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MEMORANDUM

To:	Public Services and Procurement Canada	Date:	November 24, 2021
Attention:	Kristen Ritchot		
cc:	Rachel Speller, Department of National Defence		
From:	Janet Jeffery, P.Ag., RPBio Geoff Sherman MSc, PBio	Ref:	626692
Subject:	Summary of Environment Assessment, Nanaimo Bunker, Nanaimo Lakes Road, Nanaimo BC		

1 Introduction

At the request of Public Services and Procurement Canada (PSPC) on behalf of the Department of National Defence (DND), SNC-Lavalin Inc. (SNC-Lavalin) has prepared this environmental assessment summary memorandum for implementation of the planned remediation at the Canadian Forces Base (CFB) Esquimalt Nanaimo Military Camp (NMC) Bunker (the "Site"), Nanaimo, BC.

This work was completed under PSPC Contaminated Sites Remediation Services Contract No. EZ897-192499/003/VAN (CTA) and Task Authorization No. 700592454. The Site layout and environmental overview is provided on Drawing 626692-501, attached.

2 Project/Physical Activity Description

The project will consist of the remediation of contaminated soil in four areas of the NMC Bunker property shown as Excavation Areas 1A, 1B, 2, and 3 (refer to Drawing 626692-501). Contaminants of concern in soil identified in previous investigations include ethylbenzene, naphthalene, phenanthrene, Index of Additive Cancer Risk (IACR), trichloroethylene, lead, Hydrocarbon fraction F2, and copper. The goal of remediation at the Site is to reduce future liability related to environmental conditions. A remedial excavation of the contaminated soils will be completed with the aim to achieve confirmatory results that satisfy the appropriate federal guidelines for the Site.

Remedial activities will include the following:

- Site preparation activities (i.e., utility locations, preparation of spaces for Site support, such as office trailers, portable washrooms, lay-down areas, preparation of soil staging area, worker parking, equipment refueling, where necessary, and installation of erosion and sediment control measures and traffic control requirements if needed);

- Remedial excavation, temporary stockpiling of contaminated soil on-Site, and backfilling activities; and
- Site restoration activities (i.e., restoration to pre-excavation conditions, including the re-establishment of vegetation on-Site).

The excavation sequence will be designed to allow for multiple tasks to be completed at the same time, where possible, and to limit the exposure of excavation equipment to contaminated media. Sequencing will be at the discretion of the contractor. It is recommended that Excavation 1A be conducted first to ensure the soils in the highest risk areas are removed and allow for characterization of the suspect quality overburden including topsoil. Some vegetation removal, including shrubs and immature trees, will be required for excavation and/or Site preparation activities.

All contaminated soil removed within the specified extents will be either hot-loaded or stockpiled without further characterization for subsequent transport to the off-Site facility. The exception to this is suspect quality material at Excavation 1A which requires characterization prior to off-Site disposal or reuse on-Site.

The project is anticipated to be completed in the fall of 2021.

3 Description of Environment

A Site visit was completed by SNC-Lavalin on June 22, 2021 to complete an assessment of wildlife and plant habitat to determine the potential presence of Species at Risk and/or sensitive habitat at the Site for planning purposes.

The Site is approximately two hectares in size and is located on the north side of Nanaimo Lakes Road and east of the Nanaimo Parkway, in the City of Nanaimo, as shown on Drawing 626692-501. Site access is through the entrance on the south side of the Site along Nanaimo Lakes Road.

An asphalt access road extends from the gate entrance to the northern portion of the Site (Drawing 626692-501). The Site is enclosed with chain-link fencing along the north, east, and southern perimeters, and wood panel fencing on the western perimeter. The Site is occupied by a two-storey bunker that was decommissioned and sealed in the late 1990s. The Site is currently vacant with the exception of the decommissioned and sealed bunker.

Vegetation on-Site is dominated by a mixture of grasses and herbaceous species intermixed with common hawthorn (*Crataegus monogyna*) (a cultivated European species that often naturalizes) and invasive species including Himalayan blackberry (*Rubus armeniacus*) and Scotch broom (*Cytisus scoparius*), and some native tree and shrub species (mostly immature) including black cottonwood (*Populus trichocarpa*), coastal Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*), saskatoon (*Amelanchier alnifolia*), and red alder (*Alnus rubra*).

The Chase River and Colliery Dam's Upper Lake are located across Nanaimo Lakes Road approximately 100 m south/southwest of the Site. An unnamed watercourse is also located approximately 325 m to the north of the Site. Surface water on-Site has been reported to be present during winter months within a drainage ditch reported to be present near the eastern perimeter of the Site. Portions of what appeared to be this ditch were observed at the time of the Site visit; however, the course of the ditch was unclear due to the presence of heavily armed vegetation (i.e., blackberry). What appeared to be the ditch outfall was observed along Nanaimo Lakes Road.

The general soil stratigraphy encountered during recent drilling investigations (SNC-Lavalin, 2021) is consistent with the stratigraphy observed during the previous investigations. A fill layer consisting of varying amounts of sand and gravel was identified generally to a depth between 0.5 m and 2.1 m below ground surface (bgs). The fill layer was underlain by dense silt and/or sand layers with varying amounts of gravels encountered up to a depth of 6.1 m bgs (the maximum depth investigated). Soil stratigraphy was found to be heterogeneous across the Site.

4 Species at Risk

A preliminary search through iMapBC identified some areas of the Site to be located within proposed Critical Habitat (CH) for the Western Painted Turtle (*Chrysemys picta*; Pacific Coast population) (Photograph 1; Drawing 626692-501). The Western Painted Turtle (Pacific Coast population) is listed as Threatened on Schedule 1 of the *Species at Risk Act* (SARA), and was downlisted from Endangered on February 20, 2021 (Government of Canada, 2021). A finalized recovery plan, including final Critical Habitat identification, was posted July 8, 2021 for this species (ECCC, 2021). A digital coverage of the final Critical Habitat polygons is not yet available from the federal mapping service, but the final polygons are expected to be similar to the proposed polygons.

The nearest recorded occurrence of Western Painted Turtles is located at Morrell Lake, approximately 1.1 km northwest of the Site. Additional occurrences have also been recorded at three locations ~2.0 km north of the Site (i.e., Buttertubs Marsh, Cathers Lake, and Diver Lake) (iMapBC, 2021).

