GRANTS CREEK WETLAND INTEGRATED HYDROLOGIC IMPACT ASSESSMENT

PERTH WESTERN ANNEX LANDS

March, 2023

Prepared For:

CAIVAN COMMUNITIES

Prepared By:

JFSA
WATER RESOURCES ENGINEERING, ENVIRONMENTAL MANAGEMENT AND LAND PLANNING CONSULTANTS

GEMTEC
CONSULTING ENGINEERS AND SCIENTISTS

Kilgour & Associates Ltd.
Environmental Consultants

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Prepared by:

Steve Livingstone, M.Sc., P.Geo.
GEMTEC Consulting Engineers & Scientists

Andrius Paznekas, M.Sc., P.Geo
GEMTEC Consulting Engineers & Scientists

Jason KarisAllen, MASc, EIT,
GEMTEC Consulting Engineers & Scientists

Jonathon Burnett, B.Eng, P.Eng
J.F. Sabourin and Associates Inc.

Anthony Francis, PhD,
Kilgour & Associates Ltd.

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1 Introduction

An Integrated Hydrologic Impact Assessment (IHIA) is required to ensure the form and function of the Grants Creek Provincially Significant Wetland (PSW) is maintained as the development of the Perth Western Annex Lands site advances. The following report and accompanying technical studies (provided under separate covers) provide the data, analysis and reporting required to support the proposed Perth Western Annex Lands servicing and development design, as well as satisfy tests under the CA Act (where applicable), and local and provincial policies related to wetland protection. This work has been undertaken in consideration of the following documents:

- TCRA (2016) Wetland Water Balance Monitoring Protocol
- TCRA (2017) Wetland Water Balance Risk Evaluation
- RVCA (2018) Wetland Policies Board Approved
- MVCA (2019) Regulation Policies > HIA Sections
- RVCA Technical Memorandum Western Annex (Golf Course) Lands, Town of Perth dated March 1, 2022. This document indicated that the water budget, HIS for the wetland, and part of the hydrogeological study should not be distinct investigations. These should be included in an integrated hydrological impact assessment for the full site. The interpretations and findings must be aligned with the EIS interpretations and findings.

1.1 Background

The site is located on the south side of the Tay River, across from downtown Perth and is municipally known as 141 Peter Street. It is legally described as Part of Lots 25, 26 and 27, Concessions 1 and 2 in the Geographic Township of Bathurst and Part of Lot 1 in Concessions 1 and 2 in the Geographic Township of Drummond.

A large portion of the site will be developed in and around the existing golf course to create a new primarily residential community. The development will be composed of homes, streets, stormwater facilities, parks, and municipal water and sanitary services. Portions of the existing golf course will be reconfigured.

An Infrastructure Master Plan (IMP) was prepared in 2019 to consider transportation, water supply, sanitary sewer, and stormwater servicing for these lands and other areas. The IMP sought agency and public input and reported high-level discussion related to the flood plains and wetland constraints on and adjacent to the site. Since that time, the owners undertaking the development of the site have retained professional consultants to investigate, evaluate, and refine the guidance that was reported on by the IMP. Site-specific data collection and analysis have been undertaken to support the proposed development design and relationship with the adjacent Provincially Significant Wetland, Grants Creek.

The Rideau Valley Conservation Authority (RVCA) prepared a subwatershed report on the Tay River in 2011 and 2017, and a catchment area report on Grants Creek in 2017. General considerations within the Grants Creek catchment area included water quality occasionally influenced by high nutrient concentrations, occasional bacterial and metal exceedances, concern

regarding low flow impacts on fish and wildlife habitat, and consideration of Low Impact Development (LIDs) to improve quality and reduce stormwater runoff. Recommendations emphasized the retention of wetland, increases to shoreline vegetation, and restoration of forest cover.

1.2 Objectives

The integrated hydrological impact assessment work synthesizes the information collected and analyzed by various technical investigations to establish the on-site environmental conditions and functions, identify any potential impacts related to the proposed development, and devise strategies (if required) to support the wetland environment. This work was performed by the following qualified professionals:

- GEMTEC Consulting Engineers and Scientists (geological and hydrogeological),
- David Schaeffer Engineering Ltd. (civil engineering),
- JF Sabourin and Associates Inc. (surface water), and
- Kilgour and Associates Ltd (Environmental and biological).

