APPENDIX C

EMERGENCY ACTION PLAN

EMERGENCY ACTION PLAN

FOR

COWPATH DAM AND SULLIVAN DAM

SHELBY, MONTANA

Owner-Operator:	City of Shelby, Montana 112 1st St S Shelby MT 59474
Mayor:	Gary McDermott
Engineers:	Triple Tree Engineering PO Box 162 Helena, MT 59624
Updated:	September 24, 2021

<u>If Cowpath Dam or Sullivan Dam is failing or failure seems imminent, call</u>:

All Emergency Services 911/434-5585

Toole County Disaster and Emergency Services (24 hours)
Kelsey Buckley, Coordinator . . . . . Home . 450-8013

Gary McDermott, Mayor. . . . . City Hall . 434-5222
Cell . 450-1173

Jack Johannes, City Superintendent . . . . City Shop . 434-5564
Cell . 304-1307

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INTRODUCTION

Purpose

The purpose of this emergency action plan (EAP) is primarily to safeguard the lives of secondarily to reduce property damage to the citizens of Shelby in the event of flooding caused by a failure of Sullivan Dam or Cowpath Dam.

Description of Dams

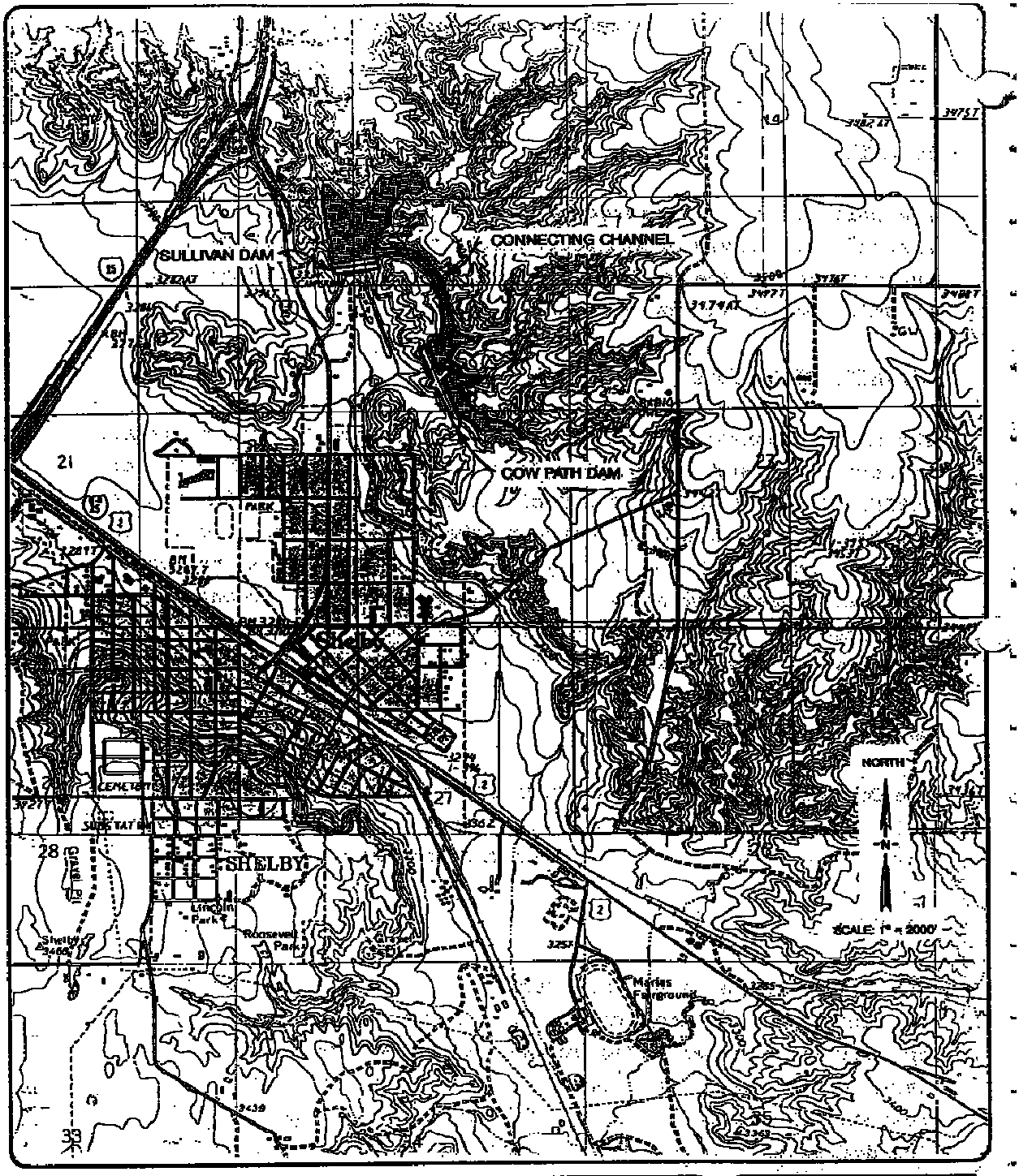
The Cowpath Dam/Sullivan Dam facility is located in the south 1/2 of Section 15, and the north 1/2 of Section 22, Township 32 North (T32N), Range 2 West (2W), Toole County, Montana. The dams are located on an unnamed tributary to the Marias River. The facility is owned by the City of Shelby and is used as a flood protection, recreation, and fish and wildlife storage facility. Technical data pertaining to the Cowpath Dam/Sullivan Dam facility are listed in Appendix A. The locations of the dams are shown on Figure 1.

Access to Dams

The Cowpath Dam/Sullivan Dam facility is located approximately one-half mile north of Shelby along Business Route 15. Two gravel roads provide access to the dams from the highway.

Hazard Area

The evacuation area extends through the City of Shelby and along the unnamed tributary to the confluence with the Marias River approximately seven miles to the south, as shown in Appendix B. Hazards include the possible inundation of commercial and residential buildings, the railroad and State Highway 2. Inundation and evacuation maps are included in Appendix B.



COW PATH AND SULLIVAN DAMS

VICINITY MAP

FIGURE 1

HKM ASSOCIATES
ENGINEERS · PLANNERS
8M334.101 | JULY 1991

Re

Responsibility and Authority

Pursuant to the Dam Safety Act, Chapter 15 of Title 85, MCA, the dam owner is responsible for production, coordination, maintenance, and implementation of this emergency action plan. The extent of owner implementation was defined through coordination of this plan with the Toole County Sheriff and the Disaster and Emergency Services (DES) coordinator.

Periodic Review/Update

The owner will review/update this EAP annually. Review/update by a qualified professional engineer will be accomplished as required by the dam's operating permit, but no less than every five years.

Approval

By my signature, I acknowledge that I, or my representative, have reviewed this plan and agree to the tasks and responsibilities assigned herein for my department and/or agency.

TOOLE COUNTY SHERIFF'S DEPT		DISASTER & EMERGENCY SERVICES	
	11-02-2024		
Signature	Date	Signature	Date

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TOOLE COUNTY SHERIFF'S DEPT		DISASTER & EMERGENCY SERVICES	
		Kelsey Bielby	11/02/2021
Signature	Date	Signature	Date

NOTIFICATION PROCEDURES

Imminent or Actual Failure

If you reasonable believe a dam failure is imminent or likely to occur, begin the "Actual or Imminent Failure" warning procedure illustrated on Figure 2 (page 5). If you reasonably believe a failure is not imminent and not likely to occur, follow the "Potentially Hazardous Situation" procedure on Figure 3 (page 7). **It is very important that you give full weight to downstream public safety while deciding which procedure to follow.** If Cowpath Dam and/or Sullivan Dam are failing, two things must be done immediately: (1) the hazard area downstream from the dam must be evacuated, and (2) any steps that might save the dam or reduce damage to the dam or hazard area downstream should be taken. (Refer to the map in Appendix B to determine the areas that are likely to be inundated if the dam fails). The evacuation should be initiated as shown in Figure 2.

It is the observer's responsibility to:

a. Call the Emergency Services Dispatch Center (911) and Disaster and Emergency Services. Be sure to say, "This is an emergency." They will call other authorities and the media and begin the evacuation.

b. Do whatever is necessary to bring anyone in immediate danger to safety. This includes someone on the dams, directly below the dams, or boating on the reservoir, or evacuees if so directed by the sheriff.

c. Keep in frequent touch with the Sheriff's Office. They will tell you how to handle the emergency.

d. If all means of communication are lost:
   - Try to find out why
   - Try to get to another radio or telephone that works
   - Get someone else to try to reestablish communications

If these means fail, handle the immediate problems as well as you can, and periodically try to reestablish contact with the Sheriff's Office. The Toole County Sheriff's Department will issue warnings to the general public in accordance with the Toole County Emergency Operations Plan.

