APPENDIX D

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Wetland Class & Function Descriptions

Flats Class: Biogeochemical Functions

FB 1.0 Does the wetland have the potential to improve, reduce, or prevent degradation of water quality, provide food chain support, and export of carbon?

FB 1.1 *Characteristics of surface water outflows from the wetland*: (This indicator is used in both the biogeochemical and the hydrologic functions.)

> **Rationale for indicator:** Pollutants that are in the form of particulates (e.g. sediment, or phosphorus that is bound to sediment) will be retained in a wetland with no outlet. Wetlands with no outlet are, therefore, scored the highest for this indicator. An outlet that flows only seasonally is usually better at trapping particulates than one that is flowing all the time because there is no chance for a downstream release of particulates for most of the year (Adamus et. al. 1991).

If possible, walk around the edge of the depressional wetland (or from imagery if too large to walk around) note carefully if there are any indications that surface water leaves the wetland and flows further down-gradient. The question is relatively easy to answer if you find a channel. You are asked to characterize the surface outlet in one of four ways for the scoring:

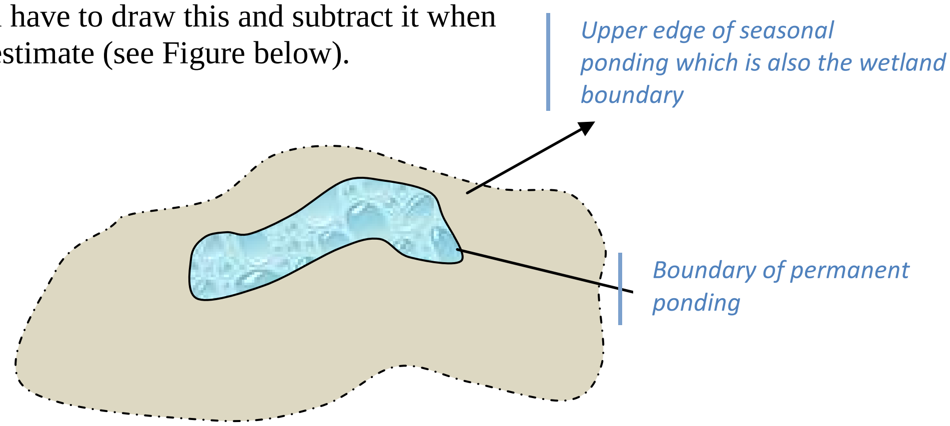
1. **Wetland has no surface water outlet** - You find no evidence that water leaves the wetland on the surface. The wetland lies in a depression in which the water never goes above the edge or the wetland is flat and has no obvious outlet or the outlet is a ditch. Flat, depressional, wetlands that are maintained by high groundwater often do not have an obvious outlet or they are drained by ditches.
2. **Wetland has an intermittent or highly constricted outlet.** Intermittent flow means surface water flows out of the wetland during the "wet" portion of the growing season or during heavy storms. Highly constricted outlets are those that are small or heavily incised, narrow channels anchored in steep slopes. In general, you will find marks of flooding or inundation. Three feet of live storage or more above the bottom of the outlet means the outlet is severely constricted. Another indicator of a severely constricted outlet is evidence of erosion of the down gradient side of the outlet.
3. **Wetland has an unconstricted or only slightly constricted outlet that allows water to flow out of the wetland across a wide distance.** The outlet does not provide much hindrance to flood waters flowing through the wetland. In general, the distance between the low point of the outlet and average height of inundation will be less than three feet. Beaver dams are considered to be unconstricted unless they are anchored to a steep bank on either side. In general, they do not hold back flood-waters because the water level is maintained at the crest of the dam.
4. **The wetland has a permanent surface outflow or outlet**.

FB 1.2 *Characteristics of persistent (ungrazed, unbrowsed) vegetation (emergent, shrub, and/or forest classes):*

> **Rationale for indicator:** Plants enhance sedimentation by acting like a filter, and cause sediment particles to drop to the wetland surface (for a review see Adamus et al. 1991). Plants in wetlands can take on different forms and structures. The intent of this question is to characterize how much of the wetland is covered with plants that persist throughout the year and provide a vertical structure to trap or filter out pollutants. It is assumed, however, that the effectiveness at trapping sediments and pollutants is severely reduced if the plants are grazed.

FB 1.3 Characteristics of seasonal ponding or inundation.

One way to estimate this area is to make a rough sketch of the wetland boundary edge of the area you believe has surface water during the wet season. If the wetland also has permanent surface water you will have to draw this and subtract it when making your estimate (see Figure below).



Rationale for indicator: The area of the wetland that is seasonally ponded is an important characteristic in understanding how well it will remove nutrients, specifically nitrogen. The highest levels of nitrogen transformation occur in areas of the wetland that undergo a cyclic change between oxic (oxygen present) and anoxic (oxygen absent) conditions. The oxic regime is needed so certain types of bacteria will change nitrogen that is in the form of ammonium ion (NH_4^+) to nitrate, and the anoxic regime is needed for denitrification (changing nitrate to nitrogen gas) (Mitsch and Gosselink 1993). The area that is seasonally ponded is used as an indicator of the area in the wetland that undergoes this seasonal cycling. The soils are oxygenated when dry but become anoxic during the time they are flooded.

***FB 1.4** The soil 2 inches below the surface is clay, organic, or smells anoxic (hydrogen sulfide or rotten eggs).*

Rationale for indicator: Clay soils and organic soils are all good indicators that a wetland can remove a wide range of pollutants from surface water. The uptake of dissolved phosphorus and toxic compounds through adsorption to soil particles is highest when soils are high in clay or organic content (Mitsch and Gosselink 1993). Anoxic conditions (oxygen absent), on the other hand, are needed to remove nitrogen from the aquatic system. This process, called denitrification, is done by bacteria that live only in the absence of oxygen (Mitsch and Gosselink 1993).

***FB1.5** The wetland unit is dominated with moss and/or sphagnum moss, hummocks, tussocks, or micro-highs and micro-lows.*

Rationale for indicator: Features that slow water movement and increase the likelihood that sediment or other pollutants can be retained. Once deposited pollutants may be altered biologically, taken up by plants and deposited in wetland sediments when the plant dies.

Flats Class: Hydrologic Functions

FH 1.0 Does the Wetland Have the Potential to Reduce Flooding?

FH 1.1 *Characteristics of surface water outflows from the wetland:*

> **Rationale for indicator**: Wetlands with no outflow are more likely to reduce flooding than those with outlets, and those with a constricted outlet will more likely reduce flooding than those with an unconstricted outlet (review in Adamus et al. 1991). In wetlands with no outflow all waters coming in are permanently stored and do not enter any streams or rivers. Constricted outlets will hold back flood waters and release them slowly to reduce flooding downstream.

See the description for question FB 1.1. This question is answered the same way.

FH1.2 *Depth of storage during wet periods (estimating"live storage"):*

> **Rationale for indicator**: The amount of water a wetland stores is an important indicator of how well it functions to reduce flooding and erosion. Retention time of flood waters is increased as the volume of storage is increased for any given inflow (Fennessey et al. 1994). It is too difficult to estimate the actual amount of water stored. This is only an approximation because depressional wetlands may have slightly different shapes and therefore the volume of water they can store is not exactly correlated to the maximum depth of storage. Live storage is a measure of the volume of storage available during major rainfall events that may cause flooding . This indicator recognizes that some wetlands, particularly those with groundwater connections, have water present all year around, or have some storage below the elevation of the outlet that does not contribute to reductions in peak flows (so called —dead storage).

In wetlands without outlets identify the deepest hole if the wetland is dry (Figure 1), or the level of the areas that are permanently flooded. Estimate the difference in elevation between these low points and the marks of seasonal inundation in FH 1.2. This will provide an estimate of the depth of live-storage during the seasonal high water. For wetlands with an outlet, locate the outlet of the wetland and identify the lowest point of the outlet (Figure 2 and 3). Try to find water marks as close to the outlet, or low point, as possible so you can make visual estimates of the height from the outlet. Figures 2 and 3 show water marks directly on the culverts. Estimate the difference in elevation between the lowest point of the outlet and the level at where marks of unundation are noted.

Figure 1. Measuring maximum depth of seasonal ponding in a wetland without an outlet.

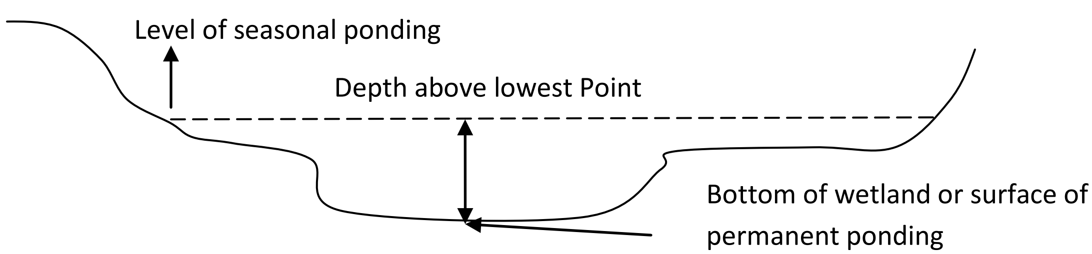


Figure 2. A box culvert that is the outlet of a depressional wetland. The live storage is measured as the distance between the bottom of the culvert and the “highest” water marks on the side. In this picture the distance is 15 inches.