2 Existing Conditions

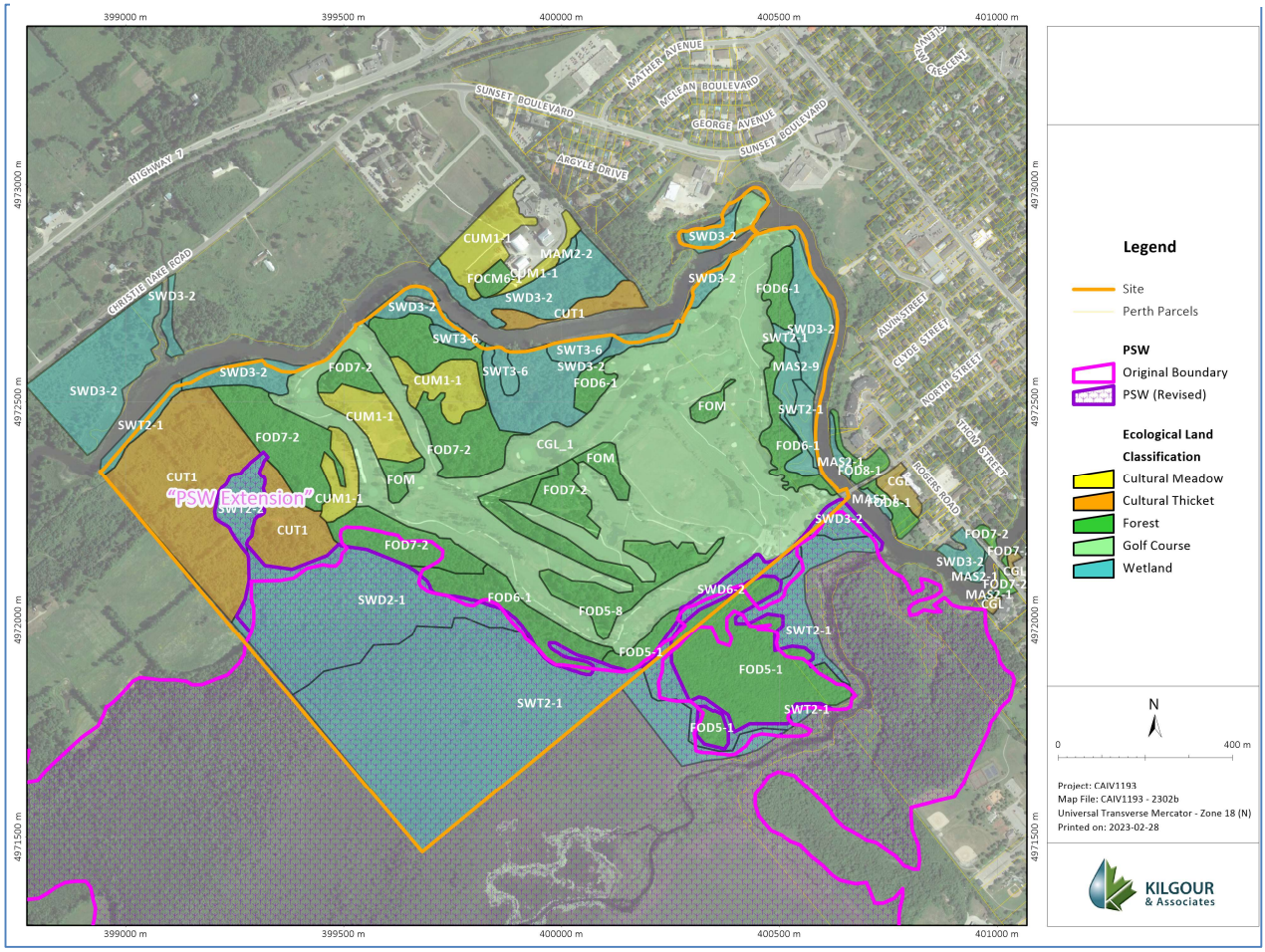
Each of the above consulting teams has prepared a standalone report that provides the data, analysis and findings related to their discipline in the context of the development proposal. The proponent seeks to establish a development envelope 30 metres or greater from the boundary of the Grants Creek Provincially Significant Wetland. The boundary used in this project has been surveyed and refined by qualified OWES assessors. A summary of existing conditions on the site, based on field studies as well as desktop research is presented below.

Figure 1: Existing Site Overview

2.1 Biological

Land cover on the site comprises nineteen distinct ELC units (ecosites and vegetation types). Ten of these ELC units are terrestrial classifications and nine are wetland (swamp and marsh) classifications. The golf course constitutes approximately 26% of the Site, while the remaining 74% is mainly natural or naturalizing habitat. Of this natural habitat approximately 40% is wetland, 23% is forested (non-wetland), 8% is cultural thicket, and 3% is cultural meadow. The peripheral areas, situated on lands adjacent to the Site, constitute swamp and marsh wetlands, deciduous forest, cultural thicket, coniferous plantation, and cultural meadows, as well as small areas of constructed green lands and residential properties (lawns). Wetland features along the south side of the site collectively constitute Provincially Significant Wetland. Wetland features along the north side of the site consist of scattered, smaller riparian pockets of wetland that are not considered provincially significant.

Figure 2: ELC Ecosites with PSW boundary



An extension of wetland contiguous with Grants Creek PWS (the "PSW Extension") was identified in the western portion of the Site. As this feature represents a contiguous wetland area, it is considered part of Grants Creek Provincially Significant Wetland. Based on historical imagery, the PSW Extension was likely not present during the evaluation of Grants Creek Provincially Significant Wetland in the 1980s, as land cover here was dominated by agricultural uses at that time. The PSW Extension represents natural regeneration by hydrophilic vegetation, as the land has been left fallow in recent years. The updated PSW boundary reflects this PSW Extension, as well as several minor adjustments along the south edge of the site based on ELC and OWES-type assessments of plant cover.

Wetland features occurring within the riparian edge of the Tay River consist mostly of Silver Maple Swamps interspersed with pockets of Sweet Gale Organic Thicket Swamp.

The south edge of the golf course within the PSW consists mostly of Silver Maple Swamp (not dissimilar to that along the Tay) with some shorter sections of Black Ash Mineral Deciduous

Swamp. The majority of the PSW, however, south of the swamp edges abutting the golf course, is dominated by Alder Mineral Thicket Swamp.

The PSW Extension, previously disturbed as an agricultural area, is vegetatively different. It is a Willow Mineral Thicket Swamp Type that is impacted by a dense cover of invasive European Buckthorn. The interior of this wetland contained patches of shallow standing water up until early summer.

All wetland areas around the periphery of the golf course provide habitat for several local turtle species including Blanding's Turtle (listed as Threatened, provincially). The wetland areas (and associated headwater features) will provide water and allochthonous material to fish habitats within the Tay River and Grants Creek, but do not provide fish habitat directly.

Six types of habitat that meet the criteria of Significant Wildlife Habitat were identified on the Site, including Bat Maternity Colonies, Turtle Nesting Areas, Woodland Amphibian Breeding Habitat, Wetland Amphibian Breeding Habitat, Woodland Area-sensitive Bird Breeding Habitat, and Special Concern and Rare Wildlife Species. These SWH categories apply, to some degree, to all woodland and wetland areas across the site and there is no portion of the site that does not correspond with at least one potential SWH category. The utility of lands within the proposed development footprint as SWH, however, is generally limited compared to the SWH-qualifying areas outside of the development footprint. Suitable, if not more ideal ecosites for all six types of confirmed Significant Wildlife Habitat exist elsewhere on the site and would be retained, such as in Grants Creek Provincially Significant Wetland and with 30 metres of the Tay River.

2.2 Hydrogeological and Geotechnical

Subsurface investigations performed at the site included the completion of overburden and bedrock boreholes, auger probes, and the installation of monitoring wells to a maximum depth of approximately 12.3 metres into the bedrock. Subsurface data informed the definition of the following stratigraphic zones for the Site, in descending order:

- Fill (silty sand) – deposited during construction of the golf course; Peats and clay – located exclusively in the wetland areas;
- Glacial till – loose to stiff grey-brown silty clay to silty sand with cobbles and boulders (0.3 to 7.2 metres thick, with an average thickness of approximately 2.2 metres)
- Precambrian Bedrock - fine grained, very strong, pinkish grey amphibole gneiss (metamorphic rock) and pink granite pegmatites (igneous rock).

