

Alberta Biodiversity
Monitoring Institute

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Wetland Field Data Collection Protocols

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ABMI

ALBERTA BIODIVERSITY
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BACKGROUND

This document describes the wetland field data collection protocols (methodology) presently being used by the Alberta Biodiversity Monitoring Institute (ABMI). Initial field protocols for wetland data collection for the ABMI were developed in 2004. A group of scientific experts developed cost effective methodologies to monitor aquatic biota and habitats. Wetland protocols were field tested during 2004-2006. Revisions were implemented to make the protocols more cost effective and to remove inconsistencies among the elements.

PART 1: MANAGING DATA QUALITY AND INTEGRITY

FIELD TECHNICIAN TRAINING PRIOR TO DATA COLLECTION

Field technicians receive extensive training, in the classroom and field, prior to performing each type of data collection. Technicians first become familiar with the protocol documents, field manuals and general field procedures; then practice data collection in a diversity of habitats (Figure 1). This training includes learning what to do in a variety of field conditions, as well as conducting data collection at practice sites. Questions that arise during training will be discussed with field supervisors, and the comprehension and capability of each technician will be monitored and tested prior to the completion of training, such that all technicians will be sufficiently prepared when they begin field data collection. To ensure that data collection remains accurate through the season and nothing is being missed, technicians must review the protocols regularly.

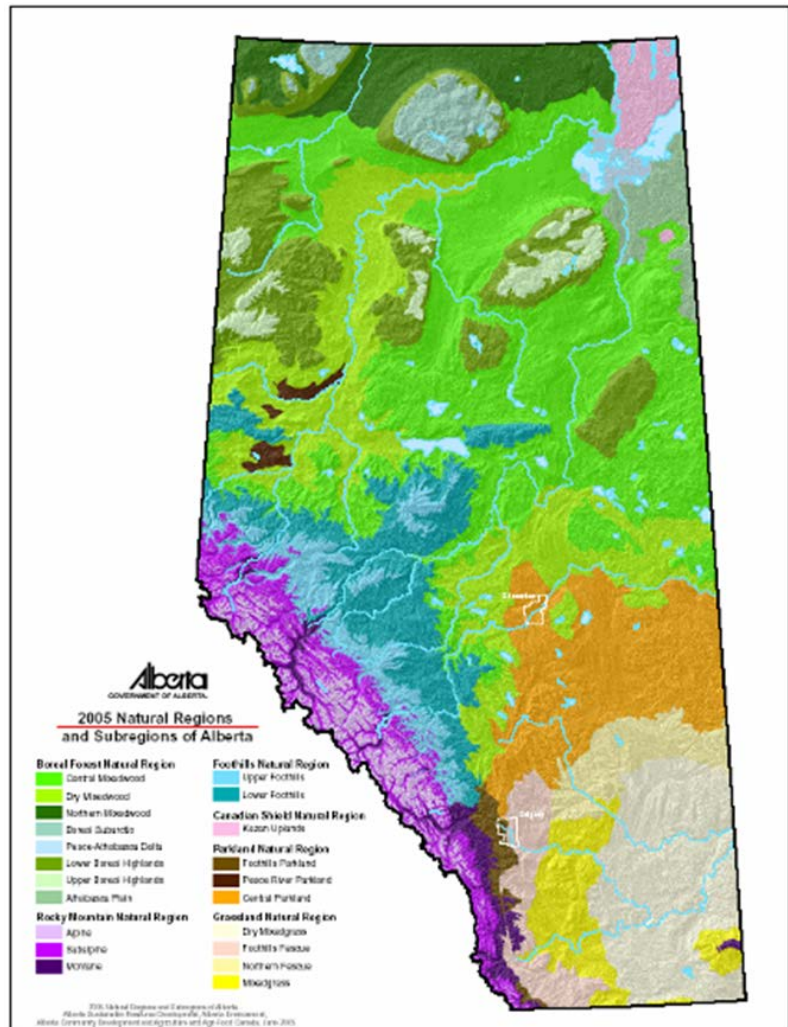


Figure 1. Alberta natural regions and sub-regions

FIELD DATA COLLECTION

Technicians will be responsible for recording information on electronic tablets or paper data sheets while conducting field protocols. Data recorded must reflect exactly what was found/measured at the site. If options for the data field do not include an appropriate response, technicians must record the most appropriate descriptors and make extensive notes. It is not permissible to create new categories or descriptors. All fields on the tablet or data sheet must have information recorded – in some cases it may be a ‘zero’ (None or 0), ‘variable not applicable’ (VNA) or ‘did not collect’ (DNC). Technicians must make every effort to collect all required data on the day of the scheduled site visit. Sites completed on the tablet will turn green once all data fields are filled. If data cannot be collected for a specific element, this must be noted in the data and the field supervisor must be advised as soon as possible. If any data is not collected during the scheduled site visit, the supervisor will make arrangements for technicians to re-visit that site and collect the missing data at the next available opportunity.

CHECKING AND EXPORTING FIELD DATA, AND STORING DATA AT CAMP

Data on tablets or data sheets must be checked for completeness before leaving the site; each complete site on the tablet will appear green and data sheets will have no empty data fields. Data must also be checked every evening for legibility and completeness, and backed up on a USB. Two zipped tablet files will be exported per technician; a data review file containing .xlsx files and a data file containing .csv files. GPS waypoints, site photos and photos of any paper data sheets used will also be backed up on the USB. It is unacceptable for a technician not to back up their data every night. Remote crews must send completed data sheets and data on a USB from the day’s site out with the helicopter each day. If written data cannot be fixed so it is legible, the data must be transcribed onto a new data sheet and both copies filed. All data must be stored in as secure an area as possible while in the field (e.g. in a folder or on a USB kept in a safe place in the trailer). Data sheets from one site cannot be taken into the field at another site. Technicians must recollect lost or missing data.

SITE VISITS AND QUALITY ASSESSMENT BY FIELD SUPERVISORS

Each field crew, made up of two technicians, will be visited at one or more sites by a field supervisor as early in each field shift as possible. During the site visit, the field supervisor will complete the following:

- o Check on the general progress of the crew and answer any questions they have regarding protocols.
- o Randomly select at least two data elements and check that data against the actual site conditions.
- o Review the tablet data or data sheets for completeness and clarity.

Crews will always have access, by phone, to one or more supervisors, to ask any protocol related questions. Crews experiencing difficulties will receive the necessary support, and will be re-visited later in the season to ensure data are collected accurately. See [SOP 002](#) for a thorough description of in season data verification.

TRANSFERING FIELD DATA TO A SECURE ABMI LOCATION

Data and samples must be transferred in person to the crew supervisor at the end of each shift. The completeness (all sites are green, and all data sheets present with all data fields filled) and clarity of the data collected will be confirmed during the transfer. Missing data will be recollected when necessary. Field supervisors take the data to a secure office at the end of the shift, or sooner if possible. Data for each site must also be stored on external hard drives. Data collected on data sheets must be transferred into the tablet program and the data files updated. Complete shift data files are sent to the Information Coordinator at the ABMI Information Center. Original data sheets are not allowed to leave the office, and all data sheets are copied once, and stored in a separate, secure location for safekeeping in the event of damage to the original.

DATA ENTRY AND VERIFICATION – POST SEASON

Data are transferred into a customized electronic database at the Information Centre. Data is verified by field supervisors, and it is ensured that all values are consistent and use the allowable codes. Any values that were entered incorrectly must be examined by the field supervisors who will determine if the intended value is unmistakable (in which case a correction is made and noted), or if the value must be re-entered as DNC (did not collect). See [SOP 001](#) for a thorough description of post season data verification.

PROTOCOL OVERVIEW

Selected wetlands in the prairies and parkland are sampled between June 15 and July 31 to ensure most vascular plants have reached maturity. In the boreal and mountains, wetlands are sampled between June 27 and July 31. Data are collected for a variety of species and habitats at each ABMI wetland site (Table 1).

Table 1. Types of data collected at ABMI baseline wetland sites.

General Habitat	Detailed Habitat	Taxa
- Physical characteristics (latitude, longitude, elevation, AWCS type) - Site Photographs - Chemistry, turbidity, nutrient content and isotopic signature of water in the wetland - Area covered by open water, emergent vegetation, graminoid vegetation, and wooded vegetation % cover of water, bare ground, low vegetation, shrubs, and trees around the wetland - Area and type of human created disturbance in and around the wetland	Trees (dead standing)	- Vascular Plants - Aquatic Invertebrates

SITE INTEGRITY

It is imperative that the integrity of the sampling area is preserved each time a site is visited. This is especially important around high traffic areas (e.g. access points and the fixed transect line). Every effort must be made to tread lightly to minimize disturbance that could alter site characteristics in future surveys (e.g. the boat and equipment are stored away from the fixed transect line).

CLEANING EQUIPMENT BETWEEN SITES

The transfer of harmful aquatic organisms and pathogens between wetlands is a concern during wetland data collection. In order to minimize the transfer of organisms, it is important to clean all equipment that contacts the water or wetland soils before going to a new site. See ABMI's [Fish Health/Aquatic Invasive Species Decontamination](#) document for specific procedures.

To reduce the spread of invasive species, trucks and quads must be washed between blocks. It must be ensured that the tires, racks, decks, and foot rests are clean. When moving between blocks, the trucks and quads must be taken to a car wash, and any mud or vegetation that may still be attached to any of these, carefully removed. The same care must be taken to clean trailers and other equipment used, such as ARGOs. Special attention must be taken to remove all of the dried mud and plant material from the exhaust, rims, and the brake areas. When accessing sites on private land, trucks and quads must be washed before and after the visit.

SAFETY

Safe practices are of utmost importance when working in aquatic systems. Field technicians will be provided adequate training for the equipment they are using. Technicians must work in pairs (or larger groups) at all times, and avoid situations that pose high risks. The bottom of many water bodies that look shallow, often consist of a thick layer of unconsolidated material that can be difficult to move through. In addition, many wetlands have floating vegetation mats that must be crossed before reaching open water, and it is possible to break through these mats. A personal flotation device (PFD) must always be worn when working in wetlands. It is important to enter wetlands cautiously if the bottom is not visible – the depth should be checked before entering.

Bears, cougars, and ungulates may be encountered in riparian zones. It is important to exercise caution and be aware in these areas as the noise you make may mask the noise these animals make, resulting in close encounters. All field personnel must take a bear awareness course.

PART 2: WETLAND SITE SELECTION

ABMI site locations are based off of the National Forestry Inventory (NFI) 20 km grid. The wetland associated with each NFI grid point is selected by ranking and randomizing water bodies in a 5 km and 10 km radius around each point using GIS and satellite imagery. Candidate wetlands are then ground-truthed to ensure the required conditions are present (see Identification of Candidate Wetlands below). During this reconnaissance, the best access route to the wetland is determined, potential hazards are described, and access descriptions are prepared to facilitate data collection during the summer.

IDENTIFICATION OF CANDIDATE WETLANDS

Candidate wetlands should be within 10 km of the NFI point. Wetlands are identified using satellite imagery and GIS software, and must appear to be:

- o permanent
- o have at least 1.0 ha of open water during July
- o have open water that is > 0.5 m deep during July
- o have the potential for wetland vegetation

Similar candidate wetlands are ordered based on a random numbers table, but in regions where suitable locations are sparse, the wetland alternates are ordered based on suitability.

WETLAND VERIFICATION**EQUIPMENT:**

Access packages

Access maps

Road atlas/ Backroads MapBook

GIS information and reference points

Compass

GPS

Digital camera

Weighted measuring tape

2 m folding measuring stick

Based on the rank order, candidate wetlands are visited to select a suitable wetland for the ABMI.

- An image of the wetland, with the most appropriate scale for the wetland size, is used while conducting site reconnaissance.

Open Water: When assessing the suitability of the wetland, it must be ensured there is sufficient open water (approximately 1.0 ha, but the required area may vary based on wetland shape) to conduct the invertebrate sampling.

To assess open water area:

- Estimate the area of open water by walking the edge of the open water and using the area calculation function on a GPS. The perimeter of the entire wetland does not need to be walked, just enough to accurately estimate the area from the wetland image.
- If the wetland is small enough that it is expected to be < 1.0 ha when sampling during July, or has less than 50 m x 50 m of open water, then assess the next candidate wetland.

Depth: To sample aquatic invertebrates, the wetland must have open water that is at least 0.5 m deep at the time of data collection. In Alberta, wetland water levels generally drop by 0.5 m between spring and summer, so a minimum depth of 1.0 m is required in spring.

To assess water depth:

- Wade into the wetland as close to the middle of the wetland as is safe, and measure depth using a weighted rope. Record the depth in 6 locations spread evenly throughout the wetland with one point at the given wetland center point.
- If it is not safe to wade, use the inflatable kayak to paddle out on the wetland and measure water depth at the 6 locations.
- If neither of the above two methods are possible/ safe, estimate water depth based on emergent vegetation; if cattails are present and alive, we will assume that the wetland will have sufficient water in July to sample aquatic invertebrates.
- If the wetland is shallow enough that it is expected to be < 0.5 m deep when sampling during July, then assess the next candidate wetland.

Wetland Vegetation: Candidate wetlands are assessed for the potential to support wetland vegetation. All wetlands are considered to have potential for wetland vegetation **except** for wetlands with:

1. Bare scree or gravel
2. Vertical drop-off
3. Bare rock or cement

Where wetland vegetation is expected but not apparent, 1.0 m on either side of the shoreline is considered to be the area with potential for wetland vegetation.

To assess wetland vegetation:

- Visually assess what percentage of the shoreline has the potential for wetland vegetation. It is most efficient to do this by estimating what percent of the shoreline is bare gravel, bare rock or a vertical drop off, and then subtracting that amount from 100%.

Shoreline is defined as the location where the open water transitions to another vegetation zone, bare ground, or a beaver dam. If there is a patchy uneven transition from another vegetation zone to open water then determine where there is on average less than 10% cover of shoreline vegetation within a 10×2m area and make that the shoreline (Figure 2). See the [Wetland Zone Classification](#) section for the definition of open water.

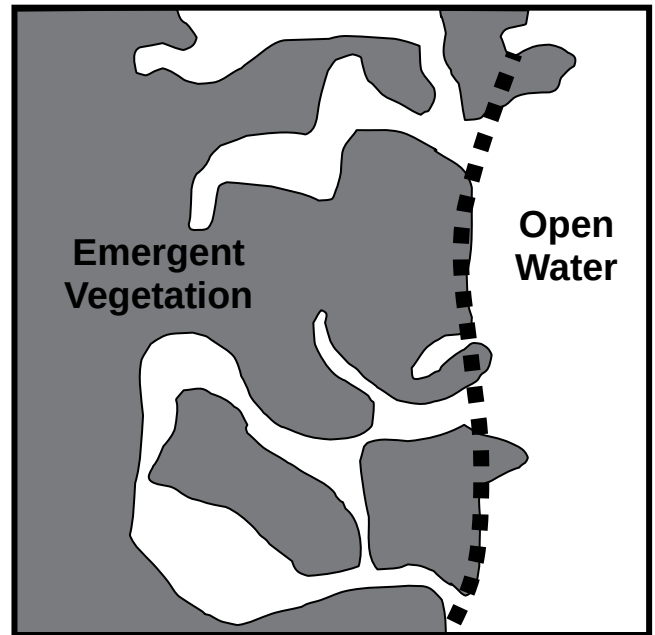


Figure 2: Shoreline is located where there is on average 10% cover of Emergent or other shoreline vegetation within a 10×2m area.

If < 50% of the wetland has the potential for transitional vegetation then assess the next candidate wetland.

Wetland vegetation zones are of secondary importance in comparison to wetland depth.

If none of the permanent wetlands > 0.5 m deep have the potential for wetland vegetation then ignore the wetland vegetation criteria.

