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NRCS Conservation Practice Standards

Constructed Wetland

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Agenda

- ▶ Constructed Wetland and related standards
- ▶ Resources for Constructed Wetland planning and design





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NRCS Standard: Constructed Wetland

- ▶ An artificial ecosystem with hydrophytic vegetation for water treatment.
- ▶ Purposes:
 - ▶ Treating wastewater
 - ▶ Improving water quality of stormwater runoff...
(or tile drainage flows!)



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CONSERVATION PRACTICE STANDARD

Constructed Wetland

Code 656

(Ac)

DEFINITION

An artificial wetland ecosystem with hydrophytic vegetation for biological treatment of w

PURPOSE

- To treat wastewater or contaminated runoff from agricultural processing, livestock, r facilities
- To improve water quality of storm water runoff or other water flows.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies where at least one of the following conditions occurs:

- Wastewater treatment is necessary for organic wastes generated by agricultural pi processing.
- Water quality improvement is desired of agricultural storm water runoff.

A constructed wetland is typically applied where wetland function can be created or enh

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Conditions Where Practice Applies

- ▶ If treatment of organic wastes from ag production/processing is needed
- ▶ If water quality improvement is desired of ag storm runoff (*or other ag water flows*)
- ▶ NOT a substitute for other wetland standards (*different purposes*)
- ▶ NOT a substitute for bioreactor or saturated buffer

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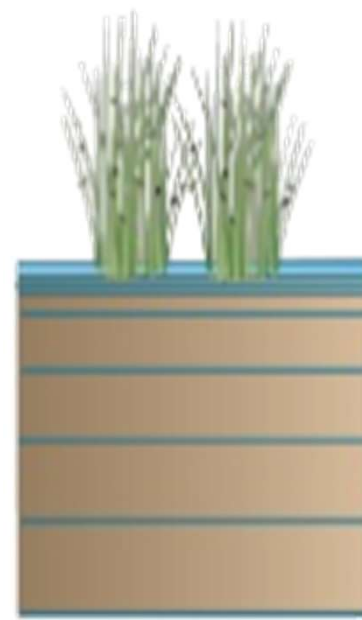




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Criteria Highlights

- ▶ General Criteria Applicable to All Purposes
 - ▶ Location
 - ▶ Structural measures
 - ▶ Vegetation
 - ▶ Safety
 - ▶ ...etc
- ▶ ~~Additional Criteria Applicable to... Wastewater Treatment~~
- ▶ Additional Criteria Applicable to... Water Quality Improvement



Let's look at a few of these...



Additional Criteria for *water quality improvement*

- ▶ In floodplain, protect from inundation or damage from 10-year, 24-hour flood event.
- ▶ Water level return to design operating level within 72 hours (*after 10-year, 24-hour event, for surface water runoff*)
- ▶ Hydraulic retention time needs to achieve intended water quality results.
- ▶ Design procedures recognized by regulatory and academic conservation partners in the State.





Guidance

- ▶ Key tips and tricks based on science

G656-1

NATURAL RESOURCES CONSERVATION SERVICE - ILLINOIS
CONSERVATION PRACTICE GUIDANCE
656 – CONSTRUCTED WETLAND
Cropland Drainage Water Treatment

I. SCOPE

A constructed wetland may be used to treat water from a variety of different sources, including wastewater and contaminated runoff from livestock facilities, stormwater runoff and other water flows. The guidance in this document refers specifically to the treatment of drainage water from cropland.

with soil drainage group A plus $\frac{1}{2}$ of the watershed acres in soil drainage group B. The constructed wetland must be located so that the flow line of the subsurface tile(s) supplying drainage flow to the wetland is above the proposed permanent pool of the wetland.

The treatment pool area of the constructed wetland should be at least 1% of the size of the contributing watershed.

- The contributing watershed is the area drained by the tile system discharging to the treatment pool plus any other area contributing to the pool.



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Call J.U.L.I.E.



Know what's below.
Call before you dig.

