Dam Inspection Guidelines

FACT SHEET • Dam Safety

OWRB
the water agency

A dam failure can cause considerable loss of capital investment, loss of income, and even the tragic loss of life. People that live or run a business near a dam depend on its owner to properly operate, maintain and inspect it and thereby prevent hazardous conditions downstream.

Notwithstanding the moral obligation of keeping the dam safe, the owner could be subjected to liability claims if the dam fails. Therefore, it is a good business practice to have an effective maintenance program in place for your dam.

The guidelines that follow, while not exhaustive in scope, will provide dam owners with the most essential information necessary to identify common problems with their dams.

Nevertheless, it is important that every dam owner be familiar with the actual rules and regulations set forth by the state of Oklahoma. Detailed information on this and many other relevant topics can be found on OWRB website at www.owrb.ok.gov/damsafety.php.

"High hazard-potential dams" require an *annual* comprehensive inspection by a professional engineer experienced in dam safety. "Significant hazard-potential dams" require the same inspection every *three years*. The owner of a "low hazard-potential dam" is required to conduct a visual inspection for downstream development that could affect the hazard-potential classification once every *five years*.

Dam owners should conduct visual inspections several times each year. Remember that all problems may not be exposed in the course of maintenance and visual inspection.

Do not rely on "home remedies". Call an experienced dam safety engineer to remedy problems.

Major Types of Dam Failure

Dam failures are usually a result of improper design, construction, and maintenance. Owners of older dams often do not have records or a comprehensive understanding of the dam's design and construction. Therefore, conclusions are commonly based on less than comprehensive inspections.

With these older structures it is important to be aware of the major types of failures and their warning signs. Earthen dam failures can generally be grouped into three classifications, briefly described below:

Hydraulic Failure

Hydraulic failure results from the uncontrolled flow of water over, around, and adjacent to a dam. This includes the erosive action of water on the dam and its foundation. Earth dams are particularly susceptible to hydraulic failure since soil will erode at low velocities (See Table 1 on page 6).

