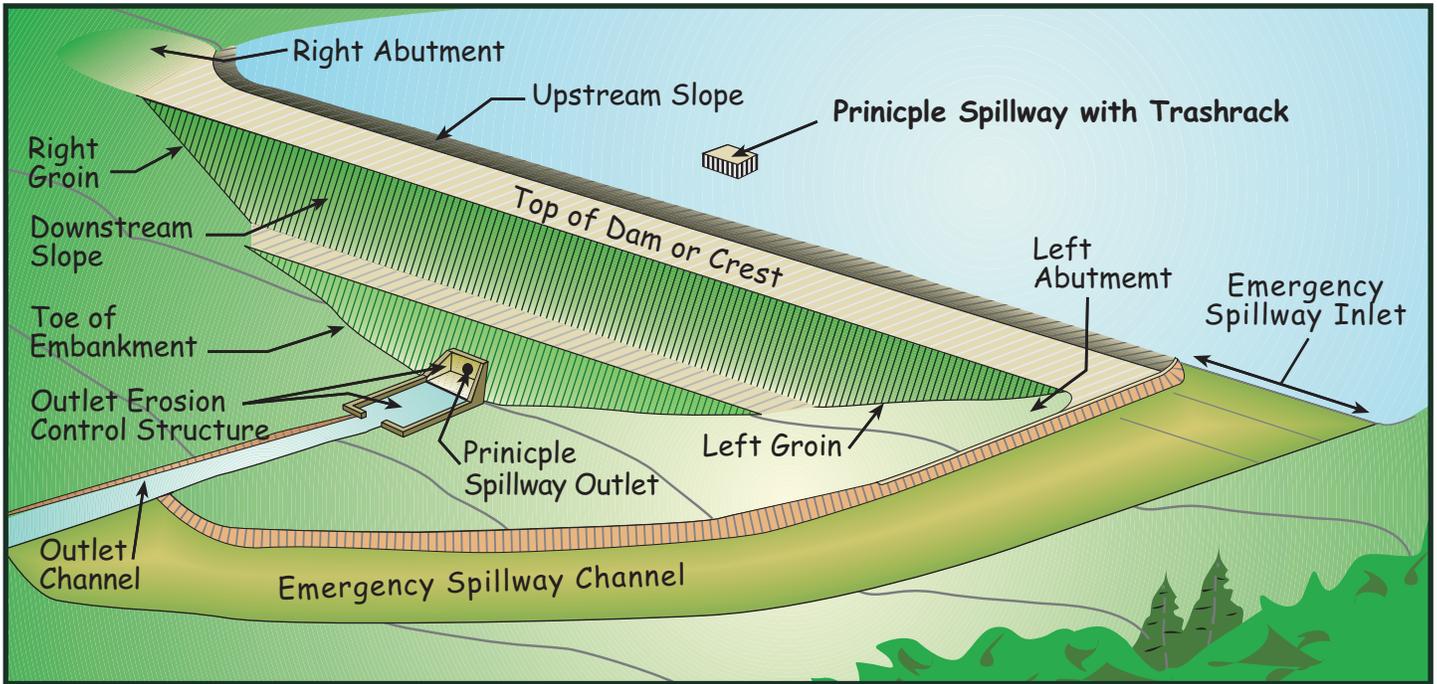


## Common Problems for Small Dams with Conduits as the Principle Spillway



A dam safely passes a flood event by a combination of storing water in the lake and passing water through its spillways. Earthen embankments are not designed to have floodwaters overtop them. An emergency spillway should not pass over the crest of the dam; it should be located in the abutment area.

The Division of Soil and Water Resources regulates over 1600 dams in Ohio and has performed thousands of safety inspections. A dam, like any man-made structure, will change and deteriorate over time. Keeping a dam in good condition will allow better inspections and easier maintenance. Proper inspection and maintenance will help prevent small problems from turning into larger, costly repairs. The following paragraphs, pictures, and fact sheets (Nos. 27, 28, 31, 49, 51, 54 & 59) address common problems that have been noted during inspections. For additional information about dam safety, please visit the division's web site at <http://soilwater.ohiodnr.gov/>.

### Earthen Embankments

The establishment and control of proper vegetation is an important part of dam maintenance. Properly maintained vegetation can help prevent erosion of embankment and earth channel surfaces, and aid in the control of groundhogs and muskrats. Embankment slopes are normally designed and constructed so that the surface drainage will be spread out in a thin layer as "sheet flow" over the grass cover. When

the sod is in poor condition or flow is concentrated at one or more locations, the resulting erosion will leave rills and gullies in the embankment slope.

### Trees and Brush

Trees and brush must not be permitted on embankment surfaces or in vegetated earth spillways. Extensive root systems can provide seepage paths for water. Trees that blow down or fall over can leave large holes in the embankment. Brush hinders visual inspection, provides a haven for burrowing animals, and retards growth of grass vegetation.



(a) Embankments covered with trees and brush makes inspection difficult. (b) Cleared of trees and brush, this embankment is much easier to inspect, but needs a good vegetal cover.