The extent of the proposed Critical Habitat in the vicinity of the Site includes terrestrial areas that extend up to 150 m from the Chase River and the Colliery Dam Upper Lake, which are located across Nanaimo Road, approximately 100 m south of the Site. Critical Habitat for this species was identified based on a compilation and review of occurrence records, identification of suitable aquatic habitat features within a radial distance of 3 km of each record, and preliminary delineation of geospatial area containing critical habitat by applying a 150 m terrestrial distance around known nest locations and suitable aquatic habitat (ECCC, 2021).

Painted turtles require both aquatic and terrestrial habitat to support basking, nesting, foraging, and overwintering habitat. In general, biophysical features of Critical Habitat for Western Painted Turtles include slow-moving or stagnant fresh waterbodies and open terrestrial habitat with exposed soil and little to no vegetation and substrate comprised of sand, gravel, and/or silt, with low organic content. Suitable nesting sites are characterized as having exposed soil with little vegetation, on south-facing aspects, with gently sloping or flat ground and in areas of open canopy, and without standing water (ECCC, 2021). The majority of nesting sites are on anthropogenic sites such as gravel road shoulders, gravel pits, boat launches, recreational beaches, lawns and gardens, gravel rails, driveways, dikes, and sandy campsites (WPTRT, 2016).

There are several potential barriers to turtle movement present between the Chase River and Lower Colliery Dam and the Site. These include Nanaimo Lakes Road and adjacent ditches (Photograph 2). On the north side of the road near the vicinity of the Site, the ditches are steeply sloped and range from an estimated 2.0 m to over 3.0 m in height (west to east). An approximately 1.0 m wide area from ditches on the north Site is subject to maintenance and had been recently mowed. Additional barriers to turtle movement into the Site area include dense vegetation and a chain-link fence present along the Site's southern boundary (Photograph 3). While some small gaps do exist under the fence, it is expected that turtle movement through these areas would be impeded by the thick vegetation. Although these barriers may not be

insurmountable, movement of turtles from the Chase River/Colliery Dam areas to the Site is considered unlikely.

The Lower Colliery Dam area is a recreational site and includes a busy off-leash dog park. Those features may result in disturbance and possible mortality for turtles leaving the water or hatchlings leaving the nest.

Vegetation is prevalent over the majority of the Site (with the exception of the paved access road, and some less thickly-vegetated areas in the north end of the Site, beyond the extent of the proposed turtle Critical Habitat), resulting in very little exposed friable soil to provide suitable nesting sites (Photograph 4). The introduction of non-native plant species to the Site has likely resulted in degraded nesting habitat in this area due to encroachment. Soils in the area have been described as dense and have likely been compacted historically during development of the Site. Exposed soil noted along a cutbank at the north end of the Site was less compact; however, this area is located over 230 m from nearest portion of the Colliery Dam Upper Lake and not located within the CH polygon. The Site has been reported as having standing water in the winter, further decreasing its suitability as nesting habitat for turtles.

A search of the BC Conservation Data Centre's (CDC) Internet Mapping Service through iMapBC also identified the potential occurrence of one sensitive species in the Site area. A request for additional information relating to the species occurrence was forwarded to the CDC on June 22, 2021. The CDC response was received on June 23, 2021 and indicated the masked species occurrence is not anticipated to be impacted by proposed activities at the Site due to its distance from the Site (CDC, 2021).

4.1 Western Painted Turtle Survey

SNC-Lavalin retained Biolinx Environmental Research Ltd (Biolinx) to conduct a site-specific study of mapped CH on and adjacent to the Site, as well as to determine the likelihood that the mapped CH has reasonable potential to support painted turtles. A Site visit was conducted on August 9, 2021 by two QEPs and an assessment report was provided (Biolinx, 2021), included in Attachment 1.

Two types of surveys were conducted during the Site visit:

- A survey of nesting habitat within the NMC property boundary; and
- A turtle survey of wetland habitats within a range of up to 1.5 km of the NMC property boundary.

The assessment of nesting habitat within the NMC boundary focused on identifying features consistent with preferred nesting habitat (described in Section 4). During the survey, the majority of the NMC property surface was observed to be covered in dense shrubs and grass and considered unsuitable for turtle nesting. A total of eight locations potentially suitable for turtle nesting were identified. Based on their suitability for turtle nesting, four locations were rated as medium-quality nesting habitat and four were rated as low-quality nesting habitat. No evidence of hatchling emergence holes was observed at any location within the NMC property, suggesting that turtle nesting had not occurred within the 2020 nesting season.

The Turtle Survey of nearby wetland habitats was conducted up to within 1.5 km of the NMC boundary and included the boundaries of Upper and Middle Colliery Dam Lakes (approximately 300 m east of the Site) and Upper Chase River wetlands (approximately 600 m south of the Site), neither of which had recorded observations of painted turtle. A survey was also conducted at Morell Lake (approximately 1.1 km north of the Site), at which a 2014 record of painted turtle occurrence exists.

The habitat at the Colliery Dam Lakes was observed to be of low suitability and poor quality due to treed and modified shorelines, lack of vegetated shallows, as well as being located in an area heavily used for recreation and off-leash dog walking. At Upper Chase River wetlands, located across Nanaimo Parkway (Hwy 19) from the Site, small wetland areas appeared to be more suitable for painted turtle habitat, but no turtles were observed during the survey. At Morell Lake, high quality turtle habitat was found at the northernmost reaches (approximately 1.5 km north of the Site); however, no painted turtles were observed during the Morell Lake survey.

Accessibility between the aquatic habitats beyond NMC property boundaries and the Site was also assessed. The perimeter chain-link fence around NMC was observed to reach the ground surface but contained some gaps that could potentially allow turtle passage, although turtles would need to find the gaps in order to successfully enter the Site. The aquatic habitat at the Colliery Dam Lakes is separated from the Site by Nanaimo Lakes Road. Crossing of Nanaimo Lakes Road is considered possible, but subject to a high rate of mortality due to high vehicle traffic. The aquatic habitat at the Upper Chase River wetlands is separated from the Site by Hwy 19, a four-lane highway. Similarly, crossing by turtles is considered possible, but with very high levels of mortality and much difficulty. The high-quality turtle habitat at the north end of Morell Lake is separated from the Site by over 1 km of densely wooded forest, as well as Hwy 19. Turtles from Morell Lake traveling to the Site is considered highly unlikely.

