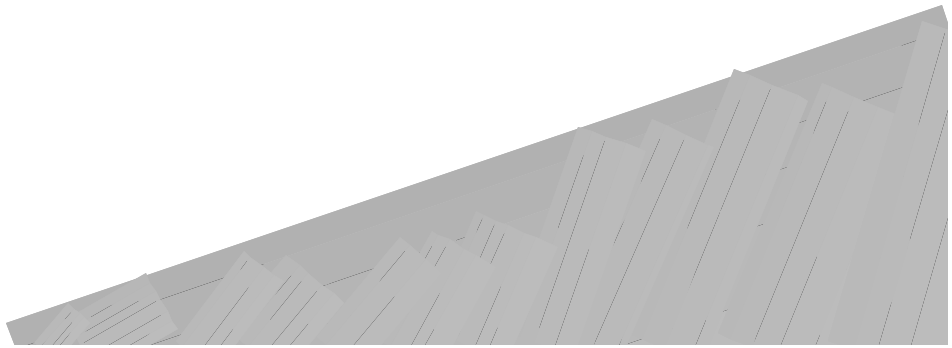
Biological Resources (Con’t.)

- Aquatic Systems
- Wetlands
- Threatened & Endangered Species

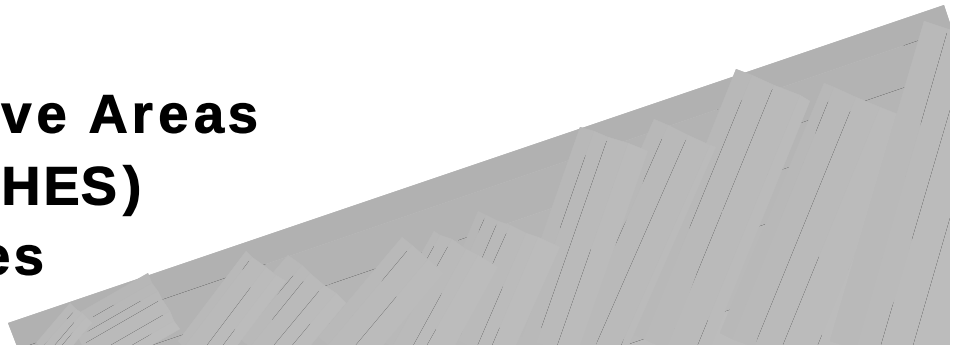


Assessing Impacts to Aquatic Systems

- **Identify Source of Potential Impacts**
  - **Changes in Water Quality**
  - **Change Hydrology (de-water/flood)**
  - **Placement of Fill**
  - **Shading**
  - **Changes in Aquatic Vegetation (invasive species)**
- **Determine Study Area**
  - **Generally areas of direct impact**
- **Determine Existing Conditions**
  - **Field Visit for Habitat**
  - **Species Likely to Occur**
  - **Fish Surveys (electroshocking/seines/traps)**
  - **Macroinvertebrates Surveys**
  - **HEP/HES**
- **Identify Standard**
  - **Usually none except for E & T species**

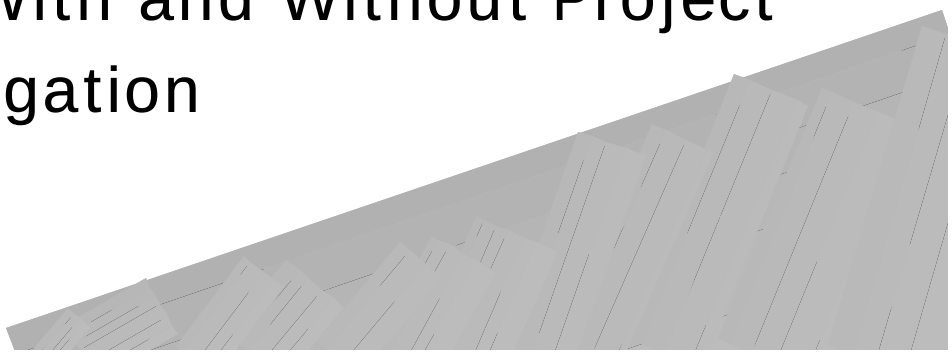
Aquatic Systems (cont.)