Figure 3. A round culvert with water present. Measure the distance from the bottom of the culvert (not the present water level). The difference here is about 5 inches.

There are four thresholds of concern: 1) more than 2 ft of storage, 2) between .5 ft (6 in) - 2 ft of storage, 3) less than 6 inches of storage, 4) unit is flat but has small depressions. These thresholds can usually be estimated without needing to use special equipment.

NOTE 1: If the outlet is a beaver dam or weir, treat the top of the dam or weir as the lowest point. If water is flowing over the dam then the water surface anywhere in the wetland can be used to establish the low point. Beaver dams generally have less than 6 inches of live storage because they allow water to flow out and over a wide area.

NOTE 2: If the wetland has multiple outlets, try to find the one that has the lowest topographic elevation.

NOTE 3: Sometimes the lowest point of the outlet is flooded or flowing. In these cases, measure from the bottom of the outlet to the level of marks of average seasonal flooding. A common mistake is to measure from the current water level in the outlet to the marks of flooding.

NOTE 4: It can be difficult to extrapolate the height of flooding above the lowest point of the outlet in large wetlands where the flood marks are distant from the outlet.

Headwater wetlands. This question also asks if the wetland being categorized is a headwater wetland. *Depressional* wetlands found in the headwaters of streams often do not store surface water to any great depth. They are however, important in reducing peak flows because they slow down and desynchronize the initial peak flows from a storm (Brassard et al. 2000). Their importance in hydrologic functions is often under-rated. Headwater wetlands are scored 2 points, out of 3 possible, regardless of the depth of seasonal storage. To identify if the wetland being rated is a headwater wetland, use the information collected in question FH 1.1. If the wetland has a permanent or seasonal outflow but NO inflow from a permanent or seasonal stream, it is probably a headwater wetland for the purposes of this categorization. *NOTE: One exception to this criterion is wetlands whose water regime is dominated by groundwater coming from irrigation practices. Depressional wetlands at the base of dams or edge of irrigation canals are not headwater wetlands, even if they have surface water that flows out of them without an inflow. If the sampling unit is best classified as Depressional, make a note on score sheets and score accordingly*.

FH1.3 *Contribution of the wetland to storage in the watershed:*

This question asks you first to estimate the area of land that is found upstream of the wetland and that contributes surface water to the wetland. This is called the contributing basin or watershed to the wetland. You will then need to estimate the area of the wetland and calculate the ratio of the two. You do not need to estimate these areas exactly because the scoring is based on thresholds for the ratio. If the contributing basin is less than 10 times the size of the wetland itself, the wetland will score the most points. On the other hand, if the area of the contributing basin is more than 100 times the area of the wetland the score is [0], and you will not need to make estimates.

You can use whatever means available to calculate the upstream basin contributing surface water to a wetland. A topographic map works well if the landscape is not too confusing. If you have GIS with basin boundaries you will have to be careful to include only the areas upgradient of the wetland. Please note that the estimates do not have to be too accurate. There are only two critical thresholds - contributing basin is 10x the area of the wetland and 100 x the area of the wetland. Thus, the polygons can be very roughly drawn unless you are near either of the thresholds.

Rationale for indicator: The potential of a wetland to reduce peak flows from its contributing basin is a function of its retention time (volume coming into a unit during a storm event /the amount of storage present). The area of the contributing basin is used to estimate the relative amount of water entering it, while the area of the wetland is used to estimate the amount of storage present. Large contributing basins are expected to have larger volumes for any given storm event than smaller basins. Thus a small wetland with a large contributing basin is not expected to reduce peak flows as much as a large wetland with a small contributing basin.

FH1.4 *The subsurface soil textures.*

> **Rationale for indicator**: The capacity of a wetland to temporarily store and retain surface and shallow subsurface water that can support stream flow depends on position of the water table, presence of restrictive soil layers, micro-and macro topographic relief. Organic soil horizons typically have greater storage capacity than mineral soils, particularly when surface organic horizons are dry. These dry horizons can act as a sink for snowmelt.

FH1.5 *The characteristics of vegetation are important for stabilizing soils and reducing water velocity.*

> **Rationale for indicator**: Wetlands with dense woody vegetation such as trees and shrubs often have deep, soil-binding root masses. Annual herbaceous plants are considered to lack such root masses.

FH 2.0 Does the wetland unit have the potential to add water to the groundwater system (recharge) or take water away from the system (discharge)? Although FLAT wetlands primarily receive water input from precipitation, loss of water can be through evapotranspiration or seepage into the groundwater.

FH2.1 *Characteristics of the landscape and vegetation*

> **Rationale for indicator**: The relationship of the groundwater table and the land surface dictates which function – groundwater recharge where wetlands add water to the groundwater system, or groundwater discharge where wetlands take water from the groundwater system. Some wetlands can act as both a recharge and a discharge system depending on weather. The proportion of surface and groundwater inputs of a wetland and the wetland's interaction with groundwater can vary depending on soil type, precipitation (rates, types, timing, and amounts) and other factors such as the extent of impervious surfaces and storm sewers. Bogs are by definition recharge mounds. They hold a lens of precipitation-derived water either directly above an underlying mineral substrate or above underlying peat. Bog and fen wetlands with thick organic soils have the ability to contribute to groundwater and transmit groundwater.

Riverine & Freshwater Tidal Fringe Wetlands: Biogeochemical Functions

RB 1.0 Does the Wetland have the Potential to Improve, Reduce or Prevent degradation of Water Quality, provide food chain support, and export organic carbon?

RB 1.1 *Area of surface depressions within wetland that can trap sediments and associated pollutants during a flooding event*:

For this question you will need to estimate the fraction of the wetland that is covered by depressions. Generally you would count depressions that hold water for more than a week after a flood recedes. If a depression is not flooded at the time of the site visit, look for deposition of fine or mucky sediments in the bottom of the depression. Fine sediments indicate the water was present in the depressions for longer periods of time. Make a simple sketch of the wetland boundary, and on this superimpose the areas where depressions are found. From this you can make a rough estimate of the area that has depressions and determine if this is more than ¾ (75%) or more than ½ (50%) of the total area of the wetland. Standing or open water present in the wetland when the river is not flooding are good indicators of depressions. Figure 4 shows a riverine wetland with depressions filled with water. *Note: These are depressions within the HGM class Riverine and Freshwater Tidal Wetland.*

> **Rationale for indicator**: Depressions in riverine wetlands will tend to accumulate sediment and the pollutants associated with sediment (phosphorus and some toxics) because they reduce water velocities (Fennessey et al. 1994), especially when the river floods. Wetlands where a larger part of the total area has depressions are relatively better at removing pollutants than those that have no such depressions.

Figure 4. Riverine wetland, oxbow, and a depression filled with water which covers more than ¾ of the wetland sampling unit.

RB 1.2 Characteristics of the vegetation in the wetland unit.

For this question group the vegetation found within the wetland into three categories – 1) Forest or shrub, 2) ungrazed herbaceous plants (> 6 inches high), and 3) neither forest, shrub nor un-grazed herbaceous plants. There are two size thresholds used to score this characteristic – more than 60% (approximately 2/3) of the wetland unit is covered in either emergent, forest, or shrubby vegetation, and more than 30% (approximately 1/3) is covered. These thresholds can usually be estimated visually in small wetlands. Large wetlands, however, may require you to draw the area of vegetation types on a map or aerial photo before you can feel confident that your estimates are accurate.

Rationale for indicator: Vegetation in a riverine wetland will improve water quality by acting as a filter to trap sediments and associated pollutants. The vegetation also slows the velocity of water which results in the deposition of sediments. Persistent, multi-stemmed plants enhance sedimentation by offering frictional resistance to water flow (review in Adamus et al. 1991). Shrubs and trees are considered to be better at resisting water velocities than herbaceous plants during flooding and are scored higher. Aquatic bed species or grazed, herbaceous (non-woody) plants are not judged to provide much resistance to water flows and are not counted as ―filters.

RB 1.3 Characteristics of nutrient cycling (biotic and abiotic processes).

Rationale for indicator: Wetland productivity depends on inputs of organic matter and nutrients; wetland systems in turn export organic matter and nutrients to the downstream environments. Deciduous shrubs turn over 34 to 43% of their biomass annually adding a substantial amount of litter to the soil surface (ADEC &USACE, 1999). Shrubs recycle nutrients effectively because tissue nutrient pools are high in proportion to biomass. The herbaceous stratum produces new growth and senesces annually decomposing more rapidly than woody vegetation and cycles nutrients fairly rapid. Mosses generally prohibit nutrient cycling by acting as nutrient sinks.