In relation to the planned remediation program, Biolinx recommended that soil disturbance in areas of medium suitability be avoided.

5 Summary

Based on the generally low suitability of the habitat of the Site, the lack of records for Western Painted Turtles, the barriers between the Site and suitable aquatic habitat for turtles, and the extent of proposed project activities, it is unlikely that the project will have impacts on Western Painted Turtle. Nevertheless, the Critical Habitat definition for this species provided in the federal recovery strategy is broad and includes "*Additional types of natural terrestrial habitat features, e.g.: forest, shrublands, grasslands, fields*" (ECCC, 2021). The final digital coverage of the Critical Habitat mapping for painted turtle should be checked, once available, to confirm that the final polygons overlap the Site.

The recovery strategy for Western Painted Turtle Pacific Coast population states:

> *"In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area be described in the Canada Gazette within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the Canada Gazette. For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies*."

Given that the Site is not a federally protected area (e.g., a national park), the prohibition of destruction of Critical Habitat within the Site would not apply until or unless the competent minister has made a statement or order as described above. Residences of all Species at Risk are protected on federal lands. A formal residence description is not yet available for Western Painted Turtle, but nest sites are likely to be included

in that designation. Although the Site appears to be medium to low-suitability for nesting habitat, obtaining a SARA permit to authorize destruction of potential residences of a Species at Risk is recommended as a best management strategy.

We do not anticipate difficulty in obtaining such a permit. Remediation of contaminated soils would ultimately improve nesting habitat quality for turtles and the chances of residence destruction or mortality of individuals are low. Construction mitigation pertaining to turtles will include instruction to construction crews to watch for wildlife (including turtles), to cover all open excavations before leaving for the day, and to check all excavations for trapped wildlife before filling.

6 References

Biolinx Environmental Research Ltd. (2021). Surveys and Mitigation Recommendations for Western Painted Turtle on DND Lands Subject to Soil Remediation at the Nanaimo Bunker Property, Vancouver Island.

Conservation Data Centre (2021). CDC request for masked species information – DND Bunker/Military Camp Property, Nanaimo, BC. Email response dated June 22, 2021.

Environment and Climate Change Canada. 2021. Recovery Strategy for the Western Painted Turtle (*Chrysemys picta bellii*) Pacific Coast population in Canada. Species at Risk Act Recovery Strategy Series. Environment and Climate Change Canada, Ottawa. 2 parts, 31 pp. + 59 pp.

Government of Canada. 2021. Canada Gazette, Part I, Volume 155, Number 8: Order Amending Schedule 1 to the Species at Risk Act. Available: https://canadagazette.gc.ca/rp-pr/p1/2021/2021-02-20/html/reg1-eng.html.

SNC-Lavalin Inc. 2021. Federal Contaminated Sites Action Plan (FCSAP) Site Closure Report: Nanaimo Military Camp Bunker, CFB Esquimalt. Report to Department of National Defence.

Western Painted Turtle Recovery Team (WPTRT). 2016. Recovery Plan for the Painted Turtle – Pacific Coast Population (*Chrysemys picta* pop. 1), in British Columbia. BC Ministry of Environment, Victoria, BC. 89 pp. Repr. of 1st ed., The Western Painted Turtle Recovery Team, Victoria, BC. 89 p.

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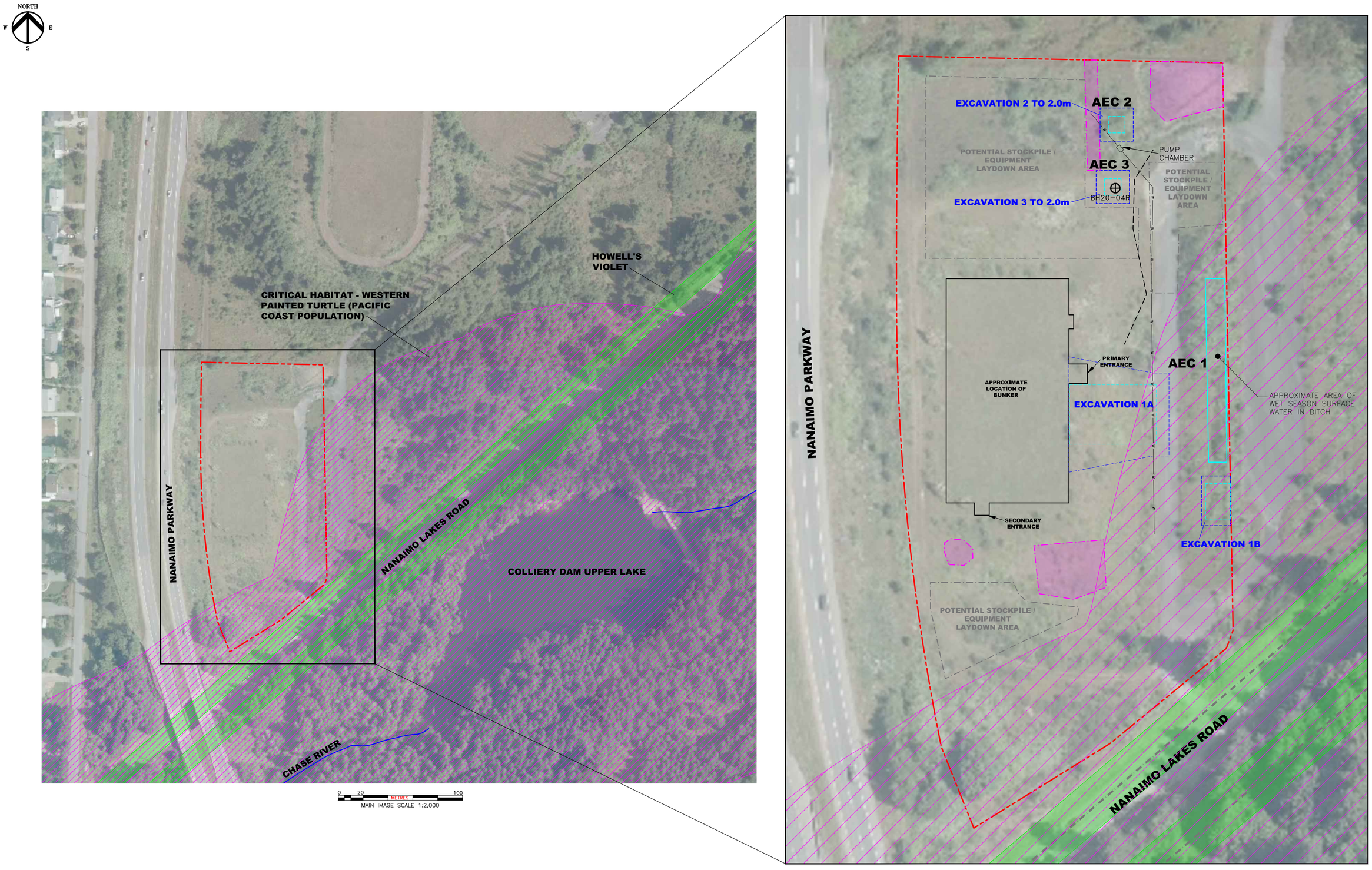
Drawing
› 626692-501 – Environmental Overview

