City of Colwood

HUMAN IMPACT ASSESSMENT FOR THE ESQUIMALT LAGOON MIGRATORY BIRD SANCTUARY - DRAFT

August 2025

Prepared by Diamond Head Consulting

The following Diamond Head Consulting staff performed the site visit and prepared the report. All general and professional liability insurance and individual accreditations have been provided below for reference.

Kevin Hutchins, RPBio
Biologist
MSc. Ecological Restoration

Aubrey Butcher, RPBio
Restoration Biologist
MSc. Ecological Restoration

Cassandra Cummings, RPBio.
Biologist, Planner
MSc. Biology, MSc. Planning

Alison Kwan, RPBio
Biologist
BSc. Biology, BSc. Ecological Restoration

Contact Information

Phone: 604-733-4886
Fax: 604-733-4879
Email: kevin@diamondheadconsulting.com; cassandra@diamondheadconsulting.com; alison@diamondheadconsulting.com; aubrey@diamondheadconsulting.com
Website: www.diamondheadconsulting.com

Insurance Information

WCB: # 657906 AQ (003)
General Liability: Northbridge General Insurance Corporation - Policy #P04061262, $10,000,000
Errors and Omissions: Lloyds Underwriters – Policy #18601123, $2,000,000

Table of Contents

List of Tables

List of Figures

1.0 Introduction

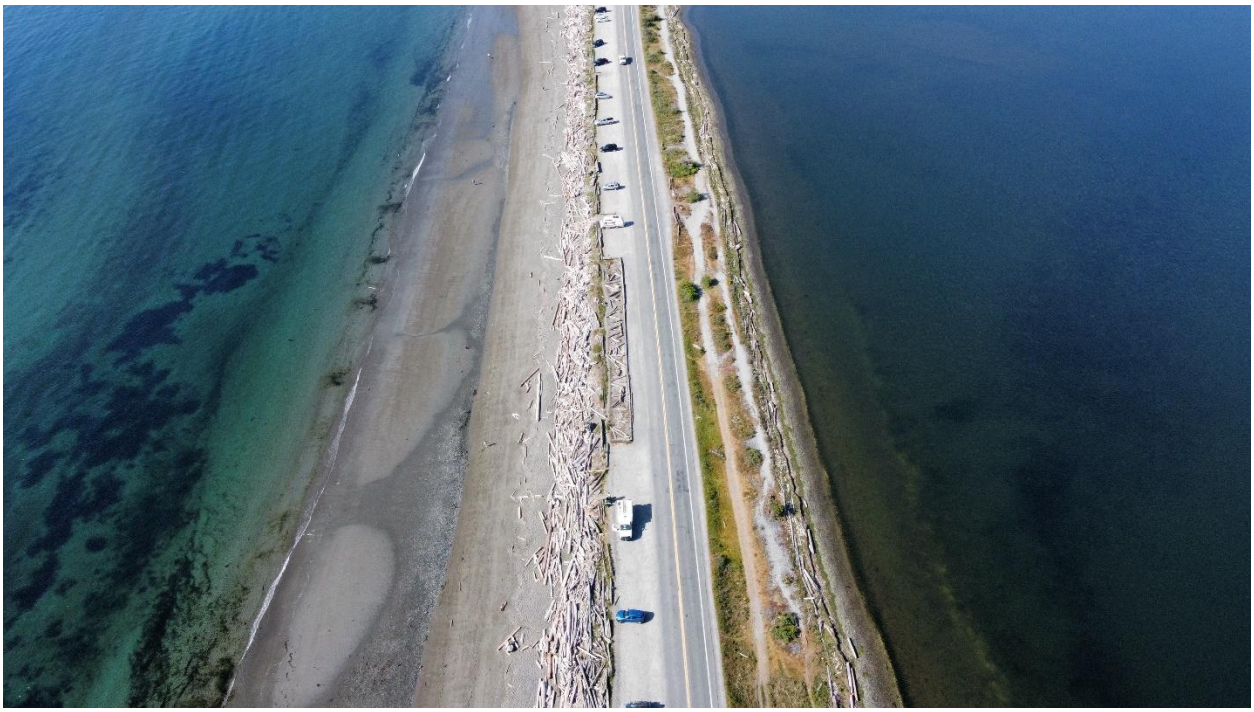
The City of Colwood is located on the southern tip of Vancouver Island in British Columbia (Figure 1). It is approximately 7 km west of the City of Victoria and is part of the Capital Regional District (CRD). A prominent feature of Colwood's coastline is Esquimalt Lagoon, which faces southeast toward the Strait of Juan de Fuca. The lagoon is separated from the Strait by the Coburg Peninsula, with a tidal channel at the northeast end of the peninsula that allows water to flow in and out of the lagoon. A two-lane paved road, Ocean Boulevard, bisects the length of the Coburg Peninsula and connects it to Fort Rodd Hill and Fisgard Lighthouse National Historic Park on the northeastern shore of the lagoon via a bridge over the tidal channel. On either side of Ocean Boulevard, where it crosses the Coburg Peninsula, are various areas for visitors to park.

Esquimalt Lagoon is an important ecological feature within Colwood that is rich in wildlife. It provides several highly valuable habitat types, such as eelgrass and kelp beds, estuary, salt marsh, sand dunes, and sand and gravel beds. On the northern shoreline of the lagoon are numerous fish-bearing watercourses, significant trees, and rocky outcrops with remnant Garry oak ecosystems. As part of the Pacific Flyway, Esquimalt Lagoon is an important area for large numbers of birds to rest and feed during migration. It was designated a migratory bird sanctuary in December 1931. It also provides spawning and rearing habitat for fish and a substrate for clams, mussels and oysters.

Esquimalt Lagoon holds deep cultural, spiritual, and historical significance for local First Nations, particularly the ʷəɬəɬkʷəŋən ("Lekwungen") speaking peoples of the Songhees and Esquimalt Nations, whose traditional territories encompass the lagoon and surrounding lands. This area within their territory has long been a site for harvesting seafood, medicinal plants, and other traditional resources. The lagoon and its creeks have supported seasonal camps, fishing, and ceremonial activities for generations. Oral histories and archaeological evidence affirm the lagoon's role as a vital place of sustenance, gathering, and knowledge transfer. These connections to the land continue to this day through land stewardship and collaborative restoration initiatives.

As a component of the development of a Biodiversity Conservation Strategy for the City of Colwood, a Human Impact Assessment has been developed for the Esquimalt Lagoon Migratory Bird Sanctuary (MBS). The goal of this assessment is to provide an overview of the existing ecology within and adjacent to Esquimalt Lagoon, the historic, current, and potential human impacts to its ecology, and possible mitigation strategies for those impacts. Esquimalt Lagoon and the Coburg Peninsula are highly valued recreation areas for residents and visitors of Colwood. Ocean Boulevard is also a popular commuter route that provides an alternate transportation corridor and scenic views. Threats to the ecology of Esquimalt Lagoon include water quality issues, impacts from human use, the emergence of invasive species, and climate change. There have also been a number of restoration initiatives undertaken at the lagoon in recent decades. A great deal of work at and around the lagoon has been carried out by the Esquimalt Lagoon Stewardship Initiative (ELSI). ELSI is a broad coalition of community and environmental groups, institutions, recreational user groups, and government that work together to protect and restore Esquimalt Lagoon, its watershed, and the Coburg Peninsula.

This Human Impact Assessment for the Esquimalt Lagoon Migratory Bird Sanctuary is based on existing research, databases, and information regarding local ecology and human impacts on wildlife and habitat features in the Lagoon. DHC biologists conducted a site assessment on April 30 and May 1, 2025, to support these findings and record observations of existing environmental conditions. For the purposes of this assessment, the study area has been delineated to include the terrestrial area within 100 m of the high-water mark of Esquimalt Lagoon. However, to gain a comprehensive understanding of the human impacts on the lagoon, all impacts that could stem from elsewhere within the watershed of the lagoon are considered.



