NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

DIKE

(Feet)
Code 356

DEFINITION

A barrier constructed of earth or manufactured materials.

PURPOSES

- To protect people and property from temporary water inundations.
- 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.

The dike standard does not apply to sites where Florida NRCS conservation practice standards Pond, Code 378; Water and Sediment Control Basin, Code 638; Diversion, Code 362; 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 comparison to the watershed area controlled.

CRITERIA

Dikes shall meet the requirements of all Federal, state, and local laws, rules, or regulations. Any required permits will be obtained prior to construction.

Impact to cultural resources, wetlands and Federal and state protected species shall be evaluated and avoided or minimized to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190 Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 6001 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), national Food Security Act Manual (NFSAM), and the National Environmental compliance Handbook (NECH).

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.

Dikes are classified as Class I where located on sites where failure may cause loss of life or serious damage to homes, primary highways, industrial buildings, commercial buildings, major railroads, or important public utilities.

Dikes are classified as Class II where located on sites where failure may cause damage to isolated homes, secondary highways, minor

railroads, relatively important public utilities, high value land, or high value crops.

All dikes with a design water height of more than 12 feet above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas are classified as Class I.

Dikes are classified as Class III where damage likely to occur from failure is minimal.

Offsite Impacts. Evaluate offsite environmental impacts from the proposed dike. Evaluate any increases in flood stage or flow velocities caused by dike induced flow restrictions for adverse offsite impacts to unprotected areas. Minimize adverse impacts.

Constructed Elevation. The constructed top of dike elevation to prevent flooding shall be the sum of the following:

1. The water elevation attained by a flood or high tide of the design frequency shown in Table 1 with the critical duration and timing. This is the design high water.
2. The larger of the minimum freeboard in Table 1 or the wave height caused by wind or boat traffic.
3. The allowance for settlement.

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

1. The water elevation at the highest water level control.
2. 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.
3. The larger of the minimum freeboard in Table 1 or the wave height caused by wind of the design frequency shown in Table 1.
4. The allowance for settlement.

Foundation Preparation. Clear the foundation area of all trees, stumps, roots, brush, organic matter and debris. Remove unstable soil prior to placement of embankment material.

Stockpile the top 4 to 6 inches of soil for placement on the finished dike or borrow area to help reestablish vegetative cover.

Settlement. Base the settlement 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. For Class II or 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:

1. 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

2. Layers that are saturated for longer periods, or were saturated before being drained, are organic if:

   (a) they have 12 percent or more of organic carbon and no clay, or

   (b) 18 percent or more organic carbon and 60 percent or more clay, or

   (c) a proportional amount of organic carbon, between 12 and 18 percent, if the clay content is between 0 and 60 percent.

   or

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

Table 1 – Minimum Design Criteria for Dikes[1/]

Classification	Dike Material [2/]	Height (H) Feet [3/]	Minimum Storm Design Frequency Years	Min. Freeboard Feet	Min. Top Width Feet	Min. Side Slope Ratio [4/] (H:V)	Berm Width Feet [5/]
Class I	Earth	0 to 6	100	H/3	10	2:1	12
		>6 to 12	100	2	10	Note 5	Note 5
		>12 to 25	100	3	12	Note 5	Note 5
		>25	100	3	14	Note 5	Note 5
	Manufactured	0 to 8	100	H/4	N/A	N/A	Note 5
		>8 to 12	100	2	N/A	N/A	Note 5
		>12	100	3	N/A	N/A	Note 5
Class II	Earth	0 to 6	25	H/3	6	2:1	12
		>6 to 12	25	2	8	2:1	15
	Manufactured	0 to 8	25	H/4	N/A	N/A	Note 5
		>8 to 12	25	2	N/A	N/A	Note 5
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 [6/]	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

[1/] Dikes shall meet the more stringent requirements of this standard or the requirements of Federal, state, and local laws, rules, or regulations.

[2/] Earth includes rock. Manufactured materials are erosion resistant materials such as concrete, PVC and steel that provides the structural strength for the dike.

[3/] 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.

[4/] Minimum side slope ratios are for compacted earth fill. Dumped earth fill without compaction will be flatter.

[5/] Side slope ratios and berm widths shall be determined by a stability analysis.

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

Top Width and Side Slopes. Design the minimum top widths and side slopes for earth embankments in accordance with Table 1.

Design all dikes to be accessible for maintenance activities. Typically, this may be along the top of the dike or along the berm. Design access roads with adequate width for the maintenance equipment and inspection vehicles. The top width of dike for vehicular traffic shall be a minimum of 12 feet. Provide wider areas for passing and turning around at regular intervals. Control access of access roads to prevent vandalism, accidents, and damage.

Berms. Base the need for a constructed berm on the results of an embankment and foundation stability analysis. If a stability analysis is not performed, design all earth dikes with berms either constructed or occurring naturally on both sides using the following criteria:

- Design constructed berms with a constant elevation and sloped away from the dike.
- Where dikes cross channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc., design the dike with berm constructed on each side. Design the top elevation of these berms 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.
- Design the minimum top width of natural or constructed berms in accordance with Table 1.
- Design the minimum side slope ratio of constructed berms to be 2 horizontal to 1 vertical (2:1)

Dike Materials. Manufactured materials are erosion resistant materials such as concrete, PVC, steel, or other material that provides the required structural strength and durability for the dike. For dikes constructed of manufactured materials, complete a structural analysis for the various loads the dike will be subjected to during its life. These include hydrostatic, uplift, earth, and equipment. Analyze the dike for stability using acceptable safety factors for each loading condition.

