

ROCKWELL DRIVE RECOVERY PROJECT ENVIRONMENTAL OVERVIEW ASSESSMENT DF1 – 3

August 2022



Prepared for.

BC Ministry of Transportation and Infrastructure

Coquitlam, British Columbia

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AMENDMENT RECORD

This report has been issued and amended as follows:

Issue	Description	Date	Approved by	
1	First version of Rockwell Drive Recovery Project Environmental Overview Assessment DF1 - 3	20220804	(Garth Taylor) Project Director	(Tim Poulton) Project Manager
2	Second version of Rockwell Drive Recovery Project Environmental Overview Assessment DF1 - 3	20220823		
			Garth Taylor Project Director	Tim Poulton Project Manager

1.0 INTRODUCTION

Hatfield Consultants LLP (Hatfield) was retained by the Ministry of Transportation and Infrastructure (MOTI) to provide environmental support for the Rockwell Drive Recovery Project (the Project). This environmental overview assessment (EOA) report summarizes key environmental features within the Project area, associated environmental permit implications, and provides design and construction mitigation strategies to assist with the design options analysis.

1.1 PROJECT DESCRIPTION

Damage to a number of stream crossings along Rockwell Drive in the District of Kent occurred as a result of flooding associated with the November 2021 atmospheric river. The Project area is comprised of three sites (DF1, DF2, and DF3) located at the southeast extent of Harrison Lake near Harrison Hot Springs (Figure 4).

Emergency repair works associated with the November 2021 flood event have been conducted at all three sites and MOTI wishes to develop permanent (long-term) solutions for each site. In addition to the permanent solution, MOTI has conducted short-term remedial repairs to prevent further flooding and damage to private property and infrastructure (Binnie 2022a).

1.1.1 Site DF1 – 6535 Rockwell Drive

At site DF1, the existing Rockwell Drive culvert was overwhelmed by an unnamed watercourse due to the heavy mountain runoff, resulting in excess water running over the road, which eroded the roadway embankment and private property lands downstream of Rockwell Drive, including the culverted portion of the watercourse within the property (Figure 1). Short-term emergency/recovery works included the removal of debris, channel grading, and placement of riprap adjacent to the private residence. The options analysis for the permanent long-term design includes repairing the existing culvert, upsizing and replacement of the existing culvert, and updating the roadway geometry (Binnie 2022b). Currently, the preferred option includes upsizing and replacement of the existing culvert; however, the design team is still reviewing the preferred option which may include a “Flat Debris Flow Breaker or similar structure with open grid deck” to address debris control at Site DF1 (Binnie 2022b).

Figure 1 Upstream view of site DF1 from within the 6535 Rockwell Drive property (December 14, 2021).



1.1.2 Site DF2 – 6969 Rockwell Drive

At site DF2, a debris flow associated with an unnamed watercourse above a private residential access road located at 6969 Rockwell Drive deposited debris and incised a new stream channel in what was previously a driveway. The debris flow damaged the Rockwell Drive roadside drainage ditch and culvert inlet crossing Rockwell Drive which discharges to Harrison Lake (Figure 2). Emergency and short-term recovery works included removal of debris deposited on Rockwell Drive, regrading and armouring the roadside ditch, and armouring the Rockwell Drive culvert inlet with riprap (Binnie 2022a). The options analysis for the permanent long-term design includes repairing the existing culvert, upsizing and replacement of the existing culvert, and updating the roadway geometry (Binnie 2022b). Currently, the preferred option includes upsizing and replacement of the existing culvert (Binnie 2022b).

Figure 2 Downstream view of site DF2 showing erosion and debris along Rockwell Drive (December 14, 2021).