Photos: Several photos of the wetland are taken to help assess the wetland. See the [Site Photos](#) protocols in the [Physical Characteristics of Wetlands](#) section.

PART 3: DATA COLLECTION PROTOCOLS

WETLAND ZONE CLASSIFICATION

Wetland zones are defined based on the presence or absence of water above the ground surface or in the soil, wetland classes (organic or mineral), and the dominant vegetation and indicator species (Appendix 2: Common and Indicator Species).

Each wetland is unique and must be assessed for plant composition in each zone on the approach from upland to open water. This will facilitate mapping each zone when working from the boat.

Record whether the wetland, as a whole, is organic or mineral in the tablet. Determine this by observing the plant community (Appendix 2: Common and Indicator Species).

Areas in which plant surveys are conducted must be categorized as one of these 6 zones (Figure 3):

- o **Open-Water zone (OPW)**
- o **Emergent zone (EMG)**
- o **Wet-Meadow-Graminoid (WG)**
- o **Peatland-Graminoid (PG)**
- o **Wet-Meadow-Wooded (WW)** – vegetation surveys are not completed in this zone
- o **Peatland Wooded (PW)** – vegetation surveys are not completed in this zone
- o **Upland (UPL)** – vegetation surveys are not completed in this zone

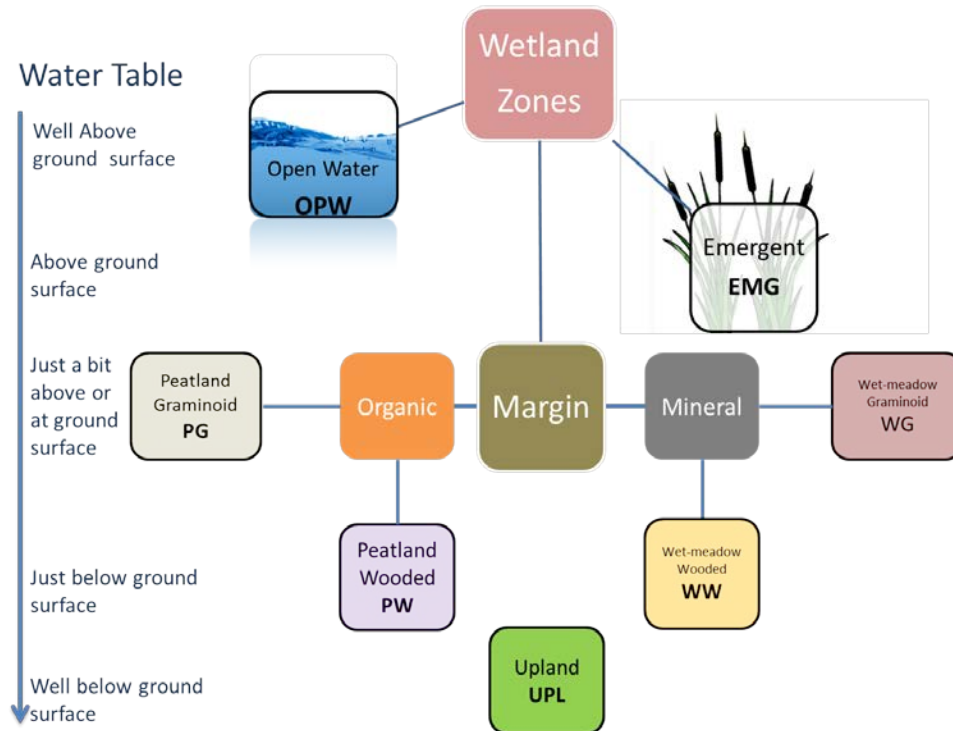


Figure 3: Wetland Zone Delineation Guide

KEY TO DEFINE THE ZONES

1.a. An area of a wetland that has permanent standing water with <10% emergent vegetation cover¹. Submerged plants may develop under water and some plants may have floating leaves or flowering structures that extend slightly above the surface. Non-rooted, floating vegetation may be present in this zone. This zone can also be devoid of vegetation. This zone must always be present when assessing a wetland. Indicator species include Hornwort (*Ceratophyllum demersum*), Spiked watermilfoil (*Myriophyllum sibiricum*) and Sago pondweed (*Stuckenia pectinata*) in Southern Alberta. In Northern Alberta indicator species include, Yellow pond lily (*Nuphar variegata*), Hornwort (*Ceratophyllum demersum*) and Pondweeds (*Potamogeton spp.*).....**Open-Water Zone (OPW)**

- AWCS: All shallow Open Water types, except for Intermittent Saline Wetlands that are dry.

1.b. All other habitat types..... **Proceed to 2**

2.a. An area of a wetland that has water present above the soil surface throughout most of the growing season during most years. This zone is characterised by ≥10% of emergent vegetation cover. Emergent plants are rooted under water but most of their developing structures extend well above the water surface. Species in the emergent zone would not be able to persist in the long term with water levels below the rooting zone. Not every wetland has an emergent zone. Indicator species include: Common cattail (*Typha latifolia*), and Bulrush (*Schoenoplectus spp.*) in Northern Alberta and Common cattail (*Typha latifolia*), Hardstem bulrush (*Schoenoplectus acutus var. acutus*) and Common great bulrush (*Schoenoplectus tabernaemontani*) in Southern Alberta.....**Emergent Zone (EMG)**

- AWCS: All Semi-Permanent Marshes

2.b. All other habitat types **Proceed to 3**

3.a. An area of a wetland that has water present at or just below the soil surface throughout all or part of the growing season during most years. This zone is hydric and is often spongy. In this zone, hydrophytic plants (plants that grow where soil is saturated with water for extended periods) comprise 100% to ≥20% of the species composition. This area may have mineral or organic (peatland) wetland characteristics.....**Proceed to 4 (Wet-Margin Zones)**

3.b. An area where the species composition includes <20% hydrophytic plant species (plants that grow where soil is saturated with water for extended periods). Upland can be mesic, xeric or hygric. Common upland indicator species include White spruce (*Picea glauca*), Pine (*Pinus spp.*), Aspen (*Populus spp.*), Rose (*Rosa spp.*), Beaked hazelnut (*Corylus cornuta*), Juniper (*Juniperus spp.*), and Saskatoon berry (*Amelanchier alnifolia*). Common upland herbs include Yarrow (*Achillea spp.*), Wild strawberry (*Fragaria Virginiana*), Wild vetch (*Vicia americana*), Fireweed (*Chamerion angustifolium*), etc.**Upland (UPL)**

¹ In terms of vegetation, percent cover is the proportion of the ground obscured by a species' leaves, stems, flowers, branches etc. it is estimated as if one were looking down from an aerial view.

- 4.a.** The zone is mineral. The zone is mineral when it has <40 cm of peat (partly decomposed organic materials). Mineral zones are typical of the wetlands found in the prairies but can also be found in wetlands located in the northern regions of Alberta.....**Proceed to 5 (Mineral (Wet-Meadow) Zones)**
- 4.b.** The zone is organic. The zone is organic when it has ≥40 cm of peat (partly decomposed organic materials). Organic zones are typical of the wetlands in the northern regions of Alberta. They are very spongy zones and their ground cover is dominated by brown mosses (fens) or sphagnum (bogs).....**Proceed to 6 (Organic (Peatland) Zones)**

5. Mineral (Wet-Meadow) Zones

- 5.a.** The vegetation cover of this zone usually comprises <10% shrubs and trees². This zone is typically spongy during most of the growing season, during most years. This zone is dominated by hydrophytic plants (plants that grow where soil is saturated with water for extended periods). This zone is typical of wet-meadows. Not every mineral wetland has this zone. In Northern and Southern Alberta a dominance of sedges (*Carex spp.*) is the main indicator of this zone.**Wet-Meadow-Graminoid (WG)**

- *AWCS: Freshwater and Slightly Brackish Seasonal Marshes,*

- 5.b.** This zone is considered the dryer zone of a mineral wetland, and is adjacent to upland. This zone is spongy in the spring or after heavy rain, but can be relatively dry on the surface during most of the growing season. Typically this zone comprises ≥20% species composition of hydrophytic plant species (plants that grow where soil is saturated with water for extended periods). This zone is typical of wet-meadows. In the northern regions, the vegetation cover of this zone usually comprises ≥10% shrubs and trees; however, in the southern regions (e.g. Prairies), shrubs and trees may be completely absent in this zone (in this instance the dryer area of the wet-zone is called Wet-Meadow-Wooded zone). Every mineral wetland has this zone. In the north, indicator species include Willows (*Salix spp.*), Birch (*Betula spp.*) and River alder (*Alnus incana ssp. tenuifolia*). In the south, indicator species include, Willow (*Salix spp.*) and foxtail barley (*Hordeum jubatum*).....**Wet-Meadow-Wooded (WW)**

AWCS : All Temporary Marshes, Moderately Brackish Seasonal Marshes, all Swamps, and Intermittent Saline wetlands that are dry.

6. Organic (Peatland) Zone

- 6.a.** The vegetation cover of this zone usually comprises <10% shrubs and trees². This zone is typically spongy during most of the growing season, most years. This zone is dominated by hydrophytic plants. This zone is typical of graminoid fens. Brown and sphagnum mosses are present and are intermixed with sedges and forbs. Not every organic wetland has this zone. A dominance of sedges (*Carex spp.*) is the main indicator of this zone.....**Peatland-Graminoid (PG)**

- *AWCS: Poor or Moderate-Rich Graminoid Fens, Extreme-Rich Graminoid Fens (if sedges are the dominant ground cover) or Shrubby Fens (if shrubs are exception species and sedges are the dominant ground cover), and Graminoid Bogs if sedges are the dominate ground cover.*

² For wet margin zones percent cover of shrubs and trees, excluding exception species, is used as a zone indicator. The following shrub species are **exception species**: Leatherleaf (*Chamaedaphne calyculata*), Bog rosemary (*Andromeda polifolia*), Sargents birch (*Betula x sargentii*) and Sweet gale (*Myrica gale*) These species are adapted to saturated soils and can be found in large quantities in these zones. **IMPORTANT: exception species are included in shrub % cover estimates and AWCS descriptions.**

6.b. The vegetation cover of this zone usually comprises >10% shrubs and trees . Typically this zone comprises ≥20% species composition of hydrophytic plant species. This zone is spongy in the spring or after heavy rain, but can be relatively dry on the surface during most of the growing season. This zone is typical of shrubby and wooded fens or shrubby and wooded bogs. Brown mosses (typically dominate the ground cover of fens) and peat mosses (typically dominate the ground cover of bogs) are present. Every organic wetland has this zone. Common species include brown mosses or sphagnums and sedges (*Carex* spp.). Indicator species include Cloudberry (*Rubus chamaemorus*), Sargents birch (*Betula x sargentii*), Willow (*Salix* spp.), Tamarack (*Larix laricina*), Small bog cranberry (*Vaccinium oxycoccos*.) and Peat mosses (*Sphagnum* spp.).

.....Peatland-Wooded (PW)

AWCS : *Wooded Coniferous and Shrubby Bogs, all Wooded Conifersous Fens, and Shrubby Fens (if shrub species are not exception species)*

OVERVIEW OF BASELINE AND REVISIT PROTOCOLS

BASELINE SITES

At all Baseline sites the following protocols must be completed:

- Establishment of the FTL (Fixed Transect Line)
- Site Photos
- Vascular Plants
- Depth Measurements
- Wetland Sketch
- Shoreline Characteristics
- Water Physiochemistry and Sample collection
- Aquatic Invertebrates

REVISIT SITES

At all Revisit sites the following protocols must be completed:

- Re-establishment of the FTL
- Site Photos
- Vascular Plants
- Wetland Sketch
- Shoreline Characteristics
- Water Physiochemistry and Sample collection
- Aquatic Invertebrates

Note: If the crew accesses a wetland and finds that, despite site reconnaissance, it does not meet the minimum requirements for suitability, the crew contacts the field coordinator for the coordinates of the back-up location.

ESTABLISHING START PIN LOCATION AND THE FIXED TRANSECT LINE

EQUIPMENT

Inflatable boat

GPS

Compass

1.5 m orange conduit, marker buoy and rope

12" metal spike

Flagging tape

RANDOM START BEARING

The Random Start Bearing (RSB) is a random bearing assigned to each wetland in order to determine a point at which to begin wetland surveys. The RSB is taken from the middle of the wetland, and is used to find the point where that bearing intersects the shoreline (Figure 4, Figure 5). Sometimes it is easier to paddle along the shoreline and use the back-bearing of the RSB ($RSB \pm 180^\circ$) to find the intersection with the shoreline.

- Paddle along the shoreline until you reach the back-bearing of the RSB on the GPS, and you are at the transition between the open water and vegetation (see [Wetland Zone Classification](#) section for a description).

FIXED TRANSECT LINE AND START PIN

- Once at the intersection of the RSB and shoreline, use a compass and proceed perpendicular to the general shoreline, away from the wetland, for 60 m. The wetland start pin is established at this location.

Note: The general shoreline angle is determined by averaging the angle of the shore 50 m on each side of where the RSB meets the shoreline.

- Mark the start pin by driving an orange 1.5 m conduit post into the ground so it protrudes 1 m above ground. Attach a marker buoy to the top of the conduit using rope.
- Also, drive a 12" metal spike below the ground surface at this point.
- If the wetland is on private land or in a location where the conduit post is likely to be disturbed by human activity (e.g. in a cultivated field or near buildings), no conduit post or metal spike is used.
- If the wetland is in a provincial or national park, the crew should review the access notes or contact their coordinator to determine if conduit can be used.
- Mark the start pin using a GPS unit and waypoint averaging.

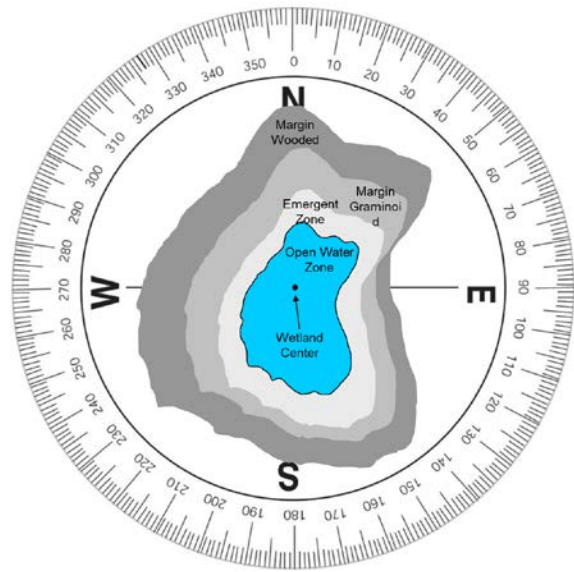


Figure 4. Use the random start bearing to find a random point along the shoreline.

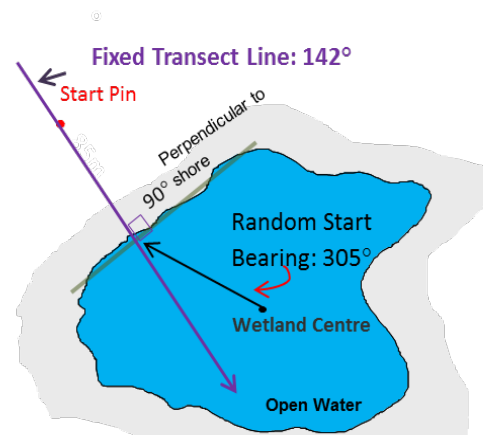


Figure 5. Establishing the Start Pin using the random start bearing (RSB). Note: the fixed transect line (FTL) bearing is taken from the start pin, facing the wetland. The random start bearing is used to find a point on shore, starting at the center of the wetland. The FTL and the RSB will never be the same bearing.