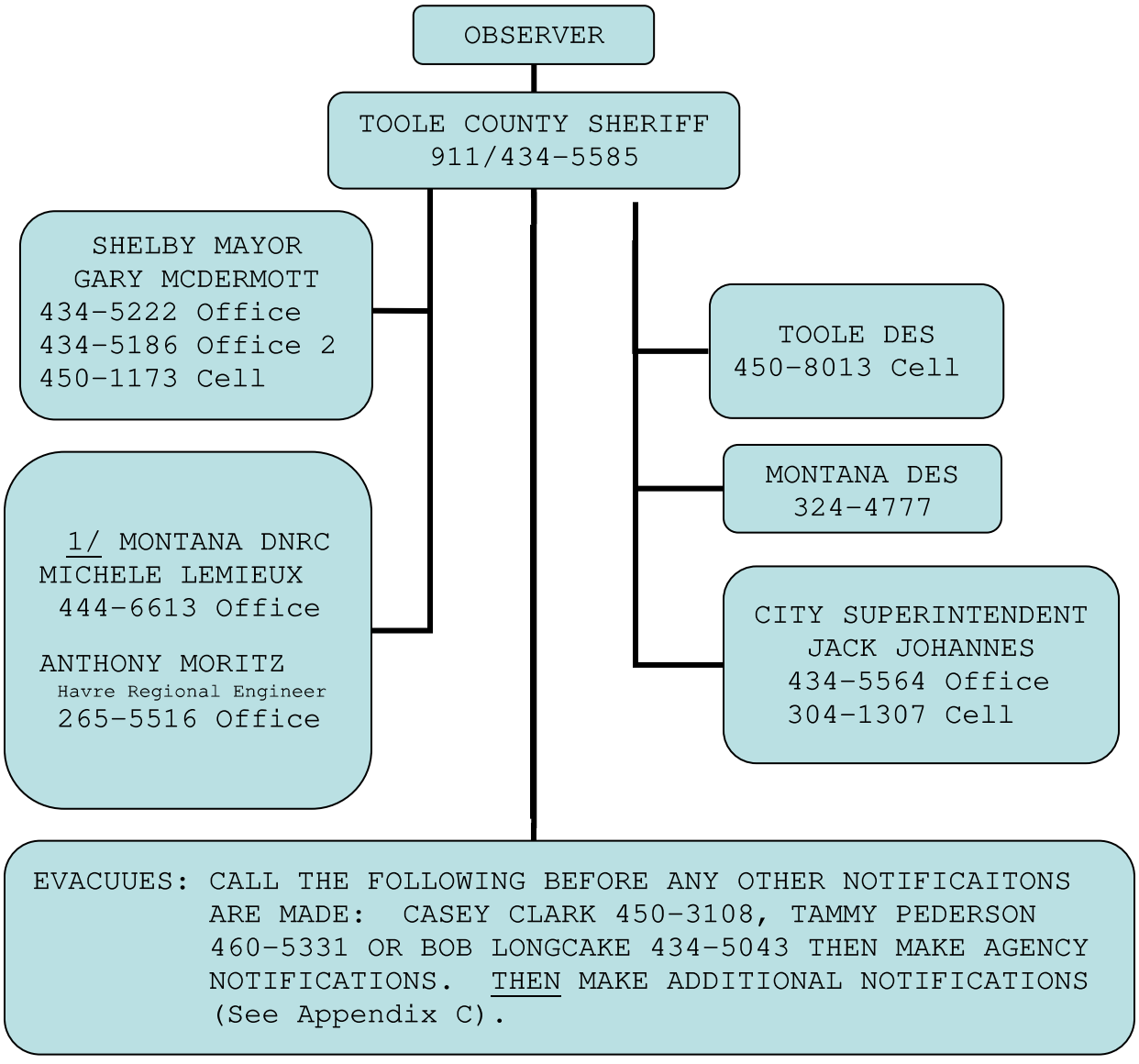
Figure 2

COWPATH/SULLIVAN DAMS

ACTUAL OR IMMINENT FAILURE

NOTIFICATION FLOWCHART

NEAREST PHONES TO THE DAM ARE:



1/ If unable to reach Montana Department of Natural Resources in the event of an emergency, call Montana DES at 327-4777 and ask for the DES Duty Officer.

Potentially Hazardous Situation

A potentially hazardous situation is an event or condition not normally encountered in the routine operation of the dam and reservoir. Among the unusual occurrences that my affect the dam are embankment problems, failure of the spillways or outlet works, heavy precipitation or rapid spring snowmelt, landslides, earthquakes, erosion, theft, vandalism, acts of sabotage, and serious accidents. Potential problems, causes, consequences, and actions are presented in Appendix E. These occurrences may endanger the dam, the public, or the downstream valley and may necessitate a temporary or permanent revision of the dam's operating procedures. The City Superintendent or his designee will appropriately inspect and monitor conditions in response to unusual occurrences that my affect the dam's structures. Help in these situations can be obtained by notifying those people shown in Figure 3.

If the observed discovers an unusual condition of the dam embankment that could threaten the structure:

a. Have a qualified engineer inspect the dam as soon as possible to determine whether emergency action is necessary
b. Notify the Toole County Disaster and Emergency Services Coordinator of the potential problem.
c. Contact Dam Safety Program of the Department of Natural Resources and Conservation.

When the City Superintendent calls either an engineer or the DNRC to report a problem, use the form in Appendix D to ensure you can provide sufficient information for the engineer to analyze the problems. In addition, prepare a sketch periodically if the problem develops further. The Manual for Operation and Maintenance of Dry Fork Dam includes further guidelines for courses of action to take to mitigate the effect of any problems. Continue to evaluate structure for failure and begin appropriate notifications if failure seems likely (see Figure 2).

Posting of the Notification Flowchart and Distribution of the Emergency Action Plan

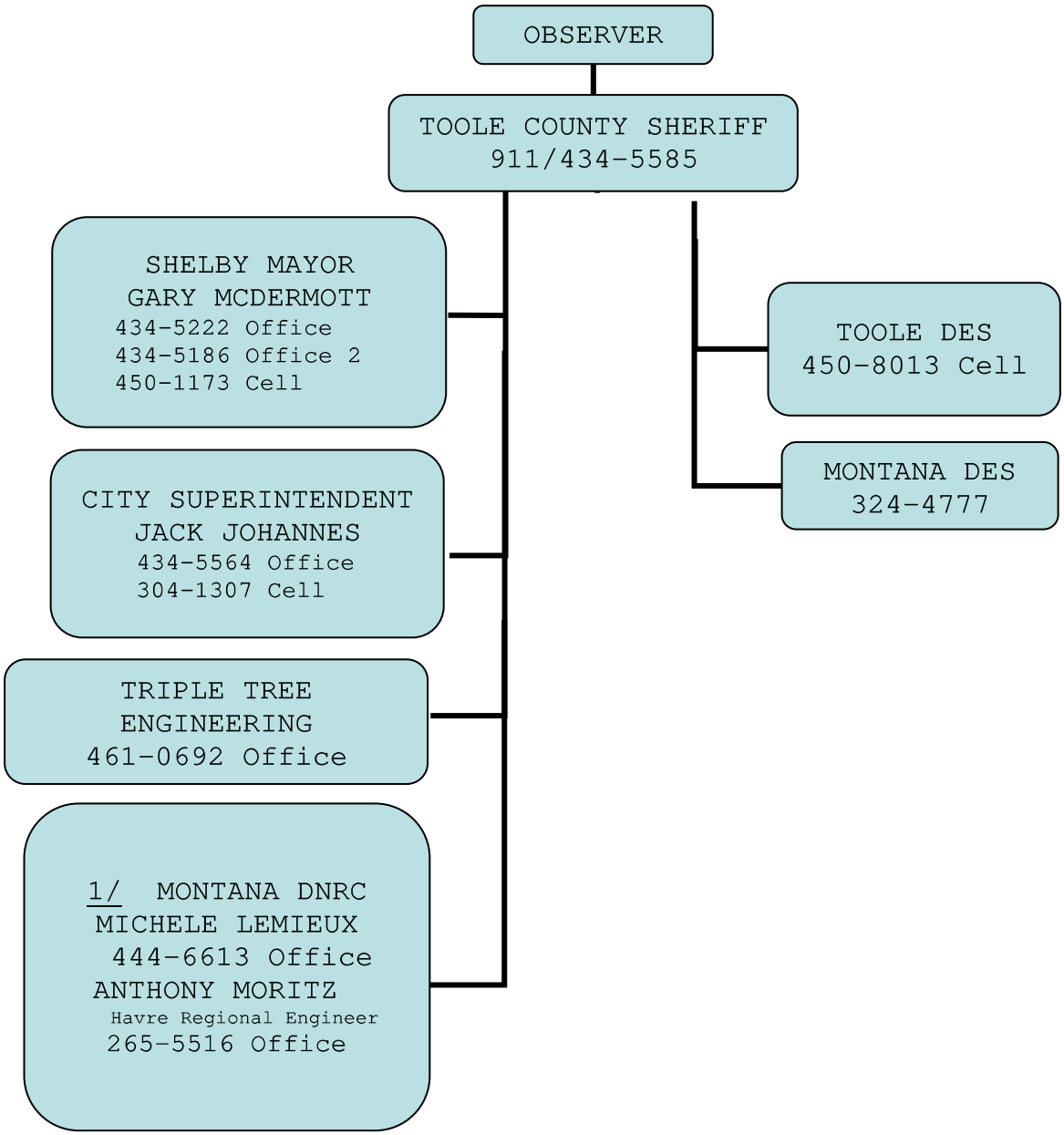
The Notification Flowchart is posted at the dam and a copy of the EAP is in the City Hall. The Toole County Sheriff's Office and the Toole County DES Coordinator also have copies of the plan.

FIGURE 3

COWPATH/SULLIVAN DAMS

POTENTIALLY HAZARDOUS SITUATION

NOTIFICATION FLOWCHART



1/ Principal notification is noted by solid lines. If the first individual in a sequence is not contacted, Toole County Sheriff's Department will provide notification to those following.

MITIGATION ACTION

Besides normal monitoring of the dam's condition the owner will provide continuous monitoring and inspection during and after extreme events such as storms and earthquakes. Information on the magnitude of an earthquake or storm can be obtained from the DNRC Dam Safety Program. Actions are suggested to mitigate problems that may develop, but those actions should never be continued at the risk of injury or at the expense of lessening efforts related to evacuation.

POTENTIAL PROBLEMS AND IMMEDIATE RESPONSE ACTIONS

Potential problems, causes, consequences, and actions are presented in Appendix E.

EMERGENCY SUPPLIES AND RESOURCES

Soils suitable for emergency repairs are present in the original borrow areas used for construction of the facility. These areas are located at the west end of Sullivan Dam and on the southwest side of the connecting channel. Soils are also available at the City of Shelby landfill.