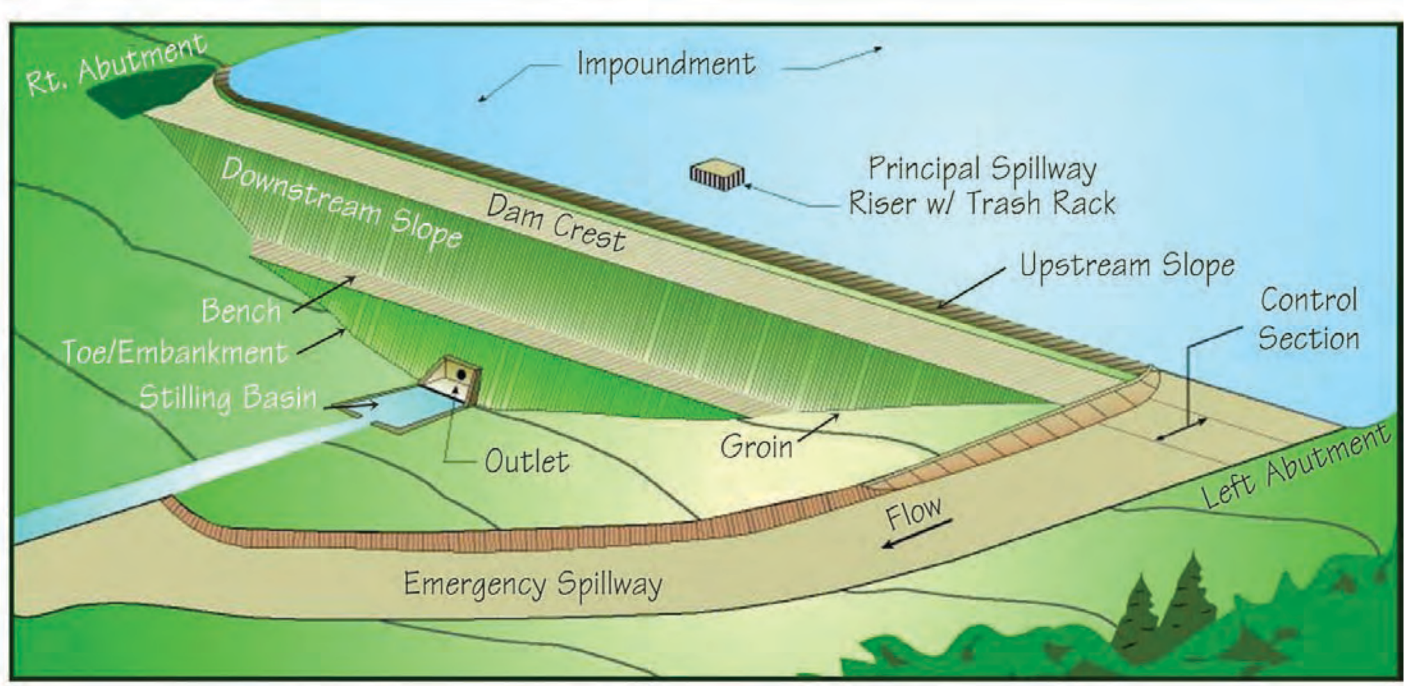

Figure 1: Parts of a Dam

Seepage Failure

All dams exhibit some seepage; the velocity and amount must be controlled. Seepage occurs both through the dam and at the foundation. If uncontrolled, it can erode material from the foundation of an earth dam to form a conduit through which water can pass. This can lead to a complete failure of the structure or "piping" (See Table 2 on page 6).

Structural Failure

Structural failure involves the rupture of the dam and/or its foundation. This is particularly a hazard for large dams and dams built of low strength materials, such as silts and sandy soils.

In actuality, dam failures generally result from a complex interrelationship of these failure modes. Uncontrolled seepage may weaken the soils and lead to a structural failure. A structural failure may shorten the seepage path and lead to piping failure. Surface erosion may lead to structural or piping failures (See Table 3 on page 7).

Parts of an Earth Fill Dam

The most common elements of an earth-fill dam are illustrated in Figure 1.

Embankments, the primary part of the dam, impound the lake and hold the water. Earth-fill embankments fall into two main classifications: "homogeneous" and "zoned." A homogeneous embankment is composed of the same material throughout, while a zoned embankment uses dissimilar materials, such as rock and clay, in different parts of a dam as shown in Figure 2. Most dams apply the zoned method, often using compacted clay to form an impermeable zone. The impermeable clay zone is surrounded by a more pervious material, which will allow drainage.

Seepage through the dam is collected and controlled by means such as toe drains, rock toes, drainage blankets, relief wells, and chimney drains. All of these seepage control systems involve a means of filtering the clay particles from the seepage and a method of discharging the water in a safe manner. A "cutoff core trench" is used in some dams to prevent the flow of water through the embankment or the foundation material.

The slopes of the embankment must be vegetated to protect from the erosive effects of rain. The upstream slope must have protection from wave action. This is usually accomplished by a rock blanket (rip-rap) or by a berm.

The Foundation is the material upon which a dam is built (Figure 2). This material must have the strength to support the embankment and reservoir behind it safely. Seepage through the foundation must be controlled in such a manner that the embankment will be stable under the design conditions and the dam will store water for its intended purpose.

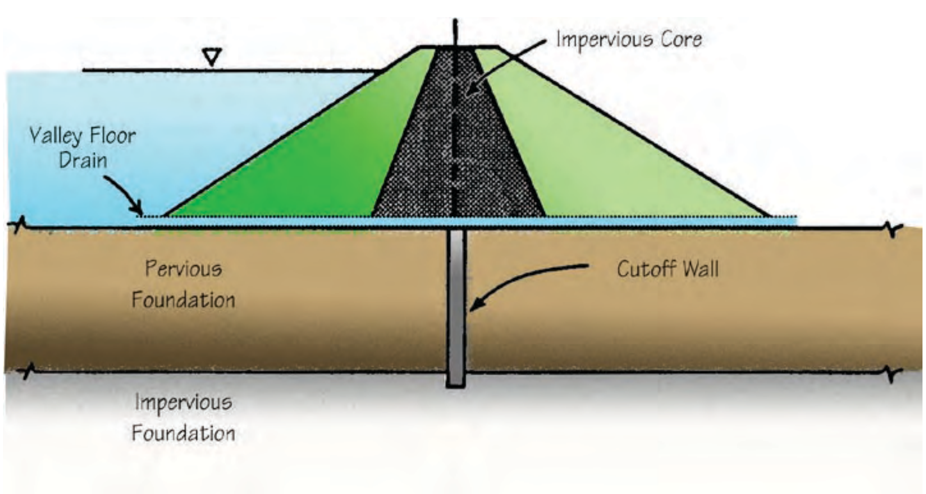

Figure 2: Typical cross section of a dam

A Principal Spillway is the path constructed for water flow over a concrete spillway or through a conduit in the dam to maintain the normal level of a lake. This spillway is usually either a metal or concrete pipe through the dam and usually incorporates a stand pipe or riser inlet structure. The principal spillway's function is to pass normal amounts of water past the dam in a safe and non-erosive manner. The inlet structure of a conduit must have provisions to prevent clogging with trash and debris.