Photographs

Attachment 1: Biolinx WPT Survey

Drawing

› 626692-501 – Environmental Overview



LEGEND

- SUBJECT PROPERTY LIMITS
- SITE FEATURES
- WATER LINE
- COMMUNICATION LINE
- APPROXIMATE TOP OF LIMITS OF EXCAVATION
- APPROXIMATE BASE OF EXCAVATION
- CRITICAL HABITAT – WESTERN PAINTED TURTLE (PACIFIC COAST POPULATION)
- HOWELL'S VIOLET
- MEDIUM QUALITY NESTING HABITAT AREA

NOTES

1. ORIGINAL DRAWING IN COLOUR.
2. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED ON SITE. NOT ALL UTILITIES MAY BE SHOWN.

REFERENCE DRAWINGS

DWG. NO.	DATE	DESCRIPTION
–	–	–

REVISIONS

REV.	DATE	DESCRIPTION	BY	CHK
1	2021-11-24	ISSUED TO CLIENT	PRT	IM
0	2021-10-21	ISSUED TO CLIENT	AJK	IM

CLIENT NAME: PUBLIC SERVICES AND PROCUREMENT CANADA

PROJECT LOCATION: NANAIMO BUNKER, NANAIMO, B.C.

SNC·LAVALIN

TITLE: **ENVIRONMENTAL OVERVIEW**

DWN BY: PRT	SCALE: AS SHOWN	DATE: 2021-06-17	DWG No: REV.: 1
CHK'D: JJ	PLOT: 20211124.1135	CADFILE: 626692R11	626692-501

PATH: P:\CURRENT PROJECTS\PWGSC\626692 – BUNKER SITE\4.0 EXECUTION\4.5 GIS AND DRAWINGS\CAD\626692R11.DWG

Photographs

Photograph 1: Western painted turtle (G Stolz, USFWS, public domain).

Photograph 2: Paved road and riprap ditch.

Photograph 3: Dense vegetation and chain-link fence at margin of Site.

Photograph 4: Paved area and typical vegetation at the Site.

Attachment 1

› Biolinx WPT Survey

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Tel: (250) 655-4602 Cell: 250 634-8909 Email: lennart@biolinx.ca

Surveys and Mitigation Recommendations for Western Painted Turtle on DND Lands Subjected to Soil Remediation at Nanaimo Bunker Property, Vancouver Island

Prepared by Kristiina Ovaska, PhD and Lennart Sopuck, MSc., RPBio.

August 2021

1.0 INTRODUCTION

SNC Lavalin, on behalf of the Department of National Defence, is planning to conduct a soil remediation project at the Nanaimo Bunker (NMC) property. The project involves the removal of contaminated soil and engaging in other remediation activities at a former military site (Figure 1). These activities may potentially impact Western Painted Turtle (*Chrysemys picta bellii*), Pacific Coast Population, which is listed as Endangered under the federal *Species at Risk Act*.

A Critical Habitat polygon overlaps the remediation site (ECCC 2021). Critical Habitat identification for Western Painted Turtle is based on the general principle of applying a 3 km radius buffer around known occurrences (in this case Morrell Lake about 1 km away from the Nanaimo Bunker), and application of a 150 m radius buffer around known and potentially suitable wetlands within this zone (potential habitat in Colliery Dam Lakes in this case). Areas that are clearly isolated by insurmountable barriers are excluded; in this case, the roads are not considered such barriers. Within the polygons so derived, terrestrial habitats that contain the following features are designated as Critical Habitat (ECCC 2021):

- "Open terrestrial habitat types, i.e.: areas with exposed soil and little to no vegetation, e.g., beaches, shoreline, sandy/loamy riparian edges or banks, natural islands, rocky bluffs, canopy gaps in forested habitats, where features include any of the following attributes:
    - flat or gently sloping ground (no pooling water)
    - substrates: sand, gravel, or silt; low organic content
- Additional types of natural terrestrial habitat features, e.g.: forest, shrublands, grasslands, fields".

This report presents the results of a nesting habitat assessment for Western Painted Turtles conducted on 9 August 2021 and provides recommendations to minimize potential impacts on this species. We also surveyed the nearest aquatic habitats for turtles, including Morrell Lake with the nearest known occurrence of the species (see Table 1 for records from the Nanaimo area).

Table 1. Summary of Western Painted Turtles sites from the Nanaimo area.

Site	Latitude	Longitude	Source
Buttertubs Marsh	49.17155	-123.976012	COSEWIC (2016)
Diver Lake	49.202503	-124.013714	COSEWIC (2016)
Long Lake, NW shore	49.2135	-124.02142	iMapBC (accessed Aug 2021)
Morrell Lake	49.1533	-123.9886	ECCC (2021); C. Engelstoft pers. comm. 2021

2.0 STUDY AREA

The NMC Bunker property is located on the north side of Nanaimo Lakes Road and east of the Nanaimo Parkway, in the City of Nanaimo. The approximately 2-ha site is enclosed with chain link fencing. It contains a currently vacant two-storey bunker that was decommissioned and sealed in the late 1990s. The study area area is demarcated by the dotted yellow line in Figure 1.

