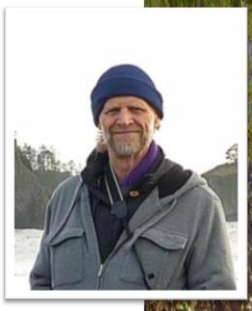
Wetlands 101 Webinar Series

Part 2: Wetland Hydrology



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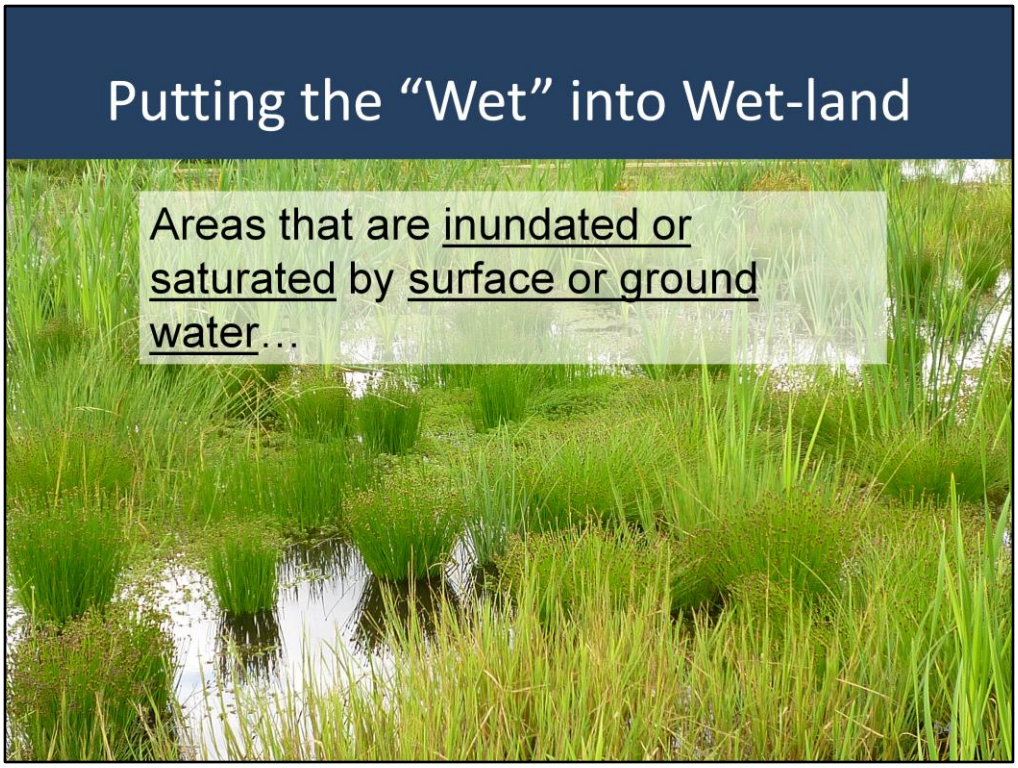
DEPARTMENT OF ECOLOGY State of Washington

COASTAL TRAINING PROGRAM Washington

What is hydrology? It's the water. The driving force…in what makes wetlands – well, wetlands.

Hey look, I dug a hole and it's filling with water!!!



Wetlands have to have water or saturation in the upper 12 inches of the soil in order to be considered "Wet-Lands" – these wet-lands can either be covered with water at the surface or they can be saturated within the upper 12 inches of the soil.

How Much Water is Enough?

- Inundatated - ponded or flooded - Generally, surface water.

- Saturated – Virtually all pores between soil particles are filled with water (WMVC 2010) – Generally, groundwater.

How much water *is* enough? The reference listed here is for the US Army Corp Regional Supplement to the wetland delineation manual called the Western Mountains, Valleys and Coast Region which came out in May 2010.

The soils have to be either inundated or saturated to the surface for at least two weeks during the growing season. This means that water has to be present in the upper 12" of soil for ***at least*** two weeks during the growing season!

This photo was taken in late April -- well within the growing season. Notice the water at the surface or inundation. If you were to dig a hole nearby, outside the area of inundation, you would expect to find that water would fill or partially fill the hole that you dug. This area is a wetland.

The Growing Season?

Essentially, wetland hydrology is:

- Enough water in an area for long enough during the growing season to cause anaerobic conditions in the upper part of the soil profile.
- The growing season varies from year to year but generally speaking, in the Puget Sound lowlands, it runs from mid-Feb. thru Oct.

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The growing season can be variable from year to year. If the native plants are beginning to grow or are actively growing, then soil temperatures are warm enough for soil microbes to be active. Soil microbes deplete the oxygen in the upper portions of the soil only when soil temperatures rise sufficiently for the plants to begin to grow. Look for the first buds that begin to open on native shrubs and trees. Watch for the emergence of skunk cabbage in very wet systems.

This is a photo of a common shrub in our region called “Indian Plum” and is one of the earliest native plants to bud in the early part of the growing season. Note that this photo was just taken this year at the end of January. Also look for salmonberry buds and swelling buds on willow species.

Sources of Wetland Hydrology

- **Precipitation** – we have enough rainfall in the rainy season to create wetlands (through ponding) in low permeability soils,
- **Backwater flooding** – along stream channels,
- **Tidal influence** – Higher tides can back up freshwater streams or groundwater flows,
- **Seasonally high groundwater table** (usually perched), and
- **Combination of any of the above.**

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Very often wetland hydrology in our region is a combination of these sources.

Questions?

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We can all recognize the obvious wetlands in our landscape.

Skunk cabbage is a clear sign that the area is wetland.

This is an aquatic bed along a lakeshore.

Is this a wetland? Is late February in the growing season? Do you see any signs of obvious inundation or saturation? In this instance, you would have to dig a hole and examine the soils to see if there is saturation within the upper 12”.

This is an agricultural field in mid-February clearly showing inundation at the surface. Is mid-February in the growing season? Is this a wetland?

Late April is well within the growing season. One of the last three images was found to NOT be a wetland. Can you guess which one was NOT a wetland?

The agricultural field in mid-February was NOT a wetland. Many years, depending upon temperatures and the severity or mildness of the winter, mid-February *IS* within the growing season AND, agricultural fields can be and often are wetlands – legally farmed wetlands; however, in this specific instance this farm field was NOT wetland. Can you guess why?

Because there was no wetland hydrology!

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We dug a hole in the agricultural field and found that there was no water below the surface in mid-February even with water standing at the surface immediately adjacent to the hole. In this instance, this agricultural field is next to a dike on a major river and the soils in this area contained fine silts from historic floods prior to the construction of the dike. The fine silts prevented the winter rains from moving downward into the soil column. Compaction from farm equipment may also have played a role.

Then what about this farm field?

