



Canadian National Wetland Inventory (CNWI)

CNWI FIELD GUIDE FOR BRITISH COLUMBIA

Version 1



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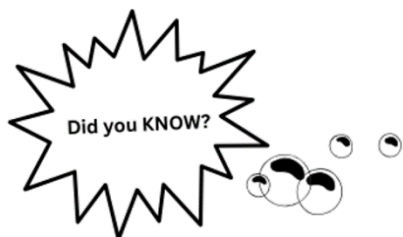
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VERSION CONTROL

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1.0 INTRODUCTION

Welcome to Wetland Classification and Field Data Collection in British Columbia!



Wetlands are critical ecosystems that provide a TON of value for humans, nature, and wildlife!

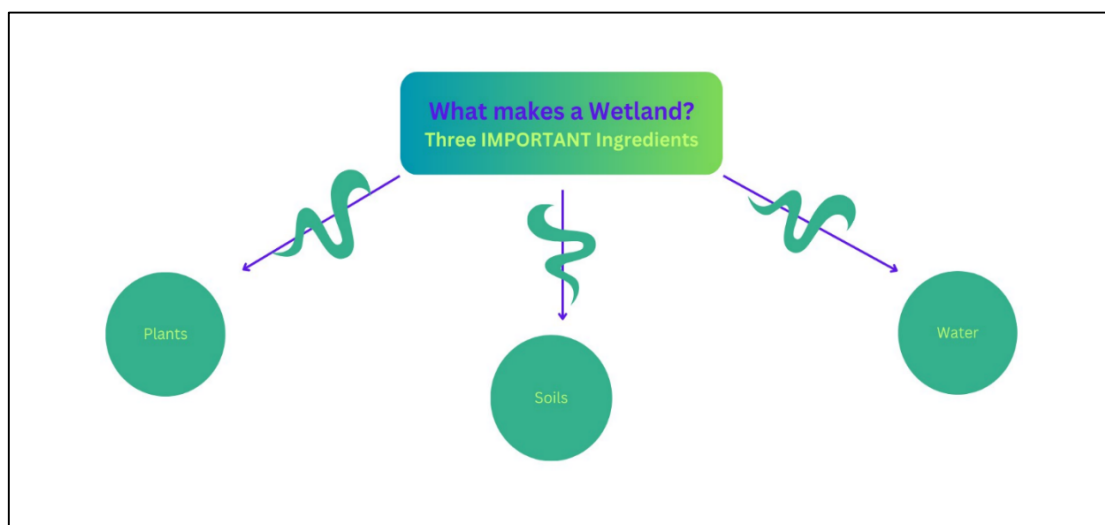
For example, they are biodiversity hotspots providing valuable habitat for an amazing number of plants and animals. They store and sequester carbon, they help clean water, and lessen the impacts of climate change, floods, and storm surges.

Wetlands are critical ecosystems that provide many ecosystem services and functions that directly and indirectly contribute to human health, nature's health, and a healthy, sustainable economy (Ramsar, 2021).

British Columbia (BC) lacks a standardized wetland mapping database which in hinders effective protection and management of these valuable ecosystems. The BCWF team of field technicians plays a key role in helping to address this data gap through the **Canadian National Wetlands Inventory (CNWI)** field data collection.

This CNWI Field Guide is for anyone collecting wetland field data for the CNWI in BC.

Wetlands are defined as “land that is saturated with **water** long enough to promote wetland or aquatic processes as indicated by **poorly drained soils**, hydrophytic **vegetation** and various kinds of **biological activity** which are adapted to a wet environment” (National Wetland



Working Group, 1988). See Figure 1-1.

Figure 1-1. The Three Wetland Ingredients

1.1 THE CANADIAN NATIONAL WETLAND INVENTORY

The CNWI is a national initiative to compile, process, and publish the best available wetland mapping and ground-truthing data throughout Canada. The CNWI aims to map all natural, constructed, and managed wetlands in both freshwater and coastal marine systems. Standardized wetland data is vital for accurate comparisons across time and space, ensuring that (for example) a wetland classed as “swamp” in BC is comparable to one in the Atlantic Maritimes, and a wetland classed as “bog” mapped in BC in a past decade is comparable to a bog wetland in present day.

The CNWI is particularly important to BC and Canada because will help:

- understand the current extent of wetlands in Canada,
- support monitoring of changes in the extent and function of wetlands,
- support assessments on how humans are influencing these changes, and
- identify suitable wetland sites for conservation, restoration, and improved management, benefiting biodiversity, and contributing to greenhouse gas emission reduction reporting.

Field data collected is also used by remote sensing experts and computer scientists to train artificial intelligence systems for predicting wetland locations based on satellite imagery. The resulting raster predictive maps will help show changes in wetland class and extent over time.

This CNWI database supports ecological analysis and reporting by various organizations and aligns with Canada’s Nature-Based Climate Solutions Initiative, aiding biodiversity conservation, climate change adaptation, and greenhouse gas carbon storage and sequestration reporting. It also supports national and provincial reporting (ECCC, 2016).

1.2 SAFETY

This CNWI Field Guide will assist field technicians, and staff, in planning and completing wetland assessments in the field. It is not meant to provide specific guidance for safety challenges or issues that may occur in the field. Please refer to your supervisors and colleagues for further information regarding other resources and references to use in planning fieldwork applicable to your employer or project.

While field work is very exciting, the importance of safety planning to ensure a positive and secure outdoor experience is crucial. Being outdoors can include risks to one’s health and safety. Examples include being encountered with wildlife, changes of weather, challenging terrain, travelling, and so forth. It is important to always have a safety plan. The safety plan should include emergency contacts, communication plan and equipment, personal protective gear, first aid kits, and vehicle emergency kits (see equipment/safety check list example in Section 5.0). Health and safety issues should be documented and addressed promptly, with a designated off-field contact available for communication in case of emergencies.

1.3 PERMITS

Depending on the location of fieldwork, permits may be required to complete fieldwork, such as to sample soil in an archeologically sensitive areas or to fly drones in controlled airspaces. Obtaining the necessary permits early in the planning process is important to ensure compliance with local, provincial, and national regulations and being able to carry out fieldwork within desired timelines. Confirming land ownership, and that you have the appropriate permissions to access your site, is also important to consider early in the planning process as there may be additional permits to work in conservation lands, parks, and privately owned areas.

2.0 CNWI WETLAND DEFINITIONS

The CNWI in BC uses a **five-wetland class system** and has **surface cover** codes to further describe the wetland ecosystems. This section provides text descriptions of the five classes and visual guides to help familiarize yourself with wetland classes (Figure 2-1, Table 2-1).

2.1 WETLAND CLASS

Wetland class should be considered during initial selection of field plots because each field plot should be within only one class. Plots should not be placed on the ‘transitional zones’ between different classes. Figure 2-1 and describe the key differences of wetland classes as per CNWI BC definitions.

Table 2-1. Five Canadian Wetland Classes	
Wetland Class	Key Features
Bog	<ul style="list-style-type: none"> Organic soil (fibric or mesic texture bounce test!) Ombrogenous: not typically connected to surface waters or groundwater. Raised or level with the surrounding terrain. Acidity: <4.8 pH Surface cover: variable, may have mosses, open water, shrub, and/or trees. Also commonly referred to as: peatland, raised bogs, ‘old’ fens, muskeg, mire, quagmire, moss-land.
Fen	<ul style="list-style-type: none"> Organic soil (fibric or mesic texture- bounce test!) Minerogenous: connected to surface water and groundwater. Surface characteristics: patterning and open water pooling can develop. Acidity: >4.8 pH Surface cover: variable, may have graminoids, mosses, water, shrubs and/or trees. Also referred to as: peatland, the ‘lagg’ of a bog, mire, muskeg, patterned wetland, forested wetland, shrubby wetland.
Swamp	<ul style="list-style-type: none"> Mineral or organic soil (humic texture) Surface cover: >25% cover of trees or shrubs Also referred to as: forested wetlands, shrubby wetlands, riparian areas, shrub carr.
Marsh	<ul style="list-style-type: none"> Mineral or organic soil (humic texture) Surface cover: herbaceous Also referred to as: salt marsh, brackish marsh, estuarine marsh, fresh marsh, cattail marsh, some alpine wetlands.
Shallow Open Water	<ul style="list-style-type: none"> Mineral or organic soil (humic texture) Surface water (if present) < 2m deep in midsummer/low tide conditions <25% surface area with above ground vegetation (trees, shrubs, herbaceous, etc.) Surface cover: aquatic vegetation, algae, eelgrass, exposed sediments, water

	<ul style="list-style-type: none">○ Also referred to as: mudflats, eelgrass, saline ponds, lily ponds, shorelines of lakes, etc.
<p>Notes:</p> <ul style="list-style-type: none">○ Organic Soil has >40cm organic soil at the topsoil horizon○ Mineral Soil can still contain an organic topsoil horizon, but it is <40cm deep○ Fibric / Mesic texture means not very decomposed (peaty) organic material, see Section X.X○ Humic texture means very decomposed (mucky) organic material, see Section X.X.	

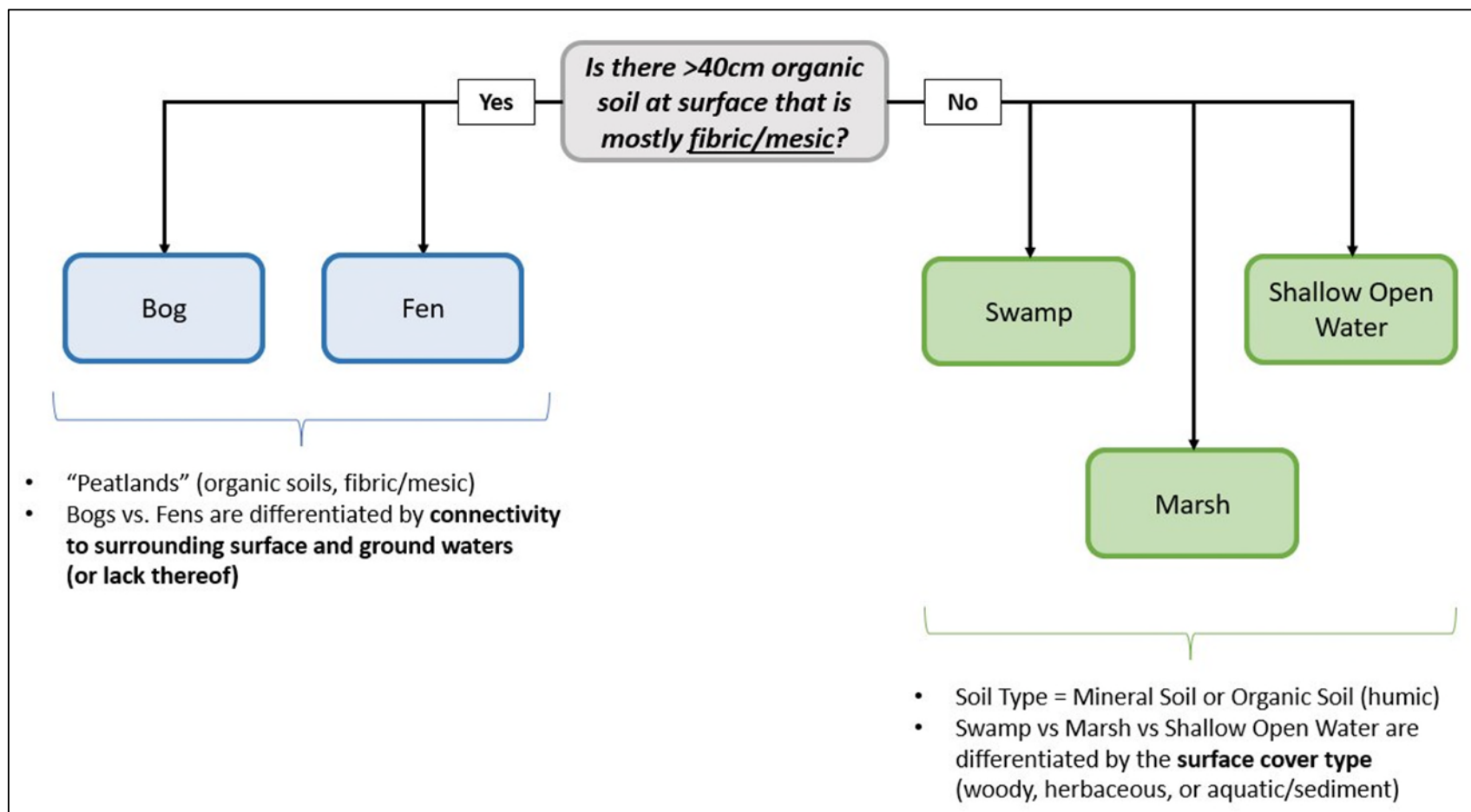


Figure 2-1. Wetland Class Flow Chart (Simplified)

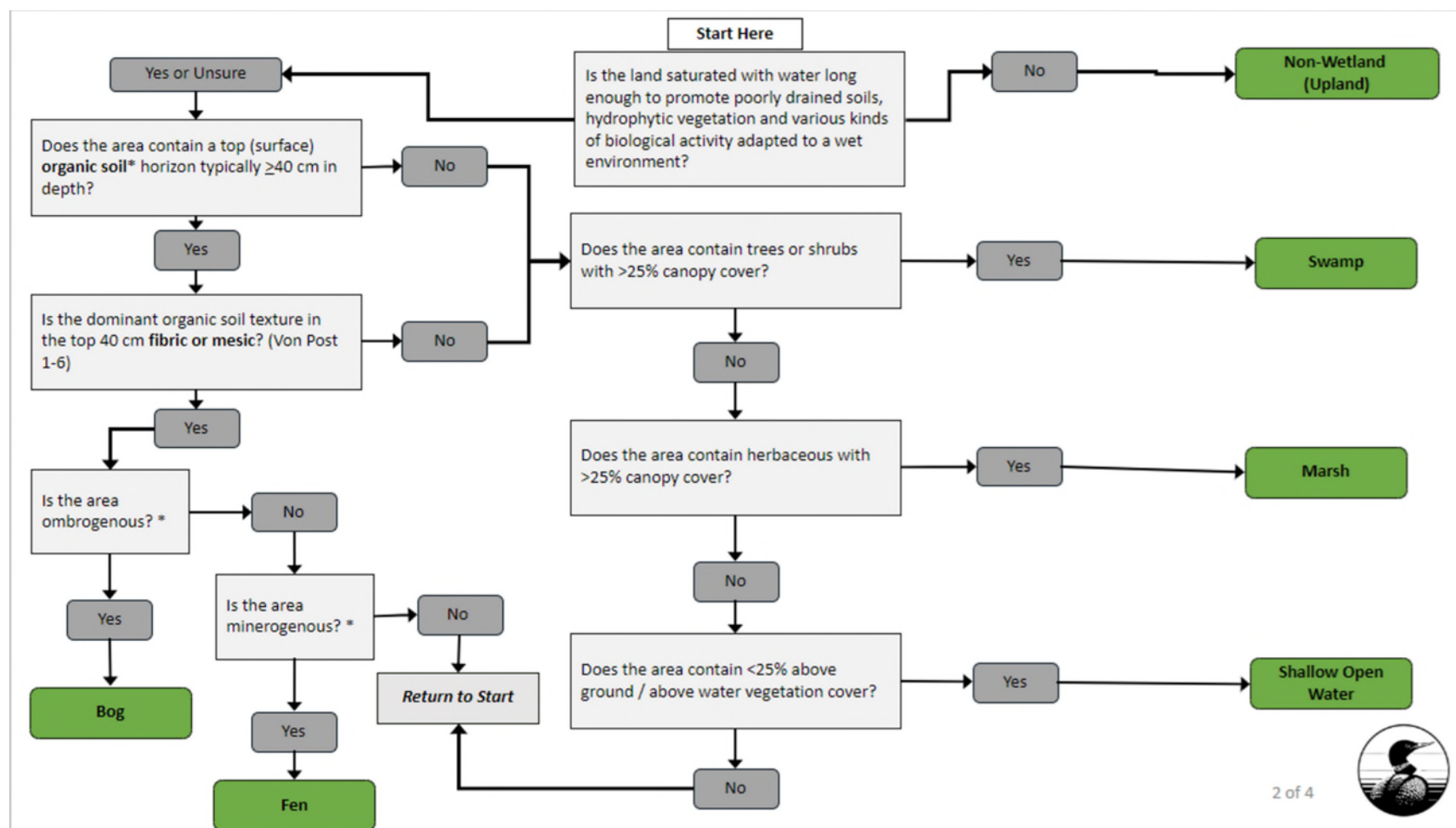


Figure 2-2. Wetland Class Flow Chart (Detailed)

2.2 SURFACE COVER

After wetland class, surface cover is the next most important attribute for the CNWI in BC to complete.

Surficial cover type is based on the general physiognomy of the land cover rather than on vegetation species composition. Common wetland class and surface cover types are shown in Table 2-2 to assist in field crews. While these relationships occur under typical conditions, mappers should be cognizant that there will be exceptions.

Table 2-2. Wetland Class and Surface Cover	
Wetland Class	Typical Surface Cover Type
Bog	Tree, Shrub, Bryophyte, Water
Fen	Tree, Shrub, Herbaceous, Bryophyte, Water
Swamp	Tree, Shrub
Marsh	Herbaceous
Shallow Open Water	Aquatic Vegetation, Algae, Eelgrass, Exposed Sediment, Water

The Surface Cover key follows a hierarchy within the 30 m² field plot: tree > shrub > woody > herbs > bryophytes > aquatic vegetation > eelgrass > macro algae > exposed sediment > exposed bedrock > open water > anthropogenic > other.

Guidance for determining the surface cover of a wetland id provided in Table 2-3 and Figure 2-2.

Table 2-3. Surface Cover		
Woody Vegetation		
1	Is >25% of the surface area covered by trees? Trees are woody vegetation >5 meters in height. Note: if unable to discern height; code to "Woody."	Yes – Treed No – Go to 2 Unsure – Go to 3.
2	Is >25% of the surface area covered by shrubs? Shrubs are woody vegetation <5 meters in height. Note: Do not include dwarf woody vegetation or woody fines in the shrubby category (See Appendix D). The reason for this is because dwarf woody vegetation looks considerably different from imagery than other 'typical' trees and shrubs. Typically, open bogs/fens with dwarf woody vegetation are coded to herbaceous or bryophyte surface cover type. Stunted trees & shrubs (e.g., black spruce [<i>Picea mariana</i>] or lodge pole pine [<i>Pinus contorta</i>] should still be included in the applicable tree/shrub surface cover category. Note: if unable to discern height; code to "Woody."	Yes – Shrub No – Go to 3.

