5494, 5500 and 5510 Boundary Road

Headwater Drainage Feature Assessment

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April 2021

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1.0 INTRODUCTION

Day & Ross Inc. is proposing to construct a truck transport facility and warehouse facility at 5494, 5500, and 5510 Boundary Road in Navan. The site is in part of Lot 1, Concession 9 in the City of Ottawa, former Township of Gloucester (Figure 1). It is bordered by Boundary Road on the east, is approximately 1 km to the south of Highway 417 and extends roughly 415 m to the west of Boundary Road (Figure 2). This development includes numerous loading docks with parking spaces for 141 cars, 55 tractors and 134 trailers. Bowfin Environmental Consulting (Bowfin) was retained by Day & Ross Inc. to provide a Headwater Drainage Feature Assessment.

The site consisted of fill with perimeter ditches/roadside ditch on all sides (Figure 2). All features are part of the Upper Bear Brook portion of the Bear Brook sub-watershed, which itself is part of the South Nation River watershed. A brief description of these features is provided below for context. Refer to Appendix A for more details on the habitat descriptions and fish community sampling results.

2.0 METHODOLOGY

The Headwater Drainage Feature Assessment Report involved the evaluation of the site's headwater drainage features is based on the guidelines outlined in the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (here after referred to as the Guidelines) (prepared by Credit Valley Conservation Authority and Toronto and Region Conservation, revised July 2014). The Guideline is divided into three parts.

- Part 1 - Evaluation and various suggested study designs/methods
- Part 2 - Classification of features
- Part 3 - Management Recommendations.

As per the definition of the catchment area for a headwater in this guideline and the relevant *Ontario Stream Assessment Protocol* (OSAP) the catchment must be at least 2.5 ha and less than 1000 ha (or <10 km^2).

The evaluation of the features requires the collection of various data: habitat descriptions, fish community sampling and amphibian surveys. The methodologies for these are described below in Section 2. A brief outline of the habitats is provided in Section 3. The detailed descriptions of stations and fish community sampling results are in Appendix A and the amphibian results are in Appendix B.

The field work included habitat assessment, fish community sampling, amphibian surveys and headwater assessments completed from April to July 2020.

Figure 1: General Location of Study Area

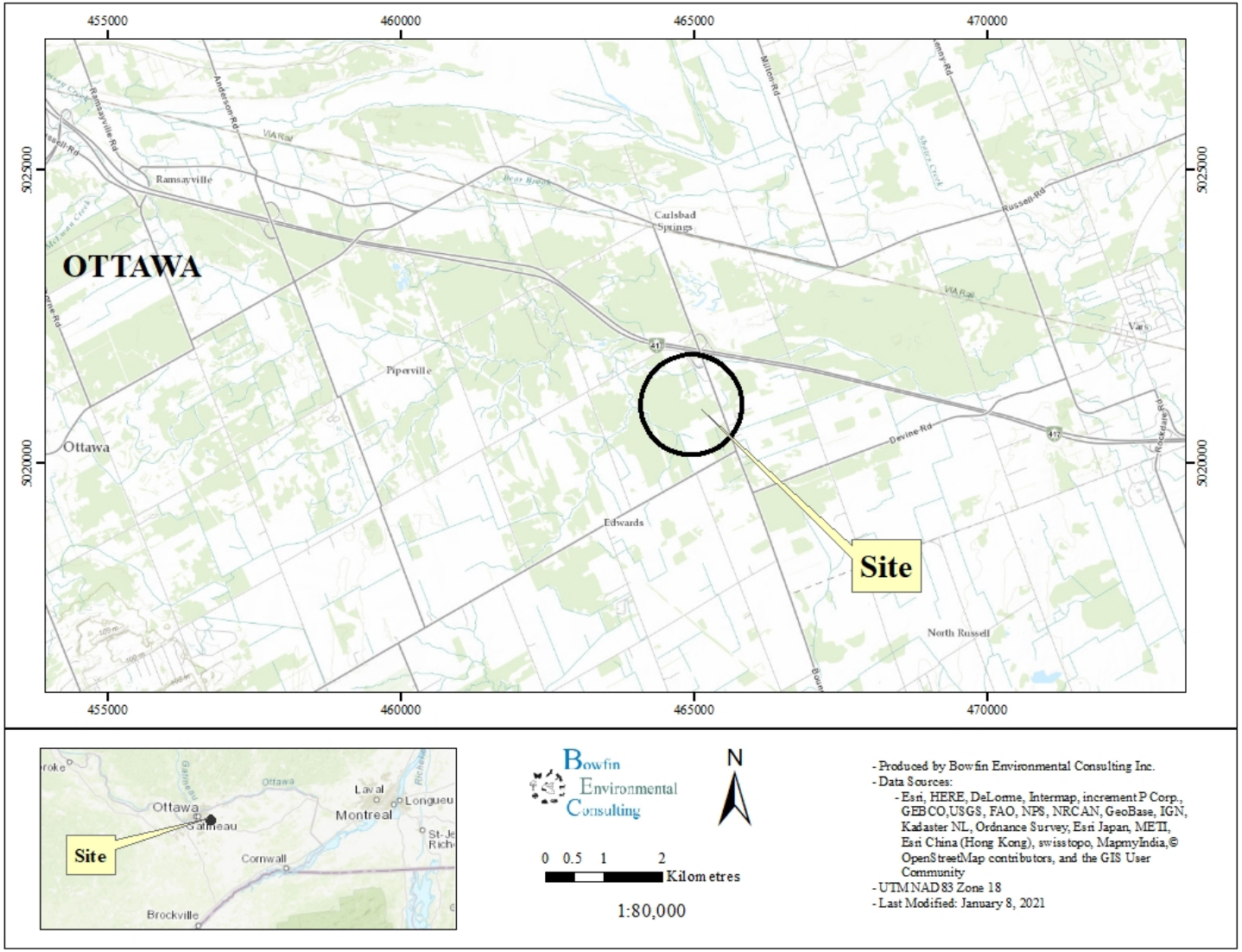
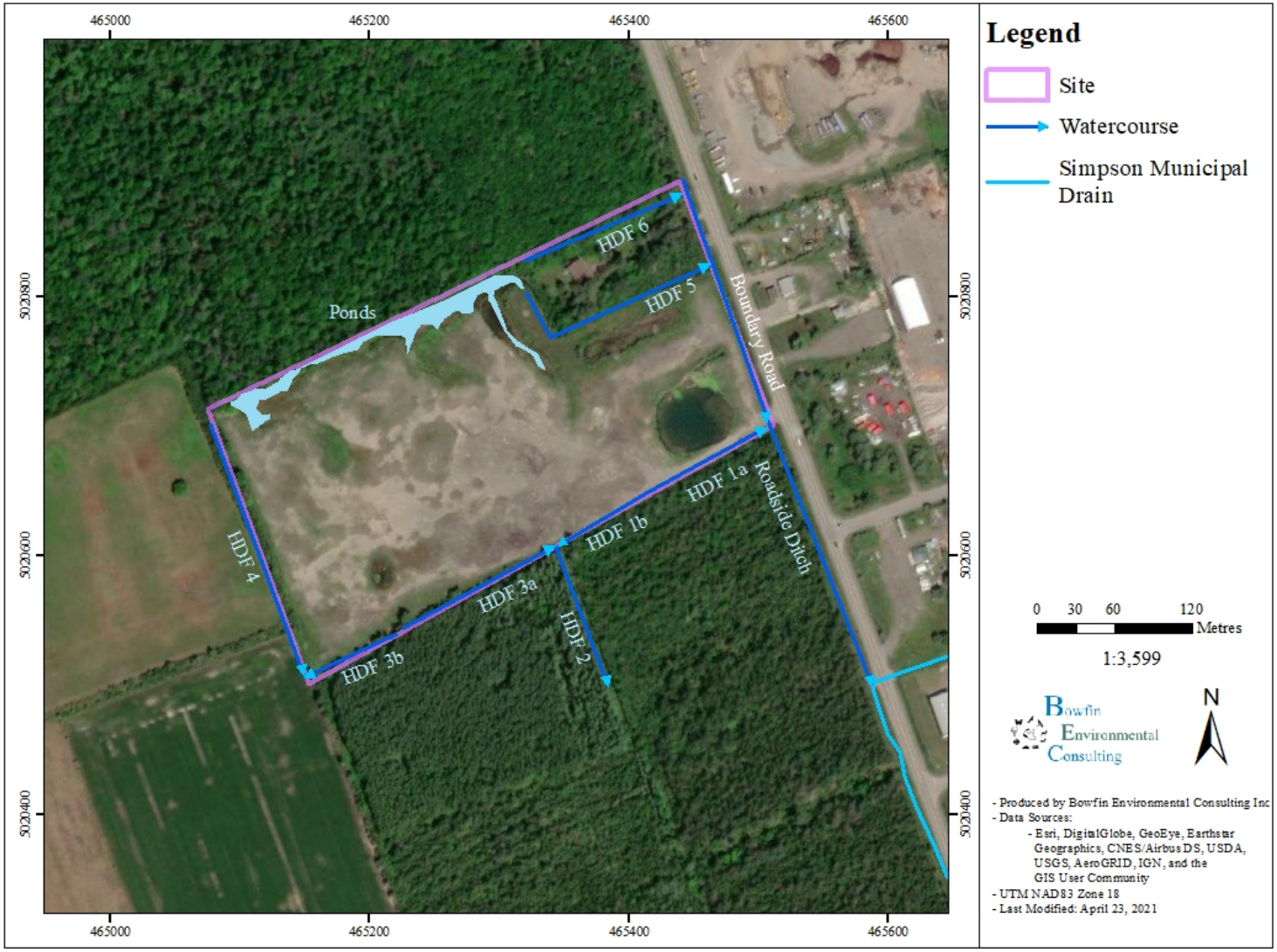


Figure 2: Location of Headwater Features



2.1 Habitat Description

The headwater features within the study area were described based on the the *Ontario Stream Assessment Protocol* (2013). The channel morphology was described using evenly spaced transects upon which data was recorded from evenly spaced observation points. The data collected included: channel width, wetted width, bankfull depth, water depth, substrate size, morphological units, and in-stream cover. The location of specific features mentioned in the text is shown on Figure 2. These summaries will be available in the fisheries assessment report.