LOCAL CONTRACTORS

Shelby:	Toole County Road Department	434-2742
	Hiline Redi-Mix	434-5391
Conrad:	Sullivan Brothers Construction	278-7940
Cut Bank:	Alme Construction	873-4771
Sunburst:	Pro Automotive	937-7400

ENGINEERS

Triple Tree Engineering, Helena, Montana 461-0692

APPENDIX A

TECHNICAL DATA FOR COWPATH DAM AND SULLIVAN DAM [1]/

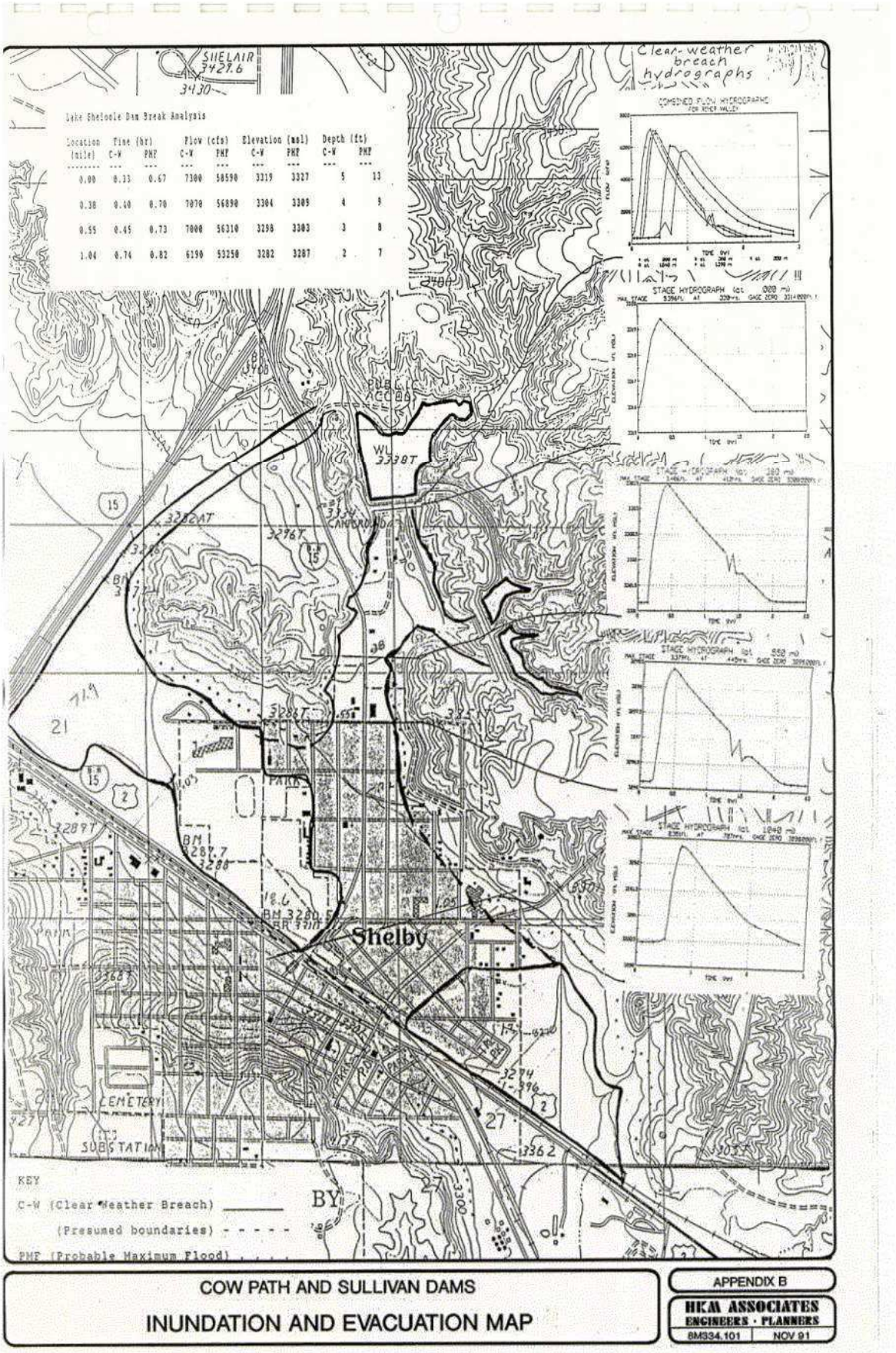
Maximum Reservoir Capacity to the Crest of the Dam:	Cowpath:	940 acre feet
	Sullivan:	1,470 acre feet
	TOTAL (including connecting channel):	2,480 acre feet
Normal Reservoir Capacity Measured to the Principal Spillway Crest:	Cowpath:	190 acre feet
	Sullivan:	360 acre feet
	TOTAL (including connecting channel):	553 acre feet
Normal Water Depth Measured from the Streambed To the Crest of the Principal Spillway:		27 feet
Dam Height Measured from the Streambed to the Crest of the Dam:		49 feet
Dam Crest Width:	Cowpath:	18 feet
	Sullivan:	18 feet
Dam Width at Base:	Cowpath:	283 feet
	Sullivan:	283 feet
Length of Dam Crest:	Cowpath:	1,425 feet
	Sullivan:	750 feet
Outlet Capacity at Maximum Surcharge:		20 cubic feet per second
Principal Spillway Capacity at Maximum Surcharge:		35 cubic feet per second
Emergency Spillway Capacity at Maximum Surcharge:		3150 cubic feet per second
Date Constructed:		1967

Slope of Upstream Face of Dam:
Cowpath: 3H:1V with a 10 feet wide berm at elev. 3341.0 feet MSL
Sullivan: 3H:1V with a 10 feet wide berm at elev. 3341.0 feet MSL

Slope of Downstream Face of Dam:
Cowpath: 2H:1V with a 10 feet wide berm at elev. 3341.0 feet MSL
Sullivan: 2H:1V with a 10 feet wide berm at elev. 3341.0 feet MSL

1/ CSSA. January 1980. Phase 1 Inspection Report, City of Shelby Watershed Dam

APPENDIX B


Clear-weather breach hydrographs
Lake Shelooke Dam Break Analysis
Location (mile) | Time (hr) C-W | PMF | Flow (cfs) C-W | PMF | Elevation (msl) C-W | PMF | Depth (ft) C-W | PMF
0.00 | 0.33 | 0.67 | 7300 | 58590 | 3319 | 3327 | 5 | 13
0.38 | 0.40 | 0.70 | 7070 | 56890 | 3304 | 3309 | 4 | 9
0.55 | 0.45 | 0.73 | 7000 | 56310 | 3298 | 3303 | 3 | 8
1.04 | 0.74 | 0.82 | 6190 | 53250 | 3282 | 3287 | 2 | 7
Shelby
KEY
C-W (Clear Weather Breach)
(Presumed boundaries)
PMF (Probable Maximum Flood)
COW PATH AND SULLIVAN DAMS
INUNDATION AND EVACUATION MAP
APPENDIX B
HKM ASSOCIATES
ENGINEERS · PLANNERS
8M334.101
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APPENDIX C

TELEPHONE DIRECTORY

A. **Priority One**

1. ALL EMERGENCY SERVICES (24 HOURS) 911

2. TOOLE COUNTY DISASTER AND EMERGENCY SERVICES. 450-8013
   Coordinator: Kelsey Buckley
   Montana Disaster and Emergency Services
   Division (Helena) 324-4777

3. EVACUEES (in upstream-to-downstream sequence)
   Clark, Casey 450-3108
   Pederson, Tammy. 460-5331
   Longcake, Bob 434-5043

B. **Priority Two**

4. ENGINEERS
   Triple Tree Engineering 461-0692

5. MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION (DNRC)
   Dam Safety Program . . . . . Office . 444-0862
   Engineer: Michele Lemieux . . Office . 444-6613
   DNRC Havre Office: . . . . . .Office . 265-5516

6. NATIONAL WEATHER SERVICE
   Great Falls 453-2081

7. OWNER AND OPERATOR OF COWPATH DAM & SULLIVAN DAM
   Mayor: Gary McDermott . . . . Office . 434-5222
   Cell . 450-1173
   Superintendent: Jack Johannes Office . 434-5564
   Cell . 304-1307

8. BUREAU OF LAND MANAGEMENT, Havre 262-2820

9. MONTANA DEPARTMENT OF STATE LANDS, Helena . . 444-5499

APPENDIX D

DAM INCIDENT REPORT FORM

DATE_____ TIME _____ A.M./P.M.