3	Is >25% of the surface area covered by woody vegetation? (Do not include dwarf woody vegetation or woody vines in this category)	Yes – Woody No – Go to 4
Ground Vegetation		
4	Is > 25% of the ground covered by vegetation (i.e., bryophytes, lichen, and/or herbaceous vegetation)?	Yes – Go to 5 No – Go to 7
5	Is >25% of the ground vegetation covered by herbaceous species? (e.g., grasses, rushes sedges, reeds, ferns, fern allies, grass-like plants, and forbs)	Yes – Herbaceous No – Go to 6
6	Is >25% ground surface covered by bryophytes (mosses, liverworts, hornworts) and/or lichens?	Yes – Bryophyte No – Got to 7
Aquatic and Exposed		
7	Is >25% of the surface area covered with floating or submerged aquatic vegetation?	Yes – Aquatic Vegetation No – Go to 8
8	Is the surface area covered with water or exposed sediment with eelgrass (e.g., <i>Zostera marina</i> , <i>Ruppia maritima</i>) at densities >1 shoot /m ² ?	Yes – Eelgrass No – Go to 10
9	Is >25% of the surface area covered with macro algae?	Yes – Macro Algae No – Go 9
10	Is the surface area dominated with exposed sediment with <25% vegetation cover of any type and no eelgrass? Exposed sediment is sand, silt, clay, gravel or small boulders, or other particle inorganic substrates. <u>Note:</u> un-vegetated intertidal areas should always be coded to exposed sediment or exposed bedrock as opposed to open water regardless of the high of the tide at the time of survey.	Yes – Exposed Sediment No – Go to 11
11	Is the surface area dominated with exposed bedrock with <25% vegetation cover of any type and no eelgrass? <u>Note:</u> un-vegetated intertidal areas should always be coded to exposed sediment or exposed bedrock as opposed to open water regardless of the high of the tide at the time of survey.	Yes – Exposed Bedrock No – Go to 12
12	Is the surface area dominated with open water with <25% vegetation surface cover and no eelgrass?	Yes – Water No – Go to 13
13	Is the surface area dominated with snow, ice, glaciers with <25% vegetation surface cover?	Yes – Snow/Ice No – Go to 14
Other		
14	Is the surface area in a non-natural state – e.g., covered with roads, buildings, structures, resource extraction (mines), parking lots, etc.	Yes – Anthropogenic No – Go to 15
15	Is the surface area covered by other vegetation or ground cover types not explicitly included above?	Yes – Other

2.3 SOIL TYPE

For the purposes of the CNWI in BC, wetland soils are characterized into broad categories, or soil types. See Table 2-4 and Section 4.7 for further details on determining the soil type.

Table 2-4. Soil Type	
Soil type	Description
Organic soil (fibric / mesic)	Soil profile with a surface organic horizon of at least 40cm. Most of the organic soil in the top 40 cm has a fibric or mesic soil texture (Von Post 1-6).
Organic soil (humic)	Soils profile with a surface organic horizon of at least 40cm. Most of the organic soil in the top 40 cm has a humic organic soil texture (Von Post 7-10).
Shallow organic on bedrock	Soils profile with a surface organic horizon 40cm (or less) (typically fibric/mesic) and is underlain by a bedrock layer. Note: this soil type is typically used for certain coastal bogs.
Organic soil over water	Soils profile with a surface organic horizon 40cm (or less) (typically fibric/mesic) and underlain by a water layer. Note: This soil type is typically assigned for a “floating” wetland such as a floating fen or floating bog. There is often water found above the organic soil (as well as in the subterrain/below).
Organic soil	Soil profile with a surface organic horizon of at least 40cm (any texture). Note: Only use this soil type where texture and subterrain type is not known.
Mineral hydric	Mineral soil profile showing hydric signs in the upper 40 cm (e.g., signs of redox concentrations/depletions, gleying or mottling or some organic matter accumulation). Note: A surface organic horizon may be present, but it is less than 40cm.
Young mineral hydric	Mineral soil profile in an area that has obvious signs of wetland hydrology AND wetland vegetation, but no/faint hydric soil signs in the upper 40 cm (e.g., signs of redox concentrations/depletions, gleying or mottling or some organic matter accumulation). Note: This soil type includes gravel bars or areas with rapid drainage or disturbed soils that do not show evidence to qualify as ‘hydric mineral soil, but are likely wetlands based on the frequency of flooding or fluctuating water table.
Non-wetland soil	A soil that is not a wetland soil (e.g., not mineral hydric soil or organic hydric soil). Non-hydric soils lack flooding or fluctuating water table.
NOTE: To qualify as an organic soil horizon, the soil must contain > 17% organic C (approximately ≥ 30% organic matter) by weight.	

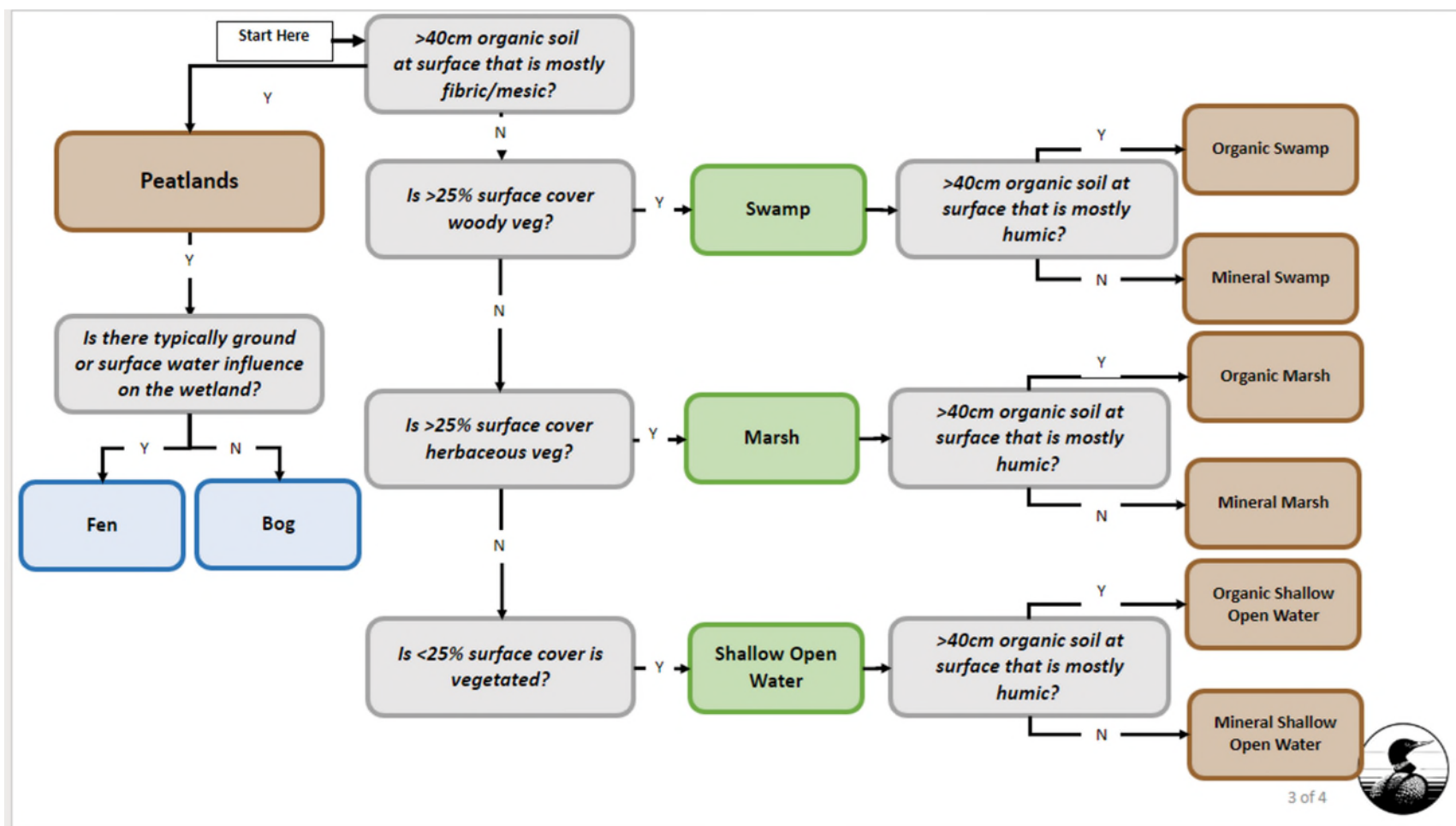


Figure 2-3. Wetland Class Flow Chart (Soil Types)

2.4 HYDROLOGICAL SYSTEM

Hydrological system describes how water has formed the wetland and how water is generally still influencing the wetland. Figure 2-4 shows how hydrological systems interact on the landscape and can have transitional zones. When you are assessing a wetland in the field, it is important to identify the correct hydrological system your wetland is in. There are 8 possible hydrological systems see Table 2-5.

Table 2-5. Hydrological Systems	
Hydrological System	Definition
Marine	Wetlands next to the ocean. Exposed to waves, tides, and saltwater.
Estuarine	Wetlands at the mouth of a river into the ocean. Exposed to waves and tides, there is freshwater and saltwater influences.
Riverine	Wetlands within or adjacent to flowing water. Freshwater.
Lacustrine	Wetlands within or adjacent to standing water. Freshwater.
Lacustrine Reservoir	wetlands within or adjacent to standing water managed for hydro-electricity production
Palustrine	wetlands in a basin or low spot on the landscape.
Multiple	<p>The wetland fits into two of the system categories.</p> <ul style="list-style-type: none"> ○ Example: the wetland is next to a river but is separated from the natural river channel by a dike, thus it could be coded to both lacustrine and palustrine. ○ Note: Where hydrological systems intersect (e.g. river drains into a lake) it can be hard to choose one hydrological system. Choose the system that you think is the predominant hydrological force on the wetlands. If you believe the hydrological forces on the wetland are equal, code to multiple.
Undetermined	<p>When none of the above definitions apply</p> <ul style="list-style-type: none"> ○ Examples: The wetland is on a sloping hill or a raised bog that is not adjacent to a river, lake, or basin.
<p>NOTE: Even though bogs are isolated from surface waters (e.g. rivers, lakes, etc.) they can still be in the lacustrine or riverine hydrological system. For example, a raised bog may form next to a river or lake.</p>	

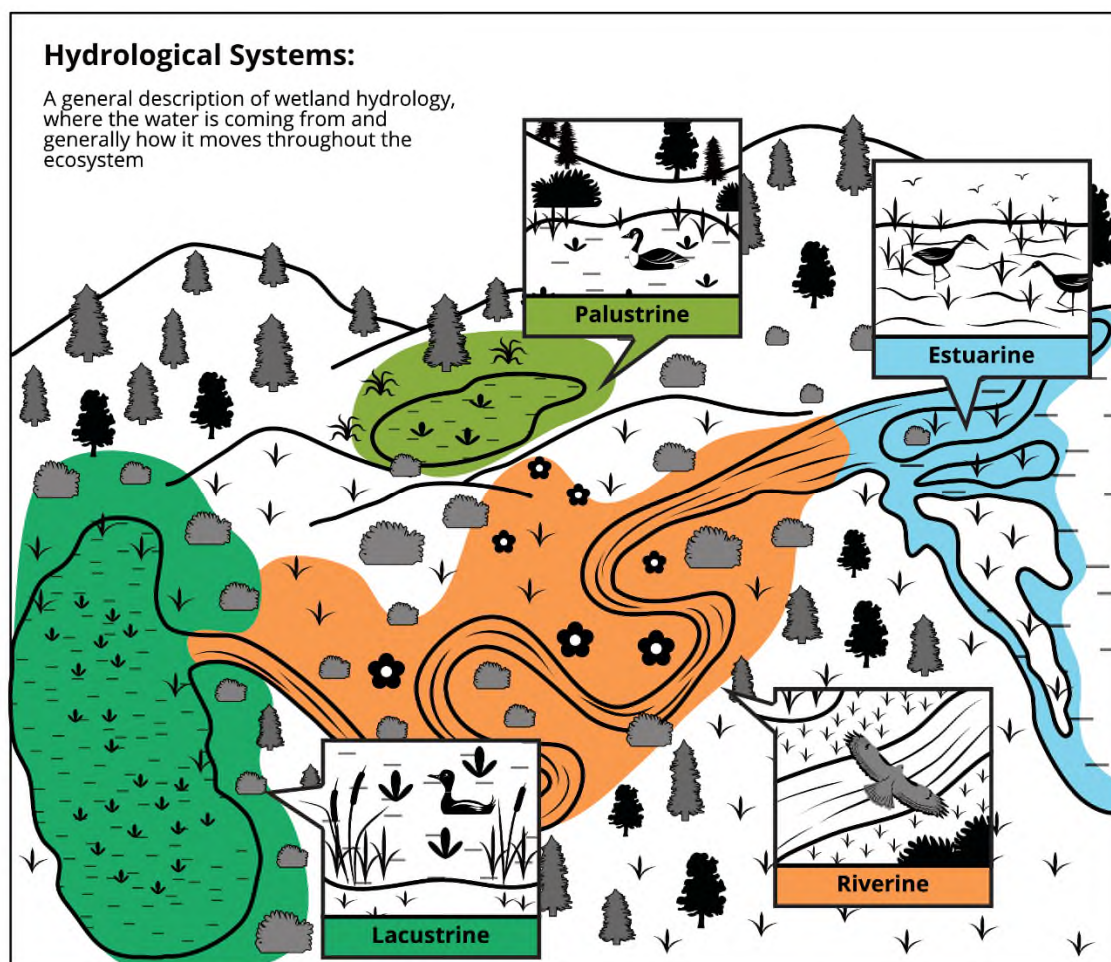


Figure 2-4. Hydrological System

2.5 HYDROPERIOD

Hydroperiod means how much time surface water is held in the wetland annually. Table 2-6 and Figure 2-6 describe the types of hydroperiods for wetlands.

The “growing season” generally begins in the spring with green-ups and ends in the fall with plant dieback and leaf-drop. “Frost-free” tables are available online for most of BC which describe plant growing seasons for gardening and agricultural activities which can be a useful guide for determining the growing season for the area. , provides frost free dates for several major cities in BC.

Table 2-6. Hydroperiod Type	
Type	Definition
	In most years, surface water (or saturated soils at the surface) is present for...
Ephemeral	...a very short time (>2 weeks) in the early growing season, or after heavy rains.
Temporary	...a short period of time (~25%) in the growing season. Topsoil is typically dry by the end of the summer.
Seasonal	...approximately half (~50%) the growing season. Topsoil is typically moist by the end of the summer.
Semi-permanent	...most (~75%) of the growing season. Topsoil is typically quite moist or wet by the end of summer.
Permanent	...present throughout (~100%) the growing season.
Not applicable	The hydroperiod field may not apply to some bogs (sloping high elevation bogs) or tidal wetlands (as tidal wetlands are influenced by daily hydroperiods).
References: Stewart and Kantrud 1971; ESRD 2015; MacKenzie and Moran, 2004.	

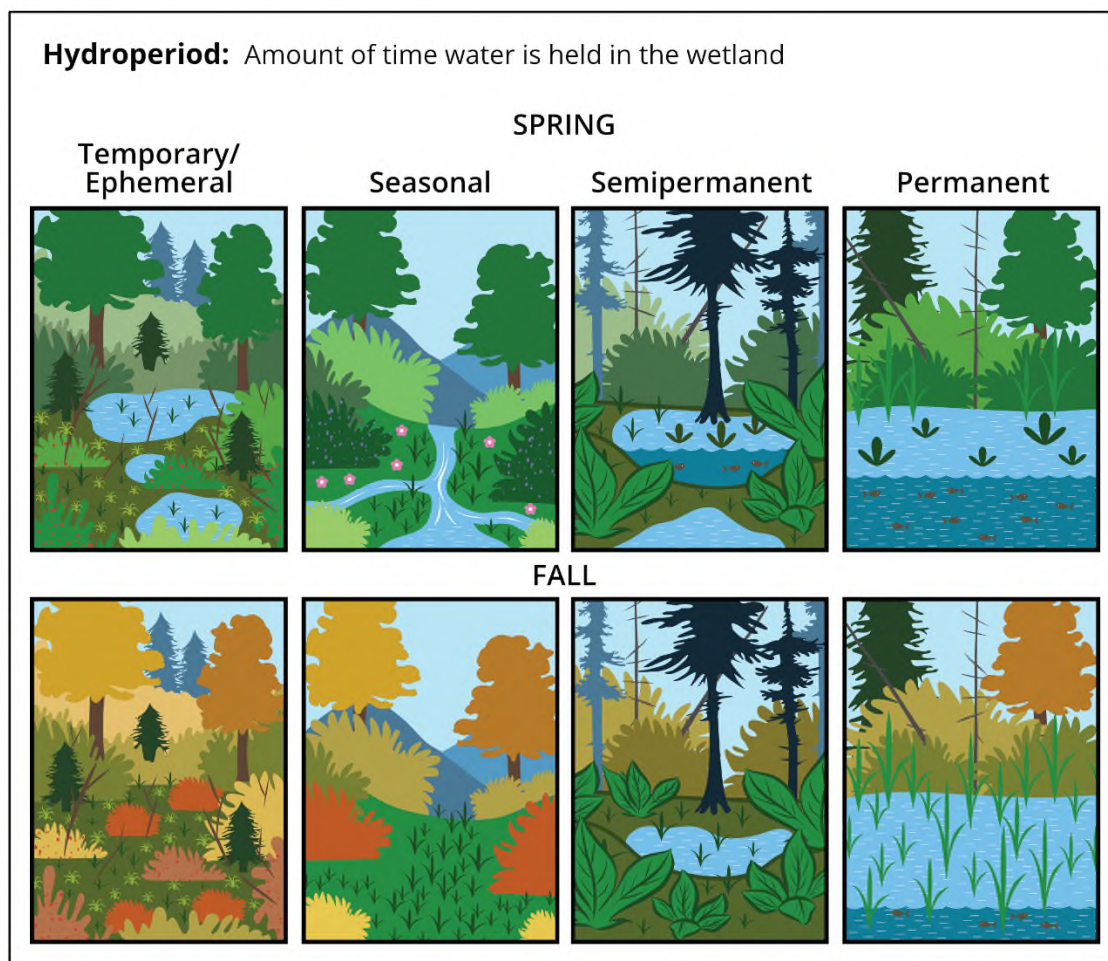


Figure 2-5. Hydroperiod and Seasonality

City	First Frost	Last Frost	Approximate Growing Season	Approximate Growing Season Months	Approximate 50% growing season period ("Seasonal")
Cranbrook	May 24	Sept 14	112 days	4 months	8 weeks
Dawson Creek	Jun 8	Aug 24	76 days	2.5 months	5-6 weeks
Fort Nelson	May 26	Sep 5	101 days	3.5 months	7-8 weeks
Golden	Jun 2	Sep 8	97 days	3 months	6-7 weeks
Kamloops	May 3	Oct 3	152 days	5 months	10-11 weeks
Kelowna	May 8	Oct 6	150 days	5 months	10-11 weeks
Nanaimo	May 4	Oct 15	163 days	5.5 months	11-12 weeks

Prince George	May 20	Sep 18	120 days	4 months	8-9 weeks
Prince Rupert	May 14	Oct 7	145 days	5 months	10-11 weeks
Port Hardy	Apr 23	Oct 22	181 days	6 months	12-13 weeks
Williams Lake	Jun 2	Sep 7	96 days	3 months	6-7 weeks
Vancouver	Apr 21	Oct 19	180 days	6 months	12-13 weeks
Victoria	Apr 14	Nov 9	208 days	7 months	14-15 weeks
Last and first frost dates are 33% probability. <u>Calculated using 1981-2010 Climate Normals from Environment Canada.</u> Data aggregated by: https://www.almanac.com/					

2.6 NUTRIENTS

Wetlands can be categorized based on nutrient availability and pH characteristics – see Table 2-8 for guidance to assign a nutrient category.