Also on 9 August 2021, we conducted turtle surveys in wetland habitats up to 1.5 km from the remediation area, including Colliery Dam Lakes (Upper and Lower), Upper Chase River wetlands, and Morrell Lake Nature Sanctuary. We scanned the water bodies with a spotting scope and binoculars from vantage points along the shoreline.

The project will consist of the remediation of contaminated soil in four areas (1a,b, 2, 3; Figure 1). The following description of project activities is as per communication with Janet Jeffery (2021). Contaminants of Concern (COC) in soil identified in previous investigations include ethylbenzene, naphthalene, phenanthrene, Index of Additive Cancer Risk (IACR), trichloroethylene, lead, hydrocarbon fraction F2, and copper. The goal of remediation is to reduce future liability related to environmental conditions. A remedial excavation of the contaminated soils will be completed with the aim to achieve confirmatory results that satisfy the appropriate federal guidelines for the site. The contaminated soil is to be excavated for transport and disposal at an approved off-site facility. Following the completion of the excavations, the disturbed areas will be backfilled and restored to their current grade.

The site is open, and vegetation consists of grasses, shrubs, and scattered small trees. Introduced shrubs including Himalayan Blackberry (*Rubus armeniacus*) and English Hawthorn (*Crataegus monogyna*) are common. A dense cover of planted grasses occurs on top of the bunker and throughout most of the site. A few patches of bare ground are present along old trails and tracks, the access road, and in recently disturbed areas.

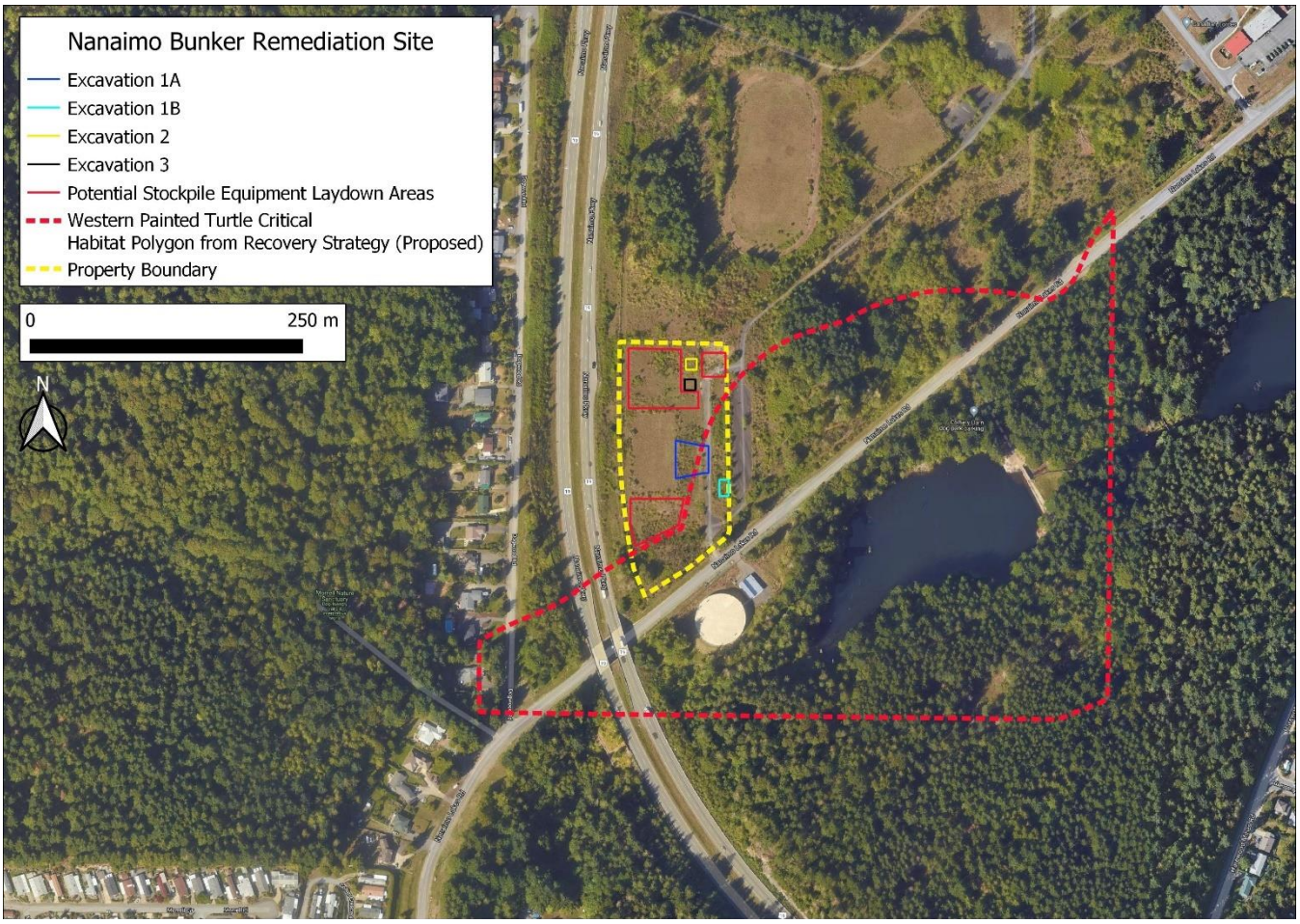
3.0 METHODS

We conducted detailed mapping of potential turtle nesting habitat and an assessment of its suitability within the remediation area, based on a site visit on 9 August 2021. Both observers (Kristiina Ovaska and Lennart Sopuck) are experienced in turtle surveys. We slowly walked throughout the remediation site and examined the vegetation, substrate type, and the presence of turtle nesting activity such as scrapes and hatchling emergent holes. We assessed nesting habitat suitability based on the degree of openness, substrate features, and

exposure to the sun. Potentially suitable habitats were rated from low to high. In addition to ratings based on nesting habitat suitability, we investigated accessibility of the remediation area by turtles and distance to the nearest suitable wetland habitat.