- Standing at the start pin and facing towards the open water, use your compass to determine the bearing of the line that is perpendicular to the general shoreline. This will be the Fixed Transect Line (FTL).
- Record the bearing of the FTL (from the start pin towards shore) on the site access sheet and the data sheets.

All plots and sample points are determined in reference to the FTL.

Note: If the random start bearing intersects with the shoreline at a beaver dam, then place the FTL perpendicular to the direction of water flow. Therefore the FTL should progress to a higher elevation as you move further away from the shoreline. Therefore it should not be influenced by the beaver disturbance. (Figure 6)

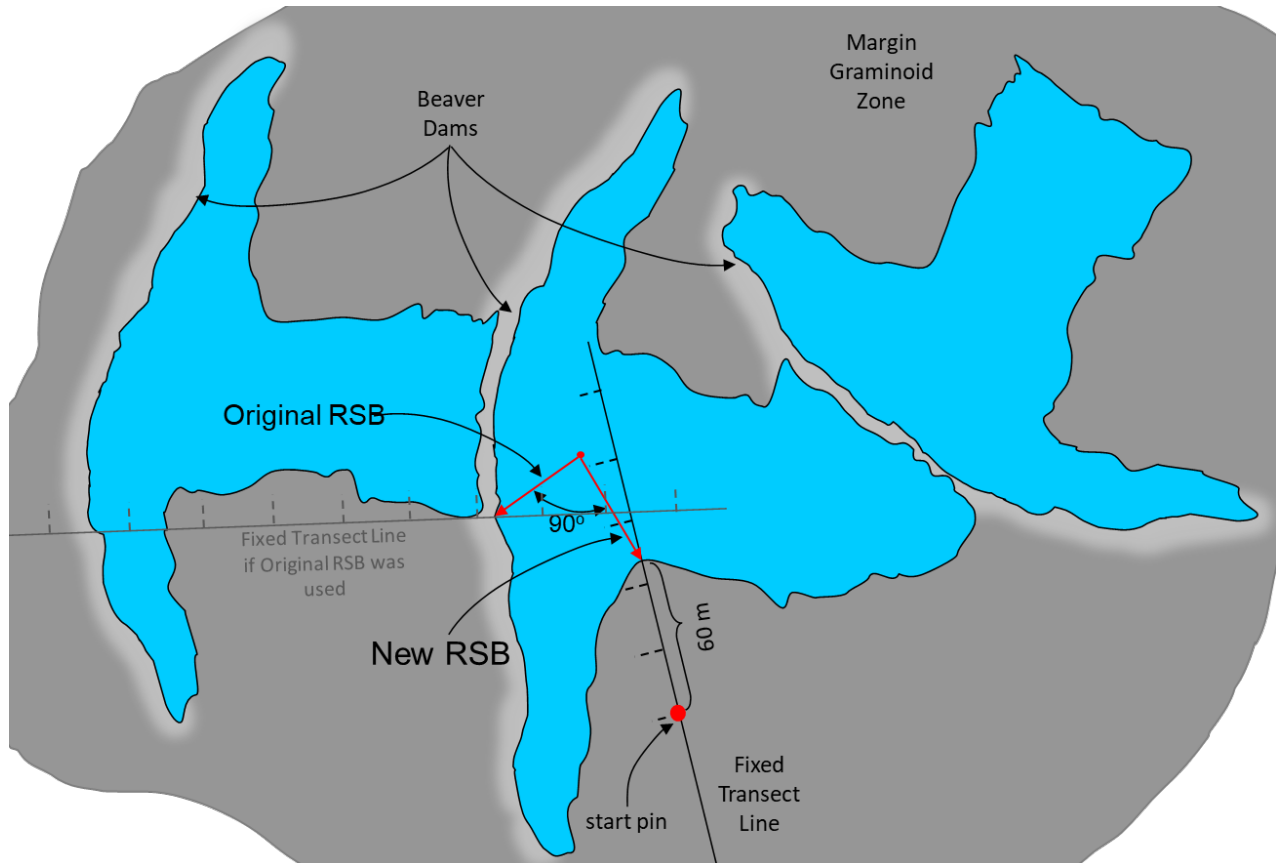


Figure 6. Establishing the Start Pin using the random start bearing (RSB). Note: Because the FTL would pass across a beaver dam and be in wetland zones primarily influenced by a different wetland system, the original RSB is not used. A new RSB at 90° to the original RSB is used to lay out an FTL that goes up the gradient of the valley and through systems whose primary influence is the wetland being surveyed.

TRANSECT RE-ESTABLISHMENT

Our goal when resurveying a wetland is to establish plant plots on the FTL in the same locations they were surveyed during the initial visit.

FIND THE START PIN

- Using a GPS navigate to the coordinates of the Start Pin.
- Search the area for the start pin. The conduit may be difficult to locate or may be submerged under water in some cases.
- A metal detector may be used to find the buried nail if the conduit has been removed.

LAYOUT FTL

- Starting at the Start Pin, use the tape measure and compass to navigate to the shore line on the FTL bearing (Figure 7).
- Ideally using a second measuring tape, start at the Start Pin and navigate away from the Start Pin using the FTL back-bearing.
- Note: If the FTL intersects a beaver dam do not move the FTL or any of the plots.

See the [Vascular Plant Surveys](#) section for more information on re-establishment.

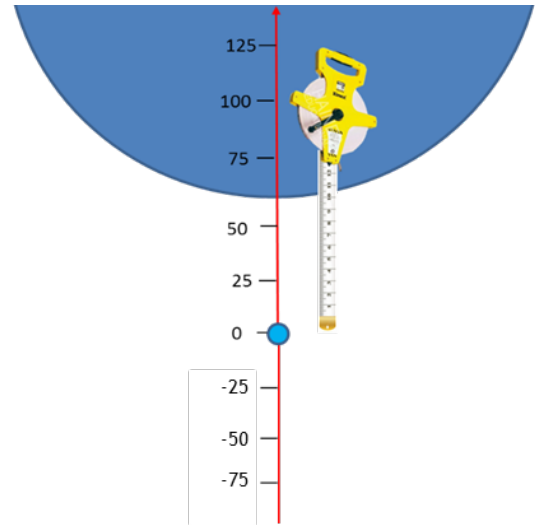


Figure 7: FTL re-establishment (work from the start pin out)

PHYSICAL CHARACTERISTICS OF WETLANDS

These protocols are designed to describe the general characteristics of, and the level of human disturbance immediately surrounding the wetland.

SITE PHOTOS

A total of 5 site photos will be taken at each wetland. Four photos must contain a scale (laminated sheet). All photos must be labelled and backed up daily.

EQUIPMENT

Digital camera
Laminated sheet
Dry erase marker
Inflatable boat
GPS

- Take four pictures of the wetland while standing at the open water-shoreline interface of the FTL and one from the boat as detailed below. **Total of 5 photos.**

Photo direction:

OPW – looking along the FTL toward the open water with laminated sheet
UPL – looking along the FTL toward the upland with laminated sheet
SCL – looking along the shoreline in a clockwise direction with laminated sheet
SCC – looking along the shoreline in a counter-clockwise direction with laminated sheet
SHORE – looking back to shore, on the FTL from 50 m into open water (no laminated sheet)

- Using the digital camera provided, ensure each photo includes the laminated photo-ID sheet (held by a crew member when possible) approximately 5 m away from the camera for scale (except for the SHORE photo). Check the quality of the photos and record the temporary picture numbers in the tablet.

PHOTO BACK-UP AND LABELING

- On a USB, back-up and label photo files as JPEG files, once back at camp. Re-label photo filenames in the following format: **Wetland_[Year]_W[site number]_[Direction]**.
- Store all photos from a shift in a single folder labeled “Site_Photos” as outlined in the ABMI field manual.
- Hand in all photos, by uploading them onto the FTP site, the end of day, or if out of internet service, then the end of each shift. Ensure the transferred files are complete and readable.

GENERAL SHORELINE CHARACTERISTICS AND HUMAN DISTURBANCE

Wetland Quadrants

At each wetland, four quadrants are created (Figure 8).

- o Quadrants for wetlands ≤ 15 ha are centered on the four cardinal compass points and based off of wetland centre (Figure 8).
- o Quadrants for wetlands > 15 ha extend 300 m each along the shoreline in a counter clockwise (quadrants 1 & 2) and clockwise (quadrants 3 & 4) direction from the FTL.

Note that for wetlands > 15 ha, all quadrant lines are perpendicular to the general shore line and thus are not parallel to each other (Figure 8).

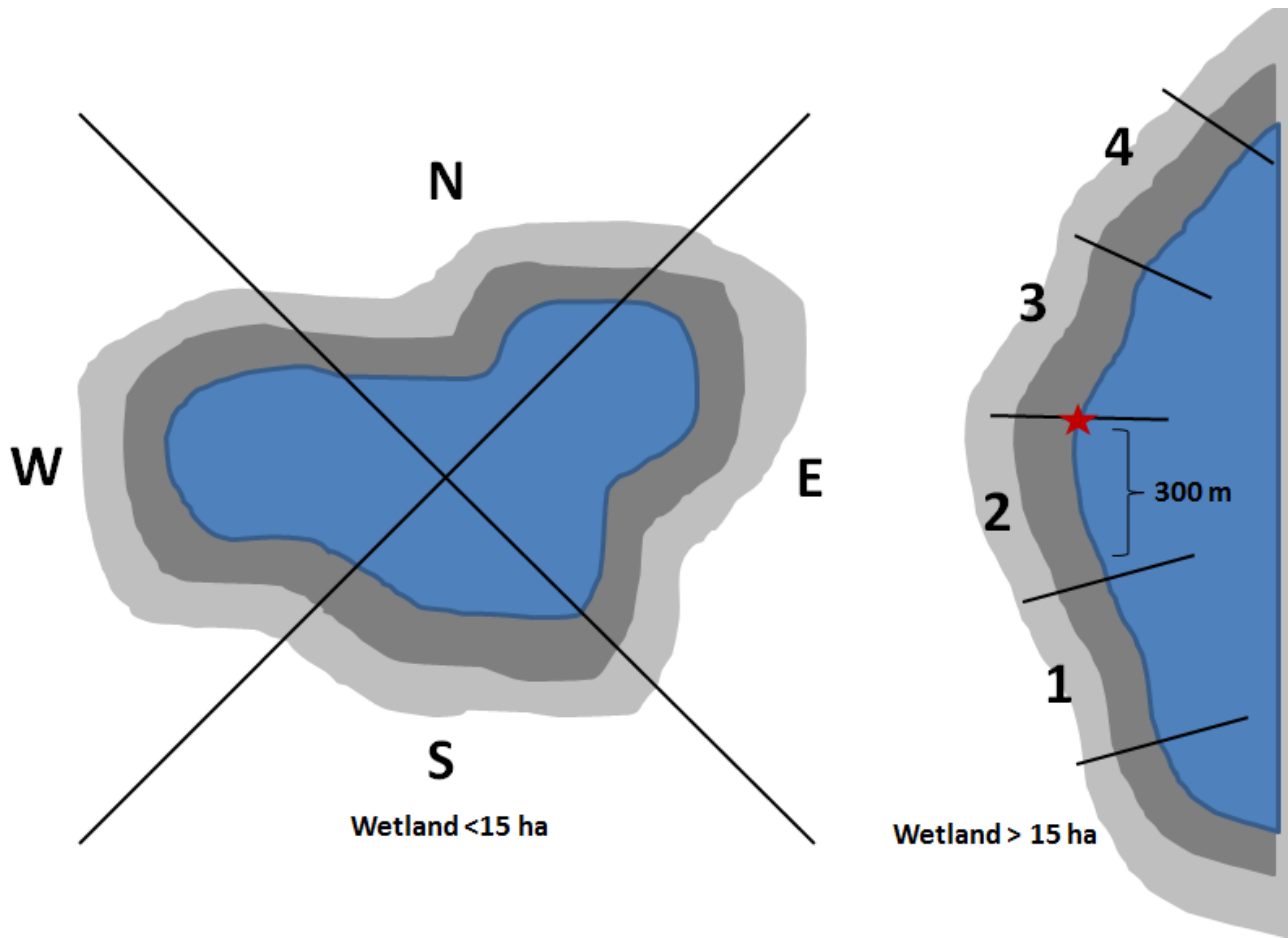


Figure 8. Quadrant set up for wetlands ≤ 15 ha and > 15 ha in size.

SHORELINE CHARACTERISTICS

General shoreline characteristics are determined and recorded separately for each quadrant (Figure 8).

- BETWEEN WETLAND CENTER TO 100 M OF THE SHORE:
 - Record the presence of any surface inflow or outflow large enough for the kayak to travel in (about 1 m by 0.15 m deep, at least 100 m long)
 - Record the presence of beaver made structures such as lodges or a dam.
- WITHIN THE FIRST 5 M OF THE SHORE:
 - Estimate the average height of the tallest layer of vegetation. Record as VNA (if there is no vegetation present), <0.25 m or to the nearest 0.5 m.
- WITHIN 20 M OF SHORE:
 - Record the number of dead trees with a DBH >15 cm using the following categories: 0, 1-5, 6-25, 26-100, or >100

- o Estimate the percent cover in 0, <1%, or in 5% increments, for any human disturbance (Table 2) present, and for each of the following “natural habitat” classes (Table 3). The 5% category includes any cover between 1 and 5%. In terms of vegetation, percent cover is the proportion of the ground obscured by a species’ leaves, stems, flowers, branches etc. it is estimated as if one were looking down from an aerial view.
- BETWEEN 20 TO 100 M OF THE SHORE:
 - o Percent cover of ‘natural habitat’ classes (Table 4) is estimated as 0%, <1%, or in 5% increments. The sum of these percentages must not exceed 100%.

Table 2. Human disturbance codes (The sum of these percentages cannot exceed 100%).

CULT	Cultivation/Agriculture	Any type of cultivated field that is used to grow agriculture crops
PAST	Pasture	Any type of pasture (tame or native), grazing reserve, etc.
HARV	Harvest/Forestry	Any type of forest harvesting (e.g. clear-cut, partial-cut, understory retention, etc.) <30 years old
IND	Industrial	Any type of building, roadway, yard, etc. associated with industrial development
PIPE	Linear Pipeline	Wide linear features associated with the energy industry
POWER	Linear Powerline	Linear features with a line for conducting electrical power
SEIS	Cutline or seismic line	Narrow linear features associated with the energy industry
ROADP	Road Paved	Any type of road with a paved surface
ROADG	Road Gravel	Any type of road with an unpaved but improved (i.e. gravel) surface
TRAIL	Trail	Truck or ATV trail with an unimproved surface
RES	Residential	Human dwelling, farm building, or farm yard in a rural or acreage setting
WELL	Well	Area cleared for oil/gas/CBM pump jacks or well heads
RAIL	Linear – Rail line	Railway
BARE	Bare ground	Human caused bare ground for which cause cannot be determined
PUGG	Pugging/Hummocking from livestock	Game trails, livestock trails, livestock tracks (pugging and hummocks)
CAMP	Recreation/Parking	Recreation facilities including camping and parking areas, improvised campsites and fire pits.
OTHER	Other	Specify other disturbance type (culverts, bridges, garbage etc.)
URB	Urban	Any type of human dwelling, associated building or yard/driveway/road in an urban setting
NONE	No disturbance present	No human caused disturbance

Table 3. Natural Habitats (the sum of these percentages must not exceed 100%).

