DRAFT REPORT

105A Avenue Improvements: Whalley Boulevard to 144 Street

Environmental Impact Assessment

Prepared for:
Aplin & Martin Consultants Ltd.
201-12448 82nd Avenue
Surrey, BC V3W 3E9

Prepared by:
Hemmera Envirochem Inc.
18th Floor, 4730 Kingsway
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File: 1053-004.01
April 2017

HEMMERA

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April 21, 2017
File: 1053-004.01

Aplin & Martin Consultants Ltd.
201-12448 82nd Avenue
Surrey, BC V3W 3E9

Attn: Jeremy Hanson, P.Eng., Project Manager

Dear Jeremy,

Re: Draft Environmental Impact Assessment Report for 105A Avenue Improvements: Whalley Boulevard to 144 Street

Hemmera Envirochem Inc. (Hemmera) is pleased to provide you with a copy of the draft Environmental Impact Assessment Report for the 105A Avenue Improvements Project.

The enclosed draft report is provided for discussion purposes. As such, the report is not signed. Please review the report and provide Hemmera with comments and written revisions you feel are appropriate. Once comments and revision requests are received and reviewed, we will finalize the report and circulate signed copies.

We have appreciated the opportunity to work with you on this project and trust this report meets your requirements. Please feel free to contact the undersigned by phone or email regarding any questions or further information that you may require.

Regards,
Hemmera Envirochem Inc.

DRAFT

Trevor Welton R.P.Bio.
Project Manager
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1.0 INTRODUCTION

The City of Surrey is proposing improvements to 105A Avenue from Whalley Boulevard to 144 Street (**Figure 1**). The project is a component to the City's vision for City Centre and Light Rail Rapid Transit (LRT) on 104 Avenue, and part of a multi-phase program to improve the 105A Avenue corridor between 132 Street and 156 Street. The 105A Avenue widening and new road construction are planned to provide an alternate route to for vehicular traffic, local neighbourhood access and circulation, and a continuous cycling corridor to compensate for the anticipated reduced capacity along 104 Avenue. The proposed improvements will also address forecasted increases in local traffic volume (City of Surrey, 2016). Improvements will also include the relocation of the existing 104 Avenue water main to 105A Avenue, in order to facilitate LRT construction. The combined activities are referred to as the 105A Avenue Improvements project or "the Project".

At the request of Aplin & Martin Consultants Ltd. (Aplin Martin), Hemmera Envirochem Inc. (Hemmera) has prepared an Environmental Impact Assessment (EIA) that describes the scope of the Project and its potential effects on four environmental components:

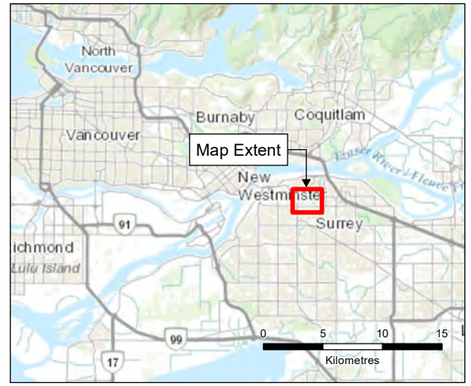
- Fish and fish habitat (including riparian areas);
- Vegetation;
- Wildlife and wildlife habitat; and
- Species at risk.

In support of this EIA, desktop review of available literature and other online resources was undertaken followed by site visits conducted on February 2 and February 14, 2017. For the purposes of this EIA, the study area is defined as the drainage ditches intersecting with the proposed 105A Avenue widening and new road section between Whalley Boulevard (to the east) and 144 Street (to the west), as well as fish and wildlife habitat located within Hawthorne Park, between 106A Avenue (to the north) and 104 Avenue (to the south; **Figure 1**). An expanded study area (an area of 1 km on either side of the proposed improvements) was specifically applied to the assessment of terrestrial species at risk.

Potential effects associated with the Project are described in this EIA, along with recommendations for site-specific mitigation measures to help avoid or minimize potential adverse impacts on these environmental components. Residual effects on these environmental components (following application of mitigation measures) were also assessed, including a determination of whether changes to local drainages will result in serious harm to fish that form part of a commercial, recreational, or Aboriginal (CRA) fishery consistent with provisions in the federal *Fisheries Act* (2012).

105A Ave. Improvements

Site Location



Legend

- Hawthorne Park
- Creeks and Rivers
- Roads

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Aerial Image: Surrey Open Data Source
- Inset Basemap: ESRI World Topographic Map

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Metres

NAD 1983 UTM Zone 10N

Page Size: 11" x 17"

1053-004.01	Production Date: Apr 20, 2017	Figure 1

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2.0 PROJECT SCOPE OF WORK

Hemmera has reviewed the Project Description and draft design drawing provided by the City of Surrey (November 29, 2016) and understands the scope of work for the Project is expected to include the following:

- 105A Avenue road widening/new road construction from Whalley Boulevard to 144 Street;
- 142 Street new road construction from 104 Avenue to 105A Avenue;
- Water main realignment on 105A Avenue from City Parkway to 144 Street; and
- Sewer main installation on City Parkway between 105 Ave to 106 Ave.

Figure 2 shows the proposed 105A Avenue alignment. The estimated total Project footprint, excluding work space areas required for use during construction, will be approximately 15,000 m^2.

105A Ave. Improvements

105A Alignment

Legend

- Project Alignment
- Project Alignment
- Road

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Road: City of Surrey

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2.1 DETAILED PROJECT DESCRIPTION

This section provides detailed information on each project component, based on the Project Description provided by the City of Surrey (November 29, 2016). Note: bolded text represents the project components that are expected to impact fish and fish habitat:

- 105A Avenue from Whalley Boulevard to 140 Street – Arterial Road Construction.
  - The road allowance will be 32.0 meters (m) width, and will include the following:
    - 6.3 m of pavement width for two general purpose travel lanes in each direction;
    - 3.3 m wide curbside and 3.0 m wide outside travel lanes;
    - 3.4 m wide raised landscaped median;
    - 2.0 m wide street tree utility strip;
    - 2.0 m wide asphalt one-way cycle tracks;
    - 2.0 m wide street tree planted buffer between cyclists and pedestrians; and
    - 2.0 m wide concrete sidewalks with consideration for asphalt path adjacent to the park.
- 105A Avenue from 140 Street to 144 Street & 142 Street – Modified Collector Road Construction.
  - The road allowance will be 24.0 m width, and will include the following:
    - 11.0 m of pavement width for two general purpose travel lanes in each direction;
    - 3.3 m wide travel lanes and 2.2m wide parking lanes;
    - 0.9 m wide buffer between cyclists and pedestrians;
    - 1.6 m wide asphalt one-way cycle tracks;
    - 2.0 m wide street tree utility strip; and
    - 2.0 m wide concrete sidewalks.
- Intersections and Crossings.
    - Existing and new intersections at: Whalley Boulevard, 137A, 138, 138A, 139, 140, 140B 142 and 144 Streets;
    - New Quibble Creek Greenway mid-block greenway crossing is anticipated to include two-stage movements with median protection;
    - ***A new crossing of Bon Accord Creek: an approximately 29 m long box culvert (1829 mm x 914 mm) installed at 0.72% grade and complete with fish baffles that are 310 mm high and spaced every 2.5 m. The culvert design, prepared by Aplin and Martin (2017), is provided in Appendix A. This culvert will have a conveyance capacity of 2.2 m^3/s with inlet control, and will be 80% full at the 100-year design flow of 1.4 m^3/s.***
    - ***The overall fill footprint at the Bon Accord Creek crossing for road construction purposes is approximately 89 m^2;***
    - ***The inlet and outlets of the box culvert will be fitted with a precast headwall complete with bolt on grills and riprap material will be placed for erosion protection purposes;***

- ***A new crossing of Hawthorne Creek Tributary: an approximately 29 m long culvert;***
- ***Relocation of 120 m of the Bon Accord Creek Tributary; and***
- ***Conversion of approximately 13,800 m2 of park area to paved road.***

- Water Main Extension.
  - New 600 mm/750 mm diameter trunk water main on 105A Avenue from City Parkway to 144 Street and along City Parkway, 140 Street, 144 Street from 104 Ave to 105A Ave for water main tie-in's.
- Sewer Main Extension.
  - Installation on City Parkway between 105 Avenue to 106 Avenue to replace the aging asbestos concrete sewer main and upsize it to a 250 mm diameter.

Note: FortisBC Energy Inc. (FortisBC) is twinning their transmission pressure gas main (Coastal Transmission System; CST) through the BC Hydro/Fortis Utility right-of-way (ROW) located adjacent to 140B Street (construction scheduled to commence in spring 2017 and reach completion in the spring 2018).

In addition, the property located at 14082 106 Ave. has been acquired by the City of Surrey. The unopened road allowance in this parcel will be closed, and the lot incorporated into Hawthorne Park.

2.2 PHASED APPROACH AND PRELIMINARY SCHEDULE

The City of Surrey anticipates delivering this Project in three separate tenders as follows (City of Surrey 2016):

Phase 1: Bon Accord Creek Culvert Crossing for 105A Avenue

The City envisions the Bon Accord Creek Culvert crossing will be constructed during the 2017 summer Fisheries Window (i.e., August 1st to September 15th), and the work being completed within 6 weeks.

Phase 2: 105A Avenue Water Main Relocation

Following the completion of Phase 1, the City anticipates undertaking the 105A Avenue Watermain Relocation work, commencing in January 2018, with work being completed within 25 weeks.

Phase 3: 105A Avenue Road Construction

The City anticipates constructing Phase 3 work in January 2019, with work being completed within 50 weeks.

3.0 METHODOLOGY

This section describes the methods and information sources utilized to gather data for each of the study components. For the purposes of this EIA, the study area is defined as the drainage ditches intersecting with the proposed 105A Avenue widening and new road section between Whalley Boulevard (to the east) and 144 Street (to the west), as well as potential fish and wildlife habitat located within Hawthorne Park, between 106A Avenue (to the north) and 104 Avenue (to the south; **Figure 1**). This study area encompasses the proposed road widening and new road construction area, and provides a suitable buffer zone for information-gathering purposes. An expanded study area (1 km) was specifically applied to species at risk for reasons described below in **Section 3.4**.

3.1 FISH AND FISH HABITAT

This section considers instream fish habitat and associated riparian fish habitat within the study area.

3.1.1 Fish Presence

Fish presence data were obtained from the BC Ministry of Environment's Fisheries Inventory Data Query (FIDQ) system (FIDQ 2017) and online mapping system (iMap BC 2017).