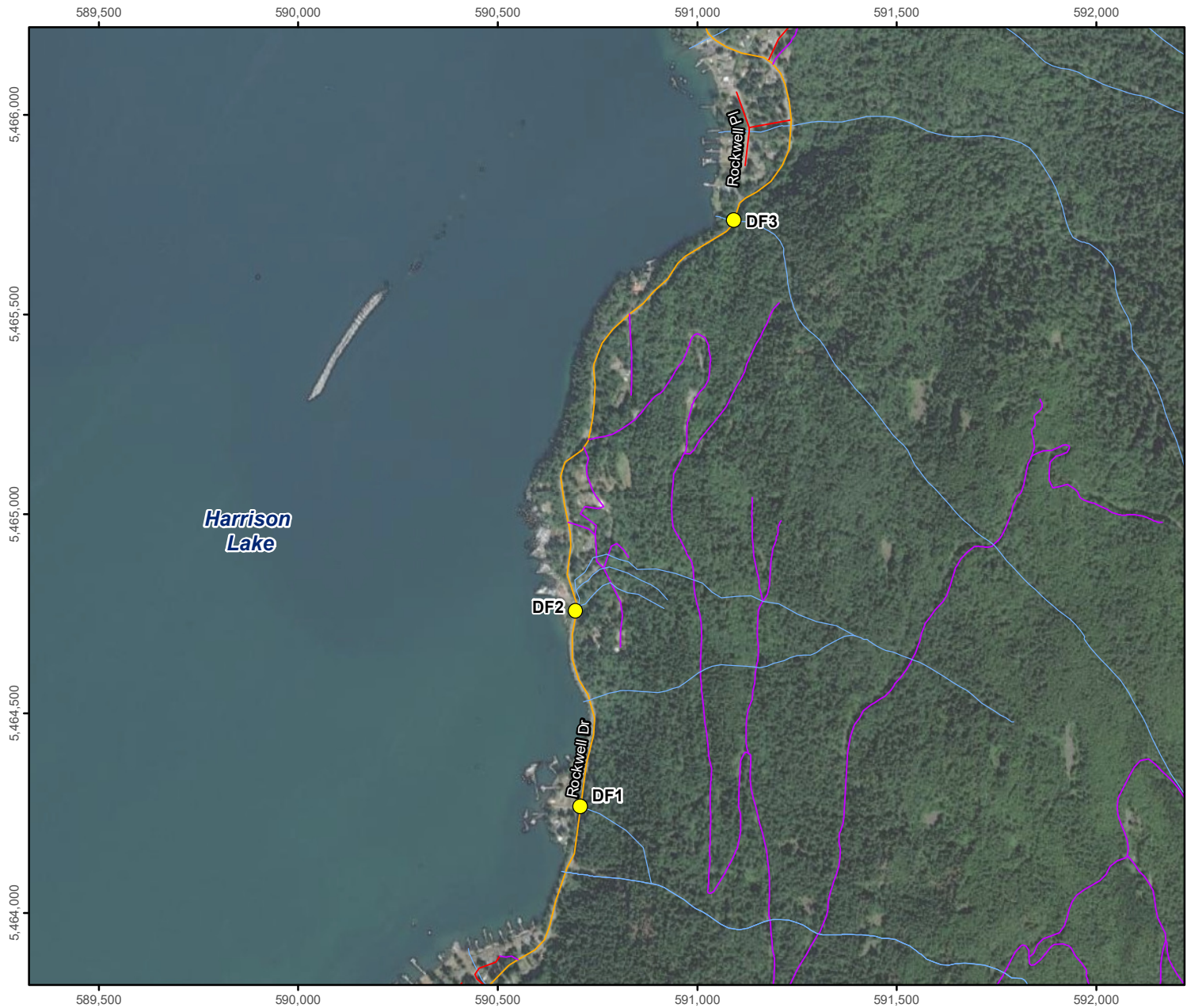
1.1.3 Site DF3 – 7370 Rockwell Drive

The November 2021 atmospheric river resulted in a watercourse avulsion upstream of Rockwell Drive at site DF3 (Binnie 2022a). The avulsion resulted in the deposition of debris onto Rockwell Drive and the redirection of flows to the north (Figure 3). No drainage system has previously been constructed to accommodate water flow to the north, and as such flooding of private residences downstream of Rockwell Drive subsequently occurred. Emergency works included re-establishing the road shoulder and installing a catch basin near the eastern edge of the road to direct flows to the western roadside ditch away from the private residences. Short-term recovery works included the construction of an asphalt curb (Binnie 2022b). The options analysis for the permanent long-term design includes repairing the existing culvert, upsizing and replacement of the existing culvert, and updating the roadway geometry (Binnie 2022b). Currently, the preferred option includes upsizing and replacement of the existing culvert and redirecting the ditch back into the existing channel to avoid crossing Rockwell Drive at an unfavourable location (Binnie 2022b).

Figure 3 **Watercourse avulsion at site DF3 (December 14, 2021).**

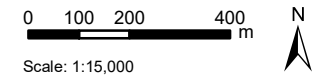
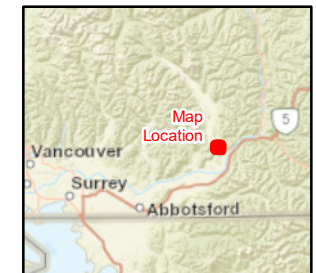


Figure 4 DF1, DF2, and DF3 Project area.



Legend

- Site Location
- Rockwell Drive
- Forest Service Road
- Road
- Watercourse



Scale: 1:15,000
 Projection: NAD 1983 UTM Zone 10N

- Data Sources:
- a) Site location, Hatfield 2022.
 - b) Road, Digital Road Atlas 2010.
 - c) Watercourse, FWA BC 2011, additional watercourses digitized by Hatfield based on data source d, 2022.
 - d) WorldView-2 50 cm, 28 June 2021 Esri Online Service.



Rockwell Drive Recovery Project

2.0 METHODS

2.1 LITERATURE REVIEW

2.1.1 Fish & Fish Habitat

Hatfield conducted a desktop review of aquatic resources within the Project area (i.e., Rockwell drive along sites DF1, DF2, and DF3) using the following data sources:

- BC Fish Inventories Data Queries (FIDQ);
- BC Conservation Data Centre (CDC):
 - CDC iMap
 - BC Species & Ecosystem Explorer
- Ecological Reports Catalogue (ECOCat);
- Habitat Wizard;
- Species Inventory Web Explorer (SIWE); and
- BC Cross-Linked Information Resources (CLIR).

2.1.2 Terrestrial Resources

A review of existing information was also completed for terrestrial resources in the vicinity of sites DF1, DF2, and DF3 and within an approximate 1-km radius surrounding each site. Data sources included:

- Wildlife –
 - Species at risk information is available from the CDC Species & Ecosystem Explorer, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and the *Species at Risk Act* (SARA) Registry; and
 - General wildlife information for the BC Ministry of Environment Species and Ecosystems Explorer, iMapBC, Species Inventory Web Explorer (SIWE), eBird, BC CLIR and the Wildlife Tree Stewardship Atlas (WTSA).
- Plants –
 - Rare plants and plant community occurrence records available from the CDC and e-Flora BC; and
 - Invasive plant/weed information from the provincial *Weed Control Act*, the BC Invasive Species Council of BC (ISCBC), and the Invasive Alien Plan Program (IAPP) database and map display.

