CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

Loggers East Neighbourhood, Squamish, BC

Environmental Review

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1 Introduction

1.1 Background

The District of Squamish has retained Cascade Environmental Resource Group Ltd. (Cascade) to conduct an Environmental Review for the Loggers East Neighbourhood in Squamish, BC. The area is designated "Residential Neighbourhood" in the District of Squamish Official Community Plan (DoS, 2017) and more detailed environmental information is required by the District to aid in long-term residential planning of the neighbourhood and the Sub Area Plan (SAP). The Loggers East Neighbourhood, as indicated on Map 1, will be referred to herein as the "study area".

The purpose of the Environmental Review is to identify environmentally valuable resources (EVRs), environmentally sensitive areas (ESAs), wildlife habitat, wildlife corridors and any significant contiguous areas that should be protected/remain undeveloped in the study area. This report summarizes findings from field investigations, past environmental assessments and includes guidelines/recommendations for future development in the area, preservation areas and habitat enhancement opportunities.

1.2 The Project Team

The study area investigation was conducted by Ruth Begg, M.E.M., R.P.Bio., E.P., of Cascade. Support and review was provided by Mike Nelson, R.P.Bio., with mapping completed by Nicola Church, M.Sc. GIS. All project team members have extensive experience conducting environmental inventories, reviews and assessments.

2 Site Description and Development Plan

2.1 Site Description

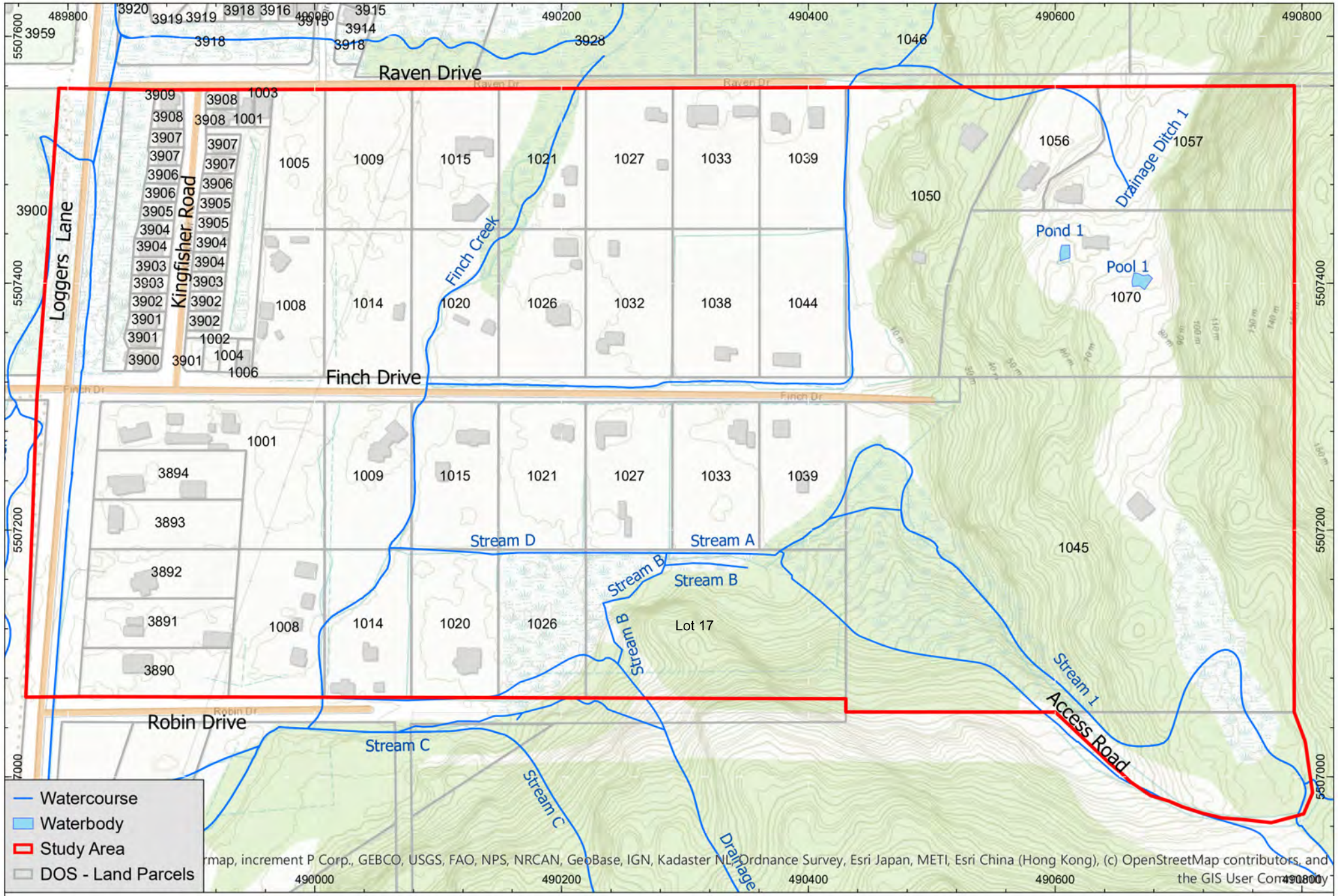
The study area is located within the District of Squamish and consists of the Loggers East Neighbourhood that is bordered to the north by Raven Drive, to the east by undeveloped and forested land, to the south by Robin Drive and to the west by Loggers Lane (Map 1).

The study area is mainly occupied by residential housing along with dog boarding kennels and horse stables. The southeastern corner of the study area is mostly undeveloped and is private and forested. The centre point of the study area is located at UTM Zone 10, 490108 E, 5507328 N.

According to aerial photos, the study area has mainly been developed as rural residential housing, with no significant development occurring until 2013 when The Maples comprehensive development was constructed in the northwestern corner of the study area (DoS, 2019a). The residential lots located along the eastern boundary and the southeastern corner of the study area remain the least developed currently, with 1045 Finch Drive only occupied by a single-family house and Lot 17 remaining forested and undeveloped.

2.2 Proposed Sub Area Plan

A Sub Area Plan has not been developed for the Loggers East Neighbourhood but will likely include residential and potentially commercial development. Hence, this report serves as a preliminary environmental assessment subject to be updated once development plans have been proposed for the study area.



GIS Cartographer: Nicola Church
Date: September 18 2019
CERG File#: 064-48-02
Projection: UTM Zone 10N NAD83

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Meters

Map 1 - Site Map

District of Squamish Community Planning
Loggers East Sub Area Plan
Environmental Review
Squamish, British Columbia

3 Methods

A desktop search of data regarding the study area was conducted prior to visiting the study area to identify riparian areas in the study area as well as to conduct a preliminary environmental review of the undeveloped and forested areas to determine whether there were any environmentally valuable resources (EVRs) within the study area. Site investigations were conducted on March 22nd and 26th, 2019. The methods are discussed in greater detail in the following sections.

3.1 Physical Environment

Information on the physical environment of the study area (i.e. climate, geology, soils, geomorphology, and hydrology) were collected from a variety of sources including *An Introduction to the Ecoregions of British Columbia* (Demarchi, 1996), *A Field Guide to Site Identification and Interpretation for the Vancouver Forest Region* (Green and Klinka, 1994), Canadian Climate Normals 1981-2010 (Environment Canada, 2019), provincial mapping data (DataBC, 2019), historical and local knowledge, and observations made during site investigations.

3.2 Terrestrial Environment

3.2.1 Terrestrial Ecosystem Mapping

A standard method of ecological land classification used in BC is the Biogeoclimatic Ecosystem Classification system (BEC). This system describes the variation in climate, vegetation, and site conditions occurring within ecosections. BEC is also hierarchal, with separate climate and site levels. There are six levels of organization with increasing specificity: zone, subzone, phase, variant, site association, and site series. At the highest level, biogeoclimatic zones are classed based on broad macroclimatic patterns; at the lowest level, site series describes the vegetation potential of the land area based on its ability to support the same climax plant association and displaying the same soil moisture and nutrient regimes (RISC, 1998).

Terrestrial Ecosystem Mapping (TEM) is built on the foundation of the BEC system principles. TEM provides the framework in which biotic and abiotic elements can be integrated to provide information on the spatial distribution of ecological units on the ground. This approach is used to assist in the identification of significant environmental features such as, riparian zones, streams, wetlands, valued ecosystem components (e.g. wildlife trees) and environmentally sensitive areas.

TEM units are derived by combining BEC unit information (i.e. site series) with terrain feature attributes (i.e. modifiers). Site series in this classification system describe a 'typical' set of environmental conditions focusing specifically on important site, soils, and terrain characteristics. Site series describe all land areas capable of producing the same late seral or climax plant community within a biogeoclimatic subzone or variant. These are usually related to a specified range of soil moisture and nutrient regimes within a subzone or variant, but other factors, such as aspect or disturbance history may influence site series as well. Site modifiers are used to describe atypical conditions for an ecosystem.

Site series classification reflects subtle changes in microclimate and soil conditions, which reflect on the plant species composition within the unit. Generally, site series are further classified into Terrestrial Ecosystem Mapping (TEM) units based on the structural stage of the vegetation and the geomorphology of the site.

The study area was assessed prior to the site visits using aerial photo analysis (DoS, 2019a) and previous assessments conducted by Ecoscape (2016a) to differentiate potential TEM polygons. During field investigations, Site Visit Forms were filled out for representative plots within each of the TEM polygons identified in the study area. Terrestrial Ecosystem data, including information on hydrology,

vegetation, and tree mensuration were collected and described on a Site Visit Form as per the Field Manual for Describing Terrestrial Ecosystems 2nd Edition (BC MOFR and BC MOE, 2010).

3.2.2 Vegetation

3.2.3 Plant Species at Risk

In BC, there are two governing bodies involved with the ranking of species and/or ecological communities at risk. At the national level, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) works under the *Species at Risk Act* (SARA), and at the provincial level, the Conservation Data Centre (CDC) manages the B.C. Status List.

The Canadian government created SARA in 2002 to complement the Accord for the Protection of Species at Risk (a national effort to identify and protect threatened and endangered wildlife and their associated habitats across the country). COSEWIC is the scientific body responsible for assigning the status of species at risk under SARA. This system uses the following terminology:

- Extinct (XX)
- Extirpated (XT)
- Endangered (E)
- Threatened (T)
- Special concern (SC)
- Not at risk (NAR)
- Data deficient (DD)

A species that is listed as Endangered, Extirpated or Threatened is included on the legal list under Schedule 1 of the Act and is legally protected under SARA with federal measures to protect and recover these species in effect.

The BC CDC designates provincial red or blue list status to animal and plant species, and ecological communities of concerns (BC MSRM, 2002). The red list includes indigenous species or subspecies considered to be endangered of threatened. Endangered species are facing imminent extirpation/extinction, whereas threatened groups or species are likely to become endangered if limiting factors are not reversed. The blue list includes taxa considered to be vulnerable because of characteristics that make them particularly sensitive to human activities or natural events. Although blue listed species are at risk, they are not considered endangered or threatened. Yellow listed species are all those not included on the red or blue list and may be species which are declining, increasing, common, or uncommon (BC Ministry of Sustainable Resource Management, 2002).

A search of the BC Species and Ecosystem Explorer was conducted for rare and endangered plants in the relevant biogeoclimatic zone, Regional District and Forest District (BC MOE, 2018a). A list of potential plant species at risk, including habitat requirements for each, was produced from the results. Potential occurrences were then designated as unlikely or possible based upon species specific habitat requirements and an on-site assessment of those habitats. A targeted survey for each species was not possible due to time and budget constraints.

3.2.4 Ecological Communities at Risk

The CDC also tracks rare and endangered plant communities for the province of British Columbia. The term "ecological" is a direct reference to the integration of non-biological features such as soil, landform, climate and disturbance factors. The term "community" reflects the interactions of living organisms

(plants, animals, fungi, bacteria, etc.), and the relationships that exist between the living and non-living components of the "community". Currently, the most common ecological communities that are known in BC are based on the Vegetation Classification component of the Ministry of Forests and Range Biogeoclimatic Ecosystem Classification, which focuses on the terrestrial plant associations of BC's native plants.

A search of the BC Species and Ecosystem Explorer was conducted for rare and endangered plants in the relevant biogeoclimatic zone, Regional District and Forest District and further narrowed down to those occurring in the relevant site series (BC MOE, 2019a). A table was produced of the search results.

3.2.5 Invasive Species

Invasive plant species were noted as they were observed during the site investigations, as their removal provides an opportunity for restoration and enhancement of native vegetation throughout the study area.

3.2.6 Additional Environmentally Valuable Resources

Prior to conducting field work, information on baseline sensitive ecosystems within the study area were gathered from previous assessments conducted on behalf of the District of Squamish (Ecoscape *et al.*, 2016b) through the District's online mapping tools (DoS, 2019a). Environmentally Sensitive Area designations were established using the criteria previous developed for the District of Squamish (Ecoscape *et al.*, 2016b) and through additional analyses conducted for this assessment.

During site investigations, any additional environmentally valuable resources within the study area were also noted including wildlife trees, coarse woody debris, riparian areas, and wildlife movement corridors.

3.3 Wildlife (Terrestrial and Aquatic)

Observations of wildlife and wildlife signs were recorded, while comprehensive surveys for these species were not conducted as part of this assessment. Lists of wildlife species potentially occurring on the site were compiled from available resources and local knowledge of wildlife and habitat use. An assessment of the available wildlife habitat was conducted during the field visits while comprehensive surveys for wildlife species were not conducted but could be incorporated into a more detailed biological inventory at a later date.

The list of potential bird species was assembled from data on birds occurring in the Squamish Estuary collected by the Squamish Environmental Conservation Society (formerly the Squamish Estuary Conservation Society) and the Canadian Wildlife Service (SESC, 2004; SECS, 1994; Tretheway, 1985).

3.3.1 Rare and Endangered Wildlife Species

An online search for known species at risk occurrences was conducted (DataBC, 2019) and a search of the British Columbia Species and Ecosystems Explorer (BC MOE, 2019a) was conducted to identify all species at risk potentially occurring in the applicable biogeoclimatic zone, Regional District and Forest District and their habitat requirements. Potential occurrences are then designated as unlikely or possible based upon species specific habitat requirements and an on-site assessment of those habitats.

3.4 Aquatic and Riparian Environment

Online mapping tools were used to identify any watercourses within the study area (DataBC, 2019; DoS, 2019a). Current conditions were field verified and prior observations by Cascade were also taken into account (Cascade, 2019a, 2019b, 2017, 2014a & 2014b). Previous ditch mapping assessments conducted by Cascade (2019a), were also referenced during the environmental assessment for the

Loggers East Neighbourhood. A *Riparian Areas Regulation* (RAR) assessment was not completed for the study area during site assessments and should be conducted at a later date.

4 Results

The results of the environmental review and the identified environmentally valuable resources (EVRs), riparian areas and other significant environmental features identified within the study area are described in the sections below and shown in Map 2.

4.1 Physical Environment

The results discussed in this section on the physical environment of the study area are not considered environmentally valuable resources (EVRs), however, they are factors that may interact with and influence the EVRs that were identified onsite, to be discussed in Section 5.

4.1.1 Climate

The subject property lies in the Eastern Pacific Range Ecosection, within the Coast Mountains Ecoprovince in southern British Columbia (Demarchi, 1996). The climate is principally influenced by frontal systems moving in from the Pacific Ocean and over the Coast Mountains to the Interior. The town of Squamish lies within the Coastal Western Hemlock biogeoclimatic zone in the Dry Maritime (dm) variant, in which summers are typically warm and dry and winters are mild with little snowfall (Green and Klinka, 1994). Canadian Climate Normals station data from 1981 to 2010 establishes a mean annual temperature of 10.1 ºC, ranging from a monthly average of 2.5 ºC in December to 17.8 ºC in July and August, while mean annual precipitation is 2230.2 mm, ranging from 59.3 mm in July to 391.3 mm in November (Environment Canada, 2019). Snowfall is not significant, averaging 87.0 cm per year and falling between November and April (Environment Canada, 2019).

4.1.2 Geology

The study area lies within the South Coast Mountain Range and is underlain by granitic bedrock of the Coast Plutonic Complex. The area of the subject site is underlain by quartz dioritic intrusive rocks of the Upper Jurassic Period (157 - 145 million years ago) of the Mesozoic Era (DataBC, 2019). Resting on this granitic bedrock are alluvial and organic deposits.

4.1.3 Soils

The general soil type for the Coast Mountain and Islands physiographic region is of the Podzolic Order, residing in the Humo-Ferric Great Group. These soils overlay igneous intrusive rock, which is resistant to weathering, thus retarding soil development. The substrate within the majority of the study area has been largely anthropogenically impacted due to residential development. However, soils in undisturbed areas of the study area along the upper eastern bench were classified as coarse loamy soils that are xeric and subxeric with a poor nutrient regime, with the soils within the lower area of the study area classified as fluvially derived silty sand and are poorly drained (Ecoscape *et al.*, 2016a and DoS, 2019a).

4.1.4 Geomorphology

The majority of the Loggers East Neighbourhood lies approximately 10 m above sea level, within the historic floodplain of large local rivers (Squamish and Mamquam) within a previously glaciated valley. However, the eastern upper bench of the study area lies between 70 and 100 m above sea level, well above the historic floodplain, however still within a formerly glaciated valley. The eastern upper bench portion of the study area is underlain by bedrock, with the eastern and southern boundaries of the study area consisting of steeply sloping bedrock cliffs.

4.1.5 Hydrology

The Loggers East Neighbourhood contains significant waterbodies, with most connecting to the Finch Creek/Loggers Lane Creek system.

