Coats Marsh Weir Removal: Environmental Impacts and Mitigation Measures for Weir Pool Area

Prepared For
Regional District of Nanaimo
1490 Springhill Road
Parksville, BC V9P 2T2

Prepared By
EDI Environmental Dynamics Inc.
208A – 2520 Bowen Road
Nanaimo, BC V9T 3L3

EDI Contact
Randy Morris
Senior Biologist

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ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

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AUTHORSHIP

Team members from EDI Environmental Dynamics Inc. who contributed to preparing this report include:

Leo Chira, M.Sc., R.P.Bio ..... Primary Author

Randy Morris, M.R.M., R.P.Bio., P.Ag. ..... Secondary Author and Senior Review

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1 INTRODUCTION

Coats Marsh Regional Park is the first protected wetland on Gabriola Island and is managed by the Regional District of Nanaimo (RDN) (RDN n.d.). This regional park is in the traditional territory of the Snuneymuxw First Nation. As identified in the *Coats Marsh Regional Park Management Plan: 2011-2021*, the primary management objective for the park is environmental conservation (RDN 2011). The water levels within the wetland are controlled by a concrete outlet weir and an upstream beaver dam. For the intent of this reporting, the "marsh area" is defined as the full extent of the Coats Marsh wetland complex impounded by the existing weir and beaver dam (see Appendix A). This report focuses on the much smaller "weir pool area", which is defined as the wetted area immediately upstream of the outlet weir but below the beaver dam.

In 2020, it was determined that the weir had deteriorated and there is a risk of private property flooding downstream if the weir fails. A subsequent study (NHC 2023a, 2023b) evaluated weir replacement and decommissioning options, after which the RDN elected to pursue a weir decommissioning plan that retains the upstream beaver dam as the preferred option.

As defined in the preliminary dam decommissioning plan report (NHC 2023b), the objective of decommissioning is to remove the concrete weir such that there is no man-made reservoir impoundment above the existing marsh grade in the weir pool. The preliminary plan assumes that the upstream beaver dam will be left in place during and after the decommissioning process. Additionally, a 1.2 m high concrete grade control structure is proposed at the current weir location to reduce erosion and sediment mobilization from upstream, and to partially restore the controlling bed level that existed prior to historical blasting of the marsh outlet channel. The dam safety regulation (DSR) requires that decommissioning be carried out in a way that mitigates adverse impacts to public safety, the environment, and infrastructure and property.

Several environmental and hydrological assessments have been conducted within the Coats Marsh and downstream watersheds including:

- Coats Marsh Weir Replacement Elevation Study – Final Report (NHC 2023a)
- Coats Marsh Dam Preliminary Decommissioning Plan Report (NHC 2023b)
- A Proposed Strategy for Water Level Management – Coats Marsh, Gabriola Island, BC (Madrone Environmental Services, 2021)
- Coats Marsh Weir Assessment (SRM Projects 2020)
- Post-Construction Report – Coats Marsh Flood Protection Berm (Madrone Environmental Services Ltd., 2013)
- Coats Marsh Regional Park – 2011-2021 Management Plan (RDN 2011)
- Citizen-science studies from local Gabriola Island resident N. Doe and Gabriola Streemkeepers (2019, 2020, 2021, 2023)

EDI Environmental Dynamics Inc has prepared a habitat assessment of the wetland (EDI 2023) and weir decommissioning plan (EDI 2023a). A public engagement open house was held in January 2024 to present

the preliminary decommissioning plan and solicit feedback from community members. Following this process, RDN requested that EDI prepare an additional environmental assessment focusing on project effects and mitigation options for the weir pool area.

This report is based on the results of a targeted field investigation at the weir pool and is supported by information from previous studies and reports. The rationale for this focus is that areas upstream of the beaver dam should remain largely unchanged by decommissioning, while conditions in the weir pool will change more substantially. The field visit provided additional data on the weir pool conditions, potential environmental impacts, and necessary mitigation measures. These mitigation measures will be refined based on input from the client and NHC, proposed work plans, project timeline, and input from provincial and federal regulators. The proposed mitigation measures will inform revisions to the decommissioning plan to reduce impacts and improve environmental outcomes of the project.

2 METHODS

The field assessment of the weir pool area included a review of background information, including government records of environmental features and constraints, with a particularly focus on aquatic and riparian values, including at-risk species and fish occurrences. A field survey was completed by EDI (Leo Chira, RPBio and Bryan Gustafson, RPBio) on April 2 and 3, 2024.

2.1 BACKGROUND INFORMATION REVIEW

Background information was collected for fish, wildlife and vegetation, including invasive species, using data available through several online databases and literature review. Using these databases, preliminary lists were developed for ecosystem types, known species occurrence records, and potential for species at risk. The databases that were queried included:

- BC Conservation Data Centre iMap: Mapped Known Locations of Species and Ecological Communities at Risk[1]
- Ministry of Environment and Climate Change Strategy BC Species and Ecosystem Explorer[2]
- EcoCat (Provincial Ecological Reports Catalogue)[3]
- Wildlife Tree Stewardship Atlas[4]
- Ministry of Environment and Climate Change Strategy HabitatWizard[5]

2.2 FIELD ASSESSMENT

The field assessment at Coats Marsh was conducted to collect comprehensive data on the values of the weir pool area of Coats Marsh, with a particular focus on characterizing water quality, fish and amphibian presence, and habitat value, and identifying environmentally sensitive features that could be affected by the proposed weir decommissioning.

To assess water quality, several key parameters were measured. In-situ measures included instantaneous water temperature, dissolved oxygen, conductivity, turbidity and pH was recorded. These measures are crucial for assessing fish and amphibian habitat values as they directly influence health, behaviour, and distribution of aquatic and semi-aquatic species.

[1] http://maps.gov.bc.ca/ess/sv/cdc/
[2] http://a100.gov.bc.ca/pub/eswp/
[3] http://www.env.gov.bc.ca/ecocat/
[4] http://wildlifetree.ca/atlas.html
[5] http://www.env.gov.bc.ca/habwiz/

Fish sampling was performed using minnow traps, following methods described in *British Columbia Fish Collection Methods and Standards* (RISC 1997). On April 2, 2024, at 13:00, twenty (20) minnow traps were strategically deployed within the weir pool to ensure a representative sample of the fish population. These traps were retrieved on April 3, 2024, at 8:13, after which any captured fish were to be identified, counted, and documented.

Amphibian surveys involved both visual observations and incidental captures. Targeted searches were conducted for amphibian egg masses, focusing on shallow, calm water regions with abundant emergent vegetation where egg masses of northern red-legged frogs and Pacific chorus frogs are typically found. Additionally, incidental captures of adult amphibians were recorded during the fish sampling process.

A habitat assessment was conducted to observe the environmental conditions of the weir pool and its surroundings. Detailed observations also included the characterization of wetland habitat and vegetative cover. The presence of underwater and emergent vegetation, which provides attachment sites for amphibian egg masses, was also noted.

3 DESCRIPTION OF NATURAL ENVIRONMENT FEATURES

Coats Marsh weir is a concrete outlet weir that is approximately 3.3 m high (downstream side), 6 m wide and 0.6 m thick with a wooden bridge built to cross the water outlet. The weir, bridge and berm are located on Coats Marsh Creek at the west end of Coats Marsh on Gabriola Island (Photo 3-1). The water storage capacity at the weir crest elevation for the full marsh area is approximately 38,950 cubic meters (NHC 2023b). The weir pool area is estimated to have a capacity of between 5% to 7% of the full marsh area, with the weir pool volume ranging between 2,000 and 2,700 cubic meters.