Table 2-8. Nutrients	
Category	Examples
Poor / Very Poor	<ul style="list-style-type: none"> Very poor (<4.5 pH) <ul style="list-style-type: none"> Typical high cover of peat moss (<i>Sphagnum spp.</i>) Stunted trees and shrubs such as black spruce (<i>Picea mariana</i>), and specialized species such as sundew (<i>Drosera rot</i>). Poor (4.5 – 5.5 pH) <ul style="list-style-type: none"> Same as very poor nutrient species but also with some other diversity including brown mosses, sedge (<i>Carex spp.</i>), willow (<i>Salix spp.</i>), hardhack (<i>Spirea douglasii</i>), lodgepole pine (<i>Pinus contorta</i>), western hemlock (<i>Tsuga heterophylla</i>), buckbean (<i>Menyanthes trifoliata</i>).
Medium/Rich	<ul style="list-style-type: none"> Medium (5.5-6.4 pH) <ul style="list-style-type: none"> Vegetation similar to poor and rich sites, often contains both poor and rich species. Rich (6.5-7.4 pH) <ul style="list-style-type: none"> Cattail (<i>Typha spp.</i>), skunk cabbage (<i>Lysichiton americanus</i>), birch (<i>Betula spp.</i>), salmonberry (<i>Rubus spectabilis</i>), blue berry (<i>Vaccinium ovalifolium</i>), western red cedar (<i>Thula plicata</i>), baltic rush (<i>juncus balticus</i>), great bull rush (<i>Schoenopletuc acutus</i>). Very rich (>7.5 pH) <ul style="list-style-type: none"> Vegetation often similar to rich sites but likely more abundant/larger Site could be eutrophic or alkaline.
Note: Nutrients are generally measured when there is open water available. Some wetlands will not have water availability OR sometimes when assessing soils, the water table will be revealed where the soil auger was dug in. If there is no water availability, vegetation is another adequate way of determining nutrient richness.	

2.7 IMPACT TYPES

Many wetlands have been modified from natural or man-made disturbances. Since the nature of these modifications often greatly influences the character of such habitats, special modifying terms are included to indicate the type of impact. The typical CNWI impact types are listed in Table 2-9.

Table 2-9. Impacts		
Type	Definition	Examples
Farmed	Soil surface has been mechanically or physically altered for production of crops, but hydrophytes will become re-established if farming is discontinued.	<ul style="list-style-type: none"> o Grazing o Croplands o Hayfields
Constructed	Soil surface has been mechanically or physically altered by excavation to create an impoundment for holding water.	<ul style="list-style-type: none"> o Sewage lagoons o Golf course ponds o Dugouts
Burned	Indications that site had been affected by recent fire whether by natural or anthropogenic cause	<ul style="list-style-type: none"> o Forest fires
Cleared	Tree/shrub cover removal in whole or part (excluding linear infrastructure) that can be permanent or temporary.	<ul style="list-style-type: none"> o Logging o Landscaping o
Linear infrastructure	Soil surface has been altered (or the vegetation cover has been removed) due to linear infrastructures.	<ul style="list-style-type: none"> o Logging o Road construction o Pipelines o Powerlines
No impact	There is no sign of any impact on wetland due to anthropogenic causes	<ul style="list-style-type: none"> o n/a
Other	An impact is present but none of the impact categories here apply.	<ul style="list-style-type: none"> o Natural disaster (other than forest fires)
Multiple	Two or more impact types identified to a wetland polygon	<ul style="list-style-type: none"> o n/a

3.0 PRE-FIELD PREPARATIONS

Before going to the field, make sure to review reference materials, consult local knowledge keeper (where appropriate), plan the field program, gather equipment, make a safety plan, and ensure the smart field forms are working properly. Checklists for field preparation, equipment, daily, weekly and data uploading tasks are provided in Section 5.0.

3.1 DESKTOP REVIEW

Some useful desktop resources to review may include the following:

Figure 3-1 represents Biogeoclimatic (BEC) zones of BC are shown in Figure 3-1. BEC zones are distinct regions of varying physiography, climate, topography, and soil properties which influence the respective plant communities (MacKenzie et al, 2004). Wetland ecosystems differ across BEC zones due to regional climate variations. Be sure to read up on the features of the BEC zone your project is in before you get to the field. Spatial files of BEC zones and subzones are available on the BC Data Catalogue or viewed on iMap (Forest Analysis and Inventory Branch, 2024).

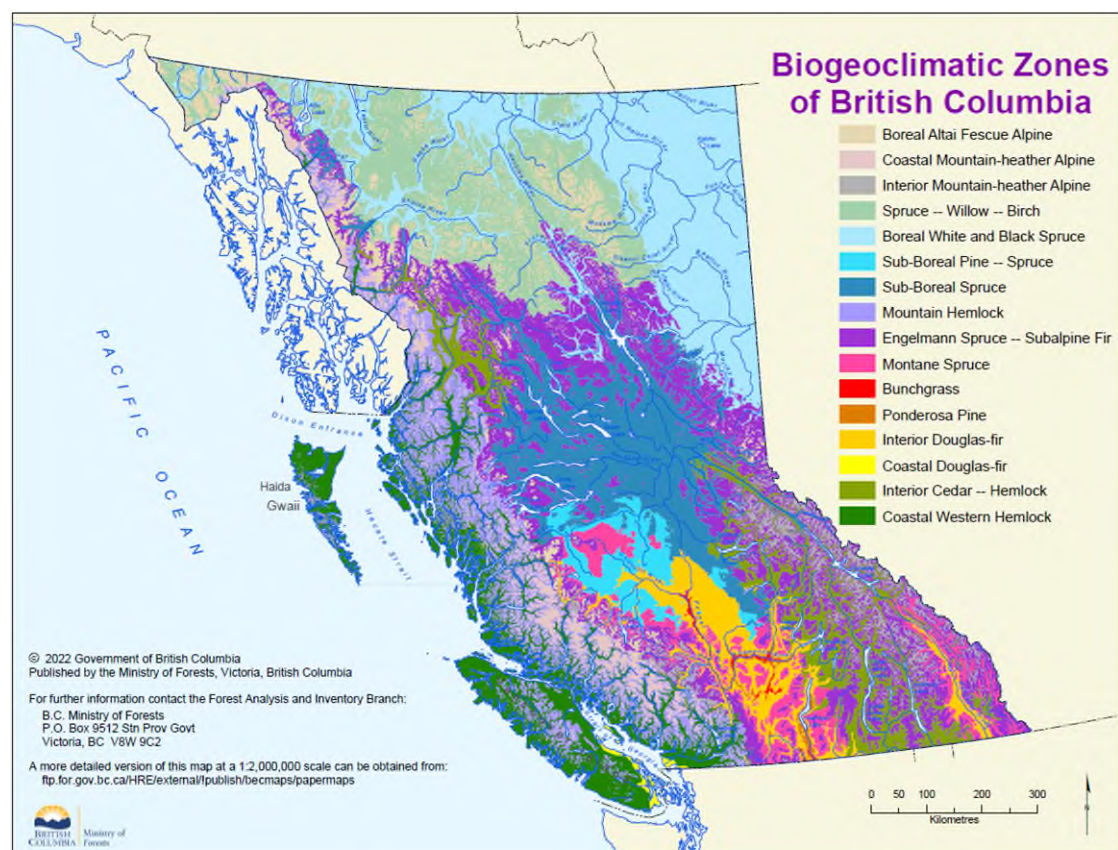


Figure 3-1. BC BEC Zones (BEC WEB, 2022).

Eco-Provinces of BC (Figure 3-2) show the nine eco-provinces in BC, characterized by consistent climate, oceanography, topography, and landforms (Demarchi, 2011). Understanding these zones and eco-provinces is helpful when classifying sites for the CNWI in BC. For instance, the Taiga Plains contain more poorly drained wetlands like bogs and fens, while the Southern Interior eco-province features more marshes due to its warm, dry climate limiting sphagnum development and fibric organic soils. For detailed insights into eco-provinces, refer to “Wetlands of British Columbia: a guide to identification” by William MacKenzie (2004).

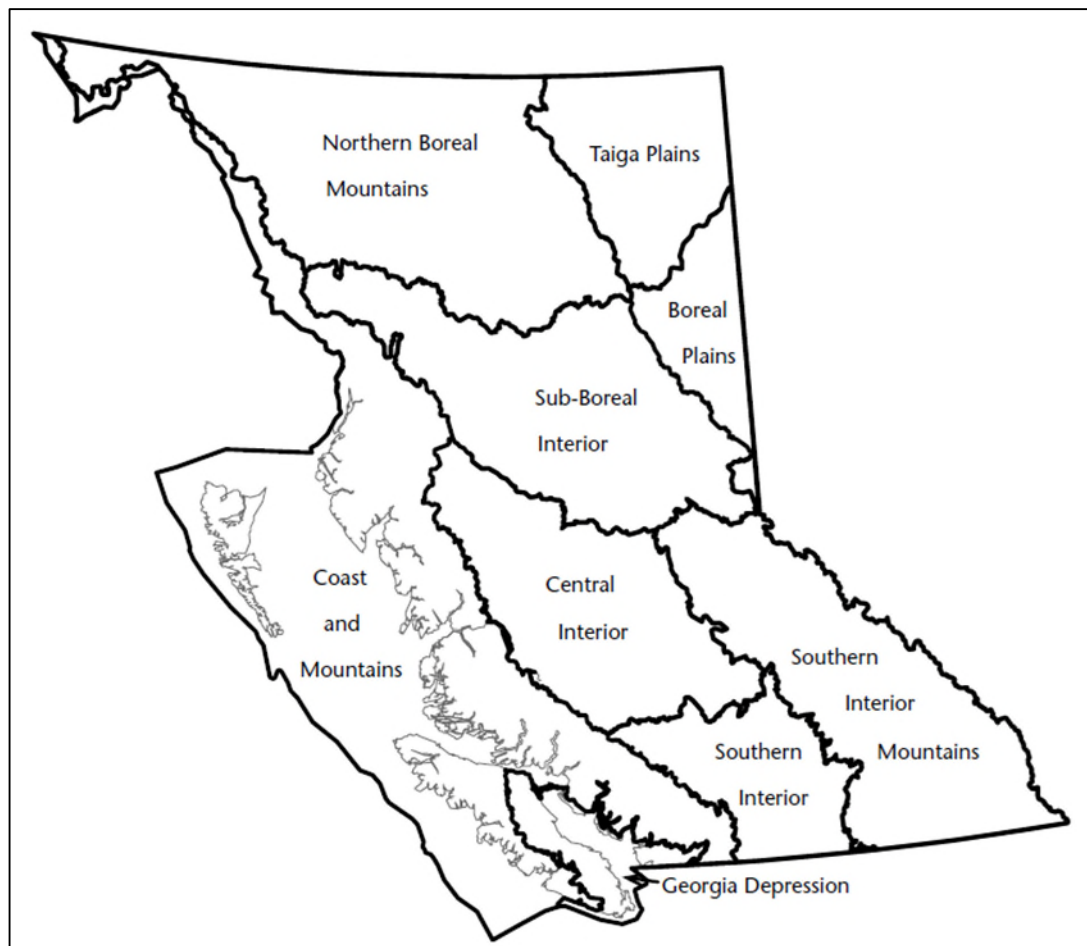


Figure 3-2. BC Eco-Provinces (Demarchi, 2011).

The Freshwater Atlas (Figure 3-3) helps understand BC’s hydrological features (rivers, creeks, lakes, streams, etc.). At the time of publication, it was a significant improvement on previous stream mapping systems because it is based on more detailed topographic maps (1:20,000) (Government of BC, 2010). This network allows for tracing water routes from headwaters to the sea and identifying all the water bodies and watersheds connected along the way. Figure 3-3 illustrates examples of features in the atlas.

NOTE: Freshwater Atlas wetland polygons are not classified, and the boundary / locations of wetlands should be considered approximate at best.

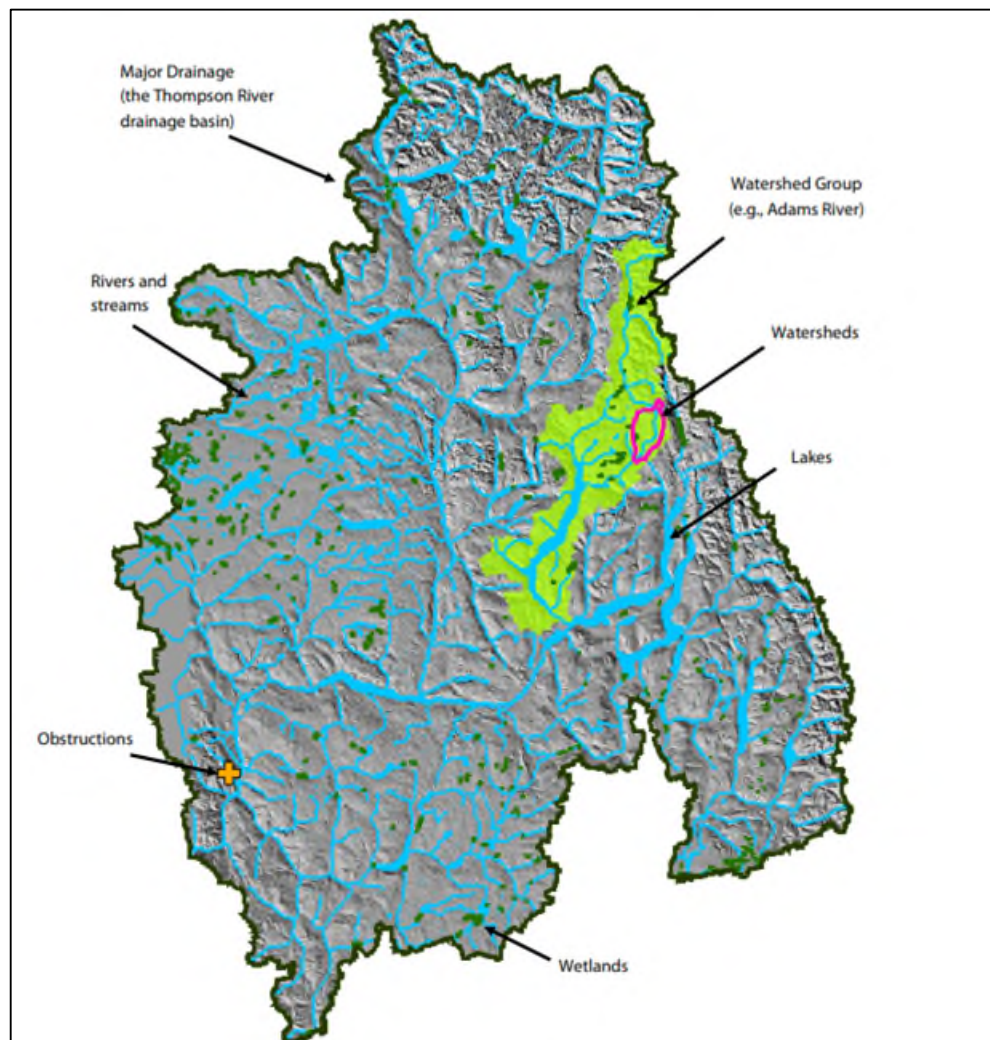


Figure 3-3. Freshwater Atlas of BC Example Features

3.2 LOCAL KNOWLEDGE KEEPERS

The local knowledge keepers will vary from region to region. They could include First Nations, farmers, ranchers, conservationists, environmental organizations, fishing, and hunting groups and/or government biologists, or others.

Specially who is appropriate to approach for consultation and engagement on your wetland field plot project will vary depending on the organization you are with, existing relationships, and where the project will take place.

Consult with your project lead before reaching out to external local knowledge keepers. Ensure you have completed a desktop review, be polite and professional, and have a clear list of questions you would like to bring to the person or group.



3.3 TIMING AND PLANNING

Field plot validation should be conducted between May to September during the growing season, when most vegetation is identifiable, and the ground is not frozen. Validation of tidal wetlands should occur at low tide to ensure the entire ecosystem is visible. Wetland surveys during flood or drought conditions are best to be avoided; if the survey must occur in flood or drought conditions, field crew should seek to interview local knowledge keepers to get a sense of the local landscape and how the wetlands may be presenting differently in these extreme conditions.

Field plots should also be located strategically in ecosystems that are difficult to interpret using the imagery. Developing a sampling plan, with potential sampling locations based on the completed polygons, prior to field work is highly recommended.

3.4 FIELD VALIDATION FOR POLYGON MAPPING

Some wetland field plot validation programs are completed to validated mapping already drawn from imagery using GIS software.

In this case, the number of wetland field validation plots required for a project (survey level intensity) depends on the number of potential wetland polygons in the project area, and the goal of the project (see). The types of field validation (e.g. quantitative vs qualitative) are described in in Section 4.0. For the CNWI in BC, we strive for Detailed Wetland Mapping survey level intensity whenever time and resources permit.

Table 3-1. Survey Level Intensity					
Project Goal ¹	Project Uses	% of Wetland Polygons Inspected	Plot Ratio Quantitative: Qualitative	Suggested Scales	Range of Study Area (ha)
Detailed Wetland Mapping	Restoration, management planning, conservation lands, parks	51-100	10:90	1:5,000	1-10,000
Landscape Wetland Mapping	Wetland inventory with limited management objectives	15-50	10:90	1:10,000-1:20,000	10,000-500,000
¹ Plot Ratios, Scales, and Range of Study area are preliminary suggestions. These should be refined based on CWS Pacific staff input and consultation with the project lead.					

3.5 ESRI FIELDMAPS AND SURVEY123

ESRI Field Maps and Survey123 are two powerful apps to efficiently collect data in the field. Field Maps is a mobile app that allows users to access maps, collect data, and perform field tasks. Survey123 is a form-centric data collection app that allows users to create and deploy surveys for collecting data in the field. [Table 3-2](#) briefly describes how to use the applications.

Table 3-2. Setting Up ESRI FieldMaps and Survey123	
Field Maps	<ul style="list-style-type: none"> o Company GIS Lead will create a map and survey in ArcGIS based on the current CNWI schema and publish as a web map and enable it for use in Field Maps. Field user will complete steps 2-5. o Install the Field Maps app on your mobile device and sign in with your ArcGIS account. o Open the app and download the desired map for offline use (if going to a field site outside of cellphone reception). o Use the app to navigate locations, view and edit data, and perform tasks like capturing photos, adding notes, or updating attributes. o Sync the changes made in the field back to the original map in ArcGIS Online or ArcGIS Pro, when an internet connection is available.
Survey 123	<ul style="list-style-type: none"> o To initially create a Survey123 form a GIS Lead will create the survey for submissions based on the most recent CNWI schema. Then <ul style="list-style-type: none"> o Customize the form by adding various question types, validation rules, templated entries, and calculations. o Publish the survey form to ArcGIS Online or ArcGIS Enterprise. o To use Survey123, the field user will: o Install the Survey123 app on your mobile device and sign in with your ArcGIS account. o Download the published survey form to your device for offline use if required. o Use the app to collect data by filling out the survey form, capturing photos, or recording GPS locations. o Sync the collected data back to the server when an internet connection is available.

4.0 IN THE FIELD

4.1 DETERMINE AREA OF ASSESSMENT

When you get to a site, the first step is to determine the area of assessment. There could be many wetlands on the landscape in/around your field site, but your first job is to determine the boundaries of your assessment. The area of assessment could be based on property boundary or project boundary, or Wetland Ecosystem Service Protocol (WESP) polygon.