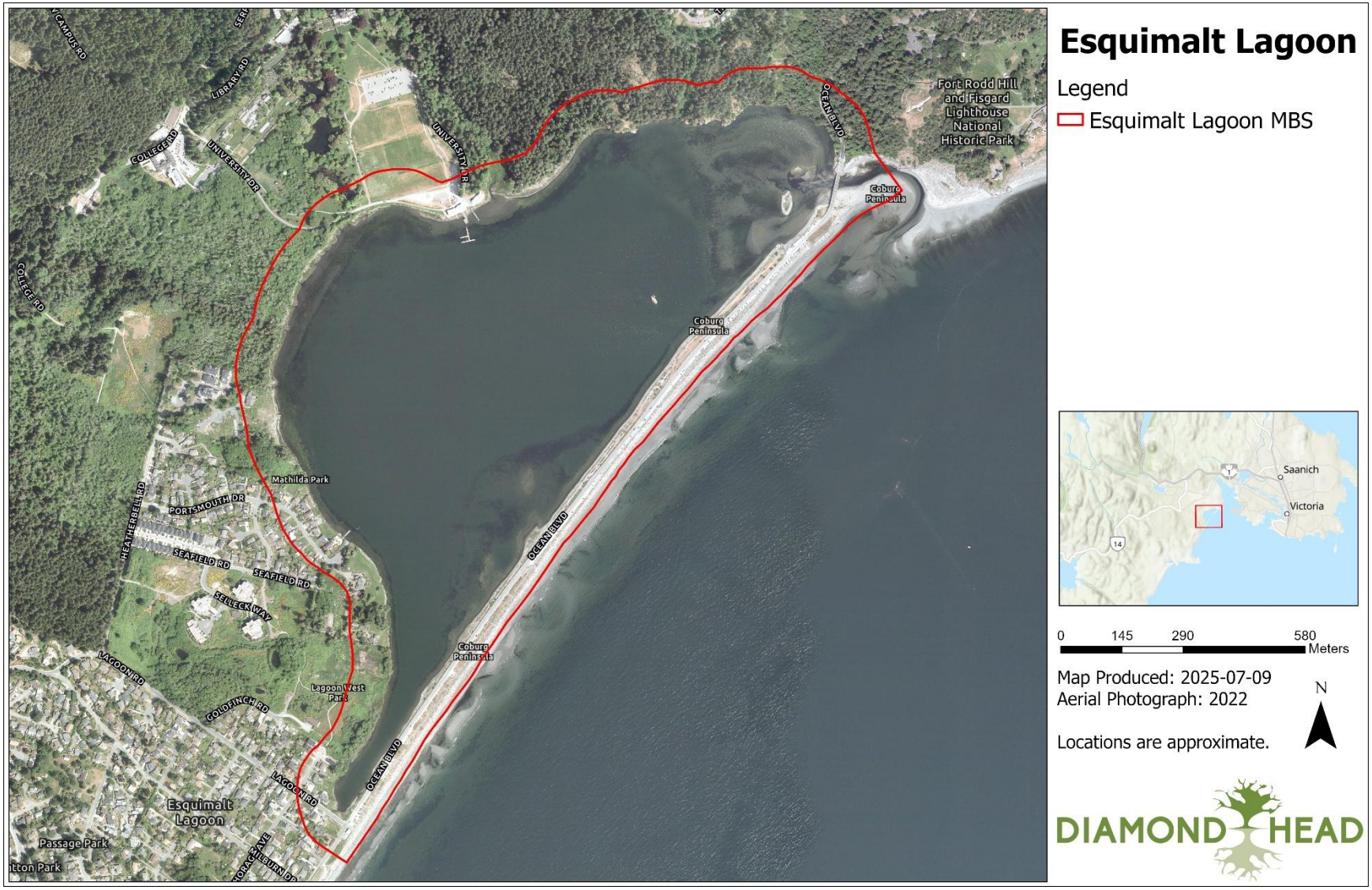


Figure 1. Study area – Esquimalt Lagoon Migratory Bird Sanctuary, located in the City of Colwood, BC.

2.0 Site Description

A field assessment was completed by Diamond Head Consulting (DHC) biologists on April 30 and May 1, 2025, to identify the existing conditions and significant environmental features within the study area. This field assessment provides a snapshot of current conditions at the study area, which have been used in tandem with existing data and research in the area to develop the following site description.

2.1 Topography

The terrestrial areas surrounding Esquimalt Lagoon are generally flat and just above sea level. These areas include the Coburg Peninsula and the southwestern shoreline of the lagoon up to Colwood Creek (Figure 2). The forested and undeveloped northeastern shoreline has steeper and more varied topography leading away from the lagoon, with a number of rocky outcrops. Ground elevation varies between 0 and 25 m above sea level (ASL) across the study area.

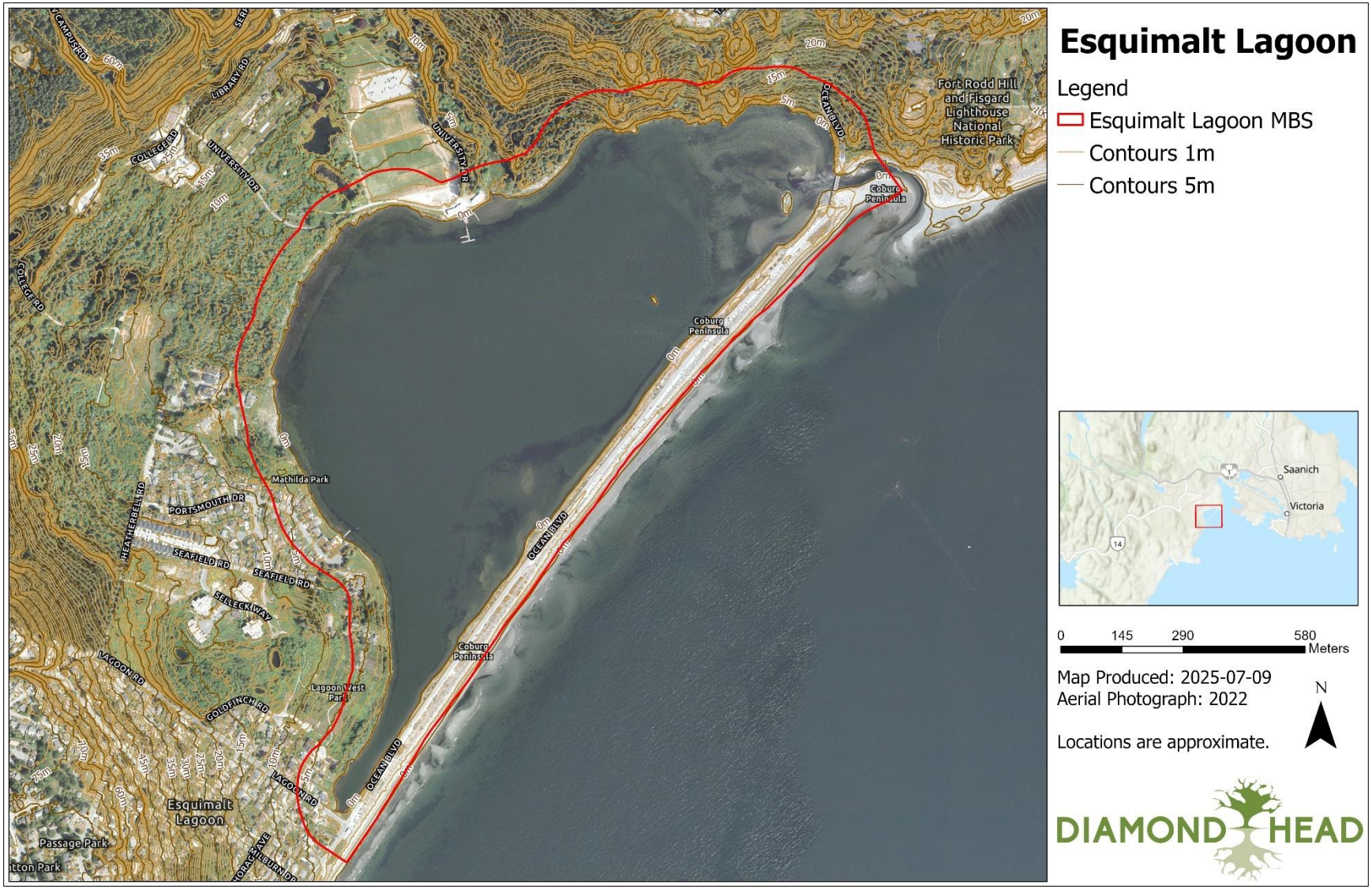


Figure 2. Topography on site, showing 1 m and 5 m contours.

2.2 Climate and Soils

This site is situated within the Coastal Douglas-fir Moist Maritime (CDFmm) subzone of the Biogeoclimatic Ecosystem Classification (BEC) System of BC. This subzone is restricted to low elevations and lies in the rain shadow of Vancouver Island and the Olympic Mountains. It is associated with warm, dry summers and mild, wet winters. Growing seasons are very long and feature pronounced water deficits on zonal and drier sites. The CDF represents the mildest climate in Canada.

Due to the size of the assessment area and the influence of topography and soil conditions, there are a variety of ecological site series (site specific ecosystem types) present on the site. The combination of climate, topography and soil characteristics have resulted in wetter ecosystems at lower elevations and drier ecosystems at higher elevations across most of the area. Areas of exposed bedrock and steep rocky terrain have thin, dry, and poorly developed soils. There are, however, some flat terraces, benches, and depressions that feature humified organic material supporting richer and wetter ecotypes.

Site series is defined by soil moisture and nutrient availability and describes the late seral or climax plant community that will develop through natural succession. Most of the study area is classified as site series 01, 04, and 11, with smaller components of site series 02 on rocky outcrops near the shore of the lagoon.

2.3 Plant Communities

The varied topography and soil conditions have produced a diversity of ecological communities on the project site. These have been categorized into four general ecotypes with similar complexes of plants and soils.

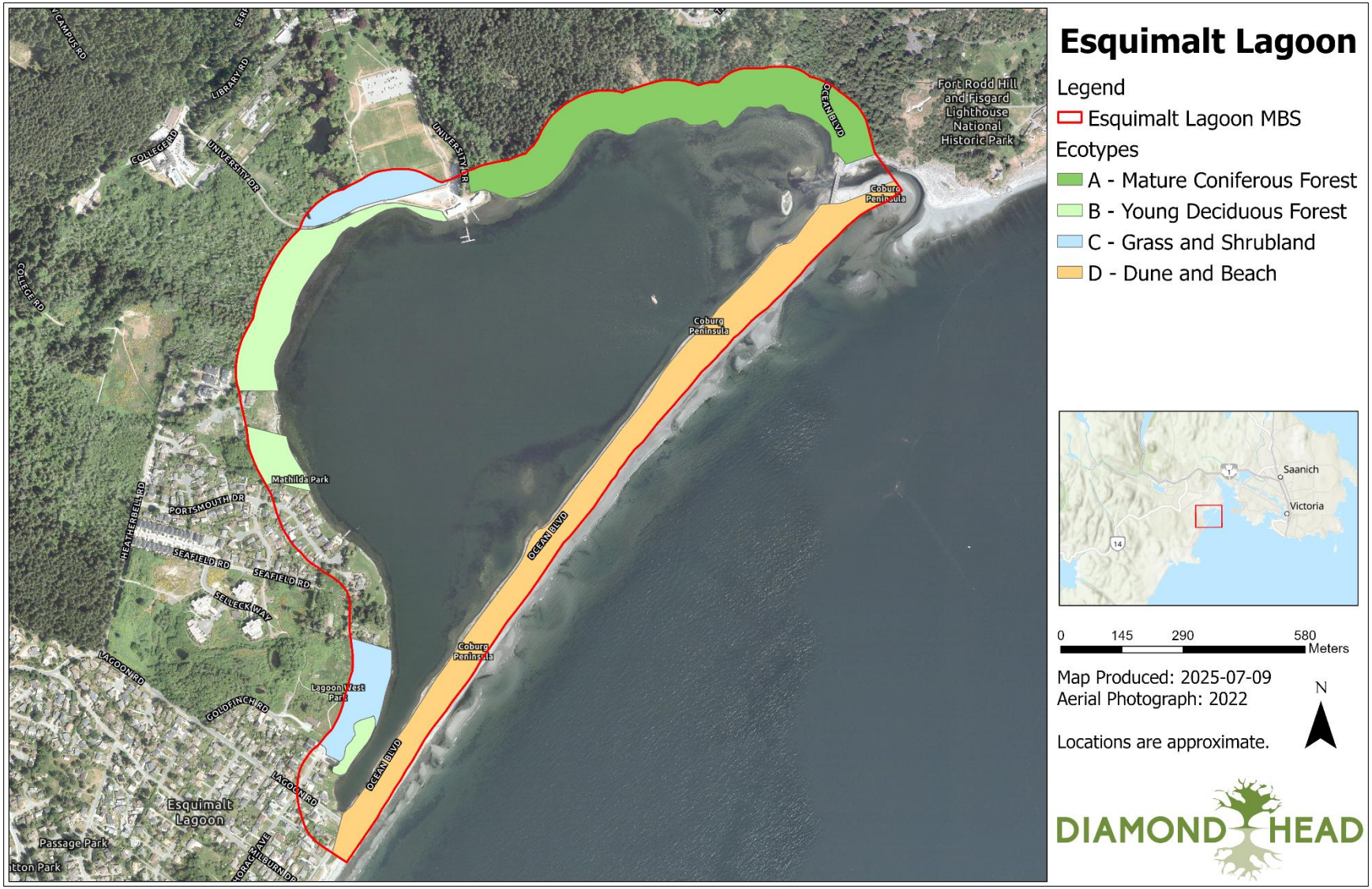


Figure 3. Ecosystems within the study area have been grouped into ecotypes based on their available soil moisture and nutrient regimes.