- Designated wildlife management areas including Wildlife Habitat Areas (WHAs), Ungulate Winter Ranges (UWRs), Special Management Zones (SMZs), and federally designated critical habitat areas for endangered and threatened species from CDC iMap.
- Literature and reports containing information on local wildlife species, plant species, and plant communities are available from the provincial ECOCat and DataBC Data Catalogue.

2.1.3 Species at Risk

Species at risk are identified by both provincial and national ranking systems. Federally, the COSEWIC assesses and recommends species ranks. The Government in Council uses COSEWIC information to decide on which species to include on Schedule 1 of SARA. Provincially, species are assessed by the CDC based on the systematic collection and analysis of information on their extent, distribution, and vulnerability to disturbance. Species are red- or blue-listed depending on the urgency of their conservation needs.

A preliminary list of federally and provincially listed species was generated by querying the CDC Species and Ecosystem Explorer database for occurrences within the Fraser Valley Regional District, within the Coastal Western Hemlock (CWH) zone in which the Project area is located. The list was refined by obtaining habitat information from local reports and determining its suitability in supporting critical life-history functions for each species. Such requisites include breeding, foraging, migration for bird species, flowering, and seed dispersal for plants.

2.2 FIELD DATA COLLECTION

Field baseline studies were conducted on March 30, 2022, and included the following activities:

- Characterization of fish habitat features upstream and downstream of each crossing; and
- A general reconnaissance of wildlife and wildlife habitat features upstream and downstream of each crossing.

2.2.1 Fish Habitat

Fish habitat features up to a maximum of 50 upstream and downstream of site DF2 were assessed as per Resource Inventory Standards Committee (RISC) methods and included the following measurements:

- Average channel width;
- Average wetted width;
- Max pool depth;
- Bankfull channel depth;
- Depth and velocity transects (3 per survey reach);
- Substrate composition;
- Channel morphology (e.g., percent riffle, pool, run, cascade) and gradient;

- Type and percent overhead and instream cover;
- Characterization of the riparian area;
- In situ water quality; and
- An assessment of fish passage.

Information from the fish habitat assessment was documented on habitat inventory datasheets as per RISC standards.

Fish habitat assessments at sites DF1 and DF 3 were limited to visual assessments of habitat features, and in situ water quality measurements given the highly modified nature of these crossings (i.e., comprised primarily of riprap ditches and/or culverts) and safety concerns (e.g., waterfall upstream of DF1 and steep terrain upstream and downstream of DF3). Fish sampling was not conducted given the presence of fish barriers upstream and downstream of each site, the exception being downstream of site DF2 which is presumed to be fish-bearing given its proximity to Harrison Lake.

2.2.2 Terrestrial Resources

Avian Species

Given the time of year and the small area associated with each site, detailed surveys for nesting birds were not conducted; however, incidental observations were documented.

Technicians also surveyed the forest surrounding each site and scanned the canopies for any stick nests. This includes the nests of hawks, ospreys, bald eagles, and great blue herons. Trees within the forested areas were assessed for whitewash (excrements) and the bases of the trees were checked for pellets, to look for activity of owl foraging, nesting, or young.

Wildlife and Wildlife Habitat Features

Technicians walked 5 to 10 m apart in the forested areas on either side of each fish habitat survey reach and assessed for different wildlife habitat features. Including:

- Cover availability (e.g., micro-terrain features, understory plants, coarse woody debris);
- Game trails, and dens; and
- Wildlife trees and snags.

Technicians also turned cobble-sized rocks during the fish habitat surveys looking for evidence of tailed frog tadpoles.

3.0 RESULTS

3.1 FISH & FISH HABITAT

All three sites are comprised of existing culvert crossings at Rockwell Drive. The unnamed watercourse headwaters associated with each site originate from the mountain east of Harrison Lake, and flows are conveyed west down steep (>40%; Binnie 2022b) forested slopes (occasionally crossing forest service roads) to Rockwell Drive, and ultimately drain into Harrison Lake.

Stream permanence of each watercourse is unknown; however, given the small catchment and steep gradient, they are likely all ephemeral, drying during the summer months. Each stream is non-fish bearing due to fish barriers (i.e., steep channel gradient and/or culverts) upstream of Harrison Lake, and as such existing literature or data does not exist for these streams. The exception is site DF2 downstream of Rockwell Drive which is assumed to be fish-bearing given its proximity to Harrison Lake and lower channel gradient (i.e., 7%).

3.1.1 Site DF1

The site DF1 watercourse originates from Bear Lake and conveys flows west down the steep mountain slopes upstream of Rockwell Drive. At Rockwell Drive, the site DF1 watercourse is characterized by a large waterfall and plunge pool immediately upstream of the Rockwell Drive culvert (Figure 5). The November 2021 atmospheric river and subsequent emergency works to remove debris from the culvert inlet has disturbed riparian vegetation surrounding the watercourse upstream of Rockwell Drive; however, due to the primarily bedrock nature of the watercourse at site DF1, riparian vegetation was likely limited prior to the flood event as well. Water temperature, pH, dissolved oxygen, and conductivity within the pool upstream of Rockwell drive were 6.4°C, 6.2, 12.4 mg/L, and 75 us/cm, respectively, during the March 30, 2022 site assessment.

Downstream of the Rockwell Drive culvert, flows are conveyed within private property (6535 Rockwell Drive) via a short section of flume to a buried culvert that ultimately daylights approximately 20 m upstream of Harrison Lake (Figure 5). Given the extensive culverting within 6535 Rockwell Drive and the large waterfall upstream of Rockwell Drive, the DF1 watercourse is considered non-fish bearing and provides limited food and nutrient inputs to the larger fish-bearing Harrison Lake during periods of surface flow.

