Supporting Document 3-6

Ecological Environment Effects Assessment Report

Eastern Ontario Waste Handling Facility Future Development Environmental Assessment

GFL Environmental Inc.

Moose Creek, Ontario

November 14, 2022

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Executive Summary

Kilgour & Associates Ltd. was contracted by GFL Environmental Inc. (GFL) to conduct an assessment of the effects of the future development of the Eastern Ontario Waste Handling Facility (EOWHF) on the ecological environment as part of the EOWHF Future Development Environmental Assessment (EA).

The EA is being carried out in accordance with the requirements of the Ontario *Environmental Assessment Act* (EAA) and project-specific Terms of Reference (ToR), which was approved by the Ministry of Environment, Conservation and Parks (MECP) on January 14, 2021.

The existing EOWHF is located within the Township of North Stormont, approximately 5 km north-northwest of the village of Moose Creek, Ontario, and 5 km east of the village of Casselman, Ontario, on the western half of Lot 16 and Lots 17 and 18, Concession 10, Township of North Stormont, United Counties of Stormont, Dundas and Glengarry, near the intersection of Highway 417 and Highway 138. The municipal street address for the facility is 17125 Laflèche Road, Moose Creek, Ontario. The lands to the east of the existing EOWHF being considered for the future development include the eastern half of Lot 16, Lots 14 and 15, and the majority of Lot 13 of Concession 10 (“Future Development Lands”). The existing EOWHF encompasses a site area of 189 hectares, while the lands to the east of the existing EOWHF being considered for future development include approximately 240 hectares.

The Study Areas include the existing site as well as potentially affected surrounding areas. The On-Site and Off-Site Study Areas identified for the EA in the approved ToR are as follows:

- On-Site Study Area – the existing EOWHF, and the future development area comprising the eastern half of Lot 16, Lots 14 and 15, and the majority of Lot 13 of Concession 10 east of the EOWHF; and
- Off-Site Study Area – the lands in the vicinity of the future development area, extending approximately 1 kilometre around the On-Site Study Area.

Two alternative methods for the proposed landfill expansion were identified in the approved ToR and were developed to a preliminary conceptual design level in a Conceptual Design Report. A net effects assessment was carried out for the two alternative methods following the methods outlined in the approved ToR, incorporating the information from the Conceptual Design Report and the Ecological Environment Existing Conditions Report.

The conceptual designs for the two alternative methods provide the same landfill disposal capacity and differ primarily in their geometry and overall footprint. Alternative Method 1 involves five stages oriented east-west (Stages 5 through 9) while Alternative Method 2 incorporates one stage oriented east-west (Stage 5) and three stages oriented north-south (Stages 6 through 8). Alternative Method 2 has a footprint that is 5,579 m² larger than that of Alternative Method 1.

For both alternative methods, the landfill development would proceed in stages (Stages 5 through 8/9) that would initiate in 2025 and would occur over the span of approximately 20 years, depending on the rate of waste accumulation. The disposal capacity for both alternative methods would be consumed at a rate of approximately 755,000 m³ per year over the 20-year planning period. The development of each stage would involve shallow excavation to approximately 3 m depth and installation of a leachate collection system to form the base of each stage. Waste would then be placed over the base and built up in incremental lifts, compacted, and then covered with an approved cover material. Waste would be placed in each stage until it reaches approved design contours. Both alternative methods include two pads where contaminated soil and approved cover material would be placed when brought to the site; this stockpiled material would be used as an approved daily cover material.

For both alternative methods, the leachate collection system would consist of granular layers and a piping network with collected leachate conveyed to leachate aeration ponds located in the southeast part of the existing landfill and then to a leachate treatment plant located north of the existing landfill. Treated effluent is then discharged to the Fraser Drain from the northwestern portion of the existing EOWHF. The capacity of the treatment plant will be expanded to accept leachate generated from the existing landfill as well as the future development. Estimated maximum annual leachate generation for Alternative Methods 1 and 2 is 123,542 m³ and 123,752 m³, annually, respectively. The alternative methods and the expanded treatment plant would be designed to provincial standards and operate under provincial approvals to treat leachate loads. The expansion of the landfill will occur in association with a new discharge pipe releasing effluent directly to Moose Creek. This would be undertaken under Authority or review by the MECP and Fisheries and Oceans.

The Future Development Lands are mostly devoid of natural vegetation, and thus both alternative methods would require limited vegetation clearing. Both methods would require the removal of 13.2 ha of organic deciduous thicket swamp (unevaluated wetland), which is within the Stage 5 area. Sparse tree cover on the Manderley Turf Products property in the southeastern corner of the Future Development Lands is anticipated to be removed. A deciduous treed hedgerow along the western edge of the Future Development Lands and the Fraser Drain is expected to be retained with the exception of trees that need to be cleared to construct crossings over the Fraser Drain.

Both alternative methods would require the conversion of sod fields to landfill in Stages 6 through 8/9. The sod fields do not meet the definition of Significant Wildlife Habitat.

It is assumed that alterations to the Fraser Drain (i.e., stormwater outlet and crossings) would be conducted under formal permission from South Nation Conservation (SNC) and Fisheries and Oceans Canada, as necessary, with all associated obligations and mitigation measures followed. It is also assumed that stormwater and leachate would be managed and treated following permissions from MECP.

Setbacks from watercourses for both alternative methods are the same and are expected to improve aquatic and riparian habitats of these features relative to existing conditions. The proposed setbacks would therefore increase the buffer between these watercourses and operations on the Future Development Lands. The planted screening buffer along the peripheries of the Future Development Lands (i.e., along the Roxborough-

Plantagenet Boundary Municipal Drain and the Upper Tayside Municipal Drain) is anticipated to enhance aquatic and riparian habitat through an increase in natural vegetation cover (e.g., soil stabilization/erosion control, shading, allochthonous inputs, habitat structure, etc.). Shading can be anticipated to reduce solar insolation, with benefits to channel cooling.

It is assumed that the potential for sediment to be released into surface water features during site preparation and construction would be mitigated using standard erosion and sediment control measures.

Potential for interactions with SAR habitat (described in detail in the Ecological Environment Existing Conditions Report) is expected to be the same for both alternative methods.

The footprint for both alternative methods is located approximately 1 km from Moose Creek Wetland. Therefore, the ecological functions of this feature, including providing Significant Wildlife Habitat and habitat for SAR, are not expected to be impacted by the landfill expansion under either alternative method.

There is no substantial difference between Alternative Methods 1 and 2 regarding net effects associated with the ecological environment, including terrestrial and aquatic ecosystems. Alternative Methods 1 and 2 would both remove 13.2 ha of thicket swamp (i.e., natural wetland vegetation, wildlife habitat, and potential SAR habitat) within the Stage 5 area. Both Methods 1 and 2 would require the same amount of tree removal and the removal of buildings at the Manderley Turf Products property (i.e., potential nesting and roosting habitat for birds and bats, respectively). Alternative Methods 1 and 2 would incorporate the same setbacks from watercourses, and both methods would incorporate plantings adjacent to watercourses in association with the visual screening buffer. Alternative Method 1 would remove a slightly greater area of sod fields (2 ha more), but this habitat is considered non-natural and large sod fields in the vicinity of the Future Development Lands would remain, thereby maintaining habitat function (i.e., geese stopover and staging) on the broader landscape.

Mitigation measures to minimize impacts to terrestrial and aquatic ecosystems are provided in this report, including commitments, monitoring, and approvals.

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Acronyms, Units and Glossary

Acronyms

Acronym	Definition
ANSI	Area of Natural and Scientific Interest
BBS	Breeding Bird Survey
CDR	Conceptual Design Report
DFO	Department of Fisheries and Oceans, now Fisheries and Oceans Canada
EAA	*Environmental Assessment Act*
ECCC	Environment and Climate Change Canada
ELC	Ecological Land Classification
ESA	*Endangered Species Act*
EOWHF	Eastern Ontario Waste Handling Facility
GFL	GFL Environmental Inc.
GHG	Greenhouse Gas
HDR	HDR Corporation
KAL	Kilgour & Associates Ltd.
MECP	Ministry of Environment, Conservation and Parks
MNRF	Ministry of Natural Resources and Forestry; now Ministry of Northern Development, Mining, Natural Resources and Forestry (MNDMNRF)
NEA	Niblett Environmental Associates Inc.
SAR	species at risk
SARA	*Species at Risk Act*
SNC	South Nation Conservation
ToR	Terms of Reference

Units

Unit	Definition
ha	Hectare
km	Kilometre
m	Metre

Glossary

Term	Definition
Approval	Permission granted by an authorized individual or organization for an undertaking to proceed. This may be in the form of program approval, certificate of approval or provisional certificate of approval
Bulking Material	Material such as woodchips added to high nitrogen materials like food scraps to provide a carbon source and increase the porosity of the compost.
Capacity (Disposal Volume)	The total volume of air space available for disposal of waste at a landfill site for a particular design (typically in m^3); includes both waste and daily cover materials but excludes the final cover.
Composting	The controlled microbial decomposition of organic matter, such as food and yard wastes, in the presence of oxygen, into finished compost (humus), a soil-like material. Humus can be used in vegetable and flower gardens, hedges, etc.
Composting facility	A facility designed to compost organic matter either in the presence of oxygen (aerobic) or absence of oxygen (anaerobic).
Environment	As defined by the *Environmental Assessment Act*, environment means: • air, land or water; • plant and animal life, including human life; • the social, economic and cultural conditions that influence the life of humans or a community; • any building, structure, machine or other device or thing made by humans; • any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from human activities; or • any part or combination of the foregoing and the interrelationships between any two or more of them (ecosystem approach).
Environmental Assessment	A systematic planning process that is conducted in accordance with applicable laws or regulations aimed at assessing the effects of a proposed undertaking on the environment
Evaluation criteria	Evaluation criteria are considerations or factors taken into account in assessing the advantages and disadvantages of various alternatives being considered
Greenhouse gas	Any of the gases whose absorption of solar radiation is responsible for the greenhouse effect, including carbon dioxide, methane, ozone, and the fluorocarbons.
Indicators	Indicators are specific characteristics of the evaluation criteria that can be measured or determined in some way, as opposed to the actual criteria, which are fairly general
Landfill gas	The gases produced from the wastes disposed in a landfill; the main constituents are typically carbon dioxide and methane, with small amounts of other organic and odour-causing compounds
Landfill site	An approved engineered site/facility used for the final disposal of waste. Landfills are waste disposal sites where waste is spread in layers, compacted to the smallest practical volume, and typically covered by soil.
Leachate	Liquid that drains from solid waste in a landfill and which contains dissolved, suspended and/or microbial contaminants from the breakdown of this waste.
Methane gas	A colourless, odourless highly combustible gas often produced by the decomposition of decomposable waste at a landfill site. Methane is explosive in concentrations between 5% and 15% volume in air.
Mitigation	Measures taken to reduce adverse impacts on the environment.
Proponent	A person who: • carries out or proposes to carry out an undertaking; or • is the owner or person having charge, management or control of an undertaking.
Receptor	The person, plant or wildlife species that may be affected due to exposure to a contaminant.

Glossary

Term	Definition
Federally significant species	Species that are listed under Schedule 1 of the federal *Species at Risk Act*.
Provincially significant species	Species that are listed under the provincial *Endangered Species Act*, along with species that are tracked by the Natural Heritage Information Centre (MNRF, 2014).
Terms of Reference	A terms of reference is a document that sets out detailed requirements for the preparation of an Environmental Assessment.
Undertaking	Is defined in the *Environmental Assessment Act* as follows: • An enterprise or activity or a proposal, plan or program in respect of an enterprise or activity by or on behalf of Her Majesty in right of Ontario, by a public body or public bodies or by a municipality or municipalities; • A major commercial or business enterprise or activity or a proposal, plan or program in respect of a major commercial or business enterprise or activity of a person or persons other than a person or persons referred to in clause (1) that is designated by the regulations; or • An enterprise or activity or a proposal, plan or program in respect of an enterprise or activity of a person or persons, other than a person or persons referred to in clause (a), if an agreement is entered into under section 3.0.1 in respect of the enterprise, activity, proposal, plan or program ("enterprise").
Waste	Refuse from places of human or animal habitation; unwanted materials left over from a manufacturing process.

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1 Introduction

Kilgour & Associates Ltd. was contracted by GFL Environmental Inc. (GFL) to conduct an assessment of the effects of the future development of the Eastern Ontario Waste Handling Facility (EOWHF) on the ecological environment as part of the EOWHF Future Development Environmental Assessment (EA).

The EA is being carried out in accordance with the requirements of the *Environmental Assessment Act* (EAA) and project-specific Terms of Reference (ToR), which was approved by the Ministry of Environment, Conservation and Parks (MECP) on January 14, 2021.

The environment was divided into environmental aspects, components and evaluation criteria as listed in **Table 1-1**. Existing conditions reports and effects assessment reports have been prepared to address the environmental components.

Table 1-1. Environmental Aspects, Components and Evaluation Criteria

Environmental Aspect	Environmental Component	Evaluation Criteria
Natural Environment	Atmospheric Environment	• Air Quality • Noise • Odour
	Geology and Hydrogeology	• Groundwater Quality • Groundwater Quantity
	Surface Water Environment	• Surface Water Quality • Surface Water Quantity
	Ecological Environment	• Terrestrial Ecosystems • Aquatic Ecosystems
Socio-Economic Environment	Economic	• Economic Effects on / Benefits to Local Community
	Social	• Effects on Local Community • Visual Impact of Facility
Cultural Environment	Cultural Environment	• Cultural Heritage Resources • Archaeological Resources
Built Environment	Transportation	• Effects from Truck Transportation along Access Roads
	Current and Planned Future Land Use	• Effects on Current and Planned Future Land Uses
	Aggregate Extraction and Agricultural	• Aggregate Resources • Effects on Agricultural Land

The purpose of the proposed undertaking is to provide approximately 15.1 million cubic metres (m^3) of additional landfill disposal capacity at the existing EOWHF over a 20-year planning period, with operations anticipated to begin in 2025 and closure anticipated in 2045. The undertaking will enable GFL to continue to provide essential disposal services for residual non-hazardous solid waste to their customers once the landfill reaches its

currently approved disposal capacity and continue to provide economic support to the local community over the long term. No changes to the approved fill rates or site access routes are proposed.

Two alternative methods for carrying out the undertaking were identified in the approved ToR and are developed to a preliminary conceptual design level in the Conceptual Design Report (CDR). Both alternative methods provide a landfill volume of approximately 15.1 million m^3 based on the approved fill rate of 755,000 tonnes per year over a 20-year planning period. Studies completed for the EOWHF have indicated that, based on the underlying soils, the design alternatives are limited to varying lateral configurations with a consistent height. Both alternative methods will continue to use established operating procedures currently in place at the EOWHF and would maximize the use of existing site infrastructure.

Alternative Method 1 (**Figure 1-1**) consists of implementing the future development through five stages: one stage adjacent to and north of the existing landfill (Stage 5); and four stages oriented east-west within the future development lands (Stages 6 through 9). Stages 6 through 8 will be identical in size, while Stages 5 and 9 will be smaller. A stormwater management system will be constructed consisting of conveyance ditches around the perimeter of each stage and a retention pond located northwest of Stage 8. The existing pond located northeast of Stage 5 will be modified to attenuate peak flows if required.

Alternative Method 2 (**Figure 1-2**) consists of implementing the future development through four stages: one stage adjacent to and north of the existing landfill (Stage 5); and three stages oriented north-south within the future development lands (Stages 6 through 8). Stages 6 and 7 will be identical in size, while Stages 5 and 8 will be smaller. A stormwater management system will be constructed consisting of conveyance ditches around the perimeter of each stage and a retention pond located north of Stages 6 and 7. The existing pond located northeast of Stage 5 will be modified to attenuate peak flows if required.

For both alternative methods, the design of the stages will be consistent with the existing landfill design. Visual screening will be constructed along the north and east perimeters and a portion of the south perimeter consisting of earthen berms and/or vegetation plantings. A new road entrance will be constructed from Laflèche Road, which will include a new scale facility.

The purpose of this Ecological Environment Effects Assessment Report is to present the potential environmental effects of the alternative methods on the ecological environment, a comparison of the net effects of each alternative method, the selection of a preferred alternative, an assessment of the environmental effects of the preferred alternative, commitments and monitoring, and approvals. The results from this study will be documented in an EA Study Report in accordance with the approved ToR, which will be submitted to the MECP for review.

Figure 1-1. Alternative Method 1

Figure 1-2. Alternative Method 2

2 Effects Assessment Methods

Using the evaluation criteria, indicators, rationale and data sources from the approved ToR and the existing conditions from the Ecological Environment Existing Conditions Report, the effects assessment is carried out as follows:

- predict the potential environmental effects for each alternative method (Section 3);
- identify the preferred alternative based on a comparative evaluation of the potential environmental effects of each alternative method (Section 4); and
- conduct an effects assessment on the preferred alternative, including the identification of mitigation measures and monitoring programs (Sections 4 and 5).

2.1 Predict Potential Environmental Effects for Alternative Methods

The potential environmental effects for each alternative method are identified based on the application of the evaluation criteria, indicators and data sources in the approved ToR and based on the maximum allowable waste receipt level for the EOWHF landfill. The potential effects can be positive or negative, direct or indirect, and short- or long-term. Mitigation measures are identified to minimize or mitigate the potential effects and then the net effects are evaluated taking into consideration the application of mitigation measures.

2.1.1 Study Areas

The existing EOWHF is located within the Township of North Stormont, approximately 5 km north-northwest of the village of Moose Creek, Ontario, and 5 km east of the village of Casselman, Ontario, on the western half of Lot 16 and Lots 17 and 18, Concession 10, Township of North Stormont, United Counties of Stormont, Dundas and Glengarry, near the intersection of Highway 417 and Highway 138. The municipal street address for the facility is 17125 Laflèche Road, Moose Creek, Ontario. The lands to the east of the existing EOWHF being considered for the future development include the eastern half of Lot 16, Lots 14 and 15, and the majority of Lot 13 of Concession 10. The existing EOWHF encompasses a site area of 189 hectares, while the lands to the east of the existing EOWHF being considered for future development include approximately 240 hectares.

The study areas include the existing site as well as potentially affected surrounding areas. The On-Site and Off-Site Study Areas identified for the EA in the approved ToR are as follows (**Figure 2-1**):

- On-Site Study Area – the existing EOWHF, and the future development area comprising the eastern half of Lot 16, Lots 14 and 15, and the majority of Lot 13 of Concession 10 east of the EOWHF; and
- Off-Site Study Area – the lands in the vicinity of the future development extending approximately 1 kilometre from the On-Site Study Area.

These study areas were used for the purposes of the ecological environment effects assessment.

Figure 2-1. Study Areas for Ecological Environment

2.1.2 Evaluation Criteria, Indicators and Data Sources

The evaluation criteria, rationale, indicators and data sources used for the ecological environment effects assessment as per the approved ToR are provided in **Table 2-1**.

Table 2-1. Evaluation Criteria, Indicators and Data Sources for Ecological Environment

Evaluation Criteria	Rationale	Indicators	Data Sources
Natural Environment: Ecological Environment			
Terrestrial Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural terrestrial habitats and vegetation, including rare, threatened, or endangered species.	• Predicted impact on vegetation communities • Predicted impact on wildlife habitat • Predicted impact on vegetation and wildlife including rare, threatened, or endangered species	• Vegetation, breeding birds, amphibian calling, and species at risk habitat survey data from previous studies and recent field studies • Aerial imagery • MNRF Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement • MNRF Significant Wildlife Habitat Technical Guide • Significant Wildlife Habitat Schedule Criteria for Ecoregion 6E • Proposed facility characteristics • Landfill design and operations data • Annual monitoring report data
Aquatic Ecosystems	Continued or expanded operation of the waste disposal facility may disturb the functioning of natural aquatic habitats and species, including rare, threatened, or endangered species.	• Predicted impact on aquatic habitat including fish habitat • Predicted impact on aquatic biota including rare, threatened, or endangered species	• Fish and fish habitat survey data from previous studies and field studies • MNRF review letters of previous existing conditions reports • Surface water quantity and quality effects assessments • Annual monitoring report data • Proposed facility characteristics • Landfill design and operations data

2.1.3 Key Design Considerations and Assumptions

The alternative methods of carrying out the undertaking are described in detail in the CDR. Regarding the alternative methods, the key design considerations and assumptions as they relate to ecological environment are described below.