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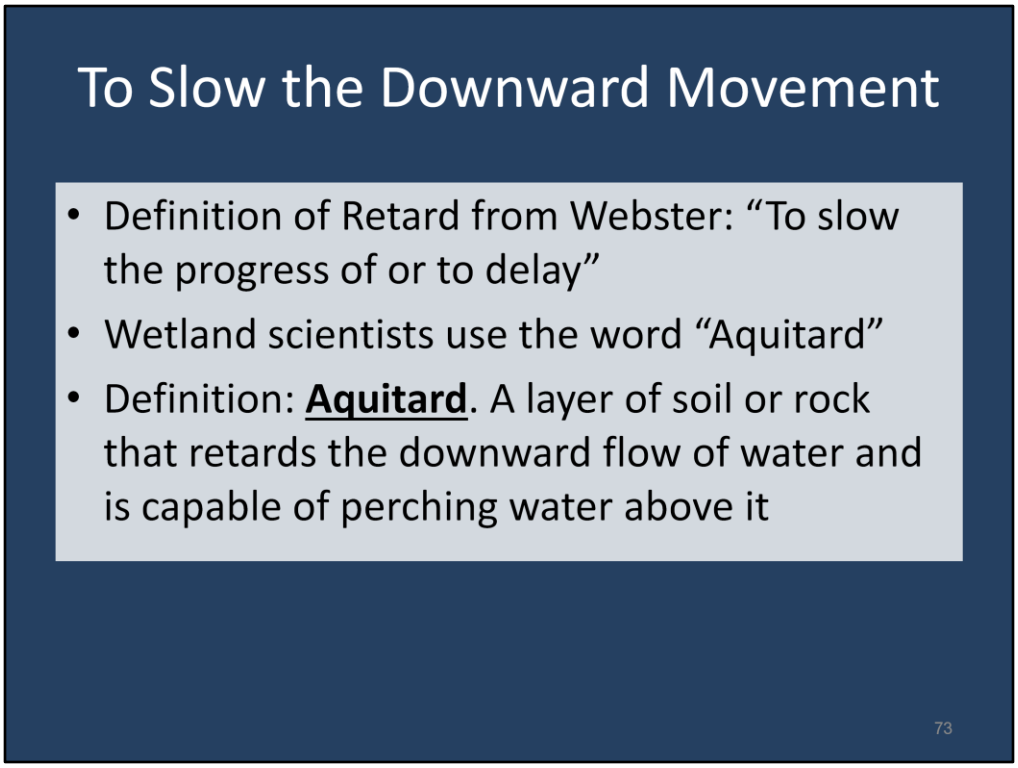
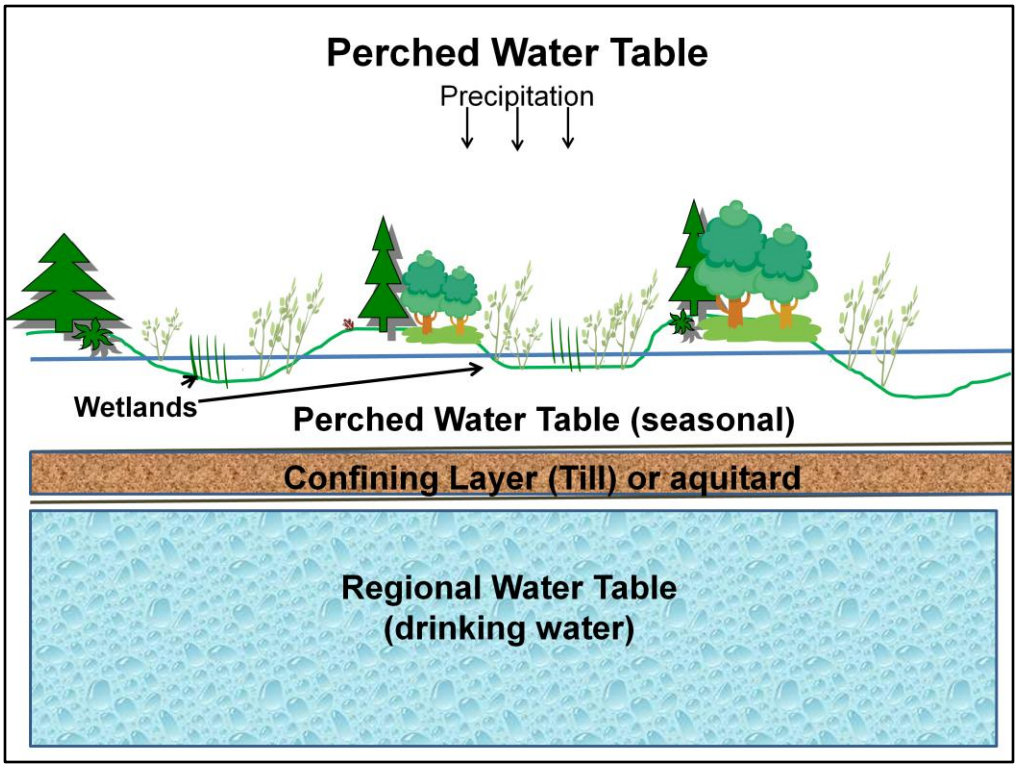
This wet-pasture was illegally trenched without authorization in an attempt to drain the wetland. Note the change in color in the soils approximately a foot below the surface. Without the trenching, this wetland has saturation in the upper 12” of the soil column well into the growing season.

This is another photo of the same wet-pasture from the previous slide. This wetland is on a gradual slope that leads toward a locally important salmon stream in a small valley. Note the change in soil color and texture at about 8” from the surface. The lighter colored soils below 8” *retard* the downward movement of water, largely in the form of precipitation from winter rains and some downslope flows from higher in the valley. To answer the question…why did a wetland form here? Part of the answer is that there is a nearly impervious soil layer near the surface which in this landscape was likely deposited by a retreating glacier.



The last two slides clearly show the presence of an aquitard.

Wetlands are often found perched on these aquitards.



This graphic depicts a perched water table above an aquitard – a very common condition in our region.

Things to consider…

- Water flows downhill, downslope, downstream, toward the lowest points in the landscape – typically!
- All land was not created equal.

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Yes it's true, water is subject to gravitational pull. You can test this yourself with your own water bottle. First, remove the cap, then tip the bottle toward your lap or if you are clever, toward your neighbor's lap!

OK, technically all land was not created ***equally***! But who talks like that?!

They deposited, compacted, scraped, advanced, retreated, then advanced again, then retreated again, on and on, all the while mixing and churning, scraping, re-depositing and to be blunt they left us with a jumbled mess!

The Ice Age is Alive and Well at Mt. Rainier

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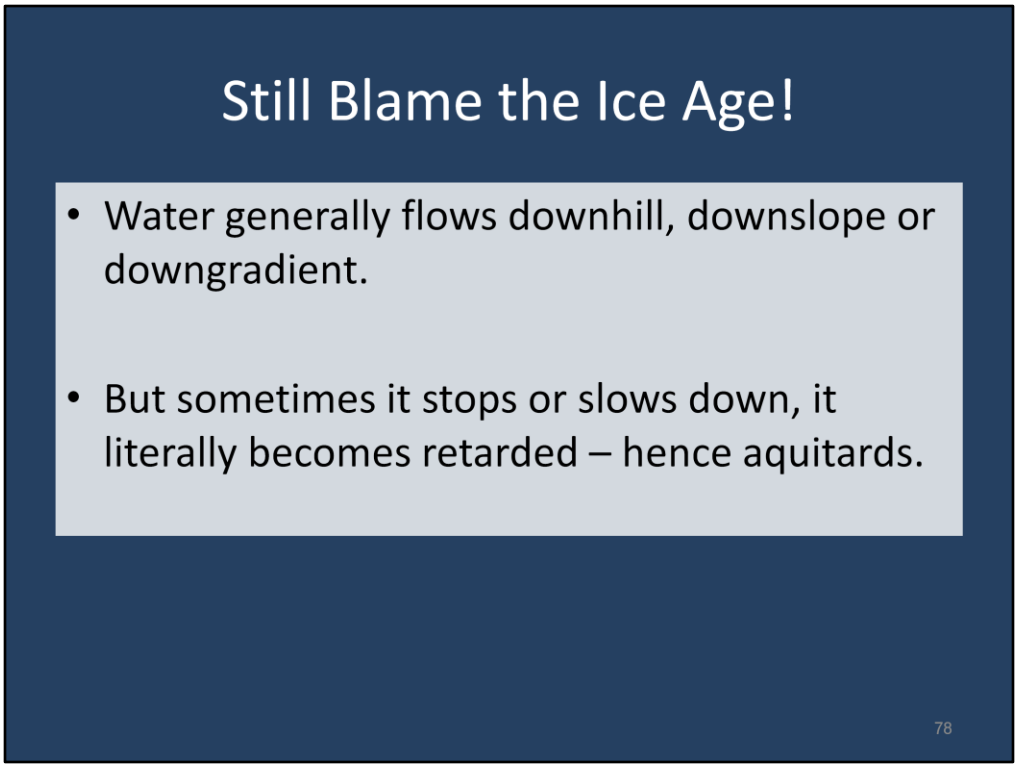
The remnant glaciers on Mt. Rainier give us insight about what took place in our landscape roughly 12,000 years ago when the Puget Sound Trough was estimated to have as much as a mile of ice above it.