RB 1.4 Characteristics of surface water flows out of the wetland to the riverine system.

Rationale for indicator: Wetlands with surface flow outlets, wetlands that flood, and wetlands used by mobile fish and wildlife species have mechanisms for exporting organic matter and nutrients. Wetlands generally export organic carbon if they are located on toe slopes or in valley bottom positions, are proximal to streams and have hydraulic gradients that direct surface and subsurface flow to the streams or have groundwater at or very close to the ground surface during much of the growing season (ADEC & USACE, 1999).

Riverine & Freshwater Tidal Fringe Wetlands: Hydrologic Functions

RH 1.0 Does the Wetland Have the Potential to Reduce Flooding and Stream Erosion?

RH 1.1 *Characteristics of the "overbank" flood storage the wetland provides based on the ratio of the channel width to the width of the wetland:*

> **Rationale for indicator**: The ratio of the width of the channel to the width of the wetland is an indicator of the relative volume of storage available within the wetland. The width of the stream between banks is a good indicator of the relative flows at that point in the watershed. Wider streams will have higher volumes of water than narrower streams. More storage is therefore needed in larger systems to lessen the impact of peak flows. The width of the wetland perpendicular to the stream is used as an indicator of the amount of short-term storage available during a flood event. A wetland that is wide relative to the width of the stream is assumed to provide more storage during a flood event than a narrow one. The ratio of the two values provides an estimate that makes it possible to rank wetlands relative to each other in terms of their overall potential for storage.

Estimate the average width of the wetland perpendicular to the direction of the flow, and the width of the stream or river channel (distance between banks). In these areas calculate this ratio by taking the width of the wetland and dividing by the width of the stream. There are five thresholds for scoring: a ratio more than 20, a ratio between 10 – 20, a ratio between 5 – <10, a ratio between 1 - <5, and a ratio < 1.

Riverine wetlands are found in different positions in the floodplain and it may sometimes be difficult to estimate this indicator. The following bullets describe some common types of riverine wetlands and how to estimate this indicator:

- If the vegetated wetland lies within the banks of the stream or river, the ratio is estimated as the average width of the delineated wetland / average distance between banks. Figure 5 shows a wetland where vegetation fills only a small part of the distance between the banks. In this case the ratio is < 1.

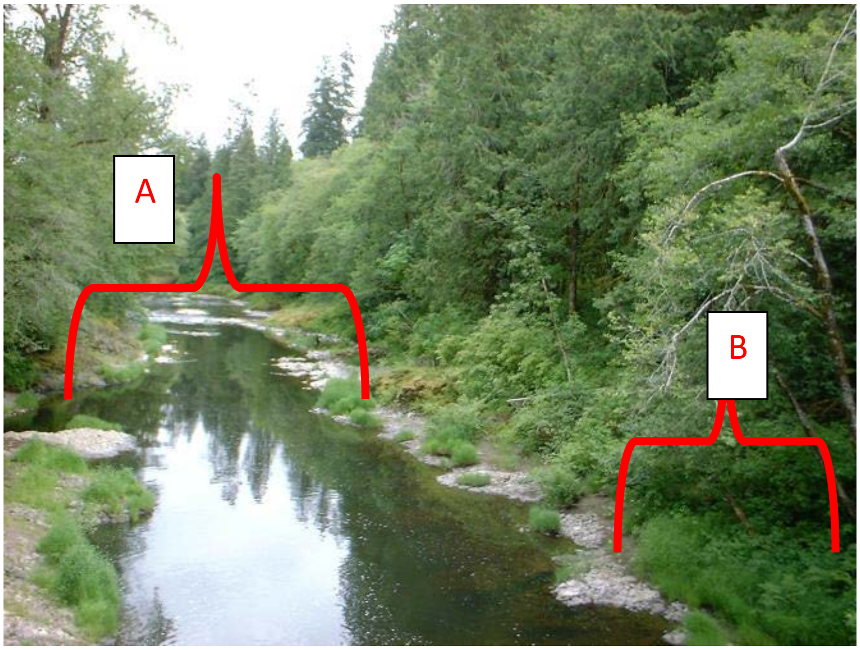


Figure 5. A riverine wetland where the width of the wetland (B) is less than the distance between banks (<1) (A).

The distance between the banks is approximately 100 ft (A). The average width of the wetland perpendicular to the river flow is approximately 10 ft (B). The width of the wetland divided by the width of the stream (10 ft/100 ft) has a ratio of < than 1.0 or 0.1.

- If the wetland lies outside the existing banks of the river, you may need to estimate the distances using a map or aerial photograph. Riverine wetlands in old oxbows may be some distance away from the river banks. Instead of trying to estimate a width for the wetland and the distance between banks in feet or yards, it may be easier to estimate the ratio directly. Ask yourself if the average width of the wetland is more or less than the distance between banks. If it is more, is it more than five times as wide? If not, the ratio is between 1- <5. If it is more than five times greater, is it more than 10 times, etc. Figure 6 shows a riverine wetland in an old oxbow where the ratio was judged to be between 1- <5.

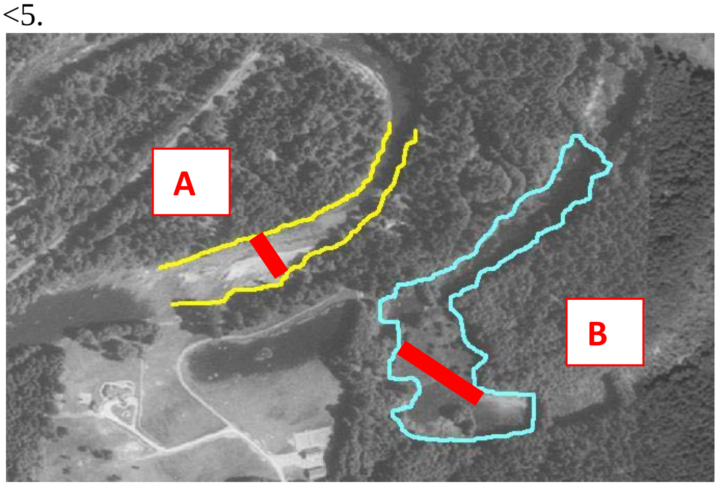


Figure 6. Riverine wetland in an old oxbow where the average width of the wetland (B) is between 1-5 times the width of the river channel (A). (

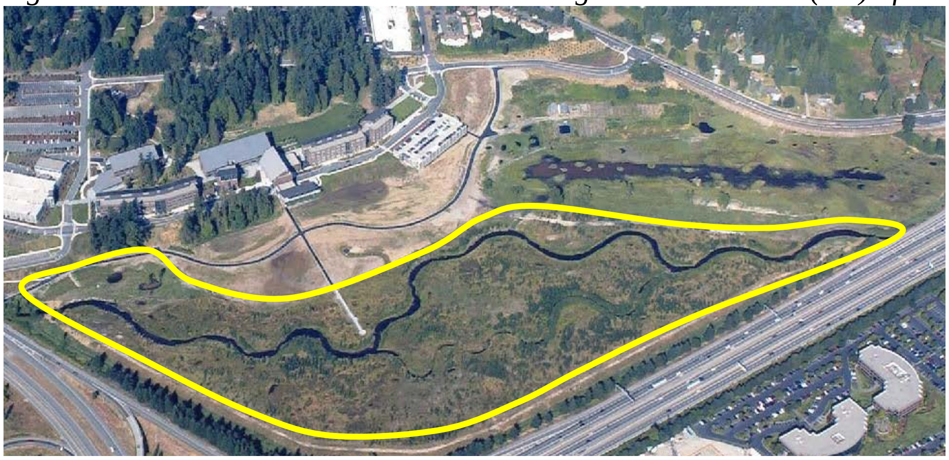
If you are including the river or stream as part of the wetland then the width of the stream is also included in the estimate of the width of the wetland.
In braided channels, if the wetland is associated with only one braid you would still use the cumulative width of all channels to calculate the average width of the channel.

RH1.2 Characteristcs of vegetation that slow down water velocities during floods:

Rationale for indicator: Riverine wetlands play an important role during floods because their vegetation acts to slow water velocities and thereby erosive flows. This reduction in velocity also spreads out the time of peak flows, thereby reducing the maximum flows. The potential for reducing flows will be greatest where the density of wetland vegetation and other obstructions is greatest and where the obstructions are rigid enough to resist water velocities during floods (Adamus et al. 1991). The indicator used in the rating system combines both characteristics for the scoring. Shrubs and trees are considered to be better at resisting water velocities than emergent/herbaceous plants. Aquatic bed species are judged not to provide much resistance and are not counted. Wetlands with a dense cover of trees and shrubs are scored higher than those with only a cover of emergent species.