2.2 Fish Community Sampling

Fish community sampling was performed to document the use of the site by fish during the spring of 2020 and the spring of 2021. The community was sampled using dip netting and backpack electrofishing. The fish were identified, counted, measured [fork length (FL)/total length (TL) as appropriate], and released. The transect length, approximate width, volts, current and effort were also recorded.

2.3 Headwater Drainage Features

The headwater drainage features within the study area were assessed based on the *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (here after referred to as the Guidelines) (prepared by Credit Valley Conservation Authority and Toronto and Region Conservation, revised July 2014). The Guideline is divided into three parts. Part 1 is the Evaluation and discusses various suggested study designs/methods. Part 2 determines the appropriate Classification following the outcome of Part 1. Finally, Part 3 outlines the Management Recommendations. An Evaluation, Classification and Management Table is provided at the end of this report.

2.4 Amphibian Surveys

Nighttime amphibian calling surveys were completed as per the *Environment Canada Marsh Monitoring Program* (MMP) guide. The protocol is summarized below:

- The surveys were completed 3 times during the spring and early summer (once during each of the three survey periods to collect data on all species).
- Observations began 30 minutes after sunset and end before midnight.
- Each station was surveyed for 3 minutes during which time the species and the calling code were recorded for each of the following distances: 0-50m, 50-100m, and >100m. Additional notes were taken on whether amphibians were in the feature being assessed. The calling codes were recorded as one of:
    - Code 1: Calls not simultaneous, number of individuals can be accurately counted
    - Code 2: Some calls simultaneous, number of individuals can be reliably estimated

    - Code 3: Full chorus, calls continuous and overlapping, number of individuals cannot be reliably estimated
- Surveys were only conducted if the wind strength was Code 0, 1, 2 or 3 on the Beaufort Wind Scale.
- The MMP protocol calls for the stations to be separated by at least 500 m however, in this instance, the stations were positioned to capture the amphibian data on the various headwater drainage features and as such, some stations were closer.

All surveys include the recording of the following information:

- Date
- Name of observer(s) conducting field work
- Time (start and end time, duration)
- Weather conditions (temperature, % cloud cover, wind)
- GPS location
- Species presence and abundance information

3.0 RESULTS

3.1 Site Investigations

3.1.1 Headwater Features

The site consisted of fill with perimeter ditches/roadside ditch on all sites (Figure 2). All features are part of the Upper Bear Brook portion of the Bear Brook sub-watershed, which itself is part of the South Nation River watershed. A brief description of these features is provided below for context. Refer to Appendix A for more details.

The entire site was flat and other than the road ditch, the features did not flow, even during the early spring. They were poorly constructed resulting in gradient barriers. Because of this, some features were split to show which ones were connected to one another in terms of possible fish movement.

- Boundary Road ditch (referred to herein as Roadside Ditch) drain south into Simpson Municipal Drain roughly 200 m downstream.

- Headwater Drainage Feature 1 (HDF 1) is found along the southeast perimeter of the site, to the east of HDF 2. One part of HDF 1 (HDF 1a) inclines towards the roadside ditch, the other (HDF 1b) towards HDF 2. HDF 1a and 1b were frozen and snow covered on April 7, 2020. There was <2 cm or no water on April 12, 2021. There was no sorting of substrate, and the features were choked with vegetation. Both are a swale.

- Headwater Drainage Feature 2 (HDF 2) travels from the perimeter of the site, straight south to Mitch Owens Road (roughly 530 m away). This feature also receives water from the treed swamp surrounding it. Station 3 provides information on this feature.

- Headwater Drainage Feature 3 (HDF 3) is the southwest perimeter ditch. Like HDF 1, this was split into two with only the lower 20 m of feature 3a directing water to HDF 2. The rest of HDF 3a was separated by gradient changes in the ditch which were not overtopped even in early April. HDF 3b inclines towards HDF 4. HDF 3a and 3b were frozen and snow covered on April 7, 2020. All but the lower 20 m of 3a is not fish habitat as it was isolated or connected to HDF 4 (4 is also isolated).

- Headwater Drainage Feature 4 (HDF 4) is found along the west edge of the site. This feature had many barriers to fish movement in the form of small soil berms throughout the northern portion. It was also a dead end on the downstream side, resulting in a deeper pool that was not connected to the other features. This was not fish habitat.

- Headwater Drainage Feature 5 (HDF 5) is situated within the northeast side of the site. The west side consists of ponds (labelled as Ponds) and the remainder is a ditch that is connected to the Roadside Ditch. The ponds were created by the fill activities on-site. One portion of the ponds branched south approximately 80 m into the site. This branch was seasonally separated from the other ponds by a soil berm.

- Headwater Drainage Feature 6 (HDF 6) is situated within the most northeast side of the site. This feature had a barrier to fish movement its downstream end, isolating it from the Roadside Ditch. This was not fish habitat.

Photo 1: Roadside ditch, looking south (May 17, 2020)

Photo 2: Headwater feature 1a, looking west from Boundary Road (May 17, 2020)

Photo 3: Feature 1b – dry except for a couple of pockets (snow melt) (April 7, 2020)

Photo 4: Headwater feature 2, looking south (May 17, 2020)

Photo 5: Headwater feature 3a, looking west (May 17, 2020)

Photo 6: Headwater feature 3b, looking west (May 17, 2020)

Photo 7: Headwater feature 4, looking north (May 17, 2020)

Photo 8: Pooling of water created by HDF 3b and 4 (May 17, 2020)

Photo 9: Headwater feature 5, looking west (April 7, 2020)

Photo 10: Ponds, with the soil berm, looking west (May 17, 2020)

Photo 11: Headwater feature 6, looking at a ponded portion (April 12, 2021)

3.1.2 Summary of Visits

Several visits were completed between April 2020 and April 2021. These included: fish community sampling, fish habitat assessment, amphibian surveys and headwater flow visits. Environmental conditions for each visit are described in Table 1 below.

Table 1: Summary of Dates, Times of Site Investigations

Date	Time (h)	Staff	Air Temperature (Min-Max) °C	Cloud Cover (%) Beaufort Wind Scale [Descriptor (scale)]	Purpose
April 7, 2020	1030-1500	M. Lavictoire S. Lafrance	7.0 (-0.4-12.5)	Clear sky Wind: light air (1) to light breeze (2)	- Fish Community Sampling
April 7, 2020	1015-1500	C. Fontaine	7.0 (-0.4-12.5)	Clear sky Wind: light air (1) to light breeze (2)	- HDF Flow Visit #1
April 28, 2020	1015-1200	S. Lafrance C. Fontaine	7.0 (-0.9-15.1)	Clear sky Wind: light breeze (2)	- HDF Flow Visit #2
April 29, 2020	1945-2115	S. Lafrance C. Fontaine	12.0-16.0 (3.0-16.2)	Overcast Wind: light breeze (2)	- Amphibian Survey #1
May 19, 2020	2045-2145	S. Lafrance M. Lavictoire	16.0 (7.9-19.1)	Clear sky Wind: light breeze (2)	- Amphibian Survey #2
June 16, 2020	2230-2315	S. Lafrance A. Yates	20.0 (8.7-27.3)	Clear sky Wind: calm (0)	- Amphibian Survey #3
July 10, 2020	0930-1100	S. Lafrance	29.0 (21.2-36.4)	Clear sky Wind: light wind (1)	- HDF Flow Visit #3
July 23, 2020	1100-1200	C. Fontaine S. Lafrance	23.0 (16.0-27.4)	Overcast Wind: light breeze (2)	- Fish Community Sampling
July 24, 2020	1000-1215	M. Lavictoire S. Lafrance	27.0-29.0 (14.6-30.8)	Clear sky Wind: light air (1)	- Fish Community Sampling
July 29, 2020	0745-1100	M. Lavictoire	21.0-25.0 (16.9-28.3)	Clear sky Wind: light breeze (2) changing to Cloudy Wind: light breeze (2)	- Fish Habitat Description
April 12, 2021	0855-0920	M. Lavictoire	13.0 (8.5-18.6)	Partially Cloudy Wind: moderate breeze (4)	- Flow Visit 1
April 13, 2021	1135-1230	S. Lafrance A. Quinsey	14.0 (8.6-18.4)	Partially Cloudy Wind: light breeze (2)	- Fish Sampling