Photo 3-1 Wood bridge over Coats Creek and adjacent to cement weir

An existing beaver dam is located approximately 60 m upstream (east) of the weir, and it is currently the main controlling factor for water level in most of the wetland. The beaver dam effectively elevates the upper wetland's water level above the existing weir's "design" spill level. Currently, a siphon system is in place to draw down the upper wetland's water levels. The long-term management goal is to phase out the siphon system in order to return the wetland hydrology to a more naturally regulated state and to protect wetland habitat.

3.1.1 VEGETATION AND ECOSYSTEMS

3.1.1.1 General

Gabriola Island is within the Coastal Douglas-fir (CDF) biogeoclimatic zone, characterized by low elevations in the rain shadow of Vancouver Island. Coats Marsh, part of the Hoggan Lake Watershed (925-380000-26400) and Coats Marsh Regional Park (Regional District of Nanaimo 2011), is a diverse wetland ecosystem influenced by the concrete weir and upstream beaver dam. The marsh spans approximately 200 meters in width and 425 meters in length, with habitats including shallow water, marsh, and shrubby swamp areas. The wetland comprises about 65% shallow water, 25% marsh, and 10% shrubby swamp.

The surrounding mature forest includes Douglas fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), and red alder (*Alnus rubra*), contributing to nutrient cycling within the wetland. The hydrology of Coats Marsh is closely linked to the interaction between the concrete weir and the upstream beaver dam, which creates diverse hydrological zones and influences plant community distribution.

Vegetation in Coats Marsh varies with hydrological conditions. Shallow water areas are dominated by water smartweed (*Persicaria amphibia*), yellow pond lily (*Nuphar variegata*), and other aquatic species. Transition zones feature emergent plants like sedges (*Carex* sp.), pondweed (*Potamogeton* sp.), and marsh horsetail (*Equisetum palustre*) (see Photo 3-2). Margins of the wetland, influenced by periodic flooding, support shrubby vegetation like pink spirea (*Spirea douglasii*) but are extensively dominated by invasive reed canarygrass (*Phalaris arundinacea*) (Photo 3-2). Reed canarygrass thrives in habitats characterized by fluctuating water levels, and frequently out-competes native wetland vegetation.

Photo 3-2 Marsh area that is currently dominated by invasive reed canarygrass.

In areas less prone to inundation, such as the margins of the wetland, shrubby vegetation like pink spirea (*Spirea douglasii*) and other shrub species provide additional habitat diversity. These areas, influenced by periodic flooding and seasonal changes in water levels, contribute to the mosaic of habitats that define Coats Marsh.

3.1.1.2 Weir Pool

The weir pool area, located between the concrete outlet weir and the upstream beaver dam, is a critical transitional zone within Coats Marsh. Water levels in the weir pool area are largely dictated by the weir elevation although the beaver dam also regulates water levels by retaining water upstream. Water levels in the weir pool, in turn, influence the composition of wetland habitat and vegetation communities.

An open water channel runs through the center of the weir pool from the beaver dam to the concrete weir, indicating a deeper, consistently wetted depression. Although dimensions will depend on vegetation growth and water levels, the open water drainage channel is approximately 2 m wide and approximately 50 m long in the weir pool. This submerged channel through the weir pool is described as an anthropogenic feature that was constructed around the same time as the weir by excavating and/or blasting a ditch along the base of the wetland (NHC 2023a). The channel extends far upstream into the marsh area (Figure 3-1).

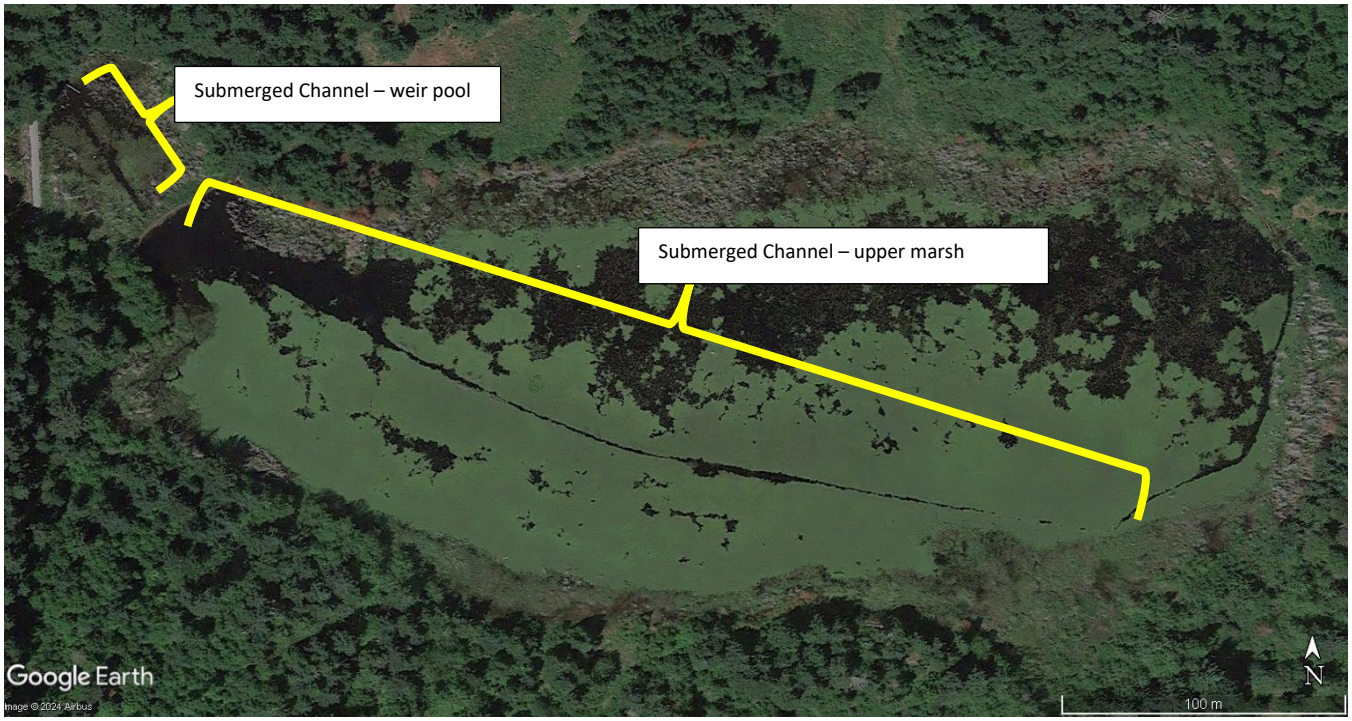


Figure 3-1 Extent of submerged channel through weir pool and upper marsh area (source: Google Earth)