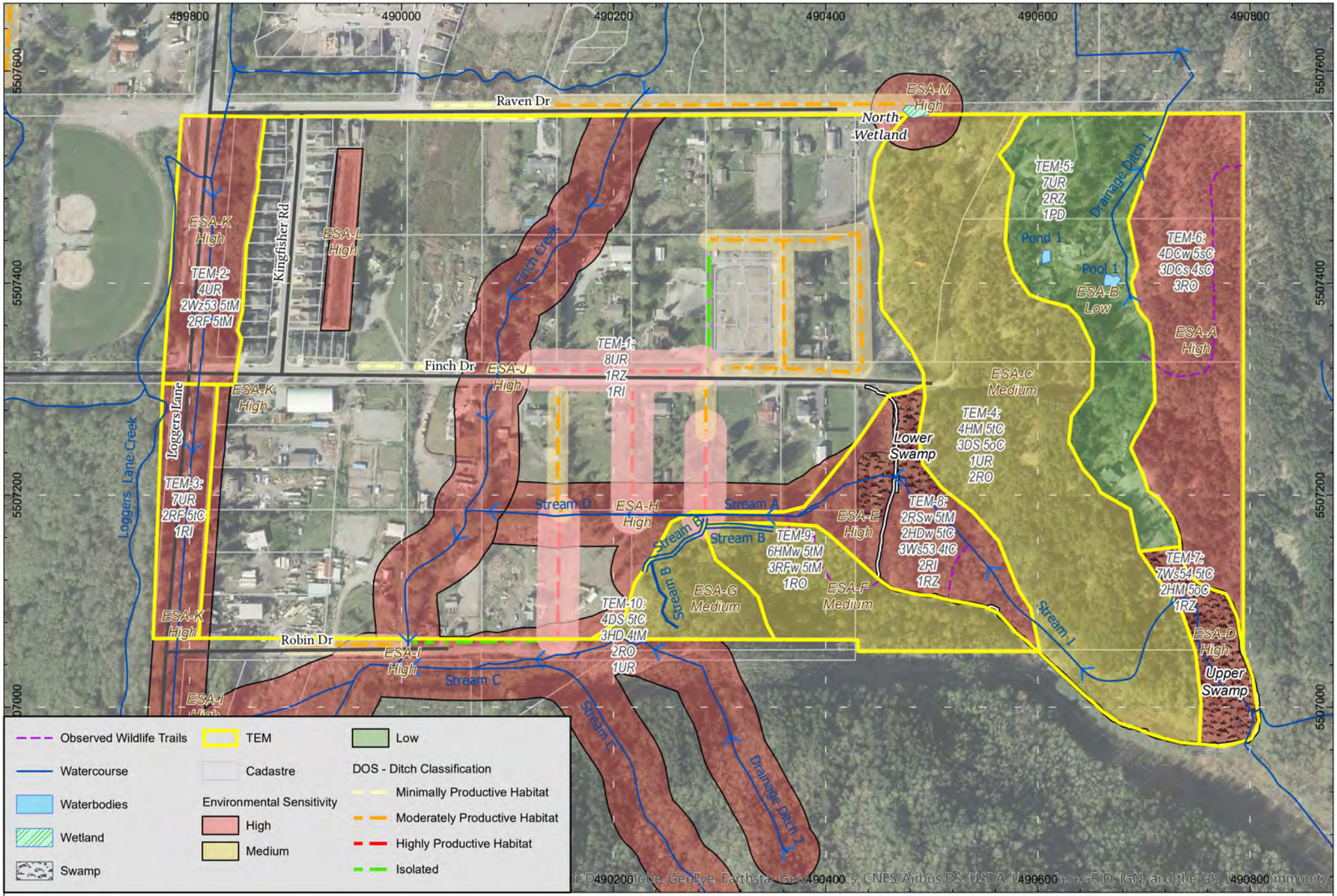
Finch Creek flows southwest through the centre of the study area and Loggers Lane Creek flows south along the western boundary of the study area. Finch Creek flows into Loggers Lane Creek approximately 300 m southwest of the southern property boundary of the study area, which then flows approximately 1.5 km south into the Mamquam Blind Channel.

Extensive roadside ditching is present throughout the Loggers East Neighbourhood, with some roadside ditches connecting to the Finch Creek/Loggers Lane Creek system.

The southeastern corner of the study area is largely undeveloped and still densely forested, with only one residential house constructed within this property. A swamp is located in the upper southeast corner of 1045 Finch Drive, and Stream 1 flows west through the upper swamp and cascades northwest down steep rocky outcrops to a second lower swamp located along the western boundary of 1045 Finch Drive. The access road for 1045 Finch Drive bisects the lower swamp located along the western property boundary of 1045 Finch Drive. The lower swamp outflows west and is channelized into Stream D that flows west behind the properties lining the southern side of Finch Drive. With no barriers to flow or fish passage, Stream D outflows to the Finch Creek system at the southeast corner at 1009 Finch Drive (Map 2). A third swamp is located off-property along the northern property boundary of 1050 Finch Drive. This swamp outflows into roadside ditching present along the northern side of Raven Drive, that eventually outflow into Finch Creek.

The upper eastern bench of the study area is generally dry and well drained, with the drainage within the site following the topography to the north and west. There was no pooling observed during the site visits of the upper eastern bench. A local drainage ditch (#1) is present that runs north along the bottom of the bedrock cliffs that border the eastern section of the study area. This drainage ditch was constructed by residents in this area to channelize the rainfall that cascades down the steep bedrock cliffs that are present along the eastern boundary of the study area.

The water features and aquatic habitat provided by these are discussed in Section 4.4 below.



GIS Cartographer: Oliver Chew
Date: September 26 2019
CERG File#: 064-48-02
Projection: UTM Zone 10N NAD83

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Map 2 - Current Environmental Conditions

District of Squamish Community Planning
Loggers East Sub Area Plan
Environmental Review
Squamish, British Columbia

4.2 Terrestrial Environment

4.2.1 Terrestrial Ecosystems Mapping

The study area is located within the dry maritime subzone (dm) of the Coastal Western Hemlock zone (CWH). Occurring at elevations up to 650 m, this biogeoclimatic subzone extends along the Sunshine Coast, and adjacent islands, to the lower Fraser Valley. (Green & Klinka, 1994)

The CWHdm has a coastal climate, which, in conjunction with existing soil conditions, results in productive forest growth. Typical tree species of this subzone include western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), shore/lodgepole pine (*Pinus contorta*), bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra)* (Green & Klinka, 1994).

The study area is described by seven vegetated and five non-vegetated TEM codes, which are shown on Map 2. Ten polygons were identified, which are subsets of the larger polygons resulting from prior mapping conducted by Ecoscape *et al.* (2016a) and have more specific codes. The breakdown of the TEM polygon codes is provided in Table 1 with definitions of the codes provided in Table 2 to Table 6 below. The paragraphs below summarize the vegetation associations and structural stages of each polygon. A list of the species observed within the study area is provided in Table 7.

4.2.2 Definitions and Descriptions

Table 1: TEM code explanations for the study area

Polygon #	TEM Code Abbreviations					
	Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
TEM-1	8	UR	-	-	-	-
	1	RZ	-	-	-	-
	1	RI	-	-	-	-
TEM-2	4	UR	-	-	-	-
	2	Ws53	-	5	t	M
	2	RF	-	5	t	M
TEM-3	7	UR	-	-	-	-
	2	RF	-	5	t	C
	1	RI	-	-	-	-
TEM-4	4	HM	-	5	t	C
	3	DS		5	o	C

	1	UR	-	-	-	-
	2	RO	-	-	-	-
TEM-5	7	UR	-	-	-	-
	2	RZ	-	-	-	-
	1	PD	-	-	-	-
TEM-6	4	DC	w	5	s	C
	3	DC	s	4	s	C
	3	RO	-	-	-	-
TEM-7	7	Ws54	-	5	t	C
	2	HM		5	o	C
	1	RZ	-	-	-	-
TEM-8	2	RS	w	5	t	M
	2	HD	w	5	t	C
	3	Ws53	-	4	t	C
	2	RI	-	-	-	-
	1	RZ	-	-	-	-
TEM-9	6	HM	w	5	t	M
	3	RF	w	5	t	M
	1	RO	-	-	-	-
TEM-10	4	DS	-	5	t	C
	3	HD		4	t	M
	2	RO	-	-	-	-
	1	UR	-	-	-	-

- **Decile** refers to the proportion of the ecosystem unit out of 10 found within a given polygon (the decile). A homogenous polygon is a 10.
- **Site Series** refers to the site series designation and can include microclimate and soil conditions (see Table 2).
- **Site Modifier** refers to possible site modifiers for atypical conditions (up to 2 letters can describe particular site characteristics such as aspect, slope, and soil; see Table 3).
- **Structural Stage** refers to the structural stage of the tree cover. Values range from 1 (sparse/cryptogam) – 7 (old forest) (see Table 4).
- **Stage Modifier** refers to possible canopy structure modifiers within a given structural stage (see Table 5).
- **Stand Composition** refers to possible stand composition modifiers (see Table 6).

Table 2: TEM codes for the study area

TEM Code Designation	BEC Site Series	Interpretation (typical conditions – assumed modifiers)
HM	01 (Hw – Flatmoss)	Significant slopes; middle slope position; deep medium textured soils (use aspect modifiers)[1].
DC	02 (FdPl – Cladina)	Gentle slope; crest position; shallow soil[1].
DS	03 (FdHw – Salal)	Significant slope, middle to upper slope position; warm aspect; deep medium textured soils[1].
RS	05 (Cw – Sword fern)	Significant slope, middle slope position, deep medium - textured soils; richer nutrient regime[1].
HD	06 (HwCw – Deer fern)	Gentle slope; lower slope position, receiving moisture, deep medium - textured soils[1].
RF	07 (Cw-Foamflower)	Gentle slope; lower slope position; richer nutrient regime, receiving moisture, medium - textured soil[1].
Ws53	Western redcedar – Sword fern – Skunk cabbage swamp	Receiving sites; occurs in depressions, toe slopes, and peatland margins; wet conditions in hollows, but better drained sites on mounds[2].
Ws54	Western redcedar – Western	Occurring in low-lying areas on floodplains and receiving sites at toe slopes and wetland margins. These sites are strongly mounded, with conifers on elevated microsites[2].

	hemlock – Skunk cabbage swamp	
PD	Pond	A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).
RI	River	A watercourse formed when water flows between continuous, definable banks. The flow may be intermittent of perennial.
RO	Rock Outcrop	A gentle to steep, bedrock escarpment or outcropping, with little soil development and spare vegetative cover.
RZ	Road Surface	An area cleared and compacted for the purpose of transporting goods and services by vehicles,
UR	Urban / Suburban	An area in which residences and other human developments form an almost continuous covering of the landscape. These areas include cities and towns, subdivisions, commercial and industrial parks, and similar developments both inside and outside city limits.

Sources:
1 Ecoscape *et al.*, 2016a
2 McKenzie and Moran, 2004.

Site series have assumed situations with respect to landscape position, soils, and moisture regimes. If a site series is atypical for any of the possible conditions, site modifiers are assigned. Table 3 describes the atypical conditions that exist on the site.

Table 3: TEM site modifiers for the subject site

Abbreviation	**Criteria**
s	Shallow soils – the site series occurs where soils are considered to be shallow to bedrock (20 – 100cm).
w	Warm aspect – the site series occurs on warm, southerly or westerly aspects (135^{o}-285^{o}), on moderately steep slopes (35%-100% slope in the CWH, CDF and MH zones).

McKenzie and Moran, 2004.

Structural stages in Table 4 describe the existing dominant stand appearance or physiognomy for the ecosystem unit.

Table 4: Vegetation structural stages found on subject site

Structural Stage Code	Interpretation
4	Pole/Sapling: Trees greater than 10 m tall, typically densely stocked, have overtopped shrub and herb layers; younger stand are vigorous (usually greater than 10-15 years old_; older stagnated stand (up to 100 years old) are also included; self-thinning and vertical structure are not yet evident in the canopy – this often occurs by age 30 in vigorous broadleaf stands, which are generally younger than coniferous stands at the same structural stage; time since disturbance is usually less than 40 years for normal forest succession; up to 100+ years for dense (5000-15 000+ stems per hectare) stagnant stands.
5	Young forest: self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers; vigorous growth and a more open stand than in the pole-sapling stage; begins as early as age 30 and extends to 50-80 years, depending on tree species and ecological conditions.

McKenzie and Moran, 2004.

Canopy structure modifiers (Table 5) and stand composition modifiers (Table 6) describe the structure and composition of the vegetation in more detail.

Table 5: Canopy structure modifiers for the subject site

Abbreviation	Interpretation
s	Single-storied: closed or open forest stand dominated by the overstorey crown class; intermediate and suppressed trees comprise less than 20% of all crown classes combine.
t	Two-storied: closed or open forest stand co-dominated by distinct overstorey and intermediate crown class; suppressed trees account for <20% of all crown classes combined.
o	Open: Forest stand with very open main and intermediate crown classes (totalling less than 25% cover); substantial understorey light levels commonly result in well-developed shrub and/or herb understorey.

McKenzie and Moran, 2004.

Table 6: Stand composition modifiers for the subject site

Abbreviation	Interpretation
B	Broadleaf: Greater than 75% of total tree layer cover is broadleaf.
C	Coniferous: Greater than 75% of total tree layer cover is coniferous.
M	Mixed: Neither coniferous nor broadleaf account for > 75% of total tree cover.

McKenzie and Moran, 2004.

4.2.3 Vegetation Associations

The paragraphs below summarize the vegetation associations and structural stages of the TEM polygons found in the study area.

Polygon TEM-1

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
8	UR	-	-	-	-
1	RZ	-	-	-	-
1	RI	-	-	-	-

Polygon TEM-1 makes up the majority of the study area and is located in the central portion of the study area (Photo 1 & Photo 2). Polygon TEM-1 is mostly non-vegetated polygon that is made up of 80% urban development, 10% road surfaces and 10% river. Residential residences and other development (horse stables, paddocks, dog kennels) dominates the polygon. Finch Creek flows southwest through Polygon TEM-1, and the roads of Raven Drive, Finch Drive and Robin Drive are also included within the polygon. It is 27.4 ha in size, making up 53 % of the study area.

Photo 1: Looking west along Raven Drive within Polygon TEM-1. March 22, 2019.

Photo 2: Looking northwest at Finch Creek culverted underneath Raven Drive, flowing southwest through study area. Within Polygon TEM-1. March 22, 2019.

Polygon TEM-2

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
4	UR	-	-	-	-
2	Ws53	-	5	t	M
2	RF	-	5	t	M

Polygon TEM-2 is located in the northwest corner of the study area and extends south along Loggers Lane (Photo 3 & Photo 4). It is made up of urban/suburban development (40%), along with 40% of young Western redcedar – Sword fern – Skunk cabbage swamp (Ws53) and a young forest instance of RF (07) CW – Foamflower (20%) site series (Ecoscape *et al.*, 2016a). Loggers Lane Creek flows south through this polygon, where it is culverted underneath Raven Drive.

Polygon TEM-2 is 1.82 ha in size, making up 3.5 % of the study area.

Photo 3: Loggers Lane Creek with Ws53 swamp present within Polygon TEM-2. September 28, 2017.

Photo 4: Ws53 swamp instance within the Polygon TEM-2. September 28, 2017.

Polygon TEM-3

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
7	UR	-	-	-	-
2	RF	-	5	t	C
1	RI	-	-	-	-

Polygon TEM-3 is located in the southwest corner of the study area along Loggers Lane (Photo 5 & Photo 6). It is made up of urban/suburban development (70%), and a young forest instance of RF (07) CW – Foamflower (20%) site series along with Loggers Lane Creek (10%) (Ecoscape *et al.*, 2016a).

Polygon TEM-3 is 1.14 ha in size, making up 2.2 % of the study area.

Photo 5: Looking south at Loggers Lane Creek flowing south through Polygon TEM-3. March 22, 2019.

Photo 6: Looking north at Loggers Lane adjacent to Loggers Lane Creek in Polygon TEM-3. March 22, 2019.

Polygon TEM-4

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
4	HM (01)	-	5	t	C
3	DS (03)	-	5	o	C
1	UR	-	-	-	-
2	RO	-	-	-	-

Polygon TEM-4 is located in the eastern section of the study area and is largely undeveloped, densely forested and consists of steep rocky outcrops through the lower middle section of the polygon (Photo 7, Photo 8, Photo 9 and Photo 10).

It is made up of a young forest occurrence of HM (01) Hw – Flat moss (40%), a young forest occurrence of DS (03) FdHw – Salal (30%), with rocky outcrops present (20%) and 10% of urban/suburban development associated with two residential houses, a denuded gravel area and an access road.

Polygon TEM-4 consists mainly of a young forest structural stage of western redcedar, western hemlock and Douglas-fir with instances of red alder, usually observed in areas of previous disturbance (i.e. road or utility development). The understorey layer consists of salal, red huckleberry, bracken fern and sword fern, with instances of dull Oregon-grape and spiny wood fern, with step moss and Oregon beaked moss included in the moss layer.

Polygon TEM-4 is 7.99 ha in size, making up 15.3 % of the study area.

Photo 7: Looking south at access road through Polygon TEM-4. March 22, 2019.

Photo 8: Looking east at steep bedrock cliffs that border Polygon TEM-4. March 22, 2019.

Photo 9: Looking northeast towards Polygon TEM-4 from access road within 1045 Finch Drive. March 26, 2019.

