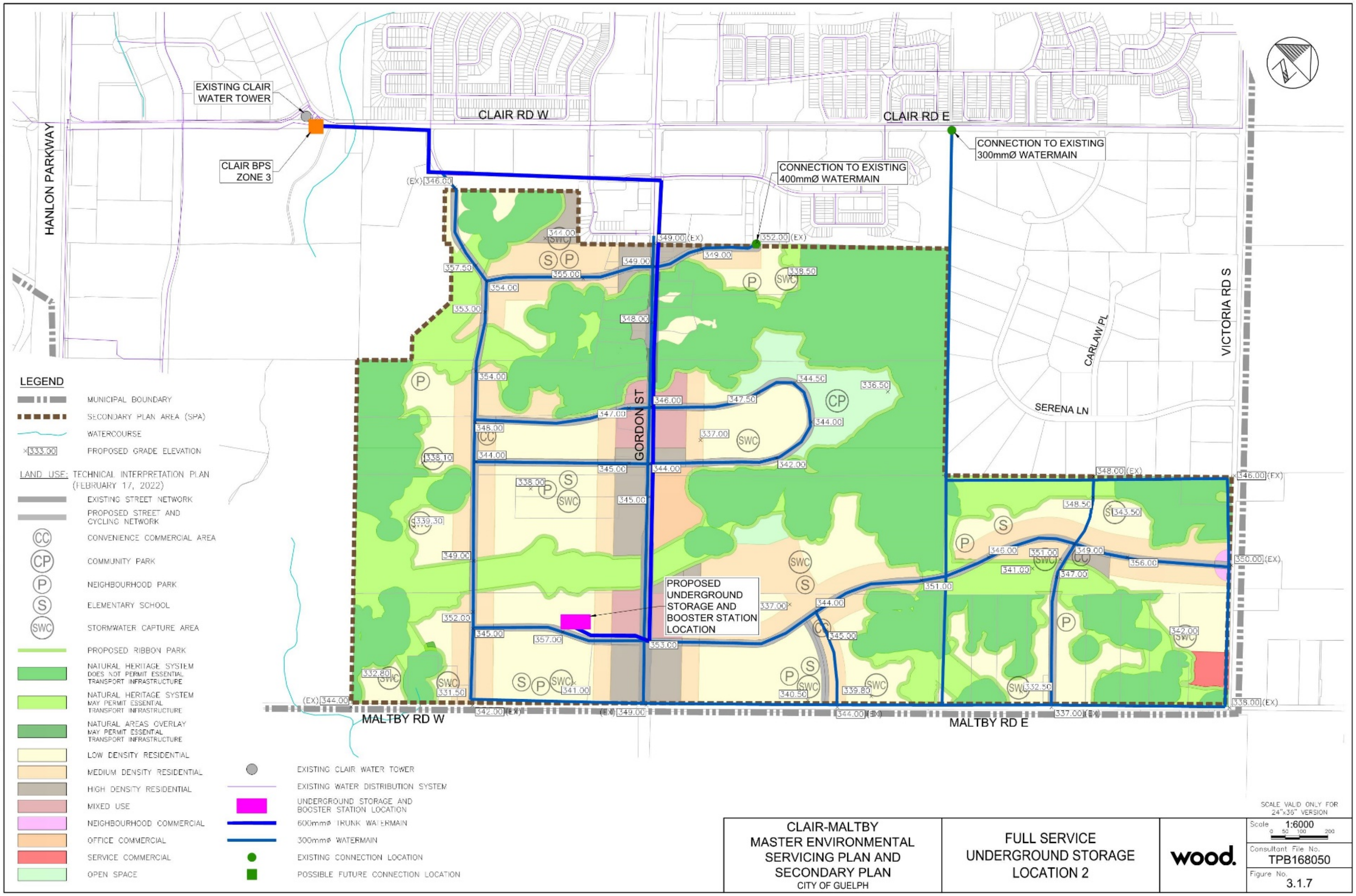
Alternative 2 (a) (ii) (Figure 3.1.8.) shows the location of the underground storage reservoir within the southern portion of the CMSP lands. The approximate mean elevation of the underground storage reservoir at this location is 359.5 masl.

Table 3.1.7 presents a summary of the infrastructure required for this alternative.

Table 3.1.7. Watermain, Storage and Pumping Information for Reservoir Location 2

Infrastructure Required	Amount
Length of 300 mm Diameter Watermain	17,550 m
Length of 600 mm Diameter Watermain	3,300 m
Capacity of Above Ground Storage Reservoir	5 ML
Capacity of the Booster Pumping Station	160 L/s

Figure 3.1.8. Underground Storage – Location 2



Underground Storage Location 3 for 100 per cent Community Growth

Alternative 2 (c) Underground Storage – Location 3

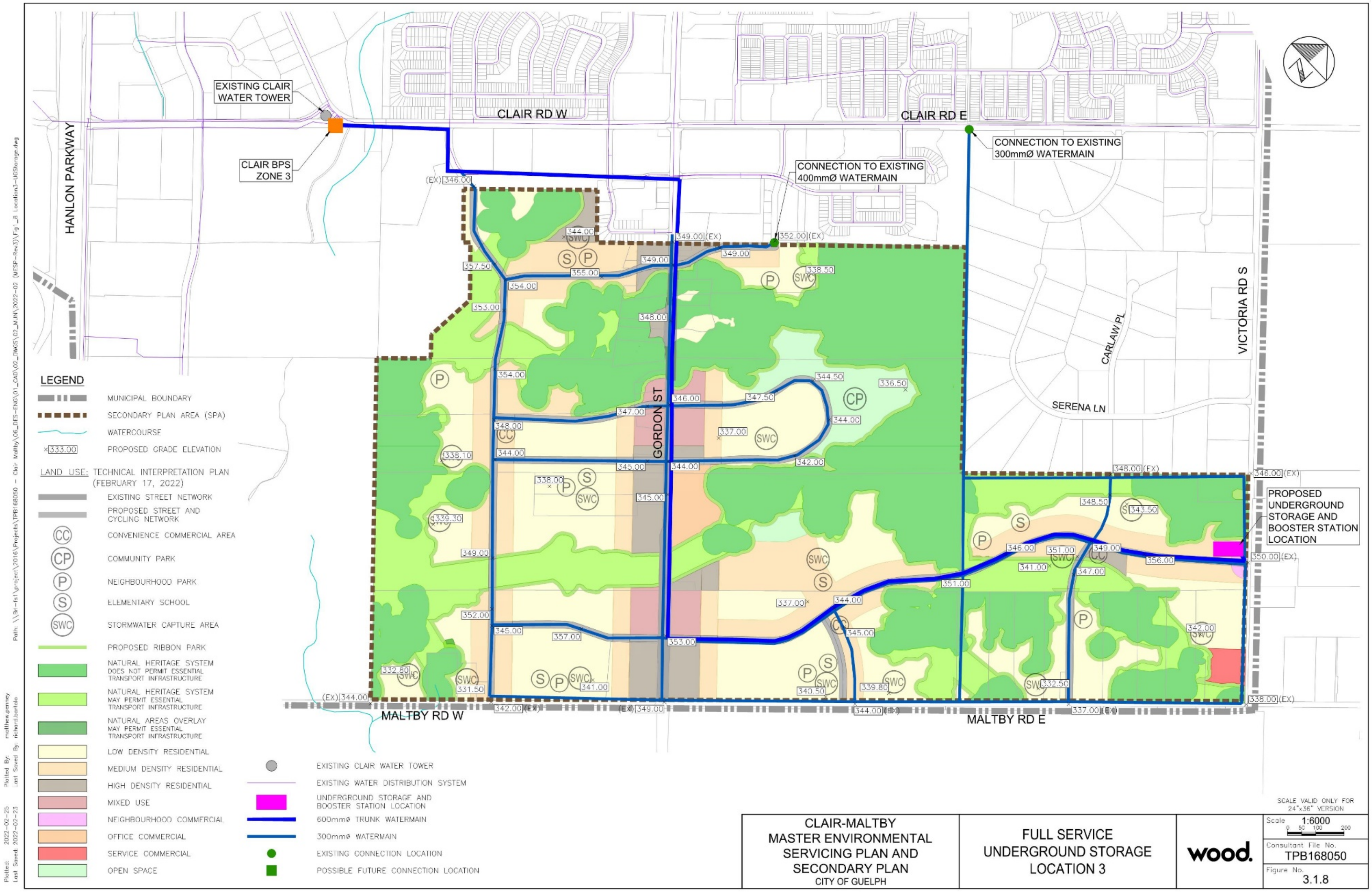
Alternative 2 (a) (iii) (ref. Figure 3.1.9) shows the location of the underground storage reservoir within the southeastern portion of the CMSP lands. The approximate mean elevation of the underground storage reservoir at this location is 352 masl.

Table 3.1.8 presents a summary of the infrastructure required for this alternative.

Table 3.1.8. Watermain, Storage and Pumping Information for Reservoir Location 3

Infrastructure Required	Amount
Length of 300 mm Diameter Watermain	17,550 m
Length of 600 mm Diameter Watermain	5,200 m
Capacity of Above Ground Storage Reservoir	5 ML
Capacity of the Booster Pumping Station	160 L/s

Figure 3.1.9. Underground Storage – Location 3



3.1.4 Economics of Water Servicing Alternatives

This section discusses the economics of the different water servicing alternatives. Order of magnitude cost estimates were developed for the various water storage and distribution for each of the alternatives. These are based on information extracted from recent tenders for the City of Guelph (provided by the City), as well as the technical publications of the American Water Works Association (AWWA) and United States Environmental Protection Agency (US EPA). The cost numbers were suitably interpolated to reflect the current servicing sizes and capacities. Property costs have been based on estimated local market conditions as provided by the City.

Annual Operating and Maintenance costs have been estimated based on a percentage of capital costs as follows:

Watermains:	0.5% of Capital Cost
Reservoirs (Above-ground)	2.0% of Capital Cost
Reservoirs (In -ground)	0.5% of Capital Cost
Booster Pumping station (including energy costs)	5.0% of Capital Cost

Property costs have been assessed at an estimated value of $800,000 per acre, or $198/m^2. Easements costs have not been included as they are considered incidental ($0.5/m^2).

3.1.4.1 Elevated Storage for Project Future Community Growth

Location 1

The approximate capital cost for a water distribution network including an Elevated Storage in Location 1 is $33.4 million, with the cost breakdown shown in **Table 3.1.9**.

Table 3.1.9. Estimated Cost – Alternative 1 (a) –Elevated Storage – Location 1

Distribution	Cost
Local Distribution Systems (150, 200, 300, 400 mm WMs, Valves, Hydrants)	$23.3 M
Elevated Storage (5 ML)	$ 5.7 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$ 3.9 M
Property Costs	$ 0.5 M
Total Capital Cost Option 1 (a)	**$33.40 M**
Estimated Annual O&M Costs	**$202 K /year**

Location 2

The approximate capital cost for a water distribution network including an Elevated Storage in Location 2 is $34.5 million, with the cost breakdown shown in Table 3.1.10.

Table 3.1.10. Estimated Cost – Alternative 1 (b) – Elevated Storage – Location 2

Distribution	Cost
Local Distribution Systems (300 mm WMs, Valves, Hydrants)	$ 21.9 M
Inline Booster	$0.5 M
Elevated Storage (5 ML)	$ 5.7 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$ 5.9 M
Property Costs	$ 0.5 M
Total Cost Option 1 (b)	**$ 3**4.5 **M**
Estimated Annual O&M Costs	**$**276 **K /year**

Location 3

The approximate capital cost for a water distribution system including an Elevated Storage in this location is $37.9 million, with the cost breakdown shown in Table 3.1.11.

Table 3.1.11. Estimated Cost – Alternative 1 (c) –Elevated Storage – Location 3

Distribution	Cost
Local Distribution Systems (300 mm WMs, Valves, Hydrants)	$ 21.9 M
Inline Booster	$0.5 M
Elevated Storage (5 ML)	$ 5.7 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$ 9.3 M
Property Costs	$0.5 M
Total Cost Option 1 (c)	**$ 37.9 M**
Estimated Annual O&M Costs	**$293 K /year**

3.1.4.2 Below Ground Storage for Projected Future Community Growth

Location 1

The approximate capital cost for a water distribution system including an underground storage reservoir in this location is $31.8 million, with the cost breakdown shown in Table 3.1.12.

Table 3.1.12. Estimated Cost – Alternative 2 (a) – Underground Storage – Location 1

Distribution	Cost
Local Distribution Systems (300 mm WMs, Valves, Hydrants)	$23.3 M
Underground Storage (5 ML) including Pumping Systems (160 L/s)	$3.4 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$3.9 M
Property Costs	$1.2 M
Total Cost Option 2 (a)	**$31.8 M**
Estimated Annual O&M Costs	**$243 K /year**

Location 2

The approximate capital cost for a water distribution system including an underground storage reservoir in this location is $32.9 million, with the cost breakdown shown in Table 3.1.13. The key difference in cost for this alternative is primarily due to a longer 600 mm transmission main connecting the Clair Gordon BPS Zone 3 and the proposed below ground storage reservoir.

Table 3.1.13. Estimated Cost – Alternative 2 (b) – Underground Storage – Location 2

Distribution	Cost
Local Distribution Systems (300 mm WMs, Valves, Hydrants)	$ 21.9 M
Inline Booster	$ 0.5 M
Underground Storage (5 ML) including Pumping Systems (160 L/s)	$ 3.4 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$ 5.9 M
Property Costs	$ 1.2 M
Total Cost Option 2 (b)	**$ 32.9 M**
Estimated Annual O&M Costs	**$269 K /year**

Location 3

The approximate capital cost for an underground storage reservoir in this location is $36.3 million, with the cost breakdown shown in Table 3.1.4.

Table 3.1.14. Estimated Cost – Alternative 2 (c) – Underground Storage – Location 3

Distribution	Cost
Local Distribution Systems (300 mm WMs, Valves, Hydrants)	$ 21.9 M
Inline Booster	$ 0.5 M
Underground Storage (5 ML) including Pumping Systems (160 L/s)	$ 3.4 M
600 mm Transmission Main from Clair Gordon BPS (with Valve Chamber Connections)	$ 9.3 M
Property Costs	$ 1.2 M
Local Distribution Systems (300 mm WMs, Valves, Total Cost Option 2 (c)	**$ 36.3 M**
Estimated Annual O&M Costs	**$286 K /year**

3.1.5 Assessment Criteria

As part of Phase 2 of the Municipal Class Environmental Assessment process, the water servicing alternatives noted above need to be evaluated systematically comparing the pros and cons of each alternative such that the servicing alternative that best meets the requirements of the subject lands could be put forth as the preferred alternative.

In order to perform a meaningful comparison, detailed evaluation criteria need to be developed to ascertain the potential impacts of the various alternatives on the natural environment, social and cultural impacts, cost impacts etc. The next section details the various evaluation criteria that were selected to carry out the comparative analysis of the various servicing alternatives.

3.1.5.1 Evaluation Criteria

The following evaluation criteria have been prepared in order to carry out the comparative evaluation of the different water servicing alternatives for the CMSP lands. The water servicing alternatives have been compared with respect to the evaluation criteria presented below. As per the Municipal Environmental Assessment process, the selected criteria relate to the consideration of potential impacts and opportunities generated by the alternatives within four distinct environments:

Table 3.1.15. Water Servicing Evaluation Criteria

Evaluation	Criteria
Social/Cultural Environment	Impacts or opportunities created by the alternative as related to the people and their current or historic relationship with the study area.
Economic Environment	Capital, operation and maintenance costs associated with an alternative.
Natural Environment	Impacts or opportunities that an alternative may have related to the natural environment (i.e., fisheries, wildlife, water quality, etc.).
Functional (Technical) Environment	Considers the ability of the alternative to address the Problem Statement and how it may impact existing physical systems. These include ease of maintenance, impact to existing infrastructure, ability to utilize available capacity in the existing infrastructure, capability of phased implementation, and ability to be implemented in concert with wastewater servicing, stormwater servicing and mobility

Within each environment, relevant and representative criteria have been considered for the evaluation. Each evaluation criterion has been assessed to ensure it results in a meaningful comparison between the water servicing alternatives.

Table 3.1.16. Water Servicing Alternatives Evaluation Factors

Component	Category	Evaluation Criteria	Criteria Indicator	Potential Measure
Natural Environment	Terrestrial / Aquatic Environment Resources	Impact to Terrestrial / Aquatic Environment Resources	Potential adverse effects on ecological sensitive lands, impacts to water bodies and aquatic species.	Extent of impact
Social / Cultural	Impact on Local Residents and Businesses	Archaeological Resources[1.]	Potential adverse effects on archaeological resources	Extent of impact
Social / Cultural	Impact on Local Residents and Businesses	Cultural Heritage Resources[2.]	Potential adverse effects on cultural heritage resources	Extent of impact
Social / Cultural	Sustainable Growth	Impacts on Adjacent Properties	Potential adverse impacts to adjacent properties due to construction of solutions etc.	Number of private or public properties

Component	Category	Evaluation Criteria	Criteria Indicator	Potential Measure
Social / Cultural	Reliability	Impact to adjacent properties.	Potential adverse impact in the event of failure of system.	Extent of impact
Social / Cultural	Regulatory Environment	Compliance with provincial / municipal regulations and standards	Potential adverse impact due to inadequate infrastructure.	Extent of impact
Social / Cultural	Land use	Impact on surrounding land use.	Potential aesthetic impact, disruption to public life during construction/operation.	Noise, odour
Economic	Cost benefit over infrastructure lifecycle	Capital Cost	Design and construction costs	Estimated cost ($)
Economic	Cost benefit over infrastructure lifecycle	Maintenance Cost	Asset management costs (lifecycle)	Estimated cost ($)
Economic	Cost benefit over infrastructure lifecycle	Property Acquisition	Amount of private property required to achieve solution	Area in ha
Functional (Technical)	Ease of Maintenance	Maintainability	Adverse impact on system performance	Extent of impact
Functional (Technical)	Impact to Existing Infrastructure	Impact of new infrastructure on the existing infrastructure to meet its assigned/allocated function	Surcharges, pressure reductions, lack of water storage	Extent of impact
Functional (Technical)	Ability to Utilize Capacity in Existing Infrastructure	Ability of new infrastructure to utilize spare capacity within the existing infrastructure	Eliminating/minimizing requirement for upgrade/ expansion to existing infrastructure	Extent of impact
Functional (Technical)	Capability of Phased	Ability of proposed scheme to be	Modularity/flexibility of the proposed servicing	Extent of flexibility in phasing

Component	Category	Evaluation Criteria	Criteria Indicator	Potential Measure
	Implementation	implemented in a phased manner over a period of time		
Functional (Technical)	Ability to be implemented in concert with the Wastewater and stormwater servicing and mobility infrastructure	Ability to be implemented within proximity of the wastewater / stormwater servicing and mobility infrastructure	Physical proximity with wastewater/storm water servicing and mobility infrastructure	Extent of proximity
Functional (Technical)	Construction Difficulty	Ability to be implemented utilizing traditional Construction Techniques	Eliminating / Minimizing locations of difficult construction	Extent of proximity

1. Combined into a single criterion due to common potential for impacts (spatially).
2. More related to detailed design versus planning stages thus removed from assessment.

Each of the water servicing alternatives has been assessed using the evaluation categories, criteria and factors provided within Table 3.3.7. The following has been noted regarding the various alternatives under consideration:

3.1.5.2 Evaluation of Servicing Alternatives

Each of the alternatives is evaluated against the criteria provided in the previous section, and based on its capacity to address the original Problem/Opportunity statement that triggered the study.

Alternative 1: Do-Nothing: The Do-Nothing alternative for water servicing would not cause disruption to the natural, social, and cultural environment. Neither would it provide any servicing in terms of infrastructure such as pipes, valves, appurtenances, storage reservoir and/or booster pumping. As a result, the CMSP development would be left without a water distribution system. Therefore, this alternative does not address the problem/opportunity statement, nor does it meet the objective of development within the subject lands and is therefore not considered a viable alternative.

Alternative 2: Limit Community Development: Limiting community development potentially would reduce the adverse impact on the natural, social and cultural environment. It also would cost less to design, construct, operate and maintain the water supply and distribution infrastructure to meet the reduced demand. However, this alternative also does not meet the objective of full development within the subject lands and is therefore, not considered a viable alternative.

Alternatives 3 a, b, c: Elevated Tank, Locations – 1, 2, 3: These alternatives are essentially similar in that the water distribution infrastructure has similar configurations and meets the water regulatory and service requirements for the entire subject lands. The water transmission and distribution mains are generally located on proposed roads except where recommended for looping. The different locations of above ground elevated tanks are similar except in capital and operating cost. All three locations offer similar operation performance. It is anticipated that the operational and capital cost will be very similar between Locations 1 and 2. Operational costs are based on the length and size of linear infrastructure installed and Locations 1 and 2 offer the most efficient use of linear infrastructure. Location 1 and 2 are therefore associated with the least operational cost. The capital cost would also be very similar to Location 1, which would have the least capital cost. Location 2 is also considered to be in the vicinity of a major commercial designated area associated with the largest fire flow demand.

Alternatives 4a, b, c: Below Ground and Pump Station, Locations – 1, 2, 3: These alternatives have similar water distribution network configurations and would be very similar in the water distribution infrastructure and meet the water regulatory and service requirements for the entire subject lands. The locations 1, 2, and 3 of the below ground/subsurface storage tanks are identical to the locations 1, 2, and 3 of the above ground storage tanks. Similar to the elevated storage tank alternatives, the main difference in the comparative evaluation is the capital and operating costs associated with the storage options.

As compared to the above ground storage options, these will need additional land due to the pump station and below-ground reservoir. Although, visually, a below-ground reservoir would be more acceptable than an above ground, the reliability of such an arrangement is lower than an above-ground tank, as the distribution is dependent on the operation of the pumps and the pump station is an additional point of failure that could impact water distribution. Additionally, below-ground reservoir arrangements are more energy intensive than above-ground reservoirs due to the requirement to operate pumps to draw water from the reservoir.

3.1.5.3 Comparative Evaluation Matrix

The different alternatives were compared against each other with respect to the various criteria established in Section 3.1.5.1. The comparative evaluation matrix is presented in the tables below.

Table 3.1.17. Comparative Evaluation Matrix – Above Ground Tank

Category	Criteria	Criteria Indicator	Do Nothing	Limit Community Growth	Above Ground Tank – Location 1 Cost Option 1(a)	Above Ground Tank – Location 2 Cost Option 1(b)	Above Ground Tank – Location 3 Cost Option (c)
Natural Environment	Terrestrial/Aquatic Environment Resources	Potential adverse effects on ecological sensitive lands, impacts to water bodies and aquatic species.	No impact as no new lands will have to be developed or utilized.	Minimal impact as watermains would be aligned along proposed road network. Overall smaller network and therefore less impact.	Minimal impact as watermains would be aligned along proposed road network.	Minimal impact as watermains would be aligned along proposed road network.	Minimal impact as watermains would be aligned along proposed road network.
Social, Cultural Environment	Impact on Local Residents and Businesses	Cultural Heritage and Archaeology	No impact as no servicing will be provided.	Moderate impact for connection to the existing Clair Booster Pump Station.	Moderate impact for connection to the existing Clair Booster Pump Station.	Moderate impact for connection to the existing Clair Booster Pump Station.	Moderate impact for connection to the existing Clair Booster Pump Station.
Social, Cultural Environment	Sustainable Growth	Impacts on Adjacent Properties	No impact to adjacent properties as no servicing will be provided.	Limited impact to adjacent properties due to limited growth and greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.
Social, Cultural Environment	Reliability	Impact to adjacent properties.	Not applicable	Dependent on whether storage would be above or below ground.	Reasonably reliable due to above ground tank.	Reasonably reliable due to above ground tank.	Reasonably reliable due to above ground tank.
Social, Cultural Environment	Regulatory Environment	Compliance with provincial/municipal regulations and standards	Not applicable	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.
Social, Cultural Environment	Land use	Impact on surrounding land use.	No impact on surrounding land use	Construction Impacts, Visual Impact of aboveground storage tank	Construction Impacts, Visual Impact of aboveground storage tank adjacent to park, school and existing residential.	Construction Impacts, Visual Impact of aboveground storage tank. Location 2 is adjacent to large demand non-residential user compared to Location 1 which is next to a park and school.	Construction Impacts, Visual Impact of aboveground storage tank

Category	Criteria	Criteria Indicator	Do Nothing	Limit Community Growth	Above Ground Tank – Location 1 Cost Option 1(a)	Above Ground Tank – Location 2 Cost Option 1(b)	Above Ground Tank – Location 3 Cost Option (c)
Economic	Capital	Design and construction costs	No capital costs, as there is no servicing	Capital costs will be less than the full servicing. However, it won't be proportionally less in accordance with the extent of servicing	Estimated Capital Cost $33.4 Million.	Estimated Capital Cost $34.5 Million	Estimated Capital Cost 37.9 Million
Economics	Maintenance	Asset management costs (lifecycle)	No maintenance cost, as there is no servicing	Maintenance cost similar to providing full service alternative. Operating cost less than providing full service alternatives.	Reasonable maintenance cost and similar to other above ground tank alternatives. Average operating cost.	Reasonable maintenance cost and similar to other above ground tank alternatives. Least operating cost due to centralized location of the above ground tank.	Reasonable maintenance cost and similar to other above ground tank alternatives. Highest operating cost as the location of the above ground elevated tank is furthest from the Clair Booster Pump Station
Economics	Property Acquisition	Amount of private property required to achieve solution	No property required.	Property requirement similar to the full-service alternatives.	Property requirement similar for all above ground tank alternatives.	Property requirement similar for all above ground tank alternatives.	Property requirement similar for all above ground tank alternatives.
Functional (Technical)	Ease of Maintenance	Adverse impact on system performance	No maintenance required as there is not infrastructure.	Infrastructure provided will be similar to full growth except for smaller size. Similar maintenance is expected.	The maintenance is expected to be similar for all above ground tank alternatives.	The maintenance is expected to be similar for all above ground tank alternatives.	The maintenance is expected to be similar for all above ground tank alternatives.
Functional (Technical)	Impact to Existing Infrastructure	Surcharges, pressure reductions, lack of water storage	No impact to existing infrastructure.	Impacted to existing infrastructure is reduced as growth is limited.	Medium impact to existing infrastructure.	Medium impact to existing infrastructure.	Medium impact to existing infrastructure.
Functional (Technical)	Ability to Utilize Capacity in Existing Infrastructure	Eliminating/minimizing requirement for upgrade/expansion to existing infrastructure	No ability to utilize existing infrastructure	Limited ability to utilize existing infrastructure due to limited growth.	Existing Zone 1 storage will be utilized to augment Zone 3 storage.	Existing Zone 1 storage will be utilized to augment Zone 3 storage	Existing Zone 1 storage will be utilized to augment Zone 3 storage

Category	Criteria	Criteria Indicator	Do Nothing	Limit Community Growth	Above Ground Tank – Location 1 Cost Option 1(a)	Above Ground Tank – Location 2 Cost Option 1(b)	Above Ground Tank – Location 3 Cost Option (c)
Functional (Technical)	Capability of Phased Implementation	Modularity/flexibility of the proposed servicing	No capability of being implemented in phases.	No capability of being implemented in phases.	Good capability for phased implementation	Good capability for phased implementation	Good capability for phased implementation
Functional (Technical)	Ability to be implemented in Concert with the Wastewater Servicing Alternatives	Physical proximity with wastewater servicing	No servicing provided, therefore, no ability to for water and wastewater servicing to be implemented together.	Limited servicing, therefore, limited opportunity to implement along with wastewater servicing.	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing.	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing.	Most services are along road right of ways, however, this is likely the last area to be developed under the wastewater servicing preferred alternative
Functional (Technical)	Construction Difficulty	Eliminating / Minimizing locations of difficult construction	No construction	Standard Construction Techniques and Trades	Standard Construction Techniques and Trades	Standard Construction Techniques and Trades	Standard Construction Techniques and Trades

Preferred → Least Preferred

Preferred Alternative

Table 3.1.18. Comparative Evaluation Matrix – Below Ground Reservoir

Category	Criteria	Criteria Indicator	Subsurface Reservoir and Booster Pump Station – Location 1 Cost Option 2(a)	Subsurface Reservoir and Booster Pump Station – Location 2 Cost Option 2(b)	Subsurface Reservoir and Booster Pump Station – Location 3 Cost Option 2(c)
Natural Environment	Terrestrial/Aquatic Environment Resources	Potential adverse effects on ecological sensitive lands, impacts to water bodies and aquatic species.	Larger facility footprint than aboveground	Larger facility footprint than aboveground	Larger facility footprint than aboveground
Social, Cultural Environment	Impact on Local Residents and Businesses	Cultural Heritage and Archaeology	Moderate impact for connection to the existing Clair Booster Pump Station.	Moderate impact for connection to the existing Clair Booster Pump Station.	Moderate impact for connection to the existing Clair Booster Pump Station.
Social, Cultural Environment	Sustainable Growth	Impacts on Adjacent Properties	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.
Social, Cultural Environment	Reliability	Impact to adjacent properties.	Inherently less reliable compared to above ground tank option, as supplies will be affected if pump station breaks down.	Inherently less reliable compared to above ground tank option, as supplies will be affected if pump station breaks down.	Inherently less reliable compared to above ground tank option, as supplies will be affected if pump station breaks down.
Social, Cultural Environment	Regulatory Environment	Compliance with provincial/municipal regulations and standards	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.
Social, Cultural Environment	Land use	Impact on surrounding land use.	Less adverse visual impact than above ground storage tank. Similar construction impact.	Less adverse visual impact than above ground storage tank. Similar construction impact.	Less adverse visual impact than above ground storage tank. Similar construction impact.
Economic	Capital	Design and construction costs	Estimated Capital Cost $31.8 Million.	Estimated Capital Cost $32.9 Million	Estimated Capital Cost $36.3 Million
Economic	Maintenance	Asset management costs (lifecycle)	Increased maintenance cost anticipated due to the pump station.	Increased maintenance cost anticipated due to the pump station.	Increased maintenance cost anticipated due to the pump station.
Economic	Property Acquisition	Amount of private property required to achieve solution	Property requirement greater than above ground alternative. It would be similar for all below ground tank alternatives.	Property requirement greater than above ground alternative. It would be similar for all below ground tank alternatives.	Property requirement greater than above ground alternative. It would be similar for all below ground tank alternatives.

Category	Criteria	Criteria Indicator	Subsurface Reservoir and Booster Pump Station – Location 1 Cost Option 2(a)	Subsurface Reservoir and Booster Pump Station – Location 2 Cost Option 2(b)	Subsurface Reservoir and Booster Pump Station – Location 3 Cost Option 2(c)
Functional (Technical)	Ease of Maintenance	Adverse impact on system performance	The maintenance is expected to be similar for all below ground tank alternatives. Maintenance however is expected to be greater than the above ground alternatives due to addition of the pump station.	The maintenance is expected to be similar for all below ground tank alternatives. Maintenance however is expected to be greater than the above ground alternatives due to addition of the pump station.	The maintenance is expected to be similar for all below ground tank alternatives. Maintenance however is expected to be greater than the above ground alternatives due to addition of the pump station.
Functional (Technical)	Impact to Existing Infrastructure	Surcharges, pressure reductions, lack of water storage	Medium impact to existing infrastructure.	Medium impact to existing infrastructure.	Medium impact to existing infrastructure.
Functional (Technical)	Ability to Utilize Capacity in Existing Infrastructure	Eliminating/minimizing requirement for upgrade/expansion to existing infrastructure	Existing Zone 2 storage will be utilized to augment Zone 3 storage.	Existing Zone 2 storage will be utilized to augment Zone 3 storage	Existing Zone 2 storage will be utilized to augment Zone 3 storage
Functional (Technical)	Capability of Phased Implementation	Modularity/flexibility of the proposed servicing	Good capability for phased implementation	Good capability for phased implementation	Good capability for phased implementation
Functional (Technical)	Ability to be implemented in Concert with the Wastewater Servicing Alternatives	Physical proximity with wastewater servicing	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing.	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing.	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing.
Functional (Technical)	Construction Difficulty	Eliminating/ Minimizing locations of difficult construction	Standard Construction Techniques and Trades	Standard Construction Techniques and Trades	Standard Construction Techniques and Trades

Most Preferred → Least Preferred

3.1.6 Preferred Solution

The preferred water servicing alternative is Alternative 3b, the above ground storage at location 2.

Consideration was given to above-ground vs below ground storage complete with booster pumping station. In this application the above-ground ground storge offers significant advantages in reliability (gravity versus mechanical equipment), capital cost and operating costs, as well as impact to the environment due to the smaller footprint of the facility. As a result, above-ground stage was preferred over below-ground storage.

For the locations of the above-ground storage site, Location 3 is the most expensive in terms of both capital and operating costs. Location 1 and Location 2 both offer similar system reliability, performance, as well as similar capital and operating costs. Location 1 offers the disadvantage of its visual proximity to a park and school, while Location 2 offers the advantage of a more central location to the CMSP development, as compared with the other two locations identified.

Additionally, Location 2 for the reservoir would be close to a large non-residential commercial use and would thereby facilitate in meeting the higher fire flow requirements for this land use.

As a result, Location 2 was deemed to be the preferred location for above-ground storage.

3.1.6.1 Discussion of the Preferred Alternative

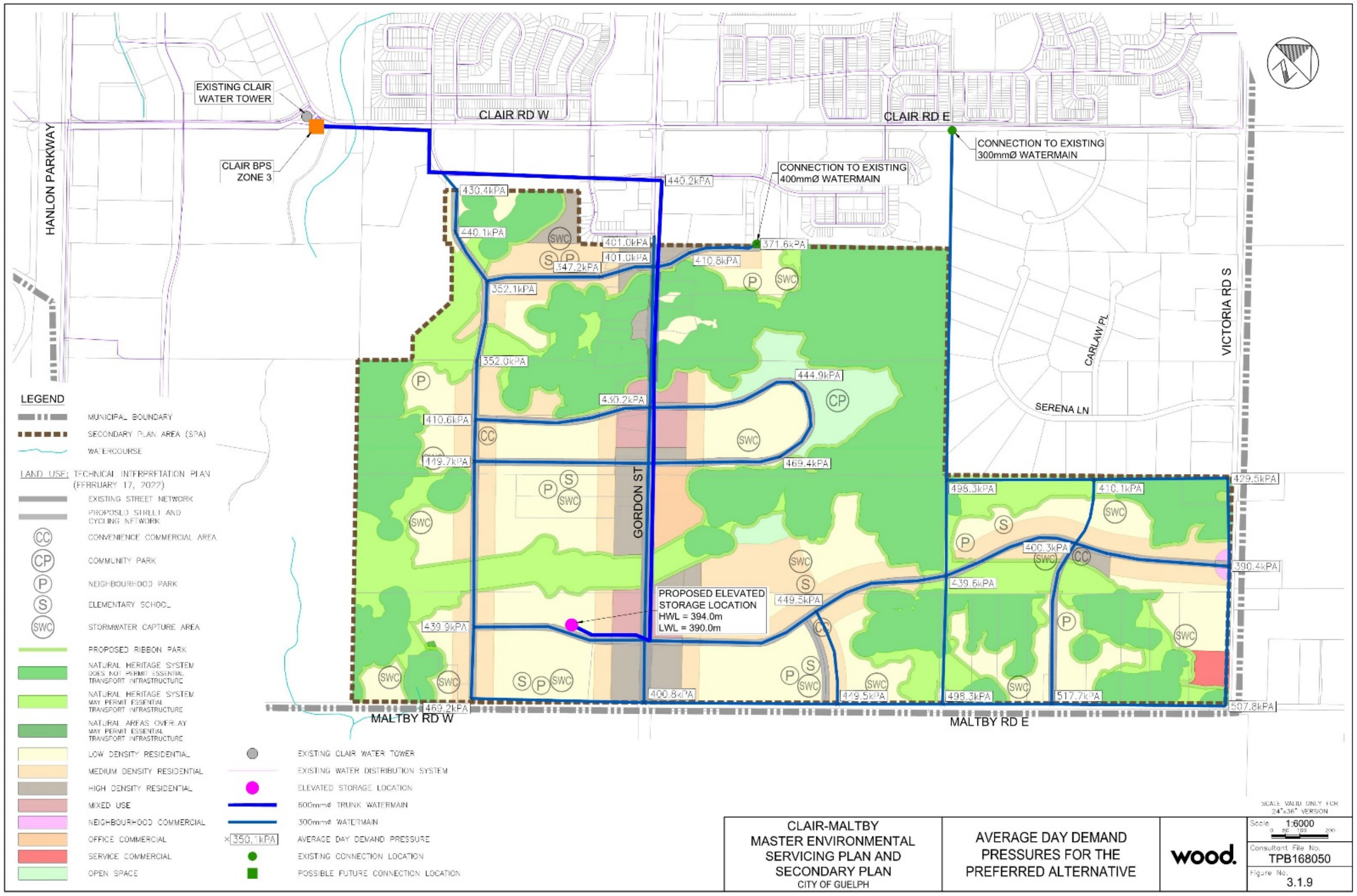
The following scenarios were modelled for the preferred alternative:

- Average Day Demand (ADD);
- Max Day Demand plus Fire (MDD + Fire); and,
- Peak Hour Demand (PHD)

Average Day Demand (ADD)

The average day demand scenario is presented in Figure 3.1.9. The pressures range from a maximum of 517 kPa (75 psi) to a minimum of 347 kPa (50 psi), which are within acceptable range.

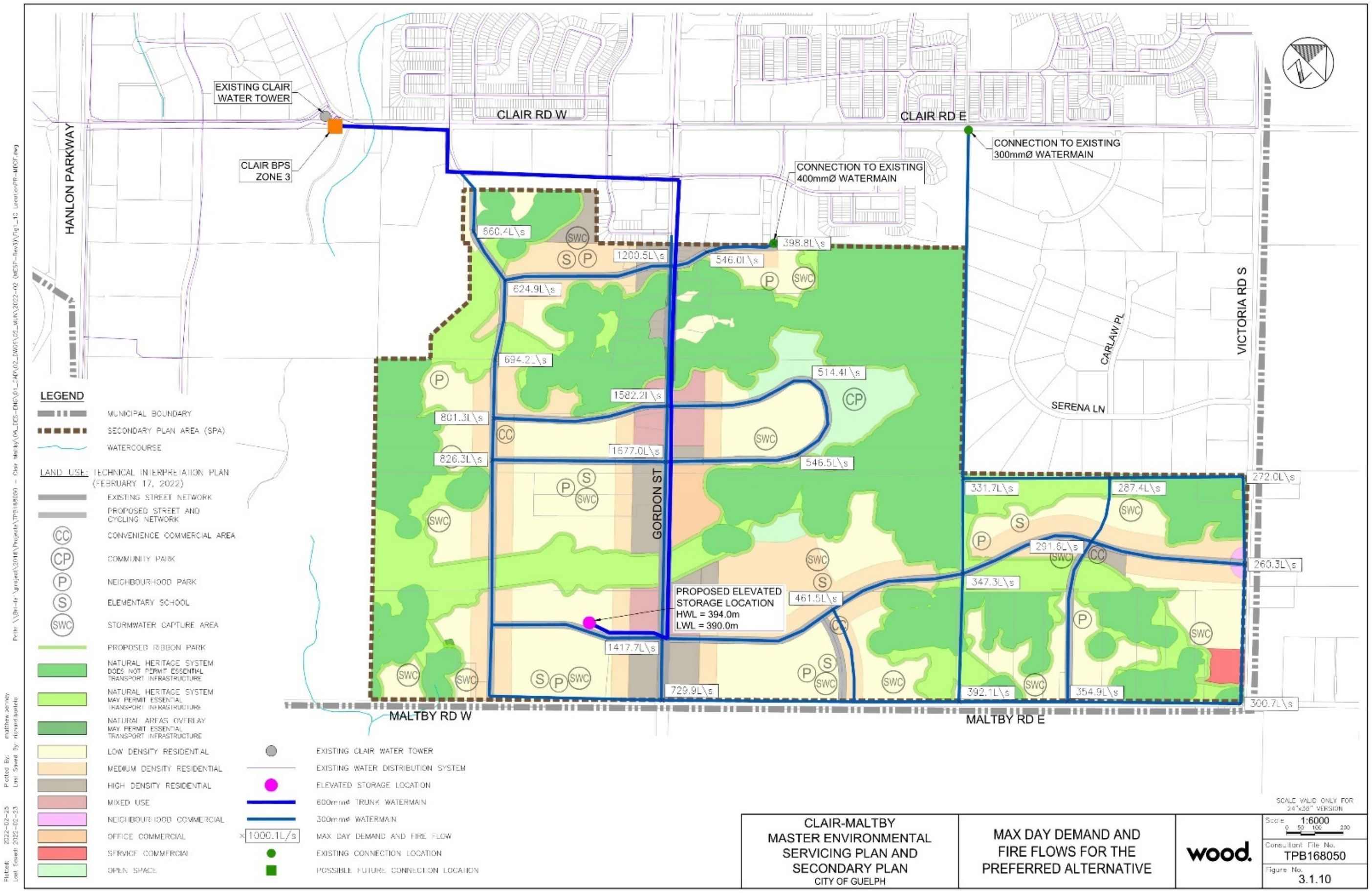
Figure 3.1.10. Average Day Demand – Pressures for the Preferred Alternative



Max Day Demand plus Fire (MDD + Fire)

The max day demand + fire flow scenario is presented in Figure 3.1.10. This figure presents the fire flows available at various junctions while max day demand is exercised at all the junctions in the backdrop. This system was modelled while keeping the pressures within the acceptable range. The fire flows predicted by the model meet the fire flow requirements established in section 3.1.2.7 of this report.

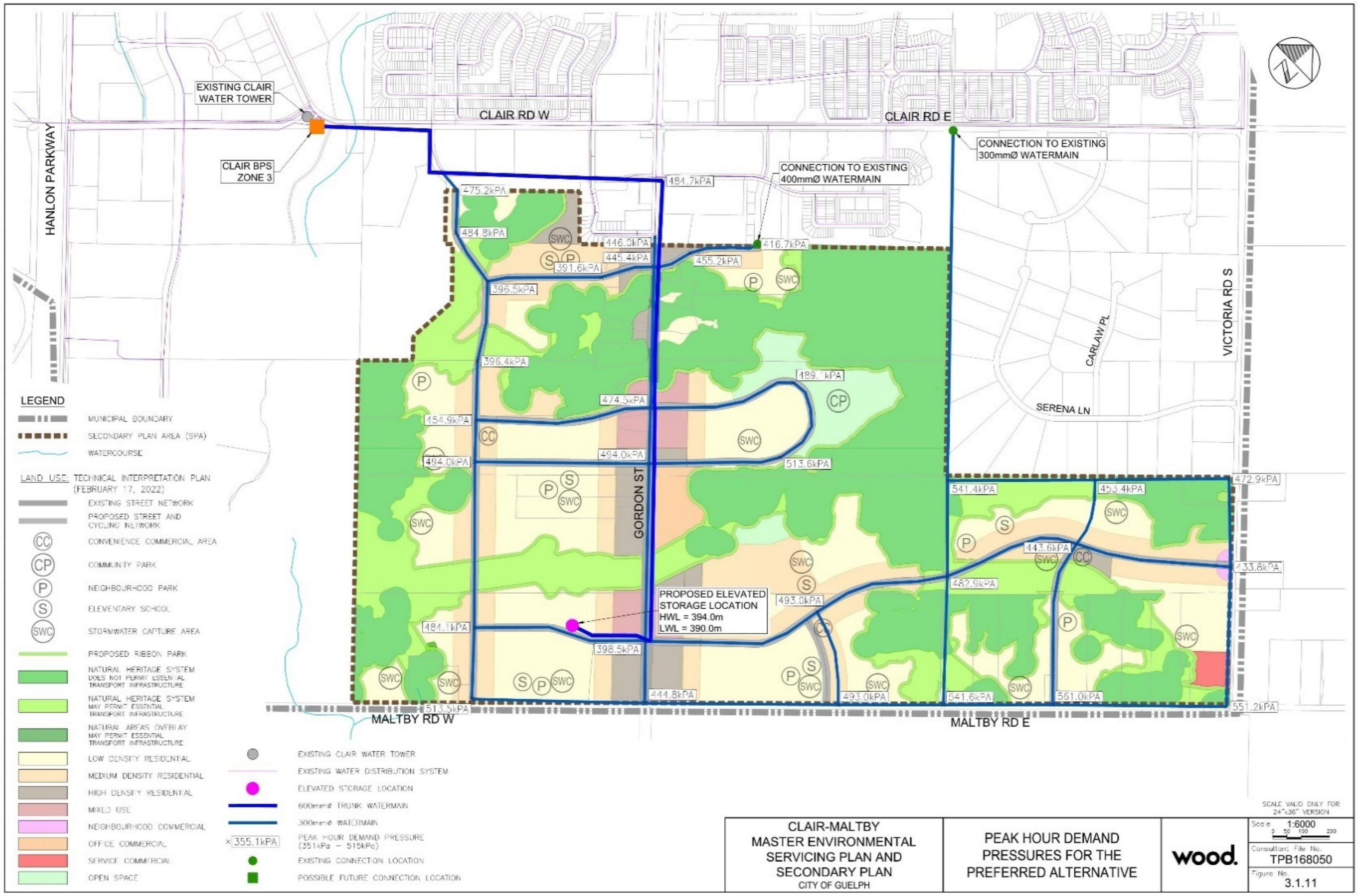
Figure 3.1.11. Max Day Demand + Fire – Fire Flows for the Preferred Alternative



Peak Hour Demand (PHD)

The peak hour demand scenario is presented in Figure 3.1.11. The pressures range from a maximum of 561 kPa (81psi) to a minimum of 391 kPa (56 psi), which are within acceptable range.

Figure 3.1.12. Peak Hour Demand – Pressures for the Preferred Alternative



Preferred Alternative Summary

For all scenarios examined, the preferred alternative provides pressures and flows within the acceptable range in accordance with MECP guidelines.

During the Average day, demand pressures range from a minimum of 347 kPa (50 psi) to a maximum of 517 kPa (75 psi). These pressures are within the preferred operating range of 350 - 550 KPa (50 - 80 psi).

Similarly, the pressure reading in the system under the Peak Hour demand, range a minimum of 391 kPa (56 psi) to a maximum of 561 kPa (81psi).

Trunk watermains and distribution piping have been sized in accordance with MECP standards to minimize head loss in the system and provide pipe velocities within acceptable ranges.

Finally, the Available fire flows meet the requirements of the MECP, the latest edition of the "Water Supply for Public Fire Protection" published by the Fire Underwriters Survey and are in accordance with the Fire flow guidelines provided in the Guelph Master Servicing Plan, 2008.

Fire Flow Conditions

Under fire flow conditions, the MECP guidelines require system pressure to be greater than 140 KPa (20 psi) near the point in the network where fire flow is drawn. Fire flow conditions are evaluated with Max Day Demand background demands in the system. For water modeling output, see Appendix A – Water.

3.2 Wastewater

This section presents the wastewater servicing alternatives, flow allocations, comparative evaluation, and the relative economics for the various alternatives. A preferred alternative is presented based on the detailed evaluation.

3.2.1 Existing Conditions

Before evaluating the internal servicing alternatives for the CMSP lands, opportunities, and constraints for routing the wastewater flows generated from the CMSP lands were evaluated. For this evaluation, the City provided its existing wastewater model. This model was used to identify key sanitary trunk sewers that could receive and convey flows to the Guelph Wastewater Treatment Plant (WWTP). These were termed as receiving branches. The wastewater model was then utilized to ascertain the spare capacity within these receiving branches to determine spare capacities in the receiving branches. There are currently no wastewater services within the SPA; it is therefore assumed that the majority of existing properties are on septic systems.

3.2.1.1 Receiving Branches

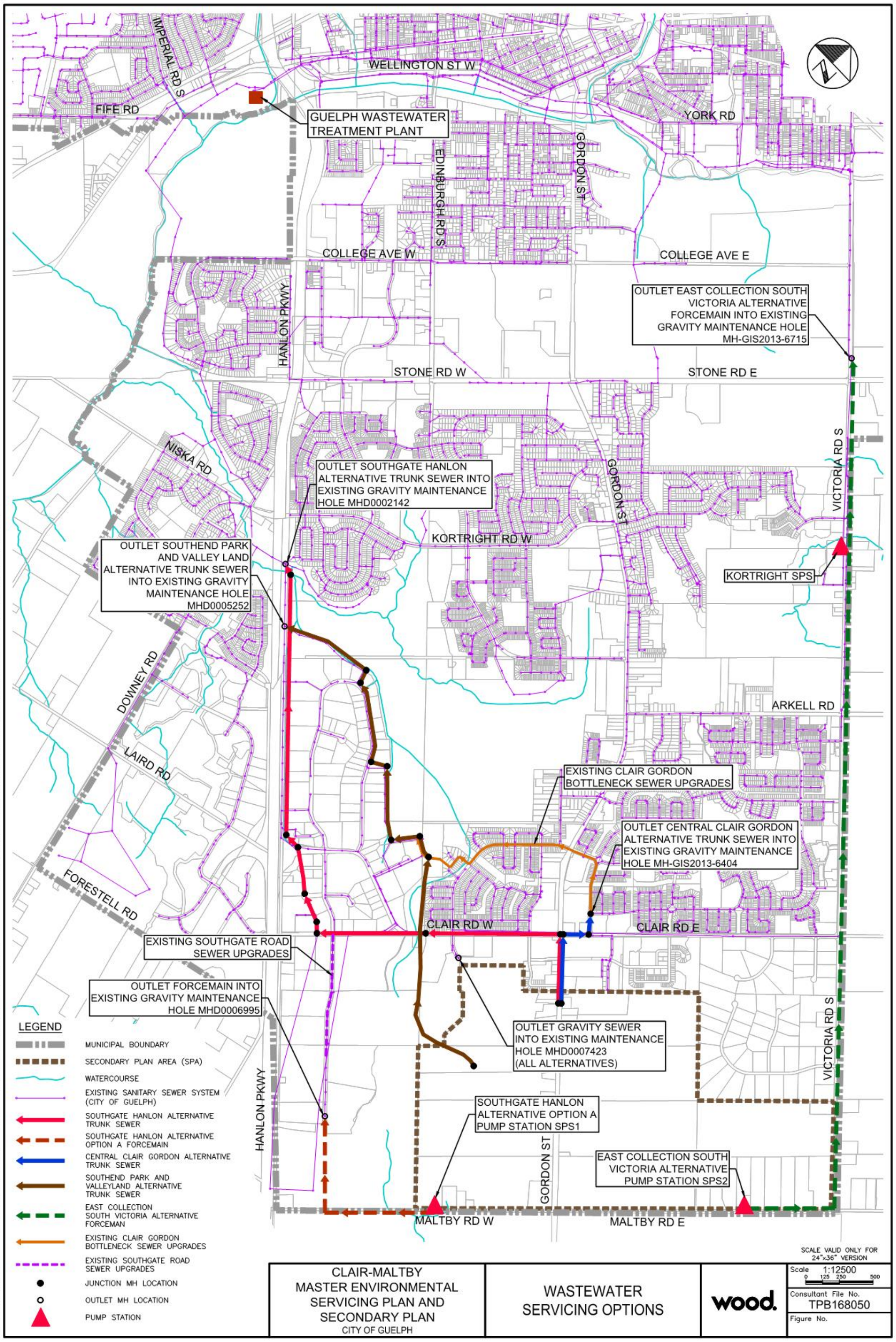
Three main receiving branches are considered potentially available to receive all or part of the wastewater flow from the CMSP area. Up to three connection points/maintenance holes have been identified per these receiving sewers with spare capacity within the sewer trunk system, as it drains to the Guelph

Wastewater Treatment Plant (WWTP), accommodating flows generated by the subject lands.

The City's wastewater model (ref. InfoSWMM Model received in 2018) has been used as the basis for understanding the available capacity in each of the potential systems. For planning purposes, the flow capacity has been converted to show the equivalent population and serviceable land area. The available capacity represents the amount, over and above the 2031 baseline flows, that can be added to the receiving system without surcharging. A comprehensive Wastewater Model Review is included in Appendix B of this report.

The three connection points and their estimated available capacity to accommodate the CMSP are shown in Figure 3.2.0 and described as follows.

Figure 3.2.0. Wastewater Servicing Options



Clair Gordon Receiving Branch

Three connection points were evaluated along the Clair Gordon trunk system to ascertain available capacity in the system.

- Clair Gordon connection point (MH-GIS2013-6404), which equates to a total population equivalent of 8,667 (for dry weather flow), an area of 98.4 ha for Infiltration and Inflow (I and I), and a resulting peak I and I flow of 27.54 L/s). This equates to approximately 40 per cent of the CMSP lands;
- Clair Gordon connection point (MHD0005955), which equates to a total population equivalent of 13,000 (for dry weather flow), an area of 159.8 ha for Infiltration and Inflow, and a resulting peak I and I flow of 44.75 L/s). This equates to approximately 60 per cent of the CMSP lands;
- Clair Gordon connection point (MHD0004348), which can accommodate 100 per cent of the subject lands without the need for upgrades.

Southgate-Hanlon Connection Point

- Southgate-Hanlon Connection Point (MH-D0006995), which equates to a total population equivalent of 2,167 (for dry weather flow), and area of 24.6 ha for Infiltration and Inflow, and a resulting peak I and I flow of 6.9 L/s). This equates to 10 per cent of the CMSP lands;
- Southgate-Hanlon Connection Point (MH0000214), which can accommodate 100 per cent of the subject lands without the need for upgrades.

Victoria Road Connection Point

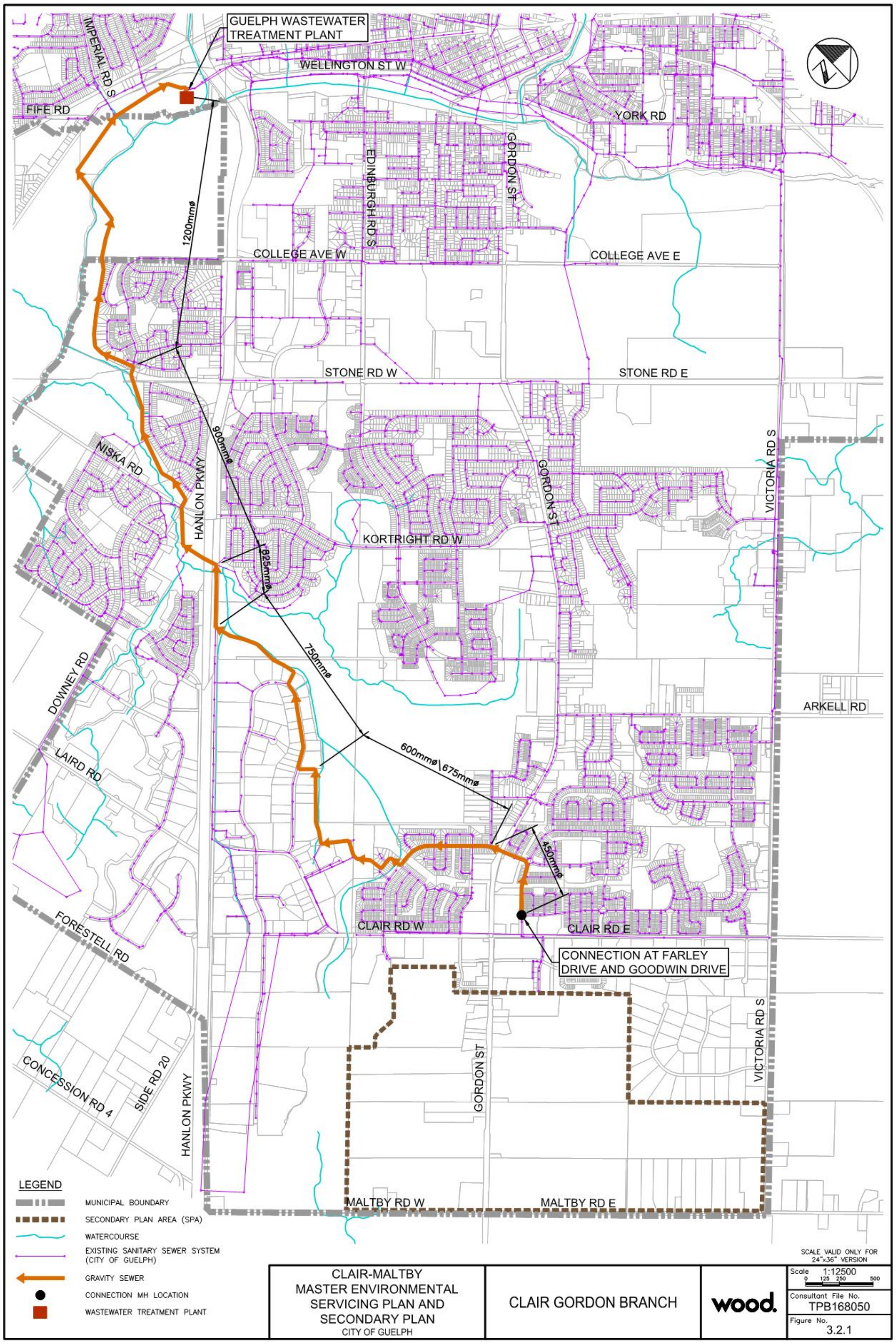
- Victoria Road connection point (MH-GIS2013-6775), which equates to a total population equivalent of 2,167 (for dry weather flow), and area of 24.6 ha for Infiltration and Inflow, and a resulting peak I and I flow of 6.9 L/s). This equates to 10 per cent of the subject lands;
- Victoria Road connection point (MH-GIS2013-6770), which equates to a total population equivalent of 8,667 (for dry weather flow), an area of 98.4 ha for Infiltration and Inflow, and a resulting peak I and I flow of 27.54 L/s). This equates to approximately 40 per cent of the subject lands;
- Victoria Road connection point (MH-GIS2013-6715), which can accommodate 100 per cent of the subject lands without the need for upgrades;
- The first two connection points will need expansion of the Kortright East Sewage Pumping Station and Forcemain, whereas the third connection point would eliminate the need to expand the Pumping Station.

Clair-Gordon Connection Branch

The Clair-Gordon Connection Branch sewer is a collection system which begins at the Farley Drive and Goodwin Drive intersection and runs north to Clairfields Drive and west to the industrial park near Kirkby Court, eventually connecting to the trunk sewer at the Hanlon Road, north of the industrial park. The collection system is shown in Figure 3.2.1.

1. Local sewers at the connection point on Farley Drive are 450 mm in size and increase to 600 mm at Dawn Avenue and Clairfields Road West. The Farley Drive connection point can accommodate 40 per cent and the 600 mm pipe segment can accommodate 60 per cent of the Clair-Maltby demands without causing surcharging downstream.
2. The section of the system between Dawn Avenue and Kirkby Court is 600 mm in size and increases to 675mm north of Kirkby Court. North of Kirkby Court the branch can accommodate 100 per cent of the Clair-Maltby demands without causing surcharging downstream.

Figure 3.2.1. Clair Gordon Branch

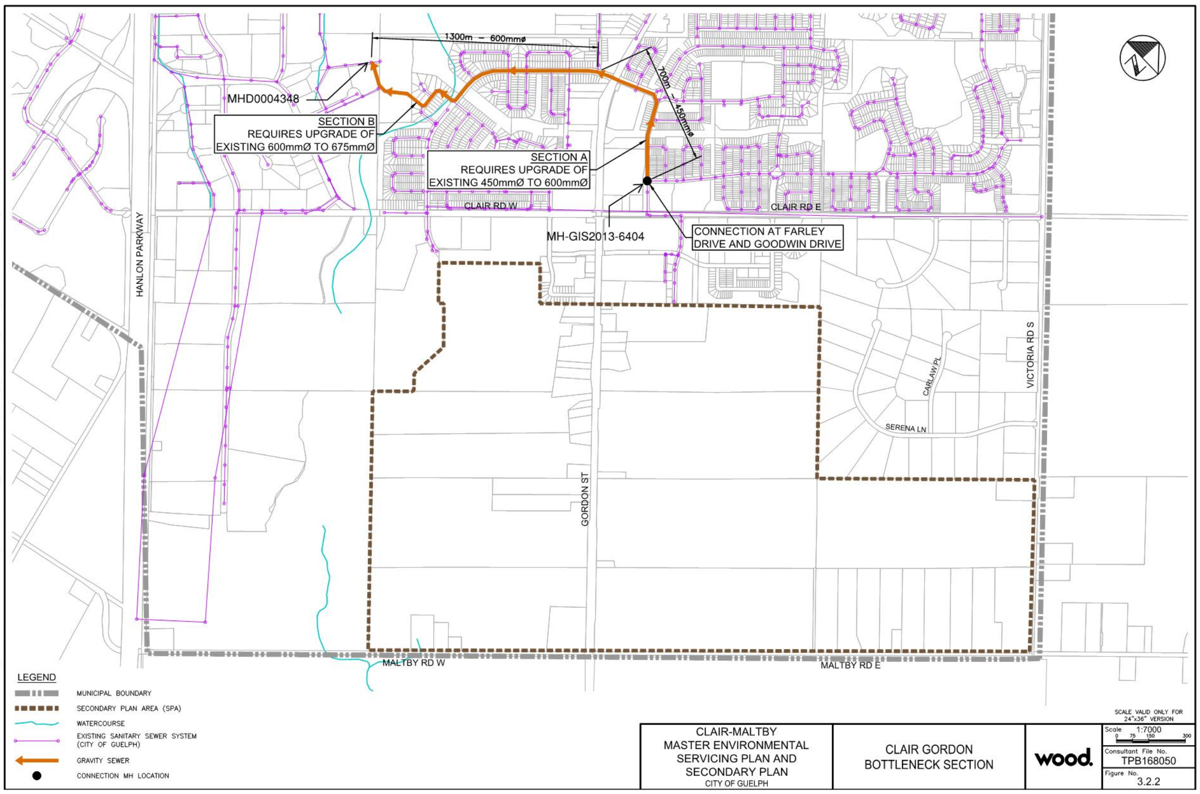


System Upgrades:

The Clair Gordon Branch has a bottleneck through a 2.0 km section, as shown in **Figure 3.2.2.**

1. Analysis has confirmed that sending 100 per cent of Clair-Maltby flows to Goodwin Drive and Farley Drive would require an upsize of the existing sewer down to the Trunk Sewer at Kirby Court. The 700 m x 450 mm section requires upgrading to a 600 mm pipe and the 1.3 km x 600 mm pipe requires upgrading to a 675 mm pipe at a total estimated cost of $2,700,000.

Figure 3.2.2. Clair Gordon Bottleneck Section



Victoria Road Connection

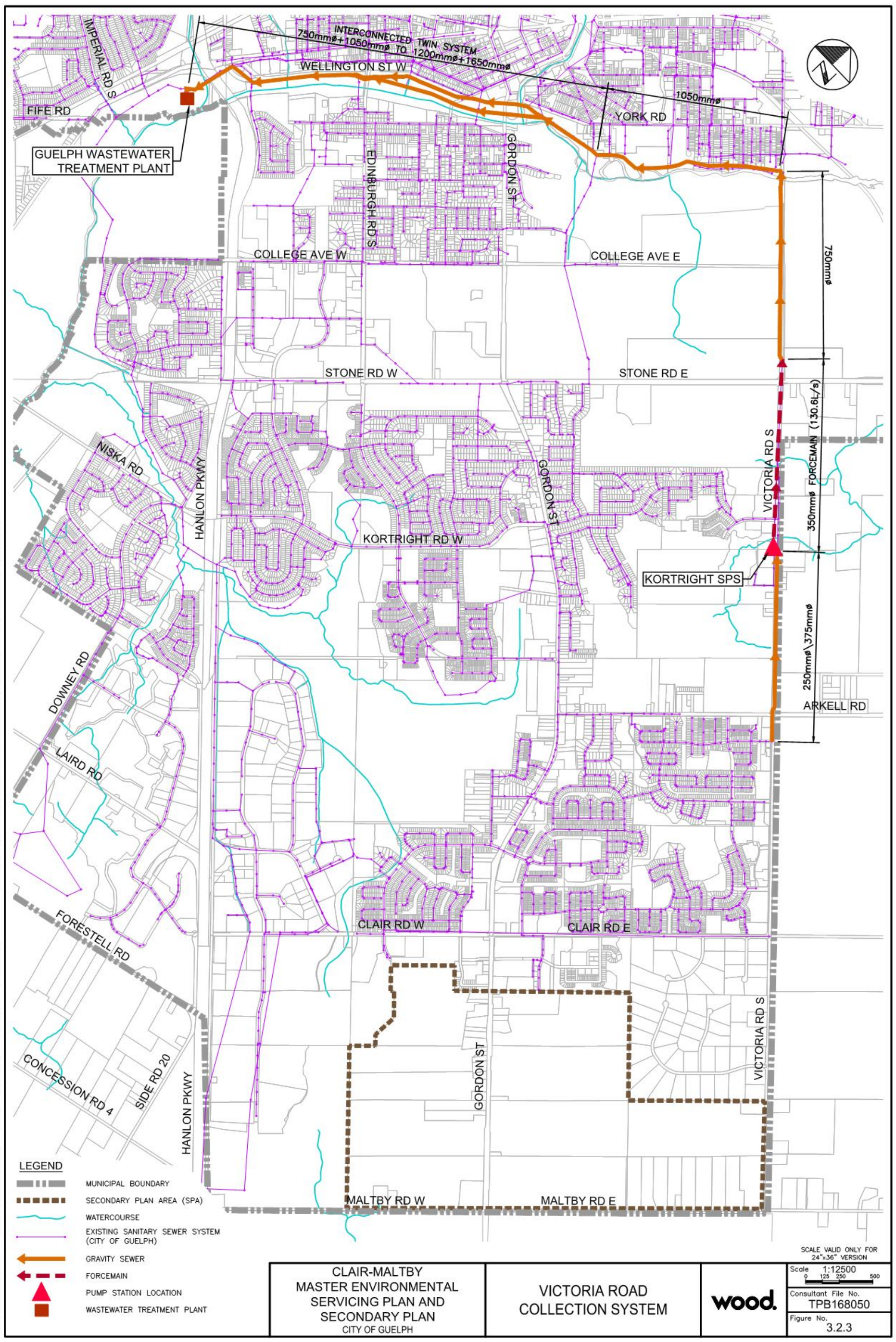
The Victoria Road Branch is a collection system located South-East of Victoria Road South and Arkell Road. The collection system discharges to the York Trunk through the following segments as shown in **Figure 3.2.3**.

1. Local sewers along Victoria Road range in size from 200 mm diameter at the connection point and increase to 375mm diameter prior to the Kortright East Sewage Pumping Station. This 375 mm pipe segment can accept 40 per cent of the Clair-Maltby demands without causing surcharging downstream.
2. The Kortright East Pumping Station and Forcemain have a firm capacity of 130.6 L/s of which is 100 per cent dedicated to existing land uses and baseline growth to 2031, excluding Clair-Maltby. There is insufficient

capacity in the Kortright East Pumping station and forcemain to accommodate additional demand beyond the 2031 baseline demand.

A 750 mm diameter sewer on Victoria Road, north of Stone Road East can accommodate 100 per cent of the Clair-Maltby flows without causing any downstream surcharging. This connection point is approximately 6.2 km to the north of the Victoria Road / Maltby Road intersection.

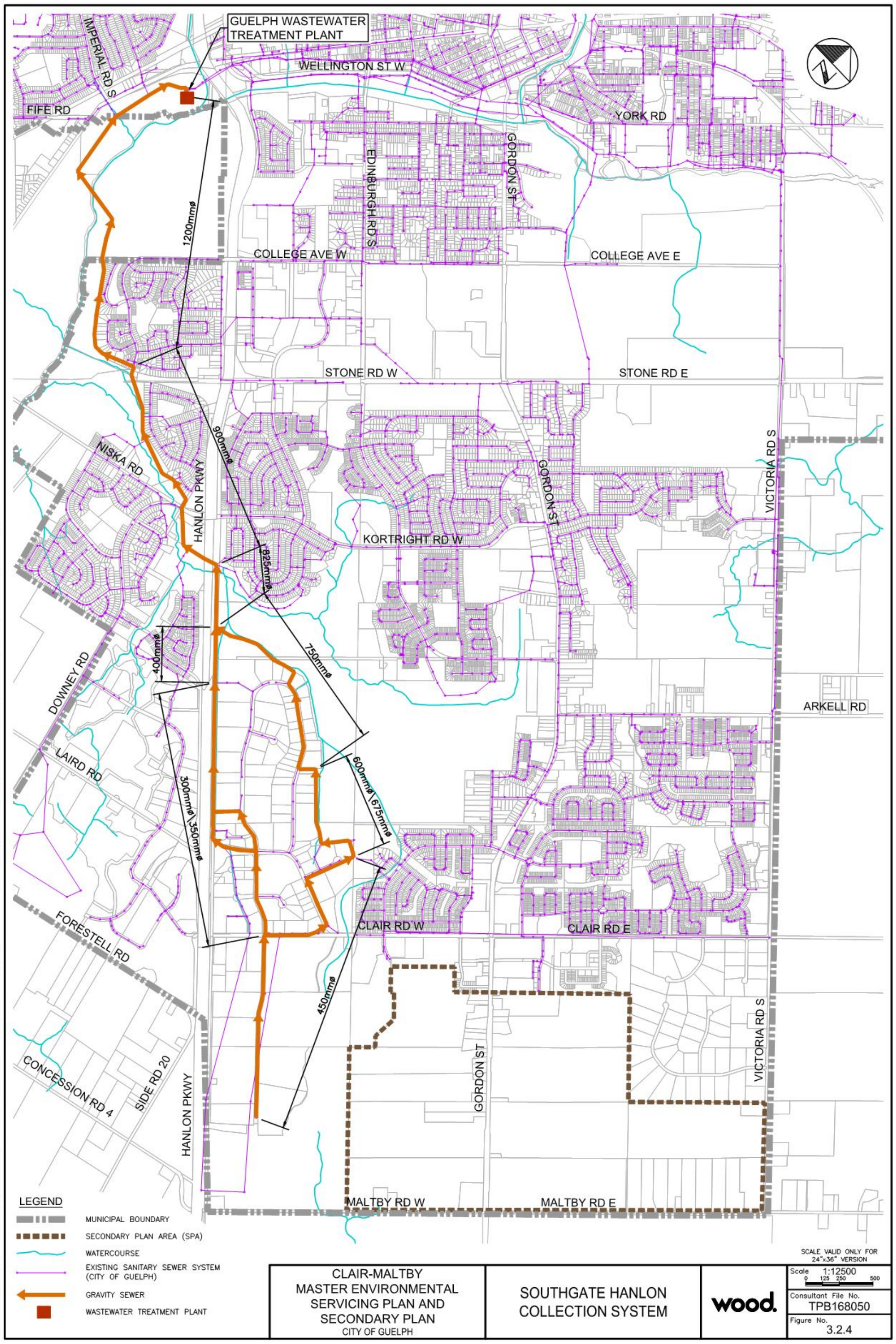
Figure 3.2.3. Victoria Road Collection System



South-Gate Hanlon Connection

The Southgate Hanlon Branch is a collection system located South-East of Southgate Drive and Clair Road W. The collection system discharges to the same trunk as the Clair-Gordon collection system. The collection system is shown in **Figure 3.2.4.**

Figure 3.2.4. Southgate – Hanlon



Local sewers along Southgate Drive are 450 mm diameter. This 450 mm pipe segment can accept 10 per cent of the Clair-Maltby demands without causing surcharging downstream. This analysis is based on the future baseline flows connecting to the system without any upgrades.

3.2.2 Criteria/Standards/Policy

3.2.2.1 Dry Weather Flow

A review of the policies, standards, and criteria, as it relates to the wastewater collection and pumping systems was undertaken. This serves as the basis for further analysis, hydraulic modelling, and preliminary sizing of the wastewater infrastructure for the CMSP lands.

The wastewater model provided by the City of Guelph contains the per capita dry weather flow allocation, for the existing system. In addition, the dynamic model includes a diurnal pattern, which was used for the current study as well.

For the Clair-Maltby planned development, a per capita allocation of 300 L/day has been applied in the modelling; this included residential population, as well as non-residential population equivalents. The diurnal pattern previously utilized within the wastewater model has been applied at each maintenance hole/node where dry weather flow has been allocated. Modelling Criteria and assumptions are in accordance with the Water and Wastewater Master Plan, 2008.

3.2.2.2 Infiltration/Inflow

Estimation of Inflow and Infiltration for the planned development in Clair-Maltby area has been established as for existing Areas, per the estimates in the baseline model by the City of Guelph. Inflow and infiltration for new areas assumed at a factor of 0.28 L/s-/ha.

3.2.2.3 Gravity Sewers

Design Slopes for new sanitary sewers

New sewers in the CMSP Lands, have been designed conceptually with a minimum full-pipe flow velocity of 0.8 m/s. This exceeds the City's minimum of 0.6 m/s and provides flexibility to ensure that other criteria, such as higher slopes for pipes running at 1/3 of the depth, can be met and that changes can be accommodated at the detailed design stage.

The minimum design slope is a function of the full pipe velocity and the pipe size.

Sewer Capacity Evaluation

The City of Guelph has adopted a no-surcharge approach regarding sewer capacity evaluation. The capacity is thus defined as the full flowing capacity of the pipe with hydraulic grade line at the pipe obvert. Upgrades to the sewer system are triggered when demand exceeds capacity.

Other conventional approaches to this problem include the hydraulic grade line risk evaluation. With this approach, sewers can be loaded beyond the full pipe-capacity and function at a higher flow rate under partially pressurized conditions, in which case the flooding risk of nearby buildings and infrastructure is evaluated with respect to the hydraulic grade line.

3.2.2.4 Pumping Stations and Forcemains

If a pumping station is required, multiple pumps are designed to meet a firm capacity. The firm capacity is defined as the system flow rate with the largest pump out-of-service. If the pumps do not have equal capacity, the highest capacity pump is assumed to be out of service for the purpose of determining firm capacity.

The use of firm capacity introduces a safety/redundancy factor as the system flow rate can exceed the firm capacity when all pumps are running.

The forcemains are sized to have velocities in the range of 0.8 m/s to 2.5 m/s in accordance with the MECP design guidelines.

A lot size of 30 m x 30 m has been assumed for each Sewage Pumping Station.

The MECP design guidelines for sewage works also indicate a need for controlled high-level wet well overflow to supplement alarm systems and emergency power generation . The need for emergency overflow shall be identified by the designer on a project specific basis.

Sewage overflows should discharge into a water body, municipal drain, storm sewer, or lined stormwater detention ponds. For Clair Maltby, overflows shall be directed to the closest Stormwater Capture Area (SWCA). The area between pump stations and cells designated for containment should be in close proximity to each other. Overflow lines shall be equipped with instruments to record overflow discharge volume and duration of the overflow event to meet MECP reporting requirements.

The alternatives reviewed for this application included:

- Pump to wetlands or existing depressional areas in NHS
- Underground tanks
- Stormwater Capture Areas (SWCAs)
- SWCA lined forebays

It was determined that pumping to wetlands is the least preferred due to environmental impacts. Underground storage tanks are expensive and could entail purchasing additional land. SWCAs utilize infiltration into the soil strata so it is also not preferred. However, should underground storage tanks be selected as a method of containment, they must be designed in a manner that allows for inspection and maintenance. SWCA forebays appear to offer the best solution. The SWCA forebays would be lined and could be designed with shut-off valving to prevent discharge to the main cells, therefore the overflow volume would need to be designed to not exceed the forebay volume. The forebays would have bypasses to allow drainage to the main cell, in the event of an emergency pump station overflow. Should stormwater retention ponds be used for the diversion of wastewater during a by-pass scenario, the ability for containment within the cell through valving at the outlet, shall be provided.

3.2.3 Future Requirements

3.2.3.1 Approach

The variation in the ground elevations for the subject lands is highly complex due to the hummocky ground; the ground elevations vary from a maximum of 357.5 m above average sea level (asl) to 331.5 m above asl. The two competing constraints in a typical sanitary sewer planning strategy are to minimize pumping to conserve energy, at the same time, minimize the sewer depths to provide ease of construction and subsequent maintenance. Due to the large variation in topography of the subject lands, optimizing these two competing constraints is an important criterion.

Due to the undulating land base, the subject lands have been delineated into three distinct catchment areas; north service area, southeast service area and southwest service area. Internal servicing concepts have been developed individually for these three distinct catchment areas. The southeast and southwest service areas individually would be expected to drain to new sanitary pumping stations, which are proposed at the lowest elevations within their catchments. The north service area can on this basis be serviced either by a new pumping station or completely by gravity depending on the different servicing alternatives developed.

Initially five alternatives were developed and as feedback was solicited, the City requested the investigation of four additional alternative solutions:

Southgate Industrial is a variation of one of the alternatives prepared by the MESP Team proposed by a local consulting engineer. The internal servicing for this alternative is presented in Figure 3.2.8a as a separate alternative.

Southend Park and Valley Land is a variation of one of the alternatives prepared by the MESP Team proposed by a Consulting Engineer. The City independently carried out hydraulic modelling for this alternative through another consultant and shared the hydraulic modelling results with the MESP Team. These results have been used by the MESP Team to present and evaluate this alternative vis-à-vis the other servicing alternatives.

Optimized Valley Land / Southgate Hanlon derives from the evolution of previously developed alternatives, based on stakeholder input, and represents an optimized version of these previously studied alternatives.

Gordon / Southgate Hanlon which sends all flows centrally to Gordon Street and avoids double pumping from one catchment to another.

3.2.3.2 Updated Wastewater Model

The City has an ongoing flow measurement program for collecting data at the sanitary sewer system and including them in the model for calibration purposes. In 2020, the City carried out further calibration of the wastewater model to reflect the flow measurement information collected. This model also included capacity allocations for part of the Clairfields Subdivision, which were not included previously. As a result, the updated model showed lesser capacities in the receiving trunks previously identified under section 3.2.1.1.

As part of generating the internal servicing alternatives discussed in the sections to follow, connection points were altered within the receiving branches to eliminate surcharging of receiving sewers where possible. The additional infrastructure upgrades required to eliminate surcharging have been captured in the modelling and the resulting costing exercise for the various servicing alternatives.

3.2.3.3 Wastewater Flow Estimation for CMSP Lands

The total CMSP population is estimated to be 23,759. This includes a projected residential population of 23,135, and an employment equivalent of 624. This population projection is exclusively for the CMSP lands and does not include additional lands outside the CMSP boundary (ref. Land use information obtained August 2019).

In order to estimate the total wastewater flows for the major infrastructure, such as pump stations, it is important to give consideration to additional adjacent lands that could potentially be serviced by the wastewater infrastructure provided within the subject lands. At this time, however, the nature and extent of this development is not available, nor has it been provided through this study.

As such, to account for the potential for development outside of the CMSP lands, 15 per cent of the projected population for CMSP lands, (i.e., a total population equivalent of 3,565) has been included for planning purposes, over and above the estimated population of 23,759. A similar ratio between residential and non-residential population has been assumed for the additional population of 3,565 (Residential population = 3,471, and non-residential population equivalent =94). This would provide a total population of 27,324.

The wastewater flow generation factors utilized in this study are as follows:

- Dry Weather Flow (Res and Non-res) 300 L/ca/d
- Infiltration and Inflow (I and I) 0.28 L/ha/s
- Harmon Peaking Factor (K) 2.52

For the Clair-Maltby SPA a total projected population equivalent of 27,324 has been applied, which includes a residential population of 26,606 persons and a non-residential population equivalent of 718 persons. The total wastewater flow for the CMSP lands is estimated as follows:

- Average Dry Weather Flow 94.9 L/s
- Peak Dry Weather Flow 238.9 L/s
- Infiltration and Inflow (I and I) 77 L/s
- Peak Wet Weather Flow 315.9 L/s

3.2.3.4 Topography of CMSP Lands and Internal Servicing Concept

The preliminary grading along the roads developed to provide stormwater servicing has been utilized to evaluate the internal sanitary servicing within the CMSP lands. These elevations vary from a maximum of 357.5 m to 331.5 m above sea level. In general, the topography of the lands is very undulating making it a challenge to optimize wastewater servicing within the subject lands.

Based on a review of the revised elevations, a sanitary servicing scheme has been developed based on the road elevations available. In general, it has been the Team's objective to keep the sewer depths relatively low and generally follow the topography of the land. Based on a careful review of the topography of the subject lands, it is observed that the area could be generally demarcated into three distinct catchments, with each having its own low spot. These three low spots are good candidate locations for building sewage lift stations.