Summary of Existing Conditions

Kilgour & Associates Ltd. (KAL) was retained by GFL to perform baseline ecological inventories on properties associated with future expansion of the EOWHF. The Ecological Environment Existing Conditions Report documented existing ecological conditions within On-Site and Off-Site Study Areas based on desktop reviews, previous ecological work performed in the area, and field campaigns performed by KAL in 2019, 2020, and 2021. The report included records of provincially and federally protected species at risk (SAR) and provided professional opinions on the potential presence of SAR, their habitat, fish habitat, and areas of ecological value that may interact with future development of the EOWHF.

The On-Site Study Area encompassed the existing EOWHF and the Future Development Lands. The Off-Site Study Area was comprised of a 1 km buffer around the On-Site Study Area. Several watercourses occur within the On-Site Study Area, including the Fraser Drain, the Upper Tayside Municipal Drain, the Roxborough-Plantagenet Municipal Drain, and the Albert Fahey Award Drain. The Study Areas fall within the Moose Creek Subwatershed of the lower South Nation Watershed. Moose Creek (the watercourse) is located within the Off-Site Study Area, west of the On-Site Study Area. A portion of Moose Creek Wetland is located within the Off-Site Study Area, directly southwest of the On-Site Study Area. Moose Creek Wetland is a locally significant wetland, a Significant Woodland, an Area of Natural and Scientific Interest (ANSI), and contains habitat that classifies as Significant Wildlife Habitat.

The Ecological Environment Existing Conditions Report described terrestrial and wetland habitats and associated flora and fauna in the On-Site and Off-Site Study Areas. The approach to characterize these habitats was focused on identifying potential SAR habitat and Significant Wildlife Habitat through Ecological Land Classification and conducting focused studies on SAR that were considered the most likely to occur in the On-Site Study Area. The On-Site Study Area is mostly non-natural (i.e., of anthropogenic nature) and is therefore not suitable habitat for most SAR known to occur or to potentially occur in the area.

A total of 32 bird species were observed in the study areas and most of these species are protected under the *Migratory Birds Convention Act*.

Five species of bats were detected in the On-site Study Area via acoustic monitoring, and the results implied that bats were potentially foraging over the future development lands and/or roosting nearby. The thicket swamp in the Stage 5 area and trees along the Fraser Drain may provide roosting habitat, but much more ideal roosting habitat exists in Moose Creek Wetland in the Off-site Study Area. Buildings and trees associated with the Manderley Turf Products property may also provide roosting habitat.

A total of six anuran (frog and toad) species were observed in the On-site Study Area. None of these species receive protection under the ESA or the *Fish and Wildlife Conservation Act*. Watercourses in the study areas and the thicket swamp in the Stage 5 area provide habitat for anurans.

Three SAR protected under the provincial *Endangered Species Act* (ESA) were observed in the Study Areas during field surveys: Bank Swallow (Off-Site Study Area), Barn Swallow (On-Site and Off-Site Study Areas), and Little Brown Myotis (On-Site

Study Area). Foraging habitat for Bank Swallow (i.e., the area within 500 m of a nest) slightly overlaps with the Future Development Lands and is currently protected under the ESA such that its function as feeding habitat cannot be significantly altered without permission from MECP. A Barn Swallow nest was observed adjacent to the Future Development Lands at the EOWHF in 2019 but was not present during subsequent surveys in 2020. Barn Swallow's status under the ESA will be reclassified by January 2023 from Threatened to Special Concern. That reclassification will mean fewer provincial requirements as they pertain to nests of Barn Swallow by the time the project commences, but active nests will remain protected under the Migratory Birds Convention Act. Little Brown Myotis was detected via acoustic monitors deployed on the western edge of the Future Development Lands; this at-risk bat species may forage over the Future Development Lands and/or roost nearby. MECP will be consulted if trees cannot be removed outside of the bat roosting season.

Western Chorus Frog (not listed under the ESA; Threatened under the federal *Species at Risk Act,* SARA) was observed within the Fraser Drain along the western edge of the Future Development Lands and along the northern border of the EOWHF lands (On-Site Study Area). Western Chorus Frog is protected under SARA as it applies to projects on federal lands or projects involving or funded by federal authorities. Snapping Turtle (listed as Special Concern under the ESA and SARA) was also observed on the Future Development Lands; this species does not receive habitat or individual protection under the ESA or SARA, but individuals receive protection under the *Fish and Wildlife Conservation Act*. The habitat in which Snapping Turtle was observed qualifies as Significant Wildlife Habitat for Special Concern Species and protecting it as such would be determined by the municipality.

Three species of snakes were observed in the Off-site Study Area: Eastern Gartersnake, Eastern Ribbonsnake, and Milksnake. These species are not protected under the ESA, but the latter two are protected under the *Fish and Wildlife Conservation Act*. The thicket swamp in the Stage 5 area may provide habitat for these snake species.

The Study Areas are part of a larger natural heritage feature that spans to the north as identified at the landscape level by the Ontario Ministry of Natural Resources and Forestry (MNRF). This natural heritage feature and therefore the Study Areas include a Migratory Bird Staging and Migration Stopover Area as it pertains to Snow Geese and Canada Geese for both spring and fall, as well as a Raptor Wintering Area for various species including Snowy Owls and Rough-legged Hawks. These habitat features are considered candidate Significant Wildlife Habitats by MNRF. Field studies of the Study Areas indicated that these habitat features do not meet the MNRF criteria to qualify as Significant Wildlife Habitat. The sod fields on the future development lands did not meet the MNRF criteria for Significant Wildlife Habitat for Migratory Bird Staging and Migration Stopover Areas; however, these fields provide staging and stopover habitat for hundreds of Snow Geese and Canadian Geese in the spring and fall.

The reach of the Roxborough-Plantagenet Boundary Municipal Drain north of the future development lands qualifies as Significant Wildlife Habitat for Special Concern Species (Snapping Turtle). Watercourses in the Study Areas likely provide habitat for other turtle species that are not protected under the ESA (i.e., Snapping Turtle and Midland Painted Turtle). Watercourses in the study areas likely act as travel corridors for these turtle

species and provide foraging (e.g., fish) resources. All turtle species in the region are protected under the *Fish and Wildlife Conservation Act*.

Fish communities of watercourses in the Study Areas were assessed in the summer of 2019 and in the spring of 2021 using non-lethal backpack electrofishing. Fish were collected from four watercourses in the Study Areas: the Roxborough-Plantagenet Boundary Municipal Drain, the Fraser Drain, the Upper Tayside Municipal Drain, the Albert Fahey Award Drain, and Moose Creek. The Fraser Drain and the Upper Tayside Municipal Drain are the only watercourses that fall on the Future Development Lands and contain water in the summer. The thermal regimes of these two municipal drains were classified using nomograms of water and air temperature data collected in August 2019. The Fraser Drain was classified as suitable for a mostly cool-warm water fishery, and the Upper Tayside Municipal Drain was classified as suitable for a warm water (i.e., tolerant) fishery. All collected fish species are typical of the Moose Creek area. No provincially and/or nationally listed (SAR) fish species were captured. No critical habitat for aquatic SAR or sensitive spawning habitat has been identified within the Study Areas. Considering this, minor alterations to fish habitat areas in the Study Areas (e.g., addition of culvert crossings) would require review by the appropriate agencies but would likely be approved through the design and implementation of standard mitigation measures such as performing in-water works outside of the spring-spawning period for fish.

Design Considerations and Assumptions

The conceptual designs for the two alternative methods provide the same landfill disposal capacity and differ primarily in their geometry and overall footprint. Alternative Method 1 involves five stages oriented east-west (Stages 5 through 9) while Alternative Method 2 incorporates one stage oriented east-west (Stage 5) and three stages oriented north-south (Stages 6 through 8). Alternative Method 2 has a footprint that is 5,579 m^2 larger than that of Alternative Method 1.

For both alternative methods, land preparation, prior to landfill construction would proceed in stages (Stages 5 through 8/9), commencing in 2023. Landfilling is anticipated to start in in 2025 and proceed over a period of approximately 20 years, depending on the rate of waste accumulation. The disposal capacity for both alternatives would be consumed at a rate of approximately 755,000 m^3 per year over the 20-year planning period. The development of each stage would involve shallow excavation to approximately 3 m depth and installation of a leachate collection system to form the base of each stage. Waste would then be placed over the base and built up in incremental lifts, compacted, and then covered with approved cover material. Waste would be placed in each stage until it reaches approved design contours. Both alternative methods include two pads where approved cover material would be placed when brought to the site; this stockpiled material would be used as an approved cover material.

For both alternative methods, the leachate collection system would consist of granular layers and a piping network with collected leachate conveyed to leachate aeration ponds located in the southeast part of the existing landfill and then to a leachate treatment plant located north of the existing landfill. Treated effluent is then discharged to the Fraser Drain from the northwestern portion of the existing EOWHF. The capacity of the treatment plant will be expanded to accept leachate generated from the existing landfill as well as the future development. Estimated maximum annual leachate generation for

Alternative Methods 1 and 2 of the landfill expansion is 123,542 m³ and 123,752 m³, respectively. The alternative methods and the expanded treatment plant would be designed to provincial standards and operate under provincial approvals to treat leachate loads. The expansion of the landfill will occur in association with a new discharge pipe releasing effluent directly to Moose Creek. This would be undertaken under Authority or review by the MECP and Fisheries and Oceans Canada.

The Future Development Lands are mostly devoid of natural vegetation, and thus both alternative methods would require limited vegetation clearing. Both methods would require the removal of 13.2 ha of organic deciduous thicket swamp (unevaluated wetland), which is within the Stage 5 area (**Figures 2-2** and **2-3**; **Table 2-2**). For the purposes of this report, it is assumed that vegetation removal would only be required in areas that lie within the development footprint (i.e., not areas outside of the footprint that may be altered during site preparation, construction, and/or operation), with the exception of the thicket swamp, which is assumed to be removed entirely (i.e., removal extending beyond the Stage 5 area; **Figures 2-2** and **2-3**). Sparse tree cover on the Manderley Turf Products property in the southeastern corner of the Future Development Lands is anticipated to be removed. The deciduous treed hedgerow along the western edge of the Future Development Lands (i.e., along the Fraser Drain) is expected to be retained with the exception of trees that need to be cleared to construct crossings over the Fraser Drain.

Both alternative methods would require the conversion of sod fields to landfill in Stages 6 through 8/9. Sod production would continue to occur in these areas for a period of years until landfill expansion encroaches into sod production areas. The sod fields did not meet MNRF criteria for Significant Wildlife Habitat for Migratory Bird Staging and Migration Stopover Areas. However, these fields provide staging and stopover habitat for hundreds of Snow Geese and Canadian Geese in the spring and fall. Removing sod fields would therefore remove such habitat, but other sod fields in the vicinity will remain providing sufficient opportunity for geese staging and stopover. Most of the adjacent agricultural fields would likely be removed to support the creation of a visual screening buffer around the periphery of the Future Development Lands; this screening buffer would consist of some combination of planted trees or other vegetation and/or a soil berm. Tree cover in Stages 6 through 8/9 is expected to be similar or greater than existing conditions once plantings associated with the visual screening buffer are mature. This screening buffer would require the removal of buildings at the Manderley Turf Products property in the southeastern corner of the Future Development Lands.

For both alternative methods, stormwater from closed stages would be directed to a stormwater management pond in the northern portion of the Future Development Lands. The stormwater pond for Alternative Method 2 is 200 m³ larger than that for Alternative Method 1. The stormwater pond would be used for quality and quantity control prior to discharging to the Fraser Drain. The outlet channel from the stormwater pond into the Fraser Drain would be located on the west side of the pond for both alternative methods. The stormwater pond north of Stage 5 (**Figures 1-1** and **1-2**) has already been constructed.

Figure 2-2. Alternative Method 1 Interaction with Ecological Land Classification Vegetation Communities

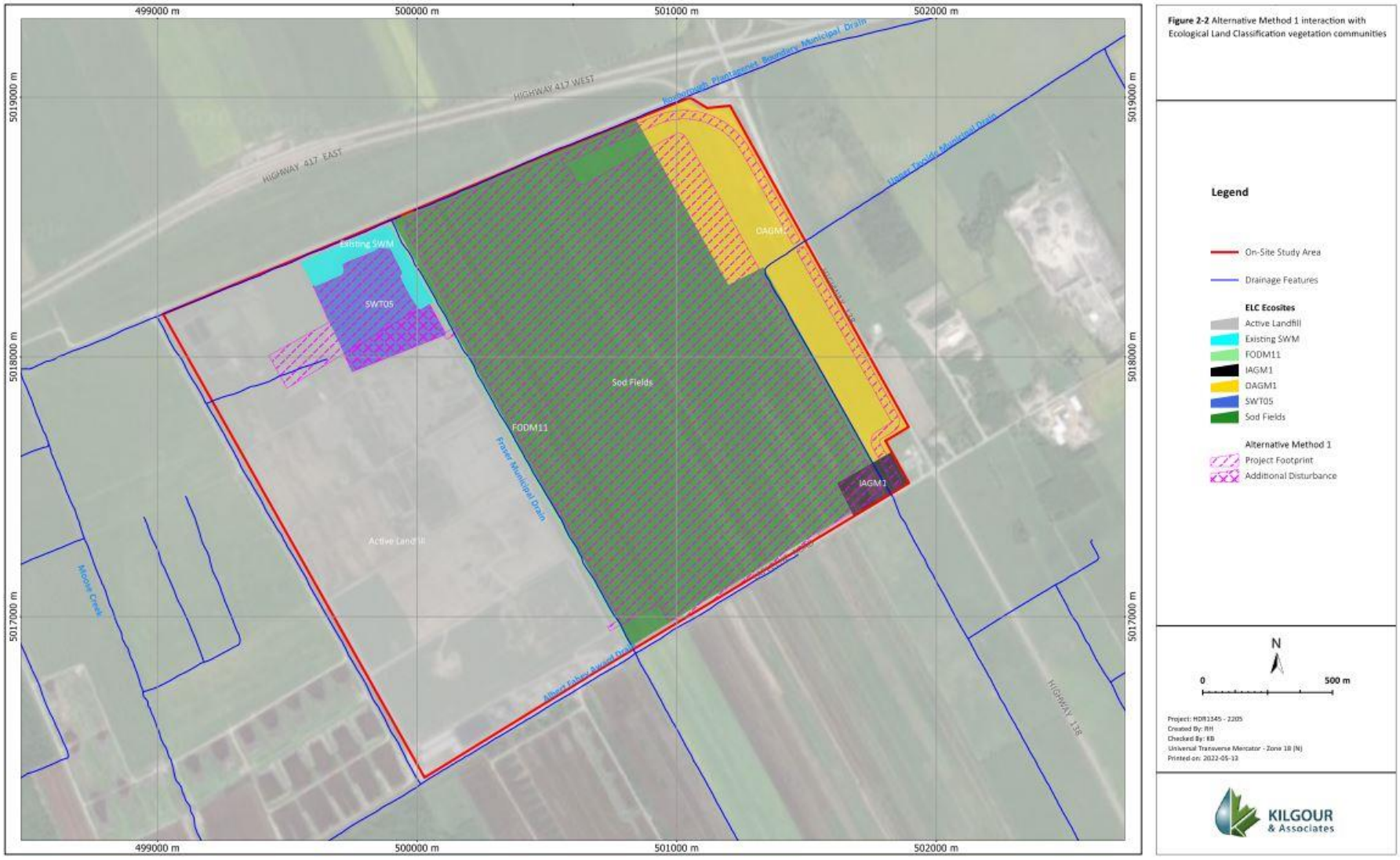

Figure 2-3. Alternative Method 2 Interaction with Ecological Land Classification Vegetation Communities

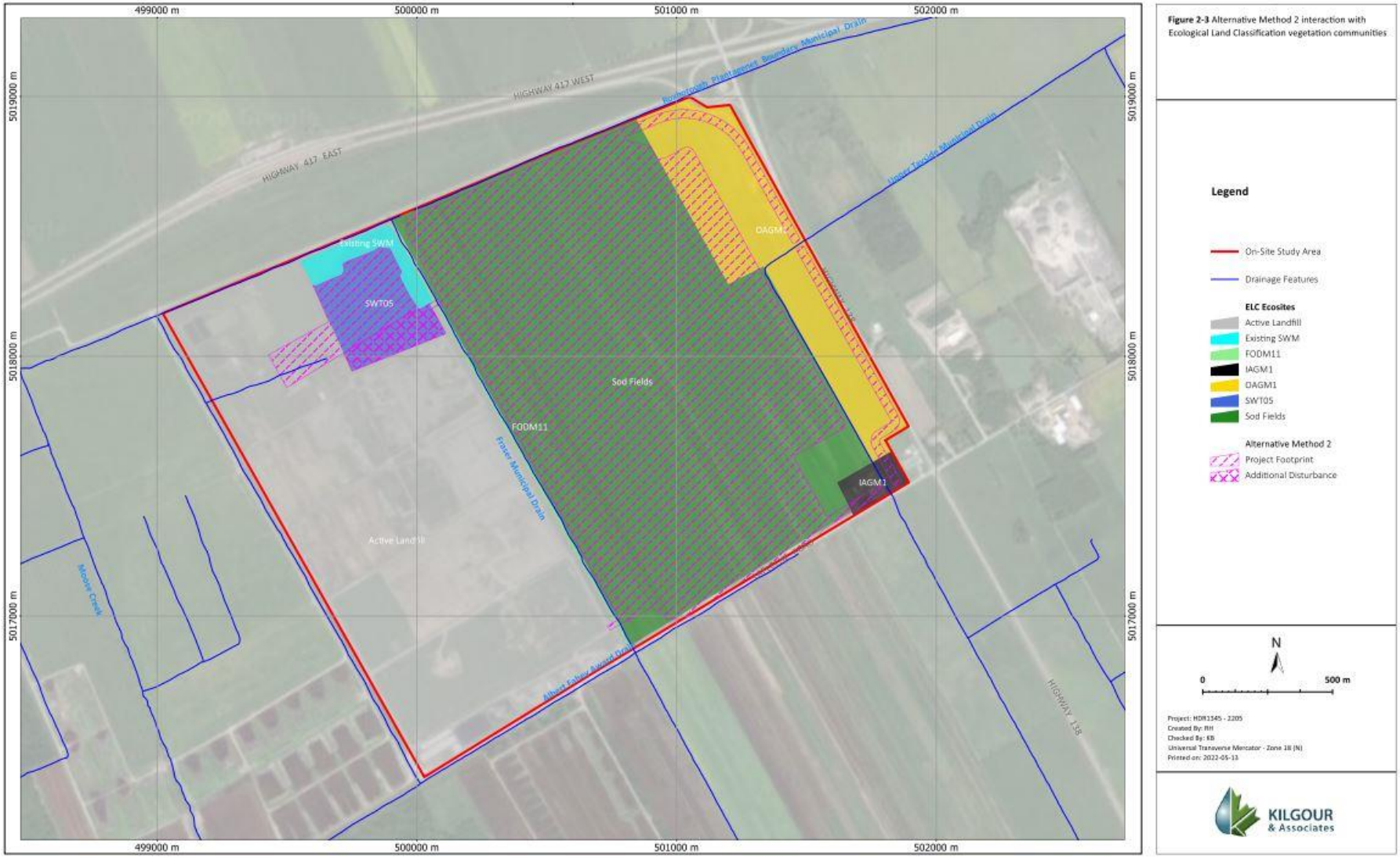

Table 2-2. Interactions of Alternative Methods 1 and 2 with Ecological Land Classification Vegetation Communities

Ecological Land Classification	Existing Conditions	Alternative Method 1			Alternative Method 2		
	Area (ha)	Area Loss (ha)	Area Remaining (ha)	% Loss	Area Loss (ha)	Area Remaining (ha)	% Loss
Sod Fields	194.6	184.1	10.5	**94.6**	182.0	12.6	**93.5**
Annual Row Crops Ecosite (OAGM1)	38.8	14.1	24.7	**36.3**	13.2	25.5	**34.0**
Organic Deciduous Thicket Swamp (SWTO5)	13.2	13.2	0.0	**100.0**	13.2	0.0	**100.0**
Agricultural Properties (IAGM1)	3.4	2.2	1.2	**64.7**	0.9	2.5	**26.1**
Naturalized Deciduous Hedgerow (FODM11)	2.9	0.1	2.8	**3.4**	0.1	2.8	**3.4**

The alternative methods both incorporate two crossings over the Fraser Drain to connect the Future Development Lands to the existing EOWHF. These crossings have the same design for each alternative method and include the installation of culverts.