NAME OF DAM _____

STREAM NAME _____

LOCATION _____

COUNTY _____

OBSERVER _____

OBSERVER TELEPHONE _____

NATURE OF PROBLEM _____

_____

LOCATION OF PROBLEM AREA _____
(looking downstream)

_____

EXTENT OF PROBLEM AREA _____

_____

FLOW QUANTITY AND COLOR _____

_____

WATER LEVEL IN RESERVOIR _____

IS SITUATION WORSENING? _____

EMERGENCY STATUS _____

CURRENT WEATHER CONDITIONS _____

_____

ADDITIONAL COMMENTS _____

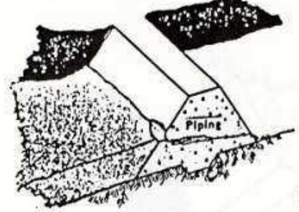
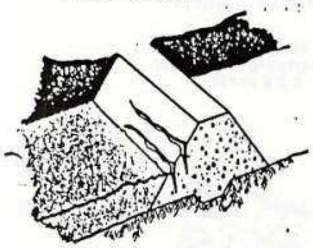
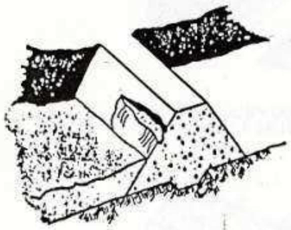
_____

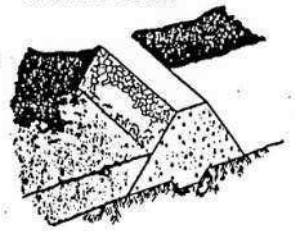
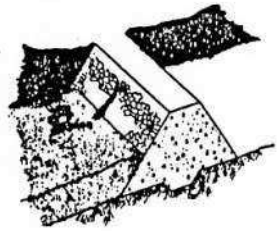
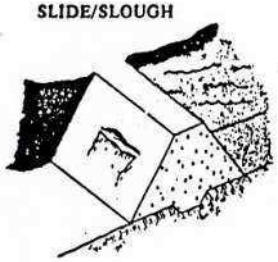
_____

APPENDIX E

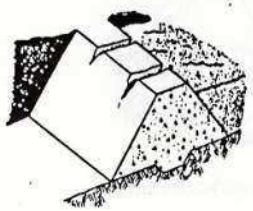
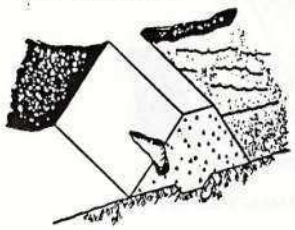
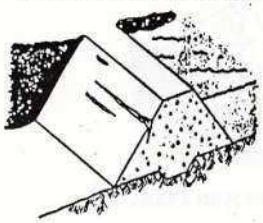
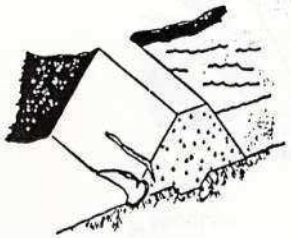
Potential Problems, Causes, Consequences and Action

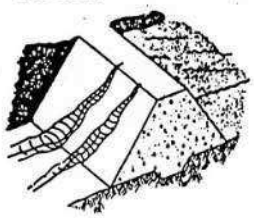
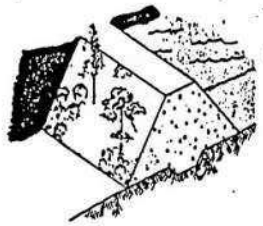
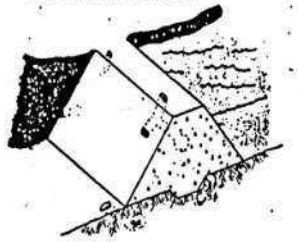
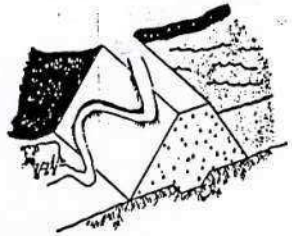
31 FIGURES 5.3.1
INSPECTION GUIDELINES - EMBANKMENT UPSTREAM SLOPE

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
SINKHOLE 	Piping or internal erosion of embankment materials or foundation causes a sinkhole. The cave-in of an eroded cavern can result in a sink hole. A small hole in the wall of an outlet pipe can develop a sink hole. Dirty water at the exit indicates erosion of the dam.	HAZARDOUS Piping can empty a reservoir through a small hole in the wall or can lead to failure of a dam as soil pipes erode through the foundation or a pervious part of the dam.	Inspect other parts of the dam for seepage or more sink holes. Identify exact cause of sink holes. Check seepage and leakage outflows for dirty water. A qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
LARGE CRACKS 	A portion of the embankment has moved because of loss of strength, or the foundation may have moved, causing embankment movement.	HAZARDOUS Indicates onset of massive slide or settlement caused by foundation failure.	Depending on embankment involved, draw reservoir level down. A qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
SLIDE, SLUMP OR SLIP 	Earth or rocks move down the slope along a slippage surface because of too steep a slope, or the foundation moves. Also, look for slides movement in reservoir basin.	HAZARDOUS A series of slides can lead to obstruction of the outlet or failure of the dam.	Evaluate extent of the slide. Monitor slide. (See Chapter 6.) Draw the reservoir level down if safety of dam is threatened. A qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
SCARPS, BENCHES, OVERSTEEP AREAS	Wave action, local settlement, or ice action cause soil and rock to erode and slide to the lower part of the slope forming a bench.	Erosion lessens the width and possible height of the embankment and could lead to increased seepage or overtopping of the dam.	Determine exact cause of scarps. Do necessary earthwork, restore embankment to original slope and provide adequate protection (bedding and riprap). See Chapter 7.

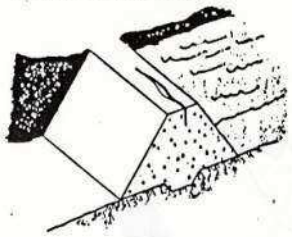
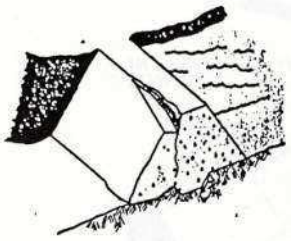
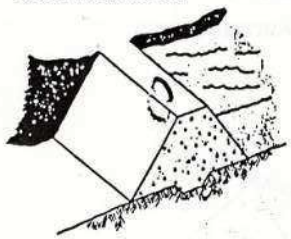
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMEND ACTIONS
BROKEN DOWN MISSING RIPRAP 	Poor quality riprap has deteriorated. Wave action or ice action has displaced riprap. Round and similar-sized rocks have rolled downhill.	Wave action against these unprotected areas decreases embankment width.	Re-establish normal slope. Place bedding and competent riprap. (See Chapter 7.)
EROSION BEHIND POORLY GRADED RIPRAP 	Similar-sized rocks allow waves to pass between them and erode small gravel particles and soil.	Soil is eroded away from behind the riprap. This allows riprap to settle, providing less protection and decreased embankment width.	Re-establish effective slope protection. Place bedding material. ENGINEER REQUIRED for design for gradation and size for rock for bedding and riprap. A qualified engineer should inspect the conditions and recommend further actions to be taken.
SLIDE/SLOUGH 	1. Lack of or loss of strength of embankment material. 2. Loss of strength can be attributed to infiltration of water into the embankment or loss of support by the foundation.	HAZARDOUS Massive slide cuts through crest or upstream slope reducing freeboard and cross section. Structural collapse or overtopping can result.	1. Measure extent and displacement of slide. 2. If continued movement is seen, begin lowering water level until movement stops. 3. Have a qualified engineer inspect the condition and recommend further action. ENGINEER REQUIRED

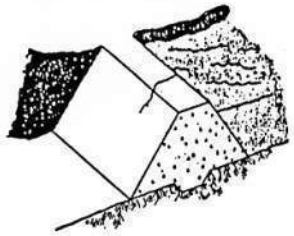
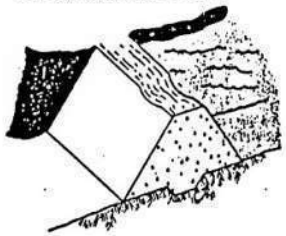
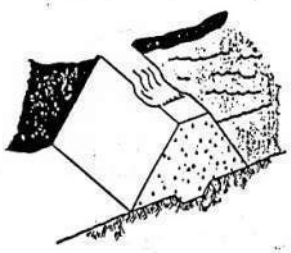
Figures 5.3.2
Inspection Guidelines - Downstream Slope

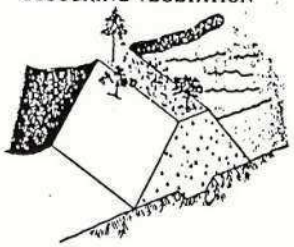
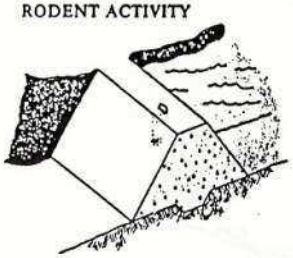
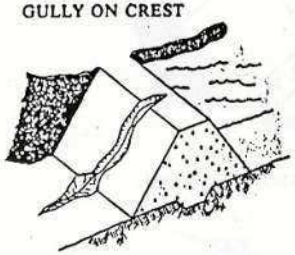
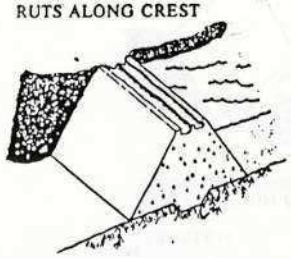
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
TRANSVERSE CRACKING 	Differential settlement of the embankment also leads to tranverse cracking (e.g., center settles more than abutments).	HAZARDOUS Settlement or shrinkage cracks can lead to seepage of reservoir water through the dam. Shrinkage cracks allow water to enter the embankment. This promotes saturation and increases freeze-thaw action.	1. If necessary, plug upstream end of crack to prevent flows from the reservoir. 2. A qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
CAVE IN/COLLAPSE 	1. Lack of adequate compaction. 2. Rodent hole below. 3. Piping through embankment or foundation.	HAZARDOUS Indicates possible wash out of embankment.	1. Inspect for and immediately repair rodent holes. Control rodents to prevent future damage. 2. Have a qualified engineer inspect the condition and recommend further action. ENGINEER REQUIRED
LONGITUDINAL CRACKING 	1. Drying and shrinkage of surface material. 2. Downstream movement of settlement of embankment.	1. Can be an early warning of a potential slide. 2. Shrinkage cracks allow water to enter the embankment and freezing will further crack the embankment. 3. Settlement or slide showing loss of strength in embankment can lead to failure.	1. If cracks are from drying, dress area with well-compacted material to keep surface water out and natural moisture in. 2. If cracks are extensive, a qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
SLUMP (LOCALIZED CONDITION) 	Preceded by erosion undercutting a portion of the slope. Can also be found on steep slopes.	Can expose impervious zone to erosion and lead to further slumps.	1. Inspect area for seepage. 2. Monitor for progressive failure. 3. Have a qualified engineer inspect the condition and recommend further action. ENGINEER REQUIRED