In addition, there is an opportunity to connect the subject lands immediately south of Clair Road to existing sewers. This would allow development of these lands to proceed first without dependence on any of the pumping stations.

For the subject lands, three main catchment areas have been identified, each draining to a pumping station. In addition to the three main catchment areas, areas on either side of Gordon Street immediately south of Clair Road have been classified as two separate catchments, each draining to existing sewers. These are classified as Catchments 4 and 5. The areas west of Gordon Street (Catchment 4) were allocated to the Poppy Drive sewer, and those to the east of Gordon Street (Catchment 5) were allocated to the Hawkins Drive sewer. Based on the updated wastewater modelling, these existing sewer stretches have adequate available capacity to accommodate wastewater flows generated from these two catchments. The internal servicing concept/sewersheds are provided in Figure 3.2.5. In addition to the general gravity servicing, the figure also shows the three pumping stations; SPS-1, SPS-2 and SPS-3.

3.2.3.5 Water Reuse – Purple Pipe Option

In several jurisdictions, the implementation of water reuse systems, referred to as the purple pipe systems, have been proposed due to water scarcity. These areas have thereby introduced detailed legislation governing its implementation. Most areas in Canada do not have a shortage of water, and as such, there is minimal legislation governing the implementation of water reuse systems such as the "Purple" Pipe scenario.

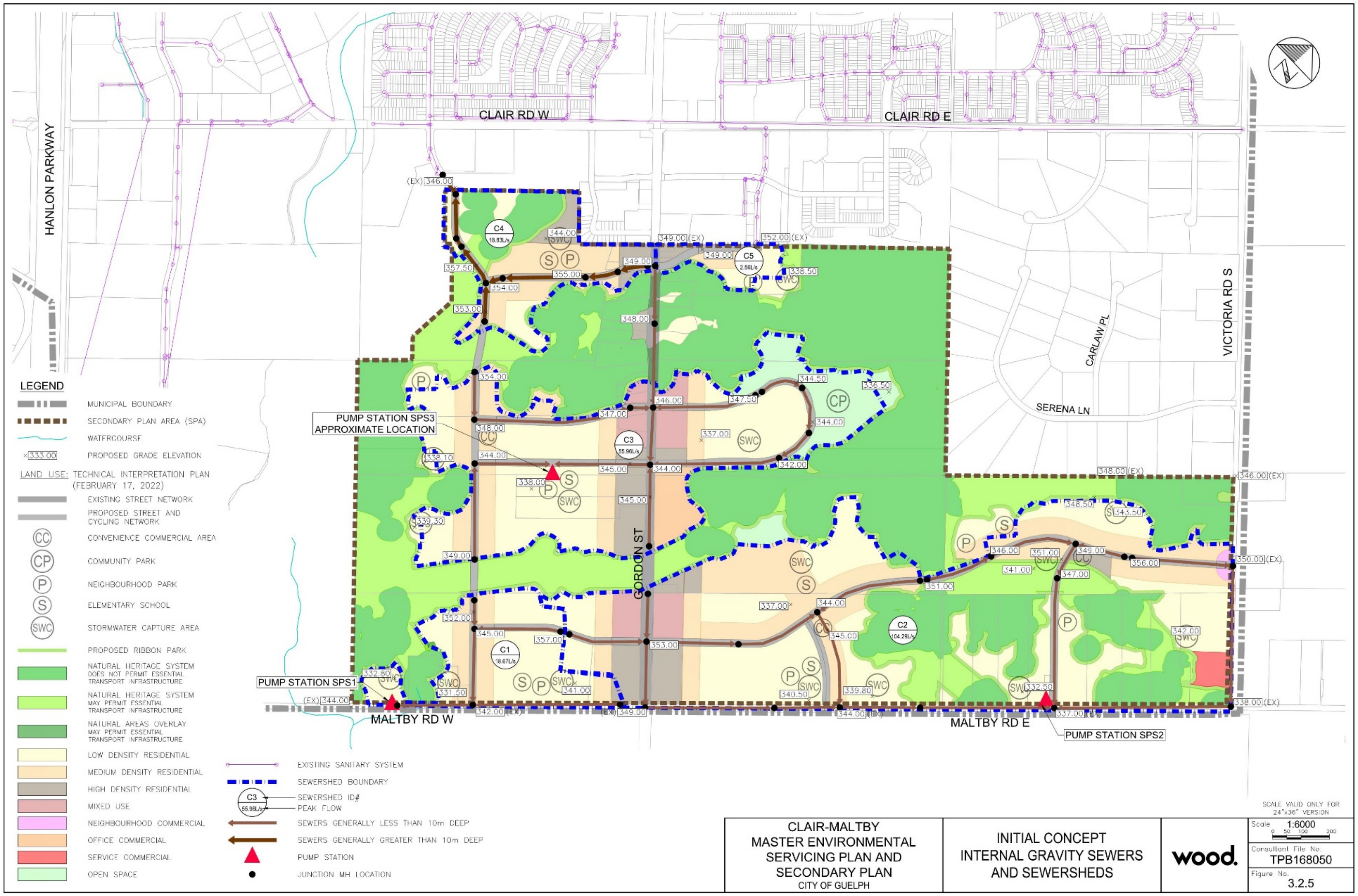
Per the United States Environmental Protection Agency (EPA), treated wastewater effluent of different quality can find beneficial use as follows:

- Unrestricted Urban Reuse and Recreational Use such as irrigation of parks, decorative fountains, fire protection etc.;
- Restricted Urban Reuse such as street cleaning, sewer flushing etc., where no contact with general public is prevalent;
- Industrial Reuse such as boiler feed, cooling towers etc.; and,
- Groundwater Recharge.

In order to obtain maximum utilization of treated water for reuse, effluent must be treated to achieve unrestricted urban reuse and recreational use, where the general public could have contact with this water. Additionally, City-wide infrastructure would be required, which would include further treatment and storage, conveyance and pumping infrastructure in the form of either bulk reuse water dispensing stations, or an infrastructure of pipes and pumps. Standard operating procedures and protocols will need to be written for utilizing this resource.

It is considered that a City-wide study is best suited to evaluate the pros and cons of this alternative and establish the cost vs benefit of implementing this alternative. It would not be cost-effective to design and construct infrastructure to treat, store, pump and convey reuse water solely for the CMSP lands. As the current study focuses on CMSP lands only, this alternative has not been considered for further analysis at this time.

Figure 3.2.5. Initial Concept – Internal Gravity Sewers and Sewersheds Water Reuse – Purple Pipe Option



3.2.4 Alternatives

The wastewater servicing alternatives have been developed, giving due consideration to the available capacity within the existing trunk sewers. Internal gravity servicing within the CMSP lands has been largely kept similar for the different servicing alternatives. The forcemains from the three pumping stations have been routed differently for the various servicing alternatives. Servicing strategies for Catchments 4 and 5 are consistent across all servicing alternatives. The wastewater servicing alternatives are presented below:

3.2.4.1 Alternative 1: Do-Nothing

This alternative would not implement any infrastructure to service the CMSP lands for wastewater. As such there would be no municipal wastewater services for the planned growth. This alternative does not present a viable solution to service the CMSP lands nor does it address the Problem/Opportunity Statement.

3.2.4.2 Alternative 2: Limit Community Growth

This alternative will generally involve limiting growth to below the levels identified in the planning Secondary Plan. The limitation in growth could limit the geographical area of development, reduce population density, or both. Limiting community growth would result in not achieving the growth targets identified in the planning studies and would therefore, not meet the planned growth targets. As such, limiting community growth to minimize/eliminate infrastructure upgrades is not a viable solution to service the CMSP lands.

3.2.4.3 Alternative 3: East Connection – Victoria Road Trunk

In the Victoria Road trunk alternative, wastewater would be conveyed from the CMSP lands to the Victoria Road trunk sewer system. In this alternative, wastewater flows collected at SPS-1 and SPS-3 are pumped to the sewer along Maltby Road to be conveyed to SPS-2. SPS-2 would collect flows for Catchments 1, 2, and 3 and will pump these wastewater flows to the existing sewer on Victoria Road, at a point north of Stone Road (MH-GIS2013-6715), which is downstream of the Kortright Pumping Station. Wastewater collected from catchments 4 and 5 would be conveyed to the City's existing sewer system as described in Section 3.2.1.

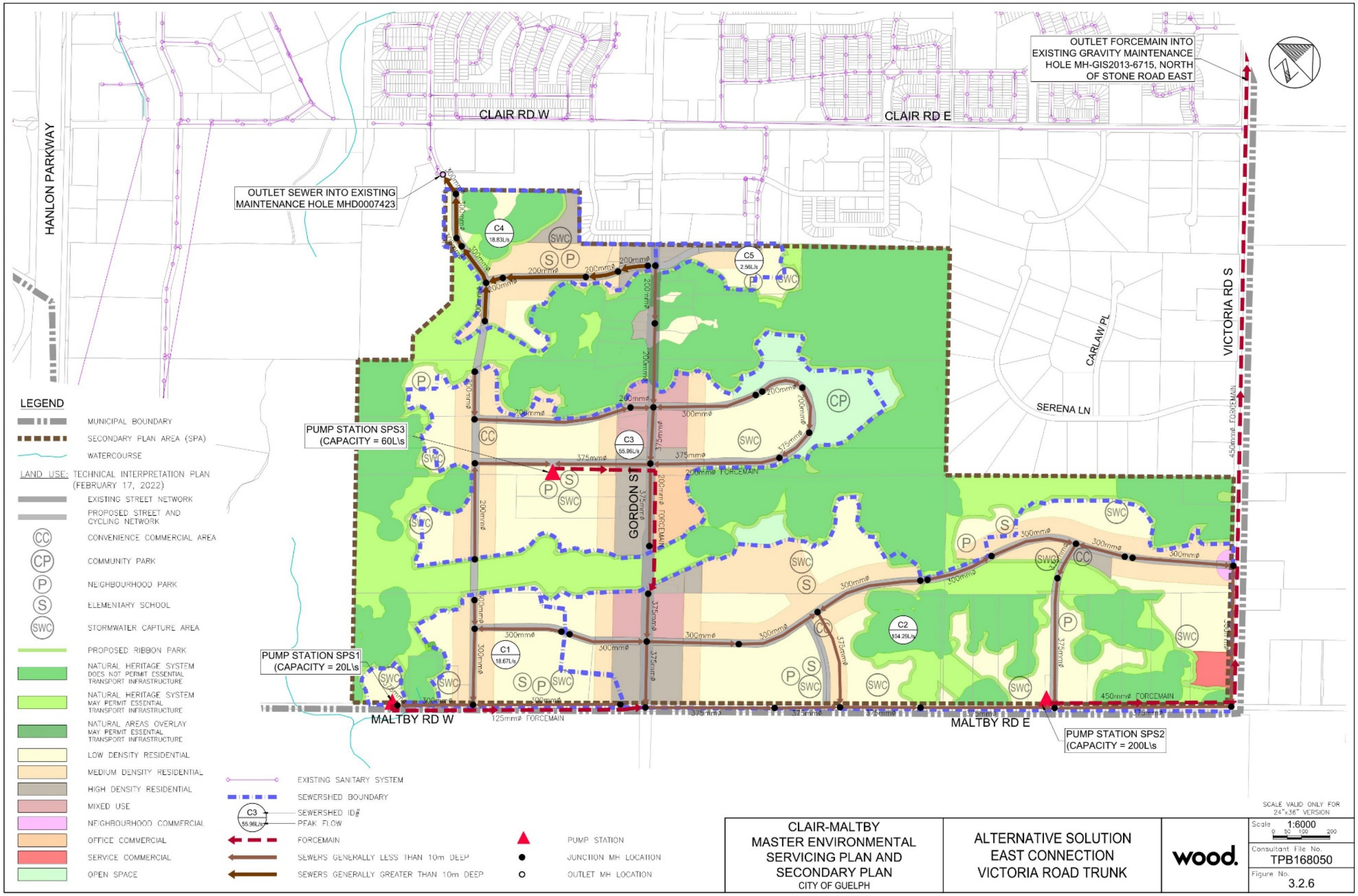
According to the wastewater modelling analysis carried out in the updated model received in 2020, it has been concluded that infrastructure downstream of the proposed maintenance hole MH-GIS2013-6715 would have adequate capacity to convey 100 per cent of the flows from the CMSP lands without the need for upgrades. As this connection point is downstream of the Kortright Pumping Station, its expansion will also not be required.

As discussed previously, the gravity infrastructure schematic and sizing is consistent across the servicing alternatives. However, depending upon the connection points, the pumping station capacities, forcemain diameters and lengths will be different depending on the alternative. This information for the Victoria Road Trunk alternative is presented in **Table 3.2.1**.

Table 3.2.1. Sanitary Sewer, Pump and Forcemain Information for the Victoria Road Trunk Alternative

Total Length of 200 mm Sewers	**2.7 km**
Total Length of 300 mm Sewers	5.2 km
Total Length of 375 mm Sewers	5.2 km
SPS-1 Capacity	20 L/s
SPS-2 Capacity	200 L/s
SPS-3 Capacity	60 L/s
FM-1 Diameter, Length	125 mm, 0.9 km
FM-1 Diameter, Length	450 mm, 7.0 km
FM-1 Diameter, Length	200 mm, 1.0 km

Figure 3.2.6. Alternative Solution – East Connection - Victoria Road Trunk



3.2.4.4 Alternative 4: Central Connection – Clair Gordon Trunk

In the Clair Gordon trunk alternative, wastewater would be conveyed from the CMSP lands to the Clair Gordon trunk sewer system. In this alternative, wastewater flows collected at SPS-1 and SPS-2 are pumped to Gordon Street and conveyed by gravity to SPS-3. SPS-3 will collect flows for Catchments 1, 2, and 3 and will pump these wastewater flows to the existing Clair Gordon trunk sewer. According to the wastewater modelling analysis carried out on the updated model received in 2020, surcharged sewers were observed downstream of existing maintenance hole MH-GIS2013-6404 at the intersection of Farley Drive and Goodwin Drive.

The hydraulic model did not show surcharging downstream of MHD0004348 to the Guelph Wastewater Treatment Plant and would be able to accommodate flow from the CMSP lands.

Maintenance hole MH-GIS2013-6404 is at the intersection of Farley Drive and Goodwin Drive, and MHD0004348 is located on an easement close to the Hanlon Park Mini Storage on Kirkby Court.

The sewer sections indicating surcharging within the modelling are within built up areas and replacing/twinning these sections of sewer will cause disruption to the public. The Forcemain from SPS-3 could be aligned along Gordon Street to avoid sanitary upgrades. However, this alternative would be very similar to the Southgate Hanlon Trunk alternative, discussed in the next section. Therefore, this option is not considered for further evaluation under this alternative.

For the purpose of this alternative, it has been assumed that the forcemain from SPS-3 would connect to MHD-GIS2013-6404, and the sewer sections showing surcharges (the Clair Gordon Bottleneck) will be replaced/twinned.

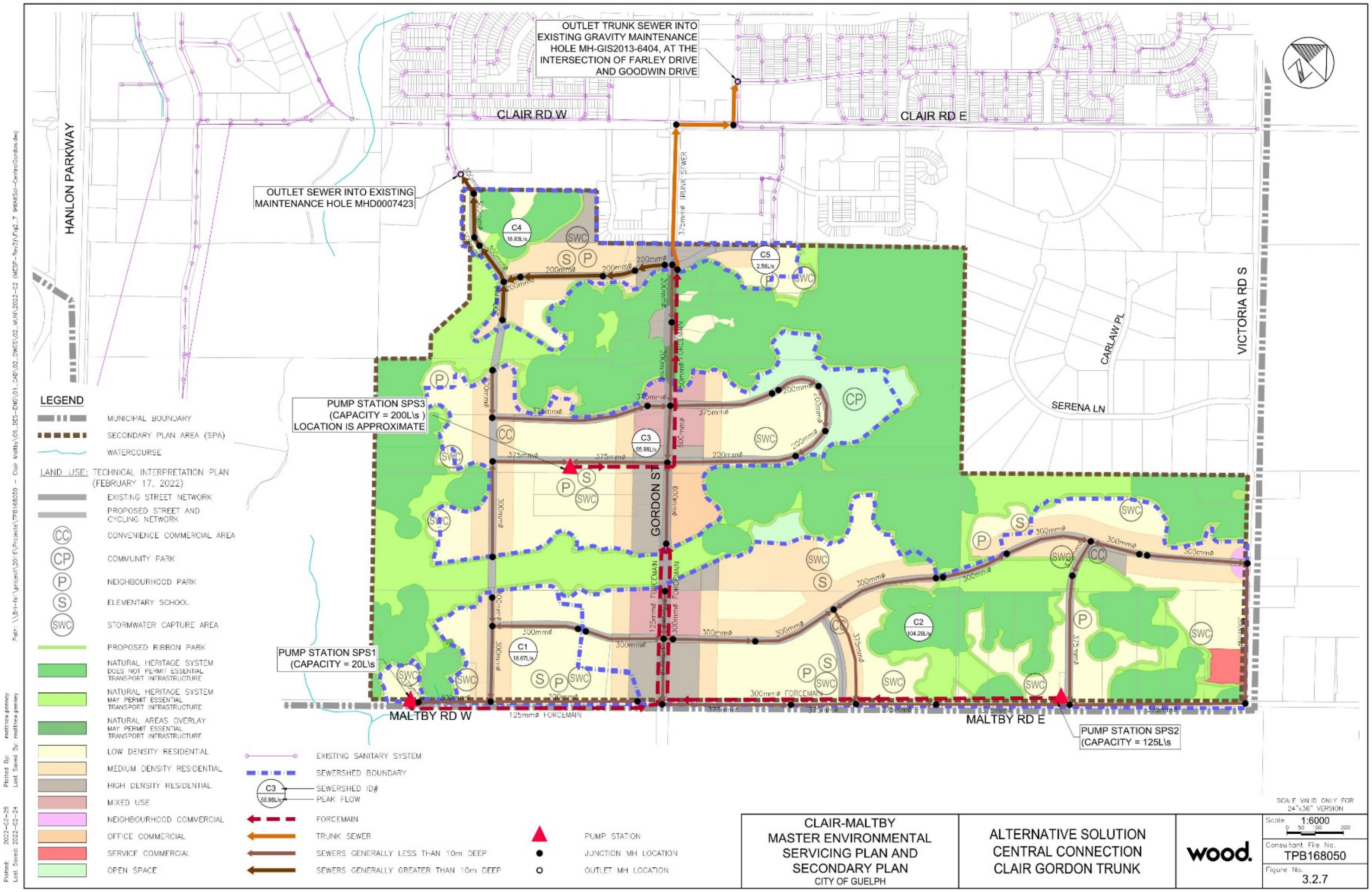
As discussed previously, the gravity infrastructure schematic and sizing will be generally consistent across the servicing alternatives except the sewers receiving forcemain discharge from another pumping station. However, depending upon the connection points, the pumping station capacities, forcemain diameters and lengths will be different depending on the alternative. This information for the Clair Gordon Trunk alternative is presented in **Table 3.2.2**.

Table 3.2.2. Pump and Forcemain Information for the Clair Gordon Trunk Alternative

Total Length of 200 mm Sewers (New Sewers)	**1.7 km**
Total Length of 300 mm Sewers (New Sewers)	5.2 km
Total Length of 375 mm Sewers (New Sewers)	4.4 km
Total Length of 600 mm Sewers (New Sewers)	1.7 km
Total Length of 200 mm Sewers (Twin Existing Sewers)	0.4 km
Total Length of 300 mm Sewers (Twin Existing Sewers)	0.8 km

Total Length of 375 mm Sewers (Twin Existing Sewers)	0.6 km
Total Length of 450 mm Sewers (Twin Existing Sewers)	1.0 km
Total Length of 600 mm Sewers (Twin Existing Sewers)	1.3 km
Total Length of 675 mm Sewers (Twin Existing Sewers)	0.7 km
SPS-1 Capacity	20 L/s
SPS-2 Capacity	125 L/s
SPS-3 Capacity	200 L/s
FM-1 Diameter, Length	125 mm, 1.5 km
FM-1 Diameter, Length	300 mm, 1.9 km
FM-1 Diameter, Length	450 mm, 1.2 km

Figure 3.2.7. Alternative Solution – Central Connection – Clair Gordon Trunk



3.2.4.5 Alternative 5: West Connection – Southgate Hanlon Trunk

In the Southgate Hanlon trunk alternative, wastewater would be conveyed from the CMSP lands to a new trunk sewer system on Gordon Street and Clair Road, eventually flowing into the Hanlon Trunk system. In this alternative, wastewater flows collected at SPS-1 and SPS-2 are pumped to be conveyed to SPS-3. SPS-3 will collect flows for Catchments 1, 2, and 3 and will pump these wastewater flows to a new 525mm Trunk Sewer. The new trunk sewer will convey flows along Gordon Street and Clair Road and north along the east side of Hanlon Parkway to connect directly to Maintenance Hole MHD0002142.

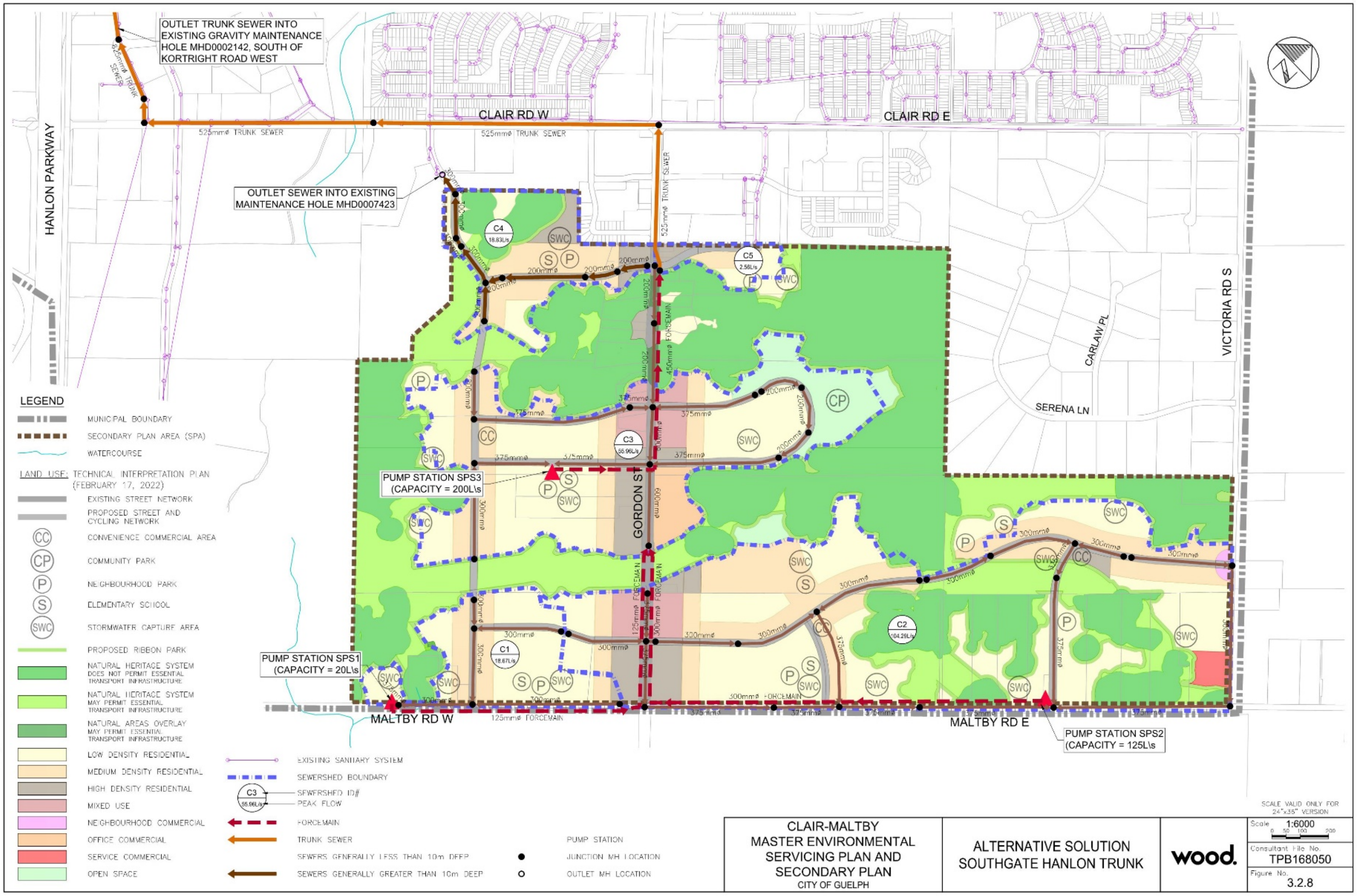
According to the wastewater modelling analysis carried out on the updated model received in 2020, the hydraulic model did not show surcharges downstream of MHD0002142 to the Guelph Wastewater Treatment Plant and will be able to accommodate flow from the CMSP lands.

As discussed previously, the gravity infrastructure schematic and sizing will be generally consistent across the servicing alternatives except the sewers receiving forcemain discharge from another pumping station. However, depending upon the connection points, the pumping station capacities, forcemain diameters and lengths will be different depending on the alternative. This information for the Southgate Hanlon Trunk alternative is presented in the Table 3.2.3**.**

Table 3.2.3. Pump and Forcemain Information for the Southgate Hanlon Trunk Alternative

Total Length of 200 mm Sewers	1.7 km
Total Length of 300 mm Sewers	5.2 km
Total Length of 375 mm Sewers	4.5 km
Total Length of 525 mm Sewers	2.4 km
Total Length of 600 mm Sewers	1.7 km
Total Length of 825 mm Sewers	2.8 km
SPS-1 Capacity	20 L/s
SPS-2 Capacity	125 L/s
SPS-3 Capacity	200 L/s
FM-1 Diameter, Length	125 mm, 1.5 km
FM-2 Diameter, Length	300 mm, 1.9 km
FM-3 Diameter, Length	450 mm, 1.2 km

Figure 3.2.8. Alternative Solution –West Connection – Southgate Hanlon Trunk



3.2.4.6 Alternative 6: West Connection – Southgate Industrial

The Southgate Industrial alternative is a variation of the Southgate Hanlon Alternative Solution presented in the previous section. This Alternative gives consideration to the servicing required for the extension of Southgate Road to Maltby Road for the extensions of the Southgate Business Park.

Based on the topography, it is expected that the servicing for the Southgate Road extension will require a sewage pumping station for the collection of wastewater from the lands serviced by the extension. The servicing alternative was based on Southgate Phase 2 Draft Plan (2006) which has since expired but which provides sufficient detail for an initial assessment of the alternative.

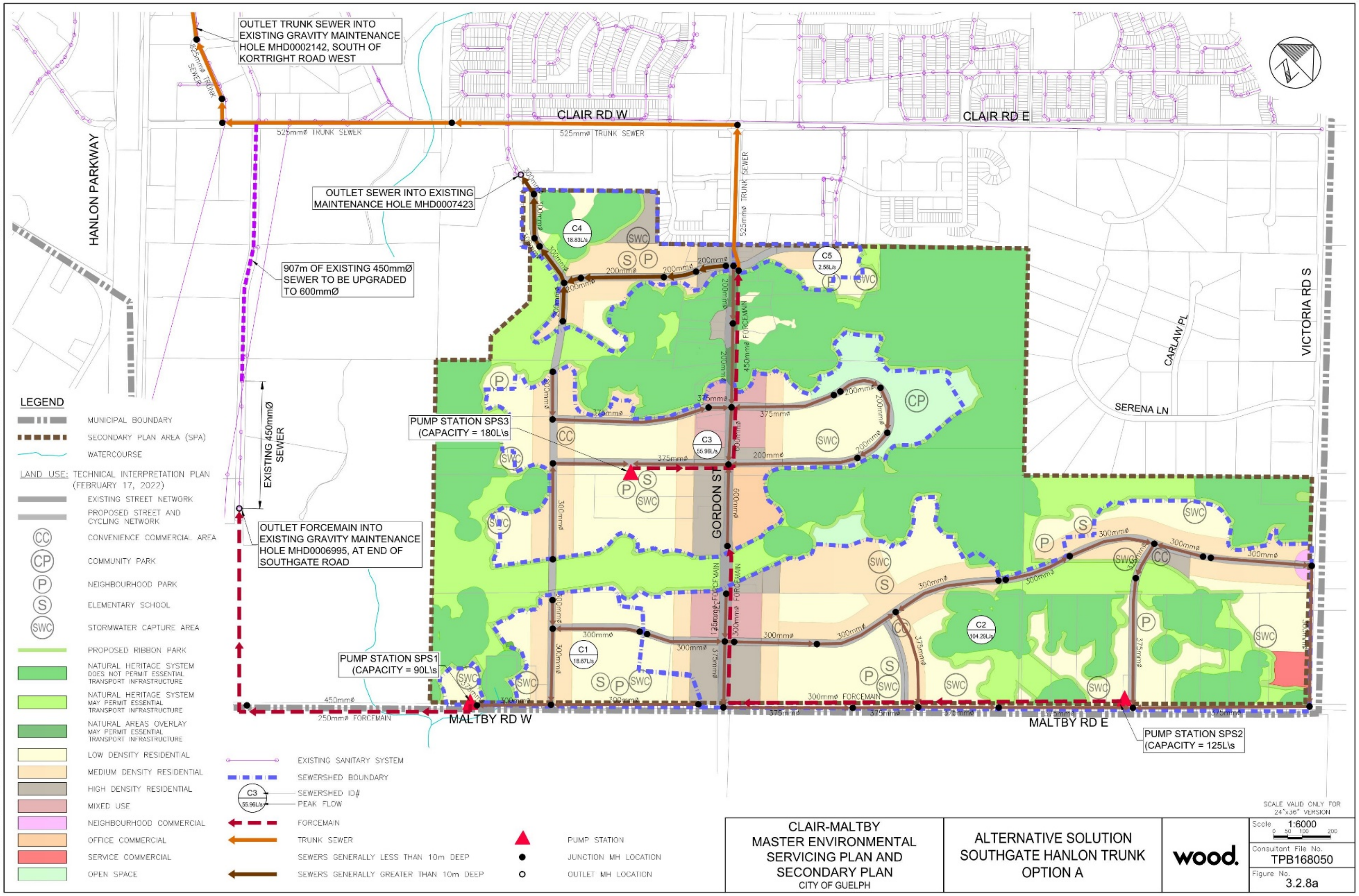
The primary difference between this alternative and the Southgate Hanlon alternative is SPS-1 receives wastewater from the Southgate Industrial Park in addition to the flow from the CMSP lands and the forcemain from SPS-1 is directed to Southgate Drive. The additional flow from lands outside the CMSP lands results in increases in size for SPS-1, from 20 l/s to 90 l/s to accommodate the additional flow. As SPS-1 no longer directs flow to SPS-1, the size of SPS-1 reduces slightly from 200l/s to 180 l/s. Additionally, approximately 900m of existing 450mm diameter wastewater line on Southgate Drive will need to be upsized to 600mm diameter to accommodate the flows. Note that these elements are shown in the plan, however they have not been included in the subsequent costing section to allow for comparative evaluation with the other alternatives.

The remainder of the collection systems is essentially unchanged from the Southgate Hanlon Alternative. This information for the Southgate Hanlon Trunk alternative is presented in the Table 3.2.4**.**

Table 3.2.4. Pump and Forcemain Information for the Southgate Industrial Alternative

Total Length of 200 mm Sewers	**1.7 km**
Total Length of 300 mm Sewers	5.2 km
Total Length of 375 mm Sewers	4.5 km
Total Length of 450 mm Sewers	1.7 km
Total Length of 525 mm Sewers	2.4 km
Total Length of 600 mm Sewers	1.7 km
Total Length of 825 mm Sewers	2.8 km
SPS-1 Capacity	90 L/s
SPS-2 Capacity	125 L/s
SPS-3 Capacity	180 L/s
FM-1 Diameter, Length	250 mm, 1.5 km
FM-2 Diameter, Length	300 mm, 1.9 km
FM-3 Diameter, Length	450 mm, 1.2 km

Figure 3.2.9. Alternative Solution – West Connection – Southgate Industrial



3.2.4.7 Alternative 7: West Connection – Southend Park and Valley Land Trunk

In the Southend Park and Valley Land trunk alternative, wastewater is conveyed from the CMSP lands to the trunk sewer system on Southgate Drive, eventually flowing into the Hanlon Trunk system. The alternative presents the connection point, which is very close to the connection point in the Southgate Hanlon Trunk alternative. However, the internal servicing as well the alignment of a new trunk sewer to convey wastewater flows is different from the Southgate Hanlon Trunk alternative.

In this alternative, the internal servicing is configured differently from the previously discussed servicing alternatives. Catchment 1 covers a much smaller area, and drains towards its lowest point, from where, wastewater gets pumped north to a gravity sewer. Wastewater flow on the south and east sides of Catchment 2 is collected and conveyed through sewers along Maltby Road and Victoria Road respectively and is conveyed to a pump station within Catchment 2, from where, it is pumped to a sewer along the north side of Catchment 2, which conveys wastewater westwards.

Along its route travelling northwards, the gravity sewer also picks up wastewater flows from catchment 3, and conveys collected wastewater through an easement through Valley Land and eventually connects to the existing trunk sewer leading to the Guelph WWTP at an easement close to Kirkby Road. As there is a low point in the east side of Catchment 3, wastewater is collected to a sewage pumping station, from where, it is lifted pumped and conveyed to a sewer connecting to the sewer conveying flows from Catchments 1 and 2. Catchment 4 is a small catchment and conveys wastewater flows to the existing sanitary sewer on Poppy Drive. As the wastewater flows from this catchment are relatively small, the existing downstream sewer would be capable of conveying the collected flow without surcharging the existing sewer. Catchment 5 is east of Gordon Street, and collects and conveys wastewater flows to an existing sewer along Hawkins Drive. This sewer and downstream infrastructure are also capable of conveying the flows collected from Catchment 5 to the Guelph WWTP without causing surcharge in the sewer system.

In this alternative, wastewater flows collected at SPS-1, SPS-2 and SPS-3 would be pumped to a gravity sewer. Each SPS will operate independently of each other. According to the wastewater modelling carried out on the updated wastewater model provided in 2020, the connection point downstream of which, there would not be any surcharges to the Guelph WWTP at MHD0005252, which is south of Kortright Road West and east of Berry Drive. This connection point is further downstream of that identified in the modelling exercise carried out with the earlier version of the model provided in 2018. This is illustrated on Figure 3.2.0 earlier in this section.

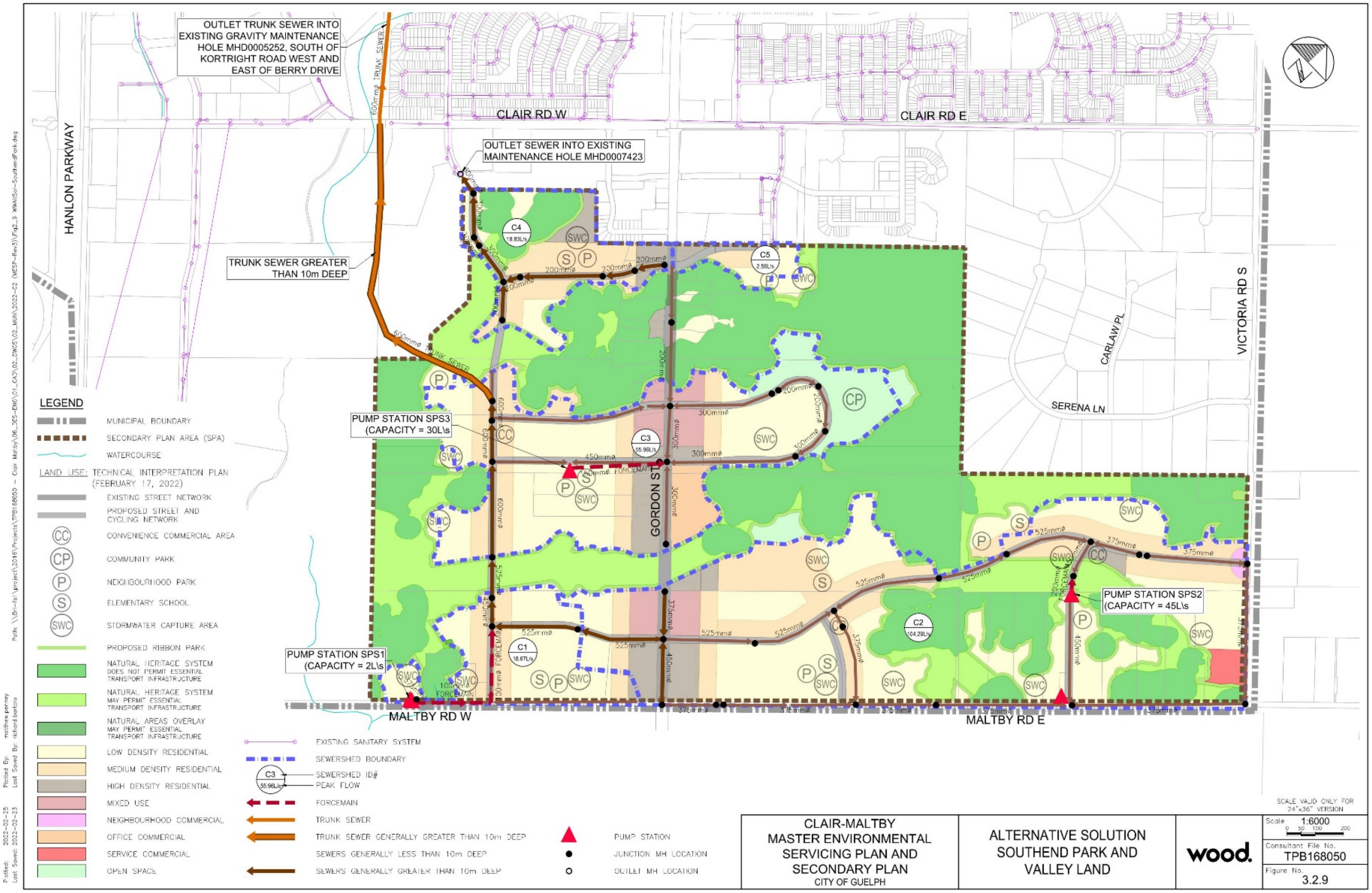
While the benefits are apparent, this alternative does have significant challenges. As the majority of the gravity route for the Southend Park Valley Land Trunk Alternative is not within a ROW, it is expected that maintenance access for this alternative will be very challenging. It is understood that roadways though natural habitat will not be supported. It should also be noted that the alignment will impact the Hanlon Creek Swamp, a Provincially Significant Wetland. Lastly, it is expected that open cut construction will be very challenging given the depth of water table in the area.

The information for the pump station capacity and forcemain diameter and length for the Southend Park and Valley Land alignment alternative is presented in Table 3.2.5.

Table 3.2.5. Pump and Forcemain Information for the Southend Park Valley Land Trunk Alternative

Total Length of 200 mm Sewers	**1.3 km**
Total Length of 300 mm Sewers	1.9 km
Total Length of 375 mm Sewers	5.3 km
Total Length of 450 mm Sewers	1.5 km
Total Length of 525 mm Sewers	2.4 km
Total Length of 600 mm Sewers	0.6 km
Total Length of Trunk Sewer (Average 10 m Depth)	4.1 km
SPS-1 Capacity	2 L/s
SPS-2 Capacity	45 L/s
SPS-3 Capacity	30 L/s
FM-1 Diameter, Length	100 mm, 0.6 km
FM-2 Diameter, Length	200 mm, 0.02 km
FM-3 Diameter, Length	150 mm, 0.6 km

Figure 3.2.10. Alternative Solution – West Connection – Southend Park and Valley Land Trunk



3.2.4.8 Alternative 8: Optimized Valley Lands / Southgate Hanlon

This alternative involves combining the advantages of Alternatives 5 and 7 and addressing their constraints, in the Optimized Valley Lands / Southgate Hanlon Trunk alternative, whereby wastewater is conveyed from the CMSP lands though a reconfigured upstream portion of Alternative 7 and the downstream section of Alternative 5.

Sanitary flows from Catchment 1 are pumped along Street A to the proposed 525mm diameter trunk. Sanitary flows from Catchment 2 are pumped west, along Street E, and then north along Gordon Street to the gravity Catchment 3A. Sanitary Catchment 3A drains all the lands owned by the owners of 2021, 2093, 2143, and 2187, while also taking flows from the proposed high-density development corridor along Gordon Street via gravity. Sanitary Catchment 3B would flow by gravity to SPS-3, which is relocated west of Gordon Street.

Sanitary Catchments 4 and 5 will be serviced by gravity in the same manner as previously outlined in the Southend Park and Valley Land Trunk and Southgate Hanlon Trunk alternatives.

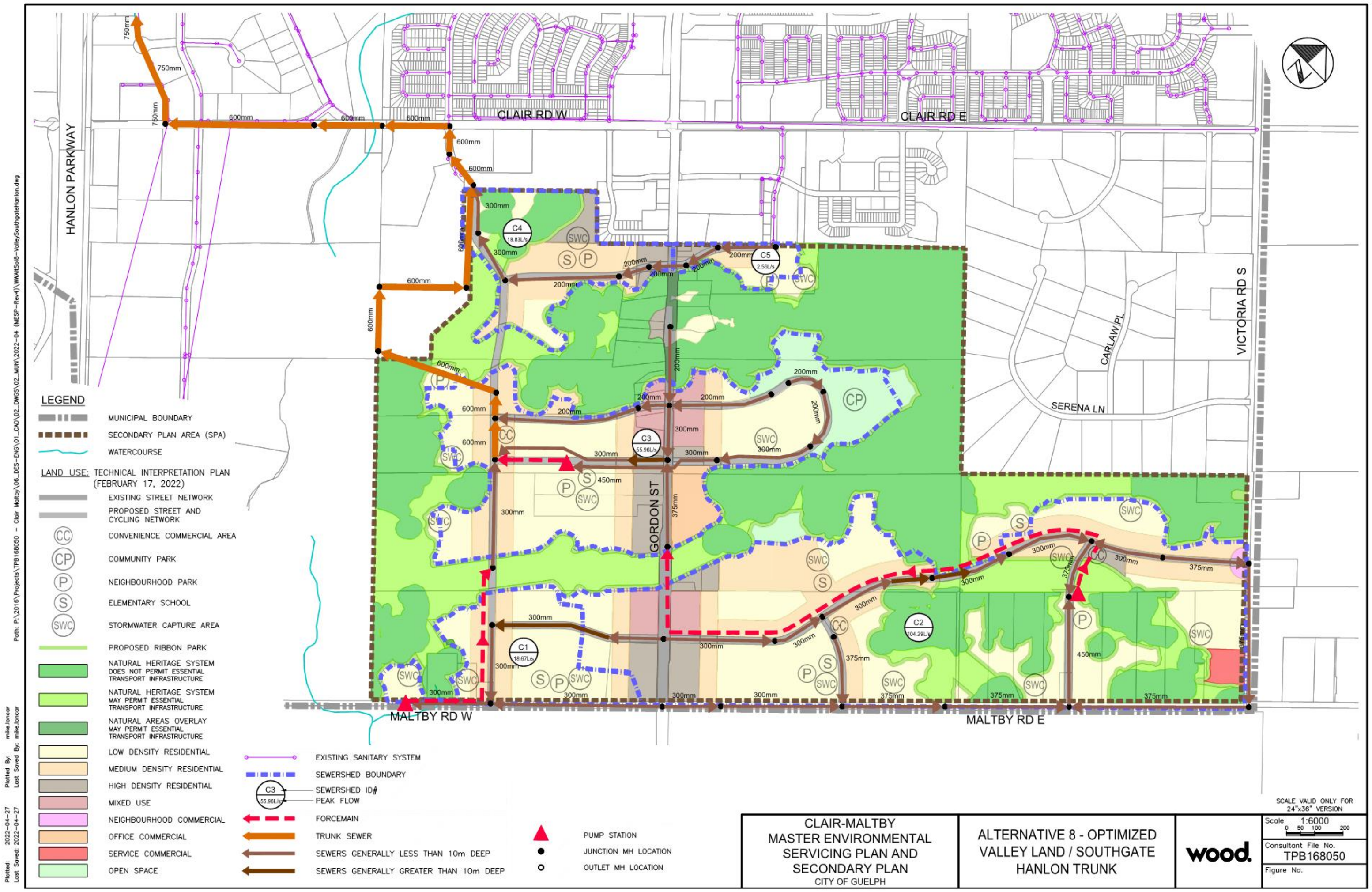
The route avoids the Valley Lands by cutting through recreational sports fields and connecting to Poppy Road.

This scenario includes a new gravity trunk combining with the updated forcemain and 3 pump stations, ultimately connecting to existing trunk system on Jean Anderson Crescent. The proposed trunk main follows the same design criteria as the Gordon/Clair Trunk alternative in terms of the cover depth, slope range and the velocity. The Sanitary model has been updated for this optimized solution and even though SPS 3 is removed from its previous location East of Gordon Street, it would still be required as per the revised sanitary collection route/pipe inverts at the east side of Gordon Street. The existing trunk main would be under the surcharge condition regardless of additional contribution from the future development.

Table 3.2.6 Pump and Forcemain Information for the Optimized Valley Lands / Southgate Hanlon Alternative – Alternative 8 – Optimized Valley Lands / Southgate Hanlon Trunks

Total length of 200mm sewers	2.7 km
Total length of 300mm sewers	6.2 km
Total length of 375mm sewers	3.0 km
Total length of 450mm sewers	1.1 km
Total length of 600mm sewers	2.7 km
Total length of 750mm sewers	2.8 km
SPS-1 Capacity	24 L/s
SPS-2 Capacity	126 L/s
SPS-3 Capacity	9 L/s
FM-1 Diameter, Length	150 mm, 0.7 km
FM-2 Diameter, Length	300 mm, 2.1 km
FM-3 Diameter, Length	150 mm, 0.3 km

Figure 3.2.11 Alternative Solution 8 Optimized Valley Land / Southgate Hanlon Trunk



3.2.4.9 Alternative 9: Gordon / Southgate Hanlon

The Gordon / Southgate Hanlon alternative was developed in an attempt to eliminate in-line pumping as well as to alleviate some concerns with the alternatives previously evaluated.

This option has the main gravity trunk running along Gordon Street from Street D along Clair Road and ultimately to the final outlet located northeast of Hanlon.

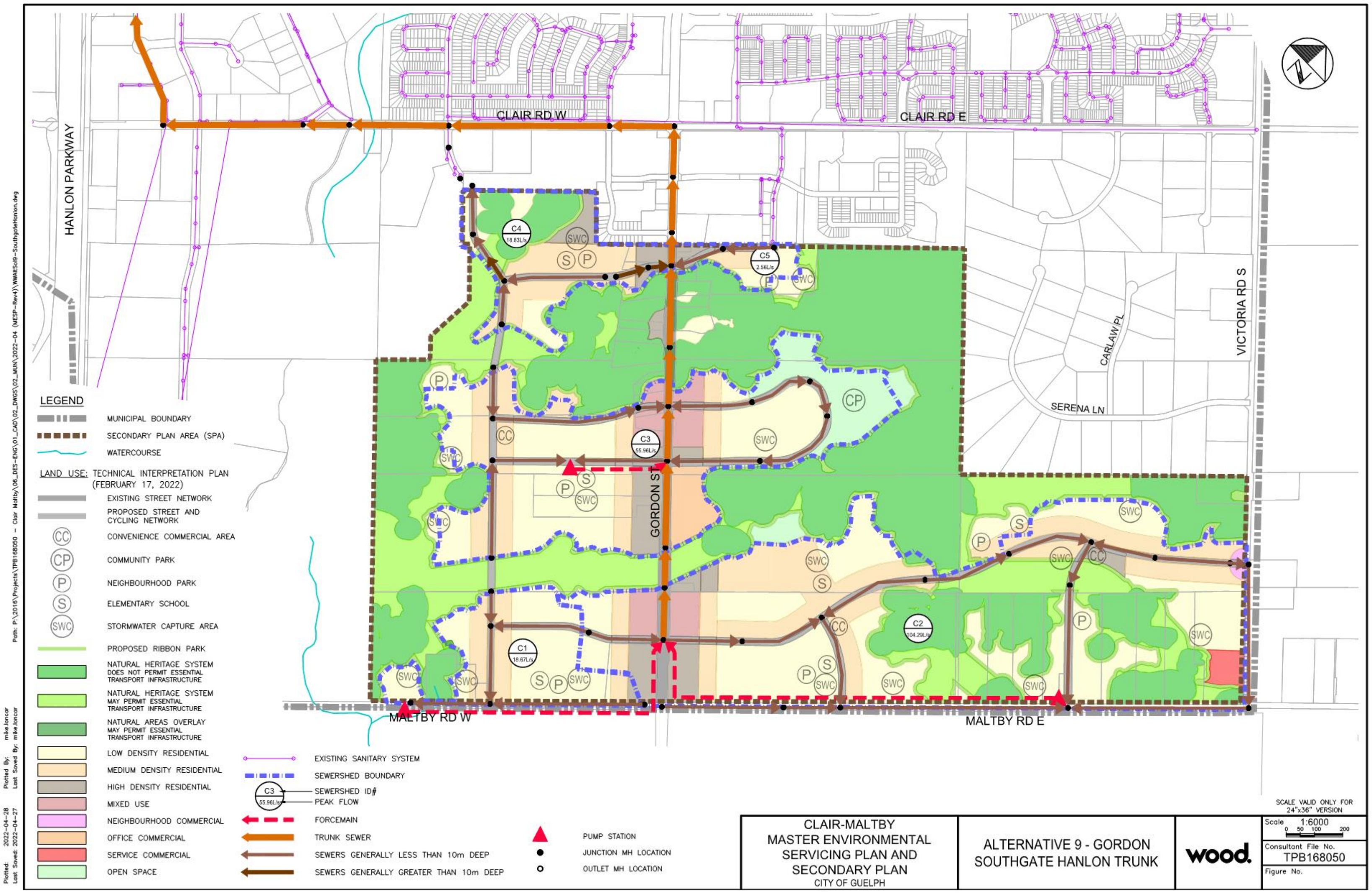
The main trunk design meets the requirements in terms of the cover depth, slope range and minimum velocity. Based on the updated model, approximately 250m of trunk main would be deeper than 10m. In this alternative, SPS 1, 2 and 3 individually contribute local flows to the trunk main.

Capacities for PS-1 and PS-2 are slightly reduced while PS-3 is greatly reduced, and this solution works from a downstream connection elevation standpoint.

Table 3.2.7 Pump and Forcemain Information for the Gordon / Southgate Hanlon Alternative - Alternative 9 – Gordon / Southgate Hanlon Trunk

Total length of 200mm sewers	2.1 km
Total length of 300mm sewers	6.6 km
Total length of 375mm sewers	2.6 km
Total length of 450mm sewers	0.3 km
Total length of 600mm sewers	1.5 km
Total length of 750mm sewers	1.8 km
Total length of 900mm sewers	2.8 km
SPS-1 Capacity	19 L/s
SPS-2 Capacity	113 L/s
SPS-3 Capacity	21 L/s
FM-1 Diameter, Length	150 mm, 1.1 km
FM-2 Diameter, Length	300 mm, 1.6 km
FM-3 Diameter, Length	150 mm, 0.4 km

Figure 3.2.12 Alternative Solution 9 Gordon / Southgate Hanlon Trunk



3.2.5 Economics of Wastewater Servicing Alternatives

This section discusses the economics of the different wastewater servicing alternatives. Order of magnitude cost estimates were developed for the various wastewater loading and collection for each of the alternatives. These are based on information extracted from recent tenders for the City of Guelph (provided by the City), Pump Station Design by R. Sanks (2006), and Engineering News Record (ENR) cost data prorated for greater depths and indexed to 2020. The cost numbers were suitably interpolated to reflect the current servicing sizes and capacities.

Annual Operating and Maintenance costs have been estimated based on a percentage of capital costs as follows:

Wastewater Piping <10m Depth:	1.0% of Capital Cost
Wastewater Piping >10m depth:	2.5% of Capital Cost
Sewage Pumping Station (including energy costs)	5.0% of Capital Cost

Property costs have been assessed at an estimated \$800,000 per acre, or \$198/m^2. Easements costs have not been included as they are considered incidental (\$0.5/m^2).

Pump Station Emergency overflows (assuming overflow to lined SWCA Forebays) have been estimated at \$100,000 inclusive of piping, valving, controls and forebay lining.

3.2.5.1 Alternative 3: East Connection – Victoria Road Trunk

The Victoria Road Trunk alternative proposes the second smallest pump station capacity as compared to the other three alternatives and as such, the pump station costs are a relatively minor component of the overall cost. The forcemains, however, are also the longest of all the other alternatives and as such are relatively expensive compared to the other alternatives. The major cost component for this alternative is the sanitary forcemains. FM-2 is almost 7km long and is the single most expensive element in the alternative.

The estimated capital cost for implementing this solution is \$30.6 Million as given in **Table 3.2.6**.

Table 3.2.6. Estimated Cost – East Connection Alternative – Victoria Road Trunk

Gravity Sewers	$10.2 Million
Sewage Pump Station (SPS) - 1	$0.7 Million
Sewage Pump Station (SPS) – 2	$4.7 Million
Sewage Pump Station (SPS) - 3	$1.6 Million
Forcemain - 1	$0.6 Million
Forcemain - 2	$10.4 Million
Forcemain - 3	$0.8 Million
Property Costs	$1.6 Million
Total Cost for East Connection Alternative – Victoria Road Trunk	**$30.6 Million**
Estimated Annual O&M Costs	$506 K per year

3.2.5.2 Alternative 4: Central Connection – Clair Gordon Trunk

The Clair Gordon Trunk alternative proposes to upgrade the section of sanitary sewer termed the Clair-Maltby bottleneck by twinning the existing sewers and as such, the sewer twinning costs are unique to this alternative. The forcemains, are much shorter in length than the Victoria Road alternative and are similar in length and cost to the Southgate Hanlon and South Industrial options. The major cost additional cost component for this alternative is the twinning of existing sewers, which is not present in any other alternative.

The estimated capital cost for implementing this solution is $33.7 Million as given in **Table 3.2.7**.

Table 3.2.7. Estimated Cost – Central Connection Alternative – Clair Gordon Trunk

Gravity Sewers	**$10.2 Million**
Twinning of Existing Sewers	$8.1 Million
Sewage Pump Station (SPS) - 1	$0.7 Million
Sewage Pump Station (SPS) – 2	$3.1 Million
Sewage Pump Station (SPS) - 3	$4.8 Million
Forcemain - 1	$1.0 Million
Forcemain - 2	$2.4 Million
Forcemain - 3	$1.8 Million
Property Costs	$1.6 Million
Total Cost for Central Connection Alternative – Clair Gordon Trunk	**$33.7 Million**
Estimated Annual O&M Costs	$787 K per year

3.2.5.3 Alternative 5: West Connection – Southgate Hanlon Trunk

This alternative is associated with the lowest capital costs of all the alternatives examined. The major cost component is the internal sewers. The pumping stations and forcemains are similar to the Clair Gordon Alternative. This alternative provides a balance of all wastewater collection elements. There are no exceptionally long forcemains, or an exceptional number of deep sewers, there are no significant property or easement requirements, and it does not require significant twinning of services through residential areas.

The estimated capital cost for implementing this solution is $29.1 Million as given in **Table 3.2.8**.

Table 3.2.8. Estimated Cost – West Connection Alternative – Southgate Hanlon Trunk

Gravity Sewers	**$13.7 Million**
Sewage Pump Station (SPS) - 1	$0.7 Million
Sewage Pump Station (SPS) – 2	$3.1 Million
Sewage Pump Station (SPS) - 3	$4.8 Million
Forcemain - 1	$1.0 Million
Forcemain - 2	$2.4 Million
Forcemain - 3	$1.8 Million
Property Costs	$1.6 Million
Total Cost for West Connection – Southgate Hanlon Trunk	**$29.1 M**
Estimated Annual O&M Costs	$720 K per year

3.2.5.4 Alternative 6: West Connection – Southgate Industrial

The Southgate Industrial alternative is a variation on the Southgate Hanlon Alternative which proposes an increased capacity for SPS -1 in order to accommodate the future flows from the extension to the industrial park. In this option flows are diverted from SPS-3 to Southgate Drive.

Additionally, some gravity piping has been included in this option to collect flows from the industrial park to SPS-1. This option will require some upsizing of existing infrastructure along Southgate Drive and Clair Rd.

The estimated capital cost for implementing this solution is $29.7 Million as given in **Table 3.2.9**. These are the costs associated with the CMSP lands only. The costs associated with the increased pump station capacity and forcemain diameter required to service the industrial lands have not been included.

Table 3.2.9. Estimated Cost – West Connection Alternative – Southgate Industrial

Gravity Sewers	$**14.6 Million**
Sewage Pump Station (SPS) - 1 *	$0.7 Million
Sewage Pump Station (SPS) – 2	$3.1 Million
Sewage Pump Station (SPS) - 3	$4.4 Million
Forcemain - 1*	$1.1 Million
Forcemain - 2	$2.4 Million
Forcemain - 3	$1.8 Million
Property Costs	$1.6 Million
Total Cost for West Connection – Southgate Hanlon Trunk	**$29.7M**
Estimated Annual O&M Costs*	$0.7M per year

*Capital and O&M Costs do not include increased pumping station size to accommodate Industrial Park expansion. Costs are shown for a 20 L/s pump station versus the 90 L/s pump station shown in Figure 3.2.9 in order to allow for comparison of the alternatives.

3.2.5.5 Alternative 7: West Connection – Southend Park and Valley Land Trunk

The Southend Park and Valley Land alignment alternative proposes smaller capacity pump stations as compared to the other three alternatives and as such, the pump station costs are a relatively minor component of the overall cost. The forcemains also are shorter in length and smaller in diameter and as such would cost relatively less than the other three alternatives. The major cost component for this alternative is the sanitary gravity sewers, as this is the only alternative which collects all flows into a gravity line withing the CMSP Lands. As such, the sewer diameters are larger.

This alternative differs from the others as the City will need to acquire an easement for the Southend Park Valley Land trunk sewer. Easement acquisition costs are negotiated with each affected landowner and as such, have not been included in the cost estimates. Notwithstanding the easement acquisition cost, this alternative is associated with the least capital cost.

The estimated capital cost for implementing this solution is $33.0 Million as given in **Table 3.2.10**.

Table 3.2.10. Estimated Cost – West Connection Alternative – Southend Park and Valley Land Route to South Hanlon Trunk

Gravity Sewers	**$16.5 Million**
Trunk Sewer (average 10 m Depth)	$11.7 Million
Sewage Pump Station (SPS) - 1	$0.2 Million
Sewage Pump Station (SPS) – 2	$1.3 Million
Sewage Pump Station (SPS) - 3	$0.8 Million
Forcemain - 1	$0.4 Million
Forcemain - 2	$0.1 Million
Forcemain - 3	$0.4 Million
Property Costs	$1.6 Million
Total Cost for West Connection Alternative – Southend park and Valley Land Route to South Hanlon Trunk	**$33.0 Million**
Estimated Annual O&M Costs	$575 K per year

3.2.4.13 Alternative 8: Optimized Valley Lands / Southgate Hanlon Trunk

The Optimized Valley Lands / Southgate Hanlon Trunk alternative proposes to optimize the pump station catchment configurations by relocating SPS3 west of Gordon Street and shortening the forcemains. This alternative also avoids sensitive Valley Lands by cutting through recreational sports fields and connecting to Poppy Drive. From Poppy Drive, the sanitary sewer ultimately connects to the existing trunk system on Jean Anderson Crescent which would need to be upgraded to a larger diameter sized trunk.

The estimated capital cost for implementing this solution is $35.7 Million as given in Table 3.2.11.

Table 3.2.11 Estimated Cost Alternative 8 Optimized Valley Lands / Southgate Hanlon Trunk

Gravity Sewers	**$26.38 Million**
Sewage Pump Station (SPS) - 1	$0.8 Million
Sewage Pump Station (SPS) – 2	$3.2 Million
Sewage Pump Station (SPS) - 3	$0.4 Million
Forcemain - 1	$0.5 Million
Forcemain - 2	$2.6 Million
Forcemain - 3	$0.2 Million
Property Costs	$1.6 Million
Total Cost for Optimized Valley Lands / Southgate Hanlon Trunk	**$35.70 Million**
Estimated Annual O&M Costs	$470 K per year

3.2.4.14 Alternative 9: Gordon / Southgate Hanlon Trunk

The Gordon / Southgate Hanlon Trunk alternative proposes to send all flows to a main central trunk on Gordon Street, eliminating double pumping and reducing the total amount of deep sewer installation.

The estimated capital cost for implementing this solution is $28.6 Million as given in Table 3.2.12.

Table 3.2.12 Estimated Cost Alternative 9 Gordon / Southgate Hanlon Trunk

Internal Sewers	**$19.7 Million**
Sewage Pump Station (SPS) - 1	$0.7 Million
Sewage Pump Station (SPS) – 2	$2.9 Million
Sewage Pump Station (SPS) - 3	$0.7 Million
Forcemain - 1	$0.8 Million
Forcemain - 2	$2.0 Million
Forcemain - 3	$0.28 Million
Property Costs	$1.6 Million
Total Cost for Gordon / Southgate Hanlon Trunk	**$28.6 Million**
Estimated Annual O&M Costs	$314 K per year

3.2.6 Assessment Criteria

The wastewater servicing alternatives noted above need to be evaluated systematically comparing the pros and cons of each alternative such that the servicing alternative that best meets the requirements of the subject lands could be put forth as the preferred alternative. In order to perform a meaningful comparison, detailed evaluation criteria need to be developed to ascertain the potential impacts of the various alternatives on the natural environment, social and cultural environment, costs etc. The next section details the various evaluation criteria that were selected to carry out the comparative analysis of the various servicing alternatives.

3.2.6.1 Evaluation Criteria

The following evaluation criteria have been prepared in order to carry out the comparative evaluation of the different wastewater servicing alternatives for the CMSP lands. The wastewater servicing alternatives have been compared with respect to the evaluation criteria presented below. As per the Municipal Environmental Assessment process, the selected criteria relate to the consideration of potential impacts and opportunities generated by the alternatives within four distinct categories:

Table 3.2.11. Wastewater Servicing Alternatives Evaluation Criteria

Environment	Criteria
Social/Cultural Environment	Impacts or opportunities created by the alternative as related to the people and their current or historic relationship with the study area.
Economic Environment	Capital, operation, and maintenance costs associated with an alternative.
Natural Environment	Impacts or opportunities that an alternative may have related to the natural environment (i.e., fisheries, wildlife, water quality, etc.).
Functional (Technical) Environment	Considers the ability of the alternative to address the Problem Statement and how it may impact existing physical systems. These include ease of maintenance, impact to existing infrastructure, ability to utilize available capacity in the existing infrastructure, capability of phased implementation, and ability to be implemented in concert with wastewater servicing.

Within each environment, relevant and representative criteria have been considered for the evaluation. Each evaluation criterion has been assessed to ensure it results in a meaningful comparison between the wastewater servicing alternatives.

Table 3.2.12. Wastewater Servicing Alternatives Evaluation Factors

Component	Category	Evaluation Criteria	Criteria Indicator	Potential Measure
Natural Environment	Terrestrial / Aquatic Environment Resources	Impact to Terrestrial / Aquatic Environment Resources	Potential adverse effects on ecological sensitive lands, impacts to water bodies and aquatic species.	Extent of impact
Social / Cultural	Impact on Local Residents and Businesses	Archaeological Resources[1.]	Potential adverse effects on archaeological resources	Extent of impact
Social / Cultural	Impact on Local Residents and Businesses	Cultural Heritage Resources[2.]	Potential adverse effects on cultural heritage resources	Extent of impact
Social / Cultural	Sustainable Growth	Impacts on Adjacent Properties	Potential adverse impacts to adjacent properties due to construction of solutions etc.	Number of private or public properties
Social / Cultural	Reliability	Prone to failure/breakdown	Potential adverse impact in the event of failure of system.	Extent of impact
Social / Cultural	Regulatory Environment	Compliance with provincial / municipal regulations and standards	Potential adverse impact due to inadequate infrastructure.	Extent of impact
Social / Cultural	Land use	Impact on surrounding land use.	Potential aesthetic impact, disruption to public life during construction/operation.	Noise, odour
Economic	Cost benefit over infrastructure lifecycle	Capital Cost	Design and construction costs	Estimated cost ($)
Economic	Cost benefit over infrastructure lifecycle	Maintenance Cost	Asset management costs (lifecycle)	Estimated cost ($)

Component	Category	Evaluation Criteria	Criteria Indicator	Potential Measure
Economic	Cost benefit over infrastructure lifecycle	Property Acquisition	Amount of private property required to achieve solution	Area in ha
Functional (Technical)	Ease of Maintenance	Maintainability	Adverse impact on system performance	Extent of impact
Functional (Technical)	Impact to Existing Infrastructure	Impact of new infrastructure on the existing infrastructure to meet its assigned/ allocated function	Sewer surcharges, Capacity exceedances at pumping stations and forcemains	Extent of impact
Functional (Technical)	Ability to Utilize Capacity in Existing Infrastructure	Ability of new infrastructure to utilize spare capacity within the existing infrastructure	Eliminating/minimizing requirement for upgrade/expansion to existing infrastructure	Extent of impact
Functional (Technical)	Capability of Phased Implementation	Ability of proposed scheme to be implemented in a phased manner over a period of time	Modularity/flexibility of the proposed servicing	Extent of flexibility in phasing
Functional (Technical)	Ability to be implemented in Concert with the Water Servicing Alternatives	Ability to be implemented within proximity of the water servicing	Physical proximity with water servicing	Extent of proximity
Functional (Technical)	Construction Difficulty	Ability to be implemented utilizing traditional Construction Techniques	Eliminating/ Minimizing locations of difficult construction	Extent of proximity

1. Combined into a single criterion due to common potential for impacts (spatially).
2. More related to detailed design versus planning stages thus removed from assessment.

Each of the wastewater servicing alternatives has been assessed using the evaluation categories, criteria and factors provided within Table 3.2.2. Alternatives 3, 4 and 5 are very similar to each other in terms of internal servicing of the CMSP lands. The key difference is that different forcemains convey to different receiving sewers within the CMSP lands. The other fundamental difference is that each of these three alternatives convey collected wastewater to different branches of the existing City of Guelph wastewater network. The following has been noted regarding the various alternatives under consideration:

3.2.6.2 Evaluation of Servicing Alternatives Against Each Criteria

Alternative 1: Do-Nothing: The Do-Nothing alternative for wastewater servicing would not cause disruption to the natural, social, and cultural environment. Neither would it provide any servicing in terms of infrastructure such as sewer pipes, maintenance holes, forcemains, valves, appurtenances, sanitary pumping stations. As a result, the CMSP development would be left without a piped sanitary collection system to convey collected wastewater to the Guelph Wastewater Treatment Plant. Therefore, this alternative does not meet the objective of development within the subject lands nor does it address the problem/opportunity statement and is not considered a viable alternative.

Alternative 2: Limit Community Development: Limiting community development potentially would reduce the adverse impact on the natural, social and cultural environment. It also would cost less to design, construct, operate and maintain the wastewater collection and pumping infrastructure to meet the reduced flows. However, this alternative also does not meet the objective of full development within the subject lands and is therefore, not considered a viable alternative.

Alternative 3: East Connection – Victoria Road Trunk: This alternative is anticipated to have the least impact on the local residents, as no sewer upgrades are required within the built-up areas. However, this alternative scores the lowest relative to other alternatives when it comes to operation and maintenance. This is primarily due to a long forcemain, which would be associated with the highest pumping cost. Odour issues associated with long forcemains may also be an issue.

Alternative 4: Central Connection – Clair Gordon Trunk: This alternative will include significant upgrades/twinning of existing sewers (more than other servicing alternatives) to provide capacity in the Clair Gordon Trunk system to accommodate CMSP wastewater flows. As such, this alternative will have the largest social/cultural impact in terms of disruption to daily life. This alternative is associated with the highest cost primarily due to a significant part of the existing sewer through the Clairfields Subdivision requiring upgrades.

Alternative 5: West Connection – Southgate Hanlon Trunk: This alternative is among the more favourable alternatives as compared to alternatives 3 and 4. As this alternative relies on three pump stations to service the entire subject lands, similar to alternatives 3 and 4, the reliability is slightly lower as compared to alternative 7, as a larger catchment area is dependent on the pump stations. Similarly, the operational cost for this alternative is expected to be higher than that for alternative 6 due to larger capacity pump stations.

Alternative 6: West Connection – Southgate Industrial: This alternative provides the benefit of acknowledging pending development outside the CMSP lands and implementing infrastructure which can support both developments. The operational cost for this alternative is expected to be significantly higher than that for the other alternatives due to larger capacity pump stations required to accept flow from outside the CMSP Lands.

Alternative 7: West Connection – Southend Park and Valleyland Trunk: This alternative presents the most reliable solution as not all the catchment areas are drained to sanitary pump stations and a significant part is captured directly by the gravity sewer system reducing the reliability on pumping. This arrangement also has the potential for less operating costs. However, the gravity solution would result in deeper sewers. Given the difficult topography of the CMSP lands, the modelling work has indicated that certain stretches will have sewer depths in excess of 10 m, going as deep as 15 m to 18 m at some locations. This would result in difficult and expensive construction and subsequent maintenance of sewers. Service easements across existing parcels will need to be acquired for the Valley Land Trunk sewer, whereas no external (outside CMSP) service easement is anticipated for sewer/forcemain installation under the other alternatives. Land requirements for the pumping stations are expected to be very similar between the alternatives as the number of pump stations remain the same. The only exception is SPS-1, which is expected to require less land for Alternative 6 due to significantly lesser flows. This alternative is associated with one of the highest capital costs, even excluding the costs of the easement acquisition for the trunk sewer easement.

Alternative 8: Valley Land / Southgate Hanlon Trunk: This alternative presents the advantages of both the Southgate Hanlon Trunk and the Valleyland Trunk, however, by addressing some of the constraints with the other alternatives, it represents a lengthy gravity sewer solution and also is the most expensive. This is, in part, caused by the routing of the trunk sewer in the South End Community Park area, which was required to ensure the trunk sewer could be accessed for maintenance.

Alternative 9: Gordon / Southgate Hanlon Trunk: This alternative presents the most direct and centralized solution minimizing both gravity sewers and forcemain and subsequently making it one of the most cost-efficient solutions and the least expensive to maintain.

3.2.6.3 Comparative Evaluation Matrix

The different alternatives were compared against each other with respect to the various criteria established in section 3.2.6.1. The comparative evaluation matrix is presented in the tables below.

Table 3.2.13. Wastewater Alternatives Evaluation Matrix

Category	Criteria	Criteria Indicator	Do Nothing (Alt 1)	Limit Community Growth (Alt 2)	East Connection – Victoria Road Trunk (Alt 3)	Central Connection – Clair Gordon Trunk (Alt 4)	West Connection – Southgate Hanlon Trunk (Alt 5)	West Connection – Southgate Industrial (Alt 6)	West Connection – Southend Valleylands Trunk (Alt 7)	Valley Land / Southgate Hanlon (Alt 8)	Gordon / Southgate Hanlon (Alt 9)
Natural Environment	Terrestrial / Aquatic Environment Resources	Potential adverse effects on ecological sensitive lands, impacts to water bodies and aquatic species.	No impact as no new lands will have to be developed or utilized.	Minimal impact anticipated, depending on the location and extent of services.	Limited impact anticipated as internal servicing would be along proposed roads. The Victoria Road Forcemain would also be along an existing Road.	Limited impact anticipated as internal servicing would be along proposed roads. Forcemain along Gordon Street.	Limited impact anticipated as internal servicing would be along proposed roads. Forcemain along Gordon Street, and Trunk Sewer along Clair Road.	Limited impact anticipated as internal servicing would be along proposed roads. Forcemain along Gordon Street, and Trunk Sewer along Clair Road.	Moderate impact anticipated as internal servicing would be along proposed roads. The trunk sewer is not aligned along a proposed road, while the alignment does not encroach on environmentally sensitive areas.	Minimal impact anticipated as internal servicing would be along proposed roads. The trunk alignment does not encroach on environmentall y sensitive areas.	Limited impact anticipated as internal servicing would be along proposed roads. Forcemain along Gordon Street and Trunk Sewer along Clair Road.
Social, Cultural Environment	Impact on Local Residents and Businesses	Cultural Heritage and Archaeology	No impact as no servicing will be provided.	No impact anticipated	While no upgrades of existing sewers are required, 7 km forcemain may cause odour issues.	Sewers along built up areas will need to be twinned / upgraded causing disruption to local residents and businesses.	Sewers along built up areas will need to be twinned / upgraded. The extent of upgrades is less than that of the Clair Gordon Trunk alternative.	Sewers along built up areas will need to be twinned / upgraded. The extent of upgrades is less than that of the Clair Gordon Trunk alternative.	Sewers along built up areas will need to be twinned / upgraded. The extent of upgrades is less than that of the Clair Gordon Trunk alternative.	Sewers along built up areas will need to be twinned / upgraded. The extent of upgrades is less than that of the Clair Gordon Trunk alternative.	Sewers along built up areas will need to be twinned / upgraded. The extent of upgrades is less than that of the Clair Gordon Trunk alternative.

Category	Criteria	Criteria Indicator	Do Nothing (Alt 1)	Limit Community Growth (Alt 2)	East Connection – Victoria Road Trunk (Alt 3)	Central Connection – Clair Gordon Trunk (Alt 4)	West Connection – Southgate Hanlon Trunk (Alt 5)	West Connection – Southgate Industrial (Alt 6)	West Connection – Southend Valleylands Trunk (Alt 7)	Valley Land / Southgate Hanlon (Alt 8)	Gordon / Southgate Hanlon (Alt 9)
Social, Cultural Environment	Sustainable Growth	Impacts on Adjacent Properties	No impact to adjacent properties as no servicing will be provided.	Limited impact to adjacent properties due to limited growth and greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development	Limited impact as most of the development is expected to be greenfield development.	Limited impact as most of the development is expected to be greenfield development	Limited impact as most of the development is expected to be greenfield development.
Social, Cultural Environment	Reliability	Prone to failure/breakdown	Not applicable	Dependent on the system configuration.	Reasonable reliability.	Reasonable reliability.	Reasonable reliability.	Reasonable reliability.	Most reliable option as large area is served through gravity servicing reducing the chances of breakdown	Reasonable reliability.	Reasonable reliability.
Social, Cultural Environment	Regulatory Environment	Compliance with provincial/ municipal regulations and standards	Not applicable	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.	Complies with guidelines.
Social, Cultural Environment	Land use	Impact on surrounding land use.	No impact on surrounding land use	Construction Impacts.	Construction Impacts.	Construction Impacts.	Construction Impacts.	Construction Impacts.	Construction Impacts.	Construction Impacts.	Construction Impacts.
Economic	Capital	Design and construction costs	No capital costs, as there is no servicing	Capital costs will be less than the full servicing, but it won't be proportionally less.	Estimated Capital Cost $30.6 Million.	Estimated Capital Cost $33.7 Million	Estimated Capital Cost 29.1 Million	Estimated Capital Cost 29.7Million	Estimated Capital Cost $33.0 Million	Estimated Capital Cost $35.7 Million	Estimated Capital Cost $28.6 Million

Category	Criteria	Criteria Indicator	Do Nothing (Alt 1)	Limit Community Growth (Alt 2)	East Connection – Victoria Road Trunk (Alt 3)	Central Connection – Clair Gordon Trunk (Alt 4)	West Connection – Southgate Hanlon Trunk (Alt 5)	West Connection – Southgate Industrial (Alt 6)	West Connection – Southend Valleylands Trunk (Alt 7)	Valley Land / Southgate Hanlon (Alt 8)	Gordon / Southgate Hanlon (Alt 9)
Economic	Maintenance	Asset management costs (lifecycle)	No maintenance cost, as there is no servicing	Maintenance cost similar to full service alternative. Operating cost less than full service alternatives.	Estimated Operation and maintenance cost. $506K	Estimated Operation and maintenance cost. $787K	Estimated Operation and maintenance cost. $720K	Estimated Operation and maintenance cost. $0.7M exclusive of Indutstrial Park expansion	Estimated Operation and maintenance cost. $575K	Estimated Operation and maintenance cost. $470K	Estimated Operation and maintenance cost. $314K
Economic	Property / Easement Acquisition	Amount of private property required to achieve solution	No property required.	Property requirement similar to the full-service alternatives.	Property requirement for pump stations similar to the Clair Gordon Trunk and Southgate Hanlon Trunk alternatives.	Property requirement for pump stations similar to Victoria Road Trunk and Southgate Hanlon Trunk alternatives.	Property requirement for pump stations similar to the Clair Gordon Trunk and Victoria Road Trunk alternatives.	Property requirement for pump stations similar to the Clair Gordon Trunk and Victoria Road Trunk alternatives	Property requirement for pump stations is less due to smaller size of PS-1. Service easement will be required for construction and subsequent maintenance of the Valley Land Trunk.	Property requirement for pump stations SPS1 and SPS2 similar to the Southgate Hanlon Alternative. SPS3 relocated west of Gordon St.	Property requirement for pump stations SPS1 and SPS2 similar to the Southgate Hanlon Alternative. SPS3 relocated west of Gordon St.

Category	Criteria	Criteria Indicator	Do Nothing (Alt 1)	Limit Community Growth (Alt 2)	East Connection – Victoria Road Trunk (Alt 3)	Central Connection – Clair Gordon Trunk (Alt 4)	West Connection – Southgate Hanlon Trunk (Alt 5)	West Connection – Southgate Industrial (Alt 6)	West Connection – Southend Valleylands Trunk (Alt 7)	Valley Land / Southgate Hanlon (Alt 8)	Gordon / Southgate Hanlon (Alt 9)
Functional (Technical)	Ease of Maintenance	Adverse impact on system performance	No maintenance required as there is not infrastructure.	Infrastructure provided will be similar to full growth except for smaller size. Similar maintenance is expected.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing / sewer flushing. 7 km forcemain may cause odour issues.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing / sewer flushing.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing / sewer flushing.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing/ sewer flushing.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing/ sewer flushing. Due to deeper sewer stretches, requirement for maintenance will be onerous.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing / flushing.	Maintenance is expected to be primarily at the lift stations and occasionally for forcemain swabbing/ sewer flushing.
Functional (Technical)	Impact to Existing Infrastructure	Sewer surcharges, Capacity exceedances at pumping stations and forcemains	No impact to existing infrastructure.	Impacted to existing infrastructure is reduced as growth is limited. Impact also dependent on the connection point.	No impact to existing infrastructure based on the chosen connection point.	The identified connection point identified surcharges in the existing sewers, therefore, upgrades will be required.	No impact to existing infrastructure based on the chosen connection point.	Minor impact to existing infrastructure based on the chosen connection	No impact to existing infrastructure based on the chosen connection point.	No impact to existing infrastructure based on the chosen connection.	No impact to existing infrastructure based on the chosen connection.
Functional (Technical)	Ability to Utilize Capacity on Existing Infrastructure	Eliminating / minimizing requirement for upgrade / expansion to existing infrastructure	No ability to utilize existing infrastructure	Limited ability to utilize existing infrastructure due to limited growth.	Existing Victoria Road Trunk downstream of Stone Road will be utilized.	Existing Clair-Maltby Road Sewer will be utilized.	Existing Hanlon Gate Trunk will be utilized.	Existing Hanlon Gate Trunk will be utilized.	Existing Hanlon Gate Trunk will be utilized.	Existing Hanlon Gate Trunk will be utilized	Existing Hanlon Gate Trunk will be utilized

Category	Criteria	Criteria Indicator	Do Nothing (Alt 1)	Limit Community Growth (Alt 2)	East Connection – Victoria Road Trunk (Alt 3)	Central Connection – Clair Gordon Trunk (Alt 4)	West Connection – Southgate Hanlon Trunk (Alt 5)	West Connection – Southgate Industrial (Alt 6)	West Connection – Southend Valleylands Trunk (Alt 7)	Valley Land / Southgate Hanlon (Alt 8)	Gordon / Southgate Hanlon (Alt 9)
Functional (Technical)	Capability of Phased Implementation	Modularity / flexibility of the proposed servicing	No capability of being implemented in phases.	No capability of being implemented in phases. ◐	Good capability for phased implementing ◕	Good capability for phased implementing ◕	Good capability for phased implementing ◕	Good capability for phased implementing ◕	Better capability for phased implementation due to larger trunk sewer accepting a large part of CMSP lands.	Good capability for phased implementin g ◕	Good capability for phased implementing ◕
Functional (Technical)	Ability to be implemented in Concert with the Water Servicing Alternatives	Physical proximity with water servicing	No servicing provided, therefore, no ability for water and water servicing to be implemented together.	Limited servicing, therefore, limited opportunity to implement along with wastewater servicing. ◐	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing. ◕	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing. ◕	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing. ◕	Most services are along road right of ways, therefore, good ability of being implemented along with wastewater servicing. ◕	The main wastewater trunk is aligned along Valley Lands, where there is no proposal for a watermain. Limited ability for implementation with water servicing. ◐	Most services are along the road right of ways, therefore good ability of being implemented along with wastewater servicing ◕	Most services are along the road right of way, therefore good ability of being implemented along with wastewater servicing ◕
Functional (Technical)	Construction Difficulty	Eliminating/ Minimizing locations of difficult construction	No servicing provided	Limited servicing ◐	Standard Construction Techniques and Trades ◕	Standard Construction Techniques and Trades ◕	Standard Construction Techniques and Trades ◕	Standard Construction Techniques and Trades ◕	Extended section of Deep Excavations ◐	Standard Construction Techniques and Trades ◕	Standard Construction Techniques and Trades ◕

Most Preferred → Least Preferred

● ◕ ◐ ○

Preferred Alternative

3.2.7 Preferred Solution(s)

The preferred wastewater servicing alternative is the Gordon / Southgate Hanlon Trunk. This alternative will have pumped flow connecting to a trunk on Gordon Street. Upsizing of existing sanitary infrastructure is not required with this option.

