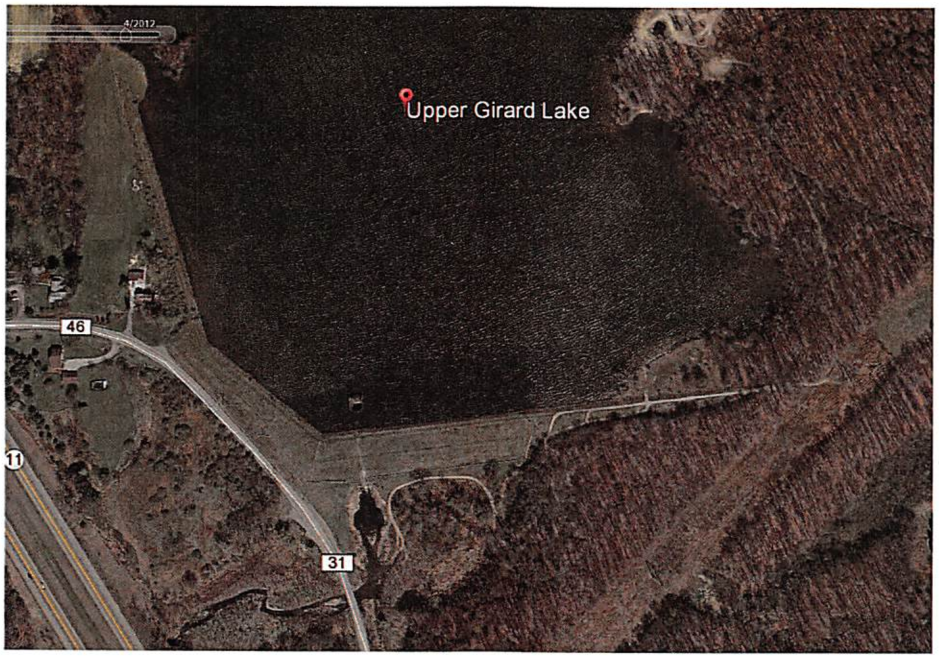
DAM SAFETY INSPECTION REPORT

Upper Girard Lake Dam
File Number: 1105-001
Class I
Trumbull County, Liberty Township
Inspection Date: May 4, 2016



In accordance with Ohio Revised Code Section 1521.062, the owners of dams must monitor, maintain, and operate their dams safely. Negligence of owners in fulfilling these responsibilities can lead to the development of extremely hazardous conditions to downstream residents and properties. In the event of a dam failure, owners can be subject to liability claims.

The Chief of the Division of Water Resources has the responsibility to ensure that human life, health, and property are protected from the failure of dams. Conducting periodic safety inspections and working with dam owners to maintain and improve the overall condition of Ohio dams are vital aspects of achieving this purpose.

Representatives of the Chief conducted this inspection to evaluate the condition of the dam and its appurtenances under authority of Ohio Revised Code Section 1521.062. In accordance with Ohio Administrative Code Rule 1501:21-21-03, the owners of dams must implement all remedial measures listed in the enclosed report.

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Section 1

Required Remedial Measures

The requirements listed below are based on observations made during inspection, calculations performed, and requirements of the Ohio Administrative Code (OAC). A checklist noting all observations made during the inspection has been enclosed in Section 3. References to right and left in this report are oriented as if you were standing on the dam crest and looking downstream.

Engineer Repairs and Investigations: The owner must retain the services of a professional engineer to address the following items. Plans, specifications, investigative reports, and other supporting documentation, as necessary, must be submitted to the Division of Water Resources for review and approval prior to construction. ***These items have been noted previously and the appropriate time period for completion has already been exceeded.*** A record of all repairs should be included in the operation, maintenance, and inspection manual.

1. The dam's discharge/storage capacity must be sufficient to safely pass the required design flood. Perform a hydrologic and hydraulic study to determine the adequacy of the dam's discharge/storage capacity to safely pass the required design flood. Prepare plans and specifications as necessary to increase the discharge/storage capacity to pass the required design flood. In accordance with OAC Rule 1501:21-13-02, the minimum design flood for Class I dams is 100 percent of the Probable Maximum Flood or the critical flood. See the Flood Routing Summary in Section 2 of this report for additional information.

2. This dam must have an emergency spillway in accordance with OAC Rule 1501:21-13-04. Prepare plans and specifications for the installation of an emergency spillway. ***This item should be completed in coordination with Item 1 above.*** See Discussion Item A included in this section for additional information.

3. The lake drain must operate properly and safely. Investigate the integrity of the sluice gates and the outlet pipe. Prepare plans and specifications for the repair of the gates and outlet pipe. See the "Lake Drains" fact sheet included in this section for additional information.

4. The lake drain must be accessible for operation and inspection. Prepare plans and specifications for replacement of the lake drain access structure. See the "Lake Drains" fact sheet included in this section for additional information.

5. The discharge tunnel must be repaired. Prepare plans and specifications for the repair of all spalling on the interior and exposed exterior portions of the principal spillway outlet pipe and for resealing the spillway joints. Monitor the joints in the principal spillway discharge tunnel quarterly for loss of sealant until repairs are made. See the "Spillway Conduit System Problems" and "Problems with Concrete Materials" fact sheets included in this section for additional information.

6. The embankment drain system must function properly. Due to the age of the embankment drain system, the questionable construction materials, and the inability to monitor the outflow, the entire embankment drain system must be investigated by a registered professional engineer to determine the functionality, suitability, and adequacy of the embankment drain system. As necessary, prepare plans

and specifications for the repair or modification of the embankment drain system. See Discussion Item B and the "Seepage Through Earthen Dams" fact sheet for additional information.

7. A geotechnical engineer must inspect the piezometer on the downstream toe of the southwest embankment to determine if it is operable, if it is needed, and an appropriate reading schedule. All the necessary repairs must be made. See Discussion Item C included in this section for additional information.

Owner Repairs: The owner must address the following items. The owner may hire a contractor or perform the work him or herself. Repair activities should be documented in the operation, maintenance, and inspection manual.

1. Remove the trees and brush from the upstream slope, the entire west embankment, and the left end of the south embankment. Seed all disturbed areas to establish a proper grass cover. See the "Trees and Brush" fact sheet included in this section for additional information.

2. Once the dam has been cleared of trees and brush, seed all embankments to establish a proper grass cover. See the "Ground Cover" fact sheet included in this section for additional information.

3. Repair the displaced slope protection on the upstream slope. See the "Upstream Slope Protection" fact sheet included in this section for additional information.

4. Repair the erosion gully on the left groin of the downstream slope of the south embankment. See the "Ground Cover" fact sheet included in this section for additional information.

5. Repair the deep ruts on the crest and downstream slope at the left end of the south embankment. See the "Ground Cover" fact sheet included in this section for additional information.

6. Repair the deterioration on the principal spillway discharge tunnel. See the "Spillway Conduit System Problems" and "Concrete Repair Techniques" fact sheets included in this section for additional information.

7. Replace the staff gauge that was located on the lake drain inlet structure. Please note that the graduations should extend below the normal pool level to allow monitoring during drawdowns. See Discussion Item D included in this section for additional information.

Owner Dam Safety Program: In accordance with Ohio Revised Code (ORC) Section 1521.062, the owner of a dam shall maintain a safe structure and appurtenances through inspection, maintenance, and operation. A dam, like any other part of the infrastructure, will change and deteriorate over time. Appurtenances such as gates and valves must be routinely exercised to ensure their operability. Inspection and monitoring of the dam identify changing conditions and problems as they develop, and maintenance prevents minor problems from developing into major ones. Dams must have these procedures documented in an operation, maintenance, and inspection manual.

Despite efforts to provide sufficient structural integrity and to perform inspection and maintenance, dams can develop problems that can lead to failure. Early detection and appropriate response are crucial for maintaining the safety of the dam and downstream people and property. The ORC requires the owner to fully and promptly notify the Dam Safety Program of any condition which threatens the safety of the structure. A rapidly changing condition may be an indication of a potentially dangerous problem. The Dam Safety Program can be contacted at 614/265-6731 during business hours or at 614/799-9538 after business hours. Dam owners must have emergency preparedness procedures documented in an emergency action plan.

The owner must address the following items.

1. Once the ruts have been repaired on the crest and downstream slope at the far left end of the south embankment, monitor the area quarterly for any reoccurrence of a wet area. See the "Seepage Through Earthen Dams" fact sheet included in this section for guidance in monitoring for seepage and for additional information.

2. Until repairs can be made, monitor the deterioration of the principal spillway discharge tunnel quarterly for further deterioration. See the "Spillway Conduit System Problems", "Concrete Repair Techniques", and "Problems with Concrete Materials" fact sheets included in this section for guidance in monitoring the spillway system and for additional information.

3. Monitor the erosion around the sides of the plunge pool quarterly for additional erosion, sloughing, or slope instability. See the "Outlet Erosion Control Structures (Stilling Basins)" fact sheet included in this section for guidance in monitoring the condition of the plunge pool and for additional information.

4. Monitor the leakage from the lake drain system quarterly for sudden increases in flow. See the "Lake Drains" fact sheet included in this section for guidance in monitoring the lake drain and for additional information.

5. This dam must have an operation, maintenance, and inspection manual (OMI) in accordance with OAC Rule 1501:21-21-04. Prepare an OMI. Guidelines for the preparation of this document is included with this report.