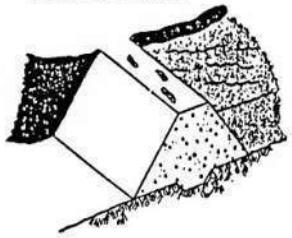
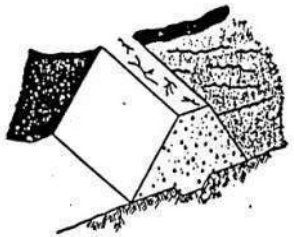
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
EROSION 	Water from intense rainstorms or snow-melt carries surface material down the slope, resulting in continuous troughs.	Can be hazardous if allowed to continue. Erosion can lead to eventual deterioration of the downstream slope and failure of the structure.	1. The preferred method to protect eroded areas is rock or riprap. 2. Re-establishing protective grasses can be adequate if the problem is detected early.
TREES/OBSCURING BRUSH 	Natural vegetation in area.	Large tree roots can create seepage paths. Bushes can obscure visual inspection and harbor rodents.	1. Remove all large, deep-rooted trees and shrubs on or near the embankment. Properly backfill void. (See Chapter 7.) 2. Control vegetation on the embankment that obscures visual inspection. (See Chapter 7.)
RODENT ACTIVITY 	Over-abundance of rodents. Holes, tunnels and caverns are caused by animal burrowings. Certain habitats like cattail type plants and trees close to the reservoir encourage these animals.	Can reduce length of seepage path, and lead to piping failure. If tunnel exists through most of the dam, it can lead to failure of the dam.	1. Control rodents to prevent more damage. 2. Backfill existing rodent holes. 3. Remove rodents. Determine exact location of digging and extent of tunneling. Remove habitat and repair damages. (See Chapter 7.)
LIVESTOCK/CATTLE TRAFFIC 	Excessive travel by livestock especially harmful to slope when wet.	Creates areas bare of erosion protection and causes erosion channels. Allows water to stand. Area susceptible to drying cracks.	1. Fence livestock outside embankment area. 2. Repair erosion protection, i.e., riprap, grass.

Figures 5.3.3
Inspection Guidelines - Embankment Crest

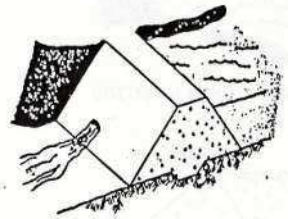
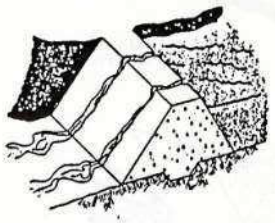
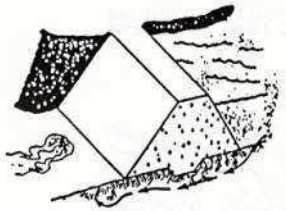
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
LONGITUDINAL CRACK 	1. Uneven settlement between adjacent sections or zones within the embankment. 2. Foundation failure causing loss of support to embankment. 3. Initial stages of embankment slide.	HAZARDOUS 1. Creates local area of low strength within embankment. Could be the point of initiation of future structural movement, deformation, or failure. 2. Provides entrance point for surface run-off into embankment, allowing saturation of adjacent embankment area, and possible lubrication which could lead to localized failure.	1. Inspect crack and carefully record location, length, depth, width, alignment, and other pertinent physical features. Immediately stake out limits of cracking. Monitor frequently. 2. Engineer should determine cause of cracking and supervise steps necessary to reduce danger to dam and correct condition. 3. Effectively seal the cracks at the crest's surface to prevent infiltration by surface water. 4. Continue to routinely monitor crest for evidence of further cracking. ENGINEER REQUIRED
VERTICAL DISPLACEMENT 	1. Vertical movement between adjacent sections of the embankment. 2. Structural deformation or failure caused by structural stress or instability, or by failure of the foundation.	HAZARDOUS 1. Provides local area of low strength within embankment which could cause future movement. 2. Leads to structural instability or failure. 3. Provides entrance point for surface water that could further lubricate failure plane. 4. Reduces available embankment cross section.	1. Carefully inspect displacement and record its location, vertical and horizontal displacement, length, and other physical features. Immediately stake out limits of cracking. 2. Engineer should determine cause of displacement and supervise all steps necessary to reduce danger to dam and correct condition. 3. Excavate area to the bottom of the displacement. Backfill excavation using competent material and correct construction techniques, and under supervision of engineer. 4. Continue to monitor areas routinely for evidence of future cracking or movement. (See Chapter 6.) ENGINEER REQUIRED
CAVE-IN ON CREST 	1. Rodent activity. 2. Hole in outlet conduit is causing erosion of embankment material. 3. Internal erosion or piping of embankment material by seepage. 4. Breakdown of dispersive clays within embankment by seepage waters.	HAZARDOUS 1. Void within dam could cause localized caving, sloughing, instability, or reduced embankment cross section. 2. Entrance point for surface water.	1. Carefully inspect and record location and physical characteristics (depth, width, length) of cave in. 2. Engineer should determine cause of cave in and supervise all steps necessary to reduce threat to dam and correct condition. 3. Excavate cave in, slope sides of excavation, and backfill hole with competent material using proper construction techniques. (See Chapter 7.) This should be supervised by engineer. ENGINEER REQUIRED

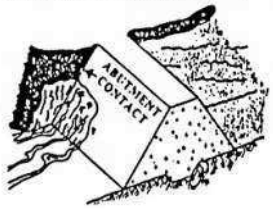
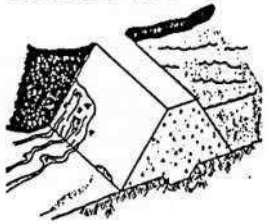
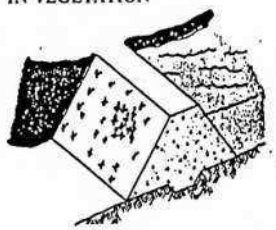
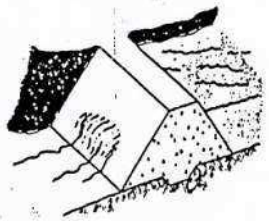
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
TRANSVERSE CRACKING 	1. Uneven movement between adjacent segments of the embankment. 2. Deformation caused by structural stress or instability.	HAZARDOUS 1. Can provide a path for seepage through the embankment cross section. 2. Provides local area of low strength within embankment. Future structural movement, deformation or failure could begin. 3. Provides entrance point for surface runoff to enter embankment.	1. Inspect crack and carefully record crack location, length, depth, width, and other pertinent physical features. Stake out limits of cracking. 2. Engineer should determine cause of cracking and supervise all steps necessary to reduce danger to dam and correct condition. 3. Excavate crest along crack to a point below the bottom of the crack. Then backfilling excavation using competent material and correct construction techniques. This will seal the crack against seepage and surface runoff. (See Chapter 7.) This should be supervised by engineer. 4. Continue to monitor crest routinely for evidence of future cracking. (See Chapter 6.) ENGINEER REQUIRED
CREST MISALIGNMENT 	1. Movement between adjacent parts of the structure. 2. Uneven deflection of dam under loading by reservoir. 3. Structural deformation or failure near area of misalignment.	1. Area of misalignment is usually accompanied by low area in crest which reduces freeboard. 2. Can produce local areas of low embankment strength which may lead to failure.	1. Establish monuments across crest to determine exact amount, location, and extent of misalignment. 2. Engineer should determine cause of misalignment and supervise all steps necessary to reduce threat to dam and correct condition. 3. Monitor crest monuments on a scheduled basis following remedial action to detect possible future movement. (See Chapter 6.) ENGINEER REQUIRED
LOW AREA IN CREST OF DAM 	1. Excessive settlement in the embankment or foundation directly beneath the low area in the crest. 2. Internal erosion of embankment material. 3. Foundation spreading to upstream and/or downstream direction. 4. Prolonged wind erosion of crest area. 5. Improper final grading following construction.	Reduces freeboard available to pass flood flows safely through spillway.	1. Establish monuments along length of crest to determine exact amount, location, and extent of settlement in crest. 2. Engineer should determine cause of low area and supervise all steps necessary to reduce possible threat of the dam and correct condition. 3. Re-establish uniform crest elevation over crest length by placing fill in low area using proper construction techniques. This should be supervised by engineer. 4. Re-establish monuments across crest of dam and monitor monuments on a routine basis to detect possible future settlement. ENGINEER REQUIRED