Responsibilities

- ▶ The person doing the excavation is responsible for locating buried utilities in the project area...including drainage tile.
- ▶ Client is in charge of obtaining all necessary permits prior to construction.

JOINT APPLICATION FORM FOR ILLINOIS		
ITEMS 1 AND 2 FOR AGENCY USE		
1. Application Number	2. Date Received	
3. and 4. (SEE SPECIAL INSTRUCTIONS) NAME, MAILING ADDRESS AND TELEPHONE NUMBERS		
3a. Applicant's Name: Company Name (if any) : Address: Email Address:	3b. Co-Applicant/Property Owner Name (if needed or if different from applicant): Company Name (if any): Address: Email Address:	4. Authorized Agent (an agent is not required): Company Name (if any): Address: Email Address:
Applicant's Phone Nos. w/area code Business:	Applicant's Phone Nos. w/area code Business:	Agent's Phone Nos. w/area code Business:

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Safety

- ▶ Safety fence and warning signs (if in populated areas)
- ▶ Access for cleanout and maintenance





Location

- ▶ Minimize potential for ground water contamination; protect aesthetics
- ▶ *Floodplain issues avoid 100-year floodplain unless you:
 - ▶ Build to withstand flood events
 - ▶ Meet permit requirements (building in a floodplain)
 - ▶ Make sure landowner agrees to additional maintenance requirements
- ▶ *Not in a jurisdictional wetland under Section 404 of the Clean Water Act
- ▶ *Not in a wetland delineated for conservation compliance
- ▶ *Low on the landscape (be able to daylight the tile)



Inlet and Outlet

- ▶ Provide an outlet water control structure
 - ▶ Must be able to bring the water level down to normal within 3 days after a 10-year storm (if any surface runoff)
 - ▶ Manage as needed for the plants that are doing the work
 - ▶ Manage as needed to achieve desired water treatment
- ▶ Inlet structure *if needed* to control inflow, prevent debris... or for monitoring/research
- ▶ Use Structure for Water Control standard (code 587)



Protect From Premature Sedimentation

- ▶ Add a Buffer
 - ▶ Filter Strip – NRCS Conservation Practice Standard 393
 - ▶ Follow program rules
 - ▶ CRP: buffer must be 2-4 times the size of the wetland
- ▶ OR exclude surface water with berms