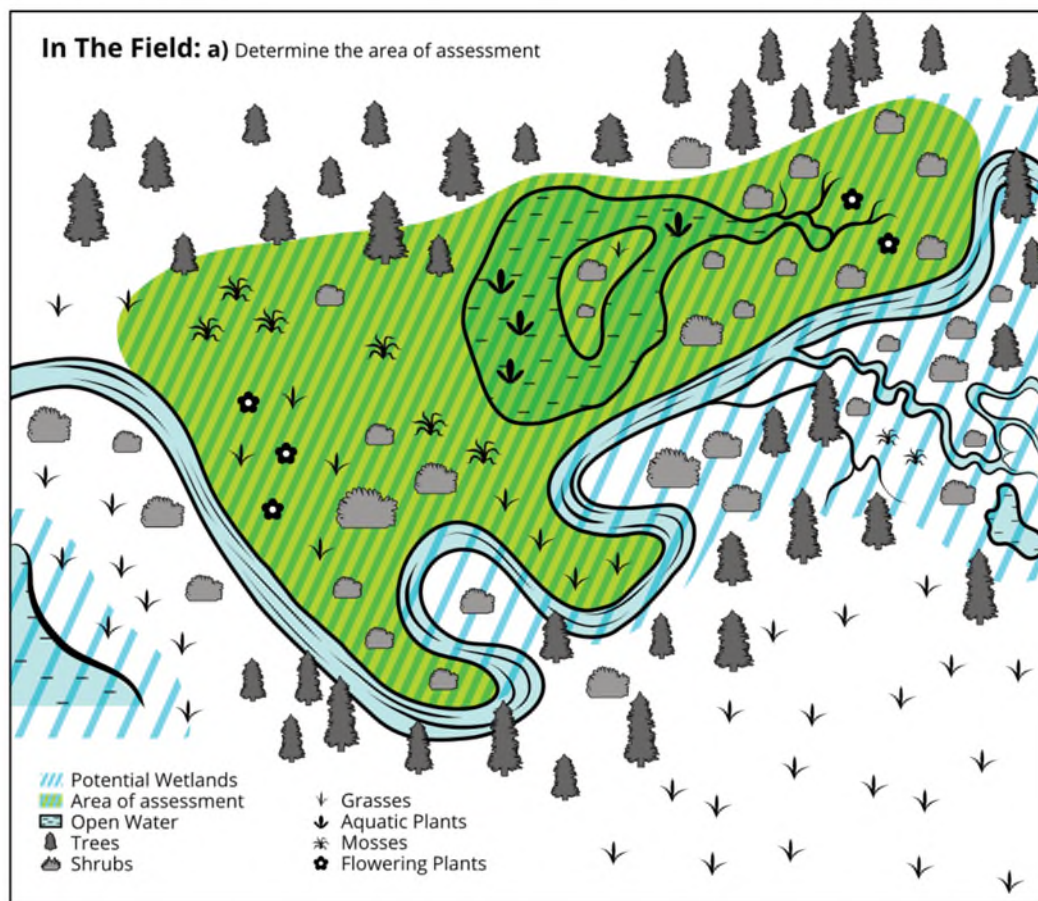


Figure 4-1. Determining Area of Assessment Example

4.2 FLY DRONE AND TAKE PHOTOS

After determining the area of assessment, if you have a drone and conditions and regulations allow, this is the perfect time to collect footage. Flying a drone to collect photos/footage will help you get a lay of the land, identify walking hazards, and help you pick your plot locations. You can either pre-plan a flight path that covers the entire wetland area of interest and collects footage that can be stitched together into a continuous product, or manually fly around the wetland and collect photos/videos at different angles.

Focus photo/footage collection on key wetland features by paying attention to key wetland features during the flight. These features may include water bodies, vegetation types, wetland boundaries, or any specific features of interest for the assessment. Capture detailed imagery and videos of these features from different angles, altitudes, and perspectives. You can also use the mark-up or photo edit tool to circle or mark up wetland of interest in the drone photos and attach the mark-up version to the plot form – this really helps the QC process!

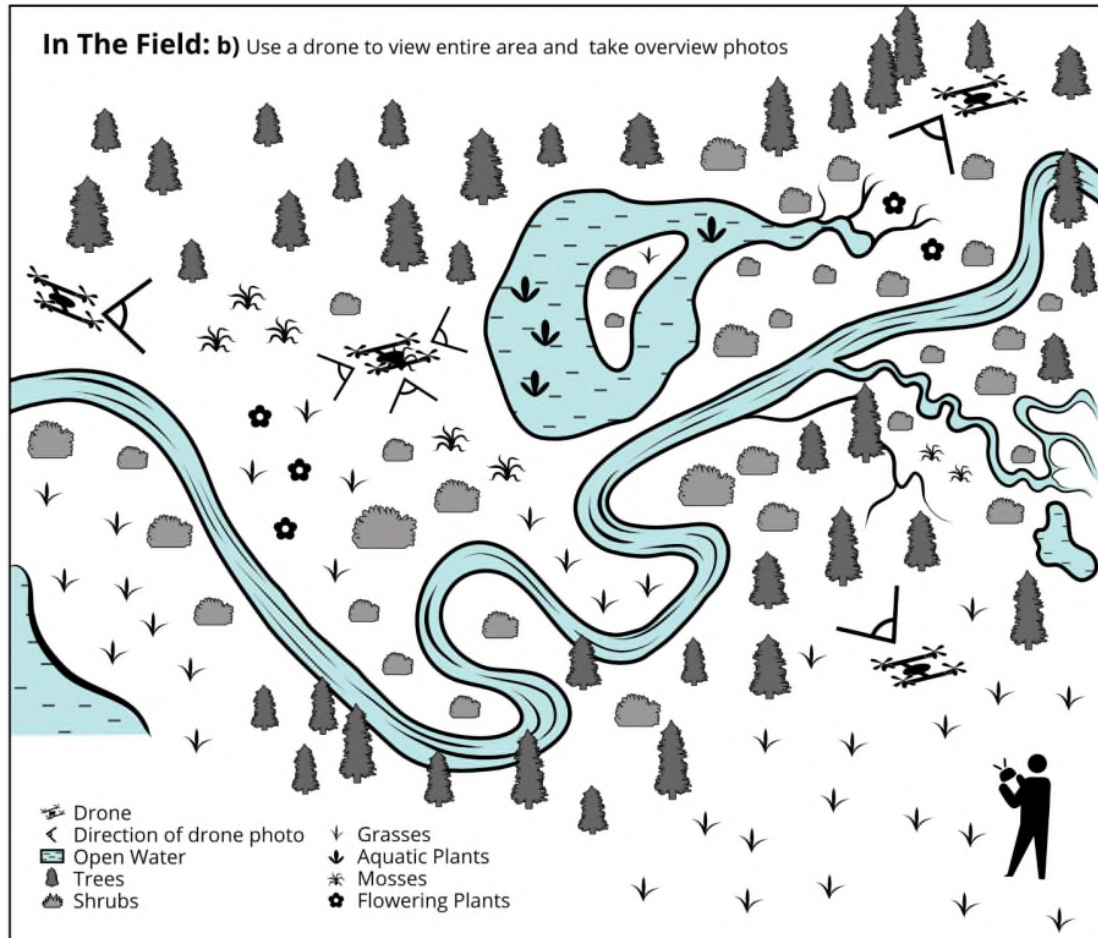


Figure 4-2. Drone Flight and Photo Capture Example

Safety: Make sure to follow all applicable regulations and be aware of potential hazards, such as power lines, trees, or other obstacles that may interfere with the flight path prior to lift off. Also, check for any legal restrictions or permits required for flying drones in the area, especially NOTAMs around wildfires. Remember to follow all local regulations, obtain necessary permits, and prioritize safety while assessing a wetland.

4.3 PLAN ROUTE AND CHOOSE PLOT LOCATIONS

Now that you have collected drone photos/footage and completed general reconnaissance of the site, its time to plan a safe and feasible for travel route for the day and which plot locations are a priority for sampling.

Consider the effort to get to a plot location and the reward of data that that path will provide. Transitional, and fringe wetlands which are hard to classify require quantitative data (soil/veg forms are always good to survey (See Section 4.4 for types of plots). If there is a large, repeating, or dominant wetland in an area, it will also be important to collect plot data in that wetland type. The path that you choose to walk to get to a priority sampling place will also provide opportunities for data collection.

Consider traveling in a loop (i.e. one pathway to get to a point of interest and surveying a slightly different pathway / ecosystem on the way back). This will provide opportunity for additional plot collection without adding extra travel time.

All plot surveys are 30-meter diameter circle. **The 30-meter plot should be the same wetland class and surface cover.**

Consistency is key in data collection. For instance, if you encounter a transition from a bog-like bryophyte zone to a shrubby swampy zone and each zone is a >30 m plot circle, you should aim do one plot in the bog area and another plot in the swamp area. Similarly, if you are in a big swamp, but one part of the swamp is shrubby and another part is treed; you should aim to do one 30 m plot in the shrubby swamp and another 30 m plot in the treed swamp.

What about small wetlands?

If you encounter a small (<30-meter diameter plot) and it is **completely surrounded by non-wetland areas, please complete a CNWI plot.**

In the Detailed Plot, make a note in the comments section on the form of the wetland dimensions and note it is a small, isolated wetland. In the Rapid Plot form, make this note in the vegetation list. Common examples of small wetlands include high elevation wetlands, or forested seeps.

If you encounter a small wetland class/surface cover type (<30-meter diameter plot) **that is adjacent to other wetlands**, do not complete an additional CNWI plot. If the project included wetland polygons, that area will simply include that wetland as a part of the adjacent wetland polygon. Common examples include a small patch of shrubby wetland within a marsh (technically a small swamp), or a small herbaceous marsh within a large shallow open water pond.

What about long and skinny wetlands?

A 30-meter plot is equivalent 0.07 ha (700 m²). For ease and consistency assessment we will round this number up to a 0.1 ha threshold (1,000m²). **If the long/skinny wetland has an overall area of >0.1 ha (or 1000 m²), please complete a CNWI plot.** Common examples would be a strip of marsh or swamp around the edge of a lake, pond, or river.

Note: 10 m X 100 m = 1,000 m² or 20 m X 50 m = 1,000 m²

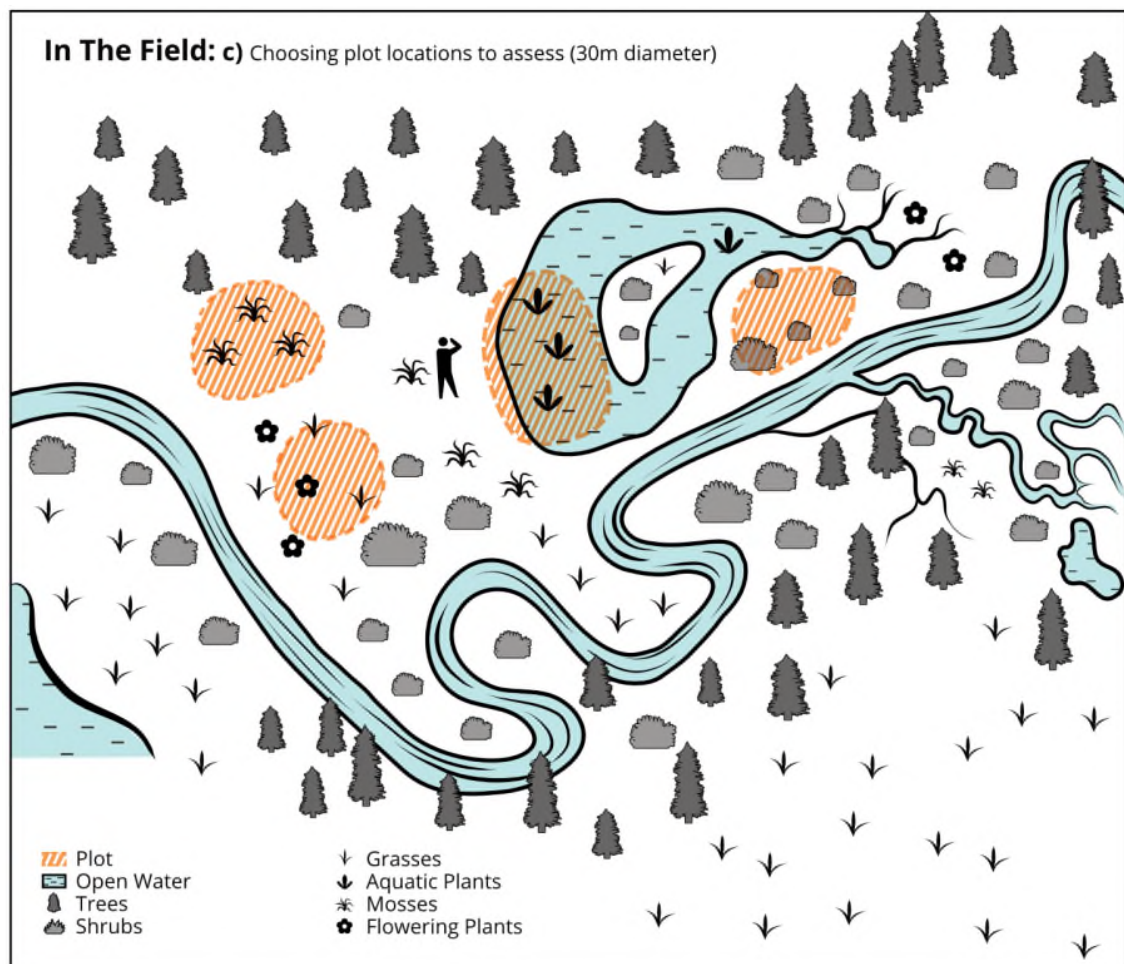


Figure 4-3. Plot Locations Example

4.4 TYPE OF PLOT ASSESSMENT

There are three types of plot assessments:

1. **Quantitative Ground Assessments** are completed where the class of the wetland is not obvious, not known, needs to be verified, or it is the first instance of that wetland type observed in the project area.
 - a. Paper vegetation plot and soils profile data sheets ARE REQUIRED and should be attached to the ESRI smart form with clear photos.
 - b. This plot must be completed from plot center (15 m from the edge of the wetland). The GPS point should also be where vegetation plot center and soil profile was recorded.
 - c. **Note:** where the indicators of wetland hydrology, soil and vegetation are faint (i.e. transitional, kind of dry wetland) and/or you are unsure of the wetland class – fill out the CNWI BC Detailed Plot Form. Otherwise, use the Rapid Plot Form.

2. **Qualitative Ground Assessments** are completed where the class of the wetland is obvious to the surveyor (e.g., vegetation includes only obligate wetland plants and clear wetland hydrology indicators are present), or it is a wetland type that has already been surveyed by the Quantitative Ground Assessment in the project vicinity and thus is well understood and easily recognizable.
 - a. This plot can be completed from plot center (15 m from the edge of the wetland).
 - b. Alternatively, this plot can be completed edge of a wetland or from a vantage point at a distance (e.g., from a road/viewing structuring observing a wetland with binoculars, drone, etc.). With this 'at a distance' option you must use the offline map location selection option to place the GPS plot in the correct location.
 - c. Paper vegetation plot and soils profile data sheets are NOT required for qualitative plots.
3. **Qualitative Air-based Assessments** are completed when the surveyor is viewing the wetland from a drone or helicopter. This data is typically collected where the class of the wetland is obvious to the surveyor (e.g., vegetation is obligate wetland plants and clear wetland hydrology indicators are present), or it is a wetland type that has already been surveyed by the Quantitative/Qualitative Ground Plots in the project vicinity.
 - a. These assessments are also completed where time is limited or where access restrictions limit physical travel to the wetland site (e.g. fast-moving water, cliff, private lands restrictions, etc.)
 - b. Attach photos with a markup showing plot location to the ESRI smart form. With this 'air-based' assessment you must use the offline map location selection option to place the GPS plot in the correct location.

Scenario examples of which type of assessment to complete in different situations that are also provided in Table 4 1 and Table 4 2.

Table 4-1 Types of Plot Assessments			
Type of Assessment	Soil/Veg Forms Required?	Form	ESRI Data Collector Application
Quantitative Ground	Yes	Detailed Plot (if faint indicators / low confidence in classification)	Survey123
		Rapid Plot (typically use)	Survey123 or Field Maps
Qualitative Ground ¹	No	Rapid Plot	Survey123 or Field Maps
Qualitative Air ²	No	Rapid Plot	Survey123 or Field Maps
<p>1 Option to complete from a distance, with the location of the plot corrected. – e.g., from viewing platform or road or with binoculars, etc.</p> <p>2 These plots are completed from a distance in the air with the location of the plot corrected. - e.g., from drone imagery or helicopter.</p>			

Table 4-2. Recommended Plot Assessment (By Scenario)

#	Scenario	Example	Recommended Plot Assessment Method	Alternate Method 1	Alternate Method 2
1	For an area that is very “transitional”, or with faint indicators of wetland hydrology, vegetation, soil or where the surveyor has low confidence in the wetland classification.	An area that has mostly facultative vegetation, hydric soil indicators are faint, and it is not immediately obvious if the area is a wetland or upland. E.g., is it meadow or marsh? Swamp or mesic forest?	Quantitative Ground Assessment, Detailed Plot Form.	Quantitative Ground Assessment, Rapid Plot Form.	n/a
2	For a wetland class that has not been yet assessed in the project.	First time seeing a fen in the project.	Quantitative Ground Assessment, Rapid Plot Form.	If time constraints or difficult access- Qualitative Ground Assessment.	If time constraints or difficult access- Qualitative Air Based Assessment.
3	For a wetland class that has been assessed in this project area during this survey, but the surface cover, hydroperiod, soil type, and/or hydrological system are <i>quite different</i> .	Second time seeing a swamp in the project. But the first one was shrubby surface cover and next to a river, and this swamp is treed and in a basin.	Quantitative Ground Assessment, Rapid Plot Form.	If time constraints or difficult access- Qualitative Ground Assessment.	If time constraints or difficult access- Qualitative Air Based Assessment.
4	For a wetland class that has been assessed in this project area during this survey, and the surface cover, hydroperiod, soil type, and/or hydrological system are <i>fairly similar</i> to the original.	Observing a new fen, and it looks very similar to the first fen observed (which had a quantitative ground assessment) but the new fen has slightly different herbaceous vegetation.	Qualitative Ground Assessment.	If time constraints or difficult access – Qualitative Air Based Assessment.	n/a
5	Completed the required ratio for Quantitative Plots: #study plots and are not seeing any new wetland classes or notable features.	Seeing more repeating marshes & swamps in an area that has already been well sampled with quantitative assessments.	Qualitative Ground Assessment.	If time constraints or difficult access – Qualitative Air Based Assessment.	n/a
6	For an area with all obligate or facultative-wet vegetation that is a classic, obvious wetland.	Classic cattail marsh. Lilypad pond, etc.	Qualitative Ground Assessment.	If time constraints or difficult access – Qualitative Air Based Assessment.	n/a

4.5 COLLECT PHOTOS

Once you get to your plot location, if you are doing either a Quantitative Ground plot, or Qualitative Gound Plot, collect photos at this point. You will attach these photos (as well as relevant drone photos/footage) to the plot forms. Skip this step if you are doing a Qualitative Air plot and only attach mark-up versions of drone photos.

Table 4-3. Photo Capture Requirements	
360 Photo Capture	<ol style="list-style-type: none"> 1. Position the 360camera at the plot's center to capture the uniformity of vegetation and settings. Soil augers with a flexible tripod can used for the 360-camera setup. Take the photos before trampling any vegetation. 2. Configure the camera to capture a photo in 360 mode and save the image iPad's photo gallery. 3. Upload photo to Field Maps or Survey123, based on the required form completion.
Cardinal Direction	<ol style="list-style-type: none"> 1. If a 360 photo aren't feasible, opt for cardinal direction photos. Capture images of the north, west, east, and south sides of the plot using alternate devices like an iPhone or Android Smart Phone. Utilize applications such as Solocator, Theolyte, or TimeStamp for accurate directional, locational, and date/time documentation. 2. Label these photos appropriately and indicating the direction they represent. Upload them to Field Maps or Survey123, aligning with the necessary form completion.