Water	Any open water (pools, puddles, adjacent wetland)
Bare ground (natural causes)	E.g. waves, overland water flow, slumping, bare ground caused by fire (e.g. burnt moss in a peatland).
Bare ground (human)	Created by human associated activities (fallow field, livestock damage, pavement, dwellings)
Rock	Bedrock, boulders, rocks.
Leaf Litter	Downed dead vegetation material and down woody material < 2 cm in diameter ³
Dead Vegetation	Dead standing vegetation (any size) and down woody material > 2 cm in diameter ³
Lichens, Fungi, and Non-vascular Plants (mosses)	
Forbs	All vascular plants (including cattails) except shrubs, trees, and grasses/sedges/rushes.
Grasses/Sedges/Rushes	
Shrubs	Any non-tree woody vascular plants, and tree species < 1.3 m.
Deciduous trees	Any deciduous tree species that is ≥ 1.3 m in height. NOTE: small trees < 1.3 m in height are included in shrub estimates.
Coniferous trees	Any coniferous tree species that is ≥ 1.3 m in height including Tamaracks. NOTE: small trees < 1.3 m in height are included in shrub estimates.

Table 4. Habitats between 20-100 m of the shore.

Water	Open water.
Bare ground (natural causes)	E.g. waves, overland water flow, slumping, rocks, bedrock.
Bare ground (human)	Created by human associated activities.
Leaf Litter	Downed dead vegetation material and down woody material < 2cm in diameter ³ .
Dead Vegetation	Dead standing vegetation (any size) and down woody material > 2 cm in diameter ³ .
Low vegetation/shrubs (natural)	Includes grasses, forbs, shrubs, and non-vascular plants regardless of height. It does not include trees > 1.3 m.
Low vegetation/shrubs (human caused)	Includes grasses, forbs, shrubs, and non-vascular plants regardless of height, from human associated activities (cutlines, lawns, crop). It does not include trees > 1.3 m.
Deciduous forest	Record if tree species is > 1.3 m and if forest is equivalent to >10% tree cover. If under <10% include in low vegetation (not significant enough to classify as a forest).
Coniferous forest	Record if tree species is > 1.3 m and if forest has > 10% tree cover. If under < 10% include in low vegetation (not significant enough to classify as a forest).

Classes will often be intermingled, making it difficult to estimate percentages accurately. It may be easiest to estimate the percentage in each class after viewing the entire quadrant.

- View each of the quadrants from the boat to determine the vegetation cover.

³ Follow the same rules as the terrestrial spring down woody material protocols when distinguishing DWM from leaf litter.

- Access the shore periodically, to better determine type of vegetation cover and presence of human disturbance, at least once per quadrant and more often when necessary.
- Use satellite images to confirm what you observe from the boat.

Within the 20 – 100 m area, if an area is predominantly forested we would say that area is 100% forested unless we can see clearly a significant piece of a different habitat (e.g. low veg natural) on the aerial map.

BATHYMETRIC MEASUREMENTS

The depth of the water is measured at 3 or more locations within the wetland to determine the location where the depth of the water column is the deepest. GPS points created on GIS are made available and used as a guide in determining sampling locations. GPS locations for each depth sample point are recorded. The deepest point found during bathymetric measurements is used as the initial water-sampling point.

EQUIPMENT:

50 m measuring tape with weighted end

2 m folding measuring stick

GPS

Compass

Satellite images

Tablet

DEPTH MEASUREMENT LOCATIONS

- Depth measurements are taken at 3 or more locations within the wetland. Depth is measured using a folding 2 m measuring stick, or a 50 m measuring tape with the end weighted.
- The following values are used in the depth column as described:
 - o VNA = The wetland is not large enough to survey these points so it is impossible to collect this data.
 - o DNC = Dense vegetation prevents the collection of this data OR the data was not collected due to human error.
 - o 0.0 = The depth of water is < 0.05 m
 - o Values recorded to the nearest 0.1 m

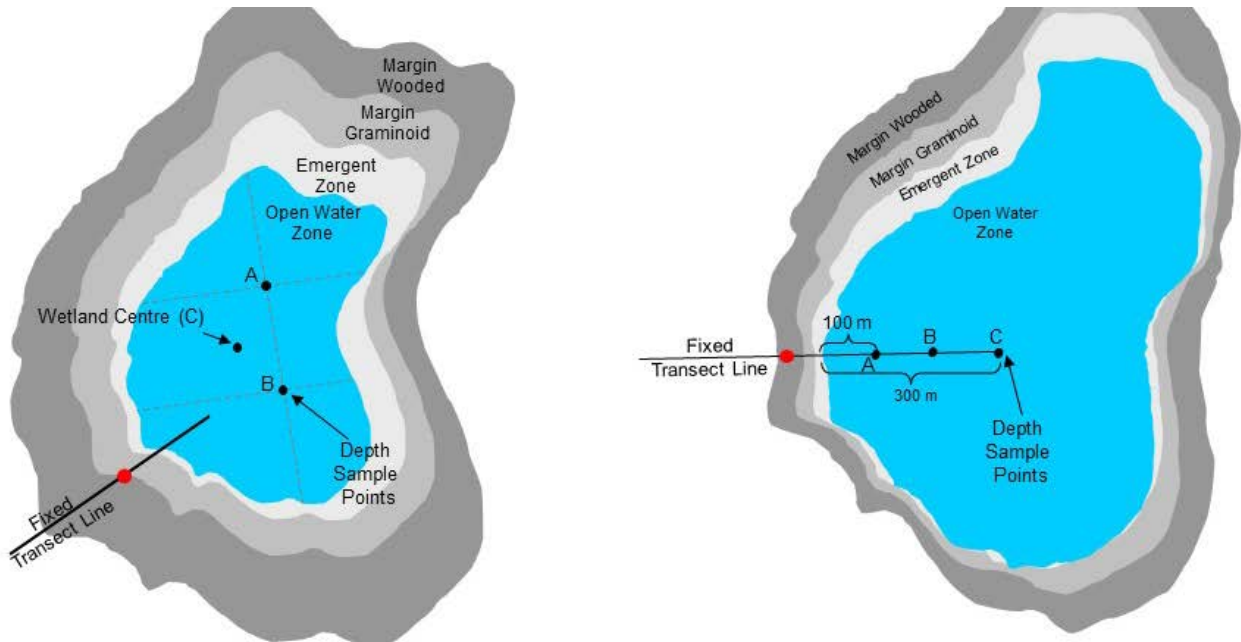


Figure 9. Bathymetric depth measurement layout for a wetland <15 ha (left) and a wetland >15ha modified layout (right).

STANDARD LAYOUT

For wetlands < 15 ha (Figure 9):

Three locations will be provided to search for the deepest point in the wetland. One is wetland centre (C), and the other two points are at 1/3 (A) and 2/3 (B) along the primary axis of the wetland. Measure depth at these 3 points and use the satellite image and your knowledge of the wetland to determine if there may be an area deeper than the ones measured. Measure as many points as required to determine the deepest point and record each depth. Continue naming them in alphabetic order (D, E, F, etc) and submit these waypoints in addition to the ones provided.

Deepest point: the point that is determined to be the deepest should be renamed as W[Site#]-DP (eg. W345-DP).

MODIFIED LAYOUT

For wetlands > 15 ha (Figure 9):

The objective is to determine the deepest point within 300 m of shore along the FTL. Project 3 waypoints from the point where the FTL meets the shoreline using the FTL bearing. Create waypoints at 100 m (A), 200 m (B), and 300 m (C) from the shoreline. Measure the depth at these points.

Deepest point: the point that is determined to be the deepest should be renamed as W[Site#]-DP (eg. W345-DP).

REVISIT SITES

Sites which have been surveyed previously still require three depth measurements. This waypoint (W[Site#]-DP) will be provided to technicians instead of a B location and the given DP should be used to complete the water chemistry and invertebrate protocols.

BACK AT CAMP

- Download the GPS points from the site into OziExplorer.
- Label the site-points file as **Wetland_[year]_W[site number].wpt** (e.g., Wetland_2016_W647.wpt).

Include in this one waypoint file, all site waypoints collected at the site from both field partners GPS's:

- o Start Pin
- o Vegetation plot locations
- o Depth locations including the deepest point
- Include access waypoints in a separate folder labelled "Access" and label the file as **Wetland_[year]_W[site number]_Access.wpt** (e.g. Wetland_2018_W647_Access.wpt)

This will involve downloading waypoints from multiple GPS units and appending the files into one.

- Copy all waypoint files to the FTP site at the end of each day, and ensure the file is complete and readable before shutting down the field computer for the night.

WATER PHYSIOCHEMISTRY

To ensure collection of comparable data among wetlands, water samples and physiochemistry readings are always collected at the deepest point. Two further locations, spaced 25 m apart moving from the deepest point toward open water, are also sampled (Figure 10). The deepest point is determined from the bathymetric depth measurements. Samples are collected and measurements recorded between **1:00 and 2:00 pm** with a 30 minute window, either side, in exceptional circumstances. The location of the deepest water sampling point is noted on the wetland sketch.

EQUIPMENT

Multiprobe meter
Turbidity tube
Nitrile gloves
5 L cooler/jug
Six 1 L Nalgene bottles
One 125 ml Nalgene bottle (dark)
One 30 ml Nalgene bottle
(1 ml) 5% H₂SO₄
Grease pen or sharpie
Masking tape
Icepack
Tablet

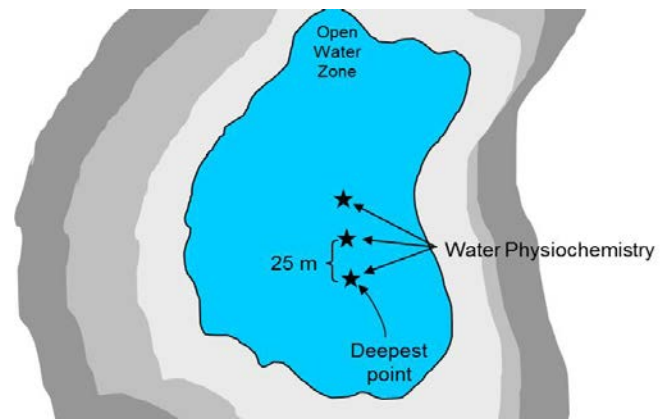


Figure 10. Water Physiochemistry data collection locations: starting at the deepest point, take two more measurements 25 m apart towards open water.

MULTIPROBE CALIBRATION

The multiprobe must be inspected and calibrated for pH, dissolved oxygen and conductivity/salinity as per the manufacturer's directions prior to each shift. The performance of each probe is tested and evaluated prior to the field season to ensure accuracy and consistency. This process is carried out by fulltime staff.

MULTIPROBE READINGS

The multiprobe meter is used to record temperature, pH, dissolved oxygen (mg/L), conductivity (mS/cm), and salinity (PSS) at the wetland.

- If the water is < 2 m deep: Readings are taken from the middle of the water column.
- If the water is > 2 m deep: Readings are taken from 1 m depth.

Ensure your sampling point is:

- Adequate distance from adjacent vegetative zones: > 1 m.
- In an area representative of the chemical, physical, and biological characteristics of the open-water zone.
- Avoid measurement in or adjacent to outlets or inlets.
- Avoid disturbing sediment.

WATER TURBIDITY

Two bottles of water are collected at each of the three water physiochemistry locations sampled. The bottles of water are used to assess light penetration into the water column using a turbidity tube. In total, six measurements are taken. Two measurements will be taken for each of the three sampling locations and recorded in the tablet. Post field season, the average of the two measurements will be calculated by the Information Center to determine the turbidity at a given sampling location.

- To fill the bottles with water, lower each bottle approximately 5 cm below the surface of the water. Label each of the water bottles with the sampling location number from which the water was collected i.e. DP (Deepest point), L1 (Location 1), L2 (Location 2).
- Once at shore, gently flip the bottle of water upside down and back to resuspend particles in the water column. Avoid introducing air bubbles when flipping the water bottle, as air bubbles can interfere with turbidity tube readings.
- Completely fill the turbidity tube using one of the bottles of water collected at the first sampling location.
- Looking down from the top of the tube, determine if the secchi disk at the bottom of the tube is visible.
- If the secchi disk is not visible, using the valve, let the water drain out of the tube until the black and white outlines of the secchi disk appear. Record the height (cm) of the water column in the tube.
- If the secchi disk at the bottom of the turbidity tube is visible when the tube is completely filled with water, record "> 60 cm" in the tablet.
- Completely empty the turbidity tube of its remaining water and repeat the steps above using the second sample of water collected at the first sampling location.
- Repeat the steps above using the water collected at the second and third sampling locations.

NUTRIENT ANALYSES

Water Sample

At each of the three locations sampled, 125 ml of water is collected for nutrient analyses. To avoid contamination and degradation, wear nitrile gloves, and avoid touching the mouth of the water bottles when collecting samples. Ensure the 125 ml sample bottle is completely full.

- Rinse the dark 125 ml dark Nalgene bottle and the carboy three times with water from the wetland.
- Collect a 125 ml sample from just below the surface at each of the three locations (do not disturb the bottom of the wetland or allow coarse organic material to enter the sample bottle). Pour each 125 ml sample into a 5 L

cooler/carboy (replace the lid on the cooler/carboy when traveling to the next sample point to avoid exposure to sunlight).

- Mix the 375 ml composite water sample by gently shaking the carboy, and collect a 125 ml sub-sample in the dark Nalgene bottle.
- Label the Nalgene with a grease pencil (ABMI Site #, Collector's Initials, Date) and store the sample in a cooler with and icepack until it can be refrigerated.

BACK AT CAMP

- Add 1 ml of 5% H₂SO₄ to the 125 ml sub-sample and store at 4 °C (refrigerate or place in cooler with icepack).
- Ensure all the water samples are labeled with a sharpie on masking tape with: ABMI Site #, Date, and Collector's Initials.

ISOTOPE SAMPLE

One 30 ml water sample is collected from the deepest point of the wetland for isotope analysis.

- Rinse the sample bottle three times and wear nitrile gloves to collect the sample by submersing the bottle just below the surface and filling it **completely** (do not allow **any** air bubbles or coarse organic material to enter the sample bottle).
- To include as little air as possible in the sample bottle, submerge the bottle and cap so they both fill with water and tap and turn them to release any attached air bubbles. Screw the cap onto the sample bottle as securely as possible while both are still below the water surface.
- Use a marker (black Sharpie) to label the 30 ml sample bottle: ABMI Site #, Date, and Collector's Initials.
- Store the water sample in a cooler with an icepack until it can be refrigerated.

SHIPPING

- Transport a cooler with ice and with all of the clearly labeled Nutrient and Isotope water samples, to the laboratory for processing (see [Processing Water Samples Protocol](#)).

CONSIDERATIONS

All samples and measurements should be taken in an area representative of the chemical, physical, and biological characteristics of the open-water zone. If the wetland is too small to allow for sampling at two 25 m intervals from the deepest point, then collect the measurements at two equally spaced points between the deepest point and the most distant shore.

Avoid sampling in or adjacent to outlets or inlets and avoid disturbing sediment where possible. Multiprobe readings should be taken at an adequate distance from adjacent vegetative zones: > 1 m.

AQUATIC INVERTEBRATES

Sample Layout:

- CABIN sampling is laid out counter-clockwise from the Fixed Transect Line (i.e. to the right when facing the wetland).
- A single timed (2 minute) sweep-net sample is collected along a sweep-net path.
- The sweep-net path for the CABIN sampling starts at least 25 m along the shoreline from the Fixed Transect Line and extends in the same counter-clockwise direction, more or less parallel to the shoreline.
- The sweep-net path is positioned as follows:
 - Starting at 25 m counter-clockwise from the Fixed Transect Line search along the shoreline for an appropriate area to sample. Avoid disturbing the sampling area prior to collecting the invertebrates.
 - The start of the sweep-net path can be placed anywhere from 25 m to 100 m counter-clockwise from the Fixed Transect Line.
 - The water depth must be at least 0.25 m deep. Although there is no maximum depth, the ideal sample depth is 0.5 to 1.0 m.
 - Select an area with submerged or emergent vegetation that is **representative of the wetland**.
 - The **priority** is to sample directly through submerged aquatic vegetation with at least 50% vegetation coverage.
 - If 50% submerged aquatic vegetation coverage is not present, sample through the submerged aquatic vegetation areas with the greatest % coverage.
 - If only emergent vegetation is present, sample directly within or adjacent to the emergent vegetation zone.
 - If both vegetation types (submerged and emergent) are present within the ideal sampling depth range, and the two vegetation types are directly adjacent to each other, position the sweep-net path along the interface so that sampling can take place in both vegetation types. If the two vegetation types are not close enough to sample both, sample within the submerged vegetation only.
 - If no vegetation is present, conduct the sweeping through the open water within the ideal sample depth zone.
 - In the case of a quick drop-off right along the shoreline (e.g. floating vegetation mat), and in the absence of submerged aquatic vegetation, sample right along the shoreline and jab the net along and under the shoreline rooting zone.
 - Avoid placing the sweep-net path in areas with duckweed and filamentous algae.
 - Lilly pads, although technically floating, are considered submerged vegetation.