Photo 10: Western redcedar and red alder typical of Polygon TEM-4. March 26, 2019.

Polygon TEM-5

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
7	UR	-	-	-	-
2	RZ	-	-	-	-
1	PD	-	-	-	-

Polygon TEM-5 is 3.45 ha in size, making up 6.6 % of the study area. This polygon extends from the northern study area boundary along the eastern portion of the study area (Photo 11, Photo 12, Photo 13 and Photo 14).

The polygon consists of 70% urban development which includes four single-family residentially homes, 20% road surface which includes part of the access road to the upper east Finch Drive lots as well as driveway surfaces and 10% pond surface which consists of two decorative ponds found in the garden spaces of two of the residential houses (Cascade, 2019b).

Photo 11: Looking west towards a single-family house in Polygon TEM-5. January 30, 2019.

Photo 12: Looking southeast at denuded and graveled area in the northern section of the study area. January 30, 2019.

Photo 13: Looking northwest at fenced garden plot located at the southern end of Polygon TEM-5. January 8, 2019.

Photo 14: Looking north towards single-family home contained within the southern portion of Polygon TEM-5. March 26, 2019.

Polygon TEM-6

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
4	DC (02)	w	5	s	C
3	DC (02)	s	4	s	C
3	RO	-	-	-	-

Polygon TEM-6 is located in the eastern portion of the study area and is characterized by young forest and pole/sapling instances of the Douglas-fir – Lodgepole pine – Cladina site series with steep bedrock escarpments (Photo 15, Photo 16, Photo 17 and Photo 18). This polygon consists of a single-storied coniferous forest dominated by Douglas fir, with lesser instances of lodgepole pine and western redcedar. The largest trees within this polygon have DBHs of 32 cm for Douglas-fir, 27 cm for lodgepole pine and 21 cm for western redcedar. The understorey layer is sparse and is dominated by salal, with instances of red huckleberry and dull Oregon-grape. Moss species observed in this polygon include red stemmed feather moss and step moss.

The terrain within this polygon is characterized by significant sloping terrain situated on a middle slope position with a warm aspect. The soils are shallow with the restricting layer being bedrock and is classified as subxeric with a poor nutrient regime. Steep rock outcrops are present along the western boundary of this polygon (Cascade, 2019b).

Photo 15: Typical vegetation in Polygon TEM-6 showing pole/sapling structural stage and dull Oregon-grape in the understorey layer. January 30, 2019.

Photo 16: Steep rock outcrops observed within Polygon TEM-6. January 30, 2019.

Photo 17: Pole/sapling structural stage observed within Polygon TEM-6 2. January 30, 2019.

Photo 18: Large amounts of coarse woody debris were observed during the site assessment of Polygon TEM-6. January 30, 2019.

Polygon-TEM-7

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
7	Ws54	-	5	t	C
2	HM		5	o	C
1	RZ	-	-	-	-

Polygon TEM-7 is 0.87 ha in size, making up 1.7 % of the study area. This polygon is located in the southeast corner of the study area.

Polygon TEM-7 mostly consists (70%) of a Western redcedar – Western hemlock – Skunk cabbage (Ws54) swamp, which acts as a drainage receiving site from heavily forested and undeveloped land to the east of the polygon (Photo 19 and Photo 20). This swamp is referred to as *Upper Swamp*, and its eastern boundary is delineated by the access road that was constructed for residential use as well as hydro maintenance.

Surrounding vegetation consists of western redcedar and western hemlock with some Douglas-fir observed as well. Red alder and instances of vine maple were observed within this polygon, especially along areas of previous disturbance such as the road and culvert installations that outflow into the identified swamp. The shrub layer consists of salal and dull Oregon-grape with instances of red huckleberry and salmonberry. Sword fern and bracken fern were observed during the site assessment, as were red stemmed feather moss and step moss.

Photo 19: Ws54 swamp observed during site assessment, within Polygon TEM-7. March 26, 2019.

Photo 20: Skunk cabbage observed within Ws54 swamp of Polygon TEM-7. March 26, 2019.

Polygon-TEM-8

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
2	RS	w	5	t	M
2	HD	w	5	t	C
3	Ws53	-	4	t	C
2	RI	-	-	-	-
1	RZ	-	-	-	-

Polygon TEM-8 is 2.28 ha in size, making up 4.4 % of the study area. This polygon is located south of Finch Drive, in the southeast corner of the study area.

Polygon TEM-8 consists of (20%) of a young forest occurrence of RS(05) Cw - Swordfern site series with 20% of young forest of HD(06) HwCw – Deerfern (Photo 21) and 40% of a Western redcedar – Swordfern – Skunk cabbage swamp (Ws53 swamp) in the northern portion of the polygon that is bisected by an access road (Photo 22 and Photo 23). This swamp is referred to as *Lower Swamp.* Stream 1 flows north through this polygon (Photo 24) outflowing into the Ws53 swamp at the northern portion of the polygon at the bottom of the steep rocky outcrops that lie to the east. The access road for the residential house within 1045 Finch Drive runs through this polygon, connecting to Finch Drive just north of Polygon TEM-8.

The tree layer is dominated by western redcedar and western hemlock along with bigleaf maple and red alder. The shrub layer is dominated by vine maple, western redcedar with salal, dull Oregon-grape and red huckleberry. The herb layer consists of sword fern, bracken fern and deer fern. Moss species observed within this polygon included step moss, red-stemmed feather moss and lanky moss.

The terrain within this polygon is a lower slope transitioning to a middle slope, with steep rocky outcrops bordering the eastern portion of the polygon. This polygon was given the modifier of a warm aspect as part of this polygon occurs on a warm westerly aspect on moderately steep slopes with deep medium textured soils (Ecoscape *et al.*, 2016a).

Photo 21: TEM plot within Polygon TEM-8, looking northeast. March 26, 2019.

Photo 22: Ws53 swamp (Lower Swamp) to the east of access road in 1045 Finch Drive, Polygon TEM-8. March 26, 2019.

Photo 23: Ws53 swamp(Lower Swamp) to the west of access road in 1045 Finch Drive, Polygon TEM-8. March 26, 2019.

Photo 24: Looking northwest down Stream 1 contained within Polygon TEM-8. March 26, 2019.

Polygon-TEM-9

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
6	HM	w	5	t	M
3	RF	w	5	t	M
1	RO	-	-	-	-

Polygon TEM-9 is 1.94 ha in size, making up 3.7 % of the study area. This polygon is located along the southern boundary of the study area and lies to the south of the properties that line the southern side of Finch Drive.

Polygon TEM-9 includes (70%) of a young forest occurrence of HM(01) Hw – Flat moss site series with 30% of the young forest occurrence of RF(07) Cw – Foamflower (Photo 25 and Photo 26). This polygon consists of a mixed forest dominated by western redcedar, western hemlock with small amounts of red alder and bigleaf maple. The understorey layer is not dense and is dominated by vine maple and salmonberry, with instances of red huckleberry, salal, hardhack and devil's club. The herb layer is dominated by sword fern with instances of spiny wood fern and deer fern. Moss species observed within this polygon included step moss and red-stemmed feather moss.

The terrain within this polygon is a lower slope transitioning to a middle slope, with steep rocky outcrops present throughout the southeastern section of the polygon. This polygon was given the modifier of a warm aspect as the southern part of this polygon occurs on a warm westerly aspect on moderately steep slopes, with medium textured soils (Ecoscape *et al.*, 2016a).

Photo 25: Looking northwest from plot location in Polygon TEM-9. March 26, 2019.

Photo 26: Sword fern and coarse woody debris dominate the forest floor within Polygon TEM-9. March 26, 2019.

Polygon-TEM-10

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
4	DS	-	5	t	C
3	HD		4	t	M
2	RO	-	-	-	-
1	UR	-	-	-	-

Polygon TEM-10 is 1.05 ha in size, making up 2.0 % of the study area. This polygon is located along the southern boundary of the study area and lies to the south of the properties that line the southern side of Finch Drive and is contained within Lot 17.

Polygon TEM-10 includes (40%) of a young forest occurrence of DS(03) FDHw - Salal site series with 30% of pole/sapling stage of HD(06) HwCw – Deer fern (Photo 27), with a small depression along the bottom of the steep rocky outcrops that are present along the southern boundary of the polygon (Photo 28). Historical clearing in the western section of this polygon has impacted approximately 10% of the total area, where red alder has predominantly grown back.

This polygon consists of a mixed forest dominated by western red cedar and western hemlock with lesser amounts of red alder. The understory layer consists of salal, salmonberry and vine maple with instances of red huckleberry. The herb layer consists of swordfern and deer fern along with instances of bracken fern and spiny wood fern observed as well. Moss species observed within this polygon included step moss and red-stemmed feather moss.

The terrain within this polygon is a lower slope transitioning to a middle slope, with steep rocky outcrops present throughout the southeastern section of the polygon, with deep medium textured soils (Ecoscape *et al.*, 2016a).

Photo 27: Looking west from plot location within Polygon TEM-10. March 26, 2019.

Photo 28: Small instance of wetted area observed at the toe of steep rocky outcrops within Polygon TEM-10. March 26, 2019.

4.2.4 Vegetation

A list of vegetation observed within the study area during the site inspections is found in Table 7 below.

Table 7: Vegetation observed in the study area

Layer	Common Name	Scientific Name
Trees	Western hemlock	*Tsuga heterophylla*
	Western redcedar	*Thuja plicata*
	Lodgepole pine	*Pinus contorta*
	Douglas-fir	*Pseudotsuga menziesii*
	Red alder	*Alnus rubra*
	Bigleaf maple	*Acer macrophyllum*
Shrubs	Salal	*Gaultheria shallon*
	Dull Oregon-grape	*Mahonia nervosa*
	Red huckleberry	*Vaccinium parvifolium*
	Salmonberry	*Rubus spectabilis*
	Snowberry	*Symphoricarpos albus*
	Thimbleberry	*Rubus parviflorus*
	Trailing blackberry	*Rubus ursinus*
	Vine maple	*Acer circinatum*
	Devil's club	*Oplopanax horridus*
	Hard hack	*Spiraea douglasii*
	English holly*	*Ilex aquifolium*
	Himalayan blackberry*	*Rubus armeniacus*
	Japanese knotweed*	*Fallopia japonica*
Herbs	Bracken fern	*Pteridium aquilinium*
	Spiny wood fern	*Dryopteris expansa*
	Bracken fern	*Pteridium aquilinum*
	Sword fern	*Polystichum munitum*
Mosses	Unidentified mosses	-
	Step moss	*Hylocomium splendens*
	Lanky moss	*Rhytidiadelphus loreus*
	Red stemmed feather moss	*Pleurozium schreberi*

* denotes invasive species

4.2.5 Plant Species at Risk

The species at risk listed in below have the potential to occur in the CWH biogeoclimatic zone within the Squamish Forest District and the Squamish-Lillooet Regional District based on their habitat requirements as outlined by the biogeoclimatic classification system.

Table 8: Potential Plant Species at Risk

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
Bidens amplissima	Vancouver Island beggarticks	Occupies a variety of wetland habitats including ditches, willow wetlands, old riverbeds, pond margins, streamsides, and tidal or non-tidal river edges. Historically known to occur within habitat restoration cells within the Squamish Estuary.	**Potential** – along ditches, streams and identified swamps within the study area	Blue	1-SC
Brachythecium holzingeri	Holzinger's brachythecium moss	Occurs at base of trees and downed woody debris, typically in more mature, un-disturbed forest stands.[1]	Unlikely – young age of forest	Blue	-
Brotherella roellii	Roell's brotherella	Rotten wood in cool to moist mixed deciduous and coniferous forest, usually at low elevations along valley margins on slopes, stream terraces and swampy floodplains; often in remnant second growth in city parks.[2]	**Potential** –known populations nearby in Squamish (Brackendale and Dentville)	Red	1-E
Bryum schleicheri	-	Wet tundra on the coast and in oceanic interior ranges; wet soil or rocks at alpine elevations. Grows on soil/rocks and stream banks.	Unlikely – low elevation	Blue	-
Callicladium haldanianum	-	Logs and stumps in coniferous and deciduous forests; at low to moderate elevations.[3]	**Potential** – in forested polygons in the eastern portion of the study area	Blue	-
Claytonia washingtoniana	Washington springbeauty	Moist to mesic moss rock outcrops and forests in the lowland and montane zones above 250 m; nearest known occurrence is in Burnaby.	Unlikely – elevation below 250 m	Red	-

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
Grimmia anomala	Grimmia dry rock moss	On rocks or in crevices of exposed rocks, 4000-7000 ft elevation.	Unlikely –due to low elevation	Blue	-
Hygrohypnum alpinum	Alpine Brook-moss	Along cold, clean swiftly running mountain streams.	Unlikely – no mountain streams	Blue	-
Pinus albicaulis	Whitebark pine	Within montane forests and on thin, rocky, cold soils at or near timberline.	Unlikely – low elevation and no montane forest habitat	Blue	1-E
Pohlia cardotii	-	Found along rills at 6000-8000 ft.	Unlikely – low elevation	Blue	-
Sphagnum contortum	-	Low to mid elevations in rich soils nears streams; shade intolerant.[1]	**Potential** – in SE polygons with swamp habitat or margins of riparian habitat within study area, only known occurrences in BC are in Peace Region[3]	Blue	-
Stellaria obtusa	Blunt-sepaled starwort	Riparian/Meadow/Seeps in the montane zone above 500 m.	Unlikely – low elevation	Blue	-
Tripterocladium leucocladulum	-	Shaded to exposed rocks, cliffs and bark of hardwoods (oaks and maples), occurring mostly at low elevations.	**Potential** – on shaded to exposed rocks and cliffs, on bark of trees in forested polygons in the eastern and southern portions of the study area	Blue	-

Source: BC Species and Ecosystem Explorer search for the CWHdm biogeoclimatic zone in the Squamish Forest District and Squamish-Lillooet Regional District (BC MOE, 2019a).
Habitat information from BC MOE, 2019a unless otherwise cited.
[1] Golder, 2014.
[2] COSEWIC, 2010.
[3] CFCI, 2011.
[4] BC MOE, 2019a.

4.2.6 Ecological Communities at Risk

There are nine listed ecological communities within the CWHdm biogeoclimatic zone in the Squamish Forest District, 6 of which are associated with the site series found within the study area and 3 of which have no site series specified (Table 9). No mature or old growth instances of any of these ecological communities were observed during the site assessments.

The first listed ecological community is the red listed Douglas-fir – lodgepole pine / oceanspray / reindeer lichen ecological community (site series DC) which is found within the young forest and pole/sapling forests of Polygon 6.

The second listed ecological community is the blue listed Douglas-fir – western hemlock / salal Dry Maritime ecological community (site series DS), which is found in young forests of Polygons 4 and 10.

The third listed ecological community is the red listed Western redcedar – sword fern ecological community (site series RS), that is found in Polygon TEM-8.

The fourth listed ecological community is the red listed Western hemlock – western redcedar / deer fern ecological community (site series HD), that is found in Polygon TEM-8 and TEM-10.

The fifth listed ecological community is the blue listed Western redcedar – Sword fern – Skunk cabbage swamp wetland class (Ws53). Instances of this ecological community were observed in Polygon TEM-8.

The sixth listed ecological community is the blue listed Western redcedar – Western hemlock - Skunk cabbage swamp wetland class (Ws54). Instances of this ecological community were observed in Polygon TEM-7.

The first ecological community for which the site series is not specified, is the red listed dune wildrye – beach pea ecological community. This herbaceous community is restricted to coastal sand dunes where the natural dynamics of ocean currents contribute to the deposition and accretion of sandy materials and no such habitat exists within the study area.

The second ecological community for which the site series is not specified, is water shield - bladderworts ecological community, the status is not listed for this community. This community is restricted to the wetland realm – mineral wetland group, with shallow water (aquatic) wetland class (Ww) there are no Ww classified wetland habitat within the study area.

The third ecological community for which the site series is not specified, is common eel-grass, the status is not listed for this community. This community is restricted to the estuarine realm, specifically the estuarine tidal flat class (Et), and no such habitat exists within the study area (BC MOE, 2019a).

Table 9: Potential Ecological Communities at Risk

Scientific Name	English Name	Site Series	BC List	Potential Occurrence
Pseudotsuga menziesii - Pinus contorta / Holodiscus discolor / Cladina spp.	Douglas fir – lodgepole pine / oceanspray / reindeer lichens	CWHdm/02 (DC)	Red	Polygon TEM-6 in study area (eastern extent of study area)
Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon	Douglas fir – western hemlock / salal	CWHdm/03 (DS)	Blue	Potentially Polygon TEM-4 and TEM-10. Mature instances were not observed during site investigations.
Thuja plicata/Polystichum minitum	Western redcedar / sword fern	CWHdm/05 (RS)	Red	Potentially Polygon TEM-8, however not likely present in study area - mature and old forest instances are not present in the study area.
Tsuga heterophylla - Thuja plicata / Blechnum spicant	Western hemlock – western redcedar / deer fern	CWHdm/06 (HD)	Red	Potentially Polygon TEM-8 and TEM-10, however not likely present in study area - Mature and old forest instances are not present in the study area.
Thuja plicata – Tsuga heterophylla – Lysichiton americanus	Western redcedar – Western hemlock - Skunk cabbage	CWHdm/Ws54	Blue	Polygon TEM-7
Thuja plicata – Picea sitchensis - Lysichiton americanus	Western redcedar – Sword fern – Skunk cabbage	CWHdm/Ws53	Blue	Polygon TEM-8
Leymus mollis ssp. mollis - Lathyrus japonicus	Dune wildrye - beach pea	CWHdm (site series not specifiied)	Red	Not present on site
Brasenia schreberi - Utricularia spp.	Water shield – bladderworts	CWHdm (site series not specifiied)	No status	Not present onsite
Zostera marina Herbaceous vegetation	Common eel-grass	CWHdm (site series not specified)	No status	Not present onsite

Source: BC Species and Ecosystem Explorer search for the CWHdm biogeoclimatic zone in the Squamish Forest District and Squamish-Lillooet Regional District (BC MOE, 2019a).