While a shallow aquitard is often present, this is not the only condition that leads to the formation of wetlands in our region. It is a common reason which you should always keep in mind.

Continue to Blame the Ice Age!

- In the jumbled messed-up post-glaciation landscape that we live in, aquitards can be found almost anywhere within the landscape.
- Therefore we need to be on the look-out for "suspicious" wetland areas "hiding" anywhere in the landscape.

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Yes folks, there are suspicious wetlands out there on the landscape – those potential would-be or could-be wetlands. They can be found wherever water lurks. Is there a suspicious wetland lurking somewhere near you?

Questions?

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Landscape positions

- Low spots or depressions
- Areas that frequently flood
- Areas that receive tidal influence
- Areas that frequently pond
- Areas adjacent to large waterbodies
- Slopes where water discharges from seeps
- Combinations of these features

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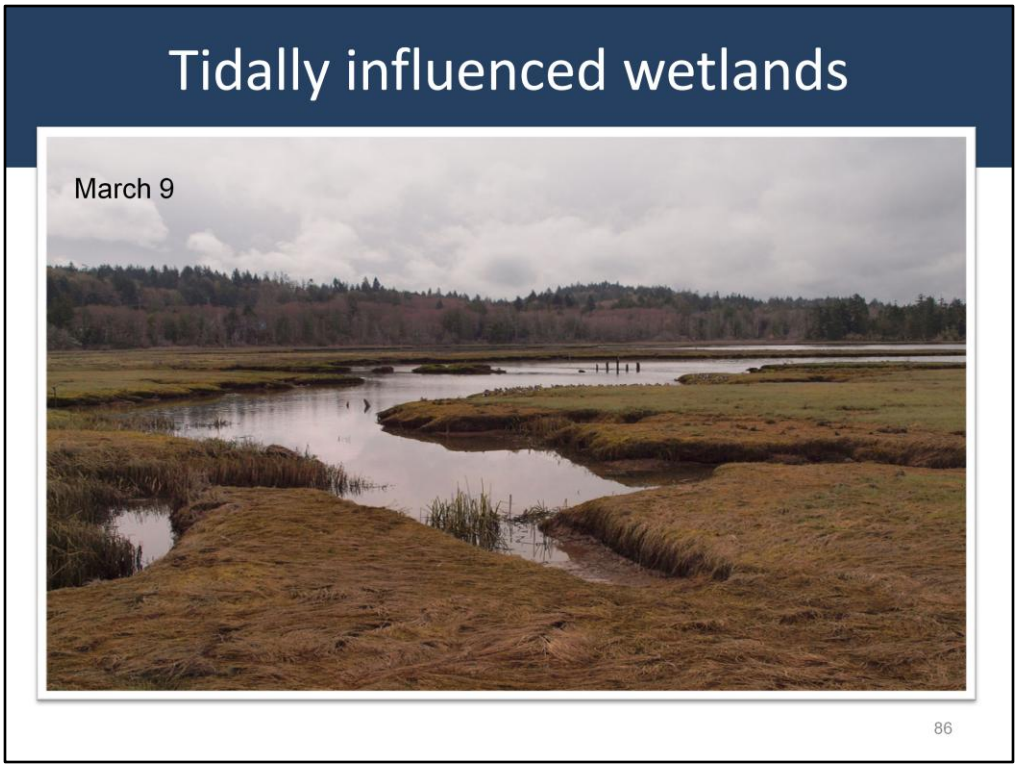
Where are wetlands found? Landscape position is especially important to consider when looking for wetlands. Look in these locations for potential “suspicious” wetlands.

Maybe you would feel sad and depressed too if you found yourself all alone in a forest! Oh, not that kind of depression huh? OK -- my bad. This is a very small depressional wetland surrounded by upland forest of largely big-leaf maple, red alder and sword-fern. This small wetland had western redcedar trees rooted along the wetland edges.

This depressional wetland is in an urban area where increased housing density and impervious surfaces have elevated the seasonal high water table. This small urban wetland has no natural outlet. March 6th is early in the growing season; however in some years with mild winters, the growing season can begin in February or even late January.

This is a small salmon stream overflowing its banks in winter. The flooding and saturation extends well beyond the channel and will persist well into the growing season.

This is a small heavily urbanized stream adjacent to I-405. This stream overflows its banks for most of the winter and well into the spring. During the dry season, there is a small incised stream channel through this wetland.



This estuarine wetland receives tidal influence twice a day every day of the year.

While this wetland contains a small stream, the characteristics of the wetland is tidally influenced. This stream discharges to saltwater less than 100 ft. downstream of this photo through a culvert under a road.

Areas adjacent to large waterbodies

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This area is connected to a lake greater than 20 acres in size during the early spring but as the lake level drops, the wetland will not be directly connected with surface waters; however, there will still be a shallow sub-surface hydrological connection between this wetland and the lake. Wetlands associated with lakes are called Lacustrine wetlands.

This area is also connected to a lake greater than 20 acres. This is a lacustrine wetland near the outlet of the lake.

This is part of a large riparian wetland in the Nisqually delta area.

This is a riparian wetland that is off-channel habitat adjacent to the Big Beef Creek in Kitsap County.

Lacustrine Wetland

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While most of the plants in the background are native species, the lily pads on this lake are non-native.

Frequently ponded areas

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This area contains shallow ponding all through the dry season in most years. Notice how “spring-green” the plants are late in the growing season – September 20th.

Slope wetlands can be some of the most difficult wetlands to locate because they often show up in places where they are not expected. This wetland was found at the base of the slope leading to Puget Sound. In the upper right-hand corner you can see the BNSF rail-road grade and tracks. The date on this photo is April 4th.

True but these flowers are in a slope wetland. The date is June 10th and if you wanted to walk out here, you better have on rubber boots!

It's all in the eyes of the beholder of course but these buttercup flowers are in a slope wetland leading down to a larger lacustrine wetland system. Again, wear your rubber boots!

A Disturbed Slope Wetland

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This site was legally logged but then was cleared and ditched without authorization. Notice the scattered skunk cabbage, horsetail and standing ponded water. Definitely wear your rubber boots!

Questions?