It is assumed that alterations to the Fraser Drain (i.e., stormwater outlet and crossings) would be conducted under formal permission from South Nation Conservation (SNC) and Fisheries and Oceans Canada ("DFO"), as necessary, with all associated obligations and mitigation measures followed. It is also assumed that stormwater and leachate would be managed and treated following permissions from MECP and SNC.

Setbacks from watercourses for both alternative methods are the same, as summarized in **Table 2-3** below.

Table 2-3. Proposed Setbacks from Watercourses Associated with the Future Development Lands for Alternative Methods 1 and 2

Setback	Alternative Method 1	Alternative Method 2
Setback for northern development limit from Roxborough-Plantagenet Boundary Municipal Drain	≥13 m (setback for visual screening buffer)	≥13 m (setback for visual screening buffer)
Setback for eastern development limit from Upper Tayside Municipal Drain	≥9 m (setback for visual screening buffer) to ≥15 m (setback for eastern drainage ditches)	≥9 m (setback for visual screening buffer) to ≥15 m (setback for eastern drainage ditches)
Setback for western development limit from Fraser Drain	≥8 m (setback for western drainage ditches) to 30 m (setback for stormwater pond)	≥8 m (setback for western drainage ditches) to 30 m (setback for stormwater pond)

The proposed setbacks from watercourses for both alternative methods are expected to improve aquatic and riparian habitats of these features relative to existing conditions. Currently sod fields and/or row crops extend to the banks of the Fraser Drain, the Roxborough-Plantagenet Boundary Municipal Drain, and the Upper Tayside Municipal Drain. The proposed setbacks would therefore increase the buffer between these watercourses and operations on the Future Development Lands. The planted screening buffer along the peripheries of the Future Development Lands (i.e., along the Roxborough-Plantagenet Boundary Municipal Drain and the Upper Tayside Municipal Drain) is anticipated to enhance aquatic and riparian habitat through an increase in natural vegetation cover (e.g., soil stabilization/erosion control, shading, allochthonous inputs, habitat structure, etc.). Shading can be anticipated to reduce solar insolation, with benefits to channel cooling.

It is assumed that the potential for sediment to be released into surface water features during site preparation and construction will be mitigated using standard erosion and sediment control measures.

Potential for interactions with SAR habitat (described in detail in the Ecological Environment Existing Conditions Report) is expected to be the same for both alternative methods.

The footprint for both alternative methods is located approximately 1 km from Moose Creek Wetland. Therefore, the ecological functions of this feature, including providing Significant Wildlife Habitat and habitat for SAR, are not expected to be impacted by the landfill expansion under either alternative method.

2.2 Comparative Evaluation and Identification of the Preferred Alternative

The two alternative methods are comparatively assessed and evaluated using the criteria and indicators to determine the preferred alternative. The differences in the potential environmental effects remaining following the implementation of potential mitigation/management measures (i.e., net effects) are used to identify and compare the advantages and disadvantages of each alternative method.

The net environmental effects are utilized in a comparison of the two alternative methods to one another at the criteria and indicator level for each discipline. The following two--step method was applied to carry out the comparative evaluation for the ecological environment:

1. Identify the predicted net effect(s) associated with each alternative for each indicator and assign a preference rating (i.e., Preferred, Not Preferred, No Substantial Difference); and
2. Rate each alternative at the criteria level (i.e., Preferred, Not Preferred, No Substantial Difference) based on the identified preference rating for each indicator and provide a rationale.

2.3 Effects Assessment of the Preferred Alternative

An assessment of the environmental effects of the preferred alternative is carried out considering the same criteria, indicators and data sources, taking into account potential mitigation/management measures and cumulative effects. The effects assessment of the preferred alternative will be presented in the EA Study Report.

3 Net Effects Assessment

The results of the net effects assessment for each alternative method are provided in Sections 3.1 and 3.2.

3.1 Alternative Method 1

The net effects assessment for Alternative Method 1 is presented in **Table 3-1**.

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

Terrestrial Ecosystems	Predicted impact on vegetation communities	• The Future Development Lands are mostly devoid of natural vegetation, and thus Alternative Method 1 would require limited removal of natural vegetation.
		• Vegetation removal throughout most of the project footprint would be necessary to accommodate site preparation, construction, and operation. Removal of natural vegetation would be required for Stage 5; this would remove organic deciduous thicket swamp (unevaluated wetland; 13.2 ha total). Trees that interact with the two crossings over the Fraser Drain would need to be removed, along with trees associated with the Manderley Turf Products property. Remaining vegetation removal is mostly associated with non-natural sod fields (Stages 6 through 9 and stormwater infrastructure).
		• No impacts to vegetation communities of Moose Creek Wetland are anticipated.
			• Removing 13.2 ha of thicket swamp in the Stage 5 area combined with tree removal (albeit minimal) could result in a loss of ecosystem functions such as biodiversity (e.g., native species), wildlife habitat, landscape aesthetics, flood attenuation, water quality improvement, pollutant removal, erosion control, carbon sequestration and storage, regulation of relative humidity, wind-shielding, shading, reduction of urban heat island effects, and filtration of dust, noise, and light pollution.
			• Removal of sod fields would remove non-natural wildlife habitat.
				• Vegetation removal will be limited to that which is necessary to accommodate construction. Vegetation removal will also be phased, if feasible, to minimize the amount of exposed soil at a given time.
				• Impacts to retained trees will be minimized by:
				  • Erecting construction fence beyond the critical root zone (10x trunk diameter) to prevent interaction with retained trees and their roots.
				  • Pruning branches to avoid conflict with construction equipment.
				  • Refraining from attaching signs and other materials to trees.
					• Natural and native vegetation cover on Stages 6 through 9 is expected to be similar or greater than existing conditions once plantings are mature. Existing functions of natural vegetation in these areas would be replaced over time.
					• Ecosystem functions associated with the thicket swamp will be lost.

	Predicted impact on wildlife habitat	• The reach of the Roxborough-Plantagenet Boundary Municipal Drain north of the Future Development Lands qualifies as Significant Wildlife Habitat for Special Concern Species (Snapping Turtle). Watercourses	• Development would not directly interact with the Roxborough-Plantagenet Boundary Municipal Drain (i.e., Significant Wildlife Habitat for Snapping Turtle). However, construction	• During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles and other smaller, less mobile wildlife. This fence will be inspected regularly,	• Wildlife habitat associated with the thicket swamp would be lost (13.2 ha). • Artificial wildlife habitat associated with sod fields would be lost (184

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

		in the Study Areas likely provide habitat for other turtle species that are not protected under the ESA (i.e., Snapping Turtle and Midland Painted Turtle). Watercourses in the Study Areas likely act as travel corridors for these turtle species and provide foraging (e.g., fish) resources. All turtle species in the region are protected under the *Fish and Wildlife Conservation Act*.
		• Three species of snakes were observed in the Off-Site Study Area: Eastern Gartersnake, Eastern Ribbonsnake, and Milksnake. These species are not protected under the ESA, but the latter two are protected under the *Fish and Wildlife Conservation Act*. The thicket swamp in the Stage 5 area may provide habitat for these snake species.
		• The sod fields on the Future Development Lands did not meet MNRF criteria for Significant Wildlife Habitat for Migratory Bird Staging and Migration Stopover Areas. However, these fields provide staging and stopover habitat for hundreds of Snow Geese and Canadian Geese in the spring and fall.
		• A total of 32 bird species were observed in the Study Areas via morning breeding bird surveys and incidental observations.
			adjacent to watercourses could interact with migrating and/or foraging turtles, with risk of these species being harmed or harassed.
			• Removing thicket swamp would remove 13.2 ha of potential habitat for snakes, birds, bats, and anurans.
			• Removing sod fields would remove 184 ha of staging and stopover habitat for geese, but remaining sod fields in the vicinity would still provide such habitat.
			• Removing trees and buildings associated with the Manderley Turf Products property would remove potential roosting and nesting habitat for bats and birds, respectively.
			• The expanded landfill, including waste and the stormwater management pond, could artificially attract wildlife. The stormwater pond would likely provide suitable foraging habitat for bats, insectivorous birds, and some species of anurans, and could provide overwintering habitat for turtles. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.
				particularly during the active season for wildlife, to confirm continued functionality. In the longer term, the visual screening buffer (e.g., berm, tree line, or a combination of both) may help deter turtles from accessing the expanded landfill site.
				• Vegetation removal and alterations to buildings will not take place during sensitive times of the year for wildlife (breeding season; early spring throughout summer). Combining the regional breeding bird window (April 15 through August 31; Government of Canada, 2018) with the bat roosting season (April through September; MECP, pers. comm.), no vegetation removal or alterations to buildings will occur between April 1 and September 30 inclusive to prevent impacts to birds and bats.
				• The following standard mitigation measures will also be followed during construction:
				  • Wildlife will not be harmed, fed, or harassed;
				  • Waste will be covered daily to limit wildlife attraction to the Site;
				  • Vehicles and equipment will be driven slowly and with an awareness for wildlife along access routes;
				  • Stockpiles and equipment (e.g., pipes) will be managed
					ha), but similar habitat would remain in the vicinity.
					• Potential wildlife habitat associated with trees and buildings on the Manderley Turf Products property would be lost.

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		Most of these species are protected under the *Migratory Birds Convention Act*. • Five species of bats were detected in the On-Site Study Area via acoustic monitoring. The recordings captured in acoustic monitoring imply that bats were feeding and/or roosting within the vicinity of the areas that acoustic monitors were installed (e.g., potentially foraging over the Future Development Lands and/or roosting nearby). The thicket swamp in the Stage 5 area and trees along the Fraser Drain may provide roosting habitat, but much more ideal roosting habitat exists in Moose Creek Wetland (Off-Site Study Area). Buildings and trees associated with the Manderley Turf Products property may also provide roosting habitat. • A total of six anuran (frog and toad) species were observed in the On-Site Study Area during evening aural surveys. None of these species receive protection under the ESA or the *Fish and Wildlife Conservation Act*. Watercourses in the Study Areas and the thicket swamp in the Stage 5 area provide habitat for anurans.		on the site to prevent wildlife from being attracted to artificial habitat • Work areas will be checked for wildlife before commencing work. • Established controls for noise, dust, waste management, and other disturbances at the landfill that are currently in use at the EOWHF will be used at the expanded landfill site. • Wildlife artificially attracted to the expanded landfill will be managed following practices used at the EOWHF (e.g., use of raptors to deter gulls) and thus are expected to align with standard and accepted approaches. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to ensure compliance with best management practices for wildlife (e.g., removal and relocation of turtles and fish under appropriate permits).	

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		• No impacts to Significant Wildlife Habitat associated with Moose Creek Wetland are anticipated.			
	Predicted impact on vegetation and wildlife including rare, threatened, or endangered species.	• No regionally rare floral or faunal species were observed in the Study Areas. • Midland Painted Turtle, a provincially significant species, was observed in the Off-Site Study Area (i.e., Fraser Drain south of the Future Development Lands and a stormwater management ditch south of the EOWHF) and has a high potential to interact with the landfill expansion. • The following SAR listed under the ESA were observed in the On-Site Study Area: Bank Swallow (Threatened; nesting in the Off-Site Study Area), Barn Swallow (Threatened), and Little Brown Myotis (Endangered). A Bank Swallow nesting colony exists directly southwest of the Future Development Lands, with ESA-defined foraging habitat for Bank Swallow slightly overlapping onto the Future Development Lands. A Barn Swallow nest was observed on the GFL office building adjacent to the Future Development Lands during the 2019 breeding season but was absent in fall 2020. A Barn Swallow nest was also observed in the Off-Site	• Construction adjacent to watercourses could interact with Snapping Turtle and/or Midland Painted Turtle (e.g., migrating and/or foraging individuals in the vicinity), with risk of these species being harmed or harassed. • The bank where Bank Swallow nests were observed (Category 1 habitat) and 50 m within the face of the bank (Category 2 habitat) would not be directly altered by the development as they fall outside of the Future Development Lands. Stage 6 of the proposed development slightly overlaps with protected foraging (Category 3) habitat for Bank Swallow. The Category 3 area is currently associated with highly disturbed areas, including peat extraction lands, roads, sod fields, and an active landfill. Landfill expansion within the Stage 6 area is not anticipated to alter the ecological function of this habitat given that open foraging space would be retained here, and Category 3	• Mitigation measures to prevent impacts to wildlife as above have potential to also minimize impacts to SAR. • During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles and other smaller, less mobile wildlife. This fence will be inspected regularly, particularly during the active season for turtles, to confirm continued functionality. In the longer term, the visual screening buffer (e.g., berm planted with trees) would help deter turtles from accessing the expanded landfill site. • GFL will consult with MECP to confirm that no additional mitigation, avoidance, or compensation measures are required to eliminate potential impacts to Bank Swallow and its habitat. • Barn Swallows may nest on buildings/structures located at the Manderley Turf Products property (17289 Laflèche Road). Buildings will be removed when Barn Swallow (or other migratory birds) are not actively nesting in or on the structures.	• Potential SAR habitat associated with the thicket swamp would be lost (13.2 ha) • Potential SAR habitat associated with sod fields would be lost (184 ha), but similar habitat would remain in the vicinity. • Potential SAR habitat associated with trees and buildings on the Manderley Turf Products property would be lost.

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		Study Area in 2021 in a culvert where Moose Creek crosses Concession Road 7. Little Brown Myotis likely forages over the Future Development Lands and is assumed to roost in the vicinity, outside of the Future Development Lands, where habitat for the species is highly suitable (i.e., Moose Creek Wetland). • In addition to the SAR above, the following SAR listed under the ESA were observed in the Off-Site Study Area: Snapping Turtle (Special Concern), Eastern Ribbonsnake (Special Concern), Eastern Whip-poor-will (Threatened), Eastern Wood-pewee (Special Concern), and Wood Thrush (Special Concern). The Snapping Turtle observation was associated with the Roxborough-Plantagenet Boundary Municipal Drain as previously described. Eastern Ribbonsnake was observed basking on exposed peat along an access road just south of the EOWHF. The thicket swamp in the Stage 5 area may provide habitat for this species, as described above. Observations of Eastern Whip-poor-will, Eastern Wood-pewee, and Wood Thrush were associated with Moose Creek Wetland; no	habitat has a high tolerance to alteration (MNRF, 2015). • Barn Swallow was not observed nesting on the Future Development Lands but is known to nest in the broader area. The existing Barn Swallow nest in the culvert off Concession Road 7 is located more than 200 m from the Future Development Lands (i.e., Category 3/foraging habitat does not occur on the Future Development Lands). The landfill expansion would remove the buildings on the Manderley Turf Products property, which would remove potential nesting habitat for Barn Swallow. • The thicket swamp in the Stage 5 area may provide marginal roosting habitat for Little Brown Myotis given that tree cover here is mostly scattered and consists of younger, smaller trees. This habitat would be removed. Foraging habitat over open sod and agricultural fields on the Future Development Lands would be removed, but similar habitat in the vicinity would remain. • Removing the thicket swamp would remove potential	• As an Endangered species, Little Brown Myotis receives “general habitat protection” under the ESA; no defined protection currently exists for this species as it does for Bank Swallow . Generally, trees and buildings that at-risk bats use for roosting cannot be significantly altered during the roosting season (April to September inclusive). Potential impacts to at-risk bats will be mitigated by clearing trees and removing buildings outside of the roosting season. • Established controls for noise, dust, waste management, and other disturbances at the landfill that are currently in use at the EOWHF would be used at the expanded landfill site. • Site workers (e.g., construction crews, landfill personnel) will be familiar with SAR that have potential to interact with the project. Observations of and interactions with SAR will be reported to GFL for further direction. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to ensure compliance with best management practices for SAR and other wildlife (e.g., removal	

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		impacts to these three bird species are anticipated. • Only SAR listed as Threatened or Endangered under the ESA receive individual and habitat protection under the Act.	habitat for Eastern Ribbonsnake. • The proposed stormwater management pond would increase foraging habitat for Little Brown Myotis, Bank Swallow, and Barn Swallow (if nesting/roosting in the vicinity), and could provide overwintering habitat for Snapping Turtle and Midland Painted Turtle. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.	and relocation of turtles under appropriate permits).	
Aquatic Ecosystems	Predicted impact on aquatic habitat including fish habitat.	• The proposed stormwater management pond would outlet into the Fraser Drain, a fish-bearing watercourse. It is assumed that the construction of the outlet channel would require working below the normal high-water mark. • Treated effluent will continue to be discharged to the Fraser Drain via pulse events from the northwestern portion of the existing EOWHF. The capacity of the treatment plant at the EOWHF will be expanded to accept leachate generated from the existing landfill as well as the future development. Estimated maximum leachate generation for Alternative Method 1 is	• Stormwater and leachate would be managed and treated under permissions from MECP (as well as SNC and DFO as may be required), and as such, effluent can be anticipated to have no net deleterious effect on fish habitat in terms of water quality, water quantity, and thermal contributions. • WSP Golder (2022a,b) predicted concentrations for regulated effluent parameters (ammonia, boron, chloride, nitrate, phenols) will align with site-specific water quality objectives, which will provide satisfactory protection to aquatic biota including fish.	• GFL will consult with MECP, SNC, and DFO to determine information, design, and permit requirements for alterations to watercourses, including mitigation and/or compensation measures. • Discharged water from the stormwater and leachate management facilities will follow requirements of an Environmental Compliance Approval to be issued for the project by MECP. • All requirements of a permit from SNC to alter the Fraser Drain shall be followed, along with any requirements of DFO. • A Request for Review of the proposed alterations to the Fraser Drain (i.e., culvert crossings and stormwater outlet) will be	• Beneficial effect of improvement to aquatic habitat associated with the future development lands due to proposed setbacks from watercourses (Table 2-3) combined with riparian/buffer plantings.