4.2.7 Invasive Species

A detailed invasive species survey was not conducted as part of the environmental review, however invasive species were noted when they were observed during field assessments. Himalayan blackberry (Photo 29) and English holly were routinely observed throughout the study area and removal can be undertaken by private residents as required for restoration purposes.

Patches of Japanese knotweed were observed along the ditch line that borders the road right-of-way north of 1050 Finch Drive, as well as along the gravel access road that runs north to south through 1050 Finch Drive (Photo 30).

Site specific invasive species survey should be conducted prior to individual lot development.

Photo 29: Instance of Himalayan blackberry observed during site assessments in Polygon TEM-1. July 10, 2019 (Cascade, 2019b).

Photo 30: Japanese knotweed observed within the study area at the northwest corner of Polygon TEM-4. June 20, 2019 (Cascade, 2019b).

4.2.8 Additional Environmentally Valuable Resources

4.2.9 Wildlife Trees

Wildlife trees include significant standing snags, mature trees, and trees with broken tops or other defects. These trees are important as perching areas for raptors such as bald eagle (*Haliaeetus leucocephalus*) and red-tailed hawk (*Buteo jamaicensis*), as foraging/nesting sites for woodpeckers, small owls and other cavity nesters, and as den habitat for small to large mammals including squirrels, bats, and bears.

Observations of wildlife trees were limited to the undeveloped areas of the study area, specifically the southeastern corner and the upper eastern bench of the study area in Polygons TEM 8 and 10 samples of which are shown in Photo 31 and Photo 32.

Photo 31: Evidence of woodpecker and sapsucker activity on stump in Polygon TEM-10. March 26, 2019.

Photo 32: Pileated woodpecker evidence observed on wildlife tree located in Polygon TEM-8. March 26, 2019.

4.2.10 Coarse Woody Debris

Coarse woody debris on the forest floor is an indicator of potential species richness for forested areas. Micro habitats, decay, and nutrient cycling provide a range of life-cycle opportunities for wildlife and vegetation.

Large amounts of coarse woody debris were observed within the forested and undeveloped polygons (Polygon TEM 4, TEM-6, TEM-7, TEM-8, TEM-9 and TEM-10) of the study area along the eastern and southern study area boundaries. Coarse woody debris observed consisted of old stumps, medium sized logs and small and medium branches (Photo 33 and Photo 34).

Photo 33: Dead and fallen trees providing coarse woody debris in Polygon TEM-8. March 26, 2019.

Photo 34: Medium-sized logs on the forest floor providing coarse woody debris in Polygon TEM-6. January 30, 2019 (Cascade, 2019b).

4.2.11 Riparian Areas

Functions of riparian areas include sediment, nutrient and pollution control (capture and retention of sediments, nutrients and pollution from upland runoff), erosion control (help to stabilize adjacent stream channels), flood storage, infiltration to recharge groundwater, wildlife habitat for small mammals, songbirds and herpetofauna, and a food and nutrient source for downstream fisheries resources. The riparian zone is one of the most biologically diverse land areas, and in some areas are the only remaining natural zones. Riparian habitats are attractive to numerous bird, mammal, and amphibian species, which utilize them as drinking, cover, movement, forage, breeding, and preening areas. The majority of the riparian habitat exists in the southeast corner of the study area, as well as the riparian areas associated with Finch Creek and Loggers Lane Creek that is retained within the study area. The riparian habitat is discussed further in Section 4.4 below.

4.2.11.1 Rock Outcrops

Rocky habitats can provide valuable habitat to reptiles, birds, and small mammals including bats, as the cracks and crevices can provide shelter and be used for denning, nesting, roosting or as hibernacula. Rocky habitats are of particular value to reptiles, which are ectothermic (i.e. have no internal means for body temperature regulation), as the rocks can retain heat and be used to regulate body temperatures.

Rock outcrops, areas of exposed bedrock, are abundant and scattered throughout the study area and are most abundant along the eastern and southern boundaries of the study area (Polygons TEM-4, TEM-6, TEM-9 and TEM-10).

4.2.12 Wildlife Movement Corridors

Wildlife tend to use routes that have particular features when moving across the landscape to forage for food, disperse, find mates, or locate breeding sites. These features can include cover, shade, vegetation, or surface characteristics. Due to the developed nature of the central and western areas of the study area, it is not expected that significant and established wildlife movement corridors are present within the residential neighbourhood. However, the less developed, forested eastern and southern areas of the study area provide cover, shade and riparian features that may attract wildlife.

A well-established wildlife trail was observed in Polygon TEM-6 that led east from the northeast corner of Polygon TEM-5 and traversed north along the upper rocky cliffs of Polygon TEM-6 (Photo 35). Black tailed deer (*O. h. columbianus)* scat was frequently observed on this established wildlife trail in Polygon TEM-6, which is adjacent to undeveloped forest to the east (Photo 36). This wildlife trail would probably be frequented by black bear (*Ursus americanus*) and coyote (*Canis latrans*) as well (Cascade, 2019b). Other wildlife trails were observed in Polygon TEM-8 and TEM-9 and appear to be used by wildlife to access water from Stream 1 and Stream A respectively.

Due to the undeveloped nature of the southeastern portion of the study area and its connection to undeveloped and heavily forested land to the east and south, it can be assumed that it is well traveled by wildlife.

In addition to large animal movement corridors, amphibians also disperse from their natal aquatic habitat to more terrestrial rearing areas. Dispersion areas around the creeks and swamps would include their associated riparian habitat and the more upland forests adjacent to those features.

Photo 35: Looking west down wildlife trail used to access the upper cliff sections of Polygon TEM-6. January 30, 2019.

Photo 36: Black-tailed deer scat observed within Polygon TEM-6. January 30, 2019.

4.2.13 Sensitive Ecosystems

There are 13 environmental sensitivity area polygons within the study area that are summarized in Table 10 below (refer to Map 2). Note that riparian areas associated with streams that run through the areas below would also have high environmental sensitivity (see Section 4.4). Ditches that flow into fish bearing waters, and their associated riparian habitat would also have high environmental sensitivity.

In the eastern portion of the study area, Polygon TEM-6 falls within ESA-A, which is rated as highly sensitive due to the presence of coniferous woodland and sparsely vegetated rock outcrop (DoS, 2019a; Ecoscape *et al.*, 2016b). It was confirmed during field investigations that the forested area in Polygon TEM-6 consists of coniferous woodland and sparsely vegetated rock outcrop. The coniferous woodland and sparsely vegetated rock outcrop is rated as highly sensitive due to its structural stage, rock outcrop features, abundance of coarse woody debris, its wildlife corridor connection to the undeveloped forest to the east, and the presence of a red listed ecological community (site series RS).

Polygon TEM-5 falls within ESA-B, which is rated as low environmental sensitivity as it consists of disturbed ecosystems (DoS, 2019a; Ecoscape *et al.*, 2016b). It was confirmed that this portion of the study area consists of existing development (residential housing and gardens) and has low environmental sensitivity. Note that the drainage ditch 1 and associated riparian habitat that flows through this polygon would have a high environmental sensitivity rating.

Polygon TEM-4 falls within ESA-C, which is rated as medium environmental sensitivity as it consists of young coniferous forest and disturbed ecosystems (DoS, 2019a; Ecoscape *et al.*, 2016b). It was confirmed that this portion of the study area consists of young coniferous forest as well as disturbed ecosystems consistent with residential development (and the access road), as well as clearing from utility installation and has medium environmental sensitivity. Environmentally valuable resources included a moderate amount of coarse woody debris in the forested portions, and some rocky outcrops. One blue listed ecological community is found in this polygon (site series DS). Note that Stream 1 and its associated riparian habitat that flows through this polygon would have a high environmental sensitivity rating.

Polygon TEM-7 falls within ESA-D, which is rated as having a high environmental sensitivity rating as it consists of 30% wetland (swamp) habitat which is associated with the identified Ws54 swamp (a blue listed ecological community), as well as 30% of disturbed ecosystems from the road alignment as well as utility maintenance that has occurred in Polygon TEM-7. Abundant coarse woody debris was noted in the undisturbed portions of Polygon TEM-7. Polygons adjacent to the Ws54 swamp also provided undisturbed dispersion opportunities for amphibians that could utilize the wetlands.

Polygon TEM-8 falls within ESA-E, which was previously rated as having moderate sensitivity (DoS, 2019a; Ecoscape et al., 2016b). Cascade has re-assessed and reclassified this polygon as having a high environmental sensitivity rating as it consists of young coniferous forest, some anthropogenic disturbance but also contains valuable riparian habitat with the presence of a Ws53 swamp (a blue listed ecological community) and outflow to Stream D, which is known to be salmon bearing. Environmentally valuable resources included an abundance of coarse woody debris and wildlife trees. Two red listed ecological communities are also found in this polygon (site series RS & HD).

Polygon TEM-9 falls within ESA-F, which is rated as medium environmental sensitivity as it consists of young mixed forest (DoS, 2019a; Ecoscape *et al.*, 2016b). It was confirmed that this portion of the study area consists of young mixed forest with open spaces and has medium environmental sensitivity. Environmentally valuable resources included an abundance of coarse woody debris and the occurrence of rocky outcrops. Note that the streams and their associated riparian habitat that flow through this polygon would have a high environmental sensitivity rating.

Polygon TEM-10 falls within ESA-G, which is rated as medium environmental sensitivity as it consists of young coniferous forest (DoS, 2019a; Ecoscape *et al.*, 2016b). It was confirmed that this portion of the

study area consists of young forest with some evidence of anthropogenic influence and has medium environmental sensitivity. Environmentally valuable resources included an abundance of coarse woody debris and wildlife trees. One red listed ecological community (Site series HD) and one blue listed ecological community (Site series DS) are also found in this polygon. Note that the streams and their associated riparian habitat that flow through this polygon would have a high environmental sensitivity rating.

ESA-H contains Stream D, that flows west along the northern boundary of Lot 17 in the southern portion of the study area. ESA-H is rated as high environmental sensitivity due to the riparian habitat associated with Stream D.

ESA-I contains Stream C, that flows west along the southern boundary of Robin Drive in the southern portion of the study area and drains into Logger Lane Creek. ESA-I also contains Drainage ditch 2, that intermittently connects downstream with Finch Creek. ESA-I is rated as high environmental sensitivity due to the riparian habitat associated with the Loggers Lane Creek and Finch Creek systems.

ESA-J is associated with Finch Creek that flows southwest through the study area. The mature broadleaf forest is located outside the study area, however the riparian habitat associated with Finch Creek in the study area is rated as high environmental sensitivity.

ESA-K is associated with Loggers Lane Creek, which Cascade has extended south to contain Polygon TEM-3 as well as Polygon-TEM 2. TEM-2 was previously rated as having moderate sensitivity, and TEM-3 was rated as having low sensitivity (DoS, 2019a; Ecoscape et al., 2016b); however, Cascade has re-assessed and reclassified these polygons as having a high environmental sensitivity rating due to the riparian habitat associated with Loggers Lane Creek.

ESA-L is associated with Polygon TEM-1 and has been rated by Ecoscape et al. (2016b) as high environmental sensitivity as it consists of wetland/swamp habitat. This feature, however, appears to have been constructed in 2010, as part of the Kingfisher Road development, likely to provide a raingarden/ stormwater retention function, in addition to its habitat function. As such, although it is rated as having high sensitivity, it should be recognized that maintenance of this feature may be required in the future to retain its stormwater functions.

ESA-M is a wetland/swamp (Ws53) (referred to as *North Wetland*) and associated riparian habitat at the eastern end of Raven Drive and has been given a high environmental sensitivity rating due to the riparian features present.

The remainder of the study area within TEM-1 has an environmental sensitivity of low due to the current development in that area, except in the noted creek and ditch side riparian areas which would have a high sensitively rating.

Table 10: Environmentally Sensitive Area (ESA) polygons within the study area

Environmentally Sensitive Area Polygon	Corresponding Polygon TEM	Environmental Sensitivity Ranking
ESA-A	Polygon TEM-6	High -80% coniferous woodland -20% sparsely vegetated rock outcrop
ESA-B	Polygon TEM-5	Low -100% Disturbed Ecosystems
ESA-C	Polygon TEM-4	Medium -80% Young coniferous forest -20% Disturbed Ecosystems
ESA-D	Polygon TEM-7	High -70% Wetland (swamp) -30% Disturbed Ecosystems
ESA-E	Polygon TEM-8	High -60% Mixed Young Forest -20% Wetland Swamp -20% Disturbed Ecosystems
ESA-F	Polygon TEM-9	Medium -100% Young mixed forest
ESA-G	Polygon TEM-10	Medium -100% Young coniferous forest
ESA-H	Polygons TEM- 9 and TEM-10, and Stream D	High -100% Riparian (fringe)
ESA-I	Stream C and Drainage Ditch 2 (outside study area)	High -100% Riparian (fringe)
ESA-J	Finch Creek	High -60% Mature Forest (broadleaf) -20% Wetland

		-20% Disturbed Ecosystems
ESA-K	Polygons TEM-2 and TEM-3 (Loggers Lane Creek)	High -40% Wetland (swamp) -40% Disturbed Ecosystems -20% Young mixed forest
ESA-L	Within Polygon TEM-1	High -100% Wetland (swamp)
ESA-M	North Wetland (partially within Polygon TEM-4) outside study area)	High -100% Wetland (swamp)

Source: Ecoscape *et al.*, 2016b and DoS, 2019a; modified by Cascade Environmental.

4.3 Wildlife (Terrestrial and Aquatic)

4.3.1 Wildlife

The study area contains potential wildlife habitat due to the presence of:

- Riparian and aquatic habitat
- Coniferous-dominated young forest
- Wildlife trees including mature trees and snags
- Coarse woody debris
- Available forage (e.g. berries)

4.3.2 Amphibians and Reptiles

A valley garter snake (*Thamnophis sirtalis fitchi*) was observed in Lot 17 during field assessments on March 22, 2019 (Photo 37). No amphibians were observed during field investigations, however amphibians typically found in the CWH biogeoclimatic zone and known to be found in the area include northern red-legged frog (*Rana aurora*), northern Pacific treefrog (*Hyla regilla*), northwestern salamander (*Ambystoma gracile*), rough-skinned newt (*Taricha granulose*), and the long-toed salamander (*Ambystoma macrodactylum*) (Green and Campbell, 1984).

Valuable riparian zone habitat associated with Finch Creek, Loggers Lane Creek, Stream 1 and swamp habitat observed in the southeast corner of the study area have habitat features that would support amphibian populations. Northern red-legged frogs have been previously captured by Cascade (2014b) in roadside ditches along Finch Drive, and it is expected that amphibians may also be found in other roadside ditches that present desirable habitat attributes within the study area.

Garter snakes (*Thamnophis* spp.) and alligator lizards (*Elgaria coerulea*) are reptiles commonly found in the region, the latter being a regionally significant species. The forested areas located on the upper east bench as well as the rocky exposures and cliff faces in the eastern section of the study area have the capacity to support reptile populations.

Photo 37: Valley garter snake observed in Lot 17. March 22, 2019.

4.3.3 Birds

The ecosystems of the CWH biogeoclimatic zone are considered to have the greatest diversity and abundance of habitat elements in British Columbia, which results in having a broad diversity of bird species. Vegetation and watercourses within the study area provide habitat for a number of avian species. The full list of potential bird species for the subject site, based on data from the Squamish River and Estuary collected by the Squamish Environment Conservation Society (formerly the Squamish Estuary Conservation Society) and the Canadian Wildlife Service, is included in Appendix 1 (SECS, 2003-2004; SECS, 1992-1994; Tretheway, 1985).

Birds audibly detected or visually observed during the site assessment on March 22, 2019 included American robin (*Turdus migratorius*), northern flicker (*Colaptes auratus*), Pacific wren (*Troglodytes pacificus*), white-crowned sparrow (*Zonotrichia leucophrys*), Steller's jay (*Cyanocitta stelleri*), pileated woodpecker (*Dryocopus pileatus*) (audibly detected in Lot 17), spotted towhee (*Pipilo maculatus*) and black-capped chickadee (*Poecile atricapillus*).

Insect and bird bore holes were observed in wildlife trees identified within the study area, indicating foraging by woodpeckers and sapsuckers, and previously used song bird nests were observed (Photo 38).

Photo 38: Songbird nest identified in Polygon TEM-10. March 26, 2019.

4.3.4 Mammals

Mammal species that are likely to visit the general area include: large mammals such as black bears (*Ursus americanus*), cougars (*Puma concolor*), and black-tailed deer (*Odocoileus hemionus columbianus*); mid-sized mammals such as coyotes (*Canis latrans*), bobcats (*Lynx rufus*), raccoons (*Procyon lotor*), spotted skunks (*Spilogale gracilis*); and small mammals such as squirrels (*Tamiasciurus* spp.), chipmunks (*Tamias* spp.), mice (*Peromyscus* spp.), voles (*Microtus* spp.), and bats (*Myotis* spp.).

4.3.5 Fish

The Finch Creek/Loggers Lane Creek system is a significant fish-bearing system that eventually flows into the Mamquam Blind Channel.