M. Lavictoire – Michelle (Nunas) Lavictoire – B. Sc. Wildlife Resources and M.Sc. Natural Resources
S. Lafrance – Sophie Lafrance – B.Sc. Biology and Graduate Certificate in Ecological Restoration
C. Fontaine - Cody Fontaine - Fisheries and Wildlife Technologist
A. Yates – Abby Yates – B.Sc. Env. Ecology
A. Quinsey – Al Quinsey – B.Sc Env. Biologist

*Min-Max Temp Taken From: Environment Canada. National Climate Data and Information Archive. Ottawa International Airport. Available http://climate.weatheroffice.gc.ca/ [April 20, 2021]

4.0 HEADWATER DRAINAGE FEATURES ASSESSMENT

4.1 Classification

4.1.1 Step 1: Hydrology Classification

In Step 1 the flow is classified based on the data recorded during the three flow visits. These are summarized in Table 3 (as per OSAP S4.M10). To put the flows observed into context, a summary of the snowpack and rain during the seven days preceding the visits is provided below.

The winter of 2019-2020 was unusually mild, with lower than average snowfall (just under 200 cm by early April), resulting in a below average snowpack. By early April, there was little amount of snowpack left across the Ottawa Area. There were a few snowfall events in mid-April, but all snow was gone by late April. The South Nation Watershed remained in flood warning conditions from late March to early June. Water levels remained above average until late June. The amount of rainfall recorded in the seven days preceding each station visit is summarized in Table 2.

Table 2: Summary of Rainfall for the 7 Days Preceding the Flow Visits

Dates	Total Rainfall (mm)
March 31 – April 6, 2020	2.7
April 21 – April 27, 2020	4.7
July 3 – July 9, 2020	0.8
April 5 – April 11, 2021	0.0

Total Rainfall taken from: Environment Canada. 2017. National Climate Data and Information Archive – Ottawa INTL. On-line (http://climate.weatheroffice.gc.ca) accessed April 20, 2021.

Table 3: Hydrology classification features using data from OSAP S4.

Tributary	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments/Modifier	Hydrology Classification
Roadside Ditch	Spring freshet or rainfall events	Surface flow substantial (5)	Roadside ditch (8)	Note that portions of the channel upstream (between HDF 5 and 6) was not flowing because of soil deposit barriers.	Valued
	Late April - May	Surface flow minimal (4)			
	July - August	Dry (1)			
HDF 1a	Spring freshet or rainfall events	Standing water (2)	Swale (7)	This feature was still frozen on April 7 and was poorly graded resulting in pooling water. Feature chocked with emergent (Common Reed) indicating little flow/water. No sorting. Its condition was verified on April 13, 2021 at which time there was <2 cm of water standing under the vegetation.	Limited
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
HDF 1b	Spring freshet or rainfall events	Dry (1)	Swale (7)	Most of the snow was gone on April 7, 2020 and there were a couple of tiny pockets of water (where snow had melted); but mostly it was already dry and no sorting. It does not contribute water to any other feature. Feature chocked with emergent	Limited
	Late April - May	Dry (1)			
	July - August	Dry (1)			

Tributary	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments/Modifier	Hydrology Classification
				(Common Reed) indicating little flow/water. April 13, 2021 at which time there was **no water** under the vegetation.	
HDF 2	Spring freshet or rainfall events	Standing water (2)	Channelized or constrained (2)	Travels through flat wetland habitat. Larger catchment than HDF 1. Could provide contributing waters downstream (to Mitch Owens).	Valued
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
HDF 3a	Spring freshet or rainfall events	Standing water (2)	Channelized or constrained (2)	This feature was still frozen on April 7, 2021 and was poorly graded resulting in pooling water. But was accessible to fish from HDF 2 (bottom 20 m only).	Valued
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
HDF 3b	Spring freshet or rainfall events	Standing water (2)	Channelized or constrained (2)	This feature was still frozen on April 7, 2021 and had no outlet resulting in pooling water. Classification lowered because it is not connected and is artificially holding back water.	Classification lowered to Contributing (from Valued)
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
HDF 4	Spring freshet or rainfall events	Standing water (2)	Channelized or	This feature was still frozen on April 7 and was poorly	Classification lowered to

Tributary	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments/Modifier	Hydrology Classification
	Late April - May	Standing water (2)	constrained (2)	graded and had no outlet resulting in pooling water.	Contributing (from Valued)
	July - August	Dry (1)			
HDF 5	Spring freshet or rainfall events	Standing water (2)	Channelized or constrained (2)	None	Valued
	Late April - May	Standing water (2)			
	July - August	Dry (1)			
HDF 6	Spring freshet or rainfall events	Standing water (2)	Swale (7)	This feature did not have a continuous channel and no opening to the road ditch. The soil barriers resulted in pooling water. A single visit has been completed to date, April 12, 2021 and the flow conditions from the other flow influences are estimated and will be confirmed. There was standing water only because of blockages in the channel (uneven gradient so bottom of channel is higher in areas further the leaf litter was present showing no	Limited
	Late April - May	Standing water (2) (estimated)			
	July - August	Dry (1) (estimated)			

Tributary	Definitions of Flow Influence	Flow Conditions	Feature Type Code	Comments/Modifier	Hydrology Classification
				flowing water. There is no sorting of the substrate and no invertebrates were noted.	
Ponds	Spring freshet or rainfall events	Standing water (2)	Channelized or constrained (2)	The branch into the site had deep areas remaining in the summer. Western area was dry by then. Classification lowered because these are artificially holding back water and there were negative impacts to fish (entrapment) and increases in water temperature as a result. Lowered classification matches that of the habitat downstream (HDF 5)	Classification lowered to Valued (from Important)
	Late April - May	Standing water (2)			
	July - August	Standing water (2)			

Figure 3: Summary of Flow Conditions – Early Spring (April 7, 2020 and April 12, 2021 visits)

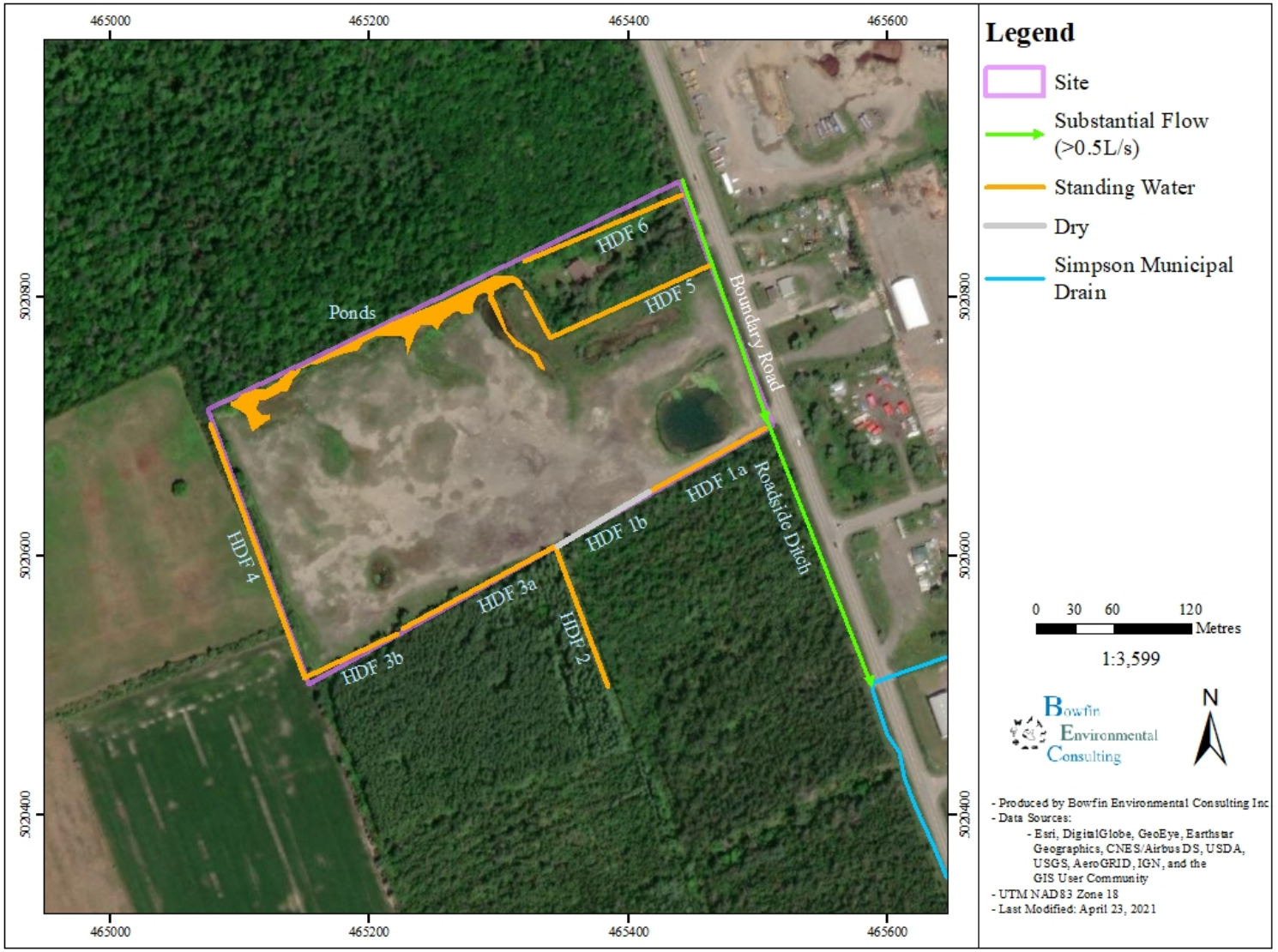


Figure 4: Summary of Flow Conditions – Late Spring (April 28, 2020)