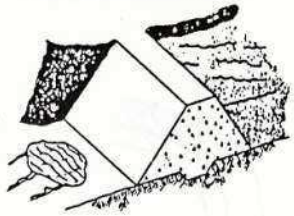
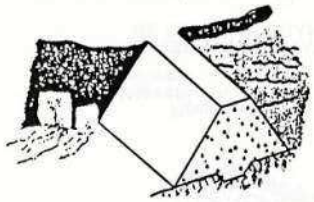
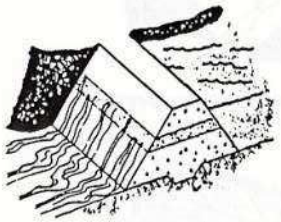
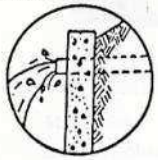
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
OBSCURING VEGETATION 	Neglect of dam and lack of proper maintenance procedures.	1. Obscures large parts of the dam, preventing adequate, accurate visual inspection of all parts of the dam. Problems which threaten the integrity of the dam can develop and remain undetected until they progress to a point that threatens the dam's safety. 2. Associated root systems develop and penetrate into the dam's cross section. When the vegetation dies, the decaying root systems can provide paths for seepage. This reduces the effective seepage path through the embankment and could lead to possible piping situations. 3. Prevents easy access to all parts of the dam for operation, maintenance, and inspection. 4. Provides habitat for rodents.	1. Remove all damaging growth from the dam. This would include removal of trees, bushes, brush, conifers, and growth other than grass. Grass should be encouraged on all segments of the dam to prevent erosion by surface runoff. Root systems should also be removed to the maximum practical extent. The void which results from removing the root system should be backfilled with wellcompetent, well-compacted material. 2. Future undesirable growth should be removed by cutting or spraying, as part of an annual maintenance program. (See Chapter 7.) 3. All cutting or debris resulting from the vegetative removal should be immediately taken from the dam and properly disposed of outside the reservoir basin.
RODENT ACTIVITY 	Burrowing animals.	1. Entrance point for surface runoff to enter dam. Could saturate adjacent portions of the dam. 2. Especially dangerous if hole penetrates dam below phreatic line. During periods of high storage, seepage path through the dam would be greatly reduced and a piping situation could develop.	1. Completely backfill the hole with competent, well-compacted material. 2. Initate a rodent control program to reduce the burrowing animal population and to prevent future damage to the dam. (See Chapter 7.)
GULLY ON CREST 	1. Poor grading Xand Improper drainage of crest. Improper drainage causes surface runoff to collect and drain of crest at low point in upstream or downstream shoulder. 2. Inadequate spillway capacity which has caused dam to overtop.	1. Can reduce available freeboard. 2. Reduces cross-sectional area of dam. 3. Inhibits access to all parts of the crest and dam. 4. Can result in a hazardous condition if due to overtopping.	1. Restore freeboard to dam by adding fill material in low area, using proper construction techniques. (See Chapter 7.) 2. Regrading crest to provide proper drainage of surface runoff. 3. If gully was caused by overtopping, provide adequate spillway which meets current design standards. This should be done by engineer. 4. Re-establish protective cover.
RUTS ALONG CREST 	Heavy vehicle traffic without adequate or proper maintenance or proper crest surfacing.	1. Inhibits easy access to all parts of crest. 2. Allows continued development of rutting. 3. Allows standing water to collect and saturate crest of dam. 4. Operating and maintenance vehicles can get stuck.	1. Drain standing water from ruts. 2. Regrade and recompact crest to restore integrity and provide proper drainage to upstream slope. (See Chapter 7.) 3. Provide gravel or roadbase material to accommodate traffic. 4. Do periodic maintenance and regrading to prevent reformation of ruts.

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
PUDDLING ON CREST-POOR DRAINAGE 	1. Poor grading and improper drainage of crest. 2. Localized consolidation or settlement on crest allows puddles to develop.	1. Cause localized saturation of the crest. 2. Inhibits access to all parts of the dam and crest. 3. Becomes progressively worse if not corrected.	1. Drain standing water from puddles. 2. Regrade and recompact crest to restore integrity and provide proper drainage to upstream slope. (See Chapter 7.) 3. Provide gravel or roadbase material to accommodate traffic. 4. Do periodic maintenance and regrading to prevent reformation of low areas.
DRYING CRACKS 	Material on the crest of dam expands and contracts with alternate wetting and drying of weather cycles. Drying cracks are usually short, shallow, narrow, and many.	Provides point of entrance for suface runoff and surface moisture, causing ststuration of adjacent embankment areas. This statura-tion, and later drying of the dam, could cause further cracking.	1. Seal surface of cracks with a tight, impervious material. (See Chapter 7.) 2. Routinely grade crest to provide proper drainage and fill cracks. -OR 3. Cover crest with non-plastic (not clay) material to prevent large moisture content variations.

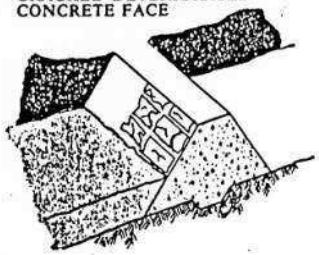
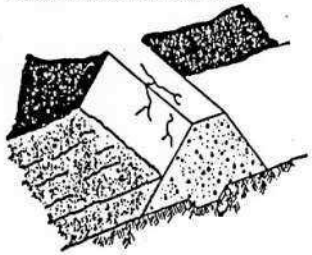
Figures 5.3.4
Inspection Guidelines - Embankment Seepage Areas

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
EXCESSIVE QUANTITY AND/OR MUDDY WATER EXITING FROM A POINT 	1. Water has created an open pathway, channel, or pipe through the dam. The water is eroding and carrying embankment material. 2. Large amounts of water have accumulated in the downstream slope. Water and embankment materials are exiting at one point. Surface agitation may be causing the muddy water. 3. Rodents, frost action or poor construction have allowed water to create an open pathway or pipe through the embankment.	HAZARDOUS 1. Continued flows can saturate parts of the embankment and lead to slides in the area. 2. Continued flows can further erode embankment materials and lead to failure of the dam.	1. Begin measuring outflow quantity and establishing whether water is getting muddier, staying the same, or clearing up. 2. If quantity of flow is increasing the water level in the reservoir should be lowered until the flow stabilizes or stops. 3. Search for opening on upstream side and plug if possible. 4. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
STREAM OF WATER EXITING THROUGH CRACKS NEAR THE CREST 	1. Severe drying has caused shrinkage of embankment material. 2. Settlement in the embankment or foundation is causing the transverse cracks.	HAZARDOUS Flow through the crack can cause failure of the dam.	1. Plug the upstream side of the crack to stop the flow. 2. The water level in he reservoir should be lowered until it is below the level of the cracks. 3. A qualified engineer should inspect the condition and recommend further actions to be taken.
SEEPAGE WATER EXITING AS A BOIL IN THE FOUNDATION 	Some part of the foundation material is supplying a flow path. This could be caused by a sand or gravel layer in the foundation.	HAZARDOUS Increased flows can lead to erosion of the foundation and failure of the dam.	1. Examine the boil for transportation of foundation materials. 2. If soil particles are moving downstream, sandbags or earth should be used to create a dike around the boil. The pressures created by the water level within the dike may control flow velocities and temporarily prevent further erosion. 3. If erosion is becoming greater, the reservoir level should be lowered. 4. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED

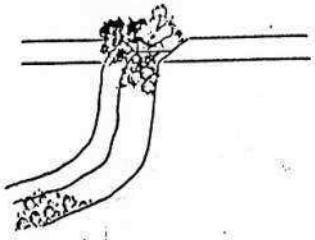
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
SEEPAGE EXITING AT ABUTMENT CONTACT 	1. Water flowing through pathways in the abutment. 2. Water flowing through the embankment.	HAZARDOUS Can lead to erosion of embankment materials and failure of the dam.	1. Study leakage area to determine quantity of flow and extent of saturation. 2. Inspect daily for developing slides. 3. Water level in reservoir may need to be lowered to assure the safety of the embankment. 4. A qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
LARGE AREA WET OR PRODUCING FLOW 	A seepage path has developed through the abument or embankment materials and failure of the dam can occur.	HAZARDOUS 1. Increased flows could lead to erosion of embankment material and failure of the dam. 2. Saturation of the embankment car lead to local slides which could cause failure of the dam.	1. Stake out the saturated area and monitor for growth or shrinking. 2. Measure any outflows as accurately as possible. 3. Reservoir level may need to be lowered if saturated areas increase in size at a fixed storage level or if flow increases. 4. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
MARKED CHANGE IN VEGETATION 	1. Embankment material are supplying flows path. 2. Natural seeding by wind. 3. Change in seed type during early post construction seeding.	Can show a saturated area.	1. Use probe and shovel to establish if the materials in this area are wetter than surrounding areas. 2. If areas shows wetness, when surrounding areas do not, a qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
BULGE IN LARGE WET AREA 	Downstream embankment materials have begun to move.	HAZARDOUS Failure of the embankment result from massive sliding can follow these early movements.	1. Compare embankment cross section to the end of construction condition to see if observed condition may reflect end of construction. 2. Stake out affected area and accurately measure outflow. 3. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED

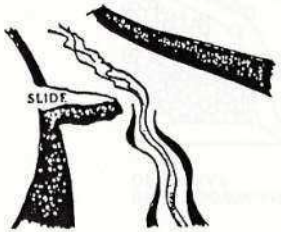
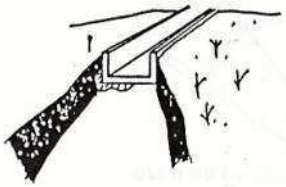
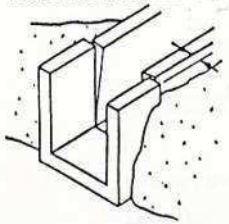
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
TRAMPOLINE EFFECT IN LARGE SOGGY AREA 	1. Water moving rapidly through the embankment or foundation is being controlled or contained by a well-established turf root system.	Condition shows excessive seepage in the area. If control layer of turf is destroyed, rapid erosion of foundation materials could result in failure of the dam.	1. Carefully inspect the area for outflow quantity and any transported material. 2. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
LEAKAGE FROM ABUTMENTS BEYOND THE DAM 	Water moving through cracks and fissures in the abutment materials.	Can lead to rapid erosion of abutment and evacuation of the reservoir. Can lead to massive slides near or downstream from the dam.	1. Carefully inspect the area to determine quantity of flow and amount of transported material. 2. A qualified engineer or geologist should inspect the condition and recommend further actions to be taken.
WET AREA IN HORIZONTAL BAND 	Frost layer or layer of sandy material in original construction	HAZARDOUS 1. Wetting of areas below the area of excessive seepage can led to localized instability of the embankment. (SLIDES) 2. Excessive flows can lead to accelerated erosion of embankment materials and failure of the dam.	1. Determine as closely as possible the flow being produced. 2. If flow increases, reservoir level should be reduced until flow stabilizes or stops. 3. Stake out the exact area involved. 4. Using hand tools, try to identify the material allowing the flow. 5. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
LARGE INCREASE IN FLOW OR SEDIMENT IN DRAIN OUTFALL 	A shortened seepage path or increased storage levels.	HAZARDOUS 1. Higher velocity flows can cause erosion of drain then embankment materials. 2. Can lead to piping failure.	1. Accurately measures outflow quantity and determine amount of increase over previous flow. 2. Collect jar samples to compare turbidity. 3. If either quantity or turbidity has increased by 25%, a qualified engineer should evaluate the condition and recommend further actions. ENGINEER REQUIRED