This alternative presents the second lowest capital cost as compared to the other sanitary servicing alternatives and provides the lowest operating costs. In addition, the maintenance issues associated with long reaches of deep sewers are limited with this option, and pump station capacities are minimized, also reducing maintenance and operational issues. The long forcemain associated with the Victoria Road alternative, is not a factor, hence odour issues are not anticipated. This option appears to offer the best balance of costs, operational expectations, and impact to adjacent residences and businesses.

3.2.7.1 Discussion of the Preferred Alternative

This alternative proposes three sewage pumping stations as with the other alternatives. However, the preferred alternative avoids pumping wastewater a second time, as a result SPS 3 is significantly smaller in size than most other alternatives.

The majority of the gravity sewers depths will be within the typical range of depths with the exception of approximately 160m of deep sewers (>10 m depth). The sewers will be readily accessible for maintenance operations, and will avoid the maintenance issues associated with deep sewers. Additional easements for construction of the sewers are not anticipated.

This preferred alternative avoids the maintenance access concerns and easement requirements associated with the Southend Park Valley Lands Trunk alternative, also avoids the requirement to upgrade the bottlenecked area of the Clair Gordon Trunk Alternative.

3.3 Stormwater

Stormwater management measures are required to mitigate the potential impacts to the quantity and quality of runoff resulting from the urbanization of the Clair-Maltby SPA in accordance with the updated Preferred Community Structure. As noted, the SPA is predominantly located within the headwaters of Hanlon, Mill and Torrance Creek and are located in the Paris Moraine. The SPA consists of hummocky terrain, with streams and creeks largely absent, resulting in surface runoff predominantly being infiltrated and evaporated under existing conditions. To the extent feasible and practical, stormwater management measures will be required to mimic the existing surface water/groundwater conditions, which largely infiltrate precipitation through numerous depressional features (ref. Figure 2.3).

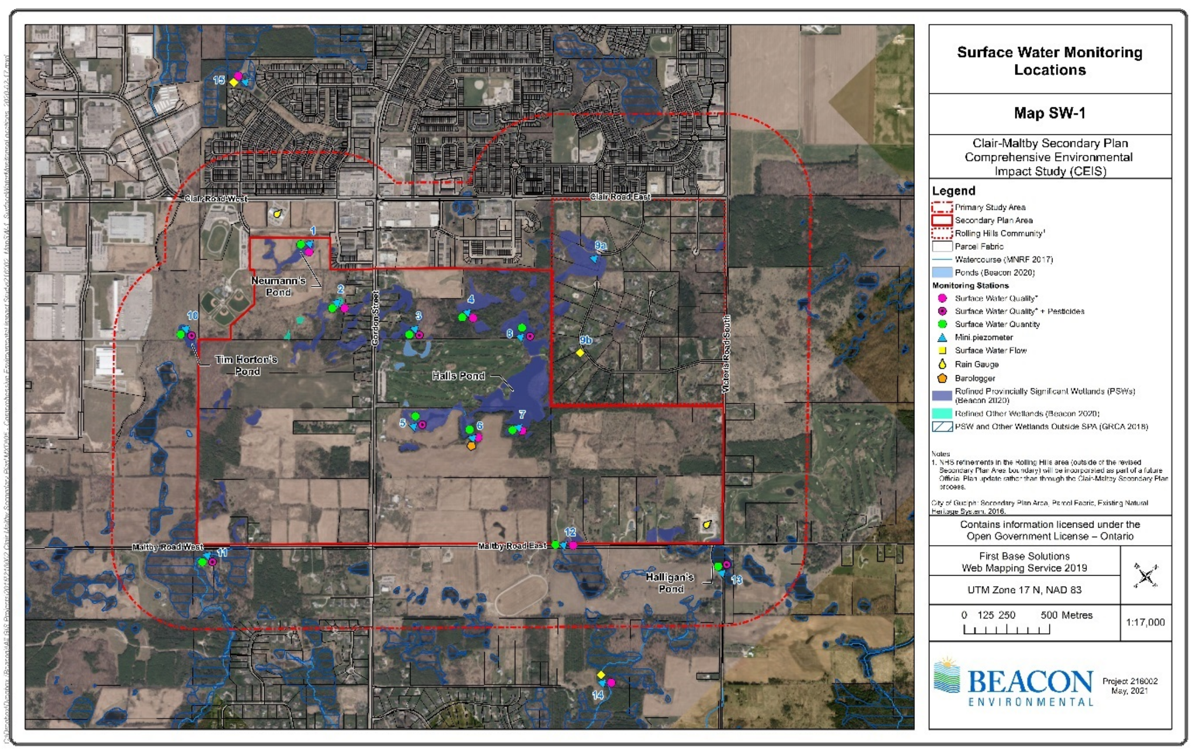
As part of the overall Secondary Planning study through the CEIS, a four-year monitoring program was undertaken (2016, 2017, 2018 and 2019). Through this program, surface water quality monitoring was conducted at key locations within the Clair-Maltby SPA and beyond to characterize the surface water chemistry for existing land use conditions. Based on the monitoring results, existing surface water quality within the Clair-Maltby SPA and immediately downstream is generally of reasonable quality, with some exceedances to provincial and federal water quality guidelines in those parameters linked primarily to agricultural and golf course land uses and roadway runoff. To protect both surface water quality and groundwater quality, stormwater quality controls will be required.

3.3.1 Existing Conditions

Surface Water Monitoring Program

As noted, a four-year monitoring program (2016-2019) was conducted as part of the Comprehensive Environmental Impact Study (CEIS), to understand and assess the Clair-Maltby study area's unique surface water / groundwater system and associated natural heritage character. The monitoring program supplemented the available data from existing studies and reports. For the purpose of validating the hydrologic model, rainfall and flow monitoring (Stations 9A, 9B, 14 and 15) were conducted in addition to spot flow measurements at other locations (ref. Figure 3.3.1). Stations 14 and 15 in Mill Creek and Hanlon Creek respectively were the only two stations where flow was observed during the monitoring period.

Figure 3.3.1. Surface Water Monitoring Locations



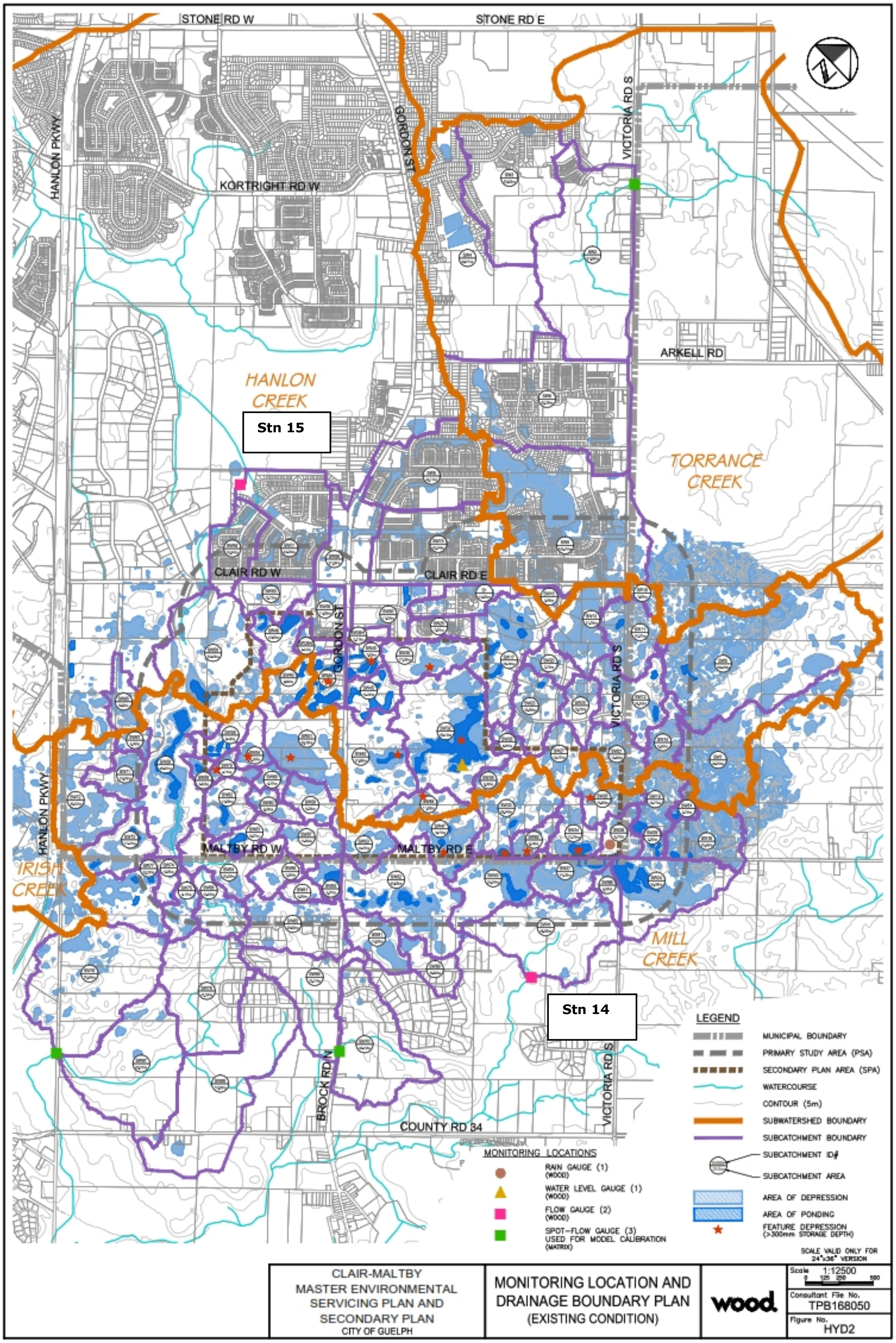
Based on the significant number of depressional features, most storm events did not result in a surface water response at the flow monitoring locations. The observed runoff response at the monitoring locations is considered largely a result of the local catchments immediately upstream of the monitoring locations. In addition, both flow monitoring locations, Hanlon Creek (Station 15) and Mill Creek (also known as Hammersly) (Station 14) are located downstream of groundwater discharge locations, which after certain storm events exhibited groundwater discharge conditions above the normal baseflow, therefore adding to the surface water response.

Hydrologic Modelling

The hydrologic analysis for the Clair-Maltby SPA was conducted using the PCSWMM modelling platform based on the US-EPA SWMM program. The PCSWMM modelling completed for the Clair-Maltby SPA was developed using the 2012 Digital Elevation Model (DEM); the subcatchment boundary plan for the overall PCSWMM hydrologic model is presented in Figures 3.3.2 and 2.3. Subcatchments have been discretized to represent the drainage areas within each primary subwatershed, Hanlon Creek, Mill Creek and Torrance Creek to specific monitoring locations, which are located outside/downstream of the SPA. The natural depressional features located within, and adjacent to, the Clair-Maltby SPA have been assessed to determine their cumulative storage volume for the contributing area, resulting in a depth (mm) of storage for each depressional feature. The intent of this effort has been to quantify the capture/storage potential of the respective depressional features.

The PCSWMM hydrologic model parameterization for existing conditions has been validated using the flow data collected for the Hanlon Creek monitoring site (Station 15) and the Mill Creek/ Hammersly (Station 14) monitoring site for the 2016 to 2017 monitoring period.

Figure 3.3.2. Existing Drainage Plan

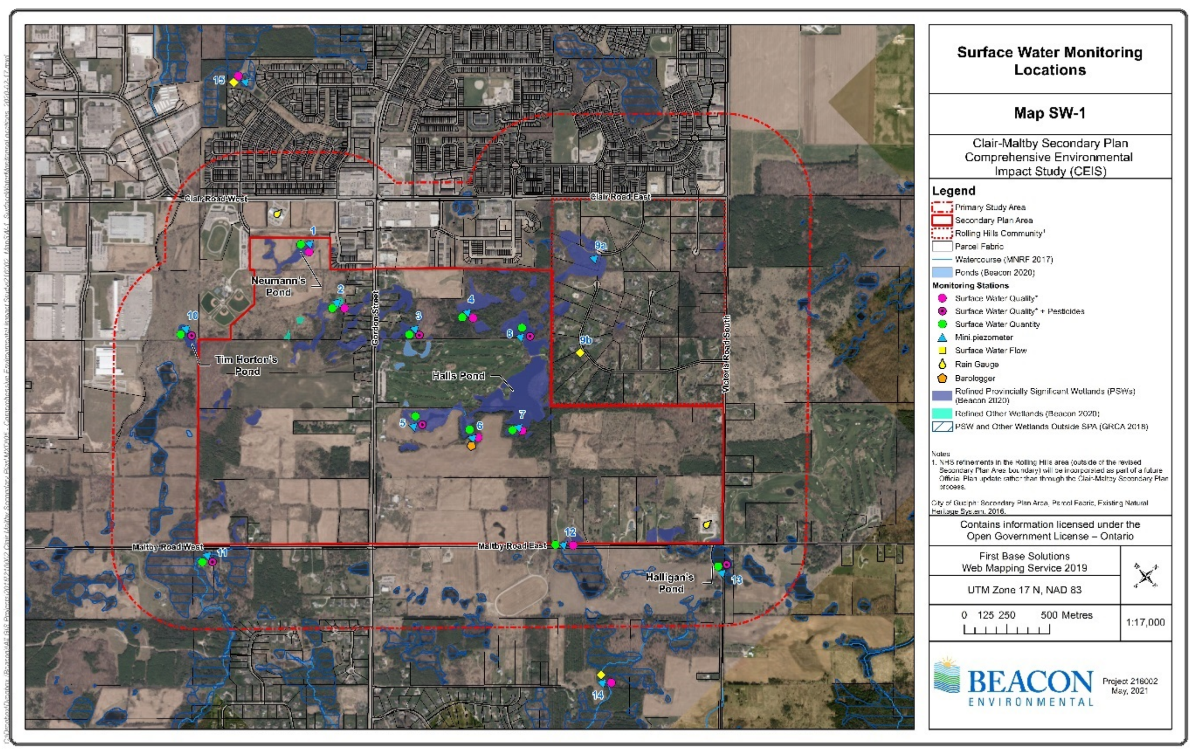


The validated PCSWMM hydrologic model for existing conditions has been executed for a continuous simulation period of 1950 to 2017 (67 years). Frequency flows have been determined using the Log Pearson Type III Distribution for both flow monitoring locations (ref. Table 3.3.1). Frequency flows for the Mill Creek and Hanlon Creek are considered low (<1.5 m^3/s for the 100 year), due to the significant influence of depressional features (capture and storage) and the existing urban area greenway stormwater management systems within the Clairfield area, which infiltrate most storm runoff.

In addition to the continuous simulation, peak flows have also been determined using design storms (City of Guelph 3-hour Chicago design storms) for the 2-to-100-year storm events, along with the Regional Storm (Hurricane Hazel), with peak flows provided within Table 3.3.2.

In addition, the 1950-2017 climate data set has been used to determine an annual water budget (premised on surface-based water modelling) within the Clair-Maltby SPA and to the monitoring locations (flow and spot flow) within the Clair-Maltby Secondary Study Area (SSA) (ref. Figure 3.3.2). The annual water budget assessment has been conducted for each subwatershed based on the subcatchments contributing to the monitoring locations within Hanlon Creek, Torrance Creek and Mill Creek.

Figure 3.3.3. Surface Water Monitoring Locations



As noted, the Clair-Maltby SPA is located at the headwaters of the Hanlon Creek, Torrance Creek and Mill Creek and with the significant number of the depressional features and lack of overland drainage routes and watercourses, surface runoff is predominantly infiltrated or evaporated. Each creek system annually infiltrates and evaporates 93 per cent to 98 per cent of the total precipitation, with Torrance Creek infiltrating the least, due to some existing development. The remaining surface water (not infiltrated or evaporated) ends up as discharge/ runoff from the system. Each creek system exhibits high annual infiltration, due to the depressional features and the urban area greenway stormwater management systems within the Clairfield area (greenways), the function of which will have to be replicated within the Clair-Maltby SPA. Based on a review of the area's topography using GIS techniques, there are approximately forty-seven (47) major depressional features that have over 300 mm storage (i.e. runoff volume of 300 mm precipitation over contributing drainage area, with runoff coefficient value of 1), of which only seven features based on the modelling results, have been identified to have the potential to discharge (Overflow) during the 67 year continuous modelling period. The water balance results for Hanlon Creek and Mill Creek are in Tables 3.3.3 and 3.3.4. Torrance Creek (with Rolling Hills not part of the Conceptual Community Structure) would not exhibit a change in water balance and as such has not been included. The existing water budget for Hanlon Creek and Mill Creek provides guidance for associated targets for stormwater management for the future land use condition.

Table 3.3.1. Frequency Peak Flows (m^3/s) - Existing Conditions

Location (Map SW-1, Appendix D)	1.003	1.050	1.25	2	5	10	20	50	100
Hanlon Creek Monitoring Site (Station 15)	0.008	0.036	0.100	0.250	0.530	0.760	0.990	1.310	1.550
Mill Creek Monitoring Site (Station 14)	0.035	0.038	0.039	0.045	0.069	0.100	0.160	0.290	0.480

Table 3.3.2. Design Storm Event Peak Flows (m3/s) – Existing Conditions

Location (Map SW-1, Appendix D)	2	5	10	25	50	100	Regional
Hanlon Creek Monitoring Site (Station 15)	0.50	0.67	0.70	0.71	0.72	0.74	0.82
Mill Creek Monitoring Site (Station 14)	0.04	0.06	0.08	0.32	1.37	2.81	4.75

Table 3.3.3. Hanlon Subwatershed Annual Water Balance Summary

	Precipitation (mm)	Infiltration/ Transpiration (mm)	Evaporation (mm)	Discharge/ Runoff (mm)
Mean	856.46	842.98	26.94	0.42
Median	846.34	828.41	26.34	0.01
Min	543.18	532.00	19.26	0.00
Max	1137.70	1127.13	38.38	5.74
Std Dev.	126.26	124.58	4.10	1.00

Table 3.3.4. Mill Creek Subwatershed Annual Water Balance Summary

	Precipitation (mm)	Infiltration/ Transpiration (mm)	Evaporation (mm)	Discharge/ Runoff (mm)
Mean	856.46	843.18	11.95	9.69
Median	846.34	830.49	11.70	8.91
Min	543.18	537.71	8.44	4.39
Max	1137.70	1125.45	17.35	21.10
Std Dev.	126.26	122.88	1.87	2.94

Water Quality (Surface Water)

In addition to understanding the existing surface water movement and annual water balance within the Clair-Maltby SPA, water quality has also been assessed as part of the Clair-Maltby Secondary Plan and Master Environmental Servicing Plan (CMSP / MESP) based on data collected and interpreted as part of the Comprehensive Environmental Impact Study (CEIS) (ref. Phase 1 and Phase 2: Characterization Report, September 5, 2018). The assessment of existing water quality conditions provides the context and baseline condition for recommending stormwater quality measures to meet local, provincial and federal water quality guidelines and policies. This section discusses the existing water quality conditions and outlines the water quality requirements from local studies in consideration of federal and provincial policies that are in place requiring stormwater quality controls to mitigate water quality impacts from the Updated Preferred Community Structure land use.

As part of the four-year monitoring program, surface water quality monitoring has been conducted at targeted locations within the Clair-Maltby SPA and beyond to characterize the surface water temperatures and chemistry under existing land use conditions. The water quality monitoring locations are illustrated in Figure 3.3.1 and include two flow stations outside the SPA (i.e., Stations 14 and 15) and an additional 11 stations (i.e., Stations 1 to 8, and 10 to 13) established in the internally draining wetlands within the PSA (with no surface water connections to any watercourses or other open water systems).

The water quality monitoring conducted in all stations over 2016 and 2017 indicated that the existing surface water quality within the Clair-Maltby SPA and immediately downstream is generally of reasonable quality. Repeat sampling conducted over 2018 and 2019 confirmed these results as being generally consistent from year to year under different weather conditions.

At the two flow stations, water temperatures remained largely below 20°C throughout the summer months at the Mill Creek station and below 24°C at the Hanlon Creek station. The instream water temperatures for the Mill Creek Flow Station 14 (south of the SPA) remained below 20°C and daily maximums of between 13.82°C and 19.47°C were recorded in the summer months (i.e., June through September) over the four years of monitoring between 2016 to 2019. The Hanlon Creek flow Station 15 (north of the SPA) was generally warmer with daily maximums in the summer months ranging between 19.85°C and 23.24°C between 2017 and 2019, considered to be impacted by runoff from existing residential development and the potential thermal impacts resulting from the permanent pool within the nearby stormwater management facility located immediately upstream of the Hanlon Creek flow gauge (ref. Figure 3.3.2).

At the 11 wetland stations, surface water temperatures in 2017, 2018 and 2019 displayed a relatively consistent seasonal rise from spring into summer, as air temperatures increased and wetland water elevations fell, followed by a drop in the fall although this trend was more pronounced in some wetlands than others. Not surprisingly, temperatures were much more variable than at the flow stations, as these wetlands are relatively isolated depressional features in which surface water temperatures will vary depending on a variety of factors including their size and depth, the extent to which the water levels in them vary over the year, air temperatures, the extent and type of natural cover, and the source(s) of their water (i.e., surface water, groundwater or both).

The larger wetlands sampled in the Halls Pond subwatershed have variable sources of water inputs other than direct precipitation depending on their location and the time of year. For example, Neumann's Pond (Station 1) and Halligan's Pond (Station 13) (ref. Figure 3.3.2) appear to be largely surface water fed, while Halls Pond (Stations 6, 7 and 8) is being sustained by both groundwater and surface water contributions with the relative importance of each fluctuating depending on the time of year. In the Mill Creek Subwatershed, the "Tim Hortons Pond" (Station 10) is being sustained by both groundwater and surface water contributions and the relatively cool temperatures documented in the remaining wetlands assessed in both Halls Pond Subwatershed (i.e., Stations 3, 4 and 5) and Mill Creek Subwatershed (i.e., Stations 11 and 12) suggest that these smaller wetlands are also being sustained to some extent by a direct connection to the groundwater table.

With respect to water chemistry, Provincial Water Quality Objectives (PWQO), Canadian Environmental Quality Guidelines (CEQG) and Canadian Drinking Water Quality Guidelines (CDWQ) repeated exceedances were documented at several stations and at different times of the year under existing conditions at both the 2 flow and the 11 wetland stations. During wet weather conditions exceedances for Total Phosphorus, Aluminum, Alum, Calcium, Cadmium, Iron, Manganese, Zinc and

Ammonia were documented across many sampling stations and multiple sampling events.

Exceedances can occur for various reasons, such as untreated runoff from roadways, application of fertilizers on agricultural and the golf course lands within the study area and, in some cases (such as Zinc in Mill Creek Subwatershed) due to naturally high occurrences. These exceedances and their potential causes were not studied as part of the CMSP, as this can be very complex and is not considered necessary to support decision-making with respect to land use planning and impact management. Moreover, exceedances are being documented in order to contribute to a more complete understanding of existing baseline conditions in the SPA to: (a) guide management directions and objectives with respect to water quality in the SPA, and (b) provide generalized baseline information against which to assess site-specific findings, as part of future development applications and related technical studies. In addition, exceedances specifically related to Sodium and Chloride will need to be addressed in accordance with the applicable source water protection policies at both the Secondary Plan and the site-specific level.

Detailed results from the four-year water quality monitoring program are provided in the Clair-Maltby CEIS Year 4 Monitoring Report (2016 – 2019).

Groundwater Monitoring Program

The four-year monitoring program (2016-2019) conducted as part of the Comprehensive Environmental Impact Study (CEIS), provided an enhanced understanding and assessment of existing regional and local groundwater flow systems. The monitoring program supplemented the available data for groundwater and surface water levels/flow from existing studies and reports (e.g., private well logs in the City and Township of Puslinch) and provided a snapshot of current water quality in the PSA. Historical surface and groundwater quality monitoring data for the Township of Puslinch are contained within various development and permit to take water (PTTW) reports which provide an understanding of the water quality in the SSA.

The conceptual model of groundwater, as depicted in Figure 2.4, was derived from these monitoring data and provided an understanding of the regional and local groundwater flow system, water table depth, groundwater recharge and discharge functions, and groundwater quality in the PSA and SSA, including areas in the City and the Township of Puslinch. Data from the City and in the Township of Puslinch were used to validate the integrated surface and groundwater flow model used to assess impacts from various land use and stormwater management options.

Integrated Surface and Groundwater Model

The CEIS stipulates that the integrated surface and groundwater MIKE-SHE and PCSWMM models prepared as part of the CEIS and MESP are to be applied at the time of site-specific development applications. A guide prepared by the City on how the models should be used will be provided early in the planning process to the applicants. The requirements for what the model must demonstrate are to be established with, and approved by, the City, and with recognition of the characteristics of the surface water and groundwater flow systems in Clair-Maltby and linkages to surrounding areas.

Water Quality (Groundwater)

Groundwater quality analyses conducted as part of the CEIS and MESP indicate that the overburden water consistently represents a calcium-magnesium carbonate system with no significant difference in most basic anions and cations between the shallow and deeper groundwater in the overburden monitoring wells. In addition, the basic anions and cations, within the two Provincial Groundwater Monitoring Network (PGMN) bedrock wells, appear to be similar to the overburden monitoring wells. Localized elevated levels of chloride and nitrate were detected. Elevated levels of chloride and/or nitrate may be related to winter de-icing and/or agricultural applications.

3.3.2 Criteria/Standards/Policy

In order to establish a preferred stormwater management plan for the Clair-Maltby Secondary Plan area, it is important to consider the various planning objectives and the current policy framework, to direct and manage future growth in the area. There are several levels of requirements related to drainage, including from previous studies' goals, objectives and criteria, local municipal criteria, standards and policies and provincial and federal requirements. The following provides a summary of relevant stormwater/drainage related criteria, standards and policy considered applicable to the Clair-Maltby SPA.

Previous Studies

i. Hanlon Creek Watershed Plan, 1993 Goals:

- To minimize the threat to life and the destruction of property and natural resources from flooding and preserve or re-re-establish natural flood plain hydrologic functions
- To restore, protect and enhance water quality and associated aquatic resources and water supplies

ii. Hanlon Creek Watershed Plan, 1993 Objectives:

- To ensure that runoff from developing and urbanizing areas is controlled such that it does not unnecessarily increase the frequency and intensity of flooding at the risk of threatening life and property
- To minimize erosion and prevent sedimentation of waterways
- To prevent the accelerated nutrient enrichment of streams and contamination of waterways from runoff containing nutrients, pathogenic organisms, organic substances, and heavy metals and toxic substances
- To maintain or restore a natural vegetative canopy along streams where required to ensure that mid-summer stream temperatures do not exceed tolerance limits of desirable aquatic organisms
- To maintain the stream or waterway free from litter, trash, and other debris
- To minimize the disturbance of streambed and prevent streambank erosion and, where practical, to restore eroding streambanks to a natural or stable condition

- To restore, rehabilitate, or enhance water quality and associated resources through the implementation of an appropriate Best Management Practices on the land
- To take full advantage of stream baseflow enhancement opportunities
- To enhance the fishery habitat, specifically to increase the quantity and quality of Brook Trout in the headwaters area and to extend their range downstream of the Hanlon Parkway to the Speed River
- To maintain or enhance the buffers provided by wetlands
- To minimize disturbance of wetlands, preserving or enhancing the habitat they provide
- To provide buffers to wetlands to maintain or enhance their biological health
- To ensure that environmental resource constraints are fully considered in establishing land use patterns in the watershed
- To retain and preserve open space and visual amenities in urban and rural areas by establishing and maintaining greenbelts along stream corridors and adjacent natural areas

iii. Mill Creek Subwatershed Plan 1996 Goals:

- To restore, protect, and enhance water quality and associated aquatic resources and water supplies
- To conserve, protect and restore natural land, water, forest and wildlife resources
- To protect restore and enhance groundwater quantity and quality
- To minimize the threat to life and the destruction of property and natural resources from flooding and preserve or re-re-establish natural flood plain hydrologic functions

iv. Mill Creek Subwatershed Plan 1996 Objectives:

- Maintain existing recharge and discharge characteristics
- Control sediment discharges and provide erosion control during development
- Ensure appropriate water quality control measures are in place following development
- Maintain/reduce existing erosion rates following development
- Maintain/enhance cold-water fisheries' potential as subwatershed creeks
- Protect natural area functions/features from development
- Enhance natural area features and functions in long term
- Maintain infiltration, baseflow and discharge to natural features
- Minimize risk to life and property with future development
- Protect natural area functions/features from development
- Enhance natural area features and functions in long term

Governing Acts, Policies and Guidelines

As a complement to the overall process of establishing Secondary Plan Area goals, objectives, and targets, there also needs to be a recognition/understanding of the context of the governing legislation with respect to resource management. Various acts, guidelines, and policies exist at a federal, provincial, and municipal level to provide a framework for managing the impacts associated with land use change.

The following table provides a summary of the key legislative and policy documents that provide direction on drainage related matters applicable to subwatershed and secondary planning studies in the City of Guelph. In addition, there are supporting guidelines and decision-making systems to help implement a number of these Acts and policies, which are also included in the table.

Table 3.3.5. Summary of Acts, Guidelines, Policy Related to Drainage

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
Federal	Federal Fisheries Act	Act	Purpose is to manage threats to the sustainability and ongoing productivity of Canada's commercial, recreational, and Aboriginal fisheries.
Federal	Canadian Environmental Protection Act (CEPA)(1999)	Act	The goal of the Canadian Environmental Protection Act (CEPA) is to contribute to sustainable development through pollution prevention and to protect the environment, human life and health from the risks associated with toxic substances.
Federal	Canadian Environmental Assessment Act	Act	The Act requires federal departments, including Environment Canada, agencies, and crown corporations to conduct environmental assessments for proposed projects where the federal government is the proponent.
Federal	Canadian Water Quality Guidelines for the Protection of Aquatic Life	Guideline	The Canadian Water Quality Guidelines consist of a set of recommended "safe limits" for various polluting substances in raw (untreated) drinking water, recreational water, water used for agricultural and industrial purposes, and water supporting aquatic life. They are designed to protect and enhance the quality of water in Canada. The guidelines apply only to inland surface waters and groundwater and not to estuarine and marine waters.

Level of Government	Name of Management Tool: Act/Regulation/Policy /Guideline/Program	Type of Tool	Purpose
Federal	Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses	Guideline	The Canadian Water Quality Guidelines consist of a set of recommended “safe limits” for various polluting substances in raw (untreated) drinking water, recreational water, water used for agricultural and industrial purposes, and water supporting aquatic life. They are designed to protect and enhance the quality of water in Canada. The guidelines apply only to inland surface waters and groundwater and not to estuarine and marine waters.
Federal	Guidelines for Canadian Drinking Water Quality	Guideline	To provide a national guideline for the protection of drinking water.
Federal	Guidelines for Canadian Recreational Water	Guideline	To provide a national guideline for the protection of recreational waters used for primary contact recreation such as swimming, windsurfing and water skiing and for secondary contact recreation activities including boating and fishing.
Federal	How Much Habitat is Enough? A Framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern (2013, EC/CWS, OMNR, OME) (D)	Guideline	Initiated in 1990 as part of the federal Great Lakes Action Plan, the Cleanup Fund represents a significant part of Canada’s commitment to restore the Great Lakes Basin Ecosystem as outlined in the 1987 Protocol to the Great Lakes Water Quality Agreement between Canada and the United States (GLWQA).

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
Provincial	Endangered Species Act (2007)	Act	The purpose of this Act is to identify and protect species that are at risk and their habitat, and to promote recovery of the species, including stewardship activities to facilitate protection and recovery of the species.
Provincial	Nutrient Management Act (OMAF) (2002)	Act	As part of the Ontario government's Clean Water Strategy, the Nutrient Management Act provides for province-wide standards to address the effects of agricultural practices on the environment, especially as they relate to land-applied materials containing nutrients.
Provincial	Lakes and Rivers Improvement Act (1990)	Act	The Lakes and Rivers Improvement Act gives the Ministry of Natural Resources the mandate to manage water-related activities, particularly in the areas outside the jurisdiction of Conservation Authorities.
Provincial	Provincial Planning Act (1990)	Act	The purpose of this Act is to promote sustainable economic development in a healthy natural environment, as well as to provide a land use planning system led by Provincial Policy. The Act is intended to be interpreted according to the Provincial Policy Statement, which was last updated in 2020.

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
Provincial	Ontario Water Resources Act	Act	The Ontario Water Resource Act deals with the powers and obligations of the Ontario Clean Water Agency, as well as an assigned provincial officer, who monitors and investigates any potential problems with regards to water quality or supply. There are also extensive sections on Wells, Water Works, and Sewage works involving their operation, creation and other aspects.
Provincial	Clean Water Act, 2006		The provincial Clean Water Act, 2006, established the need to protect Ontario's existing and future drinking water sources as part of an overall commitment to safeguard human health and the environment. A key focus of the legislation is the preparation of locally-developed Source Protection Plans (SPP). The goal of each SPP is to eliminate and/or manage existing significant threats and to ensure no future drinking water threats become significant. According to the Act, Source Protection Plans must include: - Policies and programs to eliminate and/or manage existing significant threats - Policies and programs to ensure no future activities become significant drinking water threats These policies might include:

Level of Government	Name of Management Tool: Act/Regulation/Policy /Guideline/Program	Type of Tool	Purpose
			- Rules for activities in wellhead protection areas and intake protection zones, e.g., activities that will be allowed, with conditions (e.g., risk management plans) - Public education programs - Programs to promote best management practices for voluntary action
Provincial	Environmental Protection Act	Act	The purpose of this Act is to provide for the protection and conservation of the natural environment. R.S.O.1990, c.E.19, s.3.
Provincial	Fish and Wildlife Conservation Act (1997)	Act	Fish and Wildlife Conservation Act enables the Ministry of Natural Resources (MNR) to provide sound management of the province's fish and wildlife.
Provincial	Safe Drinking Water Act (MOE) (2002)	Act	Its purpose is the protection of human health through the control and regulation of drinking-water systems and drinking-water testing.
Provincial	Threats Assessment	Regulation	(Section 1.1 of Ontario Regulation 287/07 Province identified 21 activities that are prescribed as drinking water threat activities. For water quantity vulnerable areas with a significant risk level, all existing and new water takings (prescribed drinking water threat #19) located within the areas that draw water from the municipal aquifers or Eramosa River or activities that reduce groundwater recharge (prescribed

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
			drinking water threat #20) are classified as Significant Drinking Water Quantity Threats (significant threats) Recharge reduction is or would be a significant drinking water threat in WHPA-Qs and IPZ-Qs that are assigned a significant risk level.
Provincial	Municipal Act	Act	The Municipal Act sets forth regulations in regard to the structuring of municipalities in Ontario.
Provincial	Ontario's New Drinking Water Protection Regulation for Smaller Waterworks Serving Designated Facilities O. Reg. 505/01	Regulation	The Regulation is Part of the New Drinking Water Regulations administered through the Ministry of the Environment.
Provincial	Ontario Drinking Water Protection Regulation	Regulation	In August 2000, the Government of Ontario announced a new Drinking Water Protection Regulation (Ontario Regulation 459/00) to ensure the safety of Ontario's drinking water. The regulation issued under the Ontario Water Resources Act was a part of the comprehensive Operation Clean Water action plan. This regulation put the Ontario Drinking Water Standards into law, updating and strengthening the Ontario Drinking Water Objectives.
Provincial	Bill 127, Ontario Water Resources Amendment	Act	The Bill amends the Ontario Water Resources Act in regard to the availability and conservation of

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
	Act (Water Source Protection), 2002		Ontario water resources. Specifically, the Bill requires the Director to consider the Ministry of Environment's statement of environmental values when making any decision under the Act. The Bill also requires that municipalities and conservation authorities are notified of applications to take water that, if granted, may affect their water sources or supplies.
Provincial	Provincial Water Quality Objectives (MOE) (1994)	Guideline	To provide objectives for the protection of aquatic life.
Provincial	Natural Heritage Reference Manual for the Natural Heritage Policies of the Provincial Policy Statement (2010)	Guideline	Provides guidelines for the implementation of the natural heritage components of the PPS by planning authorities.
Provincial	Protection and Management of Aquatic Sediment Quality in Ontario (MOE 1993)	Guideline	The purpose of the sediment quality guideline is to protect the aquatic environment by setting safe levels for metals, nutrients, and organic compounds.
Provincial	Guidelines for Evaluating Construction Activities Impacting on Water Resources (MOE 1995)	Guideline	These guidelines were developed to protect the receiving environment according to the physical, the chemical and the biological quality of the material being dredged.
Provincial	Incorporation of the Reasonable Use concept	Guideline	This guideline establishes the basis for the reasonable use of groundwater on property adjacent

Level of Government	Name of Management Tool: Act/Regulation/Policy /Guideline/Program	Type of Tool	Purpose
	into MOE Groundwater Management Activities (1994)		to sources of contaminants and for determining the levels of contaminants acceptable to the ministry.
Provincial	Ontario Drinking Water Standards (MOE 2001)	Guideline	The purpose of the standards is to protect public health through the provision of safe drinking water.
Provincial	Technical Guideline for Private Wells: Water Supply Assessment (MOE 1996)	Guideline	Guidance manual for the development of private wells.
Provincial	Technical Guideline for On-site Sewage Systems (MOE)	Guideline	Guidance manual for assessing the proposed impacts on on-site sewage systems on groundwater.
Provincial	Subwatershed Planning (MOE 1993)	Guideline	Technical manual on conducting subwatershed planning in Ontario.
Provincial	Integrating Water Management Objectives into Municipal Planning Documents (MOE 1993)	Policy	Policy manual on the integration of watershed management practices into municipal planning documents.
Provincial	Watershed Management on a Watershed Basis (MOE 1993)	Guideline	Guideline manual on watershed management practices.
Provincial	MOE Stormwater Management Planning	Guideline	General stormwater design guidance including quality treatment (Section 3.3)

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
	and Design Manual (MOE 2003)		
Provincial	MECP LID BMP Manual (Draft 2022)	Guideline	Guideline for implementing Low Impact Development measures (design, construction, monitoring).
Provincial	MECP Subwatershed Planning Guide (Draft 2022)	Guideline	Guideline provides advice to municipalities, conservation authorities and practitioners for implementing land use planning policies related to watershed and subwatered planning.
Provincial	Watershed Planning in Ontario. Guidance for Land-use Planning Authorities (Draft 2018)	Guideline	Guideline for Ontario municipalities in preparing watershed and subwatershed studies in support of land-use planning.
Provincial	MECP Consolidated Linear Infrastructure Environmental Compliance Approval (current)	Policy	Policy for governing design criteria, monitoring, and management of stormwater management infrastructure in the City of Guelph.
Provincial	Provincial Policy Statement (2014)	Policy	Provincial Policy Statement was issued under Section 3 of the Planning Act, came into effect on May 22, 1996 and was last updated in February 2020.
Provincial	Drainage Act	Act	Provides for the regulation of drainage practices in Ontario.
Provincial	Public Lands Act	Act	

Level of Government	Name of Management Tool: Act/Regulation/Policy /Guideline/Program	Type of Tool	Purpose
Provincial	Environmental Bill of Rights (EBR)	Bill of Rights	On February 15, 1994, the Environmental Bill of Rights (EBR) took effect and the people of Ontario received an important new tool to help them protect and restore the natural environment. While the Government of Ontario retains the primary responsibility for environmental protection, the EBR provides every resident with formal rights to play a more effective role.
Provincial	Conservation Authorities Act (1990)	Act	Originally developed in 1946 in response to Hurricane Hazel flooding, the purpose of this Act is "to provide for the organization and delivery of programs and services that further the conservation, restoration, development and management of natural resources in watersheds in Ontario". As stated in the legislation, "the objects of an authority are to provide, in the area over which it has jurisdiction, programs and services designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals".
Municipal	City of Guelph Official Plan (1994, updated through OPA 39, 42 and 48)	Policy	The Official Plan is a statutory document under the Ontario Planning Act that sets out land use policy to guide future development and to manage growth. It provides a policy framework for Council decisions regarding the use of land, the provision of municipal services required to support growth, and the phasing of development.

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
Grand River Conservation Authority, City of Guelph, Guelph/Eramosa Township, Wellington Source Water Protection, Wellington County, Ministry of the Environment and Climate Change Water Quantity Policy Development Study (In Progress)	Water Quantity Policy Development Study (In Progress)	Policies	For areas in WHPA-Q or IPZ-Q recharge reduction; lay out policy tools; Clean water policy tools include: education and outreach and incentive programs, to land use planning, prescribed instruments, and *Part IV approaches, such as risk management plans, and prohibition.*
City of Guelph	Stormwater Management Master Plan 2023 / Stormwater Management policy	Policies	The SWM MP explores, evaluates, and identifies innovative approaches to manage stormwater runoff using low impact development measures and water sensitive urban design for both new construction and existing developed areas. It includes infiltration policies and guidance on acceptable LID practices in the City.

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
Municipal	City of Guelph Private Tree Protection By-law (2010-19058)	Regulation	Regulates the damage or destruction of any tree measuring at least 10 centimetres in diameter at 1.4 metres above the ground on lots larger than 0.2 hectares (0.5 acres). Some trees are exempt from the bylaw and can be removed without a permit including dead or dying trees, trees posing danger to life or property, or trees impacted by unforeseen causes or natural events. Please refer to the full list of exemptions in the by-law.
Conservation Authority	Ontario Regulation 150/06: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (last amended Feb. 8, 2013)	Regulation	Under the Conservation Authorities Act, Ontario Regulation 150/06 allows Conservation Authorities including the GRCA to prevent the loss of life, minimize property damage, prohibit, or regulate development in or adjacent to shorelines, wetlands, floodplains, watercourses, valleys, dynamic beaches and hazard lands.
Conservation Authority	GRCA's Policies for the Administration of the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (approved and effective Oct. 23, 2015)	Policy	In valleys and/or valley systems and stream corridors, to further its objectives relating to flooding and erosion, and the maintenance of natural environmental integrity, including the conservation of land. These are the policies, procedures, and guidelines the GRCA uses for permit applications under Ontario Regulation 150/06. This document outlines the policies to be followed by the GRCA in making

Level of Government	Name of Management Tool: Act/Regulation/Policy/Guideline/Program	Type of Tool	Purpose
			decisions regarding the outcome of all applications made under O. Reg. 150/06.
Conservation Authority	GRCA's Wetland Policy, 2003		The policy provides a comprehensive planning process to allow for appropriate studies to identify natural heritage form and functions and determine methods to minimize negative environmental impacts.

3.3.3 Future Requirements

Stormwater management will need to address the drainage impacts resulting from the updated Preferred Community Structure (ref. Figure 1.10). Based on the proposed land use, without mitigation, impacts to peak flows, runoff volumes and surface water and groundwater quality would occur. The CEIS developed targets for surface water and groundwater (ref. Table 3.3.6), based on existing drainage conditions and the goals and objectives documented in Section 3.3.2. Given the hummocky terrain exhibited in the SPA, most surface water will either evaporate or infiltrate to the groundwater system, therefore groundwater targets are fully integrated and linked to surface water targets.

As part of future site-specific development applications, applicants, will be required to demonstrate:

- maintenance of water balance, recharge/discharge functions, groundwater flow directions, gradients and depth to water table; and
- that salt impacts and other potential contaminants detected in surface and groundwater meet relevant provincial requirements within the boundaries of the site.

See Section 3.3.7 for more detail on requirements for future site-specific development applications.

Targets related to discharge, recharge and water budget with a notation of ‘Work toward’, are still to be achieved. Approval/support for not meeting a target, will only be provided when it has been adequately demonstrated that all efforts have been applied in designing the site and its associated water management system to attain the target, which for technical reasons indicate that the target has not been fully met.

Table 3.3.6. Groundwater and Surface Water Goals, Objectives and Targets

System	Goals	Objectives	Targets
Groundwater	Groundwater of sufficient quantity and quality to support ecological functions, aquatic habitats, native fish communities and sustainable human needs, including drinking water, agricultural, industrial, and commercial uses.	1. Protect, Restore, and enhance groundwater recharge and discharge. 2. Protect, restore, and enhance groundwater quality. 3. Ensure sustainable rates of groundwater use.	1. Work toward maintaining pre-development groundwater recharge and groundwater discharge. 2. Provide stormwater quality treatment for infiltrated surface water. 3. Work toward maintaining pre-development groundwater recharge to support groundwater supply function of local aquifers.
Surface Water	Surface waters of a quality, volume, and naturally variable rate of flow to: • Protect aquatic and terrestrial life and ecological functions; • Protect human life and property from risks due to flooding; • Protect and contribute to the local groundwater system within Guelph, and the domestic drinking water source; • Support sustainable agricultural, industrial,	1. Protect and restore the natural variability of infiltration to significant depressional features (or surrogates). 2. Maintain and restore natural levels of baseflow 3. Maintain surface and groundwater flows to terrestrial features. 4. Eliminate or minimize risks to human life and property due to flooding and erosion. 5. Protect and restore surface water quality, with respect to toxic contaminants and other	1. Work toward maintaining pre-development water budget. 2. Work toward maintaining pre-development water budget 3. Work toward maintaining pre-development water budget 4. Provide post-to-pre-development flood control for all events up to the Regional Storm event. 5. Meet or exceed stormwater quality control for future development in accordance with provincial (MECP – TSS based or updates to MECP Guidelines) standards, with the following

System	Goals	Objectives	Targets
	and commercial water supply needs	pollutants, to ensure protection of aquatic life, ecological functions, human health, and water supply needs.	targets as per the Hanlon Creek Subwatershed Study: - Chloride levels to average below 100 mg/l during non-runoff (dry weather) conditions. - Zinc levels to average at or below 0.7 mg/l - Total Phosphorus levels to average up to 0.1 mg/l during non-runoff (dry weather) conditions, - Nitrate levels of 5 mg/l (Tributary E) and 3 mg/l elsewhere. As the Clair-Maltby SPA is internally draining, 3 mg/l should apply - Dissolved Oxygen of 6 mg/l - Stream Temperature (downstream of Clair-Maltby) for Mill Creek to be below 20 ^{o}C and for Hanlon Creek to be below 24^{o}C (based on monitoring stations temperature data), as such this temperature should be considered in developing the drainage and stormwater management systems.

3.3.4 Stormwater Management Alternatives

As part of Phase 2 of the Municipal Class EA process, a wide range, and types, of alternatives are typically developed and assessed to address the Problem Statement. Alternative stormwater management (SWM) solutions for Clair-Maltby have been advanced to consider all aspects of the environment - natural, social/cultural, and economic (also referred to as the "Triple Bottom Line"). The approach to identifying alternative SWM quantity and quality solutions to address the goals, objectives and targets cited in Section 3.3.3, has considered the Subwatershed level protection strategies derived through the CEIS, based on the area's natural and water-based resources. Stormwater management alternatives are listed in the following, including the "Do-Nothing" alternative which is required to be considered as per the Municipal Class EA process.

Alternative 1: Do-Nothing: No stormwater management would be implemented and any impacts resulting from the updated Preferred Community Structure would not be addressed.

Alternative 2: Source/ Conveyance Controls (Public lands): Stormwater management quantity and quality measures, comprised of low impact development (LID) best management practices (BMPs) would be implemented within public lands, including road right-of-ways and park lands, and other public spaces.

Alternative 3: Source/ Conveyance Controls (Private lands): Stormwater management quantity and quality measures, comprised of low impact development (LID) best management practices (BMPs) would be implemented within privately owned lands (at-source, in predominantly residential land uses).

Alternative 4: Stormwater Capture Areas: End of pipe, dry detention areas, that capture and infiltrate the runoff volume associated with a Regional Storm – Hurricane Hazel, with potential overflow from the capture areas being conveyed either overland or piped to adjacent depression areas or along public overland drainage routes.

Alternative 5: Combinations: Combinations of Alternatives 2-4.

3.3.5 Stormwater Management Assessment Criteria

In order to systematically evaluate the advantages and disadvantages of the alternatives cited above, it is necessary to develop meaningful criteria which reflect the considerations related to each of the potentially affected environments namely: natural, social/cultural, and economic environmental categories, with consideration of functional effectiveness (ref. Section 3.3.6). Direct and indirect impacts related to the specific criteria associated with each of these categories, have been further examined as part of the evaluation of alternatives.

Evaluation Criteria

The evaluation criteria have been used to assess each proposed alternative solution. The stormwater management alternatives have been assessed on the basis of evaluation criteria established specifically for the current study. As per the Municipal Environmental Assessment process, the selected criteria relate to the consideration of potential impacts and opportunities generated by the alternatives within four distinct environments:

Table 3.3.7. Stormwater Management Alternatives Evaluation Criteria

Environment	Criteria
Natural Environment	Impacts or opportunities that an alternative may have related to the natural environment (i.e., fisheries, wildlife, water quality, etc.).
Social/Cultural Environment	Impacts or opportunities created by the alternative as related to the people and their current or historic relationship with the study area.
Economic Environment	Capital, operation, and maintenance costs associated with an alternative, both in the short-term and long-term.
Functional (Technical) Environment	Considers the ability of the alternative to address the Problem Statement and how it may impact existing physical systems.

Within each environment, relevant and representative criteria have been considered for the evaluation. Each evaluation criterion has been assessed to ensure it is quantifiable and results in a meaningful comparison between the SWM alternatives. The detailed evaluation categories, criteria, factors, and measures have been established to inherently encompass the Clair-Maltby Vision, Guiding Principles and objectives.

Table 3.3.8. Stormwater Management Alternatives Evaluation Factors

Component	Category	Evaluation Criteria	Factor	Potential Measure
Natural Environment	Water Quality	Water Chemistry and Temperature	Quality of water for fish and wildlife, recreation, or human use	Provincial Stormwater Guidelines and Water Quality Objectives (PWQO) and Stream Management Objectives
Natural Environment	Hydrology and Stormwater Management	Water Quantity	Environmental flows for recreation or wildlife	Flow rate (m^3/s)
Natural Environment	Natural Heritage	Wildlife Habitat	Potential effects on wildlife due to changes in habitat	Area of impacted habitat in m^2
Natural Environment	Natural Heritage	Wetland Impacts[1.]	Impacts to identified wetland areas	Area of impacted wetland in m^2
Natural Environment	Geology, Hydrogeology and Groundwater	Groundwater / Source Protection.	Potential adverse effect on groundwater including groundwater discharge and recharge	Change in Annual Water Balance, Depth to Groundwater
Social / Cultural	Cultural Heritage and Archaeology	Archaeological Resources[1.]	Potential adverse effects on archaeological resources	Extent of impact
Social / Cultural	Cultural Heritage and Archaeology	Cultural Heritage Resources[2.]	Potential adverse effects on cultural heritage resources	Extent of impact
Social / Cultural	Future Land Use and Growth Impacts	Impacts on Adjacent Properties	Potential adverse impacts to adjacent properties due to changes in water levels, construction of solutions etc.	Number of private or public properties

Component	Category	Evaluation Criteria	Factor	Potential Measure
Social / Cultural	Hydraulics	Flooding - off-site	Impacts on flooding potential	Peak flows
Economic	NA	Capital Cost	Design and construction costs	Estimated cost ($)
Economic	NA	Operation and Maintenance Cost	Asset management costs (lifecycle)	Estimated cost ($)
Economic	NA	Utilities[2.]	Ability to minimize effects on existing and proposed utilities	Number and extent of potential impacts on utilities
Economic	NA	Property Acquisition	Amount of private property required to achieve solution	Area in ha
Technical	NA	Stormwater Management	Ability to achieve SWM standards	Stormwater quantity, quality, and water balance measure requirements
Technical	NA	Hydrology	Control of runoff	Stormwater quantity measures
Technical	NA	Constructability	The degree of ability to construct the improvements in a simple and cost-effective manner	Duration / cost
Technical	NA	Community Resilience and Sustainability	Ability of the solution to have resilience for climate change impacts	Excess Capacity beyond standard design requirements

1. Combined into a single criterion due to common potential for impacts (spatially).
2. More related to detailed design versus planning stages thus removed from assessment.

Each of the stormwater management alternatives has been assessed using the evaluation categories, criteria and factors provided within Table 3.3.7. The following has been noted regarding the various alternatives under consideration:

Alternative 1: Do-Nothing: The Do-Nothing alternative for stormwater management would provide no mitigation of urban development impacts to the natural heritage system and water cycle/budget and offer no overall environmental benefits. The minor and major drainage systems would be expected to require more substantial designs given the lack of at source and/or conveyance controls (i.e. Low Impact Development Best Management Practices – LID BMPs). Although there would be no "direct" capital costs for stand-alone SWM infrastructure associated with this alternative, there would ultimately be costs related to addressing the impacts that would be expected to occur to the natural heritage system and surface/groundwater system. Furthermore, development in the Province of Ontario would be non-compliant if it proceeded without any form of stormwater management (ref. Clean Water Act, PPS and Growth Plan).

Alternative 2: Source/ Conveyance Controls (Public lands): LID BMPs implemented within public lands, including road right-of-ways and park lands (approximately 55% of the total LID BMPs, considering LID BMPs for both public and private lands), would provide low to moderate water quantity benefits and moderate to high water quality benefits, but would not be expected to address all development-related hydrologic and water quality impacts. LID BMPs within public lands would be more easily maintained due to ownership and accessibility.

Alternative 3: Source/ Conveyance Controls (Private lands): This alternative is similar to Alternative 2 in the levels of attainable water quantity and water quality benefits, it could provide. LID BMPs located on private lands (approximately 45% of the total LID BMPs, considering LID BMPs for both public and private lands) would need to be maintained from time to time hence accessibility and landowner awareness will be required elements of an effective system-based design. Specifically, to maintain the function of the various LID BMPs, land title agreements (or equivalents) would require landowners to preserve the LID BMPs and would either require the landowner to be responsible for maintenance or the City would be responsible through a third party (agreed to by the City) to observe the state of the LID BMP and maintain the feature accordingly. To be included within the City's CLI ECA, private stormwater management systems are required to be transferred to the City.

Alternative 4: Stormwater Capture Areas: These end of pipe, dry detention areas, would be designed to fully capture and infiltrate the runoff from the Regional Storm for both public and private lands. The facilities would require water quality pre-treatment to preserve/enhance the infiltrative properties, which could be provided by various measures including CB Sheilds™ and/ or oil/grit chambers, or other pre-treatment measures.

Alternative 5: Combinations: Strategic Combinations of Alternatives 2-4, can potentially offer improved performance when compared to the singular application of any of the other Alternatives considered.

The foregoing alternatives have been assessed using the criteria noted in Table 3.3.8 by applying positive, positive-neutral, neutral, negative-neutral and negative scores. Based on this assessment the preferred stormwater management alternative is a combination of source/ conveyance controls for both public and private lands and stormwater water capture areas (i.e. Alt 5).

Table 3.3.9. Assessment of Alternative Design Concepts - Stormwater Management

Component	Category	Evaluation Criteria	Factor	Measure	Alt 1 Score	Alternative 1: Do Nothing	Alt 2 Score	Alternative 2: Source / Conveyance Controls (Public Roads)	Alt 3 Score	Alternative 3: Source / Conveyance Controls (Private)	Alt 4 Score	Alternative 4: Stormwater Capture Areas	Alt 5 Score	Alternative 5: Combinations
Natural Environment	Water Quality	Water Quality and Temperature	Quality of Water for Fish and Wildlife, Recreation, or Human Use	Provincial Stormwater Guidelines and Water Quality Objectives (PWOQ) and stream management objectives	○	Moderate impacts to local area	●	Potential for recovered capacity	●	Potential for recovered capacity	●	Potential for recovered capacity	●	Potential for recovered capacity
Natural Environment	Hydrology and Stormwater Management	Water Quantity	Environmental flows for recreation or wildlife	Flow rate (cubic metres per second, m^3/s)	○	Moderate impacts to local area	◔	Minor benefit potential	◔	Minor benefit potential	●	Moderate benefit potential	●	Moderate benefit potential
Natural Environment	Natural Heritage	Wildlife Habitat	Potential effects on wildlife due to changes in habitat	Area of impacted habitat (square metres, m^2)	◑	Moderate impacts to local area	◔	No direct change	◔	No direct change	◔	No direct change	◔	No direct change
Natural Environment	Natural Heritage	Wetland Impacts	Impacts to identified wetland areas	Area of impacted wetland m^2	○	Moderate impacts to local area	◔	Minor benefit potential	◔	Minor benefit potential	●	Moderate benefit potential	●	Moderate benefit potential
Natural Environment	Geology, Hydrogeology and Groundwater	Groundwater / Source Protection	Potential adverse effect on groundwater and wells including groundwater discharge and recharge	Change in Annual Water Balance, Depth to Groundwater	○	Moderate impacts to local area	◔	Minor water balance benefit	◔	Minor water balance benefit	◔	Moderate benefit potential	●	Moderate benefit potential
Social/ Cultural	Cultural Heritage and Archaeology	Archaeological and Cultural Heritage Resources	Potential adverse effects on archaeological and cultural	Extent of impact	●	No direct impact	◔	No direct impact (right-of-way)	◔	No direct impact (developing land base)	◑	Minor potential	◑	Minor potential

Component	Category	Evaluation Criteria	Factor	Measure	Alt 1 Score	Alternative 1: Do Nothing	Alt 2 Score	Alternative 2: Source / Conveyance Controls (Public Roads)	Alt 3 Score	Alternative 3: Source / Conveyance Controls (Private)	Alt 4 Score	Alternative 4: Stormwater Capture Areas	Alt 5 Score	Alternative 5: Combinations
			heritage resources											
Social/ Cultural	Future Land Use and Growth Impacts	Impacts on Adjacent Properties	Changes to properties resulting from changes to water levels, construction of alternatives, etc.	Private and public properties (number of)	○	Moderate impacts to local area	◕	None will occur in road right-of-ways	◐	Minor impacts to private property	◐	Minor impacts to local area	◐	Minor impacts to private property
Social/ Cultural	Hydraulics	Flooding - off-site	Impacts on flood potential	Peak Flows	○	No potential to address off-site flood risk	◕	Potentially addresses off-site flood risk	◕	Potentially addresses off-site flood risk	◕	Potentially addresses off-site flood risk	●	Addresses off-site flood risk
Economic		Capital Cost	Design and construction costs	Estimated cost ($)	◕	No capital cost	◐	Public cost at time of road works	◐	Private cost at time of redevelopment	◐	Standalone capital cost	◐	Public, Private and Standalone capital cost
Economic		Maintenance Cost	Asset management costs (Lifecycle)	Estimated cost ($)	●	No capital cost	◐	City responsibility	○	Private responsibility	◐	City responsibility	◐	Private and City Responsibility
Economic		Property Acquisition	Amount of private property required to achieve solution	Area (hectares, ha)	●	No property acquisition	◐	Within road right-of-way. Land costs for right-of-way	◐	Within institutional lands. Cost for developers.	◐	Land dedicated as part of SWM Block. Cost for developers	◐	Combination of land provisions
Technical		Stormwater Management	Ability to achieve stormwater management standards	To be determined	○	No potential to address stormwater management	◕	Likely only partially effective. Requires other stormwater management measures	◕	Likely only partially effective. Requires other stormwater management measures	◕	Likely only partially effective. Requires other stormwater management measures	●	Meets Provincial Guidelines

Component	Category	Evaluation Criteria	Factor	Measure	Alt 1 Score	Alternative 1: Do Nothing	Alt 2 Score	Alternative 2: Source / Conveyance Controls (Public Roads)	Alt 3 Score	Alternative 3: Source / Conveyance Controls (Private)	Alt 4 Score	Alternative 4: Stormwater Capture Areas	Alt 5 Score	Alternative 5: Combinations
Technical		Constructability	The ability to construct the improvements in a simple and cost effective manner	Duration / cost	Positive-Neutral	No construction	Negative-Neutral	Integrated into proposed roads and infrastructure	Negative-Neutral	Constructed as part of new development	Negative-Neutral	Constructed as part of new development	Negative-Neutral	Constructed as part of new development
Technical		Community Resilience and Sustainability	Ability of the solution to mitigate climate change impacts	To be determined	Negative	No ability to mitigate climate change impacts	Positive-Neutral	Recovers system capacity	Positive-Neutral	Recovers system capacity	Positive-Neutral	Recovers system capacity	Positive	Maximum ability to mitigate climate change impacts
Summary					Negative	**Not Preferred**	Positive-Neutral	**Preferred**	Positive-Neutral	**Preferred**	Positive-Neutral	**Preferred**	Positive	**Preferred and Selected**

Score Legend

(red open circle)	Negative
(yellow half circle)	Negative-Neutral
(purple quarter circle)	Positive-Neutral
(green circle)	Positive

3.3.6 Preferred Stormwater Management Solution(s)

The preferred stormwater management alternative based on an assessment of the various criteria associated with the respective environments considered is Alternative 5: Combination of Alternatives, including at source / conveyance controls located on both public and private property and Stormwater Capture Areas (SWCA) that will receive the residual drainage after source and conveyance controls to provide at-source infiltration of either clean drainage or pre-treated drainage. Alternative 5 provides a sustainable solution by using a distributed approach for LID BMPs within the land use fabric, with the objective of providing water quality control, contributing to the water balance requirement and reducing frequent discharge to the SWCAs. Further innovation can be assessed/applied through a collective suite of LID BMPs, that will be determined through the next stages of the planning and design process. The following sections provide further details on the technical assessment of the preferred stormwater management alternatives.

3.3.6.1 Grading

To assess the preferred stormwater management alternative, a conceptual grading plan (ref. Figures 3.3.2 and 3.3.5) has been developed with the objective of largely maintaining and preserving existing drainage areas and patterns. The proposed conceptual grading has considered the existing subwatershed boundaries, drainage areas to NHS features, significant depressional features and the limitations/restrictions of development grading (e.g. road slopes).

3.3.6.2 Hydrology

The validated PCSWMM existing condition hydrologic model prepared for the Phase 1 and 2 Characterization Report, as part of the CEIS and the future condition hydrologic model provide the base models from which to assess the Preferred Community Structure. In order to develop a preliminary drainage area plan, the existing land use drainage boundaries and depressional features have been overlaid on the Preferred Community Structure (ref. Figure 3.3.1) and then proposed drainage boundaries have been established premised on the conceptual grading (ref. Figure 3.3.2).

The SWCAs have been located and sized to capture the Regional Storm, Hurricane Hazel, hence the initial sizing or area of each of the proposed SWCA's has been approximated using 10 per cent of the contributing drainage area, which is within the industry's typical range of areas for stormwater management facilities capable of controlling the Regional Storm, based on Hurricane Hazel. Each SWCA has also been sized to provide a buffer of approximately 5 per cent to 10 per cent area to allow for consideration of climate change, maintenance and operation requirements and potential trails. Preliminary locations for overflow relief systems for each SWCA and the associated potential outlet locations have been identified, with the objective of maintaining the existing drainage patterns to the extent possible (i.e. the SWCA relief would be towards the existing drainage relief point). It is important to emphasize that the relief systems would not be operative until extreme conditions, above the Regional Storm – Hurricane Hazel (285 mm).

The foregoing drainage approaches were used as a basis to revise the existing condition PCSWMM hydrologic model. The parameterization for the PCSWMM modelling impervious coverages for the proposed land uses within the SPA have been set as per Table 3.3.8 which reflects land use values for similar forms of development across Southern Ontario and Guelph. Notably, City staff and the Study Planning lead for the Secondary Plan were also engaged in a discussion regarding these coverages to ensure that they are supportive of industry values. Impervious coverages outside of the SPA have been maintained as per the values used in the CEIS - Phases 1 and 2 Characterization assessment. The impervious coverages represent the total impervious coverages and the percentage of the impervious coverages (indirect impervious coverage) routed over pervious areas, such as landscaped lands. Indirect impervious coverages such as roof areas draining to grass areas result in less runoff as the grassed areas or landscaped areas are able to infiltrate some of the runoff from the impervious surface. The indirect impervious coverages have been determined through assessing various land uses within southern Ontario and typically drainage connections for impervious surfaces.

The directly connected impervious coverages are the difference of the total impervious coverage minus the routed impervious coverage (indirect impervious coverage).

Soil parameterization, as per the existing conditions in the PCSWMM model, has also been maintained within and outside of the SPA. The depressional areas located within the NHS have been maintained, while the depressional areas partially within the NHS and the developing area have been adjusted accordingly, based on the future land use and conceptual grading plan. Drainage catchment slopes range from 1 per cent to 5 per cent based on existing and proposed grades within the SPA while respecting significant landform policies associated with the Natural Heritage System.

Table 3.3.10. Proposed Land Use Impervious Coverages

Land Use Type	Total Imperviousness (%)	Routing Over Pervious (%)
Mixed Use	88	0
Office Commercial	85	0
Neighborhood Commercial	85	0
Service Commercial	85	0
School	65	40
High-density Residential	80	0
Medium density Residential	70	30
Low-density Residential	65	40
ROW (Local/Collector)	65	0
ROW(Arterial)	75	0

Land Use Type	Total Imperviousness (%)	Routing Over Pervious (%)
Park (neighborhood)	20	25
Open Space	10	100
Natural Heritage	5	100
SWM	10	100

The PCSWMM hydrologic model, based on the foregoing parameter assumptions, has been developed accordingly for the impact assessment.

Stormwater Capture Areas (SWCA) and Low Impact Development Best Management Practices (LID BMPs) Design Criteria and Guidance

A. **Stormwater Capture Areas**

Sizing:

In establishing stormwater capture areas and low impact development (LID) best management practices (BMPs), replication of the function of the significant number of existing depressional features on the landscape had to be considered. The most significant of these depressional areas (i.e., those with 300 mm + of runoff capture) became the primary focus to replicate existing drainage patterns and water balance conditions within the Clair-Maltby SPA, since the smaller features tended to overflow more frequently into the adjacent larger systems noted. The resulting stormwater management approach has proposed the following:

- 20 mm capture via LID BMPs to replicate the function of the numerous small depressional areas within the SPA and to provide for stormwater quality management, contribute to the water balance target and provide quantity control prior to drainage being conveyed to the SWCAs. The 20 mm capture would apply to all new development areas, including public, private properties and roads based on total impervious coverage (ref. Figure 3.3.4). Note: the CEIS reporting discusses the iterative approach to establishing the optimum capture.
- For small development areas (typically less than 5 ha), drainage catchments which are either internally draining within Clair-Maltby to other larger depressional features or are draining directly to significant depressional (>300 mm capture) features immediately next to the Clair-Maltby boundary, capture of only 20 mm would be required for water quality treatment and water budget objectives.
- For small development areas less than 5 ha that are discharging to Maltby Road, 20 mm capture within LID BMPs is required along with capture and control up to the Regional Storm (Regulatory) event within end-of-pipe stormwater management controls (e.g. SWCA) to provide water balance, water quality and to maintain peak flows at existing levels to external private lands.
- For all other remaining development areas (typically more than 5 ha), full capture of the Regional Storm (285 mm) will be required in addition to the 20 mm capture through distributed LID BMPs.

- The stormwater capture areas (SWCA) are proposed to have a volumetric safety factor to allow for operation and maintenance requirements, trails, and modifications during the design stage, as well as accommodation of climate change influences. Refer to the "Depth of Water in SWCA" section for details on the safety factor. An overflow relief system will be required for each SWCA, and it will need to be designed to function after the volumetric safety factor has been used. Depending on the location of the SWCA it may be able to discharge drainage to the adjacent NHS and be sited to maintain existing drainage patterns. Furthermore, adding a safety buffer to the Regional Storm volume, will ensure extreme events resulting from climate change would be managed.
- For the Community Park, located adjacent to Halls Pond, distributed LID BMPs are to capture the 100-year storm event. The distributed LID BMPs are to replace an earlier recommendation for a 100-year stormwater capture area, which would have been required for the park draining to Halls Pond. The rationale for using LID BMPs versus a SWCA is to prevent groundwater mounding and mitigate potential increases in the average Halls Pond water level. The detailed Halls Pond Assessment has been provided in Appendix F. Stormwater management requirements for drainage in Subcatchments S-42, S-55, and S-61 have been updated as per the recommendations and requirements of Appendix F. Figure 3.3.4 indicates SWCAs in the Community Park area prior to the Community Park being approved, as such reference Appendix F for the revised SWCAs locations in this area.

Siting:

Ultimate catchment areas and associated SWCAs do not need to fully align with those indicated in this MESP nor should they necessarily match property lines. It is important to locate SWCAs so that they are optimized in terms of their function. SWCAs may potentially serve multiple landowners/properties.

The siting of SWCAs needs to be tested through surface water modelling and integrated surface water/groundwater modelling to ensure that the physical geometry of the proposed SWCAs can adequately hold the estimated runoff (tested through PCSWMM modelling) and their location is such that impacts to groundwater elevations, flow directions and functions (tested through MIKE-SHE modelling) are not adversely affected.

Use of Significant Landform (SLF) for Stormwater Storage:

All operable elements of any proposed SWCA need to be located outside of the SLF, which includes any element of the system which may require City intervention in terms of operations and maintenance (e.g. including outlet pipes, forebays, OGS, sediment decanting areas, access paths, etc.).

Adjacent and contiguous portions of the SLF to proposed SWCAs can be used for flood storage (up to 50% of the total SWCA size), subject to the test of no negative impact to the form and function of the SLF.

There shall be no grading or site alteration of these contiguous portions of the SWCA in the SLF, with the exception of minor works to provide functional containment where required. Through a site-specific EIS, the City will generally consider works to be "minor" where they consist of transitional grading and areas of disturbance are proposed to be naturalized.

In the event the adjacent SLF is comprised of several closed depressions, natural overflow from one depression to another can be considered subject to a systems-based assessment of volumes and impacts through approved modelling.

Depth of Water in SWCA:

This MESP has applied a water depth of 2.5 m to estimate the preliminary size of SWCA footprints based on the volume requirements for full capture of the runoff volume resulting from a Regional Storm plus a 10% volumetric buffer to accommodate uncertainty due to climate change and other factors, particularly as these systems will not have a formal outlet. Due to the unique nature of SWCAs (i.e. dry systems with no designated outlet to a watercourse), the City recommends the following design approach to provide a level of flexibility to development applicants:

- Preferred maximum depth of:
  - 2.5 m including 0.0 m freeboard to accommodate Regional Storm runoff volume plus 10% volumetric safety factor; or,
  - 2.5 m including 0.3 m free board for Regional Storm with no additional volumetric safety factor
- Maximum depth of 3.0 m

Emergency Relief Overflow:

Emergency relief overflows for SWCAs need to be designed:

- for storm events greater than the combined capture of 20 mm within LID BMPs and 285 mm for the Regional Storm event within the SWCA;
- to not adversely impact downstream properties and where adjacency to roadways is prevalent, to facilitate safe vehicle ingress and egress within municipal right-of-ways;
- to avoid or minimize impacts to the Natural Heritage System.

Given these design parameters, there is a low possibility of the emergency relief overflow being used. The emergency relief overflow could be in the form of a spillway or other appropriate relief geometry. The design and associated mitigation measures will need to be approved by the City through future site-specific development approvals, including design considerations to avoid adverse impacts to downstream properties and safe vehicle ingress and egress where adjacency to roadways is prevalent.

Pre-treatment:

Stormwater runoff entering a SWCA needs to be pre-treated through suitable measures such as an appropriately sized OGS (or system of OGS) and/or a forebay designed in accordance with MECP and City criteria.

For clarity, the combination of source controls (20 mm capture for public and private lands in the catchment associated with the SWCA) along with the residual pre-treatment and capture in the SWCA will be required to meet the intended level of treatment ("enhanced" for the Clair-Maltby SPA).

Side Slopes for SWCA:

Side slopes shall be as per the guidance in the City of Guelph DEM (2019) and MECP Guidance Manual.

Decanting:

The City does not require decanting areas to be located outside of the limits of the SWCAs, however the following is required:

- Decanting areas cannot be located in the SLF or parks; and
- Decanting areas must be outside of the 100-year flood zone in the SWCA

B. Low Impact Development Best Management Practices:

Capture quantity:

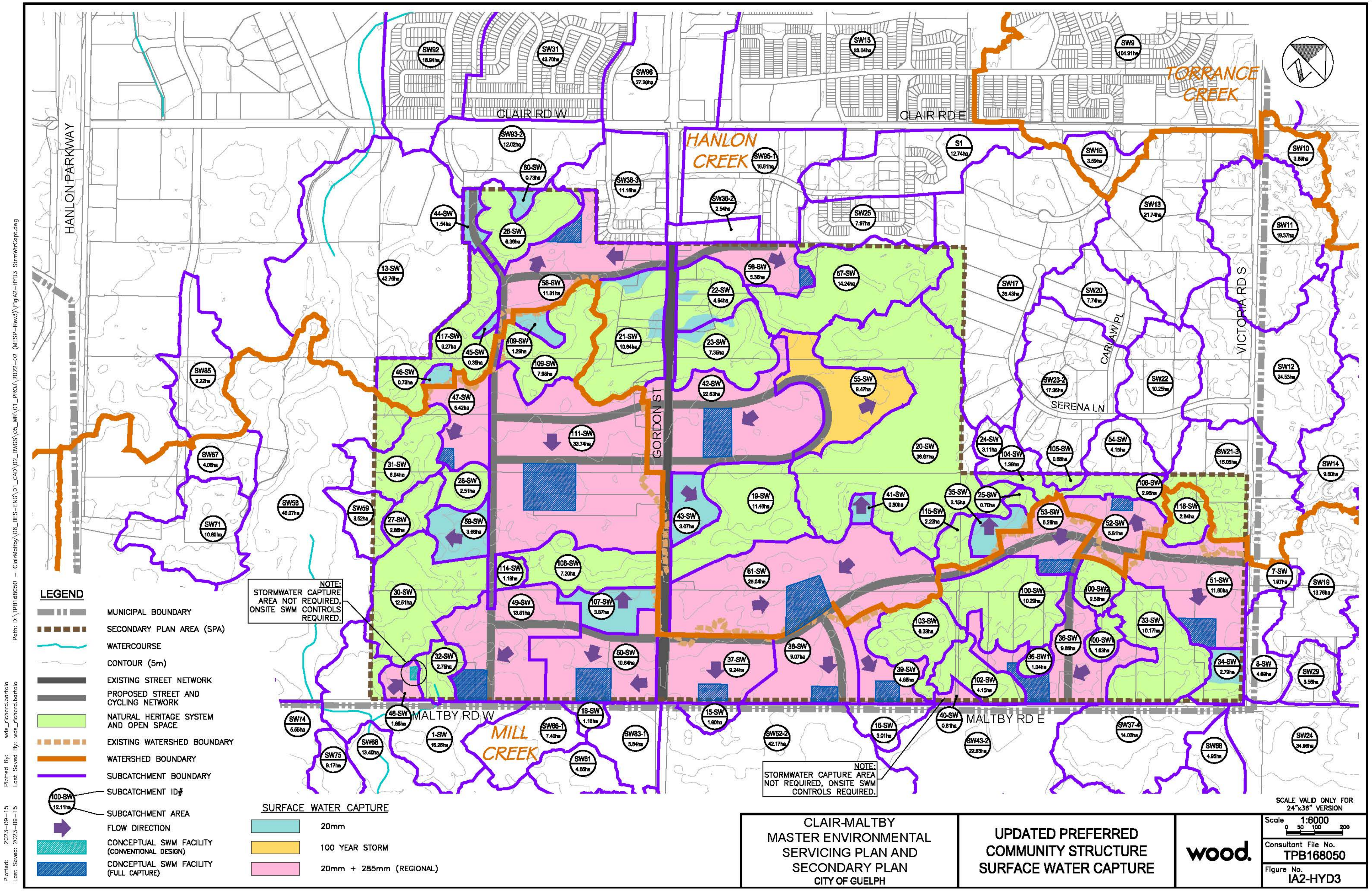
This MESP prescribes 20 mm runoff capture from both public and private lands. The City's DEM and SWM MP outline the preferred measures for achieving this capture however should proponents advance other practices, these will be reviewed by the City on a case-by-case basis. It is also recognized that fully achieving the capture equally on public and private lands may not always be easily or practically achieved. Hence, the City is advancing a level of flexibility to allow a minimum of 10 mm capture on some lands, subject to an overall average capture of 20 mm per plan of subdivision. Notably, the efficacy of the proposed approach needs to be tested and validated through numerical modelling, as described earlier.

Pre-treatment:

Runoff from paved surfaces (roads, parking lots, driveways, walkways, etc.) must be pre-treated to remove grit, sediment and those contaminants which would normally adhere to this material. The intent is to reduce the amount of contamination reaching the local groundwater system and also to enhance the long-term functionality of the local LID measures. The City has outlined its preferred measures for pre-treatment in its DEM however should proponents advance other practices these will be reviewed on a case-by-case basis. As noted in this document "*Pre-treatment water quality measures receiving runoff from paved surfaces and in a treatment train, should be able to provide a minimum of 60 per cent TSS removal (former Basic Level of water quality treatment) prior to discharging to infiltrative LID BMPs that treat the 20mm to achieve the full 80% TSS removal for the treatment train."* This should be the design objective for any pre-treatment for LID BMPs. As noted in the City's SWM MP, the requirements for pre-treatment are intended to address various contaminants beyond the TSS proxy used by the Province. Pre-treatment measures will include a variety of techniques consistent with provincial and City guidance including the SWM MP and the City's in-effect

Consolidated Linear Infrastructure Environmental Compliance Approval, including but not limited to OGS, CB Shields, grassed swales and other City-approved BMPs.

Figure 3.3.4. Proposed Stormwater Capture Criteria



Each of the stormwater capture areas (SWCAs) has been modelled using PCSWMM applying a depth/area/discharge rating curve based on a maximum operating depth of 2.5 m to the invert of the relief system. The relief system elevations have been established by matching grades at the receiving drainage system (i.e. depressional feature) to allow for positive drainage.

The distributed 20 mm capture for impervious surfaces for each drainage catchment has been modelled using a storage element that reflects the existing soil conditions and allows for evaporation, thus replicating at surface LID BMPs.

Table 3.3.11 provides a summary of the stormwater capture areas for Regional Storm capture. Drainage areas (catchments) are depicted on Figure 3.3.4. The SWCA Top Area / Drainage Area ratio ranges from 8 per cent to 11 per cent, which is within the industry's upper range for stormwater management facility sizing. Table 3.3.12 provides the unitary volumetric storage (m^3/ impervious hectare) for the SWCAs for the 25-year, 100-year and Regional Storm events. Volumetric requirements for each storm event are within typical industry expected ranges.