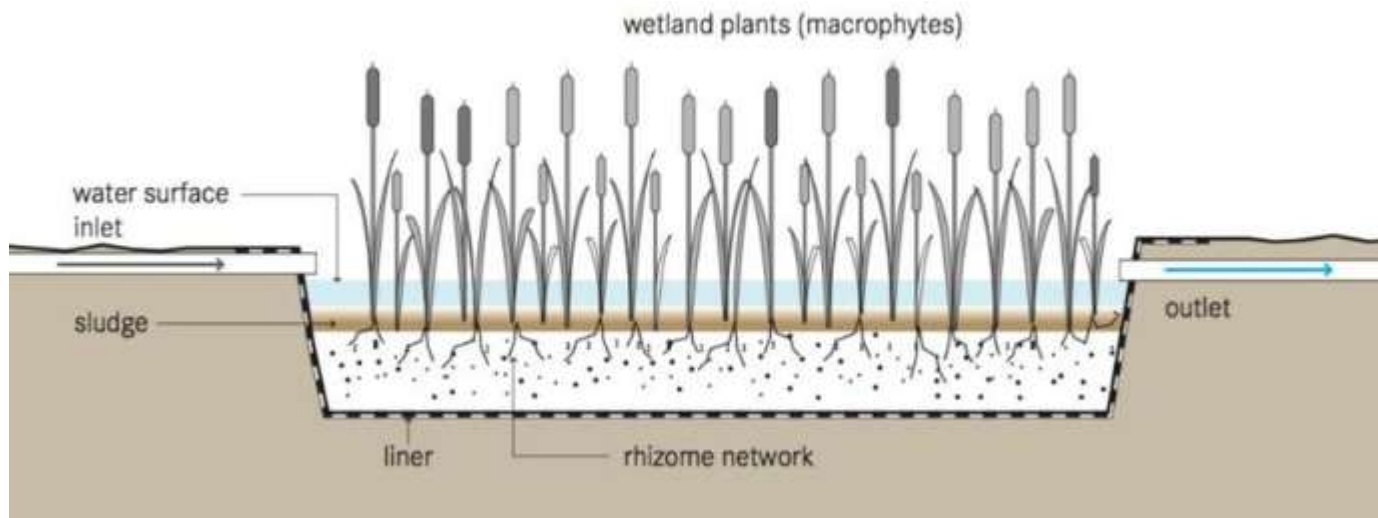


Photo by T. Lindenbaum



Wetland Volume

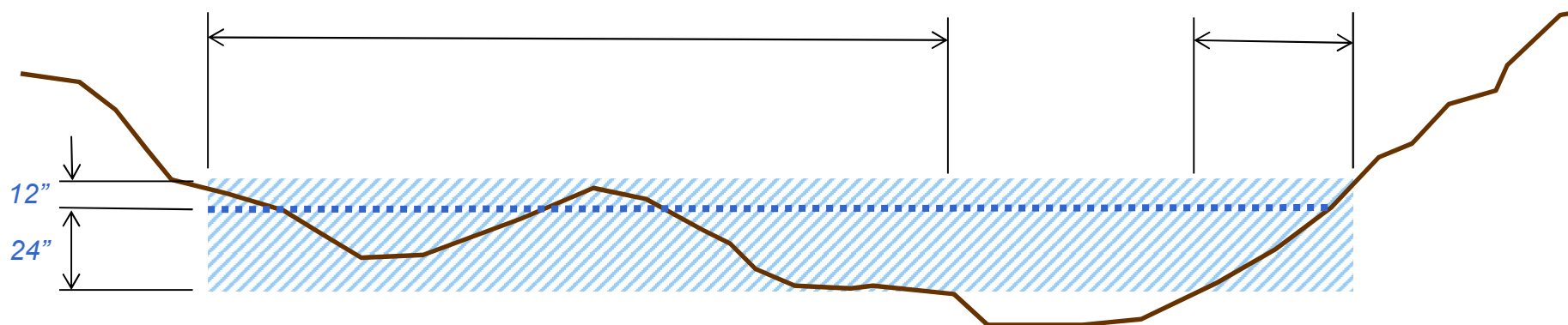
- ▶ Contain design water depth plus accretion
 - ▶ Accretion rate analysis...settleable solids, decayed plant litter, microbial biomass – or –
 - ▶ 1" per year for design life of practice (15 years) or between scheduled debris/ sediment removal operations





Treatment Pool

- ▶ At least 50% of area should be 12" deep or less
- ▶ Measured relative to permanent pool elevation
 - ▶ Count all areas between 24" below to 12" above that elevation
 - ▶ Don't count anything deeper than 24"
- ▶ Must be at least 1% of contributing drainage area