Ecotype A – Mature Coniferous Forest | This ecotype is mostly found along the northeastern shore of Esquimalt Lagoon between University Drive and Ocean Boulevard. These sites are a complex of site series 01 and 04, with scattered site series 02 occurring on rocky outcrops near the shoreline.

Ecotype A contains large patches of mature forest that are common throughout the forested portions of the Royal Roads University campus. These mature forests are dominated by Douglas-fir (*Pseudotsuga menziesii*) and western redcedar (*Thuja plicata*), with lesser components of grand fir (*Abies grandis*), arbutus (*Arbutus menziesii*), and bigleaf maple (*Acer macrophyllum*). Trace amounts of Sitka spruce (*Picea sitchensis*) occur in wetter, low-lying areas. Small pockets of site series 02 found on rocky outcrops along the shoreline have a mix of Garry oak (*Quercus garryana*), arbutus, and Douglas-fir. These mature stands typically have a canopy density of around 200 stems per hectare, with 15% crown closure. The largest trees found within the study area were observed in Ecotype A. They include Douglas-fir trees up to 2 m in diameter and up to 50 m in height.

Understory vegetation in Ecotype A is similar within forested areas and on dry outcroppings. Dominant understory vegetation includes dull-Oregon grape (*Berberis nervosa*), oceanspray (*Holodiscus discolor*), snowberry (*Symphoricarpos albus*), vanilla leaf (*Achlys triphylla*), and salal (*Gaultheria shallon*). On dry outcroppings, there are also high concentrations of camas (*Camassia quamash*).

Photo: Typical mature stand of **Ecotype A**.

Photo: Typical understory vegetation of **Ecotype A**.

Ecotype B – Young Deciduous Forest | This ecotype is mostly found along the northwestern shore of Esquimalt Lagoon between University Drive and Portsmouth Drive, with another small pocket located in Lagoon West Park. These sites are mostly made up of low-lying areas just above sea level, with a site series of 11. Soils are rich, moist, and well-developed in these areas.

Scattered mature coniferous trees remain in this area, although dense, younger patches of deciduous forest dominate the majority of Ecotype B. These forests are dominated by single-storied red alder (*Alnus rubra*) stands, with lesser amounts of Douglas-fir and western redcedar. The canopy in these forests is denser than the coniferous forest patches, with approximately 500 stems per hectare and 20% crown closure.

The understory vegetation is consistent with the wet and rich soils found in these stands. Dominant native understory vegetation includes salmonberry (*Rubus spectabilis*), common horsetail (*Equisetum arvense*), skunk cabbage (*Symplocarpus foetidus*), and common bracken fern (*Pteridium aquilinum*).

Photo: Representative views of **Ecotype B**.

Ecotype C – Grass and Shrubland | Ecotype C includes modified sites that are dominated by grasses and shrubs. This ecotype is mostly found in landscaped areas such as the southern area of the Royal Roads University campus near University Drive, in private residences near the southwestern shore of the lagoon, and in Matilda Park and Lagoon West Park. These sites have been highly modified and cannot be classified into site series. Some areas in this ecotype, such as Lagoon West and Matilda Park, have large, dense infestations of invasive species such as Scotch broom (*Cytisus scoparius*) and Himalayan blackberry (*Rubus bifrons*).

Photo: Representative view of **Ecotype C,** where large, dense infestations of invasive species occur in disturbed areas.

Ecotype D – Dune and Beach | This ecotype is located along the Coburg Peninsula and mainly includes shoreline ecosystems such as beach, coastal dune, coastal meadow, and tidal marsh. Human-modified land covers approximately one-third of the peninsula and includes the road that bisects the peninsula as well as parking locations along the road. The beach and coastal dune ecosystems are located on the ocean-facing side of the peninsula. These ecosystems are separated by small differences in elevation and frequency of seawater inundation. The beach ecosystem is located at the lowest elevations along the peninsula and is regularly inundated during tidal fluctuations. This area is mostly occupied by sand and gravel substrates with little vegetation.

The coastal dune ecosystem is present between the beach and human-modified areas of the peninsula. This area is slightly higher in elevation than the beach ecosystem and is only inundated during large storm events. The coastal dune ecosystem has a sand substrate with dominant native vegetation including beach pea (*Lathyrus japonicus*), silver beachweed (*Ambrosia chamissonis*), Oregon gumweed (*Grindelia stricta*), dune wildrye (*Leymus mollis*), and yarrow (*Achillea millefolium*). A significant amount of driftwood is scattered across the coastal dune area.

The coastal meadow ecosystem is located on the lagoon-facing side of the Coburg Peninsula, between the road and the lagoon's high-water mark. The tidal meadow is mostly vegetated with grasses and low forbs. Native shrubs and trees, including tall Oregon grape (*Berberis aquifolium*), Douglas-fir, and Pacific crab apple (*Malus fusca*), are scattered throughout the area.

Photo: Representative view of the coastal dune ecosystem in **Ecotype D**.

Photo: Beach pea is commonly observed in the coastal dune ecosystem of **Ecotype D**.

2.4 Invasive Plant Species

As part of the field assessment for this report, invasive species were mapped on public property within the study area (Figure 4). The field inventory was carried out using ESRI's ArcGIS Collector app loaded onto iPads.

Every species occurrence was denoted as a point feature. All infestation area measurements are visual estimations. The smallest measured unit is one square meter. Area estimations are made as contiguous measurements of impacted square meters (i.e., if there are 10 knotweed stems within two contiguous square meters, the impacted area is recorded as two square meters). When an occurrence impacted an area greater than 25 m^2, a polygon feature was used to record the extent. Polygon features recorded the percent cover for the species indicated. Percent cover was defined as the percent of ground affected by the species.

Fifty-one invasive plant species were surveyed for as part of this assessment (Appendix C). These species are all known to pose ecological, economic, or human health risks. Of these 51 species surveyed for, 6 were identified on site. The survey targeted only invasive species infestations that were visible from public roads and paths, and some paths within the Royal Roads University campus around Esquimalt Lagoon were not included. Therefore, this should not be considered an exhaustive invasive inventory of the study area, but a general survey to assess the relative abundance, distribution, and presence of different invasive species. The timing of the inventory may contribute to an under-representation of specific species.

Invasive coverage within the study area are detailed in Table 1. These coverages are an overestimation of the actual area covered, as invasive plants often overlap one another. Himalayan blackberry (*Rubus bifrons*) was by far the most common species observed in the study area, followed by Scotch broom

(*Cytisus scoparius*). Both of these species were observed scattered along the side of roads and trails on the Coburg Peninsula as well as large, dense infestations near the shoreline within Lagoon West Park.

Table 1. Total coverage of invasive plant species observed within the study area.

Common Name	Scientific Name	Coverage (m^2)	Comments
Himalayan Blackberry	*Rubus bifrons*	8,006	Small scattered occurrences along the Coburg Peninsula and large, denser infestations within Lagoon West Park and Matilda Park.
Scotch Broom	*Cytisus scoparius*	2,197	Small scattered occurrences along the Coburg Peninsula and large, denser infestations within Lagoon West Park and on dry rocky outcrops along the lagoon's shoreline.
Spurge Laurel	*Daphne laureola*	1,354	One large occurrence in the forest near the lagoon shoreline east of Colwood Creek. Smaller occurrences are scattered around the lagoon.
English Ivy	*Hedera helix*	1,128	Moderate infestations along the shoreline east of Colwood Creek.
English Holly	*Ilex aquifolium*	26	Small scattered occurrences throughout.
Butterfly Bush	*Buddleja davidii*	2	One occurrence was observed on a private front yard.

