Wetland Hydrology
-- Detailed explanation of parameters use for jurisdictional delineation

Elkhorn Slough National Estuarine Research Reserve
1700 Elkhorn Road
Watsonville, CA 95076

WSP Environment & Energy
160 Franklin Street, Suite 300
Oakland, CA 94607

Wetland Definition

Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions.

Hydrology

The science of water, its properties, distribution, and circulation, both on the surface and underground.

Sources of Water

- Direct precipitation
- Headwater flooding
- Backwater flooding
- Tides
- Ground water
- Combinations of above

Sources of Hydrologic Data

- Corps district offices
- USGS
- NOAA
- SCS
- State, county, and local agencies
- Developers

Factors That Influence Hydrology

- Precipitation
- Stratigraphy
- Topography
- Soil texture
- Plant cover

Hydrology indicators are often the most ephemeral of wetland indicators.

Those involving direct observation of surface water or saturated soils are usually present only during the normal wet portion of the growing season and may be absent during the dry season or during drier-than-normal years.

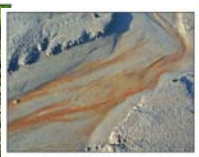


Figure 4-11. Iron deposit (orange area) in a dewatered c

Figure 4-10. Iron sheen on the water surface may be depos dewatering.

Arid West Subregions

11-17-08

SubRegions of California

***LRR* – USDA Land Resource Regions**
***MLRA* – Major Land Resource Area**

Arid West

WMVC

11-17-08 9

Hydrology Indicators in Supplements

11- 10

Table 9. 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

Table 9. Wetland hydrology indicators for the Western Mountains, Valleys, and Coast Region. - continued

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

11-17-08 12

Table 11. Wetland hydrology indicators for the Arid West.

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		
B6 – Surface soil cracks	X	
B7 – Inundation visible on aerial imagery	X	
B9 – Water-stained leaves	X	
B11 – Salt crust	X	
B12 – Biotic crust	X	
B13 – Aquatic invertebrates	X	
B1 – Water marks	X	X (riverine)
B2 – Sediment deposits	X	X (riverine)
B3 – Drift deposits	X	X (riverine)
B10 – Drainage patterns		X

Table 11. Wetland hydrology indicators for the **Arid West**. continued

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	
C7 – Thin muck surface	X	
C2 – Dry-season water table		X
C8 – Crayfish burrows		X
C9 – Saturation visible on aerial imagery		X
Group D – Evidence from Other Site Conditions or Data		
D3 – Shallow aquitard		X
D5 – FAC-neutral test		X

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) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ 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)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Crayfish Burrows (C8)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

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 Arid West – Version 2.0

MudCracks

Hydrology – Specific Indicators

Ponding

Salt Crust

Overview

Hydrology Comparison

1987 Manual

- Methods to determine growing season
- 11 field indicators
- Primary and secondary indicator status

Supplements

- New method to determine growing season
- 27 field indicators for WMVC and 23 field indicators for Arid West
- Changes in primary and secondary indicator status

The Seven Hydrology Tools
Arid West (Page 121) & WMVC Supplements (Page 107)

1. Analyze stream and lake gauge data.
2. Estimate runoff volumes to determine duration and frequency of ponding in depessional areas.
3. Evaluate the frequency of wetness signatures on aerial photography
4. Model water-table fluctuations on fields with a\parallel drainage systems using the DRAINMOD model
5. Estimate the "scope and effect' of ditches or subsurface drain lines
6. Use NRCS state drainage guides to estimate the effectiveness of agricultural drainage systems
7. Analyze data from groundwater monitoring wells

WHEN DO WE OBSERVE Hydrology Indicators?

"*Beginning and ending dates of the growing season may be needed to evaluate certain wetland indicators, such as visual observation of flooding, ponding, or shallow water tables on potential wetland sites*." Arid West – p 59; WMVC – p. 56

We observe hydrology indicators during the growing season

Methods to Determine the Growing Season

- Vegetative growth
- Soil temperature
- Air temperature

Growing Season: Vegetative Growth

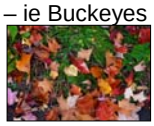
Start of the growing season: observation of growth or activity in vascular plants

- Emergence of herbaceous plants from ground
- Appearance of new growth from bulbs, etc
- Bud burst on woody plants
- Emergence or elongation of leaves of woody plants
- Emergence or opening of flowers

Growing Season Vegetative Growth

End of the growing season:

- Woody deciduous species lose their leaves
- Herbaceous plants cease flowering
- Herbaceous leaves become dry or brown
- Don't confuse with early plant senescence which may occur in the summer dry season – ie Buckeyes



Growing Season Soil Temperature

Growing season has begun in the spring and is still in progress when the soil temperature measured at 12 inch depth is 41º F (5º C) or higher.

Growing Season Air Temperature

Use WETS tables to determine the median dates of 28º F (-2.2º C) air temperatures in spring and fall based on long-term records at nearest appropriate National Weather Service meteorological station.