Sample Collection:

- A single timed (2 minute) sweep-net sample is collected along the sweep-net path using the 400-micron CABIN net.

- Sweep-netting is ideally done while wading slowly along the sweep-net path. If it is not safe to wade along the sweep-net path, the sampling can be done from a boat with one person sweeping and another person stabilizing the boat and moving it forward with slow, steady progress.
- The pace of forward progress along the sweep-net path will vary depending on the vegetation structure and bottom composition but will generally extend 5 to 15 m in length (note, these distances are a guide only – it is the time of sweeping that is the critical element).
- A timer with an audible alarm (cellphone or stopwatch) is used to keep track of the time spent sweeping.
- The sweeper must pause at the 30 second mark to quickly inspect the contents on the net. If it appears to be collecting lots of vegetation or debris that may interfere with the rest of the sample collection, the 2 minute collection is paused while the contents of the net are placed in sample bottles. Collection continues from the time and place where the sampler left off.
- If the net becomes too full of vegetation or organic debris, the sweeping is paused while the net contents are emptied into sample bottles (usually 30 second intervals will suffice in dense wetlands).
- Any time the net is not actively sweeping (i.e. while inspecting the net or removing excessive vegetation), the timer is paused; the timer is then started from where you left off once sweeping resumes.
- The sweeping is done in a steady side to side, and up-down zig-zag pattern as the sweeper progresses forward at a steady pace that keeps the net ahead of any silt that is disturbed from the bottom while wading.
- The sweeping pattern should cover the entire water column and a path approximately 1.0 m wide.
- If sampling directly in emergent vegetation, a more vigorous approach may be necessary to force the net through and between the stalks. If this is not possible, jab and sweep the net along the edge.
- If the bottom of the wetland feels solid or firm, the net is occasionally tapped lightly on the bottom to stir up invertebrates that are dwelling directly on the bottom.
- If the bottom of the wetland is soft you should only bring the net down to just above the substrate. Do not dig the net into the bottom of the wetland – if mud or silt is present in the sample, the entire sample must be discarded, the net cleaned out, and a new sample taken in a different undisturbed area (do not mistake organic debris for mud/silt).
- If there are weeds hanging outside of the net; the portion of the weeds extending more than 15 cm outside of the net are quickly broken off and discarded. The portion of the weeds extending less than 15 cm outside of the net are placed inside the net and included in the sample.
- Since this is a “cleaner” sampling method, washing of vegetation in the net should not be necessary – but in particularly dense wetlands it is permitted. Sample washing should always be **kept to a minimum** – just enough to get the contents of the net at each 30 second interval into **two** sample bottles.
- Sample bottles must be clearly labeled with the site number, date, collector’s ABMI initials, # of bottles and the word CABIN (e.g. W1618 CABIN).

Other Considerations for All Sample Collection:

The focus is to ensure that we:

- Target aquatic vegetation whenever possible

- Collect as many inverts as possible
 - Collect consistently, year to year and between crews
 - Minimize damage to specimens
-
- Whenever possible the net sweeps need to be done directly in the aquatic vegetation – sweeping directly beside the vegetation is only done when the net can't physically penetrate the vegetation (e.g. dense cattails/rushes with stiff stalks – but even here the net should be vigorously shoved against the stalks to dislodge organisms).
 - Avoid packing too much vegetation into the sample bottles – “wash” and discard **just enough** vegetation to get the samples into the sample bottle(s) (usually about 75% vegetation volume).
 - Avoid forcing things into the sample bottle – a little at a time as opposed to the entire wad at once
 - Make sure bottles are as full as possible (i.e. minimal air bubbles) both at the site and after adding the formalin.
 - Be systematic when adding formalin – we have had the occasional bottle that did not get preserved.
 - Make sure labels are clearly readable and are present on both the top and side of the bottle

BACK AT CAMP

- Preserve samples by adding 10% buffered formalin to each of the bottles. Hold the net or a square of 500 μm screen over the mouth of the sample bottle and drain enough water to allow for the addition of at least 250 ml of 10% buffered formalin. Add the formalin into the bottle slowly rather than dumping it all in at once.
- Using masking tape, label each sample bottle on the lid and side with the following: **ABMI Site#, Date, and Collector's Initials, Bottle number # of x**. Place another label (written in pencil on waterproof paper) with the same information inside each sample bottle. Ensure that the label identifies the number of bottles per site, using: “Bottle 1 of x”.

At the end of the shift a cooler, containing all invertebrate samples, is transported to the laboratory for processing.

VASCULAR PLANTS

The goal is to survey vegetation in up to 9 plots, at each wetland. The following list details how many plots should be surveyed in each wetland vegetation zone, if that zone is large enough (Figure 16):

- o **3 Open Water (OPW)**
- o **3 Emergent (EMG)**
- o **3 Graminoid (WG)/(PG)**

If a zone is absent or small, fewer than 9 vegetation plots may be surveyed. Vegetation plots are placed, perpendicular to, and on the clockwise side of the FTL (Figure 16). When surveyed, supplementary plots must be placed either all clockwise or all counterclockwise from the FTL, and are placed so that the long edge of the plot is parallel to the shoreline (for further explanation of supplementary plots, see [Supplementary Plots](#) in the “Plant Plot Layout” section below). The FTL and all vegetation plots, including supplementary vegetation plots, are drawn on the wetland sketch (details on wetland sketches can be found under the “Wetland Sketch” heading in the “Plant Plot Layout” section). Vegetation plots are **not** surveyed in upland habitats (**UPL**) or Wooded habitats (**WW/PW**). Each wetland is classified as either an **organic** or a **mineral** wetland. This is recorded for the entire wetland in the “Wetland Class” box, in the “Plots” tab of the tablet program. In some instances there may be a mineral pocket in an organic zone and vice versa. Note this in the tablet accordingly for individual vegetation plots, and make comments. The total number of vegetation plots will not change with the presence of both organic and mineral soil types.

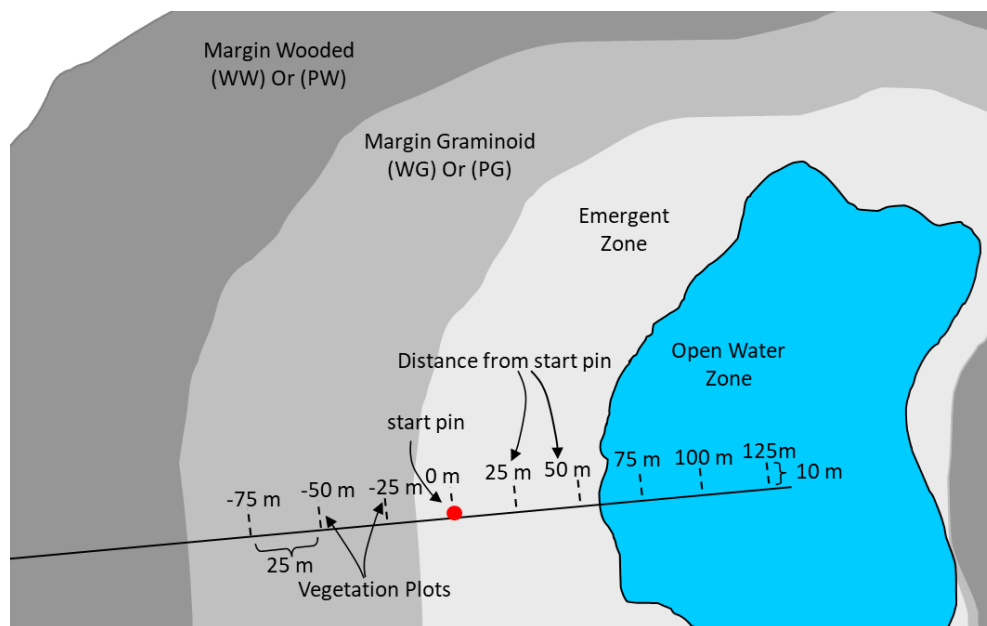


Figure 16. Vegetation plot layout for an ideal wetland; all plots fall on the fixed transect line (FTL). Note each plot's distance from shore.

EQUIPMENT

Plant press
Field guides
100 m tape measure
2 m folding measuring stick
Dip net (500um)
Cultivator
3 x 10 m rope with attached floats and anchors
10 m plot rope with pigtails attached to ends
Large Ziplocs/ Binder with plastic sleeves
Flagging or pigtails

PLANT PLOT LAYOUTVEGETATION PLOTS ON THE FIXED TRANSECT LINE

In an ideal layout, one vegetation plot is located at the Start Pin (60 m from the edge of the open water), and additional vegetation plots are located at 25 m intervals along the FTL, towards and into the open water (5 vegetation plots); and away from the water, often towards upland (3 vegetation plots). Because wetland zones have a variety of shapes and sizes, this ideal layout of vegetation plots on the FTL will seldom occur.

Plots on the FTL are used to monitor change in wetland size and shape over time. If the Start Pin is in the upland, the Start Pin is established and waypoint is made, but a vegetation plot is **not** surveyed at this point.

LAYOUT FOR WETLANDS WITH NARROW ZONES

When sampling wetlands with narrow zones, it is often impossible to sample all 9 vegetation plots on the FTL.

Supplementary Plots

It is often necessary to survey supplementary plots to achieve the desired number of surveyed plots in each wetland zone. If it is not possible to survey the required number of plots in a zone on the FTL, and the zone is present within 150 m of the FTL and no further than 250 m from shore; supplementary vegetation plots are spaced with their starting points 25 m apart along the shoreline, parallel to the shoreline, at stratified distances from shore within the zone, to obtain the required number of plots (3 in the open water, 3 in the emergent vegetation, and 3 in the -graminoid) (Figure 17).

- Note how many vegetation plots are surveyed on the FTL and determine how many supplementary vegetation plots are required.

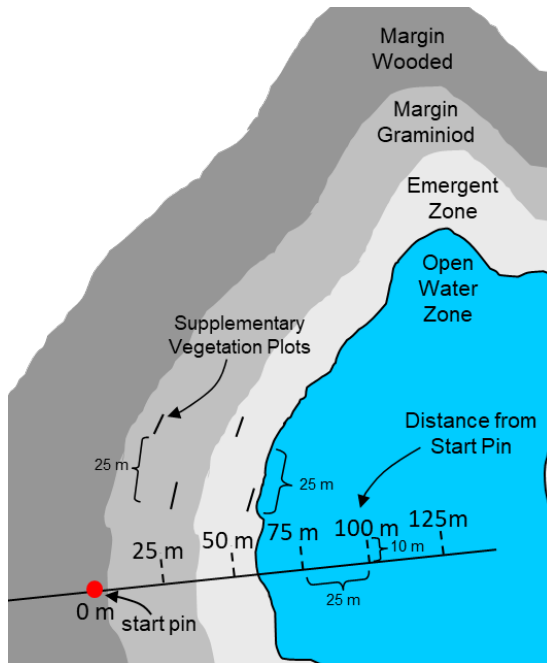


Figure 18. Example vegetation plot layout for wetlands with narrow zones. Supplementary plots are required.

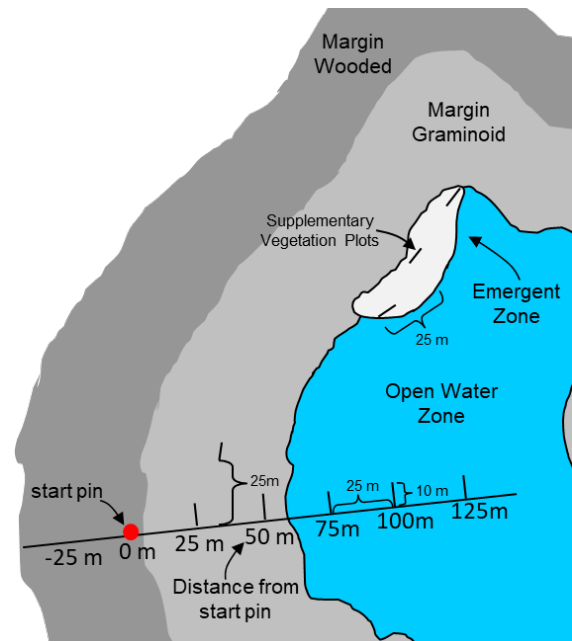


Figure 17: The emergent zone is absent on the fixed transect line (FTL) but surveyed in supplementary plots.

For the example in Figure 18, only 2 vegetation plots occurred on the FTL within the graminoid zone, 0 within the emergent zone, and 3 within the open water zone. In this case 1, 3, and 0 additional plots are required on supplementary plots for each zone respectively.

It is possible that some zones may not have any vegetation plots along the FTL and thus require all plots to be supplementary plots.

If the wetland is very narrow and 3 OPW plots will not fit, continue the FTL on the other side of the wetland to complete the required plots in the wetland zone present. Then survey additional OPW plots 25 m apart in the same direction as the other supplementary plots to complete the 3 required OPW plots (Figure 19).

Location of Supplementary Plots

Supplementary vegetation plots are added in the appropriate zone(s) around the wetland (Figure 17) and are then surveyed parallel to the shoreline. From the FTL measure 25 m perpendicular to the FTL and place the supplementary vegetation plot at the end of the 25 m interval. Position the plot so that it is parallel to the shoreline at the new location and in the correct wetland zone. Supplementary plots should not be more than 150 m from the FTL.

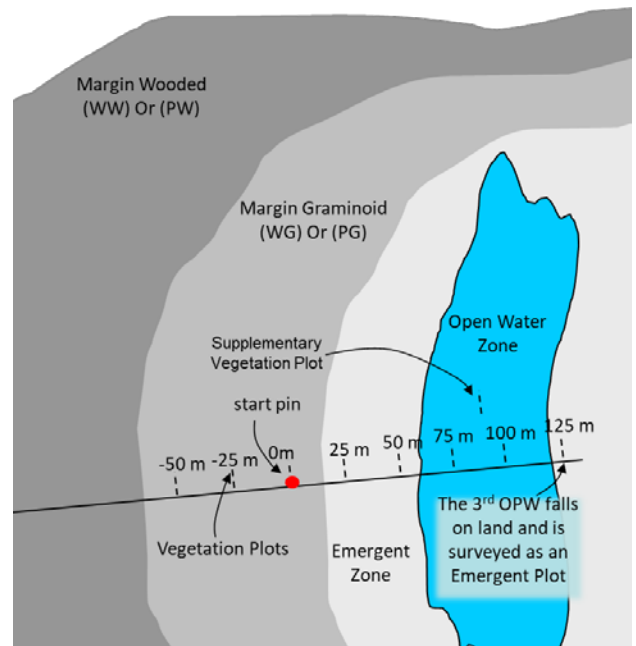


Figure 19: Plot layout for a narrow wetland

All supplementary plots for a wetland must be in the same direction from the FTL, either clockwise or counter-clockwise, based on where the under-sampled zones occur. For some wetlands it will be necessary to have supplementary plots clockwise from the FTL to sample the undersampled vegetation zones, whereas for other wetlands it will be necessary to move in a counter-clockwise direction. It is important to note that supplementary plots can only be established in one direction from the FTL, not both.