Table 3.3.11. Summary of Stormwater Capture Areas

Drainage Catchment	Drainage Area (ha)	Imperviousness Coverage (%)	Top Area (ha)	Top Area / Drainage Area	Volume Provided (m^3)	Sizing Event
38_SW	9.07	62.5	0.80	9 per cent	13160	Regional
48_SW	1.66	65.0	Onsite Control	NA	3309	Regional
36_SW	9.65	54.9	1.08	11%	14966	Regional
39_SW	4.68	60.2	0.51	11%	6951	Regional
42_SW	22.53	65.9	2.01	9%	35594	Regional
47_SW	5.42	63.3	0.58	11%	7940	Regional
49_SW	13.81	61.4	1.20	9%	21109	Regional
50_SW	10.64	58.8	1.05	10%	17294	Regional
51_SW	11.90	61.5	1.13	10%	17757	Regional
52_SW	5.81	64.3	0.60	10%	8789	Regional
53_SW	6.28	55.5	0.66	11%	8729	Regional
56_SW	5.45	58.9	0.60	11%	7728	Regional
58_SW	11.31	61.8	1.14	10%	17525	Regional
61_SW	25.04	60.4	2.27	9%	41287	Regional

Drainage Catchment	Drainage Area (ha)	Imperviousness Coverage (%)	Top Area (ha)	Top Area / Drainage Area	Volume Provided (m^3)	Sizing Event
111_SW	33.74	57.1	3.02	9%	53383	Regional
37_SW	9.24	65.0	0.92	10%	14727	Regional

Through an integrated consideration of site services, specifically stormwater and wastewater, it has been noted that the forebays for stormwater capture areas could be used as emergency overflow locations for the wastewater pumping stations. Should this be the case, there should be consideration for a forebay that could be lined with the ability to contain the pumped volume through valving of the outlet.

Figure 3.3.5. Preliminary Stormwater Management and Conceptual Grading Plan

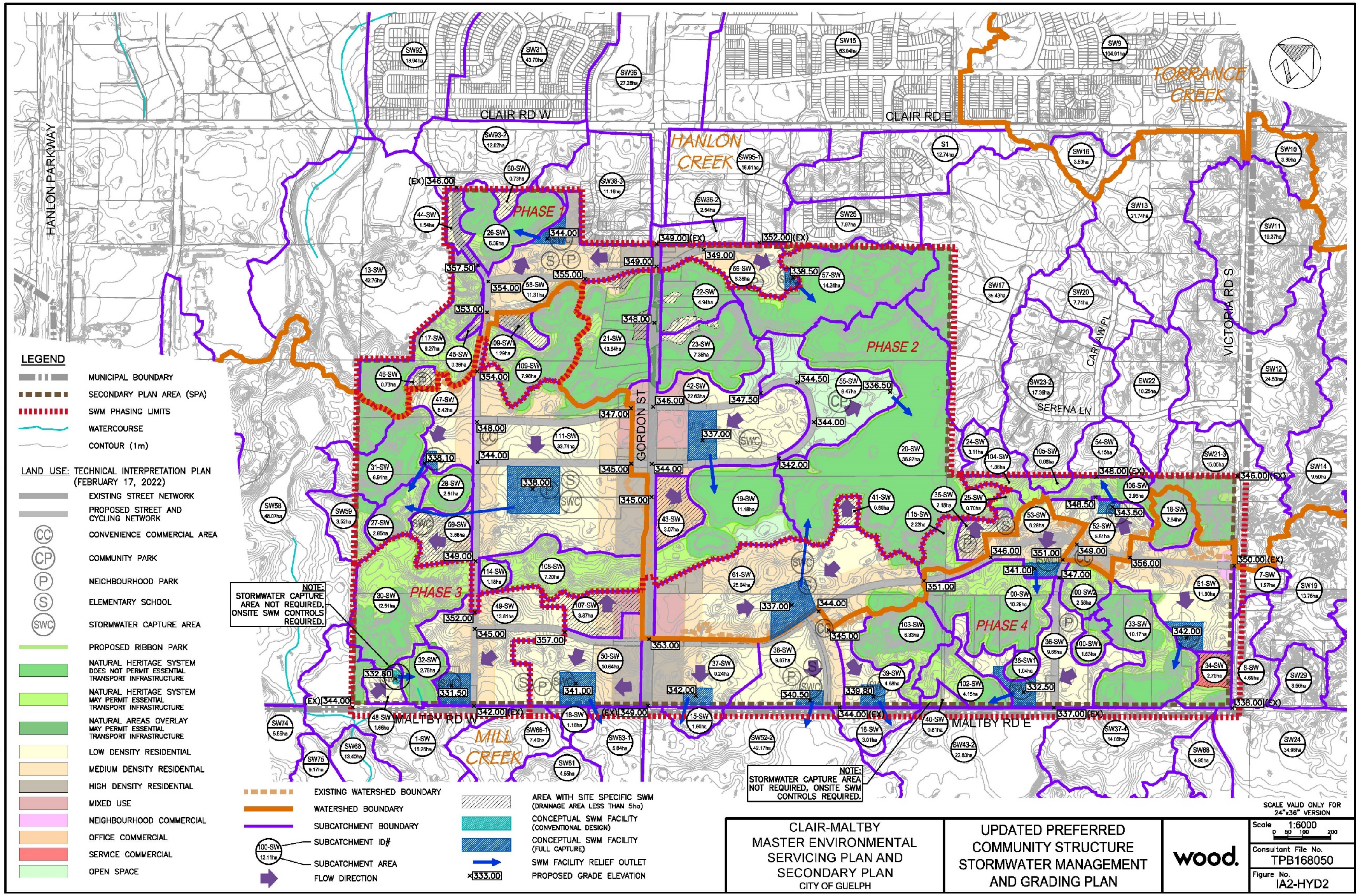


Table 3.3.12. Stormwater Capture Areas Volumetric Requirements

Drainage Catchment	Drainage Area (ha)	Sizing Event	Volume Provided (m^3)	25 Year Maximum Vol. (m^3)	25 Year Unitary Vol (m^3/imp.ha)	100 Year Maximum Vol. (m^3)	100 Year Unitary Vol (m^3/imp.ha)	Regional Storm Maximum Vol. (m^3)	Regional Storm Unitary Vol (m^3/imp.ha)
38_SW	9.07	Regional	13,160	2,726	481	4,265	752	11,640	2,053
48_SW	1.66	Regional	3,309	635.8	590	946.8	879	2,962	2,748
36_SW	9.65	Regional	14,966	2,794	528	4,395	830	11,370	2,147
39_SW	4.68	Regional	6,951	1,389	493	2,171	771	5,754	2,043
42_SW	22.53	Regional	35,594	7,003	472	10,820	729	30,960	2,085
47_SW	5.42	Regional	7,940	1,641	478	2,552	744	6,889	2,007
49_SW	13.81	Regional	21,109	4,113	485	6,448	760	17,330	2,044
50_SW	10.64	Regional	17,294	3,149	504	4,926	788	13,290	2,126
51_SW	11.90	Regional	17,757	3,545	484	5,560	760	14,940	2,042
52_SW	5.81	Regional	8,789	1,790	479	2,766	741	7,705	2,063
53_SW	6.28	Regional	8,729	1,857	532	2,898	831	7,567	2,170
56_SW	5.45	Regional	7,728	1,604	499	2,501	779	6,838	2,129
58_SW	11.31	Regional	17,525	3,421	489	5,322	761	14,800	2,117
61_SW	25.04	Regional	41,287	7,267	480	11,500	760	30,740	2,031
111_SW	33.74	Regional	53,383	9,738	505	15,360	797	40,710	2,111
37_SW	9.24	Regional	14,727	2,835	472	4,393	732	12,390	2,064

Frequency and Design Event Peak Flows

The PCSWMM hydrologic model representative of the updated Preferred Community Structure and the recommended 20 mm source capture and stormwater capture areas in-place, has been executed for the 67-year continuous period (1950-2017) as per the CEIS. The hydrologic model has been used to determine frequency flows at the Hanlon Creek and Mill Creek flow monitoring sites.

Frequency analyses using Consolidated Frequency Analysis (CFA) have been completed using the Log Pearson Type III Distribution providing the best fit to the annual maximum peak flows. Frequency flows for both flow monitoring locations have been provided in Tables 3.3.13 and 3.3.14. Frequency flows for the proposed future land use condition are comparable to those for the existing land use condition.

In addition to frequency flows calculated with continuous simulation, peak flows for the proposed future land use condition have also been determined using the City of Guelph 3-hour Chicago design storms for the 2-to-100-year storm events, along with the Regional Storm (Hurricane Hazel), with peak flows provided within Tables 3.1.15 and 3.1.16. The future land use condition design event peak flows are also comparable to those of the existing land use condition, similarly, calculated using design storm methodology. Both the future frequency and design event peak flows are comparable to the existing land use condition and are considered to be acceptable, based on little to no impact compared to existing conditions, thus demonstrating the effectiveness of the proposed SWM system. Frequency and peak flows are representative of the Updated Preferred Community Structure and Final Preferred Community Structure. Frequency flows are based on historical rainfall data and determining peak flows based on the frequency of occurrence. Frequency flows are considered to be more accurate than flows determined using synthetic storm equations (design storms) based on using actual observed rainfall data. Peak flows resulting from using design storms are considered to be conservative and are to be used for storm conveyance infrastructure design

Table 3.3.13. Hanlon Creek Monitoring Site (Station 15) Frequency Flows for Existing and Proposed Land Use Conditions (m^3/s)

Land Use Condition	Return Period 1.003	Return Period 1.05	Return Period 1.25	Return Period 2	Return Period 5	Return Period 10	Return Period 20	Return Period 50	Return Period 100
Existing	0.008	0.036	0.100	0.250	0.530	0.760	0.990	1.310	1.550
Future with SWM	0.009	0.036	0.095	0.230	0.490	0.710	0.940	1.260	1.520
Difference	0.001	0.000	-0.005	-0.020	-0.040	-0.050	-0.050	-0.050	-0.030

Table 3.3.14. Mill Creek Monitoring Site (Station 14) Frequency Flows for Existing and Proposed Land Use Conditions (m^3/s)

Land Use Condition	Return Period 1.003	Return Period 1.05	Return Period 1.25	Return Period 2	Return Period 5	Return Period 10	Return Period 20	Return Period 50	Return Period 100
Existing	0.035	0.038	0.039	0.045	0.069	0.100	0.160	0.290	0.480
Future with SWM	0.035	0.038	0.039	0.045	0.069	0.100	0.160	0.290	0.480
Difference	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3.3.15. Hanlon Creek Monitoring Site (Station 15) Design Event Peak Flows for Existing and Proposed Land Use Conditions (m^3/s)

Land Use Condition	Return Period 2	Return Period 5	Return Period 10	Return Period 25	Return Period 50	Return Period 100	Return Period Regional
Existing	0.501	0.667	0.697	0.714	0.723	0.740	0.819
Future with SWM	0.453	0.662	0.693	0.710	0.722	0.739	0.811
Difference	-0.048	-0.005	-0.004	-0.004	-0.001	-0.001	-0.008

Table 3.3.16. Mill Creek Monitoring Site (Station 14) Design Event Peak Flows for Existing and Proposed Land Use Conditions (m^3/s)

Land Use Condition	Return Period 2	Return Period 5	Return Period 10	Return Period 25	Return Period 50	Return Period 100	Return Period Regional
Existing	0.039	0.060	0.076	0.324	1.371	2.801	4.747
Future with SWM	0.039	0.060	0.076	0.324	1.369	2.798	4.747
Difference	0.000	0.000	0.000	0.000	0.002	0.003	0.000

Water Balance

In addition to determining frequency flows and design event peak flows at the two monitoring locations, the 1950-2017 climate data set has been used to establish an annual water balance (surface water-based modelling) within the Clair-Maltby SPA and to the monitoring locations (flow and spot flow) within the Clair-Maltby Secondary Study Area (SSA) (ref. Figure 3.3.2). An annual water balance assessment has been conducted for each subwatershed based on the subcatchments contributing to the monitoring locations within Mill Creek, and Hanlon Creek for the Preferred Community Structure, with the results compared to the existing land use condition. To provide flexibility in the stormwater capture area designs and to facilitate infiltration to maintain water balance, pervious land uses (i.e. parks, schools and stormwater capture areas) have been planned to be co-located (ref. Appendix C). The mean values for the annual water balance are provided in Tables 3.3.17 to 3.3.18, with detailed results provided in Appendix C.

As noted earlier, the PCSWMM hydrologic modelling methodology determines annual evaporation conditions using pan-evaporation and temperature data series sets. The evaporation does not include transpiration from vegetation, as such the transpiration is inherently included with infiltration, as the drainage that is infiltrated within the vegetation root zone would also be available for transpiration.

Baseflow within the PCSWMM hydrologic model is a continuous discharge in Clair-Maltby, and it represents groundwater discharge. Outflow represents baseflow and any other overland runoff response.

Based on a comparison of the water balance for the existing and future land use conditions, on a subwatershed basis, the total amount of drainage available for infiltration and transpiration is primarily maintained (i.e. no let loss) using the proposed stormwater management approach, including a distributed 20 mm capture and the proposed stormwater capture areas. For Hanlon Creek with a drainage area of 821.37 ha, the 0.36 mm annual infiltration/transpiration deficit is equivalent to 2957m^3 or 0.04 per cent of the annual infiltration/transpiration volume. For Mills Creek with a drainage area of 1019.87 ha the 1.26 mm annual infiltration/ transpiration deficit is equivalent to 12,850 m^3 or 0.15 per cent of the annual infiltration/transpiration volume.

Table 3.3.17. Hanlon Subwatershed Annual Water Balance Summary for Existing and Future Land Use Conditions (mm)

Land Use Condition	Precipitation	Infiltration / Transpiration	Evaporation	Discharge / Runoff
Existing	856.46	842.98	26.94	0.39
Proposed	856.46	840.62	31.38	0.31

Table 3.3.18. Mill Creek Subwatershed Annual Water Balance Summary for Existing and Future Land Use Conditions (mm)

Land Use Condition	Precipitation	Infiltration / Transpiration	Evaporation	Discharge / Runoff
Existing	856.46	843.18	11.95	9.69
Proposed	856.46	841.92	16.86	8.72

Notably, the locations of the SWCAs and the source control rate (20 mm), has been further assessed as input to the groundwater modelling (MIKE SHE) to validate the movement of water through the system. The impacts of the future conditions' scenario and effectiveness of the LID BMPs and other SWM measures has been assessed by comparison to the existing conditions for the period of 2003-2017 for the updated Community Structure (land use iteration 2). The 15-year simulation period employed (for iteration 2) provided additional insights on long term impacts compared to the shorter simulation used in iteration 1 (initial Community Structure). As noted, it is acknowledged that there is uncertainty in the hourly data used in the MIKE SHE model and it may underestimate annual precipitation, however, these data provide a climate dataset that represents the full range of wet and dry conditions and is considered appropriate for sizing of LID BMP and SWM capture.

Recognizing the general uncertainty in precipitation data and also based on stakeholder feedback related to hourly climate data used to evaluate the proposed SWM management approach, which may underestimate monthly and annual precipitation totals, the Team developed an alternative precipitation hourly dataset using daily and monthly totals from the GRCA Shades Mills Climate Station, which resulted in higher monthly average precipitation. The higher precipitation dataset was used for additional simulations of existing and future conditions using the integrated MIKE SHE model versions from the third iteration of the impact assessment. The original and higher precipitation datasets represent the range of possible precipitation and enable an evaluation of the sensitivity of the existing conditions calibration to precipitation and an evaluation of if/how the uncertainty in input data may impact the proposed stormwater management approaches. The higher precipitation dataset, simulation setup and results are documented in more detail in Appendix G.

The Secondary Study Area (SSA) simulated water budget provides an indication of potential impacts to regional surface water and groundwater flow systems and receptors in the Secondary Plan Area (SPA) and the Primary Study Area (PSA) (ref. Figure 1.3) in the Hanlon, Mill and Torrance Creeks subcatchment areas. Existing conditions groundwater flow is simulated to be maintained in the PCS under future conditions, indicating that there is no simulated impact to regional groundwater flow in the bedrock or overburden. The predicted impacts of development when using 20 mm and 27 mm of depression storage were compared following the second iteration of the updated PCS. This comparison indicated that the predicted impacts were similar and that 20 mm of depression storage was similarly protective of groundwater function as 27 mm.

Within the SSA, evapotranspiration is reduced from simulated existing conditions by approximately 1 per cent. The reduction in evapotranspiration may contribute to the negligible increase in runoff (overland flow) in the SSA, and the 1 per cent increase in recharge observed for the SSA. The pre- and post-development SSA water balance (ref. Tables 3.3.19-3.3.20) is a basic indicator that future conditions are simulated to be protective of regional groundwater functions, for areas in the SSA.

The SPA simulated water budget (ref. Tables 3.3.21-3.3.24) provides an indication of changes in local surface and groundwater flow systems and potential impacts to receptors within the SPA and highlights. The most notable changes in the future conditions water budget are in evapotranspiration, overland flow and changes in groundwater flows out of the SPA into the PSA and SSA which demonstrate the dynamic response of the system to local changes.

Evapotranspiration in the SPA is reduced by 4 per cent overall representing the change from undeveloped or agricultural conditions that exist at present to predominantly residential land uses. When evaporation and transpiration losses occurring in the subsurface are considered, neglecting ponded water evaporation at surface, the reduction of evapotranspiration is approximately 18 per cent. This reduction in evapotranspiration balances with the use of infiltration-based LID BMPs and SWCAs to provide capture, and results in an increase in recharge in the SPA (28 mm/year), (ref. Figures GW-7 to GW-9, Appendix C).

The increased recharge from the application of distributed LID BMPs results in small decreases in lateral groundwater inflow to the SPA from the east through the overburden and bedrock. While lateral groundwater outflow from the SPA increases by approximately 5 mm/year as a result of increased recharge. In contrast there are decreases in runoff/overland flow components into and out of the SPA. The decrease in runoff into and out of the SPA occurs across wetland areas that are cross-cut by the SPA boundary (a non-physical boundary). The net change in overland flow is a reduction of outflow of 3 mm/year from the SPA. The reduction of outflow predicted for the SPA is associated with the application of distributed LID BMPs and the routing of runoff in excess of LID BMPs capacity to the SWCAs for infiltration and recharge. These features serve to cause a small decrease of runoff from the SPA relative to existing conditions.

Seasonal analysis of the SPA water budget indicates that the transient behaviour of groundwater recharge in the area is maintained in future conditions, (ref. Figure 3.3.6). Peak groundwater recharge is predicted to occur in late winter/early spring in both existing and future conditions. An increase in recharge relative to existing conditions is predicted during the summer months and is associated with the LID BMPs promoting infiltration and recharge of precipitation events during this time. Evapotranspiration rates within the SPA are predicted to be reduced in future conditions relative to existing due to reductions in vegetation associated with development, (ref. Figure 3.3.6).

The water budgets for Halls, Halligan's and Neumann's Ponds subcatchments were simulated to maintain existing conditions under updated PCS Future conditions within the catchments local to these features. However, there are potentially increases in overland flow (runoff) to Halls and Neumann's ponds, as well as local increases in local water table elevation in proximity to Halls Pond (ref. Table 3.3.27).

The impact to ponded water levels was not identified in iteration 1 due to:

1. Focus on water balance (at the scale of SPA, subwatersheds and wetland catchments) and recharge as the metrics of impact and management
2. Shorter model simulation time (5 years vs current 15-year period) – i.e. change less evident
3. More generalized representation of SWCAs in first iteration which has been refined in second iteration
4. Modelling Community Park Lands conservatively as urban/residential as per land use plan

The increased run-off and groundwater elevation changes for the Halls Pond Subcatchment was predicted to result in a long-term pond level increase of approximately 2 cm/year or 26 cm over the 2003-2017 period. Analysis of water budget data and predicted groundwater elevation change indicates that this change is primarily the result of an increased local groundwater elevation resulting from concentrated recharge and increased soil saturation near the SWCAs which are in the vicinity of the Halls Pond Subcatchment. The localized increase in the water table reduces the rate of recharge (leakage) from the pond to the subsurface and thereby induces more lateral flow into the pond from subsurface. Additional overland runoff from adjacent development areas, which allows runoff to the NHS areas when LID BMPs capacity is exceeded, are thought to also contribute to local groundwater elevation increases, however their contribution is limited relative to the SWCA related changes.

For the Neumann's Pond subcatchment an increase in runoff to the subcatchment, results in pond levels increasing approximately 1 cm/year or 16 cm over the 2003-2017 period. Analysis of the water budget and groundwater elevation data indicates this is the result of overland runoff primarily. Increases in runoff are attributed to development grading near the catchments associated with these features where runoff has been directed to NHS features.

The possible management scenarios related to mitigating potential increases in ponded elevation include:

1. Move SWCAs to locations of thicker Unsaturated Zones; there are locations further south of Halls Pond which would be less impactful however this would require a change to grading and the overall drainage plan for this area.
2. Reduce urban drainage areas contributing to the SWCAs around Halls Pond. This would reduce the groundwater elevation increases associated with the SWCAs.
3. Adjust LID BMP source control capture to greater than 20 mm. This will allow more water to recharge and or evapotranspire relative to the considered scenarios and reduce runoff to the SWCAs. This should also provide more defuse recharge across the development areas which should reduce groundwater elevation increases around the SWCAs.
4. Increased evapotranspiration (street trees and plantings including Ribbon Park) in Halls Pond catchment areas. Increased evapotranspiration will

mitigate some of the increases in recharge predicted which will in turn reduce groundwater elevation rise.

5. Model the Community Park explicitly in its currently proposed location. The replacing of developed areas with the Community Park would serve to reduce impervious areas and increase evapotranspiration. This in turn should reduce predicted groundwater elevations increases in this area.

No one mitigation alternative listed above is considered to be able to fully mitigate the predicted impact however it is considered likely that a strategic combination would be effective. To assess potential to mitigate the impact to Halls Pond a detailed assessment has been conducted as detailed in Appendix F. The results of the detailed assessment indicate that the predicted impact can be mitigated through a series of measures including the relocation of the Community Park, relocation of SWCAs and increased vegetation within a buffer strip adjacent to Halls Pond. The water balance results reported in Tables 3.3.25 and 3.3.26 reflect the modelling conducted for both the Updated and Final Community Structure Plans and the Halls Pond Assessment (ref. Appendix F).

Table 3.3.19. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Pre- and Post-Development); (2003-2017 in mm/year);

a) Existing Conditions

Area / Catchment	Precip-itation	Evapo-transpiration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow Overburden - Inflow	Lateral Groundwater Flow Overburden - Outflow	Lateral Groundwater Flow Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SSA	794	461	0	135	17	40	34	118	3	98	2	6

Explanation of Water budget terms:

Area – This is the region or catchment within which the inflows, outflows and change in storage of water are assessed for the period of the water budget.

Precipitation – This term represents rainfall or snowfall which falls within the catchment. Precipitation is an inflow of water to the catchment.

Evapotranspiration – This term represents water lost to evaporation and vegetation associated transpiration. Evapotranspiration is an outflow of water from the catchment.

Overland Flow In – This term represents water flowing as runoff or in channels which enters the catchment. This is an inflow of water to the catchment.

Overland Flow Out – This represents water flowing overland as runoff or in channels which exits catchment. This is an outflow of water from the catchment

Lateral groundwater Flow – These terms represent water flowing laterally through the overburden and bedrock units in the subsurface. Inflows represent water flowing into the catchment and outflows represent water flowing out of the catchment.

Vertical Groundwater Flow – These terms represent water flowing vertically across the regional bedrock aquifer unit in the subsurface. Inflows represent water flowing into catchment and outflows represent water flowing out of the catchment.

Pumping – This term represents water extracted from the catchment through groundwater pumping. Pumping represents an outflow of water from the catchment.

Change in storage – Throughout the catchment water is stored in various locations through time. Storage areas for water include storage on vegetation canopy, storage on the land surface (e.g. as ponds, lakes or wetlands) as water, and storage on the land surface as snow and finally storage in the subsurface material pores as groundwater.

Table 3.3.20. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Pre- and Post-Development); (2003-2017 in mm/year)

b) Future Conditions

Area / Catchment	Precip-itation	Evapo-transpiration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow Overburden - Inflow	Lateral Groundwater Flow Overburden - Outflow	Lateral Groundwater Flow Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SSA	794	458	0	135	17	40	34	119	3	100	2	6

*overland flow includes amounts discharging to Mill Creek at headwaters and is not strictly runoff but includes runoff and stream flow in the headwaters.

Table 3.3.21. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Pre- and Post-Development) (2003-2017 in mm/year); Recharge Summary

Area	Scenario	Recharge (mm/year)	Recharge Volume (m^3/year)	Change (%)
SSA Model Domain	Existing Conditions	303	8.50E+06	N/A
SSA Model Domain	Future Conditions	306	8.59E+06	1%

*Recharge volume accounts for differing numbers of recharging cell locations in the model domain between scenarios.

Table 3.3.22. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development); (2003–2017 in mm/year)

a) Existing Conditions

Area / Catchment	Precip-itation	Evapo-transpiration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow Overburden - Inflow	Lateral Groundwater Flow Overburden - Outflow	Lateral Groundwater Flow Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SPA	794	493	5	9	5	28	42	197	2	132	2	12
Mill Creek in SPA	794	499	16	17	38	50	286	476	2	105	0	10
Hanlon Creek in SPA	794	491	1	5	6	34	39	179	2	143	2	13

Table 3.3.23. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development); (2003-2017 in mm/year)

b) Future Conditions

Area / Catchment	Precip-itation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow – Overburden - Inflow	Lateral Groundwater Flow – Overburden - Outflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage	Error
SPA	794	472	3	4	5	33	39	209	2	137	0	10	1
Mill Creek in SPA	794	465	18	9	37	65	283	499	2	109	0	8	4
Hanlon Creek in SPA	794	474	1	6	6	34	37	186	2	149	0	10	0

*overland flow includes amounts discharging to Mill Creek at headwaters and is not strictly runoff but includes runoff and stream flow in the headwaters.

Table 3.3.24. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development) (2003-2017 in mm/year); c) Recharge Summary

Area	Scenario	Recharge (mm/year)	Recharge Volume (m3/year)	Change (per cent)
SPA Model Domain	Existing Conditions	308	1.26E+06	N/A
SPA Model Domain	Future Conditions	336	1.37E+06	8 per cent

Table 3.3.25. Monthly Water Budget for MIKE SHE Model within Secondary Plan Area (SPA) – Existing Conditions (2003-2017 in mm/month)

Month	Precipitation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Subsurface Inflow	Subsurface Outflow	Pumping	Change in Storage
1	49	2	0	0	4	32	0	18
2	43	3	0	0	4	28	0	15
3	47	7	0	1	4	30	0	14
4	70	33	1	1	4	29	0	11
5	81	58	1	1	4	30	0	-3
6	65	94	0	1	4	27	0	-53
7	81	103	1	1	4	29	0	-47
8	81	96	1	1	4	30	0	-42
9	69	60	0	1	4	28	0	-16
10	84	26	1	1	4	31	0	30
11	68	7	0	1	4	31	0	34
12	57	3	0	0	4	31	0	27

Table 3.3.26. Monthly Water Budget for MIKE SHE Model within Secondary Plan Area (SPA) – Future Conditions (2003-2017 in mm/month)

Month	Precipitation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Subsurface Inflow	Subsurface Outflow	Pumping	Change in Storage
1	49	3	0	0	4	34	0	15
2	43	3	0	0	4	30	0	13
3	47	9	0	0	4	32	0	11
4	70	37	0	1	4	30	0	7
5	81	59	0	0	4	31	0	-4
6	65	86	0	0	4	29	0	-45
7	81	90	0	0	4	31	0	-35
8	81	83	0	0	4	32	0	-31
9	69	57	0	0	3	31	0	-16
10	84	29	0	0	3	33	0	24
11	68	10	0	0	3	33	0	29
12	57	4	0	0	3	33	0	23

Figure 3.3.6. Mean Monthly Groundwater Recharge – Existing vs Future Conditions (2003-2017)

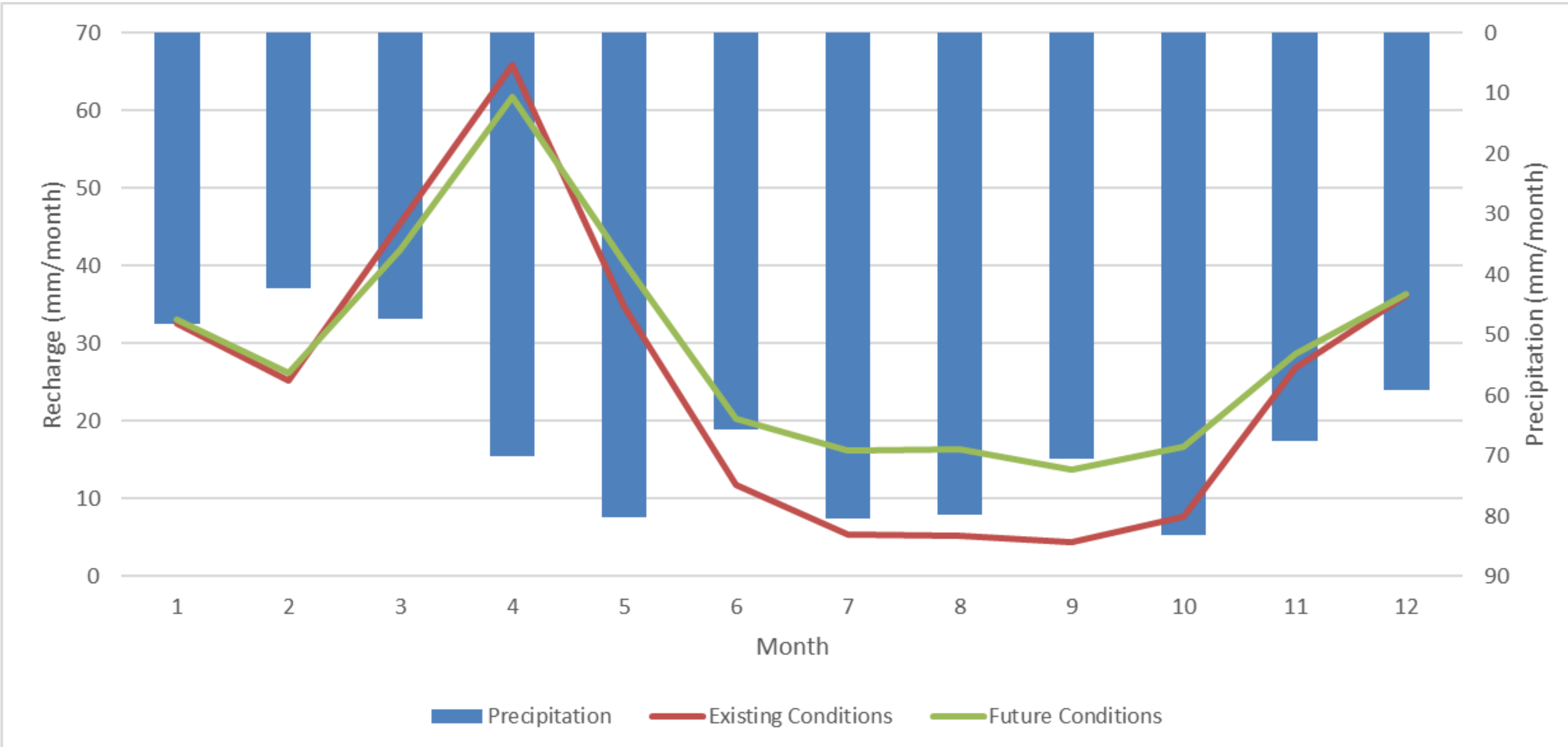


Figure 3.3.7. Mean Monthly Evapotranspiration – Existing vs Future Conditions (2003-2017)

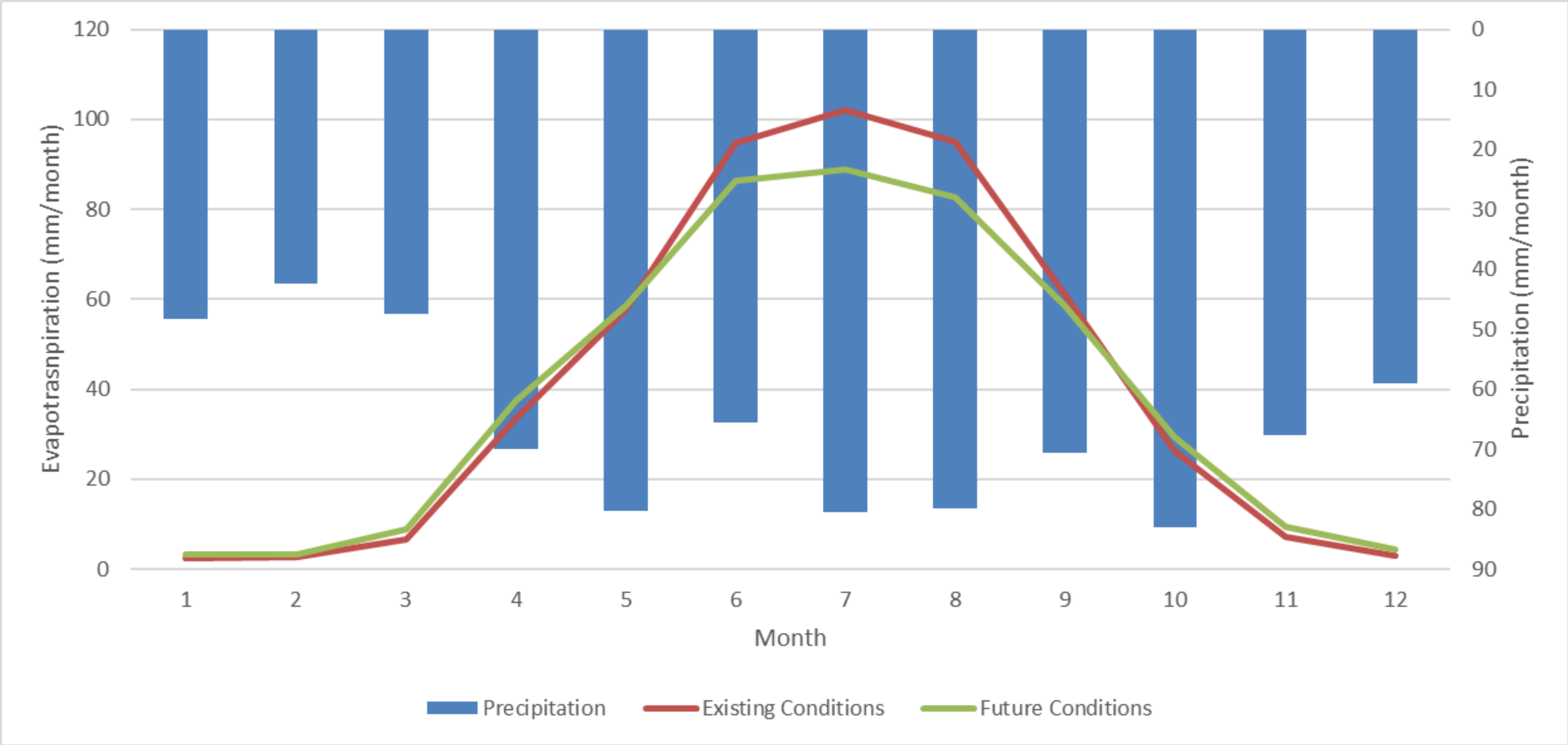


Table 3.3.27. Water Budget for MIKE SHE Model Domain for Halls, Halligan's and Neumann's Ponds (Pre- and Post-Development)

NHS Feature Water Balances – 2003-2017 (mm-year) - Subcatchment	Scenario	Precipitation	Evapotranspiration	Overland Net	Shallow GW (Layer 1) Net	Recharge	Storage Change
Halls Pond	Existing Conditions	794	-511	0	-1	-296	-14
Halls Pond	Future Land Use	794	-512	1	-1	-291	-9
Halls Pond	Future vs Existing	0	0	0	0	-5	5
Halligan's Pond	Existing Conditions	794	-493	21	-1	-281	40
Halligan's Pond	Future Land Use	794	-495	20	-1	-280	38
Halligan's Pond	Future vs Existing	0	2	-1	0	-1	-2
Neumann's Pond	Existing Conditions	794	-541	0	2	-266	-11
Neumann's Pond	Future Land Use	794	-547	11	3	-267	-6
Neumann's Pond	Future vs Existing	0	7	11	-1	1	4

Phase 3 Third Iteration Impact Assessment and Management

A third iteration of the Impact Assessment was conducted as part of the Halls Pond Water Level Uncertainty Analysis and Mitigation Measures assessment. Initially the PCS was revised to represent the newly approved Community Park, March 2020, and determine its effects on predicted water level increase at Halls Pond. A two-phase assessment was then conducted to evaluate uncertainty in factors contributing to the pond level increases and to develop a management approach to mitigate these impacts and maintain the hydroperiod of Halls Pond. A revised PCS was then assessed which implements a combination of mitigation and management measures developed through the second phase of the assessment and evaluated using the MIKE SHE model. The effectiveness of the revised PCS at mitigating impacts was assessed by comparison to the existing conditions for the period of 2003-2017. The impacts of the revised PCS scenario were evaluated based on simulated changes to:

- Water budgets in the SSA, SPA and key NHS features in, and adjacent to, the SPA,
- Groundwater flow directions and depth to water table,
- Recharge to the water table, shallow and deep bedrock aquifers,
- Groundwater discharge to streams and wetlands,
- Average annual ponded water elevation in wetlands.

Water budgets for these comparisons are found in the following section and figures are found within the Groundwater Appendix of the Phase 3 CEIS Impact Assessment Report in the figures for these comparisons are included Appendix F: Halls Pond Assessment.

The revised PCS LID BMPs and SWCAs in combination with reductions in evapotranspiration due to decreased vegetation in future land uses, are predicted to result in maintenance or enhancement of in recharge within the SPA. While localized increases and decreases in groundwater recharge to the water table are predicted within the SPA, the distributed capture storage in development areas and the additional capture capacity provided by the SWCAs are predicted to maintain or enhance recharge and maintain overall groundwater flow directions and recharge to shallow and deep bedrock aquifers, by infiltrating water as close to source as possible. By maintaining groundwater flow, gradients and linkages between recharge and discharge areas the revised PCS is predicted to maintain groundwater function within most of the study area. Further, this revised PCS adequately mitigates the predicted water level increases at Halls Pond thereby supporting the maintenance of existing pond hydroperiod and aquatic and terrestrial habitat in the vicinity of Halls Pond.

A management strategy identifying the recommended measures to help avoid, minimize, and manage potential negative impacts to the NHS at the Secondary Plan is provided in detail in Appendix F. The principal elements of the management strategy are:

- Site specific studies: Impacts will need to be addressed as part of area or site-specific studies undertaken as part of the implementation of the Secondary Plan. These studies should consider the functional insights provided in this report when designing site specific SWCA and source controls after confirming site specific conditions (e.g., infiltration capacities).
- Ongoing observation: Observation of surface water levels in key wetlands within the SPA (e.g., Halls Pond), and groundwater levels in the SPA and monitoring of ponding extent (using aerial imagery) is recommended to provide data to avoid, manage, or minimize potential impacts to the NHS.
- Implementation of the Revised PCS: Implementation of the revised PCS which relocates SWCAs to increase distance from Halls Pond, increases depth to groundwater at the SWCA locations and implements an enhanced vegetative buffer around Halls Pond.

As described previously, compiling an hourly precipitation dataset is complex and can be done using a variety of approaches, but ultimately there is uncertainty in the true precipitation numbers and that the current dataset may underestimate precipitation. Although the current dataset may underestimate annual precipitation, it is considered to provide representative hourly data including wet and dry extremes over 20 years sufficient to calibrate the integrated surface-groundwater model to existing conditions and also evaluate the effectiveness of stormwater management options for future land use conditions.

However, recognizing the general uncertainty in precipitation data and also based on stakeholder feedback that the hourly climate data used to evaluate the proposed SWM management approach which may underestimate monthly and annual precipitation totals, the Team developed an alternative precipitation hourly dataset using daily and monthly totals from the GRCA Shades Mills Climate Station, which resulted in higher monthly average precipitation. The higher precipitation dataset was used as input for additional simulations of existing and future conditions using the integrated MIKESHE model versions from the third iteration of the impact assessment, including the updates to Halls Pond representation and final SWM management approach (e.g. LID BMPs with 20 mm capture per impervious hectare and Stormwater Capture Areas (SWCAs)). The higher precipitation dataset, simulation setup and results are documented in more detail in Appendix G.

The higher precipitation simulations were completed for the 1996 through 2017 period for both the existing and future conditions models. The impact analysis approach used for iteration 3 of the impact assessment was repeated which focussed on the 2003-2017 period. The higher precipitation simulations (average annual precipitation of 957 mm/year) resulted in slightly higher groundwater levels and ponded water levels for both existing and future conditions. The simulated water levels are within the range of what was observed in the field and provide a similar level of calibration as per the original precipitation dataset (average annual precipitation of 796 mm/year). Under future conditions, groundwater recharge in the SPA is maintained and enhanced by 14% using the higher precipitation dataset compared to existing conditions. Under the lower (original) precipitation simulations the recharge was enhanced by 18%. Based on the Team’s assessment the hydroperiod for Halls Pond is also maintained based on the existing and future conditions simulations using the higher precipitation dataset.

The results of the higher precipitation run demonstrates that the proposed management approach will maintain or enhance the water balance, recharge and discharge function of groundwater and the hydroperiod for Halls Pond and other ponds/wet features in the SPA.

Based on the Team's assessment, the original and higher precipitation datasets generally represent the range of possible precipitation and provide an evaluation of the sensitivity of the existing conditions calibration to precipitation and an evaluation of if/how the uncertainty in input data may impact the proposed stormwater management approaches (See Appendix G). There is uncertainty in climate observation and potential error associated with extrapolating daily data to hourly data from nearby stations to the study area. Future planning work and model updates should use the best precipitation datasets available at that time. The use of both datasets to evaluate the potential impacts accounts for the uncertainty in precipitation data as it relates to evaluating stormwater management approaches and provides confidence in the ability of these proposed approaches to maintain or enhance the groundwater recharge and discharge function in the SPA and adjacent areas.

Tables 3.3.28 to 3.3.35 represent results for the third iteration Impact Assessment.

Table 3.3.28. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Pre-Development); (2003-2017 in mm/year);

a) Existing Conditions (revised)

Area / Catchment	Precip-itation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow – Overburden - Inflow	Lateral Groundwater Flow – Overburden - Outflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SSA	794	460	0	135	17	40	34	118	3	99	2	7

Explanation of Water budget terms:

Area – This is the region or catchment within which the inflows, outflows and change in storage of water are assessed for the period of the water budget.

Precipitation – This term represents rainfall or snowfall which falls within the catchment. Precipitation is an inflow of water to the catchment.

Evapotranspiration – This term represents water lost to evaporation and vegetation associated transpiration. Evapotranspiration is an outflow of water from the catchment.

Overland Flow In – This term represents water flowing as runoff or in channels which enters the catchment. This is an inflow of water to the catchment.

Overland Flow Out – This represents water flowing overland as runoff or in channels which exits catchment. This is an outflow of water from the catchment

Lateral groundwater Flow – These terms represent water flowing laterally through the overburden and bedrock units in the subsurface. Inflows represent water flowing into the catchment and outflows represent water flowing out of the catchment.

Vertical Groundwater Flow – These terms represent water flowing vertically across the regional bedrock aquifer unit in the subsurface. Inflows represent water flowing into catchment and outflows represent water flowing out of the catchment.

Pumping – This term represents water extracted from the catchment through groundwater pumping. Pumping represents an outflow of water from the catchment.

Change in storage – Throughout the catchment water is stored in various locations through time. Storage areas for water include storage on vegetation canopy, storage on the land surface (e.g. as ponds, lakes or wetlands) as water, and storage on the land surface as snow and finally storage in the subsurface material pores as groundwater.

Table 3.3.29. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Post-Development); (2003-2017 in mm/year);

a) Future Conditions

Area / Catchment	Precipitation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow – Overburden - Inflow	Lateral Groundwater Flow – Overburden - Outflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SSA	794	454	0	136	17	40	33	120	3	102	2	6

*overland flow includes amounts discharging to Mill Creek at headwaters and is not strictly runoff but includes runoff and stream flow in the headwaters.

Table 3.3.30. Water Budget for MIKE SHE Model Domain within Secondary Study Area (SSA) (Pre- and Post-Development); (2003-2017 in mm/year);

b) Recharge Summary

Area	Scenario	Recharge (mm/year)	Recharge Volume (m^3/year)*	Change (per cent)
SSA Model Domain	Existing Conditions (revised)	309	8.50E+06	N/A
SSA Model Doman	Future Conditions (Final PCS)	319	8.70+06	3

*Recharge volume accounts for differing numbers of recharging cell locations in the model domain between scenarios.

Table 3.3.31. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development); (2003-2017 in mm/year);

a) Existing Conditions (revised)

Area / Catchment	Precipitation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow – Overburden - Inflow	Lateral Groundwater Flow – Overburden - Outflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SPA	794	492	5	9	5	41	28	198	2	132	2	12
Mill Creek in SPA	794	499	16	17	38	50	287	477	2	106	0	10
Hanlon Creek in SPA	794	490	1	5	6	34	39	180	2	144	2	13

Table 3.3.32. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development) (2003-2017 in mm/year);
b) Future Conditions (Final PCS)

Area / Catchment	Precipitation	Evapo-trans piration	Overland Flow In	Overland Flow Out	Lateral Groundwater Flow – Overburden - Inflow	Lateral Groundwater Flow – Overburden - Outflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Inflow	Lateral Groundwater Flow – Bedrock Above Vinemount - Outflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Inflow	Vertical Groundwater Flow Across Regional Bedrock Aquifer - Outflow	Pumping	Change in Storage
SPA	794	444	4	4	5	41	36	221	2	145	0	13
Mill Creek in SPA	794	437	24	9	42	85	289	522	2	115	0	15
Hanlon Creek in SPA	794	447	1	9	7	39	34	198	2	158	0	11

*overland flow includes amounts discharging to Mill Creek at headwaters and is not strictly runoff but includes runoff and stream flow in the headwaters.

Table 3.3.33. Water Budget for MIKE SHE Model Domain within Secondary Plan Area (SPA) (Pre- and Post-Development) (2003-2017 in mm/year);

a) Recharge Summary

Area	Scenario	Recharge (mm/year)	Recharge Volume (m3/year)*	Change (%)
SPA Model Domain	Existing Conditions (revised)	311	1.26E+06	N/A
SPA Model Domain	Future Conditions (Final PCS)	394	1.49E+06	18

*Recharge volume accounts for differing numbers of recharging cell locations in the model domain between scenarios.

Table 3.3.34. Monthly Water Budget for MIKE SHE Model within Secondary Plan Area (SPA) (Pre- and Post-Development) (2003-2017 in mm/month)

Month	Precipi-tation	Evapo-trans-piration	Overland Flow In	Overland Flow Out	Subsurface Inflow	Subsurface Outflow	Pumping	Change in Storage
1	49	2	0	0	4	32	0	18
2	43	3	0	0	4	29	0	15
3	47	7	0	1	4	30	0	14
4	70	33	1	1	4	29	0	11
5	81	58	1	1	4	30	0	-3
6	65	94	0	1	4	27	0	-53
7	81	103	1	1	4	29	0	-47
8	81	96	1	1	4	30	0	-42
9	69	60	0	1	4	29	0	-16
10	84	26	1	1	4	31	0	30
11	68	7	0	1	4	31	0	33
12	57	3	0	0	4	31	0	26

Table 3.3.35. Monthly Water Budget for MIKE SHE Model within Secondary Plan Area (SPA) – Future Conditions (Final PCS) (2003-2017 in mm/month)

Month	Precipi-tation	Evapotrans-piration	Overland Flow In	Overland Flow Out	Subsurface Inflow	Subsurface Outflow	Pumping	Change in Storage
1	49	3	0	0	4	36	0	13
2	43	3	0	0	4	32	0	11
3	47	8	0	0	4	34	0	9
4	70	35	0	1	4	32	0	7
5	81	55	0	1	4	33	0	-3
6	65	82	0	0	4	31	0	-44
7	81	86	0	1	4	33	0	-35
8	81	80	0	0	3	35	0	-30
9	69	54	0	0	3	33	0	-15
10	84	26	0	0	3	36	0	25
11	68	8	0	0	3	36	0	27
12	57	3	0	0	3	35	0	21

Figure 3.3.8. Mean Monthly Groundwater Recharge – Existing (revised) vs. Future Conditions (Final PCS) (2003-2017)

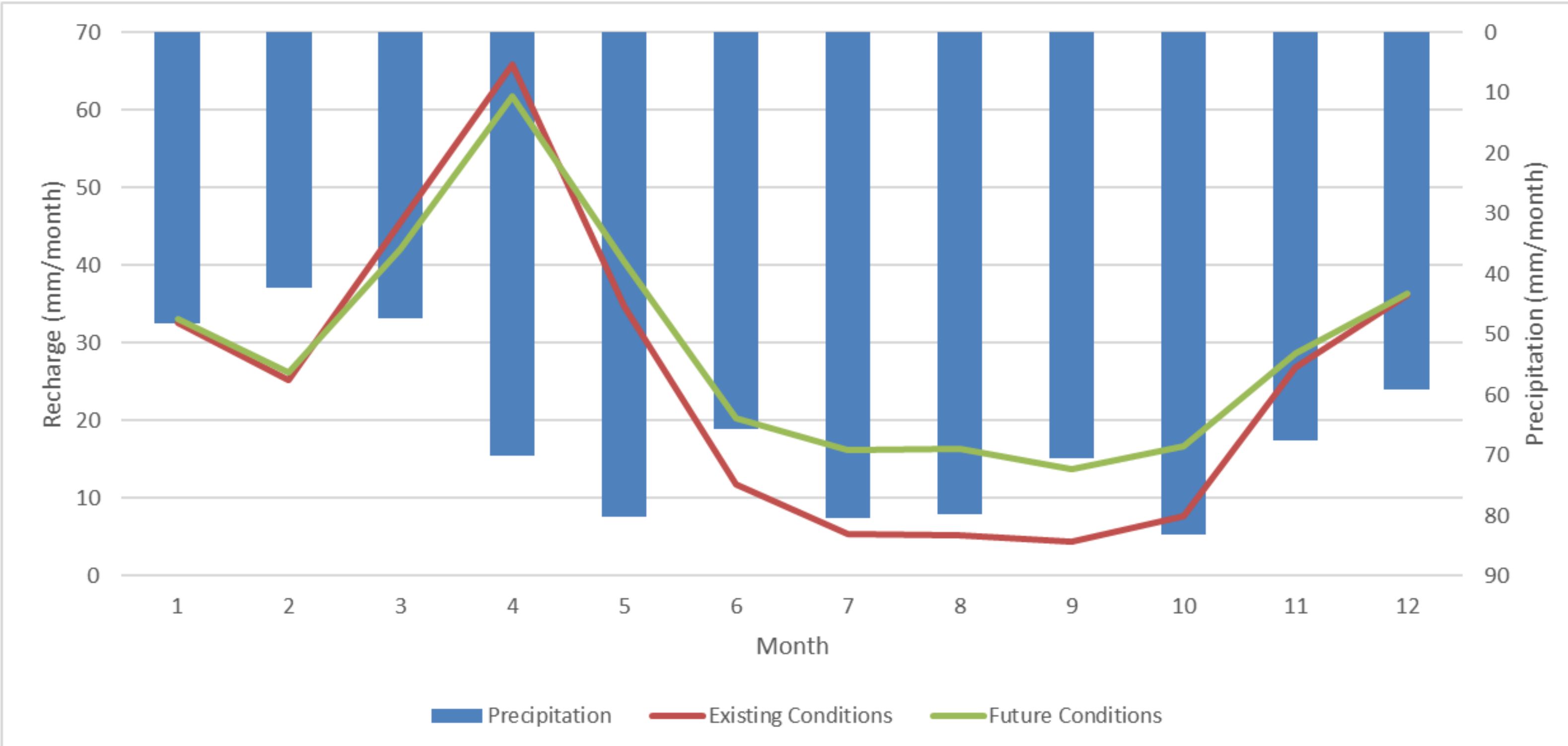


Figure 3.3.9. Mean Monthly Evapotranspiration – Existing (revised) vs. Future Conditions (Final PCS) (2003-2017)

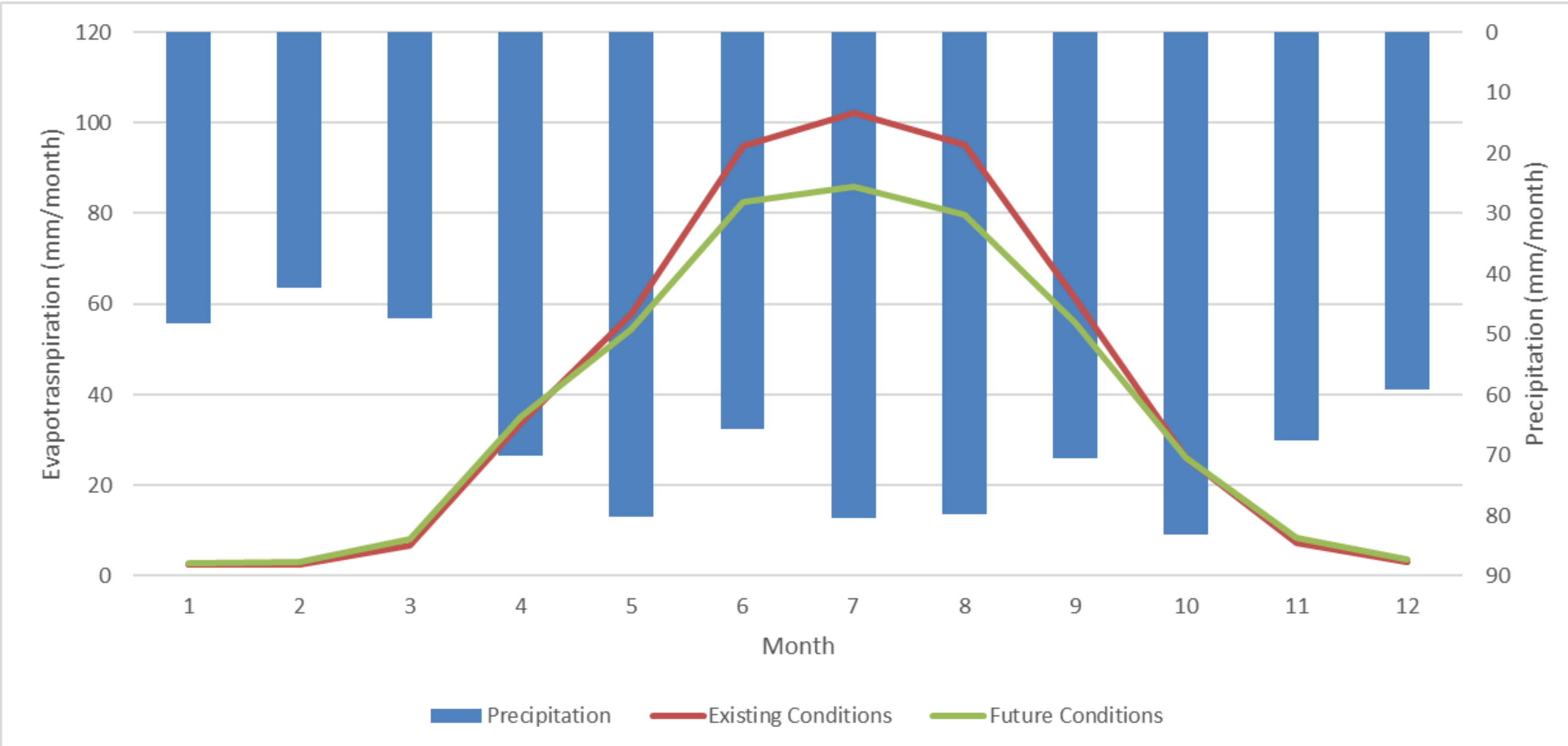


Table 3.3.36. Water Budget for MIKE SHE Domain for Halls, Halligan's and Neumann's Ponds (Pre- and Post-Development)

NHS Feature Water Balances 2003 2017 (mm year) Subcatchment	NHS Feature Water Balances 2003 2017 (mm year) Scenario*	NHS Feature Water Balances 2003 2017 (mm year) Precipitation	NHS Feature Water Balances 2003 2017 (mm year) Evapotranspiration	Overland Net	Shallow GW (Layer 1) Net	Recharge	Storage Change
Halls Pond	Existing Conditions	794	-497	1	0	-302	-4
Halls Pond	Future Land Use	794	-501	10	1	-308	-4
Halls Pond	Future vs Existing	0	4	9	1	6	1
Halligan's Pond	Existing Conditions	794	-486	-27	-1	-282	-2
Halligan's Pond	Future Land Use	794	-495	-23	-1	-277	-2
Halligan's Pond	Future vs Existing	0	9	-4	0	-5	0
Neumann's Pond	Existing Conditions	794	-541	0	4	-264	-7
Neumann's Pond	Future Land Use	794	-545	5	6	-267	-7
Neumann's Pond	Future vs Existing	0	4	5	2	3	0

*Existing Conditions refers to the revised Existing Conditions simulation completed as part of iteration 3. Future Land Use and Future refers the Future Conditions Simulation based on Iteration 3 - Final Preferred Community Structure (PCS)

Water Quality

The Preferred Community Structure includes various densities of residential land uses, commercial, institutional (schools), mixed uses and parks that will be required to drain through a series of LID BMPs towards stormwater capture areas, with the objective of maintaining the existing water balance within the SPA and thereby replicating the significant levels of infiltration under current conditions. The Ammonia and Total Phosphorous exceedances from agriculture lands and the golf course which were observed in the monitoring data would be expected to reduce after the land use has been changed to urban, however the proposed land use would typically result in other urban surface water quality concerns and need to be mitigated accordingly.

Water quality from urban land uses generally has been widely characterized by various studies including the 2007 Credit River Water Management Study Update (CRWMSU) by Credit Valley Conservation which documented water quality event mean concentrations (EMCs) for various contaminants by land use as per Table 3.3.36, with the highest EMCs resulting from runoff from roads, agricultural areas and golf courses.

Table 3.3.37. Event Mean Concentration by Contaminant and Land Use as per CRWMSU (mg/L unless otherwise noted)

Land Use	Total P	Nitrate + Nitrite	TKN	Copper	Zinc	E.Coli (#/100 ml)	TSS
Residential	0.36	1.75	1.92	0.025	0.123	25,000	91
Commercial	0.25	0.67	0.71	0.022	0.127	5,000	70
Industrial	0.30	1.16	1.06	0.027	0.220	1,138	67
Educational / Institutional	0.36	1.75	1.92	0.025	0.123	8,360	63
Open Space	0.12	0.54	0.97	0.016	0.098	4,100	70
City Parks	0.36	1.75	1.92	0.025	0.123	10,000	63
Golf/Cemetery	0.70	1.75	3.30	0.025	0.123	4,100	63
Agricultural	0.45	4.00	1.90	0.014	0.039	100,000	132
Highway	0.39	0.76	2.00	0.052	0.302	3,070	331

It is well known within the industry that most of the surface water contaminants that occur from urban runoff occur from paved surfaces, such as parking lots and roadways and from fertilizers applied to urban landscaped areas. Contaminants can include metals, TSS, *E. Coli*, nitrates and nitrites, phosphates, salt, and others. Contaminants from the landscaped areas within residential, commercial, and institutional land uses, are often sourced from the use of fertilizers.

Future land use drainage to the existing natural features within the Clair-Maltby SPA, whether overland or via a storm sewer drainage system, would be required to undergo various forms of water quality treatment (i.e. adopting a "Treatment Train" approach) in accordance with Provincial guidance to maintain and/or improve water quality within surface and groundwater receiving systems.

To mitigate potential surface water and groundwater quality impacts from the proposed urban form within the Clair-Maltby SPA, a formal water quality management strategy is required.

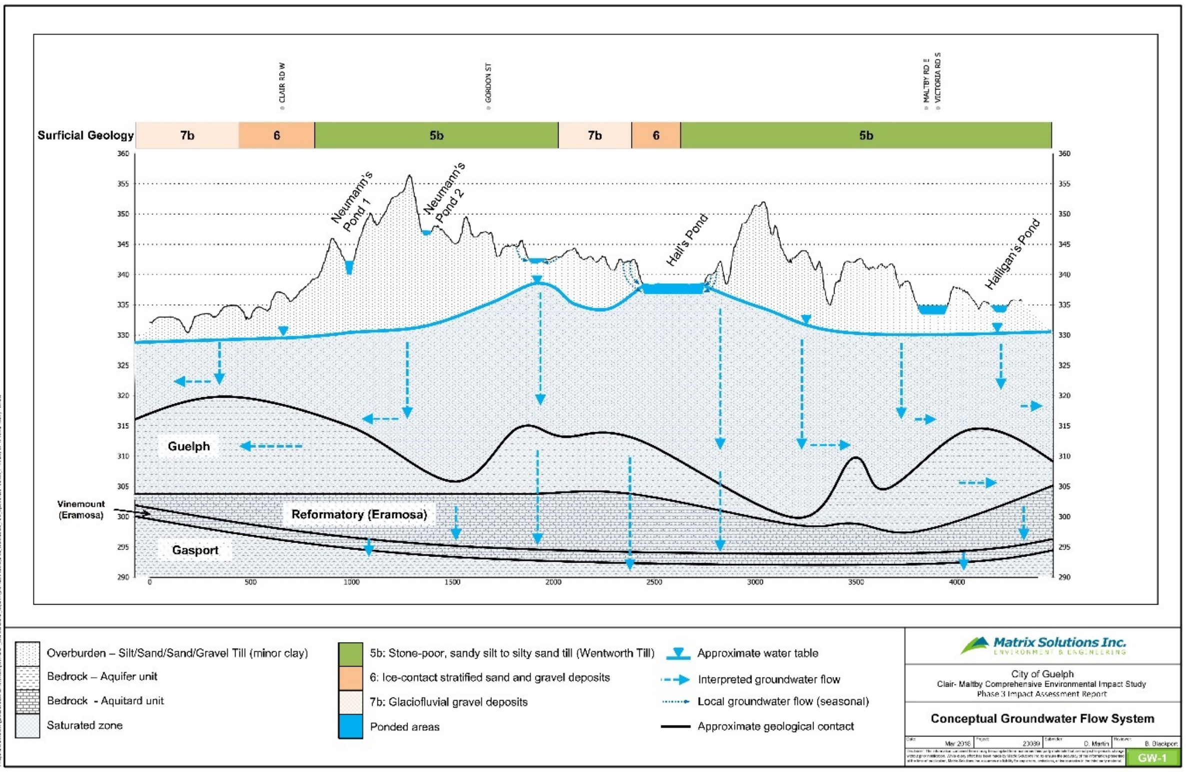
3.3.7 Water Quality Management Alternatives and Assessment

To replicate the function of the significant number of depressional features currently within the Clair-Maltby SPA with the objective of maintaining the water balance for both Hanlon and Mill Creeks, a distributed approach of low impact development (LID) best management measures (BMPs) to capture the 20 mm storm runoff response is proposed. The LID BMPs would receive surface runoff prior to the excess runoff (i.e., greater than 20 mm) flowing to the proposed stormwater capture areas, which support the local water balance.

Phase 3 of the CEIS identified, in part, the efficacy of stormwater source controls, including limited end-of-pipe facilities (e.g. SWCAs) to achieve spatially distributed recharge in order to maintain flow directions and depths to water table in the SPA, thereby maintaining groundwater flows and depths in surrounding areas. Overall groundwater quality has been prioritized through the requirement for salt management plans and pre-treatment of any runoff water using a treatment train approach. The application of LID BMPs and their infiltration functions within Clair-Maltby without pre-treatment of contaminated runoff would potentially lead to impacts to wetland features and groundwater quality in overburden, shallow and deep bedrock aquifers in the City and in the Township of Puslinch.

The Gasport/Goat Island and Guelph Formation bedrock aquifers underlie the study area and the entire City. The Gasport/Goat Island aquifer provides the majority of groundwater for the City. The Vinemount Bedrock aquitard and thick overburden that overlie the aquifer in the SSA provide a degree of protection to the main aquifer. The Guelph Aquifer (shallow bedrock) overlies the bedrock aquitard but is afforded a degree of protection form the thick overburden aquifer on the moraine. The overburden aquifer is the source of a portion of groundwater used by private residential wells in the Township of Puslinch outside of the SPA. The Burke Wells that are part of the City supply wells, extract some of their supply from the Guelph aquifer but most from the deeper Gasport/Goat Island aquifer. Based on the Tier 3 modelling work (Matrix 2017) most of the water supplying the well is recharge from areas outside the Clair-Maltby SPA (regional flow) per the SPA Groundwater Flow System (ref. Figure 3.3.10). Simulated recharge to the Gasport/Goat Island aquifer in the SPA is less than 3 per cent of the average annual groundwater demand or less than 2 per cent of total recharge in the City.

Figure 3.3.10. Conceptual Groundwater Flow System



Based on the foregoing, the following general approach to protecting these systems and functions to manage surface water quality in the SPA has been proposed:

1. Apply a distributed approach for 20 mm capture within LID BMPs
2. Separate 'clean' water (rooftop and landscaped areas runoff) from dirty water, with dirty water typically resulting from roadways and parking areas
3. Apply a treatment train approach to manage dirty water and protect the stormwater capture area's function of infiltration
4. LID BMP type selection and locations to be determined based on land ownership, land use, development form and grading (public realm and private realm), consistent with City guidance (i.e., DEM and SWM MP).
5. Require the preparation of site-specific Salt Management Plans as a condition of approval. Site-specific Salt Management Plans, will be required to demonstrate that water quality will be maintained within the boundaries of the site based on applicable City and provincial guidelines using approved salt mass loading calculations to evaluate the site-specific effectiveness of the salt management recommendations in the MESP.

6. Reduce the use of salt through the City of Guelph Salt Management Plan and MESP recommendations. Recommendations include:
   i. The City of Guelph should consider any outstanding recommendations from the 2017 SMP, particularly the construction and implementation of a snow storage facility using TAC best practices, such as non-permeable storage areas, OGS separators, and settling/dilution ponds to dilute salts and reduce particles entering the water system.
   ii. The City of Guelph should consider options for salt alternatives such as different types of chemical de-icers and agricultural by-products such as sugar beet juice. Having a variety of salt alternatives available for use, would reduce salt application by the City.
   iii. As per the SMP recommendations, the City should consider implementing technologies for liquid pre-wetting agents or sprayers for salt alternatives onto their existing truck fleet, therefore potentially reducing the amount of salt used in Clair-Maltby and across the City.
   iv. Implementing salt alternatives through financial incentives for snow removal and de-icing by independent contractors, would help facilitate alternatives other than standard road salt, and will help reduce overall dependence on road salt.
   v. Implement recommendations of the Snow and Ice Control for Parking Lots, Platform and Sidewalks (SICOPS) program, as it develops further, in an effort to reduce salt application and to streamline salt management for the City, including in the Clair-Maltby SPA.
   vi. Consider removal of snow in areas with low traffic loadings (e.g. local residential roads / Road Classes 3-5), and the transportation/storage of this snow to established snow storage / melt areas that provide treatment prior to discharge to the Speed River.
   vii. Seasonally closed or partially closed City owned parking lots could be considered by the City of Guelph. While heavily trafficked areas should be maintained with respect to snow and ice control, the City of Guelph could identify parking lots which are less trafficked during winter months, and reduce or not apply salt or other de-icing materials to sections of the parking lots or the entire parking lots should it be closed. Closed parking lots could be used for snow storage and piling, to facilitate reduced salt use for paved areas.
   viii. To control salt laden runoff from entering groundwater during the winter months, the City could consider bypasses of infiltrative LID BMPs that receive drainage from paved surfaces. The bypass systems are used on other infrastructure within southern Ontario. The City of Toronto requires automated bypass systems on new splash pads, which divert drainage away from the wastewater system, during rainfall events and during non-operational periods. Similar bypass systems could be applied to underground infiltrative LID BMPs. For above ground infiltrative LID BMPs that would receive drainage from paved surfaces, pretreatment water

quality measures should already be in place, that said salt cannot be removed once in solution, as such above ground infiltrative LID BMPs, could be designed with winter bypasses (e.g. gated bioretention systems).

7. In establishing a list of available low impact development BMPs and other stormwater quality management measures, the following have been considered, with further discussion provided thereafter. The list below should be considered in alignment with the DEM and SWM MP:

a. Oil and Grit Separators (OGS):

These end-of-pipe systems tend to most effectively service smaller drainage areas (2 ha +\-) and provide varying levels of stormwater quality treatment depending on the model selected. OGS units are typically encouraged as part of a "treatment train" approach; many municipalities and regulators will not credit the full TSS removal function of OGS units accordingly (i.e. typical maximum credit of 50 per cent to 70 per cent TSS removal). The Environmental Technology Verification (ETV) Program as established by Toronto Region Conservation Authority (TRCA) has established an OGS testing approach that once completed by OGS manufactures results in an ETV certification. ETV OGS units typically provide up to 70 per cent TSS removal and as such do not provide the required Enhanced level (80 per cent TSS removal) as per the 2003 MOECC Stormwater Management Planning and Design Manual. ETV certified OGS units are required by the GRCA. GRCA typically will only credit a maximum of 50 per cent TSS Removal for ETV certified OGS units, based on the particle size distribution that is being used to test the unit. The combination of water quality treatment measures should be demonstrated to provide 80 per cent TSS removal. The disadvantages of OGS units include the need for frequent maintenance, as well as relatively high capital costs and the ability to only service smaller drainage areas. As a pre-treatment approach for other stormwater quality measures, or for providing water quality treatment for smaller pavement areas, oil grit separators should be considered within the Clair-Maltby SPA.

b. Catch Basin Shields (or equivalent):

Catch Basin (CB) Shields (or equivalent) have been tested by the ETV Program. A (CB) Shield is an insert into a CB that prevents sediment within the CB sump from being discharged from the CB. CB Shields are able to service an area up to 0.60 ha and provide up to 56 per cent TSS removal and would be considered a pre-treatment to other stormwater management quality measures and LID BMPs.

c. Enhanced Grassed Swales:

Grassed swales designed with a trapezoidal geometry and flat longitudinal profiles with largely un-maintained turf can provide excellent filtration and treatment for storm runoff from roadways, when adequate space is provided to implement the swales. It is generally conceded that treatment levels are at a minimum, Normal (formerly Level 2) water quality treatment, and combined with other practices can provide Enhanced (Level 1) stormwater quality treatment. Their application in linear corridors is also particularly appropriate and can be further enhanced through the introduction of check dams to provide additional on-line storage. Their application in urbanized roadway cross-sections (i.e. curb and gutter) often requires alternative grading and roadway configurations which can compromise the function of the roadway itself, and are therefore typically not preferred in those cases. Notwithstanding, gutter outlets along outside lanes have been demonstrated to function effectively where the right-of-way can accommodate the design.

d. Filter Strips:

Filter strips are typically designed for small drainage areas (less than 2 ha), and are applied as part of a treatment train. Filter strips require flat areas with slopes ranging from 1 to 5 per cent and are usually in the range of 10 to 20 m in length in the direction of flow. Flow leaving filter strips should be a maximum of 0.10 m depth, based on a 10 mm storm event. Based on the limited space within the typical urban form, filter strips would only be considered to be a practical stormwater quality solution for more porous land uses such as schools and parks.

e. Bioretention Systems:

Bioretention systems provide effective removal of pollutants by sedimentation, filtering, soil adsorption, microbial processes and plant uptake. Bioretention systems should be approximately 10 to 20 per cent in size of the contributing drainage area, with typical drainage areas of 0.50 ha and a maximum drainage area of 0.80 ha. Slopes within bio-retention systems are typically 1 per cent to 5 per cent. Bioretention systems are preferred in areas that have reasonable infiltration properties (15 mm/ hr., 1x10-6 cm/s), but can be implemented in all soil types as long as the water quality event can be temporarily stored (typical depths 0.15 m to 0.25 m) before infiltrating and an underdrain is provided. The selection of filter and mulch material can impact the water quality discharging from the bio-retention system, as such the practitioner should review current LID guidelines (e.g. Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0, 2011, prepared by CVC and TRCA).

Bioretention systems should have forebays for a form of surface water pre-treatment, however for the Clair-Maltby SPA, surface runoff from roads and parking areas that has not received any pre-treatment before entering a bio-retention area, should require the bio-retention area to be lined and therefore act as a water quality filtration measure. Bioretention areas that receive drainage from pre-treatment would not need to be lined.

f. Infiltration Trenches:

Infiltration Trenches are similar to bio-retention systems but would require pre-treatment of road and parking lot runoff, unless the trenches are lined, and then would act only as a filtration system. Infiltration trenches could also provide thermal mitigation of surface runoff.

g. Soakaway Pits:

Soakaway Pits may be implemented within Clair-Maltby for residential land uses, where space allows. Soakaway pits provide a method of increasing infiltration of clean water from roof areas in particular. With residential roof drainage being directed underground, thermal mitigation could be an additional benefit of soakaway pits.

h. Permeable Pavers/ Pavement:

Permeable pavement could be used within the Clair-Maltby SPA as long as a sand bed is provided for water quality filtration for areas where vehicular movements occur. As a standalone LID BMP, a permeable paved multiuse path would not provide a stormwater quality benefit, however it would reduce the runoff volume from the paved surface. Permeable pavers/pavement could reduce the amount runoff and the duration of runoff remaining on paved surfaces, as such this LID BMP could provide thermal mitigation.

i. Pervious Pipes:

Pervious pipes could be used in combination with either bio-retention systems or infiltration trenches. As a standalone stormwater quality measure, pervious pipes can be a cost-effective and relatively simple method to accomplish infiltration requirements, while eliminating the need for surface space within the right-of-way. That said, pervious pipes within the Clair-Maltby SPA would require pre-treatment which can be provided vis-à-vis a hybrid roadway cross-section (urban / rural) and/or with catchbasin controls. Pervious pipes, with the surrounding stone media, could provide for thermal mitigation of drainage based on the contact with the cool stone media.

j. Increased Topsoil Depth. Soil Amendments:

Increasing topsoil depth from 0.10 m +/- to 0.25 m to 0.30 m within landscaped areas for residential and non-residential land uses provides a simple non-structural method of reducing runoff and increasing infiltration at source. Amending topsoil with compost can achieve further reductions in runoff and has the added benefit of creating a more drought tolerant landscaped area.

Twenty (20) mm of capture for clean water from roofs, landscaped areas and non-vehicle traffic areas could be provided by various combinations of the foregoing LID BMPs from Bioretention Systems to Increased Topsoil Depth. Notwithstanding, any LID BMPs receiving drainage from paved areas will require some form of pre-treatment such as CB Shields™, oil/grit separators, primary treatment cells for underground infiltration systems, lined forebays for above ground bioretention systems and other forms of pre-treatment as required. Pre-treatment water quality measures receiving runoff from paved surfaces and in a treatment train, should be able to provide a minimum of 60 per cent TSS removal (former Basic Level of water quality treatment) prior to discharging to infiltrative LID BMPs. The combination of pre-treatment water quality measures, at source and conveyance LID BMPs, should be able to meet or exceed an Enhanced Level of Water Quality Treatment of 80 per cent TSS removal.

Based on the foregoing, it is known that CB Shields™ are able to provide up to 56 per cent TSS removal for areas that are 100 per cent paved. As such to obtain a minimum of 60 per cent TSS removal prior to any infiltration, other stormwater quality measures will be required, in addition to, or instead of CB Shields^{TM}, and would then provide the requisite levels of TSS removal.

Soil cells such as Silva Cells^{TM} provide water quality treatment levels similar to that of bioretention systems, but have the added benefit of providing additional interception and evapotranspiration through large trees. Silva cells would receive pre-treated drainage from CB Shields^{TM} and would then provide additional TSS removal, as a minimum equivalent to a standard bioretention cell, with the Silva Cell lined if there is concern of groundwater contamination. Silva Cells have received approval from TRCA, Credit Valley Conservation (CVC) and Lower Simcoe Region Conservation Authority (LSRCA) for TSS removal equivalent to bioretention.

A bioretention system with forebay that provides 60 per cent TSS removal based on the 2003 SWM Planning and Design Manual dry pond storage requirements, receiving drainage from a single 3.75 m wide lane of road 50 m length, would need to have a storage volume of over 5m^3. This storage volume is considered significant to implement within a typical boulevard (ref. Clair-Maltby Cross-section Study, March 13, 2020, Appendix C), but could be implemented in landscaped areas in parking lots. That said, a standard bioretention cell with a forebay could provide adequate water quality control should a CB Shield^{TM} or equivalent measure be provided as a pretreatment measure.

Additional assessment will be required at the next stages of planning and design to support subdivision planning to determine groundwater and bedrock elevations and the potential areas within a development site which may restrict the function and form of LID BMPs to be constructed. The stormwater quality control strategy will necessarily need to be flexible in order to account for on-site local constraints, while still remaining consistent with the specified approach and required quality control targets.

Staging and costing for stormwater management is discussed within Implementation Section 4. In general, it is expected that onsite and conveyance stormwater quality measures will have to be implemented as development proceeds, with LID BMPs to be constructed within the municipal right-of-ways prior to LID BMPs being constructed on private development lots. Construction staging of LID BMPs should incorporate LID BMP construction guidance from CVC's 2012 LID Construction Guide Manual and construction approval guidance as per CVC's LID Stormwater Management Certification Protocols for Low Impact Development.

Costing of LID BMPs has been provided within the Implementation Section 4.

Monitoring and Adaptive Management Plans:

Monitoring of surface water and groundwater systems will be needed to determine whether the proposed development and its management system meet the quantity and quality threshold objectives and targets established within Phase 3 of the CEIS Section 7.3 and overall meet the City's Official Plan policies for the water resource system. Further, the monitoring plans will need to align with the recommendations in the City's SWM MP and the approved CLI ECA monitoring requirements.

Overall site-specific monitoring commitments are to be identified in the approved EIS with consideration for site specific Stormwater Management Plans. The details (e.g., timing, frequency, methods) are to be identified in the approved EIR and implemented as a condition of development approval. The EIR should include Adaptive Management Plans to guide an adaptive management response, if and when appropriate, to address any identified negative impacts considered significant and requiring action.

Surface Water Monitoring Requirements:

Although there are no watercourses in the SPA, it is recommended that continuous water level monitors be installed in appropriate locations to complement the groundwater monitoring program. The durations and locations of surface water stations will need to be confirmed through site-specific EIRs.

Water quality parameters as per Phase 3 CEIS Table 7.3.1 and the baseline monitoring program should be considered as part of Adaptive Management Plans. Monitoring completed as part of the Phase 3 CEIS for hydraulic functionality of SWCAs and LID BMPs should be considered, in addition to surface water quantity and quality.

Groundwater Monitoring Requirements:

As part of site-specific EISs and EIRs, proponents will be required to prepare monitoring plans which will need to monitor water balances, groundwater flow directions, gradients and depths to water table, as well as salt impacts and other potential contaminants detected in groundwater samples collected within the boundaries of the subject site. The intent will be to determine if the implemented management and/or mitigation measures are satisfactorily addressing City and provincial requirements.

Phase 3 of the CEIS demonstrated that planned development would generally not negatively impact groundwater quantity and quantity based on the source control-focused approach to stormwater management. As part of the next stage of planning and development, individual site-specific design measures need to be tested through the MIKE-SHE modelling and separate salt mass loading calculations to demonstrate that they will not negatively impact groundwater flow directions, depth to water table and water quality in the City and in the Township of Puslinch.

Testing completed through the MIKE-SHE modelling will require updating the integrated MIKE-SHE model to reflect proposed site-specific conditions, including grading and SWM. Future site-specific development will be required to demonstrate that water balance, recharge and discharge functions, groundwater flow directions, gradients and depth to water table are maintained within the development and in surrounding areas.

In addition, a salt mass loading calculation will need to be prepared with the intent of demonstrating the ability of the proposed site-specific Salt Management Plan to meet groundwater quality requirements within the boundaries of the site on City and provincial guidelines.

The updated MIKE-SHE model predictions will be used as targets for the site-specific monitoring program (see also Table 3.1.1). The predicted groundwater quality for salt impacts based on the mass loading calculation will be used for groundwater quality monitoring targets consistent with City and provincial guidelines.

Other groundwater quality parameters to be monitored will be determined by the City as part of the site-specific development application process, based on applicable provincial requirements.