4.6 VEGETATION PLOT

If doing a quantitative ground plot, complete soil, and vegetation paper forms after taking photos. The information recorded on the paper forms will inform answering the questions in ESRI Survey123 or FieldMaps forms. Skip this step if doing a qualitative ground plot or qualitative air plot.

The most important things to fill out on the plot form are vegetation type, species name, height, and percentage cover. The other columns can be filled out later if needed but must be completed before submitting forms.

See Appendix A for examples of completed Veg Plot Form, as well as a blank form.

4.6.1 SPECIES IDENTIFICATION AND NAMING

Species name: Write down every tree/shrub species () within the 30-meter tree/shrub plot and every other ground cover species within the 1m ground cover plot (). If you are unsure on a species ID, take additional photos and attach them to the Detailed/Rapid Plot Form. Identifying the vegetation to the exact species is not always expected.

When you are recording species names, use the Latin 7-Letter-Code. The first four letters of a 7-letter code are the genus, the following 3 letters are the species. Using the Latin 7-Letter-Code makes species identification more certain (e.g. you can look up exactly what the species is, without having to record/remember the entire Latin name in the field.)

- E.g. There are a few species of cattail in BC, for example: common cattail (*Typha latifolia*), narrow leaved cattail (*Typha angustifolia*) and hybridized cattail (*Thypha x glauca*).
 - If you are confident in the species identification record the full 7-Letter-Code: e.g., TYPH LAT.
 - If you are unsure which type of cattail is present on the site, record the 7-Letter-Code with “SPP”. TYPH SPP (SPP stands for species which indicates the exact species is not known).
 - If you do not know the Latin name of the species, you can still record the common name and update with the 7-letter code at the end of the field day. E.g. ‘Cattail’ would be updated to TYPH LAT or TYPHA SPP, etc. at the end of the field day.

How do I record dwarf woody veg, low woody species and woody vines?

- Dwarf woody vegetation, very low shrubs and woody vines should be recorded in the ground vegetation category. The reason for this is because dwarfed woody vegetation looks considerably different from imagery than other trees and shrubs. Typically, open bogs/fens with dwarf woody vegetation are coded to herbaceous or bryophyte surface cover types. See Appendix D for species list of dwarf and low woody species to be assigned to the ground vegetation layer.
- Typical tree/shrub species experiencing “stunting” due to low nutrient conditions, (black spruce (*Picea mariana*) or lodge pole pine (*Pinus contorta*)) should still be recorded in the woody vegetation stratum.

4.6.2 VEGETATION TYPE

We describe vegetation by broad grouping. Trees and shrubs are “Woody Vegetation” and assessed for the entire 30-meter plot. All other vegetation on the ground or on the water (grasses, mosses, aquatic vegetation, etc.) are considered “Ground Vegetation” and these are assessed based on a representative 1 m² plot (within the same area as the Woody Vegetation plot).

provides examples of common woody vegetation species. Woody vegetation means all trees and shrubs, regardless of height, with a woody stem.

Type	Characteristics	Examples
Conifer	Cone bearing trees and shrub woody species, typically with needle-like leaves. Typically, conifers have evergreen foliage but can be deciduous (Tamarack).	<ul style="list-style-type: none"> Western Red Cedar (<i>Thuja plicata</i>) THUJ PLI Western White Pine (<i>Pinus monticola</i>) PINU MON White Spruce (<i>Picea glauca</i>) PICE GLA Tamarack (<i>Larix laricina</i>) LARI LAR Common Juniper (<i>Juniperus communis</i>) JUNI CON
Broadleaf	Broadleaved tree or shrub woody species, with relatively broad flat leaves. Can be evergreen or deciduous (dropping leaves in winter).	<ul style="list-style-type: none"> Trembling Aspen (<i>Populus tremula</i>) POPUTRE Garry Oak (<i>Quercus garryana</i>) QUER GAR River Alder / Mountain Alder (<i>Alnus INC</i>) ALNU INC Salal (<i>Gaultheria Shallon</i>) GUALSHA Oregon Grape (<i>Berberis Aquifolium</i>) BERBAQU
Mixed	A mixture of conifer and broadleaved species	<ul style="list-style-type: none"> See above

Type	Characteristics	Examples
Forb	Non-woody flowering species.	<ul style="list-style-type: none"> Common silverweed (<i>Potentilla anserina</i>) POTE ANS Yarrow (<i>Achillea millefolium</i>) ACHI MIL Alfalfa (<i>Medicago sativa</i>) MEDI SAT
Graminoid	Grass-like plants characterized by long, narrow leaves with linear venation and includes grasses, sedges, reeds, rushes, and other related species.	<ul style="list-style-type: none"> Bluejoint Grass (<i>Calamagrostis Canadensis</i>) CALA CAN Water sedge (<i>Carex aquatalis</i>) CARE AQU Common Cattail (<i>Typha latifolia</i>) TYPH LAT American Bulrush (<i>Schoenoplectus pungens</i>) SCHO PUN Common Reed (<i>Phragmites australis</i>) PHRA AUS
Aquatic	Plants that only grow floating or submerged in water.	<ul style="list-style-type: none"> Common Duckweed (<i>Lemna minor</i>) LEMN MIN

		<ul style="list-style-type: none"> o Eurasian Milfoil (<i>Myriophyllum spicatum</i>) MYRI SPI o Richardson's Pondweed (<i>Potamogeton richardsonii</i>) POTA RIC
Ferns	Ferns and fern ally species.	<ul style="list-style-type: none"> o Lady fern (<i>Athyrium Felix-femina</i>) ATHY FEL o Oak fern (<i>Gymnocarpium dryopteris</i>) GYMN DRY o Bracken fern (<i>Pteridium aquilinum</i>) PTER AQU o Sword fern (<i>Polystichum munitum</i>) POLY MUN

Table 4-6. Bryophyte and Lichen Vegetation Examples		
Type	Characteristics	Examples
Moss	<ul style="list-style-type: none"> o Small, non-vascular plant o Grows in dense, low mats or tufts o Often requires moist environments 	<ul style="list-style-type: none"> o Sphagnum moss (<i>Sphagnum</i> spp.) SPHA SPP o Feather moss (<i>Hypnales</i> spp) HYPH SPP o Hook moss (<i>Drepanocladus</i> spp) DREP SPP
Lichen	<ul style="list-style-type: none"> o Symbiotic organism (consists of algae or cyanobacteria & fungi) o Grows on various surfaces (rocks, trees, soils) o Resistant to harsh environments o Indicator of air quality and pollution 	<ul style="list-style-type: none"> o Fruticose (Shrubby/cushy) Gray Reindeer (<i>Cladonia Rangiferina/Cladran</i>) o Crustose (Crust like that would appear on leaves, shrubs and trees) Fairy Puke (<i>Imadophila Ericetorum/Immaeri</i>) o Foliose (leaf like that would appear on trees, rocks in shade Lungwort (<i>Lobaria Pulmonaria/Lobapul</i>))
Liverworts	<ul style="list-style-type: none"> o Bryophyte with flat, lobed structures. o Reproduce through spores and are usually found in damp, shady environments. 	<ul style="list-style-type: none"> o Common Leafy liverwort (<i>Barbilophozia lycopodioides/Barblyc</i>)
Other	<ul style="list-style-type: none"> o Bryophyte with elongated, horn-like structures and habitats o Reproduce through spores and are usually found in damp, shady environments. 	<ul style="list-style-type: none"> o Common Hornwort (<i>Ceratophyllum Demersum/Ceradem</i>)

4.6.3 VEGETATION COVER

There are two ways to determine percent cover of vegetation in an assessment plot (Figure 4-4). Foliage cover refers to the proportion of the ground surface that is covered by each distinct leaf and branches of plants. Canopy cover refers to the proportion of the sky that is covered by the vertical projection of the outermost layer of vegetation (e.g. where the outer water drip line of the tree/plant would be). It represents the horizontal extent of the plant canopy (Pellant et al, 2020). **Use Canopy Cover for all CNWI wetland vegetation assessments.**

Tip! Use your imagination to move all the black dots (vegetation you are assessing) into half or a quarter of the assessment area. This will give you a 50% and 25% threshold. From there you can get a better sense if it is >25% or <25% which gets you closer to a more accurate reading.

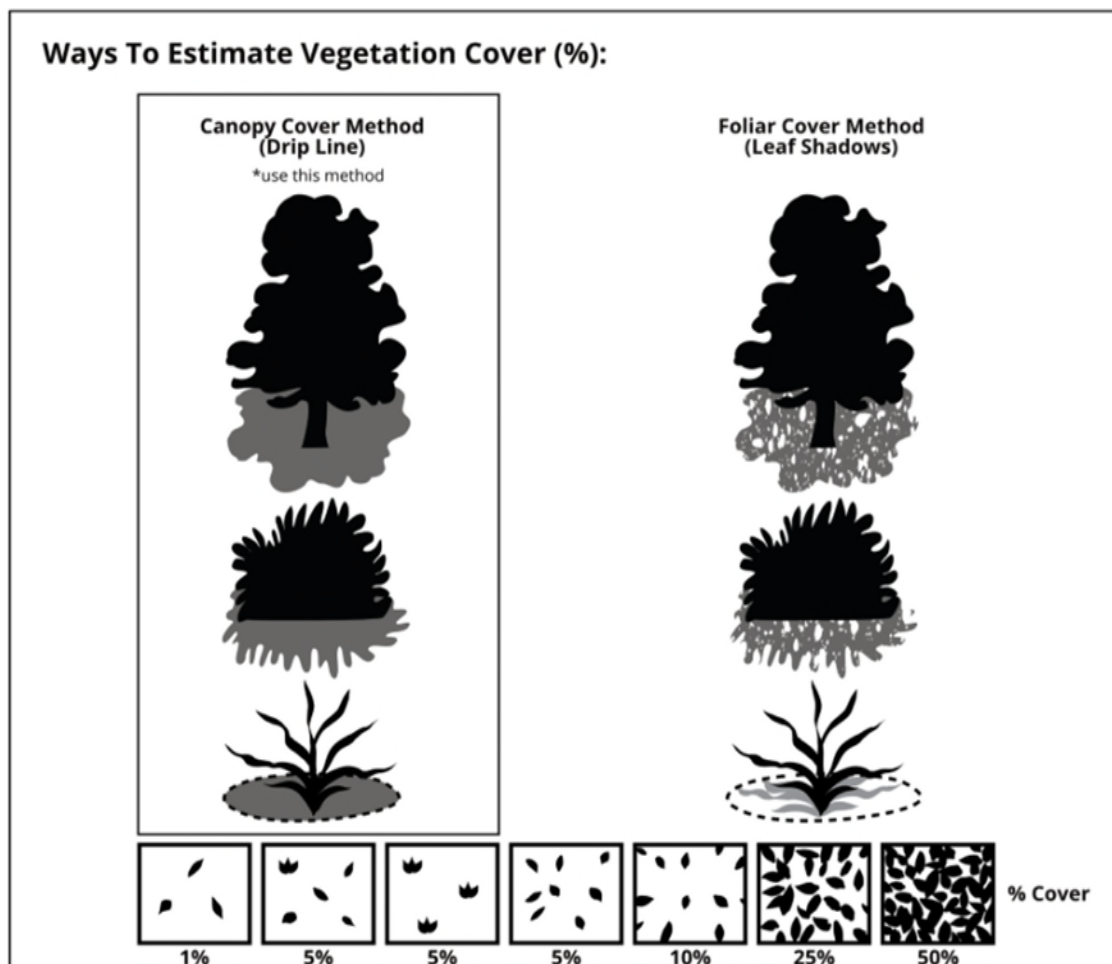


Figure 4-4. Methods to Estimate Vegetation Cover %

4.6.4 VEGETATION HEIGHT

Here are two methods/tricks to better estimate vegetation height when doing field work (Figure 4-4).

1. Using a field partner as a reference:

- a. Have your field partner stand at the base of the tree. Make sure you know your field partner's height in meters and consider the extra height of their boots or hat/helmet.
- b. Visualize and estimate how many times your field partner would have to stack on top of themselves to reach the height of the vegetation.
- c. Use simple math to arrive at an estimate for the tree. E.g. 1.8m tall person X ~2.25 stacks = 4m tall tree

2. Using a drone

- a. Fly the drone to approximately the same height as the top of the tree. Note the height reading on the drone screen.
- b. Consider the distance in height from the drone to the ground. If the tree is on a steep slope the drone may be reading a distance to a lower or higher elevation. If there is dense shrub cover the drone may be reading to the top of the shrubs. Take multiple measurements at different locations to be sure you understand any limitations your drone may have with height readings.
- c. Record a final height measurement on the form considering any issues the drone may have with a height reading.

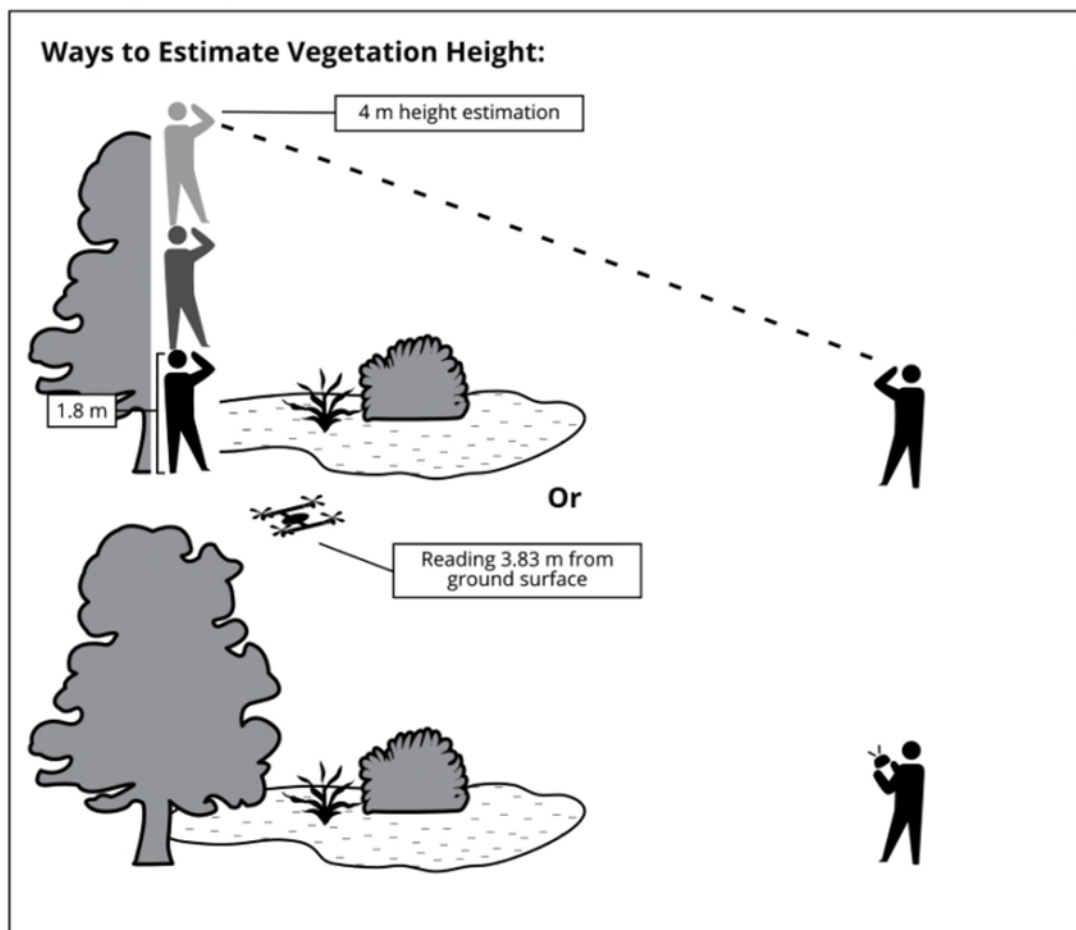


Figure 4-5. Methods to Estimate Vegetation Height

4.7 SOIL PROFILE

The most important things to fill out are soil depth, type, texture, if mineral or organic, and taking clear photos of the soil profile as shown in Appendix-B.

4.7.1 SOIL DEPTH AND HORIZONS

Use your soil auger to recreate a soil column to at least 50 cm deep. Work in stages and carefully push the soil out of the auger to create a soil profile in order of shallowest to deepest cores. Placing the soil profile on a piece of white laminated paper will help show the soil properties in the photo better. Always include a tape measure in the photo. Attach pictures of the soil profile to the Detailed/Rapid Plot form on your table/iPad.

If there is water within the auger hole, or the soils are saturated in the auger hole—record the observed depth.

Simple Horizon Method: Record a new “horizon” anytime the soil color or texture significantly changes. E.g., Soil horizon 1 is on the surface (topsoil), Soil horizon 2 is directly below 1, horizon 3 is below 2, etc.

Detailed Horizon Method: If you would like to, you can label the horizons as an O horizon, A, B, C, etc. such as described in the Canadian System of Soil Classification (Table 4-7).

Table 4-7. Soil Horizons	
Horizon	Descriptions
LFH	<ul style="list-style-type: none"> o Leaf litter from trees/shrubs. Only in forested ecosystems.
O	<ul style="list-style-type: none"> o Topmost layer of soil o Mixture of organic matter in any stage of decomposition, including decomposing leaves, moss, plant debris, etc.
A	<ul style="list-style-type: none"> o Topsoil and the layer below O o Could be a mixture of organics and mineral
B	<ul style="list-style-type: none"> o Subsoil layer beneath A o Could contain an accumulation of minerals from the upper layers o Often contains a higher clay content
C	<ul style="list-style-type: none"> o Composed of weathered parent material such as rock or sediment o Least affected by soil-forming processes

4.7.2 MINERAL OR ORGANIC SOIL DETERMINATION

Based on weight, texture and color try to determine if the soil type is mineral or organic. This is important to determine for purposes of wetland classification.

Organic matter in soil is made of plant, animal, and microbial remains at different stages of breakdown. “Organic soil” horizons contain at least 30% organic matter (by weight), and the rest of it can be more organic matter or mineral components (sand/silt/clay).

“Mineral soil” horizons have >70% mineral components (sand/silt/clay); there can still be some organic matter, but organic matter must be <30% to be considered a mineral soil. Usually, it is easy to tell the difference between “Organic” and “Mineral” soils. If you are at a site where there is approx. ~20-40% organic matter in soils by weight (i.e. what you see in the field), chances are you will have a hard time classifying the soil as “Organic” (“O” horizons) or Mineral (“A” “B” “C” horizons). If you are unsure, suggest recording “O or A” as the detailed horizon type on the soil data sheet. Here are some clues to help you in this:

- o **Texture clues:** If the mineral components are sandy, you will feel the grittiness of the sand. By considering the amount of grittiness, you can estimate what percentage of the soil is sandy mineral.

- **Weight clues:** Since clay is the heaviest of the mineral components, a soil with a lot of clay and organic matter will feel heavier than any soil with only organic matter. By the weight, you can estimate what percentage of the soil is clay mineral.
- **Malleability clues:** Soil with a lot of clay can be molded and shaped (like pottery), if you feel like there is some malleability in the soil, there could be higher contents of clay. From the malleability, you can estimate how much of the soil is clay mineral.
- **Colour clues:** A mineral soil may look very dark (like humic organics) if the organic matter from topsoil horizons has 'leached' with rainwater and stained the soil below. Exercise caution in relying on colour alone in this situation.