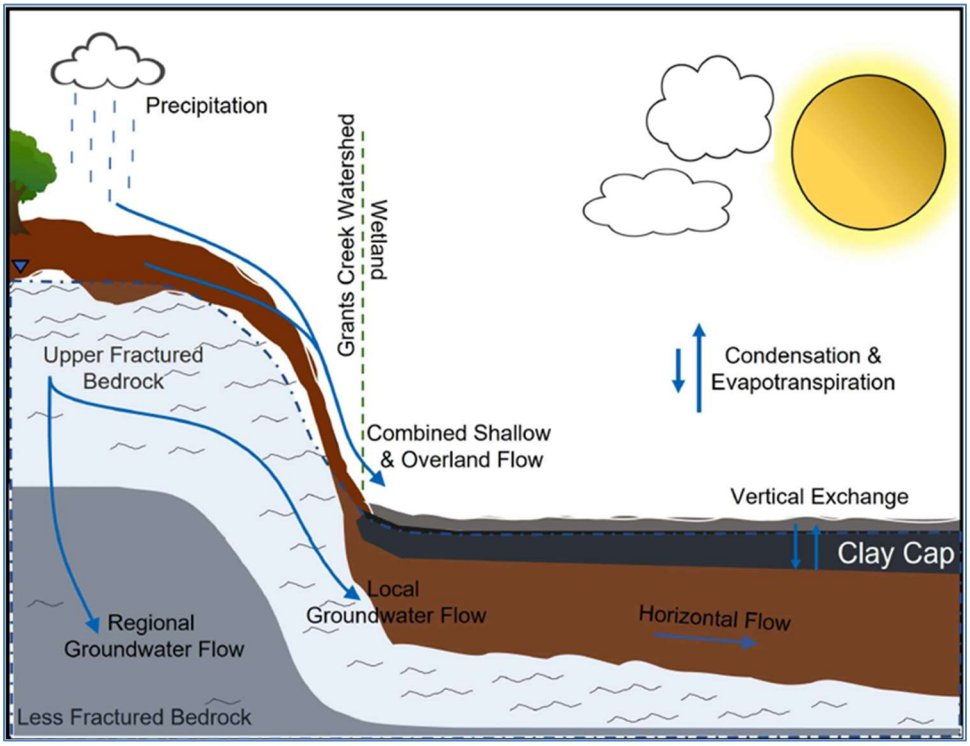
The surface topography of the Site generally reflects the underlying profile of the bedrock with the highest ground elevations found to the west sloping towards the southeast, and the lower elevations associated with surface water features. There is a groundwater divide running roughly east to west across the Site, as dictated by the topographic ridges. Thus, groundwater flow directions are interpreted to mostly mirror local topographic divides (Figure 3). The groundwater elevations are highest at the topographic highs within the central and western portions of the Site, with flow trending away from these peaks. As such, groundwater north of the divide flows towards the Tay River, whereas groundwater south of the divide flows towards the Grants Creek Wetland.

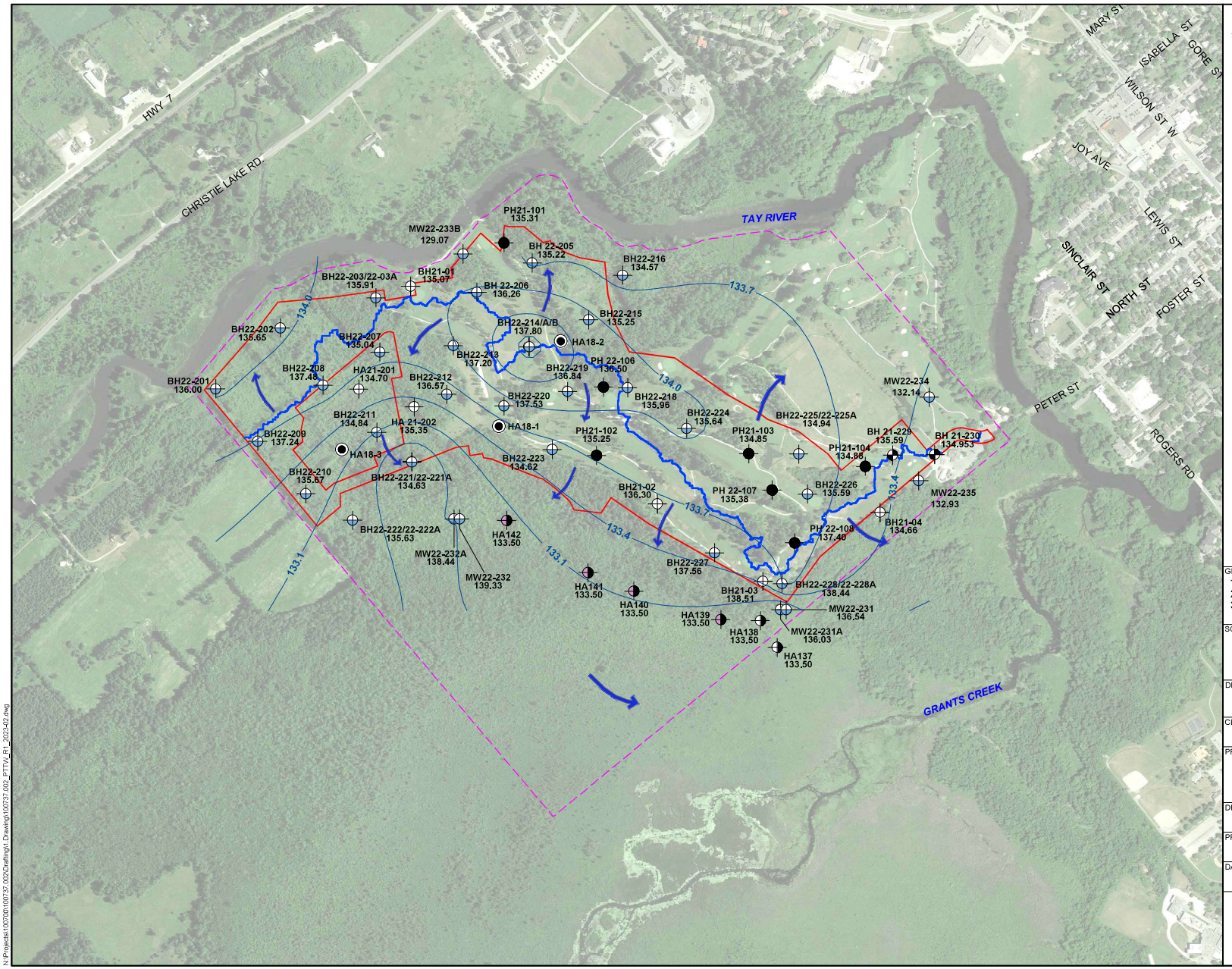
Water level monitoring was performed over the proposed development site and within the wetland. Data analysis suggest that the glacial till and upper fractured bedrock in the development area operate together as an unconfined or leaky aquifer, with the degree of confinement generally increasing with depth. Based on water levels and geology, it is believed that topography, soil, properties, fractures, and/or bedrock surface encourages shallow interflow, towards downgradient receivers (i.e., the Tay River, onsite ponds, and Grants Creek Wetland), limiting deeper percolation of water.