Tina Griffin	10/28/16	Nathan Leiberum	10/28/16
Tina Griffin, P.E. Project Manager Dam Safety Program Division of Water Resources	Date	Nathan Leiberum, E.I. Project Engineer Dam Safety Program Division of Water Resources	Date

This inspection was performed pursuant to the authority granted to the Chief of the Division of Water Resources in ORC Section 1521.062.

Mia Kannik 10/28/16

Mia P. Kannik, P.E. Date
Program Manager
On behalf of Andrew D. Ware, Acting Chief
Division of Water Resources

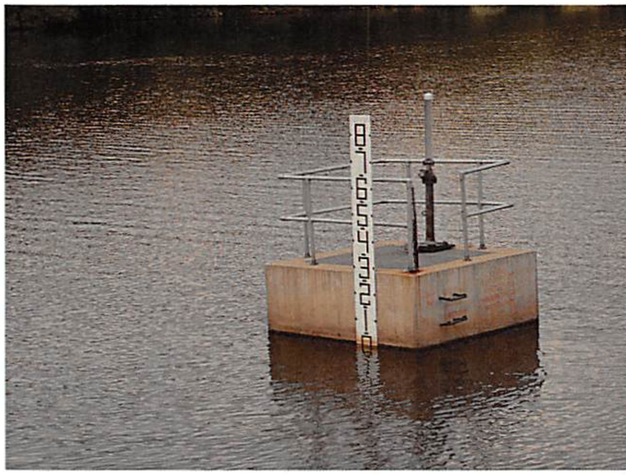
Discussion Items

A) An emergency overflow spillway shall be required for dams with pipe conduit spillways except when specifically exempted by the chief. A dam could be overtopped in the event that the principal spillway system was to become clogged or its capacity exceeded. The emergency spillway provides additional discharge capacity to help prevent flows generated by large flood events from overtopping the dam. Overtopping of the dam can cause severe erosion or dam failure. Typically, emergency overflow spillways are vegetated or unlined channels oriented so that they do not jeopardize the safety of the structure.

B) An embankment drain system that collects surface or subsurface flows to safely direct them away from the dam must operate properly and must be kept clear of obstructions such as brush, debris, and sediment. Original construction plans show that a slag material was used in the drain system. This material may not be compatible for proper filtering of the embankment without internal erosion. It appears that the drain material could be too large and allow finer material to "pipe" into the drain. This loss of material could cause the dam to fail. In addition, an obstructed inlet or outlet reduces the ability of the system to function as designed. Consequently, the reduced functionality may cause flows to back up in the system or along the toe of the dam. This reduces the accuracy of monitoring seepage and runoff flow volumes and may reduce the stability of the dam, a condition that can lead to its failure. For these reasons, the long-term performance of the drain is uncertain.

C) Piezometers are used to measure the water pressure in the soil pores of the embankment and foundation. The installation of a piezometer generally consists of a filter tip, such as perforated pipe, installed in a sand pocket. The filter tip is joined to a standpipe that is accessible from the ground surface. Readings are taken by measuring the elevation of the water in the standpipe. Professional assistance may be required to verify the status of the piezometers in the embankment, but the instruments should be checked as part of the maintenance and inspection plan. It is important that periodic observations and measurements are made. Care should be taken to be as accurate and thorough as possible. Detailed records should be kept in an organized manner so that they can be easily referred to.

D) A staff gauge helps the owner more accurately document pool levels during flood events and during routine inspections. It is very helpful to correlate seepage through drains to pool level. Please note that the graduations/numbers should extend beneath the lake level so that lowering of the pool (should it be needed or desired) can be monitored. It should be positioned to allow easy reading from a safe location. An example of a staff gauge is shown on the next page.



Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 93–26

Dam Safety: Lake Drains

A lake drain is a device to permit draining a reservoir, lake or pond. Administrative Rule 1501:21-13-06 requires that all Class I, Class II and Class III dams include a lake drain.

Types of Drains

Common types of drains include the following:

- A valve located in the spillway riser.
- A conduit through the dam with a valve at either the upstream or downstream end of the conduit.
- A siphon system (Often used to retrofit existing dams).
- A gate, valve or stoplogs located in a drain control tower.

Uses of Drains

The following situations make up the primary uses of lake drains:

Emergencies: Should serious problems ever occur to threaten the immediate safety of the dam, drains may be used to lower the lake level to reduce the likelihood of dam failure. Examples of such emergencies are as follows: clogging of the spillway pipe which may lead to high lake levels and eventually dam overtopping, development of slides or cracks in the dam, severe seepage through the dam which may lead to a piping failure of the dam, and partial or total collapse of the spillway system.

Maintenance: Some repair items around the lake and dam can only be completed or are much easier to perform with a lower than normal lake level. Some examples are: slope protection repair, spillway repairs, repair and/or installation of docks and other structures along the shoreline, and dredging the lake.

Winter Drawdown: Some dam owners prefer to lower the lake level during the winter months to reduce ice damage to structures along the shoreline and to provide additional flood storage for upcoming spring rains. Several repair items are often performed during this winter drawdown period. Periodic fluctuations in the lake level also discourage muskrat and beaver habitation along the shoreline. Muskrat burrows in earthen dams can lead to costly repairs.

Common Maintenance Problems

Common problems often associated with the maintenance and operation of lake drains include the following:

- Deteriorated and bent control stems and stem guides.
- Deteriorated and separated conduit joints.
- Leaky and rusted control valves and sluice gates.
- Deteriorated ladders in control towers.
- Deteriorated control towers.
- Clogging of the drain conduit inlet with sediment and debris.
- Inaccessibility of the control mechanism to operate the drain.
- Seepage along the drain conduit.
- Erosion and undermining of the conduit discharge area because the conduit outlets significantly above the elevation of the streambed.
- Vandalism.
- Development of slides along the upstream slope of the dam and the shoreline caused by lowering the lake level too quickly.

Operation and Maintenance Tips

A. All gates, valves, stems and other mechanisms should be lubricated according to the manufacturer's specifications. If you do not have a copy of the specifications and the manufacturing company can not be determined, then a local valve distributor may be able to provide assistance.

B. The lake drain should be operated at least twice a year to prevent the inlet from clogging with sediment and debris, and to keep all movable parts working easily. Most manufacturers recommend that gates and valves be operated at least four times per year. Frequent operation will help to ensure that the drain will be operable when it is needed. All valves and gates should be fully opened and closed at least twice to help flush out debris and to obtain a proper seal. If the gate gets stuck in a partially opened position, gradually work the gate in

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each direction until it becomes fully operational. Do not apply excessive torque as this could bend or break the control stem, or damage the valve or gate seat. With the drain fully open, inspect the outlet area for flow amounts, leaks, erosion and anything unusual.

C. All visible portions of the lake drain system should be inspected at least annually, preferably during the periodic operation of the drain. Look for and make note of any cracks, rusted and deteriorated parts, leaks, bent control stems, separated conduit joints or unusual observations.

D. A properly designed lake drain should include a headwall near the outlet of the drain conduit to prevent undermining of the conduit during periods of flow. A headwall can be easily retro-fitted to an existing conduit if undermining is a problem at an existing dam. A properly designed layer of rock riprap or other slope protection will help reduce erosion in the lake drain outlet area.

E. Drain control valves and gates should always be placed upstream of the centerline of the dam. This allows the drain conduit to remain depressurized except during use, therefore reducing the likelihood of seepage through the conduit joints and saturation of the surrounding earth fill.

F. For accessibility ease, the drain control platform should be located on shore or be provided with a bridge or other structure. This becomes very important during emergency situations if high pool levels exist.

G. Vandalism can be a problem at any dam. If a lake drain is operated by a crank, wheel or other similar mechanism, locking with a chain or other device, or off-site storage may be beneficial. Fences or other such installations may also help to ward off vandals.

H. The recommended rate of lake drawdown is one foot or less per week, except in emergencies. Fast drawdown causes a build-up of hydrostatic pressures in the upstream slope of the dam which can lead to slope failure. Lowering the water level slowly allows these pressures to dissipate.

Monitoring

Monitoring of the lake drain system is necessary to detect problems and should be performed at least twice a year or more frequently if problems develop. Proper ventilation and confined space precautions must be considered when entering a lake drain vault or outlet pipe. Items to be considered when monitoring a lake drain system include the stem, valve, outlet pipe and related appurtenances. Monitoring for surface deterioration (rust), ease of operation, and leakage is important to maintain a working lake drain system. If the stem or valve appears to be inoperable because of deterioration or if the operability of the lake drain system is in question, because the valve does not completely close (seal) and allows an excessive amount of leakage, then a registered professional engineer or manufacturer's representative should be contacted. Photographs along with written records of the monitoring items performed provide invaluable information. For further information on evaluating the condition of the lake drain system see the "Spillway Conduit System Problems", "Problems with Metal Materials", "Problems with Plastic (Polymer) Materials", and "Problems with Concrete Materials" fact sheets.

Conclusion

An operable lake drain accomplishes the following:

1. Makes for a safer dam by providing a method to lower the lake level in an emergency situation.

2. Allows the dam owner to have greater control of the lake level for maintenance, winter drawdown and emergency situations.