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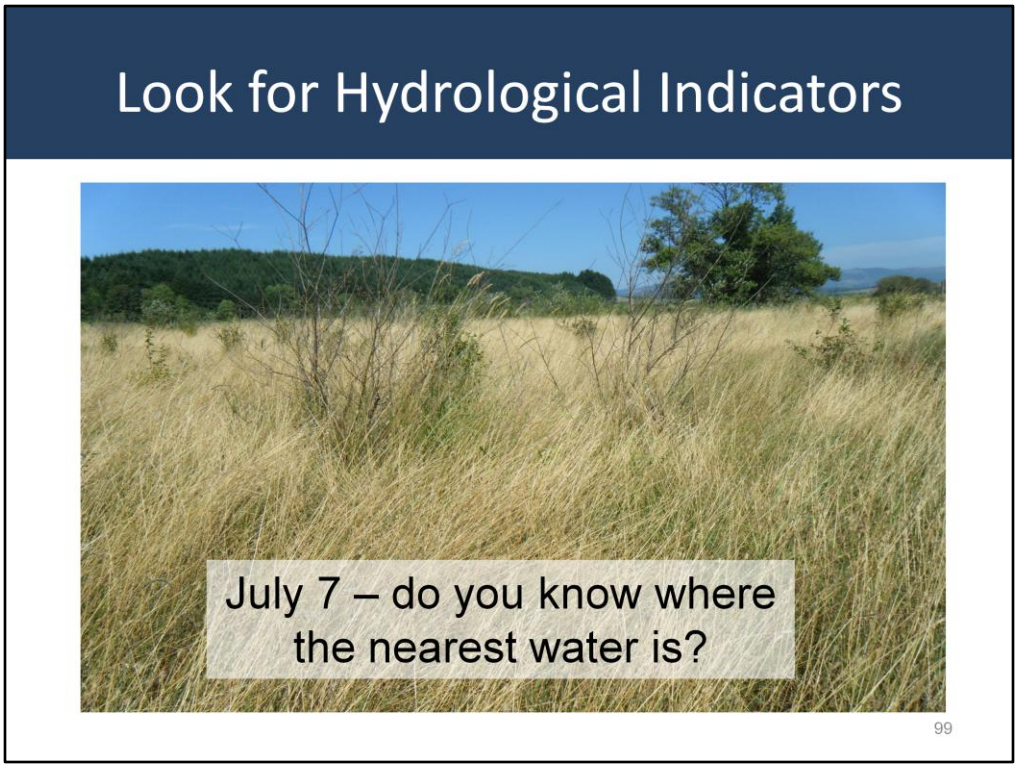
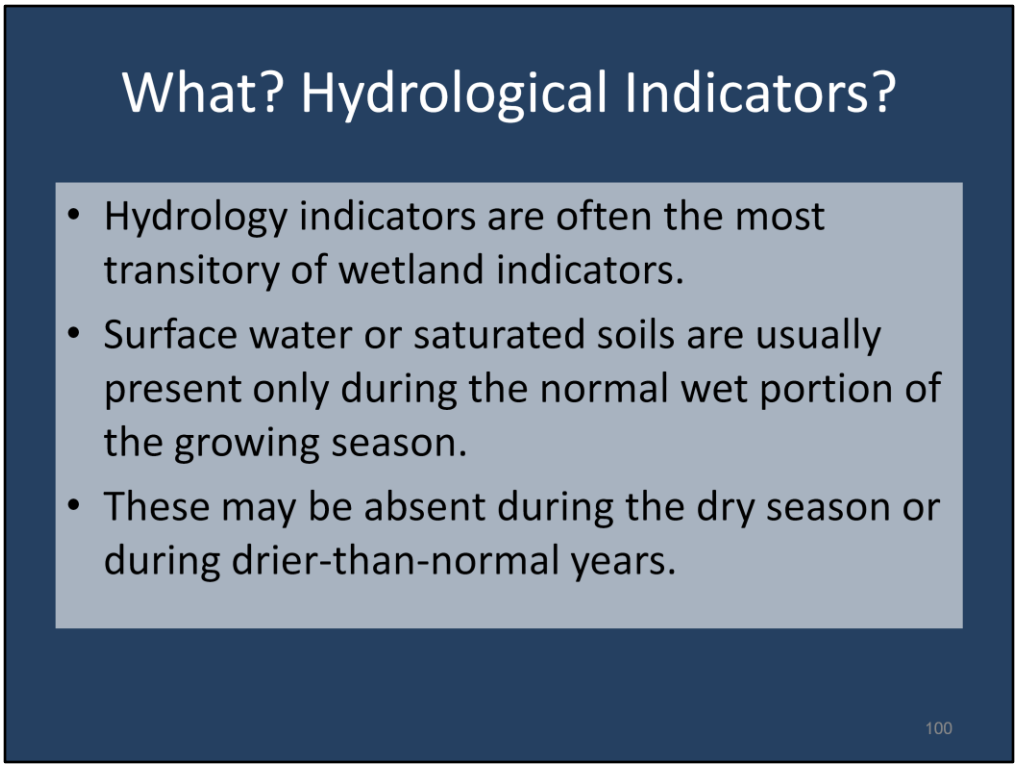
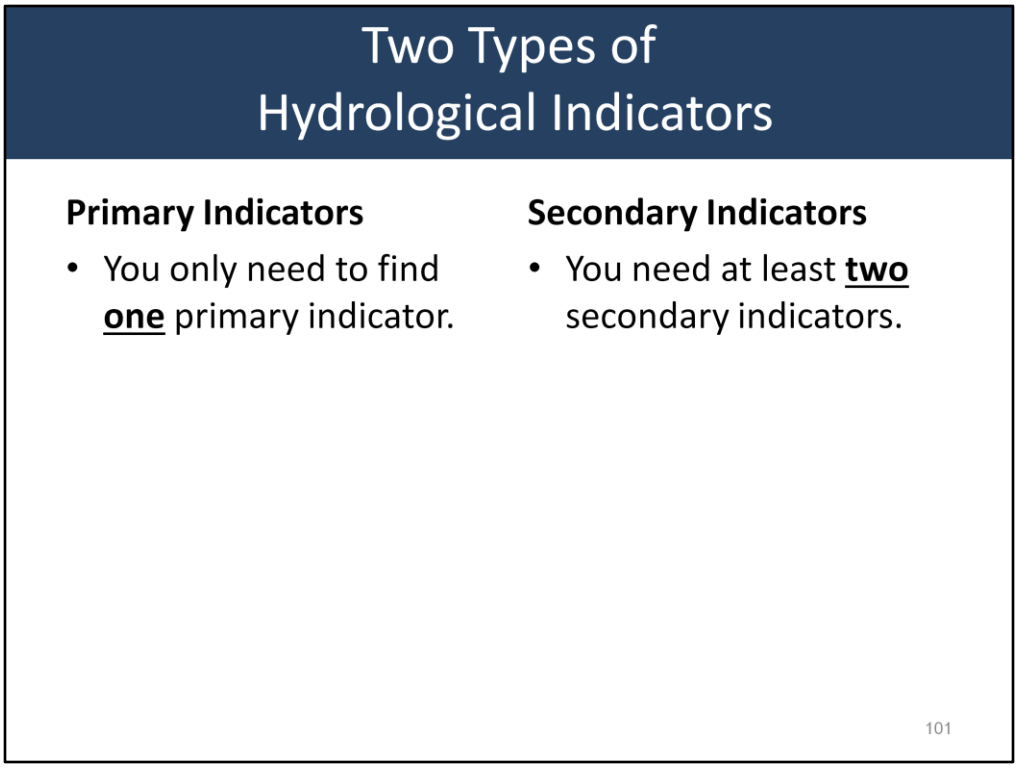


Holy Crap! It's July or August and dry as a bone! How do I know if this is a wetland?

This is a wetland by the way – one which could easily be missed during the dry season without conducting a thorough investigation.



Clues! That's what we are talking about. What clues do we need to help us find "suspicious" wetlands, especially those that are hiding in the landscape?



Look for the check-boxes for these indicators in the Hydrology section of the wetland delineation data sheets. If you find at least one primary indicator, then you have a positive indicator for the presence of wetland hydrology. If you have a least two secondary indicators, then you have a strong probability for the presence of wetland hydrology.

Table 12. Wetland hydrology indicators for the Western Mountains, Valleys, and Coast Region.

Indicator	Category	
	Primary	Secondary
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Algal mat or crust	X	
B5 – Iron deposits	X	
B6 – Surface soil cracks	X	
B7 – Inundation visible on aerial imagery	X	
B8 – Sparsely vegetated concave surface	X	
B11 – Salt crust	X	
B13 – Aquatic invertebrates	X	
B9 – Water-stained leaves	X	X (MLRA 1, 2, 4A, and 4B)
B10 – Drainage patterns		X

This table is taken directly from the Corps 2010 Regional supplement. The page is split between the next two slides to increase the readability.