. Due to the inferred predominance of runoff processes over the development area, contributions of groundwater to the Grants Creek Wetland from the development site are interpreted to be relatively minor. Clay and silt underlying the Grants Creek Wetland increase the confinement of the underlying system and further restrict groundwater exchange between the wetland and proposed development Site.

The conceptual site model for local wetland processes is presented below:

Figure 3: Conceptual Site Model (insert from Figure 6, from the GEMTEC hydrogeological report)





LEGEND

BH/ PH/ HA/ MW # ← BOREHOLE/ PROBEHOLE/ HAND AUGERHOLE/ MONITORING WELL ID

XX.XX ← GROUND SURFACE ELEVATION, IN METRES GEODETIC DATUM

- **BOREHOLE** (current investigation by GEMTEC)
- **BOREHOLE** (previous investigation by GEMTEC)
- **PROBEHOLE** (previous investigation by GEMTEC)
- **MONITORING WELL** (current investigation by GEMTEC)
- **HAND AUGER HOLE** (current investigation by GEMTEC)
- **HAND AUGERHOLE** (previous investigation by GEMTEC)
- **HAND AUGER HOLE** (previous investigation by GEMTEC, 2018)
- **HAND AUGER HOLE** (current investigation by GEMTEC,elevations are based on DEM (not surveyed data))
- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE DEVELOPMENT BOUNDARY
- WATERSHED DRAINAGE DIVIDE
- 100 WATER LEVEL CONTOUR (in metres), MASL
- **GROUNDWATER FLOW PATHS**

GENERAL NOTE(S)

1. Coordinate system: UTM83, Z18.
2. Geographic dataset source: Ontario GeoHub.
3. Contains information licensed under the Open Government Licence – Ontario.

SCALE 1:7500

0 150 300 450m

DRAWING: GROUNDWATER ELEVATION

CLIENT: CAIVAN COMMUNITIES

PROJECT: PROPOSED DEVELOPMENT
PERTH GOLF
151 PETER STREET
PERTH, ONTARIO

DRAWN BY	CHECKED BY
S.L.	A.P.
PROJECT NO. 100737.002	REVISION NO. 1
DATE FEBRUARY 2023	FIGURE NO. **FIGURE 4**

GEMTEC
Consulting Engineers and Scientists
32 Steacie Drive
Ottawa, ON, K2K 2A9
Tel: (613) 836-1422
www.gemtec.ca
ottawa@gemtec.ca

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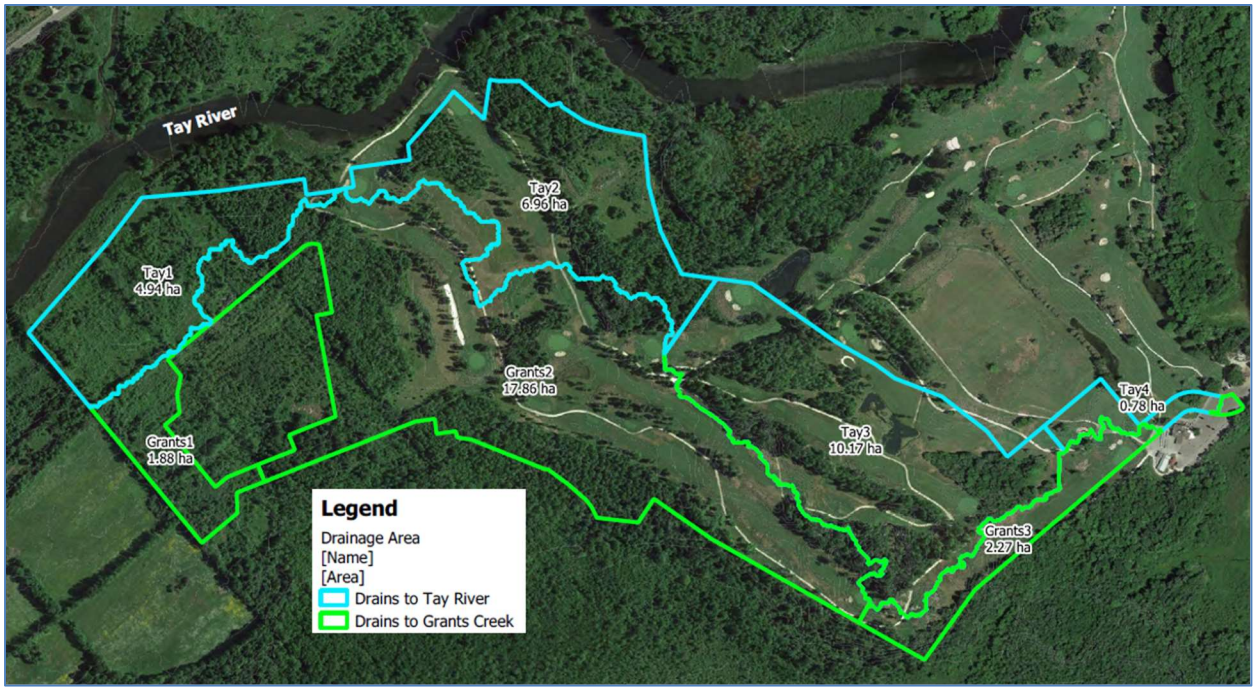
2.3 Surface Water

2.3.1 Drainage Area

A pre-development drainage area analysis has been completed for the Grants Creek watershed which includes the Grants Creek wetland in the tailwaters of the watershed near the confluence with the Tay River. Under existing conditions, the total existing drainage area of Grants Creek is approximately 9351.78 ha, primarily consisting of natural features, agricultural lands, and open water, with the Perth GC development lands making up 22.01 ha of the total drainage area to the wetland. The Perth GC under existing conditions consists primarily of a golf course with well-maintained lawns, surrounded by irregular forest patches. It has been assumed that the site will have an average runoff coefficient of 0.25. The site discharges to the Grants Creek wetland, via sheet flow, with very little to no defined watercourses/streams within the future development site to the wetland. Under existing conditions, the Perth GC development makes up 0.2% of the total drainage area to the wetland. The JFSA February 2023 report titled “Caivan Perth Development - Hydrologic And Hydraulic Conditions Report” provides the pre-development drainage divide between the development drainage area and the greater watershed, as shown below. Figure A3 of the same report outlines the greater Grants Creek watershed relative to the proposed development.