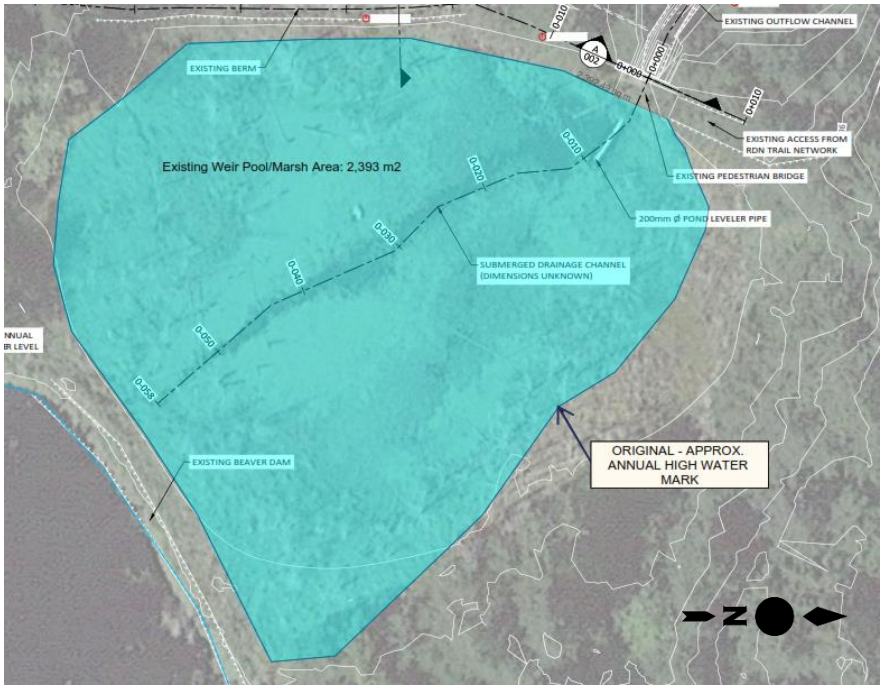
Aquatic vegetation thrives in the shallow waters adjacent to the open water channel, including hydrophytic species such as water smartweed, yellow pond lily (*Nuphar variegata*), and bladderwort (*Utricularia sp.*) (see Photo 3-3). These plants adapt to fluctuating water levels and contribute to the area's ecological richness. Further from the central channel, the wetland complex transitions towards a marsh zone, including emergent and other hydrophytic native plants such as pondweed (*Potamogeton sp.*), sedges (*Carex sp.*), and marsh horsetail (*Equisetum palustre*), although these areas are largely dominated by a thick cover of invasive reed canarygrass.

The upper extent of the wetted perimeter of the marsh areas contains numerous standing dead trees. This indicates that ecological conditions were previously drier and have changed in recent history, associated with increased water retention in the marsh. Beaver activity at the weir over the past decade is likely responsible for the increased water retention. Although the edges of the wetland may previously have been more characteristic of a swamp ecosystem, with higher water levels in recent years, these areas have now transitioned into wetter marsh conditions with small standing dead trees.

Photo 3-3 Weir pool area with shallow open water transitioning into marsh (looking north).

Based on drawings provided by NHC, the estimated area within the annual high-water mark (HWM) between the weir and beaver dam is currently 2,393 m^2 (Figure 3-2). The wetted area of the weir pool has historically been smaller but beaver activity around the weir over the past decade has resulted in higher waters in the weir pool area, as evident from the standing dead trees on the wetland periphery. Area within the annual high-water mark represents a mix of open water and marsh habitat.

Figure 3-2 Existing weir pool/marsh area (to current estimated annual high-water mark) prior to dam decommissioning



Despite the extensive cover of native wetland plant species, the encroachment of invasive reed canarygrass (*Phalaris arundinacea*) in the marshy sections poses a significant management challenge (see Photo 3-2). Reed canarygrass has created thick stands of grass on the periphery of the marsh, outcompeting native vegetation and posing significant constraints to restoration of natural ecosystems. As such, invasive management must be included as a key part of the mitigation and restoration planning.

The existing earthen berm extending from the south side of the weir may be modified as part of decommissioning, which would represent a possible change in vegetative cover (Photo 3-4). Restoration prescriptions will be further refined upon confirmation of the final decommissioning design.

Photo 3-4 Existing earthen berm south of weir

3.1.2 WILDLIFE

3.1.2.1 General

The marsh provides habitat for a variety of wildlife species, including birds, amphibians, reptiles and mammals. Bird occurrence includes several species of wading birds, swans, geese, and waterfowl. Reports from local naturalists provide records of local wildlife observations at the site (Doe 2020). As noted, the marsh provides year-round habitat for Common Ravens (*Corvus corax*) and Northwestern Crows (*Corvus caurinus*), and also sees occasional visits from Steller's Jays (*Cyanocitta stelleri*) and Bald Eagles (*Haliaeetus leucocephalus*). Forested areas harbor Spotted Towhees (*Pipilo maculatus*) and Pacific Wrens (*Troglodytes pacificus*), while clearings attract American Robins (*Turdus migratorius*) and Violet-green Swallows (*Tachycineta thalassina*).

Shallow open water areas of the marsh hosts a variety of waterfowl, including year-round residents like Mallards (*Anas platyrhynchos*) and occasional visitors like Yellowleg Waders (*Tringa sp.*). Annual migrations bring Trumpeter Swans (*Cygnus buccinator*) and Canada Geese (*Branta canadensis*) to the area.

The Coats Marsh area hosts a varied population of mammals. While reports of black bears and cougars remain unconfirmed, black-tailed deer (*Odocoileus hemionus ssp. columbianus*) are noted as commonplace, even in winter. Other documented mammals include raccoons (*Procyon lotor*), red squirrels (*Tamiasciurus hudsonicus*), and beavers (*Castor canadensis*). Additionally, the presence of rodents such as deer mice (*Peromyscus maniculatus*) and Townsend's voles (*Microtus townsendii*) is highlighted, alongside the seasonal activity of bats (*Myotis sp.*).

The Coats Marsh area hosts a thriving amphibian community, including Pacific tree frogs (*Pseudacris regilla*) and the blue-listed northern red-legged frogs (*Rana aurora*). Additionally, the presence of the western long-

toed salamander (*Ambystoma macrodactylum*) and rough-skinned newt (*Taricha granulosa*) adds to the region's amphibian diversity. Coats Marsh is not identified as critical habitat under SARA or an Approved Wildlife Habitat Area (WHA) provincially for northern red-legged frogs. Reptiles, with garter snakes (*Thamnophis ordinoides*) as the primary representative, are relatively rare.

3.1.2.2 Weir Pool

During EDI's assessment of the weir pool area on April 4, 2024, no red-legged frog egg masses were observed, while many of the underwater vegetation stalks were occupied by Pacific chorus frog egg masses (Photo 3-5). Incidental catch during the fish sampling program indicated the presence of adult northern red-legged frogs, Pacific chorus frogs, and rough-skinned newt in the weir pool area (Photo 3-6). Of these species, the northern red-legged frog is identified as a priority species, being protected as a species of special concern under the federal Species at Risk Act and as a Blue-listed species provincially. As such, consideration must be given to the potential impacts of the project to northern red-legged frog populations at the weir pool.

