16. Wetlands. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. This section lists data which may be required for feasibility design of wetlands projects. The project team and the design team should review these guidelines to determine and assemble the final data request for a specific project. Biological data other than that requested in this guideline may be required. All wetlands projects should involve appropriate specialists in biology, hydrology (surface and groundwater), landscape site planning, and/or water quality (chemical limnology) disciplines. Depending on the scope and complexity, wetlands project plans should be developed or reviewed by a certified Professional Wetlands Scientist (PWS) or at a minimum by a member of the Society of Wetlands Scientists (SWS).

According to the U.S. Environmental Protection Agency:

- **Wetlands –** "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 for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

- **Coastal Wetlands –** "found along the Atlantic, Pacific, Alaskan, and Gulf coasts. They are closely linked to our nation's estuaries, where sea water mixes with fresh water to form an environment of varying salinities."

- **Inland Wetlands –** "most common on floodplains along rivers and streams (riparian wetlands), in isolated depressions surrounded by dry land (for example, playas, basins, and "potholes"), along the margins of lakes and ponds, and in other low-lying areas where the ground water intercepts the soil surface where precipitation sufficiently saturates the soil (vernal pools and bogs)."

The following is a list of possible data required for design of wetlands:

A. **General Description of Proposed Wetlands Project:**

(1) **General Map(s) Showing:**

(a) A key map locating the general map area.

(b) The construction site or sites.

(c) Reference sites (if used).

(d) Existing towns, residences, private property, highways, roads, bridges with special loads or size limitations, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.

(e) Locations for potential construction and permanent access roads, sites for contractor's staging areas, and construction facilities.

(f) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(g) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, areas of cultural sensitivity; and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation.

(h) Rights-of-way for construction, access, and staging areas.

(i) Sources of construction power and power transmission facilities.

(j) Buried utilities, pipelines, tanks, or other structures within the proposed construction site.

(2) **General Purpose and Function (definitions are provided at the back of this section):**

(a) Discuss type of wetlands work:

(i) Establishment of new wetlands.

(ii) Restoration of previously existing wetlands.

(iii) Enhancement or enlargement of an existing wetland.

(iv) Replacement for abandoned or displaced wetlands.

(v) Protection and maintenance of existing wetlands.

(b) State overall approach to resolving problems:

(i) Watershed based.

(ii) Local area.

(iii) Both of the above.

(iv) Use natural approach or bioengineering approach or a combination or both.

(c) Describe, in detail, any specific functional requirements and goals for the wetland:

(i) Habitat restoration (restore habitat to a pre-existing condition) or creating a new wetlands:

- Restore native species.
- Create and sustain diverse habitats supporting diverse species.
- Protect or re-establish threatened or endangered species.
- Increase or improve wildlife habitat.
- Increase or improve plant habitat.
- Restore hydrologic and vegetative characteristics of altered meadows and riparian areas.
- Requirements for removal of non-native plant or animal species.

(ii) River or land restoration:

- Replace acres lost to manmade or naturally occurring activities or events.
- Provide bank or shoreline protection.
- Reduce loss of topsoil.
- Facilitate onsite sediment disposal.

(iii) Facilitate fish passage and habitat requirements (create, restore, enhance).

(iv) Recreation:

- Aesthetic needs or desires.
- Facilitate or improve sporting activities (e.g. hunting, boating, fishing, camping, and bird watching).

(v) Moderation of stream flows and flood protection:

- Reduce peak flows.
- Increase water retention.

- Increase base flow.

(vi) Water treatment for instream flows, wastewater, and overland flows:

- Reduce suspended sediment.
- Remove nutrients and/or pollutants.
- Prevent and correct pollution discharges.

(d) Describe conditions envisioned immediately after construction and long term.

(e) Type of wetlands (coastal, inland, bog, etc.)

(3) **Wetlands Project Requirements:**

(a) Describe the source(s) of water for the wetlands: river, reservoir, ground water, overland flow, or piped in.

(b) Describe any specific Federal or State Regulations.

(c) Provide desired review requirements of designs by other agencies including timeframe, period, or stage of design for the review and the level of the review.

(d) Input from advisory groups and technical teams assembled to facilitate or oversee work.

(e) Describe alternatives to be considered.

(f) Describe pre-established requirements or preferences:

(i) Potential location(s) of wetlands.

(ii) Area, shape, and depth requirements.

(iii) Importation of plants and/or animals.

(iv) Intentions to emulate conditions at an another existing site:

- Location of existing site.
- Description of desired conditions.