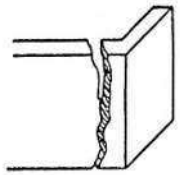
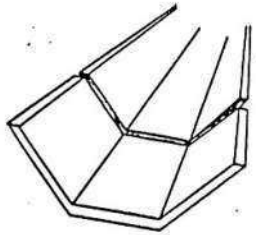
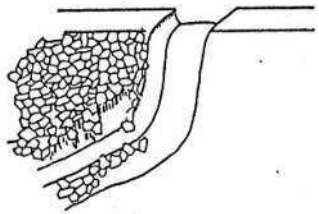
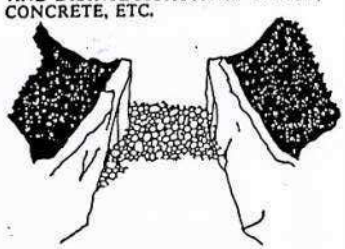
Figures 5.4
Inspection Guidelines - Concrete Upstream Slope

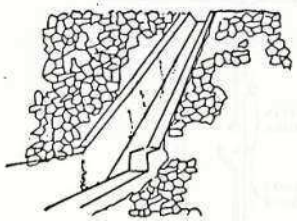
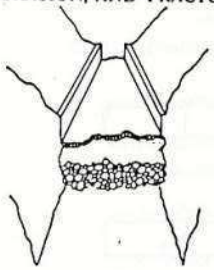
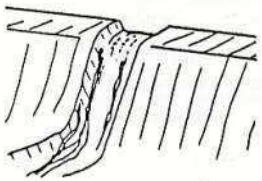
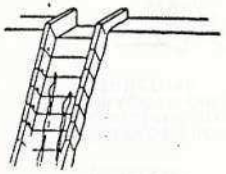
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
CRACKED DETERIORATED CONCRETE FACE 	Concrete deteriorated resulting from weathering. Joint filler deteriorated or displaced.	Soil is eroded behind the face and caverns can be formed. Unsupported sections of concrete crack. Ice action may displace concrete.	Determine cause. Either patch with grout or contact engineer for permanent repair method. 2. If damage is extensive, a qualified engineer should inspect the conditions and recommend further actions to be taken. ENGINEER REQUIRED
CRACKS DUE TO DRYING 	The soil loses its moisture and shrinks, causing cracks. NOTE: Usually seen on crest and downstream slope mostly.	Heavy rains can fill up cracks and cause small parts of embankment to move along internal slip surface.	1. Monitor cracks for increases in width, depth, or length. 2. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED

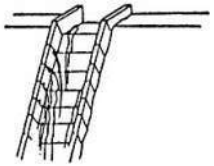
Figures 5.5
Inspection Guidelines - Spillways

EXCESSIVE VEGETATION OR DEBRIS IN CHANNEL 	Accumulation of slide materials, dead trees, excessive vegetative growth, etc., in spillway channel.	Reduced discharge capacity; overflow of spillway; overtopping of dam. Prolonged overtopping can cause failure of the dam.	Clean out debris periodically; control vegetative growth in spillway channel. Install log boom in front of spillway entrance to intercept debris.

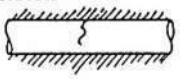
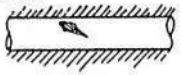
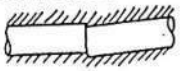
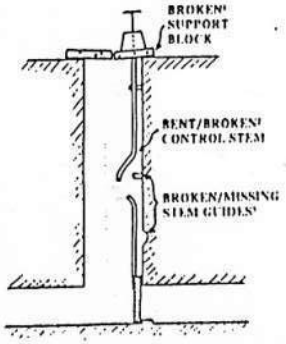
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
EROSION CHANNELS 	Surface runoff from intense rainstorms or flow from spillway carries surface material down the slope, resulting in continous troughs. Livestock traffic create gullies where flow concentrates varies.	Unabated erosion can lead to slides, slumps or slips which can result in reduced spillway capacity. Inadequate spillway capacity can lead to embankment overtopping and result in dam failure.	Photograph condition. Repair damaged areas by replacing eroded material with compacted fill. Protect areas against future erosion by installing suitable rock riprap. Revegetate area if appropriate. Bring condition to the attention of the engineer during next inspection.
EXCESSIVE EROSION IN EARTH-SLIDE CAUSES CONCENTRATED FLOWS 	Discharge velocity too high; bottom and slope material loose or deteriorated; channel and bank slopes too steep; bare soil unprotected; poor construction protective surface failed.	Disturbed flow pattern; loss of material, increased sediment load downstream; collapse of banks; failure of spillway; can lead to rapid evacuation of the reservoir through the severely eroded spillway.	Minimize flow velocity by proper design. Use sound material. Keep channel and bank slopes mild. Encourage growth of grass on soil surface. Construct smooth and well-compacted surfaces. Protect surface with riprap, asphalt, or concrete. Repair eroded part using sound construction practices.
END OF SPILLWAY CHUTE UNDERCUT 	Poor configuration of stilling basin area. Highly erodible materials. Absence of cutoff wall at end of chute.	HAZARDOUS Structural damage to spillway structure; collapse of slab and wall lead to costly repair.	Dewater affected area; clean out eroded area and properly backfill. Improve stream channel below chute; provide properly sized riprap in stilling basin area. Install cutoff wall.
WALL DISPLACEMENT 	Poor workmanship; uneven settlement of foundation; excessive earth and water pressure; insufficent steel bar reinforcement of concrete.	Minor displacement will create eddies and turbulence in the flow, causing erosion of the soil behind the wall. Major displacement will cause severe cracks and eventual failure of the structure.	Reconstruction should be done according to sound engineering practices. Foundation should be carefully prepared. Adequate weep holes should be installed to relieve water pressure behind wall. Use enough reinforcement in the concrete. Anchor walls to prevent further displacement. Install struts between spillway walls is needed. Clean out and backflush drains to assure proper operations. Consult an engineer before actions are taken. ENGINEER REQUIRED

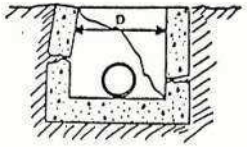
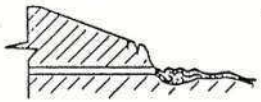
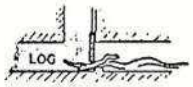
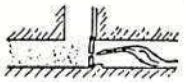
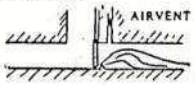
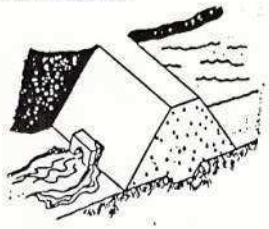
PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
LARGE CRACKS 	Construction defect; local concentrated stress; local material deterioration; foundation failure, excessive backfill pressure.	HAZARDOUS Disturbance in flow patterns; erosion of foundation and backfill; eventual collapse of structure.	Large cracks without large displacement should be repaired by patching. Surrounding areas should be cleaned or cut out before patching material is applied. (See Chapter 7.) Installation of weep holes or other actions may be needed.
OPEN OR DISPLACED JOINTS 	Excessive and uneven settlement of foundation; sliding of concrete slab; construction joint too wide and left unsealed. Sealant deteriorated and washed away.	HAZARDOUS Erosion of foundation material may weaken support and cause further cracks; pressure induced by water flowing over displaced joints may wash away wall or slab, or cause extensive undermining.	Construction joint should be no wider than 1/2 inch. All joints should be sealed with asphalt or other flexible materials. Waterstops should be used where feasible. Clean the joint, replace eroded materials, and seal the joint. Foundations should be properly drained and prepared. Underside of chute slabs should have ribs of enough depth to prevent sliding. Avoid steep chute slope. ENGINEER REQUIRED
BREAKDOWN AND LOSS OF RIPRAP 	Slope too steep; material poorly graded; failure of subgrade; flow velocity too high; improper placement of material; bedding material or foundation washed away.	HAZARDOUS Erosion of channel bottom and banks; failure of spillway.	Design a stable slope for channel bottom and banks. Riprap material should be well graded (the material should contain small, medium, and large particles). Sub-grade should be properly prepared before placement of riprap. Install filter fabric if necessary. Control flow velocity in the spillway by proper design. Riprap should be placed according to specification. Services of an engineer are recommended. ENGINEER REQUIRED
MATERIAL DETERIORATION- SPALLING AND DISINTEGRATION OF RIPRAP, CONCRETE, ETC. 	Use of unsound or defective materials; structures subject to freeze-thaw cycles; improper maintenance practices; harmful chemicals.	Structure life will be shortened; premature failure.	Avoid using shale or sandstone for riprap. Add air-entraining agent when mixing concrete. Use only clean good quality aggregates in the concrete. Steel bars should have at least 1 inch of concrete cover. Concrete should be kept wet and protected from freezing during curing. Timber should be treated before using.