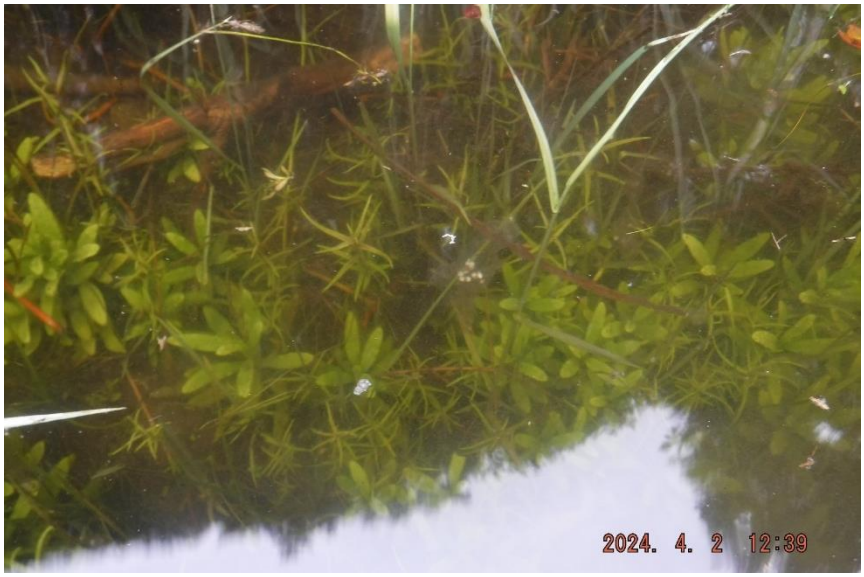


Photo 3-5 Pacific chorus frog egg mass observed in weir pool area

Photo 3-6 Incidental catch of northern red-legged frog in minnow trap

Red-legged frogs, like other amphibians, have a life cycle that depends on the water temperature. Red-legged frogs become active during the early-spring rainy periods when daytime temperatures are higher than 5°C (Maxcy 2004) and begin moving to breeding sites. In southwestern British Columbia, breeding usually starts in February - early March and lasts 2 to 4 weeks (Maxcy 2004), with egg laying when water temperature exceeds 4°C (Maxcy 2004). Egg masses are attached to stalks of emergent vegetation (e.g., rushes and sedges) in calm water of little or no flow (Maxcy 2004) with depths ranging from 0.3 m to 5.0 m deep and are at least 0.6 m from the shoreline (Maxcy 2004). Eggs hatch in approximately 5 weeks (Maxcy 2004) in water temperature of 4°C to 20°C, with variations depending on water temperature – i.e., warmer water determines a faster development. The tadpoles take at least 3–4 months to metamorphose and young of the year begin to emerge in late July/early August and continue emerging through early October (Maxcy 2004). Terrestrial habitat, where most of the juvenile development occurs, is not well understood (Maxcy 2004); however, it seems to be associated more with riparian areas – i.e., proximity to water, than other upland forests, and presence of coarse woody debris, potentially used as cover. Additionally, red-legged frogs seem to be negatively affected by clearcut and very young successional forest (Maxcy 2004).

Given that Coats Marsh is a low altitude, west coast, open water wetland that receives much solar radiation with shade provided only at the margins, red-legged frog development likely occurs earlier in the year at the weir pool and for a shorter period of time.

While there is no continuous water temperature data for the wetland, instantaneous measurements on April 2, 2024, indicated a temperature of 11.8°C, well within the egg development threshold. Additional instantaneous measurements were provided by the Gabriola Streamkeepers (RDN 2011): 16.5°C on April 14, 2016, 10.7°C on March 22, 2016, 19.9°C on August 21, 2016, 13.8°C on October 25, 2015, and 13.8 C on October 29, 2015.

Given that the water temperature in the wetland is relatively high in early spring, the assumed timing in the life cycle of red-legged frog in Coats Marsh is:

- beginning of February – breeding and egg laying;
- mid-March – egg hatching;
- beginning of July – metamorphosis.

3.1.3 FISH AND FISH HABITAT

Fish presence in the Coats Marsh area has been investigated to some extent in the past, with findings suggesting that the marsh does not sustain a salmonid fish population (Doe 2019, EDI 2023, and field data in 2024). Records indicate that fish sampling occurred in 2010, but no fish were caught (Foul Bay Ecological Research 2010). Additionally, EDI used fish roe baited minnow traps on April 4, 2024, to investigate potential fish in the weir pool, resulting in no catches. The presence of northern red-legged frog, Pacific chorus frogs, and rough-skinned newt was confirmed through trapping efforts.

Historically used for agriculture, Coats Marsh has documented barriers to fish passage, making it unlikely to support a natural population of salmonid fish. While the marsh could provide suitable habitat for three-spined stickleback (Madrone Environmental Services Ltd. 2012), sampling and observations did not provide evidence of presence in the marsh.

3.1.3.1 General

Coats Marsh is heavily influenced by barriers to fish passage, notably the 3.3-meter-high concrete outlet weir and two 1.5-meter tall, constructed rock dams situated 50 meters and 90 meters downstream. These obstacles fragment aquatic habitats and hinder fish migration (NHC 2023, Madrone 2021). Upstream of Hoggan Lake, another significant barrier described by Madrone (2021) features a bedrock step with a 50% drop over 2 meters, posing challenges for upstream fish movement. There is some doubt whether this documented barrier does in fact prevent fish passage, as Doe (2023) states that mature fish and fry were reported by Gabriola Island Streamkeepers up to 100-200 metres upstream of the South Road culvert (Doe 2023). Reports from the Coats family in 1972 (Burns 1972) suggested potential spawning by cutthroat or rainbow trout in the lowest reaches of Coats Marsh stream near Hoggan Lake, downstream of lowest documented barrier.

Downstream of the weir, Coats Marsh Creek undergoes seasonal dewatering in late summer, documented by Doe (2021) and confirmed during a field inspection on October 11, 2022 (L. Chira, EDI). Madrone's (2021) survey noted minimal flows in sections of the stream on July 23, 2021, downstream of the South Road culvert. Historical channel modifications like straightening and ditching have severely limited fish habitat, particularly in the lowest stream reaches, characterized by steep sidewalls and organic substrate with sporadic alluvial deposits. Conversely, Hoggan Lake supports a historical presence of cutthroat trout, rainbow trout, and three-spined stickleback, though recent surveys from 2007 to 2017 did not capture salmonid species

3.1.3.2 Weir Pool

Fish presence in the weir pool area of Coats Marsh has been subject to recent investigation, particularly through EDI's study using fish roe-baited minnow traps on April 2, 2024. Despite extensive trapping efforts totaling approximately 370 trap hours, no fish were captured during this study (EDI 2024). This finding suggests that the weir pool, influenced by the hydrological dynamics of the concrete weir and upstream beaver dam, does not currently support a resident fish population.

Fish habitat between the concrete weir and the beaver dam is limited, particularly for salmonid species. The weir pool offers no fish spawning gravels, having a substrate dominated by organics. The weir pool presents some opportunities for rearing and overwintering, but the pond remains inaccessible to fish due to various barriers to fish passage, including the syphon installed at the concrete weir (Photo 3-7) and the height of the concrete weir during low to average water elevation. At high water elevation the concrete weir is overtopped due to limited flow through the existing pipe outlet of 0.2 m diameter (Photo 3-8), although the lack of a plunge pool at the bottom of the weir prevents fish from being able to jump over the weir.

Photo 3-7 View of the syphon at the downstream side of the concrete weir on April 4, 2024.

Photo 3-8 View of the syphon at the downstream side of the concrete weir on March 10, 2016 (photo by Gabriola Streamkeepers 2017).

Given the existing poor fish habitat for spawning and the existing fish barriers, as well as sampling results accompanied by visual observations, the wetland is considered non-fish bearing. The one observation of threespine stickleback in Coats Marsh (Habitat Wizard ID 525063, 2017) is not supported by the stream and wetland reports available on the Government of BC's Habitat Wizard tool. In our opinion, the fish was likely trapped during the 2017 sampling in Hoggan Lake and misplaced on the provincial map database.