(g) Descriptions of existing or future conditions that will have an impact on design, arrangement, and/or location of wetlands such as:

(i) Commercial, industrial, residential, or agricultural development or operations in vicinity.

(ii) Current ground water conditions and potential future changes.

(iii) Potential changes in river channel conditions (e.g., flow, degradation, aggradation, bank erosion, etc.).

(iv) River control operations such as upstream dams and powerplants.

(h) Description of any known restrictions for construction, timing of construction, placement of facilities, water quality standards, duration of construction, preservation of existing vegetation and facilities, or construction access.

(i) Proposed project timeframe.

(j) Required provisions for public safety, accessibility, or visitor facilities.

(k) Proposed vegetation and planting requirements:

(i) Discuss the purpose(s) of the vegetation: habitat, water treatment, bank stability, re-establish original vegetation, feed for endangered species.

(ii) Specify seeding or planting requirements.

- Discuss how planting will be accomplished and whether planting can be accomplished by self-design (allowing volunteer wetland plants to be established without active planting efforts).

(iii) Furnish State or local restrictions concerning the use of soil herbicides, or local factors limiting their use.

(iv) Cost effectiveness of collecting vs. purchasing plant materials:

- Discuss the availability of riparian shrub species growing locally on public land that could be harvested for cuttings if needed.

- Practicality of collecting plants to be used in revegetation plan from: project site, other wetlands, other river sites.

(v) Revegetation limitations:

- Depth to ground water around shoreline. Discuss how wide the band of moist soils is, how steeply soil moisture drops off, and the seasonality of the water table.

- Ability of the soil immediately uphill of the shoreline to hold moisture, how fast draining the soil is based on texture or underlying geology.

(vi) Need for armoring the shoreline against wave action, particularly on a windy site or where there is a long fetch across a large water body. Is plant material desired or is a hard material desired, or a combination of the two?

(vii) Irrigation or water control needs, based on water regime requirements of the plants that will be used, and local growing conditions.

(viii) Upland vegetation requirements:

- The need for restoring and seeding cuts and fills and spoil banks.

- Source of water for irrigation, if required.

(ix) Water treatment wetlands:

- Desired goals for water treatment.

- Shoreline gradient required or desired, if any.

- Draw down requirements, seasonality and length of dry season.

- Shoreline and upland requirements for wildlife considerations.

- Suitable plants required and available for the wetlands.

- Water control requirements: depth, flow, time passing through wetland.

- Product water quality requirements (see "Water Quality" subsection and table 1 for water quality monitoring parameters).

(l) Special requirements for the water body:

(i) Water depth conditions. – Discuss the required water depth conditions and the ratios of those conditions, such as the amount of shallow benches in relation to deep water that is desired. Give amounts of each water depth desired, specifically shallow benches, intermediate benches, and deep water; and the depth of water in inches or feet required for each condition. Include a minimum required amount of water access for waterfowl, in linear feet.

(ii) Islands. – Discuss whether islands are desired and the purpose for them. Include the required shoreline configuration of the landform to support those uses, such as shallow benches, etc. Include the total acres desired to be designated to islands.

(m) Operating and maintenance data requirements:

(i) Anticipated adaptive management requirements if any.

(ii) Self sustainability requirements – Minimum or no maintenance requirements.

(iii) Details of required downstream control sections, measuring devices, gauging stations, or other operating works.

(iv) Standards by which to measure progress.

(v) Vehicle or boat access requirements for maintenance.

(vi) Need for installed maintenance and handling facilities.

(vii) Facilities required to facilitate monitoring.

(viii) Availability of or need for permanent buildings for operating personnel.

(4) **Post Construction Evaluation and Monitoring Requirements:**

(a) Baseline standards for evaluation.

(b) Organization responsible for follow-up action if required.

B. **Coordination Requirements:**

(1) Coordination/input requirements from other government and nongovernmental organizations and agencies. Identify agencies and organizations which will have input into the design, construction, and operation of the wetland. The roles and responsibilities of each party should be clearly defined.

(2) Identify any "land use agreements", or similar mechanisms which secure short- or long-term commitments by the parties to manage the site for a set of established objectives. This should include issues related to water rights/entitlements which are anticipated for the management and operation of the wetland system.

C. **Specific Wetlands Project Considerations and Parameters:**

(1) **Historic and Existing Site Conditions:**

(a) For projects where it is desired to simulate prior conditions, it is necessary to determine the historic time and conditions that are desired and feasible to simulate.

(b) Old maps.