Group A are the strongest indicators – direct observation of water. Group B indicators show strong evidence that surface water has been present. Note the checkmark boxes for primary and secondary. All these indicators are primary except for B9 and B10 which are both secondary in our region. Western Washington is in Major Land Resource Area 1 (MLRA 1) and due to the distinct rainy season in our region, B9 and B10 are secondary indicators because water can pond or flow across areas that are not wetlands.

Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C3 – Oxidized rhizospheres along living roots	X	
C4 – Presence of reduced iron	X	
C6 – Recent iron reduction in tilled soils	X	
C2 – Dry-season water table		X
C9 – Saturation visible on aerial imagery		X
Group D – Evidence from Other Site Conditions or Data		
D1 – Stunted or stressed plants	X (LRR A)	
D2 – Geomorphic position		X
D3 – Shallow aquitard		X
D5 – FAC-neutral test		X
D6 – Raised ant mounds		X (LRR A)
D7 – Frost-heave hummocks		X

Group C shows evidence that soils have been reduced, and Group D uses evidence of other parameters such as vegetation to support the fact that water has been present on the site. The organization of these four groups A-D show the most reliable (defensible) indicators to the least reliable ones in descending order of preference.

Again, take note of which ones are primary and which ones are secondary. The Northwest Forests and Coast Subregion is designated as Land Resource Region A (LRR A).

Group A – Observation of Surface Water or Saturated Soils

These are the most reliable hydrological indicators!

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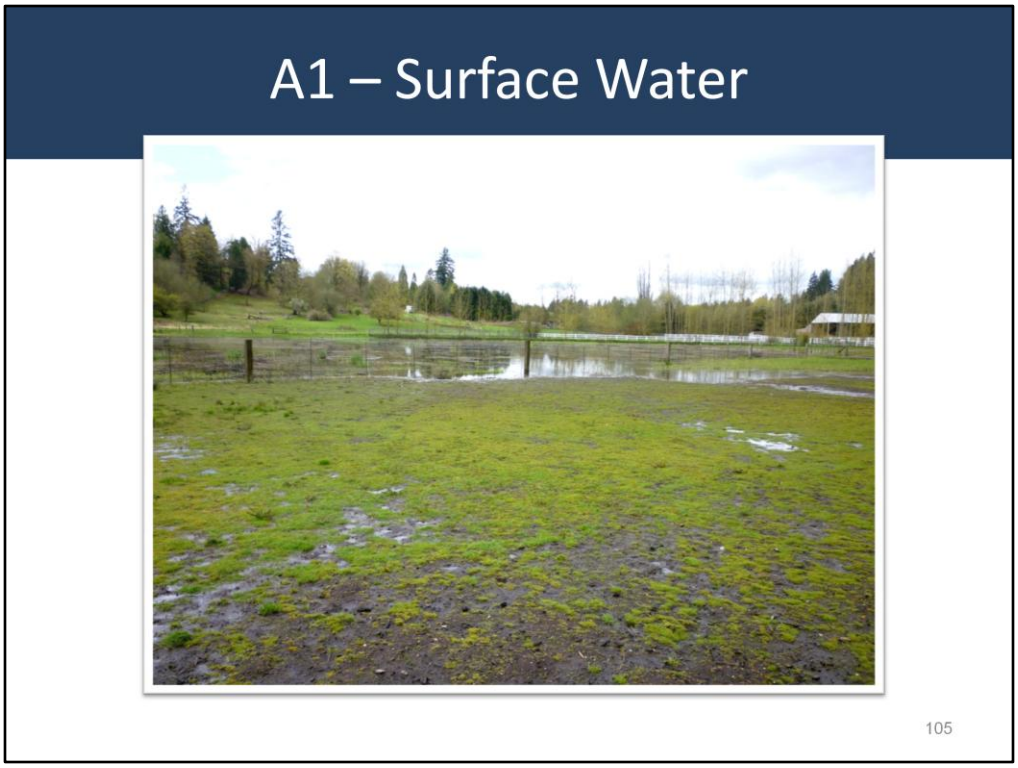

This photo shows inundation of water at the surface during the early spring. It is always important to note the time of year and to pay attention to recent storm events. In this location, the water will likely persist within the upper 12” of the soil for at least two weeks during the growing season.

A2 – High Water Table

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Water filled this hole shortly after it was dug. Note the buttercup in bloom in the photo indicating that this high water table is present well into the growing season. Be wary of high water tables in the winter or non-growing season as it may not persist for the two week duration during the growing season.

This photo shows saturation in the upper 12” of the soil during the growing season.

Group B – Evidence of Recent Inundation

The second-most reliable group of hydrological indicators.

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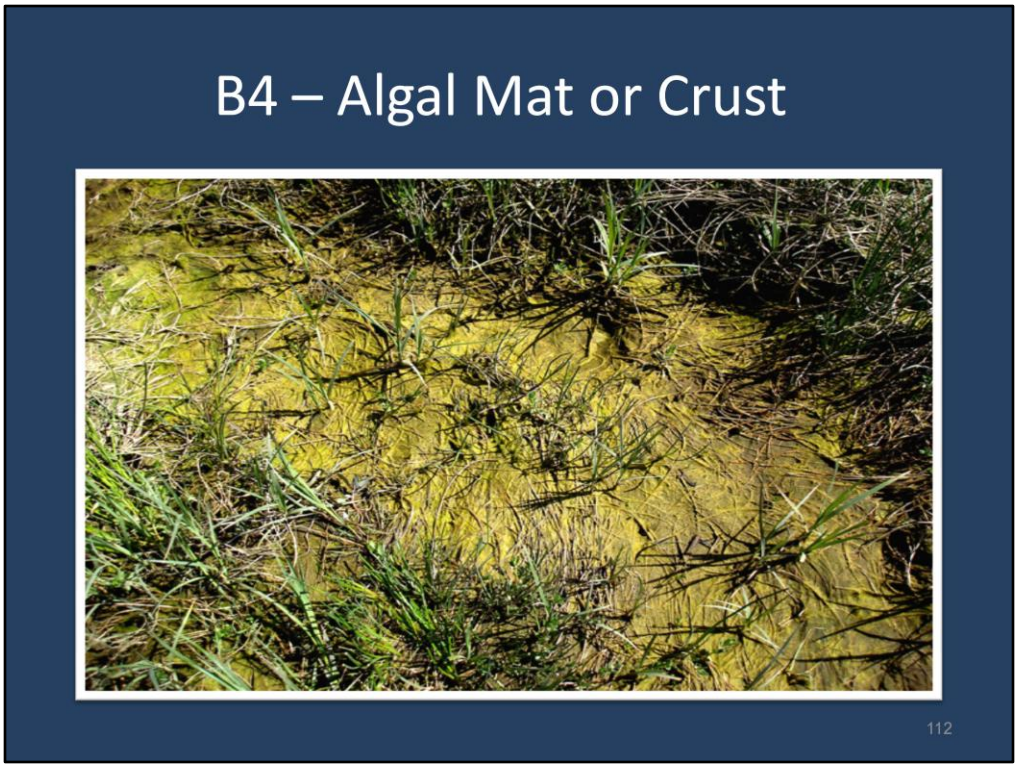
The water mark on this old stump shows where the winter water level regularly floods – look for riparian wetlands along the stream channel at or near the elevation of the water mark. Wetlands were present in the floodplain of this creek to the right of this photo.

This photo was taken following an early November flood event along the Snoqualmie River system. Note the deposition of sand and silt and the water mark that was left on the tree. This photo could have been used for water marks (B1) as well as for sediment deposits (B2).

Look for drift debris deposited through the landscape. This photo is atypical in that typically you are looking for more subtle evidence of recent drift deposits in the knee-high or below range but this illustrates the indicator.



An algal mat such as this one would take at least two weeks to form while the area was inundated during the growing season.