3. Meets the requirements of the Ohio Dam Safety Laws.

Any other questions, comments concerns, or fact sheet requests, should be directed to the Division of Soil and Water Resources at the following address:

Ohio Department of Natural Resources
Division of Soil and Water Resources
Dam Safety Program
2045 Morse Road
Columbus, Ohio 43229-6693
Voice: (614) 265-6731 Fax: (614) 447-9503
E-mail: dswc@dnr.state.oh.us
Website: http://soilandwater.ohiodnr.gov/
Emergency 24hr hotline: 614-799-9538

Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 94–28

Dam Safety: Trees and Brush

The establishment and control of proper vegetation is an important part of dam maintenance. Properly maintained vegetation can help prevent erosion of embankment and earth channel surfaces, and aid in the control of groundhogs and muskrats. The uncontrolled growth of vegetation can damage embankments and concrete structures and make close inspection difficult.

Trees and Brush

Trees and brush should not be permitted on embankment surfaces or in vegetated earth spillways. Extensive root systems can provide seepage paths for water. Trees that blow down or fall over can leave large holes in the embankment surface that will weaken the embankment and can lead to increased erosion. Brush obscures the surface limiting visual inspection, provides a haven for burrowing animals, and retards growth of grass vegetation. Tree and brush growth adjacent to concrete walls and structures may eventually cause damage to the concrete and should be removed.

Stump Removal & Sprout Prevention

Stumps of cut trees should be removed so vegetation can be established and the surface mowed. Stumps can be removed either by pulling or with machines that grind them down. All woody material should be removed to about 6 inches below the ground surface. The cavity should be filled with well-compacted soil and grass vegetation established.

Stumps of trees in riprap cannot usually be pulled or ground down, but can be chemically treated so they will not continually form new sprouts. Certain herbicides are effective for this purpose and can even be used at water supply reservoirs if applied by licensed personnel. For product information and information on how to obtain a license, contact the Ohio Department of Agriculture at the following address:

Ohio Department of Agriculture
Pesticide Regulation
8995 E. Main Street
Reynoldsburg, Ohio 43068
Telephone Number (614) 728-6987

These products should be painted, not sprayed, on the stumps. Other instructions found on the label should be strictly followed when handling and applying these materials. Only a few commercially available chemicals can be used along shorelines or near water.

Embankment Maintenance

Embankments, areas adjacent to spillway structures, vegetated channels, and other areas associated with a dam require continual maintenance of the vegetal cover. Grass mowing, brush cutting, and removal of woody vegetation (including trees) are necessary for the proper maintenance of a dam, dike, or levee. All embankment slopes and vegetated earth spillways should be maintained with a maximum grass height of 12 inches. Aesthetics, unobstructed viewing during inspections, maintenance of a non-erodible surface, and discouragement of groundhog habitation are reasons for proper maintenance of the vegetal cover.

Methods used in the past for control of vegetation, but are now considered unacceptable, include chemical spraying, and burning. More acceptable methods include the use of weed whips or power brush-cutters and mowers. Chemical spraying to first kill small trees and brush is acceptable if precautions are taken to protect the local environment.

It is important to remember not to mow when the embankment is wet. It is also important to use proper equipment for the slope and type of vegetation to be cut. Also, always follow the manufacturer's recommended safe operation procedures.

Any other questions, comments, concerns, or fact sheet requests, should be directed to the Division of Water at the following address:

Ohio Department of Natural Resources
Division of Soil and Water Resources
Dam Safety Engineering Program
2045 Morse Road
Columbus, Ohio 43229-6693
Voice: (614) 265-6731 Fax: (614) 447-9503
E-mail: dswc@dnr.state.oh.us
Website: http://ohiodnr.gov/soilandwater
Emergency 24hr hotline: 614-799-9538

Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 99–54

Dam Safety: Ground Cover

The establishment and control of proper vegetation are an important part of dam maintenance. Properly maintained vegetation can help prevent erosion of embankment and earth channel surfaces, and aid in the control of groundhogs and muskrats. The uncontrolled growth of vegetation can damage embankments and concrete structures and make close inspection difficult.

Grass vegetation is an effective and inexpensive way to prevent erosion of embankment surfaces. If properly maintained, it also enhances the appearance of the dam and provides a surface that can be easily inspected. Roots and stems tend to trap fine sand and soil particles, forming an erosion-resistant layer once the plants are well established. Grass vegetation may not be effective in areas of concentrated runoff, such as at the contact of the embankment and abutments, or in areas subjected to wave action.

Common Problems

Bare Areas

Bare areas on an embankment are void of protective cover (e.g. grass, asphalt, riprap etc.). They are more susceptible to erosion which can lead to localized stability problems such as small slides and sloughs. Bare areas must be repaired by establishing a proper grass cover or by installing other protective cover. If using grass, the topsoil must be prepared with fertilizer and then scarified before sowing seed. Types of grass vegetation that have been used on dams in Ohio are bluegrass, fescue, ryegrass, alfalfa, clover, and redtop. One suggested seed mixture is 30% Kentucky Bluegrass, 60% Kentucky 31 Fescue, and 10% Perennial Ryegrass. Once the seed is sown, the area should be mulched and watered regularly.

Erosion

Embankment slopes are normally designed and constructed so that the surface drainage will be spread out in a thin layer as "sheet flow" over the grass cover. When the sod is in poor condition or flow is concentrated at one or more locations, the resulting erosion will leave rills and gullies in the embankment slope. The erosion will cause loss of material and make maintenance of the embankment difficult. Prompt repair of the erosion is required to prevent more serious damage to the embankment. If erosion gullies are extensive, a registered professional engineer may be required to design a more rigid repair such as riprap or concrete. Minor rills and gullies can be repaired by filling them with compacted cohesive material. Topsoil should be a minimum of 4 inches deep. The area should then be seeded and mulched. Not only should the eroded areas be repaired, but the cause of the erosion should be addressed to prevent a continued maintenance problem.

Footpaths

Paths from animal and pedestrian traffic are problems common to many embankments. If a path has become established, vegetation in this area will not provide adequate protection and a more durable cover will be required unless the traffic is eliminated. Gravel, asphalt, and concrete have been used effectively to cover footpaths. Embedding railroad ties or other treated wood beams into an embankment slope to form steps is one of the most successful and inexpensive methods used to provide a protected pathway.

Vehicle Ruts

Vehicle ruts can also be a problem on the embankment. Vehicular traffic on the dam should be discouraged especially during wet conditions except when necessary. Water collected in ruts may cause localized saturation, thereby weakening the embankment. Vehicles can also severely damage the vegetation on embankments. Worn areas could lead to erosion and more serious problems. Ruts that develop in the crest should be repaired by grading to direct all surface drainage into the impoundment. Bare and eroded areas should be repaired using the methods mentioned in the above sections. Constructed barriers such as fences and gates are effective ways to limit access of vehicles.

Improper Vegetation

Crown vetch, a perennial plant with small pink flowers, has been used on some dams in Ohio but is not recommended (see Figure 1). It hides the embankment surface, preventing early detection of cracks and erosion. It is not effective in preventing erosion.

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Figure 1: Crown Vetch
(Source: http://www.vg.com)

Vines and woody vegetation such as trees and brush also hide the embankment surface preventing early detection of cracks and erosion. Tall vegetation also provides a habitat for burrowing animals. All improper vegetation must be removed from the entire embankment surface. Any residual roots that are larger than 3 inches in diameter must be removed. All roots should be removed down to a depth of at least 6 inches and replaced with a compacted clay material; then 4 inches of topsoil should be placed on the disturbed areas of the slope. Finally, these areas must be seeded and mulched to establish a proper grass cover.

Maintenance

Embankments, areas adjacent to spillway structures, vegetated channels, and other areas associated with a dam require continual maintenance of the vegetal cover. Removal of improper vegetation is necessary for the proper maintenance of a dam, dike or levee. All embankment slopes and vegetated earth spillways should be maintained with a maximum grass height of 12 inches. Reasons for proper maintenance of the vegetal cover include unobstructed viewing during inspection, maintenance of a non-erodible surface, discouragement of burrowing animal habitation, and aesthetics.

Common methods for control of vegetation include the use of weed trimmers or power brush-cutters and mowers. Chemical spraying to kill small trees and brush is acceptable if precautions are taken to protect the local environment. Some chemical spraying may require proper training prior to application. Additional information can be found on the Trees and Brush Fact Sheet.

Any other questions, comments concerns, or fact sheet requests, should be directed to:

Ohio Department of Natural Resources
Division of Soil and Water Resources
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2045 Morse Road
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Ohio Department of Natural Resources

Division of Soil and Water Resources

Fact Sheet

Fact Sheet 99–52

Dam Safety: Upstream Slope Protection

Slope protection is usually needed to protect the upstream slope against erosion due to wave action. Without proper slope protection, a serious erosion problem known as "beaching" can develop on the upstream slope.

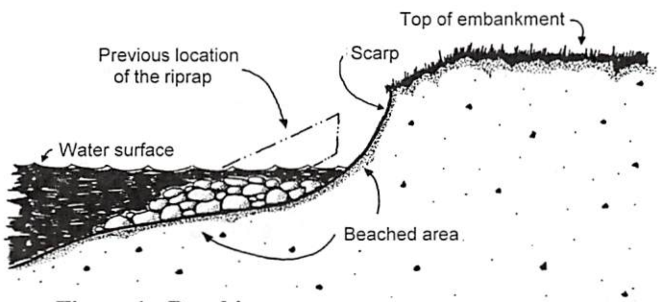

Figure 1 - Beaching

The repeated action of waves striking the embankment surface erodes fill material and displaces it farther down the slope, creating a "beach." The amount of erosion depends on the predominant wind direction, the orientation of the dam, the steepness of the slope, water level fluctuations, boating activities, and other factors. Further erosion can lead to cracking and sloughing of the slope which can extend into the crest, reducing its width. When erosion occurs and beaching develops on the upstream slope of a dam, repairs should be made as soon as possible. However, an erosion scarp less than 1 foot high may be stable and not require repair.