An Emergency or Auxiliary Spillway is a water flow route that functions in extreme conditions to prevent overtopping of the dam. The most typical form of emergency spillway is an excavated channel in earth or rock near the dam. The function of the emergency spillway is to pass the storm flows without overtopping the dam. The spillway should always discharge away from the dam and should be constructed in such a manner that the spillway will not fail due to erosion during these high flow events. Failure of the spillway can be as catastrophic as failure of the dam. Discharge of the spillway onto the toe of the dam can rapidly erode the embankment and cause failure of the dam. Many of the smaller dams incorporate the functions of both the principal spillway and emergency spillway into a single structure.

A Valley Floor Drain (Figure 2) is a water discharge point placed at the lowest elevation in the pool to empty the lake if necessary. The valley floor drain is generally a pipe with a valve, which may be operated as needed. All dams should have the ability to control the level of the lake. Lake levels are changed for a variety of reasons, such as killing weeds and mosquitoes, making repairs to the dam, or even draining the lake to avoid dam failure.

Proper Dam Maintenance

All major portions of a dam need to be maintained collectively rather than maintaining each element separately.

Embankment:

1. Establish and maintain a good cover of grass.
   a. Seed or sod areas that have been repaired, are barren, or are thinly vegetated.
   b. Mow the vegetation as needed. Mowing allows the grasses to establish a thick erosion resistant sod, helps in the control of brushy vegetation, and makes it much easier to detect any potentially dangerous conditions such as seepage, erosion channels, cracks, and burrowing animals.

2. Remove and prevent the growth of trees and brush. These develop large root systems, which can provide seepage paths. When trees fall they can leave large holes, which can weaken the embankment. Brush, vine, and johnson grass obscure the surface, limit inspections, and provide a haven for burrowing animals.

3. Control and repair erosion. Refill and compact all erosion channels on the dam. While erosion channels occur on all areas of the dam, they are frequently most severe along the line of contact at the embankment and abutments.

4. Repair slumps and slides on a dam. A slump occurs for many reasons such as improper compaction, overly steep side slopes, and/or as a result of seepage. Determine the cause of the slump before repair. Correcting the underlying causes will save you time, labor, and expenses over the life of the structure.

5. Keep embankment slopes in good repair, conforming to the appropriate slope design. Embankment slopes are particularly susceptible to weathering. The action of waves, rain, freezing, and mechanical impacts can cause the movement, settlement, and/or erosion of the embankment. The embankment slope should be kept in good repair and should conform to the appropriate slope design.

6. Make sure the dam and surrounding area are free of animal traffic and habitation. Livestock can damage the sod covering, especially if the cover is thin or the dam is wet from rainfall. Overgrazing can result in the increased incidence of erosion. Keep burrowing animals off the dam by whatever means necessary. If animal dens are found, promptly repair them.

Principal Spillway:

1. Take action to ensure the primary purpose of the spillway, passing normal flows of water in a safe manner, is being accomplished.

2. Ensure that the conduit or pipe is sound and watertight. The conduit must have the strength to support the external loads of the embankment and lake. When the pipe is composed of jointed sections, those sections must be properly designed to remain watertight. Immediately repair a collapsed or separated portion of the pipe; this will usually involve drawing down the lake, and probably reconstructing part of the embankment. Corrugated steel pipe is not recommended for use as a conduit.

3. To ensure that all concrete structures are sound and on firm foundations, backfill any undermining of the slab or pipes and tightly seal any open joints.