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

		123,542 m³. It is assumed that the expanded treatment plant would be designed to effectively treat this predicted leachate load following MECP requirements. The expansion of the landfill will occur in association with a new discharge pipe releasing effluent directly to Moose Creek.
		• Based on temperature balance models, thermal contributions of treated effluent currently do not pose significant risk to fish species in the Fraser Drain or Moose Creek downstream (Appendix A).
		• The proposed development incorporates two culvert crossings over the Fraser Drain to connect the Future Development Lands to the EOWHF.
		• Proposed setbacks from watercourses on the Future Development Lands are indicated in Table 4.
		• Surface water features on the Future Development Lands either go dry (Roxborough-Plantagenet Boundary Municipal Drain) or are very shallow by mid-summer (Fraser Drain and Upper Tayside Municipal Drain). Only the Fraser and Upper Tayside Municipal Drains provided habitat for fish communities in the summer. The
			• HDR (2022) predicts no net off-site effects related to suspended solids, and no effects on flow volumes.
			• The culvert crossings over the Fraser Drain and the stormwater pond outlet would be designed and constructed following requirements of SNC and DFO and thus can be anticipated to have no net deleterious effect on fish habitat.
			• The proposed setbacks from watercourses on the Future Development Lands are expected to improve aquatic and riparian habitats of these features relative to existing conditions. Currently sod fields and/or row crops extend to the banks of the Fraser Drain, the Roxborough-Plantagenet Boundary Municipal Drain, and the Upper Tayside Municipal Drain. The proposed setbacks would therefore increase the buffer between these watercourses and operations on the Future Development Lands. The planted screening buffer along the peripheries of the Future Development Lands (i.e., along the Roxborough-Plantagenet Boundary Municipal Drain
				submitted to DFO for consideration of potential impacts, and to determine whether they would require an Authorization under the Fisheries Act.
				• Treated effluent will be discharged according to conditions under permit from MECP.
				• To further minimize impacts to aquatic habitat and water quality in the Fraser Drain and other surface water features in the Study Areas, the construction of road crossings and the stormwater outlet channel into the drain will incorporate the following mitigation measures:
				  • Harm/death to fish and other wildlife will be prevented by isolating in-water work areas during construction. In-water works may require fish to be relocated from work areas.
				  • In-water works will be planned such that they respect timing windows to protect fish, including their eggs, juveniles, spawning adults, and the organisms upon which they feed.
				  • Riparian vegetation will be maintained to the extent possible between areas of on-land activity and the high-water mark of the drain. Use methods to avoid soil compaction, such as swamp mats or pads.	

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		stretches of the Fraser and Upper Tayside Municipal Drains on the Future Development Lands provide mostly cool-warm and warm waters for fish, respectively. Captured fish species are considered primarily to be warm- and cool-water species except for Northern Pearl Dace (captured in the Upper Tayside Municipal Drain), which also prefers coldwater streams. • The electrofishing surveys in spring 2019 and summer 2021 produced fish communities typical for the region. • Northern Pike was documented in Moose Creek in 1991 and 1996 (NEA, 1998) but has not been detected in this watercourse since then. Northern Pike is not known to occur in other watercourses in the Study Areas. Northern Pike spawning surveys confirmed that most reaches of watercourses associated with the Study Areas provide sub-optimal spawning habitat for Northern Pike, with a general absence of flooded vegetation.	and the Upper Tayside Municipal Drain) is anticipated to enhance aquatic and riparian habitat through an increase in natural vegetation cover (e.g., soil stabilization/erosion control, shading, allochthonous inputs, habitat structure, etc.). Shading can be anticipated to reduce solar insolation, with benefits to channel cooling. • Site preparation and construction could increase erosion and sedimentation, with potential for sediment to be released into surface water features. • The proposed stormwater management pond would increase fish habitat on the Future Development Lands. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.	• Following construction of the crossings and installation of the culverts, fish passage will be maintained. The changing of flows or water levels and obstructing or interfering with the movement and migration of fish will be avoided. Culvert size and position will be based on existing hydrologic conditions. • The stormwater pond will be discharged in such a way or with design options to avoid channel erosion. • Consideration will be given to the incorporation of an outlet control structure that could stop discharge into the Fraser Drain if water quality issues are encountered on site. • The potential for sediment to be released into surface water features during site preparation and construction will be mitigated using standard erosion and sediment control measures. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to confirm compliance with best management practices for minimizing impacts to fish (e.g., removal and relocation of fish under appropriate permits).	

Table 3-1. Net Effects Assessment – Alternative Method 1

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
	Predicted impact on aquatic biota including rare, threatened, or endangered species.	• None of the fish species known to occur in the Study Areas or collected via electrofishing are outside a known range. No provincially and/or nationally listed (SAR) fish species were captured. In addition, no critical habitat for aquatic SAR or sensitive spawning habitat was identified within the Study Areas.	• N/A	• Mitigation measures to minimize impacts to water quality and fish habitat (above) would also minimize potential impacts to downstream watercourses that support more complex fish communities and other aquatic biota.	• None.

3.2 Alternative Method 2

The net effects assessment for Alternative Method 2 is presented in **Table 3-2**.

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

Terrestrial Ecosystems	Predicted impact on vegetation communities	• The Future Development Lands are mostly devoid of natural vegetation, and thus Alternative Method 1 would require limited removal of natural vegetation.
		• Vegetation removal throughout most of the project footprint would be necessary to accommodate site preparation, construction, and operation. Removal of natural vegetation would be required for Stage 5; this would remove organic deciduous thicket swamp (unevaluated wetland; 13.2 ha total). Trees that interact with the two crossings over the Fraser Drain would need to be removed, along with trees associated with the Manderley Turf Products property. Remaining vegetation removal is mostly associated with non-natural sod fields (Stages 6 through 8 and stormwater infrastructure).
		• No impacts to vegetation communities of Moose Creek Wetland are anticipated.
			• Removing 13.2 ha of thicket swamp combined with tree removal (albeit minimal) could result in a loss of ecosystem functions such as biodiversity (e.g., native species), wildlife habitat, landscape aesthetics, flood attenuation, water quality improvement, pollutant removal, erosion control, carbon sequestration and storage, regulation of relative humidity, wind-shielding, shading, reduction of urban heat island effects, and filtration of dust, noise, and light pollution.
			• Removal of sod fields would remove non-natural wildlife habitat.
				• Vegetation removal will be limited to that which is necessary to accommodate construction. Vegetation removal will also be phased, if feasible, to minimize the amount of exposed soil at a given time.
				• Impacts to retained trees will be minimized by:
				  • Erecting construction fence beyond the critical root zone (10x trunk diameter) to prevent interaction with retained trees and their roots.
				  • Pruning branches to avoid conflict with construction equipment.
				  • Refraining from attaching signs and other materials to trees.
					• Natural and native vegetation cover on Stages 6 through 8 is expected to be similar or greater than existing conditions once plantings are mature. Existing functions of natural vegetation in these areas would be replaced over time.
					• Ecosystem functions associated with the thicket swamp would be lost.

	Predicted impact on wildlife habitat	• The reach of the Roxborough-Plantagenet Boundary Municipal Drain north of the Future Development Lands qualifies as Significant Wildlife Habitat for Special Concern Species (Snapping Turtle). Watercourses	• Development would not directly interact with the Roxborough-Plantagenet Boundary Municipal Drain (i.e., Significant Wildlife Habitat for Snapping Turtle). However, construction	• During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles and other smaller, less mobile wildlife. This fence will be inspected regularly,	• Wildlife habitat associated with the thicket swamp would be lost (13.2 ha). • Artificial wildlife habitat associated with sod fields would be lost (182

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

		in the Study Areas likely provide habitat for other turtle species that are not protected under the ESA (i.e., Snapping Turtle and Midland Painted Turtle). Watercourses in the Study Areas likely act as travel corridors for these turtle species and provide foraging (e.g., fish) resources. All turtle species in the region are protected under the *Fish and Wildlife Conservation Act*.
		• Three species of snakes were observed in the Off-Site Study Area: Eastern Gartersnake, Eastern Ribbonsnake, and Milksnake. These species are not protected under the ESA, but the latter two are protected under the *Fish and Wildlife Conservation Act*. The thicket swamp in the Stage 5 area may provide habitat for these snake species.
		• The sod fields on the Future Development Lands did not meet MNRF criteria for Significant Wildlife Habitat for Migratory Bird Staging and Migration Stopover Areas. However, these fields provide staging and stopover habitat for hundreds of Snow Geese and Canadian Geese in the spring and fall.
		• A total of 32 bird species were observed in the Study Areas via morning breeding bird surveys and incidental observations.
			adjacent to watercourses could interact with migrating and/or foraging turtles, with risk of these species being harmed or harassed.
			• Removing thicket swamp would remove 13.2 ha of potential habitat for snakes, birds, bats, and anurans.
			• Removing sod fields would remove 184 ha of staging and stopover habitat for geese, but remaining sod fields in the vicinity would still provide such habitat.
			• Removing trees and buildings associated with the Manderley Turf Products property would remove potential roosting and nesting habitat for bats and birds, respectively.
			• The expanded landfill, including waste and the stormwater management pond, could artificially attract wildlife. The stormwater pond would likely provide suitable foraging habitat for bats, insectivorous birds, and some species of anurans, and could provide overwintering habitat for turtles. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.
				particularly during the active season for wildlife, to ensure continued functionality. In the longer term, the visual screening buffer (e.g., berm) may help deter turtles from accessing the expanded landfill site.
				• Vegetation removal and alterations to buildings will not take place during sensitive times of the year for wildlife (breeding season; early spring throughout summer). Combining the regional breeding bird window (April 15 through August 31; Government of Canada, 2018) with the bat roosting season (April through September; MECP, pers. comm.), no vegetation removal or alterations to buildings will occur between April 1 and September 30 inclusive to prevent impacts to birds and bats.
				• The following standard mitigation measures will also be followed during construction:
				  • Wildlife will not be harmed, fed, or harassed.
				  • Waste will be managed to prevent attracting wildlife to the site.
				  • Vehicles will be driven slowly with an awareness for wildlife on vehicle and equipment access routes.
				  • Manage stockpiles and equipment (e.g., pipes) on the site to prevent wildlife from
					ha), but similar habitat would remain in the vicinity.
					• Potential wildlife habitat associated with trees and buildings on the Manderley Turf Products property would be lost.

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		Most of these species are protected under the *Migratory Birds Convention Act*. • Five species of bats were detected in the On-Site Study Area via acoustic monitoring. The recordings captured in acoustic monitoring imply that bats were feeding and/or roosting within the vicinity of the areas that acoustic monitors were installed (e.g., potentially foraging over the Future Development Lands and/or roosting nearby). The thicket swamp in the Stage 5 area and trees along the Fraser Drain may provide roosting habitat, but much more ideal roosting habitat exists in Moose Creek Wetland (Off-Site Study Area). Buildings and trees associated with the Manderley Turf Products property may also provide roosting habitat. • A total of six anuran (frog and toad) species were observed in the On-Site Study Area during evening aural surveys. None of these species receive protection under the ESA or the *Fish and Wildlife Conservation Act*. Watercourses in the Study Areas and the thicket swamp in the Stage 5 area provide habitat for anurans.		being attracted to artificial habitat. • Check work areas for wildlife before commencing work. • Established controls for noise, dust, waste management, and other disturbances at the landfill that are currently in use at the EOWHF will be used at the expanded landfill site. • Wildlife artificially attracted to the expanded landfill will be managed following practices used at the EOWHF (e.g., use of raptors to deter gulls) and thus are expected to align with standard and accepted approaches. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to ensure compliance with best management practices for wildlife (e.g., removal and relocation of turtles and fish under appropriate permits).	

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		• No impacts to Significant Wildlife Habitat associated with Moose Creek Wetland are anticipated.			
	Predicted impact on vegetation and wildlife including rare, threatened, or endangered species	• No regionally rare floral or faunal species were observed in the Study Areas. • Midland Painted Turtle, a provincially significant species, was observed in the Off-Site Study Area (i.e., Fraser Drain south of the Future Development Lands and a stormwater management ditch south of the EOWHF) and has a high potential to interact with the landfill expansion. • The following SAR listed under the ESA were observed in the On-Site Study Area: Bank Swallow (Threatened; nesting in the Off-Site Study Area), Barn Swallow (Threatened), and Little Brown Myotis (Endangered). A Bank Swallow nesting colony exists directly southwest of the Future Development Lands, with ESA-defined foraging habitat for Bank Swallow slightly overlapping onto the Future Development Lands. A Barn Swallow nest was observed on the GFL office building adjacent to the Future Development Lands during the 2019 breeding season but was absent in fall 2020. A Barn Swallow nest was also observed in the Off-Site	• Construction adjacent to watercourses could interact with Snapping Turtle and/or Midland Painted Turtle (e.g., migrating and/or foraging individuals in the vicinity), with risk of these species being harmed or harassed. • The bank where Bank Swallow nests were observed (Category 1 habitat) and 50 m within the face of the bank (Category 2 habitat) would not be directly altered by the development as they fall outside of the Future Development Lands. Stage 6 of the proposed development slightly overlaps with protected foraging (Category 3) habitat for Bank Swallow. The Category 3 area is currently associated with highly disturbed areas, including peat extraction lands, roads, sod fields, and an active landfill. Landfill expansion within the Stage 6 area is not anticipated to alter the ecological function of this habitat given that open foraging space would be retained here, and Category 3	• Mitigation measures to prevent impacts to wildlife as above would also minimize impacts to SAR. • During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles and other smaller, less mobile wildlife. This fence will be inspected regularly, particularly during the active season for turtles, to ensure continued functionality. In the longer term, the visual screening buffer (e.g., berm planted with trees) would help deter turtles from accessing the expanded landfill site. • The proponent will consult with MECP to confirm that no additional mitigation, avoidance, or compensation measures are required to eliminate potential impacts to Bank Swallow and its habitat. • Barn Swallows may nest on buildings/structures located at the Manderley Turf Products property (17289 Lafleche Road). Alterations / removal of those buildings will be done when Barn Swallow are not actively nesting. • As an Endangered species, Little Brown Myotis receives “general	• Potential SAR habitat associated with the thicket swamp would be lost (13.2 ha) • Potential SAR habitat associated with sod fields would be lost (182 ha), but similar habitat would remain in the vicinity. • Potential SAR habitat associated with trees and buildings on the Manderley Turf Products property would be lost.

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		Study Area in 2021 in a culvert where Moose Creek crosses Concession Road 7. Little Brown Myotis likely forages over the Future Development Lands and is assumed to roost in the vicinity, outside of the Future Development Lands, where habitat for the species is highly suitable (i.e., Moose Creek Wetland). • In addition to the SAR above, the following SAR listed under the ESA were observed in the Off-Site Study Area: Snapping Turtle (Special Concern), Eastern Ribbonsnake (Special Concern), Eastern Whip-poor-will (Threatened), Eastern Wood-pewee (Special Concern), and Wood Thrush (Special Concern). The Snapping Turtle observation was associated with the Roxborough-Plantagenet Boundary Municipal Drain as previously described. Eastern Ribbonsnake was observed basking on exposed peat along an access road just south of the EOWHF. The thicket swamp in the Stage 5 area may provide habitat for this species, as described above. Observations of Eastern Whip-poor-will, Eastern Wood-pewee, and Wood Thrush were associated with Moose Creek Wetland; no	habitat has a high tolerance to alteration (MNRF, 2015). • Barn Swallow was not observed nesting on the Future Development Lands but is known to nest in the broader area. The existing Barn Swallow nest in the culvert off Concession Road 7 is located more than 200 m from the Future Development Lands (i.e., Category 3/foraging habitat does not occur on the Future Development Lands). The landfill expansion would remove the buildings on the Manderley Turf Products property, which would remove potential nesting habitat for Barn Swallow. • The thicket swamp in the Stage 5 area may provide marginal roosting habitat for Little Brown Myotis given that tree cover here is mostly scattered and consists of younger, smaller trees. This habitat would be removed. Foraging habitat over open sod and agricultural fields on the Future Development Lands would be removed, but similar habitat in the vicinity would remain. • Removing the thicket swamp would remove potential	habitat protection" under the ESA; no defined protection currently exists for this species as it does for Bank Swallow. Generally, trees and buildings that at-risk bats use for roosting cannot be significantly altered during the roosting season (April to September inclusive). Potential impacts to at-risk bats will be mitigated by clearing trees and removing buildings outside of the roosting season. • Established controls for noise, dust, waste management, and other disturbances at the landfill that are currently in use at the EOWHF will be used at the expanded landfill site. • Site workers (e.g., construction crews, landfill personnel) should be familiar with SAR that have potential to interact with the project. Observations of and interactions with SAR will be reported to GFL for further direction. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to ensure compliance with best management practices for SAR and other wildlife (e.g., removal and relocation of turtles under appropriate permits).	

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		impacts to these three bird species are anticipated. • Only SAR listed as Threatened or Endangered under the ESA receive individual and habitat protection under the Act.	habitat for Eastern Ribbonsnake. • The proposed stormwater management pond would increase foraging habitat for Little Brown Myotis, Bank Swallow, and Barn Swallow (if nesting/roosting in the vicinity), and could provide overwintering habitat for Snapping Turtle and Midland Painted Turtle. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.		
Aquatic Ecosystems	Predicted impact on aquatic habitat including fish habitat.	• The proposed stormwater management pond would outlet into the Fraser Drain, a fish-bearing watercourse. It is assumed that the construction of the outlet channel would require working below the normal high-water mark. • Treated effluent will continue to be discharged to the Fraser Drain via pulse events from the northwestern portion of the existing EOWHF. The capacity of the treatment plant at the EOWHF will be expanded to accept leachate generated from the existing landfill as well as the future development. Estimated maximum leachate generation for Alternative Method 2 is	• Stormwater and leachate would be managed and treated under permissions from MECP (as well as SNC and DFO as may be required), and as such effluent can be anticipated to have no net deleterious effect on fish habitat in terms of water quality, water quantity, and thermal contributions. • Golder Associates (2022a,b) predicted concentrations for regulated effluent parameters (ammonia, boron, chloride, nitrate, phenols) will align with site-specific water quality objectives, which will provide satisfactory protection to aquatic biota including fish.	• The proponent will consult with MECP, SNC, and DFO to determine information, design, and permit requirements for alterations to watercourses, including mitigation and/or compensation measures. • Discharged water from the stormwater and leachate management facilities will follow requirements of an Environmental Compliance Approval to be issued for the project by MECP. • All requirements of a permit from SNC to alter the Fraser Drain will be followed, along with any requirements of DFO. • A Request for Review of the proposed alterations to the Fraser Drain (i.e., culvert crossings and	• Beneficial effect of improvement to aquatic habitat associated with the future development lands due to proposed setbacks from watercourses (Table 2-3) combined with riparian/buffer plantings.