Figure 5 Photographs of Site DF1 (March 30, 2022).



Photo 1: DF1 waterfall upstream of Rockwell Drive.



Photo 2: Large pool at the Rockwell Drive culvert inlet.



Photo 3: Downstream of Rockwell Drive the DF1 watercourse is culverted on private property.



Photo 4: DF1 watercourse outlet at Harrison Lake.

3.1.2 Site DF2

Upstream of Rockwell Drive the site DF2 watercourse has been historically altered within the private property located at 6969 Rockwell Drive. Prior to the November 2021 flood event, the watercourse was directed around the private residence to a corrugated steel pipe (CSP) culvert located at Rockwell Drive. Following the flood event, a portion of the watercourse incised a new stream channel in what was previously a driveway conveying flows to the roadside ditch north of the Rockwell Drive culvert. Both the original altered stream channel and newly incised flood channel converge at the Rockwell Drive culvert inlet (Figure 6). Short-term recovery works in April 2022 included armoring the roadside ditch with riprap to prevent further erosion during spring freshet (Figure 7).

Downstream of Rockwell drive the site DF2 watercourse is conveyed for approximately 40 m over a gravel shoreline to Harrison Lake (Figure 6). A summary of fish habitat features at site DF2 is provided in Table 1. Water temperature, pH, dissolved oxygen, and conductivity at site DF2 were 7.6°C, 6.6, 12.1 mg/L, and 89 µs/cm, respectively, during the March 30, 2022 site assessment.

Figure 6 Photographs of Site DF2 (March 30, 2022).



Photo 1: Terminus of the DF2 watercourse at Harrison Lake.



Photo 2: Upstream view of the Rockwell Drive culvert outlet.



Photo 3: Upstream view of the roadside ditch along Rockwell Drive upstream of the culvert.



Photo 4: Downstream view of the Rockwell Drive culvert inlet where the roadside ditch and altered channel converge.

Table 1 Summary of fish habitat features at site DF2 (March 30, 2022).

Survey Reach	Average Channel Width (m)	Average Wetted Width (m)	Average Depth (m)	Average Velocity (m/s)	Channel Gradient (%)
1	2.8	2.1	0.18	0.2	7
2	3.2	1.8	0.17	0.3	7

Survey Reach 1 = Downstream of Rockwell Drive; Survey Reach 2 = Upstream Rockwell Drive within the roadside ditch.

Figure 7 Short-term recovery works at site DF2 (April 26, 2022).



Due to the steep culvert gradient at Rockwell Drive (i.e., approximately 50% at the inlet) and gradients upstream of Rockwell Drive, the site DF2 watercourse is considered non-fish bearing upstream of Rockwell Drive; however, there is the potential for fish access from Harrison Lake upstream to the culvert outlet during periods of sufficient surface flow (Figure 6).

The Lillooet River is the main inlet to Harrison Lake, which ultimately drains to the Fraser River via the Harrison River near Harrison Mills. Harrison Lake is inhabited by a variety of fish species, (Table 1, CDCa 2022; MOEa 2019; and MOEb 2022). Although fish access for a number of fish species from Harrison Lake is possible during periods of sufficient flow, suitable spawning, rearing, or overwintering habitat for salmonids was not observed, and limited for resident forage species such as sculpin (*Cottus* sp.) and stickleback (*Gasterosteus* sp.) due to the ephemeral nature of this watercourse.

Table 2 Documented fish species in Harrison Lake.

Common name	Scientific name	SARA Schedule 1	Provincial Status
Cutthroat trout	<i>Oncorhynchus clarkii</i>	-	-
Coastal Cutthroat Trout	<i>Oncorhynchus clarkii clarkii</i>	-	Blue
Pygmy Longfin smelt	<i>Spirinchus thaleichthys</i>	-	Red
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	-	-
Chum Salmon	<i>Oncorhynchus keta</i>	-	-
Coho Salmon	<i>Oncorhynchus kisutch</i>	-	-
Coastrange Sculpin	<i>Cottus aleuticus</i>	-	-
Lamprey (General)	<i>Entosphenus</i> sp.	-	-
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	-	-
Dolly Vardan	<i>Salvelinus malma</i>	-	-
Sockeye Salmon/Kokanee	<i>Oncorhynchus nerka</i>	-	-
Lake Whitefish	<i>Coregonus clupeaformis</i>	-	-
Mountain Whitefish	<i>Prosopium williamsoni</i>	-	-
Northern Pikeminnow	<i>Ptychocheilus oregonensis</i>	-	-
Pink Salmon	<i>Oncorhynchus gorbuscha</i>	-	-
Prickly Sculpin	<i>Cottus asper</i>	-	-
Rainbow Trout/Steelhead	<i>Oncorhynchus mykiss</i>	-	-
Redside shiner	<i>Richardsonius balteatus</i>	-	-

3.1.3 Site DF3

Upstream of Rockwell Drive, the site DF3 watercourse is conveyed down steep slopes (>45%) in a poorly defined channel with an average channel width and wetted width of 4.0 m and 0.75 m, respectively (Figure 8). Substrates are comprised primarily of boulders and cobbles. During the November 2021 flood, the channel avulsed just upstream of Rockwell Drive causing a new channel to form to the north of the existing channel. At Rockwell Drive flows were directed back to the south within the existing roadside ditch as part of emergency works (Figure 8). Flows are conveyed across Rockwell Drive via a corrugated polyvinylchloride (PVC) culvert that appears to have been recently installed as part of flood emergency works (Figure 8). The culvert outlets to a steep riprap road fill slope (approximately 35% gradient) west of Rockwell Drive ultimately draining to Harrison Lake across a gravel beach and private boat launch associated with 7370 Rockwell Drive (Figure 8). Water temperature, pH, dissolved oxygen, and conductivity at site DF3 were 7.7°C, 6.5, 12.2 mg/L, and 76 us/cm, respectively, during the March 30, 2022 site assessment.