For this question you will need to group the vegetation found within the wetland into two categories – 1) herbaceous and/or emergent, and 2) forest and/or scrub-shrub. These categories of plants are based on the Cowardin classification of wetlands. There are four size thresholds used to score this characteristic: 1) forest or shrub for more than 30% (approximately 1/3) of the wetland unit, 2) herbaceous and/or emergent plants > 60% (approximately 2/3 area), 3) forest or shrubs > 10% (1/10) of the area, and 4) herbaceous/emergent plants > 30% (1/3) area. Figure 7 shows an aerial photograph of a riverine wetland that has dense shrub vegetation over most of its area. *NOTE: If the wetland is covered with downed trees, you can treat large woody debris as forest or shrub.*

Figure 7. A riverine wetland that has shrub vegetation over 30% (1/3) of its area.



RH 1.3 Characteristics of wetland to store surface water.

Rationale for indicator: The capacity of a wetland to temporarily store and retain surface and shallow subsurface water that can support stream flow depends on position of the water table, presence of restrictive soil layers, micro-and macro topographic relief. Organic soil horizons typically have greater storage capacity than mineral soils, particularly when surface organic horizons are dry. These dry horizons can act as a sink for snowmelt.

There are two thresholds to measure this indicator: 1) organic soil or organic mat is greater than 12 inches and 2) mineral soil with organic mat thin or is less than 12 inches. The thicker the organic mat (or organic soil) the higher the capacity for the wetland to store surface water.

RH 1.4 The surface and subsurface soil texture.

Rationale for indicator: Bank stability is dependent on several factors such as soil texture and soil layering. Sand and gravel are highly erodible whereas soil with cohesive aggregates is not. Soils that have a layer of cobbles or gravel will be stable in low velocity water but less so in higher velocity water. Where such factors apply, best professional judgment should be used in applying this function. Soil characteristics determine the types of vegetation present along a shoreline as well as the vulnerability for a shoreline to erosion (RVCA, 2011). Silts and sands are generally considered easily erodible while finer clay soils are more resistant to erosive forces. Soils with high organic matter content are less erodible. Granular soil structure such as sand is easily erodible and displaced. Moderate sized soil particles such as silt is highly erodible and directly impacts water quality from siltation. The smallest soil particles such as clay have different erosion rates based on soil structure. Some have high resistance against erosion and others have low resistance. A mixture of silt, clay, sand and organics such as loams are most ideal as they offer suitable growth medium for plants and have relatively strong cohesion.

There are two thresholds to measure the stability of a slope based on soil texture: 1) sands/gravels and silts, and 2) loams and organic.

RH 1.5. Bank vulnerability to disturbance.

Rationale for indicator: The stability of a slope is related to slope steepness and soil type. The effectiveness of shoreline vegetation in controlling erosion depends on the type of plants present, width of the vegetated bank, the height and slope of the bank. The vulnerability of a slope to disturbance and erosion is then dependent on the slope of the bank.

Streambanks, for the purpose of AFWA, is classified into two steepness profiles and thresholds 1) high banks with a slope ratio of 1:1 (h:v) which is greater than or equal to 35 degrees or 70 percent, and 2) low banks with a slope ratio of 3:1 (h:v) less than 35 degrees or 70 percent (Figure 8 and 9).

Refer to the Alaska Share Point Site under Wetland>Job Aids for a Slope Conversion cheat sheet.


Figure 8. Example of a Low bank with a 3:1 (h:v) slope.


Figure 9. Example of a High bank with a 1:1 (h:v) slope.

LAKE-FRINGE WETLANDS (L): BIOGEOCHEMICAL FUNCTIONS

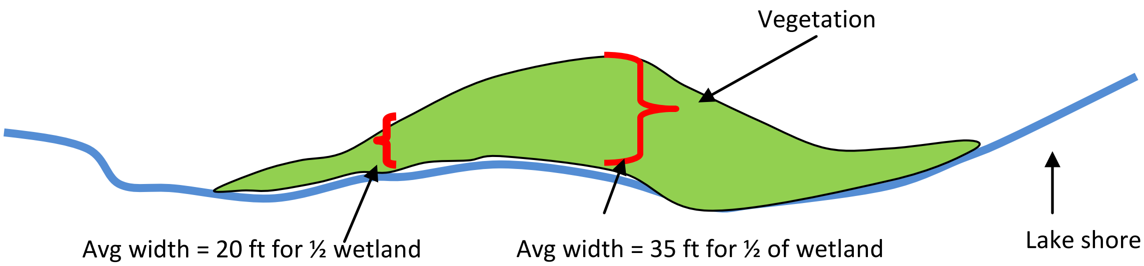
LB1.0 Does the Lake-fringe Wetland have the Potential to Improve, Reduce, or Prevent degradation of Water Quality?

LB1.1 *Determine the Average width of the vegetation along the lakeshore?*

> **Rationale for indicator**: The intent of this question is to characterize the width of the zone of plants that provide a vertical structure to trap or filter out pollutants or absorb them. Wetlands in which the average width of vegetation is large are more likely to retain sediment and toxic compounds than where vegetation is narrow (Adamus et al 1991). Even aquatic bed species that die back every year are considered to play a role in improving water quality. These plants take up nutrients in the spring and summer that would otherwise be available to stimulate algal blooms in the lake. In addition, aquatic bed species change the chemistry of the lake bottom to facilitate the binding of phosphorus (Moore et al. 1994).

It is difficult to map the outside edge of a wetland when it is along the shores of a lake where open water can extend out for large distances. For this reason the question is phrased in terms of width of vegetation perpendicular to the shore rather than the area of vegetation. There are four thresholds for scoring the average width of vegetation: 1) 33 ft or more (10m), 2) 16 ft - < 33 ft (5–10 m), 3) 6 ft - <16 ft. (2 – 5m), and vegetation width is less than 6 ft. For large wetlands along the shores of a lake it may be necessary to sketch the vegetation and average the width by segment, and then calculate an overall average such as in the Figure 10 below.

Figure 10. Estimating vegetation along the shore of a lake. The average width of vegetation for the entire area is (20ft x .5) + (35ft x .5) = 27.5 ft.



LB1.2 Describe the characteristcs of vegetation in the wetland unit.

For this question you will need to group the vegetation found within the wetland into three categories: 1) herbaceous (emergent), 2) aquatic bed and 3) any other vegetation. For this question, the herbaceous plants can be either the dominant plant form (in this case it would be called emergent class) or as an understory in a shrub or forest community). There are several size thresholds used to score this characteristic: 1) more than 90%, 2) more than 60%, or 3) more than 30%, of the vegetated area is covered in herbaceous plants or other types. These thresholds can usually be estimated visually in small wetlands. Large wetlands, however, may require you to draw the area of vegetation types on a map or aerial photo before you can feel confident that your estimates are accurate. *NOTE: In lake-fringe wetlands the area of the wetland used as the basis for determining thresholds is only the area that is vegetated. Do not include any open water in determining the area of the wetland covered by a specific vegetation type.*

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that are more effective at improving water quality in a lake environment. Herbaceous emergent species have, in general, been found to sequester metals and remove oils and other organics better than other plant species (Hammer 1989; Horner 1992).

LB 1.3 The soil has a thick organic layer.

LB 1.4 Characteristics of the vegetation.

Rationale for indicators: Wetlands with a high proportion of organic or peat soils are presumed to have higher plant productivity. A high plant diversity also provides food for several wildlife species.

LAKE-FRINGE WETLANDS (L): HYDROLOGIC FUNCTIONS

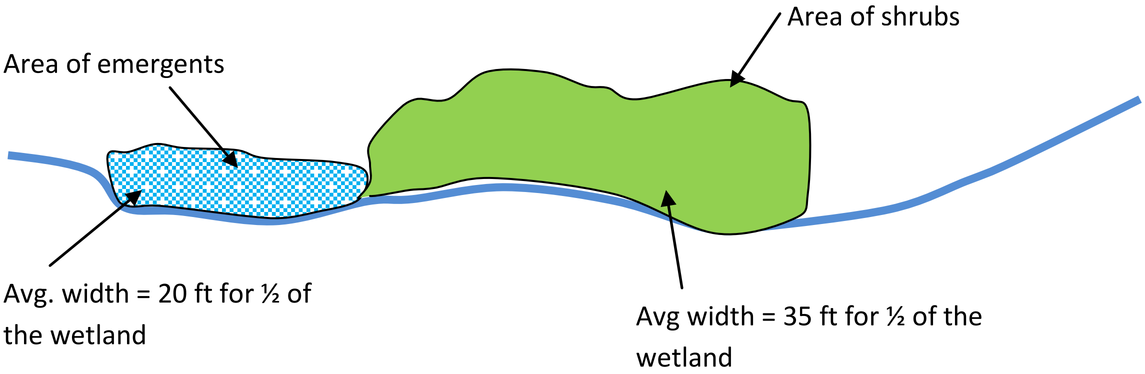
LH 1.0 Does the Lake-fringe Wetland have the Potential to Reduce Shoreline Erosion?

