



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F307

Wetland Delineation

Standard Operating Procedure

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1. Purpose

This SOP describes the field and office procedures for conducting a wetland delineation using the three-parameter approach established by the US Army Corps of Engineers (USACE). A jurisdictional wetland must exhibit all three criteria simultaneously: hydrophytic vegetation, hydric soils, and wetland hydrology (US Army Corps of Engineers, 1987). Delineation establishes the boundary between jurisdictional wetlands (and other waters of the US) and upland areas, which is a prerequisite for regulatory compliance under Section 404 of the Clean Water Act.

Wetland delineation at EA Program sites supports baseline characterization, impact assessment, restoration planning, and student training in applied environmental science.

2. Scope

- **Applies to:** Freshwater palustrine wetlands (marshes, swamps, riparian wetlands, vernal pools, seeps) at EA Program field sites in the Arid West region of California. This SOP follows the USACE Arid West Regional Supplement (US Army Corps of Engineers, 2010), which supersedes the 1987 Manual for all delineations in this region.
- **Does not apply to:** Tidal or estuarine wetlands (require separate tidal methods); riverine waters regulated solely as ordinary high water mark (OHWM) features; non-USACE state-level wetland determinations under California law (e.g., Porter-Cologne Act), which may apply different criteria.
- **Location:** All EA Program wetland field sites

3. Responsibilities

Role	Responsibility
PI / Field Lead	Approve delineation design; coordinate permits and landowner access
Trained Personnel	Conduct three-parameter assessment per this SOP
New Students	Complete training before independent plot assessment

4. Definitions

- **Dominant species:** A species contributing 50% or more of the relative frequency or relative cover within a stratum; used in the 50/20 rule for hydrophytic vegetation determination.
- **Facultative (FAC):** A wetland indicator status category applied to plant species that occur in both wetland and upland habitats with roughly equal frequency (34–66% occurrence in wetlands); neither confirms nor denies wetland conditions when dominant.
- **Facultative upland (FACU):** Plants that usually occur in uplands (67–99% upland occurrence) but are occasionally found in wetlands; their dominance is evidence against hydrophytic vegetation.
- **Facultative wetland (FACW):** Plants that usually occur in wetlands (67–99% wetland occurrence); their dominance is strong evidence for hydrophytic vegetation.
- **Hydric soil:** A soil that formed under conditions of saturation, flooding, or ponding long enough to develop anaerobic conditions in the upper part; identified by USACE hydric soil field indicators (e.g., depleted matrix, redox concentrations, sulfidic odor); a required criterion for wetland delineation (US Army Corps of Engineers, 1987).
- **Hydrophytic vegetation:** Plant community dominated (by the 50/20 rule) by species with a wetland indicator status of OBL, FACW, or FAC; a required criterion for wetland delineation.
- **Obligate wetland (OBL):** Plant species that occur almost always (> 99% of the time) in wetlands; their dominance is the strongest evidence for hydrophytic vegetation.
- **Ordinary high water mark (OHWM):** The line on the shore established by the fluctuations of water leaving physical characteristics such as a clear natural line impressed on the bank, shelving, destruction of terrestrial vegetation, or presence of litter and debris; used to define the lateral extent of jurisdictional waters.
- **Problem area:** A site where one or more of the three wetland criteria are not clearly met or where atypical conditions (drought, altered hydrology, recent disturbance) complicate standard application of the three-parameter approach; requires additional documentation and may require a USACE district determination.
- **Sample plot (data point):** A defined area (typically 5 m radius for vegetation; a single soil pit for soils; a 10 m radius for hydrology indicators) within which all three wetland criteria are assessed together.
- **Upland:** An area that does not meet one or more of the three required wetland criteria; not subject to Section 404 jurisdiction.
- **Wetland boundary:** The line on the landscape separating areas that meet all three wetland criteria from areas that do not; the primary product of a wetland delineation.
- **Wetland indicator status (WIS):** A USACE classification of plant species by their probability of occurrence in wetlands: OBL (obligate wetland), FACW (facultative wetland), FAC (facultative), FACU (facultative upland), UPL (upland). Current designations are maintained by the USACE National Wetland Plant List (NWPL).