- **Impact Prediction**
  - **Direct Taking**
  - **Change in Hydrology**
  - **Shading**
  - **Water Quality Effects**
  - **HEP/HES**
  - **Invasive Species**
- **Assess Significance of Impacts**
  - **Percentage/Professional Judgment**
  - **Unique Characteristics/ Sensitive Species**
  - **Economic Value**
- **Mitigation**
  - **Avoid/Minimize Sensitive Areas**
  - **Enhance Habitat (HEP/HES)**
  - **Control Invasive Species**



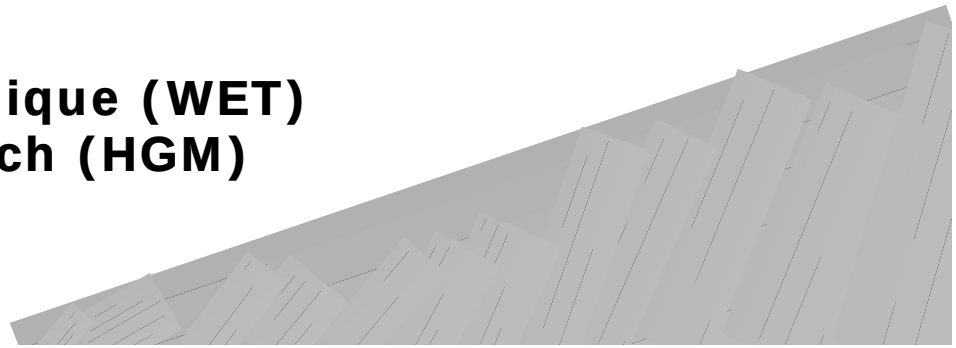
Habitat Evaluation System (HES)

- Assumes abundance of species is determined by presence of habitat.
- 2 Aquatic Systems (streams and lakes)
- 5 Terrestrial Systems
- Steps of HES
  - Derive Habitat Quality Index (HQI) scores
  - Derive Habitat Unit Values
  - Calculate Difference With and Without Project
  - Use to Determine Mitigation



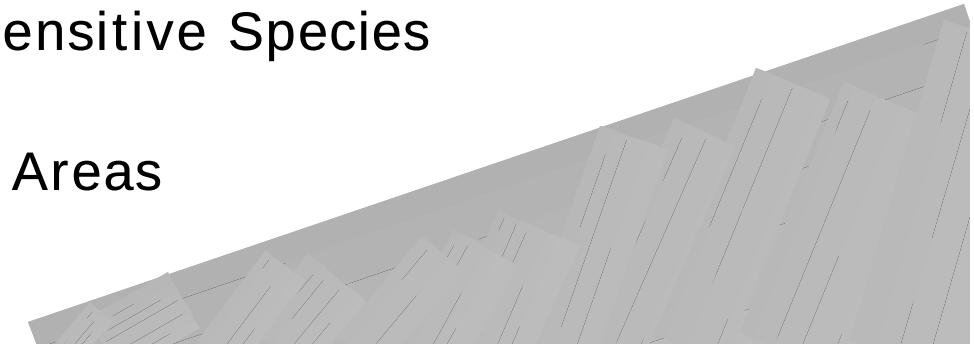
Assessing Impacts to Wetlands

- **Identify Source of Potential Impacts**
  - **Placement of Fill**
  - **Change Hydrology (de-water)**
  - **Shading**
  - **Toxic Substances**
  - **Spills**
  - **Mining**
  - **Non-indigenous Species**
- **Determine Study Area**
  - **Generally Areas of Direct Fill or Changes to Hydrology**
- **Determine Existing Conditions**
  - **Aerial Photographs**
  - **Field Visit**
  - **Wetland Delineation**
  - **Wetland Evaluation Technique (WET)**
  - **Hydrogeomorphic Approach (HGM)**



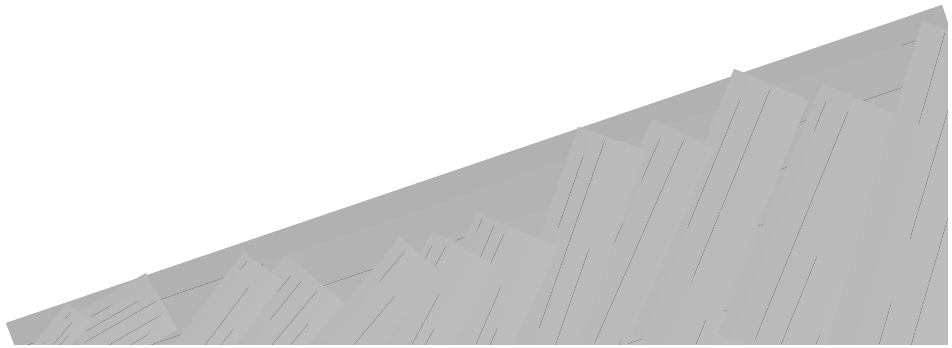
Wetlands (cont.)

