

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD AND SPECIFICATION**

**DIKE
(feet)
CODE 356**

DEFINITION

An embankment constructed of earth or other suitable materials to protect land overflow or inundation.

PURPOSE

Permit improvement of agricultural land by preventing overflow and better use of drainage facilities, to prevent damage to land and property, and to facilitate water storage and control in connection with wildlife and other developments. Dikes can also be used to protect natural areas, scenic features, and archaeological sites from damage.

CONDITIONS WHERE PRACTICE APPLIES

The land and other improvements to be protected must be suitable for the intended use.

Class I dikes are constructed on sites where:

1. There is a possibility of loss of life if dike failure occurs.
2. High-value land or improvements are to be protected.
3. Unusual or complex site conditions require special construction procedures to insure satisfactory installation.
4. A dike is designed to withstand more than 12 feet of water above normal ground surface, exclusive of crossings of sloughs, old channels, or low areas.

Class II dikes are constructed in highly developed and productive agricultural areas.

Class III dikes are usually built on sites where the spoil from excavated drainage channels is available. Class III dikes shall be only on sites where:

1. The maximum design water stage against the dike is:

Mineral soils.....6 feet

Organic soils4 feet

(Exclude channels, sloughs, swales, and gullies in determining the design water stage.)

2. Damages likely to occur from dike failure are minimal.

CRITERIA – ALL DIKES

In locating dikes, careful considerations shall be given to preserving natural areas, fish and wildlife habitat, woodland, and other environmental resources. If dike construction will adversely affect such values, concerned public agencies and private organizations shall be consulted about the project.

Protection. A protective cover of grasses shall be established on all exposed surfaces of the dike and other disturbed areas. Seedbed preparation, seeding, fertilizing, mulching, and fencing shall comply with recommendations in local technical guides.

If vegetation will not control erosion, riprap or other protective measures shall be installed.

CRITERIA – CLASS I DIKES

Location. Conditions to be considered in designing Class I dikes are foundation soils, property lines, exposure to open water, adequate outlets for gravity or pump drainage, and access for construction and maintenance. Mineral soils that will be stable in the dike embankment must be available.

Height. The design height of a dike shall be the design high water depth plus 2 feet of freeboard, or 1 foot of freeboard plus an allowance for wave height, whichever is greater. Design elevation of high water shall be determined as follows:

1. If dike failure is likely to cause loss of life or extensive high-value property damage, the elevation of design high water shall be that associated with the stage of the 100-year-frequency flood or of the maximum flood of record, whichever is greater.
2. If dike failure is unlikely to result in loss of life or extensive high-value property damage, the elevation of design high water shall be that associated with the peak flow from the storm that will insure the desired level of protection or the 50-year-frequency flood, whichever is greater.
3. If the dike will be subject to stages from more than one stream or source, the criteria indicated shall be met for the combination that causes the highest stage.
4. If the dike will be subject to tidal influence as well as streamflow, the streamflow peak shall be assumed to occur in conjunction with the mean high tide to determine the design high water depth.

The design height of the dike shall be increased by the amount needed to insure that the design top elevation is maintained after settlement. This increase shall not be less than 5 percent.

Interior drainage. If inflow from the area to be protected by the dike may result in loss of life or extensive high-value property damage, provisions shall be included in the plans to provide protection against a 10-day, 100-year-frequency inflow hydrograph, plus an allowance for seepage, and may include storage areas, gravity outlets, or pumping plants, alone or in combination.

If inflow from the area to be protected by the dike is unlikely to result in loss of life or extensive high-value property damage, storage areas, gravity outlets, or a pumping plant, alone or in combination, shall be included in the plans and designed to handle the

discharge from the drainage area based on drainage requirements established for the local area or the peak flow from the storm that will insure the desired level of protection, whichever is greater.

Embankment and foundation. The embankment shall be constructed of mineral soils, which when placed and compacted will result in a stable earth fill. No organic soil shall be used in the dike. Soils must have high specific gravity and be capable of being formed into an embankment of low permeability.

The design of the embankment and specifications for its construction shall give consideration to the soil materials available, foundation conditions, and requirements for resisting the action of water on the face of the dike and excessive seepage through the embankment and foundation. The design of the embankment and foundation requirements shall be based on the length of time and height that water will stand against the dike.