3.1.2 Fish Habitat Classification and Characterization

Fish habitat classifications for watercourses within the study area were initially identified through desktop review using the City of Surrey Mapping Online System (COSMOS). The City of Surrey maintains a Watercourse Classification Map for all city watercourses (including ditches), based on their value as habitat for salmonids and regionally-significant fish, as described below in **Table 1**.

Table 1 City of Surrey's Watercourse Classification System

Classification	Definition
A (Red)	Inhabited by salmonids year-round or potentially inhabited year-round with access enhancement.
B (Yellow)	No fish present. Significant food/nutrient contribution.
C (Green)	No fish present. Insignificant food/nutrient contribution.

A field assessment was conducted on February 2, 2017 by Hemmera biologists to ground-truth the findings of the desktop study. Site-specific data were collected on drainage channel width and morphology, evidence of flow/scour, connectivity, fish habitat value, and riparian integrity and value. *In situ* water quality data (i.e., temperature, pH, conductivity, and dissolved oxygen) were also collected to complement visual observations. Survey methods followed standards and procedures prescribed in the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory* (Resources Information Standards Committee; RISC 2001).

3.2 VEGETATION

A variety of vegetation types and species, including invasive plants, have the potential to be present within the study area. Information was gathered from the following sources:

- On-line databases (BC Conservation Data Centre (CDC), Committee on the Status of Wildlife in Canada (COSEWIC), eFlora);
- Review of available ortho-imagery (Google Earth, City of Surrey WebMap (COSMOS)); and
- Background documents and previous reports (Pojar, Klinka, and Demarchi 1991).

3.3 WILDLIFE AND WILDLIFE HABITAT

Several species of wildlife have the potential to use habitats within the study area. Methods used to determine potential wildlife species occurring in the study area and to better understand potential wildlife habitat values included:

- On-line databases (BC CDC, COSEWIC, Wildlife Tree Stewardship (WiTS), eFauna); and
- City of Surrey WebMap (COSMOS).

3.4 SPECIES AT RISK

Information related to provincially or federally listed species at risk with the potential to be present within the study area was gathered from a review of known species at risk occurrences through iMap BC.

The study area for species at risk desktop-based searches was expanded to an area of 1 km on either side of the Project alignment. This expanded study area was considered sufficiently large to capture recorded occurrences of species at risk, especially mobile species (such as birds and fish) and plant species that may have expanded their range since last detection.

4.0 EXISTING SITE CONDITIONS

This section provides the results of the desktop and field assessment activities, and describes relevant environmental resources and constraints that were identified. The proposed Project is located at the north end of the City of Surrey, partly within a Single Family Residential Zone and partly within the boundaries of Hawthorne Park, which is a designated community park. It also intersects two Sensitive Ecosystems Development Permit Areas: a *Green Infrastructure Area*, which includes the BC Hydro ROW and Hawthorne Park, and a *Streamside Area*, which includes Hawthorne and Bon Accord creeks (CoS 2017; **Figure 3**). The study area has been impacted or influenced to varying degrees by roadways and residential developments; however, remnant forest patches and riparian areas are present within the study area, and existing conditions support a range of habitats for fish, vegetation, and wildlife species. These habitats and their respective assessed values are described below.

4.1 FISH AND FISH HABITAT

Watercourses within the study area consist of Class C and B roadside ditches (on the west side of the study area), and two Class A streams flowing through Hawthorne Park (as per classification in **Table 1**; **Figure 3**). The Class C roadside ditches (located between King George Boulevard and 139 Street) lie within the Quibble Creek Catchment, which drains south into the Serpentine River (COS 2017). Hawthorne Creek, Bon Accord Creek and their respective tributaries lie within the Bon Accord Catchment, which drains north into the Fraser River. Watercourses in the study area are listed in **Table 2** and further described (from west to east) in sections below. *In situ* water quality collected during the survey is summarised in **Section 4.1.5**.

4.1.1 Class C Ditches

The Project intersects with Class C roadside ditches along 105A Avenue (between Whalley Boulevard and 138 Street), as well as at 138A Street and 139 Street (**Figure 3**); these ditches are not classified as fish habitat as defined by the federal *Fisheries Act*, but are consisted “streams” per the definition in the provincial *Water Sustainability Act*. seasonally provide a source of flow to Quibble Creek (approximately 1.2 km south). The ditches were approximately 1 m in channel width; all had water (0.3 to 0.5 m wetted width), with limited flow observed (**Appendix B-1**, **Photo 1** and **Photo 2**). Substrate was dominated by fine sediment, with pockets of small gravel and organic materials (i.e., leaf litter); sections of the ditches were overgrown with grasses. Adjacent vegetation was limited to grass, with the occasional small shrub.

105A Ave. Improvements

Natural Areas and Riparian Setbacks

Legend

- Project Alignment

City of Surrey Watercourse Classification

- A: Watercourse inhabited by fish year round
- AO: Watercourse inhabited by fish during the overwintering period
- B: Non-fish-bearing watercourse but contributes or potentially contributes significant food/nutrient inputs to downstream fish populations
- C: Non-fish-bearing watercourse that does not contribute significant food/nutrient value to downstream fish populations
- UN: Unknown
- Park
- Green Infrastructure Area
- Riparian Setback
- 30m Setback

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Project Alignment: Aplin & Martin Consultants Ltd.
- Watercourse Classification: City of Surrey
- Aerial Image: ESRI World Imagery
- Inset Basemap: ESRI World Topographic Map

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Table 2 Overview of Watercourses within the Study Area (west to east)

Watercourse Name	Current COSMOS Classification	General Description	Channel Dimensions/ Morphology	Vegetation	Connectivity
105A Ave ditch at Whalley Blvd	C	Roadside ditch along south side of 105A Ave	Average channel width ~ 1 m and bankfull depth ~ 0.4 m	Mowed roadside shoulder and uncut grass	Drains west, possibly into Quibble Creek
138A St ditches	C	Roadside ditches along both sides of 138A Street	Average channel width ~ 1 m and bankfull depth ~ 0.4 m	Mowed roadside shoulder and uncut grass	Drains south, possibly into Quibble Creek
139 St ditches	C	Roadside ditches along both sides of 139 Street	Average channel width ~ 1 m and bankfull depth ~ 0.4 m	Mowed roadside shoulder and uncut grass, with intermittent shrub/ hedgerow	Drains south, possibly into Quibble Creek
Hawthorne Creek at BC Hydro ROW (west of 140B Street)	B	Channel crosses the BC Hydro ROW. Field classification was Class A due to the presence of flow and unrestricted access to Hawthorne Creek channel downstream	Average channel and wetted widths are 1.5 m and 0.9 m, 0.5 m bankfull depth	Shrubs (possibly hardhack, *Spiraea douglasii*) and mowed Himalayan blackberry (*Rubus armeniacus*)	Drains east into Class A section of Hawthorne Creek
Tributary of Hawthorne Creek	B	Drainage ditch along east side of BC Hydro ROW and west side of 140B St	Average channel and wetted widths are 1.5 m and 0.9 m, 0.5 m bankfull depth	Young and mature red alder (*Alnus rubra*), hardhack and Himalayan blackberry	Drains north into Class A section of Hawthorne Creek
Hawthorne Creek along 106 Ave	A	Small drainage along south side of 106 Ave	Average channel and wetted widths are 3.7 m and 2.9 m, 0.35 m bankfull depth and 0.10 residual pool depth	Young and mature red alder, and shrubs	Drains east into Bon Accord Lake East
Bon Accord Lake East	A	Two ponds (likely man-made) connected by two pipes	West pond area ~ 2,500 m^2, East pond area ~ 5,300 m^2	Young and mature red alder, and shrubs	Drains east into Bon Accord Creek
Bon Accord Creek upstream reach	A	Small creek flowing south-north across Hawthorne Park	Average channel and wetted widths are 1.5 m and 0.9 m, 0.5 m bankfull depth	Young and mature red alder, and shrubs	Drains north into Bon Accord Lake East
Tributary of Bon Accord Creek	A	Drainage ditch at the south end of Hawthorne Park, tributary of Bon Accord Creek	Average channel width ~ 1 m and bankfull depth ~ 0.4 m	Young and mature red alder, and shrubs	Drains west into Bon Accord Creek
Bon Accord Creek downstream reach	A	Small creek flowing north at the northeast boundary of Hawthorne Park	Average channel and wetted widths are 1.5 m and 0.9 m, 0.5 m bankfull depth	Young and mature red alder, and shrubs	Drains north (3 km) into Fraser River

4.1.2 Hawthorne Creek and Tributary

Hawthorn Creek (unmapped in iMap BC) is a low gradient (0.5% to 1%), watercourse fed by discharge from municipal stormwater drainage mains along 140 Street (flowing from the south), and by a Class B ditch along the west side of 140B Street. It flows northeast and drains into Bon Accord Lake East. A description of the Class B and Class A sections of this creek are provided below.

4.1.2.1 Hawthorne Creek – BC Hydro Right of Way

This upstream-most section of Hawthorne Creek flows from the culvert outlet west of 140 Street east across the existing BC Hydro and FortisBC ROWs for approximately 75 m to 140B Street (**Figure 3**; **Appendix B-1**, **Photo 3**), at which point it turns north at the 105A Avenue alignment and connects to the Hawthorne Creek Tributary (**Section 4.1.2.2**) and Hawthorne Creek (**Section 4.1.2.3**).

The average channel and wetted widths were 1.5 m and 0.9 m, respectively, with a bankfull depth of 0.5 m. Substrate was dominated by fine sediment (i.e., mainly silt) and organic debris (i.e., leaf litter). Vegetation within the ROW is actively managed; therefore, the riparian vegetation was limited to shrubs: possibly hardhack (*Spiraea douglasii*) and mowed Himalayan blackberry (*Rubus armeniacus*). A concrete culvert (0.60 m in diameter) was located at the pedestrian trail that runs along the ROW (**Appendix B-1, Photo 4**).

This section of channel is currently listed as a Class B watercourse (COSMOS 2017). Although no fish sampling was conducted during the survey and no fish were seen, the conditions observed along this section of the watercourse suggest a Class A classification, as no barriers to fish passage were observed. Overall, the habitat value for fish associated with this section of Hawthorne Creek were considered “low”, as a result of limited (if any) spawning habitat, minimal structural or depth complexity present and low flow.

4.1.2.2 Hawthorne Creek –Tributary

This ditch is approximately 165 m long and is located between 140B Street and the FortisBC ROW. This ditch joins Hawthorne Creek where it turns north at approximately the 105A Avenue alignment (**Figure 3**).