Monitoring well locations and numbers will be determined by the City as part of the development application process, informed by the understanding of the system derived from the CEIS and updated MIKE-SHE modelling. At a minimum, the number and locations of monitoring wells will need to be sufficient to monitor the existing flow directions within the overburden and shallow bedrock aquifers and characterize three-dimensional groundwater flow. Groundwater sampling, parameters, locations and frequency of monitoring will need to be developed as part of the development application and be sufficient to monitor changes in groundwater quality and quantity, and thereby provide confidence in the water management system's ability to meet provincial guidelines at the site boundary. These monitoring locations will need to be installed as part of the development application to provide additional site-specific information for the subject development.

3.4 Mobility

As part of the input into the City's Secondary Plan process and Phases 1 and 2 of the Master Environmental Servicing Plan (MESP), BA Group prepared a Mobility Study dated March 6, 2019 (revised February 2021 and incorporated into this MESP document) entitled, "Clair-Maltby Secondary Plan – Transportation Master Plan Study".

The content of these reports are provided in the following Mobility section. These reports firstly comprise Phase 1 Mobility Study documentation, including a review of existing transportation conditions and planning context for the Clair-Maltby study area. The remaining sections are comprised of the review of the Preferred Community Structure Plan, supportive transportation policies and objectives, and future conditions transportation analysis to inform potential transportation network improvements and high-level transportation infrastructure requirements and options.

The Mobility Study specifically includes:

1. an introduction and overview of the transportation study, including the objective of the Phase 1 study (June 2018), and subsequent transportation direction and analysis included herein;
2. an overview of the existing Secondary Plan area context and transportation elements;
3. a review of existing travel patterns, traffic operations, and collision history based on available data within the study area;
4. a review of relevant standards, active development applications, policies, and general planning framework based on available planning and transportation studies and reports;

5. a summary of key challenges and opportunities for the Secondary Plan, from a transportation perspective, which highlights key objectives sought through directive policies;
6. an overview of the planning processes and events undertaken over the course of the MESP study to review community structure options and achieve a Preferred Community Structure plan;
7. a review of the Clair-Maltby Secondary Plan Preferred Community Structure and associated transportation network elements and attributes, including cross-sections developed by Wood in consultation with City departments;
8. an overview of general parking standards and best practice policies;
9. an overview of general transportation demand management (TDM) standards, policy objectives, and best practices;
10. a discussion of potential traffic calming measures most applicable to local streets planned as part of Secondary Plan development;
11. multi-modal travel demand forecasting for development associated with the Clair-Maltby Secondary Plan, based on the highest (most dense) land use budget developed in support of the MESP;
12. an assessment of forecast transit rider demands associated with development of the Secondary Plan; and
13. an assessment of forecast traffic resulting from development of the Secondary Plan, and summary of potential transportation improvements to accommodate anticipated traffic demands.

The findings of the Clair-Maltby Secondary Plan – Transportation Master Plan Study report (updated in February 2021) are provided herein along with its related technical appendices in Appendix D. The Mobility section of this MESP doc outlines the background analysis, policy and standards, a review of community consultation, alternatives, criteria, evaluation, and the preferred transportation network as it relates to Phase 3 of the Clair-Maltby Secondary Plan and MESP process.

3.4.1 Existing Conditions

The Secondary Planning Area is located in the south end of the City of Guelph. It is bounded by Clair Road to the north, Victoria Road (City Boundary) to the east, Maltby Road (City Boundary) to the south and the eastern limits of the Southgate Business Park to the west. It has an area of more than 520 hectares, which is currently primarily rural and agricultural in nature. The study area and existing road context is illustrated in Figure 3.4.1.

3.4.1.1 Existing Road Network

The Clair-Maltby Secondary Plan area is served by a series of rural and urbanized roads. The area road system, under existing conditions is generally defined by:

- Three north-south routes: Gordon Street, Victoria Road, and Southgate Drive; and,
- Two east-west routes: Clair Road and Maltby Road.

Additionally, Highway 6 (the Hanlon Parkway) operates in a north-south direction west of the secondary plan area.

An overview of the surrounding municipal street network highways and key roadways is provided below.

The existing local street network, including intersection lane configuration and traffic controls, is illustrated in Figure 3.4.2.

Figure 3.4.1. Study Area Location and Context

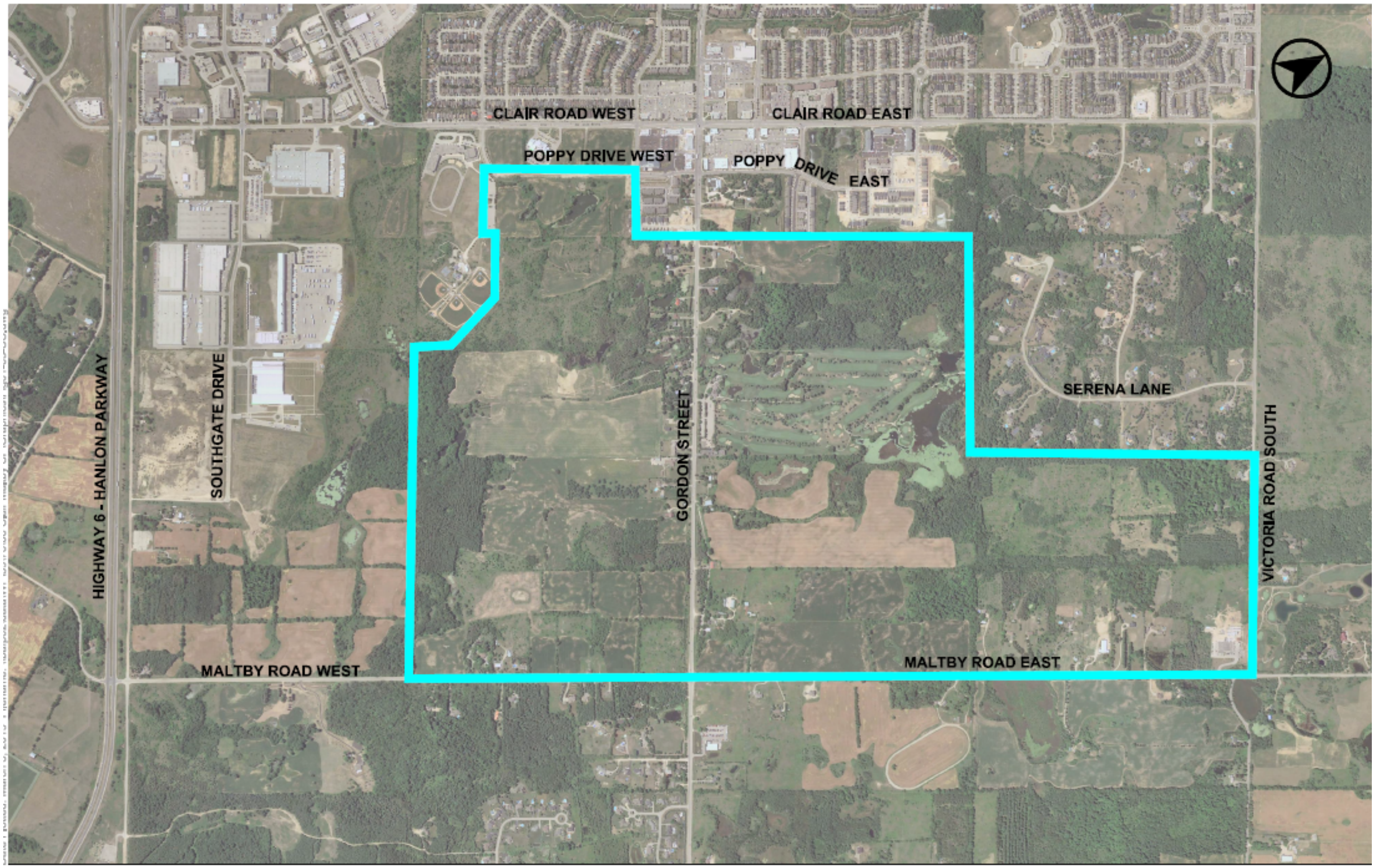
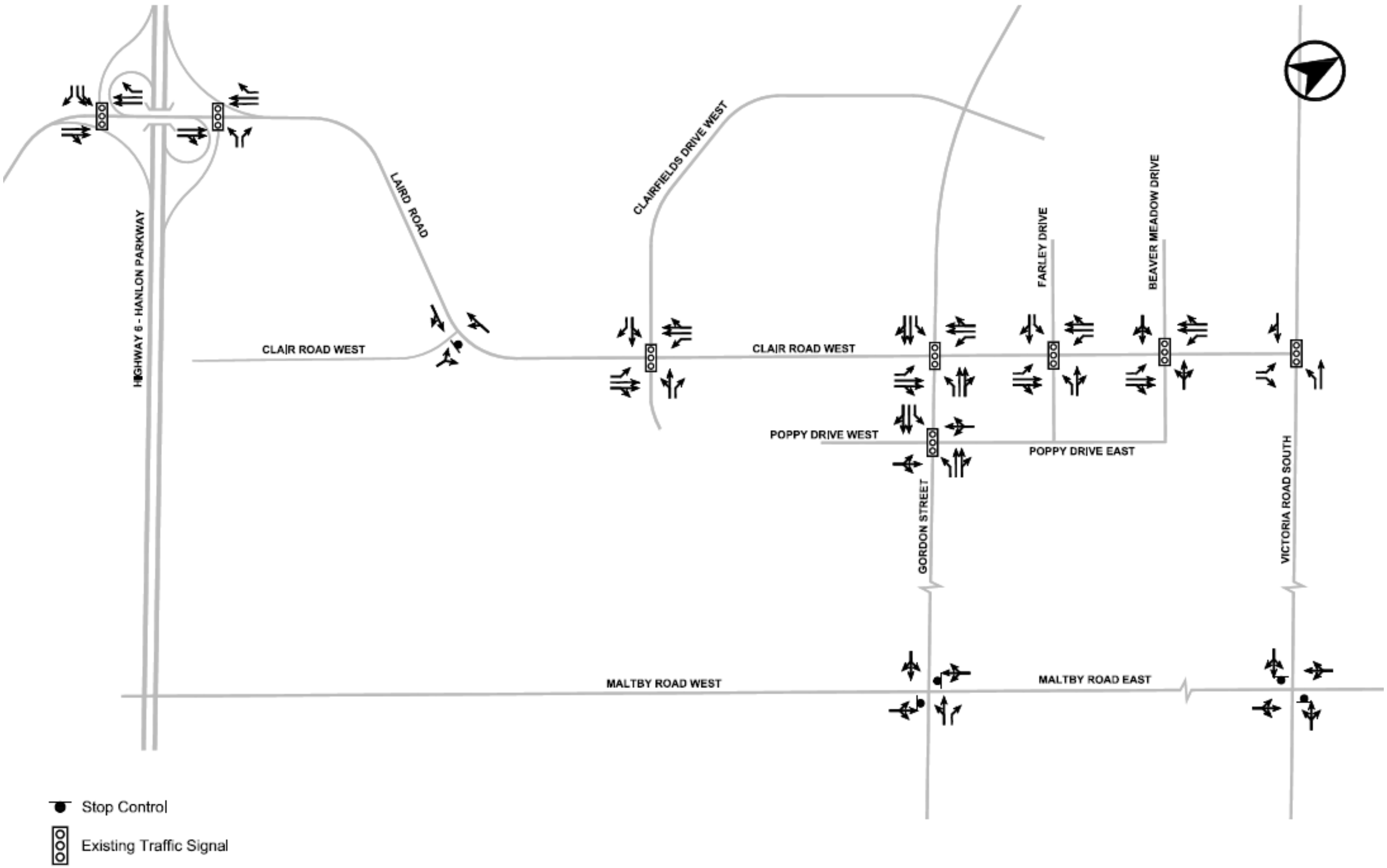


Figure 3.4.2. Existing Traffic Lane Configuration and Controls



Highway 6 (Hanlon Parkway) is a provincially-owned and maintained limited access highway (in the Guelph area) operating in a north-south direction west of the Secondary Plan area. Although the highway has limited access, and operates with a fully grade-separated interchange at Laird Road, it intersects with Maltby Road at an unsignalized intersection (east-west STOP-control). The highway operates with an 80 km/h. posted speed limit and two travel lanes in both the northbound and southbound directions. Northbound and southbound travel lanes are generally separated by a grassed median.

Highway 6 is a major traffic route linking the City of Guelph with the wider region and specifically with Highway 401 in the south. The highway begins at Highway 403 in the City of Hamilton (Dundurn) in the south and extends north through the City of Guelph to Tobermory at the northern end of the Bruce Peninsula.

Highway 6 includes a full interchange at its crossing with Laird Drive, which becomes Clair Road through the study area. The highway also intersects at an unsignalized intersection with Maltby Road, whereby eastbound / westbound traffic movements on Maltby Road operate under STOP-control.

Gordon Street is a two-way arterial road running north-south through the City of Guelph. Gordon Street becomes Brock Road south of the City Boundary at Maltby Road. The street extends south of Highway 401 as Highway 6, and north of Waterloo Avenue in Downtown Guelph as Norfolk Street, Woolwich Street, and then Highway 6 north of Woodlawn Road.

In the site vicinity, it has a 4-lane urban cross-section north of Poppy Drive and a 2-lane rural cross-section south of Poppy Drive. The roadway includes separate left-turn lanes at signalized intersections and bicycle lanes in both directions within the City limits. The street has an existing speed limit of 60 km/h. in its urban section, and a 70 km/h. speed limit in its rural section south of Poppy Drive.

Victoria Road is a north-south direction roadway stretching through the City of Guelph from Wellington County Road 36 in the south (at Highway 401) to Highway 6 in the in the north. In the site vicinity, Victoria Road has a basic 2-lane rural cross section, with a separate north left-turn lane at Clair Road. Victoria Road intersects with Maltby Road in two separate T-intersections, with the section of Victoria Road north of Maltby Road extends from a point approximately 55 metres east of where the section of Victoria Road south of Maltby Road terminates.

Southgate Drive services industrial and employment areas in the southwest area of Guelph east of Highway 6 and north and south of Laird Road. Southgate Drive is a two-way roadway with a 50 km/h. speed limit and a basic 2-lane cross section and auxiliary left-turn lanes at it intersections with Laird Road and Clair Road. The street loops north of Laird Road, intersecting with Laird Road at two points, and extends south of Laird Road (at its western intersection) before terminating in a cul-de-sac approximately 1.4 kilometres south of Clair Road.

Clair Road is a two-way road running east-west between Hanlon Road / Crawley Road in the west (just east of Highway 6) and Victoria Road in the east. It generally operates with a 2-lane cross section except for the “urbanized” portion of the street which extends from 225 metres east of Laird Road to approximately 140 metres east of Beaver Meadow Drive – where the street generally has a 4-lane urban cross section. Within the street's urban portion, auxiliary left-turn lanes are provided at all intersections, as well as bicycle lanes in both directions adjacent to the curb. Clair Road has a speed limit of 60 km/h.

Laird Road is a two-way road oriented generally in an east-west direction between Clair Road in the east and the street's termination approximately 175 metres west of Quaterman Road. It generally operates with a 4-lane cross section west of the street's signalized intersection with Southgate Drive, and a 2-lane cross section between this point and Clair Road in the east. West of the street's signalized intersection with Southgate Drive to Cooper Drive, bicycle lanes are also provided in both directions adjacent to the curb. The street intersects with Highway 6 as a grade-separated interchange, providing a high-capacity traffic connection to Highway 6 in the Secondary Plan area. Laird Road has a speed limit of 50 km/h.

Maltby Road is a two-way rural road oriented generally in an east-west direction between Nassagaweya-Puslinch Townline in the east and Highway 6 in the west. West of Highway 6, Maltby Road continues as Concession Road 4 to Roszell Road near the Town of Hespeler. It operates with a 2-lane cross section and has a speed limit of 50 km/h.

3.4.1.2 Existing Transit Facilities

Guelph Transit is responsible for transit service in the vicinity of the Secondary Plan area, and provides services within the City of Guelph generally. Guelph Transit also connects the City of Guelph with major transit terminals in the Downtown and University areas, including the University of Guelph and Guelph Central Station which provide connections to regional and inter-city transit services – including GO Transit and VIA Rail.

Existing transit routes do not serve the Secondary Plan area except along a section of Clair Road west of Gordon Street. There are currently no transit services along Gordon Street (south of Clair Road), Victoria Road, Maltby Road, or Clair Road (east of Gordon Street). A number of transit routes located just north Clair Road provide connections to Guelph Central Station, which is located approximately 7 kilometres north of the subject lands. These routes operate north of Clair Road serving Hanlon Industrial Park (Route 16), the University of Guelph (Routes 5 and 99), and the Guelph Central Station (Route 99) – which is located approximately 7.2 kilometres north of the subject lands. These routes may be revised to extend or reroute to the subject site area. Frequency of buses along these routes varies from two to six vehicles per hour during peak morning activity.

3.4.1.3 Existing Active Transportation Facilities

Cycling and pedestrian facilities in the Secondary Plan area are limited under existing conditions, owing to the rural character of existing lands.

Pedestrian sidewalks and bicycle lanes are currently provided along sections of Clair Road and Gordon Street within the Secondary Plan area. Sidewalks are also provided along sections of new streets southeast of the Gordon Street / Clair Road intersection.

3.4.1.4 Existing Travel Behaviour

The Secondary Plan area is located in the south portion of the City of Guelph in a largely rural area with few existing transit and cycling / pedestrian facilities. A review of the travel characteristics information provided by the Transportation Tomorrow Survey (TTS) for trips made in the areas immediately north of the Secondary Plan area (herein referred to as the "South Guelph Area") confirms that a majority of trips are undertaken in a private automobile either as a driver or passenger. However, a proportion of travel is undertaken using non-auto means, specifically for peak direction travel during peak travel periods.

Travel behaviour characteristics for trips to from the South Guelph Area during the weekday morning and afternoon peak periods are summarized in Table 3.4.1. Detailed TTS data calculations are included in Appendix D.

Table 3.4.1. Existing Mode Split (TTS – 2016, South Guelph Area)

Mode	Morning Peak Period Inbound	Morning Peak Period Outbound	Afternoon Peak Period Inbound	Afternoon Peak Period Outbound	Total Peak Period Travel
Auto Driver 4	67%	67%	76%	76%	72%
Auto Passenger 5	7%	8%	9%	21%	10%
Transit	2%	8%	9%	2%	6%
Walk	17%	6%	1%	1%	5%
Cycle	3%	2%	2%	0%	2%
Other 6	4%	9%	3%	0%	5%
Total	100%	100%	100%	100%	100%

Notes:
1. Based on 2016 TTS results for morning (7:00 a.m. – 9:00 a.m.) and afternoon (4:00 p.m. – 6:00 p.m.) peak traffic periods.
2. Statistics specific to 2006 GTA Zones 8062, 8064, 8067-8076, and 8078-8081.
3. Trips represent an expanded value based on a sample of persons surveyed in the study area.
4. Auto driver trips (includes auto drivers and motorcycles).
5. Auto passenger trips (includes auto passenger trips only).
6. Other trips include school bus and taxi trips, consistent with The City's model document.

The proportion of people in the South Guelph Area who chose to drive a car during the morning and afternoon peak weekday periods is in the order of 70% to 75%. The balance of travel is undertaken, significantly, as a vehicle passenger (10%), while a small portion of travel is undertaken using transit or by walking / cycling (approximately 2% to 6%).

It should be noted that "other" trips during the weekday peak periods comprise of school bus trips – and that these represent approximately 4% to 9% of trips during the morning peak period. School bus trips comprise a smaller proportion of weekday afternoon peak period trips as they tend to occur before the afternoon peak travel period (before 4:00 p.m.).

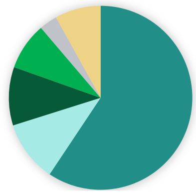
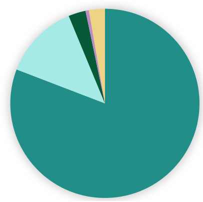
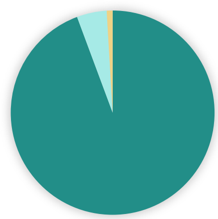
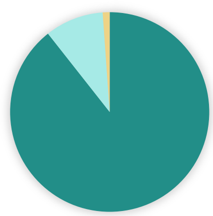
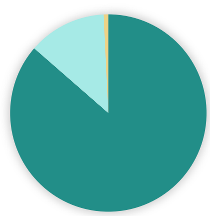
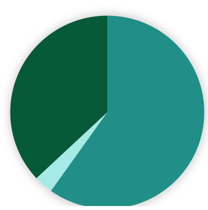
The proportion of travel undertaken as a pedestrian, using a bicycle and by transit generally represents 7% of all trips, which is a small proportion of all trips and should be improved as part of new development planned within the Secondary Plan area.

A summary of existing resident travel characteristics including travel mode by certain areas of distribution is provided in Table 3.4.1.

Trips made "local" to the South Guelph Area are more likely to be undertaken by sustainable transportation means (transit, walking, cycling) relative to trips made within the City of Guelph generally, or to trips made between the South Guelph Area and neighbouring Waterloo, Halton, and Peel Regions. During weekday peak travel periods, approximately 11 per cent of "local" trips are made by walking or cycling, while another 10 per cent is made by transit.

During weekday peak travel periods, trips oriented within the City of Guelph (outside of the "local" area) and to neighbouring regions (Halton, Peel, Waterloo, Wellington County) are predominately undertaken in a private vehicle (see Table 3.4.2). During weekday peak travel periods, trips to / from the City of Toronto comprise a small proportion of overall travel (1 per cent). Although trips to / from Toronto are still predominately undertaken by car, the transit mode share is greater than trips between the South Guelph Area and other areas analyzed herein.

Table 3.4.2. South Guelph Area: Peak Period Trip Distribution by Travel Mode

Destination Area	Proportion of All Trips	Mode Split
Local Area[1]	**54%**	
Rest of Guelph	**20%** (5 per cent Downtown)	
Waterloo Region	**10%**	
Halton / Peel Regions	**7%**	
Wellington County	**4%**	
City of Toronto	**1%**	

Colour	Travel Mode
	Auto Driver
	Auto Passenger
	Transit
	Walk
	Cycle Other
	Other

Note: 1. "Local area" consists of areas within the City of Guelph south of the Eramosa and Speed Rivers.
2. Another 4 per cent of trips are oriented to "other" areas in the region.

3.4.1.5 Collision Data Summary

A total of 134 collisions were reported at the existing intersections scoped for the Mobility Study (63-month period from 2012 to 2017). Of the total volume of collisions, 21 (16 per cent) resulted in a non-fatal injury, while 42 collisions (31 per cent) report property damage only (no injury). All other collisions were non-reported or "non-reportable". No "fatal" collisions were reported.

Within the collision data scope, approximately 51 per cent of the collisions recorded have occurred at the Gordon Street and Clair Road intersection. Most (greater than half) of these collisions were either "rear-end" collisions often resulting from following too closely or improper speed for road conditions, or "turning movement" collisions often resulting from left-turn traffic not yielding to on-coming traffic. Measures to reduce rear-end collisions include safety campaigns targeted at poor-weather vehicle operation, and greater enforcement. The introduction of protected left-turn phases at this intersection may have an impact on reducing turning movement collisions.

A total of 3 collisions involving vulnerable road users were recorded – in all instances involving cyclists. Two of the collisions occurred at the Gordon Street and Clair Road intersection, and one other at the Clair Road and Farley Drive intersection. Cycling facilities and pavement markings (including pedestrian crossings) should be highly visible and well-marked. Consideration may be made to reducing vehicle speeds and/or providing physical separation (bollards / buffers) between cycling facilities and vehicle travel lanes. It is noted that Gordon Street is planned to be upgraded to accommodate fully protected cycling infrastructure.

It should be noted that a total of 15 collisions were recorded at the Victoria Road South and Maltby Road intersection. This intersection is currently configured as two separate intersections (back-to-back T-intersections). This unusual configuration, which requires northbound / southbound traffic to conduct a right-turn then left-turn in short succession to continue in the same direction, may explain the rate of rear-end collisions at this intersection.

A detailed collision data summary table and detailed collision reports are included in Appendix D.

3.4.1.6 Existing Traffic Operations

Existing Traffic Volumes

Existing traffic volume data was obtained for all study area intersections from the City of Guelph and/or traffic counts collected by Spectrum Traffic Data Inc. on behalf of BA Group.

Traffic volume data was collected for the period 2012 to 2017 for key intersections in the study area, as well as older traffic volume data for use as reference. Traffic volumes were reviewed against historical data (TMCs and ATRs) to verify general trends and understand potential inconsistencies. Generally, the most recent intersection counts (those from 2015 to 2017) were selected at key study area intersections, and utilized as the basis for analysis.

Traffic signal timing plans were provided by the Ministry of Transportation and the City of Guelph for signalized intersection included as part of the analysis.

Existing area traffic volumes utilized in assessing current traffic operations are illustrated in Figure 3.4.3.

Intersection Capacity Analysis Methodology

Traffic operations analyses have been undertaken at study area intersections using standard capacity analysis procedures as follows.

The traffic operations analysis for signalized and unsignalized intersections was undertaken using Synchro Version 10 software, adhering to the analysis methodology outlined in the Highway Capacity Manual 2000. Key performance indicators utilized for the signalized and unsignalized analyses are volume-to-capacity (v/c) ratios, delay times, and level-of-service (LOS).

Input parameters for the analyses are based on data acquired from traffic surveys. Peak hour factors and heavy traffic percentage parameters were calculated based on the traffic data acquired where appropriate. Bus blockages were estimated based on transit service frequency during prevailing traffic volume peak hours.

Calibration

Vehicle delay surveys were undertaken for the eastbound and westbound traffic movements at the Gordon Street and Maltby Road intersection so as to ensure that the traffic model appropriately reflects existing traffic delays for the eastbound and westbound movements. The existing traffic analysis herein is calibrated to reflect existing delay results observed during updated data collection and traffic delay surveys. Parameters calibrated under existing traffic conditions is carried forward as part of future analysis traffic scenarios.

A summary of existing signalized and unsignalized traffic operations at key existing study area intersections is provided in Figure 3.4.4.[3]

Existing Operations

The signalized intersection traffic analysis indicates that all study area intersections perform acceptably, and without any traffic capacity constraints for any individual traffic movements. During the weekday afternoon peak hour, overall intersection v/c ratios are shown to be 0.70 or less, while individual traffic movements are shown to all operate with a v/c ratio of 0.73 or less.

Overall signalized intersection traffic operations are good under existing conditions, and are generally reflective of new infrastructure (updated and widened roads) and limited area development. Existing delay and capacity results are acceptable.

The key Gordon Street and Clair Road gateway intersection operates acceptably under existing traffic conditions, with an overall intersection v/c ratio of 0.63 during the weekday afternoon peak hour. Traffic volumes and resulting traffic operations

3 The free traffic movements associated with the existing Highway 6 access ramps to / from Laird Road East are not analyzed as part of the traffic analysis herein.

are reflective of the commercial land uses prevalent in each of the intersection’s four quadrants.

The intersection of Clair Road East and Victoria Road was recently signalized. The signalized intersection analysis indicates that this intersection generally operates acceptably.

The existing conditions traffic analysis indicates the that eastbound and westbound STOP-control movements at the Gordon Street and Maltby Road intersection operate with longer delays and fewer gap opportunities.

The unsignalized traffic analysis indicates that the eastbound movement operates with LOS C during the weekday afternoon peak hour, while the westbound movement operates with LOS D during the weekday afternoon peak hour. Signalization of this intersection may be considered in the longer-term given anticipated traffic growth along both streets.

All other movements at unsignalized intersections within the study area are shown to operate at LOS C or better during the weekday afternoon peak hour, which is acceptable.

Individual movement and overall volume-to-capacity ratios for each of the signalized intersections within the study area are summarized in Appendix D.

Detailed results of the Synchro analysis are included in Appendix D.

Figure 3.4.3. Existing Weekday Afternoon Peak Hour Traffic Volumes

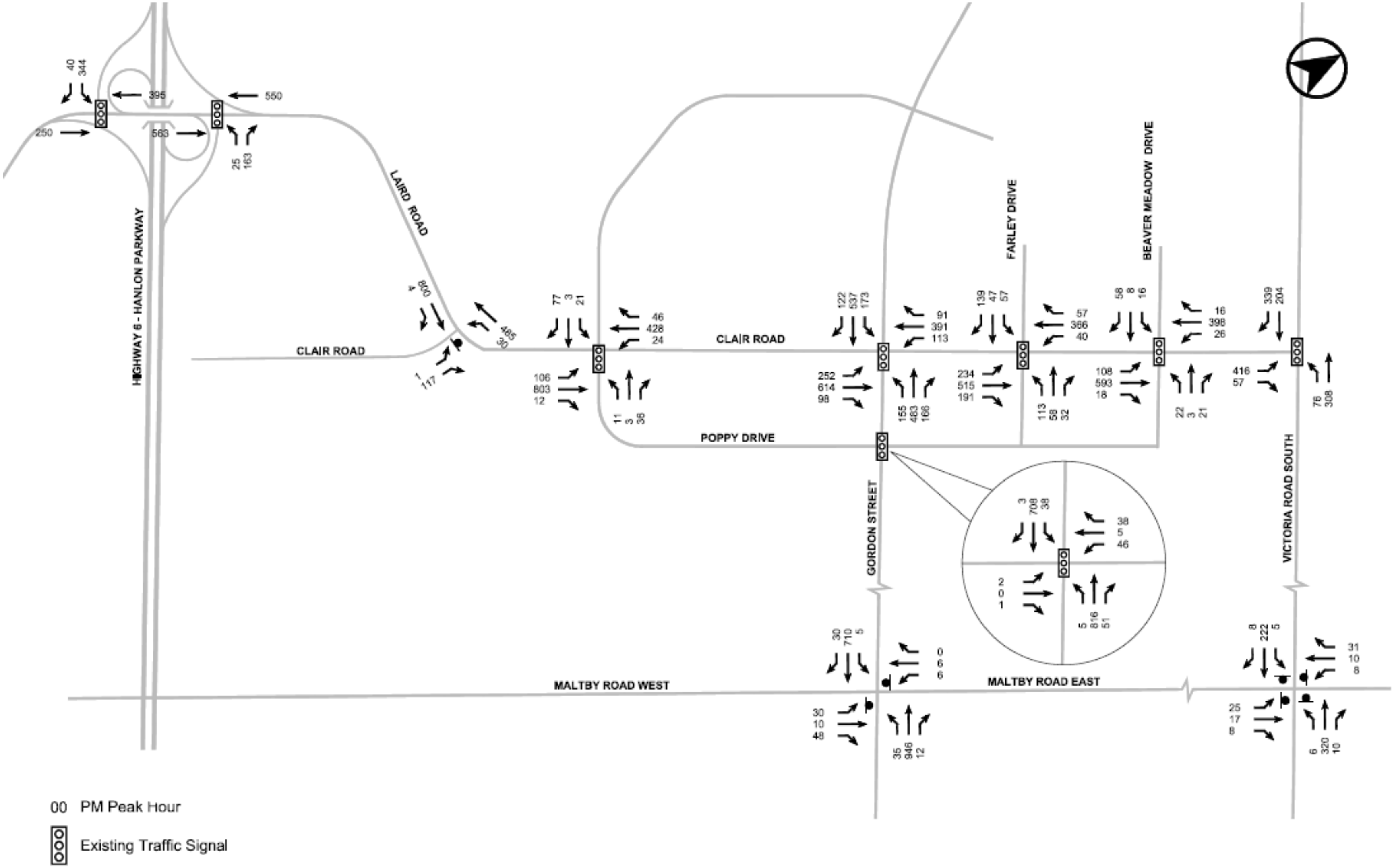
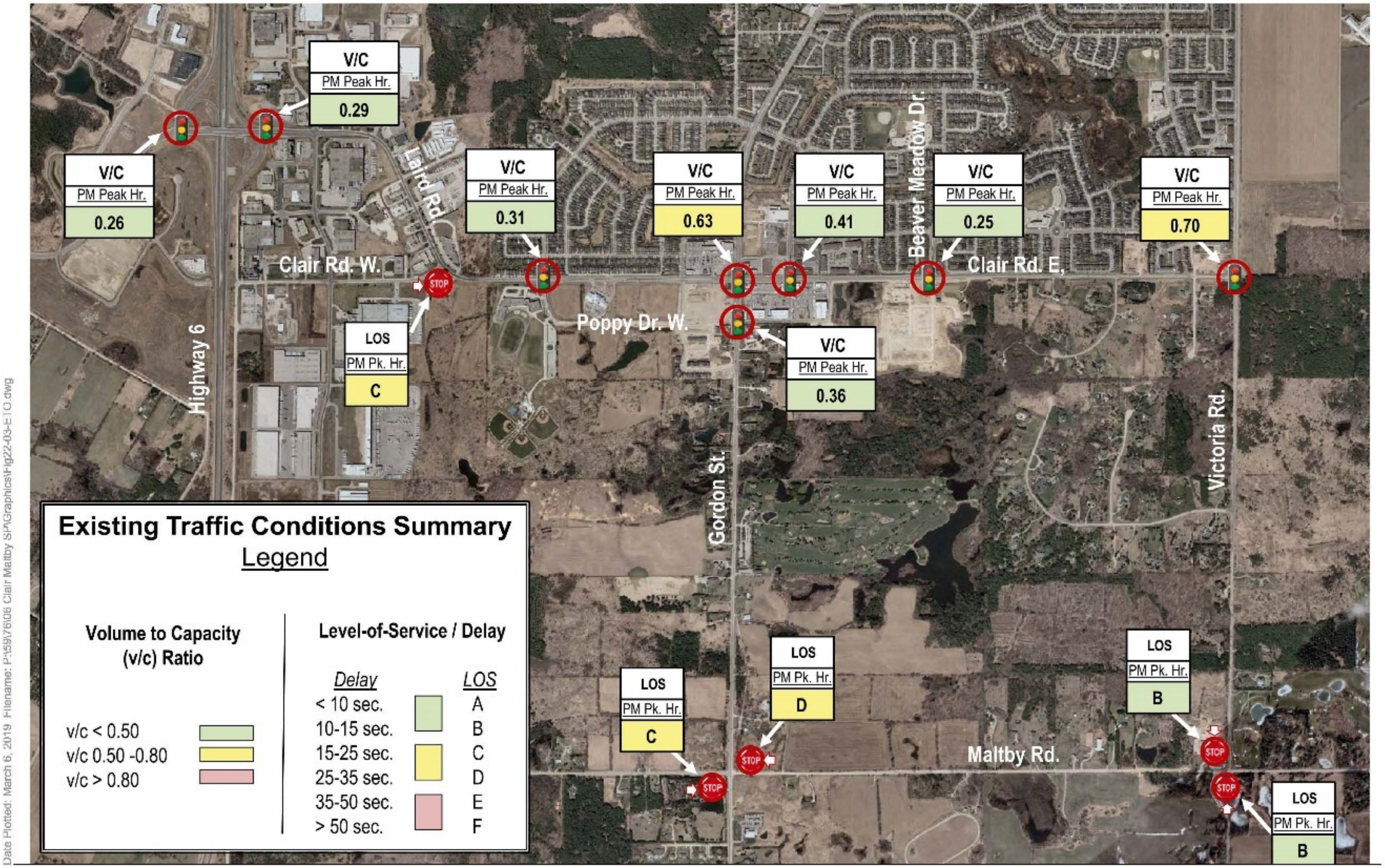


Figure 3.4.4. Summary of Existing Traffic Operations Analysis



3.4.1.7 Background Development and Area Growth Assumptions

Future background traffic operations were forecast and assessed considering:

- review of and application of general corridor growth – growth observations are summarized in Table 3.4.3; and,
- area site-specific background developments – which are summarized in Table 3.4.4.

Corridor Growth

A review of traffic patterns in the study area was undertaken over 10 years (2008 to 2018) to provide an understanding of overall traffic growth trends on key street segments within the Secondary Plan area.

Traffic volumes were reviewed for the following street segments to provide an indication of prevailing trends in vehicle activity along the arterial road corridors of Gordon Street, Clair Road, and Victoria Road within this period.

- Gordon Street south of Clair Road,
- Gordon Street north of Maltby Road,
- Clair Road east of Gordon Street,
- Clair Road west of Gordon Street, and
- Victoria Road south of Clair Road.

Traffic volumes were also reviewed for segments of Maltby Road east of Gordon Street. However, the infrequency of historical data and generally small traffic volumes could not produce a reflective traffic growth rate. Traffic volumes on Maltby Road were shown to be relatively small, and variable from count to count.

Traffic corridor review observations are outlined in the following and are summarized in Appendix D.

Table 3.4.3 Corridor Traffic Growth Summary

Street	Direction	Observed Annual Growth Rate
Gordon Street Two-way Traffic	Northbound / Southbound	+0.4% to +0.7%
Clair Road Two-way Traffic	Eastbound / Westbound	+3.7% to +4.7%
Victoria Street Two-way Traffic	Northbound / Southbound	+18%

Understanding the prevailing traffic growth trends associated with key arterial roads within the Secondary Plan area (Gordon Street, Victoria Road and Clair Road), traffic growth was assumed for these corridors. Corridor traffic growth was carried through the study area, and in the case of Clair Road, assigned to terminal ramps at the Highway 6 / Laird Road interchange based on existing turning movement proportions. Corridor growth rates were applied over a 14-year period to the 2031 planning horizon year, to account for the 2017 date of traffic data collection associated with this project.

An average annual corridor growth rate of 0.5% was applied to Gordon Street during the weekday afternoon peak hour.

Higher traffic growth rates along Victoria Road and Clair Road are expected to result from recent development along these corridors; however, this growth would not be expected to be maintained over the long-term without the introduction of new site-specific developments (accounted for the in the following section). As such, a corridor growth rate of 1.5% per annum was applied to these corridors, which is generally consistent with growth rates applied by the City in traffic planning modelling exercises.

Traffic volumes resulting from the application of corridor growth rates outlined herein, are summarized in Appendix D.

Site Specific Background Developments

Area background developments (which are summarized in Table 3.4.4) provide an understanding of current changes within the vicinity of the Clair-Maltby Secondary Plan area, and the existing development context that will be considered as part of future planning for the subject lands.

Traffic related to the proposed development comprising the Dallan Residential Subdivision (161, 205, and 253 Clair Road East) is partially captured as part of existing traffic volumes given the initial occupancy of this development. For the purposes of the traffic analysis herein, traffic volumes associated with this development are reduced by 25% to account for existing occupancy.

Traffic volumes related to the Dallan, Neumann and Bird Subdivisions were also adjusted as part of the analysis herein to account for the introduction of Poppy Road, which was not utilized in the assignment of site-specific trips within Transportation Studies prepared for the background developments.

Background Road Network Assumptions

Future lane configurations on the area street network reflect the following planned improvements that are assumed as part of the future traffic analysis scenarios:

- Widening of Gordon Street from 2 to 4 lanes (approved 2001 EA) from Kortright Road to Wellington Road 34;
- Widening of Clair Road from 2 to 4 lanes (approved 2003 EA) – COMPLETE; and
- Southerly extension of Southgate Drive to Maltby Road.

Table 3.4.4. Area Development Applications

Development	Residential Units	Non-Residential GFA	Two-Way Site Traffic[1] AM (PM)	Transportation Study / Analysis
1888 Gordon Street (Tricar Developments Inc.)	460 Apartment Units	6,350 sq. ft. non-residential GFA	297 (329)	1888 Gordon Street TIS, September 22, 2017, Stantec.
Neumann Subdivision (Coldwell Banker Neumann REB Ltd.)	Stacked townhouses and apartments (permitted use). Number of units unspecified.	3.22 ha Corporate Business Park 0.98 ha Commercial 4.2 ha	205 (203)	Neumann Subdivision Guelph, ON TIS, October 2014, Paradigm Transportation Solutions Ltd.
Bird Subdivision (Thomasfield Homes Ltd.)	21 Single Family Units 36 Townhouse Units 249 Apartment Units 306 Total Units	0.04 ha Future Development	107 (137)	Bird Residential Subdivision TIS, October 2010, Paradigm Transportation Solutions Ltd.
Southwest Corner of Gordon Street / Clair Road (Fieldgate)	-	7,408 sq. m. Retail	515[2]	Gordon Street and Clair Road October 2015, LEA Consulting Ltd.
Hanlon Creek Business Park	--	--	--	--
Dallan Residential Subdivision 161, 205 and 253 Clair Road East	409 residential units (Mix of densities)	--	--	1888 Gordon TIS assumed 105 units. ~400 units were previously proposed.

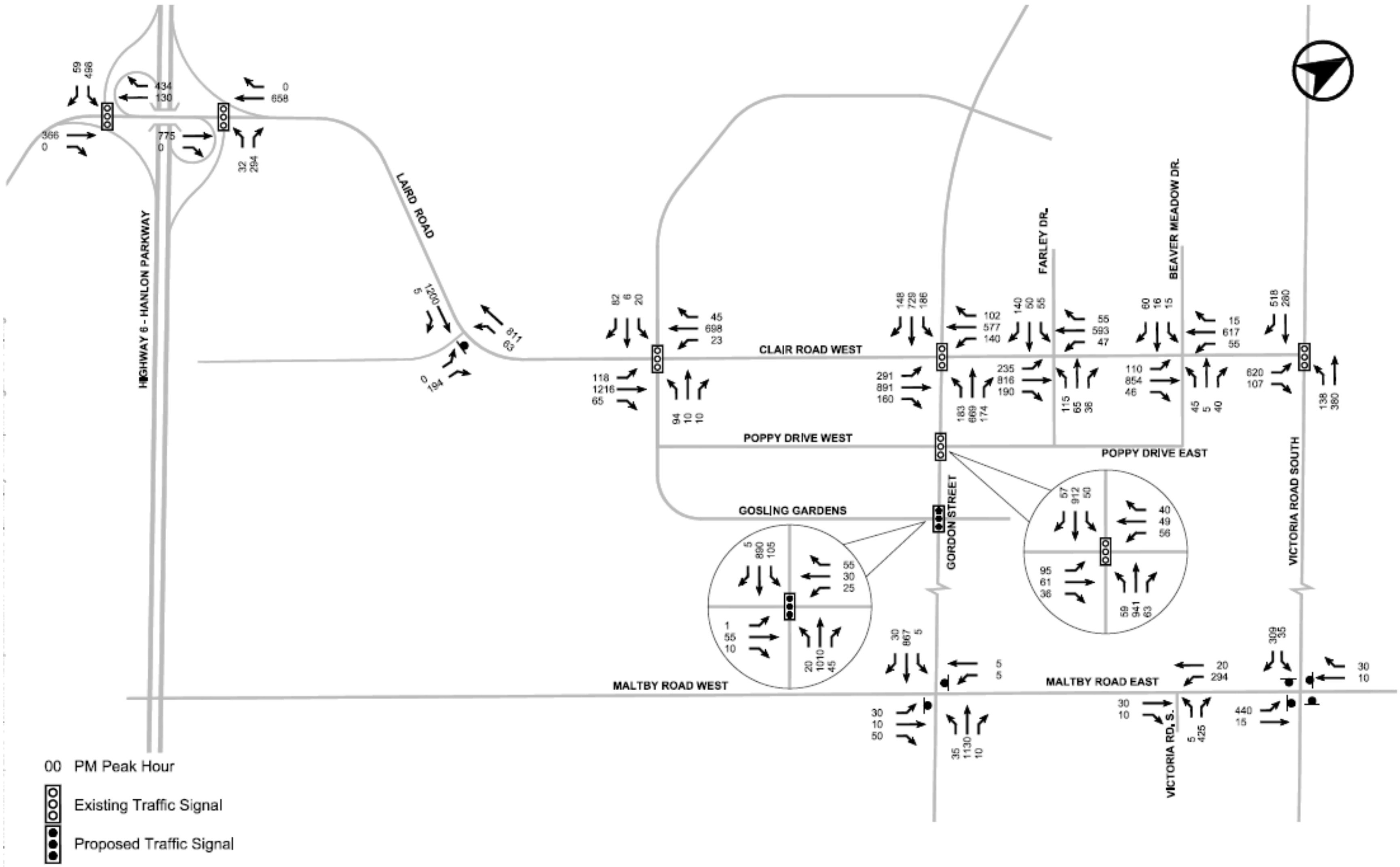
Development	Residential Units	Non-Residential GFA	Two-Way Site Traffic[1] AM (PM)	Transportation Study / Analysis
South End Centre	-	13,935 sq.m. (150,000 sq.ft.) Recreation Centre	308 (411)	No TIS. Traffic referenced from 1888 Gordon TIS.
Westminster Woods Victoria Road South and Clair Road East	101 residential apartment units	745 sq. m. Commercial	70 (149)	Kingsbury C Westminster Woods TIS. March 2015, Stantec.

Notes:
1. Two-Way Site Traffic based on individual TIS reports.
2. 515 total PM trips, 340 net new PM trip
3. TIS = Traffic (or Transportation) Impact Study

In addition to the background developments noted in the above table, traffic allowances are made for lands previously comprising the Southgate Business Park.

Future Background traffic volumes, which are the sum of existing traffic volumes, corridor growth traffic volumes, and site-specific background development traffic volumes, are illustrated in Figure 3.4.5.

Figure 3.4.5. Future Background Traffic Volumes



3.4.1.8 Background Traffic Operations

Overall signalized intersection traffic operations are generally acceptable under future background traffic conditions and are similar to those observed under existing traffic conditions, although longer delays and higher volume-to-capacity ratios are observed at the key Gordon Street / Clair Road and Victoria Road / Clair Road intersections relative to the existing conditions.

The key Gordon Street / Clair Road intersection is anticipated to operate acceptably under future background traffic conditions, with an overall intersection v/c ratio 0.87 during the weekday afternoon peak hour. Relative to the existing condition, overall intersection v/c ratios increase by 32 per cent during the weekday afternoon peak hour, which is generally the result of anticipated increases in through traffic volumes along Gordon Street and Clair Road, site-specific development traffic, and an increase in eastbound left-turn traffic volumes resulting from specific area developments.

The future background traffic analysis indicates that the Victoria Road / Clair Road intersection generally operates acceptably, despite an increase in traffic delay and volume-to-capacity ratios. Relative to the existing condition, overall intersection v/c ratios increase by 25 per cent during the weekday afternoon peak hour, which is generally the result of anticipated increases in southbound right-turn and eastbound left-turn traffic volumes resulting from area-specific background developments.

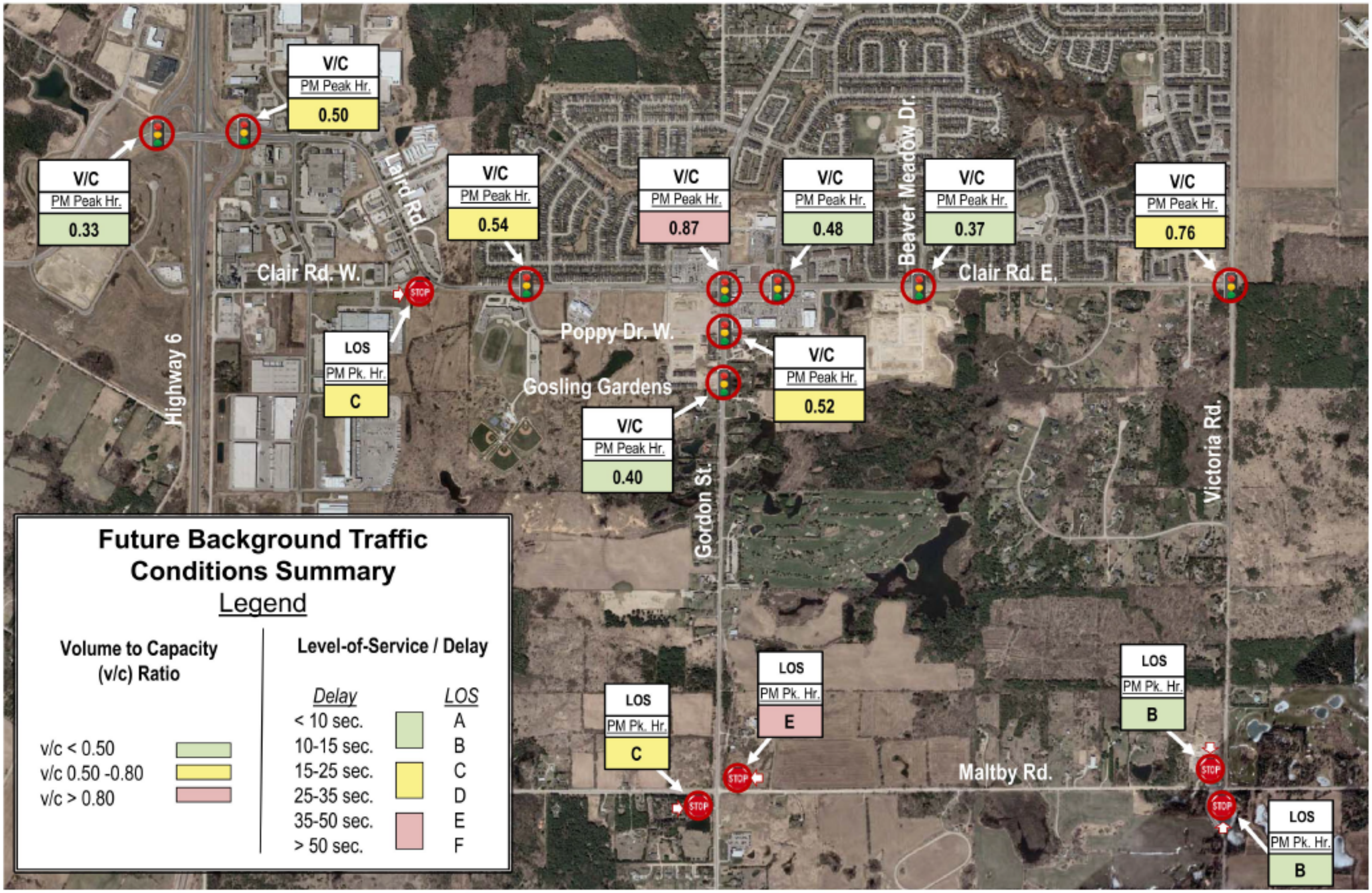
Traffic operations at unsignalized intersections within the study area are anticipated to continue to operate similar to existing conditions.

A summary of future background signalized and unsignalized traffic operations at key existing study area intersections is provided in Figure 3.4.6.

Individual movement and overall volume-to-capacity ratios for each of the signalized intersections within the study area are summarized in Appendix D.

Detailed results of the Synchro analysis are included in Appendix D.

Figure 3.4.6. Summary of Future Background Traffic Operations Analysis



3.4.2 Criteria/Standards/Policy

The Clair-Maltby Secondary Plan transportation elements are guided by the policies and plans set out in the policies outlined below.

3.4.2.1 The Provincial Policy Statement (PPS)

The Provincial Policy Statement (PPS) was enacted in 2005 and the most recent version came into effect on May 1, 2020. The PPS provides policy direction on land use planning, development and transportation matters. All planning decisions must be consistent with the PPS. The PPS is based on the principles of "maintaining strong communities, a clean and healthy environment and a strong economy" (Part IV Vision).

The PPS supports:

- connectivity within and among multimodal transportation systems, including across jurisdictional boundaries;
- safe and efficient movement of people and goods, appropriately addressing projected needs;
- density and a mix of uses to support the planning and development of alternative transportation modes and limit the length and need of vehicle trips and support current and future use of transit and
- active transportation;
- public streets that meet the needs of pedestrians and facilitate active transportation and community connectivity;
- efficient use of existing and planned infrastructure, including through Transportation Demand Management (TDM) strategies, where feasible;
- protection of rights-of-way for infrastructure including transportation and transit to meet current and project needs; and,
- protecting for long term goods movement facilities and corridors.

In addition, the PPS promotes planning decisions including intensification, redevelopment, accounting for existing building stock, promoting various types of housings, making efficient use of existing infrastructure, etc.

3.4.2.2 A Place to Grow

"A Place to Grow" - the Growth Plan for the Greater Golden Horseshoe was initially prepared by the Provincial government in 2006 and should be read in conjunction with the PPS.

All decisions made by municipalities with respect to planning matters must conform to the Growth Plan. The Places to Grow Growth Plan has been recently updated. In May 2019, the Government of Ontario released A Place to Grow: Growth Plan for the Greater Golden Horseshoe (APTG), and Amendment 1 to APTG was approved with an effective date of August 28, 2020. APTG and Amendment 1 replace the Growth Plan for the Greater Golden Horseshoe, 2006 that initially took effect on

June 16, 2006 and guides growth and development within the Greater Golden Horseshoe over the next 30 years.

The Growth Plan provides a vision and a framework for managing growth. It requires all municipalities to implement policies to achieve intensification and higher-densities to make efficient use of land and infrastructure and support transit viability, and directs growth to urban growth centres and transit corridors and stations areas. The plan also calls for the consideration of climate change in planning for future growth that supports moving towards low-carbon communities and approaches to reduce greenhouse gas emissions.

In these areas, the Growth Plan demands increased residential and employment densities to support existing and planned transit services, a mix of land uses, and designed access for various transportation modes to the transit facility including pedestrian and cycling infrastructure.

The Growth Plan requires land use planning to be coordinated with transportation planning and investment. The Plan states that transportation investments and the wider transportation system:

1. provide connectivity among transportation modes for moving people and for moving goods;
2. offer a balance of transportation choices that reduces reliance upon the automobile and promotes transit and *active transportation;*
3. be sustainable and reduce greenhouse gas emissions by encouraging the most financially and environmentally appropriate mode for trip-making and supporting the use of zero- and low-emission vehicles;
4. offer multimodal access to jobs, housing, schools, cultural and recreational opportunities, and goods and services;
5. accommodate agricultural vehicles and equipment, as appropriate; and
6. provide for the safety of system users.

The Growth Plan indicates that the design of new facilities and redesign of existing streets will adopt a complete-streets approach that will ensure the needs of all street users are accommodated; however, public transit will be the first priority for transportation infrastructure planning and major transportation investments.

Supported by the implementation of complete street policies, municipalities will ensure that active transportation networks are comprehensive and integrated into transportation planning. The Growth Plan states that Municipalities will develop and implement transportation demand management policies in official plans or other planning documents or programs to:

1. reduce trip distance and time;
2. increase the modal share of alternatives to the automobile, which may include setting modal share targets;
3. prioritize active transportation, transit, and goods movement over single-occupant automobiles;

4. expand infrastructure to support active transportation; and
5. consider the needs of major trip generators.

The Growth Plan also speaks to accommodating goods movement, through linking international gateways and employment areas by appropriate transportation facilities / infrastructure, and that municipalities establish priority routes for goods movement.

3.4.2.3 City of Guelph Official Plan

The City of Guelph Official Plan is a statement of goals, objectives and policies that guide Guelph's growth and development in the years leading up to 2031. The most recent statutory five-year review was completed in three phases with Official Plan Amendment (OPA) 48 being the third and final phase. OPA 48 was approved by Council in June 2012 and approved by the Ontario Municipal Board, with some exceptions, in October 2017.

The City of Guelph Official Plan follows the policies laid out in the PPS and Growth Plan, and the Official Plan:

a) establishes a vision, guiding principles, strategic goals, objectives, and policies to manage future land use patterns that have a positive effect on the social, economic, cultural and natural environment of the city.
b) Promotes long-term community sustainability and embodies policies and actions that aim to simultaneously achieve social well-being, economic vitality, cultural conservation and enhancement, environmental integrity, and energy sustainability.
c) Promotes the public interest in the future development of the city and provides a comprehensive land use policy basis which will be implemented through the Zoning By-law and other land use controls.
d) Guides decision making and community building to the year 2031.

The Official Plan identifies in Figure 3.4.7, the Clair-Maltby Secondary Plan area as a "greenfield area", while the Clair Road / Gordon Street junction is identified as a "community mixed-use node" (OP Schedule 1). Lands within the Clair-Maltby Secondary Plan area are designated as Reserve Lands, Significant Natural Area, Corporate Business Park, Industrial and Low-Density Greenfield Residential on Schedule 2 of the Official Plan. These areas are further noted as "reserve", "industrial" and "commercial" (ref. Figure 3.4.8).

In regards to development in new "greenfield" areas, the Official Pan directs new development to provide for a diverse mix of land uses at transit supportive densities (minimum 50 residents / jobs per hectare) that supports a multi-modal transportation network and efficient public transit that links to the City's Urban Growth Centre and surrounding communities.

Transit, along with walking and cycling, are to be supported by new development for everyday travel. The identified community mixed-use node at Clair Road / Gordon Street, is an area identified for higher density and mixed-use development that serve the wider community. The node is intended to be well served by transit and facilitate pedestrian and cycling travel.

Transportation policies are established within the Official Plan, which plans and manages the City's transportation system to accommodate the following:

a) provide connectivity among transportation modes for moving people and goods;
b) offer a balance of transportation choices that reduces reliance upon any single mode and promotes transit, cycling and walking;
c) be sustainable, by encouraging the most financially and environmentally appropriate mode for trip-making;
d) offer *multi-modal* access to jobs, housing, schools, cultural and recreational opportunities, and goods and services;
e) provide for the safety of system users; and
f) ensure coordination between transportation system planning, land use planning, and transportation investment.

Figure 3.4.7. Schedule 1, City of Guelph Official Plan – Growth Plan Elements

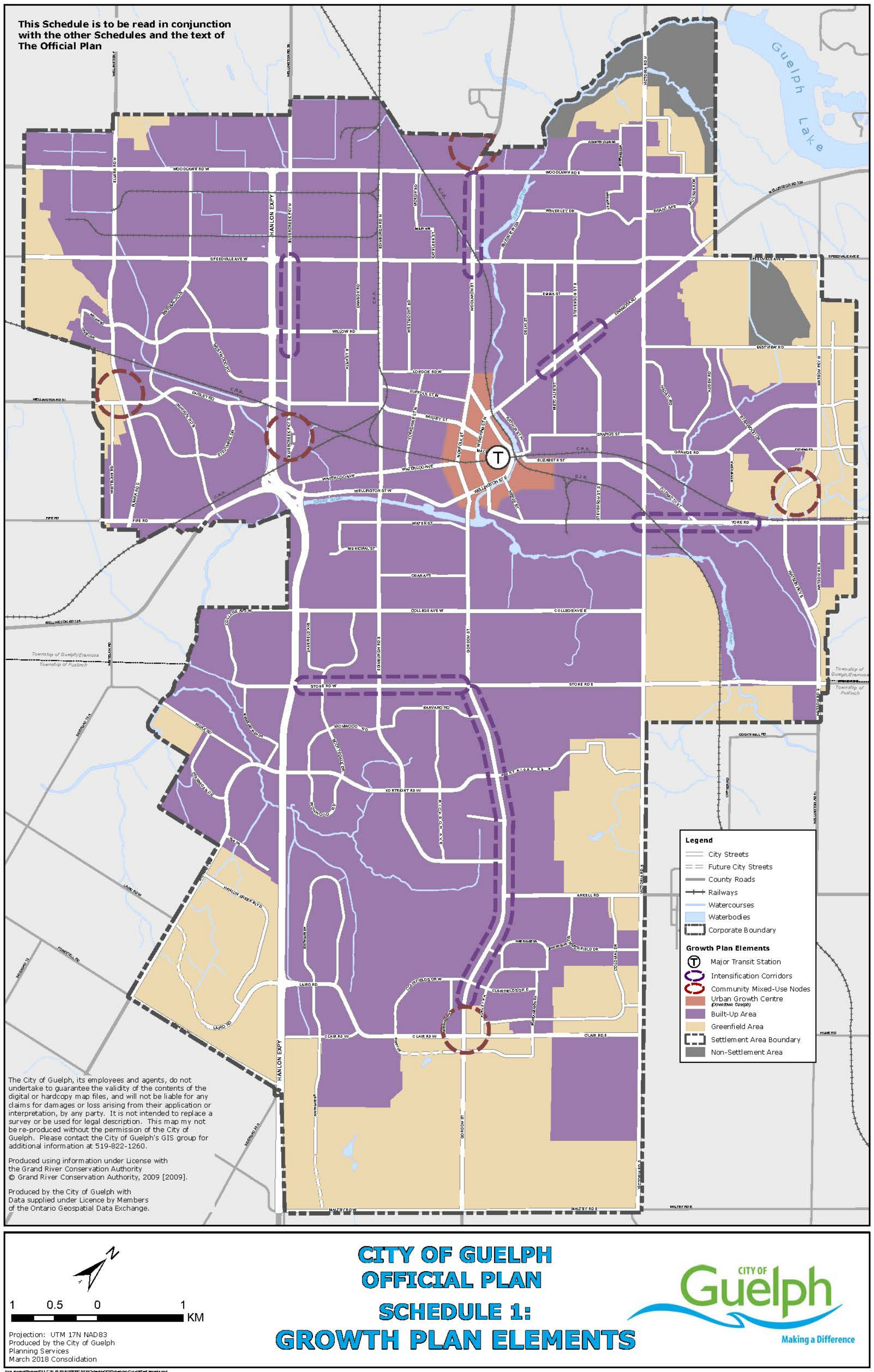
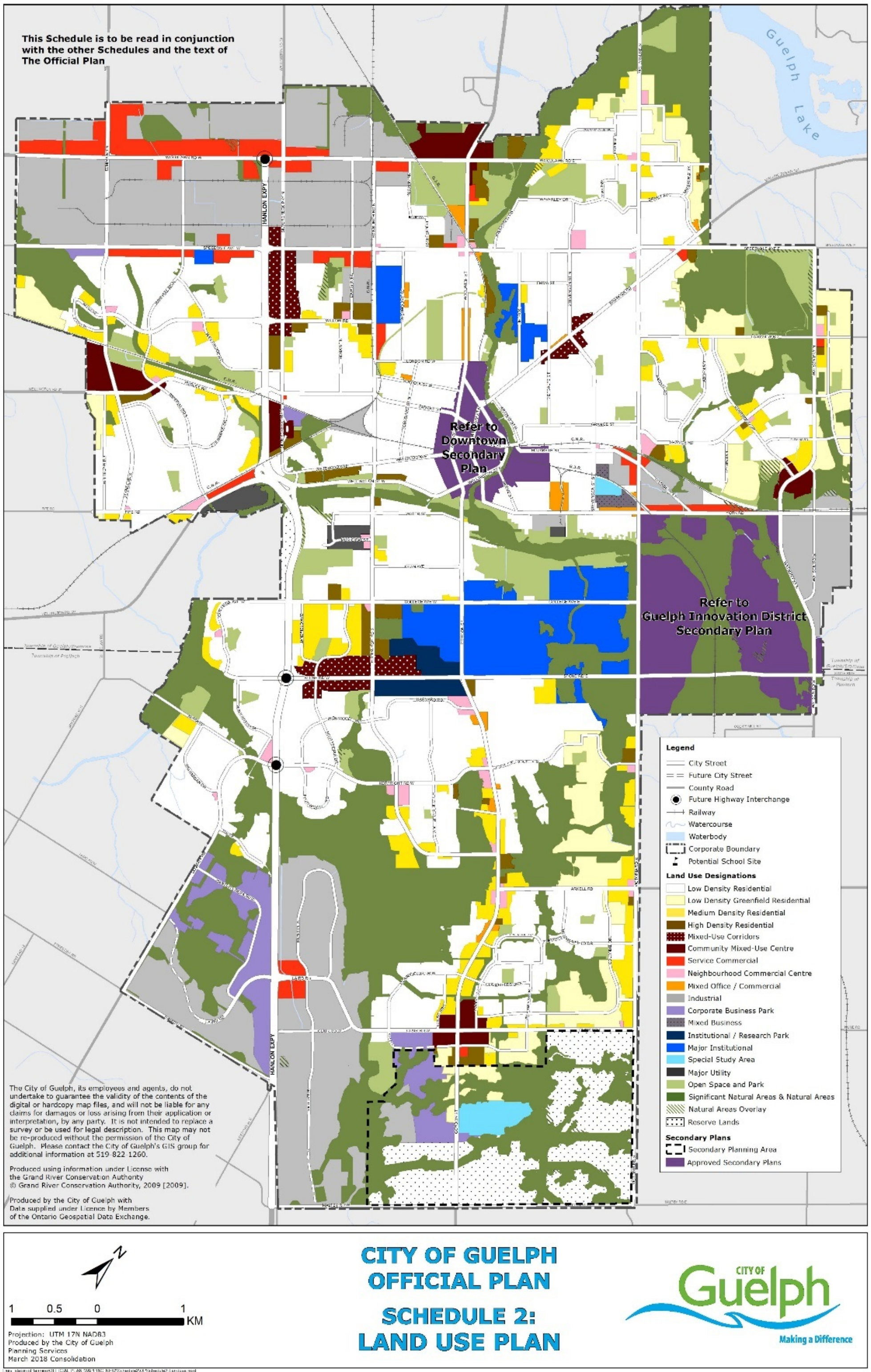


Figure 3.4.8. Schedule 2, City of Guelph Official Plan Amendment 48 - Land Use Plan



In planning for new - or reconfiguring existing - transportation infrastructure, the Official Plan states that proponents consider separation of travel modes within transportation corridors, use transit infrastructure to shape growth, place priority on increasing the capacity of existing transit systems, expand transit services to areas that are planned to achieved transit supportive densities, facilitate improved linages to / from Downtown Guelph and other intensification areas, and increase mode share of transit. In all cases, and consistent with provincial directives, public transit will be the first priority for transportation infrastructure planning.

In addition to prioritizing transit, the City is directed to develop transportation demand management (TDM) policies, and pedestrian and cycling networks to be utilized by planned new development.

The Movement of People and Goods section of the Official Plan generally defines the transportation policy for the City. The planning and design of the City Transportation system should meet the following objectives:

a) To provide a transportation system, involving all transport modes, to move people and goods safely, efficiently and economically while contributing positively to the social, cultural and natural environments of the city.

b) To ensure that the transportation system is accessible and meets the needs of all members of the community.

c) To ensure that the transportation system is planned, implemented and maintained in a financially sustainable manner.

d) To encourage and support walking and cycling as healthy, safe and convenient modes of transportation all year round and ensure that the design of pedestrian and cycling networks are integrated with other modes of transportation.

e) To place a priority on increasing the capacity of the existing transit system and facilitate its efficient expansion, where necessary and feasible, to areas that have achieved, or are planned to achieve, transit-supportive residential and employment densities.

f) To aim to increase non-auto mode shares.

g) To develop and maintain an appropriate hierarchy of roads to ensure the desired movement of people and goods within and through the city.

h) To work in co-operation with Federal, Provincial, and other local governments, to create a transportation system that accommodates current and anticipated regional transportation movements.

i) To reduce the amount of energy used for transportation.

Furthermore, the Official Plan establishes plans and objectives related to pedestrian and bicycle movement, public transport, roads, new / reconfigured road design, transportation and related urban environment, railways, and parking.

The City's policies also identify they will plan, implement, and maintain a transportation system to facilitate increasing non-auto mode shares for average daily trips to 15% for transit, 15% for walking and 3% for cycling.

Key Pedestrian and Bicycle Policies

The City, through policies and standards, will ensure that bikeways and pedestrian walkways are integrated into and designed as part of new road and other infrastructure projects in the City. They will also support the creation of programs and facilities that will encourage walking and greater use of bicycles, through the integration of safe and convenient bike and pedestrian components into the design of new streets including shade trees, street furniture, lighting, street crossing and other traffic control. Policies also support the ongoing enhancement of a pedestrian and bicycle system that is convenient, safe, and pleasant, serves both commuter and recreational purposes and provides access throughout the City. Additionally, new development will provide for bicycle / pedestrian linkages and street sidewalks, and quality (i.e. conveniently located, sheltered integrated into built form) bicycle parking facilities for uses such as employment/commercial, schools, and medium to high density residential.

The City, through policies established in the Official Plan, developed a Trail Network Plan that directs expansion of trail facilities in Guelph, including within the Clair-Maltby Secondary Plan area. This trail network plan is illustrated in Figure 3.4.9, and is complemented by the City of Guelph Active Transportation Network Plan, 2017 (ref. Figure 3.4.10).

Figure 3.4.9. Schedule 7, City of Guelph Official Plan Amendment 48 – Trail Network Plan

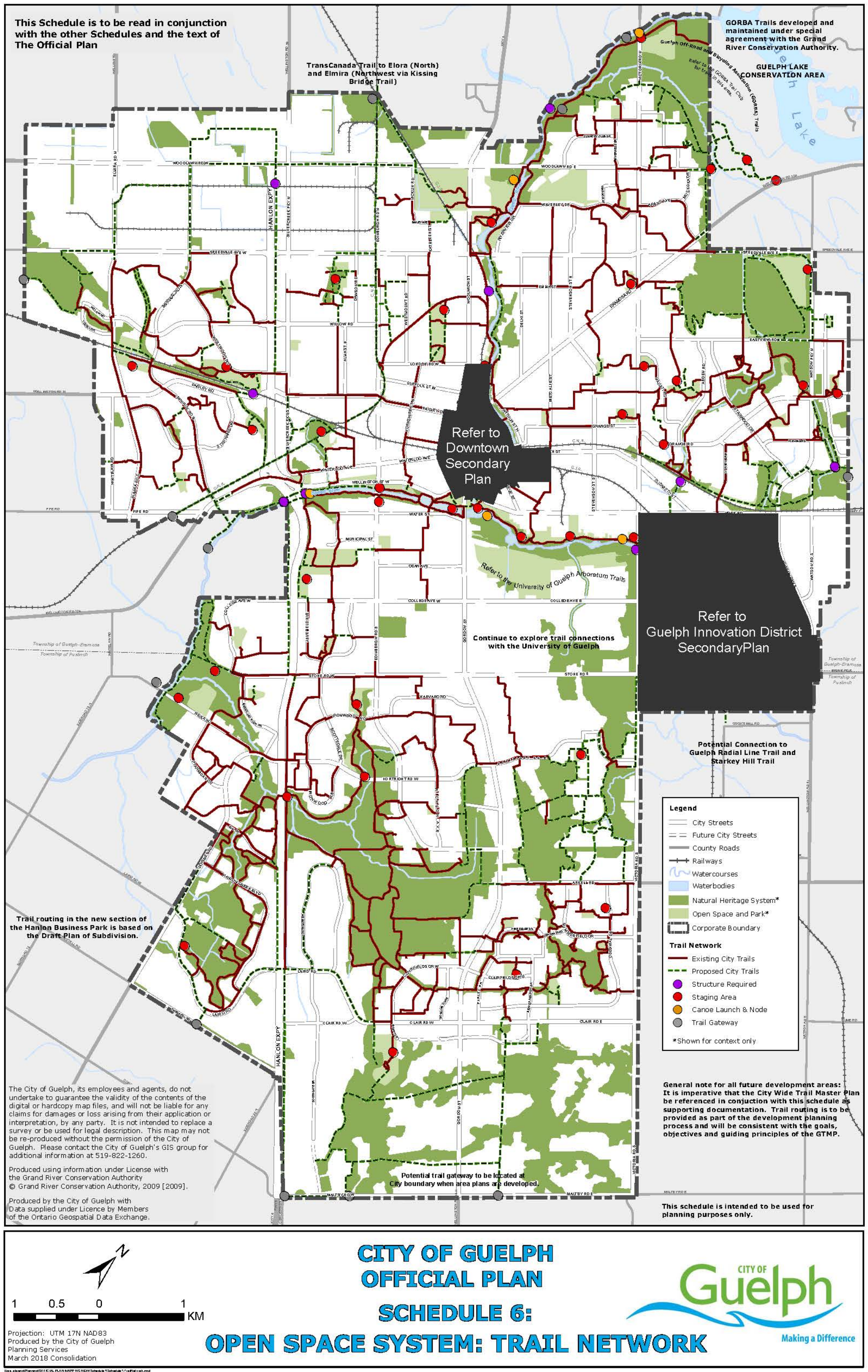
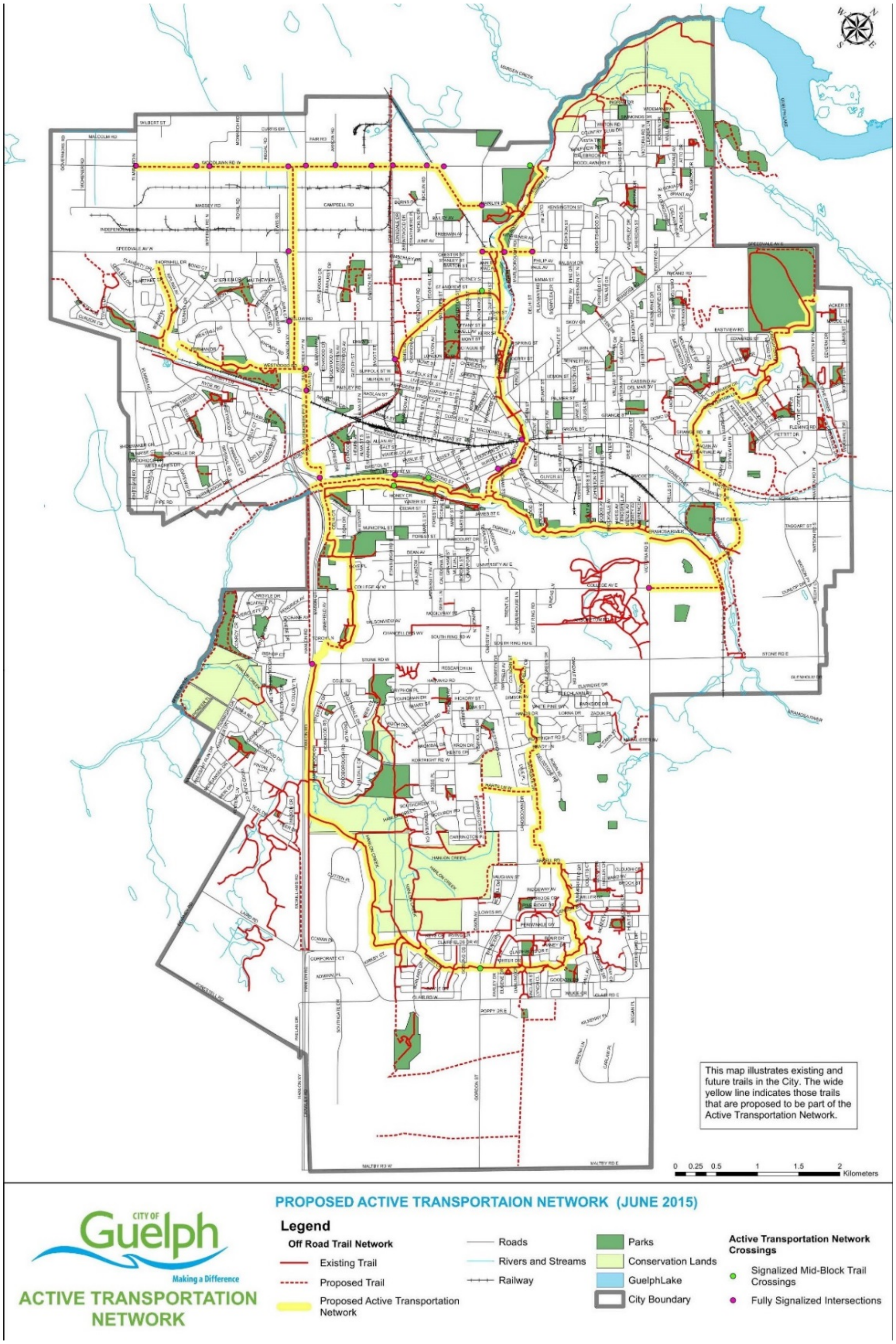


Figure 3.4.10. City of Guelph Proposed Active Transportation Network, 2017



Key Transit Policies

Important in maintaining and expanding transit services in the City of Guelph, the Official Plan cites developing a compact urban form with a mix of land uses, ensuring the creation of a street network that permits the location of transit stops within a reasonable walking distance of a significant majority of residents, jobs and other activities, and staging urban expansion to include the provision of transit service.

Within new development, transit facilities should be detailed in land use / development plans, and bus stops should be provided at regular intervals.

Roads and Road Design

The City of Guelph Official Plan recognizes that private automobiles will continue to represent the primary mode in meeting the travel needs of residents and businesses in the City, and lays out a hierarchy of public street facilities and their intended purposes / permissions: expressways, arterials, collects and locals.

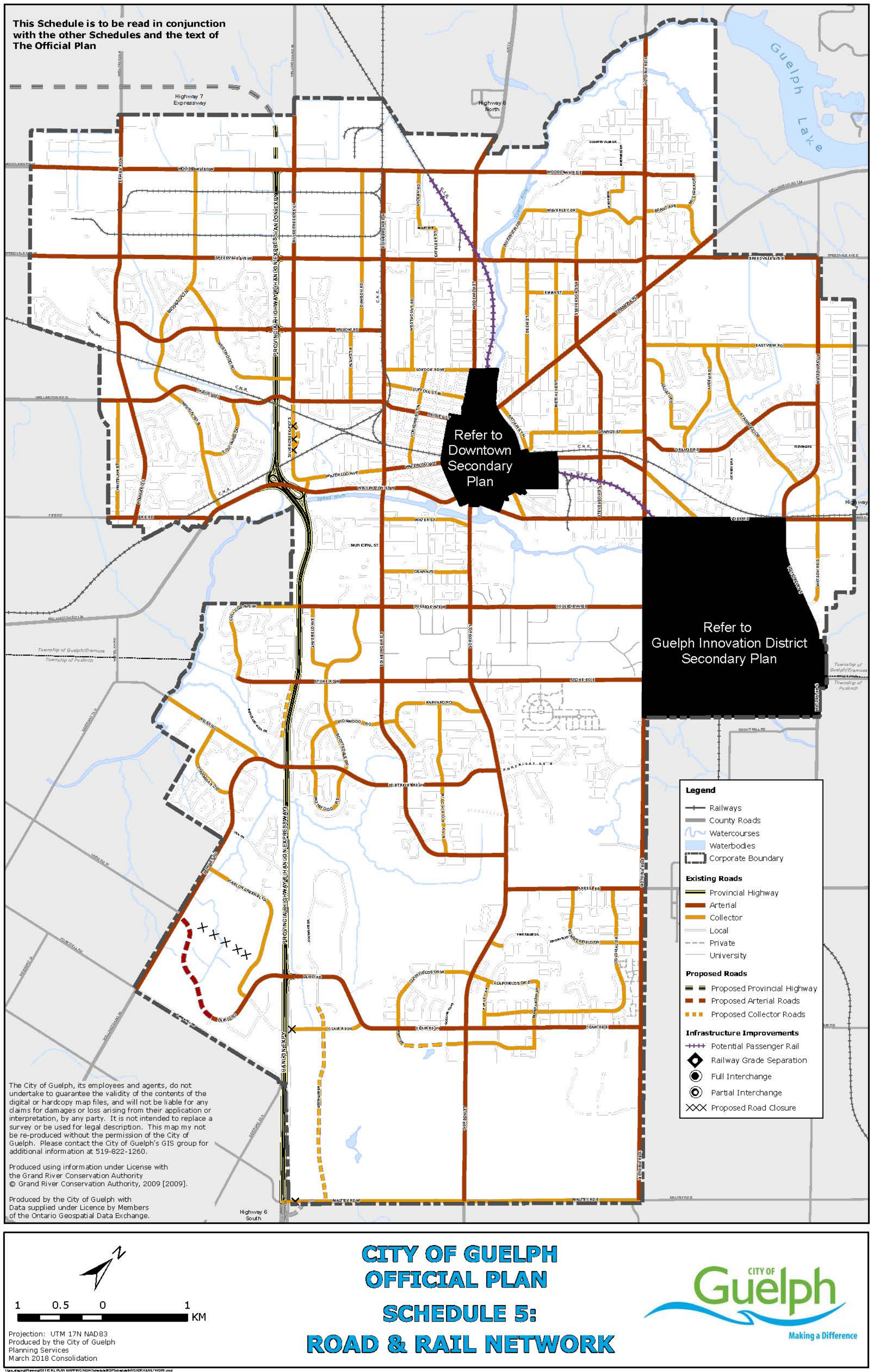
The main elements of the road network are identified in Schedule 5 of the Official Plan, which is included in Figure 3.4.11. In regard to new public streets and street design, the Official Plan promotes the creation of an arterial – collector grid system in new development areas to assist in the dispersion of traffic and to provide a reasonable walking distance to transit services. The Official Plan identifies that Arterial roads are meant to accommodate a high level of transit service and direct access from local roads / individual properties to an arterial shall be limited to avoid interference with the primary function of the roadway.

A series of public street widenings and "Ultimate Widths" are also identified in the Official Plan (Tables 5.1 and 5.2).

