

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

CONSTRUCTED WETLAND

(Ac.)

CODE 656

DEFINITION

An artificial ecosystem with hydrophytic vegetation for water treatment.

PURPOSE

For treatment of wastewater and contaminated runoff from agricultural processing, livestock, and aquaculture facilities or

For improving the quality of storm water runoff or other water flows lacking specific water quality discharge criteria.

CONDITIONS WHERE PRACTICE APPLIES

- Constructed wetlands for the purpose of wastewater treatment apply where a constructed wetland is a component of an agricultural wastewater management system.
- Constructed wetlands for the purpose of water quality improvement apply where wetland effluent is not required to meet specific water quality discharge criteria.

This standard should not be used in lieu of Conservation Practice Standards [657, Wetland Restoration](#); [658, Wetland Creation](#); or [659, Wetland Enhancement](#), when the main purpose is to restore, create, or enhance wetland functions other than wastewater treatment or water quality improvement.

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

All federal, state, and local laws, rules, and regulations governing the use of constructed wetlands must be followed.

Locate the wetland to minimize the potential for contamination of groundwater resources and to protect aesthetic values.

Provide appropriate inlet control structures to prevent debris from entering the wetland, to control the rate of inflow during normal operations, and to control inflow as necessary for operation and maintenance.

Provide an outlet control structure capable of maintaining appropriate water depths to achieve the desired water treatment and to meet the requirements of the hydrophytic vegetation.

The minimum height of interior embankments shall contain the design water depth and a sufficient depth for the accretion of settleable solids, decayed plant litter, and microbial biomass. In the absence of an accretion rate analysis, the minimum depth for accretion shall be 1 inch per year for either the design life of the practice or between scheduled debris and sediment removal maintenance operations.

Provide an auxiliary spillway or inlet bypass with sufficient capacity to pass the peak flow of the 25-year frequency, 24-hour duration storm and provide erosion protection for the perimeter embankment.

Unless otherwise specified, the spillway requirements, embankment configurations, excavated side slopes, protective cover on disturbed soils and disposal of excavated material shall comply with the general criteria, criteria for embankment ponds, and criteria for excavated ponds as appropriate as contained in [Conservation Practice Standard 378, Pond](#).

Soils used in constructing the embankment shall be suitable for that purpose according to the Unified Soil Classification System.

Use a planting medium that has a cation exchange capacity, pH, electrical conductivity, organic matter, and textural class that is conducive to wetland plant growth and retention of contaminants.

Select wetland plants that are suitable for local climatic conditions and tolerant of the concentrations of nutrients, pesticides, salts, and other contaminants flowing into the wetland. Do not use invasive or non-native species that could be a problem in native habitats.

Provide supplemental water as necessary to establish and maintain plants in a condition suitable for the water treatment purpose.

CRITERIA APPLICABLE TO WASTEWATER TREATMENT

Constructed wetlands for waste treatment shall not be designed to discharge to waters of the state unless permitted by state laws and regulations and appropriate permits have been obtained to do so.

Locate outside the boundary area of natural wetlands of any classification.

When located in a flood plain, provide protection from inundation or damage from a 25-year frequency flood event.

Pretreat water flowing to the wetland using a settling basin or other methods to reduce the concentrations of solids, organics, and nutrients to levels that will be tolerated by the wetland system and to prevent excessive accumulation of solids within the wetland.

Provide sufficient storage upstream of the wetland to contain the wastewater and runoff from a 25-year frequency, 24-hour duration storm. The outlet of this storage shall deliver the water to the wetland at a rate consistent with the treatment objectives of the wetland.

Design the wetland system with a minimum of 2 rows of functionally parallel cells.

Determine the surface area using design procedures in [Chapter 3 in National Engineering Handbook Part 637, Environmental Engineering](#), or alternative design procedures that are recognized by the regulatory and academic conservation partners in the state.

Construct wetland cells with a sufficient length-to-width ratio to ensure uniform and predictable hydraulic retention times.

Control seepage as necessary for similar wastewater management facilities. 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 in [National Engineering Handbook Part 651 \(NEH 651\), Agricultural Waste Management Field Handbook, Appendix 10d](#).