B5 – Iron Deposits

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You have probably all seen this – a thin orange/yellow crust or gel of oxidized iron on the soil surface or on objects near the surface. This forms where reduced iron discharges with groundwater and oxidizes when exposed to air. It can form a sheen on the water surface and look like oil. You can tell the difference by touching with stick or something and if it breaks up into blocks, then it is reduced iron, if it swirls, its oil.

Surface cracks form from the drying and shrinking of soils. However, these may also occur in temporary ponds that are non-wetlands. You would still need to dig a hole and look for hydric soil indicators. In this photo, the soil looks moist still, so that indicates how long ago it may have dried up.

B7 – Inundation Visible on Aerial Imagery

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The use of aerial photography has become indispensable to land-use planners and professionals. Take full advantage of the multiple resources that are immediately available to you when doing your research. Look for photos of the same location taken at different times of the year and in different years for comparison.

B8 – Sparsely Vegetated Concave Surface

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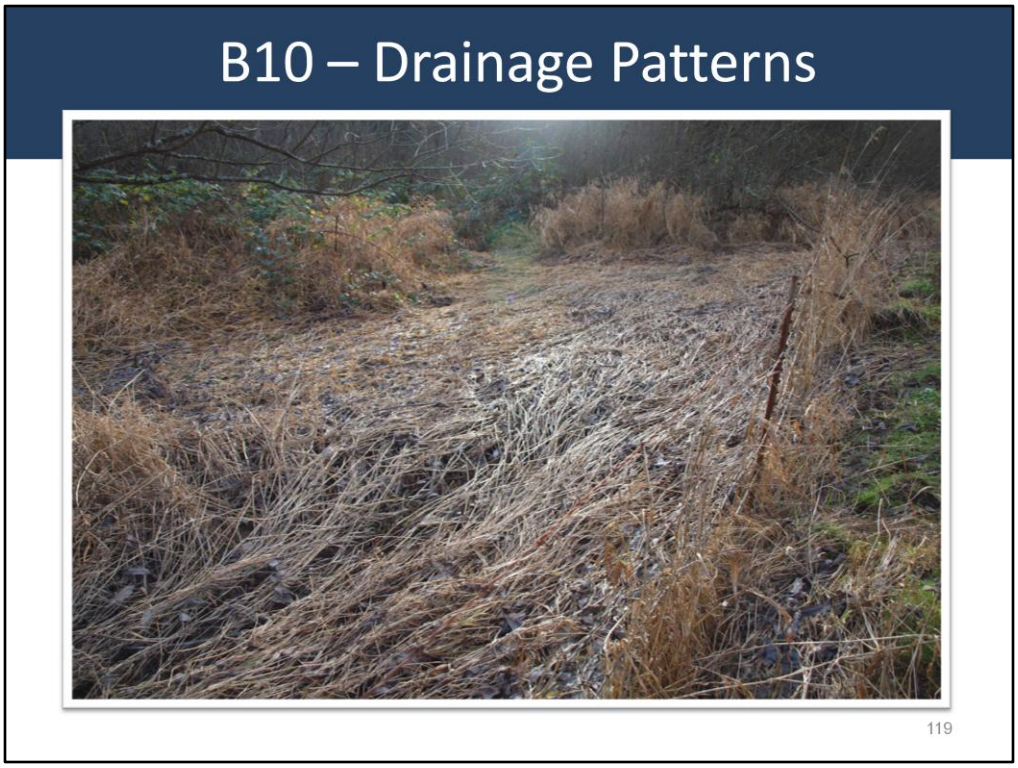
This is more common at mid-elevations and higher in our region but there may be areas along a rocky coastline that would create this condition.

Indicator B11 – Salt Crust, is almost never seen in our region. Salt crust and sparsely vegetated concave surfaces are primary indicators but are not common to Puget Sound lowlands or Western Washington.

This indicator is occasionally seen within our region, however, there are most often other more prominent primary indicators present in the near vicinity.

This indicator is a secondary indicator in Western Washington because it is considered to be less reliable due to our frequent and heavy rain events.



Look for flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, or the absence of leaf litter or small woody debris due to flowing water.

Be cautious and aware that other causes may have flattened the grasses such as a wet heavy snow.

Group C – Evidence of Current or Recent Soil Saturation

The third-most reliable group of hydrological indicators.

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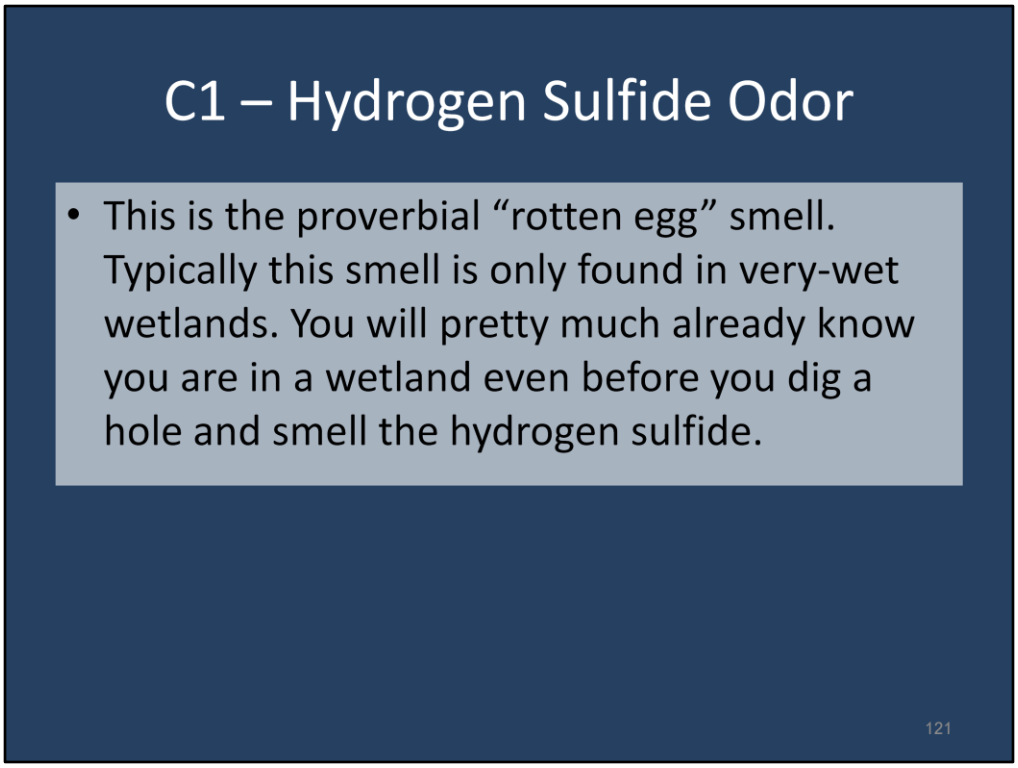

The smell must be found within 12 inches of the soil surface. The sufide odor comes from a gas produced by soil microbes in response to saturated soils where O2, nitrogen, manganese, and iron have been reduced and there is a source of sulfur. This is a primary indicator, but believe me, you will probably already know the area is a wetland.