(c) Interviews with residents.

(d) Old photographs of the wetlands area.

(e) Existing wetlands site and area vegetation:

(i) Narrative description of existing site vegetation.

(ii) Dominant plant associations (group of plants that are common and growing on the site).

(iii) Describe endangered plant species growing on the site including where they are located.

(iv) A brief listing of the area's native tree, shrub, forb (a flowering plant, with a non-woody stem, that is not grass), and grass species growing locally.

(v) Identify trees/vegetation which may or may not be removed.

(vi) Habitat survey:

- Community type.
- Surface cover.

(f) Wildlife uses of the site:

(i) Include the animals targeted for use and their specific needs and uses for the site, including feeding, cover, loafing, nesting, etc. Include the specific predator-prey relationships and how that influences design requirements such as the need for islands or specific landform types.

(ii) Is the site critical habitat for any endangered species? If so when and how do the endangered species use the site?

(g) Land use survey of upland areas, areas adjacent to the wetlands site, and the wetlands site.

(h) Soils:

(i) Provide published soil surveys by county, state, National Resources Conservation Service or others. Surveys may indicate soil types (sand, loam, clay, etc.), texture, and use (rangeland, agriculture, etc.).

(ii) Discuss the availability of topsoil either at the site or locally.

(iii) Discuss the moisture holding capacity, salinity, herbicides, plant disease organisms, or other problems with the soils.

(iv) If the wetland will be constructed from dry land, what is the availability of topsoil, either on site or locally? Typically the top six inches of soil over an area that will be cut or filled would be stripped, stockpiled, and spread back over new contours to create the final grade.

(v) Soil chemical properties related to plant growth for revegetation purposes:

- Results of a routine soil analysis performed by a professional soils testing laboratory, including recommendations for amending the soil for desired plant types to be grown. The analysis report giving values for soil texture, pH, soluble salts, organic matter, amount of available nutrients, lime. Nutrient levels reported in parts per million of the elemental

nutrient. Additional tests for gypsum and sodium adsorption ration may be run.

- Presence of soil contaminants that could be toxic in high enough concentration, such as petroleum products or herbicides. Levels of heavy metals on land that has been mined.

(vi) Presence of plant or animal disease organisms.

(2) **Environmental Considerations.** Implementation of design features should be consistent with environmental commitments listed in the NEPA compliance document and should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a design. The following items should also be included in the design data:

(a) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the construction.

(b) The need for blending structures with the surroundings.

(c) Comments on ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(d) Problems with existing bank erosion.

(e) Erosion and sediment control requirements.

(f) Environmental permit requirements (Clean Water Act).

(g) Special environmental requirements for transmission lines or underground transmission systems.

(h) Location, volume, and contamination levels or any solid waste or hazardous waste facilities within the construction area.

(i) Provide data on the method(s) of brush and tree disposal permitted by local and State pollution regulatory agencies.

(j) Biological information requirements:

(i) Disease vector control considerations. Diseases may be carried by several animals most commonly mosquitoes. Discuss which disease vectors may be present and potential control measures such as:

- Water management – prevention of stagnant water
- Excavation depths
- Use of insecticides
- Timing of construction
- Other control measures

(ii) Potential invasive species which may damage the wetlands and or adjacent areas.

(iii) State anticipated impacts to threatened and endangered species and mitigation measures which can be taken to avoid/and or minimize these impacts. Emphasis should be placed on gathering, or planning for the collection of any data which will later be required to support necessary permit applications (including Ecological Society of America (ESA) consultations and Clean Water Act (CWA) section 404 permits).

(3) **Water Supply and Water Quality Factors:**

(a) Source of water for wetlands:

(i) Describe the source of water (river, reservoir, and ground water).

(ii) Is the source of water continuous or intermittent?

(iii) Will rainfall, river flows, or reservoir adequately supply water or will supplemental water be required?

(b) Rivers/streams – hydrologic data:

(i) Design floods and flood hydrographs. Normally a probability curve of flood peak discharges up to 100-year recurrence period will be sufficient.

(ii) Flood hydrographs for frequencies of 2, 5, 10, and 25 years for use during construction.

(iii) Monthly hydrographs for past 10 to 100 years.

(iv) Historical monthly flow averages. Include periods of expected no-flow or aquifer size and recharge rate monthly averages.

(c) River morphology:

(i) Water surface elevation curves, sedimentation studies, degradation and aggradation studies should be included. Water surface elevations should be determined for floods of 100-, 50-, 10-, 5-, and 2-year frequencies.

