

## Constructed Wetland (No.) 656

### DEFINITION

A constructed shallow water ecosystem designed to simulate natural wetlands.

### PURPOSE

To reduce the pollution potential of runoff and wastewater from agricultural lands to water resources

### CONDITIONS WHERE PRACTICE APPLIES

- Where a constructed wetland is a component of a planned conservation system or comprehensive nutrient management plan
- Where wastewater or runoff originates from agricultural lands including livestock or aquaculture facilities
- Where a constructed wetland can be developed, operated and maintained without polluting air or water resources

This practice does not apply to: Wetland Restoration (657) intended to rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and

biological habitat are returned to original conditions; Wetland Enhancement (659) intended to rehabilitate a degraded wetland where specific functions and/or values are enhanced beyond original conditions; or Wetland Creation (658) for creating a wetland on a site location which historically was not a wetland, or was a wetland with a different hydrology, vegetation type, or functions that occurred naturally on site.

### CRITERIA

#### General Criteria Applicable To All Purposes

**Laws and Regulations.** All federal, state, and local laws, rules and regulations governing the use of constructed wetlands must be followed. Constructed wetlands for waste treatment shall not be designed to discharge to waters of the state.

**Location.** Constructed wetlands shall be located outside the limits of any wetland. Constructed wetlands located within a floodplain shall be protected from inundation or damage from a 25-year flood event, or larger, if required by laws, rules, and regulations.

Constructed wetlands shall be located to provide sufficient separation distances from structures such as residences and commercial buildings so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation will minimize odors and protect aesthetic values. They shall be located with a

separation distance that will minimize the potential for contamination of ground water resources. This distance shall be in accordance with laws, rules and regulations.

**Type.** Constructed wetlands shall be designed as surface flow systems consisting of adequate seepage control, a suitable plant medium, rooted emergent hydrophytic vegetation, and the structural components needed to contain and control the flow.

**Influent.** The influent to the constructed wetland shall be pretreated to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and not cause excessive accretion within the wetland.

Where significant sediment and organic debris are expected in the wastewater or runoff to be treated, provisions for its entrapment before entry into the wetland must be provided.

**Water budget.** A water budget that evaluates runoff or wastewater volumes, precipitation, evaporation, and water use shall be used to determine the required hydraulic retention time in the wetland and storage requirements of the wetland pretreatment and post-treatment facilities when included.

**Embankment.** The perimeter embankment shall have a minimum top width of 10 feet (3m). Interior embankments shall have a minimum top

width of 8 feet (2.4m). All embankment side slopes shall be a minimum of a 2 horizontal to 1 vertical.

**Vegetation.** Vegetation selected for the constructed wetland shall be hydrophytic plants suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, and other constituents in the runoff or wastewater stream and selected for their treatment potential.

Use vegetation adapted to the site that will accomplish the desired purpose. Preference shall be given to native species in order to reduce the introduction of invasive plant species; provide management of existing invasive species; and minimize the economic, ecological and human health impacts that invasive species may cause. If native plant materials are not adaptable or proven effective for the planned use, then non-native species may be used. Refer to the Field Office Technical Guide, Section II, Invasive Plant Species, for plant materials identified as invasive species.

Consider the need to remove plant materials for nutrient removal.

**Planting medium.** The soil used for the planting medium shall have a cation exchange capacity, pH, electrical conductivity, soil organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

**Seepage control.** The constructed wetland shall be located in soils with an acceptable

permeability that meets all applicable regulations, or it shall be lined. Measures for controlling seepage shall be designed according to the procedures of NEH Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, "Geotechnical Design and Construction Guidelines."

**Grazing.** Livestock shall be excluded from the wetland.

**Additional Criteria For Wetlands  
Constructed For Waste Treatment**

**Topography.** The wetland cells shall be level side to side with grades of less than 0.05 ft/ft (0.05m/m) lengthwise.

**Inlet.** An inlet structure that will allow control of flow discharged to the wetland and screening of influent to prevent debris from entering the wetland shall be provided. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion.

**Influent.** Wastewater will be of sufficient volume and duration to keep the constructed wetland moist at all times or accommodations shall be made for the addition of supplemental water.

**Surface Area.** The surface area of the wetland shall be determined using a recognized design procedure in consideration of loading, temperatures, and the desired level of treatment.

**Configuration.** The constructed wetland shall have an overall length-to-width ratio

of 1:1 to 4:1. Individual cells within the constructed wetland shall have a length-to-width ratio of 10:1 to 15:1. The wetland shall consist of at least two rows of parallel cells.