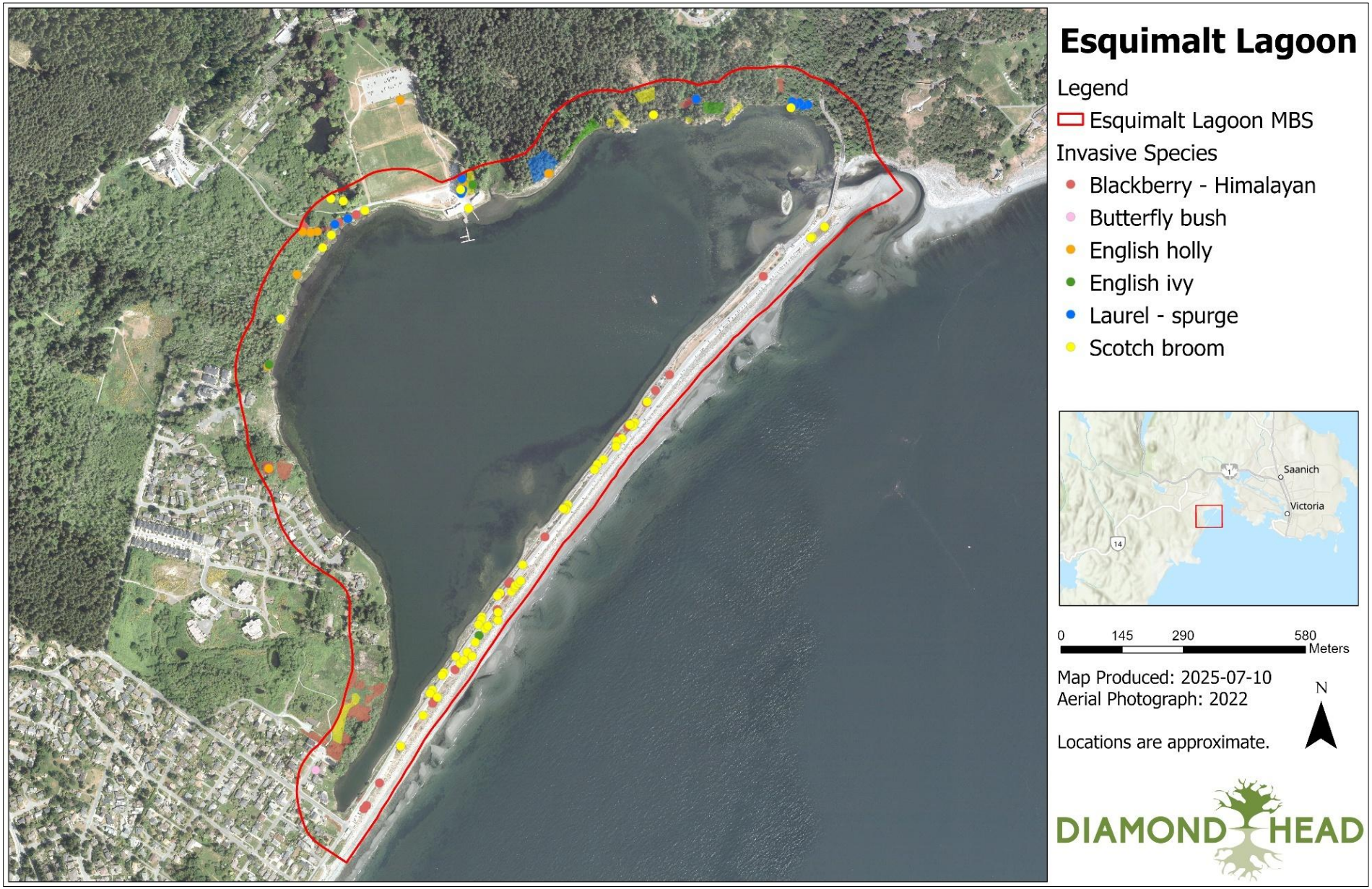


Figure 4. Invasive plant species mapped within the Esquimalt Lagoon MBS during the field assessment on April 30 and May 1, 2025.

2.5 Aquatic Habitat

The Esquimalt Lagoon watershed is approximately 1850 ha and extends to the northwest as far as the Sooke Hills Wilderness Regional Park Reserve (Figure 5). This watershed includes all of the lands that drain into Colwood, Selleck and Bee Creek, the three largest named watercourses that drain into the lagoon. There are also numerous smaller, unnamed watercourses that drain into the lagoon.

2.5.1 Colwood Creek

Colwood Creek is approximately 5.8 km in total and originates from Glen Lake in the City of Langford. From there, it meanders east through a series of greenways and Colwood Creek Park, eventually passing under Veterans Memorial Parkway. It flows north, parallel to the east side of Veterans Memorial Parkway for approximately 2 km before curving east and draining into Colwood Lake on the Royal Colwood Golf and Country Club. Colwood Creek continues to flow from the east side of the lake, flowing under Sooke Road and into the Royal Roads University Campus. On the campus, it flows south, parallel to University Drive, before entering the study area and draining into Esquimalt Lagoon.

The portion of Colwood Creek within the study area is fish-bearing. Fish species observed at the mouth of Colwood Creek where it drains into Esquimalt Lagoon include rainbow trout (*Oncorhynchus mykiss*), coho salmon (*Oncorhynchus kisutch*), cutthroat trout (*Oncorhynchus clarkii clarkii*), prickly sculpin (*Cottus asper*), threespine stickleback (*Gasterosteus aculeatus*), brown catfish (*Ameiurus nebulosus*), pumpkinseed (*Lepomis gibbosus*), redside shiner (*Richardsonius balteatus*), and smallmouth bass (*Micropterus dolomieu*).

2.5.2 Bee Creek

Bee Creek is a groundwater-fed watercourse on the western side of Esquimalt Lagoon with headwaters within the forests of the Royal Roads University campus. This is a permanent, fish-bearing watercourse. Fish species recorded within Bee Creek within the last 20 years include cutthroat trout, prickly sculpin, and coastrange sculpin (*Cottus aleuticus*).

2.5.3 Selleck Creek

Selleck Creek is located on the southwestern shore of Esquimalt Lagoon and originates from a series of ponds between Lagoon Road and Selleck Way. It flows northeast for approximately 500 m, wrapping around development within the area and eventually draining into the lagoon. No provincial data is available on the fish-bearing status of this watercourse. However, no barriers to fish movement were observed during the field assessment carried out for this report. Therefore, this watercourse is assumed to be fish-bearing.

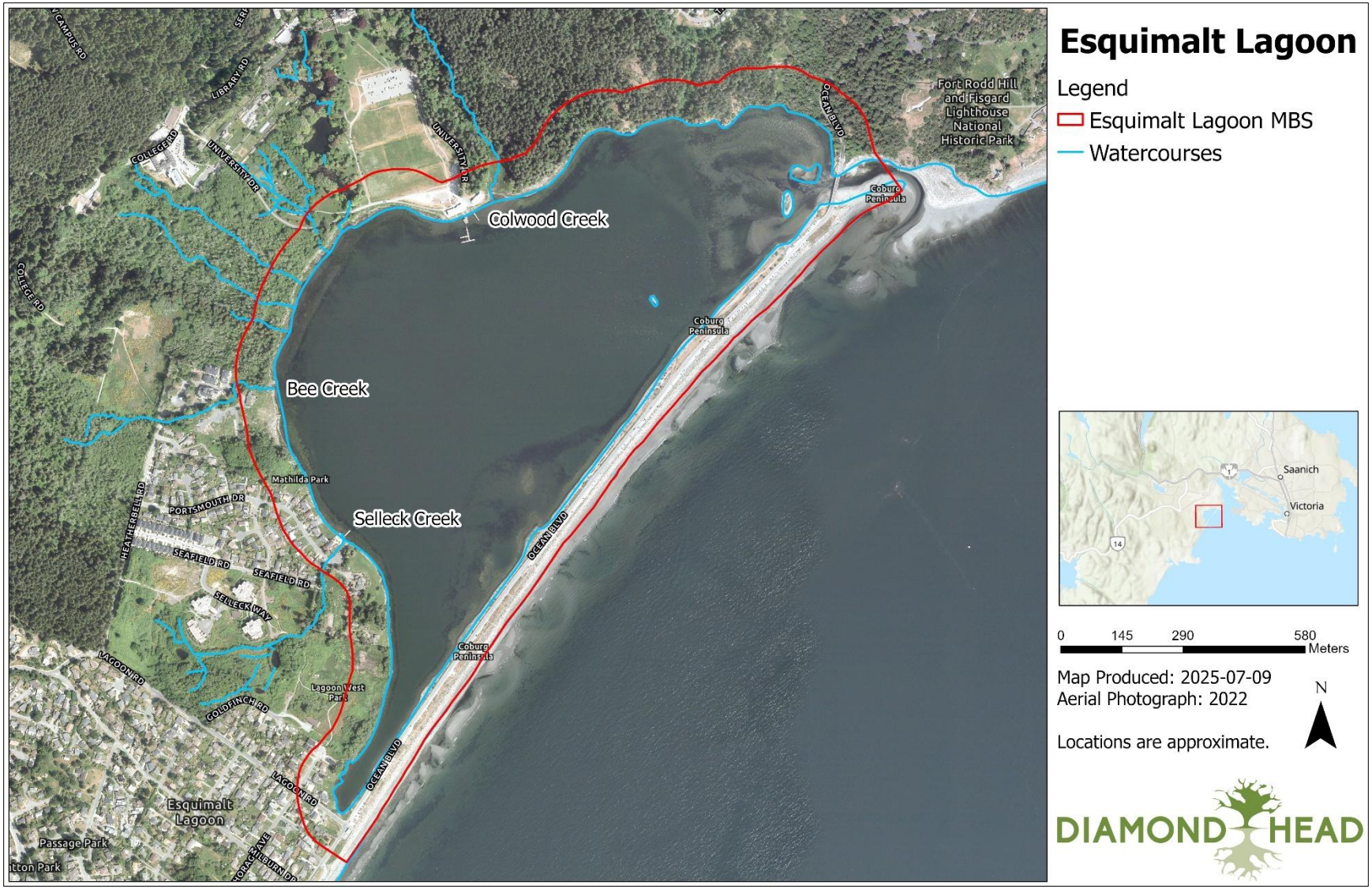


Figure 5. Overview of watercourses and water features in and around the study area.

Esquimalt Lagoon contains different habitat types, which provide important habitat and shelter for marine plants and animals. Among these are eelgrass (*Zostera marina*) beds, intertidal gravel bars, and the numerous freshwater creeks that drain into the lagoon (Figure 5). Geospatial data provided by the Capital Regional District (CRD) shows extensive eelgrass beds within the lagoon, as well as bladed kelp and foliose green algae.

Eelgrass ecosystems play a vital role in supporting rich biodiversity. They serve as important nursery habitats for numerous marine and anadromous species, such as salmonids, offering feeding grounds and protection from predators. Additionally, eelgrass beds provide shelter for invertebrates and offer a surface for diatoms and algae to grow, and sources of food for migratory birds. Their growth relies on several environmental conditions, with light availability being crucial. However, light penetration can be hindered by turbidity or man-made structures. Eelgrass is also sensitive to both physical and chemical disturbances, including nutrient imbalances and changes in water quality.