4 SUMMARY OF ENVIRONMENTAL EFFECTS

4.1 VEGETATION AND ECOSYSTEMS

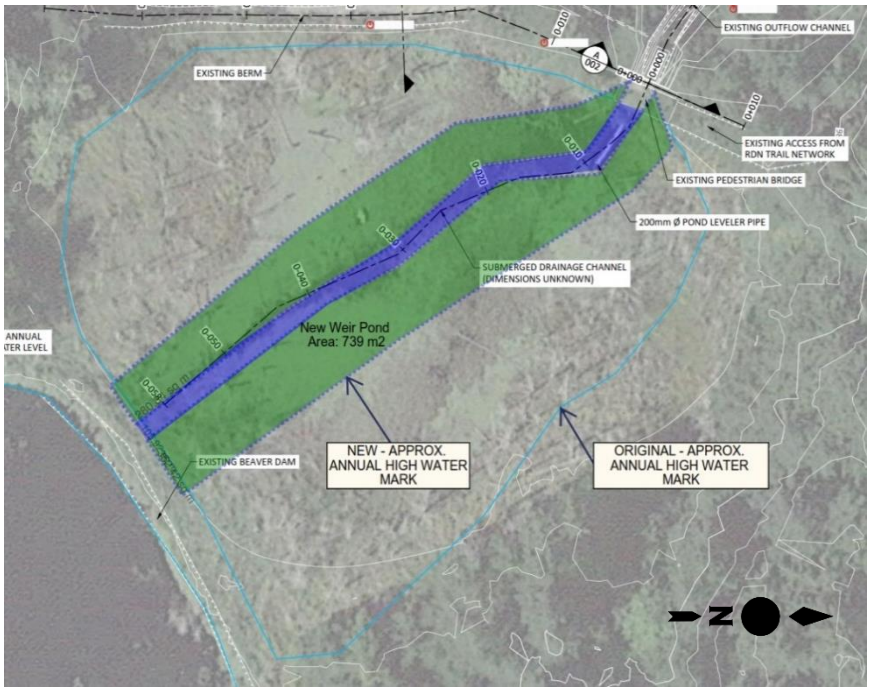
4.1.1 WETLAND AREA LOSS

With the decommissioning of the weir structure, the area within the estimated future annual high water is approximately 739 m^2 (Figure 4-1). Considering the current estimated high-water mark has an estimated area of 2,393 m^2 and the predicted annual high water mark for the weir pool area is approximately 739 m^2, this represents an area of 1,654 m^2 that will be dewatered at the weir pool, to be revegetated and enhanced to a mix of shrubby swamp and transitional riparian habitat planted with appropriate plant species (NHC 2023b).

Areas within the predicted annual high-water mark will continue to provide a mix of open water and marsh habitat. The 1,654 m^2 of dewatered area in the weir pool area is anticipated to transition towards a swamp ecosystem, with drier surface conditions but a persistent shallow water table and frequently saturated soils. The reduced area and edge length will result in the loss of aquatic plants, including open-water plant species

(e.g., yellow pond lily, water smartweed, and bladderwort) and emergent species (e.g., pondweed, sedges, and marsh horsetail).

Figure 4-1 Proposed weir pool/marsh area (to new estimated annual high-water mark) after dam decommissioning



Areas proposed as potential soil spoil sites are outside the wetted perimeter of the weir pool area and are not anticipated as having an impact on wetland values although they will represent a temporary loss of vegetative cover in shrub and grass-dominated locations at the north and south ends of the weir pool. Spoil areas are estimated to have combined area of 420 m^2. Areas proposed are shrub-dominated locations currently with limited tree cover. Any soil spoil sites areas will be enhanced as riparian forest habitat.

4.1.2 INVASIVE SPECIES

As observed on site and noted in the *Coats Marsh Regional Park 2011-2021 Management Plan* (Regional District of Nanaimo 2011), reed canarygrass has become established along most of the shore of the Coats Marsh area. The proliferation of reed canarygrass poses a major challenge as it outcompetes native vegetation and can quickly come to dominate marsh areas. Areas estimated to be dewatered (estimated at 1,654 m^2) will be susceptible to the rapid encroachment of reed canarygrass, and mitigations will be necessary to minimize this to the extent possible. Effective management of reed canarygrass will be crucial to restoring ecological balance and supporting native plant communities.

4.2 WILDLIFE

4.2.1 REDUCTION OF HABITAT

The proposed decommissioning of the weir at Coats Marsh is expected to have an impact on some species of local wildlife, particularly amphibians such as the northern red-legged frogs and Pacific chorus frogs. These species rely on aquatic habitats, particularly emergent vegetation, for breeding and egg-laying. The reduction in the wetted area from approximately 2,393 m^2 to 739 m^2 will likely decrease the availability of suitable breeding habitats in the weir pool area, potentially leading to a decline in local amphibian populations. Although the weir decommissioning will result in changes to aquatic habitat available at the weir pool, this represents a small reduction when considering the much-larger marsh area upstream of the beaver dam. The upper marsh has an estimated wetted surface area of approximately 58,000 m^2 and offers extensive suitable habitat for amphibian species.

Other wildlife that would likely be affected by the reduction in open water and marsh habitat include waterfowl and wading birds. As noted for amphibians, the large area of marsh upstream from the beaver dam should continue to provide suitable habitat for waterbirds. Although habitat conditions may be negatively affected for waterbirds, other bird species that prefer shrubby, riparian ecosystems will likely see improved habitat conditions.

4.2.2 INVASIVE SPECIES

The spread of invasive reed canarygrass can also have a negative effect on amphibian habitat and their success. In particular, the colonization and overgrowth of other emergent plant species by reed canarygrass can compromise egg-laying habitat for pond-breeding amphibians. Although red-legged frogs typically prefer moderately dense emergent vegetation for breeding, including sedges, rushes, and grasses, the monotypic stands of reed canarygrass typically present a degradation of habitat. In fact, dense stands of reed canarygrass can become almost impenetrable, reducing the amount of cover and feeding habitat available for larvae of native frog species (Adams 1999). Preventing the spread of introduced species, including vegetative species, is considered a management objective for the protection of the northern red-legged frog in BC (Tamburello and Litt 2021).

4.3 FISH AND FISH HABITAT

The decommissioning of the weir is not anticipated to have any direct impact on fish populations. As noted, no fish were captured during the field assessment, nor were any reported in previous consultant reports or government fish sampling records. Although the reduction in wetted area will lead to a decrease in available aquatic habitat in the weir pool area, the lack of fish presence in Coats Marsh and the existence of several barriers to fish passage downstream support that no negative effects to fish are anticipated, assuming the appropriate mitigations are taken during the decommissioning work to protect water quality and fish habitat downstream of the project.

5 MEASURES TO AVOID & MITIGATE ENVIRONMENTAL IMPACTS

The present decommissioning plan includes retention of the beaver dam, which is intended to allow for the maximum water retention within the wetland while still decommissioning the weir. The assumption is that this outcome will result in a scenario closest to full water retention in Coats Marsh, which had the greatest benefit for preservation of present ecological conditions, including for amphibians and waterfowl, according to the 2023 Coats Marsh Weir Replacement Study (EDI 2023). Assuming the beaver dam retains the similar pond conditions upstream, environmental outcomes are not expected to deviate significantly from Scenario 4 in the wetland assessment (EDI 2023), which assumed a small reduction in the weir height to the current beaver dam elevation (weir crest of 97.7m). However, there is a risk that the level of local beaver activity could change in time – e.g., abandonment, which could lead to a future deterioration of the beaver dam and uncontrolled fluctuations in water levels within the marsh area. EDI is not qualified to speak to the beaver dam's stability, functionality or likelihood of failure, and defers to information provided in the Beaver Dam Risk Assessment (NHC 2024) for consideration and discussion.

Only the weir pool will be dewatered as a result of the weir removal as most of the storage volume of the marsh is governed by the beaver dam. Based on preliminary drawings from NHC (2023), the current area within the annual high-water mark between the weir and beaver dam is 2,393 m^2. With the decommissioning of the weir structure, the area within the estimated future annual high water for the weir pool area is approximately 739 m^2. In total, this represents an area of 1,654 m^2 that will be dewatered at the weir pool. Dewatered areas will be subject to restoration works, with treatments being applied that are suitable for the predicted final moisture conditions (see Section 5.2).

Given the proposed changes, we anticipate that the proposed weir decommissioning will require the following permits prior to works commencing:

- Section 11 Approval under the BC Water Sustainability Act for changes in and about a stream;
- Salvage permit under the Wildlife Act for capturing, handling and transportation of amphibians and wildlife; and
- Fisheries and Oceans Canada Request for Review under the Fisheries Act, for activities in or near a watercourse that might cause a Hazardous Alteration, Disruption and Destruction (HADD) of Fish Habitat.

5.1 CONSTRUCTION ACTIVITIES

A Construction Environmental Management Plan (CEMP) must be drafted by a Qualified Environmental Professional (QEP) prior to construction commencing. The CEMP will include specific construction mitigation plans to prevent potential environmental incidents and impacts within and outside the proposed construction area. Environmental monitoring of construction activities by the QEP will be a requirement of the weir removal project. The primary objective of this CEMP is to ensure that construction activities are carried out in a manner that is (i) compliant with environmental legislation, (ii) compliant with the Project's

environmental specifications, and (iii) does not result in avoidable adverse impacts to the environment, including water quality, riparian and aquatic habitats, and fish and wildlife species.