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects

		123,752 m³. It is assumed that the expanded treatment plant would be designed to effectively treat this predicted leachate load following MECP requirements. The expansion of the landfill will occur in association with a new discharge pipe releasing effluent directly to Moose Creek.
		• Based on temperature balance models, thermal contributions of treated effluent currently do not pose significant risk to fish species in the Fraser Drain or Moose Creek downstream (Appendix A).
		• The proposed development incorporates two culvert crossings over the Fraser Drain to connect the Future Development Lands to the EOWHF.
		• Proposed setbacks from watercourses on the Future Development Lands are indicated in Table 4.
		• Surface water features on the Future Development Lands either go dry (Roxborough-Plantagenet Boundary Municipal Drain) or are very shallow by mid-summer (Fraser Drain and Upper Tayside Municipal Drain). Only the Fraser and Upper Tayside Municipal Drains provided habitat for fish communities in the summer. The
			• HDR (2022) predicts no net off-site effects related to suspended solids, and no effects on flow volumes.
			• The culvert crossings over the Fraser Drain would be designed and constructed following requirements of SNC and DFO and thus can be anticipated to have no net deleterious effect on fish habitat.
			• The proposed setbacks from watercourses on the Future Development Lands are expected to improve aquatic and riparian habitats of these features relative to existing conditions. Currently sod fields and/or row crops extend to the banks of the Fraser Drain, the Roxborough-Plantagenet Boundary Municipal Drain, and the Upper Tayside Drain. The proposed setbacks would therefore increase the buffer between these watercourses and operations on the Future Development Lands. The planted screening buffer along the peripheries of the Future Development Lands (i.e., along the Roxborough-Plantagenet Boundary Municipal Drain and the Upper Tayside Municipal
				stormwater outlet) will be submitted to DFO for consideration of potential impacts, and to determine whether they would require an Authorization under the *Fisheries Act*.
				• Treated effluent will be discharged according to conditions under permit from MECP
				• To further minimize impacts to aquatic habitat and water quality in the Fraser Drain and other surface water features in the Study Areas, the construction of road crossings and the stormwater outlet channel into the drain will incorporate the following mitigation measures:
				  • Harm/death to fish and other wildlife will be prevented by isolating in-water work areas during construction. In-water works may require fish to be relocated from work areas.
				  • In-water works will be planned such that they respect timing windows to protect fish, including their eggs, juveniles, spawning adults, and the organisms upon which they feed.
				  • Riparian vegetation will be maintained to the extent possible between areas of on-land activity and the high-water mark of the drain. Use methods	

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
		stretches of the Fraser and Upper Tayside Municipal Drains on the Future Development Lands provide mostly cool-warm and warm waters for fish, respectively. Captured fish species are considered primarily to be warm- and cool-water species except for Northern Pearl Dace (captured in the Upper Tayside Municipal Drain), which also prefers coldwater streams. • The electrofishing surveys in spring 2019 and summer 2021 produced fish communities typical for the region. • Northern Pike was documented in Moose Creek in 1991 and 1996 (NEA, 1998) but has not been detected in this watercourse since then. Northern Pike is not known to occur in other watercourses in the Study Areas. Northern Pike spawning surveys confirmed that most reaches of watercourses associated with the Study Areas provide sub-optimal spawning habitat for Northern Pike, with a general absence of flooded vegetation.	Drain) is anticipated to enhance aquatic and riparian habitat through an increase in natural vegetation cover (e.g., soil stabilization/erosion control, shading, allochthonous inputs, habitat structure, etc.). Shading can be anticipated to reduce solar insolation, with benefits to channel cooling. • Site preparation and construction could increase erosion and sedimentation, with potential for sediment to be released into surface water features. • The proposed stormwater management pond would increase fish habitat on the Future Development Lands. This constructed habitat would be considered marginal given its anthropogenic nature and stormwater treatment functionality.	to avoid soil compaction, such as swamp mats or pads. • Following construction of the crossings and installation of the culverts, fish passage will be maintained. Changing flows or water levels and obstructing or interfering with the movement and migration of fish- will be avoided. Culvert size and position will be based on existing hydrologic conditions. • The stormwater pond will be discharged in such a way or with design options to avoid channel erosion • Consideration will be given to the incorporation of an outlet control structure that could stop discharge into the Fraser Drain if water quality issues are encountered on site. • The potential for sediment to be released into surface water features during site preparation and construction will be mitigated using standard erosion and sediment control measures. • Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to confirm compliance with best management practices for minimizing impacts to fish (e.g., removal and relocation of fish under appropriate permits).	

Table 3-2. Net Effects Assessment – Alternative Method 2

Evaluation Criteria	Indicator	Key Design Considerations and Assumptions	Potential Effects	Mitigation Measures	Net Effects
	Predicted impact on aquatic biota including rare, threatened, or endangered species.	• None of the fish species known to occur in the Study Areas or collected via electrofishing are outside a known range. No provincially and/or nationally listed (SAR) fish species were captured. In addition, no critical habitat for aquatic SAR or sensitive spawning habitat was identified within the Study Areas.	• N/A	• Mitigation measures to minimize impacts to water quality and fish habitat (above) would also minimize potential impacts to downstream watercourses that support more complex fish communities and other aquatic biota.	• None.

4 Comparative Evaluation of Net Effects and Identification of the Preferred Alternative

A comparative evaluation of the net effects of each alternative method and the identification of a preferred alternative are carried out in accordance with the methods described in Section 2.2. The results of the comparative evaluation are provided below.

4.1 Comparative Evaluation Results

The results of the comparative evaluation for the ecological environment are provided in **Table 4-1**.

Table 4-1. Comparative Evaluation of Net Effects for Ecological Environment

Evaluation Criteria	Indicators	Net Effects of Alternative Methods	
		Alternative Method 1	Alternative Method 2
Terrestrial Ecosystems	Predicted impact on vegetation communities.	• Natural and native vegetation cover in Stages 6 through 9 is expected to be similar or greater than existing conditions once plantings associated with the visual screening buffer are mature. Existing functions of natural vegetation in these areas would be replaced over time. • Ecosystem functions associated with the thicket swamp (13.2 ha removed) would be lost. **No Substantial Difference**	• Natural and native vegetation cover in Stages 6 through 8 is expected to be similar or greater than existing conditions once plantings associated with the visual screening buffer are mature. Existing functions of natural vegetation in these areas would be replaced over time. • Ecosystem functions associated with the thicket swamp (13.2 ha removed) would be lost. **No Substantial Difference**
	Predicted impact on wildlife habitat.	• Wildlife habitat associated with the thicket swamp would be lost (13.2 ha). • Artificial wildlife habitat associated with sod fields would be lost (184 ha), but similar habitat would remain in the vicinity. • Potential wildlife habitat associated with trees and buildings on the Manderley Turf Products property would be lost. **No Substantial Difference**	• Wildlife habitat associated with the thicket swamp would be lost (13.2 ha). • Artificial wildlife habitat associated with sod fields would be lost (182 ha), but similar habitat would remain in the vicinity. • Potential wildlife habitat associated with trees and buildings on the Manderley Turf Products property would be lost. **No Substantial Difference**
	Predicted impact on vegetation and wildlife including rare, threatened, or endangered species.	• Potential SAR habitat associated with the thicket swamp would be lost (13.2 ha) • Potential SAR habitat associated with sod fields would be lost (184 ha), but similar habitat would remain in the vicinity. **No Substantial Difference**	• Potential SAR habitat associated with the thicket swamp would be lost (13.2 ha) • Potential SAR habitat associated with sod fields would be lost (182 ha), but similar habitat would remain in the vicinity. **No Substantial Difference**

Table 4-1. Comparative Evaluation of Net Effects for Ecological Environment

Evaluation Criteria	Indicators	Net Effects of Alternative Methods	
		Alternative Method 1	Alternative Method 2
	Criteria Rating & Rationale	***There is no substantial difference between Alternative Methods 1 and 2 regarding net effects associated with terrestrial ecosystems.*** Alternative Methods 1 and 2 would both remove 13.2 ha of thicket swamp (i.e., natural wetland vegetation, wildlife habitat, and potential SAR habitat). Both methods would require the same amount of tree removal and the removal of buildings at the Manderley Turf Products property. For both methods, plantings associated with the visual screening buffer are anticipated to exceed the removal of vegetation associated with Stages 6 through 8/9. Alternative Method 1 would remove a slightly greater area of sod fields (2 ha more), but this habitat is considered non-natural and large sod fields in the vicinity of the Future Development Lands would remain, thereby maintaining habitat function on the broader landscape. With appropriate mitigation measures in place, the anticipated net effects to terrestrial ecosystems of both methods are rated as negative, direct, and short- to long-term.	
Aquatic Ecosystems	Predicted impact on aquatic habitat including fish habitat.	• Beneficial effect of improvement to aquatic habitat associated with the future development lands due to proposed setbacks from watercourses (Table 2-3) combined with riparian/buffer plantings. **No Substantial Difference**	• Beneficial effect of improvement to aquatic habitat associated with the future development lands due to proposed setbacks from watercourses (Table 2-3) combined with riparian/buffer plantings. **No Substantial Difference**
	Predicted impact on aquatic biota including rare, threatened, or endangered species.	• None **No Substantial Difference**	• None **No Substantial Difference**
	Criteria Rating & Rationale	***There is no substantial difference between Alternative Methods 1 and 2 regarding net effects associated with aquatic ecosystems.*** Alternative Methods 1 and 2 would incorporate the same setbacks from watercourses. Both methods would incorporate plantings adjacent to watercourses in association with the visual screening buffer. With appropriate mitigation measures in place, the anticipated net effects to aquatic ecosystems of both methods are rated as positive, direct, and long-term.	

4.2 Advantages and Disadvantages of the Preferred Alternative

The differences in net effects are used to identify and compare the advantages and disadvantages of each alternative method.

From an ecological perspective, there is no substantial difference between Alternative Method 1 and Alternative Method 2. The advantages and disadvantages of each alternative method are therefore essentially the same (**Table 4-2**):

Table 4-2. Advantages and Disadvantages of Alternative Methods 1 and 2

Evaluation Criteria	Advantages	Disadvantages

Terrestrial Ecosystems	• The Future Development Lands are mostly devoid of natural vegetation, and thus the proposed development would require limited clearing of native/natural vegetation.
	• The Future Development Lands are not suitable habitat for most SAR known to occur or to potentially occur in the area due to a lack of natural vegetation cover and ongoing anthropogenic disturbance.
	• No direct impacts to Threatened or Endangered SAR are anticipated.
	  • Foraging (Category 3) habitat for Bank Swallow on the Future Development Lands would retain functionality.
	• Development would not directly interact with confirmed Significant Wildlife Habitat.
	  • Direct interactions with the Roxborough-Plantagenet Boundary Municipal Drain (i.e., Significant Wildlife Habitat for Snapping Turtle) are not anticipated.
	• Plantings associated with the visual screening buffer would enhance native vegetation cover in areas associated with Stages 6 through 9 (long-term advantage).
	• Landfill expansion is not anticipated to negatively affect Moose Creek Wetland, a significant natural heritage feature in the Off-Site Study Area, or its ecological functions.
		• Both methods would require the removal of 13.2 ha of thicket swamp (i.e., natural wetland vegetation, wildlife habitat, and potential SAR habitat).
		• Removal of buildings at the Manderley Turf Products property would remove potential habitat for Little Brown Myotis, Barn Swallow, and other (non-SAR) wildlife species.
		• Both methods would require the conversion of sod fields (184 ha for Alternative Method 1, 182 ha for Alternative Method 2) into landfill, removing artificial migratory stopover and staging habitat for geese. However, sod fields in the vicinity would remain.
		  • Snow Geese and Canada Geese were both observed in significant numbers in sod fields in the Off-Site Study Area, confirming suitability of off-site habitat.
		• Wildlife habitat adjacent to the Future Development Lands (albeit minimal) would be subject to increased disturbance associated with the expanded landfill.

Evaluation Criteria	Advantages	Disadvantages
Aquatic Ecosystems	• No provincially and/or nationally listed (SAR) fish species are known to occur in the Study Areas. No critical habitat for aquatic SAR or sensitive spawning habitat was identified within the Study Areas. • The proposed setbacks from watercourses on the Future Development Lands combined with plantings associated with the visual screening buffer are expected to improve aquatic and riparian habitats of these features.	• None; potential negative effects on aquatic ecosystems are expected to be mitigated following the mitigation measures provided in this report.

5 Commitments and Monitoring

To confirm that the commitments related to the ecological environment are carried out, and that the proposed mitigation measures address the predicted effects for the ecological environment, monitoring is proposed for construction, operations, and maintenance of the EOWHF landfill. Monitoring for compliance will be undertaken to confirm that the project complies with the commitments and mitigation measures identified in the effects assessment.

The commitments associated with the ecological environment are listed in Section 5.1. The proposed environmental effects monitoring is provided in Section 5.2. Compliance monitoring for the ecological environment is described in Section 5.2.

5.1 Ecological Environment Commitments

The commitments associated with the ecological environment are presented in **Table 5-1** for both terrestrial and aquatic ecosystems.

Table 5-1. Ecological Environment Commitments

Evaluation Criteria	Commitments

Terrestrial Ecosystems	• Vegetation removal will be limited to that which is necessary to accommodate construction. Vegetation removal will also be phased, if feasible, to minimize the amount of exposed soil at a given time.
	• Impacts to retained trees will be minimized by:
	  • Erecting construction fence beyond the critical root zone (10x trunk diameter) to prevent interaction with retained trees and their roots.
	  • Pruning branches to avoid conflict with construction equipment.
	  • Refraining from attaching signs and other materials to trees.
	• During site preparation, construction, and operation, clean equipment protocols (Appendix B) will be followed to the extent feasible to prevent the spread of invasive species.
	• Vegetation removal and alterations to buildings will not take place during sensitive times of the year for wildlife (breeding season; early spring throughout summer) unless mitigation measures are implemented and/or the habitat has been inspected by a qualified person . Combining the regional breeding bird window (April 15 through August 31) with the bat roosting season (April through September), no vegetation removal or alterations to buildings

Evaluation Criteria	Commitments

	will occur between April 1 and September 30 inclusive to prevent impacts to birds and bats, including at-risk bat species such as Little Brown Myotis.
	• During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles and other smaller, less mobile wildlife. This fence will be inspected regularly, particularly during the active season for wildlife, to ensure continued functionality. In the longer term, the visual screening buffer may help deter turtles from accessing the expanded landfill site.
	• The following standard mitigation measures will also be followed during construction to minimize impacts to wildlife:
	  • Wildlife will not be harmed, fed, or harassed.
	  • Waste will be managed to prevent attracting wildlife to the site.
	  • Vehicle and equipment access routes will be driven slowly and with an awareness for wildlife.
	  • Stockpiles and equipment (e.g., pipes) will be managed on the site to prevent wildlife from being attracted to artificial habitat.
	  • Work areas will be checked for wildlife before commencing work.
	• Established controls for noise, dust, waste management, and other disturbances at the landfill that are currently in use at the EOWHF will be used at the expanded landfill site.
	• Wildlife artificially attracted to the expanded landfill will be managed following practices used at the EOWHF (e.g., use of raptors to deter gulls) and thus are expected to align with standard and accepted approaches.
	• Maintenance works associated with the new stormwater pond (e.g., sediment cleanout) will be reviewed by a qualified person to ensure compliance with best management practices for wildlife (e.g., removal and relocation of turtles under appropriate permits).
	• Barn Swallows may nest on buildings/structures to be removed at the Manderley Turf Products property (17289 Lafleche Road). Alterations / removal of those buildings will be done when Barn Swallow are not actively nesting (generally spring through summer, but absence can also be verified by a qualified person).
	• Site workers (e.g., construction crews, landfill personnel) will be familiar with SAR that have potential to interact with the project. Observations of and interactions with SAR will be reported to GFL for further direction.

Aquatic Ecosystems	• The proponent will consult with MECP, SNC, and DFO to determine information, design, and permit requirements for alterations to watercourses, including mitigation and/or compensation measures.
	• Discharged water from the stormwater and leachate management facilities will follow requirements of an Environmental Compliance Approval to be issued for the project by MECP.
	• All requirements of a permit from SNC to alter the Fraser Drain will be followed, along with any requirements of DFO.
	• A Request for Review of the proposed alterations to the Fraser Drain (i.e., culvert crossings and stormwater outlet) will be submitted to DFO for consideration of potential impacts, and to determine whether they would require an Authorization under the *Fisheries Act*.
	• Treated effluent will be discharged according to conditions under permit from MECP.
	• To further minimize impacts to aquatic habitat and water quality in the Fraser Drain and other surface water features in the Study Areas, the construction of road crossings and the stormwater outlet channel into the drain will incorporate the following mitigation measures:
	  • In-water work areas will be isolated during construction to prevent harm to fish and wildlife. Fish will be recovered and relocated from work areas if they are present.
	  • In-water works will be planned such that they respect timing windows to protect fish, including their eggs, juveniles, spawning adults, and the organisms upon which they feed.
	  • Riparian vegetation will be maintained to the extent possible between areas of on-land activity and the high-water mark of the drain.
	  • Methods to avoid soil compaction, such as swamp mats or pads, will be used.
	  • Fish passage will be maintained, following construction of the crossings and installation of culverts. Culvert size and position will be based on existing hydrologic conditions.
	  • Stormwater effluent will be discharged in a manner to avoid channel erosion.
	  • Consideration will be given to the incorporation of an outlet control structure that could stop discharge into the Fraser Drain if water quality issues are encountered on site.

Evaluation Criteria	Commitments
	• The potential for sediment to be released into surface water features during site preparation and construction will be mitigated using standard erosion and sediment control measures. Erosion and sediment control measures will be inspected frequently to ensure continued functionality.

5.2 Ecological Environment Compliance Monitoring

Monitoring plans are developed as part of the detailed effects assessments carried out for the Preferred Alternative to confirm:

- the net effects are as predicted;
- unanticipated negative effects are addressed; and
- the effectiveness of the proposed mitigation measures.

Compliance monitoring will be undertaken to confirm that the construction, operation, and maintenance of the project are carried out in accordance with the mitigation measures and commitments identified in the effects assessment. Compliance monitoring is summarized in **Table 5-2**. The results of compliance monitoring, including details of the effectiveness of mitigation measures and fulfillment of commitments, will be provided to the MECP.

Table 5-2. Environmental Effects and Compliance Monitoring for the Preferred Alternative

Evaluation Criteria	Potential Effect	Commitment for Mitigation	Commitment for Monitoring	Compliance Monitoring
Terrestrial Ecosystems	• Removing 13.2 ha of thicket swamp combined with tree removal (albeit minimal) could result in a loss of ecosystem functions.	• Vegetation removal will be limited to that which is necessary to accommodate construction. • Minimize impacts to retained trees.	• Monitor and tend to plantings as specified in a landscape plan, if applicable.	• No specific compliance monitoring.
	• Removing trees and buildings associated with the Manderley Turf Products property would remove potential roosting and nesting habitat for bats and birds (including at-risk species), respectively.	• Vegetation removal and alterations to buildings will not take place between April 1 and September 30.	• If vegetation removal must occur during the breeding season, areas to be cleared will first be inspected by a qualified person to ensure the absence of nesting/roosting activity. • Will follow standard wildlife monitoring as	• No specific compliance monitoring.

Table 5-2. Environmental Effects and Compliance Monitoring for the Preferred Alternative

Evaluation Criteria	Potential Effect	Commitment for Mitigation	Commitment for Monitoring	Compliance Monitoring
			provided in Table 3-2.	
	• Construction adjacent to watercourses could interact with migrating and/or foraging turtles, with risk of these species being harmed or harassed.	• During construction, temporary silt fence used for erosion and sediment control could act as wildlife exclusion fence to prevent interaction with turtles.	• Exclusion fence will be inspected weekly during the turtle active season to ensure continued functionality and turtle harm prevention.	• No specific compliance monitoring.
	• Landfill expansion is not anticipated to alter the ecological function of foraging (Category 3) habitat for Bank Swallow. However, mitigation measures will be followed to ensure this.	• Site workers (e.g., construction crews, landfill personnel) will be familiar with SAR that have potential to interact with the project.	• Observations of and interactions with SAR will be reported to GFL for further direction.	• No specific compliance monitoring.
	• Barn Swallow was not observed nesting on the Future Development Lands but is known to nest in the broader area. Landfill expansion would remove buildings on the Manderley Turf Products property, which would remove potential nesting habitat for Barn Swallow.	• If building removal is required, then qualified person to confirm Barn Swallow are using structures • If Barn Swallow are present, buildings to be removed during fall or winter period. • Site workers (e.g., construction crews, landfill personnel) will be familiar with SAR that have potential to interact with the project.	• No monitoring required.	• No specific compliance monitoring.
Aquatic Ecosystems	• Stormwater and leachate would be managed and treated under permissions from MECP (as well as SNC and DFO as may be required), and as such effluent can be anticipated to have no net deleterious	• The proponent will consult with MECP, SNC, and DFO to determine information, design, and permit requirements for alterations to watercourses, including mitigation and/or compensation measures. • Discharged effluent from the stormwater and leachate management facilities will follow requirements of an	• Water quality of effluent (treated effluent and stormwater) will be regularly monitored to verify predictions from the surface water quality effects assessment	• Annually during construction and operation.

