DEFINITION
The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE
To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance condition of a site.

CONDITIONS WHERE PRACTICE APPLIES
This applies only to Class A (low hazard) structures with a fill height of ten feet or less. Dikes with an effective height greater than 10 feet shall be designed using the criteria for MN Practice Standard Pond (378) or Grade Stabilization Structure (410).

This practice applies only to natural wetland sites with hydric soils, or problem soils that are hydric, which have been subject to hydrologic or vegetative degradation, or to sites where hydric soils are covered by fill, sediment, or other deposits.

This practice is applicable only where the natural hydrologic conditions, including the hydroperiods, can be approximated by modifying drainage and/or by artificial flooding of a duration and frequency similar to the original, natural conditions.

This practice does not apply
- to creating a wetland on a site location which historically was not a wetland (Wetland Creation - 658).

CRITERIA
General Criteria Applicable to All Purposes
The purpose, goals and objectives of the restoration shall be clearly outlined, including soils, hydrology, and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology, and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

The nutrient and pesticide tolerance of the species planned shall be considered where known nutrient and pesticide contamination exists.

Upon completion of the restoration, the site shall meet soil, hydrology, vegetation and habitat conditions of the wetland that previously existed on the site to the extent practicable.

Where offsite drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes (e.g., increased water depth, berms, or microtopography).

Sites suspected of containing hazardous waste shall be tested to identify appropriate remedial measures. Sites containing hazardous material shall be cleaned prior to the installation of this practice.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. This includes the manipulation of water levels to control unwanted vegetation. The establishment and/or use of non-native plant species shall be discouraged where possible.
Criteria for Hydric Soil Restoration

Restoration sites will be located on hydric soils, or on problem soil areas that are hydric.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall, to the extent technically feasible, be removed.

Criteria for Hydrology Restoration

The hydrology (including the timing of inflow and outflow, duration, and frequency) and hydroperiod of the restored site shall approximate the conditions that existed before alteration. This includes affects to hydrology restoration caused by roads, ditches, drains, terraces, etc. within the watershed.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement or permit.

A natural water supply should be used to reestablish the site’s hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used; however, these sources shall not be diverted from other wetland resources (e.g. prairie pothole wetland complexes or springs).

To the extent technically feasible reestablish topographic relief and/or microtopography. Use reference sites within the area to determine desired topographic relief.

Excavations from within the wetland shall remove sediment to approximate the original topography and/or microtopography or establish a water level that will compensate for the sediment that remains.

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

Criteria for Vegetative Restoration

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of pre-identified, selected species will realistically dominate within 5 years, sites may be left to revegetate naturally. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

Applicable guidelines for wetland plantings can be found in MN practice standards Tree/Shrub Establishment (612); Wetland Wildlife Habitat Management (644); and Engineering Field Handbook (EFH), Chapter 13, Wetland Restoration, Enhancement, or Creation.

Seeding rates shall be based upon percentage of pure live (PLS) that shall be tested within 6 months of planting. Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the type of vegetative communities present and the vegetation type planned:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years; or, a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six species.
- If upland planting is part of the restoration plan, preference shall be given to native plants. Refer to MN Practice Standards Upland Wildlife Habitat Management (645), or Restoration and Management of Declining Habitats (643).

DESIGN CRITERIA

Hydrology & Hydraulics. The site shall be designed to handle the 10-year, 24-hour precipitation event by a combination of storage and spillway(s) capacity. Tables 2A through 2C are provided for quick and conservative design of this practice. A flood routing may be completed and the results used in place of Tables 2A through 2C. Sites exceeding the criteria in the tables must use flood routing.
The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow as shown in Tables 2A through 2C or as determined by flood routing, less any reduction creditable to conduit discharge and detention storage. Tables 2A through 2C assume an emergency spillway in good condition. A good spillway is one which will support vegetation (or is otherwise protected) and has exit slopes which lie within the ranges as defined in the EFH, Chapter 11, “Ponds and Reservoirs”, Exhibit 11-2, Table 3.

A poor emergency spillway is one that will likely sustain damage from an appreciable flow but will protect the principal spillway structure and embankment during the passage of a single design storm. Structures with a poor emergency spillway must increase the principal spillway design storm to a 25-year, 24-hour precipitation event.