Key street widenings as they related to the Clair-Maltby Secondary Plan area include:

- Clair Road – 30 metre "ultimate width" (5 metre widening on both sides)
- Gordon Street - 30 metre "ultimate width" between Clair Road and Maltby Road (5 metre widening on both sides)
- Maltby Road – 30 metre "ultimate width" (5 metre widening on both sides)
- Victoria Road - 36 metre "ultimate width" between Stone Road and South City Limit (8 metre widening on both sides)
- Clair Road and Laird Road (potential widening to accommodate intersections improvements)
- Clair Road and Crawley Road (potential widening to accommodate intersections improvements)
- Gordon Street and Maltby Road (potential widening to accommodate intersections improvements)
- Maltby Road and Crawley Road (potential widening to accommodate intersections improvements)
- Victoria Road and Clair Road (potential widening to accommodate intersections improvements)
- Victoria Road and Maltby Road (potential widening to accommodate intersections improvements)

Figure 3.4.11. Schedule 6, City of Guelph Official Plan Amendment 48 – Road and Rail Network



Urban Environment

The City of Guelph Official Plan establishes policies as they relate to the impact of transportation facilities on urban neighbourhoods and design. These policies include minimizing the impact of trucks upon residential areas, maintain and enhance the streetscape (tree planting), minimize land use conflicts between major transportation routes and residential areas, and noise and vibration mitigation.

Railways

The City recognizes the importance of rail facilities to support freight service and passenger rail service, and to minimize road / rail conflicts through a program of grade-separated under / over passes.

Parking

The City of Guelph, through the application of the City Zoning By-law, establishes parking requirements for all types of land uses to ensure parking demands are met off-street. However, the City may, where the property owner enters into an agreement with the City to ensure continued availability of an off-street parking area, permit the provision of requirement parking spaces on another site that is within convenient and reasonable walking distance.

Key Transportation Demand Management (TDM) Policies

The City has established, within the Official Plan, that transportation demand management (TDM) is an essential part of an integrated and sustainable transportation system. TDM policies will be developed and implemented to reduce trip distance and time, and to increase the modal share of alternatives to the automobile. Suggested TDM measures include the following:

- including provisions for active transportation in association with development and capital projects including secure bicycle storage facilities and pedestrian and cycling access to the road network;
- supporting transit through reduced parking standards for some land uses or locations, where appropriate, and making provisions for parking spaces for car share vehicles through the development approval process where appropriate; and
- encouraging carpooling programs, preferential parking for carpoolers, transit pass initiatives and flexible working hours.

In addition, a Transportation Demand Management Plan is listed among the type of transportation studies that the City may require as part of a development application.

3.4.2.4 Guelph – Wellington Transportation Study (Transportation Master Plan)

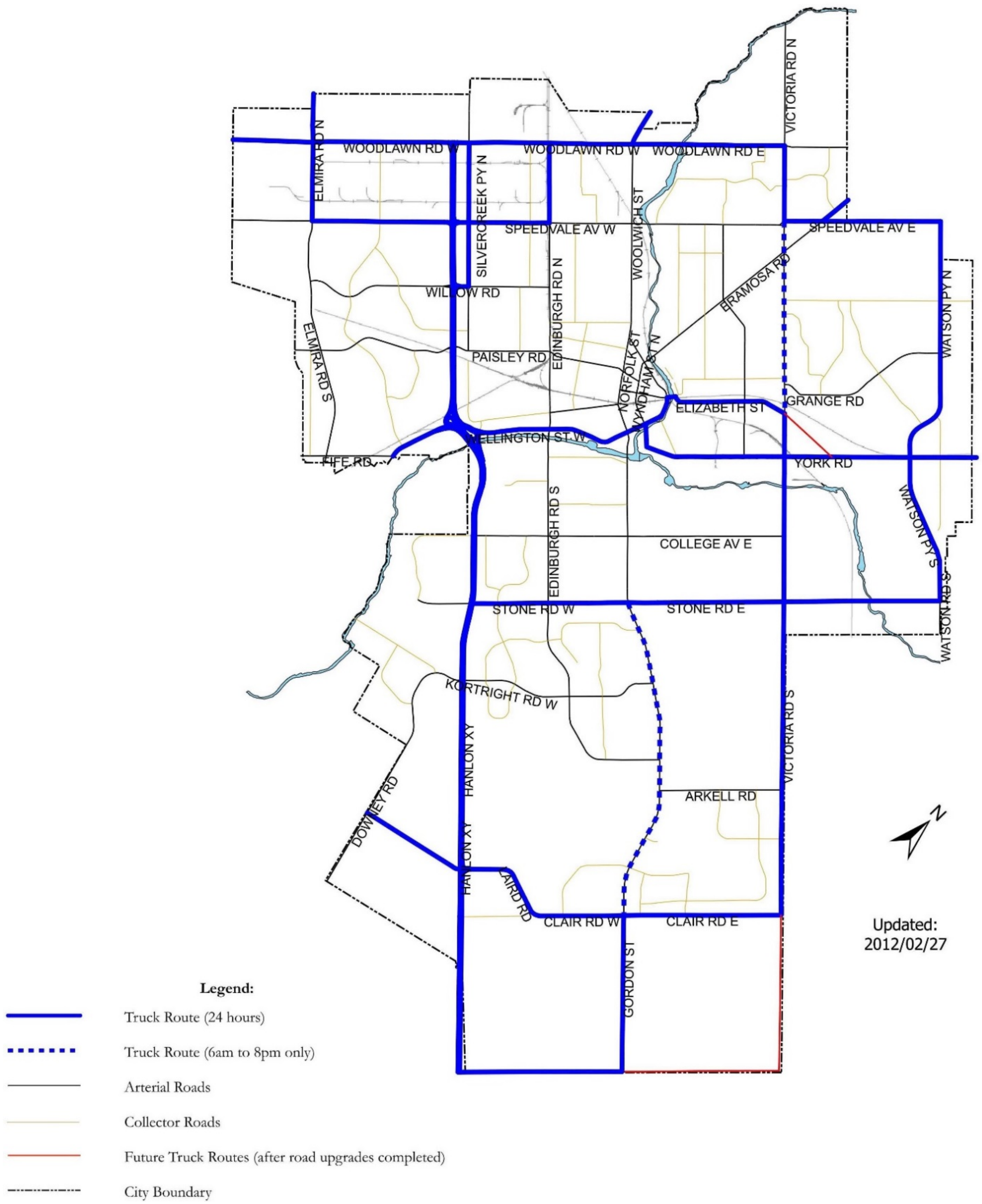
The City has updated their Transportation Master Plan (TMP), as of 2022.

The Guelph – Wellington Transportation Study was undertaken by a consortium of planning and engineering consultants on behalf of the City of Guelph and finalized in July 2005, in an effort to address long-term transportation needs and improvements in accordance with the Official Plan policies and City's Transportation Strategy and SmartGuelph Principles. The study has 5 main objectives:

1. Identify transportation needs and recommend practical improvements;
2. Recommend Transportation Demand Management (TDM) measures;
3. Identify improvements to City and County roadways;
4. Review Provincial highway initiatives affecting Guelph and Wellington County; and
5. Review inter-regional travel between Guelph, the Region of Waterloo, and the GTA and identify opportunities for transit initiatives to serve this need.

The Master Plan provides direction on the City's existing and planned cycling network, truck route network (Figure 3.4.12), and transit node and corridor framework which is intended to support transit routes and the potential removal of reduced / removed parking standards. These planned networks include components related to existing road facilities in the Clair-Maltby Secondary Plan area.

Figure 3.4.12. Truck Route Network



The Guelph – Wellington Transportation Study also reviews existing transportation behavior and forecasts future travel demands based on existing travel and demographic trends. The study concludes that travel demands are 2 to 3 times higher during weekday peak periods than typical weekday midday periods and that 83 per cent of trips within the study area are undertaken in a private automobile, and since the mid-1990s - travel demands have generally increased and average persons per vehicle have reduced. It is also important to note that a significant and increase amount of work travel is occurring between the Waterloo Region and Guelph areas.

Given the aforementioned trends, there is anticipated to be considerable road network deficiencies and traffic congestion in the long term, assuming no new infrastructure improvements, particularly in the South Guelph area. To accommodate increased traffic demand in the South Guelph area, the study identifies a number of improvements, including:

- Widening of Gordon Street from 2 to 4 lanes (approved 2001 EA) from Kortright Road to Wellington Road 34;
- Widening of Clair Road from 2 to 4 lanes (approved 2003 EA) - COMPLETE
- Southerly extension of Southgate Drive to Maltby Road; and
- Development of an internal collector road system within the Clair-Maltby Secondary Plan area connecting to Gordon Street and Maltby Road.

Of note, the forecasting model does not indicate the need to widen Victoria Road south of Clair Road, or widen Maltby Road between Victoria Road and the Hanlon Express to be widened; however, both roads require upgrading.

The recommendation of TDM measures to reduce automobile use and increase use of alternative modes of transportation is identified as one of five primary study objectives in the Guelph-Wellington Transportation Study. The Study makes a connection between land use, urban form, density, neighbourhood design, and the transportation choices made by people making use of the network.

Ultimately, the document assesses an assortment of TDM measures and their practicality in Guelph; the Table 3.4.5(Table 4.1 in the Guelph-Wellington Transportation Study) is included identifying TDM measures that either encourage alternative transportation modes or discourage automobile use:

Table 3.4.5. Guelph-Wellington Transportation Study TDM Measures

Strategy		Practical	Limitations/Barriers
Encourage Walking, Cycling, Transit and Ridesharing	Urban Form	Yes	Long term effectiveness, market barriers
	Increased Density	Yes	Community acceptance, political commitment
	Mixed Uses	Yes	Development specialization, economics
	Neighbourhood Design	Yes	Some increase in private and public cost
	Car Pool/Van Pool Programs	Yes	Large employers, longer distance trips
	Guaranteed Ride Home	Yes	Part of a TDM program - not stand alone
	Parking Supply Management	Yes	Large employers and downtown
	HOV Lanes	No	Road right of way restrictions
	Cycling Routes and Facilities	Yes	Climate, fitness level, cost, trip length
	Pedestrian Trails and Walkways	Yes	Climate, fitness level, cost, trip length
	Increased Transit Service and Routes	Yes	Budget constraints, bus shelters, traffic congestion
	Transit Fare Strategies	Yes	Lack of tax incentives, cost
	Preferential Transit Facilites	Yes	Right of way constraints, traffic congestion
	Improved Inter-City Transit	Yes	Inter-city licensing, reduced fare
Programs to Discourage Auto Use	Telecommunting	Yes	Type of work, lack of supervision, security issues
	Alternative Work Schedules	Yes	Many in use - benefits may be minimal
	Vehicle Use Restrictions	No	Public acceptance and economic development issues
	Increasing Traffic Congestion	No	Emissions, emergency service, neighbourhood infiltration
	Congestion Pricing	No	Public acceptance and economic development issues
	Increase Driving Cost	No	Legislation changes, economic development issues
	Parking Pricing and Supply Management	Yes	Limited to downtown and University, economic development issue

Additional Guelph Transportation Demand Management Policy

Additional policy documents in the City of Guelph TMP provide a basis for the advancement of Transportation Demand Management (TDM).

The Downtown Guelph Secondary Plan includes TDM policy in support of the promotion of alternatives to automobile use. Policy tools that are mandated or suggested include working with transit providers, developers, and businesses to promote TDM, requiring large-scale developments to complete a TDM plan describing facilities and programs intended to reduce single occupancy vehicle trips, minimize parking and promote alternative travel modes, and finally, suggests the City may permit reduced parking supplies if a TDM plan proves that reduced parking is appropriate.

The Guelph Innovation District Secondary Plan promoted the implementation of TDM measures, through working with developers and businesses to reduce vehicular trips and to promote alternative travel modes.

The City of Guelph Community Energy Plan makes the connection between environmental and energy related goals and the need to reduce energy use and greenhouse gas emissions generated by transportation. A stated goal is to reduce transportation energy use by 25 per cent (while accommodating Guelph's growing transport requirements) using sensitive urban design, effective alternative transport options (i.e. through TDM and a focused attention on competitive mass transit), and encouraging vehicle efficiencies.

3.4.2.5 Transit Framework

Transit Growth Strategy and Plan

The "Guelph Transit Growth Strategy and Plan and Mobility Service Review" was prepared in 2010, and was prepared to assess the transit market, estimate future travel demand (ridership forecasts), outline mobility service and higher-order transit opportunities, and detail associated capital and revenue implications associated with service recommendations. It should be noted that the plan is now over eleven years old and, at the time of the study, did not forecast any substantial development within the Clair-Maltby Secondary Plan area within the 2031 horizon year period.

Of the report's key recommendations, that includes development of the South Guelph area, include:

1. Establish the Gordon / Norfolk / Woolwich spine as a Bus Rapid Transit priority corridor, starting with the implementation of queue jump lanes, traffic signal priority, and express bus services, and additional infrastructure as demand increases (dedicated bus / HOV lanes). Specifically, the report recommends that as transit demand increases, a dedicated transit / HOV lane be provided in each direction of Gordon Street, firstly between Stone Road and Clair Road, and eventually on Gordon Street south of Clair Road. Many of these improvements have been implemented along Gordon Street north of Clair Road. Transit service improvements along the Gordon Street corridor should include improved passenger amenities at transit stops.
2. Establish new inter-city / inter-regional bus and rail transit connections, most notably to Kitchener, Waterloo, Cambridge, and potentially, Georgetown, Brampton, Milton, Mississauga, and Hamilton.
3. Work with property owners to establish a 4 to 6 bay bus terminal within the South End Node (Gordon Street and Clair Road).

Recommendations 1 and 2 in the foregoing list establish a transit structure for the City by connecting key existing and emerging nodes via priority corridors.

3.4.2.6 Cycling and Trails Framework

Cycling Master Plan – Bicycle Friendly Guelph (2012)

The City's Cycling Master Plan (February 2012), is directed by the City's Official Plan, and provides recommendations and strategies that aim to operationalize the visions of the Bicycle-Friendly Guelph Initiative formed by the City.

The City's vision for becoming one of Canada's most bicycle-friendly communities includes 1) more people cycling, 2) a safer and more connected network, 3) strong culture of cycling, and 4) measured improvements.

Engineering Principles

The Cycling Master Plan's recommendations for Safe and Continuous Infrastructure (Engineering) outlines tools for selecting types of bikeways relative to vehicular volume, vehicular speed, and local context that influence cyclist safety and comfort levels relative to other on-street facilities and vehicles.

Bikeway Treatments

The Cycling Master Plan identifies several types of bikeway treatments for consideration by the City of Guelph:

- Signed Routes
- Bicycle Boulevards
- Shared-Use Lanes (Sharrows)
- Advisory or Suggested Lanes
- Bike Lanes and Paved Shoulders
- Multi-Use Boulevard Trails, and,
- Cycle Tracks / Physically-Separated Bike Lanes

Intersection Treatments

The plan also recommends that the design of intersections should also take into account the many possible movements of cyclists at intersections including:

- General intersection guidelines to address visibility where there is a higher presence of conflicts between cyclists, motorists, and pedestrians;
- Accommodating Left Turns at signalized and unsignalized intersections; and,
- Specific cases where two arterial roads intersect and all intersections with multi-use boulevard trails.

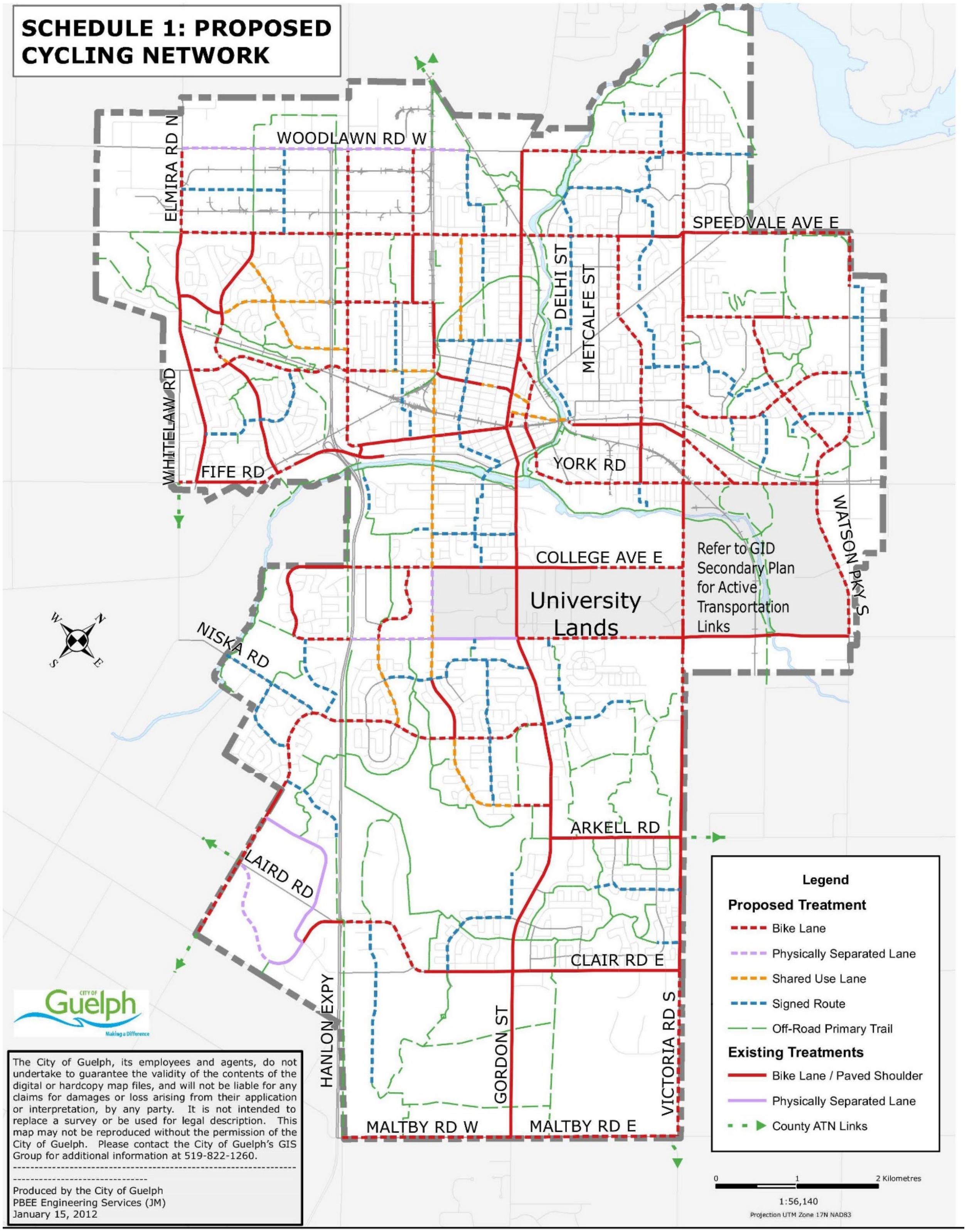
Cycling Network Plan

The recommended Cycling Network Plan from the Cycling Master Plan is provided in Figure 3.4.13.

This Cycling Network Plan identifies several existing and proposed surface treatments for the Clair-Maltby study area. Existing and proposed cycling treatments within the study area include:

- **Existing Bike Lanes / Paved Shoulder** are identified along both Clair Road East and Gordon Street within the study area.
- **Proposed 1 metre Paved Shoulder** is proposed along east-west Maltby Road and along north-south Victoria Road South (between Clair Road and Maltby Road)
- **Off-Road Primary Trails** are proposed at two locations running east-west across Gordon Street that will make connections to the proposed north-south signed routes along Southgate Drive. North-south off-road trails are also proposed within the study area that will connect to proposed signed routes along Clairfields Drive West, existing trails north of Clair Road, as well as at two locations potentially crossing Maltby Road to the south.
- **County ATN Links** are proposed at the southeast corner of the study area at the intersection of Maltby Road East and Victoria Road South.

Figure 3.4.13. Proposed Cycling Network – 2013 Guelph Cycling Master Plan



End-of-Trip Facilities Recommendations

The Cycling Master Plan outlines guidelines for providing end-of-trip facilities (bike parking facilities). They have identified two classes of bicycle parking as follows:

- Class One: Long-term bicycle parking
- Class Two: Short-term bicycle parking
- Additional Class: Artistic bicycle parking

The Cycling Master Plan outlines recommended Bicycles Parking Requirements for each Class of parking, by type of land use. Recommendations for General Rack Spacing and Rack Spacing within the Public Right-of-Way are also recommended as part of this section of the Cycling Master Plan.

Education and Encouragement

The Cycling Master Plan recommends complementing the guidelines for providing a safe cycling environment with complementary encouragement and education with a set of recommended objectives and actions.

Enforcement

The Cycling Master Plan recommends continued and improved actions to cycling enforcement as a means to reduce incidents and provide front-line education to both drivers and cyclists.

Evaluation

The Cycling Master Plan recommends actions to monitor and measure success in order to guide future planning and policy decisions.

Guelph Trails Master Plan (2005)

The Guelph Trails Master Plan in currently in the process of being updated and is currently in Phase 4 of the update, where a final draft master plan will be prepared.

The Guelph Trail Master Plan (GTMP, Fall 2005) was established to provide an overall vision to the developing trail system. The Goal of the GTMP is to:

"develop a cohesive city wide trail system that will connect people and places through a network that is off-road wherever possible and supported by on-road links where necessary"

The GTMP outlines the following areas of recommendations:

- Establishing the Need for Trails;
- Understanding the Resources;
- Planning for Trails;
- Building Trails; and,
- Supporting Trails.

The GTMP outlines a hierarchy of trail types: Primary, Secondary, Tertiary, and Water Routes for canoeists and kayakers.

The Trail Network

The GTMP Trail Network, outlining the hierarchy of trail routes including desire lines for the Clair-Maltby study area is presented in Figure 3.4.14.

The GTMP Trail Network identifies conceptual connections through the Clair-Maltby study area that are generally consistent with the Open Space Corridors outlined in the City's Official Plan. There are two north-south Primary conceptual connections through the Clair-Maltby study area and one east-west Primary conceptual connection crossing Gordon Street midblock between Clair Road and Maltby Road. The north-south connections provide an opportunity to connect to the primary trail network north of Clair Road and also to connect with potential Trail Gateways at the Maltby Road City Boundary. Conceptual secondary connections are shown at regular intervals south of Clair Road.

On and Off-Road

The GTMP Trail Network, outlining the On and Off-Road Breakdown of trails, is presented in Figure 3.4.15. The primary trails identified in the Clair-Maltby study area are largely intended to be off-road routes, with some local connections secondary connections intended to be on and off-road and located at regular intervals.

Figure 3.4.14. City Wide Trail Master Plan Trail Network

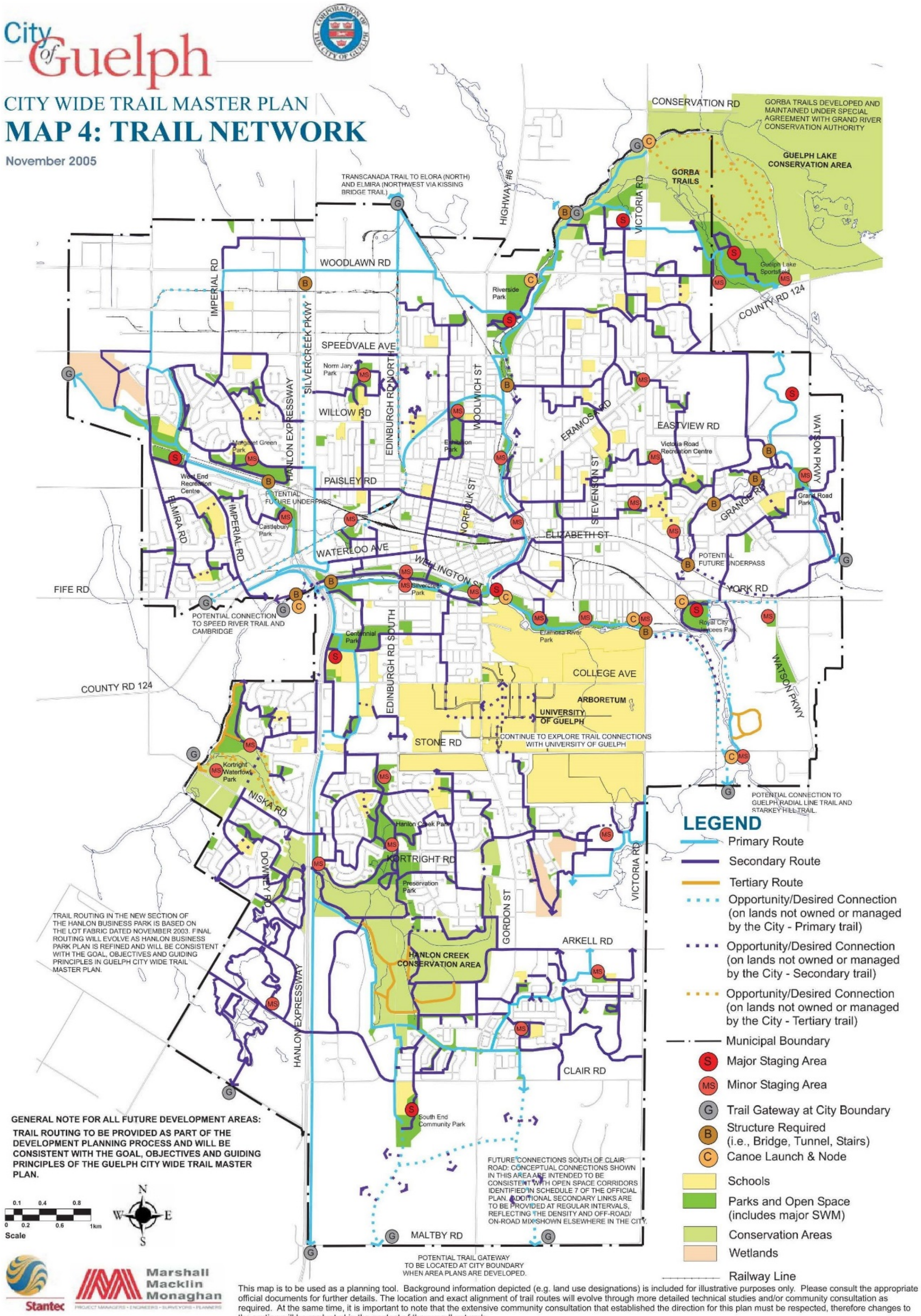
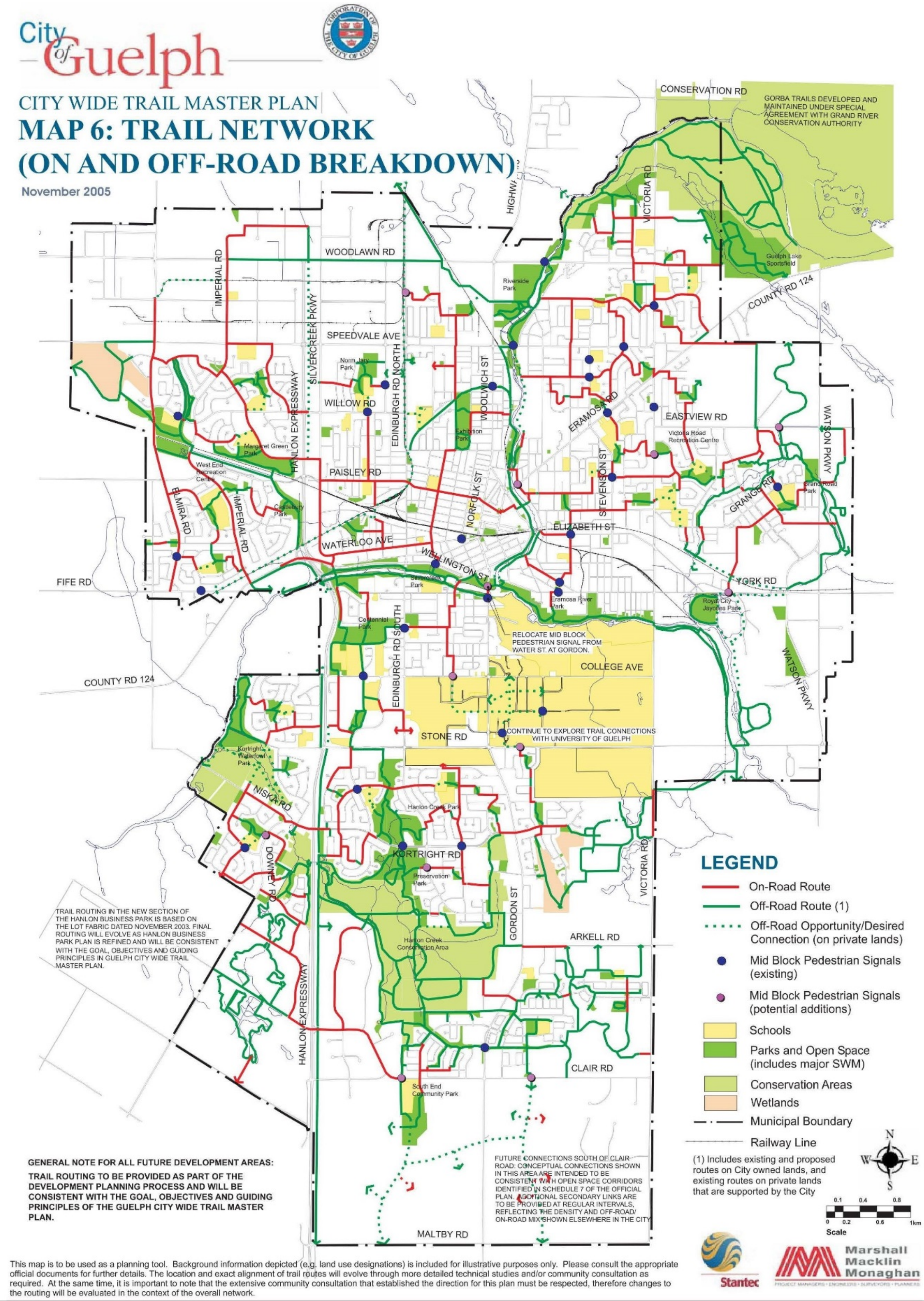


Figure 3.4.15. City Wide Trail Master Plan: Trail Network (On and Off-Road Breakdown)



On-Road Cycling Linkages

The GTMP Trail Network, outlining the potential On -Road Cycling Linkages, is presented in Figure 3.4.16. The arterial roadways in the Clair-Maltby study area, including Clair Road, Maltby Road, Gordon Street, and Victoria Road are all identified as On-Road Bicycle Network linkages. A potential connection south of the City is also identified on this figure at Maltby Road / Victoria Road.

Timing of Priorities

The current GTMP Trail Network recommends three timeline phases:

- Short Term (0 to 5 years - 2005-2010)
- Medium Term (5 to 15 years – 2011 to 2021)
- Long Term (beyond year 15 – beyond 2021)

The trail network proposed for the Clair-Maltby study area is identified as a "Medium Term" priority, as illustrated in Figure 3.4.17.

Building and Supporting Trails

The GTMP outlines available resources for design guidelines and construction details applicable to the trail network. Recommendations are also made for promoting, encouraging trail use, educating users, maintaining, managing, and monitoring trails.

Figure 3.4.16. City Wide Trail Master Plan: Potential On-Road Cycling Linkages

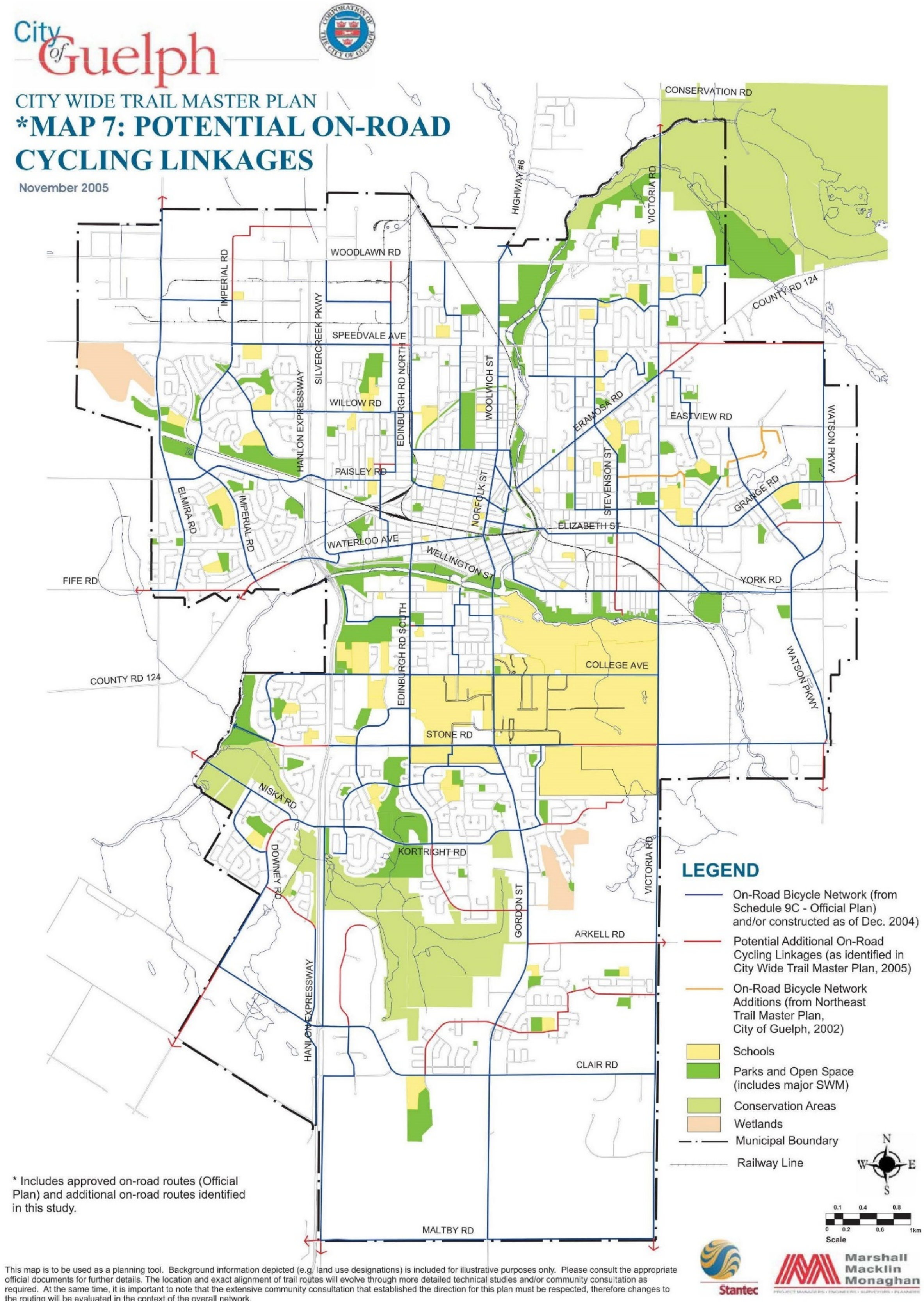
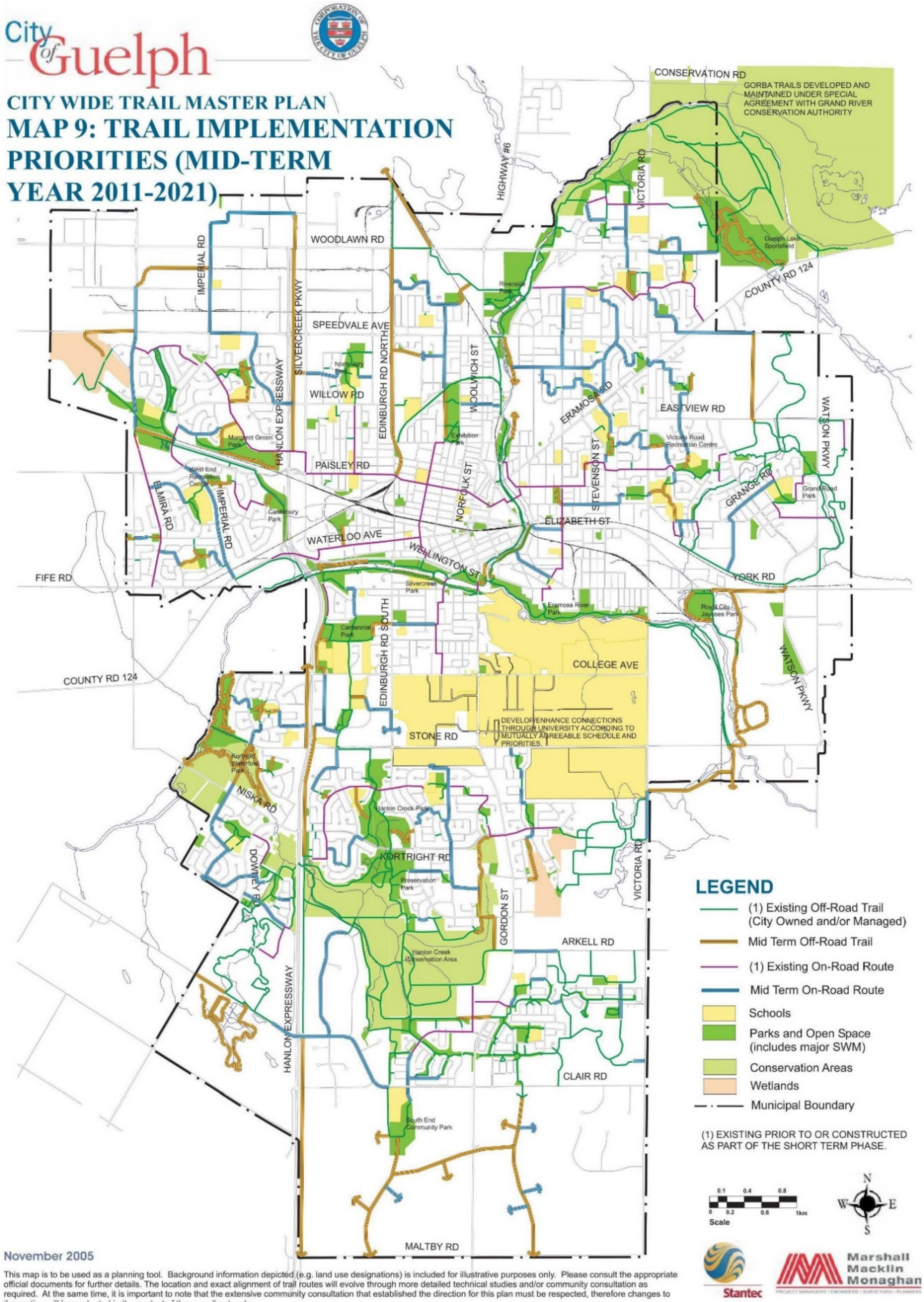


Figure 3.4.17. City Wide Trail Master Plan: Trail Implementation Priorities (Mid-Term Year 2011-2021)



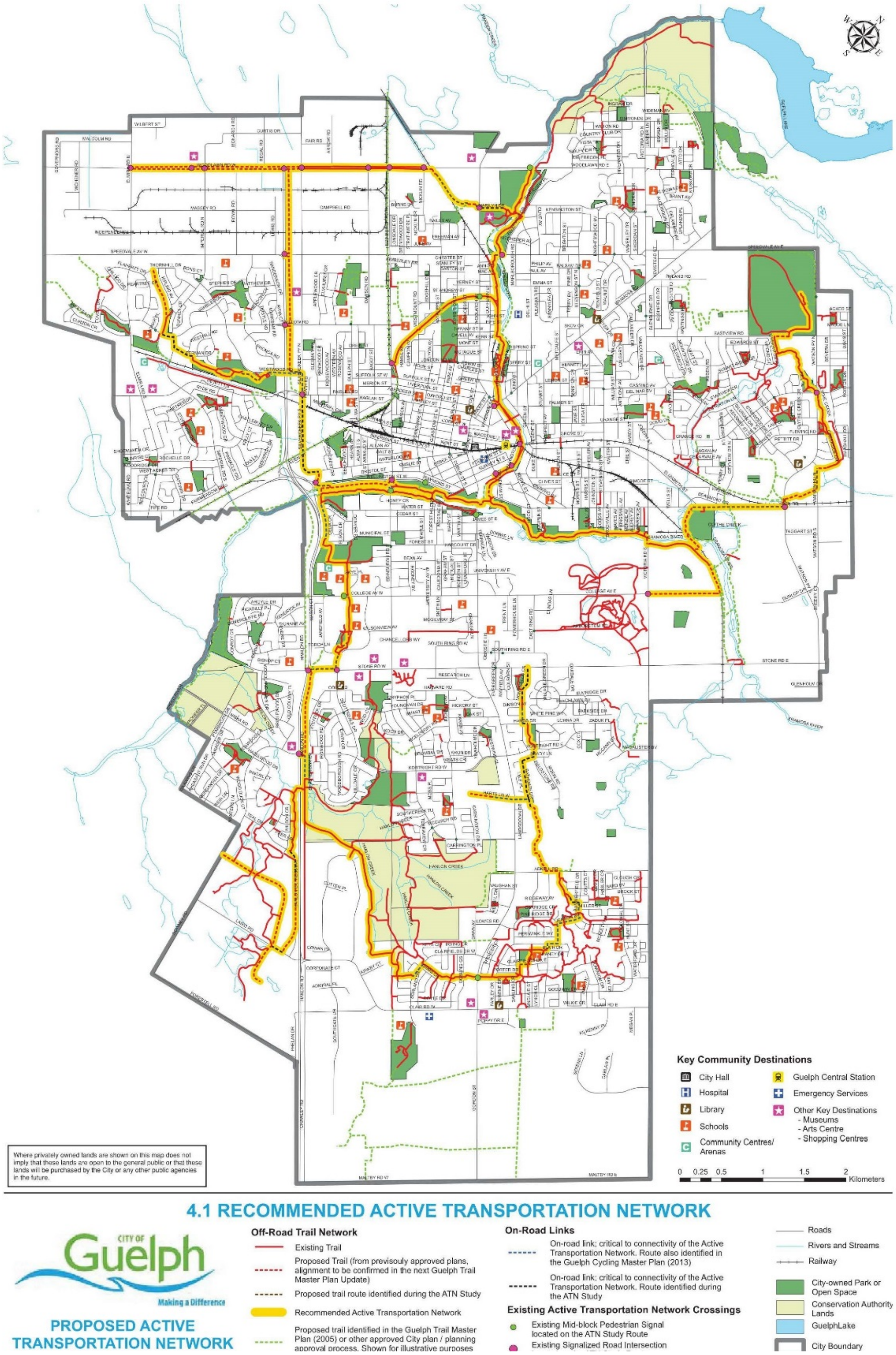
Active Transportation Network Study (2017)

The Active Transportation Network Study (ATN Study, January 2017) builds on the Primary Trails system of the Guelph Trails Master Plan (2005) and the infrastructure (Engineering) objectives of the Cycling Master Plan (2012).

The ATN Study was prepared by MMM Group / Paradigm Transportation Solutions on behalf of the City of Guelph to assess the feasibility of upgrading and maintaining existing and proposed Primary Trails in Guelph – notably the trail network identified in the City's Draft Proposed Active Transportation Network (ATN).

The ATN's Recommended Active Transportation Network is presented in Figure 3.4.18. However, given that the ATN largely reviewed the primary trail system identified by the Trail Master Plan and Cycling Master Plan, the planned trails identified in the Clair-Maltby study were outside of the scope of the ATN.

Figure 3.4.18. Recommended Active Transportation Network



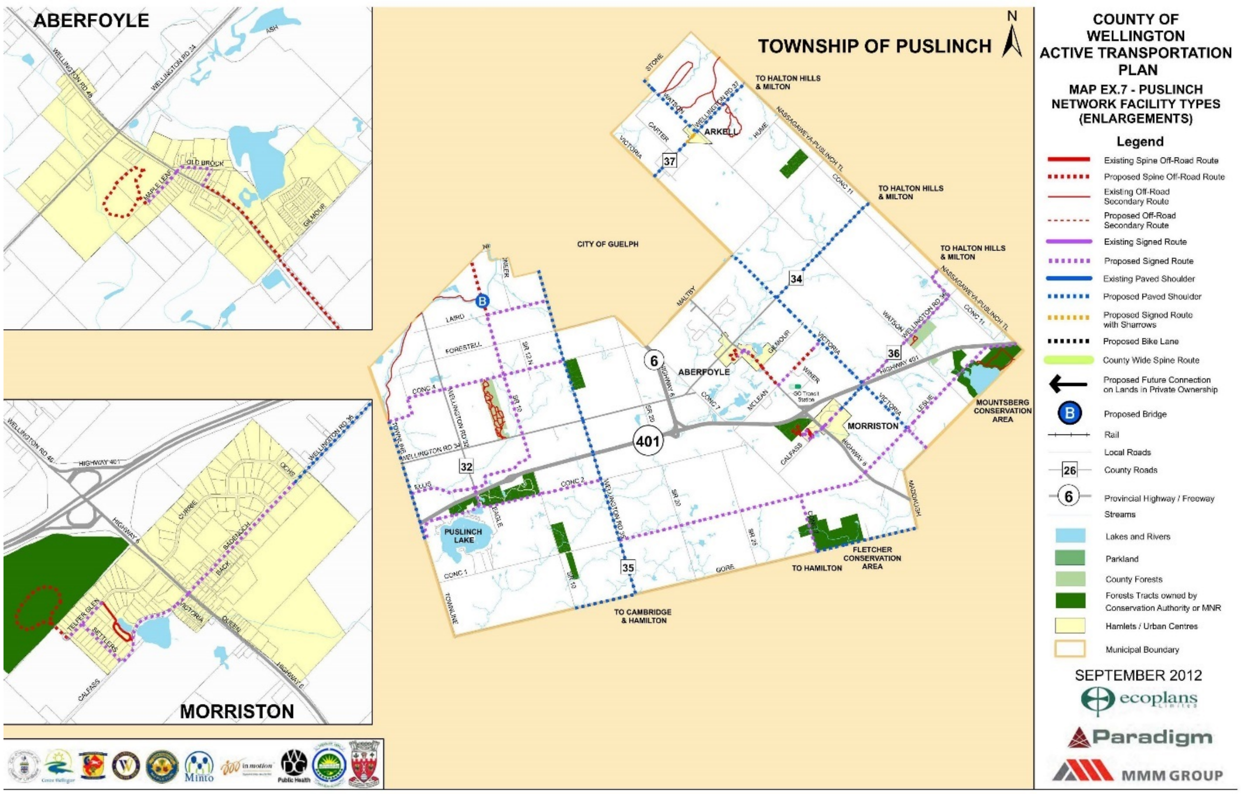
Wellington County Active Transportation Plan

The Wellington County Active Transportation Plan (ATP, September 2012) provides guidelines and strategies that aim to meet the County's goals in fostering a healthy and more sustainably community, notably including an Active Transportation Network (ATN) that connects the County's communities.

The Township of Puslinch, within Wellington County, is directly adjacent to the Clair-Maltby study area.

The County of Wellington Active Transportation Plan for Puslinch is illustrated in Figure 3.4.19. A proposed paved shoulder condition is recommended along Victoria Road, connecting with the southeast corner of the Clair-Maltby study area.

Figure 3.4.19. County of Wellington Active Transportation Plan: Map Ex.7 Puslinch Network Facility Types (enlargements)



3.4.2.7 Engineering Design Criteria and Standards

Development Engineering Manual, Version 2.0 (2019)

City of Guelph Engineering and Transportation Services prepared their Development Engineering Manual (DEM, January 2019) to guide engineering related aspects of development related work, including established Engineering Design Criteria and Standards intended to be used by developers, residents and the City to inform engineering design and related review and discussion. The DEM recognizes that the outlined standards may not be compatible to all scenarios, and engineering judgement should be used in such cases.

The key objectives of the DEM are to:

- Document existing process information related to the engineering submission of a development application;
- Outline requirements and standards for the engineering design of new developments within the City;
- Provide guidance and framework for applicants submitting engineering designs and reports in support of development applications;
- Provide guidance to City staff when reviewing and commenting on engineering aspects of a development application; and
- Identify the role and involvement of City departments and external agencies as part of the development engineering review and approval process.

The DEM is complemented by Part B Specs (Linear Infrastructure Standards, 2017) that provides, in detail the City's standard specifications.

Road Standards

The DEM, outlines a range of pavement widths, typical AADT volumes, right-of-way widths, and maximum allowable grades for local and collector roadways. Subdivision Geometric Design Criteria for local and collector roadways are presented in Table 3.4.6 and Table 3.4.7.

Table 3.4.6. Subdivision Geometric Design Criteria, Part 1

Road Classification	AADT	Pavement Width (m)	Allowable Grade	Minimum Centreline Radius	Minimum SSSD	Minimum Tangent Intersection
Local	<1,000	8.4, 8.8, 10	0.5 – 8.0	18	65	10
Collector	<12,000	10	0.5 – 6.0	140	85	25

Table 3.4.7. Subdivision Geometric Design Criteria, Part 2

Road Classification	Minimum Tangent Between Curves	Property Line Radius @ Intersection	R.O.W. Width
Local	15	8	17,18,20
Collector	30	8	20

Sight Triangles

The use of Transportation Association of Canada (TAC) Stopping Sight Distance (3-second rule) for evaluation of sight triangles at intersections and access points for new developments is adopted by the City of Guelph. The DEM notes that reduction of a sight triangle may be considered for areas located in an "Urban Growth Centre" and the specific locations identified in the Clair-Maltby study area below. Reductions to sight triangles still need to be reviewed by a professional engineer for the recommended design and should not create a condition prone to collisions. Adequate space should also continue to be provided for utility/traffic signal equipment and the final dimensions are also subject to minimum requirements set out in the City's bylaw.

Intersections subject to further consideration for sight triangle in the Secondary Plan area include:

- Victoria Road and Clair Road
- Gordon Street and Clair Road
- Gordon Street and Poppy Drive

Parking

Off-street parking is outlined in the City's comprehensive bylaw and repeated in the DEM for surface parking.

According to the DEM, on-street parallel parking should have a minimum of 15 m setback from the near side of an intersection, and a minimum of 9 m setback from the far side of the intersection (measured from the end of curb return), unless the minimum setback needs to be increased to address sight distance or operating speed.

Access Design

The DEM outlines design guidelines for throat width, lane width, radius, and spacing for access to/from residential/commercial/institutional areas and the public road network as summarized in Table 3.4.8 and Table 3.4.9.

Table 3.4.8. Layout of Accesses

Access Classification	Roadway Classification	Throat Width, W or Land Width, LW (m)	Radius, R (m)	Distance Between Accesses, S (m)
Multi-Residential	Local/Collector	6.0	6.0	7
Multi-Residential	Arterial	7.5	6.0	25
Low Volume Commercial and Institutional	Local/Collector	7.5	9.0	23-30
Low Volume Commercial and Institutional	Arterial	8.0	9.0	60
High Volume Commercial and Institutional	Collector	8.0	12.0	60
High Volume Commercial and Institutional	Collector (divided access)	3.0 m left 3.6 m through 3.6 m right 1.2 m island	12.0	60
High Volume Commercial and Institutional	Arterial	9.0	12.0	100
High Volume Commercial and Institutional	Arterial (divided access)	3.0 m left 3.6 m through 3.6 m right 1.2 m island	12.0	100
Industrial	Collector	9.0 (max 15.0)	12.0	40-60
Industrial	Arterial	9.0 (max 15.0)	12.0	40-60

Table 3.4.9. Number and Location of Accesses

Access Classification	Roadway Classification	Distance from Non-Signalized Intersection (m)	Distance from Signalized Intersection (m)
Multi-Residential	Local / Collector	15	30[1]
Multi-Residential	Arterial	30	60[2]
Low Volume Commercial and Institutional (2-way access)	Local / Collector	30	30
Low Volume Commercial and Institutional (2-way access)	Arterial	60	60[3]
High Volume Commercial and Institutional	Collector / Arterial	60	60[3]
Industrial	Collector / Arterial	30	60[3]

Notes:

1. Multi-Residential of up to 30 units
2. Multi-Residential of over 30 units
3. Full movement accesses will not be allowed within 100 m of a signalized intersection on arterial roadways. Site specific turning movement restrictions will be determined by City staff upon application.
4. Should a site require a right in/out access, the layout shall be approved by traffic engineering staff and conform to the most current TAC specifications.

3.4.2.8 Area Road Environmental Assessments

Gordon Street (Wellington Road 46) Class EA Environmental Study Report

The Gordon Street Class EA was undertaken by the City of Guelph and County of Wellington in December 2000 for the section of Gordon Street between Wellington Road 34 in the south and Lansdown Drive in the north.

The EA study utilizes three other previous transportation reports to judge the transportation impacts of new residential and commercial development along the Gordon Street corridor, and reconfirms the need for traffic capacity within this section of the street. In addition to traffic capacity and operation issues, the EA also identified other public concerns related to truck traffic volumes and roadway deficiencies, including a lack of sidewalks, bicycle lanes, and transit-related infrastructure.

At the time of the study, Gordon Street had a basic two-lane cross-section within the study area. The resulting EA concluded that Alternative 4 (basic improvements plus the widening of Gordon Street) was the preferred solution, and that widening of Gordon Street north of Clair Road would begin by 2002, while widening between Clair Road and Maltby Road would be dependent on the occurrence of development activity.

Upon the adoption of the Gordon Street EA, road widening has been undertaken from just south of Clair Road to just south of Poppy Drive. Gordon Street has not been widened from just south of Poppy Drive to Wellington Road 34 under existing conditions. This section is planned to be widened symmetrically from the road centreline except for a 500-metre section in the vicinity of the Mill Creek crossing where widening will occur on the west side only. The EA specified that rural drainage (ditches) be provided on both sides of the road, but did not specify sidewalk / bicycle lane provisions.

Clair Road Class EA Environmental Study Report

The Clair Road Class EA was undertaken on behalf of the City of Guelph in September 2003 for the section of Clair Road and Laird Road between Southgate Drive in the west and Victoria Road in the east.

The EA concluded that Clair Road (at the time of study) will not provide the level of service necessary to avoid traffic congestion, frequent delays, and unsafe driving conditions, given the predicated traffic volumes, and that the road itself is in poor physical condition and lacks sidewalk and bicycle facilities to accommodate these travel modes. Given the prevailing conditions, the EA advanced four alternative planning solutions:

1. Do nothing.
2. Non-structural solutions (increase use of alternative modes; traffic diversion).
3. Construct a new road.
4. Improve the existing road.

In summary, from transportation, natural, social and physical environment perspective, the preferred alternative was the improvement of Clair Road from Victoria Road in the east to the Hanlon Business Park in the west. Improvements include the introduction of an "urban" cross-section with curbs and sidewalks, a landscaped median in the South Guelph District and adjacent to Bishop Macdonell High School and South End Community Park, provision of sidewalks on both sides of the street, and bicycle lanes within the road surface area.

The EA considered 2 and 4 traffic lane cross-sections, and determined that the western portion of the street (west of Beaver Meadow Drive) would include 4 travel lanes, while the eastern section (east of Beaver Meadow Drive) would include 2 travel lanes – one in either direction. This lane configuration has been implemented from Victoria Road in the east to approximately 200 metres west of Poppy Drive in the west. Bicycle lanes have also been introduced along this section of the street. Sidewalks are provided on both sides of the street west of Hawkins Drive, but are often interrupted (discontinuous) in sections east of this point.

Victoria Road (Clair Road to York Road) Class EA Study

The Victoria Road Class EA was undertaken on behalf of the City of Guelph in December 2005 for the section of Victoria Road between York Road in the north and Clair Road in the south. The extent of the study area is generally north of Clair Road and does not include the section of Victoria Road adjacent to the Clair-Maltby Secondary Plan area (south of Clair Road).

The outcomes of the EA provided cross-section alignments of the street within the study area, including for Victoria Road immediately north of Clair Road. In this location, the EA identified a 3-lane cross-section with one travel lane in either direction and a continuous left-turn / median lane, bicycle lanes, and improvements at the Clair Road / Victoria Road intersection. These intersection improvements include installing traffic signal control and separate eastbound turn lanes and a northbound left-turn lane that have already been implemented.

3.4.3 Future Requirements

The Clair-Maltby Secondary Plan – Transportation Master Plan Study tested and reviewed a system of connected arterial and collector streets that was advanced as part of initial Community Structure Alternatives to support development of the Secondary Plan area. The mobility study looked at most conservative land budget requirements (i.e. most capacity constrained) and conservative street network assessed.

A key priority of the preferred transportation network is to prioritize the needs of active transportation and transit users so as to create a transportation network that accommodates and promotes these alternative modes.

Analysis in the Clair-Maltby Secondary Plan – Transportation Master Plan Study report provided in Appendix D focussed on establishing estimates and capacity considerations of separate modes of travel in order to establish the key road, transit and trail network requirements for the Secondary Plan area.

Other consideration to support the preferred transportation network include:

- **Transportation Demand Management:** An essential part to prioritizing alternatives to auto-oriented travel is the support for and implementation of Transportation Demand Management (TDM) measures. BA Group identified a number of Transportation Demand Management (TDM) measures in the Transportation Master Plan Study that are recommended for inclusion or in greater detail than current city-wide measures as part of the Clair-Maltby Secondary Plan.
- **Natural Heritage System (NHS)** Also integral to the success of the Clair-Maltby Secondary Plan is a system of connected arterial and collector streets that support development of the Secondary Plan area, while respecting the Natural Heritage System and existing topography. The Natural Heritage system therefore plays an important role in the evaluation matrix of alternative concepts.

The following section focusses on the travel demand forecasts for auto-based and non-auto-based trips for the Secondary Plan area that identify key road network, transit and trail requirements. Detailed analysis and findings are provided in the Clair-Maltby Secondary Plan – Transportation Master Plan Study report provided in Appendix D.

3.4.3.1 Land Development Scenario Assumptions and Approach

Travel demands and assessment of future conditions for development anticipated within the Clair-Maltby Secondary Plan area are summarized in the following sections, and have been developed based on the most conservative (highest density) assumptions outlined in the "Land Development Budget" prepared by the project team – dated August 27, 2018. For the purposes of the analysis herein, a total of 10,125 residential units and 333 jobs were assessed.

3.4.3.2 Traffic Zones

Travel demands were developed for nine individual "Traffic Zones" that comprise the Secondary Plan area, to provide appropriately-sized areas to assign travel demands on the area transportation network and assess the overall transportation impacts of Secondary Plan development.

Traffic zones were established for segmented areas within the overall community, and generally comprise zones east and west of Gordon Street. Travel demands for each zone are forecast and assigned individually on the area transportation network.

The nine identified Clair-Maltby Secondary Plan Traffic Zones are illustrated in Figure 3.4.20.

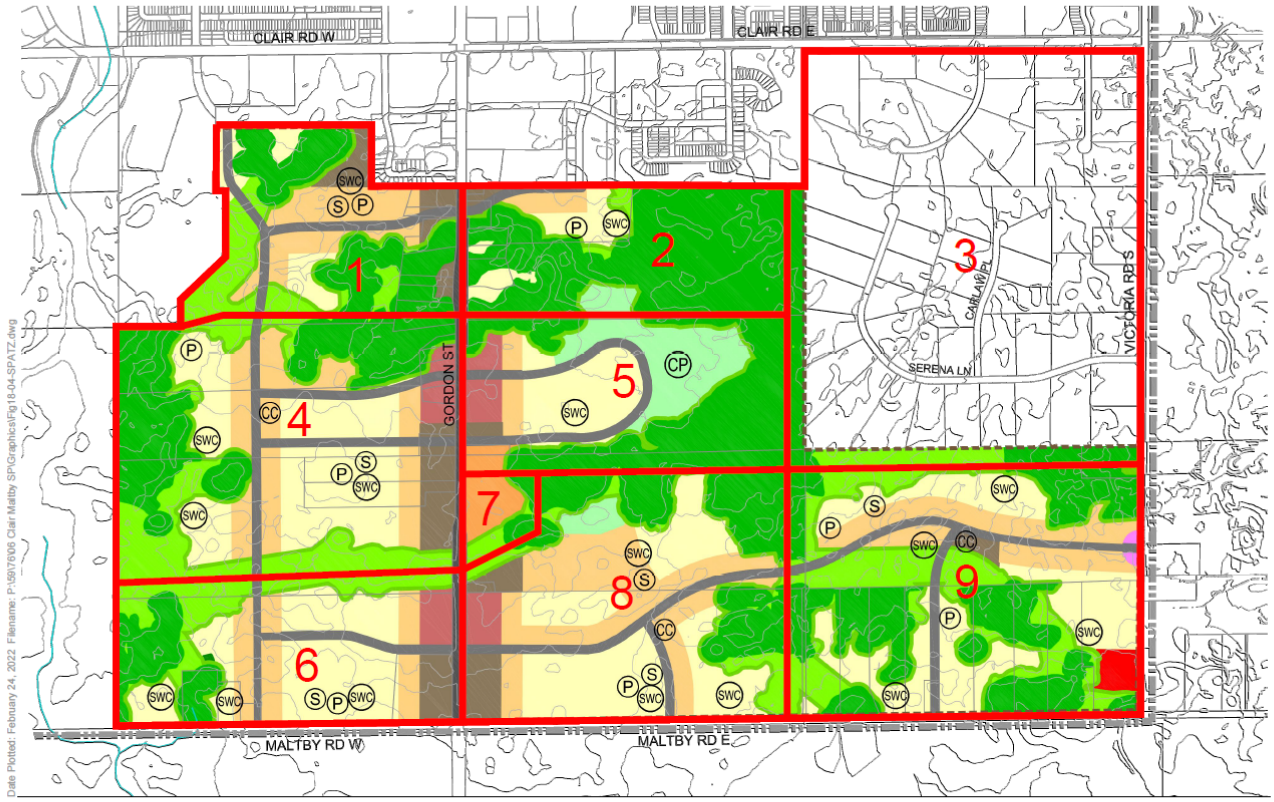


Figure 3.4.20. Secondary Plan Area Traffic Zones[4]

3.4.3.3 Multimodal Travel Forecasting

Travel demand forecasts for the Clair-Maltby Secondary Plan area development have been developed to reflect pedestrian, cycling and transit usage that is reflective of the existing travel characteristics of the area, and to the extent that transit services and active transportation infrastructure is pursued as part of the Secondary Plan. The addition of mixed-use zones within the Clair-Maltby Secondary Plan area further supports sustainable and short trip making, particular during weekday peak travel periods, and is considered in travel demand forecasting in mixed-use development zones.

Travel Mode Split

For the purpose of this analysis, travel demands to and from the Clair-Maltby Secondary Plan area have been developed for residential and office land uses by applying modal share information, which is based on a review of data retrieved from the 2016 Transportation Tomorrow Survey (TTS). A combination of study area travel information, and proxy development information was utilized in selecting an appropriate travel mode split for Secondary Plan residential development.

4 Note: traffic zones were developed prior to final selection of Preferred Community Plan. Base plan beneath zones areas does not reflect latest land use plan and is meant to be illustrative.

The "selected" travel mode split for new development associated with the Clair-Maltby Secondary Plan, for resident-related and employee-related travel during weekday morning and afternoon peak hours, is summarized in Table 3.4.10. The selected travel mode splits generally reflect a higher degree of transit use and active transportation travel relative to what is currently observed in the south portions of the City of Guelph, and results in a lower degree of automobile use relative to other areas of the City.

Table 3.4.10. Selected Clair-Maltby Secondary Plan Travel Mode Splits

Travel Mode	Weekday Morning Peak Hour - Inbound	Weekday Morning Peak Hour - Outbound	Weekday Afternoon Peak Hour - Inbound	Weekday Afternoon Peak Hour - Outbound
Resident Travel - Auto Driver [1]	85%	60%	72%	65%
Resident Travel - Auto Passenger [2]	2%	10%	10%	25%
Resident Travel - Transit	5%	10%	10%	5%
Resident Travel - Walk	8%	10%	3%	3%
Resident Travel - Cycle	0%	3%	2%	2%
Resident Travel - Other [3]	0%	7%	3%	0%
Employee Travel - Auto Driver [1]	90%	90%	90%	90%
Employee Travel - Auto Passenger [2]	2%	2%	2%	2%
Employee Travel - Transit	4%	4%	4%	4%
Employee Travel - Walk	2%	2%	2%	2%
Employee Travel - Cycle	2%	2%	2%	5%

Notes:

1. Auto driver trips (includes auto drivers and motorcycles).
2. Auto passenger trips (includes auto passenger trips only).
3. Other trips include school bus and taxi trips.

4. Employee-based mode share is summarized for the key inbound movement during the weekday morning peak period, and the key outbound movement during the weekday afternoon peak hour.

Multimodal Forecasts

Residential and office employee traffic forecasts for the Clair-Maltby Secondary Plan have been developed using Institute of Transportation Engineers (ITE) Trip Generation Manual (10^{th} Edition) traffic generation rates, combined with TTS data on residential and employee travel characteristics in the vicinity of the Secondary Plan area[5].

ITE Trip Generation Manual traffic generation rates are factored for the selected travel mode splits. Traffic generation rates are factored from an assumed 95 per cent auto mode share to a more appropriate level of automobile use for residential trips: 75 per cent during the weekday morning peak hour, and 85 per cent during the weekday afternoon peak hour. Given that employee-related trips currently are in the order of 90 per cent to 95 per cent undertaken by automobile, traffic generation rates are not factored for greater non-auto use for work-related trips (ref. Table 3.4.11).

Table 3.4.11. Clair-Maltby Secondary Plan, Maximum Density Travel Demands

Development Density	Travel Mode	AM Peak Hour In	AM Peak Hour Out	AM Peak Hour 2-Way	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour 2-Way
10,125 units; 333 employees	Auto Driver Trips (Traffic)	925	2,440	3,350	2,935	1,860	4,700
10,125 units; 333 employees	Auto Passenger Trips	20	400	420	405	680	1,085
10,125 units; 333 employees	Transit Trips	55	400	455	405	150	555
10,125 units; 333 employees	Active Trips	90	525	615	200	145	345
10,125 units; 333 employees	**Total Trips:**	**1,090**	**4,065**	**5,155**	**4,075**	**2,860**	**6,935**

[5] 2016 TTS data were used to determine existing mode split for home-based trips during the morning and afternoon peak hours in the vicinity of the Secondary Plan area. The selected study area (proxy zone) is bounded generally by Kortright Road to the north, Clair Road to the south, Victoria Road to the east and Preservation Park to the west).

Assuming the most conservative land use budget comprising 10,125 residential units and 333 employee positions[6], provided for the purposes of this analysis, the Clair-Maltby Secondary Plan would be anticipated to result in the order of 5,150 and 6,950 two-way person trips during the weekday morning and weekday afternoon peak hours, respectively. Total trips include those trips that utilize "other" travel modes, including those using school buses, taxis, or ride-share services, despite these travel modes not being explicitly identified in the above summary.

Overall, approximately 3,770 and 5,785 two-way person trips are anticipated to be undertaken in a personal vehicle (as a driver or passenger), comprising approximately 73 per cent to 83 per cent of all trips during weekday morning and afternoon peak hours. In the order of 455 and 555 two-way person trips are anticipated to be undertaken as a transit rider, comprising approximately 8 per cent of all trips during weekday peak hours. Comparatively, in the order of 615 and 345 two-way person trips are anticipated to be undertaken as a pedestrian or cyclist during the weekday morning and afternoon peak hours, respectively, comprising approximately 12 per cent and 5 per cent of all trips during the respective weekday peak hours.

Trip generation, by zone and mode, is provided in detail in Appendix D. Traffic volumes generated by the existing buildings within the Secondary Plan area are expected to be small, and generally represent individual households, small businesses, an existing golf course, and general rural activities.
A marginal volume of traffic results from existing operations and activities within the Secondary Plan area relative to the planned redevelopment of these lands. For the purposes of the traffic analysis conducted herein, existing Secondary Plan area traffic was conservatively retained on the area street network. Reductions to future forecast Clair-Maltby Secondary Plan traffic were not made to account for existing traffic resulting from current development within the subject lands.

Vehicle Traffic Assignment

Base Road Network

Future total traffic scenario lane configurations on the area street network reflect the following planned improvements that are assumed as part of the future traffic analysis scenarios:

- Widening of Gordon Street from 2 to 4 lanes (approved 2001 EA) from Kortright Road to Wellington Road 34;
- Widening of Clair Road from 2 to 4 lanes (approved 2003 EA);
- Southerly extension of Southgate Drive to Maltby Road; and
- Clair-Maltby Secondary Plan collector road network as outlined in the preferred "Community Structure".

6 Based on August 2018 Area Population and Employment of 24,495 population and 564 jobs. 333 jobs related to commercial and office uses. Remaining jobs related to Service Commercial and Neighbourhood assumed to be small, dispersed, and partly off-peak.

Future Total traffic volumes have been forecast for existing study area intersections, as well as future collector road intersections as outlined within the community plan. The base future traffic lane configurations and traffic controls are illustrated in Figure 3.4.21., as are general street names for reference purposes.

Traffic Assignment

Travel patterns for traffic generated by the residential and employments uses planned within the Secondary Plan area are based upon a review of the following:

- Travel destination information provided in the 2016 Transportation Tomorrow Survey (TTS). A comprehensive series of surveys were conducted in the development of the TTS database that describes, among other information, the travel behaviour of motorists of a specific area during the street peak periods;
- Capacity constraints on turning movements at area intersections that would, because of the extent of the delays that may be experienced, influence motorists to choose alternate routes while travelling to and from the proposed building; and
- The introduction of planned new roads and road improvements within the vicinity of the Secondary Plan, advanced through City and County transportation planning and/or site-specific development.

For destinations within the City of Guelph, forecast site traffic is routed along both local (collector) and regional transportation corridors depending on their distance to / from the Secondary Plan area. At the regional level, a greater reliance on regional corridors such as Highway 6 - the Hanlon Parkway and Gordon Street is expected as many drivers would take advantage of highway and higher-order roads to travel greater distances across the region and connect with Highway 401 to the south.

Overall traffic distribution assumptions are applied to individual Traffic Zones, identified within the Secondary Plan area, to appropriately assign traffic volumes related to specific development areas within the overall Plan.

Forecast new Secondary Plan traffic volumes on the area street network are illustrated in Figure 3.4.22 and provided in Appendix D.

Clair-Maltby Secondary Plan forecast traffic volumes are assigned based on the Traffic Zones identified in Figure 3.4.20. Understanding that local streets have not been identified within the Preferred Community Structure, forecast traffic volumes have been assigned generally to collector roads. As such, collector road traffic volumes will not balance along collector street corridors.

Future Total traffic volumes, which is the sum of future background traffic volumes and traffic volumes resulting from development of the Clair-Maltby Secondary Plan area, are illustrated in Figure 3.4.23. Future total traffic volumes also include minor adjustments to existing traffic volumes associated with Bishop Macdonell Catholic Secondary School and South End Community Park, which would be anticipated to utilize Poppy Drive upon completion of this street between Gordon Street and Clair Road West rather than being required to route through the Poppy Drive West / Clair Road West intersection.

Figure 3.4.21. Future Base Traffic Lanes Configurations and Controls

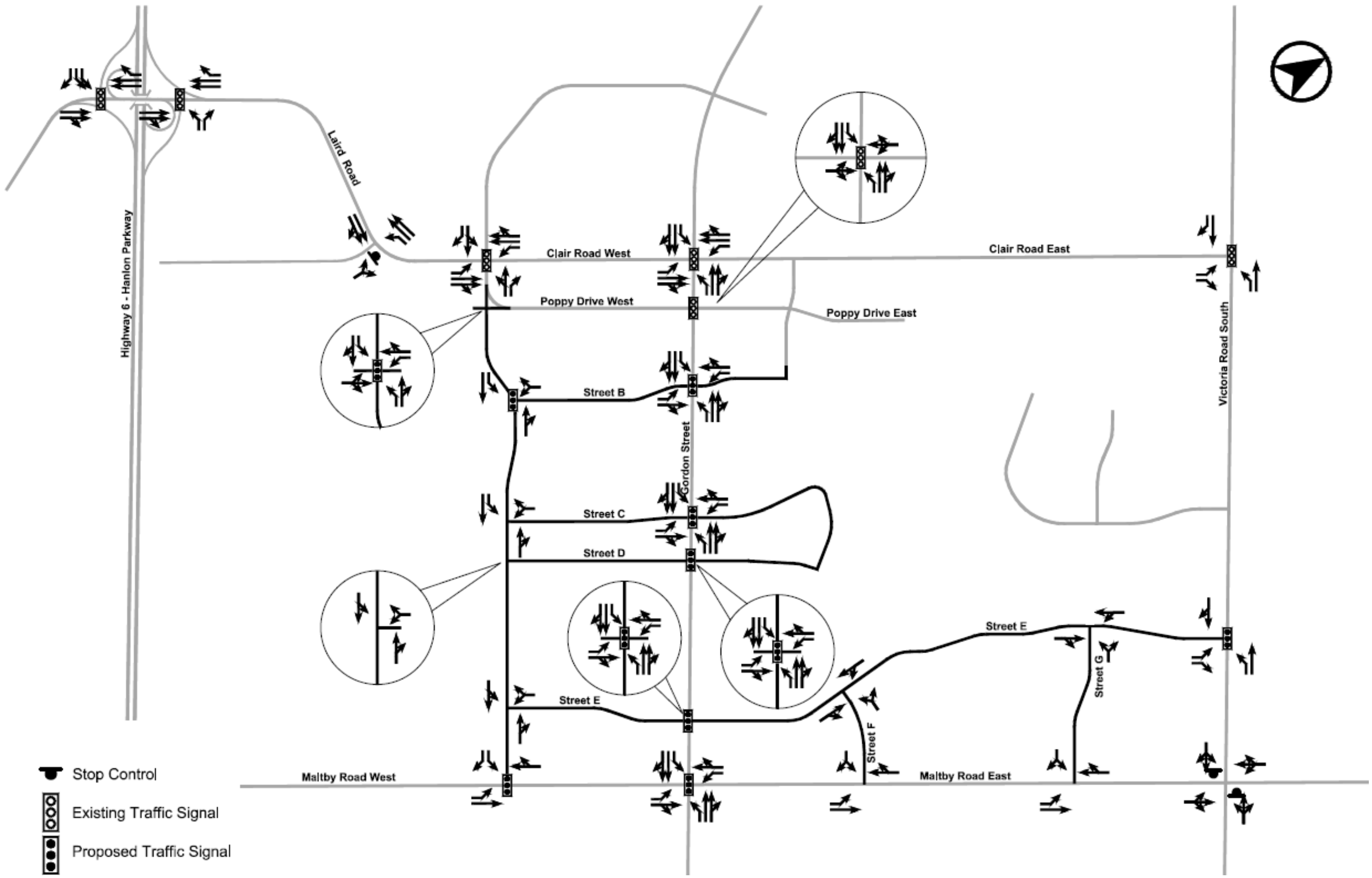


Figure 3.4.22. Forecast New Secondary Plan Traffic Volumes

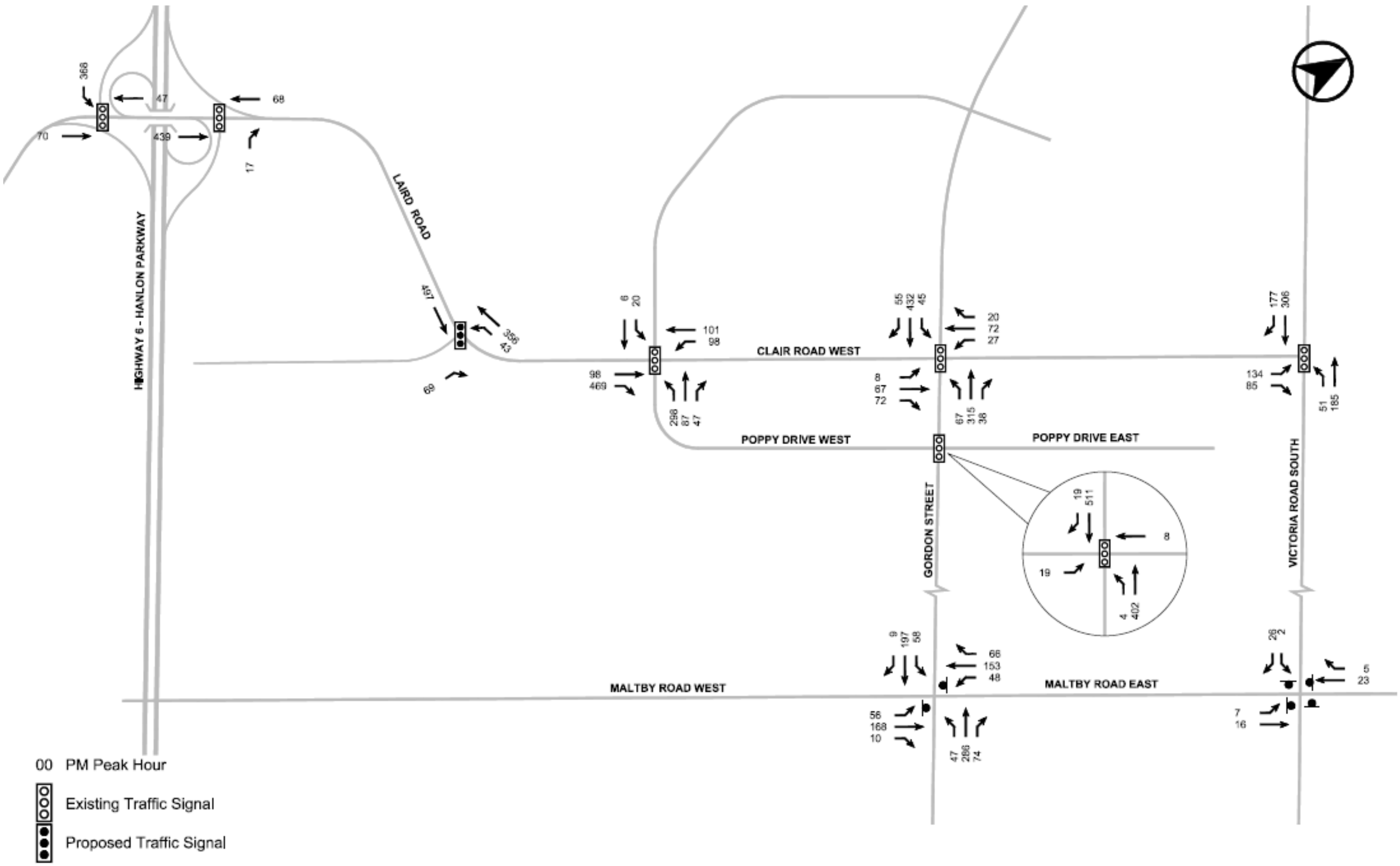
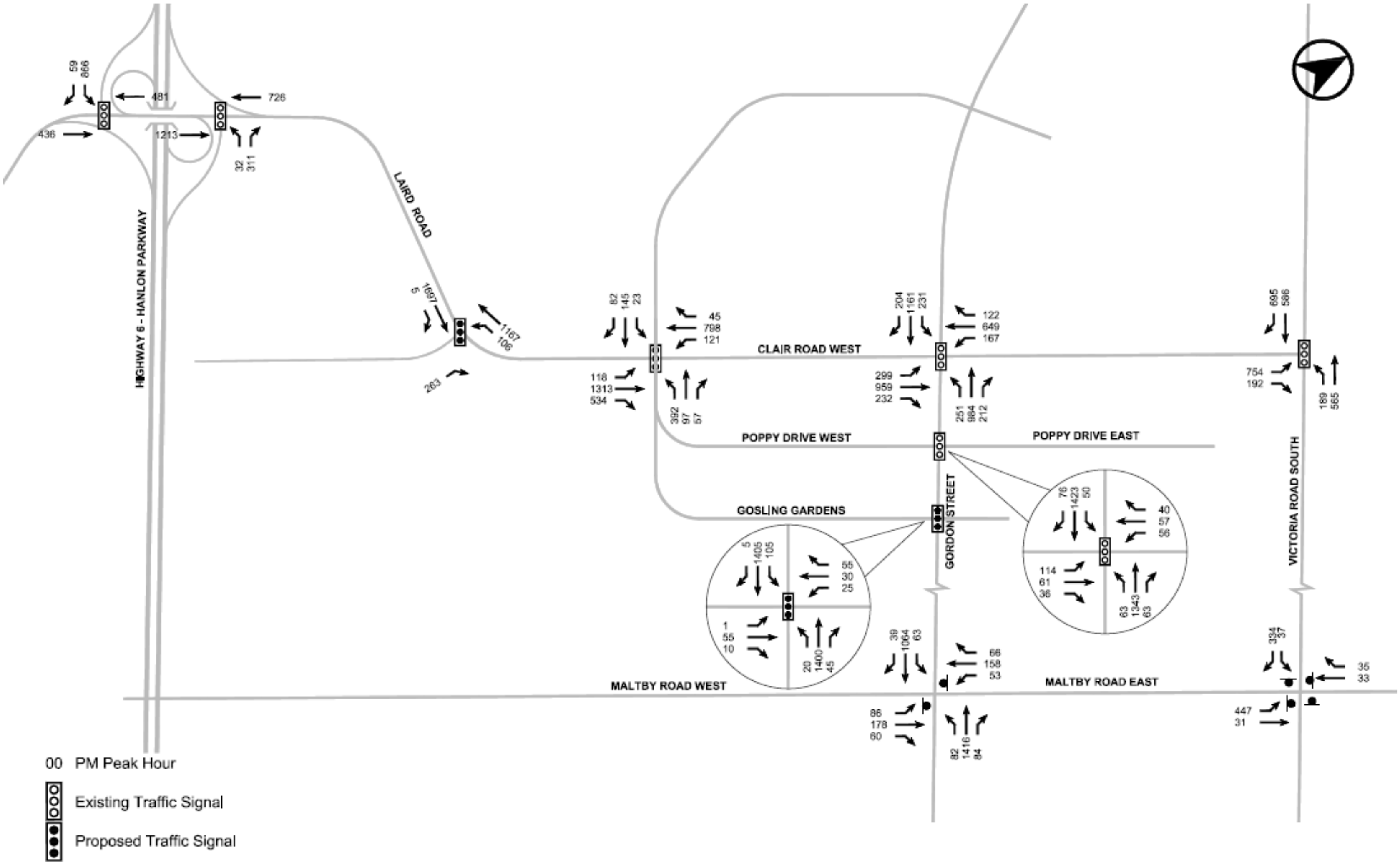


Figure 3.4.23. Future Total Traffic Volumes



FUTURE TOTAL TRAFFIC VOLUMES

Intersection Analysis Results and Road Network Requirements
Detailed results of the Synchro analysis of signalized and unsignalized intersections within the study area under future total traffic conditions are provided in Appendix D**.** A discussion of the traffic analysis findings follows.