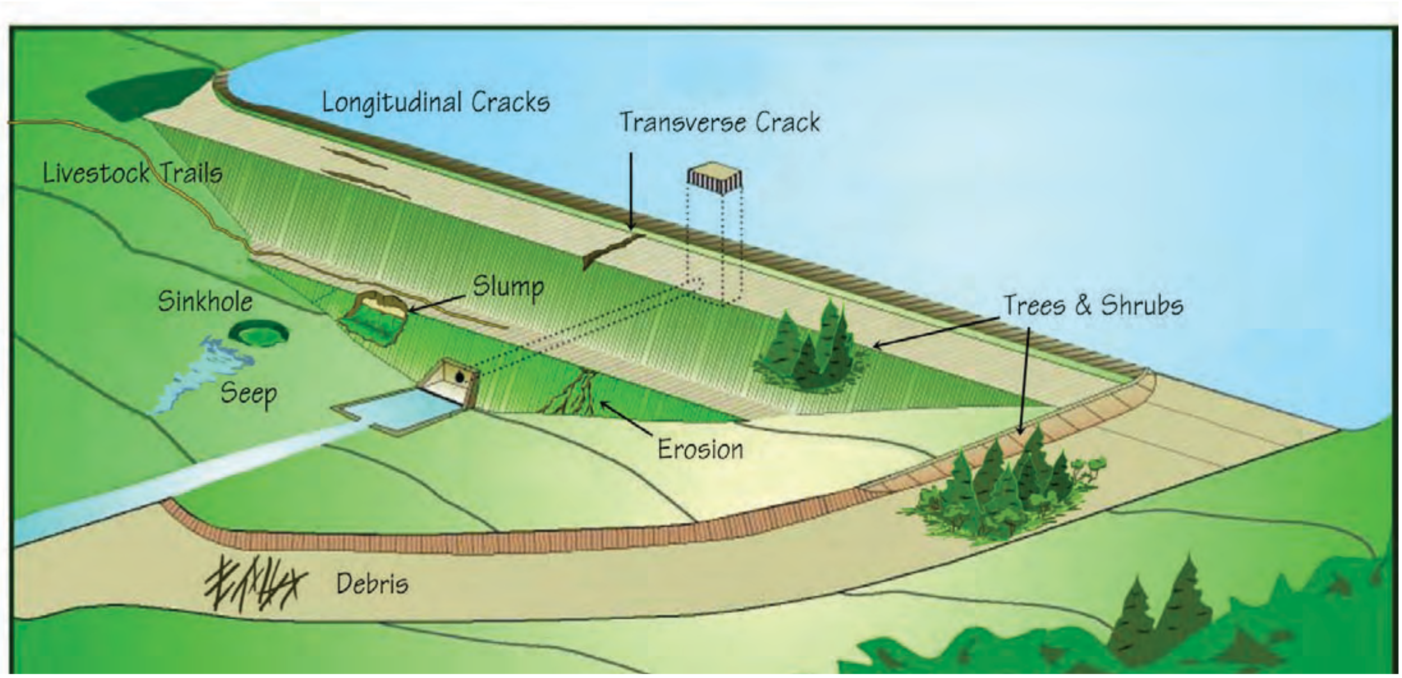

Figure 3: Problem areas on a dam

Any weep holes or drains associated with concrete structures should be open and functional. Failure to keep drains operative can cause significant damage to the structure and generate a large repair bill.

4. Ensure that the principal spillway passes flows in a manner that is not erosive to the dam, foundation, or the spillway itself. Erosion at the principal spillway outlet is caused by high velocity flow. Unchecked erosion can cause failure of the structure. Use measures such as stilling basins, commonly constructed of rip-rap or concrete baffles, to minimize erosion.

5. Eliminate any obstruction of the principal spillway. Obstructions can cause a reduction of flow and the carrying capacity of the spillway or conduit. Consequently, this increases the use of the emergency spillway. Principal spillways should be equipped with trash racks. These racks must be cleaned as a part of regular maintenance.

Emergency or Auxiliary Spillway

1. Take measures to ensure the proper function of the emergency spillway, which is to convey flood flows past the dam so the dam is not overtopped. This function is essential to the safety of any dam.

2. Ensure that the earthen portion of the spillway is covered by vegetation like that on the embankment. Grasses should be thick with well-bedded sod and mowed regularly. Barren areas and thinly vegetated areas should be reseeded or sodded. Keep the spillway area free of trees and brush.

3. Repair and vegetate all erosion gullies, slides, and slumps as soon as they occur. Erosion repair in earthen spillways is of particular importance after any period of flow in the spillway. The outlet channel and control sections of spillways are prime erosion areas. Their repair is crucial because erosion can expand very rapidly in the spillway.