Average channel and wetted widths were 1.5 m and 0.9 m, respectively, with a bankfull depth of 0.15 m (**Appendix B-1, Photo 5**). Substrate was dominated by fine sediment and organic debris. The channel was largely filled with emergent vegetation. The ditch narrows and becomes overgrown approximately 100 m upstream from its confluence with Hawthorne Creek. Riparian vegetation was limited to Himalayan blackberry on the left bank, and red alder (*Alnus rubra*), hardhack and Himalayan blackberry on the right bank. Abundant anthropogenic debris was observed along the channel. Limited flow was observed. Flow is likely dependent overland drainage from the surrounding area.

This tributary is classified as a Class B watercourse in COSMOS (2017). This classification was confirmed in the field. The fish habitat value (in terms of food and nutrient contribution) associated with this tributary was “low”.

4.1.2.3 Hawthorne Creek – North of 105A Avenue Alignment

This section of Hawthorne Creek flows north (from the 105A Ave alignment) along the west side of 140B Street for 85 m before flowing east along the south side of 106 Avenue for approximately 270 m before discharging into Bon Accord Lake East (**Figure 3**).

Average channel and wetted widths in this section of Hawthorne Creek were 3.7 m and 2.9 m, respectively, with a bankfull depth 0.35 m and average residual depth of 0.10 m (**Appendix B-1, Photo 6** and **Photo 7**). Substrate was dominated by fine sediment and organic debris (i.e., leaf litter), with pockets of sand and small gravel in the vicinity of the culvert at 141 Street. Low flow (unmeasured) was observed. Limited cover (i.e., less than 5% of the channel; RISC 2001) observed in terms of over-stream vegetation, small woody debris and undercut banks. Riparian vegetation consisted almost entirely in red alders (various stages) and shrubs. Seven culverts were observed along this section of Hawthorne Creek: all but one were on the left bank (contributing stormwater drainage from mains along 106 Avenue, and 141, 141A and 142 streets (**Figure 3**). Most of these culverts were concrete pipes (0.6 m in diameter) with concrete headwalls, and had limited flow at the time of the survey (**Appendix B-1, Photo 8**). Fish species with the potential to be present in Hawthorne Creek are discussed in **Section 3.1.1**.

This section of Hawthorne Creek is identified as a Class A watercourse in COSMOS (2017). No fish were observed; however, the apparent absence of any barriers to fish movement upstream to this section suggests the classification is appropriate. The habitat value to fish associated with this tributary was “low” as a result of limited spawning habitat, minimal structural or depth complexity present and low flow.

4.1.3 Bon Accord Lake East (Ponds)

Bon Accord Lake East comprises two ponds, centrally located in Hawthorne Park (**Figure 3**; **Appendix B-1, Photo 9**, **10** and **11**). Based on historical images dating back to August 1998, the two ponds appeared dry until 2001 (Google Earth 2017); the origin is believed to be man-made at some point in 1999 (COS 2017).

Water flows from the west pond into the east pond via two 1,200 mm corrugate metal pipes or CMPs (COS 2017; **Figure 3**). According to COSMOS, the west and east ponds have an area of approximately 2,500 m^2 and 5,300 m^2, respectively. At the time of the survey, both ponds were almost entirely covered by ice. Several mallard ducks (*Anas platyrhynchos*), a pair of hooded mergansers (*Lophodytes cucullatus*) and a single great blue heron (*Ardea herodias*) were seen on the east pond (**Appendix B-1, Photo 9**).

There are no documented records of fish presence in Bon Accord Lake East (iMap BC 2017); however, a local resident encountered during the survey affirmed he had caught (via angling) coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), carp (*Cyprinus* sp.) and black catfish (*Ameiuru melas*) in the east pond. He also mentioned seeing threespine stickleback (*Gasterosteus aculeatus*) and goldfish (*Carassius auratus*) in the pond.

In the absence of information to the contrary, Bon Accord Lake East is considered fish-bearing, consistent with the COSMOS (2017) classification (Class A). Provided the water quality remains acceptable, the two ponds likely provide rearing and over-wintering habitats for salmonids in Bon Accord Creek and Hawthorne Creek. The ponds likely represent "low to moderate" value fish habitat, based on the observed characteristics (depth was not assessed).

4.1.4 Bon Accord Creek and Tributary

Bon Accord Creek (un-gazetted watercourse; WC 100-024200) is classified as a Class A fish habitat (COS 2017). This low gradient (0.5% to 1%) creek begins at 104 Avenue; it is fed by water flowing north through municipal stormwater drainage mains along 104 Avenue, and one that flows underneath Hawthorne Park and joins the creek at the south path crossing (**Figure 3**). The creek flows north approximately 330 m through Hawthorne Park before it drains into Bon Accord Lake East, then continues north for approximately 3 km before joining the Fraser River.

4.1.4.1 Bon Accord Creek - Upstream Reach

The upstream reach of Bon Accord Creek (i.e., upstream, or south of Bon Accord Lake East) is approximately 330 m long (to 104 Avenue) (**Figure 3**; **Appendix B-1, Photo 12** and **Photo 13**). Two trails currently intersect this reach: one approximately 20 m upstream of the lake (crossing consists of a wooden bridge); and the second is 150 m upstream of the lake (crossing consists of a 1400 mm CMP). A drainage pipe and retention wall were located on the creek's right bank, approximately 160 m upstream of the lake.

Average channel and wetted widths in this reach were 3.7 m and 2.4 m, respectively, with a bankfull depth of 0.57 m and average residual depth of 0.24 m. Substrate was dominated by fine sediment (mainly silt) and organic debris (i.e., leaf litter), with pockets of sand in the upper 100 m of the creek. Low flow was observed, along with iron deposits (indicating buried organics nearby) and residue on the water surface (**Appendix B-1, Photo 14**). Moderate cover (i.e., 5% to 20% of the channel; RISC 2001) was provided mainly by over-stream vegetation and small woody debris, with occasional undercut banks and deep pools. Riparian vegetation consisted mainly in red alders (various stages), shrubs and ferns, with a few conifers.

No fish were observed during the survey of Bon Accord Creek, and no record of fish presence was available in the vicinity of the study area. Coastal cutthroat trout, coho salmon (*O. kisutch*) and threespine stickleback have been documented within the lower 500 m of Bon Accord and East Bon Accord creeks (iMap BC 2017). A coastal cutthroat trout was also observed in 1994 at a location approximately 2 km north of the Project site; no other record of fish presence has been found. Three obstacles (not necessarily barriers) to fish passage have been documented in the past: two culverts (at 800 m and 1.2 km upstream of the creek's mouth), and a dam (at 1 km from the mouth). In the absence of information to the contrary, based on the COSMOS classification and the anecdotal report provided by a local resident (**Section 4.1.3**), the section of Bon Accord Creek in the study area is considered potentially fish-bearing; therefore, the current Class A status was maintained for this report. Overall, this surveyed reach of Bon Accord Creek represented "moderate" value fish habitat, with no observed spawning gravel, high occurrence of fine sediment, and low water levels, but also with some deep pools and moderate cover and complexity.

4.1.4.2 Bon Accord Creek - Tributary

This drainage ditch is approximately 120 m long and is located along the south boundary of Hawthorne Park. This tributary joins Bon Accord Creek approximately 90 m north of 104 Avenue (Figure **3**). Average channel and wetted widths were 1.4 m and 0.75 m, respectively, with a bankfull depth of 0.15 m (**Appendix B-1, Photo 15**). Substrate was dominated by fine sediment and organic debris. Limited flow was observed at the time of the survey, and iron precipitate was observed. Riparian vegetation consisted mainly of Himalayan blackberry and red alder.

There was no evidence to dispute the current Class A designation for this watercourse; although, the habitat value to fish was determined to be “low”, as a result of the lack of complexity and low flow.

4.1.4.3 Bon Accord Creek - Downstream Reach

This section of Bon Accord Creek is downstream (or north) of outfall from Bon Accord Lake East approximately 3 km north to its confluence with the Fraser River (**Figure 3**). Only the upstream-most 50 m of this section were surveyed for this assessment. A park trail crosses over the creek at the lake outlet via a wooden bridge (**Appendix B-1, Photo 16**). A debris rack and concrete apron form part of the bridge structure and likely represent an obstacle to fish passage, except during periods of high water level when fish passage may be possible (**Appendix B-1, Photo 16** and **Photo 17**).

Average channel and wetted widths in the downstream reach were 3.7 m and 3.4 m, respectively, with a bankfull depth of 0.40 m and average residual depth of 0.16 m (**Appendix B-1, Photo 18**). Substrate was dominated by fine sediment and organic debris. Low flow was observed. Moderate cover was provided mainly by overstream vegetation and small woody debris, with the occasional large woody debris. Riparian vegetation consisted mainly in red alders (various stages), shrubs and a few western redcedar (*Thuja plicata*).

Overall, this surveyed reach of Bon Accord Creek represented “moderate” value fish habitat, with limited observed spawning gravel, high occurrence of fine sediment, and low water levels, but also with some deep pools and moderate cover and complexity.

4.1.5 *In Situ* Water Quality

In situ water quality measurements were collected at various (representative) sites throughout the study area. Temperature, pH, conductivity, and dissolved oxygen values were similar among sites. All pH and dissolved oxygen values fell within their respective range of recommended values for the protection of freshwater life (CCME, 2007; MoE, 2017).

Table 3 *In Situ* Water Quality Data

Sampling Station	Temperature (°C)	pH	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity
Hawthorne Creek at ROW	4.3	6.85	623	9.2	Moderate
Hawthorne Creek at wooden bridge	5.6	7.07	403	10.6	Low
Hawthorne Creek at confluence with Bon Accord Lake (west pond)	5.6	6.84	380	10.1	Low
Bon Accord Creek upstream of Lake, at wooden bridge[1]	5.6	6.91	471	9.4	Low
Bon Accord Creek upstream of Lake, downstream of trail culvert	5.8	6.91	487	10.2	Moderate
Bon Accord Creek upstream of Lake, upstream of trail culvert	5.8	6.81	448	9.97	Moderate
Bon Accord Creek downstream of Lake	4.6	6.93	432	9.04	Low

Note: [1] The lakes were frozen at the time of assessment, therefore no water quality samples were taken

4.2 VEGETATION

The study area is located in the Coastal Western Hemlock Very Dry Maritime Eastern subzone (CWHxm1) (Pojar, Klinka, and Demarchi 1991). Much of the study area is comprised of municipal park and residential areas. Vegetated areas within the residential areas are comprised mainly of lawns, gardens, and street trees. The Project intersects vegetated areas in the BC Hydro ROW and Hawthorne Park.