•http://www.wcc.nrcs.usda.gov/climate/wetlands.html

Using the WETS Database:

Determining Length of Growing Season if based on air temperature

"28 degrees F or higher" (air) temperature median dates in fall and spring

Example 1
Moss Landing

1. Finding nearest WETS Station to Moss Landing

- Go to WETS website http://www.wcc.nrcs.usda.gov/climate/wetlands.html
- Navigate to appropriate WETS Station: Monterey, CA5795

```
WETS Station : MONTEREY, CA5795                    Creation Date: 08/29/2002
Latitude:  3636      Longitude:  12154       Elevation:  00380
State FIPS/County(FIPS):  06053     County Name: Monterey
Start yr. - 1971   End yr. - 2000
```


2. Determine length of growing season at WETS Station: Monterey, CA5795

- Find growing season dates

GROWING SEASON DATES

	Temperature		
Probability	24 F or higher	28 F or higher	32 F or higher
	Beginning and Ending Dates Growing Season Length		
90 percent *	----------	----------	> 365 days
	> 365 days	> 365 days	> 365 days
70 percent *	----------	----------	> 365 days
	> 365 days	> 365 days	> 365 days

* Percent chance of the growing season occurring between the Beginning and Ending dates.

total 1948-2002 prop

2. Determine length of growing season at WETS Station: Monterey, CA5795

- Use 28° F Standard, 50 percent (median)

GROWING SEASON DATES

	Temperature		
Probability	24 F or higher	28 F or higher	32 F or higher
	Beginning and Ending Dates Growing Season Length		
90 percent *	----------	----------	> 365 days
	> 365 days	> 365 days	> 365 days
70 percent *	----------	----------	> 365 days
	> 365 days	> 365 days	> 365 days

* Percent chance of the growing season occurring between the Beginning and Ending dates.

total 1948-2002 prop

Growing Season Length

Hydrology Indicators in Supplements

See *Comparison of Hydrology Field Indicators*
Slides 105-106

- Group "A" – direct observation of surface or ground water during a site visit
- Group "B" – evidence the site is subject to flooding or ponding
- Group "C" – indirect evidence soil was saturated recently
- Group "D" - features showing recent vs historical wet conditions
- Read "Cautions and User Notes" for each indicator

Need 1 primary or 2 secondary indicators to meet wetland hydrology criteria.

HYDROLOGY INDICATORS A-Group

A-1 **Surface Water**: "Direct visual observation of surface water (flooding or ponding) during a site visit"

A-2 **High Water Table**: "This indicator consists of the direct, visual observation of the water table 12 in. (30 cm) or less below the surface in a soil pit, auger hole, or shallow monitoring well This indicator includes water tables derived from perched water, throughflow, and discharging groundwater (e.g., in seeps) that may be moving laterally near the soil surface."

A-3 **Saturation: "**Visual observation of saturated soil conditions 12 in. (30 cm) or less from the soil surface as indicated by water glistening on the surfaces and broken interior faces of soil samples removed from the pit or auger hole. This indicator must be associated with an existing water table located immediately below the saturated zone; however, this requirement is waived under episaturated conditions if there is a restrictive soil layer or bedrock within 12 in. (30 cm) of the surface.

Group A - Surface Water

Inundation

A condition in which water from any source temporarily covers a land surface.

Saturation

"For wetland delineation purposes, a soil layer is saturated if virtually all pores between soil particles are filled with water (National Research Council 1995, Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979)."

- WMVC p. 135; Arid West p. 117

Ponding

"Standing water in a closed depression that is removed only by percolation, evaporation, or transpiration. The ponding lasts for more than 7 days"

- p. 32 Field Indicators of Hydric Soils

A-1 Surface Water

Hydrology Field Indicator A-2:

High Water Table

"This indicator consists of the direct, visual observation of the water table 12 in. (30 cm) or less below the surface in a soil pit, auger hole, or shallow monitoring well This indicator includes water tables derived from perched water, throughflow, and discharging groundwater (e.g., in seeps) that may be moving laterally near the soil surface."

Figure 4-2. High water table observed in a soil pit.

A-3 Saturation

Figure 23. Water glistens on the surface of a saturated soil sample.

Visual observation of soil saturation

Examination of this indicator requires digging a soil pit to a depth of 16 inches and observing the level at which water stands in the hole after sufficient time has been allowed for water to drain into the hole. The required time will vary depending on soil texture. In some cases, the upper level at which water is flowing into the pit can be observed by examining the wall of the hole. This level represents the depth to the water table. The depth to saturated soils will always be nearer the surface due to the capillary fringe. For soil saturation to impact vegetation, it must occur within a *major portion of the root zone* (usually within 12 inches of the surface) of the prevalent vegetation. The major portion of the root zone is that portion of the soil profile in which more than one half of the plant roots occur.

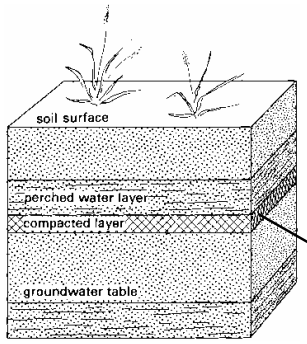
Saturated to the surface or within 12" where the preponderance of root biomass is there

Other Sources of Hydrologic Information

- Tide gauge data
- Stream gauge data
- Groundwater well data
- Aerial imagery

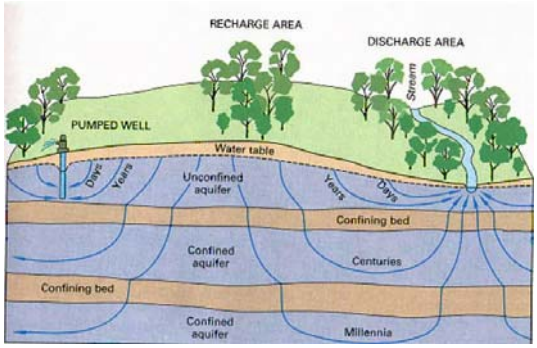
Groundwater-Driven Systems

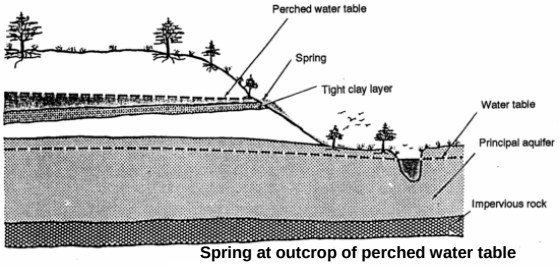
- Acceptable to use local SCS soil survey info to evaluate hydrology along with other information such as FAC neutral test.
- Use caution in areas that may have been recently drained.