LH1.1 Determine the average width and characteristics of vegetation along the lakeshore (do not include aquatic bed species):

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that provide a physical barrier to waves and protect the shore from erosion. This protection consists of both shoreline anchoring and the dissipation of erosive forces (Adamus et al. 1991). Wetlands that have extensive, persistent (especially woody) vegetation provide protection from waves and currents associated with large storms that would otherwise penetrate deep into the shoreline (Adamus et al 1991). Emergent plants provide some protection but not as much as shrubs and trees.

This characteristic is similar to that used in LB1.1 and LB1.2, but the grouping of vegetation types and thresholds for scoring are different. If you are familiar with the Cowardin classification of vegetation you are looking for the areas that would be classified as Scrub/shrub, Forested, or Emergent (Herbaceous). It is difficult to map the outside edge of a wetland when it is along the shores of a lake where open water can extend out for large distances. For this reason the question is phrased in terms of the width and type of vegetation found only within the area of shrubs, trees, and emergents. There are two thresholds for measuring the average width of vegetation: 1) 33 ft (10m) and 2) 6 ft (2m), and two thresholds based on area 1) ¾ (75%) and 2) ¼ (25%) of the vegetated areas. For large wetlands along the shores of a lake it may be necessary to sketch the vegetation types and average the width by type. Figure 11 gives an example of such a sketch.

Figure 11. Estimating width of vegetation types along the shores of a lake. The average width of shrubs is 35 ft for ½ the wetland and emergents is 20 ft for ½ of the wetland. This wetland would score 4 points because more than ¼ of the vegetation is shrubs greater than 33 ft. wide.



LH1.2 Bank vulnerability to disturbance

Rationale for indicator: The stability of a slope is related to slope steepness and soil type. The effectiveness of shoreline vegetation in controlling erosion depends on the type of plants present, width of the vegetated bank, the height and slope of the bank. The vulnerability of a slope to disturbance and erosion is then dependent on the slope of the bank.

The streambanks can be classified into two steepness profiles and thresholds 1) high banks with a slope ratio of 1:1 (h:v) which is greater than or equal to 35 degrees or 70 percent, and 2) low banks with a slope ratio of 3:1 (h:v) less than 35 degrees or 70 percent (Figure 12 and 13).

Figure 12. Example of a Low bank with a 3:1 (h:v) slope.

Refer to the Alaska Share Point Site under Wetland>Job Aids for a Slope Conversion cheat sheet.

Figure 13. Example of a High bank with a 1:1 (h:v) slope.

LH1.3 The characteristics of vegetation are important for stabilizing soils and reducing water velocity.

Rationale for indicator: Wetlands with dense woody vegetation are generally better at slowing floodwaters than wetlands dominated by open water or low-growing or herbaceous vegetation. Plant species with deep, binding root masses are also more effective at stabilizing soils on streambanks and shorelines than are species with less dense root systems. Trees and shrubs often have deep, soil-binding root masses. Annual herbaceous plants are considered to lack such root masses.

LH 1.4 Surface and subsurface soil texture.

Rationale for indicator: Soil characteristics determine the types of vegetation present along a shoreline as well as the vulnerability for a shoreline to erosion (RVCA, 2011). Silts and sands are generally considered easily erodible while finer clay soils are more resistant to erosive forces. Soils with high organic matter content are less erodible. Soil structure such as sand is easily erodible and displaced. Moderate sized soil particles such as silt is highly erodible and directly impacts water quality from siltation. The smallest soil particles such as clay have different erosion rates based on soil structure. Some have high resistance against erosion and others have low resistance. A mixture of silt, clay, sand and organics such as loams are most ideal as they offer suitable growth medium for plants and have relatively strong cohesion.

There are two thresholds to measure the stability of a slope based on soil texture: 1) sands/gravels and silts, and 2) loams and organic.

SLOPE WETLANDS (S): BIOGEOCHEMICAL FUNCTIONS

SB 1.0 Does the Slope Wetland have the Potential to Improve, Reduce, or prevent degradation of Water Quality?

SB 1.1 Characteristics of the average slope of the wetland:

> **Rationale for indicator**: Water velocity decreases with decreasing slope. This increases the retention time of surface water in the wetland and the potential for retaining sediments and associated toxic pollutants. The potential for sediment deposition and retention of toxics by burial increases as the slope decreases (review in Adamus et al. 1991).

For this question you will need to estimate the average slope of the wetland. Slope is measured either in degrees or as a percent (%). In this rating system we use the latter measurement, (%), which is calculated as the ratio of the vertical change between two points and the horizontal distance between the same two points vertical drop in feet (or meters) / horizontal distance in feet (or meters). For example, a 1 foot drop in elevation between two points that are 100 ft. apart is a 1% slope, and a 2 foot drop in the same distance is a 2% slope. For large wetlands the slope can be estimated from USGS topographic maps of the area. The change in contour lines can be used to calculate the vertical drop between the top and bottom edges of the wetland. The horizontal distance can be estimated using the appropriate scale (printed at the bottom of the map). A clinometer or other device can be used to measure slope.

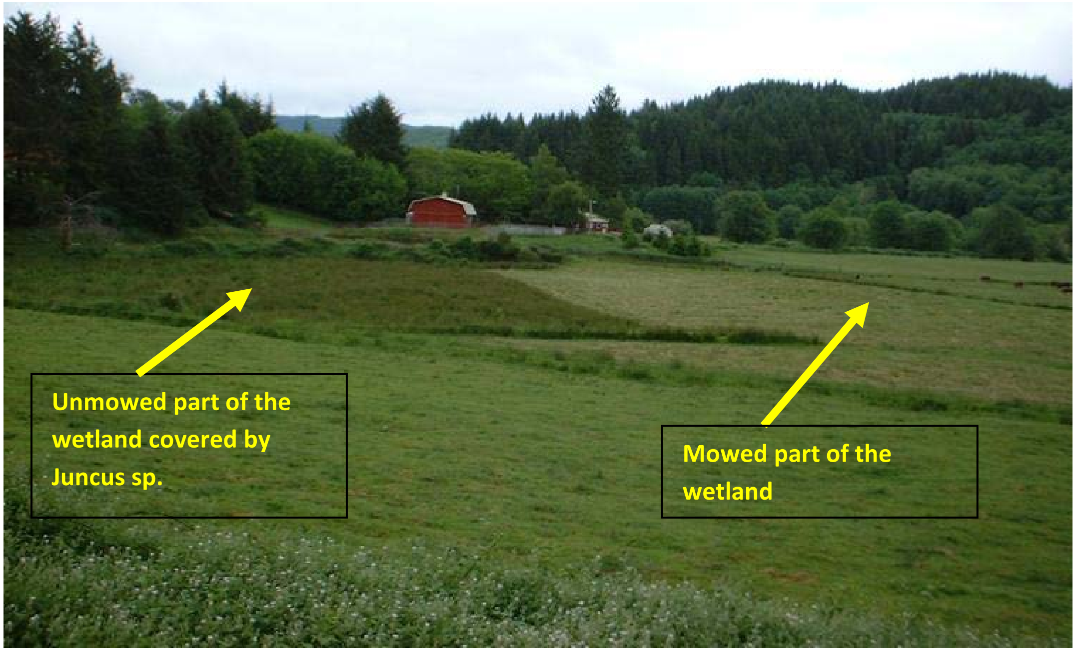
Another option, especially for small wetlands, to estimate slope can be done by pacing or using a tape measure. Visual estimates of the vertical drop are more accurate if you can find a point of reference near the bottom edge of the wetland. Stand at the upper edge of the wetland and visualize a horizontal line to a tree, telephone pole, or another person at the lower edge of the slope wetland. The point at which the imaginary horizontal line intersects the object at the lower edge can be used to estimate the vertical drop between the upper and lower edges of the wetland (refer to the Forestry HanFBook for more information on calculating slope). *NOTE: If you are standing at the upper edge of the wetland looking for a visual marker at the lower edge, do not forget to subtract your height from the total.*

SB 1.2 Characteristics of the vegetation that trap sediments and pollutants:

> **Rationale for indicator**: The intent of this question is to characterize how much of the wetland is covered with plants that are more effective at improving water quality in a slope environment. Herbaceous species have, in general, been found to sequester metals and remove oils and other organics better than other plant species (Hammer 1989, and Horner 1992). Furthermore, dense herbaceous vegetation presents the greatest resistance to the surface flow often found on slope wetlands. Water in this environment tends to flow very close to the surface and be shallow (not more than a few inches). Trees and shrubs tend to be widely spaced relative to herbaceous plants and don't provide as much resistance to this type of surface flow.

For this question you will need to group the vegetation found within the wetland into only two groups: dense, ungrazed, herbaceous vegetation and all other types (Figure 14). NOTE: **The Cowardin vegetation types are not used for this question.** For this question the herbaceous vegetation includes the areas of emergent vegetation as classified by Cowardin and the herbaceous understory in a shrub or forest. To qualify as "dense" the herbaceous plants must cover at least ¾ (75%) of the ground (as opposed to the 30% requirement in the Cowardin vegetation types).