The BC Hydro ROW (*Green Infrastructure Area)* is comprised mainly of grasses and low shrubs, which are likely regularly maintained as part of an ongoing vegetation maintenance program. A paved walking path runs the length of the ROW. The ROW is immediately adjacent to Hawthorne Park (**Appendix B-2, photo 1**).

Hawthorne Park represents a remnant patch of young, second growth, deciduous forest. Vegetation within the park is representative of rich, moist soils, and young, second-growth deciduous and mixed forest. The north and west portions of the park are deciduous-dominated including black cottonwood (*Populus balsamifera*), and red alder with a dense understorey of shrubs (**Appendix B-2, Photo 2 and 3**). The southern portion of the park has a mixed forest with alder, cottonwood, western hemlock (*Tsuga heterophylla*), and occasional western redcedar and Douglas-fir (*Pseudotsuga menziesii*) (**Appendix B-2, Photo 4**). Understory in these forested areas is a mix of native shrub species including salmonberry (*Rubus spectabilis*), thimbleberry (*R. parviflorus)*, red huckleberry (*Vaccinium parvifolium*), sword fern (*Polystichum munitum*), and hardhack.

Several weedy and invasive herbaceous species are also present in the study area including Himalayan blackberry, cherry laurel (*Prunus laurocerasus*), reed canary grass (*Phalaris arundinaceae*); and buttercup (*Ranunculus* sp.).

4.3 WILDLIFE AND WILDLIFE HABITAT

Commercial, residential and park development have removed much of the historic tree cover within the study area, replacing it with grasses and shrubs. Nevertheless, the ecosystems within Hawthorne Park represent potential habitat for a variety of wildlife species. Hawthorne Park is connected to the BC Hydro ROW Green Infrastructure Network (GIN) corridor, a feature that provides contiguous habitat connectivity for wildlife movement and seed dispersal between hubs (intact sites of naturally-functioning ecosystems) and other parts of the GIN. The corridor been assigned an ecological value of "moderate" by the City of Surrey (COS 2017), and connects Hawthorne Park to Green Timbers Park to the south and Invergarry Park to the north. Habitat values associated with the study area for birds, mammals, and amphibians/reptiles are discussed below.

Birds

Suitable songbird nesting habitat is available throughout the forested areas of the study area, as well as in several of the hedges and ornamental trees found on residential properties within the study area. Several songbirds were observed in the study area including American robin (*Turdus migratorius*), dark-eyed junco (*Junco hyemalis*), song sparrow (*Melospiza melodia*), and black-capped chickadee (*Poecile atricapillus*). The BC Hydro ROW represents suitable foraging habitat for several species of birds, including raptors such as owls and hawks, which may hunt for small mammals along the ROW. No bald eagle (*Haliacetus leucocepehalus*) or osprey (*Pandion haliaetus*) nests are recorded by the WiTS (2017) within the study area, however a large stick nest, likely a red-tailed hawk (*Buteo jamaicensis*), was noted on the west side of the park at the north end of 104 B Street within a cottonwood tree (**Figure 4, Appendix B-2, photo 5**).

Figure 4 Location of Stick Nest

Mammals

Given the presence of residential land use within the study area, the mammal species present are likely to be common and widespread species suited to developed habitats, including, but not limited to invertebrates, amphibians, songbirds, raptors, and mammals, such as small rodents, bats, raccoons (*Procyon lotor*), black-tailed deer (*Odocoileus hemionus columbianus*), and coyotes (*Canis latrans*). No wildlife sign was noted in the study area.

Amphibians and Reptiles

Outside of the breeding season (early spring to early summer), amphibians (including frogs, toads, and salamanders) have potential to occur within wooded areas and riparian areas associated with watercourses in the study area. Suitable breeding habitat for amphibians within the study area is limited to the ponds on Bon Accord Creek in the centre of the park, as well as the slow-moving sections of watercourses in the study area. Invasive species such as bullfrog (*Rana catesbeiana*) and green frog (*R. clamitans*) species, which are both considered to be tolerant of human disturbance and low water quality, may be present in

several of the ditches within the study area when wetted. Native species such as northern Pacific chorus frog (*Pseudacris regilla*) may also be present in the ponds and some of the wider ditch areas. Northern red-legged frogs (*R. aurora*) and western toad (*Anaxyrus boreas*) have low to moderate potential to occur in the ponds in the park.

Reptiles that have potential to occur on-site include garter snakes (*Thamnophis spp.),* which may use open habitat and grassy areas in the ROW for basking. Red-eared sliders (*Trachemys scripta elegans*) and western painted turtles (*Chrysemys picta*) may potentially occur in the ponds on Bon Accord Creek.

4.4 SPECIES AT RISK

Based on data available from iMap (2017) no species at risk have been recorded within 1 km of the study area. A masked occurrence is noted overlapping with the study area. A request for record specific data was submitted to the CDC, however, neither the occurrence nor suitable habitat overlaps with the study area.

Several fish and wildlife species at risk have the potential to occur in or in close proximity to the study area, including one species of fish, seven species of birds, two species of mammals, and two species of amphibian and one species of reptile. These species, along with their expected potential to occur in the study area, are presented below in **Table 4**.

Table 4 Wildlife Species at Risk with Potential to Occur in the Study Area

Scientific Name	English Name	COSEWIC[1]	BC List[2]	SARA[3]	Potential to Occur in the Study Area
Fish					
Oncorhynchus clarkii clarkii	Cutthroat trout, clarkii subspecies	-	Blue	-	Moderate - in Class A watercourses only
Birds					
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	SC (Mar 2008)	Blue	1-SC (Feb 2010)	High - foraging only, especially within the ROW
Buteo lagopus	Rough-legged Hawk	NAR (May 1995)	Blue	--	Moderate – foraging only
Chordeiles minor	Common Nighthawk	T (2007)	Yellow	1-T (2010)	Low – foraging and potential nesting in grassy fields
Ardea herodias fannini	Great Blue Heron, fannini subspecies	SC (Mar 2008)	Blue	1- SC (Feb 2010)	Low- potential foraging
Hirundo rustica	Barn Swallow	T (May 2011)	Blue	--	High – possible nesting in buildings and foraging in study area
Patagioenas fasciata	Band-tailed Pigeon	SC (Nov 2008)	Blue	1-SC (Feb 2011)	High – foraging in fields and potential nesting in forested areas

Scientific Name	English Name	COSEWIC[1]	BC List[2]	SARA[3]	Potential to Occur in the Study Area
Tyto alba	Barn Owl	T (Nov 2010)	Red	1-SC (Jun 2003)	Moderate – possible nesting nearby and foraging in ROW
Mammals					
Corynorhinus townsendii	Townsend's Big-eared Bat	--	Blue	--	Low – roosting in surrounding buildings
Myotis lucifugus	Little Brown Myotis	E (2013)	Yellow	1-E (Dec 2014)	High - roosting in surrounding buildings
Amphibians and Reptiles					
Anaxyrus boreas	Western Toad	SC (2012)	Blue	1-SC (2005)	Moderate – limited breeding habitat potential (impacted poor water quality and invasive species). Adults may be present in riparian/terrestrial areas outside of the breeding season.
Rana aurora	Northern Red-legged Frog	SC (Nov 2004)	Blue	1-SC (Jan 2005)	Moderate – low breeding habitat potential (impacted poor water quality and invasive species). Adults may be present in riparian/terrestrial areas outside of the breeding season.
Chrysemys picta	Western Painted Turtle	T (Nov 2006)	Red	1-E (Dec 2007)	Moderate- potential suitable overwintering habitat and suitable basking sites within Bon Accords Lake East
Invertebrates					
Danaus plexippus	Monarch	SC (2010)	Blue	1-SC (2003)	Low – not known from area

Note: [1] COSEWIC listing: E = Endangered, T = Threatened, SC = Special Concern

[2] BC List: Red = Species that are extirpated, endangered, or threatened; Blue = Species of special concern; Yellow = species and ecological communities that are secure.

[3] SARA listing: 1 = schedule 1, E = Endangered, T = Threatened, SC = Special Concern, (--) = no listing

5.0 ASSESSMENT OF PROJECT EFFECTS

5.1 IDENTIFICATION OF POTENTIAL PROJECT EFFECTS

This section identifies and describes potential impacts on the identified environmental components that may result from the proposed Project, including its construction and subsequent operational phases. For the purposes of this EIA, the identification and assessment of potential impacts and residual effects on fish and fish habitat constitutes an assisted Self-Assessment, to determine whether the Project will result in serious harm to fish that form part of a CRA fishery, consistent with provisions in the federal *Fisheries Act* (see **Section 5.3.1**).

5.1.1 Fish and Fish Habitat

Pathways of Effects (PoEs) for construction activities have been defined by DFO and can be used when conducting a Self-Assessment under the *Fisheries Act* to evaluate project-related activities with respect to the type of cause-effect relationships that are known to exist and the mechanisms by which stressors can ultimately lead to effects on fish and fish habitat (DFO 2014). This section describes effects that may occur as a result of Project activities that have the potential to affect fish and fish habitat, previously referenced in **Section 2.0**.

The majority of the Project potential effects, prior to implementation of mitigation, are associated with watercourse crossings, land-based construction activities (e.g., use of industrial equipment near watercourses, clearing of riparian vegetation, and grading) in relation to the 105A Avenue widening and new road construction. **Table 5** provides a summary of potential effects for the Project activities; rows list the DFO activities that are anticipated to occur as part of the proposed Project and may initiate a pathway of effects, while columns indicate the ultimate adverse effects to fish and fish habitat.

Table 5 Fisheries and Oceans Canada defined activities and pathways of effects identified for the Project (pre-mitigation)

DFO Activities	Potential Effects to Fish and Fish Habitat						
	Change in sediment concentrations	Change in contaminant concentrations	Change in water temperature	Change in habitat structure and cover	Change in nutrient concentrations	Change in food supply	Mortality of fish
Use of industrial equipment	C / O	C / O	N/A	N/A	N/A	N/A	C
Vegetation clearing	C / O	C / O	C	C	C	C	N/A
Grading	C	N/A	N/A	C	N/A	N/A	N/A
Placement of materials and structures in water	C	N/A	N/A	C	C	C	C

Note: C: Activity is anticipated to occur during the construction phase. O: Activity is anticipated to occur during the operation phase. N/A: Pathway of effect is not considered applicable to this Project.