Figure 5: Pre-Development Drainage Divide

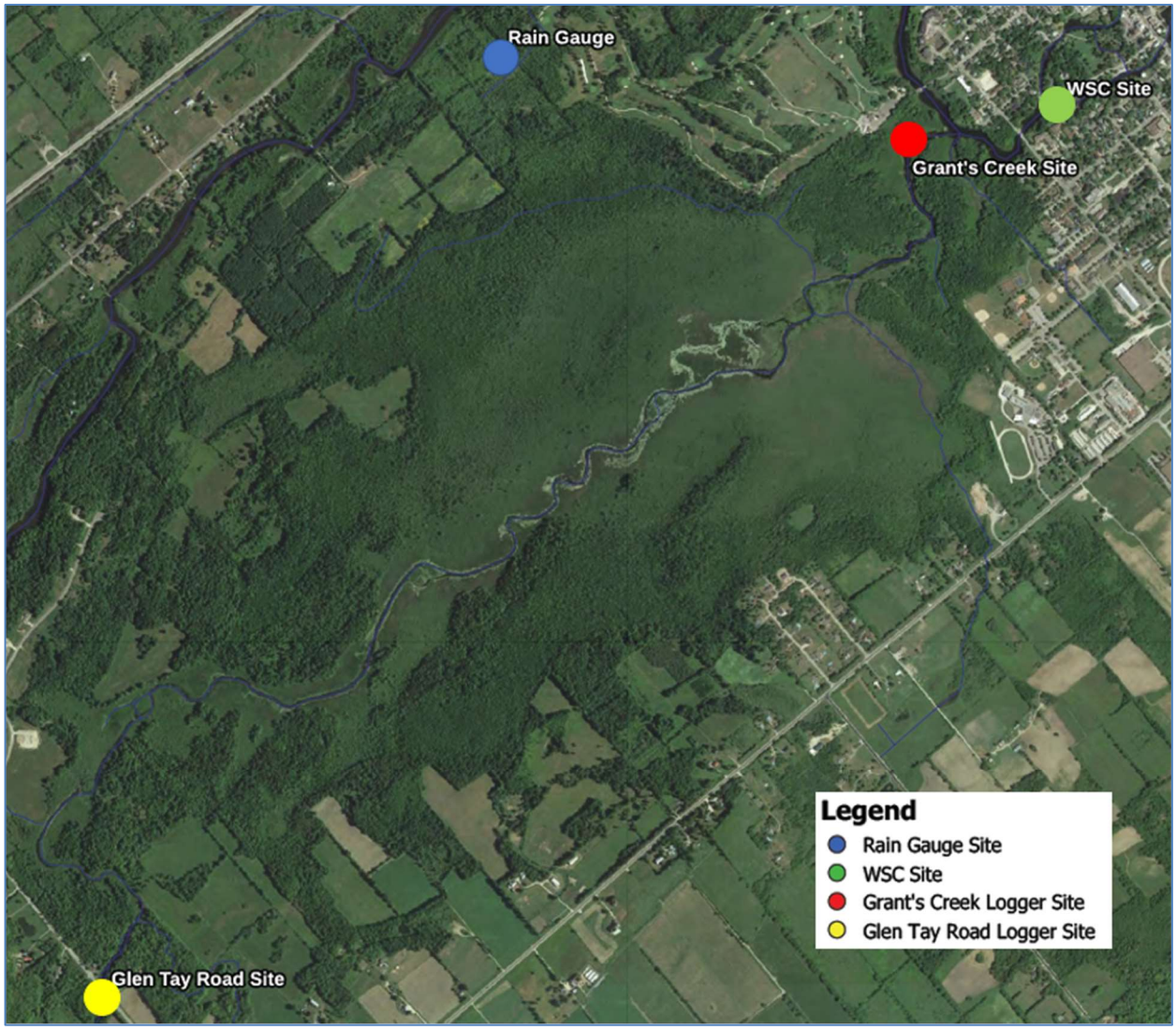


2.3.2 Surface Water Monitoring

JFSA conducted surface water monitoring around the Perth GC development area to gain a better understanding of how watercourses react to various environmental conditions, and how water flows and levels at key locations within the surrounding lands relate and fluctuate

throughout the year. The surface water and precipitation monitoring were carried out from June 2022 to November 2022, refer to the map below for the location of the monitoring. Throughout the monitoring period, a total of 325.3 mm of rainfall was recorded. Based on the rainfall data obtained during this window, 18 significant rainfall events were identified. The largest event recorded over this duration had a total rainfall volume of 38.3 mm, the maximum rainfall intensity recorded over this duration equated to less than a 5-year event. The data obtained from the surface water monitoring and precipitation monitoring helps develop a better understanding of the water flow and levels in the study area.

Figure 6: Surface Water Monitoring Sites



3 Proposed Conditions / Post Development

3.1 Servicing

The proposed development area is approximately 37.44 ha not including open space/park, SWMF and wetland areas. Overland stormwater runoff on the subject property is currently to the Tay River to the north and the Grant's Creek PSW to the south.