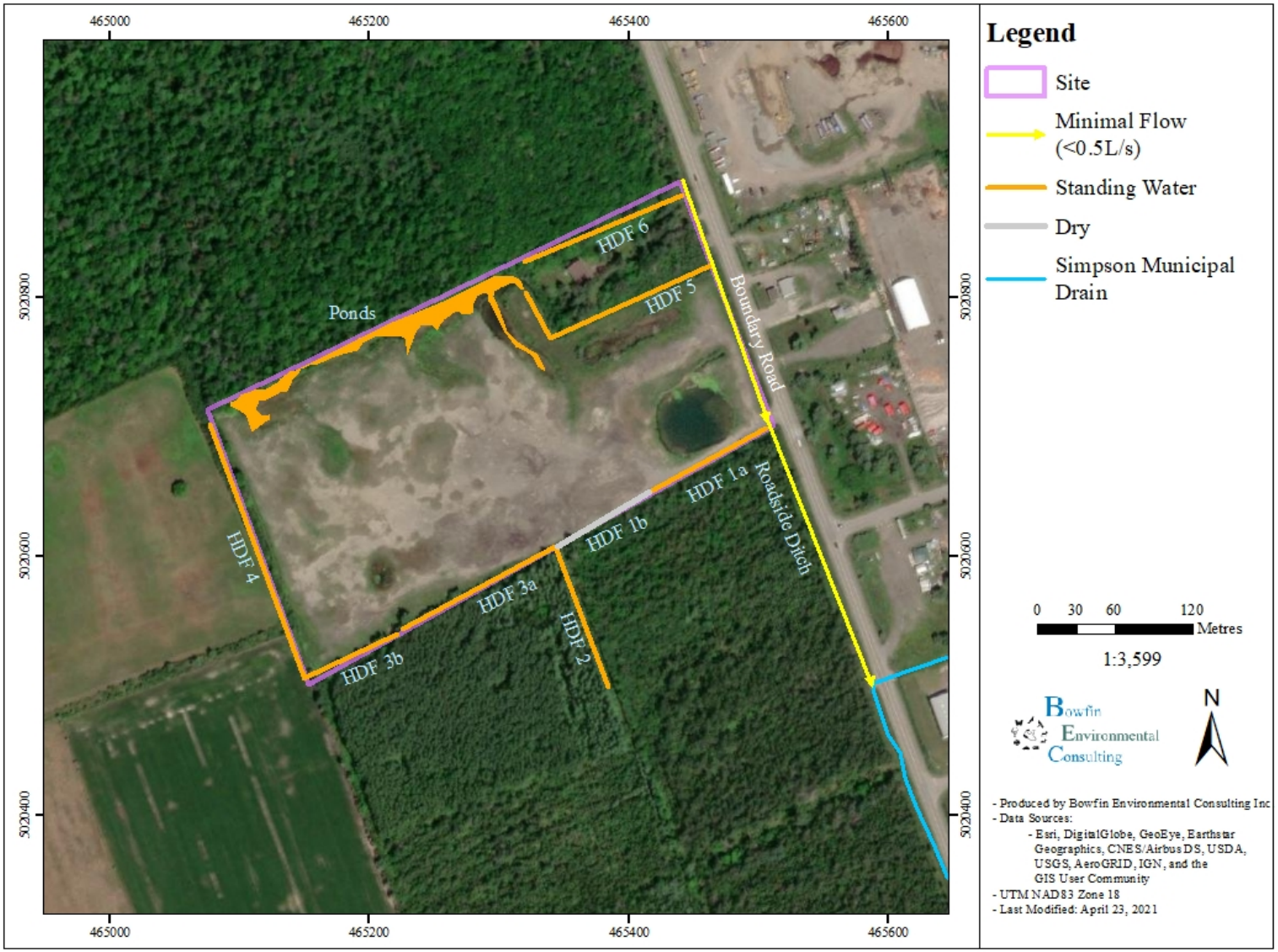
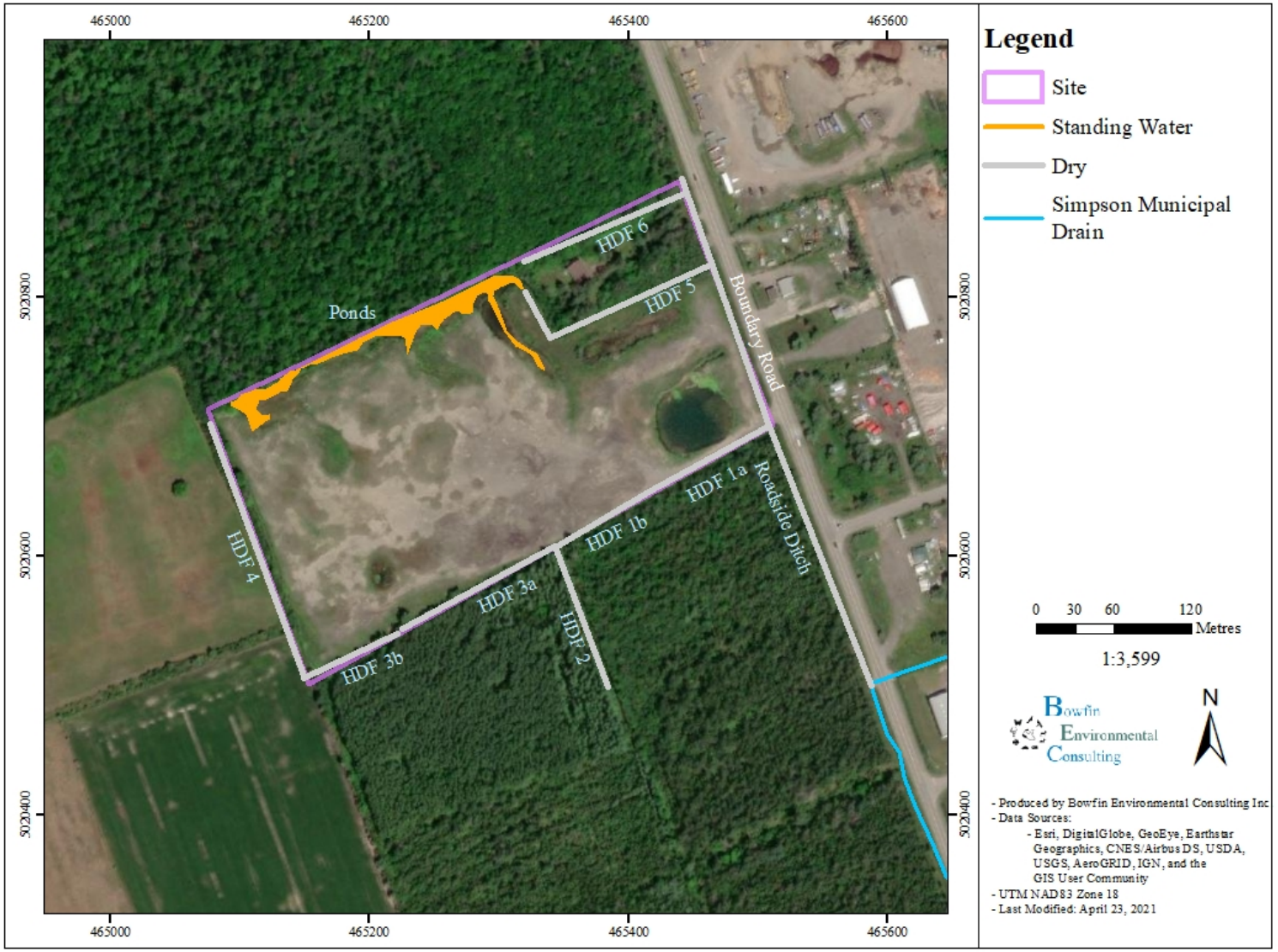


Figure 5: Summary of Flow Conditions – Summer (July 10, 2020)



4.1.2 Step 2: Riparian Classification

In Step 2 the riparian habitat is classified based on the width and type of vegetation on the banks. The features on the north and south sides of the site have one bank that is vegetated with natural woody vegetation. Since the classification is based on the best habitat (only needs to be present on one side), this all receive important classifications. The other features are limited. These are summarized in Table 4.

