

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

Constructed Wetland

(Acre)

Code 656

DEFINITION

A constructed shallow water ecosystem designed to simulate natural wetlands.

PURPOSES

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 agricultural waste management system
- Where wastewater or runoff originates from agricultural lands including livestock or aquaculture facilities
- Where a constructed wetland can be constructed, operated and maintained without polluting air or water resources

This practice does not apply to:

- wetland restoration (FOTG Standard 657) intended to rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to original conditions
- wetland enhancement (FOTG Standard 659) intended to rehabilitate a degraded wetland where specific functions and/or values are enhanced beyond original conditions

- wetland creation (FOTG Standard 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 wetland 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. In addition, if discharge is permitted, the receiving surface water must have the capacity to assimilate constructed wetland's effluent during low flow periods.

Location: Constructed wetlands shall be located outside the limits of wetlands of any classification

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.

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.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

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 wetland plants 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. Interior embankments shall have a minimum top width of 8 feet. All embankment side slopes shall be 2 horizontal to 1 vertical or flatter.

The embankments shall be seeded according to Table 1.

Table 1. Seeding mixes for embankments.

Species	PLS Rates/AC
^{1,2} Orchardgrass	6
Timothy	2
Annual Lespedeza	4
Ladino Clover	¼
¹ Redtop	2
Orchardgrass	6
Annual Lespedeza	4
Ladino Clover	¼
¹ Redtop	2
Timothy	2
Red Clover	2
Annual Lespedeza	4
Orchardgrass	6
Timothy	2
Alfalfa	6
Ladino Clover	¼
³ Smooth Brome	10
Alfalfa	6
Ladino Clover	¼
Birdsfoot Trefoil	4
⁴ Timothy	2
Smooth Bromegrass	10
Alsike Clover	1
Birdsfoot Trefoil	4
¹ Timothy	2
Ky. Bluegrass	3
Annual Lespedeza	4
Birdsfoot Trefoil	4
Switchgrass	8

¹ Better suited for the Southern part of Indiana

² Can be used on droughty sites

Species	PLS Rates/AC
⁴ Redtop	2
Timothy	2
Alsike Clover	2
Birdsfoot Trefoil	4
¹ Redtop	2
Ky. Bluegrass	3
Annual Lespedeza	4
Ladino Clover	¼
¹ Orchardgrass	6
Timothy	2
Red Clover	2
Ladino Clover	¼
Annual Lespedeza	4
³ Smooth Bromegrass	10
Timothy	2
Ladino Clover	¼
Birdsfoot Trefoil	4
¹ Orchardgrass	6
Timothy	2
Red Clover	2
Sweet Clover	3
¹ Timothy	2
Ky. Bluegrass	3
Annual Lespedeza	4
Red Clover	2
Orchard grass	6
Timothy	2
Ladino Clover	¼
Birdsfoot Trefoil	4

³ Better suited for the Northern part of Indiana

⁴ Can be used on wet sites

Note: 2 to 8 oz of any single or combination of the forb species listed below can be added to any of the above mixtures for added wildlife and aesthetic benefits or substituted for one of the legumes in the mix.

Forb Species

Blackeyed Susan	Illinois Bundle Flower	Stiff Goldenrod
Butterflyweed	New England Aster	Sunflower Heliopsis
Button Blazing Star	Partridge Pea	Tall Coreopsis
Dense Blazing Star	Prairie Dock	Virginia Mountain Mint
Entire-Leaf Rosinwood	Purple Coneflower	Wild Bergamot
Gray-Headed Coneflower	Sawtooth Sunflower	

Vegetation. Vegetation shall be established in wetland cells prior to loading. Vegetation selected for the constructed wetland cells 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.

Preference shall be given to native wetland plants with localized genetic material. Plant materials collected or grown from material collected within a 200-mile radius from the site is considered local. See Table 2 for recommended plants.