Also on 9 August 2021, we conducted turtle surveys in wetland habitats up to 1.5 km from the remediation area, including Colliery Dam Lakes (Upper and Lower), Upper Chase River wetlands, and Morrell Lake Nature Sanctuary. We scanned the water bodies with a spotting scope and binoculars from vantage points along the shoreline.

Figure 1. Map of the Nanaimo Bunker property in Nanaimo, Vancouver Island. The soil remediation site is demarcated by the yellow dotted line and the Critical Habitat polygon for Western Painted Turtle is shown by the red dotted line.



4. RESULTS AND DISCUSSION

4.1 Nesting Habitat Assessment within the Study Area

Female Western Painted Turtles select bare (unvegetated) patches of substrate in areas with good exposure to the sun for nesting, such as along warm southernly aspects in gently sloping terrain (COSEWIC 2016). Important features include good drainage and fairly compact substrate with low organic content, often composed of a mixture of sand, gravel, and soil. While walking through the study area along meandering transects, we searched for such features (see Figure 2 for survey tracks).

Most of the study area was covered by dense shrubs or grass, unsuitable for turtle nesting. However, we identified several sites that contained potentially suitable patches with bare ground and suitable substrate and exposure (Figure 3; see Appendix 1 for field notes and Appendix 2 for images). These were rated either as medium or low quality. The best habitat occurred in the northeast corner and in the south-central and southwest parts of the study area. In these areas, the potential nesting habitat overlapped with the proposed equipment and stockpile laydown areas (Figure 3).

We did not find any evidence of recent nesting activity by turtles within the remediation area. While new nests can sometimes be identified from scrapes (small patches of disturbed soil), they are notoriously difficult to detect unless recently constructed. On Vancouver Island, the peak nesting season is from late May to late June (e.g., Ovaska and Engelstoft 2018 and annual reports for Habitat Acquisition Trust). Emergence of hatchlings typically takes place in the spring following egg-laying the previous year, after an overwintering period in the nest. The holes indicating emergence are often visible long after hatchlings have departed. The absence of any evidence of such holes in the remediation area suggests that it was not used by turtles for nesting in 2020.

4.2 Turtle Surveys in Adjacent Wetlands

Western Painted Turtles spend most of their time in aquatic habitats, and only come to land when nesting or when dispersing between water bodies. Nesting sites are usually within 200 m of water bodies, but longer movements have been occasionally documented (COSEWIC 2016); in British Columbia movement distances between aquatic and nesting habitats are typically less than 150 m (BC FLNRO). Aquatic habitats include various stagnant or slow-moving water bodies, usually with shallow areas with emergent or floating vegetation and muddy substrates (COSEWIC 2016; ECCC 2021).

We conducted a turtle survey and assessed suitability of aquatic habitats within 1.5 km from the remediation site. The closest water bodies were located to the east (Colliery Dam Lakes) and southwest (Upper Chase River Wetlands) (see Figure 4 for survey routes). There are no previous records of Western Painted Turtles from any of these water bodies. The closest water bodies to the study area, Middle and Upper Colliery Dam Lakes, across Nanaimo Lakes Road, contained poor quality habitat for turtles. Middle Colliery Lake was mostly treed to the shoreline and lacked vegetated shallows preferred by turtles; it was within an off-leash dog park, which appeared to be heavily used for this purpose. Upper (northernmost) Colliery Lake contained some potential shallow turtle habitat at the southwest end, including a small patch of emergent vegetation and a few basking logs. However, it also received heavy recreational use by people and pets and overall provided poor turtle habitat. Lower Colliery Lake was steep-sided and highly modified; it was completely dry during our visit. Small shallow vegetated wetlands to the south of the Colliery Dam Lakes and on the west side of Nanaimo Lakes Road (referred to as Upper Chase River wetlands) contained better quality potential turtle habitat than the above lakes, but we observed no turtles during the visit.

The nearest record of Western Painted Turtle to the remediation area is from Morrell Lake, located ~1.1. km to the northwest (straight-line distance from edge to edge). An adult Western Painted Turtle has been documented from the lake on two occasions, last time in September 2014; C. Engelstoft pers. comm. 2021). The north end of the lake contained high-quality turtle habitat, including shallows with abundant emergent vegetation and basking logs. During our visit we observed two adult Red-eared Sliders (*Trachemys scripta*) there (basking on separate logs ~30 m apart) but no Western Painted Turtles.

Figure 2. Turtle nesting survey coverage within the Nanaimo Bunker study area.

Figure 3. Turtle nesting habitat assessment within the Nanaimo Bunker study area. Reference numbers match those in the appendices.

