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 NRCS Conservation Practice Standards, Wetland Restoration (657), Wetland Creation 658, or Wetland Enhancement (659), when the main purpose is to restore, create, or enhance, wetland functions other than wastewater treatment or water quality improvement.

CRITERIA

General Criteria Applicable to All Purposes

Locate the wetland to minimize the potential for contamination of ground water 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 Pond (378).

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 caution 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.

Exclude livestock from the wetland.

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

Provide an adequate access for cleanout and maintenance.

Criteria Applicable to Wastewater Treatment

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

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

Pretreat water flowing to the wetland 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 two rows of functionally parallel cells.

Determine the surface area using design procedures in NRCS National Engineering Handbook, Part 637, Chapter 3, Constructed Wetlands, 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 assure uniform and predictable hydraulic retention times.

Control seepage as necessary for similar wastewater management facilities.

Criteria Applicable to Water Quality Improvement

When located in a floodplain or watercourse provide protection from damage from a 25-year frequency flood event.

Design the wetland so that it will return to design operating levels within 48 hours after a 10-year frequency, 24-hour duration storm event.

Design the minimum wetland pool based on the hydraulic loading rate needed to meet project water quality objectives.

To the extent practicable, avoid existing wetlands when installing Constructed Wetlands.

Design the wetland to store the anticipated sediment accumulation for the planned service life – minimum 30 years - unless periodic sediment removal is required in the Operation and Maintenance Plan. Maintain a minimum 1-foot freeboard above the design wetland pool elevation for contributing subsurface drain outlet pipes.

Structures shall meet criteria found in Grade Control Structure (410), Dike (356), Structure for Water Control (657) and/or other appropriate design standards.

Maximize the residence time and increase hydraulic efficiency by utilizing interior submerged embankments and topographic manipulation (shelves) to promote dispersion.

If there are channels or other features that would favor short circuiting of flow, then at least one submerged embankment shall be installed in the upper third of the pool. All submerged embankments shall be placed perpendicular to pre-project flow direction and extend across the pool sufficiently to maximize residence time. Design embankment slopes no steeper than 3 horizontal to 1 vertical. The minimum top width shall be 6 feet.

Submerged embankments shall be constructed with the top no deeper than 12 inches below normal pool elevation in order to facilitate establishment of emergent vegetation.

Provide a water control structure to vary the water level for vegetation establishment and maintenance.

To promote emergent vegetation, at least 50% of the pool area shall have depths from 0-24 inches. Seed or plant appropriate emergent species and manage the water level to achieve at least 50% vegetative cover within the design wetland pool within 3 years after seeding. Refer to the appropriate Iowa technical note or job sheet for recommended species and seeding methods.

Prepare a water management plan to facilitate vegetation establishment whenever emergent cover in the wetland pool falls below 35%. The management plan shall specify timing and depth of dewatering and re-flooding operations.

Establish vegetative buffers on surrounding uplands around the wetlands to reduce the movement of sediment and soluble and sediment-attached substances carried by runoff. Use Filter Strip (393) to determine the minimum width and composition of the vegetative buffer. Buffer width shall not be less than 50 feet.

If wildlife habitat is a project objective, the buffer shall be at least twice the size of the wetland pool.

CONSIDERATIONS

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

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

Measures for controlling seepage may be designed according to the procedures in NRCS National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, “Geotechnical Design and Construction Guidelines.”

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

Consider the potential of pollutants entering the wetland that may cause environmental problems due to accumulation, biological uptake, or release during maintenance operations. Consider a sedimentation basin, and reaches of shallow and deep water within the wetland.

<u>Considerations Applicable to Wastewater Treatment</u>

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.

<u>Considerations Applicable to Water Quality Improvement</u>

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.

Consider providing embankment protection against burrowing animals.

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.

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 Wetland Restoration (657), Wetland Enhancement (659), Wetland Creation (658), Wetland Wildlife Habitat Management (644), and Shallow Water Development and Management (646).

Larger wetland to watershed area ratios are likely to improve effectiveness.

Multiple island-type grade stabilization structures may be more effective in increasing the amount of shallow water compared with a single large structure.

Consider stripping existing vegetation in a non-cropland site to provide a good seedbed and reduce competition.

Consider installing sediment basins above the Treatment Wetland to extend the practice life.

To increase the effectiveness of nitrate-nitrogen treatment wetlands, consider routing surface flows around wetlands, when feasible, so that only subsurface drain discharges are treated.

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, fertilizer, and pH adjustment sufficient to establish and grow selected species.

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. This includes most but may not contain all of the specifications that are needed for a specific project:

IA-1	Site Preparation
IA-5	Pollution Control
IA-6	Seeding and Mulching for Protective Cover
IA-9	Drainage Tile Investigation and Removal
IA-11	Removal of Water
IA-21	Excavation
IA-23	Earthfill
IA-26	Salvaging and Spreading Topsoil
IA-27	Diversions
IA-45	Plastic (PVC, PE) Pipe
IA-46	Tile Drains for Land Drainage
IA-51	Corrugated Metal Pipe
IA-52	Steel Pipe Conduits
IA-61	Loose Rock Riprap
IA-81	Metal Fabrication and Installation
IA-83	Timber Fabrication and Installation
IA-92	Fences
IA-95	Geotextile

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:

- Water level timing and depths to establish and maintain the required vegetation and aerial coverage; e.g., how/when to do drawdown and re-flooding to achieve desired vegetation condition when cover falls below 35%
- 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 shall include:

- Repair of embankments
- Control density 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.

USDA, NRCS. National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook, Appendix 10d, “Geotechnical Design and Construction Guidelines”