Many forms and sources of groundwater

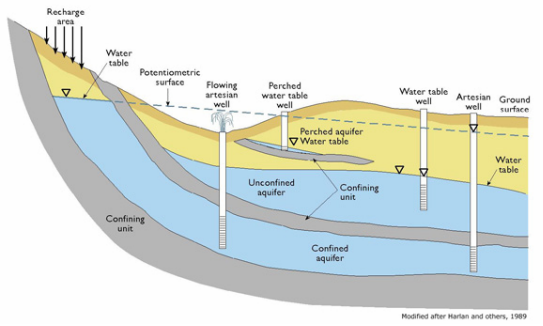
Soil Clay Layer [B2t] or plowpan





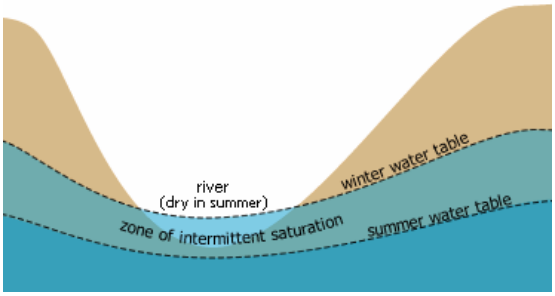
Spring at outcrop of perched water table

Episaturation. Condition in which the soil is saturated with water at or near the surface, but also has one or more unsaturated layers below the saturated zone. The zone of saturation is perched on top of a relatively impermeable layer. Arid West Manual



11-17-08 43

Seasonal or intermittent stream system



11-17-08 44

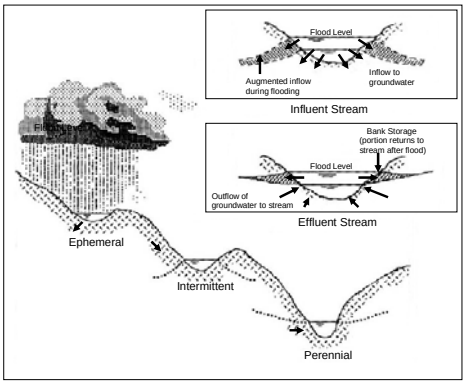


Figure 4.3. Descriptions of flow permanence. Water table level is shown as a dotted line in the main figure. Inserted diagrams illustrate how water enters the banks as the stream swells during a flood; in effluent streams, much of this bank storage returns to the stream (see also Section 4.3). Inserted diagrams are redrawn from Wilson (1969), by permission of Macmillan.

Perennial Stream

A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

From: *E. Definitions* (p. 11197). Federal Register Vol. 72, No. 47: Department of Defense, Department of the Army, Corps of Engineers [ZIN 0710-ZA02], 11092-11198.

11-17-08 46

Intermittent Stream

An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

From: *E. Definitions* (p. 11196). Federal Register Vol. 72, No. 47: Department of Defense, Department of the Army, Corps of Engineers [ZIN 0710-ZA02], 11092-11198.

11-17-08 47

Ephemeral Stream

An ephemeral stream has flowing water only during, and for short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

From: *E. Definitions* (p. 11196). Federal Register Vol. 72, No. 47: Department of Defense, Department of the Army, Corps of Engineers [ZIN 0710-ZA02], 11092-11198.

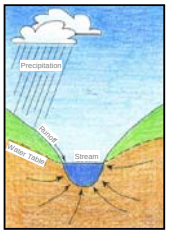
11-17-08 48

Comparisons Among Stream Type Definitions

Source: "Reissuance of Nationwide Permits; Notice." *Federal Register* 72:47 (12 March, 2007) pp. 11196 -11197

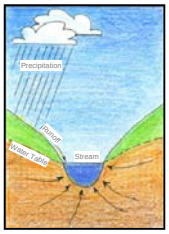
Ephemeral

- Flowing water only during and shortly after precipitation events.
- Precipitation primary source for stream flow.
- No supplemental source for stream flow.



Intermittent

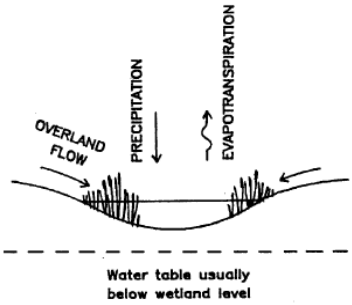
- Flowing water during certain times of the year.
- Groundwater primary source for stream flow.
- Runoff from rainfall supplemental source for stream flow.



Perennial

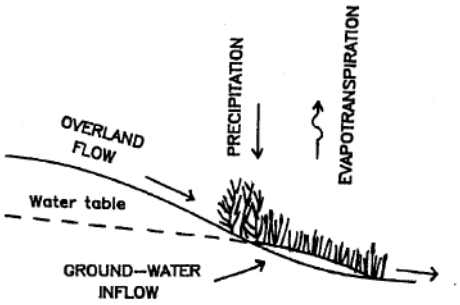
- Flowing water year-round.
- Groundwater primary source for stream flow.
- Runoff from rainfall supplemental source for stream flow.