Table 2. Recommended Plants

Deep Water Emergent Community (1-3 foot depth)

Yellow Pond Lily	Nuphar advena
White Water Lily	Nymphaea odorata

Shallow Water Emergent Community (0-1 foot depth)

Lake Sedge	Carex lacustris
Soft Rush	Juncus effusus
Hardstem Bulrush	Scripus acutus
Woolgrass	Scripus cyperinus
Three-Square Bulrush	Scripus pogens
Softstem Bulrush	Scripus validus
Sweet Flag	Acorus calamus
Pickerel Weed	Pontederia cordata
Common Arrowhead	Sagittaria latifolia
Blue Flag Iris	Iris virginica shrevei
Giant Burreed	Sparganium eurycarpum

Sedge Meadow Community (saturated soils)

Frank's Sedge	Carex frankii
Bottlebrush Sedge	Carex granularis
Awl-Fruited Sedge	Carex stipata
Tussock Sedge	Carex stricta
Fox Sedge	Carex vulpinoidea
Virginia Wildrye	Elymus virginicus
Rice Cutgrass	Leersia oryzoides
Fowl Manna Grass	Glyceria striata
Switchgrass	Panicum virgatum
Dark Green Bulrush	Scripus atrovirens
Red Bulrush	Scripus pendulus
Swamp Milkweed	Asclepias incarnata
New England Aster	Aster novae-angliae
Swamp Aster	Aster puniceus
Spotted Joe-Pye Weed	Eupatorium maculatum
Boneset	Eupatorium perfoliatum
Autumn Sneezeweed	Helenium autumnale
Cardinal Flower	Lobelia cardinalis
Great Blue Lobelia	Lobelia siphilitica
Obedient Plant	Physostegia virginiana
Riddell's Goldenrod	Solidago riddellii
Blue Vervain	Verbena Hastata

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 a permeability that meets all applicable regulations, or it shall be lined. Measures for controlling seepage shall meet the criteria of Waste Treatment Lagoon (Practice Standard 359), and Waste Storage Structure (Practice Standard 313).

Livestock shall be excluded from the wetland.

Use Part 637 Environmental Engineering, National Engineering Handbook, Chapter 3 Constructed Wetlands as a guide for design.

Additional Criteria for Waste Treatment

Topography. Site topography shall accommodate the requirements for length to width ratios of the wetland and the wetland cells, and the requirement that the wetland cells be level side to side and grades of less than 0.05 ft/ft lengthwise. The wetland shall have a bottom elevation that is a minimum of 2 feet above the high water table.

Inlet. An inlet structure that will allow control of flow discharged to wetland and separation of solids from influent to prevent debris from entering wetland shall be provided. Design of the inlet structure shall assure its function throughout the life of the wetland considering accretion. The inlet shall be designed to direct or exclude flows to each row of cells. Criteria in NRCS Practice Standard 313, Waste Storage Facility, for fabricated structures shall apply as appropriate.

Influent. Constructed wetlands for wastewater treatment shall not allow for direct inclusion of contaminated and/or uncontaminated runoff.

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. and a maximum of 1.5 ft.

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 of freeboard

The height of wetland's interior embankments shall be 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. Wastewater discharged from the constructed wetland shall be transferred to a waste storage facility, a waste treatment lagoon, or other facility for further treatment and/or utilization unless discharge is permitted by regulations.

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 Runoff Treatment

Design Storm. The constructed wetland system shall be designed to contain a 2-year storm runoff. Limited area sites handling only the "first flush" volume shall have a minimum capacity to store 0.5 inch 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 that meet treatment requirements can be used.

The standards and specifications for Dike (FOTG Standard 356) and Structure for Water Control (FOTG Standard 587) will be used as appropriate. Refer to the Engineering Field Handbook, Chapters 13, "Wetland Restoration, Enhancement, and Creation," and 6, "Structures," for additional 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 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.

Constructed wetlands shall be located to provide sufficient separation distances so prevailing winds and landscape elements such as building arrangement, landforms, and vegetation will minimize odors and protect aesthetic values.

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 and for safety in populated areas.

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

In northern cold climates consideration should be given to storage of wastewater during winter months instead of wetland operation.

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. Plans shall include construction sequence, vegetation establishment, and management and maintenance requirements.

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. Operational requirements should include:

- Control 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.

Maintenance requirements should include:

- Repair of embankments.
- Control of wetland vegetation in cells.
- Repair of fences or other ancillary features.
- Replacement of wetland plants.
- Repair of pipelines.
- Control of animals (varmints).
- Maintain vegetation on embankments.
- Manage nutrients

REFERENCES

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

2. Environmental Protection Agency Website:
www.epa.gov/owow/wetlands/constructed publication *Guiding Principals for Constructed Treatment Wetlands: Providing Water Quality and Wildlife Habitat*
3. Natural Resources Conservation Service,
Engineering Field Handbook, Chapter 13, Wetland Restoration, Enhancement, or Creation