2.6 Wildlife

A detailed inventory of wildlife (requiring trapping and extended observation) was not completed as part of this site assessment. The following provides an overview of wildlife, including those observed during the survey, key wildlife references from other professional reports, and notes about wildlife likely inhabiting the survey area based on habitat features and professional knowledge of the ecosystems.

The intact and larger natural areas surrounding Esquimalt Lagoon provide high-value habitat for a range of species from streams and wetlands, dense shrub plant communities, and a diversity of forest types. The lagoon itself is connected to numerous watercourses around the lagoon, although many have features which are not fish-passable. It is also connected to the Strait of Juan de Fuca via the tidally influenced channel at the north end of the Coburg Peninsula. The limited development in the area allows largely unrestricted movement for wildlife throughout the site. These areas provide a variety of high-value habitat features and likely support a diversity of wildlife.

2.6.1 Aquatic Species

The watercourses within the study area all drain into Esquimalt Lagoon, which is connected to the Juan de Fuca Strait via a tidally influenced channel. An assessment of fish forage habitat conducted by Emerald Sea Research & Consulting in 2010 found that the beach sediments along the Coburg Peninsula provide excellent quality spawning habitat for surf smelt (*Hypomesus prestiosus*) and Pacific sand lance (*Ammodytes hexapterus*). Forage fish provide an important food source for other species present within the lagoon.

A formal survey of marine mammals was not conducted. During the field assessment, harbour seals (*Phoca vitulina*) were observed within the lagoon and along the beach. Other marine mammals that likely forage within the study area include North American river otters (*Lontra canadensis*) and coastal minks (*Neovison vison evagor*). Other marine mammals that are likely present outside the study area within the deeper waters of the Strait of Juan de Fuca include the Stellar sea lion (*Eumetopias jubatus*),

California sea lion (*Zalophus californianus*), harbour porpoise (*Phocoena Phocoena*), grey whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), and orca (*Orcinus orca*).

2.6.2 Terrestrial Species

Mammal surveys were not completed during this study. The forest and shrub communities provide habitat for a diversity of small mammals, including squirrels, voles, shrews, and mice. Medium—and large-sized mammals likely to inhabit this area (as part of a larger range) include raccoons (*Procyon lotor)*, black-tailed deer (*Odocoileus hemionus),* black bears (*Ursus americanus*), and cougars (*Puma concolor*).

Bird surveys were not completed during this study. However, the site visits were conducted during the nesting season. Bird species identified within the study area during the field assessment can be found in Table 2.

Table 2. Bird species identified on site.

Common Name	Scientific Name
American Crow	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
American Wigeon	*Mareca americana*
Anna's Hummingbird	*Calypte anna*
Bald Eagle	*Haliaeetus leucocephalus*
Bewick's Wren	*Thryomanes bewickii*
Black Oystercatcher	*Haematopus bachmani*
Brewer's Blackbird	*Euphagus cyanocephalus*
Bufflehead	*Bucephala albeola*
Canada Goose	*Branta canadensis*
Chestnut-backed Chickadee	*Poecile rufescens*
Chipping Sparrow	*Spizella passerina*
Common Merganser	*Mergus merganser*
Common Raven	*Corvus corax*
Double-crested Cormorant	*Phalacrocorax auritus*
Eurasian Collared Dove	*Streptopelia decaocto*
Glaucous-winged Gull	*Larus glaucescens*
Great Blue Heron	*Ardea herodias*
House Finch	*Haemorhous mexicanus*
Killdeer	*Charadrius vociferus*

Mallard	*Anas platyrhynchos*
Northern Flicker	*Colaptes auratus*
Osprey	*Pandion haliaetus*
Pine Siskin	*Spinus pinus*
Purple Finch	*Haemorhous purpureus*
Red-winged Blackbird	*Agelaius phoeniceus*
Rock Dove	*Columba livia*
Rufous Hummingbird	*Selasphorus rufus*
Song Sparrow	*Melospiza melodia*
Spotted Towhee	*Pipilo maculatus*
Tree Swallow	*Tachycineta bicolor*
Turkey Vulture	*Cathartes aura*
Violet-green Swallow	*Tachycineta thalassina*

The study area provides a combination of water features, forest, and shrub communities that can provide valuable habitat for a wide variety of resident and migratory birds. A diversity of habitat features is present to support nesting, foraging, and roosting. Bird species groups likely present include shorebirds, waterfowl, raptors, swallows, hummingbirds, warblers, woodpeckers, flycatchers, jays, crows, chickadees, nuthatches, thrushes, sparrows, wrens, kinglets, and finches.

No raptor nests were found during the initial survey. However, it is likely that some exist within the study area. Raptors' nests are protected year-round under the BC *Wildlife Act* and require vegetative and noise buffers around them. These buffers are determined based on the species present and the time of year. During the field assessment, turkey vultures (*Cathartes aura*) and bald eagles (*Haliaeetus leucocephalus*) were observed soaring and perching on trees within the study area. An osprey (*Pandion haliaetus*) was also observed foraging within the lagoon.

A group of turkey vultures perched in a tree at the northeast end of the study area.

A formal survey for reptiles was not conducted. There are many dry and rocky areas across the study area. It is likely that the common garter snake (*Thamnophis sirtalis*), the northwestern garter snake (*Thamnophis ordinoides*), and the western terrestrial garter snake (*Thamnophis elegans*) inhabit the site. There is also suitable habitat for the northwestern alligator lizard (*Elgaria coerulea principis*). These species are commonly associated with rocky outcrops which are found across the study area.

A formal amphibian survey was not conducted. Several species of salamanders and frogs may inhabit the study area. Amphibians confirmed to be within the study area include the western red-backed salamander (*Plethodon vehiculum*), rough-skinned newt (*Taricha granulosa*), and Pacific treefrog (*Pseudacris regilla*) (iNaturalist, n.d.). Species that are possibly present in the study area include the long-toed salamander (*Ambystoma macrodactylum*), red-legged frog (*Rana aurora*), wandering salamander (*Aneides vagrans*), northwestern salamander (*Ambystoma gracile*), and Ensatina salamander (*Ensatina eschscholtzii*). Most amphibians present are likely to require water features or wetlands for at least part of their life cycle, particularly for breeding and during their larval stage. The existing watercourses and wetlands within the study area may provide important habitat for these species. However, species such as the wandering salamander are fully terrestrial and complete their life cycles entirely in upland habitats.

2.7 Species at Risk

2.7.1 Terrestrial

The BC Conservation Data Centre (CDC) records BC's most vulnerable vertebrate animals and vascular plants, each of which is assigned to a provincial Red or Blue list according to their provincial conservation status rank. Species or populations at high risk of extinction or extirpation are placed on the Red list and are candidates for formal endangered species status. Blue-listed species are considered vulnerable to human activity and natural events.

Eleven known terrestrial species at risk have occurrences within 1 km of the study area listed in the CDC database. A list of these species and the details of their occurrences are provided in Table 3.

Table 3. Terrestrial species at risk occurrences within 1 km of the study area.

Common Name	Scientific Name	B.C. Status	Occurrence Data
Black knotweed	*Polygonum paronychia*	Blue	76 plants over 50 m^2 of dry, rocky and sandy habitat, approximately 4 m above the high water mark. Located approximately 250 m northeast of the study area at the Fort Rodd Hill National Historic Site.
Deltoid balsamroot	*Balsamorhiza deltoidea*	Red	95 to 189 individuals growing in discrete clusters separated by unsuitable habitat across the Fort Rodd Hill National Historic Site, approximately 100 m northeast of the study area.
Great blue heron	*Ardea Herodias fannini*	Blue	Great blue herons were observed within the lagoon during the field assessments. A colony that was abandoned in 2001 is mapped approximately 1 km north of the study area near Juan de Fuca Recreation Park.
Macoun's meadow-foam	*Limnanthes macounii*	Red	Last observed in 2020 with approximately 1,400 plants scattered across habitat with seasonal moisture variation. Located northeast of the project site in For Rodd Hill and Fisgard Lighthouse National Historic Park.
Phantom orchid	*Cephalanthera austiniae*	Red	Four plants in total are located at a private residence near Hatley Park National Historic Site, approximately 1 km northwest of the study area.
Prairie lupine	*Lupinus lepidus*	Red	Last observed near Colwood Lake, approximately 1 km north of the study area, in 1908.
Seaside bird's-foot lotus	*Hosackia gracilis*	Red	Experimentally planted at two sites approximately 500 m northeast of the study area in Fort Rodd Hill and Fisgard Lighthouse National Historic Park. The plants appear to be surviving at one site and not the other.
Surf scoter	*Melanitta perpicillata*	Blue	A flock of approximately 3,000 surf scoters was observed feeding 500 m offshore of the Coburg Peninsula in 1989, a flock of 2,300 was observed in 1991, and 900 were observed in 1993.
Slimleaf onion	*Allium amplectens*	Blue	This species was observed on the northern end of the Coburg Peninsula in 2013, and may also be present elsewhere in the study area.
Wandering salamander	*Aneides vagrans*	Blue	44 wandering salamanders have been photographed and identified via iNaturalist northeast of the project site in Fort Rodd Hill and Fisgard Lighthouse National Historic Park.
Western bumble bee	*Bombus occidentalis*	Blue	This species has been observed around the Capital Regional District as recently as 2019. This includes two occurrences approximately 500 m north of the study area.
White-top aster	*Sericocarpus rigidus*	Blue	As of 2019, 704 vegetative stems were growing over 15 m^2 in three subpopulations located in Fort Rodd Hill and Fisgard Lighthouse Nation Historic Park, approximately 500 m northeast of the study area.

Critical habitat for four terrestrial species at risk is located within 1 km of the study area. This includes habitat for deltoid balsamroot, Macoun's meadow-foam, phantom orchid, and the western painted turtle (*Chrysemys picta bellii*). Critical habitat for deltoid balsamroot occupies approximately 1.7 ha in the area surrounding the known occurrence of this species within the Fort Rodd Hill National Historic Site. Critical habitat for Macoun's meadow-foam occupies approximately 0.2 ha in the area surrounding

the known occurrence of this species on the shoreline within the Fort Rodd Hill National Historic Site. Critical habitat for the phantom orchid occupies approximately 26.1 ha surrounding the known occurrence of this species northwest of the study area. Critical habitat for the western painted turtle is scattered throughout Colwood, generally encompassing freshwater areas. The closest critical habitat polygon for the western painted turtle with respect to the study area occupies approximately 27.3 ha and surrounds the headwaters of Bee Creek within the forests of the Royal Roads University campus, approximately 250 m west of the study area.