Additionally, the CEMP will be part of the required provincial and federal permitting processes.

5.2 REVEGETATION AND ENHANCMENT

Revegetation and enhancement will be required at the dewatered areas of the weir pond, the excavation areas at the berm location, and any selected soil spoil sites. As noted in the *Dam Decommissioning Checklist* (Ministry of Forests, Lands, Natural Resource Operations and Rural Development 2010), there is a requirement to leave the site in a condition that is safe and does not alienate the property for future use or enjoyment of the public. Additionally, in environmentally sensitive areas (ESAs), such as wetlands, the revegetation of disturbed soils should be completed in a manner that avoids the establishment and spread of invasive species.

Dewatered areas will be restored largely to shrubby swamp habitat in lower elevation locations and riparian transitional forest on the slightly higher, drier peripheries. The existing stream channel (anthropogenic ditch) in the weir pool area will be retained to convey water through the marsh area to the decommissioned weir outlet.

Based on current design plans and our predictions for future site conditions (i.e., post-dam decommissioning), the restoration area has been divided into four general treatment units based on anticipated ground elevation, water availability, and construction disturbance. The treatment units are described in Table 5-1 and depicted in Figure 5-1. For further details regarding proposed revegetation and enhancement work, please refer to the *Coats Marsh Dam Decommissioning: Environmental Assessment for Preliminary Decommissioning Plan* report (EDI 2023).

Table 5-1. Summary of treatment units

Treatment Unit	Area (m²)	Description	Target Species
TU1 - Low Elevation Marsh	627	Within annual high-water mark; currently open water habitat transitioning to seasonally flooded marsh.	Cattails, Beaked Sedge, Rushes
TU2 - Mid Elevation Swamp	1,135	Above annual high-water mark but below 200-year high water mark; transitioning from marsh to swamp with frequently saturated soils and shallow water table.	Hardhack, Pacific Willow, Sitka Sedge, Bluejoint
TU3 - Riparian Areas	956	Above 200-year high water mark; areas disturbed by construction activities, including soil removal, excavation, and soil placement.	Red Alder, Western Redcedar, Salal, Red Elderberry, Osoberry
TU4 - Transitional Riparian Zone	219 (35% of 626)	Peripheries of potential dewatering zone; mix of marsh and swamp conditions with some standing water; infill planting needed for dewatered pools.	Red Alder, Hardhack, Osoberry, Salal, Bluejoint

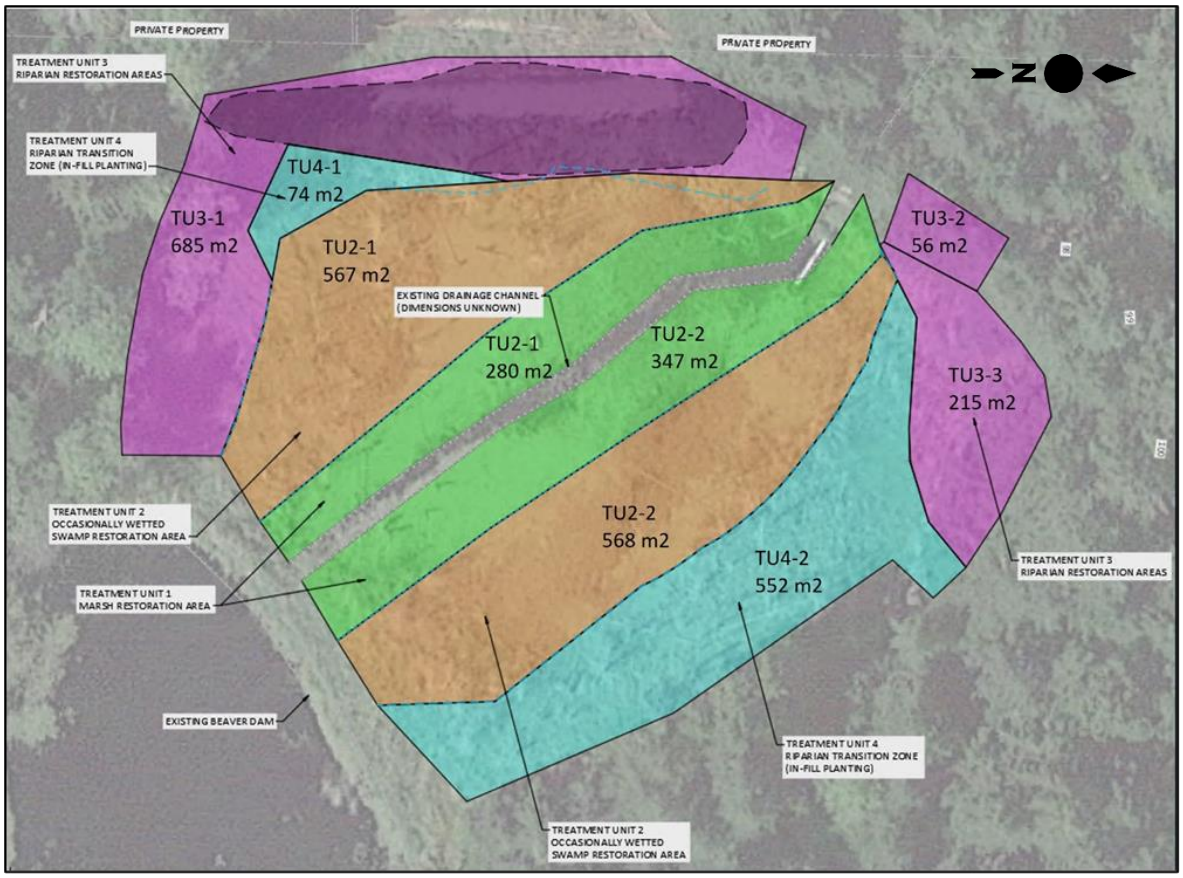


Figure 5-1 Proposed treatment units for revegetation and enhancement work.

5.3 INVASIVE SPECIES MANAGEMENT

Control of reed canarygrass in the dewatered wetland section and adjacent riparian areas should be implemented, reflecting the prescriptions outlined in the *Coats Marsh Dam Decommissioning: Environmental Assessment for Preliminary Decommissioning Plan* (EDI 2023). It is important to note that reed canarygrass is extremely persistent and aggressive, and that full removal and/or eradication is unlikely from the marsh area.

Rather, the project hopes to control reed canarygrass manually until other planted native species can become established and free growing. During the decommissioning construction works, soils excavated at site may be considered for use to cap and temporarily smother areas of reed canarygrass, which will then need to be planted as per revegetation prescriptions. Care will need to be taken to ensure that soil placement does not dramatically alter the site topography or drainage, and that it is not at risk of erosion and sediment transport.

Controls during revegetation and ongoing maintenance may include trampling/stomping, cutting/mowing, and smothering with cardboard and/or mulch. Any cutting of reed canarygrass should be implemented prior to seed maturity (May to June) (Metro Vancouver and the Invasive Species Council of Metro Vancouver, 2021).

Assuming a five-year maintenance and inspection period, each spring, and as needed through the year, reed canarygrass shall be mechanically brushed by the owner using manual methods. Reed canarygrass is pervasive through some areas of the marsh and requires care to prevent further spread of the species. To improve native plant growth and establishment within the treatment units, reed canarygrass and other non-native species will be mechanically managed to limit the height and reduce competition. This may include brushing and physical stomping down of the grass cover. Mulching may be utilized where required to help prevent establishment and control invasive species regrowth.