5. Safety and Hazards

Hazards

- **Physical:** Unstable substrates (soft muck, quicksand-like conditions in saturated soils); risk of sinking, tripping on submerged debris, or falling. Standing water may conceal holes and channels.
- **Biological:** Mosquitoes (disease vectors including West Nile virus), ticks (Lyme disease, RMSF), venomous snakes, poison oak/ivy (*Toxicodendron* spp.), stinging nettles, and waterborne pathogens. Avoid direct skin contact with standing water.
- **Environmental:** Heat stress in summer; hypothermia in winter and spring. Wetlands offer little shade in open marsh environments.

5.1. Required PPE

- ☐ Rubber boots or chest waders (knee boots minimum)
- ☐ Nitrile gloves (for soil pit work)
- ☐ Long sleeves and long pants (tick and mosquito protection)
- ☐ Insect repellent (DEET or picaridin)
- ☐ Sun protection (hat, sunscreen SPF 30+)
- ☐ Personal flotation device (if water depth exceeds knee level or if working from a watercraft)

5.2. Emergency Procedures

Work in pairs at minimum. If a team member becomes stuck in soft substrate, distribute weight on a board, backpack, or rope and pull laterally rather than vertically. Refer to [SOP-F001 Field Safety](#).

6. Equipment and Materials

Item	Notes
USACE 1987 Wetland Delineation Manual	Required reference; bring to field
USACE Arid West Regional Supplement (2010)	Required for all CA Arid West delineations
Munsell Soil Color Charts (moist)	See SOP-F405
Soil auger or push probe (60 cm minimum)	For reading soil profile to 50 cm depth
Tile spade or sharpshooter spade	For opening soil pit
30 cm metric ruler	Depth to WTHS and horizon thickness
Flagging tape (two colors: wetland, upland)	For marking boundary and sample plots
GPS unit or smartphone with mapping app	See SOP-F006
50 m fiberglass measuring tape	Transect layout
Plant identification keys (regional)	<i>Jepson Manual</i> for California
National Wetland Plant List (NWPL)	Current WIS designations (usace.army.mil)

Item	Notes
Hydric Soils Field Indicators guide	USDA NRCS Field Indicators of Hydric Soils
Wetland delineation field data sheets	See Appendix A
Clipboard, mechanical pencils, waterproof paper	Rite in the Rain recommended
Camera (waterproof or in dry bag)	Photo-document each sample plot
Compass	Transect bearings
10x hand lens	Plant identification

7. Estimated Time

Task	Time (2-person crew)
Office pre-work (maps, records, NWPL lookup)	2–4 hours
Site reconnaissance walk	30–60 minutes
Sample plot assessment (per plot)	15–30 minutes
Boundary flagging and GPS waypoints	1–2 hours per 100 m boundary
Field data compilation	30–60 minutes
Office post-work (report, map, data entry)	4–8 hours

8. Procedure

8.1. Step 1: Pre-Field Office Work

Before entering the field, complete the following:

- Obtain and review available information:
 - USFWS National Wetlands Inventory (NWI) maps (fws.gov/wetlands)
 - USDA Web Soil Survey (websoilsurvey.nrcs.usda.gov) – note mapped hydric soils and map unit descriptions
 - USGS topographic maps (7.5-minute quadrangles)
 - Aerial/satellite imagery (Google Earth historical layers) – look for inundation signatures, dark organic soils, and characteristic vegetation patterns
 - NOAA precipitation records for the region to assess whether current year is a drought, normal, or wet year (relevant to atypical situation determinations)
- Generate a base map at a scale appropriate for the site (1:2,400 for small sites; 1:4,800 for large sites). Include NWI polygons, soil map unit boundaries, topographic contours, and property boundaries.
- Look up current wetland indicator status (WIS) for all plant species expected at the site on the USACE National Wetland Plant List (plants.usace.army.mil).
- Identify the appropriate USACE district and confirm whether a preliminary jurisdictional determination (PJD) or approved jurisdictional determination (AJD) is ultimately required.