Indicator C3: Oxidized rhizospheres along living roots

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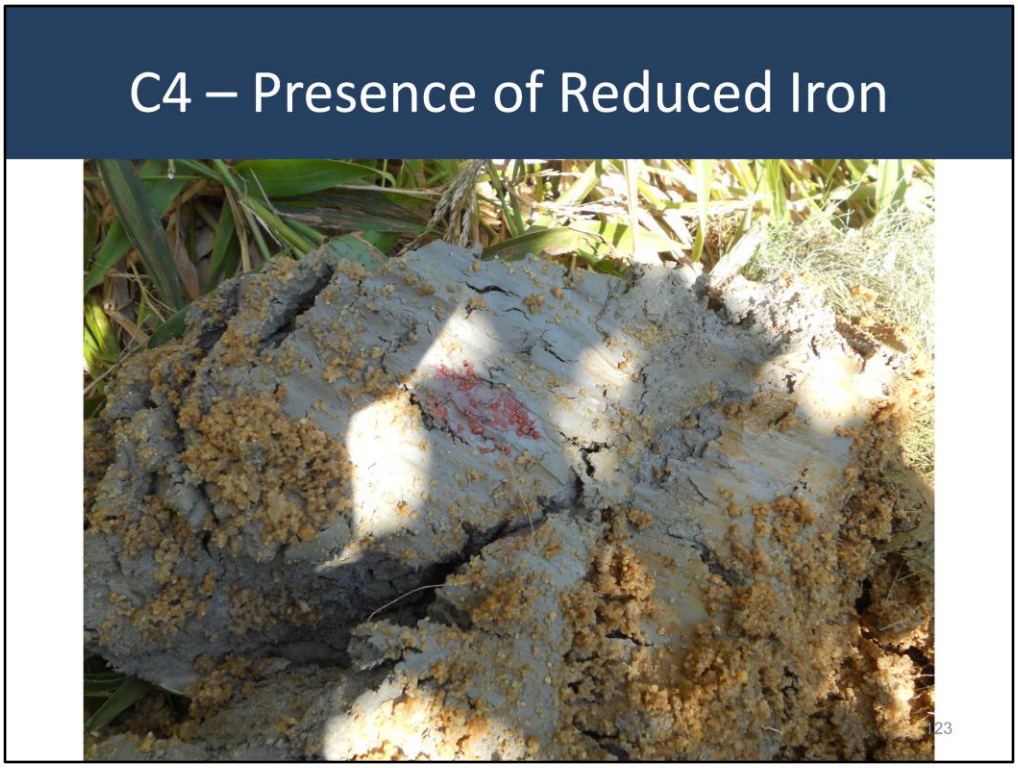
With this indicator, you need to be sure that the “rust” color is occurring along living roots. Look for orange or red colors along living roots – these are called oxidized rhizospheres.



The presence of reduced iron in this image indicates that this soil was inundated or saturated for a prolonged period of time. Long enough for the soil to develop anaerobic conditions in the upper 12” of the soil where microbial action reduced the iron. This important process will be discussed in detail in the hydric soils portion of the presentation.

C6 – Recent iron reduction in tilled soils is similar to this indicator but because the soils are tilled and mixed up regularly the recent iron deposits may be more difficult to detect.

C2 – Dry Season Water Table

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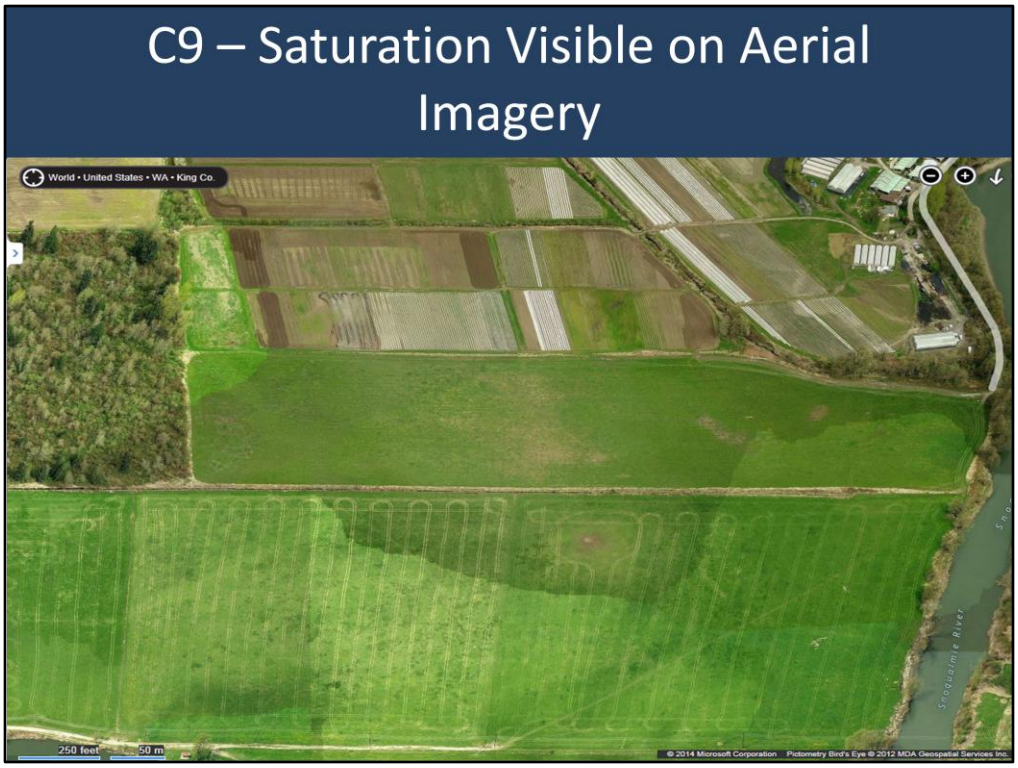
This is a secondary indicator. Water is within 24 Inches during the Dry season. If it is below 24, it does not necessarily mean that it is ***not*** wetland. Further investigation would be needed. Start by looking harder for other indicators. Try to find a primary indicator if possible or at least another secondary indicator. It may be necessary to revisit the site at another time of year, ideally early in the growing season.



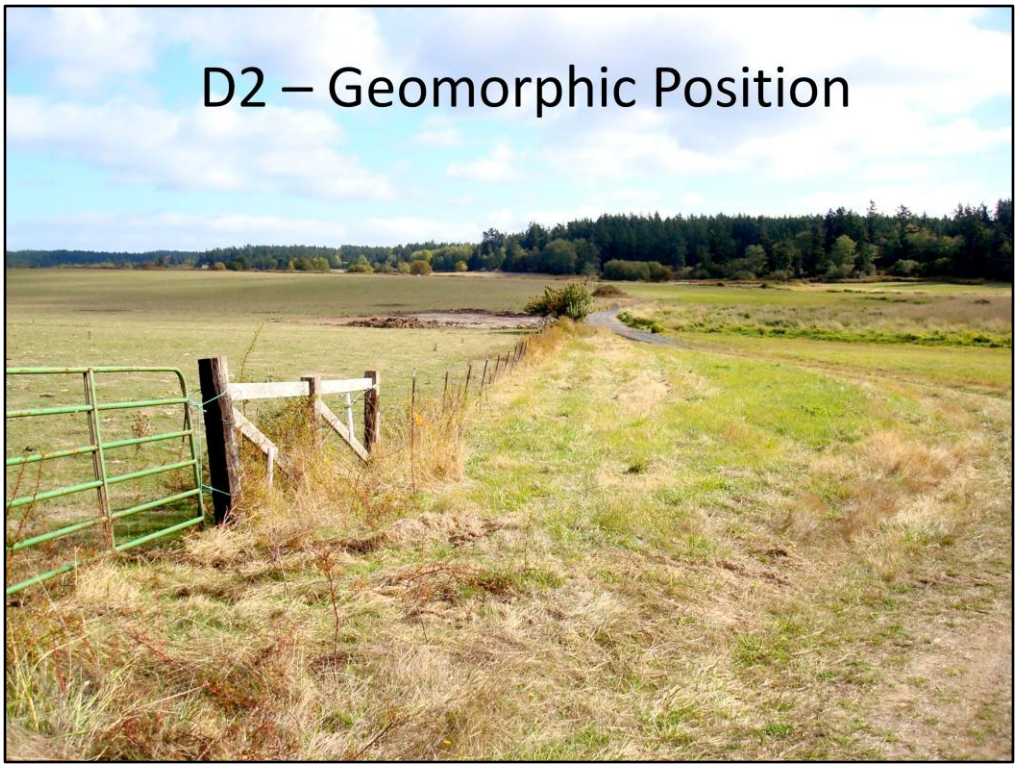
This is only a secondary indicator but note the stressed plants in the center of the photograph where some of the bare soils show. Be careful using this indicator because the images can be deceiving.