5.1.1.1 Changes in Surface Water Quality

Construction activities have the potential to release sediment-laden water into the watercourses (Class A, B, or C) identified within the study area. Construction and operation also has the potential to increase bank erosion. When present in fish-bearing waters, sediments can impact water quality and negatively affect fish by decreasing visibility, damaging fish gills, and reducing habitat quality through infilling. The use of construction equipment near watercourses also increases the potential for release of contaminants into the aquatic environment resulting from accidental spills, which have the potential to cause fish mortality, alterations in growth or reproductive success, and modification of instream habitat values.

Impacts to water quality could also be experienced during the operational phase of the Project as a result of increased stormwater runoff from the increased impervious surface (i.e., replacing vegetated areas) associated with the widened and new roads. Increased vehicle traffic near watercourses also increases the risk of incidental introduction of contaminants (e.g., polycyclic aromatic hydrocarbons; PAHs) and sediment mobilization.

5.1.1.2 Alteration of Instream and Riparian Habitat

The deposition of eroded soil (i.e., introduced through infilling and construction of new ditches and grading/excavation activities adjacent to watercourses) can affect the capacity for fish and aquatic organisms to disperse through watercourses within the study area by restricting habitat connectivity and opportunities for fish to use and move between existing aquatic environments. This effect is most relevant for activities occurring within or immediately adjacent to fish-bearing watercourses (i.e., Hawthorne and Bon Accord creeks). Removal of instream and riparian vegetation within the Class A or B watercourses can reduce channel stability, shade, biofiltration capacity and food and nutrients available for transport downstream. Class C ditches do not contribute to fish habitat; therefore, any loss or alteration of these ditches is not anticipated to have any effect on fish habitat values associated with the study area; however, attention should be paid to ensure water quality is maintained.

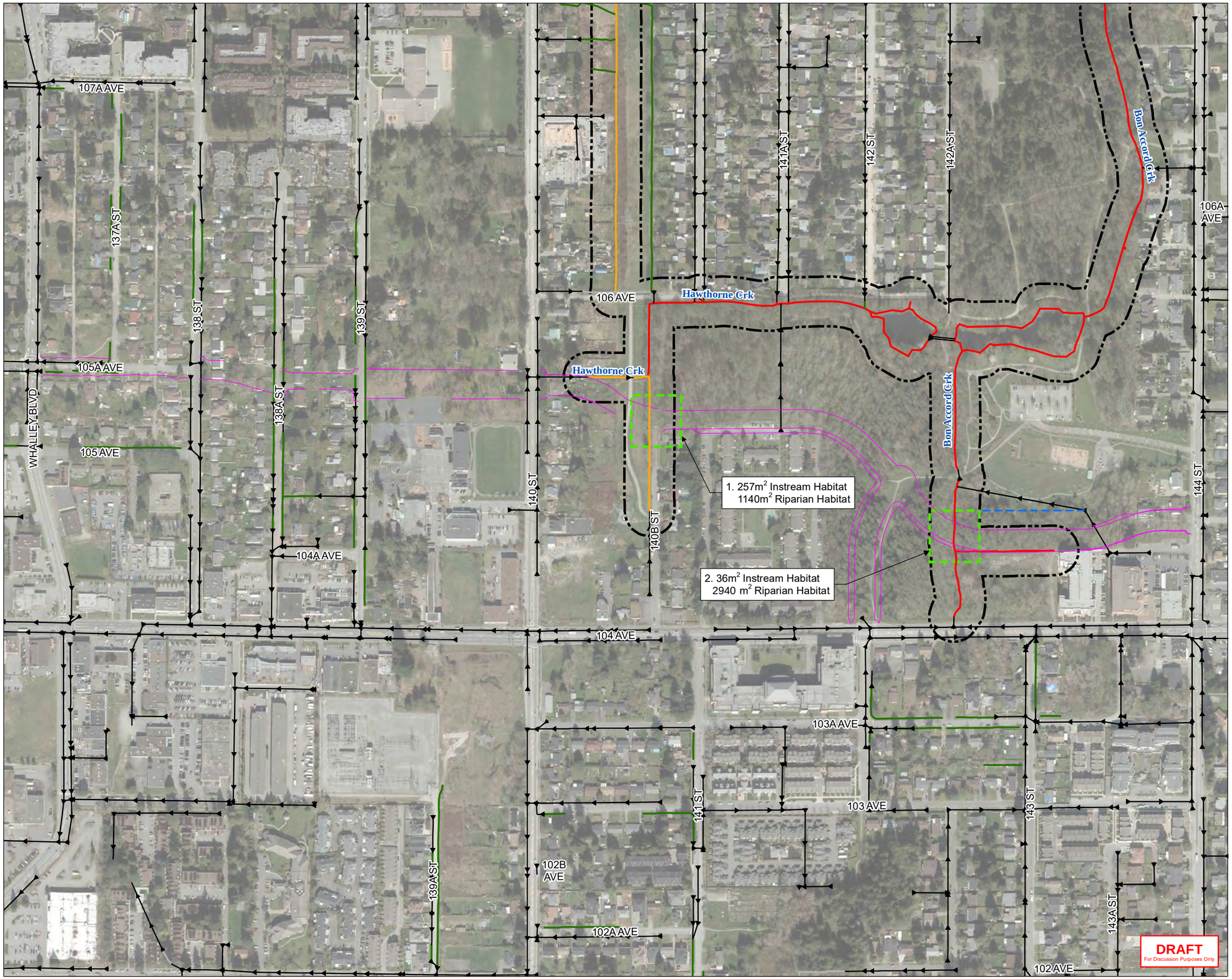
Instream Habitat

Approximately 257 m^2 of instream fish habitat (89 m^2 of Class A instream habitat[1] on Bon Accord Creek and 168 m^2 of Class A habitat[2] on Bon Accord Creek Tributary) will be impacted by the proposed Project **(Figure 5**).

[1] Average channel width = 3.7 m, width of proposed road = 24 m
[2] Average channel width = 1.4 m, length of tributary = 120 m

105A Ave. Improvements

Project Interaction



Legend

- Project Alignment
- New Ditch

City of Surrey Watercourse Classification

- A: Watercourse inhabited by fish year round
- AO: Watercourse inhabited by fish during the overwintering period
- B: Non-fish-bearing watercourse but contributes or potentially contributes significant food/nutrient inputs to downstream fish populations
- C: Non-fish-bearing watercourse that does not contribute significant food/nutrient value to downstream fish populations
- UN: Unknown
- Drainage Main and Flow Arrow
- 30m Setback
- Culvert Location

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

- Watercourse Classification: City of Surrey
- Aerial Image: ESRI World Imagery
- Inset Basemap: ESRI World Topographic Map

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Metres

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Riparian Habitat

Approximately 4,080 m^2 of riparian habitat[3] will be displaced by the new road. Of this, 1,140 m^2 will be impacted on Hawthorne Creek, 1,440 m^2 will be impacted on Bon Accord Creek, and 1,500 m^2 will be impacted on Bon Accord Tributary. Much of the riparian area is already impacted by vegetation management activities, invoice species, and human disturbance.

5.1.1.3 Changes in Water Temperatures / Thermal Cues

Clearing of riparian vegetation adjacent to watercourses could potentially result in changes to water temperatures (i.e., higher temperatures resulting from reduced vegetative cover and increased sun exposure). If resulting changes in water temperature are experienced in fish-bearing watercourses downstream of the study area, effects to fish and fish habitat could include depletion of dissolved oxygen, changes in the timing of reproductive behavior, and reduced reproductive activity or even mortality of fish.

5.1.1.4 Changes in Nutrient Concentrations, Food Supply

Clearing/removal of instream and riparian vegetation from Class B and A watercourses has the potential to result in changes to the quantity and composition of food and nutrient supply within the watercourses, potentially as a result of decreased input of organic materials and terrestrial insects to downstream fish habitats.

5.1.1.5 Incidental Injury or Mortality of Fish

Displacement or stranding of fish could occur in Class A ditches, if construction requires dewatering or results in dramatic changes in flow patterns of upstream ditches. Direct injury or mortality of fish (including eggs, ova, and larvae) may result from physical disruption from industrial equipment in fish-bearing watercourses (DFO 2014). For example, fish eggs and/or larvae may be crushed by equipment entering a stream, or juvenile fish may be trapped during the placement of a new culvert, or riprap placement for bank protection.

[3] Based on a proposed road width of 24 m and default riparian setback of 30 m measured from top of bank,

5.1.2 Vegetation

The Project will impact approximately 9,720 m^2 of terrestrial vegetation in the southern portion of Hawthorne Park. Terrestrial vegetation and ecosystems in this area are second-growth, less than 80 years old. At the west side of the park, immediately adjacent to the BC Hydro ROW, trees are predominantly alders and cottonwoods. Where the road alignment turns further south at 142 Street, it bisects a section of mixed forest with western hemlock, western redcedar, Douglas-fir, red alder, and black cottonwood. No old-growth forests or wetlands will be impacted by the Project, however there is potential for introduction of invasive plant species to the park through vehicle and machinery movement.

5.1.3 Wildlife and Wildlife Habitat

5.1.3.1 Sensory Disturbance

Sensory disturbance to wildlife includes auditory, olfactory, and visual disturbances including noise from heavy equipment operation and vegetation clearing, odors of fuels and humans, and the presence and movement of equipment and personnel. Some of these effects may also occur during the operational phase of the Project (e.g., auditory, olfactory, and visual disturbance from increased traffic on the widened road). Reactions of wildlife to sensory disturbance tend to vary between species and individuals, with effects ranging from undetectable increases in stress to movement away from the disturbance. As the Project will be undertaken within an established urban setting with pedestrian traffic and use of 104A Avenue by many large, commercial transport vehicles as well as normal vehicular traffic, the Project is not expected to result in sensory disturbance to wildlife.

5.1.3.2 Habitat Loss and Alteration

Wildlife habitat loss resulting from the Project will impact roadside and ROW habitat that primarily consists of grasses and low lying vegetation, which is considered “low” value wildlife habitat, as well as second-growth forest within Hawthorne Park, which is considered to be “moderate” value habitat (mainly due to existing disturbance by human activity). Wildlife habitat is limited to common urban and suburban species accustomed to human presence. Vegetation removal (including removal of trees and clearing of shrubs/grasses) and the alteration of riparian habitat will occur in the vicinity of the Project footprint as part of construction activities. Wildlife movement away from the study area during the construction phase, as a result of sensory disturbance (displacement), may also occur temporarily. The operations phase of the Project may impact wildlife that uses the park, specifically deer, coyotes, and small mammals.