Figure 2.2 – Surface water depression wetland



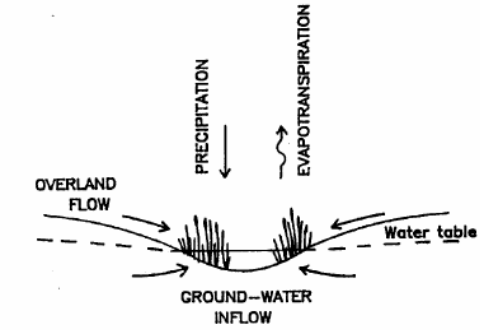
Adapted from Novitski, 1979.

Figure 2.3 - Groundwater slope wetland



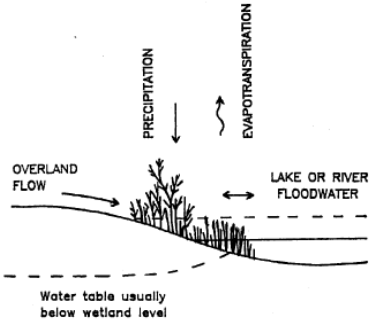
Adapted from Novitski, 1979.

Figure 2.4 - Groundwater depression wetland

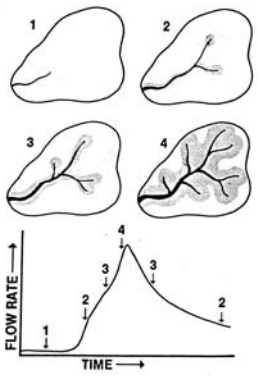


Adapted from Novitski, 1979.

Figure 2.5 - Surface water slope wetland



Adapted from Novitski, 1979.



The Hydrograph
-
Sources of water In the watershed

Different parts of the watershed become saturated at different times during a storm or melt event

***Visual observation of inundation*. : The Wingtip Test**

"If it's wet, it's wet… But if it's not wet, it may be wet"

Hydrology Indicators in Supplements

- See *Comparison of Hydrology Field Indicators*
- Group "A" – direct observation of surface or ground water during a site visit
- Group "B" – evidence the site is subject to flooding or ponding
- Group "C" – indirect evidence soil was saturated recently
- Group "D" - features showing recent vs historical wet conditions
- Read "Cautions and User Notes" for each indicator

Need 1 primary or 2 secondary indicators to meet wetland hydrology criteria.

B - Group

B-1 WaterMarks – "Water marks are discolorations or stains on the bark of woody vegetation, rocks, bridge supports, buildings, fences, or other fixed objects as a result of inundation" – Arid West p. 73

B-2 Sediment Deposits – "Sediment deposits are thin layers or coatings of fine-grained mineral material (e.g., silt or clay) or organic matter (e.g., pollen), sometimes mixed with other detritus, remaining on tree bark, plant stems or leaves, rocks, and other objects after surface water recedes." – Arid West p. 74

B-3 Drift Deposits – "Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects. Debris consists of remnants of vegetation (e.g., branches, stems, and leaves), manmade litter, or other waterborne materials. Drift material may be deposited at or near the high-water line in ponded or flooded areas, piled against the upstream side of trees, rocks, and other fixed objects, or widely distributed within the dewatered area." -- Arid West p. 75

Sediment deposits

Debris (Wrack) Deposited by Pond Creek Overbank Flooding/Surface Connection (Immediately Upstream From Pond – Caney Creek Junction)

Watermarks

Figure 4-4. Water marks on a boulder.

Drift lines

Figure 4-6. Drift deposit on the upstream side of a sapling in a flood

New Hydrology Indicators
Direct Evidence – B-Group

B4 - Algal mat or crust
(WMVC only)

B6 – Surface soil cracks

B5 – Iron deposits
(WMVC only)

Important Notes

B5 – Iron deposits
- Can be distinguished from an oil sheen by touching it; crystalline iron film deposits will crack into angular piece

B6 – Surface soil cracks
- This does not include deep cracks due to shrink-swell action in clay soils (e.g., vertisols)

Inundation visible on aerial imagery
Indicator B-7

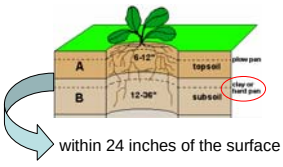
New Hydrology Indicators

B12 – Biotic Crust
(Arid West only)

B11 – Salt crust

New Hydrology Indicators
Indirect and Recent Evidence - Groups C & D

C2 – Dry-season water table
(Secondary)



within 24 inches of the surface

D3 – Shallow aquitard
(WMVC only, secondary)

Important Notes

C2 – Dry-season water table
- Visual observation of the water table between 12 and 24 inches below the surface during the normal dry season or during a drier than normal year

D3 – Shallow aquitard
- Presence of an aquitard within 24 inches of the soil surface that is capable of perching water within 12 inches of the surface
- Can often be identified by the lack of root penetration through the soil layer and redoximorphic features above this soil layer

New Hydrology Indicators

C6 – Presence of reduced iron in tilled soils

C4 – Presence of reduced iron

Important Notes

C6 – Presence of reduced iron in tilled soils

- Soil layer must contain 2 % or more of redox concentrations as pore linings of soils cultivated within 2 years

C4 – Presence of reduced iron

- Greater than 50% of the soil layer contains reduced iron (ferrous iron)
- The presence of ferrous iron can be verified by the positive reaction with alpha, alpha-dipyridyl dye.
  - Caution: Dye may not react due to a number of reasons.