Previous Cascade salvage and inventory efforts report the presence of salmonids and coarse fish. Cascade has captured coho salmon (*Oncorhynchus kisutch*), cutthroat trout (*Oncorhynchus clarkia*),

three-spine stickleback (*Gasterosteus aculeatus*), lamprey (*Lampetra sp.*) and sculpin (*Cottus sp.*) during salvage efforts of Finch Creek (Cascade, 2017 & 2014a).

Fisheries Inventory Data Queries (FIDQ) reports the presence of coho salmon, rainbow trout, cutthroat trout, lamprey, stickleback, sculpin, threespine stickleback, coastal cutthroat trout, prickly sculpin and western brook lamprey within Loggers Lane Creek (BC MOE, 2019b).

Most of the roadside ditches contained within the study area are either directly connected or are ephemerally connected to the Finch Creek/Loggers Lane Creek system. Stream D (described in Section 4.4 below) outflows from the lower Ws53 swamp into Finch Creek with no apparent barriers to fish passage.

4.3.6 Wildlife Species at Risk

The table below includes wildlife species at risk listed by the CDC (i.e. red and blue listed) as well as those listed on Schedule 1 of the SARA that have the potential to occur within the study area.

Table 11: Potential Wildlife Species at Risk

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Amphibians and Reptiles					
Anaxyrus boreas	Western Toad	Various aquatic and terrestrial habitats including riparian areas around ponds, lakes, reservoirs and slow-moving rivers/streams.	**Potential** – associated with swamp habitat in northeastern corner of study area	Yellow	1-SC
Ascaphus truei	Coastal Tailed Frog	Clear, cold swift-moving mountain streams with coarse substrates in older forest sites.	Unlikely – no mountain streams	Yellow	1-SC
Charina boottae	Northern Rubber Boa	Woodlands, meadows and clearings, not far from water, often under rotting logs or stumps, rocks or bark of dead fallen trees, from sea level to about 3,500 m.	**Potential** – in forested polygons and in eastern upper bench portion of study area	Yellow	1-SC
Contia tenuis	Sharp-tailed Snake	Moist pastures, meadows, oak woodlands, broken chaparral, and edges of coniferous or hardwood forests.	Unlikely – forest edges are unnatural and disturbed	Red	1-E

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Rana aurora	Northern Red-legged Frog	Wetlands, pools, and riparian areas of upland forests.	**Confirmed** – associated with roadside ditches and swamp habitat in SE corner of study area (Cascade, 2014b)	Blue	1-SC
Birds					
Accipiter gentilis laingi	Northern Goshawk, *laingi* subspecies	Low elevation old-growth and mature second-growth forests	Unlikely – young forest, outside of identified critical habitat	Red	1-T
Ardea herodias fannini	Great Blue Heron, *fannini* subspecies	Aquatic areas <0.5 m deep, fish bearing streams and rivers, undisturbed nesting in tall trees.	**Potential** – associated with swamp habitat in SE corner of study area	Blue	1-SC
Brachyramphus marmoratus	Marbled Murrelet	Nest in the canopy of large (30 m +) old growth forests in coastal areas up to 50 km inland, in salt water usually within 0.5 km of shore.	Unlikely – young forest, outside of identified critical habitat	Blue	1-T
Butorides virescens	Green Heron	Aquatic areas, especially slow moving, shallow waters with good riparian cover; nest in vegetation over water or sometimes in dry woodlands.	**Potential** – associated with swamp habitat in SE corner of study area	Blue	-
Chordeiles minor	Common Nighthawk	Open coniferous forests, savanna, grasslands, fields, vicinity of cities and towns. Nesting on bare ground in open areas.	**Potential** – in sparsely vegetated areas with rock outcrops	Yellow	1-T
Contopus cooperi	Olive-sided Flycatcher	Various forest habitats: subalpine coniferous forest, mixed forest, burned-over forest, bogs and forested wetlands, along forested riparian areas, especially where dead tall snags are present. Mostly nests in conifers where tall dead snags are present.	**Potential** – in forested riparian areas	Blue	1-T

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Cypseloides nniger	Black Swift	Forages over forests and in open areas. Nests behind or next to waterfalls and wet cliffs, or in caves.	**Potential** – foraging and nesting along rocky cliffs in eastern upper bench	Blue	-
Euphagus carolinus	Rusty Blackbird	Breeds in boreal forests. Winters in mid- to eastern US and irregularly in the southern part of most Canadian provinces. Winters in damp woodlands and cultivated fields. Known to occur in the Squamish River Estuary.[1]	**Potential** – overwintering habitat in forested polygons adjacent to ditches and riparian areas	Blue	1-SC
Falco peregrinus anatum	Peregrine Falcon, *anatum* subspecies	Cliff edges near water, interior rivers and wetlands.	Unlikely - nearest known nest is the Chief, 6 km away	Red	1-SC
Hirundo rustica	Barn Swallow	Open areas, fields, ponds with vertical nesting habitat, especially buildings.	**Potential** – in association with riparian areas, vertical cliff nesting habitat and residential outbuildings	Blue	1-T
Megascops kennicottii kennicottii	Western Screech-Owl, *kennicottii* subspecies	Lower elevations in woodland, especially broadleaf and riparian woodland, also moist coniferous forests; often in riparian zones; nests in tree cavities.	**Potential** – in forested riparian areas	-	1-T
Patagioenas fasciata	Band-tailed Pigeon	Partial migrants; generally breed in temperate and mountain coniferous and mixed forests; forage in cultivated areas, suburban gardens and parks.	**Potential** – foraging and breeding in forested area and residential gardens	Blue	1-SC
Strix occidentalis	Spotted Owl	Old growth, dense, multi-layer canopy coniferous forest with a range of snags and nesting hollows available.	Unlikely – young forest, outside of identified critical habitat	Red	1-E
Mammals					
Gulo gulo luscus	Wolverine, *luscus* subspecies	Large home ranges in alpine and arctic tundra, boreal and mountain forests, may overwinter in riparian areas usually having snow.	Unlikely - low elevation	Blue	1-SC

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Myotis keenii	Keen's Myotis	Associated with coastal forest habitat. Mostly, but not restricted to, old growth.	Unlikely – young forest	Blue	-
Myotis lucifungus	Little Brown Myotis	Nests in caves, hollow trees, human-made structures. Foraging usually in woodlands near water.	**Potential** – foraging in riparian forests, only critical habitat identified in BC is in northern BC[2]	Yellow	1-E
Oreamnos americanus	Mountain Goat	Steep alpine and subalpine habitat.	Unlikely - low elevation	Blue	-
Pekania pennanti	Fisher	Large tracts (>100 ha) of dense forests at low to mid-elevation <2500 m.	Unlikely – habitat highly fragmented	Blue	-
Sorex bendirii	Pacific Water Shrew	Semi-aquatic; moist riparian habitats of streams and marshes below 850 m in coniferous/mixed forests usually within 200 m of water.[3]	Unlikely – no coniferous/mixed forests, outside of identified critical habitat	Red	1-E
Ursus arctos	Grizzly Bear	Non-forested or partially forested sites with a wide range of foraging behaviours and choice of habitats.	Unlikely – habitat highly fragment, known to only pass through the Squamish area on a rare occasion	Blue	-
Fish					
Acipenser medirostris	Green Sturgeon	Coastal marine waters, estuaries and the lower reaches of large rivers.	Unlikely – only aquatic habitat are ditches and swamp	Red	1-SC
Oncorhynchus clarkia clarkii	Cutthroat Trout, *clarkia* subspecies	Low gradient coastal streams and estuarine habitats.	**Confirmed** – captured by Cascade during salvage efforts in Loggers Lane Creek	Blue	-
Salvelinus confluentus	Bull Trout	Deep pools in cold rivers <15° C and lakes to small, steep gradient streams.	Unlikely – no suitable aquatic habitat	Blue	-

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Invertebrates					
Argia vivida	Vivid Dancer	Spring fed stream or pools.	Unlikely – no suitable aquatic habitat	Red	-
Cicindela hirticollis	Hairy-necked Tiger Beetle	No habitat information provided. All known occurrences in Metro Vancouver area.	Unknown	Blue	-
Erynnis propertius	Propertius Duskywing	Open oak or mixed woodlands with the foodplant oaks.	Unlikely – no oak present	Red	-
Euphyes vestris	Dun Skipper	Grassland/shrub, vernal pools and seasonal seeps.	Unlikely – no grasslands, vernal pools or seeps	Red	1-T
Galba bulimoides	Prairie Fossaria	Habitat preferences not fully known. Descriptions vary, including perennial-water habitats (lakes, ponds and slow-moving streams), seepage areas and small streams; characteristically in seasonal flowing water.	**Potential** - associated with riparian areas	Blue	-
Galba dalli	Dusky Fossaria	Habitat preferences not fully known, but potentially include lakes, ponds, rivers and marshes across southern BC. Only 4 known occurrences, two of which are not confirmed.	**Potential** - associated with riparian areas	Blue	-
Gyraulus crista	Star Gyro	Eutrophic ponds, oligotrophic lakes, slow moving streams and seasonal ponds in central and eastern BC.	**Potential** - associated with riparian areas	Blue	-
Ophiogomphus occidentalis	Sinuous Snaketail	Sunny stream banks and sandy lakeshore beaches at low elevations.	Unlikely – no sunny streambanks	Blue	-
Parnassius clodius claudianus	Clodius Parnassian, *claudianus* subspecies	Moist riparian habitats along low-elevation streams on the coast.[4]	**Potential** – in forested riparian areas	Blue	-
Parnassius clodius pseudogallatinus	Clodius Parnassian, *pseudogallatinus* supspecies	Moist riparian habitats along low-elevation streams on the coast.[4]	**Potential** – in forested riparian areas	Blue	-

Scientific Name	**Common Name**	**Habitat Requirements**	**Potential Occurrence**	**BC List Status**	**SARA Status**
Physella propinqua	Rocky Mountain Physa	Only 14 records in BC. Board habitat types from central to southern BC. Habitat information is not available, but may include lakes and rivers.	Unknown	Blue	-
Physella virginea	Sunset Physa	Only 7 records in BC over broad habitat types (lakes, rivers, creeks and sloughs)	**Potential** – associated with riparian areas	Blue	-
Sphaerium striatinum	Striated Fingernailclam	Lotic (flowing) and lentic (still lake or pond) environments and on mud, sand, gravel and rock substrates and is most abundant at water depths of less than 2 m	**Potential** – associated with riparian areas	Blue	-

Source: BC Species and Ecosystem Explorer search for the Squamish-Lillooet Regional District, Squamish Forest District and CWH Biogeoclimatic Zone (BC MOE, 2019a).
Habitat information from BC MOE, 2019a unless otherwise cited.
[1] COSEWIC, 2006
[2] Environment Canada, 2015c
[3] Craig *et al.*, 2010.
[4] Klinkenberg, 2018

4.4 Aquatic and Riparian Environment

The study area contains numerous stream systems, roadside ditches, swamps and an isolated pool and pond. These watercourses and the associated riparian areas are discussed in the sections below and the locations shown on Map 2. As the study area consists of private property, access was not gained to some properties, hence the information contained within this section is a preliminary aquatic and riparian assessment.

4.4.1 Finch Creek

Finch Creek (Photo 39) flows southwest through the middle of the study area, for approximately 600 m until it joins Loggers Lane Creek. Finch Creek is a significant watercourse within the study area as it provides habitat for regionally significant fish (cutthroat trout) and provides valuable riparian habitat for wildlife living and travelling through the Loggers East Neighbourhood. Previous Cascade salvage and inventory efforts report the presence of salmonids and coarse fish. Cascade has captured coho salmon, cutthroat trout, three-spine stickleback, lamprey eel and sculpin during salvage efforts (Cascade, 2017 & 2014). Finch Creek is a permanent and fish-bearing watercourse with a resultant Streamside Protection and Enhancement Area (SPEA) between 15 – 30 m – *Riparian Areas Regulation* (RAR) assessment still to be conducted.

4.4.2 Loggers Lane Creek

Loggers Lane Creek (watershed code: 900-091900) (Photo 40) flows south along the western boundary of the study area and continues flowing south until it flows into the Mamquam Blind Channel approximately 1.5 km south of the study area. Loggers Lane Creek is a significant watercourse in Squamish as it supports the annual spawning of coho and chum salmon.

Fisheries Inventories Data Queries (FIDQ) as well as previous Cascade salvage and inventory efforts, report the presence of coho salmon, rainbow trout (*Oncorhynchus mykiss*), cutthroat trout, lamprey, stickleback, sculpin, threespine stickleback, coastal cutthroat trout, prickly sculpin (*Cottus asper*) and western brook lamprey (*Lampetra richardsoni*) (BC MOE, 2019b and Cascade, 2017 & 2014). Loggers Lane Creek is a permanent and fish-bearing watercourse with a resultant SPEA between 15 – 30 m – RAR assessment still to be conducted.

4.4.3 Wetlands/Swamps

Instances of a Ws53 swamp (western redcedar – sword fern – skunk cabbage) and a Ws54 swamp (western redcedar – western hemlock – skunk cabbage) were observed in the southeastern area of the study area within 1045 Finch Drive. Stream 1 is a steep watercourse with gradients of 45% that flows north through the southeast corner of the study area through the Upper Ws54 swamp before it cascades down steep rocky outcrops where it outflows into the Lower Ws53 swamp at the northern boundary of 1045 Finch Drive. The Lower Ws53 swamp is bisected by an access road and flows west where it is channelized into Stream D that flows west along the northern boundary of Lot 17, eventually outflowing into Finch Creek.

North Wetland/Swamp is a Ws53 swamp that is located at the eastern end of Raven Drive (Photo 41 and Photo 42). North Wetland drains west into a channelized ditch that is contained within the Raven Drive road right-of-way where it connects to the roadside ditching that runs along the northern side of Raven Drive, eventually flowing into Finch Creek.

Identified wetlands/swamps will be subject to SPEAs between 15-30 m depending on the assessment method used in the RAR assessment.

Photo 39: Looking southwest at Finch Creek from Raven Drive. March 22, 2019.

Photo 40: Looking south at Loggers Lane Creek from intersection of Finch Drive and Loggers Lane. March 22, 2019.

Photo 41: Skunk cabbaged observed in North Wetland. July 10, 2019 (Cascade, 2019b).

Photo 42: Sedges observed within the North Wetland. July 10, 2019 (Cascade, 2019b).

4.4.4 Tributary Streams

Stream 1 (Photo 24) flows from the Upper Swamp (ESA-D) that feeds the Lower Swamp (ESA-E). With a gradient out of the Upper swamp near 45%, it is unlikely to be fish bearing, however its waters eventually reach Finch Creek.

Stream D flows (Photo 41) west along the southern property boundaries of lots 1015 to 1039 Finch Drive and flows into Finch Creek approximately 300 m to the west of the eastern property boundary of 1039 Finch Drive. There are no barriers to fish passage between Stream D and the lower Ws53 swamp that is contained within 1045 Finch Drive. Stream D is named differentiated from Stream 1 due to its ditch morphology, however, in accordance with the *Water Sustainability Act* and the *Riparian Areas Regulation*, it is regarded as a channelized stream and is subject to those pieces of legislation.

Stream A (Photo 44) is a small tributary that collects drainage from the upper slope of Lot 17 and flows north into Stream D. Stream B also collects drainage water from the upper slope of Lot 17 and flows north into Stream A. Stream A, B and D are fish-bearing as there are there are no barriers to fish passage between Finch Creek and Stream D, and during previous assessments Cascade observed a dead coho fry at the confluence of Stream A and Stream B (Cascade, 2016).

Stream C flows west along the south side of Robin Drive and is primarily fed by stormwater drainage from the upper slope. Stream C meanders south along Robin Drive, pooling in sections until it joins with Loggers Lane Creek just south of the southern study area boundary (Photo 45 and Photo 46).

The tributary streams discussed above are subject to an RAR assessment, with resultant SPEAs ranging from 15 to 30 m, to be determined during the RAR assessment for specific development.

Photo 43: Looking west along Stream D that flows along the southern property boundaries of Finch Drive. March 26, 2019.

Photo 44: Looking west at Stream A within Lot 17. March 26, 2019.

Photo 45: Looking east up rocky slope where Stream C drains from. March 22, 2019.

Photo 46: Stream C as it flows and pools along Robin Drive. March 22, 2019.

4.4.5 Roadside Ditches

The classification, fish-bearing status, connectivity and flow of the roadside ditches were not assessed in the field for this environmental review, as Cascade has conducted a separate in-field assessment of the roadside ditches for the District of Squamish (Cascade, 2019a).

4.4.5.1 Raven Drive Ditches

Roadside ditches are present along most of Raven Drive, and act to drain the road as well as properties along the southern side of Raven Drive. The roadside ditch along the northern side of Raven Drive is ephemerally connected to the fish-bearing Finch Creek and is classified “Orange” as described in Table 34-3 - DPA 1 Ditch Classification Matrix in DPA 1 (DoS, 2019b), with a resultant 5.0 m Streamside Protection and Enhancement Areas (SPEA). The orange-classified ditch along the north side of Raven Drive also acts to collect drainage water from the upper eastern bench, however the steep bedrock cliffs west of 1056 Finch Drive preclude fish passage to the upper eastern bench of the study area. Ditches along the western end of Raven Drive have been classified “Yellow” as described in Table 34-3 - DPA 1 Ditch Classification Matrix in DPA 1 (DoS, 2019b), with a resultant 2.0 m Streamside Protection and Enhancement Areas (SPEA).