The upstream face of a dam is commonly protected against wave erosion by placement of a layer of rock riprap over a layer of bedding and a filter material. Other material such as concrete facing, soil-cement, fabri-form bags, slush grouted rocks, steel sheet piling, and articulated concrete blocks can also be used. Vegetative protection combined with a berm on the upstream slope can also be effective.

Rock Riprap

Rock riprap consists of a heterogeneous mixture of irregular shaped rocks placed over gravel bedding and a sand filter or geotextile fabric. The smaller rocks help to fill the spaces between the larger pieces forming an interlocking mass. The filter prevents soil particles on the embankment surface from being washed out through the spaces (or voids) between the rocks. The maximum rock size and weight must be large enough to break up the energy of the maximum anticipated wave action and hold the smaller stones in place. If the rock size is too small, it will eventually be displaced and washed away by wave action. If the riprap is sparse or if the filter or bedding material is too small, the filter material will wash out easily, allowing the embankment material to erode. Once the erosion has started, beaching will develop if remedial measures are not taken. Technical Release No. 69 developed by the USDA, Natural Resources Conservation Service can be used to help design engineers develop a preliminary or detailed design for riprap slope protection.

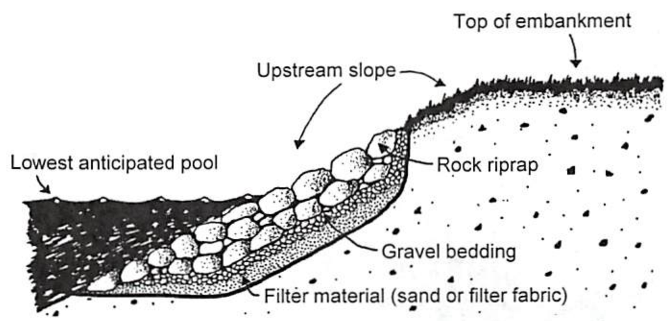

Figure 2 - Rock Riprap

The dam owner should expect some deterioration (weathering) of riprap. Freezing and thawing, wetting and drying, abrasive wave action, and other natural processes will eventually break down the riprap. Its useful life varies with the characteristics of the stone used. Stone for riprap should be rock that is dense and well cemented. In Ohio, glacial cobbles or boulders, most limestone, and a few types of sandstone are acceptable for riprap. Most sandstones and shales found in Ohio do not provide long-term protection. Due to the high initial cost of rock riprap, its durability should be determined by appropriate testing procedures prior to installation. Vegetative growth within the slope protection is undesirable because it can displace stone and disturb the filter material. Heavy undergrowth prevents an adequate inspection of the upstream slope and may hide potential problems. For additional information, see the "Trees and Brush" fact sheet.

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Sufficient maintenance funds should be allocated for the addition of riprap and the removal of vegetation. Severe erosion or reoccurring problems may require a registered professional engineer to design a more effective slope protection.

Vegetated Wave Berm

Vegetated wave berms dissipate wave energy and protect the slope from erosion. Berms are constructed on the upstream slope at the normal pool level and should be no less than 20 feet wide. This method of slope protection will not work well where the water surface fluctuates regularly from normal pool. If improper or sparse vegetation is present, the wave berm may not adequately dissipate the wave energy, allowing erosion and beaching to develop on the upstream slope. Technical Release No. 56 developed by the USDA, Natural Resources Conservation Service provides design and layout information.

The vegetation on the wave berm should be monitored regularly to verify adequate growth. Sufficient funds should be allocated for the regular maintenance of the vegetation. Severe erosion or reoccurring problems may require a registered professional engineer to design a more effective slope protection.

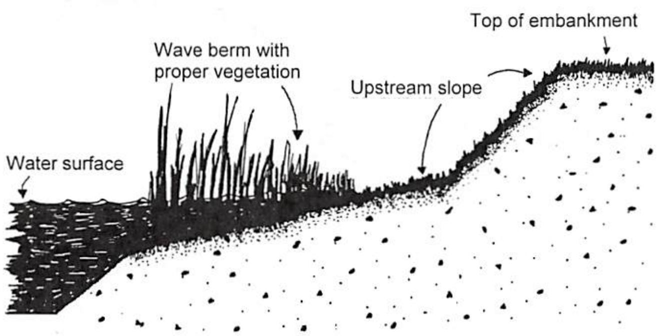

Figure 3 - Vegetated wave berm

Concrete Facing

Concrete facing can be used if severe wave action is anticipated, however, settlement of the embankment must be insignificant to insure adequate support for the concrete facing. A properly designed and constructed concrete facing can be expensive. This slope protection should extend several feet above and below the normal pool level. It should terminate on a berm or against a concrete curb or header. Granular filter or filter fabric (geotextile) is required under the concrete facing to help reduce the risk of undermining.

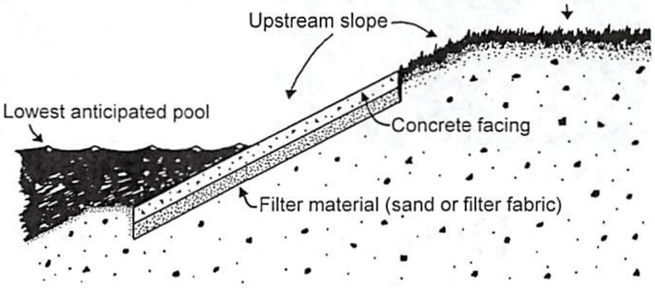

Figure 4 - Concrete facing

As with any type of slope protection, problems will develop if the concrete facing has not been properly designed or installed. Concrete facing often fails because the wave action washes soil particles from beneath the slabs through joints and cracks. This process is known as undermining, which will continue until large voids are created. Detection of voids is difficult because the voids are hidden. Failure of the concrete facing may be sudden and extensive. Concrete facing should be monitored for cracks and open joints. Open joints should be sealed with plastic fillers and cracks should be grouted and sealed. For additional information, see the "Problems with Concrete Materials" fact sheet.

Inspection and Monitoring

Regular inspection and monitoring of the upstream slope protection is essential to detect any problems. It is important to keep written records of the location and extent of any erosion, undermining, or deterioration of the riprap, wave berm or other slope protection. Photographs provide invaluable records of changing conditions. A rapidly changing condition may indicate a very serious problem, and the Dam Safety Engineering Program should be contacted immediately. All records should be kept in the operation, maintenance, and inspection manual for the dam.

Any other questions, comments concerns, or fact sheet requests, should be directed to:

Ohio Department of Natural Resources
Division of Soil and Water Resources
Dam Safety Engineering Program
2045 Morse Road
Columbus, Ohio 43229-6693
Voice: (614) 265-6731 Fax: (614) 447-9503
E-mail: dswc@dnr.state.oh.us
Website: http://ohiodnr.gov/soilandwater
Emergency 24hr hotline: 614-799-9538

Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 99–55

Dam Safety: Spillway Conduit System Problems

Many dams have conduit systems that serve as principal spillways. These conduit systems are required to carry normal stream and small flood flows safely past the embankment throughout the life of the structure. Conduits through embankments are difficult to construct properly and can be extremely dangerous to the embankment if problems develop after construction. Conduits are usually difficult to repair because of their location within the embankment. Also, replacing conduits requires extensive excavation. In order to avoid difficult and costly repairs, particular attention should be directed to maintaining these structures. The most common problem noted with spillway conduit systems is undermining of the conduit. This condition typically results from water leaking through pipe joints, seepage along the conduit or inadequate energy dissipation at the conduit outlet. The typical causes of seepage and water leaking through pipe joints include any one or a combination of the following factors: loss of joint material, separated joints, misalignment, differential settlement, conduit deterioration, and pipe deformation. Problems in any of these areas may lead to failure of the spillway system and possibly dam failure.

Undermining

Undermining is the removal of foundation material surrounding a conduit system. Any low areas or unexplained settlement of the earthfill in line with the conduit may indicate that undermining has occurred within the embankment. As erosion continues, undermining of a conduit can lead to displacement and collapse of the pipe sections and cause sloughing, sliding or other forms of instability in the embankment. As the embankment is weakened, a complete failure of the conduit system and, eventually the dam may occur.

Seepage along the conduit from the reservoir can occur as a result of poor compaction around the conduit. If seepage control devices have not been installed, the seepage may remove foundation material from around the conduit and eventually lead to undermining.

In addition, undermining can occur as the result of erosion due to inadequate energy dissipation or inadequate erosion protection at the outlet. This undermining can be visually observed at the outlet of a pipe system and can extend well into the embankment. In this case, undermining can lead to other conduit problems such as misalignment, separated joints and pipe deterioration. An extensive discussion on outlet erosion control as it relates to undermining of the pipe outlet can be found in the "Outlet Erosion Control Structures" fact sheet.