Due to continued steep slopes, the site DF3 watercourse is considered non-fish bearing and provides limited food and nutrient inputs to the larger fish-bearing Harrison Lake during periods of surface flow.

Figure 8 **Photographs of Site DF3 (March 30, 2022).**



Photo 1: Upstream view of the site DF3 watercourse upstream of Rockwell Drive.



Photo 2: Creek avulsion directed back to the south via a berm along Rockwell Drive.



Photo 3: Rockwell Drive culvert inlet.

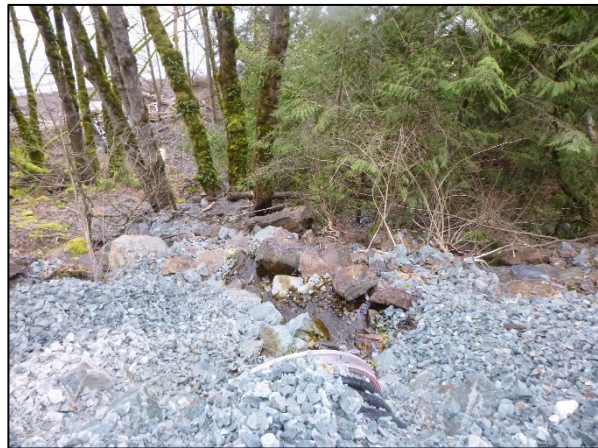


Photo 4: Rockwell Drive culvert outlet.

3.2 TERRESTRIAL RESOURCES

The Project area is located in the dry maritime subzone within the Coastal Western Hemlock biogeoclimatic zone (CWHdm). The subzone transitions to very wet maritime (CWHvm²) at an elevation of approximately 650 m – 1000 m.

Rockwell Drive runs north to south along the eastern shoreline of Harrison Lake. Surface cover along the mountain slopes is comprised of dense coniferous forest. There are several rural residential homes along the shoreline, between Rockwell Drive and Harrison Lake (Binnie 2022b).

3.2.1 Wildlife and Wildlife Habitat

The Project area does not occur within a provincially designated management area. The nearest designated management area is the Harrison-Chehalis Wildlife Management Area located approximately 10 km to the southwest near Harrison Mills. Given the Project area occurs primarily within the MOTI road right-of-way which is subject to routine maintenance, and disturbance from the November 2021 flood event, wildlife

habitat features such as coarse riparian vegetation, woody debris, or snags (i.e., standing dead trees) were largely absent. Bird nests (including stick nests and cavity nests) were not observed. Incidental wildlife observations included a pair of hooded mergansers (*Lophodytes cucullatus*) along the shoreline of Harrison Lake near site DF2, and a Pacific sideband snail (*Monadenia fidelis*) in the riparian area upstream of site DF3.

3.2.2 Species at Risk

Listed wildlife species with the potential to occur within the Project area (as determined using methods described in Sections 2.1.2 and 2.1.3) are provided in Table 3 along with the status of each species, in accordance with the CDC and SARA databases. There is a known occurrence of Oregon forestsnail further to the south near Agassiz and draft habitat mapping suggests that suitable habitat extends into the Project area (Personal communication with BC Parks and MOTI staff, May 2022); however, this species has a fairly specific habitat association with mature bigleaf maple, stinging nettle and sword fern forest types, which was not observed within the Project area during the site assessment. Additionally, there is a masked occurrence (ID 52866) 2.5 km from the Project area (CDCb 2022); however, after further discussion with CDC staff, it was determined that this species will not be impacted by the Project.

Listed plant species with the potential to occur within the Project area (as determined using methods described in Sections 2.1.2 and 2.1.3) are provided in Table 4 along with the status of each species, in accordance with the CDC and SARA databases. Invasive plant or animal species were not observed during the field survey.

3.2.3 Invasive Species

There have been several invasive plant species identified close to the Project area; tansy ragwort (*Senecio jacobaea*), common tansy (*Tanacetum vulgare*), butterfly bush (*Buddleja*), and English ivy (*Hedera helix*). Invasive animal species that have been documented in the area include the American bullfrog (*Rana catesbeiana*) and green frog (*Lithobates clamitans*) (CDCa 2022). Invasive species and/or noxious weeds as regulated by the BC *Weed Control Act* and regulation were not identified during the site assessment.

Table 3 Listed animal species with the potential to occur within the Project area.

Common Name	Scientific Name	SARA Schedule 1	Provincial Status	Habitat Requirements	Habitat Requisites to Support Critical Life Functions within Project area
Birds					
Band-tailed pigeon	<i>Patagioenas fasciata</i>	Special Concern	Blue	Found around forests, riparian habitats and springs	Yes
Barn swallow	<i>Hirundo rustica</i>	Threatened	Blue	Found around forests, wetlands, riparian habitats as well as agricultural and anthropogenic environments	Yes
Great blue heron	<i>Ardea herodias fannini</i>	Special Concern	Blue	Found around riparian and freshwater habitats	Yes
Northern goshawk	<i>Accipiter gentilis laingi</i>	Threatened	Red	Found around forests and riparian habitats	Yes
Olive-sided flycatcher	<i>Contopus cooperi</i>	Threatened	Blue	Found around forests, lakes and riparian habitats	Yes
Western screech-owl	<i>Megascops kennicottii kennicottii</i>	Threatened	Blue	Found around forests and riparian habitats	Yes
Amphibians					
Northern red-legged frog	<i>Rana aurora</i>	Special Concern	Blue	Found around riparian habitats, streams, lakes and grassland	Yes
Oregon spotted frog	<i>Rana pretiosa</i>	Endangered	Red	Found around riparian habitats, streams, and lakes	Yes
Mammals					
Pacific water shrew	<i>Sorex bendirii</i>	Endangered	Red	Found in riparian and wetland habitats	Yes
Trowbridge's shrew	<i>Sorex trowbridgii</i>	N/A	Blue	Found in forests and riparian habitats	Yes

Limited to vertebrate species that are either provincially red or blue listed, and/or on SARA schedule 1 as Endangered or Threatened.