Table 5-2. Environmental Effects and Compliance Monitoring for the Preferred Alternative

Evaluation Criteria	Potential Effect	Commitment for Mitigation	Commitment for Monitoring	Compliance Monitoring
	effect on fish habitat in terms of water quality, water quantity, and thermal contributions. • The culvert crossings over the Fraser Drain would be designed and constructed following requirements of SNC and DFO and thus can be anticipated to have no net deleterious effect on fish habitat.	Environmental Compliance Approval to be issued for the project by MECP. • All requirements of a permit from SNC to alter the Fraser Drain shall be followed, along with any requirements of DFO. • A Request for Review of the proposed alterations to the Fraser Drain (i.e., culvert crossings and stormwater outlet) will be submitted to DFO for consideration of potential impacts, and to determine whether they would require an Authorization under the *Fisheries Act*. • Treated effluent will be discharged according to conditions under permit from MECP. • To further minimize impacts to aquatic habitat and water quality in the Fraser Drain and other surface water features in the Study Areas, the construction of road crossings and the stormwater outlet channel into the drain will incorporate the following mitigation measures: • Prevent harm/death to fish and other wildlife by isolating in-water work areas during construction. In-water works may require fish to be relocated from work areas. • Plan in-water works such that they respect timing windows to protect fish, including their eggs, juveniles, spawning adults, and the organisms upon which they feed. • Maintain riparian vegetation to the extent possible between areas of on-land activity and the high-water mark of the drain. Use methods to avoid soil compaction, such as swamp mats or pads. • Fish passage will be maintained following construction of the crossings and installation of the culverts, ensure fish passage is maintained. Culvert size and	(WSP Golder, 2022a,b) and to ensure no impacts to aquatic habitat.	

Table 5-2. Environmental Effects and Compliance Monitoring for the Preferred Alternative

Evaluation Criteria	Potential Effect	Commitment for Mitigation	Commitment for Monitoring	Compliance Monitoring
		position will be based on existing hydrologic conditions. • Stormwater effluent will be discharged in a manner to avoid channel erosion. • Consideration will be given to the incorporation of an outlet control structure that could stop discharge into the Fraser Drain if water quality issues are encountered on site.		
	• Site preparation and construction could increase erosion and sedimentation, with potential for sediment to be released into surface water features.	• The potential for sediment to be released into surface water features during site preparation and construction will be mitigated using standard erosion and sediment control measures.	• As specified in an erosion and sediment control plan designed for the project.	• As specified in permissions from MECP, SNC, DFO

6 Ecological Environment Approvals

In addition to EA approval, the following ecological environment approvals may be required:

- Approvals from SNC, DFO, and MECP for release of treated stormwater and effluent.
- Approvals from SNC and DFO for physical alterations to the Fraser Drain (culvert crossings and stormwater outlet).
- Depending on SAR presence during development and consultation with MECP, approvals relating to SAR may be required.

7 References

Government of Canada

2018 General nesting periods for migratory birds. Available online at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html

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2022a Derivation of Proposed Acute and Chronic Site-Specific Water Quality Objectives – Revision 2; Eastern Ontario Waste Handling Facility Near Moose Creek, Ontario (October 25, 2022).

2022b Mass Balance Modelling of Treated Leachate Effluent Discharge to Moose Creek to Estimate Treated Leachate Effluent Storage Requirements, Technical Memorandum dated July 12, 2022, to GFL.

Appendix A. Assessment of Thermal Contributions of Landfill Effluent on Fish Communities of the Fraser Drain and Moose Creek

Assessment of Thermal Contributions of Landfill Effluent on Fish Communities of the Fraser Municipal Drain and Moose Creek

Supporting Report for the Ecological Environment Effects Assessment for the Eastern Ontario Waste Handling Facility Future Development Project Environmental Assessment

May 13, 2022

Prepared for:

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EXECUTIVE SUMMARY

Kilgour & Associates Ltd. (KAL) was retained by GFL Environmental Inc. (GFL) to prepare an Ecological Environment Effects Assessment Report for the Eastern Ontario Waste Handling Facility (EOWHF) future development project Environmental Assessment. The existing EOWHF is located on the western half of Lot 16 and Lots 17 and 18, Concession 10, Township of North Stormont, United Counties of Stormont, Dundas, and Glengarry, near the intersection of Highway 417 and 138. A portion of land associated with the existing EOWHF and lands to the east of the existing EOWHF are being considered for future development ("Future Development Lands") and include the eastern half of Lot 16, Lots 14 and 15, and most of Lot 13 of Concession 10.

This report is presented as a supporting document to the Ecological Environment Effects Assessment. This report describes the results of a desktop study that includes an assessment of the thermal regime of the Fraser Municipal Drain following landfill effluent release and the potential effect on fish species within the drain and Moose Creek downstream of the Fraser Municipal Drain.

The predicted maximum water temperature in the Fraser Municipal Drain following the release of effluent was characterized in this study. The effluent temperature has been monitored since 2017, with the maximum temperature recorded to date being 28.6^{o}C. The water temperature of the Fraser Municipal Drain was consistently monitored during the late summer and early fall of 2019, with the maximum temperature value being 24.62^{o}C. Using these maximum temperature values, along with predicted flow rates of both the Fraser Drain, Moose Creek, and the effluent, the resulting water temperature of the Fraser Municipal Drain after a 30-hour batched discharge was modelled to be 25.28^{o}C.

This study compiled incipient lethal temperature (LT_{50}) data for fish species that are known to occur in the Fraser Municipal Drain and Moose Creek. Considering these LT_{50} data and the predicted maximum temperature in the drain following a relatively short and batched discharge, it is unlikely that the temperature increase resulting from the mixing of effluent and water in the Fraser Municipal Drain would pose any significant risk to fish species known to occupy the drain and Moose Creek.

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KAL – Kilgour & Associates Ltd.
LT_{50} – Incipient Lethal Temperature

1.0 INTRODUCTION

Kilgour & Associates Ltd. (KAL) was retained by GFL Environmental Inc. (GFL) to prepare an Ecological Environment Effects Assessment Report for the Eastern Ontario Waste Handling Facility (EOWHF) future development project Environmental Assessment. The existing EOWHF is located on the western half of Lot 16 and Lots 17 and 18, Concession 10, Township of North Stormont, United Counties of Stormont, Dundas, and Glengarry, near the intersection of Highway 417 and 138. A portion of land associated with the existing EOWHF and lands to the east of the existing EOWHF are being considered for future development ("Future Development Lands") and include the eastern half of Lot 16, Lots 14 and 15, and most of Lot 13 of Concession 10.

This report is presented as a supporting document to the Ecological Environment Effects Assessment. This report describes the results of a desktop study that includes an assessment of the thermal regime of the Fraser Municipal Drain following landfill effluent release and the potential effect on fish species within the drain and Moose Creek downstream of the Fraser Municipal Drain.

The EOWHF currently uses a leachate collection system consisting of granular layers and a piping network under landfill cells. Collected leachate is conveyed to leachate aeration ponds located in the southeast part of the existing landfill and then to a leachate treatment plant located north of the existing landfill. Treated leachate is then discharged to the Fraser Municipal Drain from the northwestern portion of the existing EOWHF.

The capacity of the leachate treatment plant will be expanded to accept leachate generated from the existing landfill as well as the future development. The purpose of this study is to determine whether, under current conditions, thermal contributions of effluent could have impacts on the fish community of the Fraser Municipal Drain and Moose Creek. The results of this study will inform predictions related to effects to aquatic organisms of these watercourses under the expanded leachate treatment plant.

1.1 Effluent Mixing with the Receiving Environment

Discharge of treated effluent occurs on a batch basis during low flow periods from May 15 to October 31. The minimum recorded flow rate in Moose Creek is 60 L/sec and the effluent is batch discharged on a 5:1 ratio to the flow in Moose Creek, thus the minimum effluent flow rate is 12 L/sec and maximized at a flow rate of 50 L/sec as the flow in Moose Creek increases. The temperature of the effluent is not a function of the flow rate, and a typical batch discharge lasts approximately 30 hours (Larry Fedec (HDR Corporation), personal communication, 2022).

1.2 Thermal Tolerance

When water is discharged to a natural watercourse at a higher temperature, the sudden change in temperature decreases oxygen supply and affects the ecosystem. Fish adapt to particular temperature ranges and can be killed by abrupt changes in water temperature, referred to as *thermal shock* (Speight, 2019).

The Fraser Municipal Drain was previously classified as suitable for a mostly cool-warm water fishery (Kilgour & Associates Ltd., 2022; Figure 1).

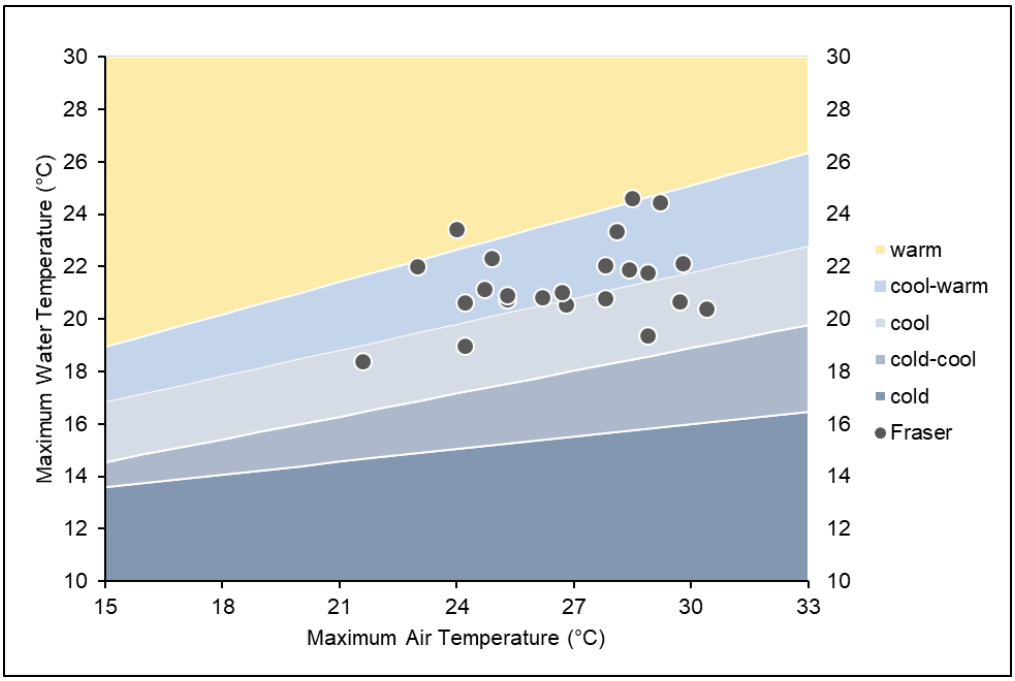


Figure 1 Nomogram for the Fraser Municipal Drain, 2019

1.2.1 Incipient Lethal Temperatures

To quantify the response of different fish species to temperature changes, upper incipient lethal temperatures (LT_{50}) are determined. LT_{50} represents the maximum temperature tolerated by 50% of a test population for a sustained period. Cold water fish species tend to have a lower LT_{50} while warm water species will have a higher LT_{50}. It is therefore important to characterize the temperature change associated with the added influx of effluent to waterbodies that provide habitat for temperature sensitive fish.

2.0 METHODS

2.1 Temperature Balance

A temperature balance was carried out under "worst-case scenario" conditions (i.e., using maximum observed effluent and watercourse temperatures). In an absence of detailed flow rates for the Fraser Municipal Drain, and the fact that effluent is batch discharged based on flow rates in Moose Creek, it was assumed that flows in the Fraser Municipal Drain are similar to those in Moose Creek.

The final water temperature following mixing of effluent with water in the Fraser Municipal Drain was determined using the following equation:

$$T_F = \frac{(Q_{FD} \cdot T_{FD}) + (Q_{EFF} \cdot T_{EFF})}{Q_{FD} + Q_{EFF}}$$

Where T_F is the final temperature (ºC) of the combined water (effluent and Fraser Municipal Drain), Q_{FD} is the maximum assumed flow rate in the Fraser Municipal Drain (L/s), T_{FD} is the maximum observed water temperature in the Fraser Municipal Drain (ºC), Q_{EFF} is the maximum flow rate of the effluent (L/s), and T_{EFF} is the maximum temperature observed of the effluent (ºC).

The effluent is batch discharged based on a 5:1 ratio to the flow of Moose Creek, which has a minimum flow of 60 L/s (Q_{MC}), and thus the minimum flow rate of the effluent, Q_{EFF}, is 12 L/s (Larry Fedec (HDR Corporation), personal communication, 2022). As mentioned above, for the purposes of this study, it was assumed that the maximum flow rate of the Fraser Municipal Drain is equal to the flow rate of Moose Creek.

Water temperature in the Fraser Municipal Drain was continuously monitored in August through October of 2019 (Kilgour & Associates, 2022). T_{FD} was set to represent the maximum temperature observed throughout the monitoring period of the Fraser Municipal Drain, which was 24.62ºC (Figure 1). Given that it is a larger watercourse, water temperatures of Moose Creek would likely be lower than those of the Fraser Municipal Drain. However, for the purpose of a conservative estimate, it was assumed that the maximum water temperatures in both watercourses are similar.

Effluent temperatures have been monitored during discharges since 2017 (see Appendix I of CanDetec Inc., 2022). T_{EFF} was set to represent the maximum effluent temperature observed since monitoring began in 2017, which was 28.77ºC.

3.0 RESULTS AND DICUSSION

Results from the temperature balance suggest that water temperature would reach a maximum of 22.28ºC for the 30-hour batched release of effluent into the Fraser Municipal Drain (Table 1).

Table 1 Temperature balance output for the Fraser Municipal Drain receiving effluent

Parameter	Value	Unit	Notes
T_{EFF}	28.60	ºC	Maximum observed effluent temperature since 2017
T_{FD}	24.62	ºC	Maximum observed water temperature in the Fraser Municipal Drain
Q_{FD}	60.00	L/s	Minimum flow rate in the Fraser Municipal Drain and Moose Creek
Q_{EFF}	12.00	L/s	Minimum effluent flow rate at 5:1 (Moose Creek/Fraser Drain: effluent)
T_F	25.28	ºC	Final calculated temperature of Fraser Municipal Drain after receiving effluent

Table 2 outlines fish species that have historically been present in both the Fraser Municipal Drain and Moose Creek. All species spawn either in the spring or summer and have low to moderate sensitivity to sedimentation and turbidity (Hasnain et al., 2010).

Table 3 outlines compiled thermal tolerance values for species present in both the Fraser Municipal Drain and Moose Creek. LT_{50} values were exceeded by the calculated final temperature in the Fraser Municipal Drain for Central Stoneroller, adult Creek Chub, juvenile Emerald Shiner, larval Northern Pike, and larval/juvenile Walleye.

Cherry et al. (1997) determined a LT_{50} value of 24^{o}C for Central Stoneroller after a seven-day test. The fish were acclimated at 15^{o}C prior to the test. The predicted temperature increase in the Fraser Municipal Drain would only last for 30 hours, therefore it is unlikely that this would be a long enough duration to pose any serious threat. Further, the maximum temperature in the Fraser Municipal Drain was observed on August 19, 2019, at which point the fish would be acclimated to much higher water temperatures. Central Stonerollers acclimated at 24^{o}C had a LT_{50} value of 30 ^{o}C (Table 3) which is likely a more representative comparison to the Fraser Municipal Drain during the summer months.

Hart (1947) determined LT_{50} values of 24.7^{o}C for adult Creek Chub and 23.3^{o}C for juvenile Emerald Shiner after a one-day test. However, in both cases the fish were acclimated at 5^{o}C prior to the test, which is considerably lower than what would be observed in the Fraser Municipal Drain during the summer months. Adult Creek Chub and juvenile Emerald Shiner acclimated between 20-25^{o}C had LT_{50} values of 30.3 and 30.7^{o}C, respectively (Table 3), which is well in excess of the predicted maximum temperature of the Fraser Municipal Drain following the release of effluent.

Hokanson et al. (1977) determined LT_{50} a value of 19.2^{o}C for larval Walleye after a 50-day test. The authors did not provide information on what temperatures the fish were acclimated to prior to the lethal test, however, considering the duration of time required to produce 50% mortality (i.e., 50 days), it is unlikely that the 30-hour batched effluent release would cause the same effect.

Finally, Kim et al. (2022) determined LT_{50} values of 19.1 and 18.9^{o}C for small and large juvenile Walleye, respectively, after a seven-day test. In this case, it is also unlikely that the 30-hour batched effluent release would cause the same effect.

In summary, based on compiled LT_{50} data from the literature, the short duration of the batched effluent release, and the fact that fish would already be acclimated to warmer water temperatures during the summer effluent discharge periods, it is unlikely that the temperature increase resulting from the mixing of the effluent and the water in the Fraser Municipal Drain would pose any significant risk to fish in this drain or Moose Creek downstream.

It is important to note that the maximum watercourse temperature used in the calculations was based off the Fraser Municipal Drain, which eventually discharges into Moose Creek. After further mixing in Moose Creek, it is even more unlikely that water temperatures in Moose Creek would exceed thermal thresholds for the relatively more complex fish communities in this system.

Table 2 Fish species captured in Moose Creek and the Fraser Municipal Drain from previous studies

MNR Code	Common Name	Scientific name	Moose Creek				Fraser Municipal Drain				
			1991	1996	2020	2021	2009	2012	2019	2020	2021
131	Northern Pike	*Esox lucius*	X	X							
141	Central Mudminnow	*Umbra limi*	X	X		X	X		X		
163	White Sucker	*Catostomus commersoni*	X	X	X		X		X	X	X
171	Shorthead Redhorse	*Moxostoma macrolepidotum*	X	X							
182	Northern Redbelly Dace	*Chrosomus eos*	X	X		X			X		X
186	Common Carp	*Cyprinus carpio*	X	X							
189	Brassy Minnow	*Hybognathus hankinsoni*	X	X						X	X
192	Hornyhead Chub	*Nocomis biguttatus*						X			
194	Golden Shiner	*Notemigonus crysoleucas*	X								
196	Emerald Shiner	*Notropis Atherinoides*	X		X						
198	Common Shiner	*Luxilus cornutus*	X	X	X	X		X	X	X	X
200	Blacknose Dace	*Rhinichthys atratulus*				X	X	X			X
203	Spotfin Shiner	*Notropis hudsonius*	X								
204	Sand Shiner	*Notropis stramineus*				X					
208	Bluntnose Minnow	*Pimephales notatus*	X	X	X	X		X	X	X	X
209	Fathead Minnow	*Pimephales promelas*	X	X		X			X	X	X
211	Longnose Dace	*Rhinichthys cataractae*	X	X	X	X	X	X		X	X
212	Creek Chub	*Semotilus atromaculatus*	X	X	X	X	X		X	X	X
213	Fallfish	*Semotilus corporalis*	X	X							
214	Pearl Dace	*Margariscus nachtriebi*	X								
216	Central Stoneroller	*Campostoma anomalium*			X	X	X	X		X	X
233	Brown Bullhead	*Ameiurus nebulosus*	X			X					
261	Branded Killifish	*Fundulus diaphanous*				X					X
235	Stonecat	*Noturus flavus*	X								
281	Brook Stickleback	*Culaea inconstans*	X	X	X	X			X		X

MNR Code	Common Name	Scientific name	Moose Creek				Fraser Municipal Drain				
			1991	1996	2020	2021	2009	2012	2019	2020	2021
291	Trout Perch	*Percopsis omiscomaycus*	X	X		X					
311	Rock Bass	*Ambloplites rupestris*	X	X				X			
313	Pumpkinseed	*Lepomis gibbosus*		X		X					
316	Smallmouth Bass	*Micropterus dolomieu*	X	X							
334	Walleye	*Sander vitreus*	X	X							
338	Iowa Darter	*Etheostoma exile*				X					X
341	Johnny Darter	*Etheostoma nigrum*	X	X		X	X		X		X
342	Logperch	*Percina caprodes*	X	X							
347	Tessellated Darter	*Etheostoma olmstedi*	X	X	X						
381	Mottled Sculpin	*Cottus bairdi*			X						

Table 3 Representative values for thermal tolerances of fish species with available LT_{50} data that have been observed in the Fraser Municipal Drain and Moose Creek