- **Identify Standard**
  - Federal/State Permits
    - **Nationwide**
    - **Individual**
- **Impact Prediction**
  - Direct Taking
  - Change in Hydrology
  - Shading
  - WET/HGM
- **Assess Significance of Impacts**
  - Individual Permit
  - Percentage/Professional Judgment
  - Unique Characteristics/ Sensitive Species
- **Mitigation**
  - Avoid/Minimize Sensitive Areas
  - Compensate (WET/HGM)
  - Banking

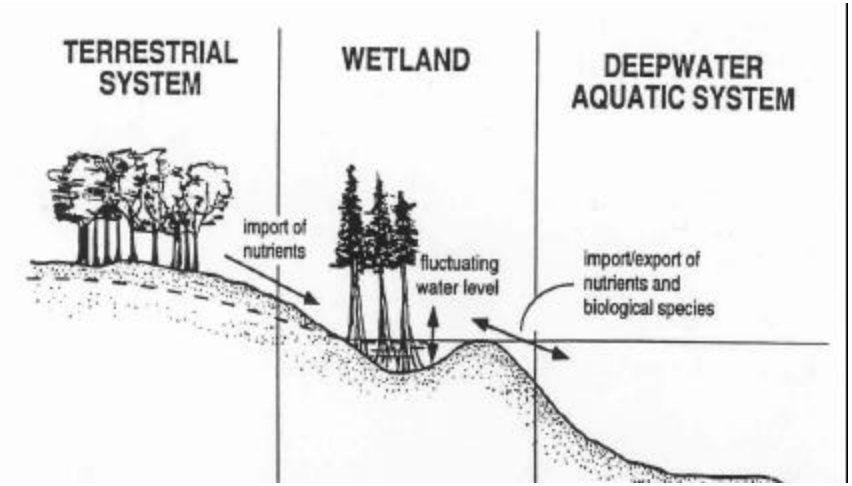


Wetland Basics

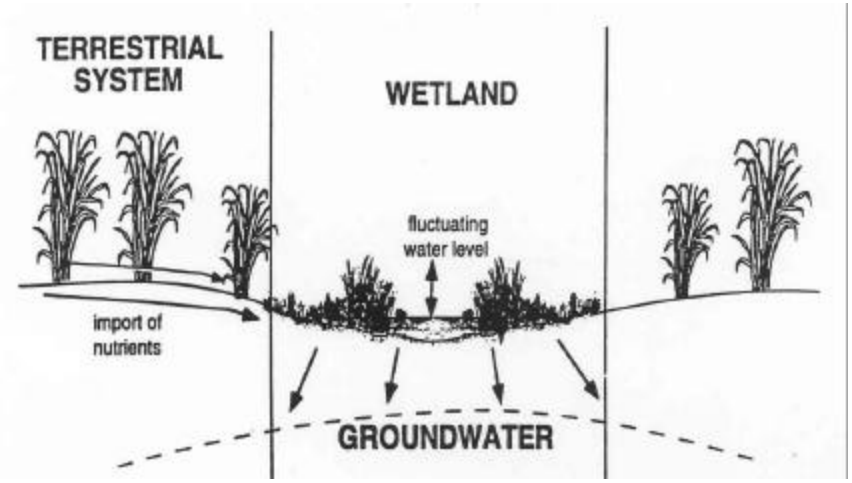
- Definition: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. (US Army Corps of Engineers, 1977)



Wetlands Basics (cont.)