Installation of seepage control devices is required as a preventative measure to control seepage along the conduit and undermining. Regular monitoring of conduit systems must include visual observation and notation of any undermining or any precursors. These precursors usually include pipe deformation, misalignment and differential settlement, pipe deterioration, separated joints and loss of joint material.

Pipe deformation

Pipe deformations are typically caused by external loads that are applied on a pipe such as the weight of the embankment or heavy equipment. Collapse of the pipe can cause failure of the joints and allow erosion of the supporting fill. This may lead to undermining and settlement. Pipe deformation may reduce or eliminate spillway capacity. Pipe deformation must be monitored on a regular basis to ensure that no further deformation is occurring, that pipe joints are intact and that no undermining or settlement is occurring.

Separated joints and loss of joint material: Joint Deterioration

Conduit systems usually have construction and/or section joints. In almost every situation, the joints will have a water stop, mechanical seal and/or chemical seal to prevent leakage of water through the joint. Separation and deterioration can destroy the watertight integrity of the joint. Joint deterioration can result from weathering, excessive seepage, erosion or corrosion. Separation at a joint may be the result of a more serious condition such as foundation settlement, undermining, structural damage or structural instability. Deterioration at joints includes loss of gasket material, loss of joint sealant and spalling

Continued on back!

around the edges of joints. Separation of joints and loss of joint material allow seepage through the pipe. This can erode the fill underneath and along the conduit causing undermining, which can lead to the displacement of the pipe sections. Separated pipe joints can be detected by inspecting the interior of the conduit. A regular monitoring program is needed to determine the rate and severity of joint deterioration. Joint separations should be monitored to determine if movement is continuing.

Conduit Deterioration

Deterioration of conduit material is normally due to the forces of nature such as wetting and drying, freezing and thawing, oxidation, decay, ultra-violet light, cavitation and the erosive forces of water. Deterioration of pipe materials and joints can lead to seepage through and along the conduit and eventually failure of conduit systems. Additional information on deterioration can be found on the "Problems with Concrete Materials", "Problems with Metal Materials", and "Problems with Plastic (Polymer) Materials" fact sheets.

Differential Settlement

Removal or consolidation of foundation material from around the conduit can cause differential settlement. Inadequate compaction immediately next to the conduit system during construction would compound the problem. Differential settlement can ultimately lead to undermining of the conduit system. Differential settlement should be monitored with routine inspections and documentation of observations.

Misalignment

Alignment deviations can be an indication of movement, which may or may not be in excess of design tolerances. Proper alignment is important to the structural integrity of conduit systems. Misalignment can be the direct result of internal seepage flows that have removed soil particles or dissolved soluble rock. Misalignment can also result from poor construction practices, collapse of deteriorated conduits, decay of organic material in the dam, seismic events or normal settlement due to consolidation of embankment or foundation materials. Excessive misalignment may result in other problems such as cracks, depressions, slides on the embankment, joint separation and seepage. Both the vertical and horizontal alignment of the conduit should be monitored on a regular basis.

Monitoring and Repair

Frequent inspection is necessary to ensure that the pipe system is functioning properly. All conduits should be inspected thoroughly once a year. Conduits that are 24 inches or more in diameter can be entered and visually inspected with proper ventilation and confined space precautions. Small inaccessible conduits may be monitored with video cameras. The conduits should be inspected for misalignment, separated joints, loss of joint material, deformations, leaks, differential settlement and undermining. Problems with conduits occur most often at joints, and special attention should be given to them during the inspection. The joint should be checked for separation caused by misalignment or settlement and loss of joint-filler material. The outlet should be checked for signs of water seeping along the exterior surface of the conduit. Generally, this is noted by water flowing from under the conduit and/or the lack of foundation material directly beneath the conduit. The embankment surface should be monitored for depressions or sinkholes. Depressions or sinkholes on the embankment surface above the spillway conduit system develop when the underlying material is eroded and displaced. Photographs along with written records of the monitoring items performed provide invaluable information.

Effective repair of the internal surface or joint of a conduit is difficult and should not be attempted without careful planning and proper professional supervision. Various construction techniques can be applied for minor joint repair and conduit leakage, but major repairs require a plan be developed by a professional engineer experienced in dam spillway construction.

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Ohio Department of Natural Resources
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Fact Sheet

Fact Sheet 94–32

Dam Safety: Concrete Repair Techniques

Concrete is an inexpensive, durable, strong and basic building material often used in dams for core walls, spillways, stilling basins, control towers, and slope protection. However, poor workmanship, construction procedures, and construction materials may cause imperfections that later require repair. Any long-term deterioration or damage to concrete structures caused by flowing water, ice, or other natural forces must be corrected. Neglecting to perform periodic maintenance and repairs to concrete structures as they occur could result in failure of the structure from either a structural or hydraulic standpoint. This in turn may threaten the continued safe operation and use of the dam.

Considerations

Floor or wall movement, extensive cracking, improper alignments, settlement, joint displacement, and extensive undermining are signs of major structural problems. In situations where concrete replacement solutions are required to repair deteriorated concrete, it is recommended that a registered professional engineer be retained to perform an inspection to assess the concrete's overall condition, and determine the extent of any structural damage and necessary remedial measures.

Typically, it is found that drainage systems are needed to relieve excessive water pressures under floors and behind walls. In addition, reinforcing steel must also be properly designed to handle tension zones and shear and bending forces in structural concrete produced by any external loading (including the weight of the structure). Therefore, the finished product in any concrete repair procedure should consist of a structure that is durable and able to withstand the effects of service conditions such as weathering, chemical action, and wear. Because of their complex nature, major structural repairs that require professional advice are not addressed here.

Repair Methods

Before any type of concrete repair is attempted, it is essential that all factors governing the deterioration or failure of the concrete structure are identified. This is required so that the appropriate remedial measures can be undertaken in the repair design to help correct the problem and prevent it from occurring in the future. The following techniques require expert and experienced assistance for the best results. The particular method of repair will depend on the size of the job and the type of repair required.

1. The Dry-Pack Method: The dry-pack method can be used on small holes in new concrete which have a depth equal to or greater that the surface diameter. Preparation of a dry-pack mix typically consists of about 1 part portland cement and 2 1/2 parts sand to be mixed with water. You then add enough water to produce a mortar that will stick together. Once the desired consistency is reached, the mortar is ready to be packed into the hole using thin layers.
2. Concrete Replacement: Concrete replacement is required when one-half to one square foot areas or larger extend entirely through the concrete sections or where the depth of damaged concrete exceeds 6 inches. When this occurs, normal concrete placement methods should be used. Repair will be more effective if tied in with existing reinforcing steel (rebar). This type of repair will require the assistance of a professional engineer experienced in concrete construction.
3. Replacement of Unformed Concrete: The replacement of damaged or deteriorated areas in horizontal slabs involves no special procedures other than those used in good construction practices for placement of new slabs. Repair work can be bonded to old concrete by use of a bond coat made of equal amounts of sand and cement. It should have the consistency of whipped cream and should be applied immediately ahead of concrete placement so that it will not set or dry out. Latex emulsions with portland cement and epoxy resins are also used as bonding coats.
4. Preplaced Aggregate Concrete: This special commercial technique has been used for massive repairs, particularly for underwater repairs of piers and abutments. The process consists of the following procedures: 1) Removing the deteriorated concrete, 2) forming the sections to be repaired, 3) prepacking the repair area with coarse aggregate, and 4) pressure grouting the voids between the aggregate particles with a cement or sand-cement mortar.
5. Synthetic Patches: One of the most recent developments in concrete repair has been the use of synthetic materials for bonding and patching. Epoxy-resin compounds are used extensively because of their high bonding properties and great strength. In applying epoxy-resin patching

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mortars, a bonding coat of the epoxy resin is thoroughly brushed onto the base of the old concrete. The mortar is then immediately applied and troweled to the elevation of the surrounding material.

Before attempting to repair a deteriorated concrete surface, all unsound concrete should be removed by sawing or chipping and the patch area thoroughly cleaned. A sawed edge is superior to a chipped edge, and sawing is generally less costly than mechanical chipping. Before concrete is ordered for placing, adequate inspection should be performed to ensure that (1) foundations are properly prepared and ready to receive the concrete, (2) construction joints are clean and free from defective concrete, (3) forms are grout-tight, amply strong, and set to their true alignment and grade, (4) all reinforcement steel and embedded parts are clean, in their correct position, and securely held in place, and (5) adequate concrete delivery equipment and facilities are on the job, ready to go, and capable of completing the placement without addition unplanned construction.

Concrete Use Guidelines

In addition to its strength characteristics, concrete must also have the properties of workability and durability. Workability can be defined as the ease with which a given set of materials can be mixed into concrete and subsequently handled, transported, and placed with a minimal loss of homogeneity. The degree of workability required for proper placement and consolidation of concrete is governed by the dimensions and shape of the structure and by the spacing and size of the reinforcement. The concrete, when properly placed, will be free of segregation, and its mortar is intimately in contact with the coarse aggregate, the reinforcement, and/or any other embedded parts or surfaces within the concrete. Separation of coarse aggregate from the mortar should be minimized by avoiding or controlling the lateral movement of concrete during handling and placing operations. The concrete should be deposited as nearly as practicable in its final position. Placing methods that cause the concrete to flow in the forms should be avoided. The concrete should be placed in horizontal layers, and each layer should be thoroughly vibrated to obtain proper compaction.