5.4 DOWNSTREAM FISH AND FISH HABITAT

Given that the area upstream of the concrete weir is non-fish bearing, the immediate risk to fish and fish habitat posed by construction is minimal. The new concrete grade control structure will still result in a water level drop at the weir pool outlet and could still present a challenge to fish passage. Potential construction effects may affect fish habitat documented downstream of the weir and South Road. Proposed mitigation measures include:

- Work will be carried out within permit obligations and project commitments.
- Works to be carried out during the least risk timing window for cutthroat trout and rainbow trout for the region – August 15 to September 15. This timing is outside the migratory birds breeding window and also coincides with the low water elevation period in Coats Marsh and potentially disconnected flow in Coats Marsh Creek.
- If flow is present, redirect the water around the construction area, such that clear water flow is maintained downstream throughout the construction period.
- Implementation of a sediment management strategy to avoid its sudden downstream mobilization during dewatering of the weir pool.
- Water quality will be monitored within the wetland and downstream of the weir if flow is present. Water quality will remain within the *BC Approved Water Quality Guidelines* for turbidity (BC MOECCS 2023).
- Implementation of a Spill Response Plan.
- Vegetation and soil management – removed aquatic vegetation will be kept on site for habitat restoration purposes. Given the organic and fine nature of the removed sediments, their return to the creek will likely result in negative effects to downstream fish habitat and aquatic insects, and they would not contribute to the geomorphological processes in the downstream sections of the stream. Therefore, it is recommended that these sediments are removed from site or applied as topsoil on disturbed upland soils where suitable.
- Improvement to fish access upstream of the existing points of difficulty and concrete weir as described below.

As an enhancement opportunity for future consideration, fish habitat may be further improved to allow upstream fish access throughout the stream section between South Road and the beaver dam. Alternatively, if the rock dams are to remain in place, fish access over the rock dams may be provided by creating a series

of smaller height pools at the base of each dam– i.e., fixed fish ladder. NHC could provide design considerations and available flows as consideration for creating fish ladders. As cutthroat trout was reported upstream of the South Road culvert, the removal of these points of difficulty for fish passage and the concrete weir at the wetland, would provide fish access to the entire stream section between Hoggan Lake and the beaver dam in Coats Marsh. That would increase rearing fish habitat by approximately 150 m linear which consists of 60 m within the wetland and 90 m between the concrete weir and the second rock dam.

5.5 AMPHIBIANS AND AMPHIBIAN HABITAT MITIGATION MEASURES

The presence of northern red-legged frogs, a federally listed species of concern and a provincially blue-listed species, has been documented in the Madrone report (Madrone Environmental Services, Ltd 2021) and confirmed by EDI through sampling on April 4, 2024. The proponent will need to engage with BC Ministry of Water, Land and Resource Stewardship (WLRS) to determine appropriate mitigations measures or any activity restrictions.

The proposed weir removal will result in an overall reduction of amphibian habitat as described in 3.1.2 and has potential to affect existing amphibians – adults and larvae directly. Potential mitigation and compensation measures for these environmental values are described below. Provided that the weir removal works are conducted during the least risk timing window for fish (August 15 – September 15), there will be no direct effects to amphibian egg masses as it is anticipated that all eggs will be hatched by April.

- Construction activities and potential amphibian salvages are to be conducted as per the conditions of the wildlife/amphibian salvage permit.
- Work activities should be planned during applicable least-risk windows to avoid potential affects to native amphibians. Although no formal window exists for amphibians in BC, given the local conditions in Coats Marsh, northern red-legged frogs likely breed in February – March, hatching occurs during March – April, and most tadpoles have metamorphosed by the end of July. Important times of the year when increased numbers of adult frogs may be observed by the pond and adjacent upland areas are during the breeding season (February – March) and during dispersal of newly metamorphosed juveniles (July- August). Weir removal should be timed to coincide after young red-legged frog dispersal, typically ending by mid-August.
- QEP to develop an Amphibian Salvage Plan as part of the amphibian salvage permitting process and to be implemented during construction. Instream work isolation to prevent amphibians from entering the work area will be installed as per the Amphibian salvage Plan and permit obligations.
- Adult and juvenile northern red-legged frogs (and all other amphibian specimens encountered) must be salvaged and relocated prior to any ground clearing or earthworks by a QEP based on the appropriate wildlife handling permits.
- Implementation of opportunities for amphibian habitat improvements and/or creation of new habitat within the future weir pool footprint.

The predicted open water habitat resulting from the removal of the weir is relatively narrow and linear, due to the morphology of the area – see Appendix A in *Coats Marsh Dam Decommissioning: Preliminary Decommissioning Plan* report (NHC 2023b). Opportunities for improvements of the resultant amphibian habitat and specifically for red-legged frog are described below. It is anticipated that these measures will benefit other amphibian species present in the marsh as well. Measures include:

- Branching of the Coats Marsh Creek channel within the proposed weir pool footprint to create side channels connected to the main flow. These side channels will create ephemeral amphibian habitat that will be used for breeding and potentially rearing of larval stages. To prevent amphibian mortality in isolated or dewatering channels during the summer, the channels should be graded such that they positively discharge into the main creek channel without creating any isolated pools. This measure would also prevent stranding of fish, if fish were to access the new habitat upon removal of the downstream barrier/points of difficulty. These side channels may be connected at both upstream or downstream ends or can have a dead upstream end. Based on the red-legged frog breeding requirements, side channels should be at a minimum 0.5 m deep and 1.2 m wide. Additionally, they should also retain water until the end of April when tadpoles will be able to move into the main channel if the side channel becomes dry. It is assumed that the main channel will remain wet to provide rearing habitat for tadpoles until metamorphosis in July/August. NHC have provided the following comment on the feasibility of channel/alcove construction based on engineering judgement considering available information (N. Valsangkar, pers. comm.):
    - The proposed concrete grade control structure will influence water levels in the weir pool because the structure crest elevation is set to match, roughly, the top elevation of the upstream ditch (stream channel). During periods of positive water balance (typically October to April, see NHC 2023), upstream water levels will be higher than the grade control structure and are expected to result in seasonal wetting of riparian areas. During periods of negative water balance (typically May to September), water levels are expected to be at or below the grade control crest, limiting wetted area to within the upstream ditch.
    - The upstream ditch was originally constructed by excavating and/or blasting through the wetland floor, which consists of organics, clay, and fractured bedrock. The construction of side channels or alcoves is likely to encounter clay and bedrock, the disturbance of which may increase losses to groundwater through the fractured substrate and be counterproductive to maintaining wetted habitat. Similar concerns were raised in the 2011 Coats Marsh Regional Park Management Plan, which evaluated the concept of marsh excavation to increase wetted area and water storage. If deep alcoves are desired, it would be necessary to carry out rock excavation and use grouting, dental concrete, or bentonite lining to seal the new channel bed, all of which are costly, would involve greater environmental disturbance, and would not support future vegetation growth.
    - A possible compromise is to construct shallow channels and alcoves with positive drainage towards the main ditch channel. These would ideally be designed to maintain some wetted area through May and June to facilitate tadpole migration into deeper waters (EDI, pers. comm.) It would be necessary to carry out a test pitting program to identify locations

where the clay and bedrock are deep enough to not be disturbed by excavation, after which the alcoves would be designed to suit subgrade conditions. Test pitting will disturb riparian, and possibly submerged, areas of the weir pool and require a separate permitting process. A potential solution is to include alcoves in the construction contract as a provisional item, subject to test pitting to be carried out when the weir pool is already dewatered, minimizing environmental effects. However, there is no guarantee that test pitting will identify suitable areas for alcove construction.

  - An alternative approach to constructing open water alcoves could be achieved using imported fill soils but this option would need to be further investigated to ensure functionality and water holding capacity.
  - Considering the foregoing, it is NHC's opinion that shallow alcove excavation may be technically feasible, but that challenging subgrade conditions will result in a low probability of success.