**Flow depth.** The design depth shall be based on the most severe season of operation, the desired level of treatment, and the required littoral zone of the plant species being used. The design depth shall be a minimum of 0.33 ft. (0.1m) and a maximum of 1.5 ft. (0.5m).

**Embankments.** Height of the constructed wetland perimeter embankment shall be the sum of the following:

- Design depth
  - Wetland accretion -- a minimum of 1 inch per year for the design life
  - 25-year, 24-hour precipitation
  - 12 inches (0.3m) of freeboard
- The height of the wetland's interior embankments shall be the minimum of the sum of the following:
- Normal design flow depth
  - Wetland accretion -- minimum of 1 inch per year for the design life

**Overflow Device.** An ungated overflow device shall be provided to operate when the 25-year, 24-hour precipitation is exceeded. The overflow device shall

operate without infringing on the wetland perimeter embankment's freeboard.

**Outlet.** Constructed wetlands will discharge to storage facilities to allow for land application or recycled through the waste management system.

An outlet structure shall be provided that allows maintenance of proper water level in the wetland and controls the flow from the wetland.

**Additional Criteria For Wetlands  
Constructed For Runoff Treatment**

**Design Storm.** The constructed wetland system shall be designed to contain a 2-year, 24-hour storm runoff. Limited area sites handling only the "first flush" volume shall have a minimum capacity to store 0.5 inch (13mm) of runoff volume from the entire drainage area. When less than full runoff is stored, bypass of the excess storm flow shall be provided.

**Detention time and surface area.** The detention time and surface area shall be calculated on the time required to achieve the required level of treatment based on the limiting contaminant present.

**Wetland Cells.** Length-to-width ratios are to be 4:1 to 10:1. Other dimensions and shapes that provide a more natural landscape appearance and meet treatment requirements can be used.

The standard for Dike (356) shall be used as appropriate. Refer to the Engineering Field Handbook, Chapters 13, "Wetland Restoration, Enhancement, and Creation," and 6, "Structures," for design information.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

**Depth.** Maximum water depth shall be 24 inches (0.6m) except in those instances where deep water areas are included as a special design.

**Outlet.** A water control structure to automatically regulate storage release in accordance with the design detention time shall be installed.

**CONSIDERATIONS**

Locate constructed wetlands downgrade and as near the source of wastewater as practical.

Install measures to exclude or minimize attractiveness of the constructed wetland to wildlife that could be adversely affected by the constructed wetland. Take measures to exclude burrowing animals should they frequent the wetland. Consider the use of fences as an exclusion measure.

Consider the potential effects of installation and operation of created wetlands on the cultural, archeological, historic and economic resources.

Consider recycling constructed wetland effluent back through the agricultural waste management system when practical.

Consideration should be given to storage of wastewater during winter months instead of wetland operation.

Consider providing additional height to embankments to accommodate accumulated ice when constructed wetlands are used in winter.

## **PLANS AND SPECIFICATIONS**

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Assistance notes or special report
- Survey notes, where applicable.
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements and site constraints, where applicable.
  - Soils/subsurface investigation report, where applicable.
- Design and quantity calculations
- Construction drawings/specifications with
  - Location map

- “Designed and checked by” names
- Approval signature
- Job class designation
- Initials from pre-construction conference
- As-Built notes
- Construction inspection records
  - Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable.
- Record of approvals of in-field changes affecting function and/or job class, where applicable.

## **OPERATION AND MAINTENANCE**

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. Constructed wetlands and associated practices shall be inspected at least annually and after significant storm events to identify repair and maintenance needs. The level of operation maintenance needed to maintain the effectiveness and useful life of the practice includes, but is not limited to, the following:

1. Operational requirements should include:
  - Maintenance of water level in wetland cells appropriate for vegetation
  - Control flow to wetland according to water budget
  - Monitoring of wetland performance

- Sampling effluent for nutrients prior to utilization.
  - Surveillance of inlet and outlet
2. Maintenance requirements should include:
- Repair of embankments
  - Control of vegetation
  - Repair of fences or other ancillary features
  - Replacement of wetland plants
  - Repair of pipelines
  - Control of unwanted animals (varmints) or vectors (mosquitoes)

## REFERENCES

Environmental Protection Agency  
Website:  
<http://www.epa.gov/owow/wetlands/constructed/constructed.pdf> publication *Guiding Principals for Constructed Treatment Wetlands: Providing Water Quality and Wildlife Habitat*.

Natural Resources Conservation Service,  
Part 637 Environmental Engineering,  
National Engineering Handbook, Chapter  
3, *Constructed Wetlands*

Natural Resources Conservation Service,  
Engineering Field Handbook, Chapter 13,  
*Wetland Restoration, Enhancement, or  
Creation*