Table 4: Riparian Classification

HDF/ Tributary	OSAP S4.M10 Code	Riparian Classification	Comments
Roadside Ditch	None (1)	Limited	Along the site, the east riparian habitat is paved road, and the west bank is cleared and fill.
HDF 1a	None (1) Forest (5)	Important	The north riparian habitat is cleared and fill, and the south habitat is forest
HDF 1b	None (1) Forest (5)	Important	The north riparian habitat is cleared and fill, and the south habitat is forest
HDF 2	Wetland (6)	Important	Riparian habitats are treed swamp.
HDF 3a	Forest (5) None (1)	Important	The north riparian habitat is forest, and the south habitat is cleared and fill
HDF 3b	Forest (5) None (1)	Important	The north riparian habitat is forest, and the south habitat is cleared and fill
HDF 4	None (1)	Limited	The east riparian habitat is cleared and fill and the west habitat is agricultural field
HDF 5	Forest (5) None (1)	Important	The north riparian habitat is cultural thicket/swamp, and the south habitat is cleared and fill
HDF 6	Forest (5)	Important	Riparian habitats are forest (and single lot residence on south side).
Ponds	Forest (5) None (1)	Important	The south riparian habitat is cleared, and fill and the north habitat is forest

4.1.3 Step 3: Fish and Fish Habitat Classification

The fish habitat is classified based on fish sampling completed during the spring and summer. All features but the ponds were dry by summer and, as such, do not provide year-round fish habitat.

Table 5: Fish and Fish Habitat Classification

HDF/ Tributary	Fish/Fish Habitat Classification	Comments
Roadside Ditch	Valued	Fish only caught in spring [central mudminnow (4 individuals)], feature was dry come summer.
HDF 1a	Valued	Potential fish habitat due to its connectivity with Roadside Ditch and the presence of water in the spring.
HDF 1b	Contributing	No fish caught or observed. Doesn't have much of a catchment, there was only a couple of tiny pockets of water present in April. The feature was dry early spring.
HDF 2	Valued	Fish only caught in spring [central mudminnow (4 individual), brook stickleback (1 individual)], feature was dry come summer.
HDF 3a and b	Contributing	No fish caught or observed. Due to gradient issues, there is no connectivity between this feature and fish habitat at any point in the year.
HDF 4	Contributing	No fish caught or observed. Due to gradient issues, there is no connectivity between this feature and fish habitat at any point in the year.
HDF 5	Valued	Fish only caught in spring [central mudminnow (12 individuals), brook stickleback (2 individuals), creek chub (1 individual)], feature was dry come summer.
HDF 6	Contributing	No fish caught or observed in spring (April 12, 2021). Due to gradient issues, there is

HDF/ Tributary	Fish/Fish Habitat Classification	Comments
		no connectivity between this feature and fish habitat at any point in the year.
Ponds	Classification lower to Valued (from Important)	No fish stations were established here in the spring as it was well connected to feature 5 and provided fish habitat. In the summer, fish were captured [central mudminnow (3 individuals, common shiner (approximately 60 individuals), brook stickleback (1 individual), pumpkinseed (3 individuals)]. But it was also noted that some fish were trapped in shallow very warm water with no downstream connection. This is poor quality habitat and impacted from filling. It would be better for the fish if this were properly connected and seasonal. For this reason, its classification has been lowered to Valued.

4.1.4 Step 4: Terrestrial Habitat Classification

This step is more of a classification of amphibian habitat than of the terrestrial habitat. According to the guidelines, only those features associated with wetland habitats can be considered Important or Valued. None of the features on-site are wetlands.
Features classed as Contributing are those that may or do provide a linkage between habitat for wildlife movement and Limited is given to those that do not meet any of the above criteria. These are summarized in
Table 6.

Table 6: Terrestrial Habitat Classification

HDF/ Tributary	OSAP S4.M10 Code	Marsh Monitoring Protocol Calling Code	Comments	Classification
Roadside Ditch	Roadside ditch (8)	0	No calls within the feature	Limited
HDF 1a	Channelized or constrained (2)	0	No calls within the feature	Limited

HDF/ Tributary	OSAP S4.M10 Code	Marsh Monitoring Protocol Calling Code	Comments	Classification
HDF 1b	Swale (7)	0	No calls within the feature	Limited
HDF 2	Swale (7)	0	One wood frog were heard in HDF 2	Limited
HDF 3a	Channelized or constrained (2)	0	No calls within the feature	Limited
HDF 3b	Channelized or constrained (2)	0	No calls within the feature	Limited
HDF 4	Channelized or constrained (2)	0	No calls within feature	Limited
HDF 5	Channelized or constrained (2)	1	Three spring peepers were heard in the feature	Limited
HDF 6	Swale (7)	0	No calls within feature	Limited
Ponds	Channelized or constrained (2)	1	Two spring peepers were heard in the feature, and one gray tree frog in the downstream section, where it meets HDF 5	Limited

4.2 Part 3 – Management Recommendations

The Guidelines groups the management recommendations into six categories: Protection, Conservation, Mitigation, Maintain Recharge, Maintain/ Replicate Terrestrial Linkage, and No Management Required. It also provides general recommendations for each. In the paragraphs and summary table below, the key functions that resulted in the management recommendations for each headwater or reach are highlighted in green in Table 7; it is these functions that should be managed/protected, as applicable.

For this project, the features fell into one of three categories: No Management Required, Conservation or Protection. Some adjustments were made to the classifications, because of the nature of these features (created when the property was filled). This was only completed where

the classification did not match the criteria in the guidelines and the changes are all discussed throughout the report and summarized in the table below. For instance HDF 4 and HDF 3b are connected but they terminate in a pond that is not connected to any other feature on or offsite. For these two features, the important value was the treed area offsite which will not be impacted.

It is noted that regardless of the management recommendation it is understood that the design of this development will achieve on-site water quality control equivalent to an "Enhanced" Level of Protection (i.e. minimum 80% long-term TSS removal), as required by the Conservation Authority. This will be accomplished through the creation of an infiltration berm. The only change will be to the Ponds and HDF 5 which needs to be relocated. While Feature 5 will be impacted, its functions will be protected (flow, fish habitat and some plantings). Further, the ponds are artificial and are currently creating a fish trap. To provide more stable and long-term benefits, it is recommended that this habitat be rehabilitated to provide more suitable fish habitat. Additional discussions on the rehabilitation of this feature will be had with SNC and DFO, through a separate process.

The standard mitigation measures for each recommendation as per the Guideline are provided in bullet for below.

1. **No Management Required**

The lack of water, and lack of sorting in **Feature 1a, 1b and 6** (swales) are the main reasons they received the No Management Required recommendation. This fits with the data collected during the site investigations. With the standing (few centimeters) to dry conditions in early April, as well as the poor grading of the swales, these did not contribute flow to downstream fish habitat and had little to no amphibian usage.

Feature 4 comes out as being recommended for Mitigation (lowest management option on this feature) only because of the presence of water. As such, the only function that has any value is the hydrology but, in this instance, this feature was isolated, and it does not contribute any flow to downstream habitats. Because of this, it should be downgraded to No Management Required.

2. **Conservation:**

Features 3b and the Road Ditch are recommended for conservation. These can be relocated but should be maintained and <u>where possible</u> the new alignment should consider natural channel design. The existing riparian value of the adjacent treed swamp will remain in place and there is no existing natural habitat on the site side.

Management Recommendations for Conservation listed in the Guidelines are:

- The channel may be maintained, relocated or enhanced. The hydrology contribution of the channel will be maintained through the stormwater system. The riparian habitat function will be compensation for with enhancement of amphibian habitat in the natural area now owned by the municipality north of Ninth Line Road (see details under Protection).
- The groundwater or wetland contribution is to be maintained or replicated. If the catchment drainage will be removed as part of the development then the function should be restored through enhancement of lot level control (i.e. restore original catchment using clean roof drainage), as feasible. This is important to ensure no negative impacts to downstream habitats.
- Maintain or replace on-site flows using mitigation measures and/or wetland creation, if necessary.
- Maintain or replace external flows
- Drainage feature must connect to downstream

3. **Protection:**

Features 2 and 5 area recommended for this designation. These features provide fish habitat and are situated adjacent to a natural treed area (lands offsite). Feature 2 will not be impacted by this project (it is mostly offsite). As discussed above, HDF 5 will be relocated but its functions will be protected and enhanced.