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Contributing Drainage Area

**Acres drained
by tile system**

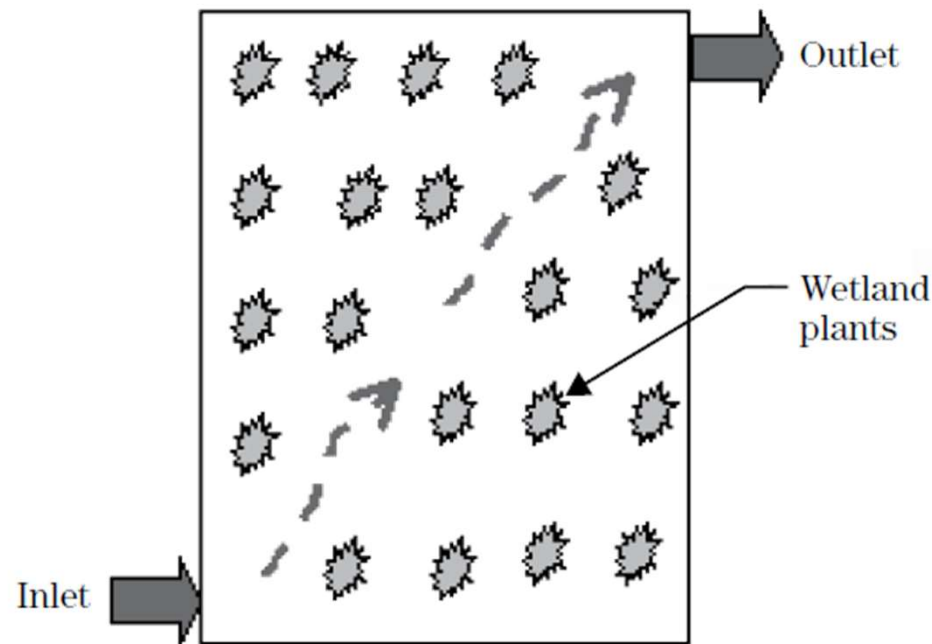
+

**Acres
contributing
surface flow to
wetland**



Wetland Hydraulics

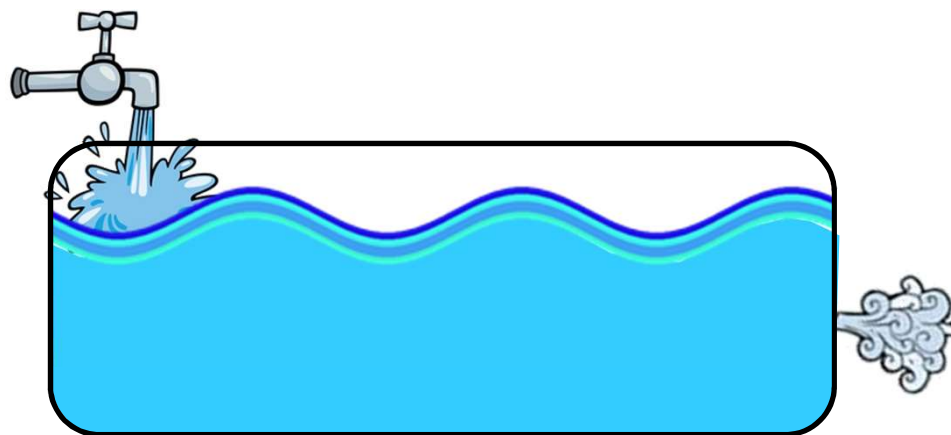
- ▶ Outlet hydraulically distant from inlet to maximize hydraulic retention time
- ▶ Consider spreaders or interior berms to minimize short circuiting



Hydraulic Retention Time

- ▶ Try to maximize HRT

$$HRT(hours) = \frac{Volume (ft^3)}{Flow Rate (ft^3 \text{ per second})} \times \frac{1}{3600}$$





Flow Velocity

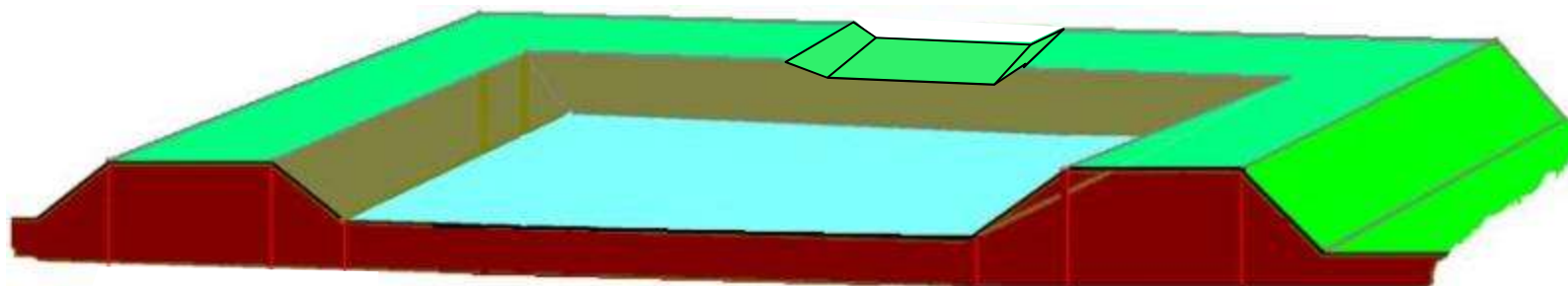
- ▶ Slow enough to settle sediment & give time for nutrient uptake
- ▶ Maximum 1.5 ft/sec
 - ▶ During the 10-year, 24-hr storm event (if surface flow)
 - ▶ When the tile flows full