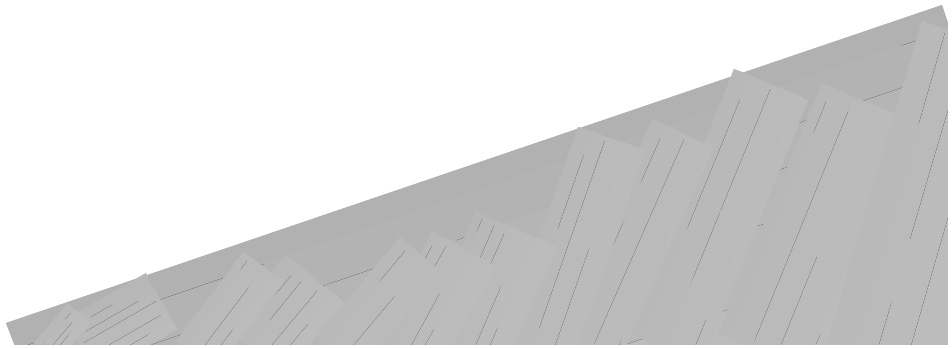
Transitional Wetlands



Depressional Wetlands

Wetland Functions

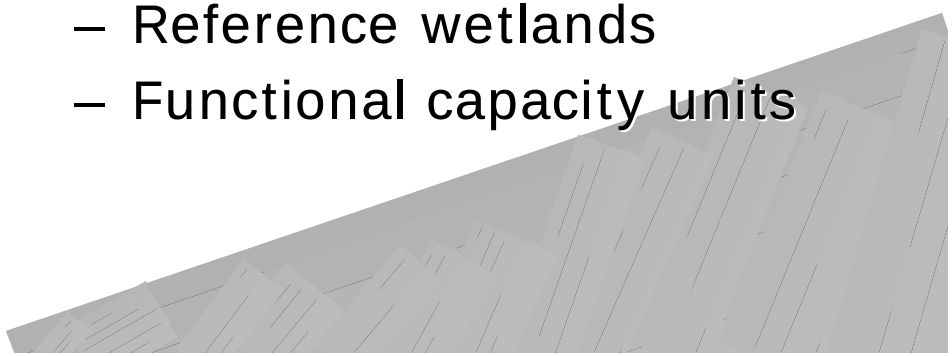
- Abiotic Functions
  - Flood Mitigation
  - Storm Abatement
  - Aquifer Recharge
  - Water Quality
    - Nutrient retention
    - Sediment trapping
  - Bank Stabilization
- Biotic Functions
  - Wildlife Habitat
  - Aquatic Habitat
  - Food Chain Support
- Human Functions
  - Active Recreation
  - Passive Recreation
  - Resource Harvest



Wetland Evaluation

- Wetland Evaluation Technique **(WET)**
  - 11 Functions
  - Evaluated on:
    - Social Significance
    - Effectiveness
    - Opportunity

- Hydrogeomorphic Analysis **(HGM)**
  - Wetland Group by;
    - Geomorphic setting
    - Water source
    - Hydrodynamics
  - Groups have different functions
  - Functional capacity models for region
  - Reference wetlands
  - Functional capacity units



HGM Wetland Classification

Table 1
Hydrogeomorphic Classes of Wetlands Showing Dominant Water Sources, Hydrodynamics, and Examples of Subclasses

Hydrogeomorphic Class (geomorphic setting)	Water Source (dominant)	Hydrodynamics (dominant)	Examples of Regional Subclass	
			Eastern USA	Western USA and Alaska
Riverine	Overbank flow from channel	Unidirectional and horizontal	Bottomland hardwood forests	Riparian forested wetlands
Depressional	Return flow from groundwater and interflow	Vertical	Prairie pothole marshes	California vernal pools
Slope	Return flow from groundwater	Unidirectional, horizontal	Fens	Avalanche chutes
Mineral soil flats	Precipitation	Vertical	Wet pine flatwoods	Large playas
Organic soil flats	Precipitation	Vertical	Peat bogs; portions of Everglades	Peat bogs
Estuarine fringe	Overbank flow from estuary	Bidirectional, horizontal	Chesapeake Bay marshes	San Francisco Bay
Lacustrine fringe	Overbank flow from lake	Bidirectional, horizontal	Great Lakes marshes	Flathead Lake marshes

HGM Computations

	Reference Standard Wetland		Project Wetland			
			Before Impact		After Impact	
Variables	Data	SubIndex	Data	SubIndex	Data	SubIndex
V_{FREQ}	<1.7	1.0	1.3	1.0	7	0.25
V_{SURFIN}	>10	1.0	>10	1.0	2	0.25
V_{MICRO}	45	1.0	33	0.7	33	0.7
V_{HERB}	70	1.0	42	0.6	22	0.3
V_{SHRUB}	15	1.0	20	1.0	5	0.2
V_{TREE}	25	1.0	23	1.0	0	0
V_{CWD}	4.3	1.0	2.1	0.5	0	0
Functional Capacity Index		1.0		0.87		0.24