Supplementary vegetation plots are stratified throughout each of the vegetation zones (e.g. If two additional emergent plots are required, place them so that their starting points are a minimum 25 m from each other along the shore), and stagger them throughout the zone width.

Avoid placing supplementary plots on beaver dams when possible. Instead skip that area and move down shore, up to 150 m from the FTL.

LAYOUT FOR WETLANDS WITH WIDE ZONES

In rare cases, a zone may be so large that a technician may have to skip plots on the FTL to reach the next zone or may not be able to survey any other zone on the FTL.

- If the graminoid or emergent zone accommodates more plots on the FTL than required, survey the first three vegetation plots in each zone, moving from the Start Pin towards open water or upland, and note which 25 m intervals are not surveyed (Figure 20).
- If a zone appears to be 'endless', the technician should walk out 150 m from shore. If the zone does not transition to another zone and the technician cannot see the zone changing in the next 100 m, the technician will survey available zones, note the inaccessible zones on the FTL and attempt to survey supplementary plots to reach the required number of plots for each zone (Figure 21).

LAYOUT FOR REVISIT SITES

When returning to a wetland that has previously been sampled, the vegetation plots that were originally surveyed on the FTL should be surveyed again in the same locations. Supplementary plots should be used to make up the desired total number of vegetation plots for each zone.

Revisit Vegetation Plots

- When revisiting a wetland site the original Start Pin should be located using the GPS coordinates provided and a visual search.
- If the original Start Pin cannot be found then the Start Pin should be re-established as close to the original GPS coordinates as possible.
- Using the Start Pin, and original FTL bearing, the original plant plots on the FTL should be re-established as close to the original plot locations as possible. These plots should always be at 25 m intervals from the Start Pin, though their distance from shore may vary due to changes in the shoreline over time.
- All original vegetation plots on the FTL should be surveyed regardless of what wetland zone they currently fall in. The following plant plots are verified, their FTL location is confirmed and entered into the tablet, but all other data for the plot is entered as VNA:

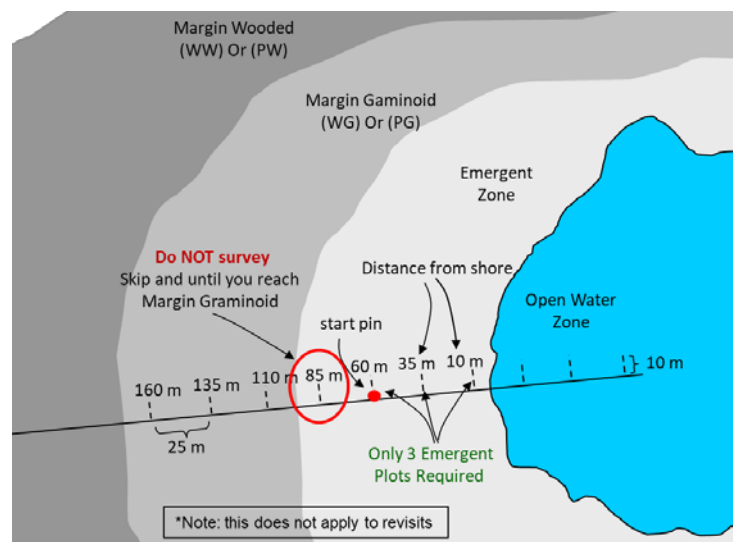


Figure 20: Vegetation plot layout for a wetland with wide zones. This example shows distance from shore which is correct if the wetland is being surveyed for the first time.

- o If the plot location is now representative of Upland or Wooded vegetation zones
- o If there are more than the necessary number of plots for one wetland zone on the FTL (3 OPW, 3 EMG, or 3 WG/PG). For example, if 7 of the original plant plots are OPW during the time of the revisit, only 3 of those plots would need to be surveyed (Figure 22).
- In circumstances where plots on the FTL are not surveyed, but the FTL location is verified:
 - o Full plant plot collections should be distributed as evenly as possible throughout that zone, using the original plot locations (Figure 23)
 - o The original plant plots not surveyed should be visited to confirm the wetland zone and noted in the tablet (Figure 23). All other data is entered as VNA.
- If wetland zones extend beyond the original vegetation plots, more plots may **not** be added to the FTL. Any additional plots that are required must be supplementary plots.
- If the minimum number of plots for each zone is not surveyed with the revisit vegetation plots, and the zone is present within 150 m of the FTL, then supplementary plots should be surveyed in the same direction (clockwise or counter clockwise) as the original supplementary plots. If no supplementary plots were sampled during the first visit then either clockwise or counter-clockwise can be used.

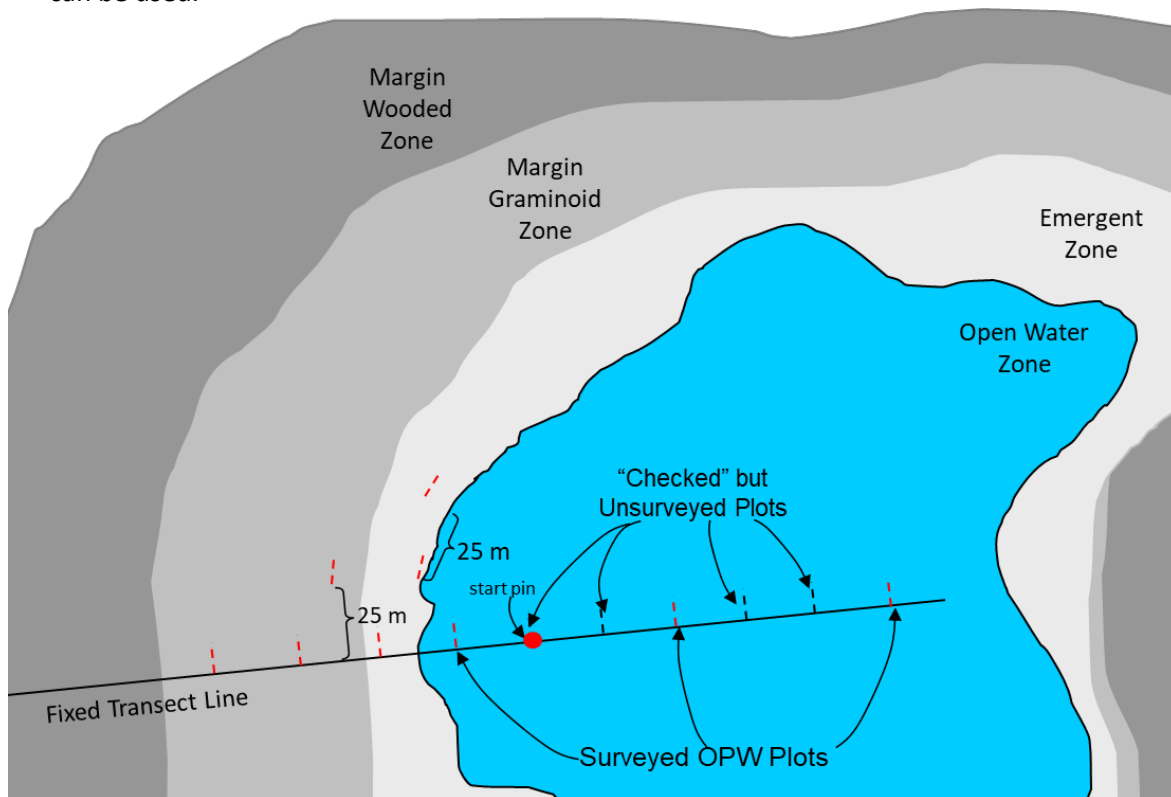


Figure 22: During wetland revisits, surplus plot locations are defined as a zone but are not surveyed because the maximum amount of plot collections have been met.

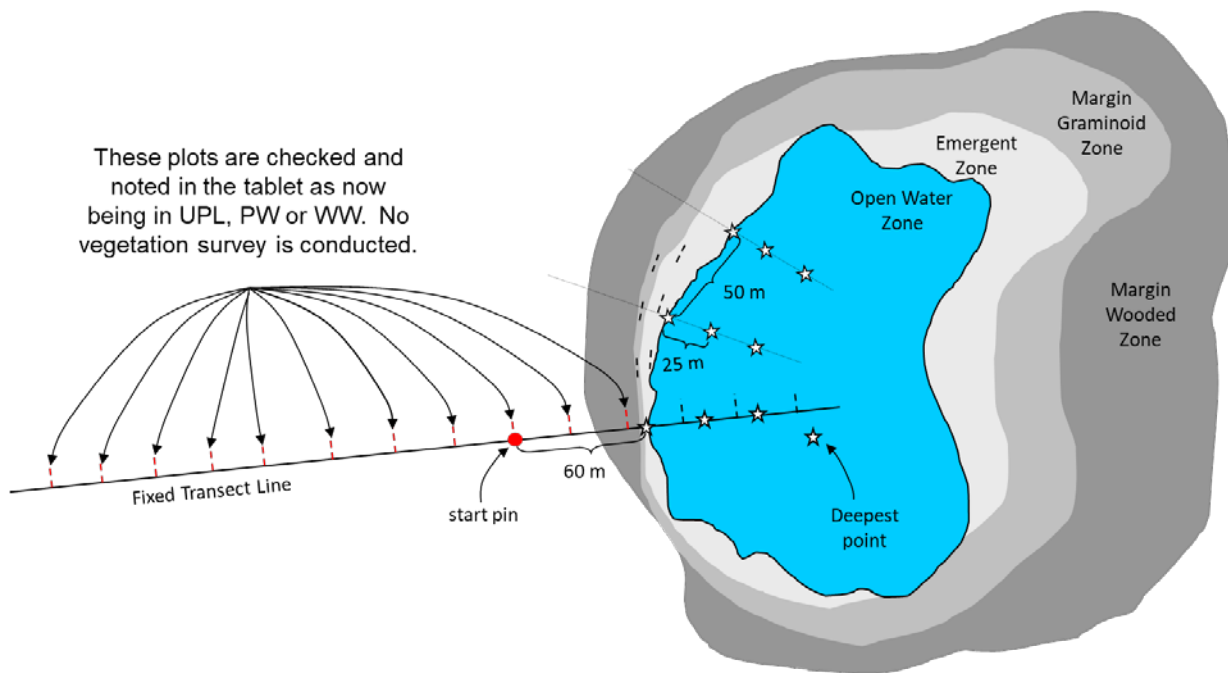


Figure 23: During a revisit survey, these plots are classified as a zone but are not surveyed

Plot Shape, Size and Direction

Where ever possible, vegetation plots are 10 x 2 m.

If a zone is < 2 m wide it may be necessary to modify the plot size to a 20 x 1 m plot. The plot is then surveyed based on this new length and width. Note this change in plot dimensions in the tablet and on the wetland sketch.

Vegetation plots are established perpendicular and clockwise to the FTL or clockwise with the long edge of the plot parallel to shoreline in the case of supplementary plots.

Lay out the vegetation plot straight if possible. If the shoreline is too curved, contour the plot along the zone. This is only done if no straight plots can be obtained within 250 m of shoreline (the survey area).

Vegetation Plot Distances and Labeling on the FTL: For vegetation plots on the FTL, distance from the Start Pin is recorded in the tablet. The plot located at the Start Pin is considered to be at distance zero (00) and the others' distances are all recorded in metres relative to the Start Pin, in multiples of 25 m. For plots moving away from the Start Pin and towards the open water, the numbers are positive (25, 50, 75, etc.). Negative numbers are used to label plots in the opposite direction, away from the Start Pin and open water (-25, -50, -75) (Figure 24).

The location of all plots are marked using a GPS and waypoint averaging. The waypoint is labelled with the site number and plot name (e.g. W1234-EMG2). **For each wetland zone, plot numbering should begin on the FTL at the location farthest from open water and increase sequentially as you move towards open water.**

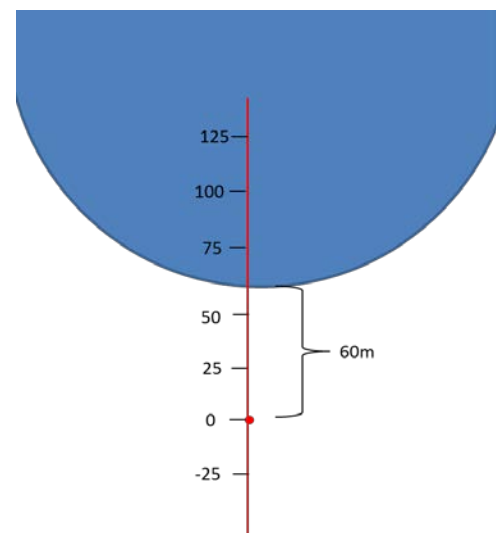


Figure 24: Labeling plant plots on the FTL

Supplementary Vegetation Plot Labeling : The location of all supplementary plots are marked using a GPS and waypoint averaging, and labelled with the site number and plot name (e.g. W1234-EMG2). Plot numbering for supplementary plots will follow those found on the FTL and increase sequentially as you move along the shoreline away from the FTL in the chosen direction, clockwise or counter-clockwise.

WETLAND SKETCH

At the end of the day, draw and label the locations of the Start Pin, FTL, and plant plots on the wetland map provided (Figure 25).

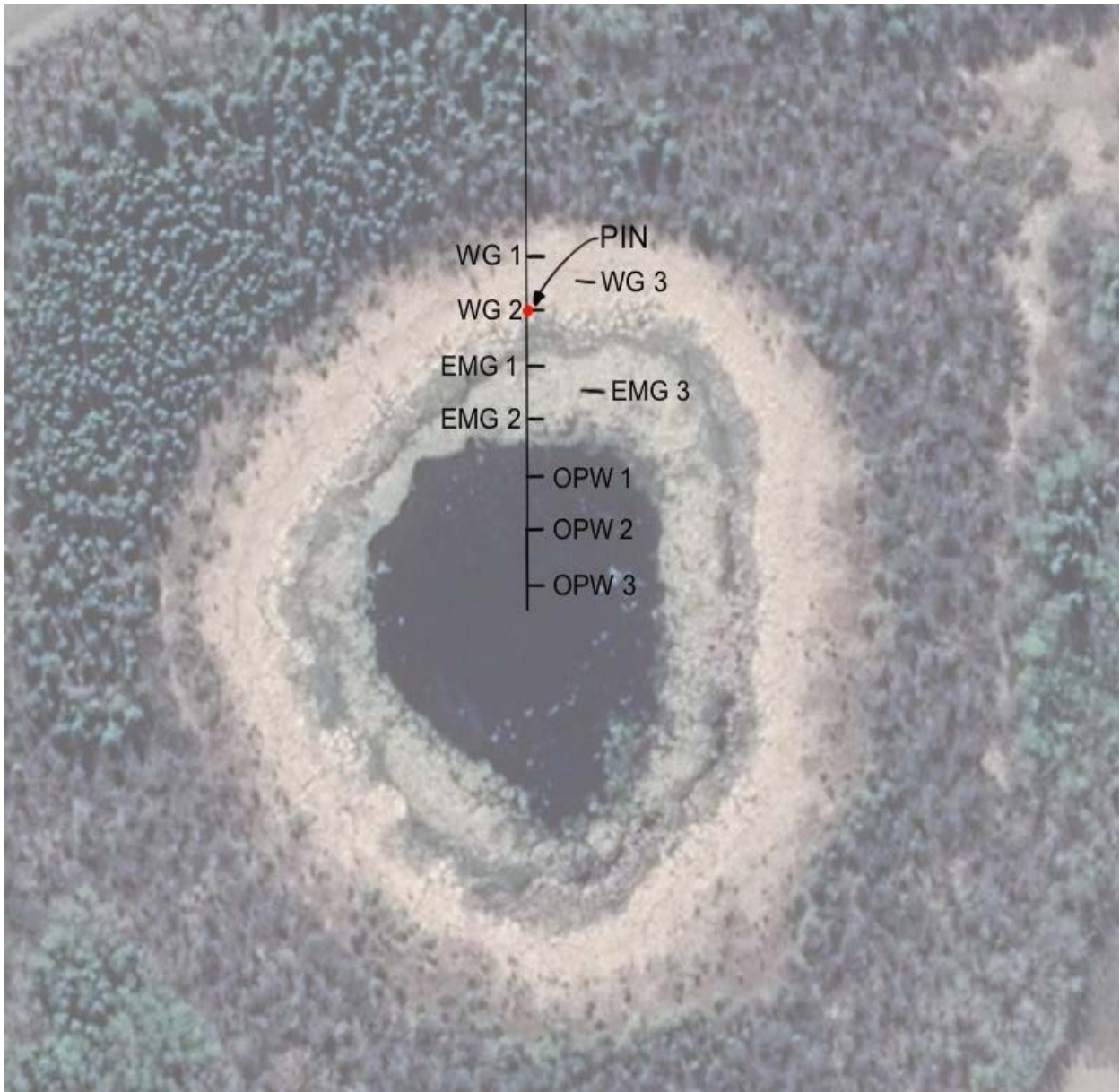


Figure 25: A completed wetland sketch with the start pin, FTL, and all plant plots drawn to scale.