- Any large trees, stumps or other woody debris that were removed during the project should be utilized on site when possible. Cut trees and large stumps can be laid out on the ground of the transitional riparian planting area (i.e., in Treatment Unit 3 and Treatment Unit 4 from Table 5-1) to provide cover for juvenile and adult red-legged frog and improve upon the terrestrial habitat that provides critical habitat for the development of young frogs. It is estimated that two units of coarse woody debris (minimum 0.5 m diameter) per 100 m^2 of habitat will provide sufficient cover for adult and young frogs. Any coarse woody material salvaged during project-related tree removal can be re-purposed as woody debris.
- Planting within the side channels created for amphibian breeding, if feasible, should include plant species selected by red-legged frog for laying their eggs on, which are thin-stemmed, emergent plants such as rushes and sedges for breeding (Maxcy 2004).

5.6 OTHER WILDLIFE MITIGATION MEASURES

The project proposes the removal of a few trees near the weir structure. To safeguard breeding birds, tree removals during the breeding bird period (typically March 1 – August 31) must be preceded by pre-clearing breeding bird surveys conducted by a QEP and mitigations implemented if active nests are identified. EDI conducted a large stick nest survey on February 9, 2024. No snags or stick nests were identified in the vicinity of the proposed construction area. As noted above, trees that are removed can be repurposed on-site as coarse woody debris habitat features.

5.7 LONG TERM MAINTENANCE AND MONITORING

Monitoring of the proposed construction activities, implemented reclamation measures, and compensation plans is very likely to be a requirement of the provincial permits for the project. The following measures may apply:

- Implement annual monitoring and maintenance to ensure survival targets are met and invasive species colonization is controlled.
- A five-year maintenance and inspection period is considered to be appropriate. Monitoring may be extended if survival targets are not achieved after five years.
- Each spring, and as needed through the year, reed canarygrass shall be mechanically brushed with manual methods. Reed canarygrass is pervasive through some areas of the marsh and requires care to prevent further spread of the species. To improve native plant growth and establishment within the treatment units, reed canarygrass and other non-native species will be mechanically managed to limit the height and reduce competition. This may include cutting and physical stomping down of the grass cover. Covering and mulching may be utilized where required to help control invasive species regrowth.
- Maintenance activities will also include the "as needed" replacement of plants. Maintenance efforts will be documented and included in the annual restoration monitoring report discussed above.
- A QEP shall inspect the site annually in the mid to late summer for 5 years. Each inspection shall include:
    - An estimate of percent survival of planted specimen (trees, shrubs, ground cover).
    - An estimate of percent area coverage of invasive plants.
    - A QEP shall provide a brief summary report with a list of recommendations to the Regional District of Nanaimo (RDN). The report shall include general observations, overall health and growth of plants (poor, fair, moderate, good etc.), number and species of replacement plants needed, where replacement plants are needed, areas in which invasive species management is needed and watering needs. The summary shall list when each of the recommendations should be completed.
    - The target survival rate of planted specimens shall be 80%. When less than 80% plant survival is observed in a given year, replacement planting shall be recommended to bring the areas back up to at least 90% survival. All failed trees will be replaced in the next planting season.
    - After five years, the site shall be considered to be successfully restored if at least 80% of planted specimens are established and healthy.
- A five-year monitoring program of the newly created aquatic habitat, including the potential side channels, to verify that it is stable and providing functional habitat to amphibians and potentially, fish:
    - A QEP shall inspect the site annually to verify if red-legged frogs utilize the newly created habitat for breeding in February/March and for rearing (May/June).
    - Observations of dewatered areas, stranding areas – including stranding areas for fish, and other aquatic habitat suitability concerns will be identified by the QEP onsite.

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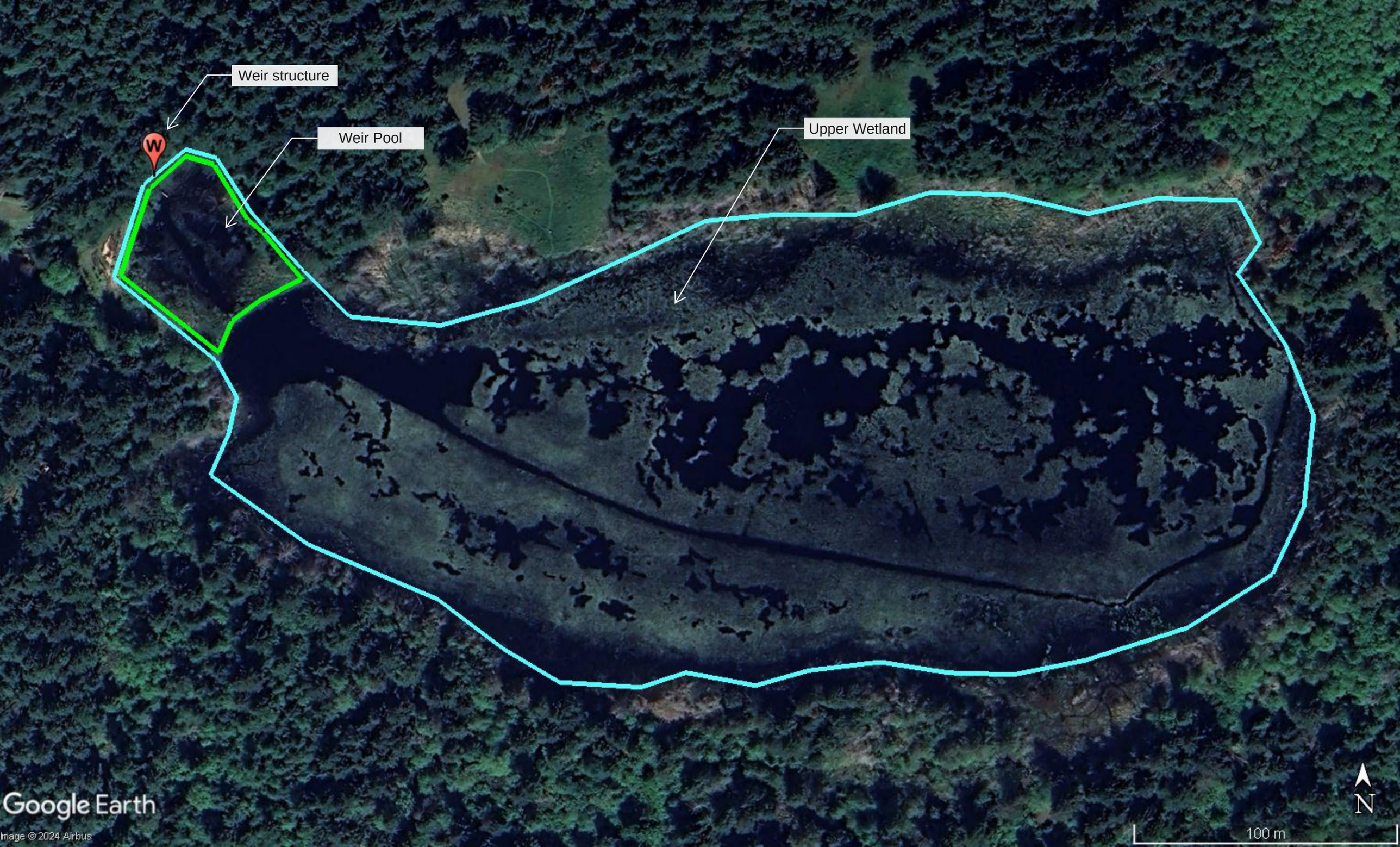
APPENDICES

APPENDIX A LAYOUT OF COATS MARSH AND ASSOCIATED WIER POOL


Weir structure
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