The design storm must be safely controlled by the reservoir with a combination of storage and spillway capacity. When flood routing is done, the routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days drawdown from the 10 year, 24 hour design storm, whichever is higher. The 10-day drawdown shall be computed from the crest of the emergency spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Emergency spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

**Subsurface Drainage Alteration**. In areas where subsurface drains are used to alter hydrology of the site, the existing drainage system shall be modified to the extent possible to restore the hydrologic conditions of the wetland. Such modifications are not subject to the requirements outlined in the **Hydrology & Hydraulics** section above, provided the restoration does not impact adjacent property owners, and no dikes, levees, or embankments are used to restore the wetland. Review of drainage records, interviews, and site investigations may be needed to determine the extent of the existing drainage system.

In some cases, existing subsurface drains may be blocked or controlled to restore wetland conditions to previously drained lands. Blocks and control structures shall be adequate to meet all hydraulic, structural, and other functional requirements.

Where the drain lines serve as outlets from other areas where drainage is still desired, appropriate measures shall be included in the design to keep the upstream drainage system(s) maintained at its current capacity.

The effects of the subsurface drainage system may be modified or eliminated by one or a combination of the following:

1. Removing or rendering inoperable a portion of the drain at the downstream edge of the site,
2. Modifying the drain with a water control device,
3. Outletting the drain above the wetland area, or
4. Routing the drain around, away from, or through the wetland area.

When removing a portion of the drain downstream of the site, the length removed shall be sufficient so that the drain does not alter the hydrology of the wetland. Use lateral effect information to determine the break location.

The minimum length of drain that should be removed or rendered inoperable at each tile break is 100 feet.

Where dikes or embankments are to be constructed over existing drains, the entire length of the drain under the earthfill shall be removed. In addition, a minimum length of 25’ of tile shall be removed upstream from the upstream toe of the earthfill, and 50 feet shall be removed downstream of the downstream toe of the earthfill.

All envelope, filter material or flow enhancing material shall be removed within the length specified for tile removal. This includes tile fragments and debris. Where tile is removed, each exposed end of the remaining tile shall be plugged or capped to prevent water from entering or exiting the tile. The trench from tile removal shall be filled with similar soil and compacted to achieve the density equivalent to adjacent existing material.

If the drain is routed around the wetland and perforated drain tubing or sectioned tile is used, the drain shall be located so that it has no hydrologic effect on the wetland area. This minimum offset distance from the wetland should be determined by scope and effect equations; see EFH, Chapter 19, “Hydrology Tools for Wetland Determination”.

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In general, routing non-perforated drainage tile through a wetland should be avoided. If it is necessary, the design shall consider flotation of the tile.

**Embankment Structures and Dikes.**

*Foundation.* A core trench is required if the fill height is greater than seven feet. A core trench should be considered under a dike to insure dike stability and to prevent excess seepage losses. This may include the entire dike length, short sections located in old drainage ways, or areas near a water control structure. The core trench shall have a bottom width adequate for the necessary excavation, backfill, and compaction, but not less than 4 feet. Side slopes shall not be steeper than 1:1.

The centerline of the cutoff shall be located at or upstream from the centerline of the dam. Core trenches will be excavated to a minimum depth of 2 feet below the existing ground level.

*Earthfill.* Dikes shall have constructed side slopes of 3:1 upstream and 2:1 downstream or flatter. Flatter upstream side slopes shall be considered when potential exists for excessive wave action, ice action, erosion in organic soils on the face, or rodent action.

The embankment or dike may be homogeneous or have an impervious core. The minimum top width shall be 8 feet. The use of organic soils and sandy soils is not allowed without a variance approved by the State Conservation Engineer.

The height of the embankment needs to include sufficient allowances for the volume of storage required, the routing of the design storm(s), additional height for wave action, freeboard required, and a settlement allowance.

The design height of the dike shall be increased by a minimum 5 percent to allow for settlement.

The difference in elevation between the crest of the vegetated spillway and the top of the settled dike shall be the sum of the flow depth of the design storm through the vegetated spillway and at least the minimum freeboard allowance of 0.5 ft. The column labeled HP in Tables 2A through 2C provides information on the flow depth of the freeboard storm through the vegetated spillway.

When the water depth exceeds two feet against the embankment, the difference in elevation between the permanent pool elevation and the top of the settled dike shall be a minimum of 1.5 feet.