Base Future Total Street Network

A summary of future total signalized and unsignalized traffic operations at key study area intersections under base future total street network conditions is provided in Figure 3.4.24.

Recommended Future Total Street Network

Assuming the introduction of the recommended intersection improvements traffic operations at signalized and unsignalized intersections are anticipated to be acceptable, except for certain capacity constraints expected for specific traffic movements at key study area intersections.

Additional analysis was undertaken with recommended intersection improvements at certain intersections within the study area. Recommended improvements specifically imply physical improvements to existing intersection configurations (additional traffic lanes), or traffic control (signalization). The improvements are illustrated in Figure 3.4.25 (and associated traffic operations are illustrated in Figure 3.4.26) and the following individual improvements are described in detail in Appendix D:

- Traffic signal optimization
- New Traffic Signal Controls
- Intersection Traffic Capacity Improvements

North-South Collector Road West of Gordon Street

The transportation modelling undertaken herein indicates that a second north-south oriented street is required to connect to Clair Road to accommodate the land budget considered as part of the planning process (approximately 10,125 units). In absence of a second street connection between the Secondary Plan area and Clair Road, Gordon Street would operate over its capacity even with a 4-lane cross-section. In addition, considerable improvements are required to the Gordon Street / Clair Road and Victoria Road / Clair Road intersections, beyond those already recommended herein.

This collector street (west of Gordon Street) also provides important connectivity between Secondary Plan development and recreational and institutional uses in the area of Clair Road / Poppy Drive West. A more robust, resilient street network is also provided that can better distribute traffic, accommodate transit vehicle routing, and provide more direct access to Secondary Plan area development (including for emergency vehicles).

Additional North-South Collector Road East of Gordon Street

The transportation modelling undertaken as part of this study demonstrates that traffic volumes resulting from background traffic and traffic related to the development of the Clair-Maltby Secondary Plan area, can be accommodated by

Gordon Street as planned (i.e. with four though-traffic lanes), understanding that certain traffic movements at the Gordon Street / Clair Road intersection will operate under busy conditions during the prevailing weekday afternoon peak hour. Specifically, southbound through movements and left-turn movements in the weekday afternoon peak hour are anticipated to operate near theoretical capacity, with v/c ratios between 0.90 and 1.00, assuming the highest density Land Budget development scenario tested herein.

Traffic analysis forecasts undertaken herein, support the implementation of 4 through-traffic lanes along Gordon Street within the Clair-Maltby Secondary Plan area. Traffic capacity constraints, should they develop during prevailing weekday peak travel periods, may be anticipated at the key Gordon Street / Clair Road intersection, but are otherwise not anticipated for link segments of Gordon Street. Improvements, by way of ancillary turn lanes, are recommended herein to mitigate traffic capacity constraints at the Gordon Street / Clair Road intersection.

A typical 4-lane street section is anticipated to sufficiently accommodate forecast traffic demands along the Gordon Street corridor, understanding the need for ancillary turn lanes – specifically separate left-turn lanes at all intersections where left-turns are permitted. Pending the frequency of separate left-turn lanes, a continuous left-turn / centre median lane along the extent, or portions of, Gordon Street within the Secondary Plan area may be warranted.

Gordon / Maltby Roundabout

The intersection of Gordon Street and Maltby Road is considered for the introduction of a roundabout, as an alternative to recommended signalization. A roundabout, at this junction, may be appropriate considering:

- its location as a gateway to / from the City of Guelph, and
- its boundary character between urban Guelph and rural Wellington County.

With regards to the first two points noted above, a roundabout may be appropriate as an option to reduce vehicle speeds on approach to the City of Guelph in transition from rural highway to urban arterial.

Understanding the opportunity for a roundabout at the junction of Gordon Street and Maltby Road, roundabout traffic analysis was completed for the future total traffic scenario.

ARCADY 9 traffic analysis results for the analyzed roundabout under future traffic conditions are summarized in Table 3.4.12. Detailed results analysis outputs are included in the Clair-Maltby Secondary Plan – Transportation Master Plan Study report provided in Appendix D.

Table 3.4.12. Roundabout Analysis Summary

Intersection	Approach Leg	Future Total Traffic Conditions - V/C Ratio	Future Total Traffic Conditions - Average Delay (sec)	Future Total Traffic Conditions - LOS
Gordon Street and Maltby Road	WB	0.56	17.12	C
Gordon Street and Maltby Road	SB	0.60	4.13	A
Gordon Street and Maltby Road	EB	0.39	6.53	A
Gordon Street and Maltby Road	NB	0.81	9.01	A
Gordon Street and Maltby Road	**Overall**	**--**	**7.74**	**A**

Notes:

1. Overall intersection capacity indicated as “residual” capacity.

Should a traffic roundabout be pursued for the junction of Gordon Street and Maltby Road, traffic operations are anticipated to be acceptable. Further consideration would be required as to its functional design and ability to appropriately accommodate pedestrian crossings, cyclists, transit vehicles and articulated trucks.

Figure 3.4.24. Summary of Future Total Traffic Operations Analysis – Base Future – Traffic Network

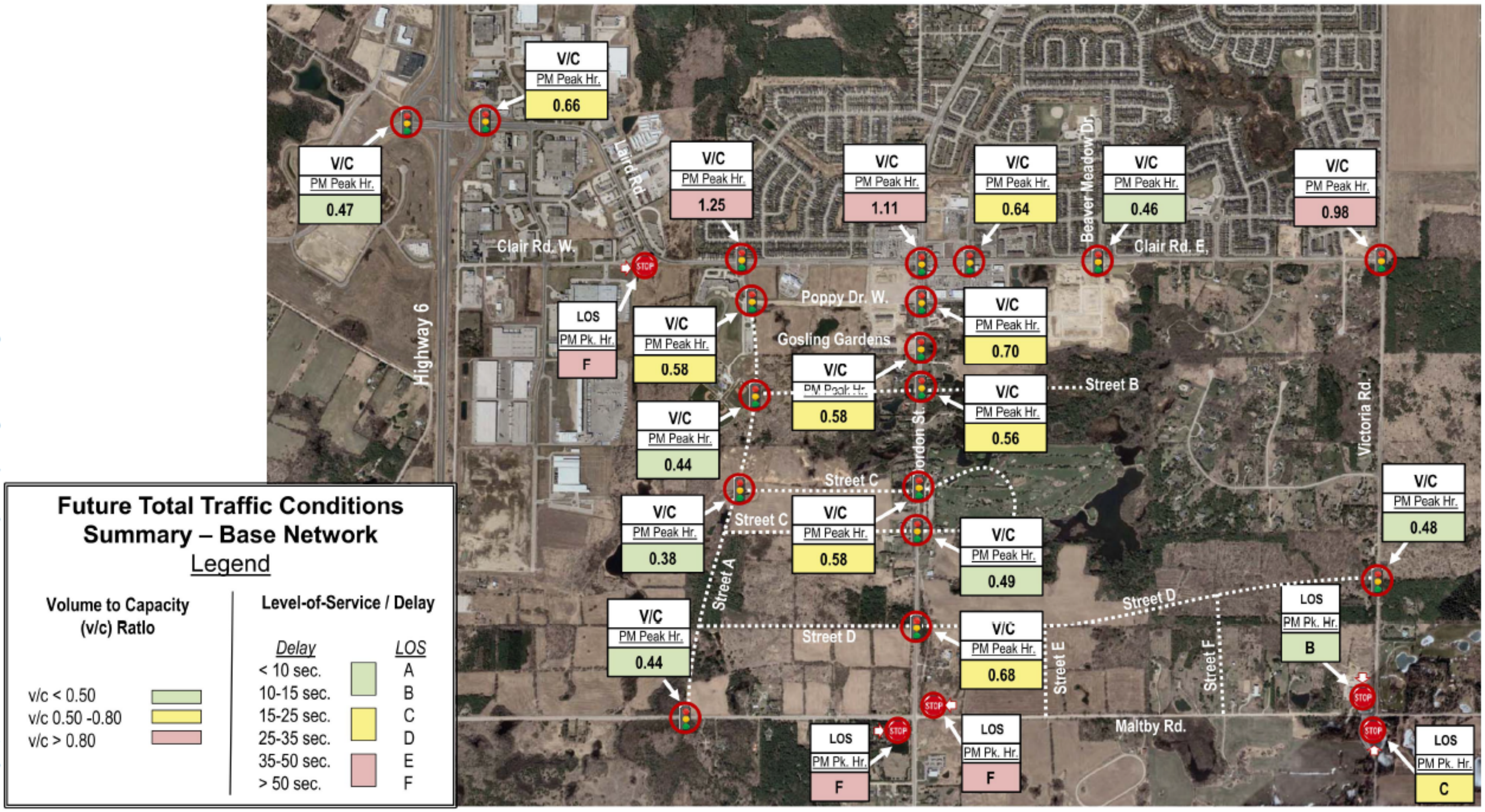
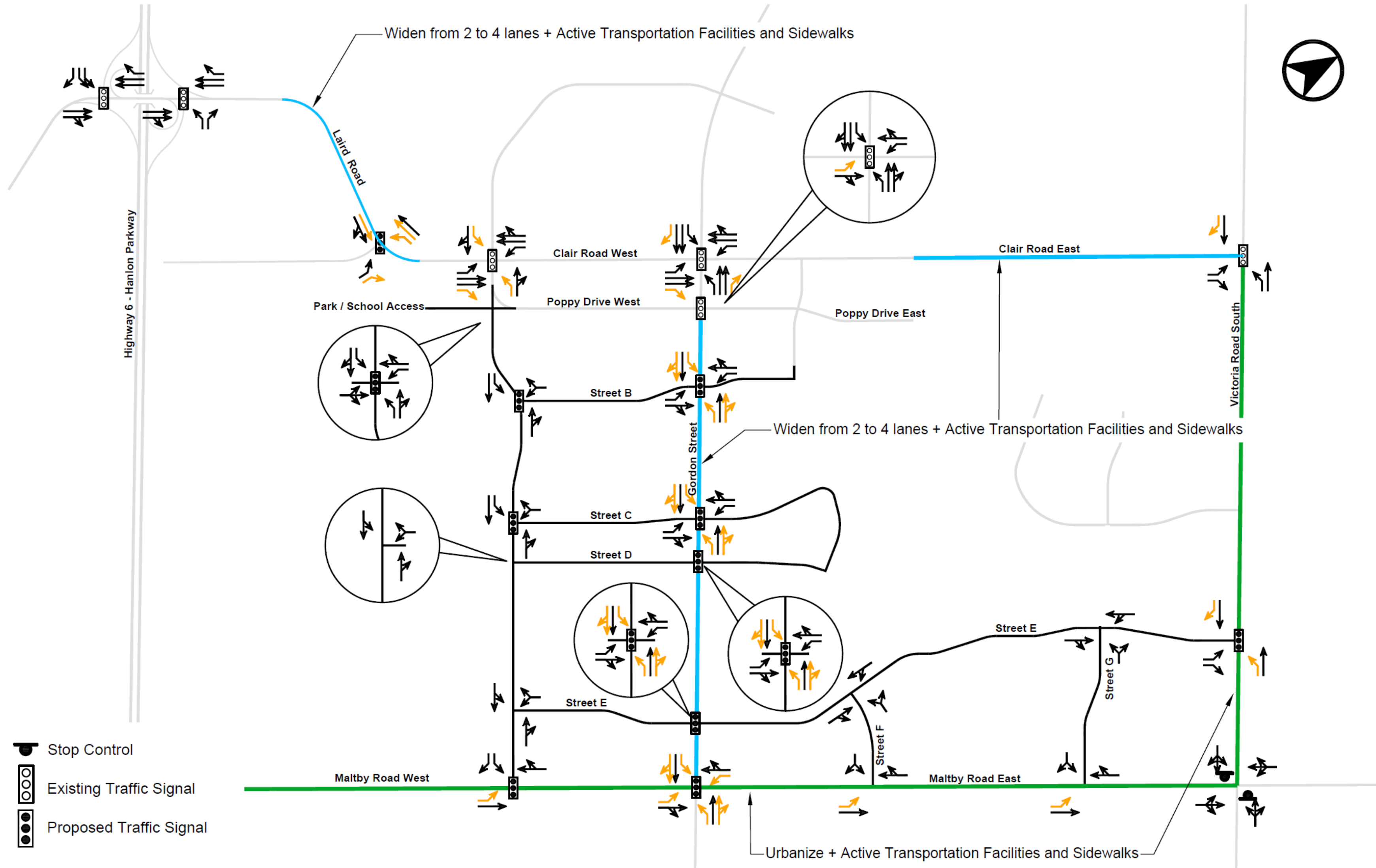


Figure 3.4.25. Recommended Future Traffic Lane Configurations and Controls



Summary of Road Improvements

Road improvements for the Clair-Maltby Secondary Plan area have been itemized in Table 3.4.13.

Table 3.4.13. Summary of Road Improvements

Road	Improvement	From	To
Clair Road East	Widen from 2 to 4 lanes with active transportation and sidewalks	Beaver Meadows Drive	Victoria Road South
Victoria Road South	Urbanize and add active transportation and sidewalks	Clair Road East	Maltby Road
Maltby Road East	Urbanize and add active transportation and sidewalks	Hanlon Parkway	Victoria Road South
Gordon Street	Widen from 2 to 4 lanes, Urbanize to include cycle tracks and sidewalks	Clair Road	Maltby Road
Street A Collector	New Road	Poppy Drive	Maltby Road
Street B Collector	New Road	Street A	Gordon Street
Street B Collector	New Road	Gordon Street	Hawkins Drive
Street C Collector	New Road	Street A	Gordon Street
Street C Collector	New Road	Street A	Gordon Street
Street C[1]	New Road	East of Gordon Street	East of Gordon Street
Street D Collector	New Road	Street A	Victoria Road
Street E Collector	New Road	Street D	Maltby Road
Street F Collector	New Road	Street D	Maltby Road
New Signals identified in Figure 3.4.45			
Lane configurations identified in Figure 3.4.45			

Notes:
1. Street C is a loop road that effectively operates as two local connections.
2. Street G (north of Street E) operates as a local connection.

Transit Service Assignment

Assignment of transit trips is based on a review of origin and destination data collected as part of the 2016 Transportation Tomorrow Survey (TTS) for the southern parts of the City of Guelph. A total of 455 and 555 new transit trips are forecast during the weekday morning and weekday afternoon peak hours, respectively.

Clair-Maltby Secondary Plan transit trips are assigned to general directions, and would be captured by local transit services. Additional opportunities to explore regional transit connectivity and demands are discussed in the later portions of this chapter.

The majority of transit trips are anticipated to route outbound during the weekday morning peak hour, and inbound during the weekday afternoon peak hour given the prevailing residential-related travel demands associated with the Secondary Plan.

The review of resident-based area transit trips indicated that the majority of transit trips were undertaken exclusively by local transit services - in the order of 85 per cent to 90 per cent, while a smaller proportion of trips utilized regional GO Transit services to access other parts of the region.

It is expected that most transit trips to the Clair-Maltby Secondary Plan area will be captured by local transit services, which is anticipated to continue to evolve in sequence with development of the Secondary Plan area, and as part of on-going service reviews conducted by Guelph Transit.

The anticipated distribution of transit trips and resulting number transit trips, based on the TTS transit distribution and forecast transit rider volumes, are summarized in the table below. Forecast transit rider volumes are summarized based on the type of service riders would be anticipated to utilize (local or regional), and general directional orientation those riders would travel.

Table 3.4.14. Resulting New Transit Trips by Orientation and Service

Orientation	Orientation of Transit Trips	Two-way Transit Trips Distribution	Two-way Transit Trips AM	Two-way Transit Trips PM
Regional Transit Services (GO Transit) East	Kitchener GO Line (Guelph Station); Aberfoyle GO Park and Ride Bus Stop	14%	65	75
Local Transit Services (Guelph Transit): North	Old Guelph (Downtown) Area	81%	370	450
Local Transit Services (Guelph Transit): North	University of Guelph Area	81%	370	450

Orientation	Orientation of Transit Trips	Two-way Transit Trips Distribution	Two-way Transit Trips AM	Two-way Transit Trips PM
Local Transit Services (Guelph Transit): Northeast	Northeast areas of Guelph	2%	10	15
Local Transit Services (Guelph Transit): Northwest	Northwest and West areas of Guelph	3%	10	15

Notes:
1. Trips Rounded to the Nearest 5.

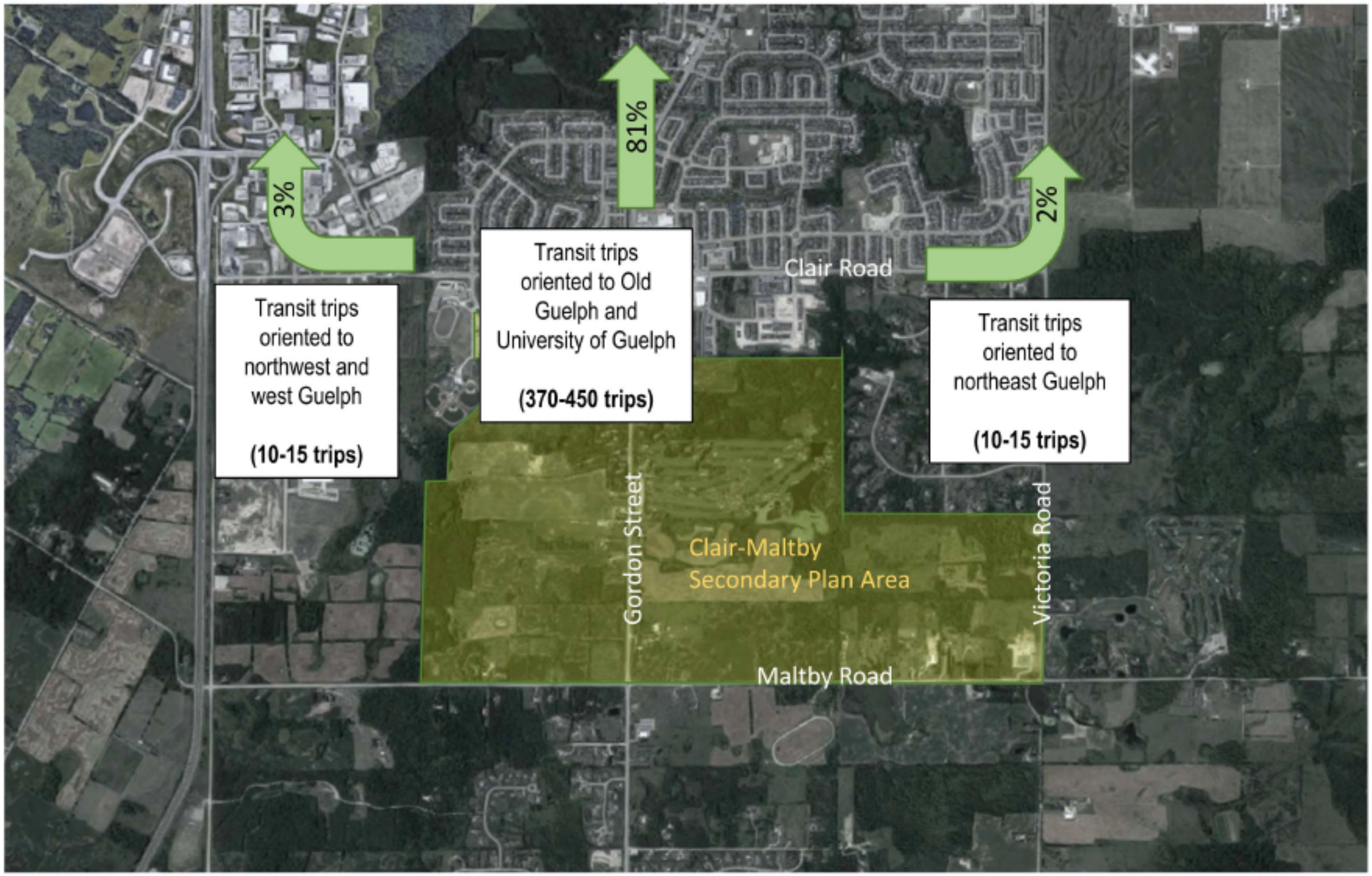
Clair-Maltby Secondary Plan area transit trips are predominantly anticipated to be oriented north of the Secondary Plan area, as transit riders tend to route to / from the downtown area, the University area, and central GO Transit Station. In the order of 370 and 450 two-way transit trips are anticipated to route to / from these areas during the weekday morning and weekday afternoon peak hours respectively.

In the order of 65 and 75 two-way transit trips are anticipated to route to / from GO Transit service stops during the weekday morning and weekday afternoon peak hours respectively, including the Guelph GO Station, as well as the existing GO Transit Bus Services routing through Aberfoyle GO Park and Ride.

A small number of transit trips are expected to route to other employment areas in the east and west portions of the City. However, as employment growth is anticipated in the Laird / Highway 6 area, opportunity to capture more trips via transit may exist given the proximity of this employment area to the Clair-Maltby Secondary Plan area, and relative direct options for transit routing.

Transit rider volumes related to development anticipated with the Clair-Maltby Secondary Plan are illustrated by general direction in Figure 3.4.26.

Figure 3.4.26. Weekday Peak Hour Forecast Transit Rider Trips



* Remaining percentage of transit rider trips (approx. 14%) are anticipated to utilize regional transit services (GO Transit) only via Guelph Station or Aberfoyle GO Park and Ride.

Transit Capacity Considerations and Network Requirements

Transit trips associated with development of the Clair-Maltby Secondary Plan area are analyzed for the prevailing directions in each of the key weekday morning and afternoon peak hours. Given that most new transit trips are resident-based, prevailing transit impacts are outbound during the weekday morning peak hour, and inbound during the weekday afternoon peak hour.

Understanding transit rider forecasts are based on the most conservative (highest density) "Land Use Budget" circulated in support of planning for Secondary Plan development, up to 400 outbound transit trips can be anticipated during the weekday morning peak hour, and 405 inbound trips can be anticipated during the weekday afternoon peak hour. In the order of 90 per cent to 95 per cent of these trips can be expected (conservatively) to be oriented north of the Secondary Plan area to / from the University and Downtown areas. Therefore, up to 385 peak direction transit trips can be expected between the Secondary Plan area and central areas of the City during weekday peak hours.

Guelph Transit currently utilizes Nova Bus LFS 40-foot buses, which have a total passenger capacity of 50-60 persons per vehicle (per Guelph Transit). As such, a total of 6 to 8 buses would be required to accommodate peak direction, peak time transit ridership demands associated with travel between the Clair-Maltby Secondary Plan area and central Guelph areas. However, transit service provisions would also have to accommodate for existing (and future) down-stream transit rider demands associated with existing developed areas north of the Secondary Plan.

The requirement for a minimum of 6 to 8 new buses (per hour) in excess of existing services, operating between the Secondary Plan area and the central areas of the City to accommodate development associated with the Secondary Plan area, can be accommodated through the provision of various routes, express-only services, or frequent services routing along the Gordon Street spine and supporting collector roads.

Guelph Transit anticipates operating bus services (new or extended) along all arterial and collector streets within the Secondary Plan area.

Transit service provisions can be further supported through measures outlined in transit supportive City policies, including:

- Queue jump lanes;
- Priority traffic signal timing; and
- Bus / Taxi / HOV curbside lane designations (Gordon Street) during weekday peak travel periods.

Transit Hub Considerations

Guelph Transit supports the concept of a "Transit Hub" within the Secondary Plan to support future transit operations in the area, and have identified a central location along the Gordon Street corridor within a designated mixed-use zoning area as being a preferred site for such a facility. A Transit Hub facility would require an approximate 65 m by 65 m area to facilitate 6 bus bays to accommodate 3 new bus routes and 2 to 3 extended (existing) routes.

Active Transportation Assignment

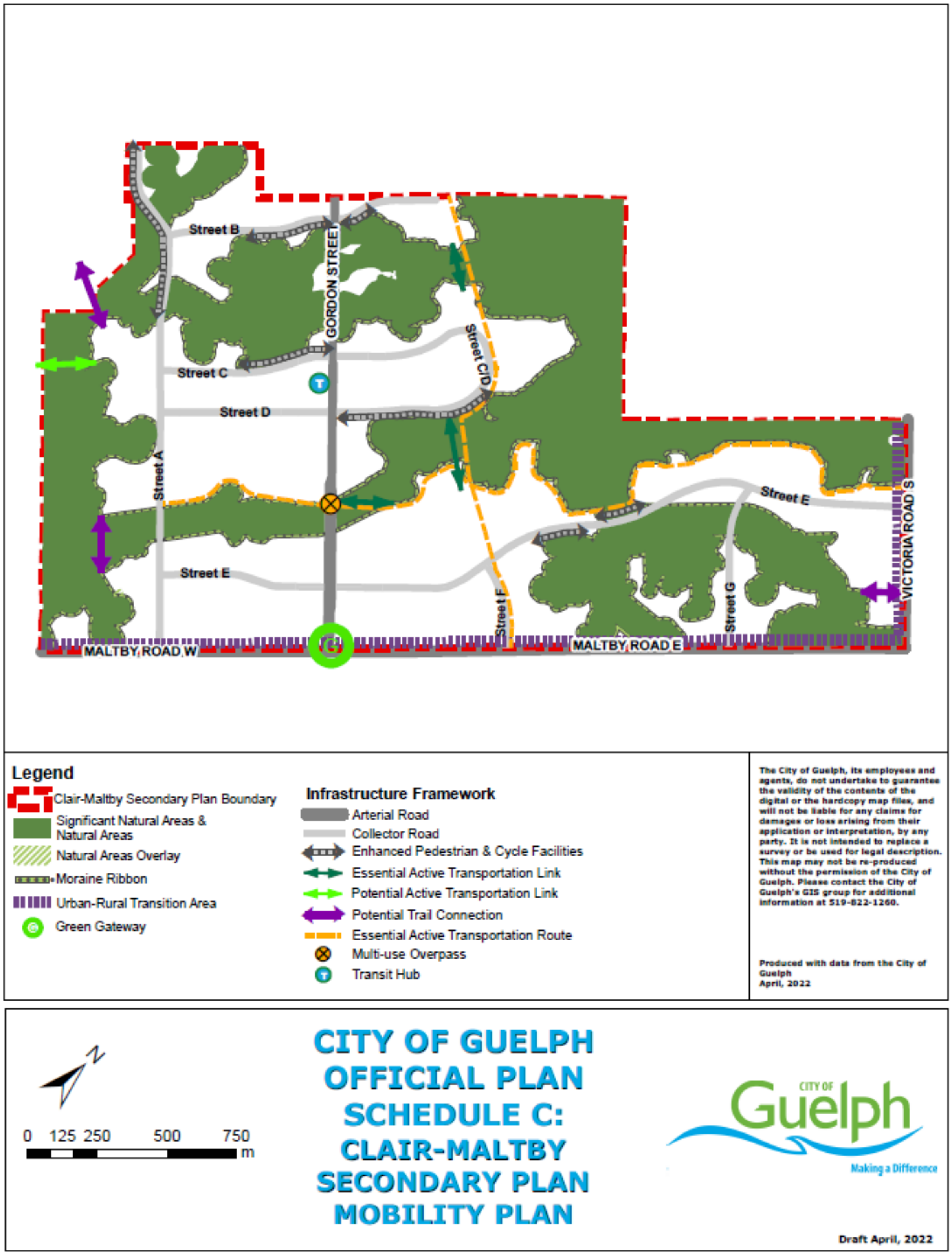
Active trips (walking and cycling) resulting from development contemplated within the Clair-Maltby Secondary Plan area are forecast for planned residential and office land uses, based on the trip forecasting methods outlined under Section 3.4.4.3 based on the most conservative (highest density) "Land Use Budget". A total of 615 and 345 active two-way trips are forecast during the weekday morning and weekday afternoon peak hours, respectively. Both Arterial and Collector Road networks are contemplating cycling facilities within their cross-sections to facilitate the Secondary Plan Active Transportation Network. Additional active and recreational trips are anticipated during the off-peak periods on both the Active Transportation Network and the Trail Network. The function of the Trail Network is to provide pedestrian and cycling facilities throughout the Secondary Plan area in addition to those already contemplated for the arterial and collector road network, in order to:

- Further accommodate commuter and practical pedestrian and cycling circulation and connectivity;
- provide recreational amenity and active transportation use;
- augment the wider trail network in the southern parts of the City of Guelph; and,
- augment the collector street network prepared as part of the Preferred Community Structure plan.

The Clair-Maltby Secondary Plan must create a robust linked trail system with direct and convenient connections for both recreational and utilitarian users that accommodates and prioritizes active transportation travel modes. An illustration of the proposed Secondary Plan Active Transportation and Trail system is provided in Figure 3.4.28.These networks must be integrated in a manner with the surrounding street network that facilitates safe and direct crossings between both sides of Gordon Street. The Active Transportation Network must also facilitate safe and direct access between transit stops on both sides of Gordon Street. An overpass (or pedestrian signal) may be considered at the key street crossing of Gordon Street, between Streets D and E, given the distance to either Street would be considered too long.

East of Gordon Street, important elements of the Trail Network are proposed to cross the Natural Heritage System to continue to allow for pedestrian and cycling connectivity. Future studies will be required to demonstrate that the Trail Network can be accommodated without a negative impact to the NHS or the cultural heritage attributes located in these areas.

Figure 3.4.27. Clair-Maltby Secondary Plan Mobility Plan



3.4.3.4 Community Consultation

The City of Guelph has engaged with local residents, landowners, technical advisors, a community working group, key stakeholders, and the general public over the course of four years to develop a Preferred Community Structure to guide development of the Clair-Maltby Secondary Plan area.

Before the start of any formal study process, the City hosted a public house, focus group, and engaged with area property owners in 2015 and 2016. Early engagement with interested parties outlined existing conditions including the extent of municipal transportation infrastructure in the vicinity of Clair-Maltby, works related to retaining a study team, and outlined the pending study process. The study structure identified the need for a Mobility Study, to support a comprehensive review of background planning and engineering material and inform a formal Secondary Plan and Master Environmental Service Plan.

Following commencement of the Clair-Maltby Secondary Plan and Master Environmental Service Plan study, the City hosted a series of formal meetings to engage with the public, land owners, and technical advisors. In April 2018, the City held a five day planning and design charrette, which used collaborative design and planning workshops with stakeholders and the public to evaluate the three initial land use alternatives, leading to the Preliminary Preferred Community Structure for the SPA. At these sessions, the Wood Team provided information from the CEIS on the environmental systems and also outlined preliminary concepts and principles for servicing, while the BA Group added insights associated with transportation needs. Subsequent to the design charrette, modifications were made to the Preliminary Preferred Community Structure, including removal of the Rolling Hills area from the SPA and other land use revisions, resulting in an initial Preferred Community Structure.

The Clair-Maltby Secondary Plan community engagement process has included two Public Information Centres (April 2017 and April 2018). A third Public Information Centre occurred in June 2021.

Key community engagement sessions, which informed and shaped a “Preferred Community Structure Plan”, are summarized in the following:

Community Visioning Sessions (April 2017, September 2017)

Community Visioning Sessions were undertaken to help establish a vision, goals and guiding principles for the study.

The planning objectives of the Secondary Plan included a vision for a complete and healthy community with an integrated transportation network to promote transit, walking and cycling.

A Community Visioning Workshop undertaken in September 2017 assisted in establishing a Conceptual Community Structure, which was carried-forward as part of meetings with a Community Working Group and Technical Advisory Group. This initial concept included prospective street alignments, new road connections to the existing street work, and considerations for active transportation that were intended to establish a modified street grid to support future development, robust transit routing options, and active transportation connectivity and mobility, while noting key natural heritage attributes.

The Conceptual Community Structure was further used in the development of three Community Structure Alternatives, which formed the discussion of a 5-day planning and design charrette held in April 2018.

Planning and Design Charrette (April 2018)

The planning and design charrette was a multi-disciplinary, intensive, and collaborative design and planning workshop, and was undertaken in order to develop a Preliminary Preferred Community Structure with input from stakeholders, community members, City departments and the project team.

The charrette evaluated three Community Structure Alternatives in order to develop a Preliminary Preferred Community Structure. The alternative structures included different transportation network elements intended to support the creation of an *interconnected and interwoven* community given the multi-disciplinary considerations of the Secondary Plan. Transportation network options are intended to provide mobility choice, connect neighbourhoods to each other and the rest of the City, and to utilize networks of parks, open spaces, and trails to accommodate active / passive recreation and more utilitarian active transportation use.

Transportation-related considerations made of the Community Structure Alternatives included:

- Suggestions for a more connected, 'grid' network of collector streets;
- General support for as few street crossings of the Natural Heritage System (NHS) as possible;
- Concerns of single-loaded roads adjacent to NHS;
- Consideration of grading, landform and topography;
- Discussion of municipal street right-of-way widths, and cross-section elements;
- Suggestions to incorporate additional trails, including those to employment lands;
- General concerns related to a conceptual new collector street (east of Gordon Street) through a Cultural Heritage landscape and the NHS, and that the need for this street be further studied and analyzed; and
- Additional trail connections be provided in consultation with parks staff.

The planning and design charrette resulted in a Preliminary Preferred Community Structure to advance planning for the future development of the Clair-Maltby Secondary Plan, and utilized as a basis for detailed technical analysis – including transportation modelling analysis.

Following the planning and design charrette, a transportation modelling assessment was conducted of the anticipated future traffic conditions within the Secondary Plan area pending the introduction of the aforementioned north-south oriented collector street extending between Clair Road and Maltby Road (located east of Gordon

Street). This assessment demonstrated that Gordon Street would be able to accommodate future traffic demands without this collector street on the easterly side of Gordon Street. This modelling allowed a general understanding of the potential impacts that a collector street would have on the existing NHS in two locations, as well as on an identified Cultural Heritage Landscape, and resulted in the removal of this collector road where it crosses these features as part of the Secondary Plan. Further analysis has also subsequently been conducted on the Preferred Community Plan to confirm the need for a north-south oriented street, west of Gordon Road.

Public Workshop: Secondary Plan Policy Directions (December 2018)

This workshop included focused conservations and discussion to help establish and refine the policy directions that will inform the creation of the Clair-Maltby Secondary Plan. The workshop addressed mobility and trails in addition to other topics.

These discussions helped inform, and are included within, the *Plan Policy Directions: Framework for the Clair-Maltby Secondary Plan* report (May, 2019). Key transportation considerations are cited therein, including sustainable transportation, transit, trails, design standards, parking, and general transportation networks.

A summary of transportation-related comments received from workshop attendees is provided in the following:

- Support for mobility choice and accommodating sustainable transportation modes, including active transportation routes to schools;
- A need to accommodate transit service and discussion of a transit hub;
- Discussion of the overall trail network and design standards to address environmental and safety concerns;
- Support appropriate amounts of vehicle parking, consider parking for electric vehicles, and encourage underground or rear laneway parking;
- Consider traffic impacts, vehicle congestion, reliance on automobiles to connect to employment areas, and traffic level-of-service metrics;
- Ideas for buffering / protecting the NHS from transportation infrastructure; and
- Various transportation design considerations related to street crossings of the NHS, low-impact (environmental) street designs, accommodating species migration, sidewalk provisions, cycling facility design, traffic calming measures, and grading impacts on existing landscapes.

3.4.3.5 Evolution of Community Structure

The Community Structure was advanced through modifications to alternative Community Structures developed as part of the April 2018 design and planning workshop and subsequent advisory group meetings.

These modifications to the community structure plan included adjustments to the Secondary Plan boundary, the removal of a conceptual north-south direction collector street aligned east of Gordon Street, changes to the location of high-density residential development, and the identification of cultural heritage resources and existing wetlands.

3.4.4 Alternatives

3.4.4.1 Do Nothing and Community Structure Alternatives (4)

The Clair-Maltby Secondary Plan has been evaluated from a transportation lens based on four primary alternatives to the land use plan that were presented as part of a 2018 Design Charette:

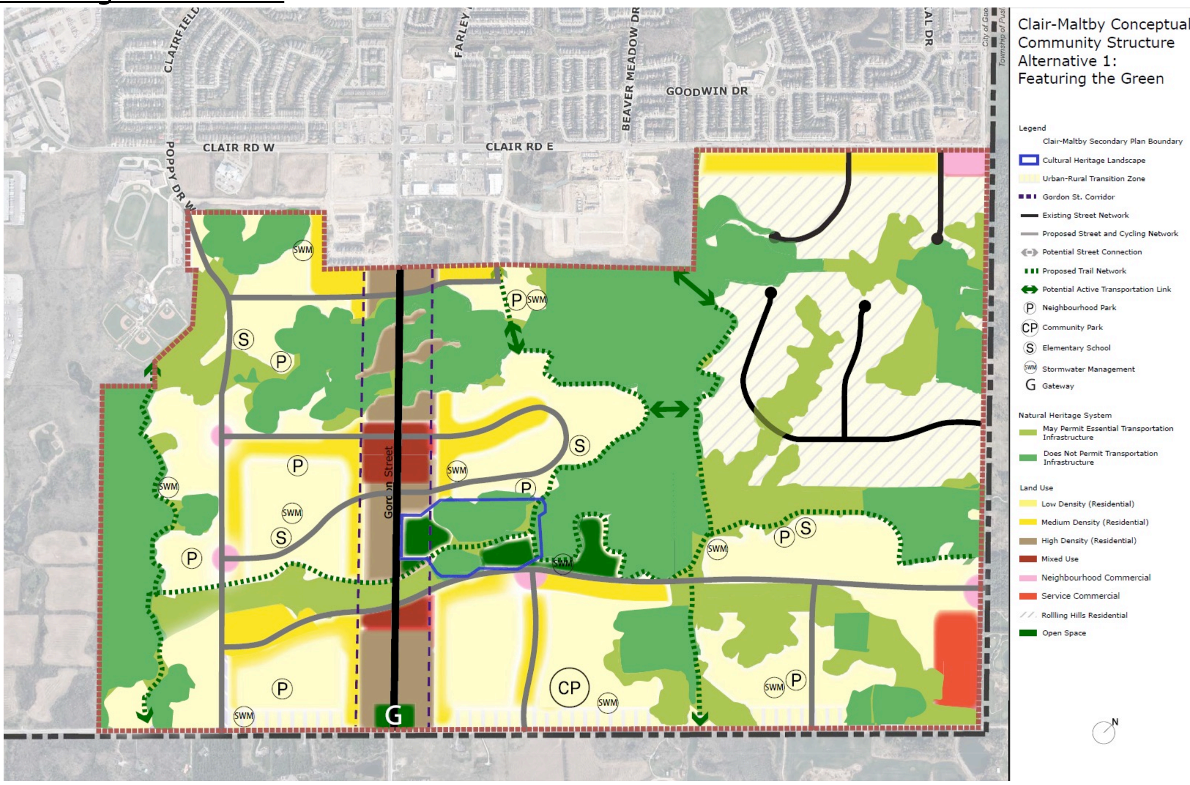
1. Do Nothing – No new roads
2. Featuring the Green– 2 continuous collectors (one N-S, one E-W)
3. Focus on Community Services– 2 continuous collectors (one N-S, one E-W)
4. Urban and Connected – 3 continuous collectors (two N-S, one E-W)
5. Preferred Community Structure Plan – 2 continuous collectors (3rd continuous collector replaced by continuous active transportation link)

Alternatives 2 to 5 are illustrated in Figure 3.4.30. Note, the land use alternatives pre-date a modification to the Secondary Plan that removes the Rolling Hills neighbourhood from the Secondary Plan study area.

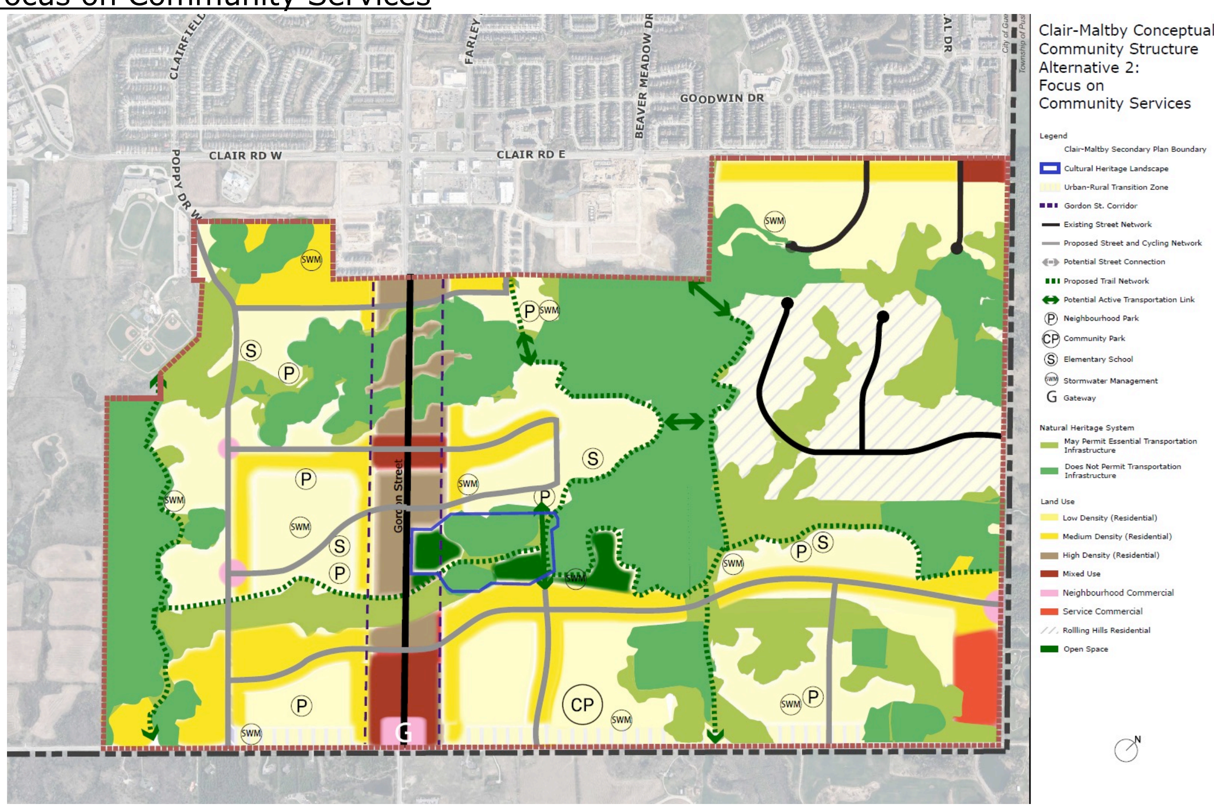
A total of five alternative land use scenarios with differing transportation network were considered based on the criteria noted below, including a "Do Nothing" option. Three alternatives reviewed as part of the Clair-Maltby Secondary Plan Charette (March 2018), and the final "Preferred Community Structure Plan" transportation network that resulted from direction provided as part of the March 2018 Charette, public consultation, and internal analysis and multi-disciplinary consultation. "Featuring the Green" and "Focus on Community Services" (aside from location and walkability of land uses) have similar mobility networks, with one notable difference in the north-south active transportation links east of Gordon Street.

Figure 3.4.28. Community Structure Alternatives Reviewed- 2018

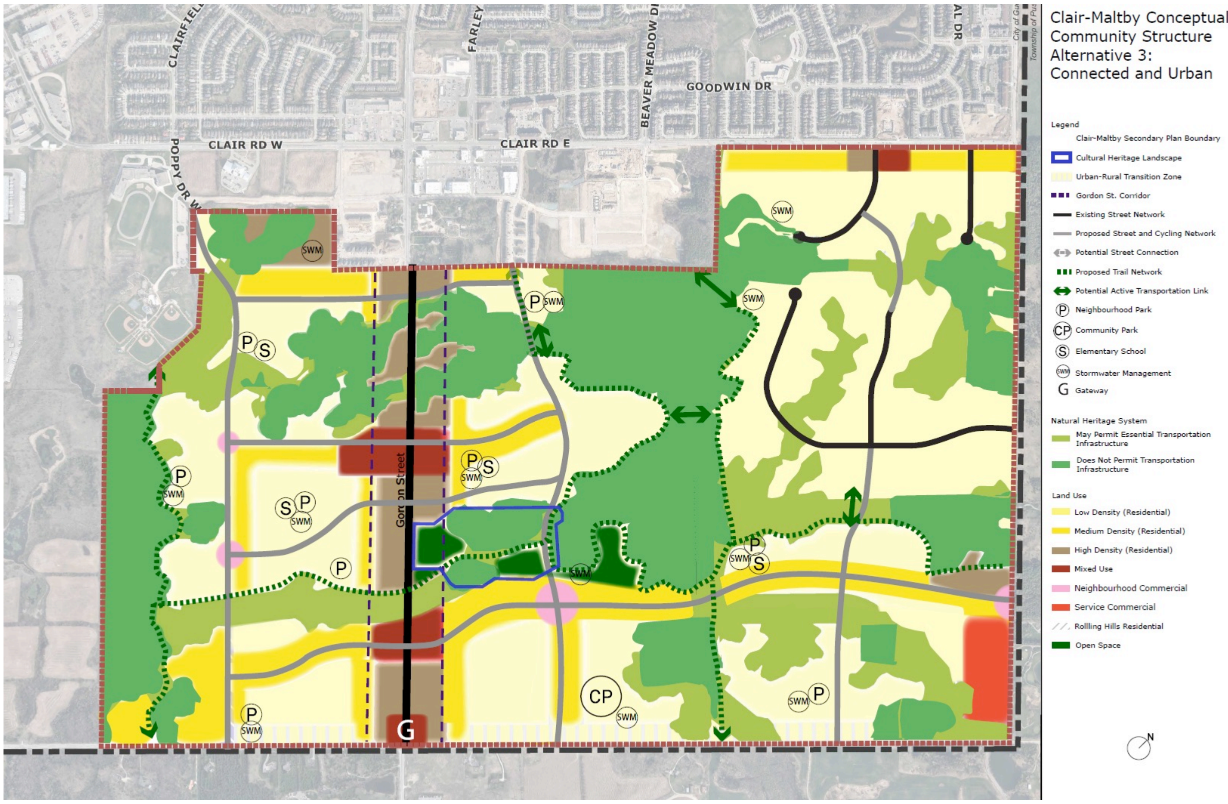
Featuring the Green:



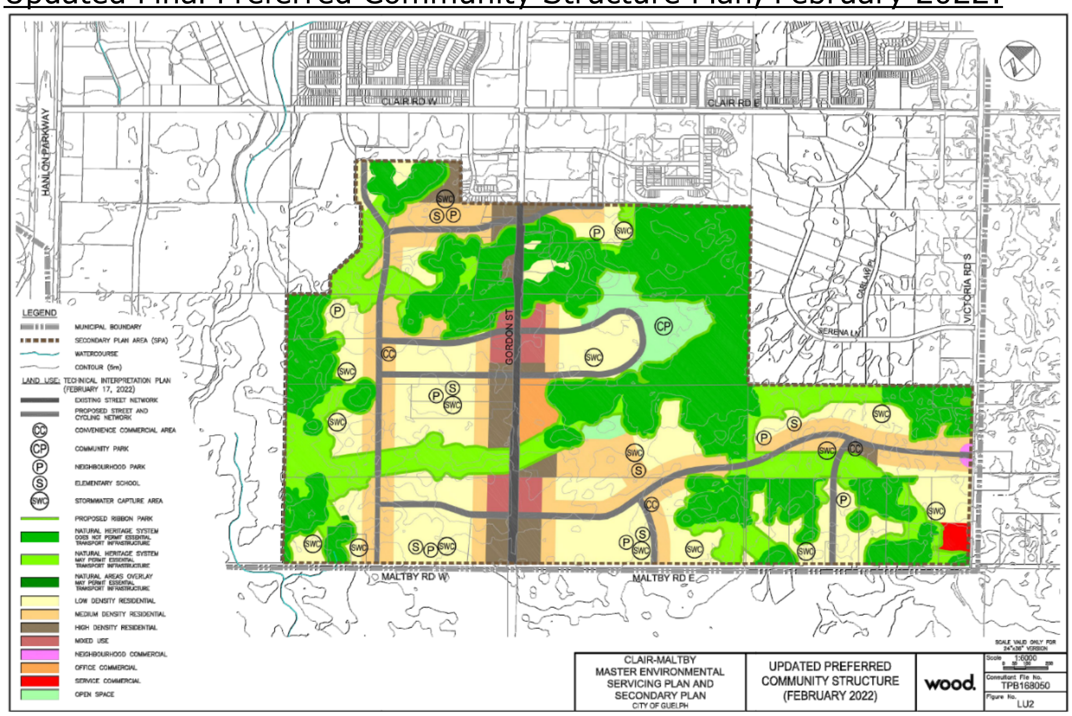
Focus on Community Services



Urban and Connected:



Updated Final Preferred Community Structure Plan, February 2022:



3.4.5 Assessment Criteria

The transportation criteria used to evaluate each alternative are described below:

Street Network:

- Modified grid collector street system with a fine-grained block structure to disperse traffic and encourage walking and cycling.
- Cost of implementing street network.
- Ability to provide property access.
- Potential to service future travel demands.
- New street network continuity and connectivity internal to Secondary Plan area.
- Multiple vehicular connections with local, regional and provincial roads to connect with the existing street network and distribute traffic.
- Impact to Natural Heritage System and natural / environmental

Active Transportation:

- Provide facilities within the public and private realm which encourage cycling, and includes off-road cycling facilities.
- Active transportation links to the Clair-Gordon mixed use node, South End Community Park, and other community facilities (schools, parks, community centres).
- Safety

Transit:

- Extends and connects to existing transit routes and facilities within the City of Guelph
- Transit hub along Gordon Street in a location that connects riders with high density residential, commercial and mixed use areas.
- Bus stops are provided at regular intervals, generally within 400m of 90 per cent of residence and business.
- Opportunity to provide efficient transit routing options.

Trails:

- Facilities for recreational trail use.
- Facilitates for day-to-day travel demand.
- Connections to City-wide trail network
- Local connections between residential areas and community facilities / commercial areas

Alignment with Objectives of the Secondary Plan (Interconnected & Interwoven):

- Green and Resilient

- Healthy and Sustainable
- Vibrant and Urban
- Interconnected and Interwoven
- Balanced and Livable

3.4.5.1 Ranking

Alternative Community Structure Plans and the evaluation matrix for mobility is provided below.

The network alternatives were ranked for each criteria to provide an understanding of overall network performance.

The ranking system is outlined in the following:

Table 3.4.15. Mobility Alternative Evaluation Matrix

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
Street Network	**Modified grid collector street system with a fine-grained block structure to disperse traffic and encourage walking and cycling.**	Does not advance a collector street network to accommodate traffic from future development. Does not establish a fine-grain network of collector streets to accommodate traffic movement or multi-modal travel connectivity.	East-west and north-south oriented collector streets provide a fine-grained grid of streets west of Gordon Street. East-west oriented parallel collector streets provide traffic routing alternatives and supports efficient dispersal of traffic. Limited provision of north-south oriented parallel collector streets east of Gordon Street. Proposed collector streets, in addition to existing road network, provides connectivity and access to planned development. Gaps in collector street grid network east of Gordon Street.	East-west and north-south oriented collector streets provide a fine-grained grid of streets west of Gordon Street. East-west oriented parallel collector streets provide traffic routing alternatives and supports efficient dispersal of traffic. Limited provision of north-south oriented parallel collector streets east of Gordon Street. Proposed collector streets, in addition to existing road network, provides connectivity and access to planned development. Gaps in collector street grid network east of Gordon Street.	East-west and north-south oriented collector streets provide a fine-grained grid of streets west and east of Gordon Street. East-west oriented and north-south parallel collector streets provide traffic routing alternatives and supports efficient dispersal of traffic. Direct north-south collector connections to Clair Road east of Gordon Street.	East-west and north-south oriented collector streets provide a fine-grained grid of streets west of Gordon Street. East-west oriented parallel collector streets provide traffic routing alternatives and supports efficient dispersal of traffic. Limited provision of north-south oriented parallel collector streets east of Gordon Street. Proposed collector streets, in addition to existing road network, provides connectivity and access to planned development. Gaps in collector street grid network east of Gordon Street.
Street Network	**Cost of implementing street network.**	Does not advance a collector street network. Minimal cost implications.	Approximately 9 km of collector streets. Limited roadworks through ecologically sensitive areas. Fifteen (15) new or reconstructed collector / arterial street intersections within the study area. Some grading challenges to more considerable grading challenges for Street E alignment west of Gordon Street.	Approximately 9 km of collector streets. Limited roadworks through ecologically sensitive areas. Fifteen (15) new or reconstructed collector / arterial street intersections within the study area. Some grading challenges to more considerable grading challenges for Street E alignment west of Gordon Street.	Additional 11.5 km of collector streets. Additional costs associated with roadworks through ecologically sensitive areas. Eighteen (18) new or reconstructed collector / arterial street intersections within the study area. Some grading challenges to more considerable grading challenges for Street E alignment west of Gordon Street.	Approximately 9 km of collector streets. Limited roadworks through ecologically sensitive areas. Fifteen (15) new or reconstructed collector / arterial street intersections within the study area. Some grading challenges including challenges for Street E alignment west of Gordon Street; however to a lesser degree then other concepts.

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
Street Network	**Ability to provide property access.**	Property access provided from existing arterial / collector streets.	Collector network adequately services development areas.	Collector network adequately services development areas.	Collector network adequately and most directly services development areas.	Collector network adequately services development areas.
Street Network	**Potential to service future travel demands.**	Limited opportunities to effectively distribute future development traffic. Reliance on existing arterial / collector streets to accommodate future development. Existing arterial / collector streets included limited active transportation facilities to accommodate multi-modal travel.	Collector street network adequately services anticipated development contemplated in land budget. Intersection improvements may be required to appropriately accommodate traffic demands at certain existing intersections north of the area. A macro-level traffic analysis conducted by a City consultant, supported a 4-lane Gordon Street cross-section without introduction on a new north-south oriented collector street between Clair Road and Maltby Road east of Gordon St.	Collector street network adequately services anticipated development contemplated in land budget. Intersection improvements may be required to appropriately accommodate traffic demands at certain existing intersections north of the area. A macro-level traffic analysis conducted by a City consultant, supported a 4-lane Gordon Street cross-section without introduction on a new north-south oriented collector street between Clair Road and Maltby Road east of Gordon St.	Collector street network adequately services anticipated development contemplated in land budget. Provides additional north-south direction vehicular capacity. Provides additional vehicle routing to / from Clair Road and neighbourhoods north of Clair Road. Fewer intersection improvements may be required to appropriately accommodate traffic demands at certain existing intersections north of the area.	Collector street network adequately services anticipated development contemplated in land budget. Intersection improvements may be required to appropriately accommodate traffic demands at certain existing intersections north of the area. A macro-level traffic analysis conducted by a City consultant, supported a 4-lane Gordon Street cross-section without introduction on a new north-south oriented collector street between Clair Road and Maltby Road east of Gordon St.
Street Network	**New street network continuity and connectivity internal to Secondary Plan area.**	Does not advance a collector street network to provide to support development.	West of Gordon Street: good collector street connectivity and continuity. East of Gordon Street: discontinuity in north-south collector street network.	West of Gordon Street: good collector street connectivity and continuity. East of Gordon Street: discontinuity in north-south collector street network.	Good collector street connectivity and continuity east and west of Gordon Street.	West of Gordon Street: good collector street connectivity and continuity. East of Gordon Street: discontinuity in north-south collector street network.
Street Network	**Multiple vehicular connections with local, regional and provincial roads to connect with the existing street**	No new street connection with local, regional or provincial roads.	Provides connectivity to planned collector street network and existing arterial street network.	Provides connectivity to planned collector street network and existing arterial street network.	Provides connectivity to planned collector street network and existing arterial street network.	Provides connectivity to planned collector street network and existing arterial street network.

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
	network and distribute traffic.		No connectivity to planned Southgate Drive extension or Rolling Hills neighbourhood.	No connectivity to planned Southgate Drive extension or Rolling Hills neighbourhood.	Additional collector street connectivity to Clair Road, and north-south collector street connectivity internal to the area.	No connectivity to planned Southgate Drive extension or Rolling Hills neighbourhood.
Street Network	**Impact to Natural Heritage System and natural / environmental elements.**	No provision of new transportation infrastructure. No substantive impacts to existing physical environment.	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted. Trail connections provided within Natural Heritage System.	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted. Trail connections provided within Natural Heritage System.	Construction of new collector street network. Eight (8) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is and is not permitted. Trail connections provided within Natural Heritage System.	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted. Trail connections provided within Natural Heritage System.
Active Transportation	**Provide facilities within the public and private realm which encourage cycling, and includes off-road cycling facilities.**	New cycling facilities not provided.	Pedestrian and cycling facilities to be incorporated in all municipal street right-of-ways. Potential active transportation links considered to connect proposed north-south oriented collector streets east of Gordon Street.	Pedestrian and cycling facilities to be incorporated in all municipal street right-of-ways. Potential active transportation links considered to connect proposed north-south oriented collector streets east of Gordon Street.	Pedestrian and cycling facilities to be incorporated in all municipal street right-of-ways. Active transportation links provided within / adjacent to municipal right-of-ways across Natural Heritage System corridors.	Pedestrian and cycling facilities to be incorporated in all municipal street right-of-ways. Potential active transportation links considered to connect proposed north-south oriented collector streets east of Gordon Street and west to Stonegate Drive industrial area.
Active Transportation	**Active transportation links to the Clair-Gordon mixed use node, South End Community Park, and other community facilities (schools, parks, community centres).**	New cycling and pedestrian facilities not provided.	Collector street network, and potential active transportation links provide direct connectivity to most community facilities.	Collector street network, and potential active transportation links provide direct connectivity to all community facilities.	Collector street network, and potential active transportation links provide direct connectivity to all community facilities.	Collector street network, and potential active transportation links provide direct connectivity to all community facilities.

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
Active Transportation	**Safety**	Existing streets will be upgraded consistent with the Transportation Master Plan, according to best practices and engineering standards to prioritize safety. New cycling infrastructure limited to improvements already identified in current plans and studies. New pedestrian infrastructure limited to improvements already identified in current plans and studies. No new pedestrian facilities, pedestrian crossing infrastructure, or cycling facilities, other than those identified in current plans and studies, to support new development.	Streets will be designed according to best practices and engineering standards to prioritize safety. Separate cycling facilities are proposed for arterial and collector street segments. Off-street trails will complement the planned cycling network. Sidewalks will be provided on both sides of all arterial and collector streets, and provide connections to properties, amenities and transit. Appropriate street crossing facilities will be incorporated to complement the pedestrian network.	Streets will be designed according to best practices and engineering standards to prioritize safety. Separate cycling facilities are proposed for arterial and collector street segments. Off-street trails will complement the planned cycling network. Sidewalks will be provided on both sides of all arterial and collector streets, and provide connections to properties, amenities and transit. Appropriate street crossing facilities will be incorporated to complement the pedestrian network.	Streets will be designed according to best practices and engineering standards to prioritize safety. Separate cycling facilities are proposed for arterial and collector street segments. Off-street trails will complement the planned cycling network. Sidewalks will be provided on both sides of all arterial and collector streets, and provide connections to properties, amenities and transit. Appropriate street crossing facilities will be incorporated to complement the pedestrian network.	Streets will be designed according to best practices and engineering standards to prioritize safety. Separate cycling facilities are proposed for arterial and collector street segments. Off-street trails will complement the planned cycling network. Sidewalks will be provided on both sides of all arterial and collector streets, and provide connections to properties, amenities and transit. Appropriate street crossing facilities will be incorporated to complement the pedestrian network.
Transit	**Extends and connects to existing transit routes and facilities within the City of Guelph**	Existing area bus routes do not service the area.	Provides opportunity for existing area bus routes to connect to, and circulate within, the area.	Provides opportunity for existing area bus routes to connect to, and circulate within, the area.	Provides opportunity for existing area bus routes to connect to, and circulate within, the area. Provides additional opportunity to route existing bus services to / from Clair Road east of Gordon Street.	Provides opportunity for existing area bus routes to connect to, and circulate within, the area.
Transit	**Transit hub along Gordon Street in a location that connects riders with high density residential,**	Opportunity to appropriately locate a transit terminal along a mixed-use / high-density section of Gordon Street. Limited opportunity to accommodate high-density	Opportunity to appropriately locate a transit terminal along a mixed-use / high-density section of Gordon Street. Opportunity to utilize east-west oriented collector	Opportunity to appropriately locate a transit terminal along a mixed-use / high-density section of Gordon Street. Opportunity to utilize east-west oriented collector	Opportunity to appropriately locate a transit terminal along a mixed-use / high-density section of Gordon Street. Opportunity to utilize east-west oriented collector streets to provide flexibility and	Opportunity to appropriately locate a transit terminal along a mixed-use / high-density section of Gordon Street. Opportunity to utilize east-west oriented collector

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
	commercial and mixed use areas.	and/or commercial retail development without new collector road network and improvements to the existing road network.	streets to provide flexibility and efficient bus routing to transit terminal.	streets to provide flexibility and efficient bus routing to transit terminal.	efficient bus routing to transit terminal.	streets to provide flexibility and efficient bus routing to transit terminal.
Transit	**Bus stops are provided at regular intervals, generally within 400m of every residence and business.**	Existing area bus routes do not service the area. Bus routing and stops limited to existing roads and unable to provide service within 400m of all development areas.	Collector street network established to accommodate bus routing and stops within 400m of all development areas.	Collector street network established to accommodate bus routing and stops within 400m of all development areas.	Collector street network established to accommodate bus routing and stops within 400m of all development areas.	Collector street network established to accommodate bus routing and stops within 400m of all development areas.
Transit	**Opportunity to provide efficient transit routing options.**	Existing area bus routes do not service the area. Few opportunities to efficiently provide turnaround or "end-of-route" facilities.	Continuity in collector streets provides opportunity to efficiently route bus services north-south / east-west through the area.	Continuity in collector streets provides opportunity to efficiently route bus services north-south / east-west through the area.	Continuity in collector streets provides opportunity to efficiently route bus services north-south / east-west through the area. Additional north-south collector street east of Gordon Streets provides additional opportunity for efficient routing of bus services east of Gordon Street.	Continuity in collector streets provides opportunity to efficiently route bus services north-south / east-west through the area.
Trails	**Facilities for recreational trail use.**	New recreation trails not provided.	Opportunities for trail facilities adjacent to natural heritage system. Limit trail crossing of collector / arterial street network.	Opportunities for trail facilities adjacent to natural heritage system. Limit trail crossing of collector / arterial street network.	Opportunities for trail facilities adjacent to natural heritage system. Additional trail crossing of collector streets required.	Opportunities for trail facilities adjacent to natural heritage system. Limit trail crossing of collector / arterial street network.
Trails	**Facilitates for day-to-day travel demand.**	New recreation trails, multi-use trails, and other cycling and pedestrian facilities not provided.	Provides opportunities to connect with planned / existing on-street cycling facilities.	Provides opportunities to connect with planned / existing on-street cycling facilities.	Provides opportunities to connect with planned / existing on-street cycling facilities. Supplements on-street cycling facilities within the area.	Provides opportunities to connect with planned / existing on-street cycling facilities.

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
			Supplements on-street cycling facilities within the area.	Supplements on-street cycling facilities within the area.		Supplements on-street cycling facilities within the area.
Trails	**Connections to City-wide trail network**	New recreation trails not provided.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan. Potential active transportation link considered to connect with Southgate Drive.
Trails	**Local connections between residential areas and community facilities / commercial areas**	New recreation trails, multi-use trails, and other cycling and pedestrian facilities not provided.	Trails supplement collector street network to provide direct connectivity to most community facilities and Gordon Street corridor.	Trails supplement collector street network to provide direct connectivity to all community facilities and Gordon Street corridor.	Trails supplement collector street network to provide direct connectivity to all community facilities and Gordon Street corridor.	Trails supplement collector street network to provide direct connectivity to all community facilities and Gordon Street corridor.
Alignment with Objectives of the Secondary Plan	**Green and Resilient**	No provision of new transportation infrastructure. No substantive impacts to existing physical environment.	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted.	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted.	Construction of new collector street network. Eight (8) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is and is not permitted. Trail connections provided within Natural Heritage System	Construction of new collector street network. Five (5) new collector street crossings of the Natural Heritage System within areas where transportation infrastructure is permitted. Trail connections provided within Natural Heritage System.
Alignment with Objectives of the Secondary Plan	**Healthy and Sustainable**	No provision of new transportation infrastructure, recreation trails, multi-use trails, and other cycling and pedestrian facilities.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan.	Provides opportunities to connect City Cycling Master Plan, Active Transportation Network Plan, and Trail Network Plan. Potential active transportation link

Transportation Network Elements	Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan"
		○	◕	◕	Least financially viable and least optimized for use of existing infrastructure. ◑	considered to connect with Southgate Drive. Provides direct active transportation opportunities where typical road cross-section are not permitted through Natural Heritage System. ●
Alignment with Objectives of the Secondary Plan	**Vibrant and Urban**	No provision of new transportation infrastructure, recreation trails, multi-use trails, and other cycling and pedestrian facilities. ○	Gordon Street is central spine with connectivity Village Core / Main ◕	Gordon Street is central spine with connectivity Village Core / Main ◕	Gordon Street is central spine with connectivity Village Core / Main. N-S Collector connection on either side of Gordon Street. ●	Gordon Street is central spine with connectivity Village Core / Main. N-S Active Transportation connection on either side of Gordon Street. ●
Alignment with Objectives of the Secondary Plan	**Interconnected and Interwoven**	No provision of new transportation infrastructure, recreation trails, multi-use trails, and other cycling and pedestrian facilities. ○	Efficient transit service. Provide connections to parks, open spaces and trails from the Moraine Ribbon and the road network to promote active transportation and passive recreation ◑	Efficient transit service. Provide connections to parks, open spaces and trails from the Moraine Ribbon and the road network to promote active transportation and passive recreation ◕	Continuous multi-modal travel throughout Clair-Maltby with connections to city-wide travel networks. Efficient transit service. Provide connections to parks, open spaces and trails from the Moraine Ribbon and the road network to promote active transportation and passive recreation ◕	Continuous multi-modal travel throughout Clair-Maltby with connections to city-wide travel networks. Efficient transit service. Provide connections to parks, open spaces and trails from the Moraine Ribbon and the road network to promote active transportation and passive recreation. Priority on walking, cycling, and transit. ●
Alignment with Objectives of the Secondary Plan	**Balanced and Livable**	No provision of new transportation infrastructure, recreation trails, multi-use trails, and other cycling and pedestrian facilities. ◑	Adequately served by trails, walkable areas, access to Natural Heritage System. ◕	Adequately served by trails, walkable areas, access to Natural Heritage System. ◕	Adequately served by trails, walkable areas, access to Natural Heritage System. ◕	Adequately served by trails, walkable areas, access to Natural Heritage System. ●

3.4.6 Preferred Solution(s)

A summary of the Evaluation Matrix (by criteria) is provide below.

Table 3.4.16. Mobility Evaluation Summary

Criteria	Alternative 1: "Do Nothing"	Alternative 2: "Featuring the Green"	Alternative 3: "Focus on Community Services"	Alternative 4: "Urban and Connected"	Alternative 5: "Preferred Community Structure Plan
Street Network	○	◐	◕	●	◕
Active Transportation	○	◕	◕	◕	●
Transit	○	◕	◕	●	◕
Trails	○	◕	◕	◕	●
Alignment with Objectives of the Secondary Plan	○	◕	◕	◕	●

3.4.6.1 Preferred Solution

Alternative 4 "Urban and Connected" provides the most robust transportation network to adequately accommodate development of the Secondary Plan area, but it is also the most expensive alternative and most extensively impacts the Natural Heritage System and existing physical environment.

Alternative 5, the "Preferred Community Structure Plan" street network provides equivalent / better active transportation and trail connectivity relative to the Alternative 4 concept, adequately accommodates future development and transit services, is less costly, and, importantly, results in less impact to the Natural Heritage System.

The Preferred Community Structure has built upon the road network, active transportation network, and trail network in the preferred Mobility alternative (Alternative 5).

The street network represents a modified grid system, which is intended to allow for frequent and robust routing for all street users, while respecting the important environmental features of the area.

A total of four east-west oriented collector streets are proposed to cross Gordon Street between Gosling Gardens in the north and Maltby Road in the south. One north-south oriented collector street is proposed to extend between Poppy Road in the north and Maltby Road in the south, and will be located in the western portion of the Secondary Plan area (west of Gordon Street). This second north-south oriented street is required to connect to Clair Road to accommodate the land budget considered as part of the planning process (approximately 10,125 units). In absence of a second street connection between the Secondary Plan area and Clair Road, considerable improvements are required to the Gordon Street / Clair Road and Victoria Road / Clair Road intersections, beyond those already recommended herein.

Two additional north-south collector streets are illustrated in the south-eastern portions of the Secondary Plan area in order to establish a robust street-network grid in this location. All collector streets, as well as existing arterial streets, are intended to appropriately integrate cycling and pedestrian facilities to ensure multi-modal mobility and accessibility.

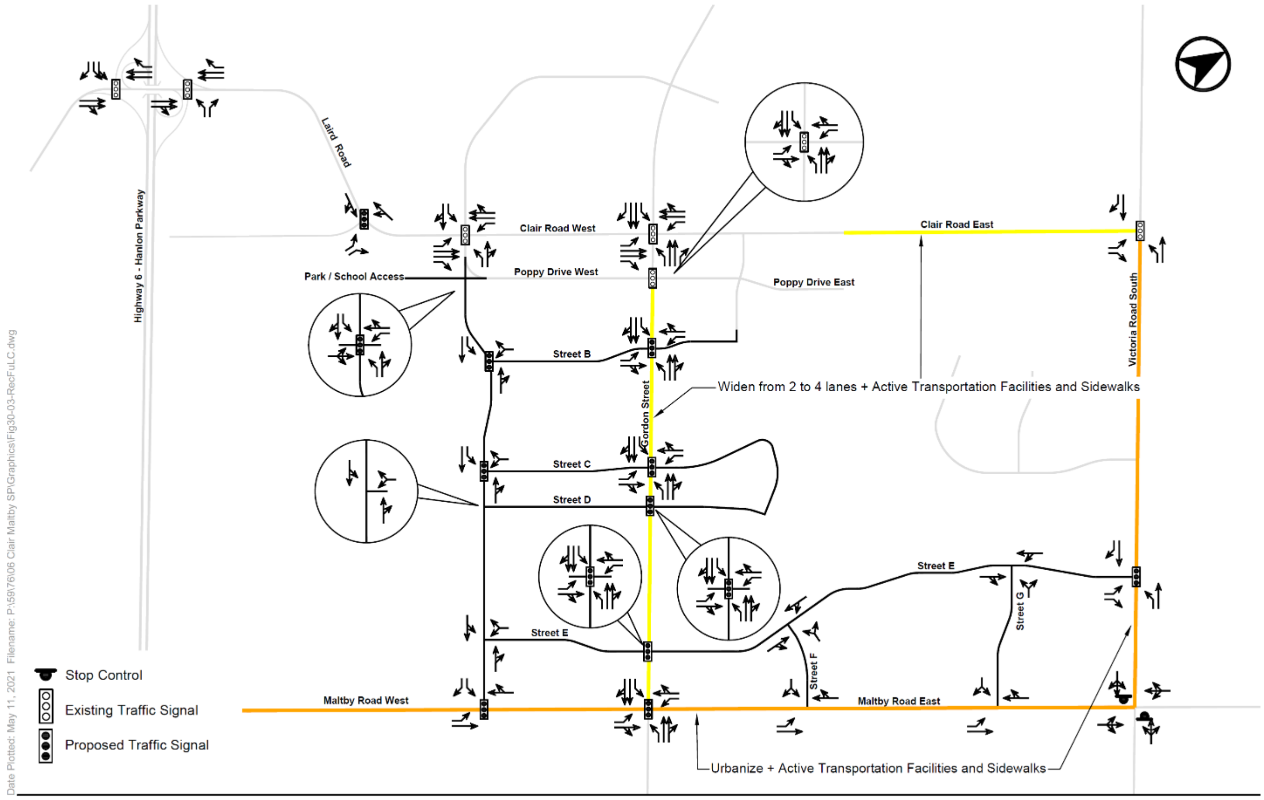
The design of all collector streets and existing arterial streets is intended to allow for the operation of buses, to provide several opportunities and flexibility for transit vehicle routing throughout the Clair-Maltby Secondary Plan. Transit services are intended to route throughout the Secondary Plan area, allowing for bus stops to be provided at regular intervals within 400 metres of 90 per cent of residents and businesses. Additional transit provisions may also be made along the Gordon Street corridor to allow for convenient service transfers, and infrastructure to support the efficient and reliable routing of transit vehicles.

The planned network of streets (and trails) are intended to achieve safe, convenient and comfortable travel and access for all street-users, with priority given to pedestrians, cyclists, and transit operations, to provide mobility choice and support city policy and modal-split objectives. Vehicular movement will be accommodated, but is not prioritized, and will be subject to levels-of-service which are more constrained then typical in new-build areas within the City.

The Preferred Community Structure provides a general layout of land use, connective elements (arterial / collector streets and trails), community facilities, potential locations for storm water management facilities, existing cultural heritage resources, and wetlands.

The Clair-Maltby Secondary Plan Preferred Community Structure advances an urban village concept comprised of the Gordon Street Corridor, surrounding neighbourhoods and the Natural Heritage System. The Plan indicates that the area will be primarily residential in character with a full range and mix of housing types and a variety of other uses that meet the needs of all residents. The Natural Heritage System and the Paris Moraine, together with a system of parks and open spaces, provide a framework for the balanced development of interconnected and sustainable neighbourhoods. The Natural Heritage System further informs the opportunities for transportation infrastructure including a network of development-supportive collector streets.

Figure 3.4.29. Preferred Road Network



RECOMMENDED FUTURE TRAFFIC LANE CONFIGURATIONS AND CONTROLS

Road Cross-Sections

The City of Guelph has a set of standard road cross-sections that guides design of the right-of-way, boulevard, and pavement width standards for municipal roadways. There is potential to update the road / design standards specifically for the Clair-Maltby Secondary Plan area to permit further programming within the pavement or boulevard spaces to include multi-modal uses where appropriate or to account for variations in natural landscape where a context sensitive standard may be most suitable.

The Clair-Maltby Cross-Section Study, March 2020 was conducted by Wood specifically for the Clair-Maltby Secondary Plan area. Excerpts of the latest cross-sections are provided in Figures 3.4.30, 3.4.31, and 3.4.32.

Gordon Street Corridor

The Gordon Street corridor is a central element in the local transportation network, connects the area with the wider City and County, provides an opportunity for transit priority, and is envisioned as a main street / village core destination.

The Gordon Street right-of-way is intended to accommodate all street users through the delivery of multimodal infrastructure. Its design will support the efficient and effective routing of transit services, the comfortable movement of cyclists and pedestrians, and accommodate for automobile travel.

A 4-lane Gordon Street cross-section is anticipated to appropriately accommodate traffic demands along the corridor given optimized signal timing and coordination, and the inclusion of ancillary turn lanes where necessary. Separate left-turn lanes should be provided at all junctions where left-turns are permitted, which may further support the introduction of a continuous left-turn / centre median lane along the extent of Gordon Street within the Secondary Plan area.

The Clair-Maltby Secondary Plan encourages dense, mixed-use development along the Gordon Street corridor to support the deployment of transit services. Transit priority measures can be potentially introduced along the Gordon Street corridor to increase the proportional uptake of transit use, and can include physical design elements to reduce transit vehicle delays and provide amenity and convenience to perspective riders, and policy measures to make transit more appealing, affordable, and competitive with other travel modes.