5.1.3.3 Mortality or Injury

Wildlife mortality or injury may occur as a result of vegetation clearing and construction activities within the construction footprint. Birds, small mammals, and amphibians are most susceptible to these activities, without appropriate mitigation to reduce risk (**Section 5.2**). Increased vehicular traffic on the widened road also has the potential to result in injuries or mortalities (i.e., “road kills”) during the operational lifespan of the Project. Vegetation clearing will occur outside the bird nesting window of March 15 to August 31. If any clearing is to occur within the nesting window, a qualified biologist will conduct a bird nest sweep at least 24 hours prior to the clearing activity. Mortality and injury may also occur as a result of road operation.

5.1.4 Species at Risk

Species identified as having low potential to occur on site (see **Table 3**) are generally considered to have nil- to low- potential for interaction with the Project, and are not further considered in this section. Potential effects on coastal cutthroat trout habitat (the only at-risk fish species considered to have potential to be present) are outlined in **Section 5.1.1**. As described for wildlife in **Section 5.1.3** above, Project construction and subsequent road operation have the potential to negatively affect terrestrial wildlife species at risk through sensory disturbance, habitat alteration and/or loss, and mortality or injury. The majority of the terrestrial wildlife species at risk with moderate-to high potential to occur on site are anticipated to use the study area primarily for foraging (see **Table 3**). Exceptions to this include specific bird, bat, and amphibian species (as described below).

Barn swallow and bats, which may utilize nearby buildings for nesting or roosting, and barn owl and common nighthawk may potentially use the ROW for forging. No buildings will be impacted by the Project activities; therefore, no negative impacts on these species are anticipated. The ROW will be impacted by the road improvements, however sufficient habitat for foraging exists to the north and south of the study area to mitigate this potential impact.

Olive-sided flycatcher and band-tailed pigeon have potential to use mature trees within the study area for nesting, though it is considered unlikely that either of these species would construct nests in trees within the study area as very few mature trees exist. If nests are present within the study area, these birds could be subject to sensory disturbance and habitat alteration during construction.

Northern red-legged frogs require slow-moving streams, marshes, or bogs with at least 50 cm of water in which to breed (Ovaska and Sopuck 2004). Adults prefer mature, deciduous forest with abundant leaf litter and fallen logs. Western toads also require aquatic habitat to lay eggs; however, they will use a wider range of breeding habitat, including roadside ditches (COSEWIC 2012). Adult toads are primarily terrestrial. Breeding habitat for both is considered limited within the study area; however, adults are considered to have moderate potential to occur in riparian habitat along ditches, creeks, and the ponds in the park. If present within the study area, these amphibians could be subject to sensory disturbance, habitat alteration, and mortality/injury as a result of construction activities. Increased vehicular traffic on the widened road also presents potential for increased risk of mortality/injury during the operations phase of the Project.

An at-risk plant survey was not undertaken as the time of year was not conducive to detection. However, given the highly-disturbed nature of the study area, at-risk plants are not anticipated in the Project footprint; therefore, no negative interactions are anticipated. However, an at-risk plant survey should be considered prior to construction.

5.2 BEST MANAGEMENT PRACTICES AND MITIGATION MEASURES

5.2.1 Best Management Practices and Guidelines

Best Management Practices (BMPs) and guiding documents and ensure that a project is planned and carried out in compliance with applicable legislation, regulations, and policies. Guiding documents and BMPs that should be followed during the Project include, but are not limited to, the following:

- *A General Guide to Construction Over or Near Watercourses* (CoS 2011);
- Measures to Avoid Causing Harm to Fish and Fish Habitat (DFO 2016);
- *A User's Guide to Working in and Around Water* (MOE 2005);
- *British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture* (MOE 2017);
- *Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia* (MOE 2014);
- Guidelines for Amphibian and Reptile Conservation during Urban and Rural Development in British Columbia (MFLNRO 2014);
- Best Management Practices for Amphibian and Reptile Salvages in British Columbia (Wind et al. 2013);
- Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (MoE 2013); and
- Best Management Practices for Bats in British Columbia (MoE 2016).

5.2.2 Site-Specific Mitigation Measures

Table 6 provides a summary of key site-specific measures that may be applied to the Project to avoid or minimize potential Project effects described in **Section 5.1**, including mitigative approaches and strategies derived from the above list of BMPs and guiding documents.

Table 6 Site-Specific Mitigation Measures

Activity	Mitigation Measures
Protection of Surface Drainages and Water Quality	• Equipment must arrive onsite washed and free of leaks, invasive species, and noxious weeds. • All fuelling, washing, and maintenance of equipment must be conducted at a safe distance at (i.e., at least 30 m away) from aquatic habitats to prevent the introduction of deleterious substances into these habitats (i.e., outside the riparian buffer area). • Use biodegradable fluids in heavy machinery associated with instream works, where practicable, and ensure equipment is clean and free of excess oil and grease prior to initiating work. • Ensure basic spill kits are available within every vehicle and piece of equipment operating within the Project site. • Vegetation removal within the riparian buffer area should be minimized to the extent possible. • Clearing, grubbing, drainage and grading work near Class A or B watercourses should occur during dry summer conditions. • The riparian vegetation on Class A or B drainages should be replanted (e.g., with willow stakes) to maintain bank stability, provide shade to the channel, and contribute food and nutrients. • Ensure gravels, rock, riprap, or other materials placed on the banks or within watercourse channels are inert, and free of silt, debris, or other substances deleterious to aquatic life.
Erosion and Sediment Control	• Appropriate erosion and sediment control measures (e.g., silt fences, scattered straw, drainage swales) must be implemented prior to the commencement of construction activities, as necessary. • All installed erosion and sediment control measures should be regularly inspected and replaced/modified as required during construction. • Install silt fence (or other acceptable product) along the top of bank of any wetted Class A or B watercourses prior to construction activities in that area to prevent surface runoff from entering the channel. • Cover any soils exposed as a result of Project activities, and/or implement other erosion protection or sediment control measures until such time that re-vegetation (soil stabilization) can be implemented. • Direct any sediment-laden water to stable, vegetated areas away from any watercourses to allow for infiltration back into the ground.
Fish and Fish Habitat	• Conduct instream works on Class A and B watercourses in the dry or within window of least risk (August 1st to September 15th) unless otherwise determined acceptable by a Qualified Environmental Professional (QEP) and/or allowed by the DFO and/or the Ministry of Forests, Lands, and Natural Resource Operations (FLNRO). • Minimize the duration of instream works to the extent possible. • The erosion protection design and the inlet and outlet of the Bon Accord Creek culvert will include deep (~1.0 m) pool habitats • The new ditch on the north side of the road will be connected to Bon Accord Creek, and will be designed to improve fish access and water quality. • Fish passage will be maintained in fish-bearing watercourses. • Fish salvages should be conducted by a qualified professional prior to the commencement of instream work activities on Class A watercourses. • Utilize the acquired property at 106 Avenue. to enhance and/or restore riparian habitat on Hawthorne Creek.

Activity	Mitigation Measures
Vegetation	• Minimize the area of vegetation clearing to the extent possible. • Clearly mark the limits of construction activities and appropriate buffers around any sensitive environmental features prior to vegetation clearing. • If possible, trees requiring removal and areas of native shrubs disturbed by clearing activities should be replaced/replanted with the same or similar species. • To the extent practicable, maintain hydrology in any new roadside and adjacent ditches to encourage growth of emergent vegetation such as cattail. • Prevent introduction of invasive plants into the work area through use of clean fill materials and inspection of vehicles and machinery for plant parts. • Additional enhancement and/or restoration may be undertaken on the acquired lot at 14082 106 Avenue (**Section 5.2.3**).
Wildlife and Wildlife Habitat	• Maintain habitat connectivity to the extent possible and hub by minimizing vegetation clearing within the GIN corridor and hub. • Conduct raptor nest surveys in advance of clearing activity to identify any active or inactive raptor nests within a 200 m buffer of the clearing boundaries. • Vegetation clearing should ideally be conducted outside of the breeding bird period (March 15 to August 15). Any clearing that occurs within the breeding bird period will require a nest clearing survey due to the potential for tree, shrub, and grassland nesting birds. • Conduct in-stream work, including infilling of ditches in summer months and time of low water levels to reduce potential impacts to breeding amphibians, egg masses, tadpoles and toadlets. If construction is to occur within or near areas of potential native amphibian breeding habitat when wetted, conduct an amphibian salvage as per the requirements of the *Wildlife Act* and relevant BMPs. • Remove wildlife attractants from the Project site (i.e. garbage) regularly during construction. • Consider including wildlife crossing structure(s) (i.e., small- to medium-sized mammal underpass(es) within the GIN corridor as part of the final Project design. ▫ Any crossing structures should be designed to meet the needs of the widest range of species possible, and designed to minimize the intensity of noise and light coming from the road and traffic. ▫ Use topography and natural features as much as possible to encourage the use of any crossing structure(s). Additional measures such as fencing, rock walls, drift fences or other barriers along 105A Avenue, particularly within Hawthorne Park, may also be implemented to encourage use of the crossing(s). • Upon completion of the Project, warning signage for wildlife should be erected along 105A Avenue where it crosses the BC Hydro ROW GIN Corridor and at both ends of vegetated area associated with the GIN Hub (Hawthorne Park).
Species at Risk	• See “Fish and Fish Habitat” “Vegetation” and Wildlife and Wildlife Habitat” above.
Environmental Monitoring	• Conduct environmental monitoring, with an emphasis on those works with the greatest potential to impact aquatic and terrestrial habitat. The Environmental Monitor must have written authority to halt work if environmental monitoring indicates there is a current or imminent impact to the environment that has not been otherwise permitted or approved. • Monitor turbidity and pH on an ongoing basis, to ensure that water quality in watercourses meets provincial and City of Surrey’s water quality objectives.

5.2.3 Proposed Restoration and Enhancement

The propose Project will impact instream (257 m^2) and riparian (4,080 m^2) habitat on Hawthorne and Bon Accord creeks. The restoration and enhancement measures described below are proposed to address these Project effects. These options are proposed for further discussion with Aplin and Martin and the City of Surrey.

5.2.3.1 Hawthorne Creek Riparian Area

A parcel of property has been acquired at 14082 106 Avenue, on the northwest corner of Hawthorne Park, at the corner of 106 Avenue and the 140B Street road allowance. This property is located approximately 18 m east of Hawthorne Creek, and may be used to mitigate riparian area that is negatively impacted along the creek. Invasive species removal may be considered on this property to improve riparian vegetation and upland habitat. This parcel will eventually be incorporated into Hawthorne Park. Instream enhancements on Hawthorne Creek may also be considered to improve fish access and habitat within the Class B section. Approximately 160 m^2 of instream habitat is available for enhancement in the Class B section of Hawthorne Creek.