2.7.2 Aquatic

The Government of Canada has compiled critical habitat and distribution data for aquatic species listed under the Species at Risk Act (SARA). Fourteen aquatic species at risk were identified within 1 km of the study area. The majority of these are open-water species, such as sharks and whales, or deep-water fishes that are not likely to be found in the shallower waters of Esquimalt Lagoon or directly adjacent to the Coburg Peninsula. Three out of these 14 species have the potential to be found within the lagoon and adjacent shoreline. These include the green sturgeon (*Acipenser medirostris*), northern abalone (*Haliotis kamtschatkana*), and Steller sea lion (*Eumetopias jubatus*).

2.8 Ecological Communities at Risk

The BC CDC also records rare ecological communities. There are three mapped occurrences of ecological communities at risk within the study area. These include the grand fir / dull Oregon grape, grand fir / three-leaved foamflower, and red alder / skunk cabbage ecological communities. All three of these ecological communities were historically observed in the natural areas on the Royal Roads University campus. All of the species that make up these communities were observed within the study area during the field assessment. Each of these ecological communities has experienced large declines in the last century as a result of extensive harvesting and the conversion of land for development.

The grand fir / dull Oregon-grape ecological community is red-listed in BC and occurs in ecosystems classified as site series 04. It is typically found on all aspects of mid-slopes on morainal and inactive colluvial materials. The grand fir / three-leaved foamflower ecological community is red-listed in BC and occurs in ecosystems classified as site series 06. It typically occurs on lower slopes with east-to-west aspects, over morainal and inactive fluvial materials. The red alder / skunk cabbage ecological community is red-listed and occurs in forested wetlands restricted to low-lying depressions associated with streams and rivers, or the edges of fens and bogs. The mapped occurrence for this community is near Colwood Creek, approximately 300 m north of the study area.

In general, the forests of the greatest value for habitat and biodiversity within the study area are the older and more developed forests within the natural areas of the Royal Roads University campus. The younger, regenerating forests are not as diverse, but will over time develop into older forests and should be considered as having recruitment potential.

Rare and endangered plant communities that occur or could possibly occur within the study area are identified in Table 4. These include all ecological communities listed in the CDC database that have the potential to occur within the study area historically or in the future, through natural processes or restoration efforts.

Table 4. CDC ranked plant communities with mapped occurrences or the potential to occur within the study area.

Scientific Name	Common Name	BEC Unit	BC Status
Abies grandis / Mahonia nervosa	grand fir / dull Oregon-grape	CDFmm/04	Red
Abies grandis / Tiarella trifoliata	grand fir / three-leaved foamflower	CDFmm/06	Red
Alnus rubra / Lysichiton americanus	red alder / skunk cabbage	CDFmm/Ws52	Red
Alnus rubra / Rubus spectabilis / Equisetum arvense	red alder / salmonberry / common horsetail	CDFmm/09	Blue
Leymus mollis ssp. mollis - Lathyrus japonicus	dune wildrye - beach pea	CDFmm	Red
Carex macrocephala Herbaceous Vegetation	large-headed sedge Herbaceous Vegetation	CDFmm/00	Red
Eleocharis palustris Herbaceous Vegetation	common spike-rush Herbaceous Vegetation	CDFmm/Wm04	Blue

2.9 Valued Ecosystem Components

Valued Ecosystem Components (VECs) are elements of the environment that are considered important based on their ecological value. The VECs selected represent those components that could be affected by human activities in the area and should be considered during any design and development process within the study area. VECs within the Esquimalt Lagoon MBS include:

- **Fish and fish habitat**: Water bodies, fish species present, and forage fish spawning habitat.
- **Vegetation Communities**: Plant communities, including trees and ground vegetation.
- **Wildlife**: Critical habitat for wildlife that inhabit the site.
- **Species and communities at risk**: Wildlife and plant communities that are considered at risk.

During the fieldwork, some features of significance were identified. Significant trees were identified based on their species, size, or age. This includes several old-growth Douglas-fir trees, large-diameter western redcedars, and other character specimens. However, this should not be considered a comprehensive review of all features of significance on the site.

3.0 Human Impacts on Esquimalt Lagoon

Esquimalt Lagoon has faced a complex array of human impacts both historically and currently. These influences affect its sediment dynamics, water quality, biodiversity, and cultural significance. The following discussion synthesizes findings from various sources to highlight the primary human-induced pressures on the lagoon, while also noting ongoing restoration efforts.

3.1 Anthropogenic Interference to Sediment Supply

The Coburg Peninsula provides important protection to Esquimalt Lagoon from ocean waves. Because of this, the form of the peninsula is actively undergoing geomorphic change that is dependent on sediment transport processes. Historically, the Colwood delta supplied sediment through longshore drift. However, significant anthropogenic changes have disrupted this balance. Mining operations at the Metchosin gravel pit (active from 1909 to 2007) supplied large volumes of fine sediment to the shoreline, artificially inflating beach profiles and enhancing dune formation (O'Connor, Muller, & Perkins, 2014). The pit's closure has resulted in sediment starvation, leading to beach narrowing and a return to coarser substrate conditions (Goulet et al., 2013).

Furthermore, shoreline armouring and infrastructure development, including riprap and the road along the spit, have exacerbated erosion by interrupting littoral drift and deflecting wave energy onto adjacent beaches (Goulet et al., 2013; Flottorp et al., 2013).

3.2 Human Bird Disturbances

During the field assessment for this report, kayakers were observed in the lagoon. Boating is a valued recreational and educational activity, but has the potential to be a major source of disturbance to wildlife. Studies indicate that boating accounts for 63% of human-caused disturbances to birds in the Esquimalt Lagoon MBS (Clowater, 2008). Educational programs such as EcoRowing, once based at the lagoon, balanced boating with environmental stewardship, but were eventually relocated due to increased storm impacts and conflicting land uses (Goulet et al., 2013).

Additional disturbances to birds noted during field work include swimming near birds. One noted instance caused a great blue heron to startle and fly away. Finally, multiple instances of feeding the birds were noted.

3.3 Development within the Esquimalt Lagoon Watershed

The Esquimalt Lagoon's watershed has been significantly altered by residential, commercial, and institutional development. Urban expansion has increased impervious surface coverage, exacerbating stormwater runoff and sedimentation in the lagoon (Johannessen & Macdonald, 2008). The large residential development at the former gravel pit site is expected to change the watershed's hydrology further and reduce sediment delivery to the lagoon (Goulet et al., 2013).

3.4 Water Quality

Nutrient enrichment, particularly from nitrates, has contributed to eutrophication and recurring harmful algal blooms within the lagoon. These blooms cause oxygen depletion and have been associated with fish kills during bloom decay periods (Johannessen & Macdonald, 2008). 6-PPDQ, a toxic chemical formed from tire wear particles, is tracked by Researchers from the BC Conservation Foundation and Vancouver Island University. Data shows that this chemical is present in Colwood Creek, and spikes in its detection are often correlated with rainfall, indicating that urban runoff is a primary transport mechanism (BC Conservation Foundation & Vancouver Island University, 2024). Laboratory studies confirm that juvenile coho salmon exhibit 92–100% mortality at concentrations as low as 40 - 80 ng/L of 6-PPDQ over 1 - 24 hours (BC Conservation Foundation & Vancouver Island University Applied Environmental Research Lab, 2024). Additional sources of contamination include livestock waste, aging septic systems, and urban runoff. These inputs degrade water quality and compromise habitat for both aquatic species and birds.

Since 2011, the CRD has undertaken a Stormwater Quality Program. The program includes testing streams and stormwater discharges flowing into Esquimalt Lagoon, both in wet and dry seasons, analyzing parameters like *E. coli*, metals (e.g., copper, cadmium, zinc), dissolved oxygen, and nutrients such as nitrite. The most recent Core Area Stormwater Quality Program Report (2024) found that across the CRD, the number of discharges assigned a high public health concern rating has decreased since 2011. However, the most recent water quality testing within the lagoon in 2023 showed that parameters for which water quality objectives were developed are still a concern. Water quality measurements for metals and dissolved oxygen were similar to those from 2018 and 2011/2012. While stormwater inflows showed low E. coli levels (geomean < 200 CFU/100 mL), lagoon bacteria counts, especially fecal coliforms and enterococci, exceeded provincial objectives, with the highest values near the Colwood Creek mouth likely linked to bird activity.

3.5 Vegetation Trampling

The dunes on the Coburg Peninsula are highly sensitive to being trampled by pedestrians and pets. Native vegetation such as dunegrass plays a critical role in stabilizing sand and supporting rare ecosystems. Trampling destroys root systems, reduces vegetative cover, and increases erosion risk, particularly during storm events (Flottorp et al., 2013; Watson & Christian, 2013). During the field assessment for this report, it was observed that there are numerous trails to access and traverse the beach on the ocean-facing side of the Coburg Peninsula. These trails also appeared to be used more frequently by visitors. On the lagoon-facing side, there were typically only one or two well-defined trails extending along the peninsula.

A sign located along the Coburg Peninsula requesting visitors to stay on roads and trails.

3.6 Off-Leash Dogs

Dogs off-leash pose multiple threats: trampling sensitive dune vegetation, disturbing wildlife (especially birds), and enabling invasive plant spread through disturbed soils. While the Esquimalt Lagoon Migratory Bird Sanctuary is designated as an on-leash area, compliance remains an issue—suggesting a need for stronger enforcement or education campaigns (Flottorp et al., 2013; Goulet et al., 2013). Numerous off-leash dogs were observed along the Coburg Peninsula during the field assessment for this report. The majority of these dogs were on the ocean-facing side of the peninsula, below the high-water mark, where there was no vegetation. However, some dogs were observed running within areas of dune vegetation. One instance of an off-leash dog on the lagoon-facing side of the peninsula was observed near the bridge at the northeast end of the spit. A bird watcher informed the dog owner that pets must be on a leash in this area, and the dog owner quickly put their pet on a leash.