Table 4 Listed plant species with the potential to occur within the Project area.

Common Name	Scientific Name	SARA Schedule 1	Provincial Status	Habitat Requirements	Habitat Requisites to Support Critical Life Functions within Project area
Plants					
American sweet-flag	<i>Acorus americanus</i>	Not listed	Blue	Found around lakes, wetlands and riparian habitat	Yes
Tall bugbane	<i>Actaea elata var. elata</i>	Endangered	Red	Found around forest habitats	Yes
Cut-leaved water-parsnip	<i>Berula incisa</i>	Not listed	Blue	Found around lakes, springs, riparian habitat and lakes	Yes
Angled bittercress	<i>Cardamine angulata</i>	Not listed	Blue	Found around forests, riparian habitats and streams/rivers	Yes
Phantom orchid	<i>Cephalanthera austiniiae</i>	Threatened	Red	Found around forests habitats	Yes
Streambank lupine	<i>Lupinus rivularis</i>	Endangered	Red	Found in anthropogenic environments as well as forests, grassland, streams and rivers.	Yes

Limited to plant species that are either provincially red or blue listed, and/or on SARA schedule 1 as Endangered or Threatened.

4.0 PRELIMINARY ASSESSMENT OF IMPACTS

4.1 DESIGN

Based on the draft Design Options Analysis Report (Binnie 2022b) the preferred option includes culvert upsizing and replacement at each site to meet current design flow requirements. Additionally at site DF3, flows upstream of Rockwell Drive will be returned to the original channel location away from the creek avulsion. It is expected that replacing the culverts to current design standards that consider climate change and debris flow events will reduce erosion and flooding of downstream environments, infrastructure, and property. Despite this overall net benefit, there is potential to adversely impact aquatic and terrestrial resources as a result of the design of each culvert. Potential adverse design impacts include the loss of aquatic (e.g., fish-bearing and non-fish-bearing watercourses) and terrestrial (e.g., riparian environments within 30 m of a watercourse) habitats that support fish and wildlife species should the footprint of the new culverts and associated riprap extend beyond the footprint of the existing crossing structures.

4.2 CONSTRUCTION

Potential adverse impacts to the aquatic environment during construction are primarily related to water quality, including but not limited to:

- Erosion of exposed soils and resultant sediment release; and
- Use of heavy machinery and potential accidental release of hydrocarbons.

Potential adverse impacts to the terrestrial environment during construction include direct temporary and/or permanent loss of localized riparian wildlife habitat, habitat degradation associated with construction, and mortality of small vertebrates breeding in microhabitats within the construction footprint. Potential indirect adverse impacts include habitat avoidance and reduced reproductive success as a result of sensory (visual and auditory) disturbance to wildlife species nesting/denning in the Project area.

5.0 IMPACT MITIGATION STRATEGIES

Potential residual impacts (i.e., predicted to occur after all mitigation is considered) to environmental resources are not expected to occur so long as conventional design and construction BMPs are followed. The Project will be undertaken in a small area already heavily affected by anthropogenic disturbances that limit fish and wildlife usage of the area. Habitat in the area is highly disturbed as a result of routine road maintenance, and a high level of disturbance from traffic noise.

5.1 DESIGN

Generally, the footprint of new culverts and associated riprap scour protection at each site should be minimized to the extent feasible while maintaining current design standards. Minimizing the footprint at each site to within the existing culvert footprint will reduce the permanent loss of aquatic and terrestrial resources. Top-dressing riprap required below a watercourse high watermark with native stream substrates salvaged during excavation and maintaining the natural channel shape is a design impact mitigation strategy that should be utilized where possible. This is especially important at site DF2 downstream of Rockwell Drive, given the proximity to Harrison Lake and the potential for fish presence, and upstream of site DF3 where repairs to the channel avulsion will occur. Riparian areas disturbed during construction should be revegetated with native shrub and tree species suited to site conditions.

In accordance with Part 3 of the Water Sustainability Regulation the installation of a culvert is considered an authorized change if the following design conditions are met:

- The culvert inlet and outlet incorporate measures to protect the structure and the stream channel against erosion;
- Debris can pass through the culvert;
- The culvert and its approach roads do not produce a backwater effect or increase the head of the stream;
- The culvert capacity is equivalent to the hydraulic capacity of the stream channel or is capable of passing the 1 in 200-year maximum daily flow without the water level at the culvert inlet exceeding the top of the culvert;
- The culvert has a minimum equivalent diameter of 600 mm;
- The culvert has an equivalent diameter of 2 m or greater or has a design capacity to pass a flow of more than 6 m³ per second, the culvert is designed by an engineering professional and constructed in conformance with that design;
- The culvert is installed in a manner that permits the removal of obstacles and debris within the culvert and at the culvert ends;
- Embankment fill materials do not, and are unlikely to, encroach on culvert inlets and outlets;
- The culvert has a depth of fill cover that is at least 300 mm or as required by the culvert manufacturer's specifications;

- The maximum fill heights above the top of the culvert do not exceed 2 m; and
- The culvert is made of materials that meet the applicable standards of the Canadian Standards Association.