5.2.3.2 Bon Accord Creek Culvert Crossing

The erosion protection design at the inlet and outlet of the proposed Bon Accord Creek culvert will include placement of riprap material. To help avoid loss of surface flow during low water periods and to create functional fish habitat features, deep pool habitats (approximately 5 m wide x 10 m long x 1.0 m) are proposed to be incorporated in the design. This will require over-excavation of the zone where the riprap material will be placed to enable sufficient erosion protection as well as creation of this pool habitat features.

5.2.3.3 Bon Accord Creek Tributary

The proposed road improvements will require relocation of the Class A tributary to Bon Accord Creek (**Figure 3**). This tributary is considered to be low-productivity habitat with iron-laden water and limited flows (**Section 4.1.4.1**). A new ditch is proposed for the north side of the new road. This ditch will be the same length as the existing tributary. It will be designed to provide improved fish access and water quality and will also represent improved productivity habitat. These fish-friendly design features will be discussed with Aplin and Martin at the time of development. Additional riparian restoration will also be undertaken to replace riparian vegetation impacted by the proposed project.

5.2.3.4 Wildlife Crossings

The new road may represent a barrier to movement for small mammals and amphibians, and may be a source of injury or mortality for larger animals such as deer, coyotes, racoons, and skunks. The proposed road extension will fragment a portion of the southern part of Hawthorne Park from the rest of the park. The entry to the park from 104 Street already bisects this area from south to north. The road will also isolate a portion of the GIN corridor. These areas may represent travel corridors for common urban wildlife species.

Potential mitigation includes signage to inform motorists of the potential for wildlife crossing. The concrete box culvert proposed for the Bon Accord Creek crossing will be 1829 mm wide by 914 mm high, suitable to assist small mammals and amphibians cross the road. If over-sized, the culvert on Hawthorne Creek can also provide a crossing structure for small mammals and amphibians.

5.3 RESIDUAL EFFECTS ASSESSMENT

This section of the assessment considers potential residual effects on fish and fish habitat, vegetation, wildlife and wildlife habitat, and species at risk following the implementation of the proposed mitigation and restoration/enhancement measures. Residual effects were evaluated based on the criteria described in **Table 7** below.

Table 7 Criteria Used to Evaluate Residual Effects

Characteristic and Description		Rank and Description of Associated Effect	
Likelihood	Likelihood and risk of the residual effect occurring.	Likely	Residual effect likely to occur
		Unlikely	Residual effect unlikely to occur
Duration	Length of time over which the residual effect is expected to persist. E.g. is the duration short enough not to diminish the ability of an organism to carry out one or more of its life processes?	Short Term	Days to weeks
		Moderate Term	Months to year
		Long Term	Multiple years to permanent
Magnitude	Intensity of the effect relative to natural or baseline conditions.	Negligible	No measurable change in populations, or habitat quality or quantity
		Low	A measurable change within the range of natural variability, but not affecting population viability
		Moderate	A measurable change outside the range of natural variability, but not posing a risk to population viability
		High	A measurable change outside the range of natural variability and may affect long-term population viability
Geographic Scale	Geographic extent / distribution of the residual effect. E.g. is the scale small enough not to disrupt organisms that would otherwise be occupying the habitat?	Localized	Limited to Project site, localized effect, or temporary displacement
		Small scale	Effects experienced on the scale of the study area
		Large Scale	Effects experienced beyond the study area
Reversibility	Potential for the effect to be reversed or naturally return to baseline level after the disturbance has ceased.	Reversible	Baseline conditions will be naturally restored after disturbance has ceased
		Irreversible	Baseline conditions will not be naturally restored after disturbance has ceased
Ecological Context	Availability and condition of the habitat to be altered, relative to nearby habitat. E.g. is the habitat that is being altered or destroyed the only habitat of its type and quality in the vicinity of the Project site?	Prevalent	Type of altered habitat remains prevalent and widely distributed in the study area or altered habitat is still suitable
		Limited	Altered habitat is confined to small areas or has limited distribution in the study area or habitat is significantly reduced in function or quality
		Rare	Altered habitat is rare or limiting (critical habitat, SAR habitat) and is no longer suitable

The anticipated residual impacts associated with the proposed Project are summarized below in **Table 8**. Overall, the risk of significant negative residual impacts on the environmental components (fish habitat, wildlife habitat and species at risk) was assessed as “low”, provided the recommended mitigation, restoration, and enhancement measures are effectively implemented during construction and maintained during operation.

Table 8 Residual Effects Evaluation

Component	Potential Effects	Residual Effects (following implementation of mitigations)
Fish and Fish Habitat	Change in surface water quality	Limited residual effects on water quality associated with construction activities are expected, provided appropriate mitigation measures are implemented. Long-term effects to water quality during the operational phase of the Project (as a result of stormwater runoff) are expected to be of a negligible or low magnitude, when compared to the existing condition, such that no significant residual impacts are expected.
	Alteration of instream and riparian habitat	Overall, there will be a net loss of ~89 m2 of instream fish habitat and relocation (temporary disturbance) to 168 m2 of instream fish habitat). These losses and temporary disturbances are primarily associated with low value fish habitats and no negative residual impacts to fish habitat productivity are anticipated, provided the culverts at Bon Accord Creek and Hawthorne Creek are designed and constructed in a manner that maintains fish access and the proposed fish habitat restoration and enhancement measures/features are implemented. Any changes to water temperatures, nutrient and food supply as a result of riparian vegetation clearing are expected to be reversible, of short- to moderate-term duration, and of low magnitude, particularly following implementation of the proposed riparian restoration activities. No significant residual impacts are anticipated in fish-bearing watercourses within or downstream of the study area.
	Incidental injury or mortality of fish	Fish population numbers are expected to be low in Hawthorne and Bon Accord creeks within the study area. No residual effects are expected if appropriate mitigation measures are implemented (e.g., work in Class A and B watercourses during low water periods and/or least risk window).
Vegetation	Loss or alteration of vegetation	Plant communities within the construction footprint within the ROW and residential areas consist largely of mowed grass and weedy species, which are prevalent within the study area and surrounding habitat. No negative residual effects are anticipated in these areas. Exceptions are the ecosystems within Hawthorne Park. Trees or native shrubs to be cleared in the park should be replaced/replanted with the same or similar species to mitigate negative effects to vegetative habitat value in these areas. No negative residual effects are anticipated if mitigation measures are implemented and restoration activities are undertaken.
	Introduction/ spread of invasive plants	No residual effects are expected if appropriate mitigation measures are implemented.
Wildlife and Wildlife Habitat	Sensory disturbance	Sensory disturbance to wildlife may result from during construction as well as during the Project's operational phase. However, given the presence of existing infrastructure in the vicinity of the Project it is anticipated that wildlife in the area are already accustomed (habituated) road) to a similar baseline level of disturbance. As a result, no negative residual impacts are expected if appropriate mitigation measures are implemented.
	Habitat alteration/ loss	The Project footprint represents permanent loss of habitat for wildlife, and areas of vegetation disturbance or clearing of vegetation followed with riparian planting represent a temporary alteration of wildlife habitat. However, this alteration/loss of habitat is on a small scale, and similar- or better-quality habitat is prevalent nearby. No residual negative impacts on wildlife are anticipated.
	Injury or mortality	No residual effects are expected during the construction phase with appropriate mitigation measures in place. Increased signage and/or wildlife crossing structures are expected to mitigate injury or mortality of wildlife during the operational phase such that negative residual impacts on wildlife populations are not expected to be significant. The Culvert at Bon Accord Creek will provide a crossing structure for small mammals and amphibians.

Component	Potential Effects	Residual Effects (following implementation of mitigations)
Species at Risk	Sensory disturbance	For the species at risk considered to have moderate- to high- potential to occur on site, sensory disturbance is generally expected to be limited to temporary disturbance of foraging behavior during the construction phase. As described for wildlife and wildlife habitat above, species at risk present within the study area are likely already habituated to a similar background level of disturbance, therefore no significant negative residual impacts are expected if appropriate mitigation measures are implemented.
	Habitat alteration/ loss	As described above for wildlife and wildlife habitat, any alteration or loss of habitat is on a small scale, and similar- or better-quality habitat is available nearby. No residual negative impacts on the identified species at risk due to habitat alteration / loss are anticipated.
	Injury or mortality	Implementation of appropriate mitigation measures (i.e., construction timing, nest surveys and amphibian salvages) are expected to avoid or minimize any potential effects such that no significant impacts are expected at the population level for any of the identified species at risk.

5.3.1 QEP Determination Regarding Potential for Serious Harm to Fish as a Result of the Project

Based on the features, function and conditions observed at the time of the field assessments, the Class A and B drainages in the Project area represented primarily “low” value fish habitat with some “moderate” value habitats present. Although both Hawthorne and Bon Accord creeks are classified as Class A (fish-bearing or potentially fish-bearing) watercourses, no confirmed records of fish presence were available. Overall, the fisheries productivity of the drainages within the study area is expected to remain unchanged following construction of the Project. Furthermore, the Pathway of Effects assessment conducted by a Hemmera Qualified Environmental Professional identified a “low” potential for adverse residual effects to fish and fish habitat following effective implementation of relevant mitigation measures. The proposed restoration and enhancement measures will help ensure and residual effects to fish and fish habitat are neutralized.

The Project will result in fragmentation of Hawthorne Park from a wildlife habitat perspective, however, the wildlife habitat values associated with the park were “low to moderate” and primarily associated with common urban wildlife species. There were no species at risk of concern.

Based on our understanding of the proposed Project, the information available regarding the local natural environment and the features, functions and conditions observed in the field, this Environmental Impact Assessment concludes there is a “low” risk of the proposed Project causing serious harm to fish that form a CRA fishery.

As the Project will involve relocation and enclosure of Class A fish habitat, we do recommend submitting a Request for Project Review to DFO.

6.0 CLOSURE

We sincerely appreciate the opportunity to assist Aplin Martin with preparation of this Environmental Impact Assessment for the 105A Avenue Improvements project. If there are any questions regarding this report, please do not hesitate to contact the undersigned by phone at 604.669.0424.

Report prepared by:
Hemmera Envirochem Inc.