Extensive literature confirms that dog presence, particularly off-leash, can result in bird flushing, displacement from key habitats, reduced foraging rates, nest abandonment, increased alert behaviours, and, in some cases, mortality (Hentze et al., 2022). Public surveys in the Esquimalt Lagoon MBS area documented consistent disturbances across multiple sub-sites, particularly during sensitive bird activity

periods. These findings emphasize the cumulative and conservation-relevant impacts of off-leash dogs and the need for collaborative regulation and management.

Signage along the Coburg Peninsula requesting that dogs be kept on a leash.

3.7 Invasive Species

Invasive species such as Scotch broom and Himalayan blackberry dominate disturbed sites within the lagoon's ecosystems. These species displace native flora, reduce habitat quality, and alter ecological processes. Their spread is facilitated by human activity and habitat disturbance (Flottorp et al., 2013). Invasive plant species within the study area were mapped during the field assessment for this report (Figure 4). In addition to invasive plant species, invasive animal species use the lagoon as well. One such species is the European green crab, first spotted in 2022, which is a threat to local eelgrass beds and can outcompete local native species. Volunteer-led local initiatives, such as one spearheaded by the Esquimalt Lagoon Stewardship Initiative (ELSI), are working on monitoring and controlling this local outbreak.

3.8 Garbage

Across the length of the Coburg Peninsula, there are numerous garbage cans located along Ocean Boulevard, mostly beside parking areas. Despite this, some instances of littering were observed scattered across the peninsula. Research by Buchan et al. (2013) found that littering is often associated with vehicle-based users of the lagoon, who will come and stay parked in their car to enjoy the view. Litter not only pollutes the environment but also detracts from the area's cultural and aesthetic values. In contrast, pedestrian users are more likely to engage in stewardship, highlighting a divide in user impact patterns (Buchan et al., 2013). During the field assessment for this report, a group of pedestrian users on the lagoon side of the peninsula were observed cleaning up litter as they walked. In addition to this, ELSI partners with the Surfrider Foundation South Vancouver Island to host an annual beach clean-up at Esquimalt Lagoon.

One of many garbage bins adjacent to parking areas on Ocean Boulevard along the Coburg Peninsula

3.9 Potential Impacts of Climate Change

Global climate change, driven by human activities worldwide, has the potential to significantly affect the Esquimalt Lagoon ecosystem through processes such as sea-level rise, increased storm intensity, and ocean acidification. Sea-level rise poses a direct threat to the integrity of the Coburg Peninsula, which acts as a barrier between the ocean and the lagoon. As this natural barrier is eroded, the risk of lagoon inundation increases, potentially transforming the lagoon's brackish water system into a more marine-dominated environment, disrupting habitat conditions for migratory birds and aquatic species (O'Connor, Muller, & Perkins, 2014). Increased storm events, already influencing local decision-making around infrastructure and education programs like EcoRowing, are likely to intensify shoreline erosion and damage to restoration plantings (Goulet et al., 2013; Watson & Christian, 2013). Additionally, ocean acidification may impact the lagoon's food web by impacting plankton and shell-forming species, which are essential to support foraging fish and birds (Johannessen & Macdonald, 2008). These changes underscore the urgency of implementing adaptive management strategies to protect the lagoon's ecological integrity and the communities it supports.

4.0 Restoration Initiatives at Esquimalt Lagoon

4.1 Invasive Species Management

Management of invasive plant species is complex. In many cases, though eradication of well-established invasive plant species is impossible, the focus on managing these species is often in sensitive ecosystems and restoration sites. Early detection and rapid response (EDRR) strategies are crucial to managing invasive species effectively. This approach prioritizes monitoring for new high-risk species outbreaks and eradication of new priority species introductions. By acting early, it is possible to prevent high long-term costs and reduce the risk of permanent ecological damage.

4.1.1 Plant species

Monitoring and managing invasive plants is important at Esquimalt Lagoon. The removal of Scotch broom, English ivy, Himalayan blackberry, and thistle has been prioritized through ELSI volunteer stewardship programs and coordinated municipal efforts (Flottorp et al., 2013). Rapid response will be important for any new invasive plant introductions. These actions aim to promote the recovery of native plant communities and restore ecological resilience.

4.1.2 Canada Geese

The overpopulation of non-migratory Canada geese in coastal and urban environments poses significant ecological challenges. Their intense grazing pressure leads to the degradation of native plant communities, particularly in sensitive shoreline and wetland habitats like Esquimalt Lagoon. This loss of vegetation increases erosion risk, reduces biodiversity, and impairs habitat quality for other wildlife. Additionally, large goose populations contribute excessive nitrogen and phosphorus through fecal deposition, which can degrade water quality, promote algal blooms, and disrupt aquatic ecosystems. Nesting geese also displace native bird species and may contribute to the spread of disease.

The Capital Regional District (CRD) has implemented annual moult surveys and egg addling programs to monitor and control the non-migratory Canada goose population (CRD, 2024b; CRD, 2024c). The annual moult survey is conducted as part of the Capital Regional District's Canada Goose Management Strategy. During the moulting period, when geese are flightless and easier to count, biologists recorded the abundance and distribution of adult and juvenile Canada geese across the region. The 2024 survey confirmed continued high concentrations of non-migratory geese in urban and estuarine areas, with potential ecological consequences such as vegetation degradation, nutrient loading from feces, and competition with native species.

The CRD's spring egg addling program is a population control technique where goose eggs are treated (typically through oiling or shaking) to prevent hatching without triggering renesting. In 2024, trained personnel identified and treated nests on both public and private lands throughout the region. The addling program aims to reduce the reproductive success of non-migratory Canada geese, which are known to cause ecological degradation, including shoreline erosion and reduced plant biodiversity. The report also discusses challenges such as nest detection on private property and emphasizes the need for continued collaboration and public awareness.

4.1.3 European Green Crab

Monitoring and mitigation programs have been established to assess the spread of European green crabs (*Carcinus maenas*), which are a harmful invasive species that prey on native shellfish and disrupt sediment structure. These crabs also have the potential to damage eelgrass meadows. ELSI has been collaborating with volunteers and the Department of Fisheries and Oceans to monitor the lagoon for European green crabs. This effort includes monthly crab trapping and identification conducted from April to September each year. Early detection and rapid response are crucial for minimizing the long-term ecological impacts of this invasive species.

4.2 Bee Creek Restoration

Restoration work has been conducted along Bee Creek to improve fish passage, reduce erosion, and enhance riparian habitat. These projects have targeted degraded stream banks and culverts to increase connectivity for salmonids and other aquatic species. A team of volunteers from ELSI monitor cutthroat trout within Bee Creek. Data from 2024 showed an average of approximately 13 cutthroat trout per trap, marking a decline from the peak average monthly count per year of approximately 23. However, monthly counts in 2024 fluctuated between highs of about 30 fish and lows near 5. The Bee Creek volunteer team have begun to approach conservation of the creek with a more holistic view, to include natural vegetation, weather, and invertebrates in addition to cutthroat trout.

4.3 Dune Habitat Restoration

Dune stabilization and revegetation efforts along the Coburg Peninsula have focused on planting native dunegrass and installing protective fencing to minimize trampling and erosion (Watson & Christian, 2013). These efforts are essential for protecting rare coastal ecosystems and maintaining the peninsula's role in buffering the lagoon from storm surges.

5.0 Conclusions and Recommendations

The Esquimalt Lagoon MBS continues to face compounding human pressures. These include shoreline erosion from sediment disruption and armouring, stormwater pollution (including bacteria, metals, and tire-derived toxins like 6-PPDQ), invasive species proliferation, and disturbance from off-leash dogs and recreational boating. Many of these pressures directly affect sensitive habitats used by migratory birds, salmonids, and invertebrates. In light of these pressures, local stewardship groups participating in ELSI (a CRD-facilitated program) and the City of Colwood have collaborated on restoration efforts at the lagoon.

The following best management practices (BMPs) have been identified and discussed at a high level. They are meant to inform the long-term protection and enhancement of VECs and ecological processes within the Esquimalt Lagoon MBS. These BMPs may also enhance other planning objectives within the City of Colwood, including the mitigation of climate change impacts, stormwater management, providing access to nature and recreation, and the enhancement of livability throughout the city. The protection and enhancement of natural areas will also help to preserve cultural and heritage resources that are associated with these areas. This includes protecting significant trees, providing space for culturally significant plants and animals to thrive, and ensuring the availability of natural areas to teach cultural traditions into the future.

5.1 Improve Habitat Protection and Access Management

To protect the sensitive habitats within the Migratory Bird Sanctuary, especially those used by overwintering and breeding birds, stronger access management strategies are needed. This includes establishing or expanding seasonal wildlife refuge zones where human access is limited during peak bird activity periods. Formalizing pathways, fencing off high-use informal trails, and improving signage can reduce trampling in fragile dune and riparian zones. In addition, consistent enforcement of dog control bylaws, coupled with education campaigns on the ecological risks posed by off-leash dogs, will help minimize wildlife disturbance and habitat degradation.

5.2 Protect and Enhance Streams and Fish Habitat

The health of Esquimalt Lagoon is deeply interconnected with the condition of its freshwater tributaries, particularly Bee Creek and Colwood Creek, which support important fish habitat and contribute to the lagoon's water quality and hydrological balance. Protecting and enhancing these streams is essential for sustaining resident cutthroat trout, improving forage fish spawning conditions, and supporting broader biodiversity goals within the Esquimalt Lagoon MBS.

One of the most critical actions is to restore and maintain riparian buffers along the creek corridors throughout the Esquimalt Lagoon watershed. Native vegetation in these areas provides shade, reduces erosion, stabilizes banks, and supplies organic matter essential to aquatic food webs. Restoration projects along Bee Creek have demonstrated the value of riparian planting, and expanding these efforts upstream and along other creek segments would help moderate stream temperatures and reduce sedimentation. Maintaining intact riparian zones is also vital for filtering runoff before it reaches the

lagoon. The protection and enhancement of riparian corridors can be facilitated through strong municipal environmental policy, like a Development Permit process for Environmentally Sensitive Areas. Additionally, the incorporation of green infrastructure upstream and public education on pollution prevention can also help sustain water quality and stream health.