Minimum requirements for certain features of the embankment, the foundation, and borrow pits are as follows:

Minimum top width of Class I dikes shall be 10 feet for embankment heights of 15 feet or less and 12 feet for heights more than 15 feet. If maintenance roads are to be established on the dike top, "turnarounds" or passing areas shall be provided, as needed.

Side slopes shall be determined from a stability analysis, except that an unprotected earth slope on the water side shall not be steeper than 4 horizontal to 1 vertical if severe wave action is anticipated.

If dikes cross old channels or have excessively porous fills or poor foundation conditions, the landside toe shall be protected by a banquette or constructed berm. Banquettes shall be used if channel crossings are under water or saturated during construction. Banquettes shall be designed on the basis of site investigations, laboratory analysis, and compaction methods. The finished top width of the banquettes shall not be less than the height of dike above mean ground. The finished top of the banquettes shall be not less than 1 foot above mean

ground and shall be sloped away from the dike.

A cutoff shall be used if foundation materials are sufficiently pervious to be subject to piping or undermining. The cutoff shall have a bottom width and side slopes adequate to accommodate the equipment to be used for excavation, backfill, and compaction operations. It shall be backfilled with suitable material placed and compacted as required for the earth embankment. If pervious foundations are too deep to be penetrated by a foundation cutoff, a drainage system adequate to insure stability of the dike shall be used.

Landside ditches or borrow pits shall be located so the hazard of failure is not increased. Ditches for borrow pits when excavated of the water side of dikes shall be wide and shallow. Plugs, at least 15 feet in width, shall be left in the ditches at intervals not greater than 400 feet to form a series of unconnected basins.

For dikes having a design water depth of more than 5 feet, the landside ditch or borrow pit shall be far enough away from the dike so that a line drawn between The point of intersection of the design water line with the water side of the dike and the landside toe of a dike meeting minimum dimensional requirements shall not intersect the ditch or borrow pit cross section. A drainage system shall be used if necessary to insure the safety of a dike.

Toe drains, if used, shall be located on the landside and shall have a graded sand-gravel filter designed to prevent movement of the foundation material into the drain.

Subsurface drains shall not be installed, or permitted to remain without protection, closer to the landside toe of a dike than a distance three times the design water height for the dike. If subsurface drains are to installed or remain closer than the distance stated, protection shall consist of a graded sand-gravel filter, as for a toe drain, or a closed pipe laid within the specified distances from the dike.

Pipes and conduits. Dikes shall be protected from scour at pump intakes and discharge locations by appropriate structural measures. A pump discharge pipe through a dike shall be installed above design high water, if feasible, or be equipped with antiseep collars.

All conduits through a dike below the design high waterline shall be equipped with antiseep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent. Discharge conduits of pumps placed below the designed water line shall be equipped with a Dayton or a similar coupling to prevent vibration of the pumping plant being transmitted to the discharge conduits.

CRITERIA - CLASS II DIKES

Design water stage. The maximum design water stage permitted is 12 feet above normal ground level exclusive of crossings at channels, sloughs, and gullies.

If the design water depth against dikes, based on the required level of protection, exceeds 4 feet the design shall be based on at least a 25-year-frequency flood. If this degree of protection is not feasible, the design shall approach the 25-year flood level as nearly as possible, and planned fuse plug sections and other relief measures shall be installed where appropriate.

Height. The design height of an earth dike shall be the design water depth plus a freeboard of at least 2 feet or freeboard of 1 foot plus an allowance for wave height, whichever is greater.

The constructed height of the dike shall be the design height plus an allowance for settlement necessary to insure that the design top elevation is maintained but shall be no less than 5 percent of the design height.

Interior drainage. Provisions must be made for adequate drainage from the area to be protected by the dike.

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Cross section. The minimum requirements for the cross section of the dike where fill is compacted by hauling or special equipment shall be as follows.