5.2 CONSTRUCTION

The successful Contractor(s) will be required to submit a detailed Construction Environmental Management Plan (CEMP) with work procedures prior to commencing construction. The CEMP shall be prepared in compliance with MOTI's Standard Specifications for Highway Construction (MOTI 2020a) Section 165 Protection of the Environment (SS 165), and align with the Requirements and Best Management Practices for Making Changes in and About a Stream in British Columbia (BC Gov. 2022), and the Measures to Protect Fish and Fish Habitat (DFO 2019). The CEMP shall be submitted to MOTI for review and approval prior to the start of works. Special Provisions (SPs) contained in the Project Tender package will identify any expectations that differ from MOTI SS 165 and will also include conditions of any environmental approvals. SPs may also refer to mitigation measures outlined in this or any other environmental assessment reports prepared for the Project that form part of regulatory application submissions. Mitigation measures and best management practices (BMPs) detailed in the CEMP will include but not be limited to the following management plans:

- Fish and fish habitat protection plan (including fish salvages where required);
- Spill prevention and emergency response plan;
- Erosion and sediment control plan;
- Vegetation management plan (including management of invasive and noxious weeds);
- Wildlife protection plan including a salvage for Pacific water shrew at site DF3 pending results of the pre-construction survey; and
- Waste management plan.

In accordance with Part 3 of the Water Sustainability Regulation the installation of a culvert is considered an authorized change if the following construction BMPs are met:

- The equipment used for site preparation, or for installation of the culvert, is situated in a dry stream channel or operated from the top of the bank; and
- The installation of the culvert does not destabilize the stream channel.

5.2.1 Least Risk Windows

Fish

Instream works should be conducted during the regional least risk work window of August 1 to September 15 to protect potential trout and salmon species downstream of site DF2 (MOEc 2006). The least risk window does not apply to sites DF1 and DF3 given these streams are not fish-bearing; however, instream work areas should be isolated from flows to prevent the delivery of sediment-laden water to Harrison Lake

which is fish-bearing. It should be noted that the least risk window for fish does not apply if the watercourse is naturally dry.

Birds

Vegetation should be minimal at these previously disturbed sites but if vegetation clearing is required, particularly for site preparation works, mitigation during construction should include work restrictions during the breeding bird window, March 15 to August 30 (ECCC 2018). Bird nesting surveys, as per MOTI protocol, and measures to protect active nests are required for vegetation removal and disturbance activities during the active nesting period (MOTI 2020b). If clearing cannot be conducted during this time due to the Project schedule, pre-clearing bird nesting surveys by a Qualified Environmental Professional will be required to ensure compliance with the federal *Migratory Birds Convention Act*, which prohibits the removal or destruction of birds or bird habitat during the breeding season. Surveys should be conducted so that no-disturbance buffers can be established around active nest sites. Raptor nests were not observed during the preliminary design studies; however, raptor nest surveys should be completed immediately prior to construction to ensure conditions have not changed.

6.0 REGULATORY CONSIDERATIONS

Based on a review of the draft options analysis (Binnie 2022b) and existing environmental resources identified in this EOA, Hatfield has identified the following environmental legislation and permits that may apply to the Project (Table 5).

Table 5 Summary of legislation applicable to the Project.

Legislation	Agency	Area of Regulation	Possible Permits/Action
Federal			
<i>Species at Risk Act</i>	Environment and Climate Change Canada (ECCC)	Protects threatened or endangered species	No endangered or threatened species listed under Schedule 1 have been identified in the Project area; however, pre-construction surveys for SARA-listed species should be conducted.
<i>Migratory Birds Convention Act</i> and Regulations	ECCC	Prohibits injury, molestations, and destruction of migratory birds and their nests.	Bird nesting surveys and measures to protect active nests are required for vegetation removal during the active nesting period (March 15 to August 30).
<i>Fisheries Act</i>	Fisheries and Oceans Canada (DFO)	No person shall carry on any work, undertaking or activity that results in the death of fish or the harmful alteration, disruption or destruction (HADD) of fish habitat.	A request for project review will be required if all measures to protect fish and fish habitat cannot be followed (see Section 6.3). An Authorization is not expected to be required.
Provincial			
<i>Water Sustainability Act</i> and Regulation	BC Ministry of Forests (MOF)	Regulates activities being carried out in and about a stream.	Each culvert replacement will require submission of a notification pursuant to Part 3 of the Water Sustainability Regulation a minimum of 45 days before commencement of works. Site DF3 will also include a notification for the restoration or maintenance of a stream channel by the government.
<i>Wildlife Act</i>	MOF	Section 34 prohibits the disturbance of birds, their eggs, and their nests while occupied by a bird or its eggs. The nests of eagles, peregrine falcon, gyrfalcon, osprey, heron, and burrowing owls are protected year-round.	Nests protected year-round have not been identified within the Project area. A pre-construction survey should be conducted to confirm that there are no active nests or nests protected year-round in the Project area.
		Regulates works that impact vertebrate species, other than birds	A wildlife permit is required to salvage small vertebrates before works (required for Pacific water shrew at site DF3).
<i>Weed Control Act</i> and Regulation	BC Ministry of Agriculture and Lands	The Weed Control Regulation prohibits the spread of provincial and/or regional noxious weeds throughout the province. This includes vectors such as soils, machinery or vehicles, and seed mixes.	Noxious weeds have not been identified within the Project area; however, a pre-construction survey should be conducted to assess if conditions have changed. Requires all land occupiers to control the spread of provincial and/or regional noxious weeds on their land and premises.