New Hydrology Indicators
Landscape Position

B8 – Sparsely vegetated concave surface
(WMVC only, primary)

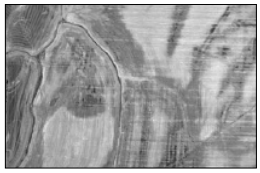
D2 – Geomorphic position
(WMVC only, secondary)

New Hydrology Indicators

D1 - Stunted or stressed plants
(only in WMVC LRR A
(NW Forests and Coast region))

- Only use in agricultural or planted areas
- Ensure stunting is not due to low soil fertility, excessively drained soils, uneven application of chemicals, etc

New Hydrology Indicators
Using Aerial Imagery



C9 – Saturation visible on aerial imagery
(Secondary)

New Hydrology Indicators
Animals

B13 – Aquatic invertebrates

C8 – Crayfish burrows
(Arid West only)

D6 – Raised ant mounts
(WMVC only;
secondary in WMVC LRR A
[NW forests and coast] only)

Important Notes

B13 – Aquatic invertebrates
- Should be numerous and not imported or relic

C8 – Crayfish burrows (Arid West only)
- Found near areas with seasonal inundation or water tables near or at the surface

D6 – Raised ant mounds (Secondary in WMVC NW forest and coast subregion only)
- Elevated (6 inches or greater in height) ant mounds built in response to seasonal flooding, ponding, or high water tables

New Hydrology Indicators

C1 – Hydrogen sulfide odor

D7 – Frost heave hummocks
(WMVC only, secondary)

"This indicator consists of a layer of muck 1 in. (2.5 cm) or less thick on the soil surface." Arid West p 80

C7 – Thin muck surface
(Arid West only, primary)

C-3 Always primary

OxRoots within 12 inches

Figure 4-19. Iron oxide plaque (orange coating) on a li
which the root was removed.

B-9 Primary and locally secondary

Water-stained leaves

Oxidized Rhizospheres

- Acceptable hydrologic indicator on case by case basis.
- Should be abundant and within upper 12" of soil.
- Must use other hydrologic indicators if hydrology evidence is weak.
- Use caution that rhizospheres are not relics of past hydrology.

Additional Secondary Plant Indicator of hydrology

D-5 *Fac Neutral Test*

OBL + FACW > FACU + UP

Ignore FAC-, FAC, & FAC+

Cautions About Hydrology Indicators

- Seasonal effects
- Annual effects
- Soil effects
- Timing of inundation
- Duration of inundation
- Depth to saturation

DEFINITIONS:

Saturation

"For wetland delineation purposes, a soil layer is saturated if virtually all pores between soil particles are filled with water under 0 tension (National Research Council 1995, Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension-saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979)."

Manuals p 117 & 135

Ponded

A condition in which water stands in a closed depression. The water is removed only by percolation, evaporation, or transpiration.

Flooded

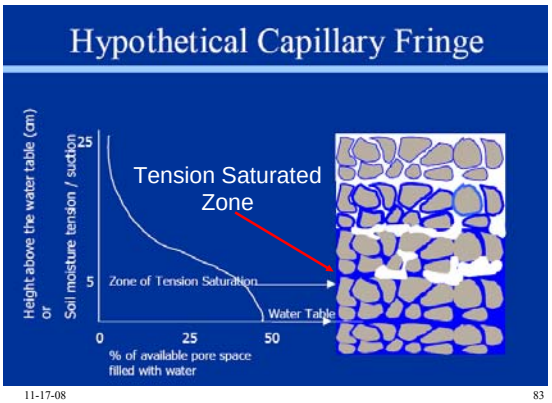
The soil surface is temporarily covered with flowing water from any source, such as overflowing streams or rivers, runoff from adjacent slopes, and inflow from high tides.

Capillary Fringe

A zone immediately above the water table in which water is drawn upward by capillary action.

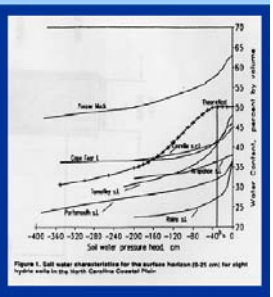
"This definition (of saturation) includes part of the *capillary fringe* above the water table (i.e., the tension saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979)." (glossary – both manuals).

Hypothetical Capillary Fringe



Capillary Fringe - Reality

- Thickness of the cap. Fringe depends on:
  - Size of the largest pores
    - Texture, structure, OM
  - Whether water table is rising, falling, or static
  - Whether plants are extracting water from the soil

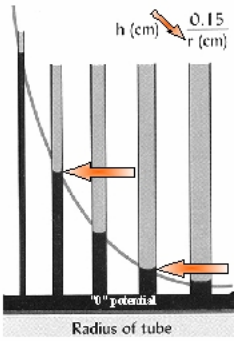


What determines the height of capillary water rise?

The diameter of the soil pore

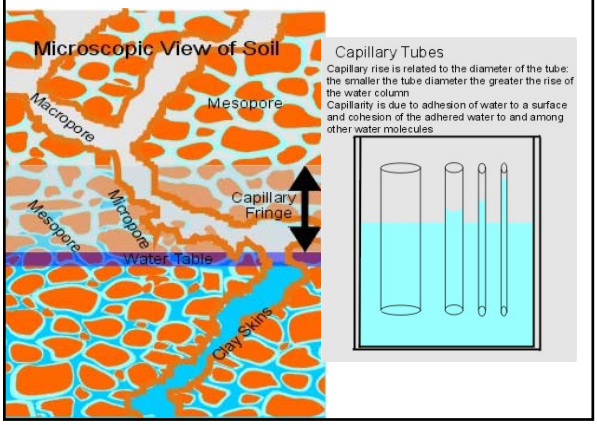
At maximum height -

force of gravity equals the attractive force of adhesion and cohesion
(matric potential)



coarse (sand) 20 to 50 cm
medium 50 to 80 cm
fine (clay) more than 80 cm up to several meters