4.4.5.2 Finch Drive Ditches

Roadside ditches are present along Finch Drive that act to drain subject properties and the paved road of Finch Drive. All roadside ditches east of Finch Creek are either ephemerally or directly connected to the fish-bearing Finch Creek and are either classified “Orange” or “Red” as described in Table 34-3 - DPA 1 Ditch Classification Matrix in DPA 1 (DoS, 2019b), with resultant 5.0 m or 10.0 m SPEA respectively.

Previous assessments have been conducted by Cascade for the Finch Drive roadside ditches east of Finch Creek (Cascade, 2014b). The roadside ditches east of Finch Creek along Finch Drive are linear, with the average channel width measuring 1.51 m. This stretch of “Orange” classified ditch was dry during the RAR assessment conducted by Cascade on June 27, 2014, but contained water during follow up visits by Cascade (October 23, 27 & 28, 2014), with a maximum water depth of approximately 40 cm. Water and sediment were orange in colour and heavily oxidized. On October 28, 2014, the water temperature was 9.9 °C, turbidity was 7.34 NTU, pH was 4.75 and dissolved oxygen was 3.8 mg/L (34%) (Cascade, 2014b). Bed materials are dominantly silty fines, leaf litter and organic debris. Both banks are moderately sloped. There was no large woody debris observed as it is a maintained roadside ditch; however, overgrown shrubs and young coniferous trees offer cover. Riparian vegetation observed along the ditch line included young western redcedar, red alder, salmonberry and Himalayan blackberry. No fish were found during minnow trapping; however, one northern red-legged frog (*Rana aurora*) was caught during the assessment (Cascade, 2014b). The northern red-legged frog is Blue listed in BC and listed as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

4.4.5.3 Robin Drive Ditches

Roadside ditches are present on the north side of Robin Drive (Photo 45), and Stream C flows west along the southern side of Robin Drive and flows into Loggers Lane Creek just south of the southern boundary of the study area (Photo 46). The roadside ditches that border the southern boundaries of 1014 and 1020 Robin Drive are isolated and merely collect stormwater runoff from the two subject properties and the adjacent Robin Drive. The roadside ditches that border the southern property boundaries of 38900 Loggers Lane and 1008 Robin Drive, are ephemerally connected to the fish-bearing Finch Creek and are classified “Orange” as described in Table 34-3 - DPA 1 Ditch Classification Matrix in DPA 1 (DoS, 2019b), with a resultant 5.0 m SPEA.

Photo 47: Looking west showing Robin Drive ditch. March 22, 2019.

Photo 48: Looking south from Robin Drive where Finch Creek confluences with Stream C. March 22, 2019.

4.4.6 Other Ditches and Aquatic Features

Onsite Drainage Ditch 1 (flowing north through 1070 & 1057 Finch Drive)

There is an onsite drainage ditch 1 located on 1057 and 1070 Finch Drive that is an artificial watercourse that was constructed by residents for drainage purposes and flows north from the southern property boundary of 1070 Finch Drive (Photo 49). The drainage ditch 1 works to drain water off the study area that cascades down the bedrock cliffs that border the eastern study area boundary. The drainage ditch 1 flows north off the study area eventually flowing into the Finch Creek / Loggers Lane Creek system downstream. The drainage ditch 1 is non-permanent, with its flow influenced primarily by precipitation from the adjacent bedrock cliffs. The intermittent nature of the drainage ditch 1 and the steep slope that exists between the northern study area boundary and the wetland confluence precludes fish passage into this onsite drainage ditch 1 (Cascade, 2019b).

Private Property Boundary Ditches

As shown on Map 2, there are several ditches along the private property parcels in the Loggers East Neighbourhood. These ditches are straight, and were constructed to facilitate site drainage. They have low gradients, and are generally ephemerally or permanently connected to the fish bearing streams in the area. As such, depending on the specific situation, they can provide rearing fish habitat when they are wetted, as well as providing breeding sites for amphibians (Photo 50).

Photo 49: Looking south within 1070 Finch Drive at drainage ditch 1 running along bottom of bedrock cliffs between Polygons TEM-5 and TEM-6. January 8, 2019.

Photo 50: Typical ditch bordering private property within the study area. March 22, 2019.

Artificial Ponds

There are two isolated, artificial waterbodies located within 1070 Finch Drive that are associated with the residential house and are both located in Polygon TEM-5.

Pool 1 is located along the eastern boundary of Polygon TEM-5 and has been constructed by the property owner to collect rainwater in the study area and is part of the fenced garden complex (Photo 51). There is no inflow into the pool, with outflow into the ditch occurring only during extreme storm events.

Pond 1 is located directly west of the residential house at 1070 Finch Drive and, through the analysis of aerial photos, it appears the pond was constructed by the excavation of bedrock when the house was developed (Photo 50). The pond is isolated with no apparent inflow or outflow (precluding fish presence) (Cascade, 2019b).

Photo 51: Looking east at Pool 1 within the fenced garden on 1070 Finch Drive. February 21, 2019.

Photo 52: Looking east at Pond 1 located behind the residential house on 1070 Finch Drive. February 21, 2019.

5 Discussion

The sections below discuss the implications of the Environmentally Valuable Resources (EVRs) that were identified within the study area in Section 4 above, and their implications in the development of the Loggers East Sub Area Plan. Recommended habitat preservation areas and areas where sensitive design is recommended in regards to the identified EVRs in the study area are shown on Map 3.

5.1 Physical Environment

As previously stated, the elements of the physical environment are not considered environmentally valuable resources (EVRs) and the discussion in this section instead focuses on how these elements may interact with and influence the EVRs identified on and near the site.

5.1.1 Climate

As the climate changes, the International Panel on Climate Change (IPCC) predicts an increase in the frequency, intensity and/or amounts of precipitation in mid-latitude locations (IPCC, 2013). Increased precipitation and, in turn, increased stormwater runoff will emphasize the importance of wetland and riparian area functions as they relate to sediment control, erosion control and flood storage.

5.1.2 Geology

The geology of the study area, and potential associated geotechnical issues, is being addressed through a separate geotechnical study.

5.1.3 Soils

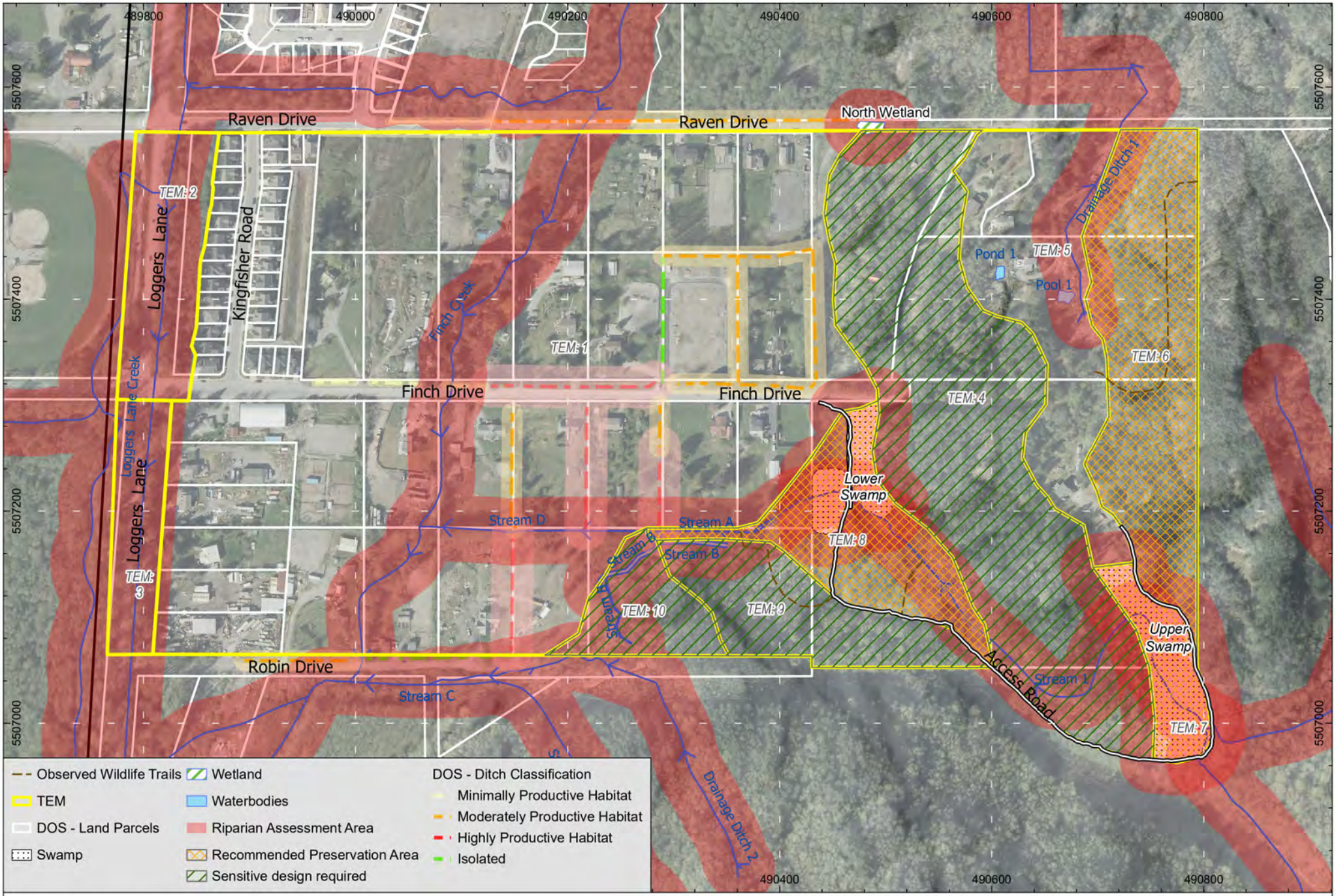
Detailed analysis of the soils found in the study area was not part of the terms of reference for this study.

5.1.4 Geomorphology

The geomorphology of the study area influenced the location and formation of the various environmental features within the study area. The geomorphology of the area will also influence the location of any new servicing in the Loggers East neighbourhood, which in turn could affect the EVRs described below.

5.1.5 Hydrology

Vegetation removal, soil compaction by machines, and surface hardening for any proposed development (e.g. paved roads, roofs, etc.) will decrease the stormwater infiltration capacity of the study area, and increase the likelihood of flashy, unfiltered stormwater drainage. The District of Squamish have developed storm water standards within their Subdivision and Development Control Bylaw, to address the design of stormwater management systems, to provide guiding principles for conventional stormwater management methods, and to provide alternative, preferred, stormwater management systems. The District may review these criteria, to ensure that applicable storm water management is adhered to for any future development within the study area.



GIS Cartographer: Oliver Chew
Date: September 25 2019
CERG File#: 064-48-02
Projection: UTM Zone 10N NAD83
Orthophoto/Data: DOS
TOB from GPS NOT Surveyed

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Map 3 - Recommended Habitat Protection Areas
District of Squamish Community Planning
Loggers East Sub Area Plan
Environmental Review
Squamish, British Columbia

5.2 Terrestrial Environment

5.2.1 Terrestrial Ecosystem Mapping

The results of the Terrestrial Ecosystem Mapping were used to determine the potential for species and ecosystems at risk to occur in the study area, which are discussed separately in the sections below.

5.2.2 Vegetation

5.2.3 Plant Species at Risk

There are no known occurrences of any plant species at risk in the study area (as listed by the BC Conservation Data Centre or on Schedule 1 of the *Species at Risk Act*), nor were any observed during the site investigations, however, there is the potential for some species at risk to occur. One flowering plant and four species of mosses were identified as having the potential to occur within the study area: Vancouver Island beggarticks (Blue, Special Concern), Roell's brotherella (Red, Endangered), *Callicladium haldanianum* (Blue), *Sphagnum contortum* (Blue) and *Tripterocladium leucocladulum* (Blue).

Vancouver Island beggarticks were identified as having the potential to occur along the ditch and swamp margins within the study area. The suitable habitat for these species will mostly be protected under the prescribed riparian setbacks through the *Riparian Areas Regulation* (RAR) and DPA 1 guidelines of the current District of Squamish OCP.

Habitat requirements for the mosses were all identified as having the potential to occur within the forested polygons either on the moist soil, rotting coarse woody, or on the bark of deciduous trees or on shaded to exposed rocks or cliff faces. Preservation of riparian areas and rock bluff areas would ensure that suitable areas for these species would be retained.

5.2.4 Ecological Communities at Risk

The red listed ecological community (CWHdm/02) of Douglas-fir – lodgepole pine / oceanspray / reindeer lichen (DC) is found within the young forest and pole/sapling forests of Polygon TEM-6. This ecological community occurs on ridge crests, hilltops and south-facing upper slopes, often on areas with shallow soils and exposed bedrock. Sites are rapidly to well drained, very dry and often nutrient poor (Green and Klinka 1994; University of British Columbia Department of Forest Sciences, 1991). Within the study area, this community is located on the upper cliff bench that borders the eastern study area boundary. Due to its steep and inaccessible nature, future development of this area would require significant alterations to the land. Within Polygon TEM-6, 40% is comprised of this red listed community, with a further 30% consisting of rock outcrops. With 70% of this polygon consisting of EVRs, Polygon TEM-6 is an excellent candidate for preservation (Map 3).

The red listed ecological communities (CWHdm/05) of western redcedar / sword fern (RS) and (CWHdm/06) western hemlock – western redcedar / deer fern (HD) are both found in the young forests within Polygon TEM-8. With 90% of the polygon's area consisting of EVRs (20% red listed RS, 20% red listed HD, 30% Ws53 swamp, and 20% riverine), Polygon TEM-8 is a good candidate for preservation (Map 3).

Red listed ecological community HD is also found in Polygon TEM-10, making up 30% of that polygon. A further 20% of polygon TEM-10 is comprised of rock outcrops; with 50% of this polygon's area being comprised of EVRs, environmental issues from potential future development may be able to be dealt with on a site specific basis, where the specific EVRs are retained in Polygon TEM-10 (Map 3).

The blue listed ecological community (CWHdm/03) Douglas-fir – western hemlock / salal (DS) is found in the young forests of Polygons TEM-4 and TEM-10. According to the BC Conservation Data Centre, this ecological community has a wide range, and overall the threat impacts to this community are assessed as

high due to conversion of forest with good ecological integrity to residential development, harvesting impacts and climate change impacts (BC MOE, 2019a). Development in the study area should be carefully designed to retain as much of the ecological integrity of the existing forest stand as possible (Map 3).

The blue listed ecological community (CWHdm/Ws53) Western redcedar – Sword fern – Skunk cabbage is found in Polygon TEM-8 and in the swamp at the eastern end of Raven Drive. This ecological community is associated with the swamp/wetland habitat that will be protected under the *Water Sustainability Act* as well as the District of Squamish's DPA 1. Development pressures are a continuing threat for this ecological community (BC MOE, 2019a.). Ws53 swamps should be protected.

The blue listed ecological community (CWHdm/Ws54) Western redcedar – Western hemlock - Skunk cabbage is found in Polygon TEM-7. This ecological community is associated with the swamp/wetland habitat that will be protected under the *Water Sustainability Act* as well as District of Squamish's DPA 1. Polygon TEM-7 is an excellentcandidate for preservation (Map 3).

5.2.5 Invasive Species

The removal of the invasive species from the study area will help prevent their spread. Invasive species in the study area should be removed during any proposed development of the Loggers East Neighbourhood and measures taken to ensure that no additional species are brought onto the site (i.e. with imported fill or on equipment). In addition, private land owners and the District of Squamish should be encouraged to be proactive and remove any invasive species characterized as "prevent, eradicate or control" by the Sea to Sky Invasive Species Council (SSISC, 2018).

5.2.6 Other Environmentally Valuable Resources

5.2.7 Wildlife Trees

It is recommended that as many wildlife trees be retained as possible within the constraints of the Sub Area Plan, with due consideration for public safety. Occurrences of wildlife trees were noted in Polygons TEM-8 and TEM-10, however a specific survey of wildlife trees was not conducted for this study. Wildlife trees within the riparian areas identified within the study area provide high value to wildlife and should be retained if they do not present safety concerns. Adaptation of a hierarchical approach for the removal of hazardous wildlife trees, i.e. avoidance, limbing/topping, the falling with stump retention, as per BC MOE Best Management Practises (BC MOE, 2009), should be a goal for the Loggers East neighbourhood.

5.2.8 Coarse Woody Debris

Coarse woody debris (CWD) within the forested areas of the study area present valuable habitat to species of small mammals, reptiles and amphibians, including some species at risk. CWD was noted in Polygons TEM-4, TEM-6, TEM-7, TEM-8, TEM-9 and TEM-10, with an abundance in the TEM polygons noted as preservation candidates on Section 5.2.2.2 (Map 3).

5.2.9 Riparian Areas

Riparian areas are protected under the Riparian Areas Regulation (RAR) of the provincial *Riparian Areas Protection Act*, the District of Squamish Development Permit Area 1 (Official Community Plan Bylaw 2500, 2017) and the *Water Sustainability Act* (WSA, 2014). The riparian areas are discussed in further detail in Section 5.4 below. All Streamside Protection and Enhancement Areas (SPEAs) should be viewed as significant habitat that should be protected.

5.2.10 Wildlife Movement Corridors

The existing wildlife trail that exists along the top of the cliffs that border the eastern side of the study area will not be impacted if Polygon TEM-6 is preserved. The potential wildlife movement corridor in the southeastern corner of the Loggers East Neighbourhood, from polygon TEM-7, through the southern portion of TEM-4, TEM-8, TEM-9 and TEM-10, should be considered if development is proposed for these areas (Map 3).