Figure 14. A slope wetland with dense unmowed vegetation is between ¼ (25%) and ½ (50%) of the area of the wetland.



SB1.3 Characteristics of the vegetation cover in SB1.2 are deciduous trees and shrubs, and the herbaceous strata.

Rationale for indicator: Wetland productivity depends on inputs of organic matter and nutrients; wetland systems in turn export organic matter and nutrients to the downstream environments. Deciduous shrubs turn over 34 to 43% of their biomass annually adding a substantial amount of litter to the soil surface (ADEC &USACE, 1999). Shrubs recycle nutrients effectively because tissue nutrient pools are high in proportion to biomass. The herbaceous stratum produces new growth and senesces annually decomposing more rapidly than woody vegetation and cycles nutrients fairly rapid. Mosses generally prohibit nutrient cycling by acting as nutrient sinks.

SB 1.4 The soil has permafrost and/or a thick organic layer.

Rationale for indicators: Wetlands with a high proportion of organic or peat soils are presumed to have higher plant productivity. A high plant diversity also provides food for several wildlife species.

SLOPE WETLANDS (S): HYDROLOGIC FUNCTIONS

SH 1.0 Does the Slope Wetland Have the Potential to Reduce Flooding?

Note: The function "Sediment/shoreline stabilization" is not considered principle for the Slope Class.

SH1.1 Characteristics of vegetation that reduce the velocity of surface flows.

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that provide a physical barrier to sheetflow coming down the slope. Vegetation on slopes will reduce peak flows and the velocity of water during a storm event. The importance of vegetation on slopes in reducing flows has been well documented in studies of logging (Lewis et al. 2001) though not specifically for slope wetlands. The assumption is that vegetation in slope wetlands plays the same role as vegetation in forested areas in reducing peak flows. Slope wetlands function about the same relative to flood desynchronization regardless of their position in the landscape.

For this question you will need to estimate the area of two categories of vegetation found within the wetland: 1) dense, uncut, rigid vegetation, and 2) all other vegetation. This indicator of vegetation is **not** related to any of the Cowardin classes. *Note: **Dense** means that individual plants are spaced closely enough that the soil is barely, if at all, (> 75% cover of plants) visible when looking at it from the height of an average person. **Uncut**, means that the height of the vegetation has not been significantly reduced by grazing or mowing. **Significantly reduced** means that the height is less than 6 inches. **Rigid** is defined as having stems thick enough (usually > 1/8 in.) to remain erect during surface flows.* There are three size thresholds used to score this characteristic: 1) dense, ungrazed, erect vegetation for more than 90% of the area of wetland (Figure 15) and 2) ½ the area, and 3) ¼ the area. The wetland in Figure 14 was mowed over much of its area, except where the *Juncus sp.* was growing. The mowed vegetation was less than 6 in. high, so the only plants that were included for this indicator were the *Juncus*. The wetland in Figure 14 has between ¼ and ½ of its area with dense, unmowed, erect vegetation.

Figure 15. A slope wetland with dense erect ungrazed vegetation over more than 90% of the area. The direction of the slope is from left to right. The arrow points in the direction of water flow.

SH1.2 Characteristics of vegetation that is more effective at stabilizing soils.

Rationale for indicator: Wetlands with dense woody vegetation are generally better at slowing sheet flow than wetlands dominated by open water or low-growing or herbaceous vegetation. Plant species with deep, binding root masses are also more effective at stabilizing soils such as trees and shrubs often have deep, soil-binding root masses. Annual herbaceous plants are considered to lack such root masses.

SH1.3 The surface and subsurface soil textures are important especially for discharge and recharge wetlands.

Rationale for indicator: Groundwater and peat development play a major role in creating fens and bogs. Peatlands have the ability to hold precipitation and feed underlying aquifers that eventually discharge into surface water or valley bottoms. Spring fens are small peatlands surrounded by uplands with no surface connection to the stream network and therefore do not perform streamflow moderation as a principal function. However, because of the permeable subsurface soil texture they provide a principal function in transmission of groundwater and serve as a hydrologic source for wetlands, streams, and water bodies. The combination of thick organic material on top of permeable sub surface material allow subsurface flow paths for nutrients and are made available for uptake when discharged to the surface. This transmission is known to have a strong ecological effect in plant species health and diversity.

There are three indicators for measurement: 1) a thick organic soil over well sorted coarse grained material, 2) organic soil over frozen or silt loam soil, and 3) mineral soil.

ESTUARINE TIDAL FRINGE WETLANDS (E): BIOGECHEMICAL FUNCTIONS

Tidal forces cause the wetland to be flooded at least once annually with saline or brackish surface water originating partly or wholly from the ocean. They are often located within or along the fringes of a major estuarine embayment or a slough off the embayment. This class is typically located within zones classified as “Marine” or “Brackish” on maps published by Hamilton (1984), the National Estuarine Inventory (1985, NOAA 1985; http://spo.nos.noaa.gov/projects/cads), and/or as “Estuarine” on National Wetlands Inventory maps. The wetland and/or its immediate receiving waters may have one or more of the following indicators suggestive of marine water: barnacles, seaweed, kelp, salt marsh plant species (halophytes such as *Triglochin*, *Distichlis, Plantago maritima*), salinities ranging fresh (less than 0.5 ppt salts) to saline (up to 35ppt salt), or a preponderance (in adjacent flats) of rounded sediment particles indicative of marine-derived sediments. Currently, for the purpose of this document, this class has not been subdivided into Low Tidal Fringe wetland (low marsh) and High Tidal Fringe wetland (high marsh) due to the difficulty of distinguishing them apart and for the purpose of AFWA, but if requested, the subclasses can be added as needed (Adamus, P.R. 2006).

A low tidal fringe wetland is where the wetland is inundated at high tide at least once during the *majority of days during each month of the year*. This may be indicated by a combination of direct observation of tidal inundation, predominance of plant species characteristic of “low marsh” marine environments (i.e., an absence of woody plants, lower plant species richness than high marsh, and/or by reference to elevation data on local tidal range (geodetic benchmarks). Less definitively, a boundary between low and high marsh may be evidenced by a vertical break in the marsh surface or by accumulations of fresh seaweed, plant litter, and debris. High marsh areas are flooded by tides less often.

EB 1.0 Does the wetland unit have the potential to improve, reduce or prevent degradation of water quality, provide food chain support, and provide export of organic Carbon?

EB1.1 Maximum risk of nutrient overload in the wetland.

EB1.2 Maximum risk of the wetland being exposed to chemical pollutants (excluding nutrients).

A **minor source** type: widely scattered houses, small lawns and gardens, low-density grazing, parking lots, and extensive stands of native vegetation and/or occasional large boat traffic. **Major source** type: neighborhoods (not on sewer lines), extensive concentrated grazing, waste treatment plant effluent, many malfunctioning septic systems, large scale agriculture, fallow fields, and/or boatyards, harbors. **Load:** runoff load of contaminants will depend partly on size, slope, and soil type of the contributing area; consider annual maximum for a normal year. **Extent:** “limited” would apply if surface water travels only in a single internal channel, or if the only contaminant source is at a localized spot along the upland edge. Question EB 1.1 and EB 1.2 refer to the risk for both nutrient overload and the potential for the wetland to be exposed to chemical pollutants (excluding nutrients). Chemical pollutants could be from leaking underground storage tanks, tank farms, oil spills, storm water, animal waste or processing plants, or other non-natural substances. **Toxicity:** pollutants include substances potentially harmful to plants or animals and present well above any natural background level. The following thresholds are used:

EB 1.1 Nutrient Load Risk

S Source Type	Score
No abnormal sources	0
Minor potential or known source of nitrogen or phosphorus	1
Major potential or known source of nitrogen or phosphorus	2

L Maximum Load (of nutrients)	Score
Diffuse or diluted (distant source) or infrequent	1
Concentrated (nearby source) or frequent	2

E Maximum Extent	Score
Only a small % of the wetland is likely to receive inputs due to its relative elevation & other factors	1
Not localized	2

Calculate: S * (L + E) = score for nutrient overload risk. There are three thresholds for the calculated scores: 0 = 2 points; 2 - 4 = 1 point; >4 = no points

EB 1.2 Exposure to Chemical Pollutants

T Toxicity	Score
No pollutant sources likely in nearby runoff, groundwater, or surface water; no history of recent Spills reaching the wetland	0
Some pollutants	1

L Maximum Load (of contaminants)	Score
Diffuse (distant source) or infrequent (severe storms only)	1
Concentrated (nearby source) or frequent	2

E Maximum Extent (of contaminants)	Score
Limited (only a small % of the wetland is likely to be exposed to the chemical)	1
Most of wetland could be exposed	2

Calculate: T * (L + E) = score for chemical pollutant exposure. There are three thresholds for the calculated scores: 0 = 2 points; 2 - 3 = 1 point; 4 or greater = no points

Rationale for indicators: A healthy tidal marsh receives inputs of nitrogen, phosphorus, and other naturally-occurring elements in forms and seasonal patterns that are appropriate for the site's landscape setting, and converts these inputs between inorganic and organic forms (and gaseous forms for N and C) at rates appropriate for the age of the site, its elevation, substrate, exposure, and salinity (Adamus, P.R. 2006.)