Capillary Rise DOES NOT EQUAL TENSION SATURATION



Difficult Wetland Situations in the Arid West and WMVC Regions

"Significantly Disturbed" and

"Naturally Problematic"

"Normal Circumstances"

- Definition of wetlands: Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and that under normal circumstances do support a prevalence of vegetation typically adapted to life in saturated soil conditions
- Consider extent and relative permanence of the alteration
- "Significantly disturbed" situations are not typically "normal circumstances" (e.g., mechanized land clearing)
- "Naturally problematic" areas can be "normal circumstances" (e.g., seasonal wetlands)

Overview

Difficult Wetland Situations

1987 Manual
- Atypical Situations
- Problem Areas
  - 4 examples
- Procedures:
  - Verify presence of two parameters
  - Document reason for missing parameter

Supplements
- Significantly Disturbed
- Naturally Problematic
  - 16 examples in WMVC
  - 13 examples in Arid West
- Procedures
  - Verify presence of two parameters
  - Document reason for missing parameter

Areas that are "significantly disturbed"

(formerly "atypical situations")

Areas in which indicators of one or more wetland parameters have been obscured by some recent human or natural change or disturbance

Difficult Wetland Situations in the AW and WMVC Regions

Naturally Problematic Hydrology

Areas that are "naturally problematic"

(formerly "problem areas")

Naturally occurring wetland types that lack one of the indicators periodically due to normal seasonal or annual variability or permanently due to the nature of the soils or plant species on the site

Difficult Wetland Situations in the AW and WMVC Regions

Problematic Hydrology

- Verify presence of hydrophytic vegetation and hydric soils
- Verify area is in a landscape position that is likely to collect or concentrate water
- Identify the "problematic hydrology situation" and include documentation
- If there was no significant hydrologic manipulation, then consider the site to be wetlands

Difficult Wetland Situations in the AW and WMVC Regions

Problematic Hydrology Situations

- Site Visits During the Dry Season
  - Determine if evapotranspiration exceeds precipitation
- Periods with Below-Normal Rainfall
  - Determine if the amount of rainfall 2 – 3 months before the site visit was below-normal
- Drought Years
  - Determine if the region has been subject to a short- or long-term drought
- Years with unusually low winter snowpack
  - Determine if the region has been subject to a winter with unusually low snowpack

Disturbed Areas Hydrology

Step 1. Describe the alteration

- Dams (man-made or natural)
- Levees or dikes
- Ditches or subsurface tiles
- Filling of channels or depressions
- Water diversion
- Ground-water extraction
- Channelization

Disturbed Areas Hydrology

Step 2. Describe the effects on hydrology

- Frequency of inundation
- Duration of inundation and soil saturation

Disturbed Areas
Hydrology

Step 3. Characterize previous hydrology

- Stream or tidal gauge data
- Field hydrologic indicators
- Aerial photography
- Historical records
- Floodplain management maps
- Public or local government officials

Step 4. Determine whether wetland hydrology was once present

Disturbed Areas
Hydrology

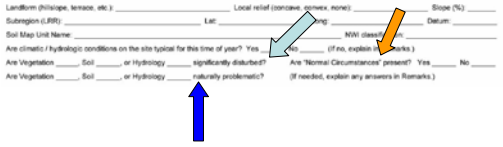
Step 5. Determine whether wetland hydrology still exists

- Review existing information (gauges, wells, recent observations)
- Examine wet-season aerial photos
- Examine field indicators (except hydric soil morphological characteristics)
- Examine a nearby undisturbed reference site
- Determine "zone of influence"
- Conduct groundwater studies

Hydrology Tools

(1) Analyze stream and lake gauge data
(2) Estimate runoff volumes to determine duration and frequency of ponding in depressional areas
(3) Evaluate the frequency of wetness signatures on aerial photography
(4) Model water-table fluctuations in fields with parallel drainage systems using the DRAINMOD model
(5) Estimate the "scope and effect" of ditches or subsurface drain lines
(6) Use NRCS state drainage guides to estimate the effectiveness of agricultural drainage systems
(7) Analyze data from groundwater monitoring wells

Supplement Data Sheet


WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

"problem area"

Difficult Wetland Situations in the AW and WMVC Regions
Areas Affected by Grazing

Difficult Wetland Situations in the AW and WMVC Regions
Areas Affected by Grazing

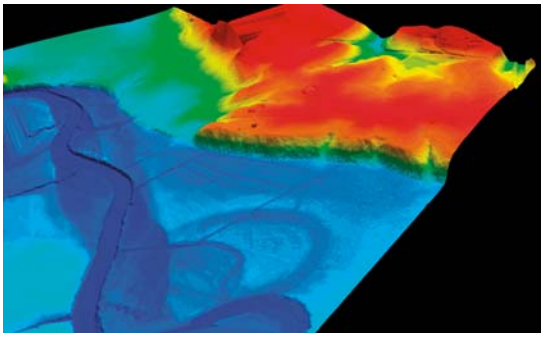
Situation:

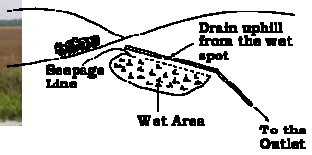
- Short and long-term grazing can cause shifts in dominant species in the vegetation

Procedure:

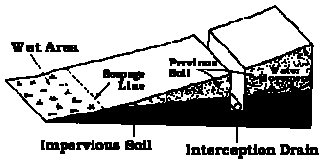
- Verify presence of hydric soil and wetland hydrology
- Verify area is in a landscape position that is likely to collect or concentrate water
- Remove livestock and allow natural vegetation to emerge
- Use a reference site (adjacent is preferable)
- Use off-site data, aerial photography, NWI maps, etc
- If undisturbed plant community cannot be determined, just use presence of hydric soils and wetland hydrology for the wetland determination

LIDAR reveals old agricultural drains in floodplain





Drains may not be Visible after installation



Comparison of Hydrology Field Indicators in the 1987 Manual, WMVC and Arid West Supplements (Version 10-20-08)

1987 Manual	WMVC (Interim April 2008)	Arid West (Interim December 2006)
Primary Indicators		
inundated	A1 - Surface water	A1 - Surface water
Saturated in the upper 12 inches	A2 - High water table A3 - Saturation	A2 - High water table A3 - Saturation
Water mark	B1 - Water mark	B1 - Water mark (Secondary in riverine systems)
Sediment deposits	B2 - Sediment deposit	B2 – Sediment deposit (Secondary in riverine systems)
Drift deposits	B3 - Drift deposits	B3 – Drift Deposits (Secondary in riverine systems)
	B4 - Algal mat or crust	
	B5 - Iron deposits	
	B6 - Surface soil cracks	B6 - Surface soil cracks
Recorded data	B7 - Inundation visible on aerial imagery	B7 - Inundation visible on aerial imagery
	B8 - Sparsely vegetated concave surface	
	B9 - Water-stained leaves	

SUMMARY – Primary Indicators

Summary – Secondary Indicators

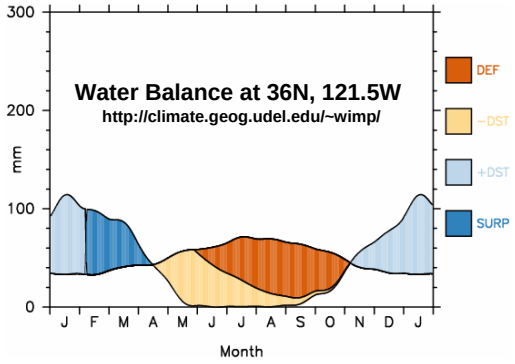
Secondary Indicators	WMVC	ARID WEST
Water-stained leaves	(Secondary on Coastal subregion)	B9 - Water-stained leaves
Drainage patterns in wetlands	B10 - Drainage pattern (S)	B10 - Drainage pattern (S)
	B11 - Salt crusts	B11 - Salt crusts
	B13 Aquatic invertebrates	B12 - Biotic crusts B13 Aquatic invertebrates
	C1 - Hydrogen sulfide odor	C1 - Hydrogen sulfide odor
	C2 - Dry-season water table (S)	C2 - Dry-season water table (S)
Oxidized root channels in the upper 12 inches	C3 - Oxidized rhizospheres along living roots	C3 - Oxidized rhizospheres along living roots
	C4 - Presence of reduced iron	C4 - Presence of reduced iron
	C6 - Recent iron reduction in tilled soil	C6 - Recent iron reduction in plowed soil
	C7 - Thin muck surface (S	
		C8 - Crayfish burrows (S)
	C9 - Saturation visible on aerial imagery (S)	C9 - Saturation visible on aerial image (S)
	D1 - Stunted or stressed plants (only in NW Forests and Coast region)	
	D2 - Geomorphic position (S) D3 - Shallow aquitard (S)	D3 - Shallow aquitard (S)
FAC-neutral test	D5 - FAC-neutral test (S)	D5 - FAC-neutral test (S)
	D6 - Raised ant mounts (S) (only in NW Forests and Coast region)	
	D7 - Frost-heave hummocks (S)	
Local soil survey data	Not used	Not used

SUMMARY - Growing Season

Definition of Growing Season		
1987 Manual	**WMVC (Interim April 2008)**	**Arid West (Final December 2006)**
	Median dates of 28º F air temperatures in spring and fall (using WETS tables and NWS meteorological station).	Median dates of 28º F air temperatures in spring and fall (using WETS tables and NWS meteorological station).
	Observations of growth or activity in vascular plants.	Two or more different non-evergreen vascular plant species show growth or activity.
Soil temperature measured at 20 inch depth is 41º F (5º C) or higher	Soil temperature measured at 12 inch depth is 41º F (5º C) or higher.	Soil temperature measured at 12 inch depth is 41º F (5º C) or higher.

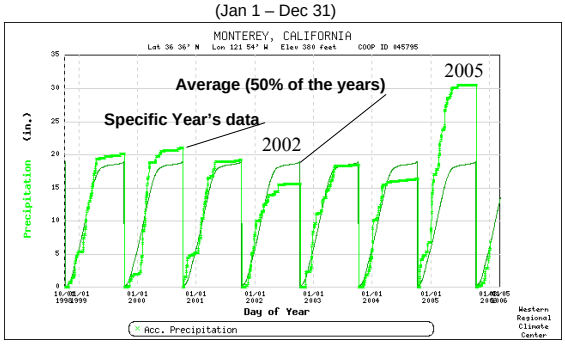
Tools for Supplementing Hydrologic Information

Supplemental Hydrology Data Sources



Supplemental Hydrology Data Sources

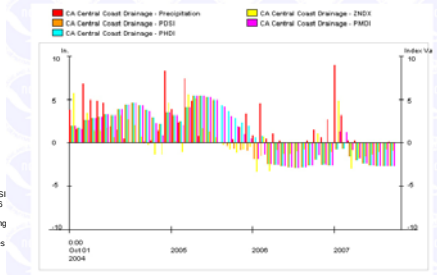
Accumulated calendar-year precipitation – Monterey Co-Op Station NWS data (Jan 1 – Dec 31)



Use for *Normalization* of rainfall

Supplemental Hydrology Data Sources

http://www.ncdc.noaa.gov/oa/climate/onlineprod/drought/xmgr.html#ds



Palmer Drought Severity Index (PDSI) ranges generally between –6 and +6 with negative values indicating dry Periods and positive values indicating wet periods. An index of –1.0 indicates mild drought, –2.0 indicates moderate drought, –3.0 indicates severe drought, and –4.0 indicates extreme drought.