Option 1 for Further Analysis: Water Jar Test

The water jar test is an example of determining soil texture. It is used to determine the texture of soil by observing how different soil particles settle in a jar of water.

Brief guide on test (Milkwood soil type calculator, 2024):

1. Collect soil sample: Remove any rocks, roots, or debris from the sample.
2. Fill a clear jar with soil: Fill up the jar to one-third of the jar's height. Add water to the jar until nearly full, leaving some space at the top. Add a drop of dish soap.
3. Shake the jar: Secure lid on jar and shake it for a few minutes to make sure that the soil and water are well mixed.
4. Let the jar sit: Leave the jar in a safe location where it won't be disturbed. Allow the jar to settle for several hours or overnight to allow the soil particles to settle.
5. Observe the layers: After the soil is settled, you should see distinct layers. The top layer will be organic material, followed by layers of sand, silt, and clay from top to bottom.
6. Determine soil texture: Based on the thickness of each layer and the proportions of sand, silt, and clay, you can determine the texture of the soil.



Figure 4-6. Water Jar Test (Milkwood Soil Type Calculator, 2024)

Option 2 for Further Analysis: Loss on Ignition Method (Oven Drying Test)

The Oven Drying Method is a simple test to determine the percentage (%) of organic matter in a sample that can be completed in a laboratory with the right equipment. The threshold of organic matter in the Loss on Ignition method shifts to 17% because it is the difference of the dried weight of a sample to the

Brief guide on Oven Drying Method:

1. Weigh 10g of field collected soil on a known weight aluminum sample tray.
2. Dry sample at 105°C (221 °F) for at least 24 hours to remove all water moisture.
3. Weigh dried sample.
4. Ignite (bake) the sample at 375°C (707°F) for 2 hours to remove all particulate organic content.
5. Weight sample again.
6. Determine what percentage (%) of sample is organic matter (OM).

If the 'lost' organic content of the post ignition soil is >17% of the original dried sample weight, the soil would be classified as organic.

$$\% \text{ OM} = \frac{\text{oven dried sample weight (g)} - \text{post-ignition weight (g)}}{\text{oven dried sample weight (g)}} \times 100$$

4.7.3 ORGANIC SOIL TEXTURE

If the soil is organic, determine if it is fibric, mesic, or humic (Figure 4-7). This is important because if there is 40cm of organic matter at the surface that is mostly fibric/mesic, the wetland class must be a bog or a fen.

If there is 40cm of humic organic matter at the surface, the wetland soil type will be organic (humic) and the possible wetland classes are swamp, marsh, or shallow open water.

Reminder: if the organic matter horizon at the surface is <40cm (of any texture) then the overall Soil Type is classified as mineral. Please still record the depth of the organic horizon and the texture on the soil profile data sheet.

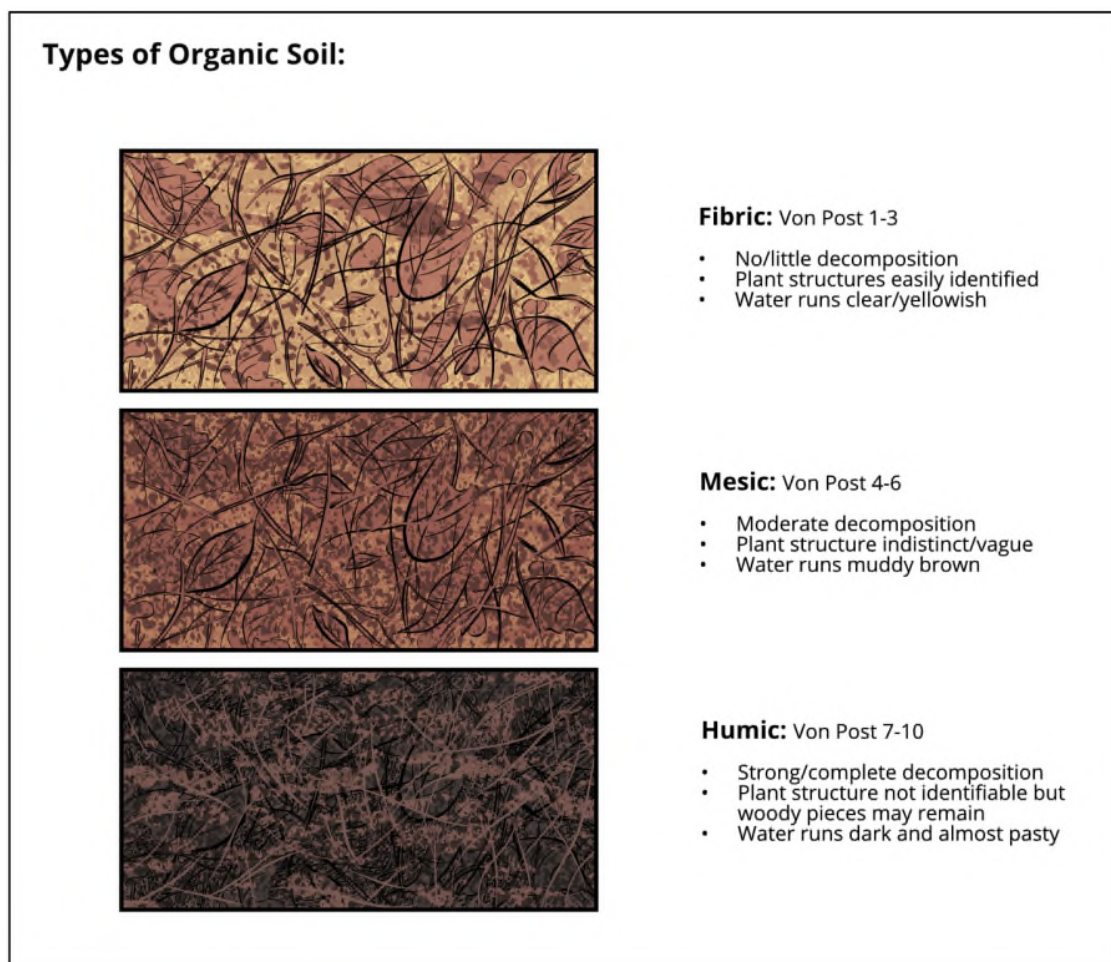


Figure 4-7. Organic Soil Texture

- Reference: Soil Classification Working Group. 1998. The Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp.

Table 4-8. Von Post Level of Decomposition				
Type	Level	Fibres	Water colour when squeezed	Particulate matter (“peat”) that escapes with the water /paste when squeezed
Fibric	1	Undecomposed	Clear to light yellow	No peat escapes
	2	Almost undecomposed	Light yellow to brown	No peat escapes
	3	Very weakly decomposed	Light to medium brown	No peat escapes, residue not mushy.
Mesic	4	Weakly decomposed	Medium brown	No peat escapes, residue rather mushy.
	5	Moderately decomposed	Medium brown	Some peat escapes, residue very mushy
	6	Very moderately decomposed	Medium to dark brown	A third of peat escapes, residue strongly mushy.
Humic	7	Strongly decomposed	Very dark brown / black – sample has more greasy / humic texture.	Half of peat escapes.
	8	Very strongly decomposed	Little water escapes when squeezed, it is more of a solution/paste.	Two thirds of peat escapes, residue only consist of resistant remnants (root fibres & wood).
	9	Almost completely decomposed	No free water escapes, it is more of a solution/paste.	Nearly all peat escapes.
	10	Completely decomposed	No free water escapes, it is more of a solution/paste	All peat escapes.

4.7.4 MINERAL SOIL TEXTURE

Mineral soils are formed from the weathering of rocks and are primarily composed of inorganic material. A “Mineral Soil” can still contain up to 30% organic matter by field weight/volume, for help determining if the soil is classified as “Mineral” or “Organic” please refer to section 4.7.2.

Mineral soil is described by the size of the inorganic particles (grains) (Table 4-9).

Table 4-9. Mineral Particle/Grain Size		
Type	Diameter (mm)	Texture

Coarse sand	0.5 +	Coarse grains, can feel individual sand particles
Medium sand	0.25 – 0.5	Grainy, can feel individual sand particles
Fine sand	0.10 – 0.25	Grainy, can feel individual sand particles
Very Fine Sand	0.05 – 0.10	Grainy, can faintly feel individual sand particles.
Silt	0.002-0.05	Floury when dry, soapy/sticky when wet (sticks to hands)
Clay	<0.002	Hard when dry, very sticky (like gum) when wet (sticks to itself)
Loam	Mixed (sand, silt, clay)	Variable depending on proportions of sand, silt, clay

Reference: Soil Classification Working Group. 1998. The Canadian System of Soil Classification, 3rd ed. Agriculture and Agri-Food Canada Publication 1646, 187 pp.

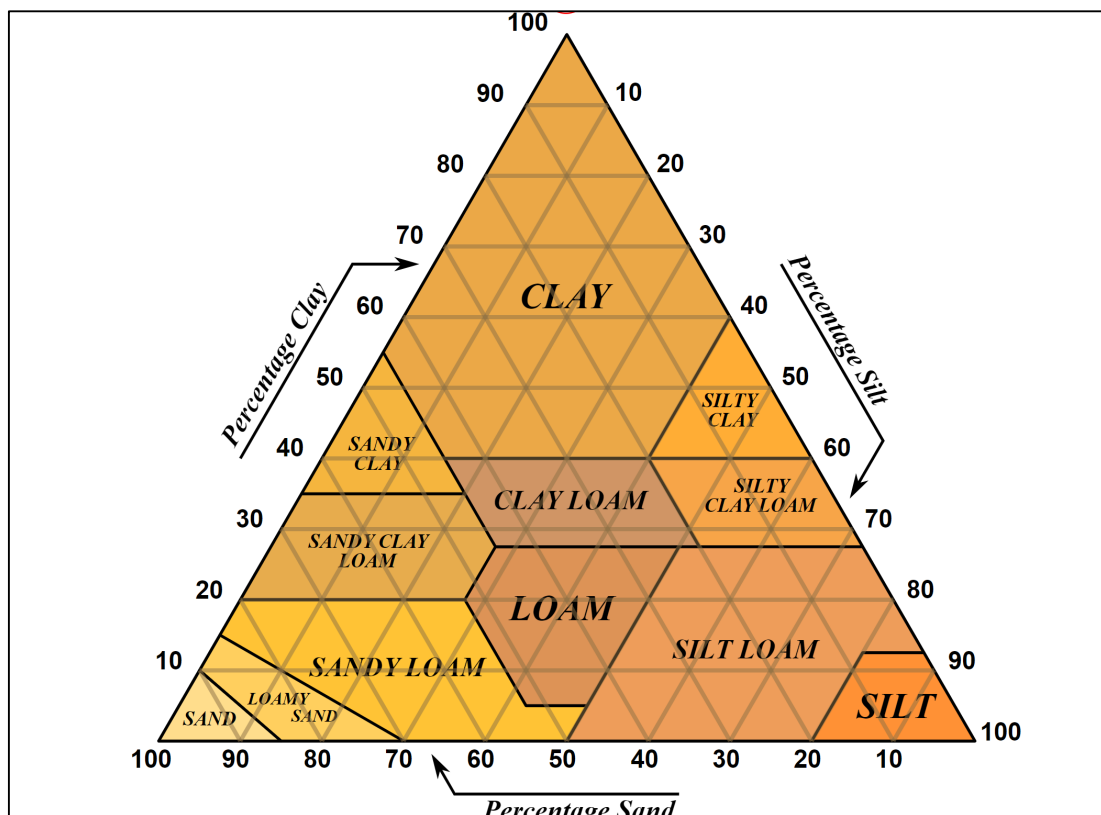


Figure 4-8. Mineral Soil Texture

4.7.5 HYRIC SOIL SIGNS

Hydric soils are defined as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil (Federal Register, July 13, 1994). Look for hydric soil signs (i.e. evidence of water – either current water present or signs of past water presence) in the top 40 cm of the soil profile.

Typical Signs of a Hydric Soil

1. Accumulation of Organic Matter
 - A soil with >40cm of organic soil (fibric/mesic/humic) at the surface is always considered a hydric soil.
 - A soil with ~20cm organic soil underlain by a mineral horizon that is a light-medium grey colour are generally considered a hydric soil.
2. Redoximorphic depletion (grey colours or “gleying” colours)
 - occurs in mineral soils where the iron/manganese in soil is reduced (not exposed to oxygen due to prolonged water saturation). The reduced soil looks light-medium grey, grey/green, or blue/grey in colour.
 - In the Munsell Soil Colour book, the light-medium grey colours are colours in with a chroma of 1 or 2, and a value of 4+ or more on any of the 5R-5Y pages. The other place in the Munsell book you would find these colours is on the “Gley1” and “Gley2” pages, so long as the value is 4+. (See Figure 4-9).
 - Soils within the upper 40cm that meet this colour criteria are generally considered a hydric soil.
 - Note: depletions (as a sign of hydric soil) cannot form in materials that contain naturally low amounts of iron/manganese. Field test: do ALL soils in the area appear grey-ish in colour? If yes, then exercise caution when relying on this indicator for hydric soil determination.
3. Redoximorphic concentrations (rust coloured mottling or oxidized rhizospheres)
 - occur in mineral soil when the when iron/manganese is exposed to oxygen. This is a are sign of a fluctuating water table. (See Figure 4-10).
 - Mottling occurs when iron/manganese is oxidized in a soft mass, nodule or splotchy pattern in the soil profile. Rhizosphere means the area in the soil around the living plant roots; when iron/manganese is oxidized in the rhizosphere area, we call this an oxidized hydrosphere.
 - Oxidized iron/manganese (mottles or oxidized rhizospheres) are rust coloured (red/orange) but overtime in drier conditions, it can also appear more yellow in colour.
4. Sulphur or methane smell (rotten eggs)

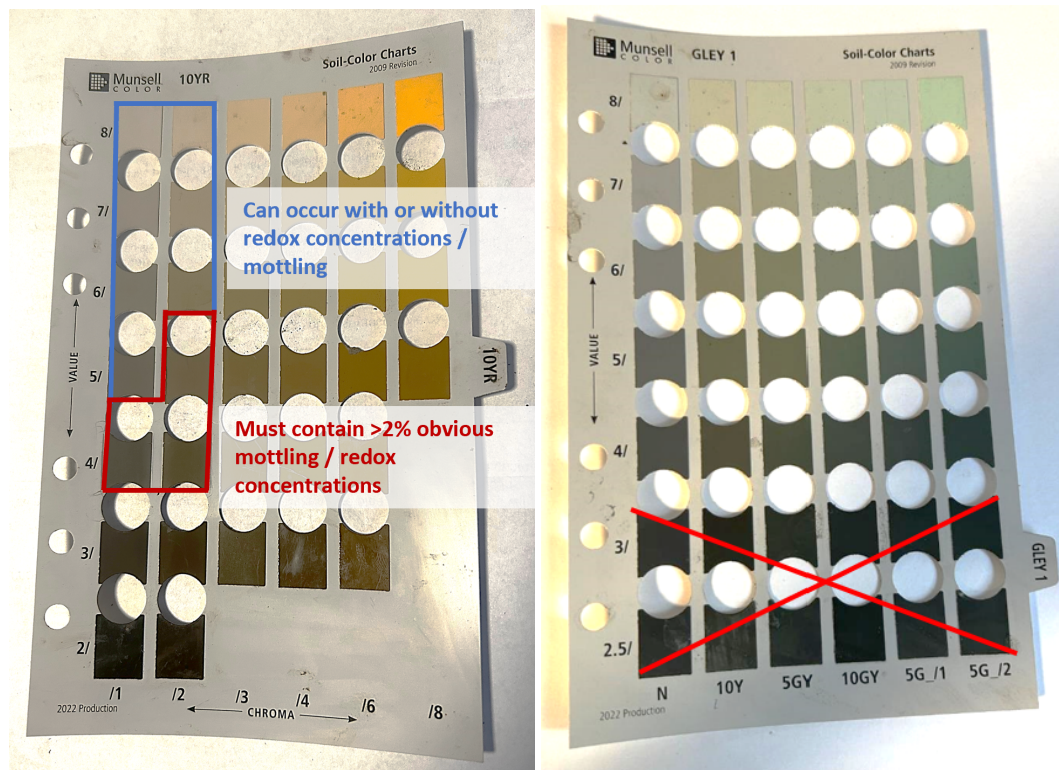


Figure 4-9. Redox Depletion (Grey and Gley Colour Examples)



Figure 4-10. Redox Concentrations (Mottling & Oxidized Rhizospheres)

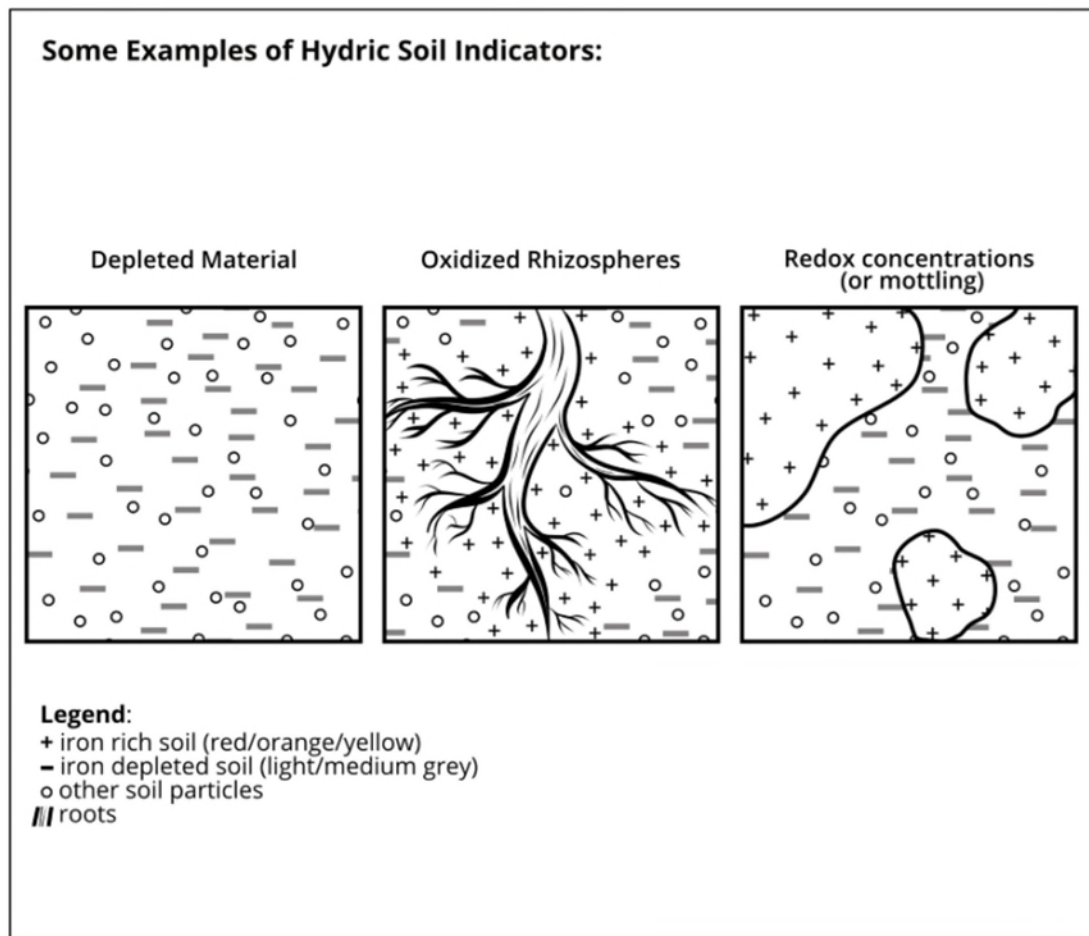


Figure 4-11. Mineral Hydric Soil Signs Example

4.8 DETAILED AND RAPID PLOT FORMS

Following the Soil Profile and Vegetation Plot data sheets, complete the Rapid or Detailed Plot digital forms. Open your tablet, iPad, or cellphone to complete the Rapid or Detailed Plot forms using ESRI Survey123 or FieldMaps. A paper form of the Rapid Plot Form is available as a back up if technology fails.