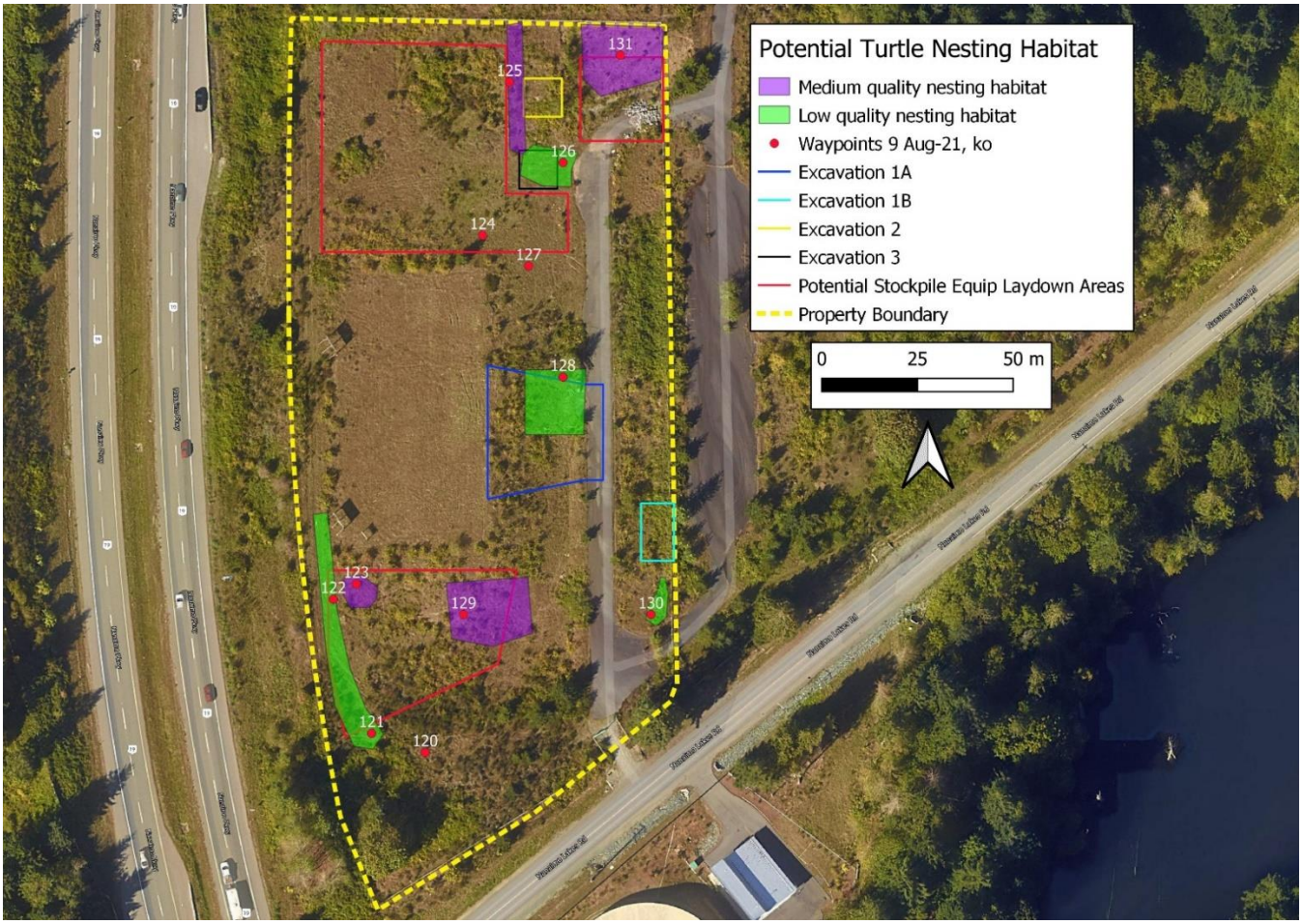
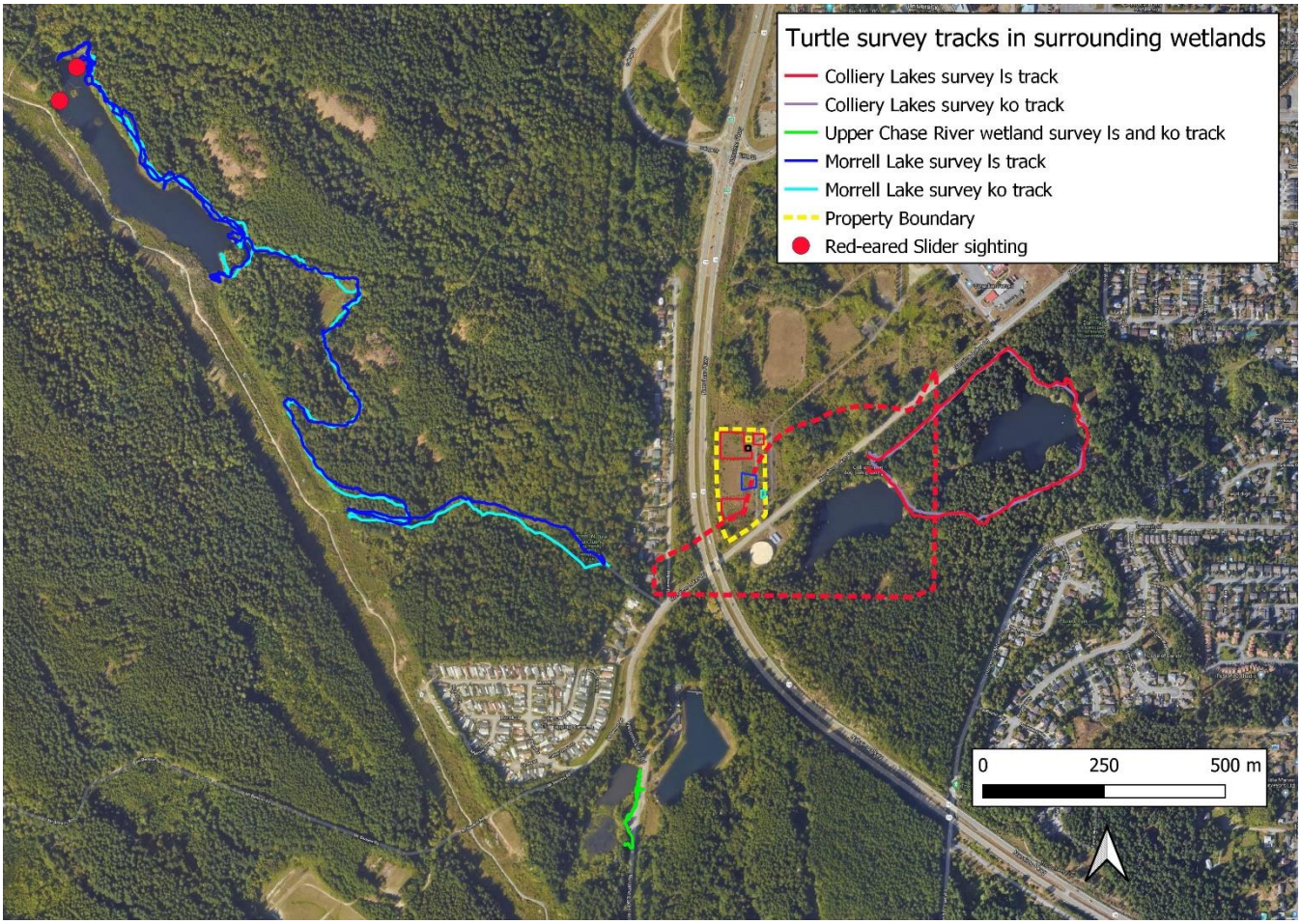


Figure 4. Turtle survey coverage in wetland areas up to 1.5 km from remediation area, showing observations of two Red-eared Sliders in Morrell Lake, 9 August 2021.