$$\text{Velocity (ft/sec)} = \frac{\text{Inflow (ft}^3\text{/sec)}}{\text{Limiting cross section (ft}^2\text{)}}$$



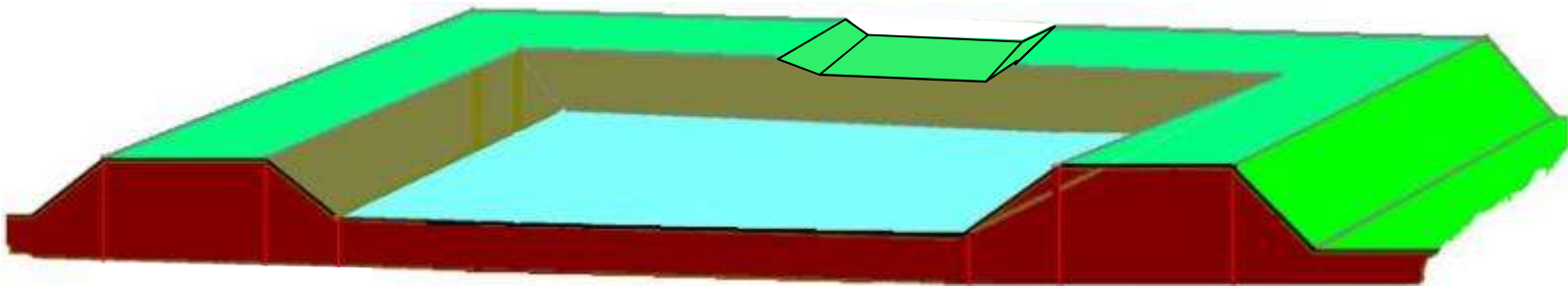
Embankment and Spillways

- ▶ Build like a shallow pond, usually with auxiliary spillway
 - ▶ Big enough to handle peak flow and volume from 25-year, 24-hour storm without overtopping
 - ▶ Protect from inundation or damage from 10-year, 24-hour event when located in floodplain