Species	Stage	Acclimation Temperature (ºC)	Duration (days)	Upper LT_{50} and or CT Max (ºC)[a]	Reference
Blacknose Dace (*Rhinichthys obtusus*)	adult	5	1d	26.5	Hart (1947)
		10	1d	28.8	
		15	1d	29.6	
		20	1d	29.3	
		25	1d	29.3	
Bluntnose Minnow (*Pimephalus notatus*)	adult	5	1d	26	Hart (1947)
		10	1d	28.3	
		15	1d	30.6	
		20	1d	31.7	
		25	1d	33.3	
Brown Bullhead (*Ameiurus nebulosus*)	-	5	1d	27.8	Hart (1952)
		10	1d	29	
		15	1d	31	
		20	1d	32	
		25	1d	33.8	
		30	1d	34.8	
		34	1d	34.8	
Central Stoneroller (*Campostoma anomalium*)	-	15	7d	**24**	Cherry et al. (1977)
		21	7d	27	
		24	7d	30	
		30	7d	33	
Common Carp (*Cyprinus carpio*)	egg	25	-	35	Jinks et al. (1981)
	late-stage embryo	-	-	40-42.5	Crippen and Fahmy (1981)
	larva	16-21	-	36.4	Talmadge (1978)
		19-27	-	38.8	
		26	1d	35.7	Black (1953)
		-	-	40.9	Horoszewicz (1973)

Species	Stage	Acclimation Temperature (ºC)	Duration (days)	Upper LT_{50} and or CT Max (ºC)[a]	Reference
Common Shiner (*Luxilus comutus*)	adult	5	1d	26.7	Hart (1947)
		10	1d	28.6	
		15	1d	30.3	
		20	1d	31	
		25	1d	31	
	adult	10	1d	29	Hart (1952)
		15	1d	30.5	
		20	1d	31	
		25	1d	31	
		30	1d	31	
	-	15	-	30.6	Kowalski et al. (1978)
		15	-	31.9	
Creek Chub (*Semotilus atromaculatus*)	adult	5	1d	**24.7**	Hart (1947)
		10	1d	27.3	
		15	1d	29.3	
		20	1d	30.3	
		25	1d	30.3	
	adult	10	1d	27.5	Hart (1952)
		15	1d	29	
		20	1d	30.5	
		25	1d	31.5	
		30	1d	31.5	
Emerald Shiner (*Notropis Atherinoides*)	YOY	-	-	35.2	Talmadge (1978)
	juvenile	5	1d	**23.3**	Hart (1947)
		10	1d	26.7	
		15	1d	28.9	
		20	1d	30.7	
		25	1d	30.7	
	adult	10	1d	28.2	Hart (1947)

Species	Stage	Acclimation Temperature (ºC)	Duration (days)	Upper LT_{50} and or CT Max (ºC)[a]	Reference
Fathead Minnow (*Pimephalus promelas*)		20	1d	31.7	
		30	1d	33.2	
Golden Shiner (*Notemigonus crysoleucas*)	adult	10	1d	29.5	Hart (1952)
		15	1d	30.5	
		20	1d	32	
		25	1d	33.5	
		30	1d	34.5	
Johnny Darter (*Etheostoma nigrum*)	-	winter	-	30.7	Kowalski et al. (1978)
		spring	-	31.4	
Longnose Dace (*Rhinichthys cataractae*)	-	15	-	31.4	Kowalski et al. (1978)
Mottled Sculpin (*Cottus bairdi*)	-	15		30.9	Kowalski et al. (1978)
Northern Pike (*Esox lucuis*)	YOY	summer	2d	30.8	Cvancara et al. (1977)
	juvenile	30	2d	33	
Pumpkinseed (*Lepomis gibbosus*)	-	24	1d	30.2	Black (1953)
Rock Bass (*Ambloplites rupestris*)	underyearling	18	7d	27	Cherry et al. (1977)*
		21	7d	27	
		24	7d	30	
		30	7d	33	
		36	7d	37	
Sand Shiner (*Notropis stramineus*)	-	winter	-	32.3	Kowalski et al. (1978)
		spring	-	33	
Smallmouth Bass (*Micropterus dolomieu*)	underyearling	18	7d	27	Cherry et al. (1977)
		21	7d	30	
		24	7d	33	
		30	7d	33	
		33	7d	35	
	-	10	7d	25.7	

Species	Stage	Acclimation Temperature (ºC)	Duration (days)	Upper LT_{50} and or CT Max (ºC)[a]	Reference
Threespine Stickleback (*Gasterosteus aculeatus*)		20	7d	27.2	Jordan and Garside (1977)
Walleye (*Sander vitreus*)	larvae	-	50d	**19.2**	Hokanson (1977)
	small juveline	-	7d	**19.1**	Kim et al. (2022)
	large juveline	-	7d	**18.9**	
	juvenile	25.8	-	31.6	Smith and Koenst (1975)
	juvenile	8 - 24	-	27-31.5	Ellis (1984)
	adult	7.2	-	28.9	Wrenn and Forsythe (1978)
		26	-	34	
White Sucker (*Catostomus commersoni*)	adult	5	1d	26.3	Hart (1947)
		10	1d	27.7	
		15	1d	29.3	
		20	1d	29.3	
		25	1d	29.3	

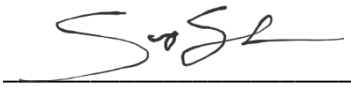
Table Notes:
-LT_{50} = incipient lethal temperature tolerated by 50% of the test population for a sustained period; CT Max = critical thermal maximum at which point locomotory movement becomes disorganized and the animal loses its ability to escape from conditions that may ultimately lead to its death.
-Bold and shaded values represent LT_{50} values that are below the predicted temperature of the Fraser Municipal Drain following mixing of 25.62ºC.
-LT_{50} were not available for Brassy Minnow, Brook Stickleback, Central Mudminnow, Fallfish, Finescale Dace, Hornyhead Chub, Iowa Darter, Logperch, Northern Redbelly Dace, Pearl Dace, Shorthead Redhorse, Stonecat, Trout Perch, and Tesselated Darter
- LT_{50} values were adapted from Environment Canada (2014)

4.0 CLOSURE

This report was prepared for exclusive use by HDR Corporation and GFL Environmental Inc. and may be distributed only by HDR Corporation and GFL Environmental Inc. Questions relating to the data and interpretation can be addressed to the undersigned.

Respectfully submitted,

KILGOUR & ASSOCIATES LTD.



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Appendix B. Clean Equipment Protocol for Industry

Clean Equipment Protocol for Industry

Inspecting and cleaning equipment for the purposes of invasive species prevention

Invasive Species Centre

Catalyst for research and response

Ontario

Peterborough County Stewardship

ONTARIO INVASIVE PLANT COUNCIL

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For more information on invasive plants in Ontario, visit www.ontario.ca/invasivespecies, www.ontarioinvasiveplants.ca, www.invadingspecies.com, or www.invasivespeciescentre.ca.

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Introduction

Why Invasive Plants are a Problem

Invasive alien species are "a growing environmental and economic threat to Ontario. Alien species are plants, animals and microorganisms that have been accidentally or deliberately introduced into areas beyond their normal range. Invasive species are defined as harmful alien species whose introduction or spread threatens the environment, the economy, or society, including human health (Government of Canada 2004)." (Ontario Invasive Species Strategic Plan, 2012). The great majority of plant invasions occur in habitats that have been disturbed either naturally or by humans (Rejma´nek 1989; Hobbs and Huenneke 1992; Hobbs 2000).

The ecological effects of invasive species are often irreversible and, once established, they are extremely difficult and costly to control or eradicate. According to Pimental et al. (1999), invasive species in the U.S. cause economic and environmental damages totalling over $138 billion per year, with agricultural weed control and crop losses totalling approximately $34 billion per year. Exact figures for the total economic and environmental damages are not available for Canada. In Ontario however, the costs of dealing with just one invasive species is astonishing; Zebra Mussels cost Ontario power producers who draw water from the lake $6.4 million per year in increased control/operating costs and about $1 million per year in research costs (Colautti et al. 2006).

Invasive species can spread to new areas when contaminated mud, gravel, water, soil and plant material are unknowingly moved by equipment used on different sites. This method of spread is called an unintentional introduction, and is one of the four major pathways for invasive species introduction into a new area of Ontario (Ontario Invasive Species Strategic Plan, 2012).

Buckthorn removal, Lynde Shores Conservation Area.
Photo by: Central Lake Ontario Conservation Authority

Invasive plant seed and other propagules (plant material, i.e. rhizomes) have the ability to travel sight unseen in mud attached to or lodged in various parts and spaces between parts of vehicles, machinery and other mechanical equipment. A recent study at Montana State University found that most seeds (99% on paved roads and 96% on unpaved roads) stayed attached to the vehicle after traveling 160 miles (257 km) under dry conditions.

Invasive plant species are commonly transported on or in vehicles and construction equipment when they are moved to new locations. Those vehicles include four-wheel drives, excavators, tractors, loaders, water trucks and all-terrain vehicles. Failure to properly clean vehicles and machinery of soils, mud, and contaminated water that may contain invasive species seed and propagules can result in permanent, irreversible environmental impacts. These impacts can mean substantial cost to the landowner, land manager and/or the user. Businesses may also face liability issues for activities and operations that result in the introduction of invasive species.

Some of the invasive species in Ontario which have been known to spread through equipment transfer include:

- **Common Buckthorn** *(Rhamnus cathartica)*
- **Dog-strangling Vine** *(Cynanchum rossicum)*
- **Garlic Mustard** *(Alliaria petiolata)*
- **Giant Hogweed** *(Heracleum mantegazzianum)*
- **Glossy Buckthorn** *(Frangula alnus)*
- **Japanese Knotweed** *(Polygonum cuspidatum)*
- **Miscanthus or Chinese Silver Grass** *(Miscanthus sinensis)*
- **Invasive Phragmites or Common Reed** *(Phragmites australis subsp. australis)*
- **Reed Canary Grass** *(Phalaris arundinacea)*
- **Wild Parsnip** *(Pastinaca sativa)*
- **Wild Chervil** *(Anthriscus sylvestri)*

Dog-strangling Vine
(Cynachum rossicum)
Photo by: Hayley Anderson

Garlic Mustard
(Alliaria petiolata)
Photo by: Ken Towle

Invasive Phragmites
(Phragmites australis subsp. australis)
Photo by: Michael Irvine

These plants impact biodiversity by out-competing native species for space, sunlight, and nutrients. They can also have impacts on road and driver safety by physically blocking intersection sightlines, and in the case of invasive *Phragmites* and *Miscanthus*, may fuel intense grass fires if ignited, which can damage utility stations and hydro lines.

The harmful effects of invasive species include:

- Physical and structural damage to infrastructure
- Human health hazards (i.e. giant hogweed and wild parsnip exposure)
- Delays and increased cost in construction activities
- Environmental damage (i.e. erosion)
- Aesthetic degradation
- Loss of biodiversity
- Reduced property values
- Loss of productivity in woodlots and agriculture

Why Cleaning Vehicles and Equipment is Important

Passenger and recreational vehicles as well as heavy machinery are major vectors for spreading terrestrial invasive species into new areas.

Preventing the spread of invasive species has proven to be considerably more cost effective than controlling established populations. The spread of invasive species through unintentional introduction can be minimized significantly by the diligent cleaning of vehicles and equipment when leaving one site and moving to the next. In the case of large properties, cleaning before moving to a new site is recommended, even if it is within the same property.

This guide has been developed for the construction, agriculture, forestry, and other land management industries, to provide equipment operators and practitioners with tools and techniques to identify and prevent the unintentional introduction of invasive species. It establishes a standard for cleaning vehicles and equipment and provides a guide where current codes of practice, industry standards or other environmental management plans are not already in place.

Passenger and recreational vehicles include:

- 2WD and 4WD cars
- 2WD and 4WD trucks
- All Terrain Vehicles (ATV's)
- Motorbikes
- Snowmobiles

Heavy machinery includes:

- Trucks
- Tractors
- Mowers
- Slashers
- Trailers
- Backhoes
- Graders
- Dozers
- Excavators
- Skidders
- Loaders
- Water Tankers and Trucks

Dog-strangling Vine plants attached to ATV.
Photo by: Francine Macdonald

Plant material attached to bobcat.
Photo by: TH9 Outdoor Services

Impacts of Invasive Species on Industry

Construction

In the UK, Japanese Knotweed (*Polygonum cuspidatum* or *Fallopia japonica*) is classified as a hazardous material. When construction occurs in established Japanese Knotweed stands workers sift the soil to remove root fragments and institute treatment plans to ensure that the Knotweed does not re-sprout, as it can damage housing foundations by growing through concrete and asphalt. The contractors must also thoroughly clean their equipment, and dispose of the contaminated soil at biohazard waste sites. While we do not have these requirements in Ontario, Japanese Knotweed is present here.

Invasive plant species can also increase site preparation and weed control costs, and reduce property values. For example, in Vermont the presence of the aquatic invasive plant Eurasian Watermilfoil (*Myriophyllum spicatum*) depressed shoreline residence property value by as much as 16.4% (Zhang and Boyle, 2010).

Forestry/Agriculture

Invasive plant species which become established in forests will out-compete native species and prevent forest re-generation after logging or natural disturbance. Dog-strangling Vine (*Cynanchum rossicum*) is of particular concern in conifer plantations. This species thrives in the filtered light and open soils of mature plantations, and suppresses seedling establishment of native hardwoods. If its invasion continues, very few juvenile trees will survive to fill the shrinking canopy of over-mature pines. Reforestation sites are also susceptible; the thick mats of vegetation and aggressive competition from Dog-strangling Vine decrease available planting space and increase costs as more mature vegetation needs to be planted in order to ensure the new vegetation can outcompete the invasive plant. As a result, expensive control programs are often required.

Land Management (Trail Use/Maintenance)

Recreational trail use and the maintenance of trails can facilitate the transport of invasive plant material and seeds, and create open and disturbed sites that are prime locations for the establishment of invasive species. Studies have proven that trails act as corridors which assist in the spread of invasive plant species. Humans, their pets, and vehicles such as ATV's can be vectors of invasion along trails because seeds and plant pieces can be carried on equipment and clothing. In addition, frequent trampling along trails alters soil properties, limits the growth of some native species, and creates conditions that may favour the growth of non-native species (Kuss et al. 1985; Marion et al. 1985; Yorks et al. 1997).

Roadsides/Utilities

Invasive species can increase the cost of roadside and utility maintenance by requiring additional maintenance and control efforts. The presence of invasive species can also provide a safety hazard. In the case of Phragmites and Miscanthus (invasive grass species), along with interrupting sight lines, the dead stalks which remain standing each autumn also provide combustible material. Fires in these stands burn intensely, and can damage utilities and hydro lines. Phragmites along roadsides is generally assumed to be spread through the transport and burial of rhizome fragments through ditching, ploughing, and other human activities that transport rhizomes on machinery. Studies have shown that vehicles and road-fill operations can transport invasive plant seeds into uninfested areas, and road construction and maintenance operations provide optimal disturbed sites for seed germination and seedling establishment (Schmidt 1989; Lonsdale & Lane 1994; Greenberg et al. 1997; Trombulak & Frissell 2000).

Steps to Prevent the Unintentional Introduction of Invasive Species from Equipment

Inspection and cleaning of all machinery and equipment should be performed in accordance with the procedures, checklists and diagrams provided in this protocol.

When visiting more than one site, always schedule work in the sites that are the least disturbed and free of known invasive species first, and visit sites with known invasive species infestations last. This will greatly reduce the risk of transferring plants to new locations.

When to Inspect

Inspection should be done before:

- Moving vehicles out of a local area of operation
- Moving machinery between properties or sites within the same property where invasive species may be present in one area, and not in another
- Using machinery along roadsides, in ditches, and along watercourses
- Vehicles using unformed dirt roads, trails or off road conditions
- Using machinery to transport soil and quarry materials
- Visiting remote areas where access by vehicles is limited

Inspection should be done after:

- Operating in areas known to have terrestrial invasive plants or are in high risk areas (i.e. recently disturbed areas near known invaded areas)
- Transporting material (i.e. soil) that is known to contain, or has the potential to contain, invasive species
- Operating in an area or transporting material that you are uncertain contain invasive species
- In the event of rain. If mud contains seeds, they can travel indefinitely until it rains or the road surface is wet, allowing for long distance transport. This may result in transporting seeds to areas where those species did not previously exist

How to Inspect

- Inspect the vehicle thoroughly inside and out for where dirt, plant material and seeds may be lodged or adhering to interior and exterior surfaces.
- Remove any guards, covers or plates that are easy to remove.
- Attention should be paid to the underside of the vehicle, radiators, spare tires, foot wells and bumper bars.

If clods of dirt, seed or other plant material are found, removal should take place immediately, using the techniques outlined below.

When to Clean

Vehicles and heavy equipment that stay on formed and sealed roads have a low risk of spreading invasive species. Cleaning is only required when inspection identifies visible dirt clods and plant material or when moving from one area to another.

Depending on the invasive species present, vehicles may need to be cleaned even when deep snow is present. Invasive *Phragmites*, for example, can still be spread, even in packed snow because the seed heads are usually above the surface of the snow. Other plants, such as dog-strangling vine, will be contained beneath deep snow.

**Regular inspection of vehicles and machinery will identify if any soil or plant material has been collected on or in vehicles and machinery.*

Where to Clean

Clean the vehicle/equipment in an area where contamination and seed spread is not possible (or limited). The site should be:

- Ideally, mud free, gravel covered or a hard surface. If this option is not available, choose a well maintained (i.e. regularly mowed) grassy area.
- Gently sloping to assist in draining water and material away from the vehicle or equipment. Care should be taken to ensure that localized erosion will not be created, and that water runs back into the area where contamination occurred.
- At least 30m away from any watercourse, water body and natural vegetation.
- Large enough to allow for adequate movement of larger vehicles and equipment.

**Safely locate the vehicle and equipment away from any hazards. If mechanized, ensure engine is off and the vehicle or equipment is immobilized.*

How to Clean Inside

Clean the interior of the vehicle by sweeping, vacuuming or using a compressed air device. Particular attention should be paid to the floor, foot wells, pedals, seats, and under the seats.

How to Clean Outside

Knock off all large clods of dirt. Use a pry bar or other device if necessary.

Identify areas that may require cleaning with compressed air rather than water such as radiators and grills. Clean these areas first prior to using water.

Clean the vehicle with a high pressure hose in combination with a stiff brush and/or pry bar to further assist the removal of dirt clods.

Start cleaning from the top of the vehicle and work down to the bottom.

Emphasis should be placed on the undersides, wheels, wheel arches, guards, chassis, engine bays, radiator, grills, and other attachments.

When the cleaning is finished avoid driving through the waste water when removing the vehicle or equipment from the cleaning site.

For equipment such as water trucks that may be exposed to aquatic invasive species, trucks should be disinfected with bleach solution before conducting work in a new area. For further information please refer to the Invading Species Awareness Program's Technical Guidelines listed under Contacts and Resources.

Hosing down a vehicle in Queensland, Australia
Photo by: TH9 Outdoor Services

Final Inspection Checklist

Conduct a final inspection to ensure the following general clean standard has been achieved:

- No clods of dirt should be visible after wash down.
- Radiators, grills, and the interiors of vehicles should be free of accumulations of seed, soil, mud and plant material parts including seeds, roots, flowers, fruit, and or stems.

Diagrams have been provided to assist in quickly identifying key areas to inspect and clean on a variety of vehicles associated with the targeted industries. These can be used in combination with vehicle checklists to ensure all areas of the vehicles have been inspected and cleaned.