4. On dams with concrete structures, keep the concrete sound by filling joints and cracks with appropriate filler. Keep drains in concrete structures open and functional. In earth spillways, concrete may be used to form control sections and chutes. Keep this concrete sound and functional.

5. Keep the emergency spillway area clear of trash, debris, and undesirable vegetation, such as trees and brush. Other obstacles are buildings, fences, fish screens, and guardrails. If left in place, all these obstructions can catch trash and reduce the capacity of the spillway, potentially causing hydraulic failure of the embankment.

Valley Floor Drain

1. Test the valley floor drain periodically to make sure it is functioning. It must be operable at all times for a variety of purposes including demands for water downstream and repair of spillway structures or embankment.

2. Handle all drawdowns in a controlled manner to minimize erosion and prevent slumping of the upstream embankment. Valley floor drains typically discharge into stilling basins or other erosion resistant structures.

Regular Dam Inspection

Regular inspection is the heart of your maintenance program. Only by regular inspection can problems be detected at an early stage and remedied. This is essential to preserve the integrity of the dam. The scope of the inspection should include the dam and spillways, areas downstream, on the abutments, and a general overview of the pool area. The dam and lake areas have to be viewed in the proper perspective with the surrounding terrain. Failure to inspect these areas raises the possibility of unforeseen problems in the valley and dam abutments, often influenced by the dam and lake. For a summary of inspections guidelines see Table 4. A Dam Inspection Checklist is also included on the last page of this guide.

During an inspection, the owner should be aware of various signs of danger. These signs can rarely be seen by simply driving past the dam. Many problems can often not be detected without a thorough examination on a well maintained (mowed and free of woody vegetation) dam.

Some signs of danger to look for are the following :

Seepage

The appearance of seepage on the downstream slope, abutments, or downstream area is cause for concern. The type and quantity of seepage should be studied. If the water is muddy or murky and is coming up from a well-defined hole, material is probably being eroded from inside the embankment and a potentially dangerous situation can develop. This type of problem requires immediate attention to stop the removal of material and control the seepage. Failures due to internal erosion or piping are examples of this type of seepage problem.

If the water is clear, it may be coming from an older hole and should be monitored closely for any changes in color and quantity.

Seepage can also occur on abutments, under spillways, and through the foundation and sometimes can exit some distance from the dam. Generally speaking, the further seepage exits from the dam, the less the probability of danger; however, it is important that all areas of seepage related to the dam be watched for changes.

Erosion

Erosion on the dam and spillway is one of the most evident signs of danger. The size of erosion channels and gullies can increase greatly with slight amounts of rainfall. Early detection of erosion channels can greatly facilitate necessary repairs of refilling, re-grading, and re-vegetation. Left unattended erosion can be significant enough to damage the integrity of the dam.

Erosion due to wave action is another easily detected danger sign. Remedies usually involve refilling the area with rock or earth and reseeding with the necessary vegetation.

Erosion from seepage through the dam, foundations, or abutments is a danger signal. This is more difficult to repair due to the seepage water. Repair generally involves refilling of the areas along with measures to collect and filter the seepage water. Repairs usually require the services of an engineer.

Cracks

The entire embankment should be closely inspected for cracks. Short isolated cracks are not usually significant, but larger, well-defined cracks indicate a problem is developing. Cracks are of two types: transverse and longitudinal.

Transverse cracks appear perpendicular to the axis of the dam and indicate settlement of the dam. Such cracks are an available avenue for water. Internal erosion could then develop very quickly.

Longitudinal cracks run parallel to the axis of the dam and may be the signal for a slide or slump on either face of the dam.

Cracks usually call for lowering the lake and taking reconstruction measures. They generally require the consultation of an engineer for remedy. Cracks may be evident in other areas such as spillway.

Slides and Slumps

Slides and slumps are usually the most detectable danger signal. A massive slide can mean catastrophic failure of the dam. Slides occur for many reasons, and their occurrence can mean major reconstruction effort.

Slides and slumps are normally preceded by cracks. Regular inspection can prevent any sudden failure. Repair will usually involve lowering the lake level. This can, if done too rapidly, cause a slide or slumping of the saturated material on the upstream embankment.

Remove any resultant slide material found in the spillway areas immediately since their presence reduces flow capacities.

Subsidence

Subsidence is vertical movement of the foundation materials due to failure of consolidation.