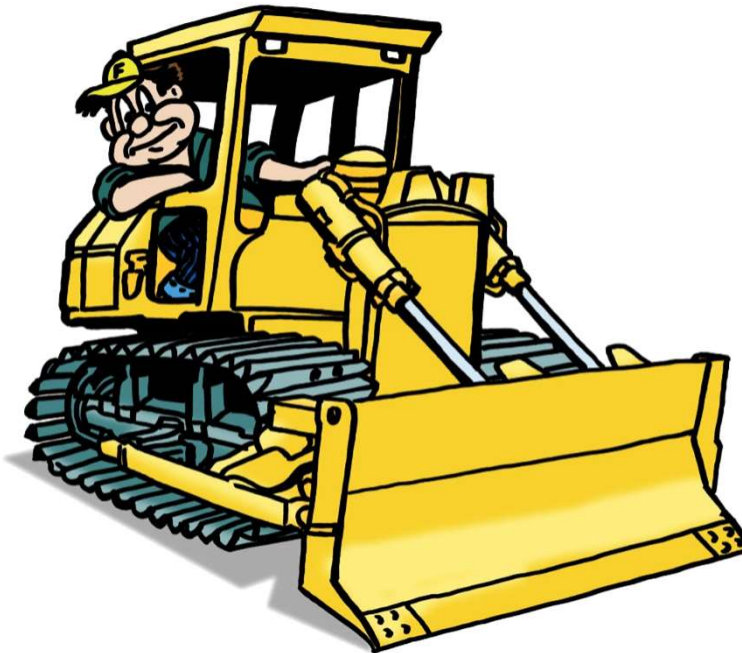
Embankment and Spillways

- ▶ Pond standard: use excavated pond criteria if auxiliary spillway is < 3 ft above lowest original ground under dam centerline.
 - ▶ Minimum 1 ft freeboard
 - ▶ Stable side slopes (flat enough, and vegetate!)
 - ▶ Auxiliary should not flow until site receives more than 25-yr flow (10-yr if drainage area is ≤ 20 acres)



How Much Excavation?

- ▶ 1 acre wetland, 12" deep \approx 1600+ cubic yards
- ▶ But your tile may be 4 feet below ground...and you want to daylight it!





Soils

- ▶ Capable of holding a water table
 - ▶ Relatively shallow depth rating
 - ▶ Disable any tile within 100 ft, or use non-perforated
- ▶ Capable of growing wetland plants
 - ▶ Medium textured or loamy

Water Features		?	⌵
Depth to Water Table			
Flooding Frequency Class			
Ponding Frequency Class			

Soil Physical Properties		?	⌵
Organic Matter			
Percent Clay			
Percent Sand			
Percent Silt			
Plasticity Index			
Saturated Hydraulic Conductivity (Ksat)			
Saturated Hydraulic Conductivity (Ksat), Standard Classes			
Surface Texture			

<http://websoilsurvey.sc.egov.usda.gov>



Hydrophytic Vegetation

- ▶ Enhanced denitrification and nutrient adsorption; encourage microbial activity
- ▶ Select plants that will grow in the climate and be tolerant of the “contaminants” in the wetland
- ▶ Avoid invasive species!



Vegetative Establishment

- ▶ Methods to establish emergent wetland vegetation:

- ▶ Transplanting

- ▶ Seeding (broadcast)



- ▶ Cattails

- ▶ Rushes

- ▶ Arrowhead

- ▶ Prairie cordgrass

- ▶ Common threesquare

- ▶ Natural regeneration

- ▶ Gradually increase water depths to allow emergent vegetation to grow



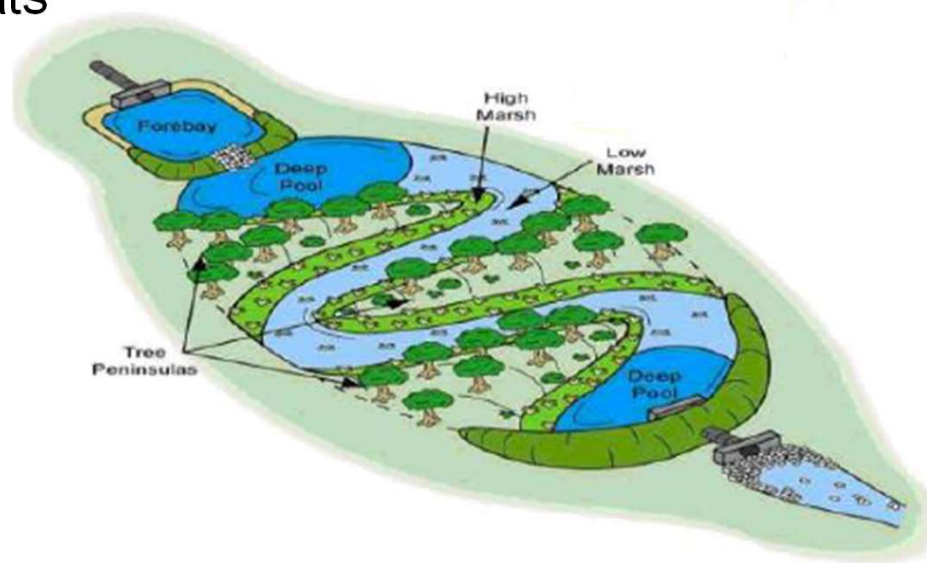
Natural Revegetation

- ▶ Is there a seed bank of suitable wetland plants?
 - ▶ Stockpile top 6" of soil and spread out in the wetland cell