8.2. Step 2: Site Reconnaissance

On arrival at the field site, conduct a reconnaissance walk before placing any sample plots:

1. Walk the entire site perimeter and any internal drainages or basins to develop a mental model of landscape position, drainage patterns, and vegetation transitions.
2. Identify probable wetland areas (standing or ponded water, dark organic soils visible at surface, wet-adapted vegetation) and probable upland areas (well-drained soils, upland vegetation).
3. Identify any obvious disturbances (ditching, filling, altered hydrology, grazing, invasive species) that could create problem areas.
4. Note the approximate location of vegetation transitions, which are often close to the wetland boundary.
5. Sketch a rough site map with probable wetland/upland zones and planned transect routes.

8.3. Step 3: Establish Transects and Sample Plots

1. Establish transects perpendicular to the suspected wetland boundary, spaced to adequately characterize the site. For EA Program sites, transects are typically spaced 25–50 m apart; closer spacing is used in complex or small-scale boundaries.
2. On each transect, place sample plots at:
 - A clearly wetland location (well within the apparent wetland)
 - A clearly upland location (well outside the apparent wetland)
 - One or more locations straddling the suspected boundary
3. Flag each sample plot center with flagging tape and record GPS coordinates. Use a consistent color for wetland plots and a different color for upland plots.
4. Number all sample plots sequentially and record them on the base map.

8.4. Step 4: Assess Hydrophytic Vegetation

At each sample plot (approximately 5 m radius), assess vegetation in all strata present (tree, shrub/sapling, herb, woody vine):

1. List all plant species in each stratum. Identify to species level using regional keys (*Jepson Manual* for California).
2. Estimate percent areal cover for each species within each stratum to the nearest 5–10%.
3. For each species, record the current wetland indicator status (WIS) from the USACE NWPL for the Arid West region.
4. Determine dominant species in each stratum using the **50/20 rule**:
 - a. Rank species within each stratum by decreasing percent cover.

- b. Add species from highest to lowest cover until the cumulative cover total reaches 50% or more of the total stratum cover.
 - c. Include one additional species if it contributes at least 20% of the total stratum cover.
 - d. All species added in steps (b) and (c) are dominant species for that stratum.
5. Tally the number of dominant species that are OBL, FACW, or FAC (hydrophytic) and the number that are FACU or UPL (upland).
6. The **hydrophytic vegetation criterion is met** if more than 50% of the dominant species across all strata are OBL, FACW, or FAC.

i FAC-Neutral Test

In borderline cases where FAC species are dominant, apply the FAC-neutral test: exclude all FAC species and recalculate dominance using only OBL, FACW, FACU, and UPL species. If the remaining dominants are predominantly hydrophytic, the criterion is still met. The FAC-neutral test is described in the Arid West Regional Supplement (US Army Corps of Engineers, 2010).

8.5. Step 5: Assess Hydric Soils

At each sample plot, excavate a soil pit to at least 50 cm depth (or to the water table or bedrock, whichever is shallower):

1. Excavate with a sharpshooter spade. If the pit fills with water, record the depth to water table and excavate no deeper.
2. Describe the soil profile using the form in Appendix A:
 - Horizon designation (A, B, C), depth (cm), and thickness
 - Munsell color (matrix and mottles/redoximorphic features) per [SOP-F405](#) – record moist colors only
 - Texture (field ribbon test; see [SOP-F401](#))
 - Structure, consistence, roots
3. Check for USDA NRCS Field Indicators of Hydric Soils (Version 8.2 or current). For the Western Mountains, Valleys, and Coast (WMVC) region, the most applicable indicators include:

Indicator Code	Name	Key Feature
A1	Histosol	Organic soil (Oi, Oe, or Oa horizon > 40 cm)
A2	Histic epipedon	Organic surface layer 20–40 cm
A3	Black histic	Black (10YR 2/1) organic layer ≥ 20 cm
A11	Depleted below dark surface	Dark A over low-chroma (chroma ≤ 2) matrix

Indicator Code	Name	Key Feature
F2	Loamy gleyed matrix	Gley hue matrix in loamy soils
F3	Depleted matrix	> 60% low-chroma (chroma ≤ 2) matrix
F6	Redox dark surface	Dark A over depleted or reduced matrix
F8	Redox depressions	Redox concentrations in depressions

4. The **hydric soil criterion is met** if one or more applicable field indicators are present at the appropriate depth. For most indicators in the Arid West Supplement, this means within the upper 30 cm of the soil profile (US Army Corps of Engineers, 2010).

Problematic Hydric Soil Situations

Soils in the Arid West may have low-chroma colors from parent material (e.g., some shales, volcanic tuffs) rather than from saturation. If in doubt, check for redox concentrations (bright orange/red Fe masses) as corroborating evidence, and note the soil series and parent material from Web Soil Survey.

8.6. Step 6: Assess Wetland Hydrology

At each sample plot, document evidence of wetland hydrology. The USACE defines wetland hydrology as saturation within 30 cm of the surface for a continuous period of at least 5% of the growing season (US Army Corps of Engineers, 1987, 2010).

- Record depth to surface water or saturated soil (standing water in the pit).
- Check for **primary hydrology indicators** (in order of reliability):

Indicator	Description
Surface water	Standing water present at time of visit
High water table	Water within 30 cm of surface in soil pit
Saturation	Saturated soil within 30 cm (water oozes when squeezed)

- Check for **secondary hydrology indicators** (two or more required when primary indicators are absent):

Indicator	Description
Water marks	Staining on tree trunks or structures
Sediment deposits	Fresh mineral sediment on leaves or stems
Drift lines	Lines of debris deposited by receding water
Waterlogged soils	Confirmed by soil pit; no free water but saturated
Water-stained leaves	Grayish-brown discoloration of litter

Indicator	Description
Oxidized rhizospheres	Orange halos around living roots in grey matrix
FAC-neutral plant communities	Vegetation dominance by OBL/FACW species
Crayfish burrows	Chimney mounds indicating seasonal saturation

4. For arid-region sites, pay particular attention to oxidized rhizospheres (a primary indicator in the Arid West Supplement) and drift/wrack lines along swales and basins.
5. The **wetland hydrology criterion is met** if at least one primary indicator is present, or at least two secondary indicators are present, at the time of visit; or if the site has documented evidence of seasonal or periodic inundation from well records or gauges (see [SOP-F306](#)).

i Arid-Region Hydrology Timing

At arid and semi-arid sites, surface water and high water tables may only be present during a brief seasonal window. When conducting delineations outside the wet season, rely on secondary indicators and, where available, water level logger data from monitoring wells. Document the date of the visit and regional precipitation conditions in all field data sheets. See [SOP-F306](#) for long-term hydrology monitoring methods.

8.7. Step 7: Apply the Three-Parameter Test

At each sample plot, compile results from Steps 4–6:

1. Record whether each of the three criteria is met (yes/no) on the field data sheet (Appendix A).
2. **A sample plot is classified as wetland if and only if all three criteria are met.** If any criterion is absent, the plot is classified as upland (or a transitional/problem area if two of three are met).
3. If two of three criteria are met, flag the plot as a potential **problem area** and document the specific conditions. Common problem area types include:
 - Recently disturbed wetlands (vegetation removed, soil disturbed)
 - Drought-year assessments (hydrology not apparent)
 - Altered hydrology (ditched, drained, or impounded areas)
 - Atypical vegetation (recent burn, mowing, herbicide)
4. For problem areas, apply the appropriate USACE atypical situation procedures as described in the Regional Supplement (US Army Corps of Engineers, 2010).