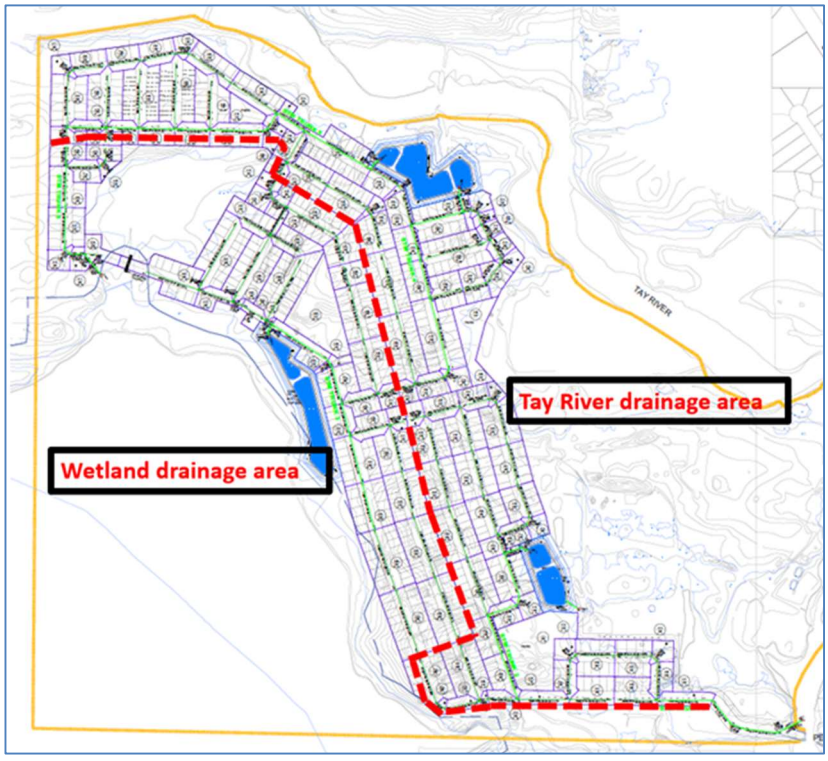
Drainage area pre and post development conditions

Condition	Grants Creek	Tay River
Pre-Development	22.01 ha	22.86 ha
Post-Development	16.32 ha	28.54 ha

The stormwater strategy for these lands proposes to establish the drainage areas such that flows to the wetland and Tay River are maintained to support the form and function of these features.

The concept design provides for two stormwater management wet ponds to discharge to the Tay River and one discharging to the Grants Creek wetland. Low Impact Design measure swill be implemented upstream of the SWMF, where practical and functional. Two additional small areas, one draining to the river and one to the wetland, are proposed to be serviced with a combination of Low Impact Development (LID) measures and an end of pipe oil grit separator. Rear yards

Figure 7: Post Development Drainage Areas



abutting the Tay River and Grants Creek Wetland will drain towards those features and will not be captured in the stormwater conveyance system.

The proposed stormwater management system will provide water quality treatment, peak flow attenuation, and flood control for the project site, maintaining pre-development peak flows to the Tay River and Grants Creek PSW. A preliminary SWM facility sizing has been completed to approximate the amount of storage volume that will be needed to ensure that sufficient land is set aside under post-development conditions to meet the above objectives. Major events in excess of the 100-year event will also outlet to the Tay River and Grant's Creek PSW.

A treatment train approach will be designed where Low Impact Development (LID) measures will be implemented upstream of the wet ponds. The wet ponds will be designed to achieve enhanced total suspended solids removal or better to protect water quality in the Tay River and Grants Creek PSW.

The LID measures provide additional quality control and support the water budget for the site. These are expected to include:

- Infiltration features with subdrains to allow for drainage during high groundwater conditions),
- Increased soil thickness on lawns for increased storage/infiltration potential,
- LID features located in areas with proposed grade raises,
- Catchbasins with infiltration trenches,
- Rear-yard infiltration trenches,
- Direct roof runoff to lawns/parks, increasing thickness of topsoil (e.g., increase from the typical minimum of 15cm to 30cm to increase retention),
- Construction dewatering installation of services and basement construction in accordance with recommendations in geotechnical and hydrogeological reports.

Detailed design on the stormwater facilities will also relate to the abutting natural features by considering outlet design as a way to support the receivers. In particular, the wet pond adjacent Grants Creek Wetland will be designed with a level spreader filtering flows through a permeable material onto a wide area in the buffer lands, rather than creating a concentrated outlet.

Figure 8: Proposed SWMF Outlets

3.2 Hydrogeological and Geotechnical

3.2.1 Conceptual Water Budget

The water balance completed for the Site indicates that pre- and post-development runoff is greater than infiltration. The post-development runoff will increase by 405 mm/year and 385 mm/year for the north (discharges to the Tay River) and south (discharges to the Grants Creek) subwatersheds of the Site, respectively. o The post-development infiltration (without mitigation measures) will be reduced by 102 mm/year and 86 mm/year for the north and south subwatersheds, respectively. Accordingly, the post-development runoff will increase by 405 mm/year and 385 mm/year for the north and south subwatersheds, respectively. The post-development infiltration reductions are considered minimal in comparison to runoff and excess surface water which will be effectively managed through SWMP and LID measures.

The hydrogeological conceptual model suggests that overland flow and interflow (e.g., rapid vadose zone transport and/or exfiltration following infiltration) and not groundwater discharge as baseflow are the primary contributors of water to the Grants Creek Wetland and Tay River from the Site; these flowpaths are considered together as runoff, as described by Fetter (2001). The infiltration calculated from the water balance does not distinguish between infiltration lost to shallow subsurface runoff processes (e.g., interflow) and infiltration that contributes to the deeper groundwater system (i.e., recharge). The Mississippi Rideau Source Protection Region's Tier 1 Water Budget and Water Quantity Stress Assessment estimated baseflow contributions to range

from as low as 2% in shallow bedrock settings (site-specific study in Tay River Subwatershed) to 40%. Based on boreholes advanced on-site as part of the geotechnical investigation, the degree of fracturing of the Precambrian bedrock decreased with depth. As such, limited deep groundwater recharge (pre- and post-development) is anticipated on-site.