VASCULAR PLANT SURVEYS

VEGETATION SURVEY

Vascular plant surveys are performed by a person that is capable of identifying most common species in that habitat type. This person will receive specific training on vascular plant identification prior to conducting surveys.

The vascular plant technician is to complete all of the plots on shore. Either technician, or both working together, may complete the open water and/or emergent surveys.

5 MINUTE VEGETATION SURVEY

- Begin with setting up the survey plot (10 x 2 m). Run a 10 m rope or measuring tape perpendicular and clockwise to the FTL; or, for supplementary plots, parallel to the shoreline and starting in a clockwise direction, 25 m along shore from the start of the closest plot in that zone. This plot rope will define the centre (longest axis) of the 10 x 2 m plot. Use a 2 m folding measuring stick to define the 1 m boundary to either side of the central line.
- Determine whether the wetland as whole is organic or mineral and record in the Plots tab of the tablet program. **Do this once per wetland.**
- Focus on the vegetation plot and record the AWCS type based on the vegetation that is present in the plot (see Appendix 3: AWCS – Simplified Chart). **Do this for every vegetation plot.** Note that it is possible to have mineral AWCS types for plots at an organic wetland and vice versa.
- **Conduct a quick ≤5-minute pre-survey** and record all the known vascular plants observed in the surrounding zone, avoiding looking at the established vegetation plot. Turning away from the plot is the easiest way to avoid this bias. **Do the pre-survey once per zone.**

This initial list of vascular plants is created so that the subsequent official timed search of the 10 x 2 m plot is spent looking for new species, with minimal time spent entering known vascular plant names into the tablet.

- Starting at one end of the plot, begin the **5-minute** vegetation survey, moving slowly along one side of the centre line at a time and recording **all** vascular plant species present.
- After the 5-minute survey, measure the water depth in **the middle** of the 10 x 2 m plot.

Surveys must be **exactly** 5 minutes long. You may stop the timer for non-survey issues. This includes maneuvering around obstacles and/or troubleshooting tablet issues etc. If you are searching, then the timer must be running.

Inconspicuous vascular plants on the ground can be easily overlooked. Be sure to check all height levels of the plot. Look up for trees, move taller vegetation out of the way to search for inconspicuous species, and if necessary, get on your hands and knees.

Field ID guides **are not** to be used during the 5 minute surveys: if a species cannot be immediately identified during the search, place a (numbered) piece of flagging tape next to the specimen in question and come back to it after the 5 minutes is up (see the **Unidentified Species** section for what to do if an unknown species is encountered).

Note that plants **do not have to be rooted** in the plot to be included in the survey. If a plant hangs over the 10 x 2 m survey plot or lies across it, it should be included.

In the open water zone:

- Work from the boat and use a floating line to establish the long axis of the plot.
- Use the cultivator to selectively harvest specific plants. Be careful not to destroy the wetland floor.

When conducting the open water vegetation surveys with two crew members, the second crew member may paddle the kayak but does not help find or identify plants.

UNIDENTIFIED SPECIES (UIS)

IF A SPECIES CANNOT BE IDENTIFIED

A specimen must be collected if you cannot be certain of the species' identity.

- Use flagging to mark the unidentified species (UIS) during the 5-minute survey.
- After the 5-minute search period you may choose to look up or confirm identifications with your field resources, however these confirmations should be kept short (aim for a maximum of 10 minutes per plot).
- If the species cannot be **quickly and correctly** identified with a field guide (after the 5-minute search time), take the best possible sample of that species from at least 5 m outside the vegetation plot if possible.

Sample Collection:

Ensure your samples include as many parts of the plant as possible, including roots, rhizomes, stems, leaves, flowers and seed heads.

Roots are best collected by using a knife to dig up a small clump of soil around the base of the plant. Then remove the excess soil from the root ball to the best degree possible. Wet mud can be difficult to remove by hand but can often be “washed” out in water.

- Place samples in a labeled plastic sleeve, and transport to camp. Keep samples cool to avoid damage and wilting.

When collecting willows (*Salix spp.*):

- Collect flowering specimens where possible (pistillate catkins).
- Collect specimens that are most representative of the plants/populations growing in the area. A specimen that is as ‘average’ as possible is best for identification.
- Collect at least one full branchlet for each specimen.

When collecting grasses, rushes and sedges:

- Collect an adequate sample of the roots and rhizomes with your specimen. These are often necessary for identification and are essential in identification of vegetative specimens.

VOUCHER SPECIMENS (VS)

For rare species, weedy species, species found outside their historic range, and in cases where you manually add a species to the tablet, the tablet will prompt for a voucher. Vouchers must be collected when the tablet prompts for one. You may also voluntarily send in vouchers for any species you wish to have confirmed. Voucher specimens are collected in the same way a UIS specimen is collected. See the [Advanced Identification](#) section for more specifics on pressing and labeling.

PHOTO VOUCHERING

When working in a residential setting, you might not be able to collect physical specimens for submission to the RAM, while at other sites, physical impediments (e.g., a cliff) might prevent you from safely collecting a specimen. Should this occur, and with permission from your field coordinator, use the following photo vouchering protocols.

Photographs must show the plant along with a ruler for scale. At least one photograph should be taken for each of the following:

1. Distinguishing key features used to identify the plant. Where possible, including a macro shot.
2. A close-up photo showing the entire plant.
3. A zoomed-out photo showing the plant in its immediate surroundings (aim to capture an area of about 0.25-1m²).
4. A large-scale photo showing the habitat where the plant is found.

Photos should always be checked prior to leaving site to ensure the plant is clearly visible and in focus. It is recommended to include the photo numbers in comment section for each plant in the tablet. Also include any pertinent information that would usually be recorded for an unknown specimen tag.

Labelling photographs:

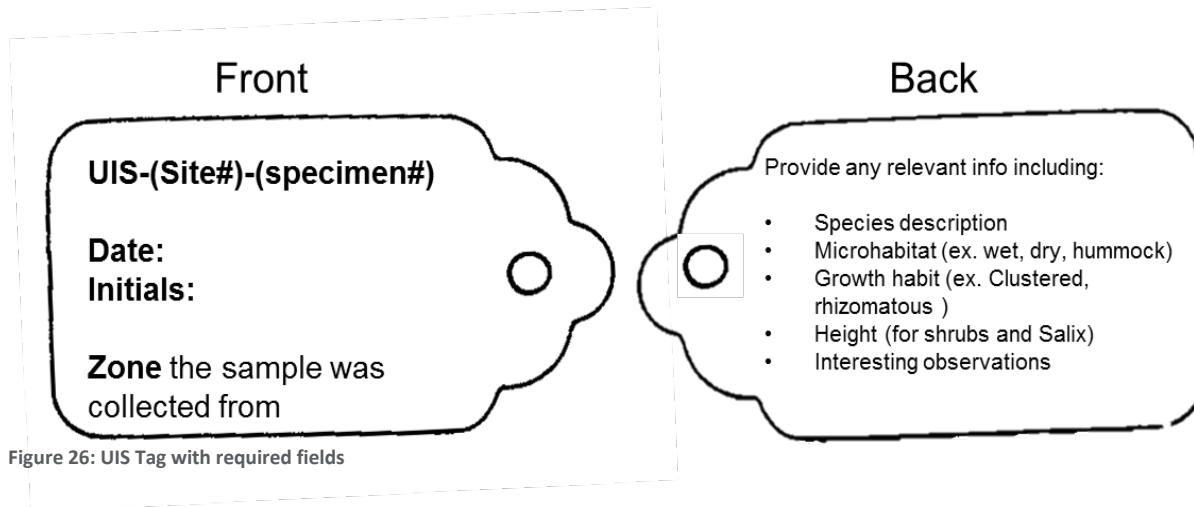
- File names for photographs follow the same format as UIS or VS specimen tag labels, but using the prefix “PS” (photo specimen)
- Label photos as follows:
 - Photos showing distinguishing key features: PS_W[site#]_[specimen#]_FEATURES
 - Photos showing close-up of entire plant: PS_W[site#]_[specimen#]_FULL
 - Photos showing plant with 1 x 1 m area: PS_W[site#]_[specimen#]_HABITAT
 - Photos showing large area of habitat where plant is found: PS_W[site#]_[specimen#]_LRG
- If there is more than one photo per category, simply add a (2), (3), etc. to the end of the label. E.g. PS_W123_1_FEATURES(4) or PS_W123_CALACAN_FULL(2)
- Create folder called “Photo Specimens” and include all photographed specimens. In this folder, along with the photos, create an associated .txt file using WordPad on the tablet. This text file must list all photos found in the folder in the following format: PS_W[site#]_[7-letter species code]
- The “Photo Specimens” folder must be included on the USB with your shipping document that is attached to the plant press and uploaded to the FTP along with the tablet data.

ADVANCED IDENTIFICATION

You may identify an unknown species back at camp, permitting that you have adequate training and skills. Excessive time and effort should not be spent keying species. It is recommended that multiple specimens be collected (population numbers permitting). Then regardless of identification success, a good sample can be submitted for either an unknown specimen or a voucher.

Specimens should be labelled and placed in a plant press as soon as possible to prevent wilting (Figure 26). An unidentified species tag includes: ABMI site# and a unique reference code (UIS-[site #]- specimen #) from the tablet or field data sheet (e.g. the fifth unidentified specimen from wetland 383 would be: UIS-W383-05).

Voucher specimens should be labelled similarly to the UIS label using the reference code (VS-[site#]-7 letter species code) from the tablet. (E.g. for a *Drosera linearis*, from wetland site 383, the label would be: VS-W383-DROSLIN).



Ensure that the information (location, reference code, date, and collector's name) on the tablet matches the information included with the specimen in the plant press.

On the tag, include the wetland zone that the specimen was taken from. If the specimen was taken from a habitat that was atypical for the site (e.g. a sandy ridge in a peatland site, a wet depression in an otherwise dry site, a copse of trees in a grassland site, or a clearing in a forest), include this information also to indicate the conditions the specimen was found in (e.g. "shady spot", "sandy", "wet").

Attach tags in such a way that they are securely attached to the specimen, while avoiding damage to the specimen. Avoid wrapping the tag strings around delicate parts such as fibrous roots or very fine stems that will easily break when the specimen is dry.

When labeling willows (*Salix spp.*), note the approximate height of the plant on the tag. This can be a distinguishing characteristic for many species. Precision should be to the 0.5 m for plants <2 m tall, and to the closest 1 m for plants >2 m.

PRESSING

- Lay the unidentified or voucher plant specimen flat inside a sleeve of newspaper with the correct UIS or VS label attached (Figure 27).
- Layer the newspaper sheet with blotting paper and then cardboard on either side. Ideally, only one or two specimens should be layered between each set of blotters. Wet specimens will need more blotters and cardboard than drier specimens.
- Do not tightly scrunch specimens.
- Do not press stocky specimens, like shrub cuttings or bulky bunchgrasses, in the same newspaper sleeve as delicate specimens. The delicate ones will not flatten properly.
- Do not overload your newspaper sheets: too many specimens on a sheet can negatively impact how well each specimen flattens. Specimens should never overlap, as they can stick together when dry.
- Check wet specimens regularly for mould and replace any cardboard or blotters that become damp. Very wet or thick specimens, or specimens with wet soil attached to the roots, are susceptible to mould, which can spread to adjacent specimens and papers.
- Use wax paper, instead of a newspaper sleeve to press open water vegetation and other wet plant specimens.

As specimens dry, some of the blotters and cardboard can be removed and used for fresh specimens. Bulky root-balls may be left hanging out of the press, so long as the remainder of the specimen is secure within the press and will not fall out while the press is in transit.

At the end of the field shift, plant presses should be labelled with flagging tape. Include your initials, date, sites and a USB with the shipping document.

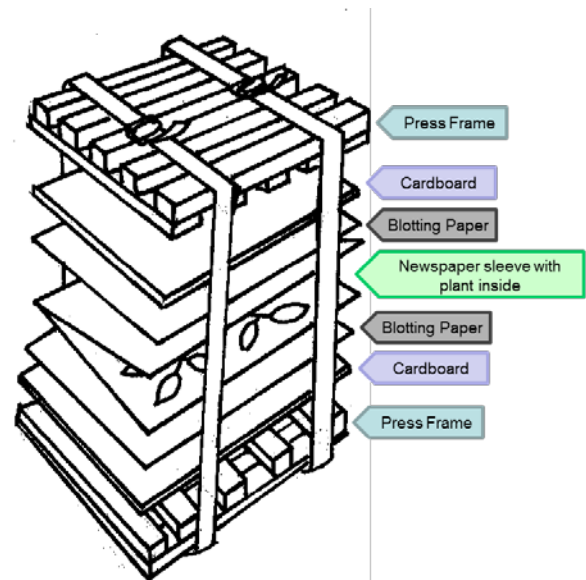


Figure 27: Plant Press Layout

RELATIVE DENSITY OF SPECIES (COMMON VS DOMINANT)

Coarse estimates of density for vascular plant species are determined for each of the 10 x 2 m vegetation plots.

After the 5-minute search record which vascular plant species are 'common' (C), 'dominant' (D) or 'uncommon' (U) (Figure 28).

- Stand near the center of the plot and mentally divide the plot into ten 1 X 2 m sections.
- Common species are defined as those that are present in five or more of the sections. Those species present that do not meet the common species criteria are labelled as uncommon.
- Of the species labeled as common, determine which species has the highest percent cover and label this as the dominant species in the plot.