Design water height	Minimum top width	Steepest side slope
<u>feet</u>	<u>feet</u>	<u>Horizontal to Vertical Ratio</u>
0-6	6	1-1/2:1
6-12	8	2:1

If soils or water conditions make it impractical to compact the dike with hauling or special equipment, dumped fill may be used and shall have minimum cross section dimensions incorporated in the fill as follows:

Design water height	Minimum top width	Steepest side slope
<u>feet</u>	<u>feet</u>	<u>Horizontal to Vertical Ratio</u>
0-6	8	2:1
6-12	10	2-1/2:1

Side slopes of 3 (horizontal - H) to 1 (vertical - V) on waterside and 2 (H):1 (V) on landside may be used instead of 2-1/2 (H):1 (V) for both slopes.

The cross sections shall be strengthened or increased as required to provide additional protection against floods of long duration. The top width shall be not less than 10 feet if a maintenance road is planned on top the dike. "Turnarounds" or passing areas shall be provided as required on long dikes.

The side slopes shall be 3 (H):1 (V) or flatter on the waterside if severe wave action is expected or if a steeper slope would be unstable under rapid drawdown conditions. Side slopes shall be 3 (H):1 (V) or flatter on both sides where permeable soils of low plasticity such as SM and ML, are used in construction.

A banquette (or constructed berm) shall reinforce the landside toe if a dike crosses an old channel or if excessively porous fill or poor foundation conditions justify such reinforcement. Such banquettes shall be used if, during construction, the channel condition is under water or saturated. The top width of the

banquette shall be equal to or greater than the fill height of the dike above the top of the banquette unless a detailed investigation and analyses show a different design is adequate.

Foundation cutoff. A cutoff shall be installed if there are layers of permeable soils or layers creating a piping hazard through the foundation at a depth less than the design water depth of the dike below natural ground level. The cutoff trench shall be of sufficient depth and width and filled with suitable soils to minimize such hazard.

Ditches and borrow pits. Minimum berm widths between the toe of the dike and the edge of the excavated channel or borrow shall be:

<u>Fill height</u>	<u>Minimum berm width</u>
Less than 6 feet	10 feet
More than 6 feet	15 feet

A landside ditch or borrow pit shall be far enough away from the dike to minimize any hazard to the dike because of piping through the foundation.

For dikes having a design water depth of more than 5 feet, the landside ditch or borrow pit shall be far enough away the dike so that a line drawn between the point of intersection of the design waterline with the waterside of the dike and the landside toe of a dike meeting minimum dimensional requirements shall not intersect the ditch or borrow pit cross section.

Pipes and conduits. The dike shall be protected from scour at a pump intake and discharge by appropriate structural measures. A pump discharge pipe through the dike shall be installed above design high water, if feasible, or else equipped with antiseep collars.

All conduits through the dike below the design high waterline shall be equipped with antiseep collars designed to increase the distance of the seepage line along the conduit by at least 15 percent. Discharge conduits of pumps placed below the designed waterline shall be equipped with a Dayton or a similar coupling to prevent vibrations of the pumping plant being transmitted to the discharge conduits.

Drains. Drains shall be used where necessary to insure safety of dikes and shall be located on the land side, have a graded sand gravel filter, and be designed and installed in accordance with Natural Resources Conservation Service standards for such drains.

Field subsurface drains shall not be installed or permitted to remain without protection closer to the landside toe of a dike than a distance 3 times design water height for the dike. If such drains are to be installed or remain closer than the distance stated above, protection shall consist of a graded sand-gravel filter, as for a toe drain, or closed pipe laid within the specified distances from the dike.

CRITERIA –CLASS III DIKES

The design criteria shall be on site conditions for mineral or organic soils as applicable.

Top width. Minimum top width is 4 feet.

Side slopes. Minimum side slope is 1:1.

Freeboard. The minimum freeboard is 1 foot plus wave height. The constructed height shall be increased by the amount necessary to insure that the settled top is at design elevation but not less than 5 percent.

Foundation cutoff. A cutoff shall be installed if necessary to insure dike stability.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing dikes shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

All dikes must be adequately maintained to the required shape and height. Erosion-controlling vegetation shall be established on dikes as required by climatic conditions and the need for protection against wave action. The maintenance of dikes must include periodic removal of woody vegetation that may become established on the embankment. Provisions for maintenance access must be provided.