Rate of subsidence may be so slow that its detection can go unnoticed without proper inspection procedures. At its onset subsidence refers to movement over and beyond that anticipated . Subsidence may not have any well-defined cracks or seepage associated with it.

Danger signals of subsidence include conduit displacements or separations at joints, conduit ruptures or any collapses associated with it.

Conduit separations or ruptures can result in water leaking into the embankment and the subsequent weakening of the dam. Pipe collapse can result in hydraulic failures of the dam. It should be noted that rigid pipes, such as concrete pipes, are most likely to separate and crack, while flexible pipes, such as metal or plastic pipe conduits, are more subject to collapse.

Structure movements can be noticeable signs of subsidence. Listing or tilting of structures set in foundation material is a sign of distress. Movements of intake or discharge structures can cause loss of function of conduits and diminished hydraulic capacities. Further, these movements endanger the stability of the dam due to the introduction of water at conduit rupture points.

Subsidence is measured on embankments via permanent reference marker on the dam along with associated structure points off the dams. Check elevations regularly for readings. Changes in elevation can be an indication of subsidence.

Vegetation

A prominent danger signal is the appearance of undesirable types of vegetation such as cattails, reeds, mosses, and other wet area types of vegetation. The "wet environment" types of vegetation can be a sign of seepage. Prominent areas for undesirable vegetation are the toe of the dam, any area immediately downstream, and the abutments. Look closely in these areas for signs of seepage and take appropriate measures as discussed in the above section on seepage. Maintenance on these areas should involve the mowing and clearing of woody debris.

Boils

Boils are a serious danger signal and indicate seepage water exiting under some pressure. Boils typically occur in areas downstream of the dam. In boils, material is being removed, indicating piping in the foundation. Measures must be taken to filter and discharge the seepage in a controlled manner. To determine the cause and provide a permanent remedy, you will usually need to consult an engineer.

Livestock and Vehicle Trails

Trails left by livestock or vehicles can lead to erosion damaging the crest of the dam, its embankments and emergency spillway. Proper road material should be placed on the top of the dam if vehicle traffic is to be allowed. Dam embankments should be fenced off and livestock kept permanently off the dam. Vehicles should not be allowed on embankments or the emergency spillway.

Debris

The collection of debris on the dam and spillways has a potential for danger. Remove debris as soon as possible so it cannot reduce the function of spillways, damage structures and valves, or destroy vegetative cover.

TABLE 1. Hydraulic Failures

Form	Characteristics	Causes	Preventive or Corrective Measures
Overtopping	Flow over embankment washing out the dam.	1. Inadequate spillway capacity. 2. Clogging of spillway with debris. 3. Insufficient freeboard due to settlement or poor design.	1. Spillway designed for probable maximum flood. 2. Maintenance, trash booms, better design. 3. Allowance for freeboard and settlement in design; increase crest height.
Wave Erosion	Notching of upstream side of dam by waves.	Lack of rip-rap; too small rip-rap.	Properly design rip-rap.
Toe Erosion	Erosion of toe by outlet.	Spillway too close to drain; inadequate rip-rap.	Training walls; properly design rip-rap.
Embankment Erosion	Rainfall erosion on embankment.	Lack of sod or poor drainage control.	Grass sod; fine rip-rap; surface drains.

TABLE 2. Seepage Failures

Form	Characteristics	Causes	Preventive or Corrective Measures
Loss of Water	Excessive loss of water from lake and/or occasionally increased seepage or increased groundwater levels near lake.	1. Pervious dam foundation; 2. Pervious dam; 3. Leaking conduits; 4. Settlement cracks in dam; 5. Shrinkage cracks in dam.	1. Use foundation cutoff; grout; or upstream blanket 2. Impervious core; 3. Watertight joints; waterstops; grouting. 4. Remove compressible foundation; avoid sharp changes in abutment slope; compact soils at high moisture. 5. Use low plasticity clays for core; adequate compaction.
Seepage Erosion or Piping	Progressive internal erosion of soils from downstream side of dam or foundation backward toward the upstream side to form an open conduit (pipe). Can lead to a washout of a section of dam.	1. Settlement cracks in dam; 2. Shrinkage cracks in dam; 3. Pervious seams in foundation; 4. Pervious seams, roots in dam; 5. Concentration of seepage at face; Boundary seepage along conduits, walls; Leaking conduits; Animal burrows.	1. Remove compressible foundation; avoid sharp changes; internal drainage with protective filters; 2. Low plasticity soil; adequate compaction; internal drainage with protective filters. 3. Foundation relief drain with filter; cutoff. 4. Construction control; core; internal drainage with protective filter. 5. Toe drain; internal drainage with filter. 6. Stub cutoff walls, collars; good soil compaction. 7. Watertight joints; water stops; durable materials. 8. Rip-rap wire mesh.