Only use the Detailed Plot form if you meet the requirements in Table 4-1.

For the Rapid Plot form, use either the ESRI FieldMaps or Survey 123 application to complete the form.

The definitions and diagrams in Section 2.0 will help you complete the Plot forms.

5.0 CHECKLISTS

5.1 EQUIPMENT

Before fieldwork, ensure that you have the necessary gear and preparation completed. Consider the risks involved, such as transportation, terrain and access, availability of water necessitating kayaks and lifejackets, or the need for an All-Terrain Vehicle (ATV) for trail access. Make sure you are proficient in using all the safety gear, tools and software required for your field collection. Table 5-1 below lists many items that may be useful for your fieldwork, but the specific requirements may vary depending on the site and objectives of the fieldwork.

Table 5-1. Equipment Checklist	
Safety / Transportation	Packed?
1. Communications- inReach, cell phone, 2-way radios, and chargers	<input type="checkbox"/>
2. First aid kit	<input type="checkbox"/>
3. Truck safety kit- Spare tire, jack kit, saw, hatchet, ratchet straps, fire extinguisher, etc.	<input type="checkbox"/>
4. Field safety plan- with check in person and directions to hospital	<input type="checkbox"/>
5. Animal Safety - Bear spray, holsters, travel safe canisters, and wildlife deterrent air horn	<input type="checkbox"/>
6. Maps and navigational resources	<input type="checkbox"/>
7. High visibility clothing	<input type="checkbox"/>
8. Headlamp	<input type="checkbox"/>
9. Water transport (if required) canoe / kayak / power boat, car attachment, PFDs, throw bag, bailer, paddles	<input type="checkbox"/>
10. Copies of access permissions / permits	<input type="checkbox"/>
11. ATV / UTV / E-bike (if required)	<input type="checkbox"/>
Electronics	Packed?
1. iPad or Tablet- loaded with BC CNWI Forms (Detailed and Rapid), and GPS booster (e.g., Bad Elf)	<input type="checkbox"/>
2. Drone- with SD cards, batteries and charging cables; Permits and restrictions; pre-loaded flight plans if collecting ortho-photos	<input type="checkbox"/>
3. 360 camera- with SD cards, batteries and charging cables	<input type="checkbox"/>
4. pH meter – with calibration solutions	<input type="checkbox"/>
5. Rangefinder	<input type="checkbox"/>
6. Battery bank	<input type="checkbox"/>
Technical Equipment	Packed?
1. Soil Sampling Kit - Auger, soil knife, hand lenses, ruler/measuring tape, Munsell colour book, etc.	<input type="checkbox"/>
2. Veg Plot Sampling Kit- Local Plant ID Books, other appropriate field guides, 30m tape (or rangefinder)	<input type="checkbox"/>

3. Clipboard with printed copies of Vegetation Plot & Soil Profile & Hydrology Data Sheets, printed on waterproof paper.	<input type="checkbox"/>
4. Binoculars & clinometer (optional)	<input type="checkbox"/>
Personal Gear	Packed?
1. Footwear- Rubber boots, hikers, waders, wading belt, wading staff	<input type="checkbox"/>
2. Weather appropriate clothing – rain gear, sun protection, insect/tick protection, etc.	<input type="checkbox"/>
3. Weather appropriate accessories – sunglasses, sun hat, toque, gloves, sunscreen, bug spray, bug hat etc.	<input type="checkbox"/>
4. Water, lunch, snacks	<input type="checkbox"/>
5. Backpack	<input type="checkbox"/>
6. Cleaning gear – soaps, disinfecting wipes, boot brushes, bleach, cloths	<input type="checkbox"/>

5.2 FIELD PREPARATION TASKS

A successful field program starts long before you hit the road. Use this check list to ensure your preparation tasks are complete and you have set yourself up for success on your wetland field work journey.

Table 5-2. Field Preparation Tasks	
Approx. One Month Before	Completed?
1. Pre-select plot sites and back-up site options	<input type="checkbox"/>
2. Book accommodations (if applicable)	<input type="checkbox"/>
3. Update field work calendar with travel locations, and expected travel plans	<input type="checkbox"/>
4. Download BC backroad map book area for your region	<input type="checkbox"/>
5. Confirm site access, permits, and permissions (if applicable)	<input type="checkbox"/>
6. Scout drone permissions- distance to airports, active fires, etc.	<input type="checkbox"/>
7. Submit drone request in Nav Canada	<input type="checkbox"/>
8. Complete Desktop Review (see Section 3.0)	<input type="checkbox"/>
Note: If other First Nations partners/environmental monitors are joining field work	<input type="checkbox"/>
o Gather contact information for field monitors	<input type="checkbox"/>
o Communicate and organize meeting times and locations	<input type="checkbox"/>
o Provide equipment requirements and overview of activities	<input type="checkbox"/>
Approx. One Week Before	Completed?
1. Download maps with satellite basemap for navigation (at “building” level resolution)	<input type="checkbox"/>
2. Download field maps for sites (site choice #1, #2 and #3 if applicable)	<input type="checkbox"/>
3. Confirm access and navigation to site	<input type="checkbox"/>
4. Prepare drone flight plans for field sites (ensure downloaded for offline use)	<input type="checkbox"/>

5. Calibrate pH probe once per week	<input type="checkbox"/>
6. Ensure SD cards are clear, and equipment and batteries are fully charged	<input type="checkbox"/>

5.3 DAILY FIELD TASKS

It is very easy to get overwhelmed in the field with everything there is to go. Use this Daily Field Task Checklist to help ensure you are not forgetting any critical steps mid-day.

Perhaps the most important step occurs when you get back to the hotel each night. Back up your data each night on Wi-Fi! The data is the entire reason we do this work, and it must be kept safe.

Table 5-3. Daily Field Tasks	
Start of day (at the hotel)	Completed?
1. Check weather and pack accordingly	<input type="checkbox"/>
2. Check wildfire, transportation and/or emergency alerts	<input type="checkbox"/>
3. Review flight conditions for drone	<input type="checkbox"/>
4. Drone site survey (if needed, e.g. Wilco app)	<input type="checkbox"/>
5. Make equipment is packed (see in Table 5-1)	<input type="checkbox"/>
Start of day (at the truck)	Completed?
1. Tailgate safety meeting (hazards and egress)	<input type="checkbox"/>
2. Send safety check-in message (start monitoring on InReach)	<input type="checkbox"/>
3. Set alarm for mid-day and end of-in safety check-in message	<input type="checkbox"/>
Collecting Data (at wetland site)	Completed?
1. Fly drone (if permittable)	<input type="checkbox"/>
2. Determine hydrological sites of interest (inflow and outflow)	<input type="checkbox"/>
3. Identify 30m X 30m plots E.g. homogenous patches of vegetation - woody vegetation, shrubs, herbaceous, water.	<input type="checkbox"/>
4. At each plot determine if doing qualitative or quantitative	<input type="checkbox"/>
5. If quantitative plot: 360 photo, GPS point, vegetation plot, soil profile as well as a Rapid Plot Form (or Detailed Plot Form)	<input type="checkbox"/>
6. If quantitative plot: 360 photo, GPS point, and a Rapid Plot Form	<input type="checkbox"/>
End of day (at the truck)	Completed?
1. Do not forget any gear behind (e.g., soil auger)	<input type="checkbox"/>
2. Review submissions for accuracy and completeness	<input type="checkbox"/>
3. Disinfect and clean gear used between field sites (or at end of day)	<input type="checkbox"/>
4. Record and submit information about any invasive species observed and/or safety incidents.	<input type="checkbox"/>
End of day (at the hotel)	Completed?
1. Charge batteries and devices	<input type="checkbox"/>
2. Record drone flight in logbook	<input type="checkbox"/>
3. Final safety check-in (end monitoring on InReach)	<input type="checkbox"/>

4. <u>Upload Survey123/FieldMaps Rapid and Detailed Plot forms with all attachments</u>	<input type="checkbox"/>
5. Back up photos from drone and 360 cameras	<input type="checkbox"/>
6. Prepare for following field day. Confirm travel and site details (Update fieldwork calendar with any changes)	<input type="checkbox"/>

5.4 WEEKLY TASKS

Perhaps the most important (and easily) overlooked part of wetland field work is the follow up data review and equipment management. These tasks are essential to a long-term, efficient, and successful program. Be sure to take the time to review your data regularly throughout the field season, update any mis-identified plants for errors, and make sure that the equipment is ready for you next trip out.

Table 5-4. Weekly Tasks	
Data Review	Completed?
1. Review ESRI Rapid and Detail Plot submission and address any errors or any submissions remaining	<input type="checkbox"/>
2. Process drone & 360 images	<input type="checkbox"/>
Equipment Management	Completed?
1. Calibrate pH meter	<input type="checkbox"/>
2. Clean and maintain all equipment, report deficiencies to crew lead or supervisor	<input type="checkbox"/>

5.5 UPLOADING DATA

Rapid and Detail Plot Forms from ESRI FieldMaps and Survey123 must manually be uploaded and synced to the Cloud when connected to the internet. Uploading data from devices like GoPro or drones involves extracting the SD card and transferring images to a computer via USB or directly inserting the SD card into a computer's slot. Organizations may prefer storing images on cloud drives, ensuring backups on hard drives to prevent loss. Speak with your supervisor about storage and upload preferences.

ALWAYS UPLOAD & BACK UP DATA AND PHOTOS EVERY DAY.

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APPENDIX-A.EXAMPLE VEGETATION AND SOILS FORMS

CNWI BC Vegetation Plot Field Form (2024)

Date: June 1, 2024
 Surveyors: ER, KR

Plot ID or Lat/Long: PW-017
 Weather: Sunny, clear

Mid Points: 1% 3% 7.5% 17.5% 37.5% 75%

Woody Vegetation Stratum (Plot Size: 30-m diameter circle)

Species (Latin Code or common name)	Percent Cover	Average Height (m)	Dominant Y/N	Native(N) Exotic (E)	Life Form	Other
1. <u>PICE MAR</u>	<1%, 1-5, 5-10, 10-25, <u>(25-50)</u> 50%+	<1m, 1-2, 2-5, <u>(5-10)</u> 10-25, 25m+	<u>Y</u>	<u>N</u>	<u>T</u>	<u>FACW</u>
2. <u>BETU GLA</u>	<1%, 1-5, 5-10, <u>(10-25)</u> 25-50, 50%+	<1m, <u>(1-2)</u> 2-5, 5-10, 10-25, 25m+	<u>N</u>	<u>N</u>	<u>S</u>	<u>FAC</u>
3. <u>RHOD GRO</u>	<1%, 1-5, 5-10, 10-25, <u>(25-50)</u> 50%+	<u>(1m)</u> 1-2, 2-5, 5-10, 10-25, 25m+	<u>Y</u>	<u>N</u>	<u>S</u>	<u>FACW</u>
4. <u>1</u>	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	<1m, 1-2, 2-5, 5-10, 10-25, 25m+				
5.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	<1m, 1-2, 2-5, 5-10, 10-25, 25m+				
6.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	<1m, 1-2, 2-5, 5-10, 10-25, 25m+				
7.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	<1m, 1-2, 2-5, 5-10, 10-25, 25m+				
50/20 Dominance Guide:		A. Total % cover all species: <u>92.5%</u>	B. 50% of the total cover: <u>46.25%</u>	C. 20% of the total cover: <u>18.5%</u>		

Ground Vegetation Stratum (Plot Size: 1-m diameter circle)

Includes: forbs, herbs, grasses, sedges, rushes, ferns, mosses, bryophytes, algae, AND plants submerged in water e.g. tily pads, milfoil, eelgrass, etc.

Species (Latin Code or common name)	Percent % Cover	Average Height (cm)	Dominant Y/N	Native (N) Exotic (E)	Life Form	Other
1. <u>CALA CAN</u>	<1%, 1-5, <u>(6-10)</u> 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+	<u>N</u>	<u>N</u>	<u>H</u>	<u>FAC</u>
2. <u>EQUI ARV</u>	<1%, <u>(1-3)</u> 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+	<u>N</u>	<u>N</u>	<u>H</u>	<u>FAC</u>
3. <u>SPHAGNUM</u>	<1%, 1-5, 5-10, 10-25, 25-50, <u>(50%)</u>	0-10cm, 10-50, 50-100, 100cm+	<u>Y</u>	<u>N</u>	<u>M</u>	<u>OBL</u>
4.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
5.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
6.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
7.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
8.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
9.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
10.	<1%, 1-5, 5-10, 10-25, 25-50, 50%+	0-10cm, 10-50, 50-100, 100cm+				
50/20 Dominance Guide:		A. Total % cover all species: <u>85.5%</u>	B. 50% of the total cover: <u>42.75%</u>	C. 20% of the total cover: <u>17.1%</u>		

Species (Latin Code or common name)	Comments (describe the prevalence / distribution / height of the specie).	Life Form
1.		
2.		
3.		
4.		

Notes:

- Species Name** – Latin Code is the first 4 letters of Genus and first 3 letters of species (E.g. ACER MAC; CARE AQU)
- Dominance** is determined by the 50/20 Rule which is done in 4 Steps:
 - Step 1:** Figure out total % cover of all species by using the mid-points (can be >100%). ("A")
 - Step 2:** Figure out what 50% and 20% of the total % cover is. ("B") and ("C")
 - Step 3:** "50 Rule" In decreasing order of coverage, select all species until the cumulative coverage exceeds 50% of the total coverage for the stratum ("B"). If two or more species are equal in coverage (i.e., same %), they should all be selected.
 - Step 4:** "20 Rule" Select any other species that, by itself, is at least 20% of the total percent cover in the stratum ("C")
- Native / Exotic** – Indicate if the species is native to this region or an exotic (ornamental or invasive).
- Life Form** (T) Tree (S) Shrub (H) Herbaceous (M) Moss (L) Lichen (Aq) Aquatic (Al) Algae (O) Other
- Other:** (OLB) Obligate (FACW) Facultative Wet (FAC) Facultative (FACU) Facultative Upland (UPL) Upland

Data collection to support the Canadian National Wetland Inventory in BC

Data Sheet adapted from: "B.C. Ministry of Forests and Range. 2010. Field manual for describing terrestrial ecosystems. 2nd ed. Land Management Handbook 25. Co-published with B.C. Ministry of Environment." and "DUC Boreal Wetland Site Surveying Field Form. Helicopter Surveys. Rev. 08/20/12" and "US Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0."



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CNWI BC Water & Soil Field Form (2024)

Date: June 1 2024
 Surveyors: ER, KR

Plot ID or Lat/Long: PW-017
 Weather: Sunny, clear

WATER			
Depth of water to the ground (puddle):	<u>variable, 10-12 cm</u>	pH:	<u>6.2 pH</u>
Depth to the water table in the soil core:	<u>n/a above surface cm</u>	Salinity:	<u> </u> ppt
Remarks: <u>site is very hummocky. Bottom of mounds (holes) filled w/ water w/ 10-12 cm deep. soil core taken from middle of mound (approx @ water surface level). (mineral soil)</u>			

SOIL										
Horizon (simple)	Depth (cm)	Horizon (detailed) LFH, O, A, B, C	Type / Texture see notes below for suggested values	Colour (mineral horizons only)				Hydric Signs		Comments: (wetness/saturation, roots, organic mixing/seepage, woody debris, tephra layer, frozen soil, etc.)
				Colour #1	%	Colour #2	%	Type (C/D)	Strength (P/D/F)	
1	0-20	O	fibric							moss + sphagnum Remnants visible
2	20-26	O	mesic							only roots/stems visible
3	26-35	A	silty clay loam		90		10	C = P D = P		
4	35-60+	B	silty clay		100			D P		
5										
6										

Depth/Horizons:

- Core to least 50cm deep. If not possible, say why (e.g. too compact, bedrock, permafrost, frozen, etc.).
- Leaf litter is usually only found in forested ecosystems. Record this as increasing number. E.g. 6-0 cm means 6 cm of litter on top of soil.
- O, A, B, C horizons are below the litter layer; and is recorded as decreasing numbers. E.g. O = 0-10cm; A = 10-15cm; B = 15-40cm+.

Type/Texture for the Leaf Litter Horizon (LFH)

- Record what you see: Twigs, leaves, needles, scat, etc. Is it partially decomposed? fully decomposed?

Type/Texture for Organic Horizons (O)

- Fibric: Von post 1-3. Plants still identifiable, not very decomposed, when squeezed water is clear/light brown.
- Mesic: Von post 4-6. Plants somewhat recognizable but vague, moderately decomposed, when squeezed water is muddy brown.
- Humic: Von post 7-10. Plants not recognizable, very decomposed, when squeezed water is very dark/almost pasty.

Type/Texture for Mineral Horizons (A, B, C): Use Mineral Soil Texture Guide for the feel, worm, ribbon, moist cast, and shine tests.

- Sand: Feels gritty, can feel individual grains of sand.
- Silt: Feels floury when dry. Feels slippery/soapy when wet.
- Clay: Forms hard lumps when dry. Feels sticky and you mold/create shapes when wet.
- Loam: A mixture, at least 20% of each sand silt and clay. Usually 40% sand, 40% silt, 20% clay.

Colour: Only record for Mineral Horizons

- Use Munsell Book to identify colour for mineral soil horizons. E.g. 10YR, 2/3 - Hue (colour), Chroma (light/dark) / Value (bright/grey).
- If you don't have a Munsell, record the colour type: E.g. very dark brown, medium grey, light yellowish brown, etc.

Hydric Signs: (there can be more than one)

- (C) Redox Concentrations: red/orange/yellow (Fe/Mn) splotches/streaks in the soil. Can occur with/without depletions. "Mottling"
- (D) Redox Depletions: typically, light-medium grey soil with blue/green undertones. Can occur with/without concentrations. "Gleying"

Strength of Hydric Signs

- (P) Prominent: confident it is present and is dominant in the soil profile. You can see the hydric sites from standing.
- (D) Distinct: confident that it is present, but not dominant in the soil profile. You can see the hydric signs from arms length.
- (F) Faint: barely visible, or unsure if present. You think you can see hydric signs, but only when viewed up close (nose length).

Data collection to support the Canadian National Wetland Inventory in BC

Data Sheet adapted from: "B.C. Ministry of Forests and Range. 2010. Field manual for describing terrestrial ecosystems. -- 2nd ed. Land Management Handbook 25. Co-published with B.C. Ministry of Environment." And "Watson, K., and D. Pennock 2016. Section 3. Soil Profile Description. From: D. Pennock, K. Watson, and P. Sanborn. 2016. Field Handbook for the Soils of Western Canada. Pedology Subcommittee, Canadian Society of Soil Science." And "US Army Corps of Engineers. 2010. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0."