6.1 SPECIES AT RISK ACT

SARA-listed birds and aquatic species are protected where their critical habitat has been identified, in all lands regardless of jurisdictions. Management Plans and Recovery Strategies are federal stewardship initiatives that involve collaboration with provincial governments, and as such it is expected that these protocols are adhered to on provincial lands as a matter of due diligence. It is expected that SARA permits will not be required for this Project.

6.2 MIGRATORY BIRDS CONVENTION ACT

ECCC's Canadian Wildlife Service (CWS) has jurisdiction over birds listed under the federal *Migratory Birds Convention Act* (MBCA 1994), which in the general area of the Project includes insectivorous birds (i.e., warblers, flycatchers, hummingbirds, wrens, thrushes, vireos, nightjars, swallows, tanagers, woodpeckers, chickadees, and their allies), seed eaters (i.e., sparrows, finches, grosbeaks, tanagers), and water birds (i.e., shorebirds, gulls, waterfowl, and their allies). Some of these species are listed under SARA. MBCA prohibits injury, molestations, and destruction of migratory birds and their nests. Generally accepted work windows revolve around the breeding bird nesting periods defined by ECCC which is between March 15 and August 30 for birds in the Fraser Valley (ECCC 2018). If works cannot be conducted outside of these windows, measures to protect active nests are required.

6.3 FISHERIES ACT

The new fish and fish habitat protection provisions of the *Fisheries Act* pursuant to Bill C-68 came into force on August 28, 2019. The *Fisheries Act* requires that project works, undertakings or activities avoid causing:

- The death of fish by means other than fishing; and
- Harmful alteration, disruption or destruction (HADD) unless authorized by the Minister of Fisheries and Oceans Canada.

In accordance with the Fish and Fish Habitat Protection Policy Statement (DFO 2019), DFO interprets HADD as any temporary or permanent change to fish habitat that directly or indirectly impairs the habitat's capacity to support one or more life processes of fish.

Hatfield has evaluated the proposed Project works, undertakings or activities to confirm if all Measures to Protect Fish and Fish Habitat (DFO 2019) can be implemented. A Request for Review application to DFO will be required given the Project is unable to avoid "disturbing or removing materials from the banks, shoreline or waterbody bed" (DFO 2019) at each site. It is expected that DFO will issue a letter of advice for the Project to proceed within 60 days of submitting the Request for Review application.

6.4 WATER SUSTAINABILITY ACT

To make changes in and about a stream requires a license, use approval or change approval; or compliance with an order, or Part 3 of the Water Sustainability Regulation (the Regulation), which includes submitting a Notification to a Habitat Officer. The BC Water Sustainability Act defines changes in and about a stream as "any modification to the nature of a stream, including any modification to the land, vegetation and natural environment of a stream or the flow of water in a stream, or any activity or construction within a stream

channel that has or may have an impact on a stream or a stream channel” (WSA 2016). A stream channel includes the bed and banks of the stream and includes side channels.

In accordance with Part 3 of the Regulation and based on the draft options analysis (Binnie 2022b) it is anticipated that Project works may proceed via Notification of works (i.e., culvert replacement at each site and maintenance of a stream channel by the government at site DF3). Notifications must be submitted within 45 days of Project works.

6.5 BC WILDLIFE ACT

Wildlife in BC are protected from harm under the *Wildlife Act*, except as allowed by regulation for such activities as hunting and trapping. The *Wildlife Act* falls under the jurisdiction of MOF and extends to vertebrate animals including bird species not listed under the *Migratory Birds Convention Act*. A *Wildlife Act* permit is required for the live capture, temporary possession, transport, and release of species of concern from the construction footprint to avoid disturbance and mortality (e.g., Pacific water shrew). The permit application includes a detailed description of the salvage plan and a BC Animal Care Form. The target time frame for making a decision on a *Wildlife Act* permit application is 30 days following submission, although applications to FrontCounter BC can be expedited.

Permits pursuant to the *Wildlife Act* are not expected to be required for sites DF1 and DF2; however, based on the habitat conditions and nature of work at site DF3 it is recommended that a pre-construction salvage for Pacific water shrew occur before realigning the channel back to its original location upstream of Rockwell Drive. It will be the contractor’s appropriately qualified professional’s (AQP) responsibility to obtain a permit and define appropriate salvage methods for Pacific water shrew.

6.6 WEED CONTROL ACT

Pursuant to the *Weed Control Act* (WCA 1996), the spread of all regional and provincial designated noxious weeds must be controlled. It aims to protect the province’s economy, natural resources, and society from the negative impacts that noxious weeds put on native ecosystems and infrastructure. Noxious weeds are to be managed throughout the construction phase of the Project per the contractor’s CEMP.

7.0 CLOSURE

MOTI proposes upgrades to 3 watercourse crossings along Rockwell Drive, which were damaged during the November 2021 atmospheric river. Project works include changes in and about a stream and as such will require regulatory review in accordance with the federal *Fisheries Act* and provincial *Water Sustainability Act*. Based on a review of the draft options analysis (Binnie 2022b) and contingent upon recommended design and construction mitigation strategies provided in this EOA it is Hatfield's opinion that residual impacts on environmental resources will not occur as a result of the Project. More detailed quantification of Project-related impacts in support of environmental permit applications will be provided as Project design drawings are advanced.

8.0 REFERENCES

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