TABLE 3. Structural Failures

Form	Characteristics	Causes	Preventive or Corrective Measures
Foundation Slide	Sliding of entire dam, one face or both faces in opposite directions; with bulging of foundation in the direction of movement	1. Soft or weak foundation. 2. Excess water pressure in confined sand or silt seams.	1. Flatten slope; employ broad berms; remove weak material; stabilize soil. 2. Drainage by deep drain trenches with protective filters; relief wells.
Upstream Slope	Slide in upstream face with little or no bulging in foundation below toe.	1. Steep slope. 2. Weak embankment soil. 3. Sudden drawdown of lake level.	1. Flatten slope or employ berm at toe. 2. Increased compaction; better soil. 3. Flatten slope; rock berms; operating rules.
Downstream Slope	Slide in downstream face.	1. Steep slope. 2. Weak soil. 3. Loss of soil strength by seepage pressure or saturation by seepage or rainfall.	1. Flatten slope or employ berm at toe. 2. Increased compaction; better soil. 3. Core; internal drainage with protective filters; surface drainage.
Flow Slide	Collapse and flow of soil in either upstream or downstream direction.	Loose embankment soil of low cohesion triggered by shock, vibration, seepage, or foundation movements.	Adequate compaction.

TABLE 4. Summary of Inspection Guidelines.													
Inspect For	Alignment	Animal Burrows	Cracks	Debris	Deterioration	Erosion	Human Activity	Leakage	Muddy Water	Seepage	Settlement & Slides	Vegetation	Weathering
Embankment Dam													
Upstream slope	X	X	X			X	X				X	X	
Downstream slope	X	X	X			X	X	X	X	X	X	X	
Abutments		X	X			X					X	X	
Crest	X	X				X					X	X	
Seepage areas								X	X	X		X	
Internal drainage					X			X	X				
Relief drains	X		X		X			X	X				
Concrete Dams													
Upstream face		X	X								X		X
Downstream face		X	X					X		X	X		
Abutments		X	X					X		X	X	X	X
Crests	X		X		X						X		X
Spillways													
Approach channel				X									
Stilling basin						X							
Discharge channel				X	X						X	X	
Control features				X	X								
Erosion protection							X				X		
Side slopes		X				X		X			X	X	
Inlets, Outlets, and Drains													
Inlet & Outlets	X			X	X			X				X	
Stilling basin													
Discharge channel			X	X								X	
Trash Racks				X									
Emergency systems					X		X						
General Areas													
Reservoir surface								X					
Shoreline											X	X	
Mechanical systems					X								
Electrical systems					X								
Upstream watershed						X							
Downstream floodplains						X							

SCS Sugar Creek Site # 44 dam, Caddo Cnty, OK washed out from heavy rains - 2007

OKLAHOMA WATER RESOURCES BOARD

PLANNING & MANAGEMENT DIVISION - DAM SAFETY PROGRAM

DAM INSPECTION CHECKLIST

Name of Dam:	______________________	State Inventory ID:	______________________
Owner of Dam:	______________________	Purpose of Dam:	______________________
Address:	______________________	Hazard Classification:	______________________
Phone:	______________________	County:	______________________
Email:	______________________	Inspected By:	______________________
Legal Location:	______________________	Date of Inspection:	______________________
Latitude:	______________________	Estimated Lake Level:	______________________
Longitude	______________________	Weather Conditions:	______________________

Note: Latitude-Longitude should be measured using a GPS and taken on the crest of the dam at the center.