Considerations

- ▶ Reaches of shallow and deep water to enhance wetland function
- ▶ Inflow and outflow structures and cell geometries to promote mixing
- ▶ Vegetative buffer to filter pollutants or sediment
- ▶ Wildlife and pollinator habitats
- ▶ Fences





Operation and Maintenance



- ▶ Wetland plant establishment
- ▶ Management information (water levels and timing)
- ▶ Sediment cleanout
- ▶ Inspection and maintenance requirements

Structure Summary

Structure ID	Elevation, ft		Boards in Control Structure (maximum)	
	Top of Box	Highest Board Level	Height, ft	Number of Boards

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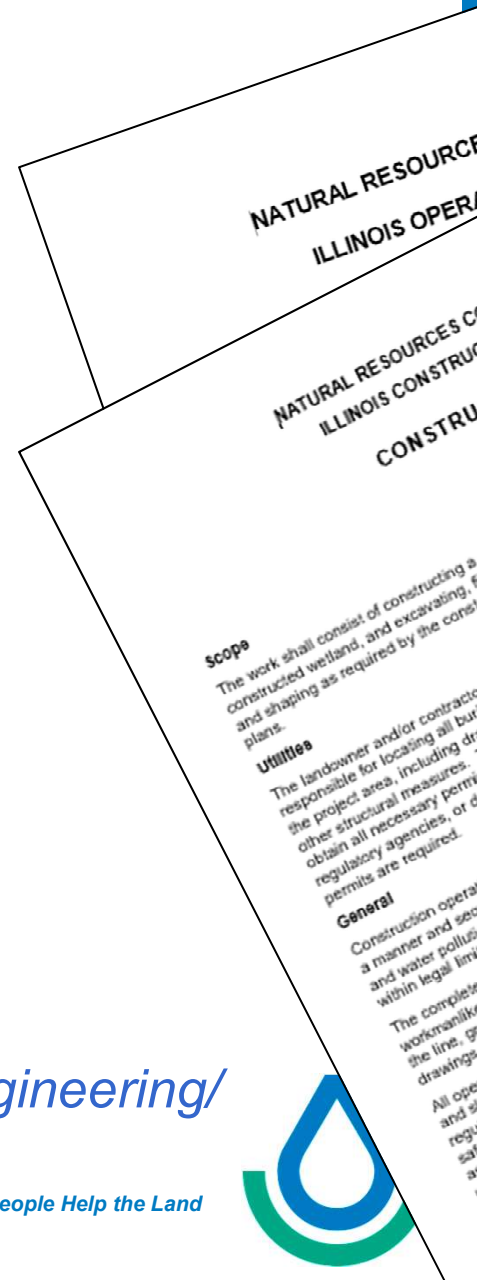
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ILLINOIS OPERATION AND MAINTENANCE
CONSTRUCTED WETLAND
How the operation and maintenance plan below to establish wetland your constructed wetland functioning as intended:
• Establishing wetland plants using the Transplanting method:
- When construction of the wetland is completed, keep the wetland structure open) until after the basin is planted with emergent the spring.
- For the first year after planting, adjust the water control structure kept moist to saturated with fresh water, up to a maximum the first growing season or until 75% of the plants in the structure have increased the water level to the normal depth has been reached.



NRCS Resources

- ▶ Section IV FOTG
 - ▶ Practice Standard (CPS 656) *(and others)*
 - ▶ Guidance Document
 - ▶ Customizable construction specs and O&M documents
 - ▶ Statement of Work
- ▶ Illinois NRCS engineering website - software
 - ▶ Flow capacity of water control structure
 - ▶ Flood routing of impoundment (if surface flow is involved)
 - ▶ Analysis of floodplain (if flooding from stream is involved)

<https://www.nrcs.usda.gov/wps/portal/nrcs/il/technical/engineering/>





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