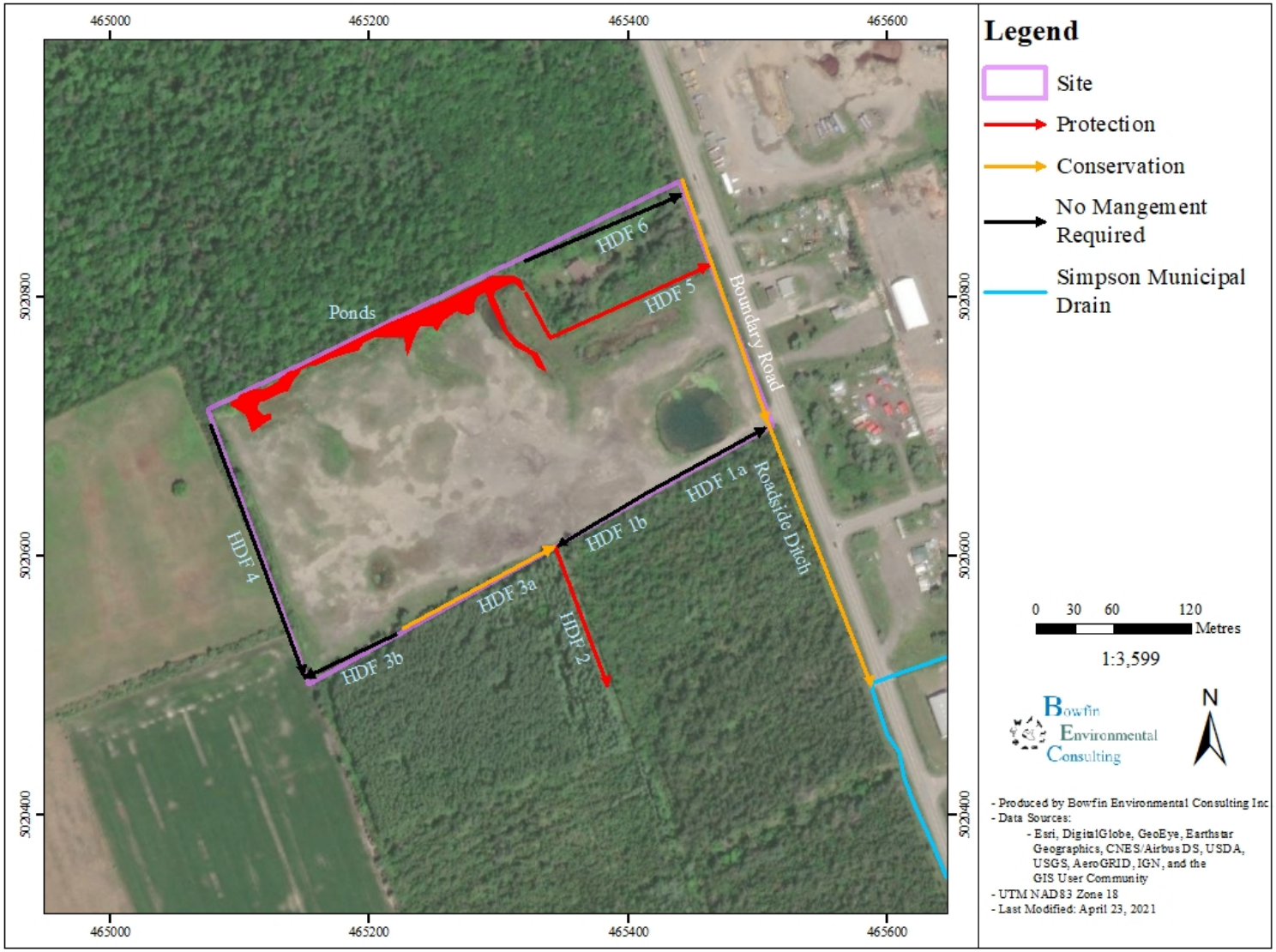
Management Recommendations for Protection listed in the Guidelines

1. Protect and/or enhance the existing feature and its riparian zone corridor.
2. Maintain hydroperiod
3. Incorporate shallow groundwater and base flow protection techniques
4. Use natural channel design techniques or wetland design to restore and enhance existing habitat features
5. Design and locate the stormwater management system

Table 7: Evaluation, Classification and Management Summary

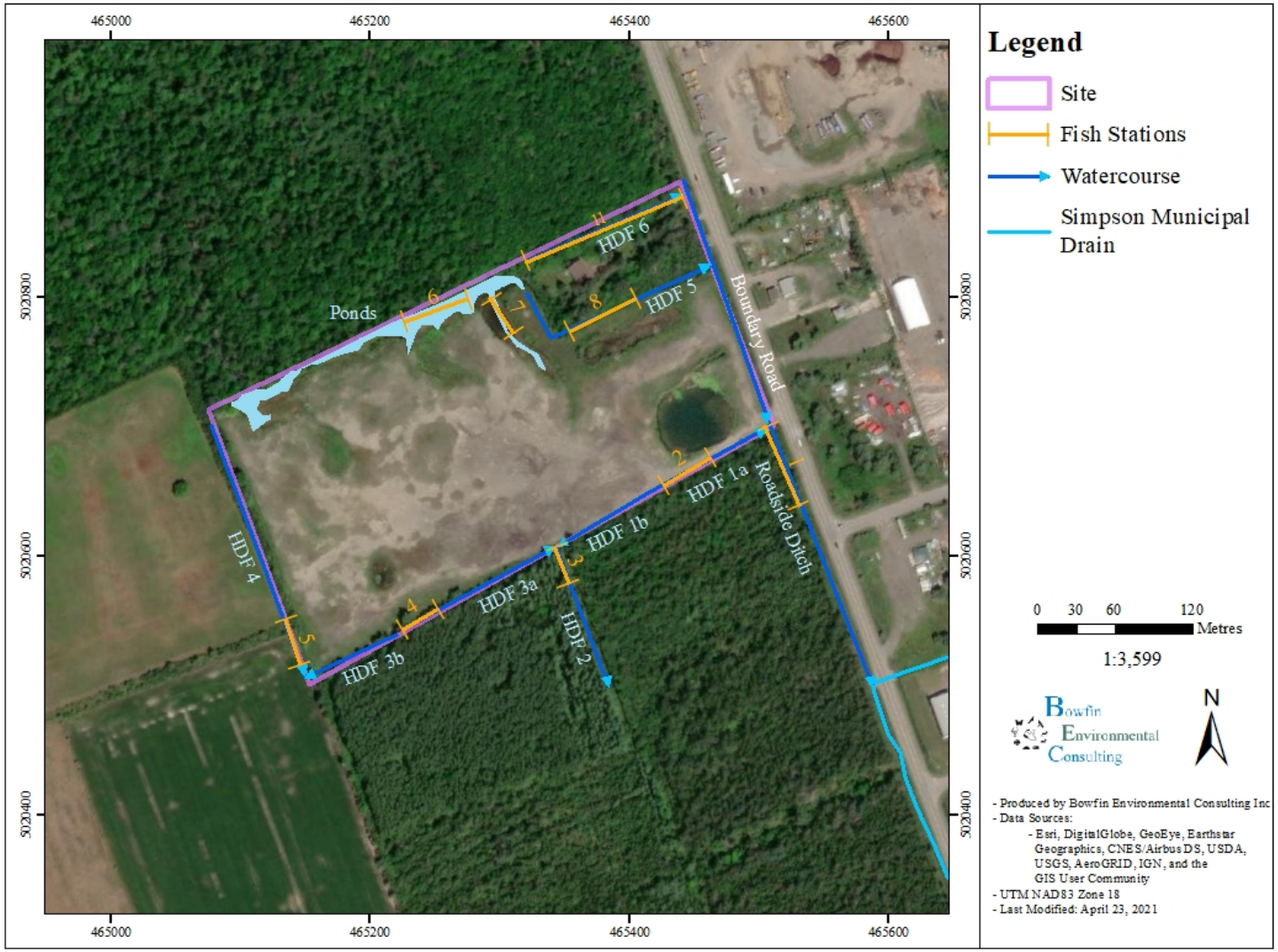
Drainage Feature Segment	Hydrology Classification	Riparian Classification	Fish and Fish Habitat Classification	Terrestrial Habitat Classification	Management Recommendation
Roadside Ditch	Valued	Limited	Valued	Limited	Conservation
HDF 1a	Limited	Important	Valued	Limited	No Management Required
HDF 1b	Limited	Important	Contributing	Limited	No Management Required
HDF 2	Valued	Important	Valued	Limited	Protection
HDF 3a	Valued	Important	Contributing	Limited	No Management Required (downgraded from Conservation because it is not connected to any other features (on or offsite) and the important value (vegetation) is offsite and will not be impacted)
HDF 3b	Contributing (lowered from Valued)	Important	Contributing	Limited	Conservation
HDF 4	Contributing (lowered from Valued)	Limited	Contributing	Limited	No Management Required (downgraded from Mitigation because it is not connected to any other feature on or offsite)
HDF 5	Valued	Important	Valued	Limited	Protection
HDF 6	Limited	Important	Contributing	Limited	No Management Required
Ponds	Valued (lowered from Important)	Important	Valued (lowered from Important)	Limited	Protection

Figure 6: Management Recommendations



Appendix A: Fish Habitat and Community Details

Figure A: Study Area and Sampling Sites



The entire site was flat, and the features did not flow, even during the early spring. All were poorly constructed, or simply the result of the on-site fill, resulting in gradient barriers. Because of this, some features were split to show which ones were connected to one another in terms of possible fish movement. A total of nine stations were established within the site boundaries (Figure), at least one for every feature present on site or in its adjacent lands (120 m).