### Upstream Slope

Slope protection may be needed to protect the upstream slope against erosion. Erosion can lead to cracking and sloughing, which can extend into the crest. Muskrats and groundhogs can also damage the slope. The upstream face of a dam is commonly protected against wave erosion by placement of a layer of rock riprap over a layer of bedding and a filter material.



An excellent grass cover will reduce erosion and is easily maintained.



(a) Collapsed muskrat burrows increase shoreline erosion and sloughing. (b) This shoreline has eroded due to lack of proper erosion protection leading to sloughing and cracking of the slope.



**Crest**

Vehicular traffic should be discouraged, especially during wet conditions, to avoid ruts. Water collected in ruts may cause localized saturation, thereby weakening the embankment. Ruts can develop into low areas. Low areas on the crest increase the likelihood that a dam will be overtopped during severe floods. Earthen embankments are not designed to be overtopped. Should the dam overtop, floodwaters will concentrate in the low area, increasing the likelihood of erosion of the crest and downstream slope. Severe erosion can lead to failure of the embankment. A well-vegetated earth embankment may withstand limited overtopping if its crest is level and water flows over the crest and downstream slope as an evenly distributed sheet without becoming concentrated.



This slope is well maintained with rock riprap along the shoreline.



(a) Embankment crests with vehicle ruts will collect water and weaken the embankment. (b) Crest beginning to overtop in low area. This could lead to erosion and failure of the dam.



**Principle Spillway**

The principal spillway is the first spillway to experience flow after a storm when the pool rises above normal pool level. The spillway must consist of an erosion-resistant material such as concrete, steel, or plastic because it will frequently experience flow. It is important that spillways remain unobstructed and in good structural condition.



Crest with a good cover that will reduce the effects of vehicular traffic.

**Trashracks**

A spillway must remain free from obstructions to maintain its flow capacity. Trashracks are designed to keep trash and other debris from entering the spillway and restricting flow. Trashracks should be designed to allow small debris such as leaves to pass through the spillway while stopping larger debris from entering the spillway where they might become lodged. Trashracks usually become plugged if the openings are too small or the trashrack is flat across the opening. Small openings will collect debris such as twigs and leaves, which in turn cause a progression of larger items to build up, eventually blocking the entire inlet. Vegetation around the inlet also can reduce flow through the spillway.

**Structural Condition**

Spillways must remain in good structural condition to convey water safely downstream of the dam. Structural problems include deterioration of the material itself, separated joints, and erosion at the spillway outlet. Corrosion is a common problem for metal and concrete spillways. Corrosion can destroy the bottom of the pipe, allowing water to flow outside of the pipe and erode embankment material.



Trashracks with openings that are too small cause leaves to clog the inlet – fencing should not be used.



Flat trashracks can quickly become clogged with debris. Also notice the encroaching vegetation.



Good trashrack almost completely blocked with vegetation.



Trashracks with properly sized openings will pass smaller debris and stop larger items.



A trashrack with properly sized openings, large surface area and an anti-vortex plate will likely perform best.

Continued erosion can lead to failure of the dam. Corrugated metal pipe has a service life of 25 years or less and is not acceptable for dam construction or repairs.



This corrugated metal pipe has corroded completely through the bottom.



Leaking joints can cause the soil outside the pipe to erode and the spillway to fail.



This Dam failed from seepage along the principal spillway.



Deteriorated concrete.

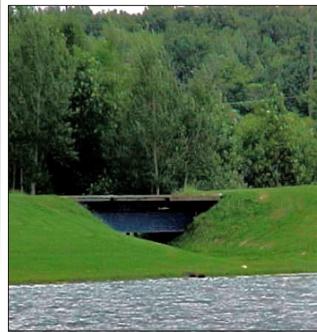


A spillway outlet with inadequate erosion control can lead to undermining of the outlet and failure of the dam.

### Emergency Spillways

The emergency spillway is the second spillway to experience flow during a flood event. For most dams in Ohio, the emergency spillway consists of a grass-lined, earthen open channel. An open channel can convey much more flow than a pipe spillway, so it is important to keep the spillway free of obstructions. Obstructions reduce the flow capacity and could cause the dam to overtop and fail. Permanent structures including buildings, fences, and roadway embankments for access across the spillway should not be constructed in the spillway. Earthen channels should be protected by a good grass cover, an appropriately designed rock cover, concrete, or other various types of erosion control matting. Grass-lined channels should be mowed at least twice per year to maintain a good grass cover and to prevent trees, brush, and weeds from becoming established. Poor vegetal cover can result in extensive and rapid erosion when the spillway flows.

### Emergency Spillway Examples and Issues



This bridge blocks much of the spillway, reducing its ability to convey water.



Landscaping, directly behind the table, is obstructing the spillway reducing the capacity to convey water. It also can collect debris, further diminishing spillway capacity.



Earthen channels spillways that flow often or continuously will erode. This can eventually cause the dam to fail.



A tree is obstructing this spillway.



Severe erosion and near failure of the dam (2004) resulted after the principal spillway plugged during a storm. The dam did not have an emergency spillway. The dam was removed one week later.



This open-channel emergency spillway is clear of trees, brush and other obstructions. Also note the good grass cover.

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