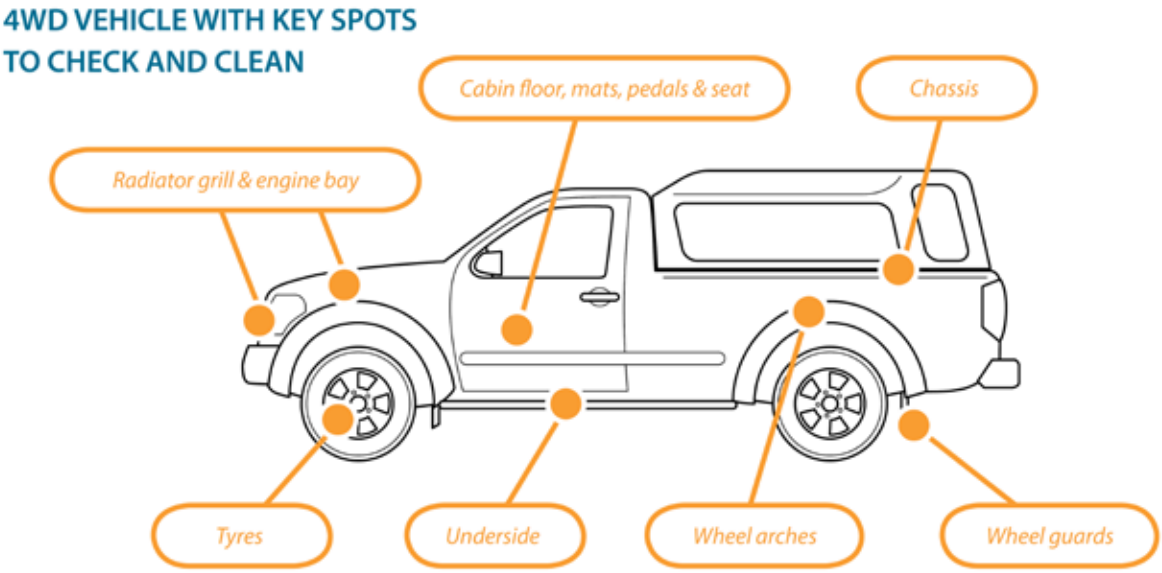
Equipment Required

- A pump and high pressure hose OR high pressure water unit
- Minimum water pressure for vehicle cleaning should be at least 90 pounds per square inch. Water can be supplied as high volume/low pressure or low volume/high pressure (NOAA Fisheries Service).
- Air compressor and blower OR vacuum
- Shovel
- Pry bar
- Stiff brush or broom

Cleaning station at construction site.
Photo by: Mark Heaton, OMNR

Inspection and Cleaning Diagrams and Checklists

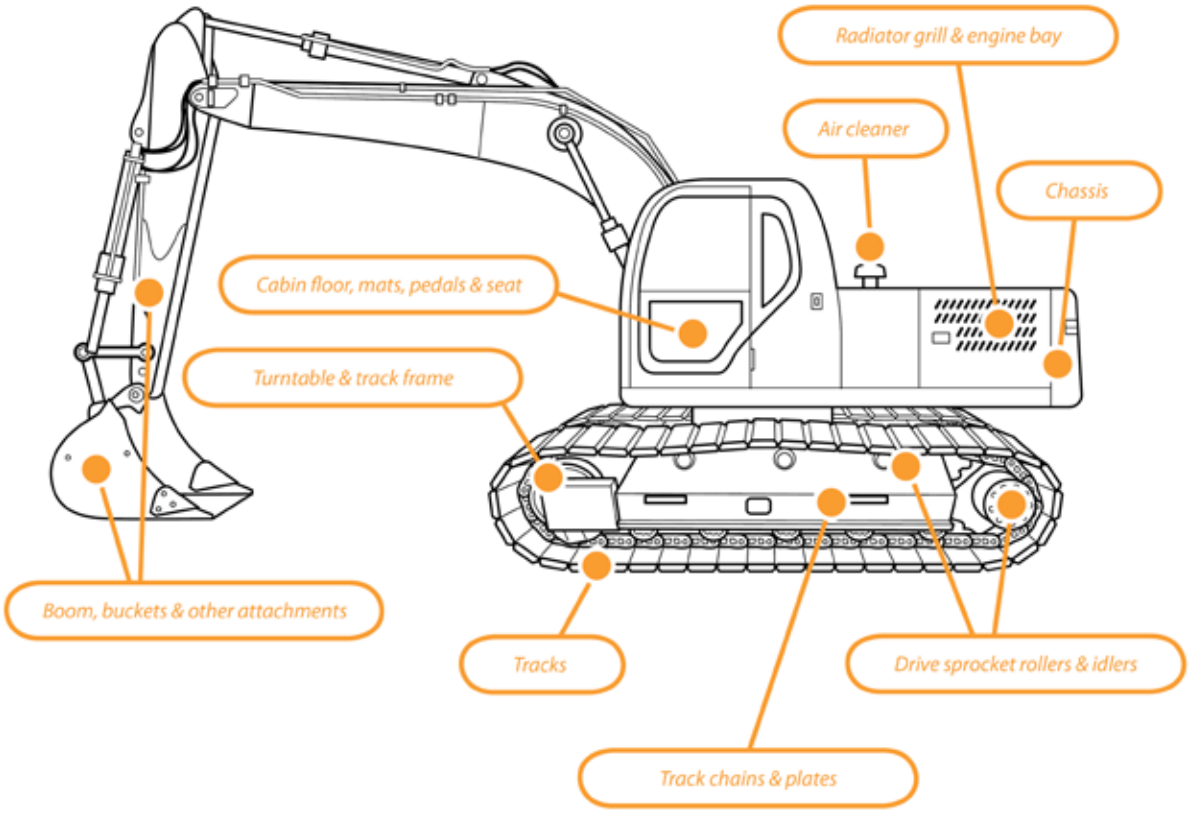
2WD and 4WD Vehicles



		✓
Cabin	Floor, mats, pedals, seats	
Engine	Radiators, engine bay, grill	
Body	Underside, chassis, crevices, ledges, bumper bars	
Wheels	All wheels (including spare), wheel arches, guards	
Tray	Floor, canopy (if included)	

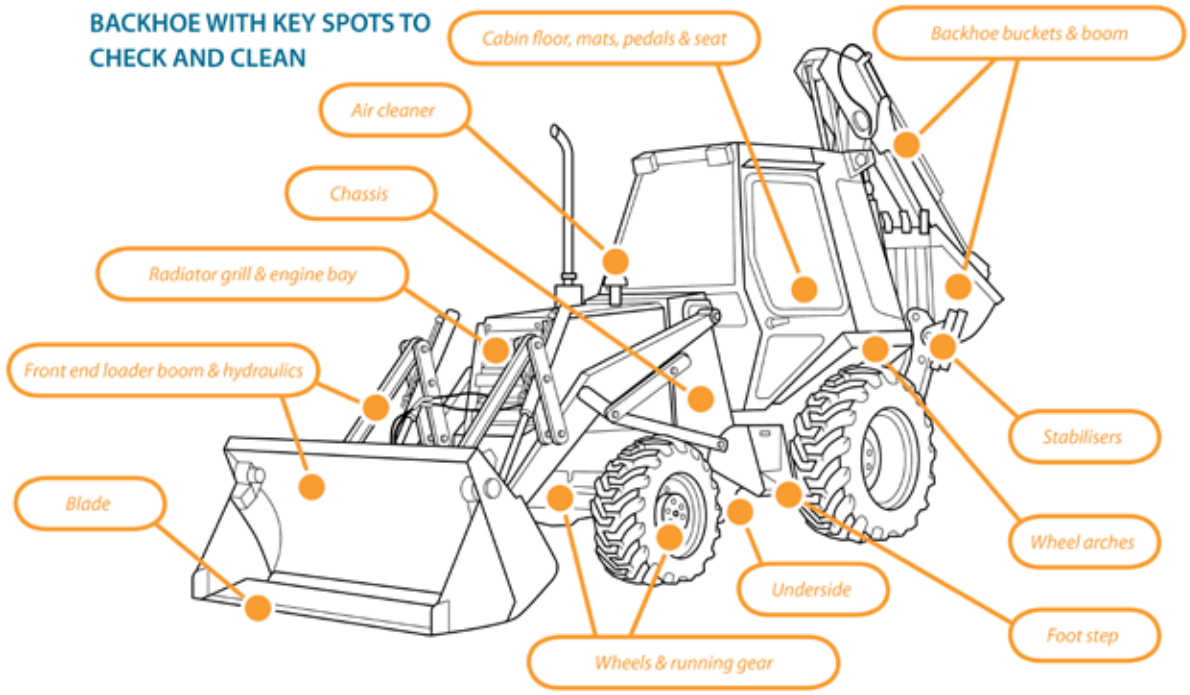
Excavator

EXCAVATOR WITH KEY SPOTS TO CHECK AND CLEAN



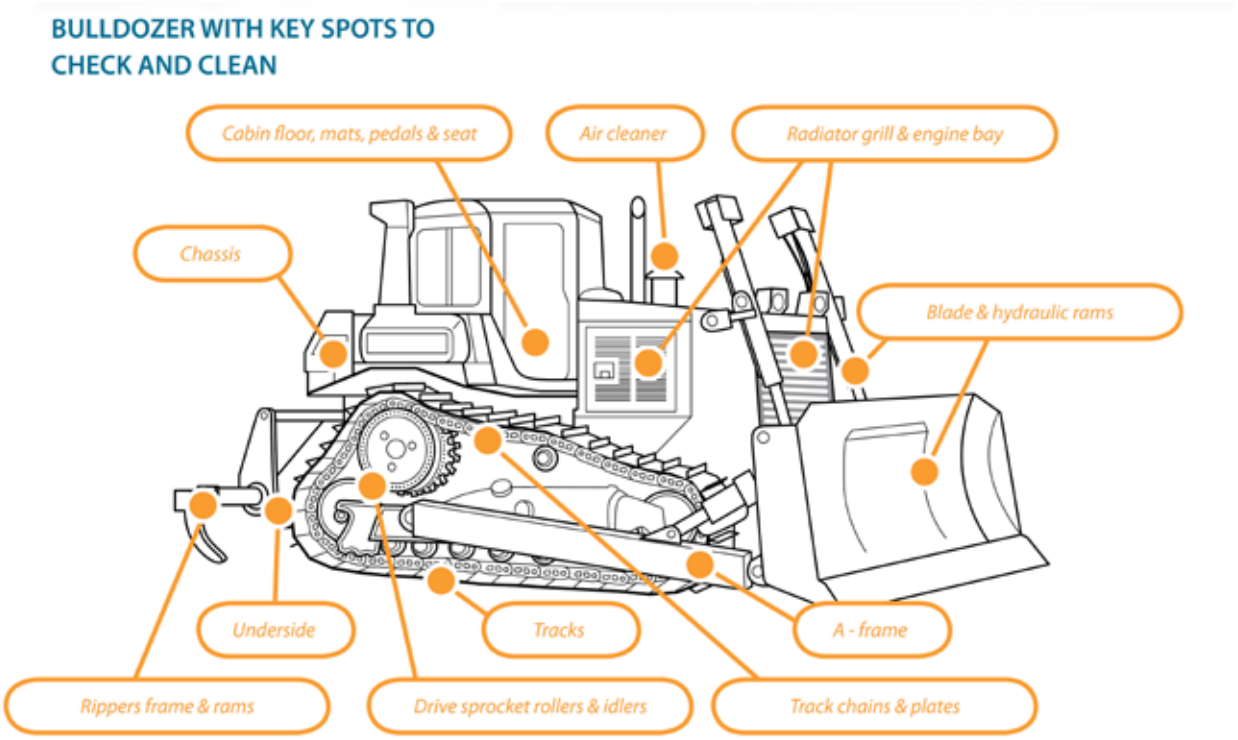
		✓
Cabin	Floor, mats, pedals, seats	
Engine	Radiators, engine bay, grill, air cleaner	
Tracks	Tracks, track frame, drive sprocket rollers, idlers	
Body Plates	Plates of cabin	
Body	Ledges, channels	
Bucket		
Booms		
Turret Pivot		

Backhoe



		✓
Cabin	Floor, mats, pedals, seats, foot step	
Engine	Radiators, engine bay, grill, air cleaner	
Wheels	All wheels (including spare), wheel arches, guards	
Front end loader	Blade, hydraulics, booms	
Backhoe	Buckets, boom, hydraulics, stabilisers	

Bulldozer



		✓
Cabin	Floor, mats, pedals, seats	
Engine	Radiators, engine bay, grill, air cleaner	
Tracks	Tracks, track frame, drive sprocket rollers, idlers	
Body Plates	Belly plates, rear plates	
Body	Ledges, channels	
Blade	Pivot points, hydraulic rams, a-frame	
Ripper	Ripper frame, ripper points	

Contacts and Resources

Ontario Invasive Species Strategic Plan 2012. Government of Ontario. Online, accessed May 8, 2012.
http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@biodiversity/documents/document/stdprod_097634.pdf

Invasive Species Management for Infrastructure Managers and the Construction Industry 2008. Wade, M. Booy, O. and White, V. Online, accessed April 27, 2012.
http://www.ciria.org/service/Web_Site/AM/ContentManagerNet/ContentDisplay.aspx?Section=Web_Site&ContentID=9001

T.I.P.S (Targeted Invasive Plant Solutions) Highway Operations. British Columbia Invasive Species Council. Online, accessed May 8, 2012.
http://www.bcinvasiveplants.com/iscbc/publications/TIPS/Highways_Operations_TIPS.pdf

Invading Species Awareness Program Workshop Manual: Aquatic Invasive Species: An Introduction to Identification, Collection and Reporting of Aquatic Invasive Species in Ontario Waters (includes information on decontaminating equipment).
http://www.invadingspecies.com/download/publications/manuals/WorkshopManual.pdf

Reporting Invasive Species

To report invasive species, or view maps of existing records, visit the Invading Species Awareness Program website www.invadingspecies.com/report/ or www.eddmaps.org/Ontario.

Or call the OFAH/MNR Invading Species Awareness Program Hotline at **1-800-563-7711.**

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Clean Equipment Protocol Working Group:

Diana Shermet, Central Lake Ontario Conservation Authority; Paula Berketo, Ontario Ministry of Transportation; Travis Cameron, Ontario Ministry of Natural Resources; Jennifer Hoare, Ontario Parks; Michael Irvine, Ontario Ministry of Natural Resources; Alison Kirkpatrick, OFAH/MNR Invading Species Awareness Program; Erika Weisz, Ontario Ministry of Natural Resources; Amanda Chad, Ontario Power Generation; Nancy Vidler, Lambton Shores Phragmites Community Group; Nigel Buffone, Du Pont Canada Company; Ewa Bednarczuk, Lower Trent Conservation Authority

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More Information:

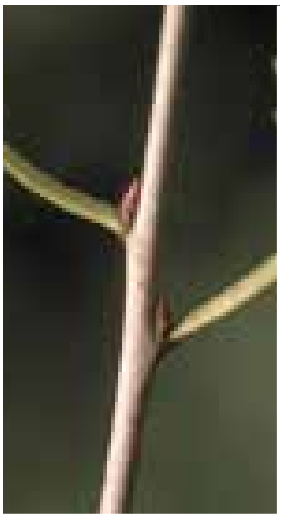
Ontario Invasive Plant Council: www.ontarioinvasiveplants.ca

Appendix A: Identification of Invasive Plants Found in Ontario

- **Common Buckthorn** (*Rhamnus cathartica*) and **Glossy Buckthorn** (*Frangula alnus*)
- **Dog-strangling Vine** (*Cynanchum rossicum*)
- **Garlic Mustard** (*Alliaria petiolata*)
- **Japanese Knotweed** (*Polygonum cuspidatum*)
- **Phragmites or Common Reed** (*Phragmites australis subsp. australis*)
- **Giant Hogweed** (*Heracleum mantegazzianum*)

common & glossy buckthorn

(Rhamnus cathartica & R. frangula)



Plant type: Shrub/small tree

Arrangement: Common buckthorn are sub-opposite (almost opposite). Glossy buckthorn are alternate.

Leaf: The common buckthorn leaf is egg shaped, edge of the leaf is "pebbled" (small rounded teeth). Veins converging toward leaf top. The glossy buckthorn leaf is more slender (tear drop shaped) and smooth margined.

Bark: Smooth, young bark with prominent raised patches or lenticels; rough texture and peeling bark when mature.

Seed/Flowers: Flowers are green-yellowish, small and inconspicuous. Green berries becoming purplish/black in late summer, berry > 1 cm in diameter.

Buds/Twigs: Common buckthorn has thorn-like tip on many twigs. Glossy buckthorn buds have no bud scales and lack thorny tips to twigs.

Habitat: Various - forest, thickets, meadows, dry to moist soils.

Similar native species: Native dogwoods, which lack the thorny "tip". Native dogwoods are truly opposite in arrangement of twigs; only alternate leaved (pagoda) dogwood has alternate branching.

dog-strangling vine
(Cynanchum rossicum & C. nigrum)

Plant type: Herb, twining vine

Arrangement: Opposite

Leaf: Lance shaped, smooth margin (edge)

Bark: n/a

Seed/Flowers: Bean shaped seed pod with seeds attached to downy 'umbrellas'. Flowers - pink (C. rossicum) or purple (C. nigrum) with five petals.

Buds/Twigs: n/a

Habitat: Dry to moist soils; more dominant in meadows and woodland edges.

Similar native species: Swamp milkweed (Asclepias incarnata spp.), is an upright plant, typically found in wetland habitats.

garlic mustard
(Alliaria petiolata)

Plant type: Herb

Arrangement: Alternate

Leaf: Saw tooth like edge, elongated heart shape. Garlic/onion smell when crushed. Leaves are kidney shaped with prominent veins.

Bark: n/a

Seed/Flowers: Cluster of small white flowers with four petals. Small black < 1 mm rounded seed found in elongated 'tube-like' seed pods (similar to a bean pod).

Buds/Twigs: n/a

Habitat: Various – dry to moist soils, in all habitat types, less often in meadows.

Similar native species: n/a

japanese knotweed
(Polygonum cuspidatum)

Plant type: Herb, 2 - 4 m in height.

Arrangement: Alternate

Leaf: Tear drop shaped, sharp pointed, dark green, flattened at base.

Bark: n/a

Seed/Flowers: Flowering stalk of many small greenish-white flowers.

Buds/Twigs: Large plant with a 'bamboo-like' stem. Stem light green maturing to tan colour.

Habitat: Moist to wet soils found in wetlands, water-courses and roadside ditches.

Similar native species: None.

common reed
(Phragmites australis)

Plant type: Grass

Arrangement: Alternate

Leaf: Broad leaf > 1 cm wide.

Bark: n/a

Seed/Flowers: Dense cascading 'broom-like' flower head. 'Cottony' in appearance when mature.

Buds/Twigs: Stems rough and ridged, ligule a densely hairy band. Mature plants > 3 m tall.

Habitat: Moist to wet soils. Found in wetlands, water- courses and road side ditches.

Similar native species: Species of mannagrass (Glyceria sp) including tall northern, eastern and rattlesnake grass. A native common reed exists but has a smooth stem and the ligule is not hairy. It is also quite rare.

giant hogweed
(Heracleum mantegazzianum)

Plant type: Herb. Mature plants can be over 3m tall.

Arrangement: Alternate

Leaf: Lobed leaf 1-2 m wide, lobes sharp-pointed.

Bark: n/a

Seed/Flowers: Small, white flowers in a large umbrella-shaped cluster, .75 m wide.

Buds/Twigs: Hairy stem with purple spots.

Habitat: Fresh to wet soils in forests, swamps, meadows, marshes.

Similar native species: Cow parsnip *(Heracleum maximum)* – has smaller flowers, no purple spots on stems.Angelica (Angelica atropurpurea) has a rounded-topped flower cluster and leaves divided into many leaflets.

Do not touch this plant because it is poisonous. If you do, wash your skin immediately in cool soapy water and do not expose the area to sunlight.

Seek professional advice before removing.

Identification of Invasive Plants found in Ontario Photos by:

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