Definition: deposition and retention of inorganic and organic particulates (>0.45<mu>m), primarily through physical processes. Effects on-site: sediment accumulation contributes to the nutrient capital of the ecosystem. Deposition increases surface elevation and changes topographic complexity. Organic matter may also be retained for decomposition, nutrient recycling, and detrital food web support.

$$FCI = \sqrt{\left\{\sqrt{(V_{FREQ} \times V_{SURFIN}} \times \left[\frac{(V_{MICRO} + V_{HERB} + V_{SHRUB} + V_{TREE} + V_{CWD})}{5}\right]\right\}}$$

V_{FREQ} = Frequency of floodplain inundation in average number of years between flooding events. V_{SURFIN} = Surface inflow to the wetland as a ratio of inflow volume to wetland volume. V_{MICRO} = Microtopographic complexity measured in cm as the difference in elevation between the height of the low point of wetland basin and the maximum depth of the wetland. V_{HERB} = Herbaceous plant density measured as percent cover within the wetland assessment area. V_{SHRUB} = Shrub and sapling density measured as percent cover within the wetland assessment area. V_{TREE} = Tree density measured as the frequency (number ha^{-1}) of trees within the wetland assessment area. V_{CWD} = Volume of coarse woody debris ($m^3 ha^{-1}$) measured as downed wood >10 cm dia. and >1 m length within the wetland assessment area.

HGM Output

Table 5
Sample Data Sheet for Comparing Functional Capacity Indices (FCIs) and Functional Capacities (FCs) for Wetland Assessment Area Under Preproject and Postproject Conditions

FCIs and FCs for WAA Under Preproject and Postproject Conditions

Date: _____

Project: _____

Wetland Assessment Area: _____

Assessors: _____

	Preproject			Postproject		
Functions[1]	FCI	Size of WAA in acres	FC	FCI	Size of WAA in acres	FC
Dynamic Surface Water Storage	1.0	10	10	0.5	10	5
Long-Term Surface Water Storage	1.0	10	10	1.0	10	10
Energy Dissipation	1.0	10	10	1.0	10	10
Subsurface Storage of Water	1.0	10	10	1.0	10	10
Modification of Groundwater Flow or Discharge	1.0	10	10	1.0	10	10
Nutrient Cycling	1.0	10	10	0.5	10	5
Removal of Elements and Compounds	1.0	10	10	0.5	10	5
Retention of Particulates	1.0	10	10	0.5	10	5
Export of Organic Carbon	1.0	10	10	0.1	10	1
Maintain Characteristic Plant Community	1.0	10	10	1.0	10	10
Maintain Characteristic Detrital Biomass	1.0	10	10	1.0	10	10
Maintain Spatial Structure of Habitat	1.0	10	10	1.0	10	10
Maintain Interspersion and Connectivity	1.0	10	10	1.0	10	10
Maintain Distribution and Abundance of Invertebrates	1.0	10	10	0.5	10	5
Maintain Distribution and Abundance of Vertebrates	1.0	10	10	1.0	10	10

[1] From Brinson et al. (In Preparation).

Assessing Impacts to Species of Concern (T&E, Rare)

- **Identify Source of Potential Impacts**
  - **Clearing and Grubbing**
  - **Change Hydrology (de-water/flood)**
  - **Toxic Substances**
  - **Spills**
  - **Placement of Fill**
  - **Shading**
  - **Noise**
  - **Human Contact**
  - **Non-Indigenous Species**
- **Determine Study Area**
  - **Generally Areas of Direct**
- **Determine Existing Conditions**
  - **Consultation with US Fish & Wildlife service**
  - **Habitat for Species Likely to Occur**
  - **Field Visit for Habitat**
  - **Survey for Species**

Species of Concern (cont.)

- **Identify Standard**
  - **Jeopardy**
- **Impact Prediction**
  - **Biological Assessment**
    - **Direct Taking**
    - **Habitat Alternation**
  - **Biological Opinion**
- **Assess Significance of Impacts**
  - **Affect on Wildlife Species of Concern**
    - **No Jeopardy**
    - **Jeopardy**
- **Mitigation**
  - **Avoid/Minimize Sensitive Areas**
  - **Enhance Habitat**
  - **Move Species**

ESA Consultation Process