Improving fish passage and connectivity is another key priority. Culverts and poorly designed road crossings can act as barriers to salmonid movement, particularly during low-flow periods. To ensure year-round access to upstream spawning and rearing habitats, culvert retrofitting and the construction of fish-passable structures along Bee and Colwood Creeks should be implemented when feasible. Increasing habitat complexity through the addition of features like large woody debris and gravel substrates can also be explored to support all life stages of native fish species.

5.3 Expand Invasive Species Control Programs

Invasive species pose a significant risk to the integrity of natural ecosystems in the study area, and their control should remain a priority for ecological restoration at the lagoon. Effective invasive species control requires a two-pronged approach: addressing established invasive populations and preventing the establishment of new, high-risk species.

Established invasive plant species like Scotch broom, Himalayan blackberry, and English ivy require coordinated municipal programs and support for community-based stewardship efforts. Invasive plant species should be managed to protect natural biodiversity and prevent further spread and encroachment to and from adjacent areas. These invasive plants should be treated using the current best management practices for each species. Manual removal is recommended wherever possible to minimize the introduction of chemical herbicides into sensitive environmental areas. Exact treatment and control methods depend on site conditions and the species encountered. Management may require control methods that are adapted into site-specific control plans. Chemical treatments are not advisable in riparian areas, particularly when adjacent to watercourses.

Equally important is early detection and rapid response (EDRR) to emerging invasive threats. Regular monitoring is needed to identify new or low-abundance species before they become established. Through the CRD's Regional Invasive Species Program, participating local governments such as Colwood share information and coordinate control efforts, strengthening the City's ability to respond quickly and effectively to new invasions.

Additionally, Canada goose overpopulation, which degrades shoreline vegetation and water quality through fecal loading, should be managed through ongoing egg addling, moult surveys, and public education about feeding restrictions. In the aquatic environment, early detection and rapid response programs for species such as European green crab and Eurasian watermilfoil are essential to prevent further spread and damage.

5.4 Support Biodiversity Monitoring and Research

Effective conservation requires sound science and long-term data. Continued monitoring of cutthroat trout in Bee Creek, forage fish habitat on the outer beaches, and macroinvertebrates within tributaries should be maintained and expanded. Standardized protocols and shared data platforms would support regional planning and cross-agency collaboration. Integrating new tools, such as the CRD Harbours Atlas and real-time dashboards for tire-wear toxins or stormwater contaminants, can also enhance the precision and responsiveness of restoration actions.

5.5 Support Indigenous Leadership and Knowledge

Indigenous stewardship and rights-holders must be meaningfully included in the lagoon's long-term management. The Esquimalt and Songhees Nations maintain strong cultural, historical, and ecological relationships with the area. Supporting co-governance structures, cultural interpretation signage, and language integration will ensure the management of the lagoon reflects Indigenous worldviews. Opportunities to collaborate on restoration, harvesting, and land use decisions can help revitalize traditional knowledge systems while improving ecological outcomes.

5.6 Promote Community Stewardship and Education

Public engagement is key to building long-term stewardship. Expanding the reach of initiatives like the Esquimalt Lagoon Stewardship Initiative (ELSI), community art installations, and place-based learning programs can strengthen the community's connection to the lagoon. Interpretive signage, school-based citizen science, and public reporting tools (e.g., invasive species tracking, wildlife sightings) empower residents to play an active role in conservation. Partnerships with local governments, non-profits, and academic institutions can help provide training, funding, and technical support.

Appendix A: Statement of Limitations

This document was prepared by Diamond Head Consulting Ltd. Should this report contain an error or omission then the liability, if any, of Diamond Head Consulting Ltd. should be limited to the fee received by Diamond Head Consulting Ltd. for the preparation of this document. Recommendations contained in this report reflect Diamond Head Consulting Ltd.'s judgment in light of information available at the time of study. The accuracy of information provided by Diamond Head Consulting Ltd. is not guaranteed. This report is valid for 6 months from the date of submission. Additional site visits and report revisions are required after this point to ensure accuracy of the report.

Neither all nor part of the contents of this report should be used by any party, other than the client, without the express written consent of Diamond Head Consulting Ltd. This report was prepared for the client for the client's own information and for presentation to the approving government agencies. The report may not be used or relied upon by any other person unless that person is specifically named by Diamond Head Consulting Ltd as a beneficiary of the report, in which case the report may be used by the additional beneficiary Diamond Head Consulting Ltd has named. If such consent is granted, a surcharge may be rendered. The client agrees to maintain the confidentiality of the report and reasonably protect the report from distribution to any other person. If the client directly or indirectly causes the report to be distributed to any other person, the client shall indemnify, defend and hold Diamond Head Consulting Ltd harmless if any third party brings a claim against Diamond Head Consulting Ltd relating to the report.

Appendix B: References

Archipelago Marine Research. (2010). *Forage fish survey and beach profiling at Esquimalt Lagoon*. Capital Regional District.

BC Conservation Foundation & Vancouver Island University Applied Environmental Research Lab. (2024). *Standard Operating Procedures: Tire Wear Toxins database (SOP_Website-Database V1)* [PDF]. Retrieved July 2025, from https://www.tireweartoxins.com/wp-content/uploads/2024/05/SOP_Website-Database_V1_final.pdf

BC Conservation Foundation & Vancouver Island University. (2024). *Tire wear toxins and 6-PPDQ in Pacific Northwest watersheds [Interactive ArcGIS Dashboard]*. Retrieved July 2025, from https://experience.arcgis.com/experience/597c33d27da84f1789bc41a36e37253d

Buchan, R., Kopp, I., Gordon, C., Isomura, E., Gose, S., & Dusdal, C. (2013). *The cultural significance of the Esquimalt Lagoon*. University of Victoria.

Capital Regional District. (2024a). *2023 Core Area Stormwater Quality Program Report*. Regional Stormwater Management Program, Environmental Sustainability Department.

Capital Regional District. (2024b). *2024 Canada Goose Moult Survey Report*. Regional Canada Goose Management Strategy.

Capital Regional District. (2024c). *2024 Canada Goose Egg Addling Report*. Regional Canada Goose Management Strategy.

Clowater, J. S. (2008). *Disturbance of birds in the Esquimalt Lagoon Migratory Bird Sanctuary*. Environment Canada.

Flottorp, N., Hamilton, S., Vosper, W., Matthews, E., Ocampo, G., & Larsen, D. (2013). *Place making at Esquimalt Lagoon: Terrestrial ecology*. University of Victoria.

Goulet, C., Lewis, R., McWillis, E., Nasadyk, A., Pelletier, K., & Verdun, Z. (2013). *Contemporary site use: Place making at Esquimalt Lagoon*. University of Victoria.

Hentze, N. T., Morgan, K. H., Boynton, C. K., & Roberts, E. M. (2022). *Dogs and migratory birds within migratory bird sanctuaries in the Greater Victoria Area* (Technical Report Series No. 540). Canadian Wildlife Service, Environment and Climate Change Canada.

iNaturalist. (n.d.). *iNaturalist*. Retrieved August 15, 2025, from https://www.inaturalist.org

Johannessen, D., & Macdonald, J. S. (2008). *Phytoplankton blooms and fish kills in Esquimalt Lagoon: Assessing the role of eutrophication*. Fisheries and Oceans Canada.

O'Connor, B., Muller, N., & Perkins, J. (2014). *An investigation into erosion and armouring effects on the Coburg Peninsula at the Esquimalt Lagoon, Colwood BC*. University of Victoria.

Watson, J., & Christian, R. (2013). *Restoration of dune habitat: Coburg Peninsula*. Habitat Acquisition Trust / CRD.

Appendix C: Invasive Plant Species Included in Survey

Common Name	Scientific Name
Black Locust	*Robinia pseudoacacia*
Blueweed	*Echium vulgare*
Butterfly Bush	*Buddleja davidii*
Cherry Laurel	*Prunus laurocerasus*
Clematis	*Clematis vitalba*
Clumping Bamboo	*Bambusa spp.*
Common Comfrey	*Symphytum officinale*
Common Hops	*Humulus lupulus*
Common Reed	*Phragmites australis*
Common Tansy	*Tanacetum vulgare*
Cordgrass	*Spartina spp.*
English Hawthorn	*Crataegus monogyna*
English Holly	*Ilex aquifolium*
English Ivy	*Hedera helix*
Eurasian Watermilfoil	*Myriophyllum spicatum*
Evergreen Blackberry	*Rubus laciniatus*
Flowering Rush	*Butomus umbellatus*
Garlic Mustard	*Alliaria petiolata*
Giant Hogweed	*Heracleum mantegazzianum*
Golden Willow	*Salix × sepulcralis*
Gorse	*Ulex europaeus*
Goutweed	*Aegopodium podagraria*
Hedge Bindweed	*Calystegia sepium*
Himalayan Balsam	*Impatiens glandulifera*
Himalayan Blackberry	*Rubus bifrons*
Italian Arum	*Arum italicum*
Japanese Butterbur	*Petasites japonicus*
Japanese Kerria	*Kerria japonica*
Knotweed (Japanese/Bohemian/etc.)	*Reynoutria spp.*
Lesser Celandine	*Ficaria verna*
Orange Hawkweed	*Pilosella aurantiaca*
Parrot's Feather	*Myriophyllum aquaticum*
Periwinkle	*Vinca spp.*
Pickerelweed	*Pontederia cordata*
Poison Hemlock	*Conium maculatum*

Common Name	Scientific Name
Portuguese Laurel	*Prunus lusitanica*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*
Running Bamboo	*Phyllostachys spp.*
Scotch Broom	*Cytisus scoparius*
Small-flowered Touch-me-not	*Impatiens parviflora*
Spurge Laurel	*Daphne laureola*
Sycamore Maple	*Acer pseudoplatanus*
Teasel	*Dipsacus fullonum*
Thistle	*Cirsium spp.*
Wild Chervil	*Anthriscus sylvestris*
Yellow Archangel	*Lamiastrum galeobdolon*
Yellow Flag Iris	*Iris pseudacorus*