*Flow over Top.* In special situations, it may be desirable to design an embankment with spillway flow over the top of the embankment. The use of this type of design is limited to shallow earthfill within a drainage ditch. All of the following conditions must be met for a flow-over embankment within a ditch (also called a ditch plug) to be allowed:

1. Damage likely to occur from the failure of the embankment is minimal.
2. Drainage area < 50 acres.
3. A trickle tube or principal spillway is optional by the design tables in this standard.
4. Fill height < 5 feet.
5. No baseflow is present.
6. Stable grade downstream.
7. A good stand of vegetation can be established on the earthfill.

In these cases, use a minimum top width of 50 feet, 3:1 upstream slopes, and 20:1 or flatter downstream slopes. An upstream slope of 6:1 or flatter is preferable.

*Borrow Area.* If a borrow area is located upstream or downstream from an embankment, it will be located so that the minimum distance between the toe of the embankment and the edge of an excavated borrow area will be at least fifty (50) feet.

*Wave Action.* The design of all earthen embankments shall consider the impacts of wave action. Appropriate measures to protect against wave damage may include:

1. A flatter upstream embankment slope;
2. A berm with a minimum 10 foot radius may be provided around a 24” diameter or larger water control structure to minimize vegetative plugging;
3. Riprap or other erosion control material;
4. Additional fill height.

*Vegetation.* A seeding plan shall be prepared according to the criteria in MN Practice Standard Critical Area Planting (342).
**Principal Spillway.**

The minimum pipe diameter shall not be less than 6 inches. If the pipe conduit diameter is 10 inches or greater, or 8 inches with an effective trash rack, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway in a flood routing. The pipe may not be considered in the flood routing unless it has a free outlet. In no case shall the difference in elevation between the principal and vegetated spillway be less than 0.5 foot.

If base flow, which may include seepage, subsurface drainage or spring flow exists, a trickle tube or water control structure shall be provided.

Pipe conduits under or through the dam shall meet the following requirements.

1. Flexible pipe strength shall not be less than that necessary to support the design load with a maximum of 5 percent deflection.
2. The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe.

Acceptable pipe materials for fills less than ten feet in height are:

- PVC 1120 or 1220, conforming to ASTM D 1785 or ASTM D2241 – Standard Dimension Ratio (SDR) 26 or Schedule 40
- Corrugated steel pipe - minimum gage 16
- Corrugated aluminum – minimum thickness 0.06 inch up to 24” diameter, and 0.075 inch for 30” and 36” pipe
- Reinforced concrete pipe
- High density plastic dual wall

Other pipe material may be used if not under the fill.

**Seepage control.** Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The conduit is of smooth pipe larger than 8 inches in diameter and the pool depth is 3 feet or greater against the embankment.
2. The conduit is of corrugated pipe larger than 12 inches in diameter.

Seepage control is required on all structures with a permanent pool adjacent to the upstream slope of the fill that is more than 2 feet deep and exists for more than two days. Seepage control may not be needed where the water control structure outlets into a downstream tile line. Table 1 indicates required seepage control.

<table>
<thead>
<tr>
<th>Depth of water against fill, feet</th>
<th>Minimum Seepage Control Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 feet</td>
<td>None</td>
</tr>
<tr>
<td>2-5 feet</td>
<td>one anti-seep collar</td>
</tr>
<tr>
<td>Greater than 5 feet</td>
<td>Follow criteria in 378, Pond standard</td>
</tr>
</tbody>
</table>

Seepage along pipes extending through the embankment shall be controlled by use of a filter and drainage diaphragm, unless it is determined that antisep collars will adequately serve the purpose.

**Vegetated Spillway.**

The vegetated spillway shall be designed to safely control the flow from the storm as indicated in Tables 2A through 2C, or as determined by the flood routing procedure. Use of vegetated spillways in natural low areas without shaping is desirable since established vegetation is not disturbed. A natural or excavated spillway shall have a minimum 10 foot bottom width.

A vegetated spillway must be provided for each embankment, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an emergency spillway: (1) a conduit with a cross-sectional area of 3 ft² or more; (2) an inlet that will not clog; and (3) an elbow designed to facilitate the passage of trash.

Spillways shall have a minimum length of level section upstream from the control section of 30 feet. The centerline of the approach channel upstream of the level section shall be tangent to the centerline of the level section. The shape of the level section shall have the same dimensions (side slope and bottom width) as the outlet section.

The designer shall be responsible for determining that the flow through a vegetated spillway is designed to be stable in as-built and aged conditions.