Group D – Evidence from Other Site Conditions or Data

The fourth-most reliable group of hydrological indicators.

126

The plants in this agricultural field show clear signs of stress. Water inundated this portion of the field early in the growing season. This does not make it certain that this is a farmed wetland. This could have been an unusually wet spring. More investigation would be required. This is a secondary indicator.



Always note the landscape position for the area you are investigating. This photo shows a low spot in the center of the wide gradually sloping field. This is a common place to find wetlands in our region. This is a secondary indicator.

This is the same photo that was used earlier when the concept of aquitard was first introduced. It is used again here because it is difficult to depict an aquitard in any other manner other than a trench. If you were to dig a hole in the pasture grass, your shovel would easily penetrate the first 8" of the dark brown soil but then would suddenly encounter a much harder layer – that is the aquitard. Sometimes it is ***very difficult*** to dig into the aquitard as they can be composed of extremely tight and compacted glacial till materials. This is a secondary indicator.

Other Secondary Indicators

- D5 - The FAC Neutral Test – will be discussed in a presentation that follows
- D6 - Raised Ant Mounds – these are not common in our region but are seen from time to time
- D7 - Frost-heave Hummocks – these are rarely if ever seen in Western Washington

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Review Wetland Data Sheets

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

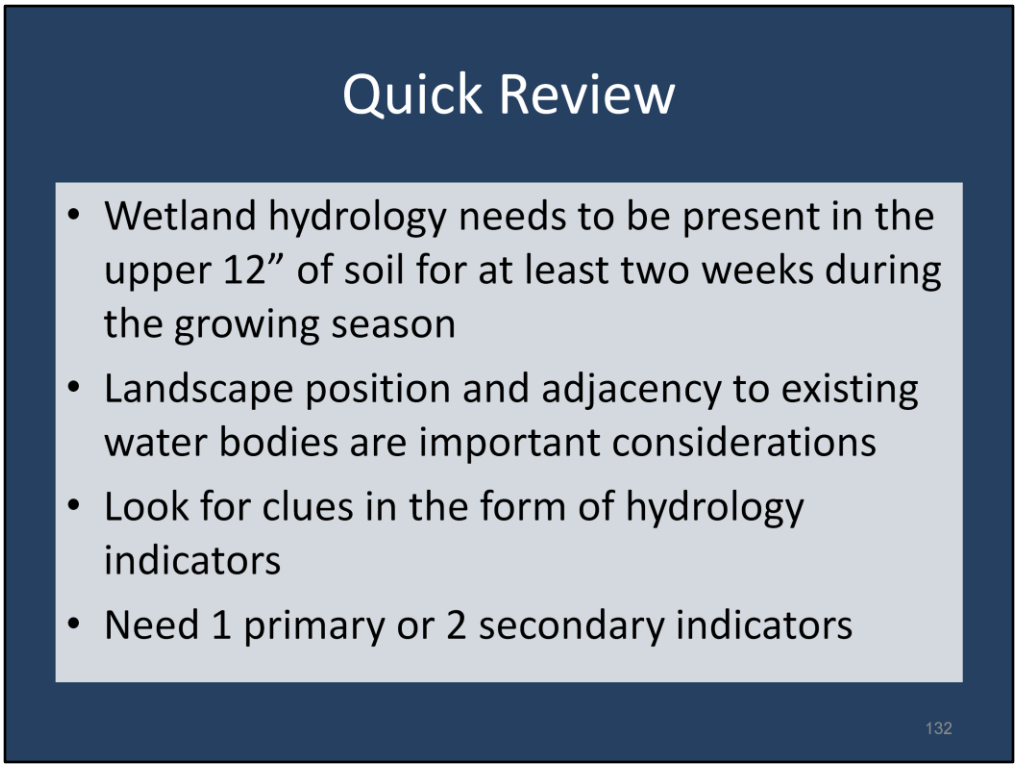
Wetland Hydrology Present? Yes _____ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

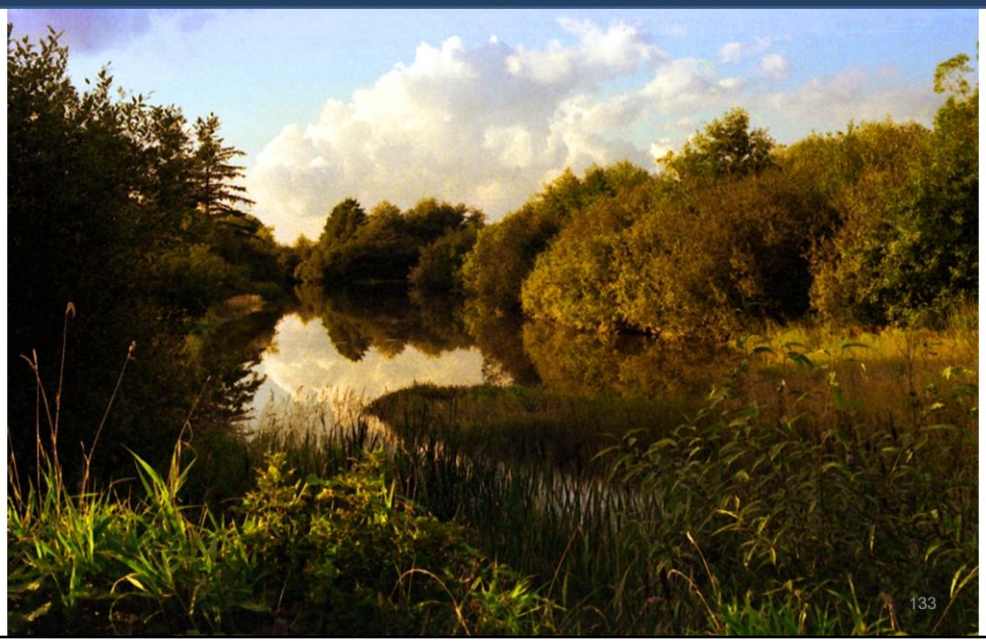
US Army Corps of Engineers — Western Mountains, Valleys, and Coast – Version 2.0

•This is a portion of a field data sheet for the hydrology section that would be included within any delineation report. The wetland hydrology indicators that were just presented are listed on this sheet. There should be one sheet for each data plot recorded for the wetland delineation. **Always pay attention to the date that that data was collected** – this is critical with regards to the growing season. The box in the middle-right-hand side should be the box that is checked either “Yes” or “No” for the presence of wetland hydrology. A good delineator will check all the boxes that apply to the data plot being recorded. While you only need one “check” for any of the primary indicators listed, it is common to find more than one primary and sometimes two or more secondary indicators at any one data point sampling location. More information is better.



So, when you are reviewing data sheets for wetland hydrology, pay close attention to the date on which the data was collected and look at the checks for the hydrological indicators. Always look for consistency with regards to the recording of the data collected and the final wetland (or non-wetland) determination being made.

Questions?



Moving On

- Was the soil saturated long enough during the growing season such that microbial activity used up all the oxygen in the upper 12" of the soil and created anaerobic soil conditions?

•STOP!

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Webinar Infringement Rights – Hydric Soils Block to follow this Wetland Hydrology Block.

Shhhh…Don't tell anyone I told you this but you only have hydric soils formation if there is water in the upper part of the soil during the growing season.

That is the Wet in Wet-Land!

That ends our first session: Introduction to wetlands and hydrology.

Session two is next Tuesday, January 20, 2015. We'll be providing information on Soils and Plants.

We look forward to talking with you then. Thanks for your participation.

Questions?

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Contact a regional wetlands specialist
http://www.ecy.wa.gov/programs/wetlands/contacts.htm

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