Maintaining riparian buffers adjacent to watercourses (discussed in Section 5.4.2 below) will protect wildlife use of these water features within the study area. Appropriate amphibian dispersion routes should also be considered around the Upper and Lower swamps, and North Wetland at the eastern end of Raven Drive to ensure maintenance of connections between natal streams and wetlands to more terrestrial rearing habitat.

5.2.11 Sensitive Ecosystems

The sensitive ecosystems identified in the study area are associated with high-value riparian or wetland (swamp) habitat, red listed ecological communities, and the abundance of other EVR such as coarse woody debris, wildlife trees, wildlife corridors and rock outcrops. Riparian and fish habitat will be protected under the *Riparian Areas Regulation* (RAR) as well as the Aquatic Guidelines of DPA 1 of the current District of Squamish OCP (DoS, 2019b), hence the high sensitivity ecosystems associated with riparian habitat will be protected during any future development.

Polygon TEM-6, TEM-7 and TEM-8 have high environmental sensitivity due to the presence of red and blue listed ecological communities, and an abundance of EVRs, comprising over 70% of the area of these polygons. Preservation/retention of these areas should be considered (Map 3). In addition, the potential for wildlife movement along the southern portion of the Loggers East neighbourhood should be considered for the medium environmentally sensitive TEM-10, TEM-9 and the southern lobe of TEM-4, should these lands be developed in the future (Map 3).

5.3 Wildlife (Terrestrial and Aquatic)

5.3.1 Wildlife

5.3.2 Birds

In general, preserving or rehabilitating the environmentally sensitive habitats, as discussed in the sections above, will serve to protect the existing avian wildlife habitat values and mitigate. It is interesting to note that while breeding birds are legally protected in Section 34 of the BC *Wildlife Act* (BC MOE, 1998), their habitat is not generally protected by legislation unless a breeding bird is present, with the exception of raptors nests, which are protected whether they are occupied or not. The *Migratory Birds Convention Act* (Government of Canada, 1994) also prohibits the possession of a migratory bird, its nest, or its egg.

5.3.3 Mammals

The Loggers East Neighbourhood is bordered to the north, east and south by undeveloped and heavily forested land, hence there is a greater chance that wildlife may visit this neighbourhood due to the unrestricted access. Preservation of larger tracts of lands and provision for wildlife movements should be considered. In this regard, the preservation of Polygons TEM-6, TEM-7 and TEM-8 is recommended, with the observed well-established wildlife movement corridor in TEM-6. Provision for investigating wildlife movement corridors along the southern perimeter of the neighbourhood through the southern lobe of TEM-4, TEM-9 and TEM-10, if those lands are developed in the future, should be considered. The

retention of adequately sized riparian areas also provide a natural dispersion route for mammals. It is also important that all residential landscaping does not contain bear attracting species and adhere by Bear Aware standards (WildSafe BC, 2016), so that bears are not attracted in areas where they are not desired.

5.3.4 Fish

Valuable fish (salmonid) and riparian habitat is located throughout the study area. Most watercourses found within the study area are either fish bearing, or either directly connected or ephemerally connected to fish bearing waters. Protecting aquatic and riparian resources through adherence to existing legislation, District of Squamish DPA-1 guidelines, Provincial *Riparian Areas Regulation* and *Water Sustainability Act* and federal *Fisheries Act*, are the most effective ways to protect fish populations. As discussed in Section 5.4, streams and their associated riparian habitat, should be considered high environmentally sensitive habitats, with appropriate SPEAs determined for any future development.

5.3.5 Wildlife Species at Risk

The residences of species listed as Threatened or Endangered on Schedule 1 of the federal *Species at Risk Act* are protected by Section 33 of the *Act*, which states:

> *No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.*

In addition, Section 26 of the *BC Wildlife Act* prohibits the wounding or killing of endangered and threatened (i.e. Red and Blue listed) wildlife species. Some listed species have been identified as potentially occurring within the study area. The potential for these to be impacted by the proposed development is discussed below in this section.

5.3.6 Amphibians and Reptiles

Valuable aquatic habitat for amphibians and reptiles exists within the study area, particularly within the swamp habitats contained with Polygon TEM-7 and TEM-8 and North Wetland located at the eastern end of Raven Drive. Finch Creek, Loggers Lane Creek, Stream 1 and the streams contained within Lot 17 will also provide valuable aquatic and riparian habitat for amphibian and reptile populations.

Western toads (Blue) breed in slow-moving waters and temporary or permanent waterbodies with little to no flow. During breeding season, large numbers tend to congregate at waterbodies and actively search for mates. They then migrate up to 1 km between breeding habitat and non-breeding upland habitat. Upland habitat is varied and includes grasslands, meadows and forests from sea level to the alpine and western toads may hibernate in underground burrows or crevices (BC MOE, 2014c).

Habitat for northern red-legged frogs (Blue, Special Concern) includes a variety of permanent and temporary freshwater bodies adjacent to areas having significant forest cover and emergent vegetation (BC MOE, 2015b). Suitable terrestrial habitat includes dense riparian vegetation that maintains cool and moist conditions, loose soils, coarse woody debris, and leaf litter (BC MOE, 2015b). A northern red-legged frog was captured by Cascade in a roadside ditch along Finch Drive during a riparian assessment in 2014.

Northern rubber boas (Yellow, Special Concern) are frequently found near rocks in forests and clearings in humid mountainous regions or dry lowland areas and are sometimes found in disturbed areas (BC MOE, 2015a). Specific habitats are required for thermoregulation and overwintering, which include loose soils suitable for burrowing, leaf litter, woody debris, rocks, outcrops and talus slopes (BC MOE, 2015a).

The rocky and cliff habitat located along the eastern boundary of the study area may provide suitable habitat for rubber boas.

Best management practices for these amphibian and reptile species recommend protecting habitat up to 30-150 m from the high-water mark of any waterbodies (BC MOE, 2014b).

In addition to preserving the environmentally sensitive habitat provided in TEM-7, TEM-8 and the swamp at the eastern end of Raven Drive, dispersion routes between these features and to upland habitats should also be considered. Particular attention should be given to providing amphibian dispersion routes through the southern lobe of TEM-4, as well as TEM-9 and TEM-10.

5.3.7 Birds

Great Blue Heron and Green Heron

Great Blue Herons (Blue, Special Concern) tend to forage along the seacoast, in fresh and saltwater marshes, along rivers and in grasslands. Smaller numbers of heron forage in kelp forests, from wharves and at anthropogenic waterbodies. They are mostly arboreal nesters and colonies are typically situated in forests near large eelgrass (*Zostera marina*) meadows, along rivers, and in estuarine and freshwater marshes (COSEWIC, 2008b).

Green Herons (Blue) forage in slow moving or shallow water, and nest in dense trees or tall shrubs within 1 km of foraging habitat. They breed as either solitary pairs or widely spread in small colonies, and nests can be used for multiple years. The species is migratory and is at the northern extent of its range in southern British Columbia (BC MOELP, 1996).

Both of these species have the potential to forage in swamp areas associated with Polygons TEM-7 and TEM-8 in the study area, as well as along the riparian areas of Finch Creek and Loggers Lane Creek and will use the surrounding forested riparian areas for roosting and perching.

Common Nighthawk

Common nighthawk (Yellow, 1 T) has been previously observed foraging above the old golf course property located immediately to the west of the study area. The species breeds in a variety of habitat such as short grass prairies, pastures, marshes, lakeshores, river banks, rocky outcrops and urban parks (COSEWIC, 2007). The rocky outcrops and sparsely vegetated areas within the study area provide potentially suitable habitat for this species. The species lays eggs directly on soil or bare rock. In order to mitigate potential impacts on this species, potential disturbances of the rock outcrops and sparsely vegetated areas should be timed to occur between August 1 and March 31, outside of the bird nesting window, or be preceded by a nest survey by a Qualified Environmental Professional.

Olive-Sided Flycatcher and Rusty Blackbird

Olive-sided flycatchers (Blue, Threatened) breed in coastal forests with the highest densities in the mountains of western Canada. They tend to occur in open coniferous or mixed forests, or along forest edges, often near water including wetlands. They prefer patchy landscapes influenced by natural disturbances such as fires. They can occur in young forests and along the edges of clearcuts, they require the presence of snags and tall trees for perching and foraging. Nests tend to be in shorter trees under thick canopy cover (Environment Canada, 2015d). Individuals may be observed within the southern area of Polygon TEM-4.

Rusty blackbirds (Blue, Special Concern) breed in boreal wetlands but migrate to overwinter in forested wetlands further south (COSEWIC, 2006). While they use a variety of sites, the presence of wet ground covers and shallow water are associated with an increased presence (COSEWIC, 2006).

The study area includes potentially suitable habitat for these species due to the presence of riparian areas, forest edges, and wildlife trees and snags. The previously recommended preservation areas, TEM-6, TEM-7, TEM-8 and the riparian areas will provide habitat for these species.

Black Swift

Black swift (Blue) nests are associated with waterfalls, caves and canyons, as well as occasionally sea cliffs. While there is no suitable nesting habitat within the study area, they may use the area as foraging habitat. They tend to spend their time at high altitudes when away from their nests, foraging above open and forested mountainous and lowland areas. As such, residential development within the study area would is expected to have minimal impact on this species (COSEWIC, 2015).

Barn Swallow

The barn swallow (Blue) is the most widespread of the swallow species; it breeds in all provinces and territories of Canada and overwinters in Central and South America. The barn swallow has been nesting in human built structures since before the arrival of European settlers, however, this is now the most common nesting habitat used by the species. Preferred nesting sites are sheltered horizontal surfaces or vertical faces located near a source of mud used for building their nests and close to a variety of open habitats used for foraging. Until the mid-1900s, the number of nesting opportunities for this species increased with the development of human-made structures and open foraging habitats. Such nesting opportunities are now decreasing, however, as these structures are replaced with more modern construction, often lacking in nesting habitats. The population and distribution in British Columbia currently remains static (COSEWIC, 2011).

There is the potential for barn swallows to nest and forage in the study area, particularly in residential buildings and cliffs that border the eastern boundary of the study area (Polygon TEM-6).

Western Screech-Owl

There are known occurrences of western screech-owls (Blue, Threatened) in the Squamish River Estuary (SECS, 2004; SECS, 1994; Tretheway, 1985). As a species listed as Threatened on Schedule 1 of the *Species at Risk Act*, the residences (i.e. occupied nests) of this species are legally protected. This species nests in natural cavities, including rotted out branch cavities and those excavated by larger woodpeckers such as pileated woodpeckers and northern flickers (COSEWIC, 2012). Preferred trees have diameters at breast height of 25 cm or greater, and include deciduous trees such as black cottonwood and bigleaf maple, and occasionally coniferous trees (COSEWIC, 2012). Dense conifer and mixed deciduous/coniferous forests have been identified as necessary for survival (COSEWIC, 2012).

The wildlife trees in the eastern and southeastern areas of the study area as well as the forested areas within riparian fringes have the potential to provide nesting opportunities for this species. It is therefore recommended that Polygons TEM-6, TEM-7 and TEM-8 should be preserved, and that if development is proposed for polygons TEM-4, TEM-9 and TEM-10, that a site specific survey and habitat plan be implemented for the western screech-owl.

Band-tailed pigeon

The band-tailed pigeon (Blue; Special Concern) breeds in western regions of the Americas from coastal BC to northern Argentina. Those that breed in south coastal BC often winter in California; however, a few remain in BC for the winter. In BC, these pigeons breed in scattered monogamous pairs from near sea level to 760 m elevation in edges and openings in mature coniferous, mixed and deciduous forest, yards, city parks, wooded groves, open bushland, golf courses and orchards. In BC, they aggregate in favoured feeding areas that offer flowering and berry-producing trees and shrubs, from spring through fall. They are also noticeable in BC when relatively large flocks migrate in the fall. (COSEWIC, 2008a)

Suitable habitat exists within the study area in forested areas and along the forest edges – mostly in the southeastern portion of the study area. Similarly to other bird species, preservation of the identified high environmentally sensitive habitat will provide habitat for this species.

5.3.8 Mammals

Little brown myotis are more abundant in older forests where snags and hollow trees are available for roosting in (COSEWIC, 2013). The maternity colonies of this species can occur in rock crevices or in tree cavities (COSEWIC, 2013). This species forages in woodlands near water and as such have the potential to use the forested riparian areas found within Polygon TEM-7, TEM-8 and TEM-9 within the study area for foraging.

5.3.9 Fish

Cutthroat trout (Blue) prefer gravelly, lowland streams and lakes. Small, cool, clean streams with gravel are needed for spawning. Cutthroats are confirmed to occur in the Finch Creek / Loggers Lane Creek system (MOE, 2019b). The creeks and their associated riparian habitat should be considered to be high environmental sensitivity and should be protected with applicable SPEAs.

5.3.10 Invertebrates

Prairie and dusky fossaria, star gyro, and sunset physa (all Blue listed) are species of freshwater snails whose habitat preferences are not fully known. Habitat descriptions for the fossarias vary widely and include perennial water habitats (lakes, ponds and slow-moving streams), seepage areas and small streams, while they are believed to characteristically occur in seasonal flowing water. There are only 7 records of sunset physa in BC and these are spread over broad habitat types including lakes, rivers, creeks and sloughs. The star gyro is known to occur in slow moving waters and eutrophic ponds and oligotrophic lakes. The striated fingernailclam (Blue) is a small clam that occurs in both lotic (flowing) and lentic (still lake or pond) environments. It occurs on mud, sand, gravel and rock substrates and is most abundant at water depths of less than 2 m, although it has been found down to 13.5 m depths. The two subspecies of Clodius Apollos (*Clodius Parnassian claudianus* and *pseudogallatinus*) (Blue) occur in moist habitats in the riparian areas of lowland streams (BC MOE, 2019a).

It is possible that one or more of the freshwater species may occur within the riparian habitats contained within the study area, specifically the swamp habitat and potentially within the Finch Creek / Loggers Lane Creek system. Under the Riparian Areas Regulation and DPA 1 (DoS, 2019b), the riparian areas, and therefore the habitat associated with these species, will be protected.

5.4 Aquatic and Riparian Environment

The potential implications of aquatic and riparian resources in the Loggers East Neighbourhood Sub Area Plan are discussed in the sections below, while the hydrology is discussed in Section 5.1.5 above.

5.4.1 Aquatic Habitat

As discussed in Section 4.4, the study area contains numerous watercourses with associated valuable riparian habitat. The Finch Creek / Loggers Lane Creek system is a significant salmonid-bearing system that flows south through the study area. Most of the roadside ditches contained within the study area either directly or ephemerally connect to the Finch Creek / Loggers Lane Creek system. Stream D outflows from the lower Ws53 swamp and flows west along the northern boundary of Lot 17, with no known barriers to fish passage, and joins Finch Creek. The upper Ws54 swamp contained within Polygon TEM-7 is not expected to be fish-bearing, as Stream 1 has an average 45% slope, however the upper Ws54 swamp presents valuable aquatic habitat for amphibian populations. North Wetland connects to Finch Creek via Raven Drive roadside ditches with no apparent barriers to fish passage.

It is important that the water features within the study area and the water quality within them be protected, as they are protected under the Fisheries Act, the *Water Sustainability Act* and DPA 1 (Aquatic Guidelines). Upon further future development in the Loggers East Neighbourhood, water quality must be maintained during all watercourses/features during and after development and an erosion and sediment control plan and a stormwater management plan must be developed for each development. The latter should meet the Urban Stormwater Guidelines and Best Management Practices for Protection of Fish and Fish Habitat (DFO, 2004) and the applicable District of Squamish development guidelines (DoS, 2019b).

5.4.2 Riparian Habitat

As per the District of Squamish Official Community Plan Bylaw No. 2500, 2017 (DoS, 2018b), Development Permit Area 1 (DPA 1) applies to those parcels of land either entirely or partially within a 30 m Riparian Assessment Area (RAA) as defined by DPA1, whether or not it is mapped on Schedules K-1 or K-2. Each development permit application that includes a development proposal related wholly or partially to a RAA must be accompanied by an assessment report prepared and certified by a Qualified Environmental Professional (QEP) in accordance with the Riparian Areas Regulation (RAR) (BC MWLAP, 2004b) of the provincial *Riparian Area Protection Act* for the purpose of determining the applicable Streamside Protection and Enhancement Areas (SPEA) requirements in Table 34-2-Method to Determine Riparian SPEA, which stipulates which assessment method is to be used based on fish-bearing status, permanence of the watercourse as well as project classification (DoS, 2019b). During the riparian assessment all high-water marks and/or top of banks of each watercourse will be flagged and must be surveyed by a BC Land Surveyor (BCLS). SPEAs must be determined and marked on the ground by a BCLS prior to development.

Upon development and construction adjacent to any riparian areas, it is recommended that all SPEA boundaries are delineated with silt fencing and orange construction fencing to ensure that there are no intrusions into these protected areas. It is also recommended that a permanent fence, vegetative barrier or signage be installed along this boundary to prevent intrusions into this area following construction.

As per DPA 1, any proponent of development must protect and avoid degradation of aquatic habitat and associated riparian areas. Both an erosion and sediment control plan and a stormwater management should be prepared for any development that occurs within the study area that is associated with valuable riparian habitat. The stormwater management plan must adhere to the Urban Stormwater Guidelines and Best Management Practices for Protection of Fish and Fish Habitat (DFO, 2004) and the applicable District of Squamish development guidelines and that will prevent the release of any sediments or sediment-laden water or untreated stormwater into the watercourses or the RAA.