Roadside Ditch (west side of Boundary Road – tributary to Simpson's Drain further downstream)

This is the west road ditch of Boundary Road. Roughly 200 m downstream of the site, this road ditch meets Simpson's Municipal Drain.

Station 1

Station 1 was located on Roadside Ditch and was 65 m in length. The average channel width was 1.2 m and the average bankfull height 19 cm. The average spring wetted width and depth were 1.1 m and 9 cm, respectively. The station was dry during the summer visit.

The substrate consisted primarily of fines and the stream morphology was a glide. The in-water cover throughout the station was provided mostly by aquatic vegetation (cattails and purple loosestrife), with some overhanging vegetation. The top of the banks was fully vegetated (purple loosestrife, Canada goldenrod, cow vetch, American hog-peanut, bird's-foot trefoil, glossy buckthorn, and narrow-leaved meadowsweet). There was some glossy buckthorn and trembling aspen on the west bank. Much of the station contained no or poor canopy cover.

During the April 7, 2020 visit, the station was electroshocked over an area of approximately 72 m^2 for 648 seconds. A total of 5 central mudminnow were captured (size range: 30 – 50 mm). The electrofishing effort was of 9 s/m^2. No sampling took place during the summer as the station was dry (July 29, 2020).

Photo 12: Roadside Ditch, upstream of station 1, looking downstream (July 29, 2020)

Feature 1 (southeast perimeter swale)

Feature 1 was the portion of the perimeter drain on the south side of the site, east of Feature 2. It was not graded properly and only the eastern 100 m was connected to the Roadside Ditch (1a). The remainder was mostly dry with a few pockets of very shallow water on April 7, 2020 (1b). There was no sorting of substrate

Station 2

Station 2 was located on feature 1a and was 40 m in length. The average channel width was 2.2 m and the average bankfull height 12 cm. The average spring wetted width and depth were 1.7 m and 11 cm, respectively. The station was dry during the summer visit.

The substrate consisted primarily of fines and the stream morphology was standing water. The in-water cover throughout the station was provided by aquatic vegetation (reed canary grasses, cut-leaved water horehound, lakebank sedge, purple loosestrife, smartweed, broad-leaved cattail, and cow vetch). The top of the banks was fully vegetated (reed canary grass, water horehound, lakebank sedge, purple loosestrife, smart weed, broad-leaved cattails, willow, speckled alder, and glossy buckthorn). Much of the station contained areas of no canopy cover on the north side but was entirely shaded by the dense woody vegetation on the south and inside the channel by the dense common reed.

The area was not fished in the spring because it was covered in snow and ice during the sampling visit. A few days later, when the water melted, it was confirmed to be connected to the Roadside

Ditch without any barriers to fish movement along the first 100 m. No sampling took place during the summer as the station was dry (July 29, 2020).

Photo 13: Feature 1a, upstream of station 2, looking downstream (July 29, 2020)

The remaining section (labelled as 1b) could direct flow towards feature 2 but it was already dry by April 7, 2020 and as such does not provide fish habitat (Photo 3).

Photo 14: Feature 1b, looking upstream from downstream (April 7, 2020)

Feature 2 (Offsite and connected to the north ditch of Mitch Owens Road to the south)

Feature 2 had a north to south direction and was situated entirely offsite but connected to the perimeter drain. The distance to Mitch Owens Road ditch was ±530 m.

Station 3

Station 3 was located on feature 2, ending at the perimeter ditch and was 30 m in length. The average channel width was 3.7 m and the average bankfull height 25 cm. The average spring wetted width and depth were 5.1 m and 28 cm, respectively. The station was dry during the summer visit. Portions of the channel were ice covered on April 7, 2020.

The substrate consisted primarily of fines and the stream morphology was standing water. The in-water cover consisted of leaf litter, and large and small woody debris. There was also overhanging vegetation providing some cover. The banks were fully vegetated with trees (red maple and green ash), shrubs (speckled alder and glossy buckthorn) and herbs (purple loosestrife, sensitive fern, broad-leaved cattail, narrow-leaved and tall meadowsweet, and lakebank sedge). Most of the station contained little to no canopy cover.

During the April 7, 2020 visit, the station was electroshocked over an area of approximately 153 m^2 (1274 seconds). The electrofishing effort was of 8 s/m^2. A total of 4 central mudminnow (size range: 28 – 100 mm) and 1 brook stickleback (45 mm) were captured. In addition, 3 central mudminnows were observed but not captured. No sampling took place during the summer as the station was dry (July 29, 2020)

Photo 15: Feature 2, upstream of station 3, looking downstream (July 24, 2020)

Feature 3 (Portion of 3a was connected to Feature 2; 3b to Feature 4)

Feature 3a ran along the southwest perimeter of the site and measured 130 m long. Approximately 20 m of the downstream portion of feature 3a was connected to feature 2 and is considered fish habitat. But gradient issues made it that the rest of the feature was not connected to any other watercourse, even during the early spring, making this portion an isolated waterbody that is not fish habitat.

Station 4

Station 4 was located on feature 3a, alongside the southeast perimeter of the site in the section that was not fish habitat. The station was 40 m in length. The average channel width was 2.6 m and the average bankfull height 15 cm. The station was dry during the summer visit.

The substrate consisted primarily of fines and the stream morphology was standing water. The in-water cover throughout the station was provided by overhanging vegetation, aquatic vegetation, and small wooded debris. The top of the banks was fully vegetated (speckled alder, glossy buckthorn, willow, lakebank sedge, sensitive fern, purple loosestrife, glossy buckthorn, grasses, and horsetail). The left bank was a treed swamp (willow, red maple). Much of the station had complete canopy cover.

The area was not sampled in the spring. Even during the first visit only the downstream 20 m was accessible to fish. The remaining 110 m is not considered fish habitat due to its lack of connectivity with feature 2. No sampling took place during the summer as the station was dry (July 29, 2020).

Photo 16: Feature 3a, upstream of station 4, looking downstream (July 24, 2020)

Feature 3b also ran along the southwest perimeter of the site and measured 80 m. This feature contained some water in the spring but was only connected to Feature 4. That feature was isolated from all fish bearing watercourses. No stations were created.

Photo 17: Feature 3b, downstream of station 4, looking upstream (May 17, 2020)

Feature 4 (Isolated)

Feature 4 was the west perimeter drain and measured 210 m long. The feature was not connected to any other watercourse as it flowed towards the southwest corner of the site where it ended in a ponded area. The lack of connections to other waterbodies, even during the spring, makes this an isolated waterbody that is not fish habitat.

Station 5

Station 5 was located on feature 4, alongside the west perimeter of the site, and was 50 m in length. The average channel width was 3.1 m and the average bankfull height 18 cm. The spring average wetted width and water depth was 2.1 m and 26 cm, respectively. The station was dry during the summer visit.

The substrate consisted primarily of fines and the stream morphology was standing water, with a few pools. The in-water cover throughout the station was provided by terrestrial and aquatic vegetation (purple loosestrife, reed canary grass, grasses, purple clover, bird's-foot trefoil, cow vetch, and willows). The top of the banks was fully vegetated (wild carrot, cow vetch, bird's-foot trefoil, sow thistle, glossy buckthorn, trembling aspen, willow, purple loosestrife). Much of the drain had no canopy cover but some had complete cover from the willows growing within the channel.

The area was not sampled in the spring as it was covered in snow. It was then found that it is not fish habitat due to its lack of connectivity with any other features.

Photo 18: Feature 4, downstream of Station 5, looking upstream (May 17, 2020)

Photo 19: Feature 4, downstream of station 5, looking upstream (July 29, 2020)

Feature 5 (connected to the Roadside Ditch)

Information was collected from within the ponded areas (stations 6 and 7) and from the ditched portion of this habitat (station 8). The entire feature was 450 m long and flowed into the Roadside Ditch.

Station 6 (upper pond along edge of forest)

Station 6 was located on the Ponds of Feature 5 and was 50 m in length. The average channel width was 7.6 m and the average bankfull height 23 cm. The spring wetted width and depth were 13.0 m and 50 cm, respectively, and the summer wetted width and depth were 4.1 m and 4 cm, respectively. During low water, this area becomes an area with isolated pools of shallow water, subjected to thermal impacts.

The substrate consisted primarily of fines and the stream morphology was a pool. The in-water cover consisted of aquatic vegetation (algae, water plantain, water plant, grasses, and softstem bulrush) and large woody debris. The banks were mostly vegetated (burweed, stonewort, Joe-pye-weed, wild carrot, sensitive fern, purple loosestrife, broad-leaved cattail, willow, and eastern cottonwood). The cottonwood was young (regenerating) and did not provide canopy cover. Most of the station contained little to no canopy cover.

This station was not sampled in the spring as it shared fish habitat with station 8 and is considered fish habitat (see species list from station 8). In the summer, this station was dip

netted. One central mudminnow (36 mm) and approximately 60 common shiners (size range: 15-30 mm) were captured. Several other small minnows were observed but not captured.