Where the outlet has or will have seepage problems, appropriate measures shall be installed to maintain a stable outlet and promote good sod producing vegetation.
The vegetated spillway shall be located in a position that minimizes the likelihood for flood flows from the stream system to damage the dike and water control structure and vegetated spillway. Refer to EFH, Chapter 11, Ponds and Reservoirs, for design procedures.

**Floodplain Wetland Dikes.**

For dikes located in a floodplain, overtopping of the dike by flow from the floodway into the wetland is likely. In addition to the criteria already given, vegetative spillways associated with dikes located in a floodplain may be located on level natural ground, in excavation, or on compacted fill. Vegetated spillways shall be at least 100 feet wide and have a crest length of at least 30 feet.

Dikes constructed in a floodplain with a principal spillway shall have an additional 1 foot of overfill added to the constructed height to protect the control structure from damage by the overflow water. This additional height shall be constructed for a distance of 50 feet on each side of the principal spillway or water control structure.

**CONSIDERATIONS**

It is expected that for wildlife purposes, planting density and stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than those used for production purposes.

On sites where woody vegetation will dominate, consider adding 1 to 2 dead snags, tree stumps or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

Water surface draw-downs will affect concentrations of aquatic species, such as turtles in diminished pool area resulting in increased mortality.

Wetland functions and/or values may be adversely impacted.

The water budget should be evaluated for volumes and rates of runoff, infiltration, evaporation, and transpiration changes on the site.

Downstream flows or aquifers may affect other water uses or users.

Water control structures may impact the ability of fish or other aquatic species to move in and out of the wetland.

Herbaceous vegetation can be established on the site by a variety of methods over the entire site, or a portion of the site, and at densities and depths that are appropriate.

Wetlands and water-related resources, including fish and wildlife habitats, may be impacted by the installation of this practice.

Wetlands linked by corridors enhance the wetland’s use and colonization by the native flora and fauna and wildlife.

Vegetative buffers on surrounding uplands reduce sediment and soluble and sediment-attached substances carried by runoff and/or wind.

The temperature of water resources on the site is important to prevent undesired effects on aquatic and wildlife communities.

Soil disturbance may result in invasion by unwanted species. The restoration may alter disease vectors such as mosquitoes.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

Microtopography and hydroperiod influence vegetative species’ vigor. Choose appropriate species.

Control water levels to prevent oxidation of organic soils and to avoid inundated organic matter and materials.

Water depth and duration may be utilized to control unwanted vegetation.

The objectives of a wetland project should describe the specific functions to be achieved. Successful attainment of those wetland functions will require consideration of soils, hydrology, vegetation, fish and wildlife, problem plants and animals, recreational use, aesthetic quality, cultural features, social factors, economic considerations, environmental evaluation, and permits and regulations. Refer to EFH, Chapter 13 for additional information on wetland functions.

Consider effects on wetlands and water-related wildlife habitats, including threatened and endangered species. Refer to Section II of the NRCS Field Office Technical Guide (FOTG) for policy and county specific resources.
The work associated with the wetland must not adversely affect other properties, including, but not limited to, surface and subsurface drainage systems. Surface water must not back onto an adjoining property unless the landowner has obtained a flowage easement.

A DNR dam safety permit may be required for low head dams if the storage volume is large enough.

PLANS AND SPECIFICATIONS
Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the conservation plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications.

OPERATION AND MAINTENANCE
The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

- Any use of fertilizers, mechanical treatments, prescribed burning, pesticides and other chemicals shall assure that the intended purpose of the wetland restoration shall not be compromised;
- Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) shall be implemented where available and feasible;
- An inspection schedule shall be established for embankments and structures for damage assessment;
- The depth of accumulated sediment should be measured and the accumulations removed when the planned project objectives are jeopardized.

Management actions shall maintain desirable vegetation, and control undesirable vegetation.

For wildlife habitat purposes, haying and grazing, if justified as a necessary wildlife/wetland management tool, can be used for management of vegetation. Disturbance to ground nesting species shall be minimized.

REFERENCES


USDA, NRCS. Wetland Restoration, Enhancement, or Creation, Engineering Field Handbook, Chapter 13, Part 650, pp. 3, 24, 77, 78.

USDA, NRCS. 2002. Field Indicators of Hydric Soils in the U.S., Version 5.0. G.W. Hurt, P.M. Whited and R.F. Pringle (eds.). USDA, NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX.