All concrete repairs must be adequately moist-cured to be effective. The bond strength of new concrete to old concrete develops much more slowly, and the tendency to shrink and loosen is reduced by a long moist-curing period.

In general, the concrete repair procedures discussed above should be considered on a relative basis and in terms of the quality of concrete that one wishes to achieve for their particular construction purpose. In addition to being adequately designed, a structure must also be properly constructed with concrete that is strong enough to carry the design loads, durable enough to withstand the forces associated with weathering, and yet economical, not only in first cost, but in terms of its ultimate service. It should be emphasized that major structural repairs to concrete should not be attempted by the owner or persons not experienced in concrete repairs. A qualified professional engineer experienced in concrete construction should be obtained for the design of large scale repair projects.

Crack Repair

The two main objectives when repairing cracks in concrete are structural bonding and stopping water flow. For a structural bond, epoxy injection can be used. This process can be very expensive since a skilled contractor is needed for proper installation. The epoxy is injected into the concrete under pressure, welding the cracks to form a monolithic structure. This method of repair should not be considered if the crack is still active (moving). For a watertight seal, a urethane sealant can be used. This repair technique does not form a structural bond; however, it can be used on cracks that are still active. Cracks should be opened using a concrete saw or hand tool prior to placing the sealant. A minimum opening of $^1/_4$ inch is recommended since small openings are hard to fill. Urethane sealants can be reapplied since they are flexible materials and will adhere to older applications. As previously noted, all of the factors causing cracking must be identified and addressed before repairing the concrete to prevent the reoccurrence of cracks.

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Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 99–56

Dam Safety: Problems with Concrete Materials

Visual inspection of concrete will allow for the detection of distressed or deteriorated areas. Problems with concrete include construction errors, disintegration, scaling, cracking, efflorescence, erosion, spalling, and popouts.

Construction Errors

Errors made during construction such as adding improper amounts of water to the concrete mix, inadequate consolidation, and improper curing can cause distress and deterioration of the concrete. Proper mix design, placement, and curing of the concrete, as well as an experienced contractor are essential to prevent construction errors from occurring. Construction errors can lead to some of the problems discussed later in this fact sheet such as scaling and cracking. Honeycombing and bugholes can be observed after construction.

Honeycombing can be recognized by exposed coarse aggregate on the surface without any mortar covering or surrounding the aggregate particles. The honeycombing may extend deep into the concrete. Honeycombing can be caused by a poorly graded concrete mix, by too large of a coarse aggregate, or by insufficient vibration at the time of placement. Honeycombing will result in further deterioration of the concrete due to freeze-thaw because moisture can easily work its way into the honeycombed areas. Severe honeycombing should be repaired to prevent further deterioration of the concrete surface.

Bugholes is a term used to describe small holes (less than about 0.25 inch in diameter) that are noticeable on the surface of the concrete. Bugholes are generally caused by too much sand in the mix, a mix that is too lean, or excessive amplitude of vibration during placement. Bugholes may cause durability problems with the concrete and should be monitored.

Disintegration and Scaling

Disintegration can be described as the deterioration of the concrete into small fragments and individual aggregates. Scaling is a milder form of disintegration where the surface mortar flakes off. Large areas of crumbling (rotten) concrete, areas of deterioration which are more than about 3 to 4 inches deep (depending on the wall/slab thickness), and exposed rebar indicate serious concrete deterioration. If not repaired, this type of concrete deterioration may lead to structural instability of the concrete structure. A registered professional engineer must prepare plans and specifications for repair of serious concrete deterioration. For additional information, see the "Concrete Repair Techniques" fact sheet.

Disintegration can be a result of many causes such as freezing and thawing, chemical attack, and poor construction practices. All exposed concrete is subject to freeze-thaw, but the concrete's resistance to weathering is determined by the concrete mix and the age of the concrete. Concrete with the proper amounts of air, water, and cement, and a properly sized aggregate, will be much more durable. In addition, proper drainage is essential in preventing freeze-thaw damage. When critically saturated concrete (when 90% of the pore space in the concrete is filled with water) is exposed to freezing temperatures, the water in the pore spaces within the concrete freezes and expands, damaging the concrete. Repeated cycles of freezing and thawing will result in surface scaling and can lead to disintegration of the concrete. Hydraulic structures are especially susceptible to freeze-thaw damage since they are more likely to be critically saturated. Older structures are also more susceptible to freeze-thaw damage since the concrete was not air entrained. In addition, acidic substances in the surrounding soil and water can cause disintegration of the concrete surface due to a reaction between the acid and the hydrated cement.

Cracks

Cracks in the concrete may be structural or surface cracks. Surface cracks are generally less than a few millimeters wide and deep. These are often called hairline cracks and may consist of single, thin cracks, or cracks in a craze/map-like pattern. A small number of surface or shrinkage cracks is common and does not usually cause any problems. Surface cracks can be caused by freezing and thawing, poor construction practices, and alkali-aggregate reactivity. Alkali-aggregate reactivity occurs when the aggregate reacts with the cement causing crazing or map cracks. The placement of new concrete over old may cause surface cracks to develop. This occurs

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because the new concrete will shrink as it cures. Surface cracks in the spillway should be monitored and will need to be repaired if they deteriorate further.

Structural cracks in the concrete are usually larger than 0.25 inch in width. They extend deeper into the concrete and may extend all the way through a wall, slab, or other structural member. Structural cracks are often caused by settlement of the fill material supporting the concrete structure, or by loss of the fill support due to erosion. The structural cracks may worsen in severity due to the forces of weathering. A registered professional engineer knowledgeable about dam safety must investigate the cause of structural cracks and prepare plans and specifications for repair of any structural cracks. For additional information, see the "Concrete Repair Techniques" fact sheet.

Efflorescence

A white, crystallized substance, known as efflorescence, may sometimes be noted on concrete surfaces, especially spillway sidewalls. It is usually noted near hairline or thin cracks. Efflorescence is formed by water seeping through the pores or thin cracks in the concrete. When the water evaporates, it leaves behind some minerals that have been leached from the soil, fill, or concrete. Efflorescence is typically not a structural problem. Efflorescence should be monitored because it can indicate the amount of seepage finding its way through thin cracks in the concrete and can signal areas where problems (i.e. inadequate drainage behind the wall or deterioration of concrete) could develop. Also, water seeping through thin cracks in the wall will make the concrete more susceptible to deterioration due to freezing and thawing of the water.

Erosion

Erosion due to abrasion results in a worn concrete surface. It is caused by the rubbing and grinding of aggregate or other debris on the concrete surface of a spillway channel or stilling basin. Minor erosion is not a problem but severe erosion can jeopardize the structural integrity of the concrete. A registered professional engineer must prepare plans and specifications for repair of this type of erosion if it is severe.

Erosion due to cavitation results in a rough, pitted concrete surface. Cavitation is a process in which subatmospheric pressures, turbulent flow and impact energy are created and will damage the concrete. If the shape of the upper curve on the ogee spillway is not designed close to its ideal shape, cavitation may occur just below the upper curve, causing erosion. A registered professional engineer must prepare plans and specifications for repair of this type of erosion if the concrete becomes severely pitted which could lead to structural damage or failure of the structure.

Spalling and Popouts

Spalling is the loss of larger pieces or flakes of concrete. It is typically caused by sudden impact of something dropped on the concrete or stress in the concrete that exceeded the design. Spalling may occur on a smaller scale, creating popouts. Popouts are formed as the water in saturated coarse aggregate particles near the surface freezes, expands, and pushes off the top of the aggregate and surrounding mortar to create a shallow conical depression. Popouts are typically not a structural problem. However, if a spall is large and causes structural damage, a registered professional engineer must prepare plans and specifications to repair the spalling.

Inspection and Monitoring

Regular inspection and monitoring is essential to detect problems with concrete materials. Concrete structures should be inspected a minimum of once per year. The inspector should also look at the interior condition of concrete spillway conduit. Proper ventilation and confined space precautions must be considered when entering a conduit. It is important to keep written records of the dimensions and extent of scaling, disintegration, efflorescence, honeycombing, erosion, spalling, popouts, and the length and width of cracks. Structural cracks should be monitored more frequently and repaired if they are a threat to the stability of the structure or dam. Photographs provide invaluable records of changing conditions. A rapidly changing condition may indicate a very serious problem, and the Dam Safety Engineering Program should be contacted immediately. All records should be kept in the operation, maintenance, and inspection manual for the dam.

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Ohio Department of Natural Resources
Division of Soil and Water Resources
Fact Sheet

Fact Sheet 99–51

Dam Safety: Outlet Erosion Control Structures
(Stilling Basins)

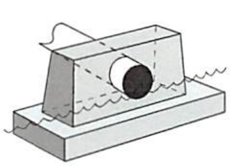
Water moving through the spillway of a dam contains a large amount of energy. This energy can cause erosion at the outlet which can lead to instability of the spillway. Failure to properly design, install, or maintain a stilling basin could lead to problems such as undermining of the spillway and erosion of the outlet channel and/or embankment material. These problems can lead to failure of the spillway and ultimately the dam. A stilling basin provides a means to absorb or dissipate the energy from the spillway discharge and protects the spillway area from erosion and undermining. An outlet erosion control structure such as a headwall/endwall, impact basin, United States Department of the Interior, Bureau of Reclamation Type II or Type III basin, baffled chute, or plunge pool is considered an energy dissipating device. The performance of these structures can be affected by the tailwater elevation. The tailwater elevation is the elevation of the water that is flowing through the natural stream channel downstream during various flow conditions.

