



NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

DIKE

CODE 356 (FT.)

DEFINITION

A barrier constructed of earth or manufactured materials.

PURPOSE

- To protect people and property from floods.
- To control water level in connection with crop production; fish and wildlife management; or wetland maintenance, improvement, restoration, or construction.

CONDITIONS WHERE PRACTICE APPLIES

All sites that are subject to damage by flooding or inundation and where it is desired to reduce the hazard to people and to reduce damage to land and property.

Sites where the control of water level is desired.

Class III dikes located on sites where damage likely to occur from failure will be minimal.

The dike standard does not apply to sites where Wisconsin NRCS Conservation Practice Standards (WI NRCS CPS) Pond (Code 378), Water and Sediment Control Basin (Code 638), Diversion (Code 362); Grade Stabilization Structure (Code 410); or Terrace (Code 600) are appropriate. Dikes used to reduce flooding are normally constructed adjacent and/or parallel to a stream, river, wetland or water body and are not constructed across the stream, river or water body. Dikes used to control water levels usually have small interior drainage areas in relation to the surface area of the regulated water level.

CRITERIA

General Criteria Applicable to All Purposes

Design and install measures according to a site-specific plan in accordance with all local, State, Tribal, and Federal laws and regulations.

Apply measures that are compatible with improvements planned or being carried out by others.

Upstream surface and subsurface drainage will not be impacted unless mitigation measures are implemented. The impoundment owner must have ownership or legal control of the impoundment including the right to flood all land in the impoundment up to the [1% flood event](#). Legal control is usually obtained through permanent easements recorded on the deed of the affected property.

The impact on water surface profiles of any fill placed in a floodplain area will be determined prior to construction of the project.

Classification. The dike classification is determined by the hazard to life, the design water height, and the value of the protected land, crops, and property. Classification must consider land use changes likely to occur over the life of the dike.

Constructed Elevation. The constructed elevation of a dike whose purpose is to control water level shall be the sum of the following:

- The water elevation at the highest water level control.
- The rise in water height above the highest water level control caused by a flood of the design frequency shown in Table 1. This is the design high water.
- The larger of the minimum freeboard shown in Table 1 or the wave height caused by wind of the design frequency shown in Table 1.
- The allowance for settlement.

Settlement. Settlement shall be based on an analysis of the fill material, foundation material and condition, and compaction methods.

In lieu of an analysis, the allowance for settlement shall be as follows:

1. For dikes constructed of compacted earth fill material, the allowance for settlement shall be a minimum of 5 percent of the [dike height](#).
2. Class III dikes, constructed of fill material that is hauled from off-site, dumped, and shaped (referred to as “dumped and shaped”), the allowance for settlement shall be a minimum of 15 percent of the dike height. For fill material that is excavated adjacent to the dike and dropped from the excavator (referred to as “dropped”), the allowance for settlement shall be a minimum of 20 percent of the dike height. The allowance for settlement of dumped and shaped or dropped organic soil fill material shall be a minimum of 40 percent of the dike height. Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition. For the purpose of this standard, organic soils are described as follows:
 - a. Soil layers that are not saturated with water for more than a few days at a time are organic if they have 20 percent or more organic carbon.

OR

 - b. Soil layers that are saturated for longer periods, or were saturated before being drained, are organic if:
 - They have 12 percent or more of organic carbon and no clay, or
 - 18 percent or more organic carbon and 60 percent or more clay, or
 - A proportional amount of organic carbon, between 12 and 18 percent, if the clay content is between 0 and 60 percent.

OR

- c. All soils described in the local soil survey as an organic soil.

Top Width and Side Slopes. The minimum top widths and side slopes for earth embankments shall be as shown in Table 1.

All dikes must be accessible for maintenance activities. Typically, this may be along the top of the dike or along the berm. Access roads shall provide adequate width for maintenance equipment and inspection vehicles. The minimum width for vehicular traffic should be 12 feet. Provide wider areas for passing and turning around at regular intervals. Access roads may need to be controlled to prevent vandalism, accidents, and damage.

Berms. The need for a constructed berm on an embankment will be based on the results of an embankment and foundation stability analysis. If a stability analysis is not performed, all earth dikes shall have berms either constructed or occurring naturally on both sides meeting the following criteria:

- Where dikes cross channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc., they shall have a berm constructed on each side. The top elevation of these berms shall be at least 1 foot above the average ground surface on each side of the channel, ditch, borrow area, stream, slough, swales, gully, etc., and sloped away from the dike.
- The minimum top width of natural or constructed berms shall be as shown in Table 1.
- The minimum side slope ratio of constructed berms shall be 2:1 (Horizontal:Vertical).
- Constructed berms shall be at a constant elevation and sloped away from the dike.

Dike Materials. Earth dike materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of materials in the various fills shall be subject to approval by the engineer or designer. Fill materials shall contain no frozen soil, sod, brush, roots, or other perishable materials. Rock particles larger than the maximum size specified for each type of fill shall be removed prior to placement and compaction of the fill. The types of materials used in the various fills shall be as listed and described in the specifications and drawings.