Figure 3.4.30. Local Roadway

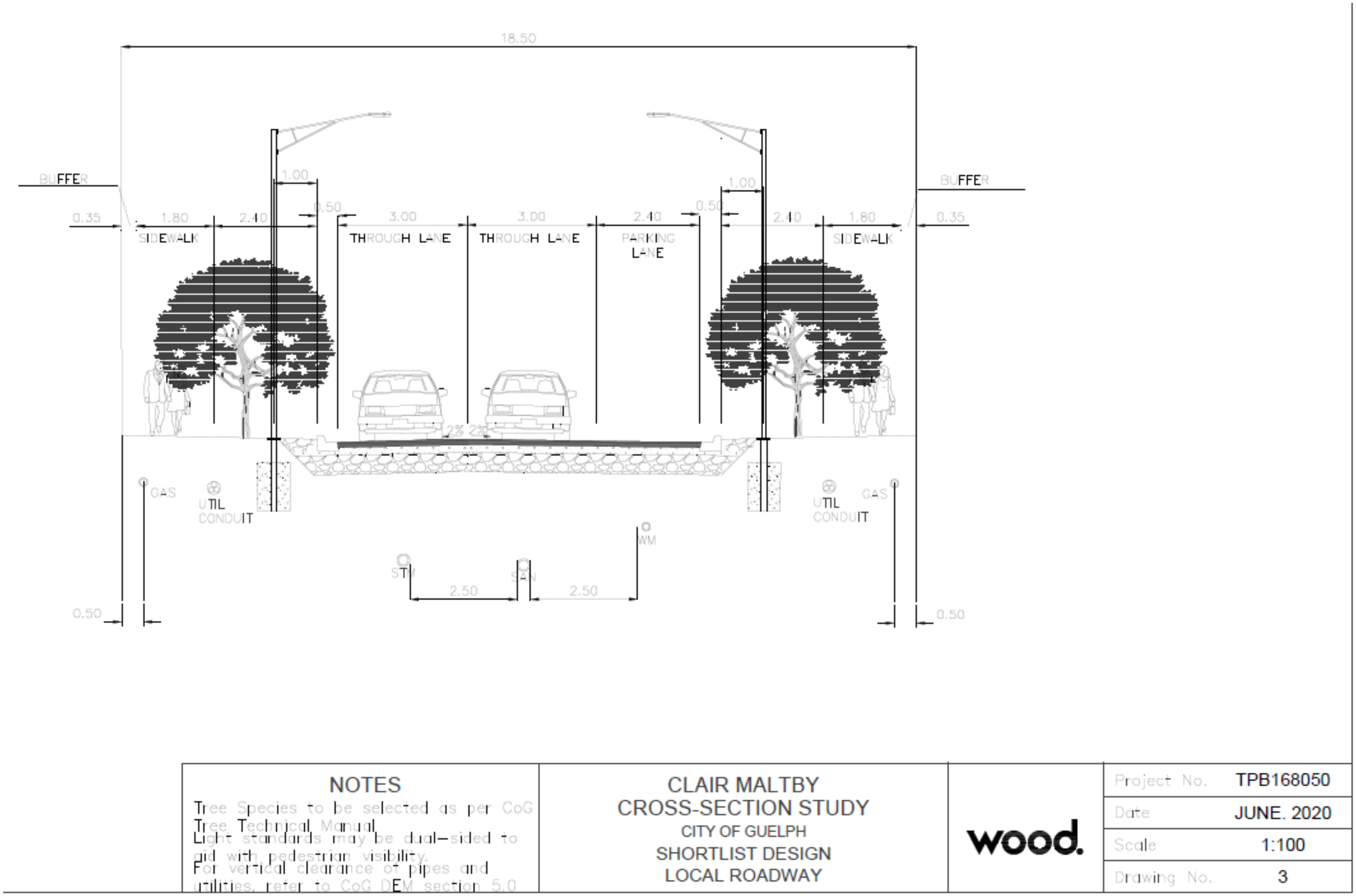
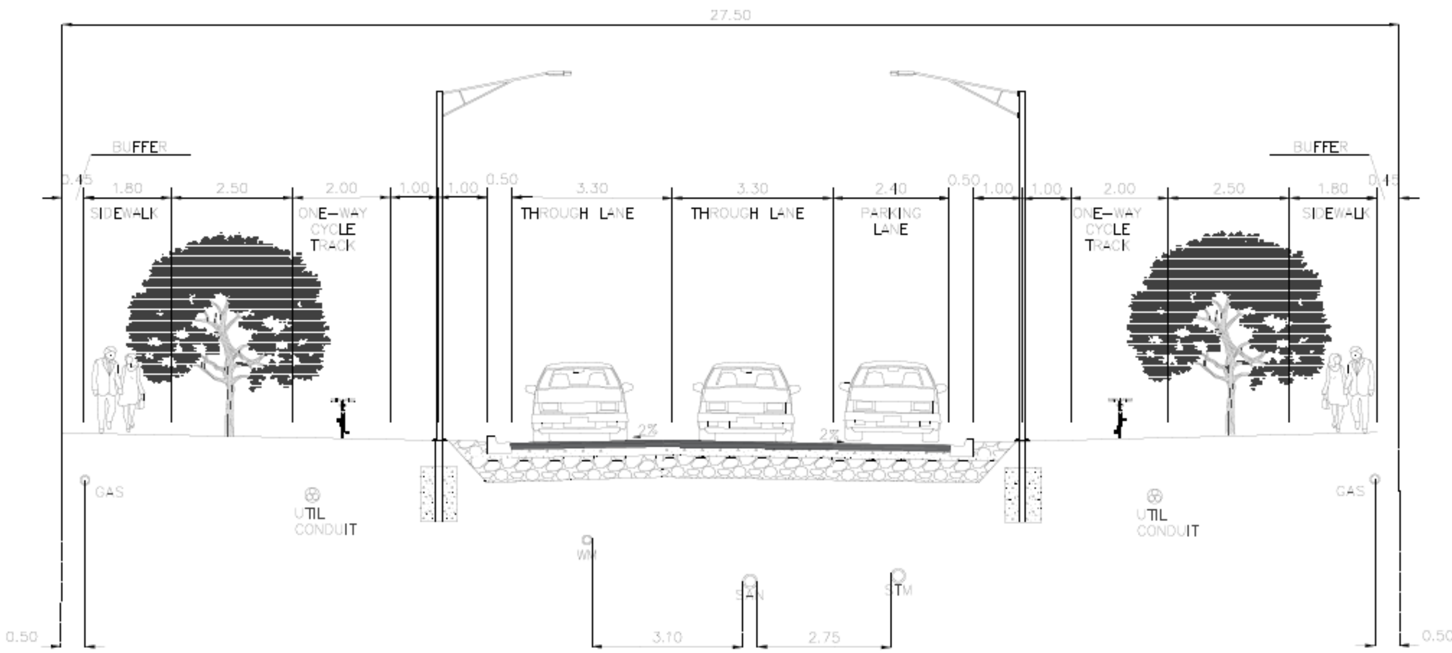
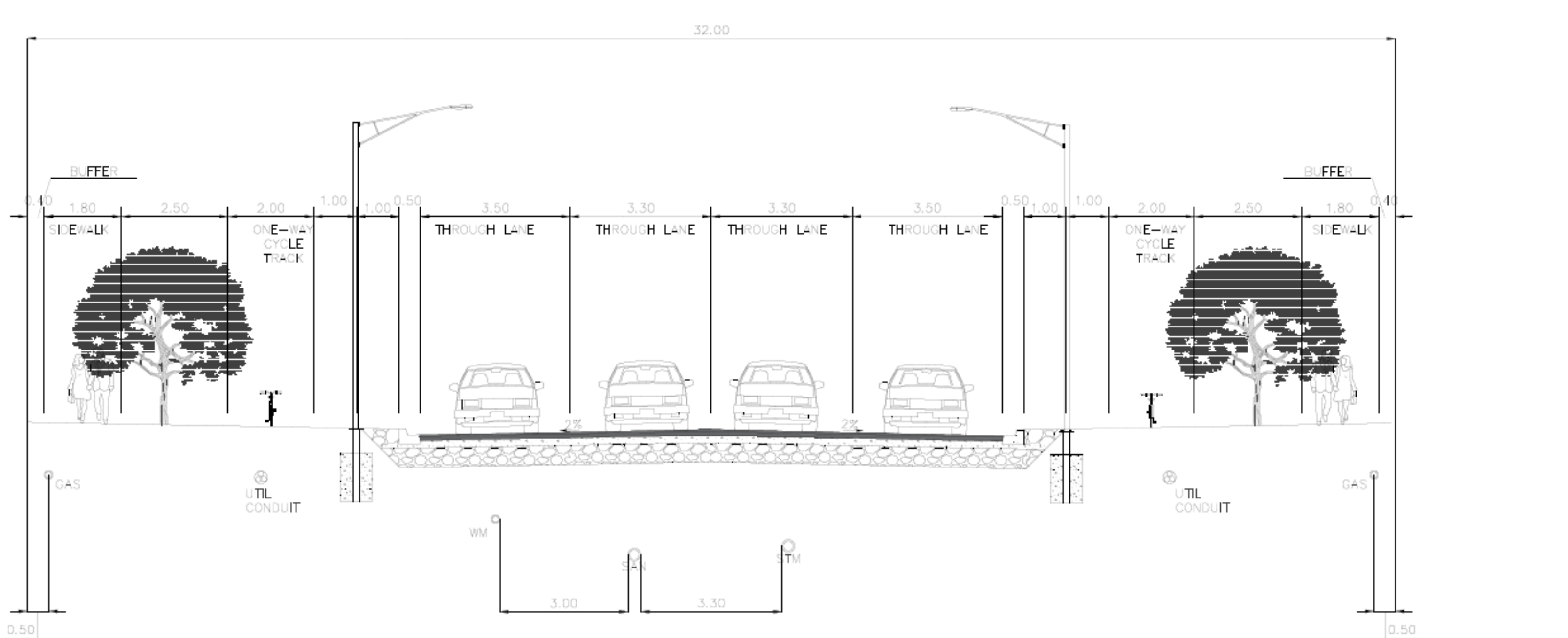


Figure 3.4.31. Collector Roadway



NOTES	CLAIR MALTBY CROSS-SECTION STUDY		Project No.	TPB168050
Tree Species to be selected as per CoG Tree Technical Manual. Light standards may be dual-sided to aid with pedestrian visibility. For vertical clearance of pipes and utilities, refer to CoG DEM section 5.0	CITY OF GUELPH	wood.	Date	JUNE. 2020
	SHORTLIST DESIGN		Scale	1:100
	COLLECTOR ROADWAY		Drawing No.	2

Figure 3.4.32. Arterial Roadway



NOTES			
Tree Species to be selected as per CoG Tree Technical Manual Light standards may be dual–sided to aid with pedestrian visibility. For vertical clearance of pipes and utilities, refer to CoG DEM section 5.0	CLAIR MALTBY CROSS-SECTION STUDY CITY OF GUELPH SHORTLIST DESIGN ARTERIAL ROADWAY	wood.	Project No. TPB168050 Date JUNE. 2020 Scale 1:100 Drawing No. 1

Clair-Maltby Secondary Plan Cross-Sections

Right-of-way cross-sections have been developed for collector streets contemplated as part of the Clair- Maltby Secondary Plan, as well as existing arterial streets and concept future local streets within the area.

A series of cross-sections are developed for different types of streets, which are appropriately designed to accommodate a diverse mix of users and respond to the urban design, land use, and public realm contexts. Cross-sections are intended to be understood in conjunction with City of Guelph construction standards and guidelines, and should be flexible enough to meet context specific limitations and servicing / utility requirements and will be designed in detailed plan and section view as part of future area development.

Cross sections prepared in support of the Clair-Maltby Secondary Plan intend the design and delivery of complete streets, which include pedestrian and cycling infrastructure, support transit service routing, street trees and landscaping, and utility / service delivery. Vehicle travel lanes are reduced to an appropriate level, to accommodate vehicle movement while not prioritizing vehicles over other street users.

In the design of public right-of-ways, the City will balance the provision of safe, functional, and attractive pedestrian-oriented, cyclist friendly and transit-supportive environments while accommodating for an acceptable level of vehicular traffic and operation.

Different public right-of-way cross-sections have been developed for unique circumstances that accommodate for differences in adjacent land uses and the types of demands these uses can place on a typical street. For example, three-lane collector street cross-sections may be more appropriate for corridors with frequent transit service, larger (heavy) turning vehicles, intended to accommodate a greater number of "through" traffic, or frequent driveway connections. Wider pavement areas, or off-centre median lane designs, may also be pursued in instances where on-street parking will be accommodated. It is noted that Guelph Transit does not support vehicle parking on streets where transit services operate, as there is concern about motorists blocking or parking adjacent to transit stops. Similarly, wider right-of-ways may be pursued in instances where other infrastructure are required such as major trunk utilities, municipal service corridors, or overland flow routes.

The narrowest public right-of-ways are typically reserved for local streets intended to provide property access, accommodate local traffic and relatively low volumes of street users, and serve low and medium density development.

4 Implementation

Implementation of water, wastewater, stormwater, and mobility infrastructure must consider phasing / staging considerations and costing. The following outlines the phasing considerations and preliminary costing for each of the infrastructure components.

4.1 Phasing

The following outlines the phasing considerations for each of the infrastructure components.

4.1.1 Water

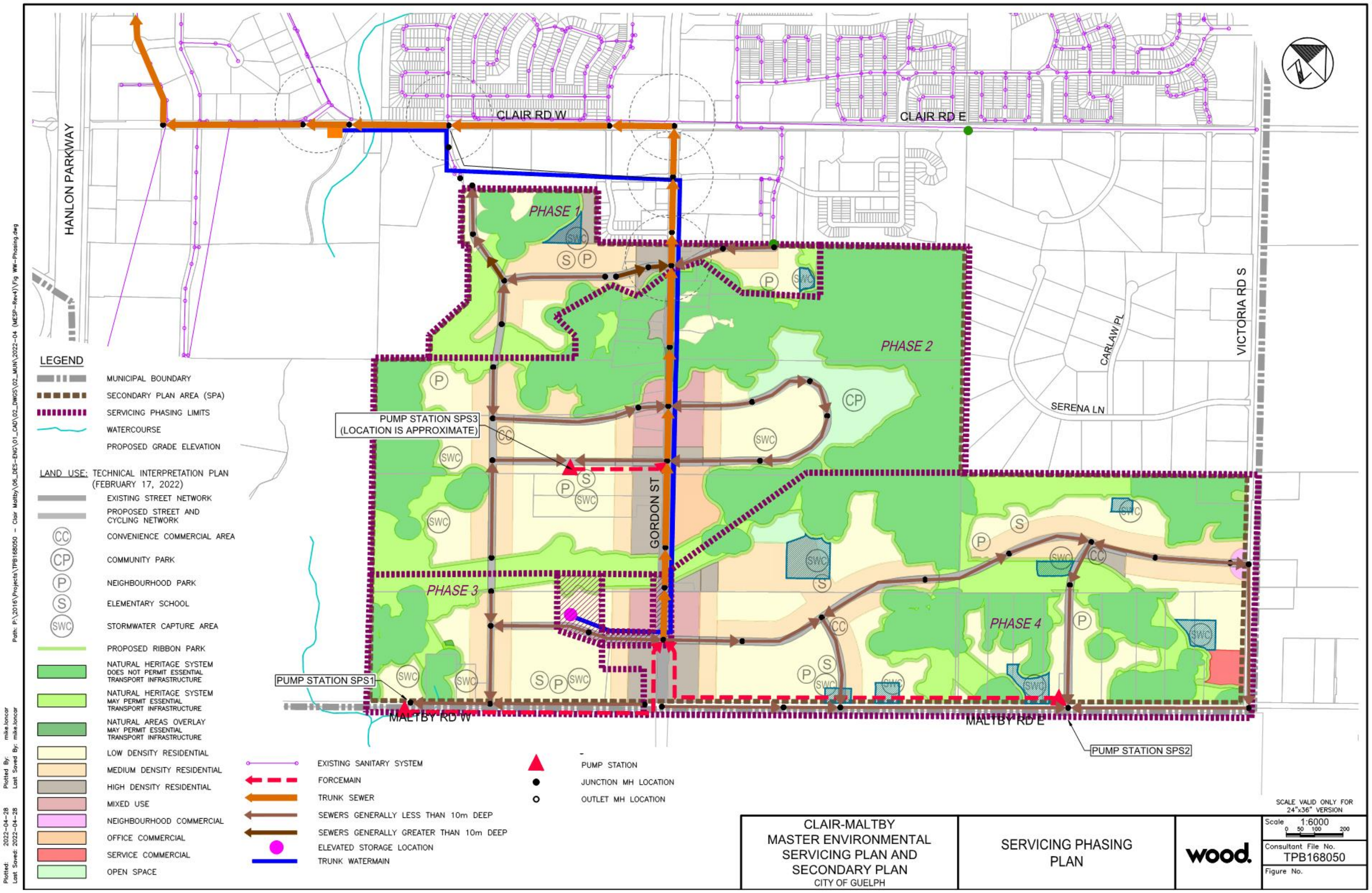
As there is available capacity in Zone 1 to supply the demands of Zone 3 in part, development in the CMSP lands can begin before the Zone 3 storage reservoir and the transmission main is constructed. In general, it would be advantageous for the development to progress from north to south, given access to infrastructure to the north. It appears that this would be the most economic sequencing of development from the perspective of infrastructure costs versus return on investment. Additionally, the transmission main could be extended southwards as development advances.

A Conceptual Servicing Phasing plan is shown on Figure 4.1.1 which indicates the general recommended sequencing of phasing areas and developments, with detailed phasing figures provided in Section 4.1.5. The relative proximity of Phase 1 to the Clair Booster Pump Station (BPS) would ensure that the transmission main conveying water to the new development would minimize the length to service this initial Phase. It is estimated that approximately 20%-25% of the total demand could be met by the existing infrastructure, however for redundancy in the event of an issue with the existing Clair Road BPS, the Team has added an in-line Booster Pumping Station to serve as back-up. It is expected that Phase 1 could be developed before the Water Storage from Zone 1 is fully applied and the new Zone 2 storage reservoir will be required. The exact timing of this requirement will depend on the sequencing of development within each phase and will need to be determined/confirmed by updated modelling.

4.1.2 Wastewater

A Conceptual Servicing Phasing is shown in Figure 4.1.1 which indicates the general recommended sequencing of developments. Phasing of the development will be sequential from downstream to upstream. Catchments 4 and 5 in Phase 1 can discharge to existing services. In order to develop Phase 2 pumping infrastructure the trunk sewers for the SPS3 catchment area from Gordon St to the receiving branch connection at MHD00002142, will be required. Once that infrastructure is in place, development of the catchment areas associated with either SPS1 (Phase 3) or SPS2 (Phase 4) could proceed in a logical manner.

Figure 4.1.1. Conceptual Servicing Phasing Areas



4.1.3 Stormwater

Staging:

Stormwater management measures are typically constructed for the contributing development area, as development proceeds, with stormwater management measures implemented at various stages of construction. End-of-pipe stormwater management facilities, in the case of Clair-Maltby, stormwater capture areas (SWCA), are proposed to be constructed near the commencement of construction of each development phase, tributary to that SWCA, therefore providing runoff capture from the disturbed lands. At-source public and conveyance stormwater management measures would be constructed during right-of-way construction and for LID BMPs located on private lands, during the finishing construction of private lot grading and sodding. High level staging for stormwater management has been illustrated in Figure 3.3.5 and Figure 4.1.2 building from the staging required for water and wastewater servicing.

For SWCAs that could receive drainage from multiple developments, agreements will have to be in place between the respective developers and the City, which provide staging and financial arrangements to facilitate construction of the respective SWCAs. The agreement will need to outline if the SWCA is to be constructed partially (in stages) or in its entirety, should the contributing developments be staged at different times. Any staging of associated stormwater management measures will have to be detailed in the subdivision Stormwater Management Reports prepared by development representatives and agreed to by the City, GRCA and the MECP.

Maintenance and Monitoring:

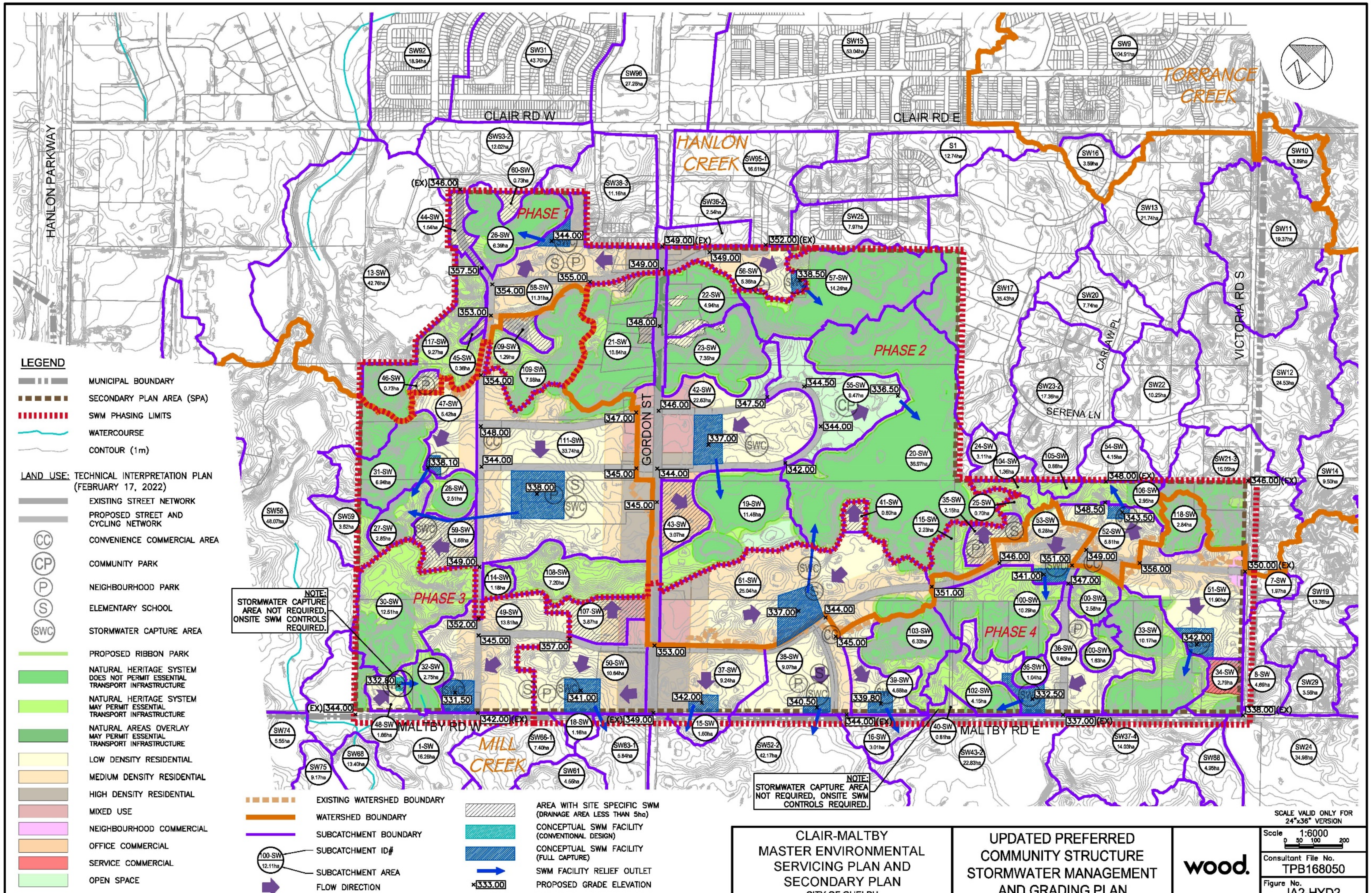
Stormwater management measures will have to be maintained during the various construction stages and if required, cleaned-out prior to assumption by the City. Stormwater management measures will be required to be monitored to ensure, performance is as per the detailed design criteria and that water quantity and quality targets are being met or exceeded.

The specific frequency and duration of post-construction and compliance monitoring will be determined by the City in consultation with the applicable agencies and landowners, as well as other partners, as applicable. This will be confirmed through the development application process, as indicated in Phase 3 CEIS Section 7.3.3. The frequency and duration of monitoring will vary depending on the parameters being monitored, and the objectives of the monitoring.

Other Requirements:

In preparing development plans, investigations are also required to determine the possibility of tile drainage systems onsite or on adjacent lands that may contribute water (surface/subsurface) to tile drainage either in tiles or overland via tile system outlets. The assessment of tile drainage systems and potentially connected ponds and/or wetlands is required to demonstrate no negative impacts to the ultimate receiving drainage system(s) and to the upstream tile drainage system and connecting pond and/or wetlands.

Figure 4.1.2. Stormwater Management Staging Plan



4.14. Mobility

The timing of development applications and their associated road network is unknown at this time for lands within the Secondary Plan area. Individual development applications will have to demonstrate, as part of a traffic impact study or driveway operations review, that there is sufficient capacity on the existing/background road network and what, if any specific improvements would be required to support their development including new road connections. As part of the development application, they would also be required to provide the planned rights-of-way for the Secondary Plan collector and arterials road system that would be DC eligible and construct/pay for local roads serving the development. Depending on the location of a specific development and its associated impact, a developer may be required to construct a segment of DC eligible collector/arterial road network.

The recommended road network improvements for the Secondary Plan study area are identified in Table 4.1.1, along with the anticipated EA Schedule for roads projects within and surrounding the Secondary Plan area.

There are also a number of amendments in progress for the MCEA process that may influence whether roads >$2.4m proceed to Schedule C or instead remain exempt through Schedule A undertakings.

Table 4.1.1. Summary of Road Improvements and Anticipated EA Schedules

Road	Improvement	From	To	Anticipated EA Schedule Required	Anticipated Cost Relative to MCEA Limit	MCEA Schedule Reference[2,3,4]
Clair Road East	Widen from 2 to 4 lanes with active transportation and sidewalks	Beaver Meadows Drive	Victoria Road South	Schedule C	>$2.4	20
Victoria Road South	Urbanize and add active transportation and sidewalks	Clair Road East	Maltby Road	Schedule A+[6]	NL[1]	19
Maltby Road East	Urbanize and add active transportation and sidewalks	Hanlon Parkway	Victoria Road South	Schedule A+[6]	NL[1]	19
Gordon Street	Widen from 2 to 4 lanes, Urbanize to include cycle tracks and sidewalks	Clair Road	Maltby Road	EA Update to former study	>$2.4m	20
Street A Collector	New Road	Poppy Drive	Maltby Road	Schedule C	>$2.4m	20
Street B Collector	New Road	Street A	Gordon Street	Schedule B	<$2.4m	20
Street B Collector	New Road	Gordon Street	Hawkins Drive	Schedule B	<$2.4m	20

Road	Improvement	From	To	Anticipated EA Schedule Required	Anticipated Cost Relative to MCEA Limit	MCEA Schedule Reference[2,3,4]
Street C Collector	New Road	Street A	Gordon Street	Schedule B	<$2.4m	20
Street D Collector	New Road	Street A	Gordon Street	Schedule B	<$2.4m	20
Street C/D[5]	New Road	East of Gordon Street	East of Gordon Street	Schedule B	<$2.4m	20, 23
Street E Collector	New Road	Street A	Victoria Road	Schedule C	>$2.4m	20
Street F Collector	New Road	Street E	Maltby Road	Schedule B	<$2.4m	20
Street G Collector	New Road	Street E	Maltby Road	Schedule B	<$2.4m	20

Notes:

1. NL = No financial limit in MCEA Schedule
2. Ref 20 = Reconstruction or widening where the reconstructed road or other linear paved facilities (e.g. HOV lanes will not be for the same purpose, use, capacity or at the same location (e.g. additional motor vehicle lanes, continuous centre turn lane)
3. Ref 19 = Reconstruction where the reconstructed road or other linear paved facilities (e.g. HOV lanes) will be for the same purpose, use, capacity and at the same location (e.g. addition or reduction of cycling lanes/facilities or parking lanes, provided no change in the number of motor vehicle lanes)
4. Ref 23. Construction of local roads which are required as condition of approval on a site plan, consent, plan of subdivision or plan of condominium which will come into effect under the Planning Act prior to the construction of the road. [Note – Reference to "local" roads refers to roadway function not municipal jurisdiction.
5. Street C/D is a loop road that effectively operates as a local connection.
6. Widening or change in number of lanes would modify this to a Schedule C.

4.1.5 Integrated Phasing

The following provides a summary of each of the four (4) phases for each of the four (4) servicing components, water, wastewater, stormwater and mobility as per Tables 4.1.2 to 4.1.5. Each table indicates the project (item) that would be constructed, capital cost (see Section 4.2 for further costing details) and anticipated municipal class environmental assessment schedule required. Figures 4.1.3 to 4.1.6 depict infrastructure requirements for Phases 1-4. The capital projects listed below are required to be in place to support the growth in each phase (i.e., must build this infrastructure before the full build-out of each phase).

Table 4.1.2. Summary of Phase 1 Infrastructure Projects

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
Water			
1	Partial 600mm Transmission Main from Clair Gordon BPS	$2,982,600	Schedule B_1
2	Local Distribution System (300mm diameter, Valves, Hydrants, etc.)	$2,257,500	Schedule B_1
3	Include Inline Booster	$465,000	Schedule B_1
Wastewater			
1	Local Gravity Sewers	$1,697,328	Schedule B_1
2	Trunk Sewer	$9,850,800	Schedule B_1
Stormwater			
1	Stormwater Capture Area 56	$1,915,930	Schedule B_1
2	Stormwater Capture Area 58	$2,759,998	Schedule B_1
Mobility			
1	Commence EA Study for Laird Road (Southgate Drive to west of Poppy Drive): widening to 4-lanes plus Active Transportation		Schedule C
2	Commence EA Study for Clair Road (Dallan Drive to Victoria Road): widening to 4-lanes plus Active Transportation		Schedule C
3	Commence EA Study for Street A Collector Road (Poppy Drive to Maltby Road)		Schedule C
4	Commence EA Study Update for Gordon Road (Gosling		Schedule C EA Update

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
	Gardens to south of Maltby Road)		
5	Intersection Improvements[2,3] at: - Clair Road / Laird Road - Clair Road / Poppy Drive - Clair Road / Gordon Street - Gordon Street / Poppy Drive - Gordon Street / Street B - Gordon Street / Maltby Road	$1,404,300	NL[4]
6	Street B (west of Gordon) – 615 m	$2,054,285	Schedule B[1]
7	Street B (east of Gordon) – 375 m	$1,252,613	Schedule B[1]
8	Street A (Stage 1: Poppy to Street B) – 355 m + NHS Crossing	$4,745,807	Schedule C
	TOTAL PHASE 1 COSTING	**$31,386,161**	

1. MCEA Schedule requirements have been fulfilled by MESP
2. Phase 1 assumes the buildout of background development and units north of the Phase 1 Servicing/SWM phasing boundary. Timing of intersection improvements noted above should be monitored through Plan of Subdivision and development applications, recognizing the short time period (0-2 years) and variability in development buildout that could occur.
3. Collector costs based on per intersection costs outlined in April 2020 Cost Estimate Memorandum: $3,340,300 / km for 2-3 lane plus AT
4. NL = No Financial Limit for MCEA Requirement 12. a) Construction of localized operational improvements at specific locations and <$9.5m MCEA Requirement 13 Installation, construction, or reconstruction of traffic control devices (e.g. signing, signalization)

Table 4.1.3. Summary of Phase 2 Infrastructure Projects

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
Water			
1	600mm Transmission Main from Clair Gordon BPS	$2,910,600	Schedule B[1]
2	Local Distribution System (300mm diameter, Valves, Hydrants, etc.)	$5,483,750	Schedule B[1]
43	Elevated Storage	$5,700,000	Schedule B[1]
54	Property Costs	$500,000	Schedule B[1]
Wastewater			
1	Local Gravity Sewers	$2,589,461	Schedule B[1]
2	Sewage Pumping Station SPS-3	$700,000	Schedule B[1]
3	Forcemain FM-3	$280,000	Schedule B[1]
4	Property Costs	$540,000	Schedule B[1]
5	Trunk Sewer	$998,800	Schedule B[1]
Stormwater			
1	Stormwater Capture Area 42	$4,030,640	Schedule B[1]
2	Stormwater Capture Area 47	$1,911,477	Schedule B[1]
4	Stormwater Capture Area 111	$6,149,941	Schedule B[1]
Mobility			
1	Widen Laird Road (Southgate Drive to west of Poppy Drive) to 4-lanes plus Active Transportation (approx. 950 m)	$5,149,760 [2]	Schedule C
2	Widen Clair Road (Dallan Drive to Victoria Road) to 4-lanes plus Active Transportation (approx. 1.2 km)	$6,504,960[2]	Schedule C
3	Street A (Stage 2: Street B to south of Street D) – 908 m + NHS Crossing	$6,504,960	Schedule C
4	Street C (Street A to Gordon Street) – 638 m	$2,131,111	Schedule B[1]
5	Street D (Street A to Gordon Street) – 633 m	$2,114,409	Schedule B[1]

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
6	Street C/D (East of Gordon) – 1,232 m	$4,115,249	NL[3]
7	Widen Gordon Street to 4-lanes plus Active Transportation (approx. 1.7 km)	$9,215,360[2]	EA Update
8	Intersection Improvements[2,3] at: - Street A / Street B - Street A / Street C - Street C / Gordon Street - Street D / Gordon Street	$882,400	Schedule A[1], NL[4]
TOTAL PHASE 2 COSTING		**$68,412,878**	

1. MCEA Schedule requirements have been fulfilled by MESP
2. Arterial Roads Widening to 4-lanes with AT (Clair Road, Laird Road, Gordon Street) based on $5,420,800 per km.
3. NL = No Financial Limit for MCEA Requirement 23. Construction of local roads which are required as condition of approval on a site plan, consent, plan of subdivision or plan of condominium which will come into effect under the Planning Act prior to the construction of the road. Note – Reference to "local" roads refers to roadway function not municipal jurisdiction.
4. NL = No Financial Limit for MCEA Requirement 12. a) Construction of localized operational improvements at specific locations and <$9.5m MCEA Requirement 13 Installation, construction, or reconstruction of traffic control devices (e.g. signing, signalization)

Table 4.1.4. Summary of Phase 3 Infrastructure Projects

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
Water			
2	Local Distribution System (300mm diameter, Valves, Hydrants, etc)	$1,660,000	Schedule B_1
Wastewater			
1	Local Gravity Sewers	$874,016	Schedule B_1
2	Sewage Pumping Station SPS-1	$700,000	Schedule B_1
3	Forcemain FM-1	$770,000	Schedule B_1
4	Property Costs	$540,000	Schedule B_1
Stormwater			
1	Stormwater Capture Area 49	$2,669,583	Schedule B_1
Mobility			
1	Street A (Stage 3: North of Street E to Maltby Road) – 535 m + NHS Crossing	$5,348,730	Schedule C
2	Commence EA Study for Street E Collector Road (Street A to Victoria Road)		Schedule C
3	Street E (Stage 1: Street A to Gordon Street) – 633 m	$2,114,409	Schedule C
4	Intersection Improvements[2,3] at: Street A / Maltby Road Street E / Gordon Street	$441,200	Schedule A_1, NL_2
	TOTAL PHASE 3 COSTING	**$15,117,938**	

1. MCEA Schedule requirements have been fulfilled by MESP
2. NL = No Financial Limit for MCEA Requirement 12. a) Construction of localized operational improvements at specific locations and <$9.5m MCEA Requirement 13 Installation, construction or reconstruction of traffic control devices (e.g. signing, signalization)

Table 4.1.5 Summary of Phase 4 Infrastructure Projects

Item	Item Details	Capital Cost ($)	Anticipated EA Schedule Required
Water			
1	300mm Diameter Distribution System	$12,471,121	Schedule B[1]
Wastewater			
1	Local Gravity Sewers	$3,531,833	Schedule B[1]
2	Sewage Pumping Station SPS-2	$2,900,000	Schedule B[1]
3	Forcemain FM-2	$2,000,000	Schedule B[1]
4	Property Costs	$540,000	Schedule B[1]
Stormwater			
1	Stormwater Capture Area 36	$2,512,704	Schedule B[1]
2	Stormwater Capture Area 38	$2,096,632	Schedule B[1]
3	Stormwater Capture Area 39	$1,556,036	Schedule B[1]
4	Stormwater Capture Area 50	$2,436,047	Schedule B[1]
5	Stormwater Capture Area 51	$2,749,138	Schedule B[1]
7	Stormwater Capture Area 52	$1,880,932	Schedule B[1]
8	Stormwater Capture Area 53	$1,954,733	Schedule B[1]
9	Stormwater Capture Area 61	$4,345,800	Schedule B[1]
Mobility			
1	Street E (Stage 2: Gordon Street to Victoria Road) – 2,138 m + NHS Crossing	$10,701,561	Schedule C
2	Street F (Street E to Maltby Road) – 343 m	$1,145,722	Schedule B[1]
3	Street G (Street E to Maltby Road) – 588 m	$1,964,096	Schedule B[1]
4	Intersection Improvements[2,3] at Street E / Victoria Street	$138,100	Schedule A[1], NL[4]
5	Urbanize Victoria Road and add active transportation and sidewalks	$6,660,780[3]	Schedule A+[1]
6	Urbanize Maltby Road and add active transportation and sidewalks (approx. 4,200 m)	$13,321,560[3]	Schedule A+[1]
7	Multi-use Overpass of Gordon Street	$2,200,000[4]	Schedule C EA Updates[5]
	TOTAL PHASE 4 COSTING	**$77,106,795**	

1. MCEA Schedule requirements have been fulfilled by MESP
2. NL = No Financial Limit for MCEA Requirement 12. a) Construction of localized operational improvements at specific locations and <$9.5m MCEA Requirement 13 Installation, construction or reconstruction of traffic control devices (e.g. signing, signalization)
3. Arterial Roads Urbanizing with AT (Victoria Road, Maltby Road) based on $3,171,800 per km
4. $2,200,000 based on DC costing for GID-GJR Pedestrian Bridge & Trail.
5. Assumed to be studied as part of the Gordon Street EA Update.

Figure 4.1.3. Phase 1 Plan

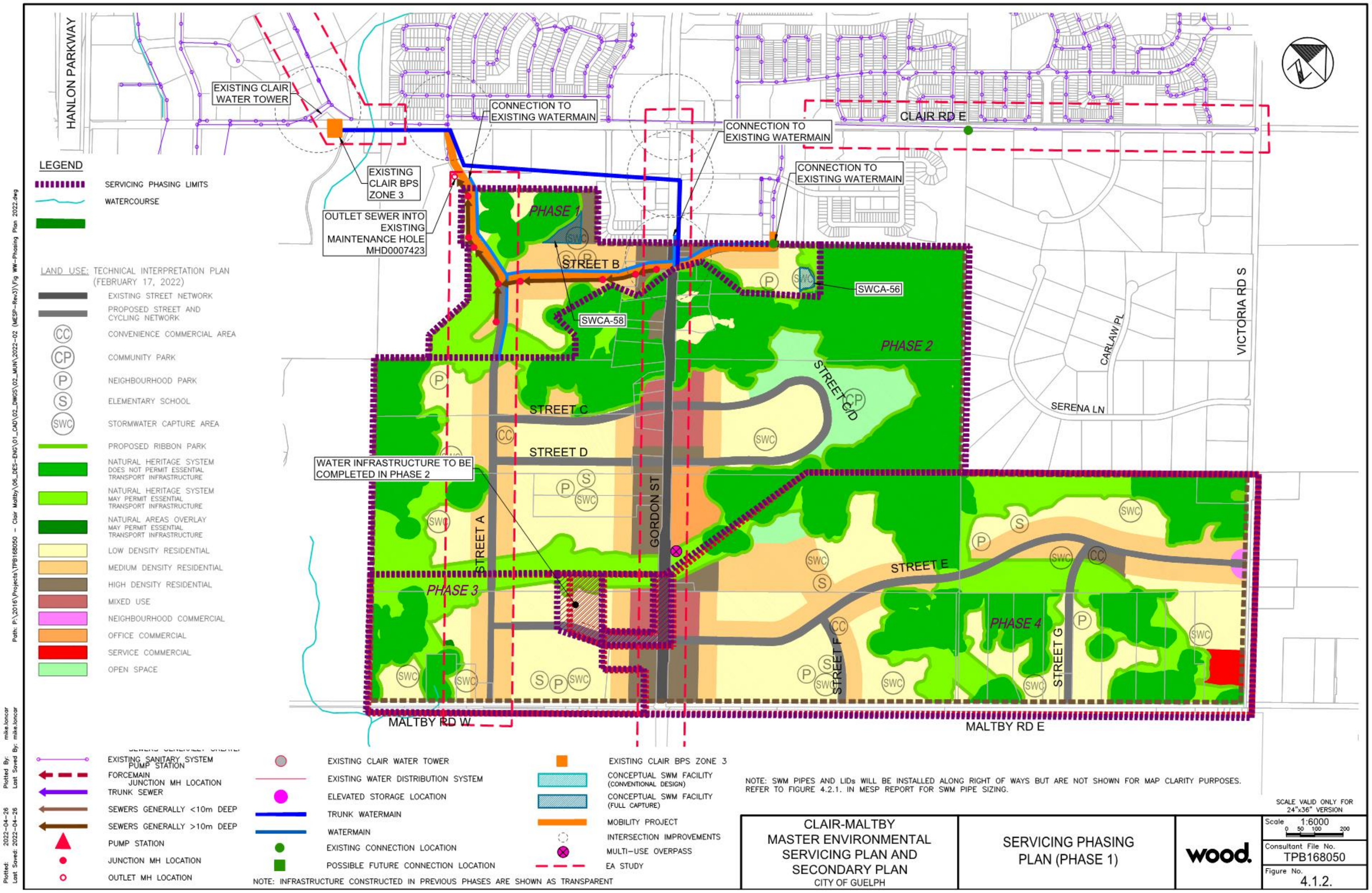


Figure 4.1.4. Phase 2 Plan

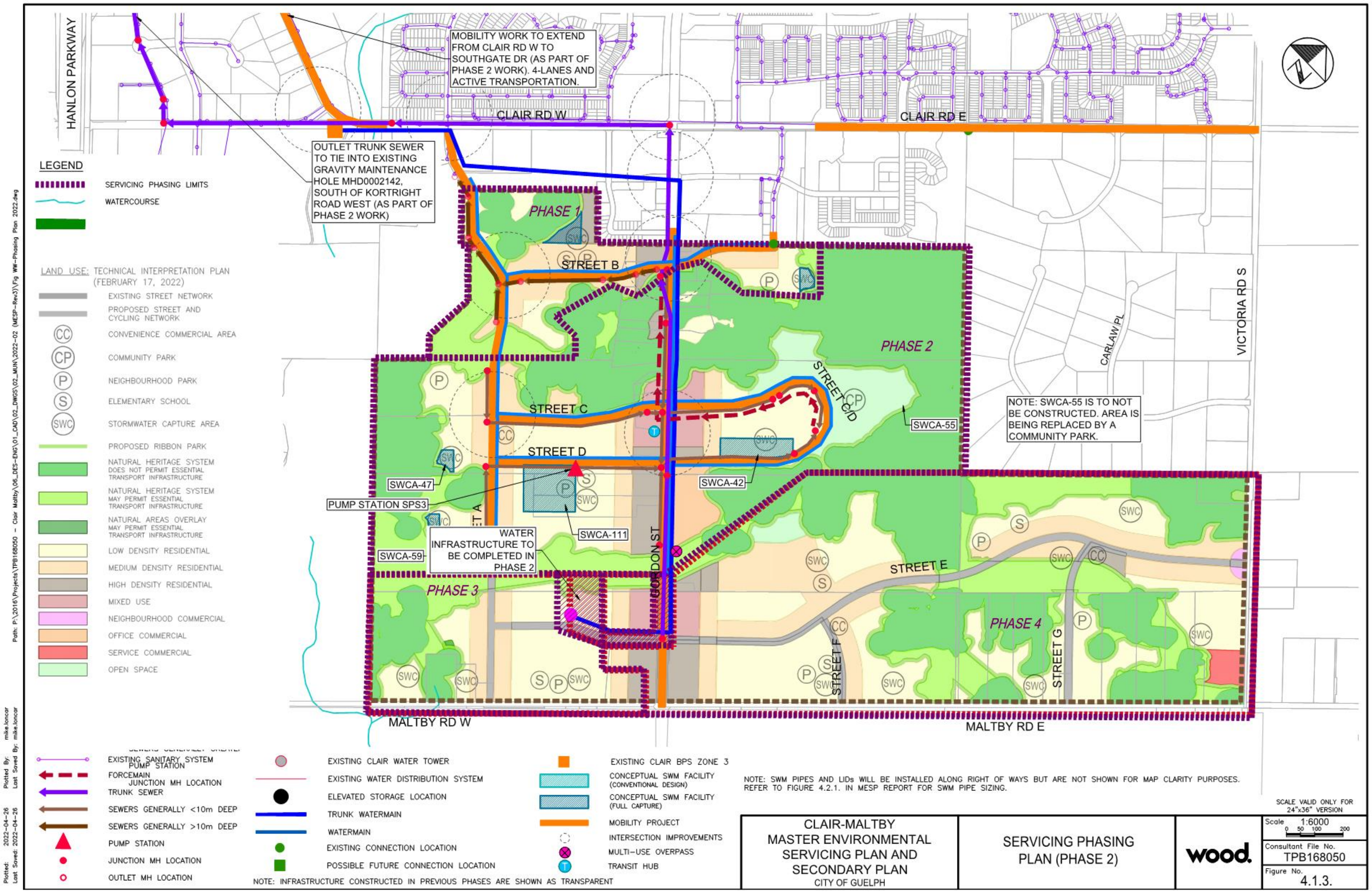


Figure 4.1.5. Phase 3 Plan

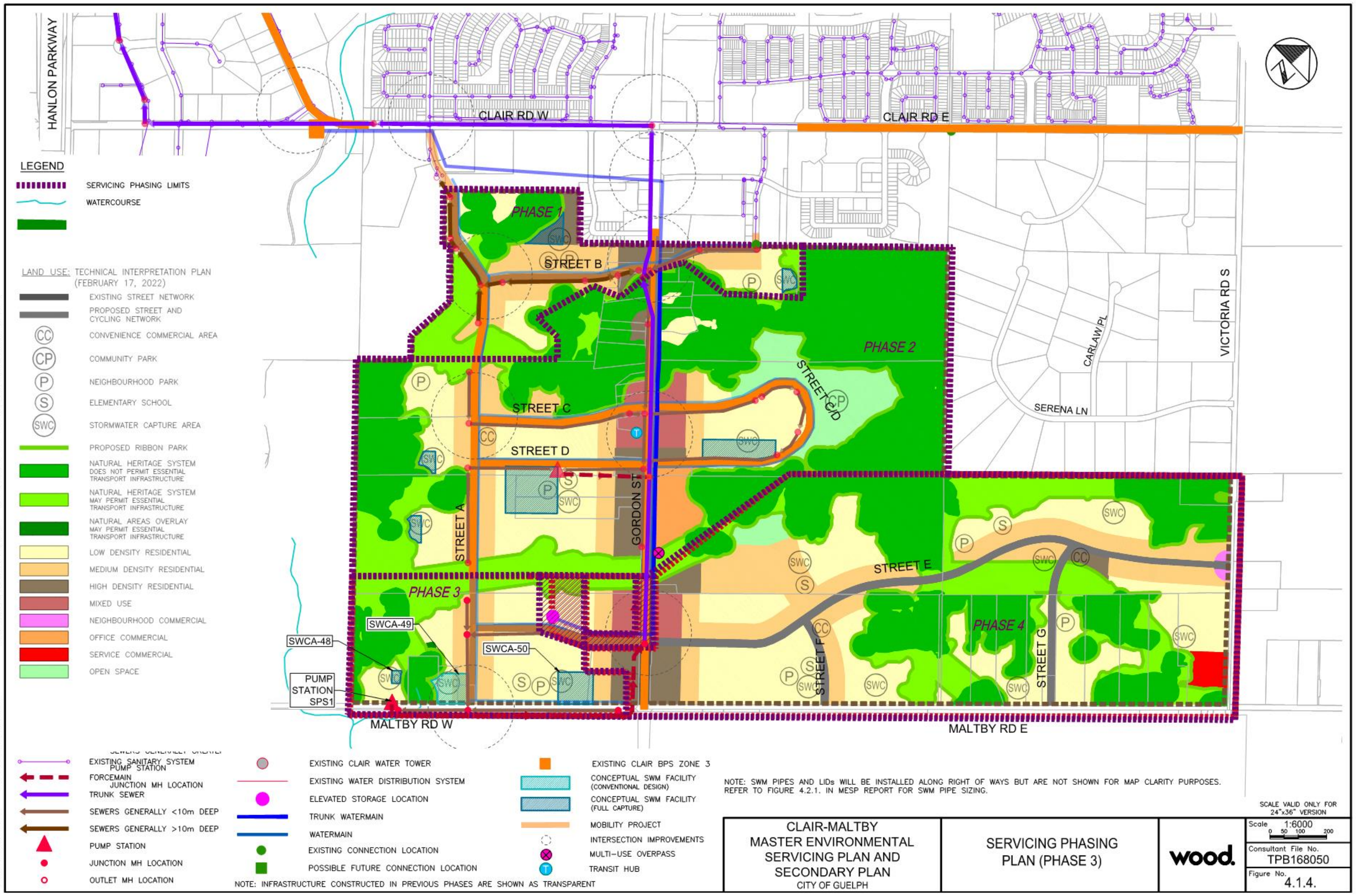
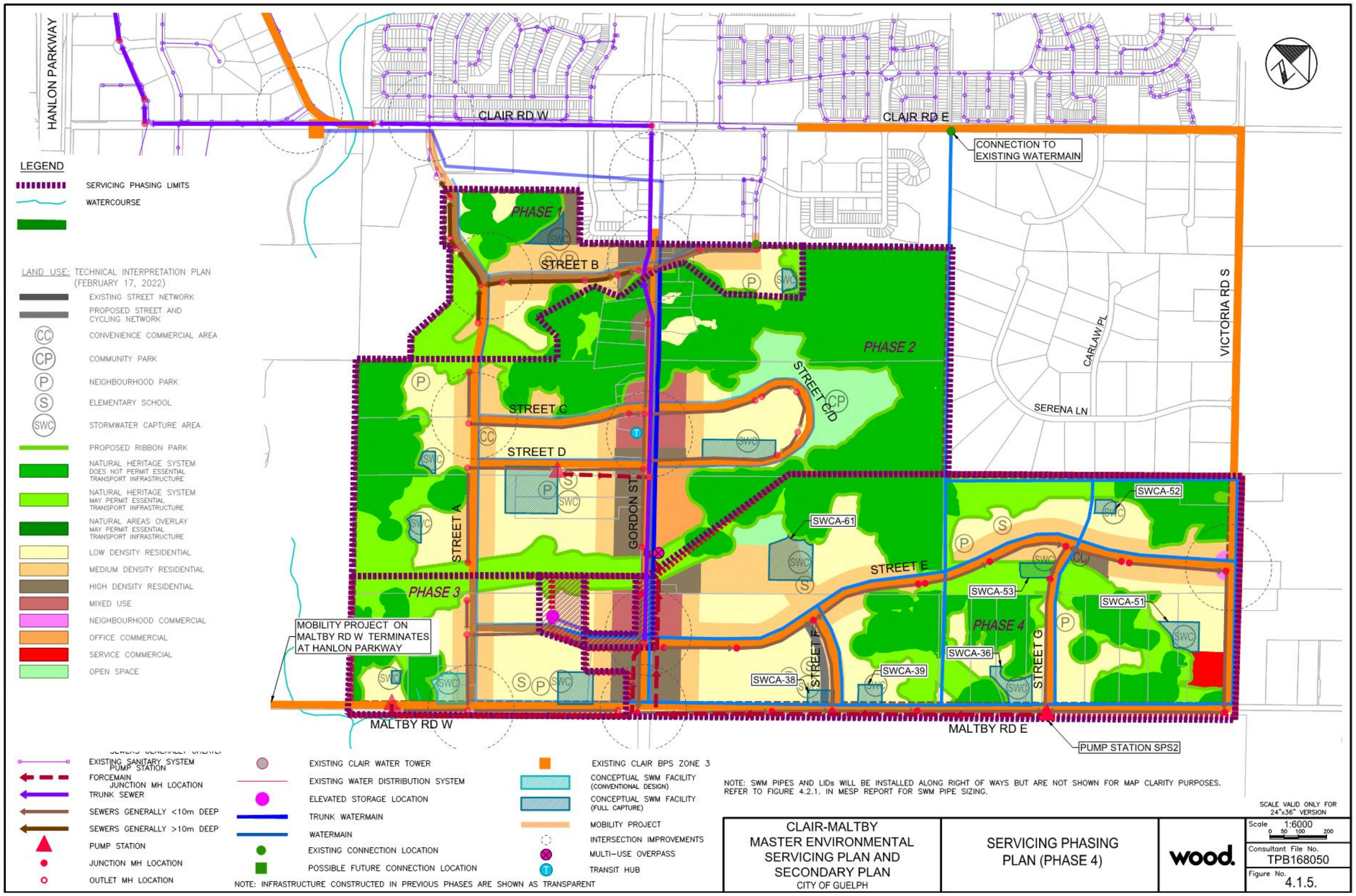


Figure 4.1.6. Phase 4 Plan



4.2 Costing

The following outlines costing considerations for each of the infrastructure components.

4.2.1 Water

The cost estimates have been included in Appendix A for the various above ground and below ground storage alternatives. In general, the cost estimates are within a reasonable range from each other, with no major difference between the capital costs of the elevated tank vs. the in-ground reservoir and booster pump station, as any cost savings for an in-ground reservoir would be made up by the booster pump station. However, underground storage does have higher operating and maintenance costs. The preferred alternative, aboveground storage at Location 2, has one of the lowest capital and operating costs and is indicated in Table 4.2.1.

Table 4.2.1. Preferred Water Alternative Estimated Cost

Alternative	Capital Cost	Annual O&M Cost
Aboveground Storage		
Location 2	$ 34.5 M	$ 276 K

In addition to costing for water infrastructure, costs will also be incurred by the City retaining engineering consulting firms to review proposed water distribution modelling, an approximate cost of $15,000 should be allocated by the City for each update, but will be the responsibility of the developer.

4.2.2 Wastewater

The cost estimates for the various wastewater servicing alternatives have been provided in Appendix B. The preferred alternative is the West Connection – Southgate Hanlon Trunk. This alternative is associated with the lowest Capital Cost and reasonable operating costs. The resultant gravity sewers depths will be within the typical range of depths at all locations. The sewers will be readily accessible for maintenance operations, and will avoid the maintenance issues associated with deep sewers.

In addition to costing for wastewater infrastructure, costs will also be incurred by the City retaining engineering consulting firms to review proposed wastewater modelling, an approximate cost of $15,000 should be allocated by the City for each update, but will be the responsibility of the developer.

Table 4.2.2. Preferred Wastewater Alternative Estimated Cost

Alternative	Capital Cost	Annual O&M Cost
Gordon / Southgate Hanlon	$28.6 Million	$314 K

*Capital and O&M Costs include pumping station costs inclusive of Industrial Park expansion

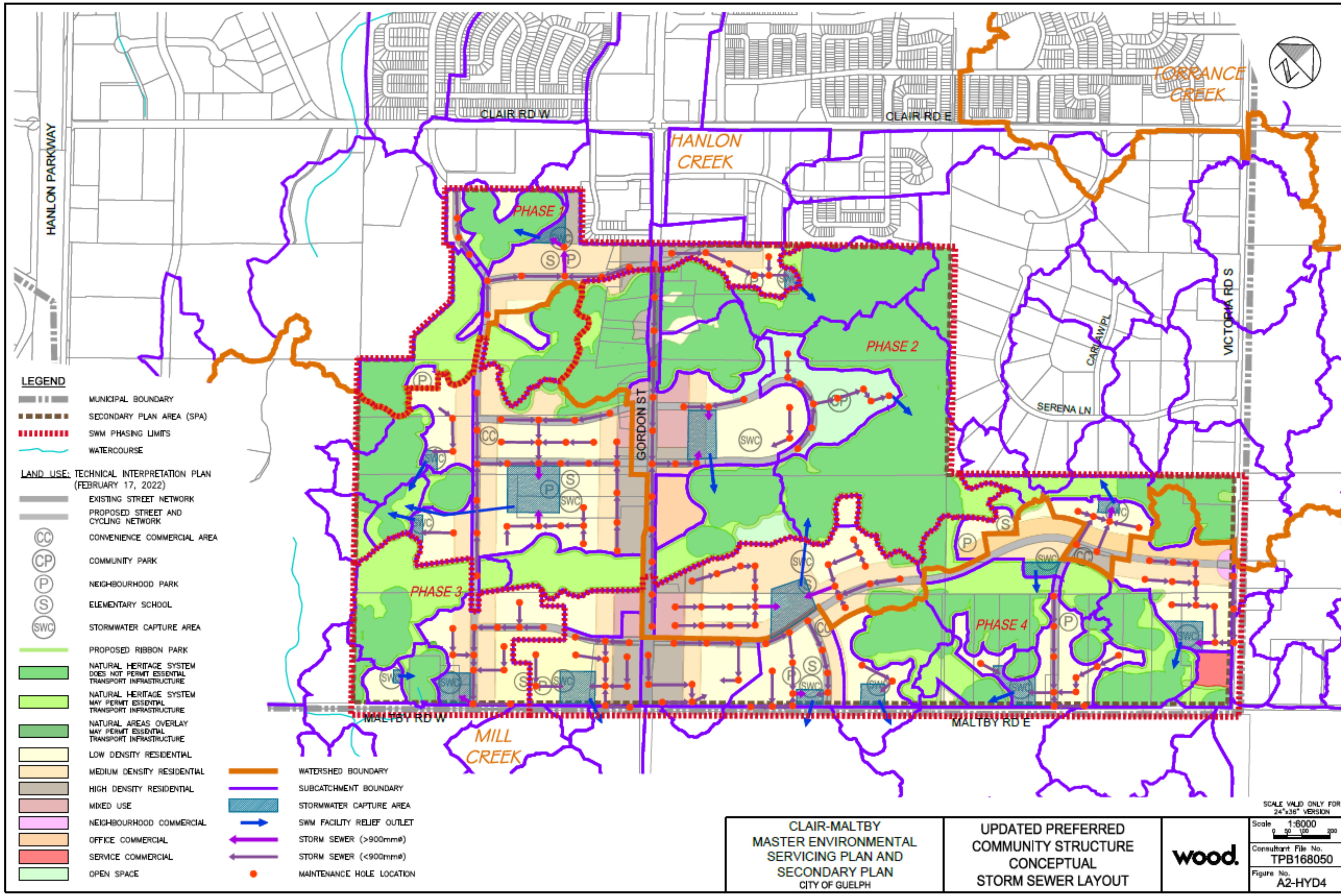
4.2.3 Stormwater

Preliminary cost estimates for stormwater management measures have been determined for the fifteen (15) SWCAs and for low impact development best management practices (ref. Appendix C). SWCAs have been estimated at approximately $26,607,075, with an average cost of storage of $105/m^3$, which would be covered through development agreements between the Clair-Maltby developers. Costing for low impact development best management practices with a runoff capture volume of 20mm or 14,106 m^3 (apart from the community park which captures the 100 year storm), for the overall area has been determined using a unit rate of $307/m^3$ for a total estimated cost of $4,324,419, which would be covered by Development Charges as part of the road work, as stormwater management measures. The storage volume of public versus private LID BMPs will be determined during the detailed design stage based on runoff from public versus private lands, that said, the split in sizing would be based on the impervious areas for public lands versus private lands.

As per the City of Guelph's DC Local Service Policy, storm sewers up to and including 900 mm diameter are a direct developer responsibility. Development Charges are responsible for storm sewers exceeding 900 mm provided that the oversizing is required to service existing external upstream lands and provided that the contribution towards 'over-sizing' through Development Charges for pipe sizes over 900 mm diameter for storm sewers shall be the cost less the cost of a 900 mm pipe. Due to the internally draining nature of the study area and the comparatively small drainage areas, it is not anticipated that storm sewers greater than 900 mm will be required, although development areas draining to SWCA 111 (44.81 ha), 55 (9.47 ha) 61 (25.04 ha), 38 (9.07 ha), 52 (5.8 ha), 51 (11.90 ha) and 49 (13.81 ha) may require short lengths of storm sewer above 900 mm dimeter in size; this would be determined at the time of subdivision design (ref. Figure 4.2.1). For the MESP preliminary stormwater costing, storm sewers are assumed to be covered by the City's DC Local Service Policy. Storm sewers should be sized without the size reduction benefit from the 20 mm LID BMP capture, to provide for climate change resiliency, which depending upon the selected/applied climate change representative concentration pathway (RCP) could result in storm sewers being upsized by one (1) pipe size; the LID BMP 20 mm capture would essentially offset the potential increase in storm sewer sizing for climate change.

In addition to costing for storm infrastructure and stormwater management measures, costs will also be incurred by the City retaining engineering consulting firms to review and validate the performance of the proposed stormwater management measures and LID BMP sizing associated with the MIKE SHE modelling and PCSWMM modelling. For each model update and associated technical assessment, an approximate cost of $10,000 should be allocated by the City.

Figure 4.2.1. Conceptual Storm Sewer Layout



4.2.4 Mobility

Estimated transportation infrastructure costs have been determined for the Clair-Maltby Updated Preferred Community Structure land use plan and reflect the March 2019 Transportation Master Plan Study.

General cost estimates, where available, were derived from the February 2019 Development Charges Background Study – Consolidated Report, prepared by Watson and Associates Economists Ltd. for the City of Guelph. This document provides the basis for understanding the unit cost of identified infrastructure. General costs account for the extent of new collector streets reflected in the "Preferred Community Structure" Plan, as identified in the City of Guelph Official Plan Schedule C: Clair-Maltby Secondary Plan Mobility Plan. A summary of key transportation infrastructure, assumed unit costs, and estimated overall costs are included in Table 4.2.3.

Table 4.2.3. Mobility Infrastructure Preliminary Costs

Item	Volume	Unit Cost	Cost
Widened Arterial Streets • Laird Road • Clair Road • Gordon Street	Approximately 3.85 km	$5,420,800/km[1]	$20,870,000
Urbanized Arterial Streets • Victoria Road • Maltby Road	Approximately 6.3 km	$3,171,800/km[1]	$19,982,000
New Collector Streets Includes: 4 lane pavement (2-3 traffic lanes and bicycle lanes) Sidewalks Trees Basic Signage Lighting Basic Storm	Approximately 9.354 km of new collector roads.	$3,340,300/km 1 [2]	$31,245,000
Traffic Signals (excluding bike signals)	Assumed 11 traffic signals. Assumed traffic signal for all collector / collector and collector / Arterial intersections	$138,100 per intersection	$1,519,100

Item	Volume	Unit Cost	Cost
Improvements to existing intersections. Turn lanes, taper and storage, medians, etc. along sections of existing road that will intersect with new collector streets. It is anticipated that the Gordon Street EA does not include costs associated with the improvements at new intersections.	Assumed 9 intersections requiring improvements along Gordon Street, and Clair Road.	$165,000 per intersection [4]	$1,485,000
New bridges / culverts along new collector streets	Assumed 4 crossing structures along new collector streets (not including new, replaced, or refurbished structures along Gordon Street) 6	$3,560,000 per bridge	$14,240,000
Off-street paved bicycle paths	n/a	$200,000 per kilometer + potential culverts / bridges in NHS (pedestrian bridge = $1,680,000 per item). [3]	n/a
Multi-use Overpass of Gordon Street	Each	$2,200,000[7]	$2,200,000
TOTAL:			**Approx. $91,541,100**

Notes:

1. Road costs are based on consultation with Wood on Clair-Maltby section costs and review of comparable 'per km' rates in Guelph DC and comparable Brampton DC study rates.

2. Collector Street costs averaged between 2-lane and 3-lane sections, plus on-street cycling infrastructure.
3. Culverts not included cost considerations. Culverts greater than 3m = $830,000 per item.
4. Bus infrastructure not included. Bus signage, pad and shelter = approximately $9,000 per stop.
5. Cost of intersection improvements extracted from City of Brampton DC By-law, less the cost of traffic signal infrastructure.
6. Bridge structure assumed for each instance where a new collector street crosses the NHS
7. $2,200,000 based on DC costing for GID-GJR Pedestrian Bridge & Trail. Assumed to be studied as part of the Gordon Street EA Update.

The above-outlined costs are not exhaustive, and generally reflect the extent of details derived from the Secondary Plan structure. A summary of included and excluded costs from Table 4.2.3 are provided in the following.

Costs include:

- New collector streets and basic components within the municipal right of way (sidewalks, bicycle lanes, trees, signage, lighting and basic storm);
- Traffic control signals;
- Improvements for existing intersections; and
- New collector street bridges and culverts.

The costs do not include:

- Arterial Road urbanization, widening, and resurfacing
- Land acquisition;
- New local streets;
- Potential improvements to the Victoria Road / Maltby Road intersection;
- New off-street paved bicycle paths (estimated cost: $268,700 per kilometre), new pedestrian / bicycle bridges (estimated cost: $1,680,000 per item), and new trail culverts (estimated cost: $830,000 per item);
- Servicing (sanitary, sewer) within the right-of-way;
- Engineering / planning and Environmental Assessments (estimated 15 per cent to 18 per cent of total cost);
- Transit facilities (queue jump lanes, posts, signs, shelters); and
- Street furniture.

As is typically the case, a contingency is often included. A contingency of 20 per cent may be appropriate given the early stages of planning that would be in addition to other costs not included in the table above.

5 Conclusions and Recommendations

The following conclusions and recommendations have been determined based on the water, wastewater, stormwater, and mobility assessments described herein. Table 5.1 summarizes the projects for each infrastructure category and provides the MEA Class EA Schedule requirements.

5.1 Conclusions

5.1.1 Water

1. Water Pressure Zone 1 is unable to meet the entire storage requirements (Equalization + Fire + Emergency). As such, a separate above ground reservoir is proposed for Zone 3, which includes CMSP lands, to meet the full equalization storage and part fire and corresponding emergency storage.
2. A looped water distribution system is proposed to eliminate dead ends, reduce water age and mitigate low residual chlorine issues.
3. All watermains would be installed along the proposed roads.
4. The proposed water distribution system will be able to meet the demands of the full buildout of CMSP lands while maintaining adequate pressures for various demand scenarios.
5. In order to support Phase 1 with Zone 1 pressure and storage, an in-line booster pump has been included for resiliency.
6. As Zone 3 may extend beyond the CMSP lands, an allowance of 15 per cent population over and above the CMSP lands has been made and the system has been sized accordingly.

5.1.2 Wastewater

1. Due to the undulating nature of the CMSP lands, and to keep the sewer depths as shallow as possible, three pump stations are proposed to lift collected wastewater.
2. Each of the pump stations (SPS1, SPS2 and SPS3) discharge independently to the main gravity trunk running along Gordon Street from Street D along Clair Road and ultimately to the final outlet to the Hanlon Trunk system at MHD0002142.
3. By making the connection into the Hanlon Trunk sewer at MHD0002142, all sewer upgrades are avoided, and the existing trunk sewer system can convey the flow from the CMSP lands to the Guelph Wastewater Treatment Plant without surcharge. A new trunk sewer from the Clair Maltby lands to MHD0002142 is proposed.

5.1.3 Stormwater

1. The Clair-Maltby SPA is mostly inwardly draining to either dry depressional features, ponds and/or wetlands, with few overland drainage outlets, as such most drainage infiltrates to the groundwater system or evaporates. The drainage and stormwater management strategy for the Clair-Maltby SPA has

considered the existing drainage system and has worked towards replicating existing conditions through at source infiltration and stormwater capture areas.

2. The Phase 3 CEIS Impact Assessment (third iteration), which represented the Final Preferred Community Structure land use and the revised location of the Community Park next to Halls Pond, has determined that groundwater impacts resulting from the land use plan can be mostly mitigated, without significant water level impacts to Halls Pond and Neumann's Pond and hydroperiod will be maintained.
3. The Final Preferred Community Structure land use plan will result in both surface water and groundwater quality impacts, requiring various water quality measures to mitigate the impacts.
4. The Final updated Preferred Community Structure land use plan will result in urbanization of non-natural heritage system lands, with a different suite of potential water quality contaminants.

5.1.4 Mobility

1. The Final Preferred Community Structure Plan street network would provide active transportation and trail connectivity that will adequately accommodate future development and transit services. The street network represents a modified grid system, which is intended to allow for frequent and robust routing for all street users, while respecting the important environmental features of the area.
2. The planned network of streets (and trails) is intended to achieve safe, convenient, and comfortable travel and access for all street-users, with priority given to pedestrians, cyclists, and transit operations, to provide mobility choice and support city policy and modal-split objectives. Vehicular movement will be accommodated, but is not prioritized, and will be subject to levels-of-service which are more constrained then typical in new-build areas within the City.
3. Road cross sections prepared in support of the Clair-Maltby Secondary Plan intend the design and delivery of complete streets, which include pedestrian and cycling infrastructure, support transit service routing, street trees and landscaping, and utility / service delivery. Vehicle travel lanes are reduced to an appropriate level, to accommodate vehicle movement while not prioritizing vehicles over other street users.

5.2 Recommendations

5.2.1 Water

1. The Water servicing for the updated land use within CMSP lands (Zone 3) will be provided with a system of water distribution mains, an above-ground reservoir, and a transmission main brining water from the Clair Booster Pump Station to the overhead reservoir, with associated hydrants, valves and appurtenances as required.
2. The new 5 ML overhead reservoir could meet the equalization demands of 100 per cent of the CMSP development and part of the fire flow and corresponding

emergency demands. The remainder of the demands will be provided by the Zone 1 system. The size and reliance on Zone 1 will also be confirmed through the Water and Wastewater Master Plan study.

3. The preferred location of the overhead reservoir is identified in Figure 3.1.4 and will be able to provide adequate pressures during various scenarios and fire flows during a max day demand period while keeping the pressures within acceptable range.
4. Provision has been made to accommodate 15 per cent additional population over and above the updated land use plan recommendations to accommodate Pressure Zone 3 lands outside of the CMSP area.

5.2.2 Wastewater

1. The wastewater servicing for the updated land use within CMSP lands will be provided with a system of wastewater mains, sanitary pump stations and sanitary forcemains.
2. The study area was delineated into five independent catchments based on topography, preliminary grading plan for stormwater servicing, and proximity to the City's existing sanitary system.
3. A new trunk sewer is proposed to be routed along Gordon Street to Clair Road, Laird Road and Kirkby Ct and connect to the Hanlon Trunk system.
4. At this time, 15 per cent additional population over and above the updated land use plan recommendations has been accommodated by the CMSP wastewater system.

5.2.3 Stormwater

1. To provide stormwater management for the Clair-Maltby SPA, it is recommended that distributed low impact development best management practices (LID BMPs) capturing 20 mm runoff be provided within both public and private lands, with the remaining drainage being conveyed to stormwater capture areas (SWCA), sized to capture the Regional Storm runoff volume, with 10 per cent buffer (volume) to allow for climate change impacts and maintenance access, trails, sediment removal and other detailed design requirements. Stormwater capture areas are to have an overflow relief to existing adjacent depression areas, which mimics existing conditions, should the stormwater capture area storage capacity be fully used, however in no case shall this exceed existing runoff rates for events up to and including the Regional Storm. The design of stormwater capture areas and associated emergency relief systems will be prepared at the time of site-specific development and will be informed by the recommendations of a site-specific Environmental Impact Study (EIS), Section 3.3.3 and Section 3.3.7 of the MESP, and the Phase 3 CEIS.
2. For small development areas (typically less than 5 ha), unless draining to Maltby Road (see Note #3), 20 mm capture only will be required to provide water quality treatment and maintain water balance.

3. For small development areas (typically less than 5 ha), draining to Maltby Road, 20 mm capture within LID BMPs and Regional Storm (285 mm) capture and control within end-of-pipe stormwater management controls will be required, to mitigate stormwater quantity, quality and water balance impacts to properties located south of Maltby Road.
4. For the Community Park, located adjacent to Halls Pond, distributed LID BMPs are to capture the 100-year storm event. The distributed LID BMPs are to replace a stormwater capture area sized for the 100-year event, which would have been required for the park draining to Halls Pond. The rationale for using LID BMPs versus a SWCA in this location is to prevent localized groundwater mounding resulting in potential increases in the average Halls Pond water level.
5. The SWCAs for Subcatchments SW-42 and SW-61 should be located as per the recommendations of the Halls Pond Assessment (ref. Appendix F).
6. Sites with infiltrative LID BMPs that receive runoff from paved surfaces will require salt management plans and pretreatment to protect groundwater quality. Pre-treatment may include various techniques including but not limited to OGS, CB Shields, grassed swales and other suitable and approved BMPs. Pre-treatment measures will be used to address TSS and other contaminants consistent with provincial and City guidance including the City's recently completed Stormwater Management Master Plan (SWM MP) and the design criteria associated with the recently implemented Consolidated Linear Infrastructure (CLI) Environmental Compliance Approval (ECA).
7. A treatment train approach should be used to protect the stormwater capture areas' function of infiltration and to protect groundwater quality.
8. Surface and groundwater quality monitoring, as determined through the CEIS and Section 3.3.7 of this report, will be required to assess and suitably protect existing surface water and groundwater resources.
9. Developments should demonstrate that target infiltration volumes as per existing conditions will be achievable based on LID BMPs and stormwater capture areas proposed as part of the development application.

   Future development applications will be required to update the integrated groundwater-surface water models (MIKE SHE and PCSWMM models) based on technical studies prepared in support of proposed development and apply on-going monitoring data to appropriately assess cumulative impacts in Clair-Maltby. The models should be used for on-going decision making, including simulation of development phasing, and to revise/refine planning analyses with more detailed development design reflecting proposed land uses, grading and stormwater management. Acknowledging the uncertainty in the climate data, additional monitoring and analysis should be considered by the City to provide and establish an improved climate dataset for future planning projects. Future planning work and model updates should use the best precipitation datasets available at the time when evaluating proposed stormwater management approaches.

10. Feature-based water budgets, including monthly water balance assessment should be prepared to demonstrate mitigation of impacts from proposed land use conditions. The MIKE-SHE model for Clair Maltby should be used to demonstrate mitigation of impacts to recharge and discharge function, groundwater flow directions and depth to the water table by proposed developments.
11. As part of a development application, the City of Guelph will require a Salt Management Plan. These plans will include a site-specific salt mass loading calculation and associated monitoring plans that will be required to demonstrate that groundwater quality within the boundaries of the subject development will not exceed relevant provincial and City guidelines at the time of development.
12. The forebays associated with Stormwater capture areas could be used as emergency overflow locations for the wastewater pumping stations. Should this be the case, there should be consideration for a forebay that could be lined with the ability to contain the pumped volume through valving of the outlet.
13. To achieve these management criteria the City will require salt reduction and management measures per the following:
    i. The City of Guelph should consider any outstanding recommendations from the 2017 SMP.
    ii. The City of Guelph should consider options for salt alternatives such as different types of chemical de-icers and agricultural by-products.
    iii. Implement salt alternatives through financial incentives for independent contractors conducting snow removal and de-icing.
    iv Implement recommendations of the SICOPS program, to reduce salt application and improve salt management.
    v. Consider removal of snow in areas with low traffic loadings and the transportation/storage of this snow to established snow storage / melt areas that provide treatment prior to discharge to the Speed River.
    vi. Seasonally closed or partially closed City owned parking lots could be considered by the City of Guelph. Closed parking lots could be used for snow storage and piling, to facilitate reduced salt use for paved areas.
    vii. To control salt laden runoff from entering groundwater during the winter months, the City could consider bypasses of infiltrative LID BMPs that receive drainage from paved surfaces.

5.2.4 Mobility

1. Cross sections have been developed by the Team in consultation with the City of Guelph as part of the Clair-Maltby Secondary Plan, to permit further programming within the pavement or boulevard spaces to include multi-modal uses where appropriate or to account for variations in natural landscape where a context sensitive standard may be most suitable.

2. Road sections should be flexible to meet context specific limitations and servicing / utility requirements and should be designed in detailed plan and section view as part of future area development.
3. Wider pavement areas, or off-centre median lane designs, should be pursued in instances where on-street parking will be accommodated. Similarly, wider right-of-ways should be pursued in instances where other infrastructure is required such as major trunk utilities, municipal service corridors, or overland flow routes.
4. The following roads projects are anticipated to require Schedule C EAs as part of Phases 3&4 of the MCEA:
   - Widening of Clair Road from 2 to 4 lanes (east of Beaver Meadows Road to Victoria Road)
   - Widening of Gordon Road from 2 to 4 lanes (south of Poppy Drive to Maltby Road) – EA Update
   - Street A (north-south) Collector Road (from Clair Road to Maltby Road) that will exceed Schedule B requirements (>$2.4m) and have crossings within the NHS.
   - Street E (east-west) Collector Road (from Gordon Road to Victoria Road) that will exceed Schedule B requirements (>$2.4m) and have a crossing within the NHS.
5. There are also numerous ways the roads could be phased and built out within the Clair-Maltby SP, given:
   a) there are a number of landowners in the SP area,
   b) phasing of development can happen in a number of ways; and
   c) there are a number of amendments in progress for the MCEA process that can influence whether roads >$2.4m proceed to Schedule C or instead to Schedule A.

   Given the above, each road project's classification under the MCEA process should be reviewed by the City and developers as draft plans of subdivision come forward.

5.2.5 Project Summary and Schedule Requirements

The MESP has been conducted in accordance with the Master Plan Approach #2 requirements of the Municipal Engineers Association Cass Environmental Assessment (EA) process (Section A.2.7 of the Municipal Class EA document, October 2000, as amended in 2007, 2011 and 2015). The MESP has followed Phases 1 and 2 of the Class EA Schedule B process and identifies a series of servicing projects that will be required to service the Clair-Maltby SPA. The MESP addresses Phases 1 and 2 of the MEA Class EA Process with the servicing needs for the Final Preferred Community Structure determined in Phase 1 and servicing alternatives identified and selected in Phase 2.

The Projects have been determined for each infrastructure category/ type consisting of water, wastewater, stormwater and mobility. The Municipal Class Environmental Assessment (MCEA) process classifies projects according to their level of complexity and potential environmental impacts. These are termed "Schedules" and are summarized as follows:

- **Schedule 'A' and 'A+'** include projects that involve minor modifications to existing facilities. Environmental effects of these projects are generally small; therefore, the projects are considered pre-approved. The difference between a Schedule 'A' and 'A+' project is the latter requires a mechanism to inform the public.
- **Schedule 'B'** includes projects that involve improvements and minor expansion to existing facilities. There is a potential for some adverse environmental impacts and, therefore, the proponent is required to proceed through a screening process, including consultation with those affected. Schedule 'B' projects are required to proceed through Phases 1, 2 and 5 of the Class EA process.
- **Schedule 'C'** includes projects that involve construction of new facilities and major expansion of existing facilities. These projects proceed through the environmental assessment planning process outlined in the Class EA document, and are required to fulfill the requirements of all five phases of the Class EA process.
- The projects in Table 5.1 are categorized as either Schedule A, A+, B and C. Schedule 'C' undertakings, which would have to satisfy Phases 3 and 4 of the MCEA Class EA process, requiring consultation with stakeholders, agencies, public and Indigenous Nations. It would also require the need for alternative design evaluation, and the preparation of preliminary (30 per cent) design drawings and an Environmental Study Report (ESR). The only projects indicated as Schedule C, would be the collector streets (>$2.4 million).

Table **5.1** provides a summary of the recommended projects emanating from MESP and the associated MCEA requirements.

Table 5.1. Summary of MCEA Project Requirements

Project Description	Municipal Class Environmental Assessment (MCEA) Schedule Determination
Water: Watermains	**Schedule B** Establish, extend, or enlarge a water distribution system and all works necessary to connect the system to an existing system or water source, where such facilities are not in either an existing road allowance or an existing utility corridor.
Water: Above Ground Storage Tank	**Schedule B** Establish new or expand/replace existing water storage facilities.
Wastewater: Wastewater Pumping Stations	**Schedule B** Construct new pumping station or increase pumping station capacity by adding or replacing equipment and appurtenances, where new

Project Description	Municipal Class Environmental Assessment (MCEA) Schedule Determination
	equipment is located in a new building or structure.
Stormwater: Storm sewer system	**Schedule A** #10 - Establish, extend, or enlarge a sewage collection system and all necessary works to connect the system to an existing sewage outlet, where it is required as a condition of approval on a site plan, consent plan of subdivision or plan of condominium which will come into effect under the Planning Act prior to the construction of the collection system. **Schedule A +** *#1-* Establish, extend, or enlarge a sewage collection system and all necessary works to connect the system to an existing sewage or natural drainage outlet, provided all such facilities are in either an existing road allowance or an existing utility corridor, including the use of Trenchless Technology for water crossings. **Schedule B** # 1 - Establish, extend or enlarge a sewage collection system and all works necessary to connect the system to an existing sewage outlet where such facilities are not in an existing road allowance or an existing utility corridor.
Stormwater: Low Impact Development Best Management Practices	**Schedule A –** #11. Establish new or replace or expand existing stormwater detention/retention ponds or tanks and appurtenances including outfall to receiving water body provided all such facilities are in either an existing utility corridor or an existing road allowance where no additional property is required. **Schedule B –** #2- Establish new stormwater retention/detention ponds and appurtenances or infiltration systems including outfall to receiving water body where additional property is required.
Stormwater: Stormwater Capture Area (s)	**Schedule B** #2- Establish new stormwater retention/detention ponds and appurtenances or infiltration systems

Project Description	Municipal Class Environmental Assessment (MCEA) Schedule Determination
	including outfall to receiving water body where additional property is required.
Mobility: New Collector Streets	**Schedule B: (<$2.4m), Schedule C: (>$2.4m)** #21 – Construction of new roads
Mobility: Intersection Improvement	**Schedule A+** #12 a) - Construction of localized operational improvements at specific locations.
Mobility: Traffic Signals	**Schedule A: (<$9.5m), Schedule B :(>$9.5m)** #13 - Installation, construction, or reconstruction of traffic control devices (e.g. signing, signalization).
Mobility: New bridges/ culvert along collector streets	**Schedule A+ –** #18 – Construction of a new culvert or increase culvert size dur to change in the drainage area.
Mobility: Off-street paved bicycle paths	**Schedule A+ –** #22 - New Construction or removal of sidewalks, multi-purpose paths or cycling crossings outside existing right-of-way

6 References

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- City of Guelph Stormwater Management Master Plan, Aquafor Beech, 2023

Appendix A

Water

Appendix B

Wastewater

Appendix C

Stormwater

Appendix D

Mobility

Appendix E

Public Consultation

Appendix F

Halls Pond Assessment

Appendix G

Sensitivity Analysis of Clair-Maltby CEIS Stormwater Management Approach using Higher Precipitation Dataset