A headwall/endwall, impact basin, Type II or Type III basin, and baffled chute are all constructed of concrete. Concrete structures can develop surface defects such as minor cracking, bugholes, honeycombing, and spalling. Concrete structures can have severe structural defects such as exposed rebar, settlement, misalignment and large cracks. Severe defects can indicate structural instability.

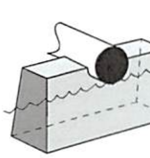
Headwall/Endwall

A headwall/endwall located at or close to the end of the discharge conduit will provide support and reduce the potential for undermining. A headwall/endwall is typically constructed of concrete, and it should be founded on bedrock or have an adequate foundation footing to provide support for stability. A headwall/endwall can become displaced if it is not adequately designed and is subject to undermining. Displacement of the headwall/endwall can lead to separation of the spillway conduit at the joints which could affect the integrity of the spillway conduit. If a concrete structure develops the structural defects mentioned in the opening paragraphs, or if the discharge spillway conduit does not have a headwall/endwall, then a registered professional engineer should be contacted to evaluate the stability of the outlet.

Headwall



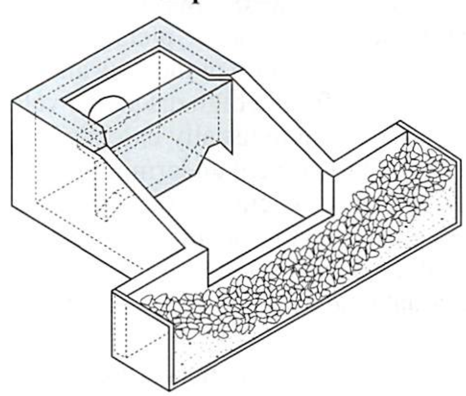
Endwall



Impact Basin

A concrete impact basin is an energy dissipating device located at the outlet of the spillway in which flow from the discharge conduit strikes a vertical hanging baffle. Discharge is directed upstream in vertical eddies by the horizontal portion of the baffle and by the floor before flowing over the endsill. Energy dissipation occurs as the discharge strikes the baffle, thus, performance is not dependent on tailwater. Most impact basins were designed by the United States Department of Agriculture, Natural Resources Conservation Service and the United States Department of Interior, Bureau of Reclamation. If any of the severe defects that are referenced in the opening paragraphs are observed, a registered professional engineer should be contacted to evaluate the stability of the outlet.

Impact Basin



U.S. Department of Interior, Bureau of Reclamation Type II and Type III Basins

Type II and Type III basins reduce the energy of the flow discharging from the outlet of a spillway and allow the water to exit into the outlet channel at a reduced velocity. Type II energy dissipators contain chute blocks at the upstream end of the basin and a dentated (tooth-like) endsill. Baffle piers are not used in a Type II basin because of the high velocity water entering the basin.

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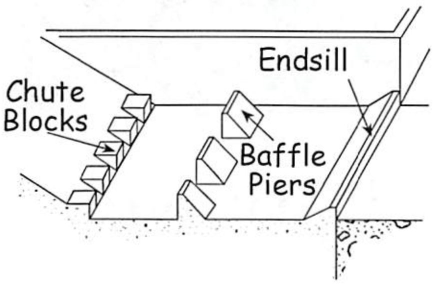
Type III Basin

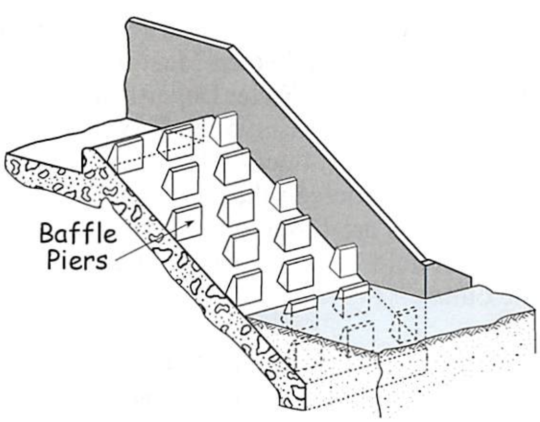


Type III energy dissipators can be used if the entrance velocity of the water is not high. They contain baffle piers which are located on the stilling basin apron downstream of the chute blocks. Located at the end of both the Type II and Type III basins is an endsill. The endsill may be level or sloped, and its purpose is to create the tailwater which reduces the outflow velocity. If any of the severe defects associated with concrete structures are observed, a registered professional engineer should be contacted to evaluate the stability of the basin.

Baffled Chute

Baffled chutes require no initial tailwater to be effective and are located downstream of the control section. Multiple rows of baffle piers on the chute prevent excessive acceleration of the flow and prevent the damage that occurs from a high discharge velocity. A portion of the baffled chute usually extends below the streambed elevation to prevent undermining of the chute. If any of the severe problems associated with concrete that are referenced in the opening paragraphs are observed, a registered professional engineer should be contacted to evaluate the stability of the outlet.

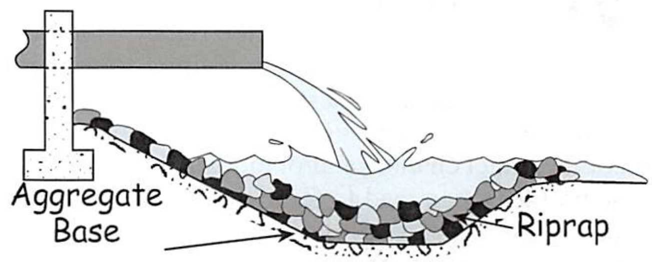
Baffeled Chute Basin



Plunge Pool

A plunge pool is an energy dissipating device located at the outlet of a spillway. Energy is dissipated as the discharge flows into the plunge pool. Plunge pools are commonly lined with rock riprap or other material to prevent excessive erosion of the pool area. Discharge from the plunge pool should be at the natural streambed elevation. Typical problems may include movement of the riprap, loss of fines from the bedding material and scour beyond the riprap and lining. If scour beneath the outlet conduit develops, the conduit will be left unsupported and separation of the conduit joints and undermining may occur. Separation of the conduit joints and undermining may lead to failure of the spillway and ultimately the dam. A registered professional engineer should be contacted to ensure that the plunge pool is designed properly.

Plunge Pool



Additional information about related topics can be found on the following fact sheets: "Inspection of Concrete Structures," "Spillway Conduit System Problems," "Open Channel Spillways (Concrete Chutes and Weirs)," and "Problems with Concrete Materials."

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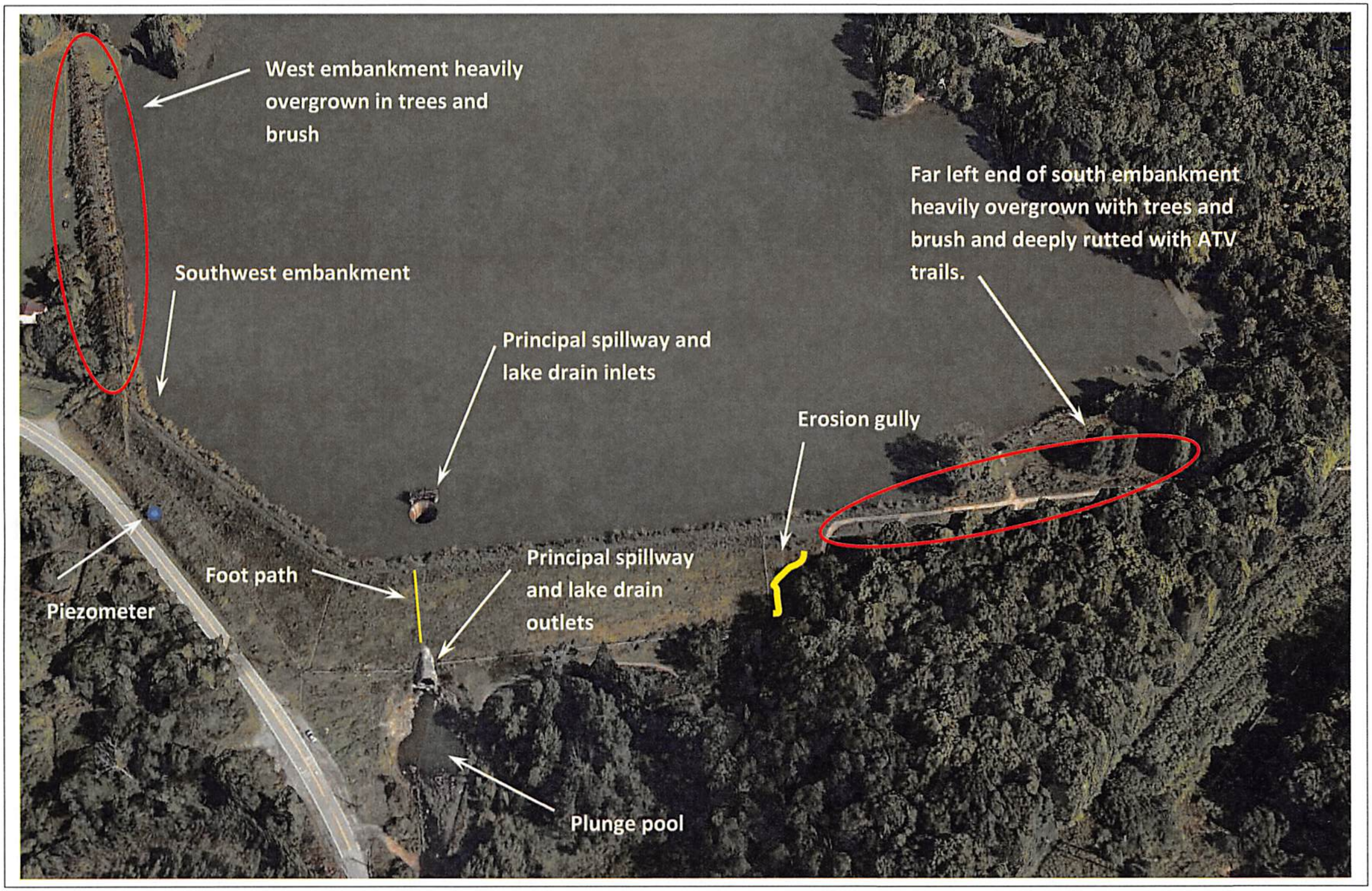
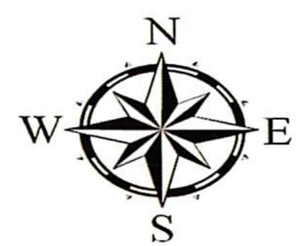
Emergency 24hr hotline: 614-799-9538