3.3 Surface Water

3.3.1 Drainage Area

Under proposed conditions, approximately 16.32 ha of the 44.86 ha development will drain south to the nearby wetland and Grants Creek. This is a drainage area reduction of 5.69 ha to the Grant Creek watershed from the pre-development conditions. This results in a 0.06% reduction in the total drainage area to the Grants Creek watershed from pre-development conditions. Note that efforts have been made to maintain the existing drainage areas within the development site as much as possible with consideration for grading and servicing limitations. It is also important to note that the development will result in an increase in surface runoff volume due to the increase in impervious area (see section 3.1.1), so although the drainage area to the Grants Creek watershed will be reduced, the total annual runoff volume may increase. It has been assumed that post-development the site will have an average runoff coefficient close to 0.7. The implementation of various LID measures through out the development, where practical, will provide additional mitigation in terms of improved water quality, quantity moderation and subsurface water inputs. Given the overall size of the Grants Creek watersheds in comparison to the discrete development site, the linear reach of the watershed system and upgradient headwaters feeding the Grant Creek watershed, and the location of the drainage area change (at the confluence of the two watersheds) it is unlikely that this change under post-development conditions will have a quantifiable impact on the hydraulic and hydrologic conditions of the surrounding watercourses.

3.3.2 Grants Creek PSW Extension

As a part of Kilgour's study, a small pocket of wetland (1.48 ha) has been identified within the western extent of development lands, referred to as the PSW Extension. The proposed development will be built around this wetland with a 30m buffer applied and the wetland will be maintained by clean surface water runoff from rear yard lots and, if required, additional clean water from the development. The exact drainage area contributions for these lands will be assessed during detailed design and designed to support proposed restoration and enhancements to the wetland community. The existing vegetation community within the area – early-successional thicket with an abundance of invasive species (primarily buckthorn) – is proposed to be enhanced through a buckthorn removal program and extensive planting of deciduous wetland tree species. These enhancements will naturalize the former agricultural feature to match existing mature wetland in the vicinity.

4 Summary

4.1 Ground and surface water systems

- There will be minor changes to the total drainage area contributing to the wetland although this change is negligible and equates to a 0.06% reduction in the total drainage area to

the Grants Creek Wetland. This slight change in drainage area will have no impact on wetland hydroperiod.

- The wetland is primarily surface water-fed, as indicated by the conceptual water balance where runoff is greater than infiltration pre- and post-development.
- The water from the project site is primarily being received by the wetland via overland processes or interflow pathways.
- The groundwater flows are dictated by the topography and corresponding surface water divides. The receivers include localized depressions, PSW Extension, Grants Creek Wetland and Tay River.
- Deeper groundwater pathways contributing to the wetland are limited by the clay base of the wetland and its low conductivity relative to its underlying materials.
- Glacial till and fractured bedrock beneath the clay layer may encourage groundwater flow paths to be horizontal beneath the Grants Creek Wetland. As such, it is our interpretation that any reduction in infiltration or baseflow recharge caused by the proposed development, can be effectively offset through stormwater management and low impact development features, sustaining the key processes of the Grants Creek Wetland.
- Site-specific studies conducted by others in the Tay River subwatershed suggest rapid groundwater recharge processes are localized to areas of thin soils, primarily controlled by the hydraulic conductivity of the bedrock, and are dependent on fracture location and spacing.
- The post-development conditions will include a significant increase in impermeable surface area compared to pre-development conditions, which will decrease the infiltration volumes and increase runoff volumes. Assuming an average runoff coefficient of 0.25 for pre pre-development, and a coefficient closer to 0.7 for post development. This results in 21 ha x 0.25 = 5.2516 ha of area contributing runoff to the wetland under existing conditions, compared with 16 ha x 0.7 = 11.2 ha contributing to the wetland under post development conditions The total volume of runoff will be further increased post-development due to the reduction in evapotranspiration potential associated with a decrease in vegetated area.
- SWM measures will be designed to closely reflect pre-development inflow locations. LID measures will be implemented throughout the site and flow from main SWM pond will be distributed by a level spreader rather than concentrated outlet.
- Runoff processes (i.e., overland flow and interflow) are inferred to account for most of the water surplus of the site under pre- and post-development conditions, with a minor component being transported to deeper recharge.

4.2 Wetland form and function

- The wetland across the site is a mix of palustrine (intermittent/no inflow and intermittent/permanent outflow), and riparian features.

- Wetland enhancements are proposed through restoration of vegetation from thicket swamp to deciduous (maple) swamp within the PSW Extension.
- Animal species present with wetland areas include several species of turtles common to the area (including Blanding's Turtles [Threatened), snakes (including Gray Ratsnake [Threatened]), bats (including Little Brown Myotis and Tri-colored Bat [both Endangered]), and Birds (including Eastern Wood-Pewee, Wood Thrush and, to a limited extent, Rusty Blackbird [all Special Concern]. There are extensive existing wetland areas surrounding the site which also support this type of habitat.
- Wetland swamp and thicket-swamp ecosites along the Tay River and composing the Grants Creek PSW are comprised of tree and shrub species that are generally tolerant of a range of fluctuating water conditions. The flora is unlikely be affected by small changes in water levels.
- No modifications are proposed to the outlet of the PSW.

5 Potential Impacts and Mitigation

Based on the weight of evidence from the studies completed by the consulting team to date and regional scientific studies conducted by others, it is the team's professional opinion that the potential impacts of the development on the Grant Creek Wetland will be minimal. Further, proposed monitoring and mitigative measures will be designed and in place to ensure the health, sustainability and function of this wetland system. The following sections provide an integrated summary of the study evaluations completed by the consulting team.

5.1 Wetland Impacts

- Potential for a range of fluctuating water conditions in limited locations where storm outlets are located. The flora is unlikely to be affected by this water level fluctuation.
- Potential for erosive flows to affect existing soils.
- Animal species present within wetland are expected to remain in the area and continue to using the existing/improved wetland areas as habitat.
- No change to the wetland type is expected: a mix of palustrine (intermittent/no inflow and intermittent/permanent outflow), and riparian features.
- Potential for contaminants from stormwater impacts on wetland veg ie chlorides/nutrients.
- Invasive species may be imported from nearby development. Garden waste and litter may be more proximate to the wetland boundary.
- Removal of 635 m^2 of wetland at the Peter Street Bridge Road alignment, and impacts on a further 308 m^2 from proposed road crossing.
- Minor changes are proposed to the shape and size of the wetland where the road access from the Peter Street bridge encroaches by up to 11 m for a distance of 78 m, removing 635 m^2 of PSW. The PSW Extension is connected to the main portion of the PSW by a

narrow (20 m wide) isthmus thicket swamp. This strand of wetland will be the crossing point for a new road corridor. The corner of one block in the northwest corner of the site removes 233 m^2 of Tay River riparian deciduous swamp with (<0.2% of the total Tay River riparian wetland on the site), where that feature briefly extends >70 m from the riverbank.