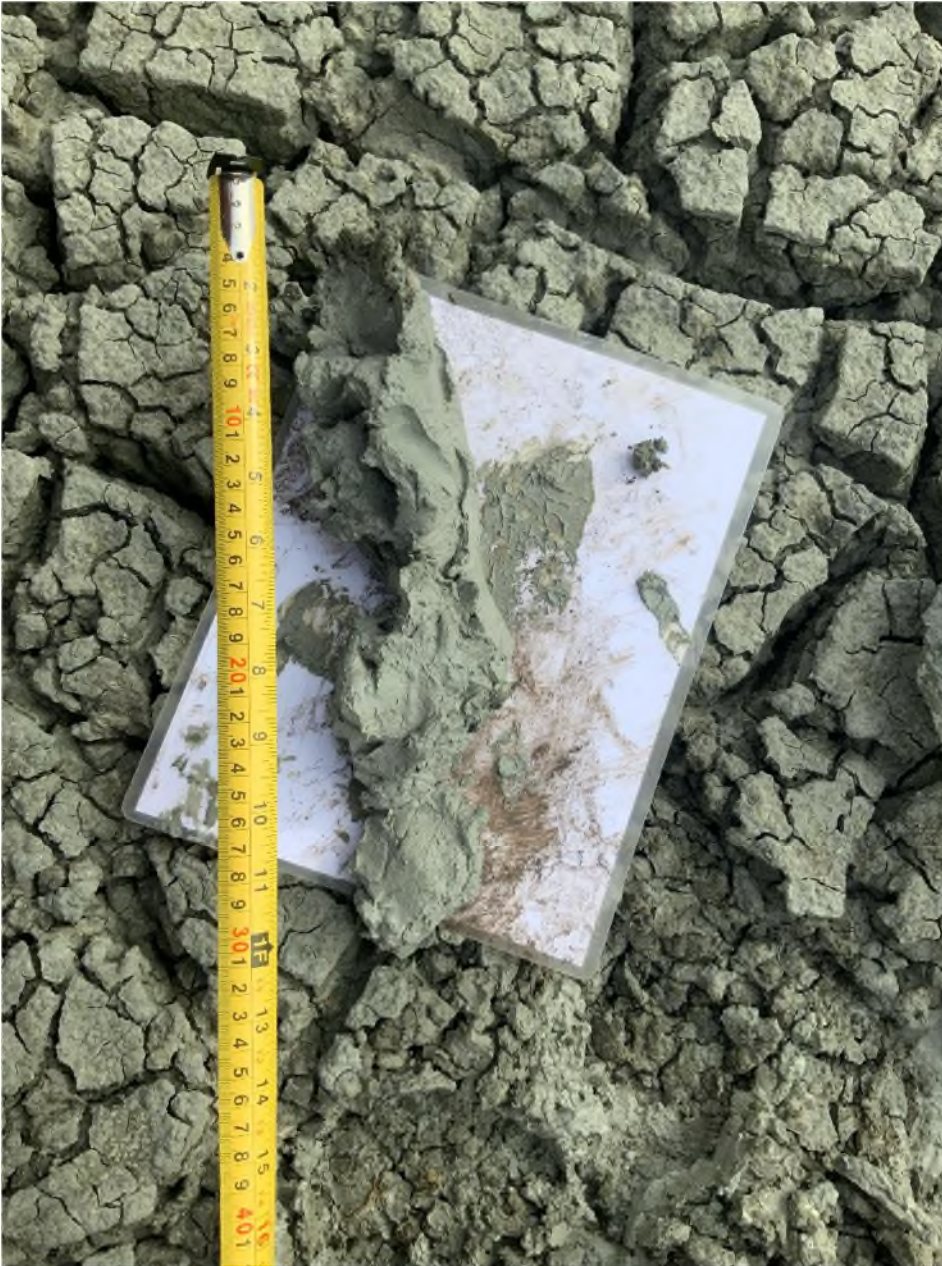
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APPENDIX-B. EXAMPLE SOIL PROFILE

Soil Profile Example 1



What is good about this photo:

- Contains a ruler
- Good lighting, very clear/crisp
- On white laminated sheets for contrast

What could be improved:

- Depth is <50 cm
- Soil core could be straightened along white paper
- Fingerprints / smears along outside of profile will alter the Munsell colour reading

General notes about profile:

- This is a great example of blue grey gleying “gleige”
- The soil surface cracks are a clear sign of wetland hydrology
- This wetland is an alkaline (salt) mudflat in the interior of BC
- CNWI Wetland Class = Shallow Open Water with mineral wetland class and seasonal hydroperiod

Soil Profile Example 2



What is good about this photo:

- Contains a ruler
- On white laminated sheets for contrast
- Depth is >50 cm
- GPS location included
- Plot ID on photo

What could be improved:

- Lighting
 - Shaded for most of the profile which affects ability to view / compare colour
- Busyness (datasheets, Munsell, auger, corner of field technician)
- Close up photos of perhaps ~20cm increments would improve clarity and resolution

General notes about profile:

- This was a tricky wetland soil to classify, it was completed during July of a drought year.
- CNWI Wetland Class = marsh with temporary hydroperiod and mineral soil



Soil Profile Example 3

What is good about this photo:

- Contains a ruler
- Auger indicates the direction of depth
- On white laminated sheets for contrast
- Depth is >50 cm
- GPS location included
- Plot ID on photo

What could be improved:

- Lighting
 - OK, could be a more consistent and brighter
- Close up photos of perhaps ~20cm increments would improve clarity and resolution

General notes about profile:

- There is an O horizon ~10cm deep with mesic texture.
- The (suspected) Ah horizon is perhaps borderline humic organic, 10-90cm+. This would be a good soil sample for a water jar test or loss on ignition test to confirm organic matter content in the horizon.
- CNWI Wetland Class = treed swamp with seasonal hydroperiod. Mineral soil suspected but not laboratory confirmed.



Soil Profile Example 4

What is good about this photo:

- Contains a ruler
- Good lighting
- Clear/crisp resolution

What could be improved:

- Depth is <50 cm
- No white laminated sheets
- No GPS location
- No Plot ID on photo

General notes about profile:

- This is an organic soil with fibric & mesic textures extending to 40cm
- Wetland classification is a shrubby fen with semi-permanent hydroperiod.



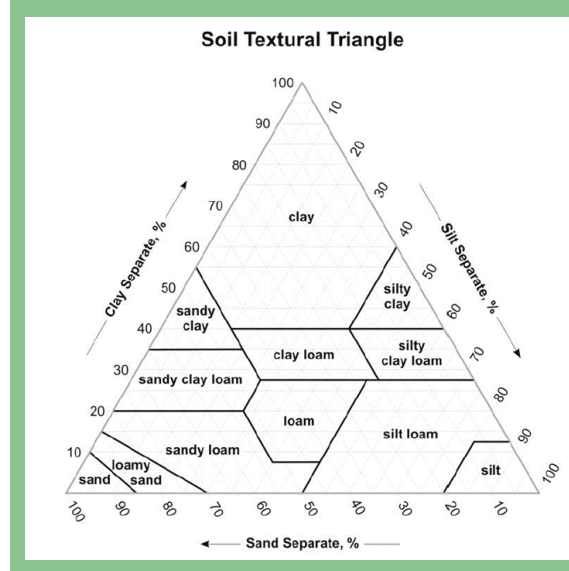
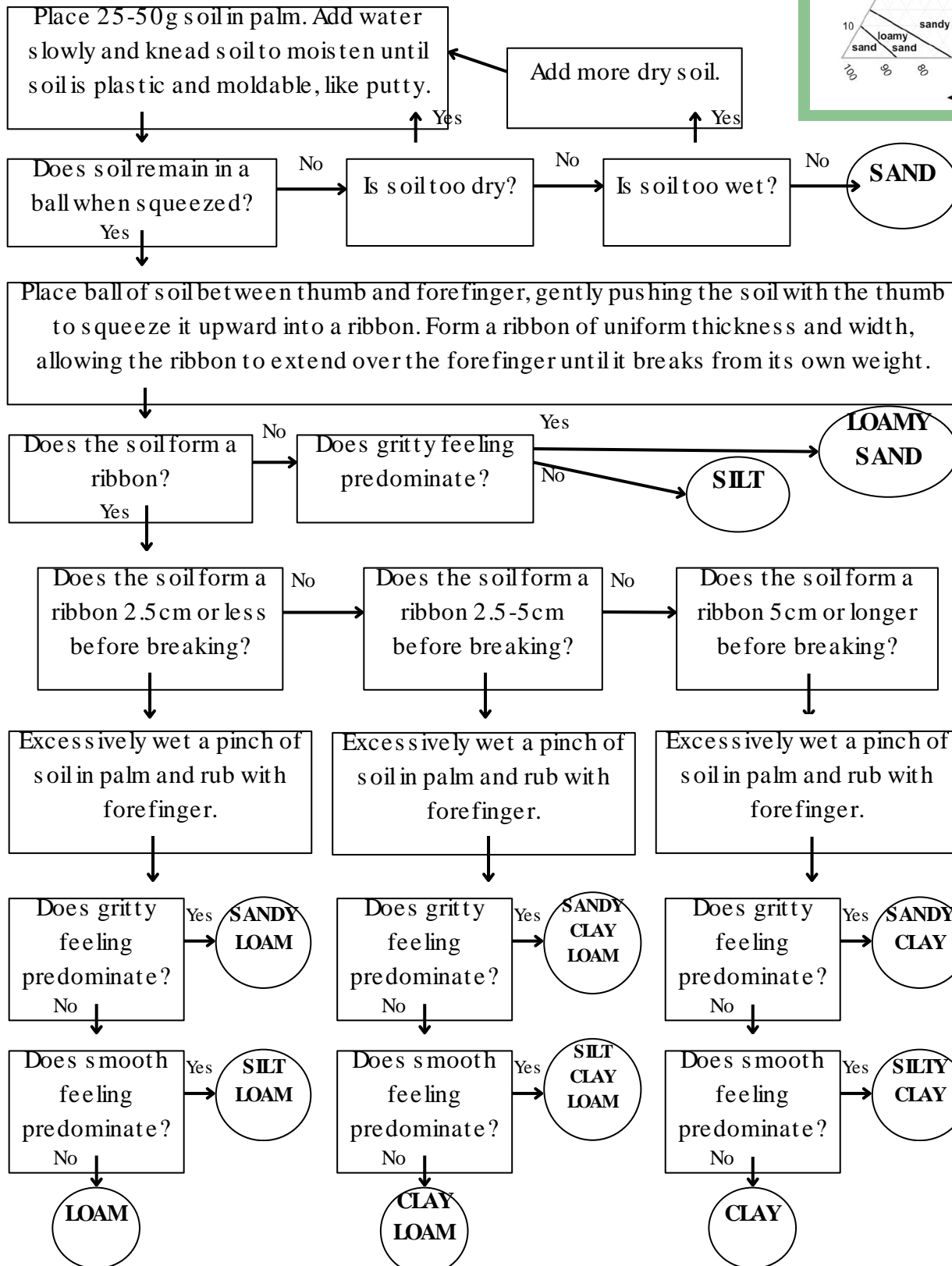
APPENDIX-C. SOIL TEXTURE GUIDE

Soil Classification

Soil develops very slowly, formed by environmental forces acting on mineral, rock, and organic compounds. Soils can be divided into two groups: organic soils and mineral soils. Organic soils are formed from sedimentation and are primarily organic matter. Mineral soils are formed from the weathering of rocks and are primarily inorganic material. To classify a mineral soil, use the Ribbon Test. To classify an organic soil, use the Von Post Scale Test.

START

Mineral Soils - Ribbon Test



Definitions

Mineral soil: Soil with an organic content of less than 30%

Organic soil: Soil with an organic content of greater than 30%.

Sand: 0.06 – 2 mm

Silt: 0.004 – 0.06 mm

Clay: <0.004 mm

Loam: Relatively equal parts sand, silt, and clay

Hint

Clay tends to feel sticky, like a ball of sticky-tack/pottery.

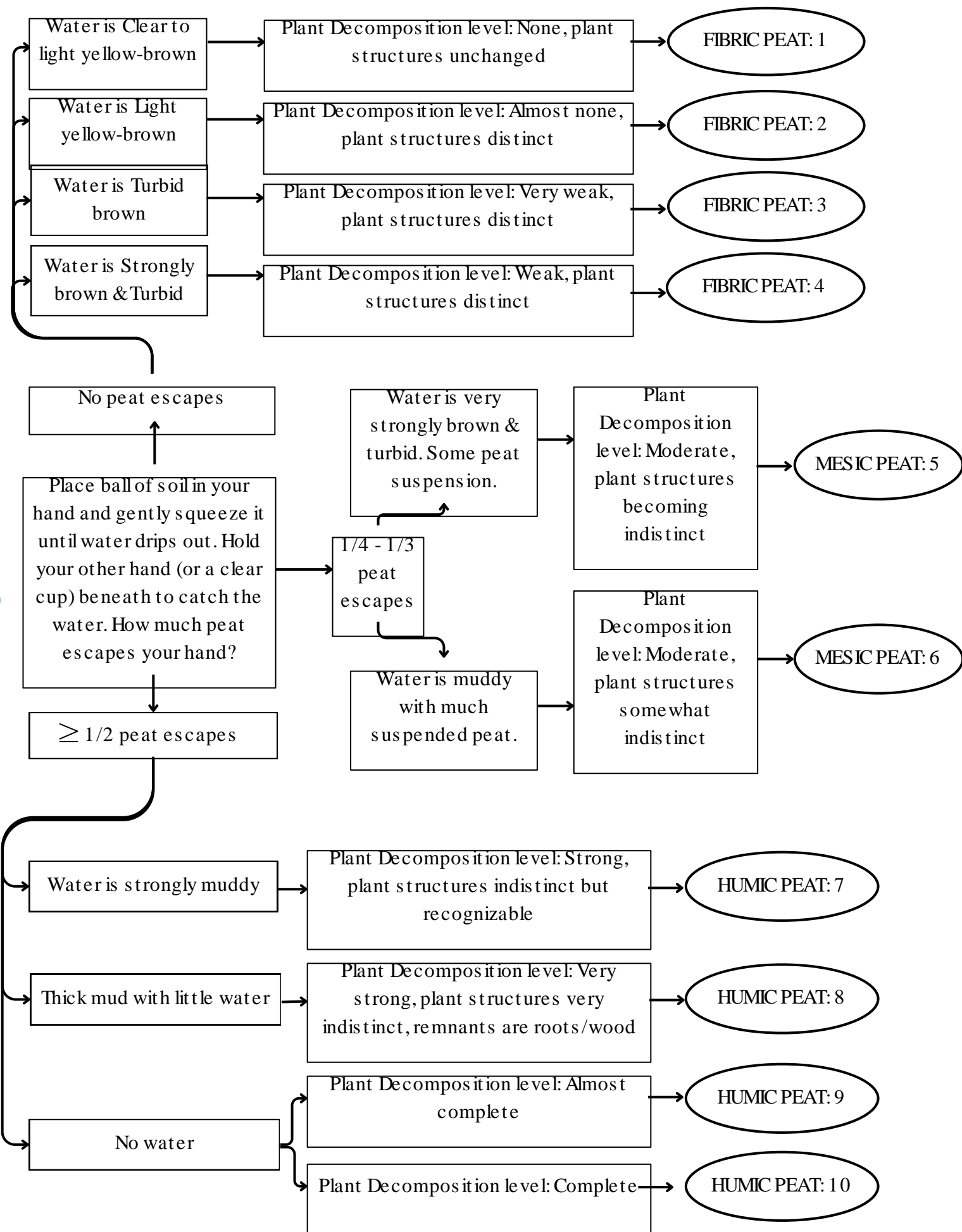
Silt tends to feel soapy/floury.

Sand tends to feel gritty.

Soil Classification

Organic Soils - Von Post Scale

START





APPENDIX-D.DWARF AND LOW WOODY VEG LIST

CNWI BC Field Guide Appendix D –

List of dwarf shrubs, low shrubs to include in the ground vegetation stratum on the CNWI Vegetation Plot Form

Scientific Name	English Name	Synonyms	2024 BC Wetland Plant Ranking
<i>Andromeda polifolia</i>	bog rosemary		OBL
<i>Arctostaphylos uva-ursi</i>	kinnikinnick		FACU
<i>Arctous alpinus</i>	alpine bearberry		FACU
<i>Arctous ruber</i>	red bearberry		FAC
<i>Cassiope lycopodioides</i>	club moss mountain heather		FACU
<i>Cassiope mertensiana</i>	white mountain heather		FACU
<i>Cassiope tetragona</i>	four angled mountain-heather		FACU
<i>Chimaphila menziesii</i>	Menzies'prince's pine		UPL
<i>Chimaphila umbellata</i>	common prince's pine		UPL
<i>Dryas drummondii</i>	yellow mountain avens		UPL
<i>Dryas integrifolia</i>	entire leaved mountain-avens		UPL
<i>Dryas octopetala</i>	mountain avens		UPL
<i>Empetrum nigrum</i>	black crowberry		FAC
<i>Gaultheria hispidula</i>	creeping-snowberry		FAC
<i>Gaultheria humifusa</i>	alpine teaberry		FAC
<i>Gaultheria ovatifolia</i>	western teaberry		FACU
<i>Harrimanella stelleriana</i>	Alaska moss-heather		FACU
<i>Kalmia microphylla</i>	western bog-laurel		FACW
<i>Linnaea borealis</i>	twinflamer		FACU
<i>Loiseleuria procumbens</i>	alpine azalea		not ranked
<i>Luetkea pectinata</i>	partridge foot		FACU
<i>Oxycoccus macrocarpus</i>	large cranberry	<i>Vaccinium macrocarpon</i>	OBL
<i>Oxycoccus oxycoccus</i>	bog cranberry	<i>Vaccinium oxycoccus</i>	OBL
<i>Penstemon davidsonii</i>	Pdavidson's penstemon		UPL
<i>Penstemon ellipticus</i>	oval-leaved penstemon		UPL
<i>Phyllodoce empetriformis</i>	pink mountain heather		FAC
<i>Phyllodoce glanduliflora</i>	yellow mountain-heather		FACU
<i>Polygonum cuspidatum</i>	japanese knotweed	<i>Fallopia japonica</i>	not ranked
<i>Polygonum paronychia</i>	black knotweed		UPL
<i>Polygonum polystachyum</i>	milkwort knotweed		FACU
<i>Polygonum sachalinense</i>	Giant knotweed	<i>Reynoutria sachalinensis</i>	not ranked
<i>Rhododendron groenlandicum</i>	labrador tea, trappers' tea		FACW
<i>Rhododendron lapponicum</i>	lapland rhododendron		UPL
<i>Rubus nivalis</i>	snow bramble		UPL
<i>Rubus pedatus</i>	five-leaved bramble		FACU

Scientific Name	English Name	Synonyms	2024 BC Wetland Plant Ranking
Rubus pubescens	dwarf raspberry		FACU
Rubus ursinus	training blackberry		FACU
Salix arctica	arctic willow		FAC
Salix cascadiensis	Cascade willow		UPL
Salix nivalis	dwarf snow willow		UPL
Salix petrophila	tea-leaved willow		FACW
Salix polaris	poldar willow		UPL
Salix reticulata	net-veined willow		FAC
Salix stolonifera	creeping willow		FACU
Vaccinium caespitosum	dwarf blueberry		FAC
Vaccinium myrtillus	velvet-leaved blueberry		UPL
Vaccinium scoparium	grouseberry		UPL
Vaccinium vitis-idaea	lingonberry		FAC
Adapted from: B.C. Ministry of Forests and Range and B.C. Ministry of Environment. 2023. Field Manual for Describing Terrestrial Ecosystems 2nd Edition. Land Manage. Handb. No. 25.			