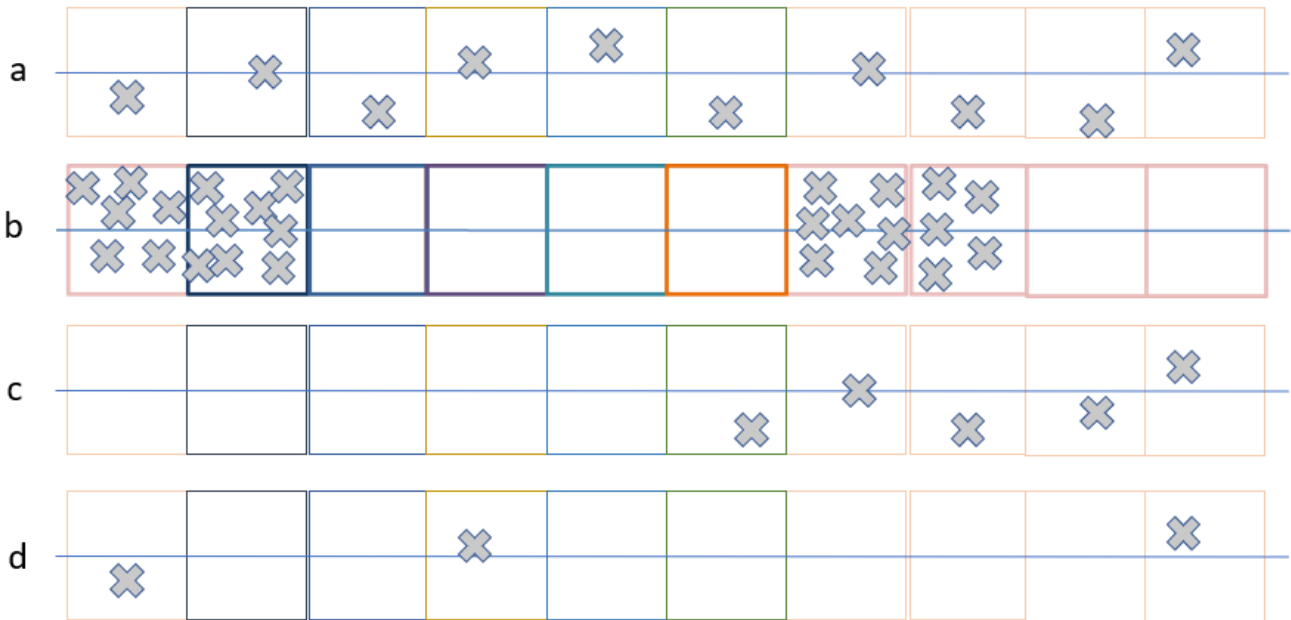


Figure 28: Examples of common and uncommon plant species within the 10 x 2 m vegetation plots. Each X represents one specimen of the same species. a) Common, b) Uncommon, c) Common, d) Uncommon.

PLOT CHARACTERISTICS

% Cover of Shrubs & Trees

Shrub and tree cover is measured in each 10 x 2 m vegetation plot. Shrubs and trees are defined as woody vascular plants and **all live shrubs and trees** are included.

- Estimate percent canopy cover of all shrub/tree species in each of four height categories (<0.5 m, 0.5-1.29 m, 1.3-5.0 m, and >5 m high).
- Record the percentage of shrub or tree canopy cover as 0, <1%, or in 5% increments. Note that due to overlap of leaves, the sum of the estimates can exceed 100%.

Percent cover is determined by ocular estimation and requires practice before starting data collection to ensure estimates are accurate and consistent.

In terms of vegetation, percent cover is the proportion of the ground obscured by a species' leaves, stems, flowers, branches etc. It is estimated as if one were looking down from an aerial view.

Dominant Vegetation (for each zone)

- Identify the species with the largest % cover overall for each zone. Note: you MUST designate a dominant species for each zone present at the wetland in the tablet program! Consider the whole zone to select a dominant species, not just the area on the FTL. In this case, a species does not have to be common to be dominant.

Water Depth

- If water is present, record the water depth to the nearest 0.1 m in the middle of the plot. If water is not present, record a 0.

Human and Natural Disturbance

- Record the percentage and type of human or natural disturbance in each 2 x 10 m plot as 0, <1%, or in 5% increments (Table 5).

Table 5. Human Disturbance.

CULT	Cultivation/Agriculture	Any type of cultivated field that is used to grow agriculture crops
PAST	Pasture	Any type of pasture (tame or native), grazing reserve, etc.
HARV	Harvest/Forestry	Any type of forest harvesting (e.g. clear-cut, partial-cut, understory retention, etc.) <30 years old
IND	Industrial	Any type of building, roadway, yard, etc. associated with industrial development
PIPE	Linear Pipeline	Wide linear features associated with the energy industry
POWER	Linear Powerline	Linear features with a line for conducting electrical power
SEIS	Cutline or seismic line	Narrow linear features associated with the energy industry
ROADP	Road Paved	Any type of road with a paved surface
ROADG	Road Gravel	Any type of road with an unpaved but improved (i.e. gravel) surface
TRAIL	Trail	Truck or ATV trail with an unimproved surface
RES	Residential	Human dwelling, farm building, or farm yard in a rural or acreage setting
WELL	Well	Area cleared for oil/gas/CBM pump jacks or well heads
RAIL	Linear – Rail line	Railway
BARE	Bare ground	Human caused bare ground for which cause cannot be determined
PUGG	Pugging/Hummocking from livestock	Game trails, livestock trails, livestock tracks (pugging and hummocks)
CAMP	Recreation/Parking	Recreation facilities including camping and parking areas, improvised campsites and fire pits.
OTHER	Other	Specify other disturbance type (culverts, bridges, garbage etc.)
URB	Urban	Any type of human dwelling, associated building or yard/ driveway/ road in an urban setting
NONE	No disturbance present	No human caused disturbance

AWCS

AWCS identifies the dominant vegetative community present. (Appendix 3). NOTE: All vegetation is included when defining the wetland type, including exception species. Exception species are only discounted when classifying zones.

- First, determine the Class of the vegetation plot (Appendix 3), then the Form, and finally the Type.

See [Wetland Zone Classification](#) in Appendix 3 for further descriptions of the vegetation zones.

REVIEW- DATA-CHECK IN

- Ensure all data sheets are complete and have been reviewed for blanks/legibility/species codes.
- Ensure all tabs on the tablet program have turned green or yellow, having been reviewed for blanks/legibility/species codes.
- Download and label all site photos: Wetland_YEAR_Site#_location (e.g. Wetland_2018_W123_OPW.jpg)
- Backup all waypoints and ensure they are labelled correctly
 - Access waypoints should be put into a folder labelled “Access”, one .wpt file for each site
 - Wetland_YEAR_[Site#]_Access.wpt e.g. Wetland_2018_W123_Access.wpt
 - Site waypoints should be put into folder labelled “Site” in one .wpt file for each wetland (Wetland_2018_W123.wpt) including:
 - bathymetric points (given and collected): W[Site#]-A, B, C etc. e.g. W123-C
 - deepest point relabelled: W[Site#]-DP e.g. W123-DP
 - Start pin: W[Site#]-PIN e.g. W123-PIN
 - Plant plots: W[Site#]-[Plot name] e.g. W123-PW1
- Press and label all UIS’s and vouchers.
- Create folder on the USB called “Photo Specimens” and include all photographed specimens. In this folder, along with the photos, create an associated .txt file using WordPad on the tablet. This text file must list all the species found in the folder in the following format: PS_W[site#]_[7-letter species code]
- Export a shipping Document for Inverts, Water Samples and the Plant Press. Include photo specimens on the shipping doc USB for plant presses.
- Keep water samples cool until they can be transported to the museum.
- Label coolers with Crew ID, date, contents (number and type of bottles) and total # of coolers (e.g. 1 of 3, 2 of 3, 3 of 3).

PART 4. APPENDICES**APPENDIX 1: EQUIPMENT LIST**

The equipment needed to implement the ABMI field data collection includes:

- o Field gear needed by each crew member
- o Standard equipment needed by each of the field crews to gather data and access and move around the sites
- o Equipment needed by each of the crews, specific to wetland protocols
- o Some equipment items are not specific to a particular protocol, but rather are required for multiple protocols or to address safety concerns

<i>Personal Equipment</i>	<i>Standard Field Equipment for All Crews</i>
• Bear spray	• Cellular and/or satellite telephone
• Two-way radio with spare batteries	• Emergency kit containing:
• GPS unit with spare batteries	• Matches
• Binoculars	• First aid kit
• Compass	• Flashlight
• Camera with spare batteries GPS	• Tarp (remote)
• Backpack	• Axe
• Rubber boots	• Digital camera
• Field boots	• Memory card for camera
• ATV Helmet	• Battery Charger
• Jacket (nylon shell)	• Flagging tape
• Chest waders	• Gear bag (dry type)
• Personal floatation device (PFD)	• Backpack
• Pocket knife	• Markers
• Rain jacket	• Maps, air photos, satellite images
• Rain pants	• Tape measure (50 m)
• Sleeping bag (remote)	• Tape measure (100 m)
• Covered clipboard	• Data Sheets
• Leather gloves	• Tablet and extra batteries
• Insect repellent & sunscreen	• Field guides

EQUIPMENT SPECIFIC TO WETLAND SAMPLING

- o Inflatable kayak / canoe including: two sets of paddles, 2 boat seats, 2 pumps with hoses, 1 boat repair kit, throw line.
- o 2 m folding measuring stick
- o 50 m tape measure (with a weight and quick-link at the end)
- o 10 m rope with attached floats and anchors
- o 10 m plant plot rope
- o Multiprobe (e.g. Quanta Hydrolab)
- o Turbidity tube
- o 5 L Water-cooler with spigot
- o CABIN sweep net with handle
- o Cultivator with pole handle
- o Plant press
- o 1.5 m orange conduit with marker buoy attached
- o 12" metal spike
- o Ice pack and cooler
- o Folder with mapping supplies and bottle labels
- o Chemical processing kit
- o Nitrile gloves
- o Preservatives, chemicals, and sample bottles
 - o 5% H₂SO₄
 - o 10% buffered formalin

APPENDIX 2: COMMON AND INDICATOR SPECIES

		North	South
Open-water	Common Species	<i>Ceratophyllum demersum</i> (Hornwort)	<i>Ceratophyllum demersum</i> (Hornwort)
		<i>Nuphar variegata</i> (Yellow Pond Lily)	<i>Stuckenia pectinata</i> (Sago Pondweed)
		<i>Potamogeton friesii</i> (Fries' Pondweed)	<i>Myriophyllum</i> spp. (Watermilfoil spp.)
	Indicator Species	<i>Ceratophyllum demersum</i> (Hornwort)	<i>Ceratophyllum demersum</i> (Hornwort)
		<i>Nuphar variegata</i> (Yellow Pond Lily)	<i>Stuckenia pectinata</i> (Sago Pondweed)
		<i>Potamogeton</i> spp. (Pondweed spp.)	<i>Myriophyllum sibiricum</i> (Spiked Watermilfoil)
Emergent	Common Species	North	South
		<i>Calla palustris</i> (Water Arum)	<i>Eleocharis palustris</i> (Creeping Spikerush)
		<i>Schoenoplectus</i> spp. (Bulrush spp.)	<i>Schoenoplectus</i> spp. (Bulrush spp.)
		<i>Typha latifolia</i> (Cattail)	<i>Typha latifolia</i> (Cattail)
	Indicator Species	<i>Schoenoplectus</i> spp. (Bulrush spp.)	<i>Schoenoplectus</i> spp. (Bulrush spp.)
		<i>Typha latifolia</i> (Cattail)	<i>Typha latifolia</i> (Cattail)
Wet-Meadow- Graminoid	Common Species	North	South
		<i>Carex</i> spp. (Sedge spp.)	<i>Carex</i> spp. (Sedge spp.)
		<i>Comarum palustre</i> (Marsh Cinquefoil)	<i>Rumex crispus</i> (Curled Dock)
		<i>Galium trifidum</i> (Small Bedstraw)	<i>Ranunculus cymbalaria</i> (Seaside Buttercup)
			<i>Beckmannia syzigachnene</i> (Slough Grass)
	Indicator Species	<i>Carex</i> spp. (Sedge spp.)	<i>Carex</i> spp. (Sedge spp.)
		North	South

Wet-Meadow-Wooded	Common Species	<i>Alnus incana ssp. tenuifolia</i> (River Alder)	<i>Sonchus arvensis</i> (Perennial Sow Thistle)
		<i>Betula spp.</i> (Birch spp.)	<i>Salix spp.</i> (Willow spp.)
		<i>Carex aquatilis</i> (Water Sedge)	<i>Cirsium arvense</i> (Creeping Thistle)
		<i>Carex disperma</i> (Two Seeded Sedge)	<i>Hordeum jubatum</i> (Foxtail Barley)
			<i>Poa pratensis</i> (Kentucky Bluegrass)
	Indicator Species	<i>Salix spp.</i> (Willow spp.)	<i>Salix spp.</i> (Willow spp.)
		<i>Betula spp.</i> (Birch spp.)	
		<i>Alnus incana ssp. tenuifolia</i> (River Alder)	
Peatland-Graminoid	Common Species	North	South
		<i>Eriophorum spp.</i> (Cotton Grass spp.)	<i>Eriophorum spp.</i> (Cotton Grass spp.)
		<i>Vaccinium oxycoccos</i> (Small Bog Cranberry)	<i>Vaccinium oxycoccos</i> (Small Bog Cranberry)
	Indicator Species	<i>Carex spp.</i> (Sedge spp.)	<i>Carex spp.</i> (Sedge spp.)
Peatland-Wooded	Common Species	North	South
		<i>Picea mariana</i> (Black Spruce)	<i>Picea mariana</i> (Black Spruce)
		<i>Andromeda polifolia</i> (Bog Rosemary)	<i>Andromeda polifolia</i> (Bog Rosemary)
		<i>Chamaedaphne calyculata</i> (Leatherleaf)	<i>Chamaedaphne calyculata</i> (Leatherleaf)
		<i>Carex gynocrates</i> (Northern Bog Sedge)	<i>Carex gynocrates</i> (Northern Bog Sedge)
		<i>Rubus chamaemorus</i> (Cloudberry)	<i>Rubus chamaemorus</i> (Cloudberry)
		<i>Rhododendron groenlandicum</i> (Labrador Tea)	<i>Rhododendron groenlandicum</i> (Labrador Tea)

	Indicator Species	<i>Salix</i> spp. (Willow spp.)	<i>Salix</i> spp. (Willow spp.)
		<i>Betula x sargentii</i> (Hybrid Dwarf Bog Birch)	<i>Betula x sargentii</i> (Hybrid Dwarf Bog Birch)
		<i>Rubus chamaemorus</i> (Cloudberry)	<i>Rubus chamaemorus</i> (Cloudberry)
		<i>Larix laricina</i> (Larch)	<i>Larix laricina</i> (Larch)
		<i>Sphagnum</i> spp. (Sphagnum Moss spp.)	<i>Sphagnum</i> spp. (Sphagnum Moss spp.)
		<i>Vaccinium oxycoccos</i> (Small Bog Cranberry)	<i>Vaccinium oxycoccos</i> (Small Bog Cranberry)
Upland	Common Species	North	South
		<i>Achillea</i> spp. (Yarrow spp.)	<i>Achillea</i> spp. (Yarrow spp.)
		<i>Frageria virginiana</i> (Wild Strawberry)	<i>Frageria virginiana</i> (Wild Strawberry)
		<i>Vicia americana</i> (Wild Vetch)	<i>Vicia americana</i> (Wild Vetch)
		<i>Chamerion angustifolium</i> (Fireweed)	<i>Chamerion angustifolium</i> (Fireweed)
	Indicator Species	<i>Populus</i> spp. (Aspen, Poplar etc)	<i>Populus</i> spp. (Aspen, Poplar etc)
		<i>Rosa</i> spp. (Rose spp.)	<i>Rosa</i> spp. (Rose spp.)
		<i>Corylus cornuta</i> (Beaked Hazelnut)	<i>Corylus cornuta</i> (Beaked Hazelnut)
		<i>Amelanchier alnifolia</i> (Saskatoon Berry)	<i>Amelanchier alnifolia</i> (Saskatoon Berry)
		<i>Juniperus</i> spp. (Juniper spp.)	<i>Juniperus</i> spp. (Juniper spp.)
		<i>Picea glauca</i> (White Spruce)	
		<i>Pinus</i> spp. (Pine spp.)	



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