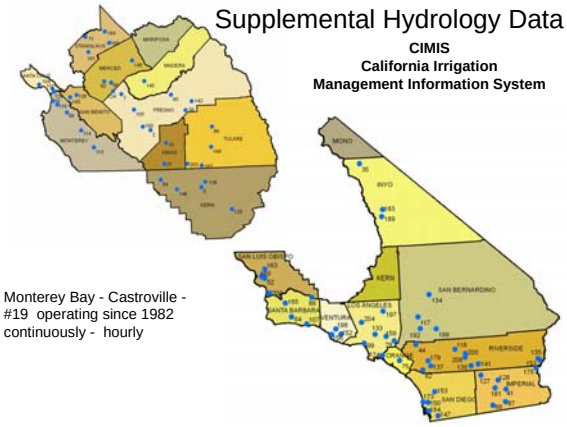
monthly water year data Oct 1 thru Sept 30

Graph Help

Index Key	
Palmer Drought Severity Index (PDSI)	Palmer Hydrological Drought Index (PHDI)
Palmer "Z" Index (ZNDX)	Modified Palmer Drought Severity Index (PMDI)
Cooling Degree Day (CDD)	Heating Degree Day (HDD)

Supplemental Hydrology Data

CIMIS
California Irrigation Management Information System



Monterey Bay - Castroville - #19 operating since 1982 continuously - hourly

Tides and the tidal datum

Waters of the United States --

Day 3, 1st Field Stop

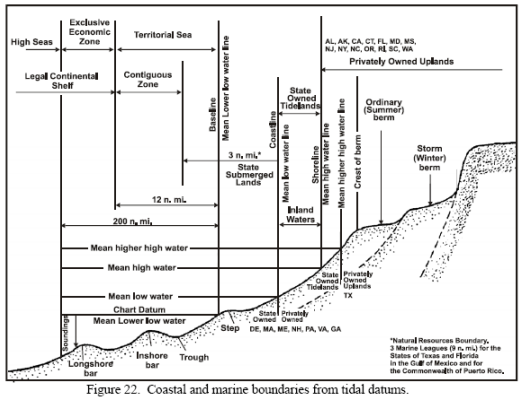
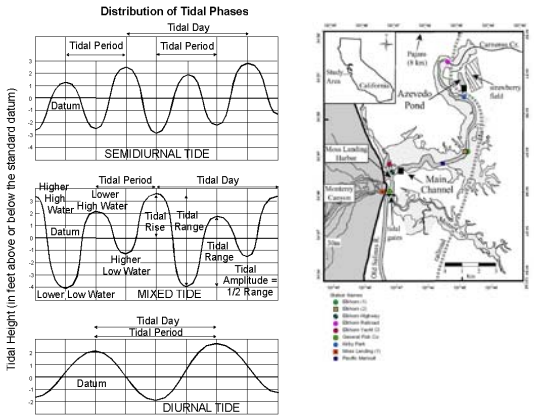


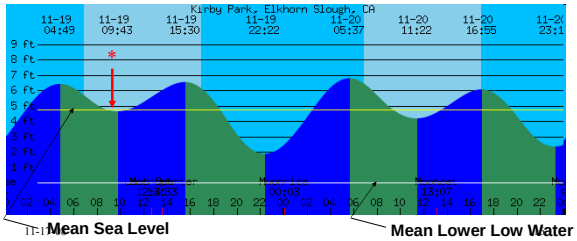
Figure 22. Coastal and marine boundaries from tidal datums.



DAY 3 ~9:15 AM*

2008-11-19 04:48 PST 6.42 feet High Tide 2008-11-19 06:49 PST Sunrise 2008-11-19 09:43 PST 4.64 feet Low Tide 2008-11-19 12:40 PST Moonset 2008-11-19 13:33 PST Last Quarter 2008-11-19 15:30 PST 6.54 feet High Tide 2008-11-19 16:54 PST Sunset 2008-11-19 22:22 PST 1.88 feet Low Tide 2008-11-20 00:03 PST Moonrise 2008-11-20 05:37 PST 6.78 feet High Tide 2008-11-20 06:50 PST Sunrise 2008-11-20 11:22 PST 4.18 feet Low Tide 2008-11-20 13:07 PST Moonset 2008-11-20 16:54 PST Sunset 2008-11-20 16:55 PST 6.06 feet High Tide 2008-11-20 23:14 PST 2.35 feet Low Tide

Kirby Park, Elkhorn Slough, CA
19 November 2008 - 20 November 2008 **http://tbone.biol.sc.edu/tide/tideshow.cgi**



ORDINARY HIGH WATER MARK -- OHWM
For Waters of the United States

Natural line impressed on the bank
Shelving
Changes in the character of soil
Destruction of terrestrial vegetation
Presence of litter and debris
Wracking
Vegetation matted down, bent, or absent
Sediment sorting
Leaf litter disturbed or washed away
Scour
Deposition
Multiple observed flow events
Bed and banks
Water staining
Change in plant community

Former Ft. Ord vernal pools between Mima Mounds - Goldfields

END OF LECTURE