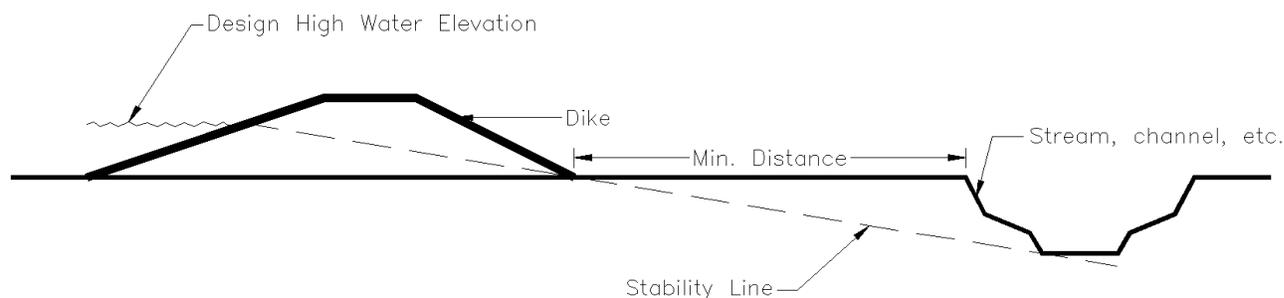
Embankment and Foundation Seepage. Embankment and foundation drainage and seepage control shall be designed on the basis of site investigation, laboratory data, seepage analysis, and stability analysis. The resulting design shall minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

In the absence of more detailed data and analysis, the following criteria for a foundation cutoff apply for Class III dikes where H is equal to dike height:

- Minimum of H feet deep for $H < 3$ feet.
- Minimum of 3 feet deep for $H \geq 3$ feet.
- Minimum of 4 feet bottom width.
- 1:1 or flatter side slopes.

A stream, channel, ditch, borrow area, slough, swale, gully, etc. shall be far enough away from the dike so that the extension of a line drawn from the design high water elevation on one side of the dike to the dike toe on the opposite side shall not intersect any stream, channel, etc. (See Figure 1). This line criterion applies to both sides of the dike. This criterion will minimize the hazard to the dike caused by piping through the foundation.

Figure 1.



Interior Drainage. Dikes to prevent flooding shall be provided with interior drainage systems for the area being protected. The interior drainage system shall prevent flood damage to the interior area from a flood of the design frequency in Table 1 for both the 1-day and the 10-day storm duration. The interior drainage system may include storage areas, gravity outlets, and pumping plants as needed to provide the required level of flood protection.

Spillways. Spillways for Class III dikes shall meet the requirements for spillways in WI NRCS CPS Wetland Restoration (Code 657), WI NRCS CPS Ponds (Code 378), or NRCS Technical Release 60 as appropriate.

Dikes shall be protected from scour at pipe inlet and outlet locations by appropriate measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible. Pump discharge pipes shall be equipped with a flexible connection or similar coupling to prevent vibration of the pumping plant being transmitted to the discharge pipe.

Slope Protection. Slopes of earthen dikes shall be protected from sheet, rill, and gully erosion; erosion from flowing floodwaters; and wave action created by wind and/or boat traffic. Erosion protection measures such as non-woody vegetation, berms, rock riprap, sand-gravel, or soil cement shall be utilized as needed.

CONSIDERATIONS

Location. When locating the site for the dike, consider the foundation soils, property lines, setbacks from property lines, exposure to open water, distance to streambanks, availability of outlets by gravity or pumping, buried, utilities, cultural resources, and natural resources such as wetlands, natural areas, and fish and wildlife habitat.

Fluvial geomorphologic concepts contained in National Engineering Handbook (NEH) Part 653, Stream Corridor Restoration Principles, Processes and Practices should be considered when placing a dike near a stream.

Berms. Give special consideration to wider berms, additional setbacks, or protecting the berm side slope when adjacent to actively eroding or moving streams to protect the dike for its design life.

Adverse Impacts. Adverse environmental impacts from the proposed dike will be evaluated. Any increases in flood stage caused by dike-induced flow restrictions will be evaluated for adverse impacts to unprotected areas. Adverse impacts should be minimized.

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 purpose.

OPERATION AND MAINTENANCE

Operation and maintenance requirements for all dikes will be provided to the landowners.

Table 1. Minimum Design Criteria for Dikes

| Classification | Material ¹ | Height (H) in Feet ² | Minimum Storm Design Frequency in Years | Minimum Freeboard in Feet | Minimum Top Width in Feet | Minimum Side Slope Ratio ³ (H:V) | Berm Width in Feet |
|----------------|----------------------------|---------------------------------|---|---------------------------|---------------------------|---|--------------------|
| Class III | Mineral Soils | 0 to 3 | 10 | H/3 | 4 | 2:1 | 8 |
| | | >3 to 6 | 10 | 1 | 6 | 2:1 | 8 |
| | | >6 to 12 | 25 | 2 | 8 | 2:1 | 8 |
| | Organic Soils ⁴ | 0 to 2 | 10 | H/2 | 4 | 2:1 | 10 |
| | | >2 to 4 | 10 | 1 | 6 | 2:1 | 10 |
| | | >4 to 6 | 10 | 2 | 8 | 2:1 | 15 |

¹Earth includes rock.

²Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies.

³Minimum side slope ratios are for compacted earth fill. Dumped earth fill without compaction will be flatter.

⁴Organic soils are permitted only for Class III dikes 6 feet or less in height. Higher dike heights result in excessive settlement and decomposition.

DEFINITIONS

1% Flood Event - A flood determined to be representative of large floods, which in any given year has a 1% chance of occurring or being exceeded. The 1% flood is based on a statistical analysis of lake level or streamflow records available for the watershed or an analysis of rainfall and runoff characteristics in the watershed, or both. This is commonly referred to as the 100 year event or regional flood.

Dike Height - Height is the difference between normal ground elevation at the dike centerline and the design high water elevation. When determining normal ground elevation, exclude crossings of channels, sloughs, small low areas, small ridges, swales, or gullies.

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