Obtain materials for earth dike from required excavations and designated borrow areas. Specify the selection, blending, routing, and disposition of materials in the various fills in accordance with sound engineering principles. Fill materials shall contain no frozen soil, sod, brush, roots, or other perishable materials. Remove rock particles larger than the maximum size specified for each type of fill prior to placement and compaction of the fill. List and describe in the specifications and drawings the types of materials used in the various fills.

Embankment and Foundation Seepage. Design embankment and foundation drainage and seepage control based on site investigation, laboratory data, seepage analysis, and stability analysis. In the resulting design, minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

Complete an analysis on all Class I dikes that have a height of six (6) feet or greater and Class II dikes that have a height of eight (8) feet or greater.

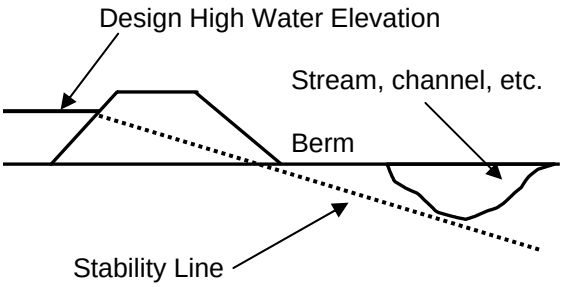
In the absence of more detailed data and analysis, apply the following criteria for a foundation cutoff for Class I dikes less than 6 feet in height, Class II dikes less than 8 feet in height and Class III dikes over 3 feet in height:

- 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 sufficient distance 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). Apply this line criterion to both sides of the dike. This criterion will minimize the hazard to the dike caused by piping through the foundation.

Interior Drainage. Provide dikes to prevent flooding with interior drainage systems for the area being protected. Design the interior drainage system to 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.

Figure 1 - Section Through Dike



Pipes. Pipes installed through a Class I dike below the design high water with a dike height greater than 12 feet shall meet the requirements for principal spillways in NRCS Technical Release 60 - Earth Dams and Reservoirs, except for the minimum size requirements.

Pipes through all other dikes shall meet the requirements for a principal spillway in Florida NRCS conservation practice standard Pond, Code 378.

Protect dikes from scour erosion 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. Equip pump discharge pipes with a flexible connection or similar coupling to prevent vibration of the pumping plant being transmitted to the discharge pipe.

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

At a minimum, establish a protective cover of grasses on all exposed surfaces of the dike and other disturbed areas according to Florida NRCS conservation practice standard Critical Area Planting, Code 342.

CONSIDERATIONS

Flood of Record. For Class I dikes, consider the flood of record when establishing the top of dike elevation.

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, threatened and endangered species, and natural resources such as wetlands, natural areas, and fish and wildlife habitat.

Consider fluvial geomorphologic concepts contained in National Engineering Handbook (NEH) Part 653, Stream Corridor Restoration Principles, Processes and Practices 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.

PLANS AND SPECIFICATIONS

Prepare the plans and specifications in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended purpose.

As a minimum, include as applicable, the following items in the plans and specifications:

- Location of dike
- Profile of top of proposed dike and natural ground along centerline of proposed dike
- Typical cross sections, including allowance for settlement
- Structural details of pipes, if applicable
- Slope protection requirements, if applicable
- Seepage protection, if applicable
- Borrow source
- Disposal of unsuitable soil
- Vegetative requirements

OPERATION AND MAINTENANCE

Provide operation and maintenance requirements for all dikes to the landowners. For Class I dikes with a height greater than 12 feet, complete an emergency action plan meeting the requirements of 500.70 of the National Operation and Maintenance Manual prior to construction of the dike. For Class I and Class II dikes, complete and provide a detailed

written Operation and Maintenance (O&M) Plan in accordance with 500.40 through 500.42 of the National Operation and Maintenance Manual to the owner.

As a minimum, include the following items in the O&M:

- Inspect the dike periodically and especially after heavy rains to determine whether it is functioning properly or if repairs are needed.
- Fill rills on the slopes of the dike with suitable material, compacted, seeded and fertilized as needed.
- Check seepage through or under dike. If seepage through or under the dike occurs, implement proper corrective measures immediately.
- Maintain the vegetative cover of the dike. Trees can cause leaks and safety hazards and shall not be permitted on the dike.

REFERENCES

Florida NRCS Conservation Practice Standards
- Critical Area Planting, Code 342
- Diversion, Code 362
- Pond, Code 378
- Water and Sediment Control Basin, Code 638
- Terrace, Code 600

General Manual
- Title 420-Part 401
- Title 450-Part 401
- Title 190-Parts 410.22 and 410.26

National Cultural Resources Procedures Handbook

National Engineering Handbook (NEH) Part 653, Stream Corridor Restoration Principles, Processes and Practices

National Environmental Compliance Handbook

National Food Security Act Manual

National Operation and Maintenance Manual

National Planning Procedures Handbook Florida Supplements to Parts 600.1 and 600.6

Technical Release 60 - Earth Dams and Reservoirs