(ii) Potential impacts of the project that require design considerations, e.g., increased channel scour, and downstream channel protection, etc.

(iii) Anticipated future river channel improvement or other construction (upstream and downstream in the river) which might change regimen.

(iv) Data on upstream and downstream dams, diversions, pumping plants and reservoirs.

(d) Reservoirs:

(i) Maximum and minimum operating water surfaces.

(ii) Operating procedures.

(e) Anticipated occurrences and amounts of silt, sediments, biomass, ice (thickness) and drift (trash).

(f) Ground water:

(i) Describe and provide background data on ground water elevations over time period, including seasonal and over a long period of time.

(ii) Chemical composition (See table 1 for water quality monitoring parameters).

(iii) Recharge and percolation rates.

(g) Water quality:

(i) Existing water quality (see table 1 for water quality monitoring parameters).

(ii) Results of water quality studies carried out at or near the site.

(iii) Potential changes to land use which may affect water quality: industrial, residential, logging, mining, and agricultural.

(iv) Product water quality requirements (water treatment wetlands):

- Water quality requirements or standards which have to be met.
- Desired salinity of product water and limits on specific ion levels, if applicable.
- Consider potential impacts to the wetlands site, which may occur from surface water runoff originating form off-site sources, containing salts, fertilizers, oils, or any other non-point source of pollution.
- Screening requirements for potential contaminants which may impact the ability of the project to meet design and operating criteria, or pose potential hazards to wildlife or human health and safety.

(4) **Climate:**

(a) Climatic conditions that will affect construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; and probability of excessive dust or sand.

(b) Number of days of frost in the area of the project site.

(c) Evaporation - Annual net evaporation rates and monthly distribution. Include average monthly wind velocities, extreme wind velocities and prevailing directions.

D. **Site Design and Construction Data:**

(1) **Surface Data Including Historic Conditions:**

(a) **Surveying:**

(i) **Survey Control.** Minimal field surveys should be done to obtain horizontal and vertical control. Use of any existing coordinate system or vertical control system is acceptable, but tying to the State plane coordinate system is recommended.

(ii) Survey data should show existing facilities:

- Existing manmade site features such as roads, parking turnarounds, buildings, structures, power lines, buried tanks, campgrounds; leach fields, picnic areas, and marinas.
- Surface drainage features such as drainage from the approach roadways, streams, and ravines plus any existing bridges or culverts (include invert elevations) in close proximity.
- Site features which would be important design information such as, springs, marsh areas, overflow channels, channel changes, edge of water, high water marks, types of vegetative cover, large boulders, exposed bedrock, etc.
- Surface and underwater topography (bathymetric chart) (see subsection for “Topography”).
- Existing right-of way, easement and fencing. Give dimensions and bearings of the property lines and a dimensional tie to a known section corner as required.
- Township lines, range lines, and section lines.
- Show the direction of all transmission lines within the area.
- Indicate general drainage of the area.

(iii) Survey data should show the proposed features/facilities:

- Show locations and ties to all proposed facilities such as buildings, structures, powerlines, buried utility lines and tanks, picnic areas, marinas, sublaterals and deliveries, road crossings, railroad crossings and utility crossings.
- Grid coordinates for major structures such as pumping plants, flow control stations, tanks, reservoirs, etc.
- Proposed right-of-way and easement acquisitions and fencing.
- Geologic exploration holes.
- Location of river thalweg.
- Channel modifications.

(b) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures and features; normally this should be on a scale of 1 inch equals 50 feet with a contour interval of 1 foot (wetlands are normally flat areas which require a small contour interval for design and construction). Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

Show underwater contours (bathymetric chart). Bythymetric survey should extend a minimum100 feet upstream, 100 feet downstream, and 100 feet beyond the ends of the wetlands. The area covered by the Bythymetric survey should be large enough to cover all alternative sites and site arrangements being evaluated.

(c) **Photographs -** Photographs of the sites are desirable, in color if available with proposed structures marked in ink.

(2) **Foundation Data**. Sufficient data on foundation conditions must be included to determine type of excavation materials that will be encountered. Logs of all auger holes and exploration pits will be included.

(a) Determine ground water conditions with attention being paid to water levels, occurrence of unconfined and confined aquifers, water-producing capabilities, and chemistry.

(b) Determine depth to impermeable layer.

(c) Determine soil percolation rates (exfiltration and infiltration).

(d) Provide logs of explorations.

(3) **Construction Materials Data:**

(a) Location of and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; topsoil; and for riprap for channel or slope protection.