5.2 Surface Water Impacts

- Minor changes to the total drainage area to the Grants Creek catchment under post development conditions with a reduction in total area of 0.06%.
- Approximately 23% reduction of land in the development area contributing surface water flows to the adjacent Grants Creek Wetland.
- Due to the development an increase in impervious area will increase surface water volumes available.

5.3 Hydrological Impacts

- Most water supplied to the Grants Creek Wetland is derived from headwater sources upstream rather than through local surface water or, to an even lesser degree, groundwater originating from the proposed development area. Since the groundwater contribution to the nearby area of the Grants Creek Wetland is small, post-development mitigation measures should focus on runoff volume management and water quality controls to ensure the health and function of the wetland.
- Shallow groundwater to the wetland was deemed to represent a minor contribution to the wetland, relative to surface water (including interflow) discharges. The pre-development factors controlling recharge to the deep bedrock system (i.e., shallow water table, low-conductivity bedrock, and horizontal drainage) are unlikely to be significantly altered by the proposed development, as the shallow system functionality is maintained.
- Excavations below the water table and associated dewatering will be required for municipal services (storm, sanitary, and water) and stormwater management ponds. Minimal groundwater taking is anticipated given the low hydraulic conductivity of overburden and bedrock encountered on-site. The estimated groundwater pumping rates for individual service trenches and stormwater management ponds are low, estimated to be less than 50,000 litres per day per source, with a radius of influence less than 21 metres.
- Temporary and transient groundwater pumping for the installation of municipal services is not anticipated to negatively impact groundwater users, surface waters, or wetlands. Groundwater taking and discharge will be completed subject to MECP approvals (Environmental Activity Sector Registry or Category 3 Permit To Take Water).

5.4 Mitigation

5.4.1 Stormwater Management and Low Impact Development (LID) Measures

Under post development conditions the increase in impervious area will offset reductions from the reduced drainage area, in annual flow contributions to the wetland. SWM and LID measures will be designed to closely reflect pre-development inflow locations and SWM outlets will be designed to replicate outflow locations under pre-development conditions.

Outflows from the main SWM pond will use a level spreader to distribute outflows across the site instead of having a single piped outlet location.

A treatment train approach of LIDs, Oil and Grit Separators (OGS) and or conventional SWM ponds will be implemented to ensure runoff is clean and will not adversely impact the wetland. SWM facilities have be sized to ensure post development peak flows do not exceed pre-development conditions. LIDs are proposed throughout the site to treat, attenuate, and distribute outflows from the development to the wetland.

5.4.2 Restoration

Invasive Reed-canary Grass and European Buckthorn were abundant within the PSW Extension as well more broadly along parts of the riparian edge of the Tay River in the northwest corner of the site. A re-naturalization/enhancement program, including invasive species removal and extensive plantings of native deciduous wetland trees (e.g. Silver and Red Maple) will be completed within these areas.

5.4.3 Development and Servicing Design

For the road ROW along the southern site boundary with the PSW, the intervening area is to be raised to form a wide, gently sloping berm of sufficient width and gradient, and constructed of sufficiently impervious fill, such that meltwater from salt-laden snow accumulations (windrows) from winter plowing drain fully towards the stormwater collection system of the roadway, and not towards the wetland. The top and backside of the berm are to be fully revegetated with dense trees of similar species to those of the adjacent band of forest including Sugar Maple, Basswood, Bitternut Hickory, and Black Cherry.

5.4.4 Education

Homeowner educational information will be provided to ensure good stewardship of the natural features in the community. In particular, information on fertilizer and other nutrient contaminant management, the location of the stormwater outlets, and control of invasive ornamental vegetation and disposal of yard wastes will be covered.

Flora within the PSW Extension is early successional regrowth including invasive buckthorn. Removal of Buckthorn here and replanting with locally appropriate deciduous wetland tree species (Silver Maple in the wet center with Red Maple around the periphery) is recommended.

5.4.5 Proposed Future Monitoring

Monitoring upstream and within Grants Creek PSW has been completed for the year 2022. Monitoring will continue in future years to develop a greater understanding of the wetlands hydrologic operations (hydroperiod) under existing conditions.

Monitoring of the PSW Extension to demonstrate it is being effectively used as habitat. Invasive species and PSW boundary condition will be surveyed over a ten year period.

6 CONCLUSIONS

This Integrated Hydrologic Impact Analysis has been prepared to ensure the form and function of Grants Creek Provincially Significant Wetland (PSW) is maintained as the development of the Perth Western Annex Lands site advances. The CA Act (where applicable), states the Authority may grant permission for development in or on the areas described in subsection 2 (1) if, in its opinion, the control of flooding, erosion, dynamic beaches, pollution or the conservation of land will not be affected by the development. O. Reg. 174/06, s. 3 (1).

The local policies of the RVCA under O.Reg 174/06 state that proposed development within the regulated area shall not have an adverse effect on the control of flooding, erosion, pollution or the conservation of land and, in the case of wetlands, the hydrologic function of the wetland.

Section 2.1.4 of the 2020 Provincial Policy Statement states that development and site alteration shall not be permitted in: a) significant wetlands in Ecoregions 5E, 6E and 7E1.

Further, Section 2.1.8 states that *development* and *site alteration* shall not be permitted on adjacent lands to the natural heritage features and areas identified in policies 2.1.4, 2.1.5, and 2.1.6 unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.

Development: means the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act, but does not include:

a) activities that create or maintain infrastructure authorized under an environmental assessment process;

Infrastructure: means physical structures (facilities and corridors) that form the foundation for development. Infrastructure includes: sewage and water systems, septage treatment systems, stormwater management systems, waste management systems, electricity generation facilities, electricity transmission and distribution systems, communications/telecommunications, transit and transportation corridors and facilities, oil and gas pipelines and associated facilities.

It is understood that to remove 635 m^2 of wetland, and impact a further 308 m^2 with a road crossing, the proposed transportation corridors shall be subject to a EA process, or a Ministerial Zoning Order shall be required.

It is the professional opinion of the consultants responsible for the preparation of this report, that the wetland is part of a significant continuous system that supports the form and function of Grants Creek Wetland and is not significantly influenced by changes to the adjacent land use at the downstream end. Appropriate mitigation through the design and construction of the community shall maintain the hydrologic function of the wetland, and its related form and functions. Grants Creek Wetland shall not be adversely affected by the Perth GC development project.