EB 1.3 Number of easily-recognizable vegetation structures present within the wetland. Check all that predominate over a 100 sq.ft.area.

Rationale for indicator: A healthy tidal marsh receives sustained inputs of characteristic quantities, sizes, and decay classes of large woody debris; exhibits levels of decomposition rates of soil organic matter and dissolved oxygen that are appropriate for the age of the site and its elevation, substrate, exposure, temperature, and salinity. Large logs or "nurse logs" and stumps, present on the marsh surface which, because of the elevated substrate they provide and protect germinating plants on top of the log from potentially lethal long-duration flooding and high salinity (Adamus, P.R. 2006.)

EB 1.4 Number of internal channel exists. Aerial imagery will be needed or helpful to answer this question.

Rationale for indicator: A healthy tidal marsh exhibits salinity regimes and experiences freshwater inputs in spatial and temporal patterns that are seasonally and diurnally appropriate for the site's vertical and horizontal position in the estuary (Adamus, P.R. 2006)

The number of exits is strongly related to marsh size, substrate type, and HGM subclass (e.g., high marsh and low marsh), and also to disturbance. **Exits** are where internal channels flow into unvegetated waters or tideflats outside of the wetland. **External wet edge length** is measured as the wetland's edge with unvegetated water or tideflat at low tide. For channels that connect at both ends to a tideflat or unvegetated bay or river, count both ends as exits. Do not count constructed drainage ditches. Count the number of internal channel exits using a 1:24,000 aerial image or what is applicable. Note the image scale on the data sheet. Next, using the top row of the relevant table below (A or B) (use the same lengths for Table B) find the wetland edge length. In that column find the number of channel exists the wetland has. Then look along the row to the last column for the resulting score.

Table A. Wetlands on silt, clay, or muck substrate:

Length of external wet edge (ft)			score
<1000 ft	1000– 3400 ft	**> 3400 ft**	
0 exits	0 exists	0 exists	0
1	1-2	1-3	1
2	3-5	4-6	2
3-4	6-10	7-12	3
>4	>10	>15	4

Table B. Wetlands on sand substrate:

Exits	score
0	0
1	1
>1	2

*EB 1.5 Record the type of freshwater sources that feed the wetland internally. Do not count major rivers adjoined by the wetland as freshwater sources. Perennial tributaries flow year-round most years. Intermittent tributaries flow seasonally and have recognizable channels extending uphill at least twice the width of the tidal marsh. Non-tidal wetlands may be dominated by willow, sweet gale, and alder. Adjoining means present within 10m. *Large is wider than the tidal wetland (width measured perpendicular to slope). Select the maximum score in each group and then sum the two maxima:*

Group A: Flowing into the wetland	**Score**
Perennial fresh tributary	1
Intermittent fresh tributary or stormwater pipe	0.5
neither	0

Group B: Adjoining on the uphill side	**Score**
Large* non-tidal freshwater wetland, pond, or spring	2
Small non-tidal wetland, seep, or hydric soil patch	1
Other land cover, and tidal wetland is not an island	0.5
Tidal wetland occupies nearly all of an island	0

ESTUARINE TIDAL FRINGE WETLANDS (E): HYDROLOGICAL FUNCTIONS

EH 1.0 Does the wetland unit have the potential to reduce flooding and erosion?

EH 1.1 Onsite soil disturbance. There are two thresholds used to assess the wetland that has been affected by ongoing or past erosion/compaction caused directly by human activities: 1) ongoing disturbance, and 2) historical but still apparent disturbance. Infer past disturbance using historical imagery, local contacts, presence nearby of old pilings, and partially-buried cut logs. Infer livestock from presence of fences or local knowledge. Potential sources include eroding banks, logged or burned areas, mining (especially gravel and placer), frequent dredging, livestock, ATV use and roads. Consider proximity, extent, slope, substrate, type, and number of years to recover. "Normal" for a wetland near the estuary mouth may be a greater load than for a wetland near head-of-tide, because load increases downstream even in pristine estuaries.

> **Rationale for indicator**: A healthy tidal marsh exhibits erosional/depositional regimes and has sediment particle size distributions that are appropriate for the site's position in the estuary and watershed geology/soils (Adamus, P.R. 2006)

EH 1.2 Degree that the wetland becomes ***drier (1.2a)*** *or* ***wetter (1.2b)*** *as a result of ditches or installation of dikes, tidegates, culverts, and other artificial constrictions.* Wetlands receiving little upland runoff or groundwater seepage are especially vulnerable to "drier" conditions if they are diked. Include constrictions within or along the upland or water edge of the wetland. Ignore drying due to geologic uplift (i.e., glacial rebound) or to sediment-related increases in elevation of marsh surface, but do include if the drying is due to sediment blockage of surface water inputs. Drying may result from upriver dams, water diversions, or dredging of estuary mouths. Wetter conditions may be the result from diversions, storm-water runoff/inputs, increased onsite flooding from impervious surfaces, offsite ditches, or clearcutting in the watershed. Four thresholds for each scenario address human alteration and the degree that alteration has on the normal flooding / tidal circulation of the wetland.

EH 1.3 Possible instability of the wetland. This question addresses the ability of the wetland to exhibit a resilient assemblage of native wetland-associated plants, site stability based on substrate, salinity, exposure, and elevation. Four variables are evaluated: A) living trees and shrubs, B) location of wetland relative to flooding regime (i.e., percent of wetland that is high marsh), D) change in the area of the wetland and adjoining tidflat, and D) predominant substrate. The sum of the four variables, A+B+C+D is the total score for the question.

All Classes of Wetlands (AH): Habitat Functions

AHAB 1.0 Does the Wetland Have the Potential to Provide Habitat?

AHAB 1.1 Vegetation Structure

Rationale for indicator: Habitat "niches" are increased within a wetland as the number of types of vegetation structure increase. The increased structural complexity provided by different vegetation types optimizes potential breeding areas, escape, cover, and food production for the greatest number of species (Hruby et al. 1999). This increased species richness arising from the increased structural diversity also supports a greater number of terrestrial species in the overall wetland food web (Hruby et al 1999). The Cowardin vegetation classes are used as indicators of different types of structure in the plant community. In addition, the presence of vertical structure in forested communities is considered a characteristic that increases habitat complexity and niches.

For this question you will need to identify the Cowardin classes of vegetation in the wetland. The classes are:

1. Aquatic Bed: *plants that grow on or below the surface of the water*
2. Moss-Lichen: *mosses or lichens*
3. Emergent: *herbaceous angiosperms*
4. Scrub-Shrub: *shrubs or small trees(areas where shrubs have >30% cover)*
5. Forested: *large trees (areas where trees have >30% cover)*

There may be several "layers" within the shrub category including prostrate, dwarf, low, medium, and tall shrubs which can provide valuable cover and food for several wildlife species. If a shrub category contains more than one layer, add a point.

NOTE 1: Each vegetation class has to cover more than ¼ acre, or if the wetland is smaller than 2.5 acres, the threshold is 10% of the area of the wetland. Cowardin vegetation types are distinguished on the basis of the uppermost layer of vegetation (forest, shrub, etc.) that provides more than 30% surface cover within the area of its distribution.

NOTE 2: Aquatic bed plants do not always reach the surface and care must be taken to look beneath the water's surface. Because waterfowl can heavily graze certain species of aquatic bed early in the growing season, it can be incorrectly concluded that aquatic bed is not present if the field visit is made during this time period**. Therefore, examine the substrate in open water areas for evidence of last year's growth of aquatic bed species.** If a wetland is being rated very late in the growing season, when either the standing water is gone or very limited in extent, examine mudflats and adjacent vegetated areas for the presence of dried aquatic bed species.

NOTE 3: If a vegetation type is distributed in several patches, the patches can be added together if the patches are large enough. Large enough means that 10 or fewer patches are needed to meet the size threshold (average patch size is greater than 10% of threshold in Note 1 above).

AHAB 1.2 Hydroperiods

Rationale for indicator: Many aquatic species have their life cycles keyed to different water regimes of permanent, seasonal, or saturated conditions. A number of different water regimes in a wetland will, therefore, support more species than a wetland with fewer water regimes. For example, some species are tolerant of permanent pools, while others can live in pools that are temporary (Wiggins et al. 1980).