(b) Information on concrete aggregates.

(c) Data on commercial concrete plants within practical hauling distance from the structure site.

(4) **Electrical Data:**

(a) Names, telephone numbers, email addresses and web sites of electrical power suppliers and contacts within those organizations.

(b) Location of point where connection to power supply will be made.

(c) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(5) **Construction Considerations:**

(a) Allowable construction methods.

(b) Requirements for maintaining stream flow or diversions during construction and maximum length, time, and number of permitted interruptions.

(c) Comments on disposal of special excavation problem materials such as lignite.

(d) Measures which need to be taken prior to construction.

(e) Disposal areas for excess excavated materials.

(6) **Cost Data:**

(a) If potential actions exceed anticipated funding, should the cost estimate reflect incremental costs of potential actions? Provide any known increment or arrangement of the incremental costs.

(7) **Right-of-Way:**

(a) Proposed right-of-way boundaries for construction and access purposes (if required).

(b) Existing private or public easements and right-of-way across or adjacent to the construction area.

(8) **Miscellaneous Data:**

(a) Availability or accessibility of public facilities or utilities such as: water supply, sewage disposal, telephone utility, and fire protection services. Names telephone numbers, email addresses and web sites of local utilities and contacts within those organizations.

Table 1 – Water quality monitoring parameters

Water Quality Monitoring – Selected parameter groups			Technical Service Center, 86-68520 January 10, 2007	
Series		Symbol	Parameter	Description
A.	1. 2. 3. 4. 5.	Flow Rate (Q) Water Depth Air Temperature Atmos. Pressure Weather	stream gauge, weir, or flume field record or staff gauge field measurement field barometer reading filed note observations	Site flow and weather measurements
B.	1. 2. 3. 4.	Water Temp. DO pH EC	field measurement field Dissolved Oxygen field / lab pH meter units field / lab Specific Conductivity	Basic field or continuous monitoring methods
C.	1. 2. 3. 4. 5. 6. 7.	NO_3 + NO_2 as N NH_3 as N TKN as N SRP-PO_4 TDP TP Chlorophyll a	dissolved nitrate+nitrite (as N) total Ammonia (as N) total Kjeldahl Nitrogen soluble ortho-Phosphate total dissolved Phosphorus total (unfiltered), Phosphorus total - phytoplankton filter	Nutrients and algae growth indicators
D.	1. 2. 3. 4. 5. 6. 7.	Turbidity TSS VSS BOD_5 COD TOC DOC	Standard turbidity units Total Suspended Solids Volatile Solids, TSS Biochemical Oxygen Demand Chemical Oxidation Demand Total Organic Carbon Dissolved Organic Carbon	Organics and particulate matter indicators
E.	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	Alkalinity Carbonate Bicarbonate TDS Na K Ca Mg SO_4 Cl SiO_2 F B	meq CO_3+HCO_3 total CO_3 titration total HCO_3 titration total dissolved solids dissolved Sodium dissolved Potassium dissolved Calcium dissolved Magnesium dissolved Sulfate dissolved Chloride dissolved Silica dissolved Fluoride dissolved Boron	Major ions and inorganic chemistry parameters
F.	1. 2. 3.	Fecal Coliform Enterococci E. Coli	unfiltered, std. micro. test unfiltered, std. micro. test unfiltered, std. micro. test	Enteric bacteria indicators
G.	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.	Fe Mn Cu Ni Zn Cr Cd Pb Hg As Se	total Iron total Manganese total Copper total Nickel total Zinc total Chromium total Cadmium total Lead total Mercury total Arsenic total Selenium	Metals and trace elements
Notes: The parameters represent common water quality indicators. Actual monitoring should be adjusted to study objectives. Other methods may apply to specific site conditions or topics of interest. Refer to applicable sampling, preservation, analytical standard methods, and quality control procedures.				

DEFINITIONS

Basin – A drainage basin is a region of land where water from rain or snowmelt drains downhill into a body of water, such as a river, lake, dam, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. The drainage basin acts like a funnel - collecting all the water within the area covered by the basin and channeling it into a waterway. Each drainage basin is separated topographically from adjacent basins by a ridge, hill or mountain, which is known as a water divide or a watershed.

Bog – A bog is a wetland type that accumulates acidic peat, a deposit of dead plant material.

Creation – Construction of a wetland in an area that was not a wetland in the recent past (within the last 100-200 years) and that is isolated from existing wetlands (i.e. not directly adjacent).