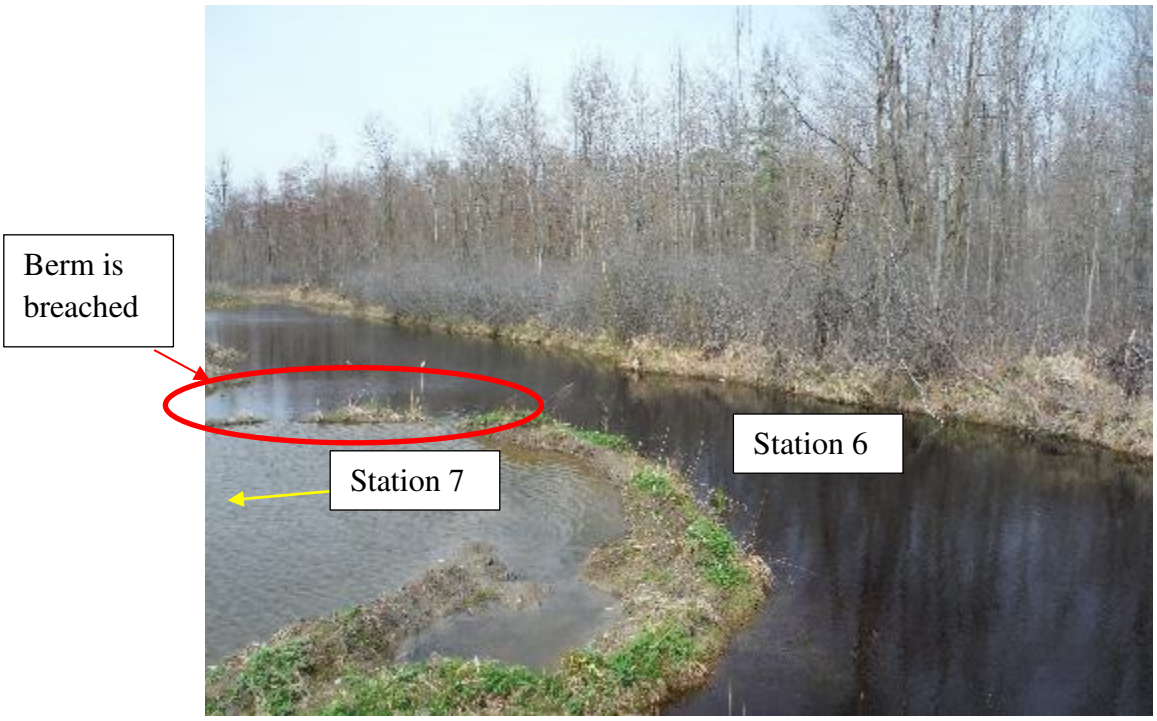


Photo 20: Feature 5 (upper ponds), downstream of station 6, looking upstream (May 17, 2020)

Photo 21: Feature 5 (upper ponds), downstream of station 6, looking upstream (July 24, 2020)

Station 7 (pond perpendicular to rest of feature)
The entire pond was 75 m in length and Station 7 was placed in the permanent habitat (northern 35 m). The average channel width was 10.9 m and the average bankfull height 46 cm. The spring wetted width and depth were 7.0 m and 80 cm, respectively. In the summer, the southern 44 m in length of the pond was dry. The remainder had a summer average wetted width and depths of 6.7 m and 33 cm, respectively. A seasonal barrier to fish movement was found on the northern edge of this pond. This berm was overtopped during the spring. In the summer, the soil berm created a seasonal barrier and was 49 cm high (Photo 20).

The substrate consisted of fines and the stream morphology was a pond. The in-water cover consisted of aquatic vegetation (softstem bulrush, narrow-leaved cattail, purple loosestrife, stonewort, common reed, water plantain, and woolgrass). The banks were mostly vegetated (willow, common reed, wild carrot, sensitive fern, common vetch, narrow-leaved cattails, and purple loosestrife). The station contained no canopy cover.

This station was not sampled in the spring as it shared fish habitat with station 8. The station was sampled in the summer using two hoop nets. Two central mudminnows (length 76 and 90 mm) and three pumpkinseeds (size range: 86 to 89 mm) were captured. A brook stickleback (approximately 15 mm in size) was observed in the water and a painted turtle was also captured in the nets.

Table 8: Feature 5 in the Ponds, Station 7 – Summer Catch

Species Name	Scientific Name	No. of fish (size range, mm) Spring
Central Mudminnow	*Umbra limi*	2 (76-90)
Brook Stickleback	*Culaea inconstans*	1 (15)
Pumpkinseed	*Lepomis gibbosus*	3 (86-89)
	Effort	**2 hoop nets**
	Total No. Species	**3**
	Total No. Individuals	**6**

Photo 22; Feature 5 (pond), downstream of station 7, looking south (July 24, 2020)

Station 8 (ditch)

Station 8 was located along the northeast perimeter and was 55 m in length. The average channel width was 2.0 m and the average bankfull height 18 cm. The spring average wetted width and water depth was 2.4 m and 17 cm, respectively. The station was dry in the summer.

The substrate consisted primarily of fines and the hydrological flow was a glide. The in-water cover consisted of aquatic vegetation (narrow-leaved cattail, and purple loosestrife). The top of the banks was mostly vegetated with grasses and shrubs (goldenrod, cow vetch, willows, Manitoba maple, and sensitive fern). Most of the station contained areas of good canopy cover.

During the April 7, 2020 visit, the station was electroshocked over an area of approximately 134 m^2 (819 seconds). The electrofishing effort was of 6 s/m^2. A total of 15 fish were captured, representing 3 species: central mudminnow, creek chub, and brook stickleback (Table 4). No sampling took place during the summer as the station was dry (July 29, 2020).

Table 9: Feature 5, Station 8 – Spring Catch

Species Name	Scientific Name	No. of fish (size range, mm) Spring
Central Mudminnow	*Umbra limi*	12

Species Name	Scientific Name	No. of fish (size range, mm) Spring
		(40 – 97)
Creek Chub	*Semotilus atromaculatus*	1 (105)
Brook Stickleback	*Culaea inconstans*	2 (48 – 53)
	Effort	**6 s/m^2**
	Total No. Species	**3**
	Total No. Individuals	**15**

Photo 23: Feature 5 (ditch), upstream of station 8, looking downstream (July 29, 2020)

Feature 8 (ephemeral swale, not fish habitat)

Information was collected from a shallow ephemeral swale without defined banks located north-east of the site, in the forest. There was no connection with the roadside ditch (there was a soil berm between this feature and the ditch, no exit location was found).

Station 11

Station 11 was in the woodlands north-east of the study area and was 120 m in length. The spring average wetted width and water depth was 1.4 m and 5 cm (range: 2-13 cm), respectively. The station has not been visited in the summer but would likely be dry.

Th substrate consisted primarily of soil (no sorting) and the hydrological flow consisted of standing water. The in-water cover consisted of leaf litter. The top of the banks was mostly vegetated with trees and shrubs. The station had good canopy cover overall.

During the April 13, 2021 visit, the station was fished using a dipnet over an area of approximately 120 m^2 (over 50 dipnets). No fish were seen or caught.

Photo 24: Downstream of the station, looking upstream (April 12, 2021)

Photo 25: Looking upstream at the soil berm separating the feature from the roadside ditch (April 12, 2021)

Appendix B: Amphibian Results Summary

HDF	Amphibian Station	Visit 1 April 29, 2020 (Species, #)		Visit 2 May 19, 2020 (Species, #)		Visit 3 June 16, 2020 (Species, #)	
		In feature	In adjacent habitat	In feature	In adjacent habitat	In feature	In adjacent habitat
Roadside Ditch	**4/5**	NONE	NONE	NONE	NONE	NONE	NONE
HDF 1	**5**	NONE	NONE	NONE	NONE	NONE	GRTR, 6 (Some possibly same as HDF 5)
HDF 1b	**2**	NONE	NONE	NONE	NONE	NONE	NONE
HDF 2	**2**	WOFR, 1	NONE	NONE	SPPE, 2	NONE	NONE
HDF 3	**2**	NONE	NONE	NONE	NONE	NONE	NONE
HDF 3b	**1**	NONE	AMTO, 1 SPPE, FC WOFR, 1	NONE	AMTO, 1 SPPE, 3	NONE	AMTO, 1 GRTR, 3
HDF 4	**1**	NONE	NONE	NONE	NONE	NONE	GRTR, 3
HDF 5	**4**	SPPE, 1	NONE	SPPE, 2	AMTO, 3 SPPE, 10	NONE	GRTR, 11 GRFR, 3
HDF 6	**4**	NONE	NONE	NONE	NONE	NONE	NONE
Ponds	**3**	SPPE, 2	SPPE, FC	NONE	SPPE, 5	GRTR, 1	GRTR, 5

AMTO – American Toad GRTR – Gray Treefrog GRFR – Green Frog SPPE – Spring Peeper WOFR – Wood Frog