DRAFT

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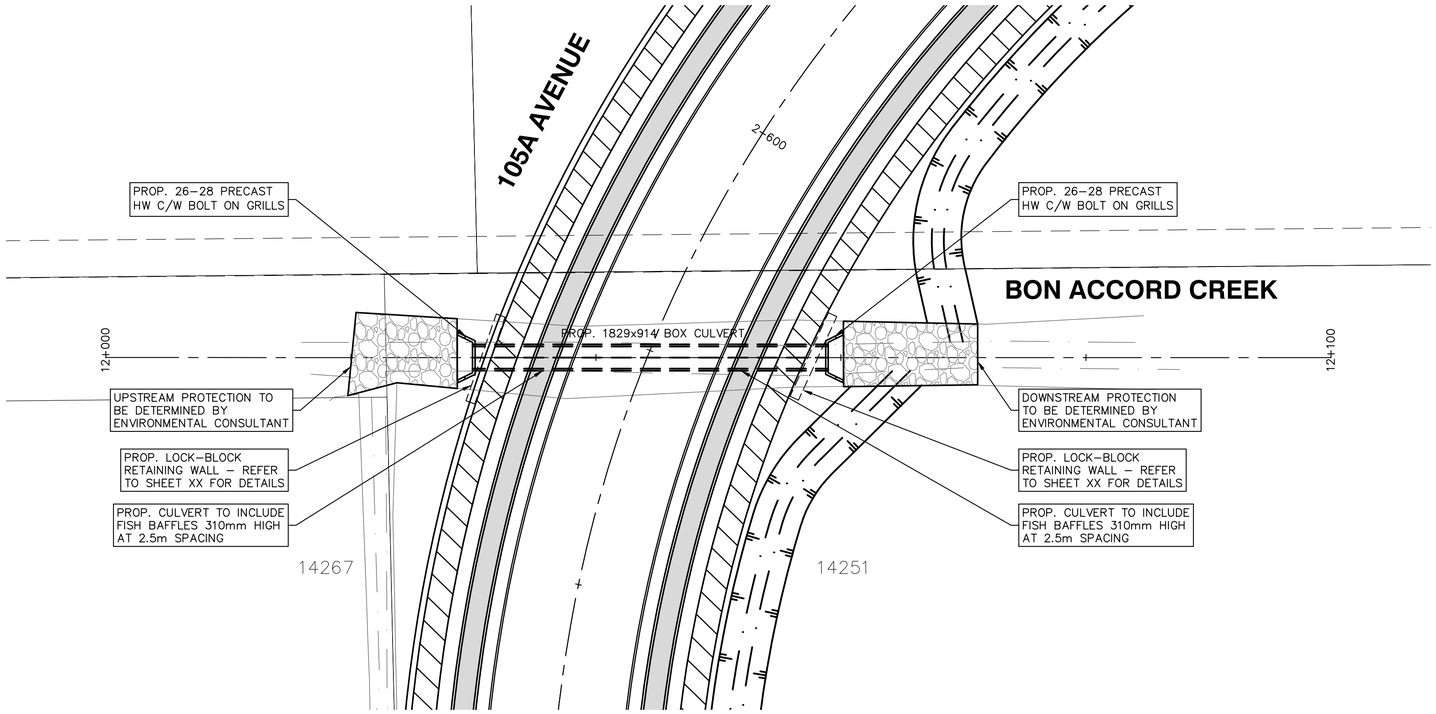
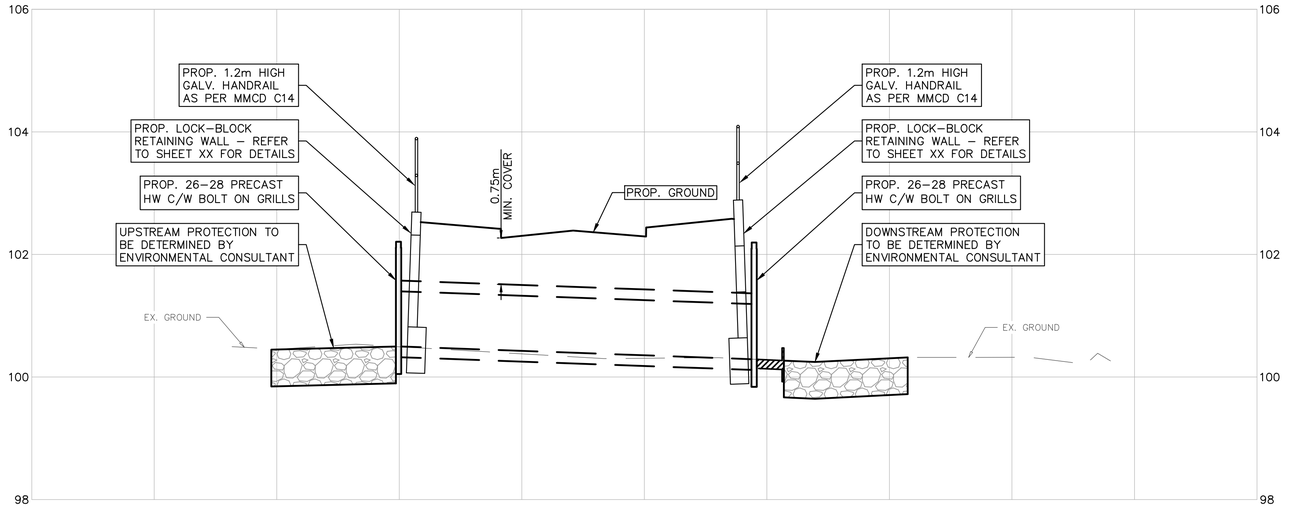
APPENDIX A

Bon Accord Creek Culvert Design

NOTICE TO CONTRACTOR

IT IS THE RESPONSIBILITY OF THE CONTRACTOR'S SURVEYOR TO VERIFY THAT ALL LEGAL SURVEY DIMENSIONS SHOWN ON THE ENGINEERS DRAWINGS AGREE WITH THOSE ON THE REGISTERED LEGAL SURVEY PLAN. SHOULD THERE BE ANY DISCREPANCIES, THEN IMMEDIATELY NOTIFY THE ENGINEER OF RECORD





IMPORTED BACKFILL 75mm PIT RUN GRAVEL
TYPE '1' BEDDING

STORM LENGTH, SIZE, TYPE AND GRADE					29.02m–1829mmx914mm CONC. ASTM C1443M STM @ 0.72%							
INVERT ELEVATION					100.50 N				100.29 S			
CHAINAGE	12+000	12+010	12+020	12+029.94	12+030	12+040	12+050	12+058.96	12+060	12+070	12+080	12+090	12+100

LEGAL DESCRIPTION:

SURVEY BENCHMARK MON: OCM 84H0579 N: E: SCALE FACTOR: ELEV: 81.288m

REV.	DATE	DESCRIPTION	APP
1	07/04/17	30% DESIGN SUBMISSION	JAH

I _____ PROFESSIONAL ENGINEER, IN GOOD STANDING IN AND FOR THE PROVINCE OF BRITISH COLUMBIA, HEREBY CERTIFY THAT THE WORKS AS HEREIN SET OUT ON THE ATTACHED DRAWINGS HAVE BEEN DESIGNED TO GOOD ENGINEERING STANDARDS AND IN ACCORDANCE WITH THE LATEST EDITION OF THE CITY OF SURREY DESIGN CRITERIA MANUAL, THE MMCD AND THE CITY OF SURREY STANDARD CONSTRUCTION DOCUMENTS (GENERAL CONDITIONS, SUPPLEMENTARY SPECIFICATIONS AND SUPPLEMENTARY STANDARD DRAWINGS), ADOPTED BY THE CITY OF SURREY

CONSULTANT
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CITY OF SURREY

CLIENT: **CITY OF SURREY**
13450 – 104 AVE. SURREY, B.C., CANADA V3T 1V8

TITLE: **105A AVENUE STORM WORKS**
BON ACCORD CREEK CULVERT

SEAL:

SCALE: HORZ. 1:250 VERT. 1:50
DESIGNED: DEW
DRAWN: NAP
REVIEWED: DEW

DATE (YYYY.MM.DD): 2017/02/21
CONSULTANT PROJ. NO: **16-295**
DWG. NO. **10** OF **14**
REV. **1**

SURREY PROJECT NUMBER **M.S. 1717-059-D1**
DRAWING TYPE: **STORM WORKS**

0 2 1:250 12m

APPENDIX B
Photo Documentation

APPENDIX B-1
Fish and Fish Habitat

Photo 1: View of 139 Street east ditch (Class C) near proposed new road alignment, facing north.

Photo 2: View of 138A Street east ditch (Class C) near proposed new road alignment, facing north.

Photo 3: View of Hawthorne Creek (currently listed as Class B), upstream of the BC Hydro ROW pedestrian trail and culvert, facing west.

Photo 4: View of Hawthorne Creek, downstream of the BC Hydro ROW pedestrian trail and culvert, facing west.

Photo 5: View of Class B drainage ditch along east side of BC Hydro ROW and west side of 140B St (tributary to Hawthorne Creek), facing south.

Photo 6: View of Hawthorne Creek upstream of 141 Street, facing west (upstream).

Photo 7: View of Hawthorne Creek downstream of wooden bridge, facing east (downstream).

Photo 8: View of (one of seven) concrete culvert on Hawthorne Creek long 106A Avenue.

Photo 9: View of Bon Accord Lake East – west pond, facing east.

Photo 10: View of Bon Accord Lake East – west end of east pond, facing west.

Photo 11: View of Bon Accord Lake East – east end of east pond (with island in middle), facing west.

Photo 12: View of Bon Accord Creek upstream reach: upstream of wooden bridge, facing south (upstream).

Photo 13: View of Bon Accord Creek upstream reach: upstream of culvert crossing, facing south (upstream).

Photo 14: View of Bon Accord Creek upstream reach drainage pipe and retention wall on right bank, facing east.

Photo 15: View of Bon Accord Creek Tributary drainage, facing east.

Photo 16: View of trail bridge on Bon Accord Creek at Bon Accord Lake outlet, facing east.

Photo 17: View of the concrete apron and debris rack at the Bon Accord Lake outlet.

Photo 18: View of Bon Accord Creek downstream reach, facing north.

APPENDIX B-2

Vegetation, Wildlife and Wildlife Habitat

Photo 1: View of BC Hydro ROW facing north.

Photo 2: Example of dense understorey vegetation in Hawthorne Park.

Photo 3: Deciduous forest at west side of Hawthorne Park.

Photo 4: Mixed forest at south portion of Hawthorne Park.

Photo 5: Stick nest in cottonwood.