4.3 Accessibility by Turtles to the Remediation Area

Habitat connectivity between aquatic and terrestrial nesting habitats is an important component of turtle habitat requirements (COSEWIC 2016). Turtles may travel along water courses or overland, including crossing roads, while moving between the two habitats.

During the site visit, we investigated access routes by turtles to the remediation area from nearby wetlands. From the nearest aquatic habitats in Colliery Dam Lakes, turtles would have to cross the busy, paved Nanaimo Lakes Road. Although mortality risk is high, a crossing would be plausible. From the higher quality aquatic habitat in the Upper Chase River Wetlands, turtles would have to cross the even busier HWY 19, placing them at greater risk from road mortality. The remediation site is enclosed by a chain-link fence that for the most part is flush to the ground; however, there are several gaps, including a few larger unauthorized holes clipped with wire cutters. It is plausible that any turtles that made it across the roads and attempting to access the remediation area could do so, albeit with difficulty.

It is highly unlikely that turtles would enter the remediation area from the nearest known Western Painted Turtle site in Morrell Lake. To do so, turtles would have to travel through densely wooded second growth forest for a distance of over 1 km and then cross the busy HWY 19.

4.4 Conclusions

The remediation site contains patches of potential turtle nesting habitat rated as medium or low suitability. However, the aquatic habitat in the nearest wetlands (Colliery Dam Lakes) that would provide a source population is of poor quality, and there are no records of Western Painted Turtles from there. If turtles occurred in these lakes or the better-quality aquatic habitat farther south (Upper Chase River Wetlands), they would have to cross a busy road and negotiate the fence surrounding the remediation site. Use of the remediation site by turtles from the nearest known Western Painted Turtle occurrence in Morrell Lake is highly unlikely due to access concerns through unfavourable habitat and a required four-lane highway crossing.

Nesting habitat is typically in short supply for turtles on Vancouver Island, where open habitats with bare ground and suitable substrates for digging nests are limited around wetlands. A precautionary approach is to minimize disturbance to the medium suitability habitats within the remediation area, as discussed below, in the unlikely event that they are or might be used by Western Painted Turtles in the future.

5.0 RECOMMENDED MITIGATION MEASURES

The following measures are intended to minimize potential impacts for nesting Western Turtles, were they to use the remediation area:

- Avoid soil disturbance in areas rated as medium suitability for the species (see Figure 3). This may include re-routing of access roads and turn-around areas in the soil remediation area, if required; avoid widening existing access roads into the site; all new roads should be restored after completion of remediation activities. Avoid using those portions of equipment and stockpile laydown areas that overlap with medium quality nesting habitat.
- Maintain patches of bare ground in the habitat rated as medium suitability by removing dense grasses to expose the soil, if needed. This activity should be carried out during a brief window of opportunity in mid-late May before nesting season commences but after turtle hatchlings from previous year's nests have emerged.
- Maintain or create gaps (e.g., 10 cm high) at the bottom of the chain link fence surrounding the property on the south side (facing Nanaimo Lakes Road) to allow turtles access to the property.
- Monitor the site periodically over time to ensure that native vegetation and soil conditions have been restored, and nesting habitat remains in functional condition.

6.0 LITERATURE CITED

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Appendix 1. Turtle nesting habitat assessment within the Nanaimo Bunker remediation area, 9 August 2021. Reference points correspond to those in Figure 3. All potential nesting areas were in open-canopy habitats and contained bare patches of soil. Coordinates shown were taken with handheld Garmin GPS unit (accuracy 3 m; NAD83)

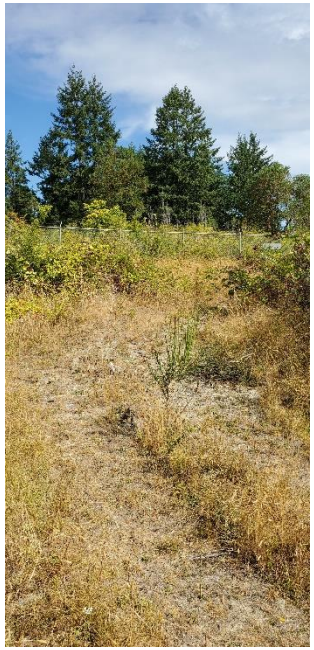
Reference point	UTM zone	UTM E	UTM N	Aspect	Comments	Suitability
120	10	429146	5444311	SE	very small patches of compact bare soil among grasses & low shrubs	marginal
121	10	429132	5444317	SE	several patches of compact bare soil among grasses	low
122	10	429122	5444353	SE	old track with bare soil and gravel	low
123	10	429128	5444356	S	larger patch of bare soil among grasses	medium
124	10	429160	5444447	NE	suitable bare soil patches but with unfavourable northern exposure	marginal
125	10	429168	5444487	SSW	slope along old track with compact bare soil, which extends north almost to the perimeter fence	medium
126	10	429133	5444466	level	disturbed area with bare compact soil adjacent to access road	low
127	10	429173	5444439	NE	slope by access road; some bare soil but with unfavourable northern exposure	marginal
128	10	429165	5444409	SE	many patches of bare, compact soil, sloping down to the access road	low
129	10	429155	5444349	S	abundant, compact but fine textured bare ground within an area of ~15x15 m; best potential turtle nesting habitat at the site	medium
130	10	429205	5444348	E	open habitat with bare soil along access tract and newly created soil sampling site; somewhat shaded	low
131	10	429197	5444494	SSW	relatively large (~18x14 m) area of exposed, hard-packed soil on a gentle (5º) slope	medium

Appendix 2. Images of potential turtle nesting habitat rated as medium suitability within the remediation area and a road that turtles would need to cross to access the sites. Site numbers correspond to those in Figure 3 and Appendix 1.

Site 123

Site 131

Site 129



Site 125

Access to the remediation area by turtes from the nearest wetlands (Colliery Dam Lakes) would necessiate crossing the Nanaimo Lakes Road. The remediation site is on the right, bordered by Himalayan Blackberry bushes and enclosed by a chain link fence.