For this question you will need to identify areas in the wetland with different water regimes as they appear during the wettest time of the year. You are looking for areas with different patterns of flooding or saturation. For example, does part of the wetland have surface ponding only for a very short time (we call this occasionally flooded) (Figure 16) or are there areas that have surface water all year (permanently flooded)? The purpose is to identify the wettest water regime within different areas of the wetland. A drawing on a map or imagery of the different hydroperiods can assist. Thus, an area that is seasonally flooded, but only saturated during the field visit in the summer, would still be categorized as seasonally flooded. To count, the water regime has to cover more than 10% of the wetland or ¼ acre. The six water regimes that you need to identify are:

1. **Permanently Flooded or Inundated** — Surface water covers the land surface throughout the year, in most years. NOTE: During high water in the winter and spring, it may be difficult to determine the area that would be permanently flooded during the summer dry period. One indicator of permanent water is an area of open water without vegetation inside the zone of seasonal inundation. Aerial photos taken during the summer may also show areas of permanent water.
2. **Seasonally Flooded or Inundated** — Surface water is present for extended periods (for more than 2 consecutive months during a year), especially early in the growing season, but is absent by the end of the season in most years. During the summer dry season it may be difficult to determine the area that is seasonally inundated. Use the indicators described in FB1.3 (p. 74) to help you determine areas that are seasonally flooded or inundated.
3. **Occasionally Flooded or Inundated** —Surface water is present for brief periods of less than two months during the growing season, but the water table usually lies below the soil surface for most of the season. Plants that grow in both uplands and wetlands are characteristic of this water regime (facultative).
4. **Saturated** — The soil is saturated near the surface for long enough to create a wetland, but surface water is seldom present. The latter criterion separates saturated areas from inundated areas. In this case, there will be no signs of inundation on plant stems or surface depressions.
5. **Permanently Flowing Stream** — The wetland contains a river, stream, channel, or ditch with water flowing in it throughout the year within its boundaries or along one edge (in a riverine situation).
6. **Intermittently Flowing Stream** — The wetland contains a river, stream, channel, or ditch in which water flow is intermittent or seasonal within its boundaries or along one edge.
    a. *Note: Wetlands that are classified as estuarine tidal fringe or lake-fringe are scored 2 points for this question. The water regimes in these two types of wetlands do not fit the water regimes and/or are too difficult to determine.*

Figure 16. A large depressional wetland (not a lake) with three water regimes: permanently flooded, seasonally flooded, and occasionally flooded. The areas that are seasonally and occasionally flooded are found around the outer edge of the wetland.

AHAB 1.3 Richness of Plant Species:

Rationale for indicator: Richness is the **number** of plant species present in a wetland reflects the potential number of niches available for invertebrates, birds, and mammals. The total number of animal species in a wetland is expected to increase as the number of plant species increases (Hruby, et al. 1999). For example, the number of invertebrate species is directly linked to the number of plant species (Knops et al. 1999). This indicator includes both native and non-native plant species (with the exceptions noted below) because both provide habitat for invertebrate and vertebrate species. Diversity is the abundance (eveness or unevenness) of a species within the sample unit or community. For example, perfect evenness of 5 species in a community would mean that in 100% cover, they were distributed 20,20,20,20, & 20. Diversity is thus measured by recording the number of plant species and their relative abundance.

As you walk through the wetland, or do your delineation, keep a list of the patches of different plant species you find. You do not have to record individual plants, only species that form patches that cover at least 10 square feet (this helps reduce variability among users). Different patches of the same species can be combined to meet the size threshold. You should try to identify plants, but keying them out is not necessary. All you need to track is the total number, so you can identify species as Species 1, Species 2, etc. In order to capture the full range of plant species present during the year, record any species that are dead and recognizably different from other species present. There are 3 thresholds to keep in mind: 1) 15 or more species, 2) 5-14, and 3) less than 5 species. If you count more than 15 you do not need to continue identifying plants. *Note: Invasive plant species that tend to form large, mono-cultures that exclude other plant species and therefore, reduce the structural richness of habitat are not included. Invasive plants can be recorded by species and cover in the remarks or notes section.*

AHAB 1.4 Interspersion of Habitats:

Rationale for indicator: In general, interspersion among different physical structures (e.g. open water) and types of vegetation (e.g. aquatic bed, emergent vegetation, shrubs) increases the suitability for some wildlife guilds by increasing the number of ecological niches (Hruby et al. 1999). For example, a higher diversity of plant forms is likely to support a higher diversity of macro-invertebrates (Chapman 1966, Dvorak and Best 1982, Lodge 1985).

In question *AHAB1.1* you determined how many different vegetation types (e.g., Cowardin) are present in the wetland being rated. *AHAB1.4* uses this information and also asks you to identify if there are any areas of open water in the wetland (open meaning without vegetation on or above the water surface during the spring, summer, or fall). You are asked to rate the interspersion between these structural characteristics of the wetland. The diagrams on the Wetland Class & Function Score sheetshow what is meant by ratings of High, Medium, Low, or None. Different shading represents a different habitat structure, either a vegetation type or open water. To answer this question first consider if the interspersion falls into the two default ratings:

1. If the wetland has only one vegetation category present (question AHAB1.1) and no open water, it will always be rated as NONE or 0 point; and
2. If the wetland has four vegetation types (from question AHAB1.1), or three vegetation types and open water it will always be rated as HIGH or 3 points. An example would be a depressional wetland with open water, emergents, aquatic bed, shrubs and forest classes. Thus, it automatically rates a HIGH. The only time you will have to make a decision is when the wetland has two or three types of structure that provide habitat. In scoring units with 2 types of structure the difference between a LOW and MODERATE interspersion is the amount of edge habitat between the structures. Units with convoluted edges are scored moderate while those with relatively straight edges are scored low. Additional notes for determining the interspersion are:

Note: Riverine, Estuarine and Lake-fringe wetlands will always have at least two categories of structure (open water and one type of vegetation). A wetland with a meandering, unvegetated, stream (seasonal or permanent) should be rated MODERATE if it has only one vegetation category, or HIGH if it has two or more. Several isolated patches of one structural category (e.g. patches of open water) should be considered the same as one patch with many lobes.

AHAB 1.5 Special Habitat Features

Rationale for indicator: There are certain habitat features in a wetland that provide refuge and resources for many different species. The presence of these features increases the potential that the wetland will provide a wide range of habitats (Hruby et al. 1999). These special features include: 1) large downed woody debris in the wetland that provide major niches for decomposers (i.e. bacteria and fungi) and invertebrates, 2) snags that provide perches and cavities for birds and other animals, 3) undercut banks that provide protection for fish and amphibians, 4) stable, steep banks of fine material that might be used by aquatic mammals for denning, 5) thin-stemmed vegetation that provide structure on which amphibians can lay their eggs, and 6) vegetation dominated by non-invasive species that indicates the community is relatively undisturbed.

Record the presence of any the following special habitat features within the wetland on the rating form. Record the total "checked" features that are present:

1. Large woody debris within the wetland that is more than 4 inches in diameter at the base and more than 6 ft. long
2. Snags present in the wetland that are more than 4 inches in diameter at breast height
3. Steep banks of fine material for denning, or evidence of use of the wetland by beaver or muskrat. Look for banks that are at least 33 ft long, 2 ft. high within or immediately adjacent to the wetland and determine if they have the following characteristics: steep bank of at least 30 degrees slope, with at least a 3 foot depth of fines such as silt. This criterion can also be met if there is evidence of recent use of the area by beaver. Recently cut trees and shrubs, where the cuts are conical, are good evidence of beaver use.
4. At least ¼ acre of thin-stemmed persistent vegetation or woody branches are present in areas that are permanently or seasonally inundated.(structures for egg-laying by amphibians)
5. For riparian and "riverine" classes, are pools and riffles and boulders present which provide habitat for fish
6. Willows, emergents (herbaceous), berry-producing plants and other species specific forage present
7. Invasive plants cover less than 25% of the wetland area in each vertical stratum of plants present in the wetland (i.e. forest, herbaceous, ground-cover). For example, a forested wetland with a 100% forest cover of native species but with an understory of bird vetch that covered 70% of the ground would not quality for this characteristic (refer to Alaska Invasive Plant Species List).
8. Substrate is sandy or rocky within the stream itself which is important fish habitat
9. Wetland unit is adjacent to an anadromous stream and/or anadromous species observed (list if know).
10. Estuarine fringe habitats that are associated with tidal flats and are accessible to young anadromous fish
11. If you observe other special habitat characteristics please note and score.

APPENDIX D

Wetland Class & Function Score Sheets

Appendix D and All score sheets are available as separate files on the Alaska Share Point Site. Click on link for score sheet. For all the score sheets go to: Ecological Sciences > Wetlands > Wetland Function Assessment > Appendix D Indicators by Class Function

For score sheets by function and HGM class the links are:

Appendix D Indicators_Class_Function\SCORESHEETS\BIOGEOCHEM_FLAT_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\BIOGEOCHEM_Estuarine_TidalFringe_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\BIOGEOCHEM_Lake Fringe_SCORESHEET.doc
Appendix D Indicators_Class_Function\SCORESHEETS\BIOGEOCHEM_Riverine_TidalFringe_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\BIOGEOCHEM_Slope_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\HABITATFUNCTION_AllClass_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\HYDRO_Flat_SCORESHEET.doc

Appendix D Indicators_Class_Function\SCORESHEETS\HYDRO_Estuarine_TidalFringeSCORESHEET.doc

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