Enhancement – The modification of specific structural features of an existing wetland to increase one or more functions based on management objectives typically done by modifying site elevations or the portion of open water. Although this term implies gain or improvement, a positive change in one wetland function may negatively affect other wasteland functions.

Mitigation – Refers to the restoration, creation, or enhancement of wetlands to compensate for permitted wetland losses.

Establishment – The manipulation of the physical chemical or biological characteristics present to develop a wetland that did not previously exist.

Marsh – A marsh is a type of wetland, featuring grasses, rushes, reeds, typhas, sedges, cat tails, and other herbaceous plants (possibly with low-growing woody plants) in a context of shallow water. A marsh is different from a swamp, which is dominated by trees rather than grasses and low herbs. The water of a marsh can be fresh, brackish or saline.

Playas – Playa lakes are round hollows in the ground in the Southern High Plains of the United States. They are ephemeral, meaning that they are only present at certain times of the year.

Prairie potholes – Prairie potholes are depressional wetlands (primarily freshwater marshes) found most often in the Upper Midwest, especially North Dakota, South Dakota, Wisconsin, and Minnesota. This formerly glaciated landscape is pockmarked with an immense number of potholes, which fill with snowmelt and rain in the spring. Some prairie pothole marshes are temporary, while others may be essentially permanent. Here a pattern of rough concentric circles develops. Submerged and floating aquatic plants take over the deeper water in the middle of the pothole while bulrushes and cattails grow closer to shore. Wet, sedgy marshes lie next to the upland.

Protection/Maintenance – The removal of a threat to, or preventing decline of wetland conditions by an action in or near a wetland. Includes purchase of land or easement, repairing water control structures or fences, or structural protection such as repairing a barrier island. This term also includes activities commonly associated with the term preservation. Protection/Maintenance does not result in a gain of wetland acres or function.

Swamps – A wetland that features permanent inundation of large areas of land by shallow bodies of water, generally with a substantial number of hummocks, or dry-land protrusions. Swamps are usually regarded as including a large amount of woody vegetation. When a wetland area does not include such vegetation, it is usually termed a marsh.

Reallocation or replacement – Applies when most or all of a wetland is converted to a different type of wetland.

Restoration – The term indicates that degraded and destroyed natural wetland systems will be reestablished to sites where they once existed. But, what wetland ecosystems are we talking about? How far back in time should we go to find target ecosystems? Is establishing any type of wetland enough to be called "restoration"?

- **Re-establishment** – Restoration should reestablish insofar as possible the ecological integrity of degraded aquatic ecosystems
- **Rehabilitation** –The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of degraded wetland. Rehabilitation results in a gain in wetland function, but does not result in a gain in wetland acres.
- Guiding principles
    - Preserve and protect aquatic resources.
    - Restore ecological integrity – Restoration strives for the greatest progress toward ecological integrity achievable within the current limits of the water shed by using designs that favor the natural processes and communities that have sustained native ecosystems through time.
    - Restore natural structure – Restoring the original site morphology and other; physical attributes is essential to the success of other aspects of the project, such as improving water quality and binging back native biota.
    - Restore natural function – It is essential to identify what functions should be present and make missing or impaired functions priorities in the restoration. Verifying whether desired functions have been reestablished can be a good way to determine whether the restoration project has succeeded.
    - Broader context – Requires a design based on the entire watershed.

- Natural potential of the watershed – requires knowledge of historical range of conditions that existed on the site prior to degradation and what future conditions might be.

- Ongoing causes of degradation – identify the causes of degradation and eliminate or remediate ongoing stresses wherever possible. It is important to look at upstream and up-slope activities.

- Develop clear and achievable measurable goals.

- Anticipate future changes.

- Design for self-sustainability.

- Use passive restoration when appropriate – i.e., simply reducing or eliminating the sources of degradation and allowing recovery time. Restoring the hydrologic regime may be enough to let time reestablish the native plant community, with its associated habitat value. Relies on natural processes. Over time.

- Restore native species and avoid non-native species.

- Use natural fixes and bioengineering techniques, where possible – create wetlands to treat storm water, to restore vegetation on river banks, to enhance natural decontamination of runoff.

- Monitor and adapt -

Vernal pools – A vernal pool is usually a shallow, natural depression in level ground, with no permanent above-ground outlet, that holds water seasonally. They could colloquially be referred to as temporary wetlands. In the northeast United States (Maine, Massachusetts, and perhaps others) vernal pools fill with the rising water table or with the melt water and rain of spring. Many vernal pools in the northeast are covered with ice in the winter.