All roadside ditches contained within the study area are subject to *Section 34.7 - Aquatic Guidelines* of DPA 1, that states, “the SPEAs in Table 34-3, Ditch Classification Matrix, should apply” (DoS, 2019b).

6 Conclusion and Recommendations

6.1 Conclusions

This report details the findings of the preliminary environmental review of the Loggers East Neighbourhood and the environmentally valuable resources (EVRs) identified within the study area. A discussion of potential impacts on the identified EVRs as a result of future development of the Loggers East Sub Area Plan is included as well as recommendations to mitigate any impacts during the Sub Area Plan design.

EVRs identified on or near the site include the fish-bearing watercourses of the Finch Creek /Loggers Lane Creek system, identified Ws53 and Ws54 swamps in the southeast corner of the study area, identified North Wetland (Ws53 swamp), watercourses within Lot 17, Stream 1 that flows north through 1045 Finch Drive and the roadside ditches contained within the study area – all of which provide valuable fish and/or amphibian habitat.

EVRs also include the red listed ecological community (CWHdm/02) of Douglas-fir – lodgepole pine / oceanspray / reindeer lichen (DC) found within the young forest and pole/sapling forests of Polygon TEM-6. 70% of Polygon TEM-6 consists of EVRs. Polygon TEM-6 is an excellent candidate for preservation.

The red listed ecological communities (CWHdm/05) of western redcedar / sword fern (RS) and (CWHdm/06) western hemlock – western redcedar / deer fern (HD) found in the young forests within Polygon TEM-8. 90% Polygon TEM-8 consists of EVRs. Polygon TEM-8 is an excellent candidate for preservation.

The red listed ecological community HD is also found in Polygon TEM-10, making up 30% of that polygon. 50% of Polygon TEM-10 consists of EVRs. Potential future development may be able to be dealt with on a site specific basis, where the specific EVRs are retained in Polygon TEM-10.

The blue listed ecological community (CWHdm/03) Douglas-fir – western hemlock / salal (DS) is found in the young forests of Polygons TEM-4 and TEM-10. Development in the study area should be carefully designed to retain as much of the ecological integrity of the existing forest stand as possible.

The blue listed ecological community (CWHdm/Ws53) Western redcedar – Sword fern – Skunk cabbage is found in Polygon TEM-8 and in North Wetland at the eastern end of Raven Drive. Development pressures are a continuing threat for this ecological community (BC MOE, 2019a.). Ws53 swamps should be protected.

The blue listed ecological community (CWHdm/Ws54) Western redcedar – Western hemlock - Skunk cabbage is found in Polygon TEM-7. Polygon TEM-7 is a good candidate for preservation.

The existing wildlife trail that exists along the top of the cliffs that border the eastern side of the study area will not be impacted if Polygon TEM-6 is preserved. The potential wildlife movement corridor in the southeastern corner of the Loggers East Neighbourhood, from Polygon TEM-7, through the southern portion of Polygon TEM-4, TEM-8, TEM-9 and TEM-10, should be considered and protected if development is proposed for these areas. Development in Polygons TEM-4, TEM-9 and TEM-10 should be carefully designed to retain as much of the ecological integrity of the existing forest stand as possible and protect the existing EVRs of each Polygon.

There is also the potential for occurrences of 26 species at risk, including 5 plant species, 2 amphibian species, 1 reptile species, 9 bird species, 1 mammal, 1 fish and 7 invertebrates, listed below.

Plants:

- Vancouver Island beggarticks (Blue, 1-SC),
- Roell's brotherella (Red, 1-E),
- *Callicladium haldanianum* (Blue),
- *Sphagnum contortum* (Blue),
- *Triptocladium leucocladulum* (Blue),

Amphibians and Reptiles:

- Western toad (Yellow, 1-SC),
- Northern rubber boa (Yellow, 1-SC),
- Northern red-legged frog (Blue, 1-SC)

Birds:

- Great blue heron (Blue, 1-SC),
- Green heron (Blue),
- Common Nighthawk (Yellow, 1-T),
- Olive-sided flycatcher (Blue, 1-T)
- Black Swift (Blue),
- Rusty blackbird (Blue, 1-SC)
- Barn Swallow (Blue)
- Western screech-owl *kennicottii* (1-T),
- Band-tailed pigeon (Blue, 1-SC)

Mammals:

- Little brown myotis (Yellow, 1-E)

Fish:

- Cutthroat trout *clarkia* (Blue)

Invertebrates:

- Prairie fossaria (Blue),
- Dusky fossaria (Blue),
- Star gyro (Blue),
- Clodius Parnassian *claudianus* (Blue),
- Clodius Parnassian *pseudogallatinus* (Blue),
- Sunset physa (Blue),
- Striated fingernailclam (Blue)

6.2 Recommendations

Based on the results of the preliminary environmental assessment, the following recommendations are made to minimize potential negative impacts from proposed new development of the Loggers East Neighbourhood. Recommended guidelines for new development of the Loggers East Neighbourhood are also discussed.

Loggers East Neighbourhood Sub Area Plan – Design Stage:

1. The sensitive ecosystems identified in the study area are associated with high-value riparian or wetland (swamp) habitat, red listed ecological communities, and the abundance of other EVR such as coarse woody debris, wildlife trees, wildlife corridors and rock outcrops. These sensitive ecosystems should be protected.
    - Cascade recommends the preservation of Polygon TEM-6 and Polygon TEM-8 as significant EVRs make-up 70% and 90%, respectively, of each polygon.
    - Cascade recommends the preservation of Polygon TEM-7, as this ecological community is associated with the sensitive swamp/wetland habitat. This habitat will however be protected under the *Water Sustainability Act* as well as District of Squamish's DPA 1.
    - Development in Polygons TEM-4, TEM-9 and TEM-10 should be carefully designed to retain as much of the ecological integrity of the existing forest stand as possible and protect the existing EVRs of each Polygon.

2. The existing wildlife trail that exists along the top of the cliffs that border the eastern side of the study area will not be impacted if Polygon TEM-6 is preserved. The potential wildlife movement corridor in the southeastern corner of the Loggers East Neighbourhood, from polygon TEM-7, through the southern portion of Polygons TEM-4, TEM-8, TEM-9 and TEM-10, should be considered and protected if development is proposed for these areas.

3. Maintaining riparian buffers adjacent to watercourses, will protect wildlife use of water features within the study area. All Streamside Protection and Enhancement Areas (SPEAs) should be viewed as significant habitat that should be protected.
    - Have a *Riparian Areas Regulation* assessment conducted by a QEP early on in the neighbourhood development planning phase in order to inventory watercourses and riparian areas that may not have been discovered during preliminary field assessments and to determine specific riparian setbacks for watercourses within the study area for planning purposes.

4. In addition to preserving the environmentally sensitive habitat provided in TEM-7, TEM-8 and the North Wetland; amphibian and reptile dispersion routes between these features and to upland habitats should also be considered. Particular attention should be given to providing amphibian dispersion routes from Polygon TEM-7 and TEM-8 through the southern lobe of Polygon TEM-4 and TEM-9 and TEM-10.

5. Maintain vegetated corridors between watercourses and riparian areas where possible to provide wildlife movement corridors and prevent further fragmentation of available habitat. Incorporate amphibian and small mammal eco-passages under roadways via culverts to preserve and enhance habitat connectivity.

6. The wildlife trees in the eastern and southeastern areas of the study area as well as the forested areas within riparian fringes have the potential to provide nesting opportunities for western screech owl and will also provide habitat to the olive-sided flycatcher, rusty blackbird and band-tailed pigeon. It is therefore recommended that Polygons TEM-6, TEM-7 and TEM-8 be

preserved, and that if development is proposed for polygons TEM-4, TEM-9 and TEM-10, that a site-specific survey and habitat plan be implemented.

7. Avoid vegetation clearing within the riparian areas; this is not permitted under the *Riparian Areas Regulation* or the District of Squamish's DPA 1.

8. Light pollution in the vicinity of sensitive habitats (i.e. riparian areas and rock outcrops) should be minimized by directing permanent/residential lighting away from these areas.

9. Bear-safe guidelines should be incorporated into the proposed SAP, including garbage/composting facilities and landscaping.

10. Low impact creek crossings such as clear span bridges should be used where stream crossings are necessary. Permitting for stream crossings will be required from Ministry of Forests, Lands, Natural Resource Operations & Rural Development Contacts under the *Water Sustainability Act*.

11. Development of the Loggers East Neighbourhood should follow guidelines and recommendations outlined in: *Environmental Best Management Practices for Urban and Rural Land Development* (BC MOE, 2014a). This includes best management recommendations for storm water, pollution prevention, wildlife and ecosystem management.

12. An invasive species survey and management plan that incorporates the recommendations included in this report should be developed by a Qualified Environmental Professional (QEP) and implemented for the Sub Area Plan. Removal of invasive species presents an opportunity for restoration within the neighbourhood.

<u>Loggers East Neighbourhood Sub Area Plan – Development Stage</u>

13. A Stormwater Management Plan and a Sediment Erosion and Control Plan should be developed for site preparation, construction and post-construction for the proposed neighbourhood development that adhere to the Urban Stormwater Guidelines and Best Management Practices for Protection of Fish and Fish Habitat (DFO, 2004) and applicable District of Squamish guidelines and that will prevent the release of any sediment or sediment-laden water or untreated stormwater into the watercourses or the RAA.

14. Ensure that pre-determined SPEAs are protected both during and after any development. Silt fencing and orange construction fencing should be installed along riparian buffer boundaries prior to the start of any construction to ensure that there is no intrusion into these areas. A permanent fence, vegetative barrier or signage should be incorporated along these boundaries in the development design to prevent intrusions following construction.

15. Any construction activities anticipated to have any potential effect on water quality in water bodies on or adjacent to the study area should follow best practices and be monitored by a QEP.

16. All vegetation removal should occur outside of bird nesting season (April 1 to August 31) or should be preceded by a survey for the presence of active bird nests by a QEP and all active nests must be protected by a suitable buffer until nesting is complete. Heavy construction works during this period should also be preceded by a nesting survey for songbirds, raptors, and species at risk and a 'quiet' buffer maintained around any active nests. Particular attention should be paid to:
    - forest edges and openings for band-tailed pigeon;

- rock outcrops and sparsely vegetated areas for common nighthawk, black swift and barn swallow; and
- wildlife trees and snags for western screech-owl.

17. Avoid disturbance of rocky outcrops where possible and minimize impact when disturbance is unavoidable. If any blasting or other disturbance of rocky outcrops is to occur, it is recommended that this occur between late spring and early fall when mammals are less likely to be seeking shelter and temperatures are warm enough for reptiles to maintain body heat away from the rocks. Prior to any disturbance of these habitats, targeted surveys should be conducted by a QEP for the following species at risk (if any are located, appropriate mitigation measures will be determined):
    - northern rubber boa, and
    - common nighthawk, black swift and barn swallow nests, particularly between April 1 and August 31.

18. Prior to any construction activities within the riparian areas for any necessary creek crossings, targeted surveys and salvages must be conducted by a QEP for the following species at risk and significant species. If any are found, they can be relocated to suitable riparian areas nearby.
    - northern red-legged frog,
    - western toad,
    - cutthroat trout, and
    - salmonid species.

19. Prior to any land clearing, areas to be cleared should be surveyed by a QEP for potentially occurring plant species at risk. Surveys for Vancouver Island beggarticks and Roell's brotherella should be conducted in spring or early summer while surveys for mosses can be conducted at any time of year. If any are found, these can be carefully relocated to suitable areas nearby that will not be disturbed during construction activities.

20. It is recommended that as much coarse woody debris (CWD), of varying sizes and stages of decay be maintained as possible. CWD was noted in Polygons TEM-4, TEM-6, TEM-7, TEM-8, TEM-9 and TEM-10, with an abundance in the TEM polygons previously noted as preservation candidates. If CWD is to be removed, this should occur between late spring and early fall when mammals are less likely to be seeking shelter. There is the opportunity to improve existing riparian habitat by carefully relocating any pieces of CWD needing to be removed into the riparian areas.

7 Signature and Seal

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9 Statement of Limitations

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This document should not be construed to be:

- A Preliminary Bio-inventory Report
- An Environmental Impact Assessment
- A Phase 1 - Environmental Site Assessment
- A Stage 1 – Preliminary Site Investigation (as per the Contaminated Sites Regulation of the Environmental Management Act)

10 Appendices

Appendix 1 – Potential Bird Species

Common Name	Scientific Name
Blackbird - Brewer's	*Euphagus cyanocephalus*
Blackbird - Red-winged	*Agelaius phoeniceus*
Bufflehead	*Bucephala albeola*
Bushtit	*Psaltriparus minimus*
Chickadee - Black-capped	*Parus atricapillus*
Chickadee – Chestnut-backed	*Parus rufescens*
Cormorant – Double Crested	*Phalacrocarax auritas*
Creeper – Brown	*Certhia americana*
Crossbill – Red	*Loxia curvirostra*
Crow - Northwestern	*Corvus caurinus*
Dipper – American	*Cinclus mexicanus*
Duck – Wood	*Aix sponsa*
Eagle – Bald	*Haliaeetus leucocephalus*
Falcon - Peregrine	*Falco peregrinus*
Finch - Purple	*Carpodacus purpureus*
Finch - House	*Carpodacus mexicanus*
Flicker - Northern	*Colaptes auratus*
Flycatcher – Hammond's	*Empidonax hammondii*
Flycatcher – Pacific-slope	*Empidonas difficilis*
Flycatcher – Willow	*Empidonax trailii*
Gadwall	*Anas strepera*
Goldeneye – Barrow's	*Bucephala islandica*
Goldeneye – Common	*Bucephala clangula*
Goldfinch - American	*Carduelis tristis*
Goose – Canada	*Branta canadensis*
Grebe – Eared	*Podiceps nigricollis*
Grebe – Pied-billed	*Podilymbus podiceps*
Grosbeak - Black-headed	*Pheucticus melanocephalus*
Gull – Glaucus Wing	*Larus glacescens*
Gull – Mew	*Lara canus*

Common Name	Scientific Name
Hawk- Red-tailed	*Buteo jamaicensis*
Heron – Great Blue	*Ardea Herodias fannini*
Hummingbird - Rufous	*Selasphorus rufus*
Jay - Steller's	*Cyanocitta stelleri*
Junco - Dark-eyed	*Junco hyemalis*
Killdeer	*Charadrius vociferus*
Kingbird - Western	*Tyrannus verticalis*
Kingfisher – Belted	*Ceryle alcyon*
Kinglet - Golden –crowned	*Regulus satrapa*
Kinglet - Ruby –crowned	*Regulus calendula*
Loon - Common	*Gavia immer*
Loon – Yellow Billed	*Gavia adamsii*
Mallard	*Anas platyrhynchos*
Merganser – Common	*Mergus merganser*
Merganser – Hooded	*Lophodytes cucullatus*
Nighthawk – Common	*Chordeiles minor*
Nuthatch - Red-breasted	*Sitta canadensis*
Osprey	*Pandion haliaetus*
Owl – Barred	*Strix varia*
Owl – Great Horned	*Bubo virginianus*
Owl – Northern Pygmy	*Glaucidium gnoma*
Owl – Western Screech	*Megascops kennicottii*
Pine Siskin	*Carduelis pinus*
Pigeon – Band-tailed	*Columbia fasciata*
Pigeon – Rock	*Columbia livia*
Pipit – American	*Anthus rubescens*
Raven – Common	*Corvus corax*
Robin – American	*Turdus migratorius*
Sandpiper – Spotted	*Actitis macularia*
Sapsucker – Red-breasted	*Sphyrapicus ruber*
Sparrow - Fox	*Passerella iliaca*

Common Name	Scientific Name
Sparrow - House	*Passer domesticus*
Sparrow - Golden-crowned	*Zonotrichia atricapilla*
Sparrow - Lincoln's	*Melospiza lincolnii*
Sparrow - Savannah	*Passerculus sandwichensis*
Sparrow – Song	*Melospiza melodia*
Sparrow - White-crowned	*Zonotrichia leucophrys*
Starling - European	*Sturnus vulgaris*
Swallow - Barn	*Hirundo rustica*
Swallow – Northern Rough-winged	*Stelgidopteryx serripennis*
Swallow - Tree	*Tachycineta bicolor*
Swallow - Violet-green	*Tachycineta thalassina*
Tanager – Western	*Piranga ludoviciana*
Teal – Cinnamon	*Anas cyanoptera*
Thrush – Hermit	*Catharus guttatus*
Thrush – Swainson's	*Catharus ustulatus*
Thrush – Varied	*Ixoreus naevius*
Towhee - Spotted	*Pipilo erythrophthalmus*
Vireo - Hutton's	*Vireo huttoni*
Vireo – Warbling	*Vireo gilvus*
Vulture – Turkey	*Cathartes aura*
Warbler – MacGillivray's	*Oporornis tolmiei*
Warbler – Orange-crowned	*Vermivora celata*
Warbler – Townsend's	*Dendroica townsendii*
Warbler – Wilson's	*Wilsonia pusilla*
Warbler – Yellow	*Dendroica petechia*
Waxwing – Cedar	*Bombycillia cedrorum*
Widgeon – American	*Anas americana*
Woodpecker - Downy	*Picoides pubescens*
Woodpecker – Hairy	*Picoides villosus*
Woodpecker - Pileated	*Dryocopus pileatus*
Wood-Pewee – Western	*Contopus sordidulus*

Common Name	Scientific Name
Wren – Winter	*Troglodytes troglodytes*
Yellowthroat – Common	Geothlypis trichas

Sources: SECS, 2004; SECS, 1994; Tretheway, 1985.