USDA, NRCS. Ponds and Reservoirs, Engineering Field Handbook, Chapter 11, Part 650
DESIGN TABLES

These tables were developed using a 10 year frequency, 24-hour duration storm event. A runoff curve number (RCN) of 85 was used in the evaluations. The RCN is a composite representation of the entire drainage area, including the wetland. Sites having variables beyond the scope listed in the tables must be flood routed.

Table 2A  Designs where DA:PA is less than 10

<table>
<thead>
<tr>
<th>Drainage Area, Ac</th>
<th>Watershed Slope</th>
<th>Bottom Width, ft</th>
<th>HP ft</th>
<th>Min.Pipe Diam. Required</th>
<th>Pipe HW (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤40</td>
<td>Up to 5%</td>
<td>15</td>
<td>0.7</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>≤40</td>
<td>Up to 5%</td>
<td>10</td>
<td>0.4</td>
<td>10&quot;</td>
<td>0.5</td>
</tr>
<tr>
<td>41 - 60</td>
<td>Up to 5%</td>
<td>25</td>
<td>0.7</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>41 - 100</td>
<td>Up to 5%</td>
<td>15</td>
<td>0.6</td>
<td>10&quot;</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Table 2B  Designs where DA:PA is greater than 10

<table>
<thead>
<tr>
<th>Drainage Area, Ac</th>
<th>Watershed Slope</th>
<th>Bottom Width, ft</th>
<th>HP ft</th>
<th>Min Pipe Diam. Required</th>
<th>Pipe HW (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 20</td>
<td>Up to 5%</td>
<td>15</td>
<td>0.7</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>20 - 40</td>
<td>Up to 5%</td>
<td>15</td>
<td>1.0</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>40 - 60</td>
<td>Up to 5%</td>
<td>30</td>
<td>1.0</td>
<td>10&quot;</td>
<td>0.5</td>
</tr>
<tr>
<td>60 - 80</td>
<td>Up to 5%</td>
<td>40</td>
<td>1.0</td>
<td>10&quot;</td>
<td>0.5</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Up to 5%</td>
<td>50</td>
<td>1.0</td>
<td>12&quot;</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Sites with a drainage area exceeding 100 acres must be flood routed. Sites having variables beyond the scope listed in the tables must be flood routed.

If effective skimmers or other trash restricting devices are used, an 8” diameter pipe may be used in place of a 10” diameter pipe when using the designs in Tables 2A and 2B.

The auxiliary spillway should not carry flow from a 10-year 24-hour frequency event for more than 24 hours to increase the likelihood that the auxiliary spillway will avoid damages during the storm event.

Table 2C  Red River Valley Designs

<table>
<thead>
<tr>
<th>Drainage Area, Ac</th>
<th>Watershed Slope</th>
<th>Bottom Width DA:PA ≤ 10</th>
<th>Bottom Width DA:PA &gt; 10 ft</th>
<th>HP ft</th>
<th>Min. Pipe Size Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤20</td>
<td>2% or less</td>
<td>10</td>
<td>20</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>21-40</td>
<td>2% or less</td>
<td>15</td>
<td>50</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>41-60</td>
<td>2% or less</td>
<td>25</td>
<td>80</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>61-80</td>
<td>2% or less</td>
<td>30</td>
<td>105</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>80-100</td>
<td>2% or less</td>
<td>40</td>
<td>125</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>Up to 150</td>
<td>2% or less</td>
<td>55</td>
<td>165</td>
<td>0.5</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 2C was developed specifically for conditions that occur in the Red River Valley where the precipitation that occurs during a 10 year frequency, 24 hour duration rain event is 3.5 inches or less and the depth of flow in the vegetated spillway will be shallow. If the effective height of the structure will exceed two feet, or the maximum storage exceeds 25 acre-feet, or another parameter in the table is exceeded, a flood routing must be completed to verify the design.

Sites with a drainage area exceeding 150 acres must be flood routed. Sites having variables beyond the scope listed in the tables must be flood routed.

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Definitions.

DA:PA – Ratio of acres of drainage area to acres of pool area. The pool area is measured at the run-out elevation.

Drainage Area – Watershed area in acres that contributes water, surface and subsurface, to the wetland basin. This includes the wetland area.

Watershed Slope – Average watershed slope measured not including the wetland area.

Bottom Width – Minimum required bottom width of the vegetated spillway measured in feet.

HP – The calculated flow depth in feet of the design storm through the vegetated emergency spillway.

Pipe HW – The minimum pipe headwater measured in feet from the pipe inlet elevation to the vegetated spillway crest elevation.