8.8. Step 8: Flag and Map the Wetland Boundary

1. Between each pair of adjacent wetland and upland sample plots on a transect, locate the wetland boundary by walking perpendicular to the transect and reassessing the three criteria at intermediate points until the line of change is identified.

2. Flag the wetland boundary with a distinct color (use a third color different from the wetland and upland plot flags). Place flags every 5–10 m or at every change in direction.
3. Record GPS waypoints at each boundary flag using [SOP-F006](#). Waypoint naming convention: WB_[transect]-[sequence] (e.g., WB_T1-01).
4. Photograph the boundary flags from multiple angles; include a scale bar (person or measuring tape) in at least one photo per transect.
5. Sketch the boundary on the field base map, noting all sample plot locations and transect lines.

8.9. Step 9: Field Quality Review

Before leaving the site, complete the following checks:

- ☐ All sample plots have GPS coordinates recorded
- ☐ Every plot has complete data for all three criteria
- ☐ All boundary flags are GPS-logged
- ☐ At least two representative photographs per sample plot
- ☐ Boundary is continuous between all transects (no gaps)
- ☐ Problem areas are flagged and documented
- ☐ Equipment has been decontaminated per [SOP-F007](#)

8.10. Step 10: Post-Field Office Work

1. Enter all field data into the project database within 48 hours per [SOP-L803](#).
2. Import GPS waypoints and generate a georeferenced boundary map in GIS software (see [SOP-L804](#)).
3. Overlay the delineated boundary on aerial imagery, NWI maps, and soil survey maps to check for consistency; note and document any discrepancies.
4. Calculate wetland area (hectares) from the GIS boundary polygon.
5. Compile the delineation report with:
 - Site description and location map
 - Methods summary (reference to this SOP)
 - Summary table of all sample plots and three-parameter results
 - Wetland boundary map
 - Photographs
 - Conclusions regarding jurisdictional status
 - Any problem areas and how they were addressed
6. Archive all raw field data sheets (scanned), GPS track files, GIS shapefiles, and the final report per project data management protocols.

9. Quality Control

- A minimum of two observers must conduct the vegetation assessment at each sample plot; independent species lists must be reconciled before leaving the plot.
- Munsell color readings must be made by two observers and must agree within one value and one chroma step; discrepancies require a consensus re-read per [SOP-F405](#).
- GPS boundary waypoints must be collected with horizontal accuracy < 3 m (WAAS-enabled or equivalent). Record DOP and fix type.
- At 10% of sample plots, return the following day and re-assess the hydrophytic vegetation criterion independently; dominant species lists must agree within 10 percentage points cover.
- Final delineation maps must be reviewed by the PI before submission to any regulatory agency or inclusion in project reports.

10. Data Management

1. Raw field data sheets must be scanned and uploaded to the project folder within 48 hours of fieldwork.
2. Enter tabular sample plot data into the project database using the standardized template in Appendix B.
3. GPS tracks and waypoints must be exported and backed up immediately on return from the field.
4. All GIS boundary files must be saved in both shapefile and GeoJSON formats and versioned in the project Git repository.
5. Version-control all analysis scripts and report documents per [SOP-L801](#).

11. References

- US Army Corps of Engineers (1987)
- US Army Corps of Engineers (2010)
- Mitsch & Gosselink (2015)

Mitsch, W. J., & Gosselink, J. G. (2015). *Wetlands* (5th ed.). John Wiley & Sons.

US Army Corps of Engineers. (1987). *Corps of engineers wetlands delineation manual* (Technical Report Y-87-1). Waterways Experiment Station, US Army Corps of Engineers. <https://www.frl.usace.army.mil/Portals/64/docs/regulatory/Wetland-Delineation-Manual.pdf>

US Army Corps of Engineers. (2010). *Regional supplement to the corps of engineers wetland delineation manual: Arid west region (version 2.0)* (ERDC/EL TR-08-28). Engineer Research; Development Center, US Army Corps of Engineers.

12. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F006	GPS and Site Navigation	Boundary waypoint collection
F007	Field Decontamination	Between-site gear decontamination
F306	Wetland Hydrology Monitoring	Hydrology criterion support; long-term records
F405	Soil Color (Munsell)	Required for hydric soil assessment
F407	Soil Profile Description	Soil pit documentation
L803	Data Entry and Database Management	Post-field data entry
L804	GIS and Spatial Data	Boundary mapping and area calculation

13. Training Record

Before conducting wetland delineations independently, personnel must:

1. Read this SOP, [SOP-F001](#), [SOP-F306](#), and [SOP-F405](#) in full
2. Review the USACE 1987 Manual and Arid West Regional Supplement (US Army Corps of Engineers, 1987, 2010)
3. Complete at least one supervised delineation transect, including independent application of the 50/20 rule and hydric soil field indicators, with results reviewed by the PI
4. Demonstrate Munsell color reading proficiency per [SOP-F405](#) inter-observer calibration requirements
5. Successfully enter and map a practice delineation dataset in GIS
6. Be signed off by the PI or field lead

14. Appendix A: Field Data Sheet

Print double-sided on waterproof paper (Rite in the Rain). Complete one sheet per sample plot.

Site: _____ Date: _____ Observers: _____

Plot ID: _____ Transect: _____ GPS (lat/lon): _____

Landscape position: upland / footslope / toeslope / depression / flat / other: _____

14.1. A. Hydrophytic Vegetation

Species	Stratum	% Cover	WIS
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50/20 Rule Tally: Dominants that are OBL/FACW/FAC: ____ / Total dominants: ____

Hydrophytic vegetation criterion met? YES / NO / Problem area

14.2. B. Hydric Soils

Depth to water table or bedrock: _____ cm

Horizon	Depth (cm)	Munsell (moist)	Texture	Notes
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Hydric soil field indicator(s) present: _____

Hydric soil criterion met? YES / NO / Problem area

14.3. C. Wetland Hydrology

Primary indicators (check all present):

- ☐ Surface water (depth: ____ cm)
- ☐ High water table (depth: ____ cm)
- ☐ Saturation within 30 cm

Secondary indicators (check all present):

- ☐ Water marks ☐ Sediment deposits ☐ Drift lines
- ☐ Water-stained leaves ☐ Oxidized rhizospheres
- ☐ Waterlogged soils ☐ Crayfish burrows ☐ FAC-neutral community

Wetland hydrology criterion met? YES / NO / Problem area

14.4. D. Determination

All three criteria met? YES – WETLAND / NO – UPLAND / PROBLEM AREA

Notes / atypical situation documentation:

15. Appendix B: Sample Plot Summary Table Template

Enter into data/raw/wetland_delineation_[site]_[date].csv:

```
plot_id,transect,lat,lon,veg_criterion,soil_criterion,hydro_criterion,
determination,dominant_species,hydric_indicator,primary_hydro_indicator,
notes,observers,date
```

Column definitions are in the project data dictionary (data/metadata/wetland_delineation_datadictionary.csv)

16. Appendix C: Wetland Indicator Status Quick Reference

Code	Category	Wetland Occurrence	Delineation Implication
OBL	Obligate wetland	> 99%	Strong evidence for hydrophytic veg
FACW	Facultative wetland	67–99%	Evidence for hydrophytic veg
FAC	Facultative	34–66%	Equivocal; apply FAC-neutral test
FACU	Facultative upland	1–33%	Evidence against hydrophytic veg
UPL	Upland	< 1%	Strong evidence against hydrophytic veg

Current WIS designations for the Arid West region are available at plants.usace.army.mil. Always use the regional list, not the national list, for California delineations.