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
POOR SURFACE DRAINAGE 	No weep holes; no drainage facility; plugged drains.	Wet foundation has lower supporting capacity; uplift pressure resulting from seepage water may cause damage to spillway chute; accumulation of water may also increase total pressure on spillway walls and cause damage.	Install weep holes on spillway walls. Inner end of hole should be surrounded and packed with graded filtering material. Install drain system under spillway near downstream end. Clean out existing weep holes. Backflush and rehabilitate drain system under the supervision of an engineer. ENGINEER REQUIRED
CONCRETE EROSION, ABRASION, AND FRACTURING 	Flow velocity too high (usually occurs at lower end of chute in high dams); rolling of gravel and rocks down the chute; cavity behind or below concrete slab.	Pock marks and spalling of concrete surface may progressively become worse; small hole may cause undermining of foundation, leading to failure of structure.	Remove rocks and gravels from spillway chute before flood season. Raise water level in stilling basin. Use good quality concrete. Assure concrete surface is smooth. ENGINEER REQUIRED
LEAKAGE IN OR AROUND SPILLWAY 	1. Cracks and joints in geologic formation at spillway are permitting seepage. 2. Gravel or sand layers at spillway are permitting seepage.	HAZARDOUS 1. Could lead to excessive loss of stored water. 2. Could lead to a progressive failure if velocities are high enough to cause erosion of natural materials.	1. Examine exit area to see if type of material can explain leakage. 2. Measure flow quantity and check for erosion of natural materials. 3. If flow rate or amount of eroded materials increases rapidly, reservoir level should be lowered until flow stabilizes or stops. 4. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED
TOO MUCH LEAKAGE FROM SPILLWAY UNDER DRAINS 	Drain or cutoff may have failed.	HAZARDOUS 1. Excessive flows under the spillway could lead to erosion of foundation material and collapse of parts of the spillway. 2. Uncontrolled flows could lead to loss of stored water.	Same as above.

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
SEEPAGE FROM A CONSTRUCTION JOINT OR CRACK IN CONCRETE STRUCTURE 	Water is collecting behind structure because of insufficient drainage or clogged weep holes.	1. Can cause walls to tip in and over. Flows through concrete can lead to rapid deterioration from weathering. 2. If the spillway is located within the embankment, rapid erosion can lead to failure of the dam.	1. Check area behind wall for puddling of surface water. 2. Check and clean as needed; drain outfalls, flush lines, and weep holes. 3. If condition persists a qualified engineer should inspect the condition and recommend further actions to be taken.

Figures 5.6
Inspection Guidelines - Inlets, Outlets and Drains

OUTLET PIPE DAMAGE			
CRACK 	Settlement; impact.	Excessive seepage, possible internal erosion.	Check for evidence of water either entering or exiting pipe at crack/hole/etc.
HOLE 	Rust (steel pipe) Erosion (concrete pipe) Cavitation	HAZARDOUS Excessive seepage, possible internal erosion.	Tap pipe in vicinity of damaged area, listening for hollow sound which shows a void has formed along the outside of the conduit.
JOINT OFFSET 	Settlement or poor construction practice.	HAZARDOUS Provides passageway for water to exit or enter pipe, resulting in erosion of internal materials of the dam.	If a progressive failure is suspected, request engineering advice.
CONTROL WORKS 	1. BROKEN SUPPORT BLOCK Concrete deterioration. Excessive force exerted on control stem by trying to open gate when it was jammed. 2. BENT/BROKEN CONTROL STEM Rust. Excess force used to open or close gate. Inadequate or broken stem guides. 3. BROKEN/MISSING STEM GUIDES Rust. Inadequate lubrication. Excess force used to open or close gate when it was jammed.	Causes control support block to tilt: control stem may bind. Control head works may settle. Gate may not open all the way. Support block may fail completely, leaving outlet inoperable. HAZARDOUS Outlet is inoperable. Loss of support for control stem. Stem may buckle and break under even normal use, (as in this example).	Any of these conditions can mean the control is either inoperable or at best partly operable. Use of the system should be minimized or discontinued. If the outlet system has a second control valve, consider using it to regulate releases until repairs can be made. Engineering help is recommended.

PROBLEM	PROBABLE CAUSE	POSSIBLE CONSEQUENCES	RECOMMENDED ACTIONS
FAILURE OF CONCRETE OUTFALL STRUCTURE 	Excessive side pressures on nonreinforce concrete structure. Poor concrete quality.	HAZARDOUS Loss of outfall structure exposes embankment to erosion by outlet releases.	1. Check for progressive failure by monitoring typical dimension, such as "D" shown in figure. 2. Repair by patching cracks and supplying drainage around concrete structure. Total replacement of outfall structure may be needed.
OUTLET RELEASES ERODING TOE OF DAM 	Outlet pipe too short. Lack or energy-dissipating pool or structure at downstream end of conduit.	HAZARDOUS Erosion of toe oversteepens downstream slope, causing progressive sloughing.	1. Extend pipe beyond toe (use a pipe of same size and material, and form watertight connection to existing conduit). 2. Protect embankment with riprap over suitable bedding.
VALVE LEAKAGE			
DEBRIS STUCK UNDER GATE 	Trashrack missing or damaged.	Gate will not close. Gate or stem may be damaged in effort to close gate.	Raise and lower gate slowly until debris is loosened and floats past valve. When reservoir is lowered, repair or replace trashrack.
CRACKED GATE LEAF 	Ice action, rust, affect vibration, or stress resulting from forcing gate closed when it is jammed.	Gate-leaf main fail completely, evacuating reservoir.	Use valve only in fully open or closed position. Minimize use of valve until leaf can be repair or replaced.
DAMAGE GATE SEAT OR GUIDES 	Rust, erosion, cavitation, vibration, or wear.	Leakage and loss of support for gate leaf. Gate may bind in guides and become inoperable.	Minimize use of valve until guides/seats can be repaired. If cavitation is the cause, check to see if air vent pipe exist, and is unobstructed.
SEEPAGE WATER EXITING FROM A POINT ADJACENT TO THE OUTLET 	1. A break in the outlet pipe. 2. A path for flow has developed along the outside of the outlet pipe.	HAZARDOUS Continued flows can lead to raid erosion of embankment materials and failure of the dam.	1. Thoroughly investigate the area by probing and/or shovelling to see if the cause can be determined. 2. Determine if leakage water is carrying soil particles. 3. Determine quantity of flow. 4. If flow increases, or is carrying embankment materials, reservoir level should be lowered until leakage stops. 5. A qualified engineer should inspect the condition and recommend further actions to be taken. ENGINEER REQUIRED

EMERGENCY ACTION PLAN

Names and Mailing Addresses

Gary McDermott, Mayor
City of Shelby
112 1st St S
Shelby, MT 59474

MT Disaster & Emergency Services
1900 Williams St
Helena, MT 59602

Michele Lemieux
Dam Safety Program
Montana DNRC
PO Box 201601
Helena, MT 59620-1601

Toole County Sheriff
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Shelby, MT 59474

Kelsey Buckley
Toole County DES Coordinator
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Shelby, MT 59474

Jack Johannes
City Superintendent
City of Shelby
112 1st St S
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Montana Dam Safety Program
PO Box 202301
Helena, MT 59620-2301

Havre DNRC
PO Box 1828
Havre, MT 59501

Triple Tree Engineering
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Helena, MT 59624

National Weather Service
5324 Tri-Hill Frontage Rd
Great Falls, MT 59404-4933

High Hazard Dam Owner's Plan
to Meet Engineer's Report Recommendations

*To be signed by dam owner and submitted to DNRC along with engineer's inspection report within 90 days of inspection.

Dam Name: Cowpath and Sullivan **Inspection Date:** 7/9/2021

Dam Owner: City of Shelby

Dam Inspection			
Engineer's Recommendation	**Recommended Completion Date**	**Owner's Plan to Address Engineer's Recommendation**	**Date to be Completed**
Monitor Erosion Areas Noted in Report - Upstream Left Groin - Sullivan - Downstream Abutment Groin - Sullivan - Upstream Face Right Groin - Cowpath - Downstream Face Left Groin - Cowpath - Upstream Abutment Left Groin - Cowpath	7/9/2022		
Periodic Removal of Debris from the Drop Structure	7/9/2022		
Ensure Toe Drain Outlet on Sullivan Dam is Unobstructed	7/9/2022		

**The engineer shall deliver the report and discuss it with the owner within 60 days of the investigation. (ARM36.14.603) Within 90 days of the inspection, the owner shall deliver a copy of the report to the Department, together with a statement of the owner's intent in regard to any deficient or unsafe items identified by the report, and a time schedule to remedy the items. (ARM36.14.601)*

Dam Inspection

Engineer's Recommendation	Recommended Completion Date	Owner's Plan to Address Engineer's Recommendation	Date to be Completed
Consider Installing a Cap on the Threads at the Principal Spillway Gate	7/9/2022		
Cut or Spray Trees 6" or Smaller in Diameter from the Spillway Channel and Upstream Slope of Cowpath Dam	7/9/2022		
Clear Vegetation Away from Toe Drains on Cowpath Dam	7/9/2022		
Rodent Control	7/9/2022		

Operation and Maintenance Manual Review

Engineer's Recommendation	Recommended Completion Date	Owner's Plan to Address Engineer's Recommendation	Date to be Completed
Annual Lubrication and Operation of the Principal Spillway Outlet Gate	7/9/2022		
Monitor Water Levels Below Primary Outlet Structure	7/9/2022		

Emergency Action Plan Review

Engineer's Recommendation	Recommended Completion Date	Owner's Plan to Address Engineer's Recommendation	Date to be Completed
None, the EAP was updated on September 24, 2021.			

General Comments

By signing this document, you agree to diligently pursue remedies to your engineer's recommendations.

Signature – Dam Owner:_____ Date: _____

High Hazard Dam Owner's Plan
to Meet Engineer's Report Recommendations

*To be signed by dam owner and submitted to DNRC along with engineer's inspection report within 90 days of inspection.

Dam Name: Cowpath and Sullivan **Inspection Date:** 7/9/2021

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Dam Inspection			
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Dam Inspection

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General Comments

By signing this document, you agree to diligently pursue remedies to your engineer's recommendations.

Signature – Dam Owner: _____ **Date:** 11/1/21