	Item	Yes	No	N/A	[1]Condition (Good-Acceptable-Deficient-Poor)	Remarks
1	**General Conditions of Dam**					
A	Alterations to the dam?					
B	Development in downstream floodplain?					
C	Grass cover adequate?					
D	Settlements, misalignments, or cracks?					
E	Recent high water marks?					elevation
2	**Upstream Slope of Dam**					
A	Erosion, slides, or depressions?					
B	Trees or excessive vegetation?					
C	Animal burrows or holes?					
D	Evidence of livestock on dam?					
E	Cracks, settlement, or bulges?					
F	Evidence of slides or scarps?					
G	Adequate and sound slope protection (rip-rap)?					
3	**Crest of Dam**					
A	Longitudinal or transverse cracking?					
B	Trees or excessive vegetation?					
C	Crest arching or bowing?					
D	Erosion or ruts?					
E	Low areas or depressions?					
F	Evidence of livestock on crest?					
G	Road on crest?					
4	**Downstream Slope of Dam**					
A	Erosion, slides, or depressions?					
B	Trees or excessive vegetation?					
C	Animal burrows or holes?					
D	Evidence of livestock on embankment?					
E	Cracks, settlement, or bulges?					
F	Drains or wells flowing?					Estimated gpm clear or cloudy?
G	Seepage or boils?					Estimated gpm clear or cloudy?
5	**Abutment Contacts**					
A	Erosion, cracks, or slides?					
B	Seepage or boils?					Estimated gpm clear or cloudy?
6	**Inlet Structure**					
A	Concrete? ☐ Metal? ☐					
B	Spalling, cracking, or scaling?					
C	Exposed reinforcement?					
D	Corrosion present?					

	Item	Yes	No	N/A	[1]Condition (Good-Acceptable-Deficient-Poor)	Remarks
E	Coating adequate?					
F	Leakage?					Estimated gpm
G	Trash rack adequate?					
H	Obstacles to inlet?					
I	Drawdown operative? Opened & closed					
7	**Conduit & Outlet**					
A	Concrete? ☐ Metal? ☐					
B	Spalling, cracking, or scaling?					
C	Exposed reinforcement?					
D	Joints displaced or offset?					
E	Joint material lost?					
F	Leakage of valve or gates?					Estimated gpm
G	Other leakage?					Estimated gpm clear or cloudy?
H	Conduit misaligned?					
I	Outlet or channel obstructed?					
J	Outlet channel eroding?					
8	**Concrete Spillway**					
A	Spalling, cracking, or scaling?					
B	Exposed reinforcement or deterioration?					
C	Joints displaced or offset?					
D	Joint material lost?					
E	Leakage (joints, cracks, other)?					Estimated gpm clear or cloudy?
F	Wall displaced?					
G	Dissipater deteriorating?					
H	Dissipaters clean of debris or vegetation?					
I	Erosion at toe of spillway?					
J	Spillway undercutting?					
9	**Auxiliary (Emergency) Spillway**					
A	Obstructions, debris, trees?					
B	Erosion or sinkholes?					
C	Animal burrows or holes?					
D	Evidence of livestock on spillway?					
10	**Stilling Basin**					
A	Spalling, cracking, or scaling?					
B	Exposed reinforcement?					
C	Joints displaced or offset?					
D	Joint material lost?					
E	Joints leak?					Estimated gpm clear or cloudy?
F	Rock adequate?					
G	Excessive vegetation or debris in basin?					
H	Dissipater deteriorating?					
I	Dissipaters clean of debris or vegetation?					
11	**Gates**					
A	Floodgates broken or bent?					
B	Floodgates eroded or rusted?					
C	Floodgates operational?					
D	Floodgates leaking?					Estimated gpm
12	**Instruments**					
A	Structure instrumented?					
B	Monitoring performed?					
C	Instruments operational?					
13	**Development Below Dam** **(Low or Significant Hazard Dams)**					
A	Are there homes, businesses, or habitable structures located down-stream of the dam?					
14	**Emergency Action Plan &** **Maintenance Plan**					
A	Emergency action plan?					
B	Emergency services contacts up-to-date?					
C	Maintenance Plan?					

Remarks:

For High and Significant Hazard-Potential Dams Only

Professional Engineer Seal

Name of Engineer: ______________________________

Date: ______________________________

Engineering Firm: ______________________________

Address ______________________________

City, State, ZIP ______________________________

Signature: ______________________________

Telephone Number: ______________________________

Engineer's Email: ______________________________

[1]**Condition**: Please rate the condition of Sections 1 – 11 on inspection form either: Good, Acceptable, Deficient, or Poor.

Good - No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
Acceptable - No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.
Deficient - A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. Poor may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.
Poor - A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency

3800 Classen Blvd, Oklahoma City, OK
(405) 530-8800 • www.owrb.ok.gov

For more information on dams visit
www.damsafety.org/

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Natural Resources Conservation Service

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