There shall be an adequate investigation of soils to a minimum depth of 10 feet below the proposed bottom of the constructed wetland. This investigation will identify the elevation of groundwater (if any) and provide soil information for liner design. The [Conservation Practice Standard 313, Waste Storage Facility](#), shall be used for minimum depth to groundwater.

Exclude livestock from the wetland.

CRITERIA APPLICABLE TO WATER QUALITY IMPROVEMENT

When located in a flood plain or watercourse, provide protection from damage from a 10-year frequency flood event.

When used to improve the water quality of surface water runoff, design the wetland so that it will return to design operating levels within 72 hours after a 10-year frequency, 24-hour duration storm event.

When used in populated areas, install safety fences and warning signs forbidding access by unauthorized persons.

Provide an adequate access for cleanout and maintenance.

CONSIDERATIONS

Consider the impact a constructed wetland could have on existing wetlands or other significant features in the landscape ecosystem.

Consider bat boxes, mosquitofish, and other measures to control vectors and nuisance insects when locating the wetland near residences, commercial buildings, and public use areas.

Consider seasonal storage of contaminated water upstream of the wetland during cold, dry, or excessively wet climatic conditions when the function of the wetland may be compromised.

Effluent from the wetlands may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Measures for controlling seepage may be designed according to the procedures in [NEH 651, Appendix 10d](#).

Where wetland performance may be compromised by large, infrequent storm events, consider providing an inlet that captures the first flush of stormwater runoff and allows excess flow to bypass the wetland.

Consider a sedimentation basin and reaches of shallow and deep water within the wetland.

Provide inflow and outflow structures and cell geometries that promote cross-sectional mixing of water flowing through the wetland cell.

Consider the potential of pollutants entering the wetland that may cause environmental problems due to accumulation, biological uptake, or release during maintenance operations.

When selecting vegetative species, give priority to native wetland plants collected or grown from material within the Major Land Resource Area (MLRA) of the constructed wetland location, and consider the potential to transport chemical contamination from the wetland plant site to the constructed wetland.

Select plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators.

Fences or other measures may be needed to exclude or minimize access of humans or animals that could be adversely affected by the constructed wetland or that would inhibit its function.

Consider access for animals that might be attracted to the wetland and egress for fish that could be entrained and trapped. Flatter side slopes generally provide better habitat for wildlife. If there is a desire to use the constructed wetland for wildlife habitat, consult Conservation Practice Standards [657, Wetland](#)

[Restoration; 658, Wetland Creation; 659, Wetland Enhancement; 644, Wetland Wildlife Habitat Management; and 646, Shallow Water Development and Management.](#)

Consider providing embankment protection against burrowing animals.

Consider vegetative buffers (herbaceous and woody) around the perimeter of a constructed wetland for additional filtering of pollutants entering and leaving wetland areas during precipitation events.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each specific field site where a constructed wetland will be installed. Define the purpose, goals, and objectives of the practice and the soils, hydrology, and vegetation criteria. Include information about the location, construction sequence, and vegetation establishment.

Specifications shall include:

- Dimensions of the constructed wetland
- Species selection
- Seeding rates, sprigging rates, or planting density of containerized plants
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival
- Site preparation such as stabilizing crop, mulching, or mechanical means of stabilizing, fertilizing, and adjusting pH sufficiently to establish and grow selected species

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes and intended life of the practice. Include the requirements for safety, water management, cleanout of sediment, maintenance of structures, embankments, and vegetation, control measures for vectors and pests, and containment of potential pollutants during maintenance operations.

Operational requirements include:

- Maintenance of water level in wetland cells appropriate for vegetation

- Control of flow to wetland according to water budget
- Monitoring of wetland performance
- Sampling of effluent for nutrients prior to utilization
- Surveillance of inlet and outlet

Maintenance requirements should include:

- Repair of embankments
- Density control of desirable vegetation

- Removal of invasive and/or non-native species that could be a problem in native habitats
- Repair of fences or other ancillary features
- Replacement of wetland plants
- Repair of pipelines and spillways
- Control of unwanted animals (varmints) or vectors (mosquitoes)

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 637, Chapter 3. Constructed Wetlands.