Section 2



UPPER GIRARD LAKE DAM

May 4, 2016



	Photograph No. 1: View of the upstream slope and crest at the far left end of the dam. Note the heavy growth of trees and brush, and the deep rutting on the crest.
	Photograph No. 2: View of the upstream slope. Note the trees and brush growing up through the slope protection.
	Photograph No. 3: View of an area where the slope protection has become displaced.

Photograph No. 4:

View of the upstream slope and crest.

Photograph No. 5:

View of the embankment at the far right end. Note the heavy growth of trees and brush on the entire embankment.

Photograph No. 6:

Overview of the area on the downstream slope that had recently been cleared. You can see that the slope is sparsely covered in grass.

	Photograph No. 7: View along the downstream toe of the south embankment.
	Photograph No. 8: Note that there is a slight bench constructed in the downstream slope. This bench is present on the south embankment and part of the south west embankment. It is not believed that a bench is on the west embankment, but heavy trees and brush prohibited a proper inspection.
	Photograph No. 9: View of the far left end of the downstream slope. ATV riders have carved roads on the slope and left them rutted and bare of vegetation.

Photograph No. 10:

Immediately below the road you can see the rutting and ponded water. This area may be where seepage was noted in a previous inspection report.

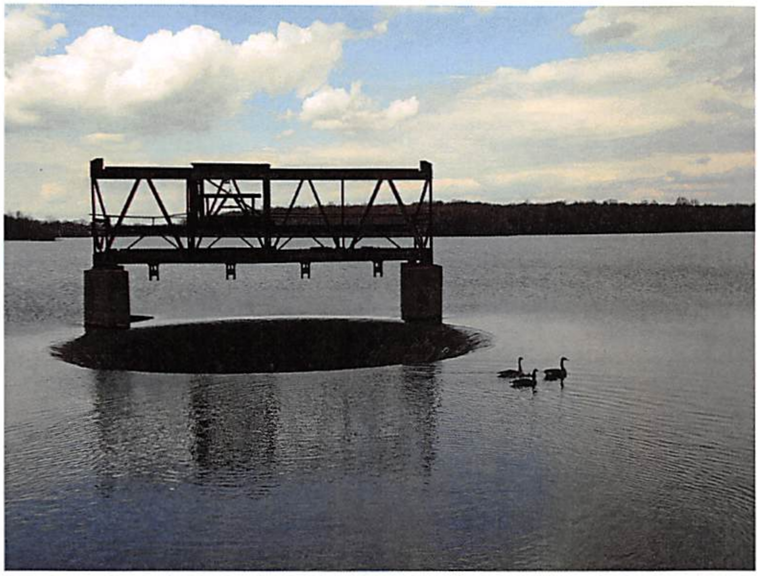
Photograph No. 11:

Far left end of the downstream slope. Note the trees and brush.

Photograph No. 12:

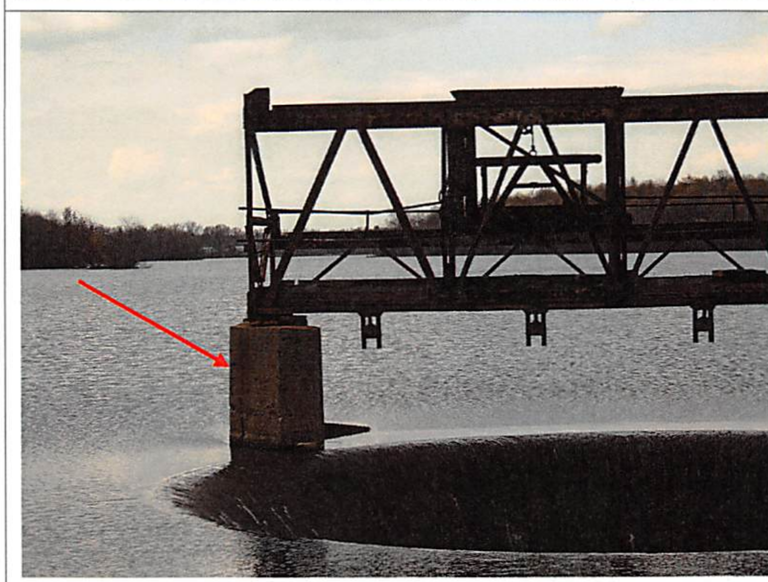
View of the far left end of the downstream slope. ATV riders have carved roads on the slope and left them rutted and bare of vegetation.

	Photograph No. 13: View of the far left end of the downstream slope. ATV riders have carved roads on the slope and left them rutted and bare of vegetation.
	Photograph No. 14: A deep erosion gully had developed at the lower downstream groin near the left end of the dam.
	Photograph No. 15: A bare foot path was located on the slope directly above the principal spillway outlet pipe. Again, note the sparse grass cover on the slope.



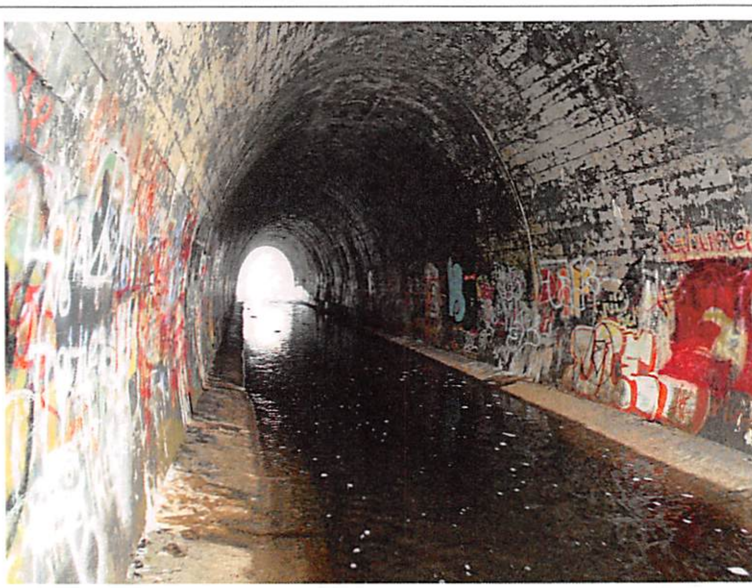
Photograph No. 16:

View of the morning glory principal spillway inlet and lake drain structure.



Photograph No. 17:

View of the lake drain structure abutment. The arrow points to where the staff gage was adhered to at the last inspection.



Photograph No. 18:

View of the interior of the principal spillway outlet.

Photograph No. 19:

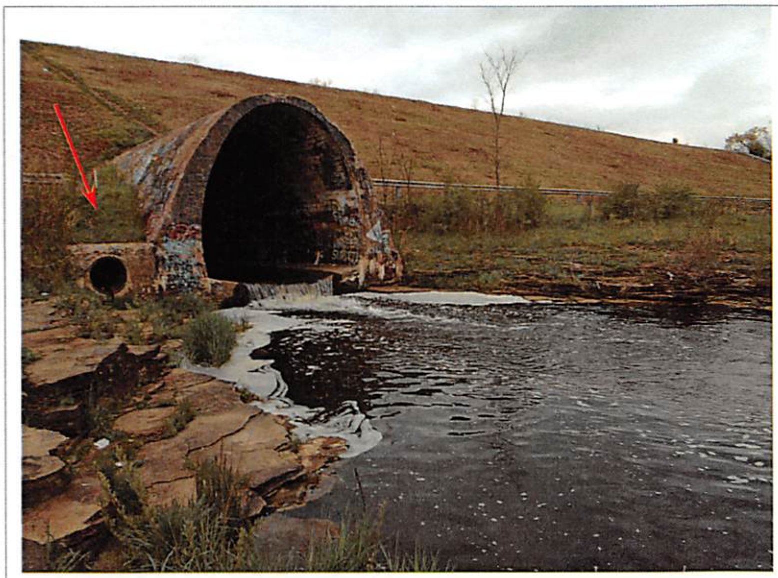
View of some exposed rebar in the principal spillway outlet pipe.

Photograph No. 20:

View of some exposed rebar in the principal spillway outlet pipe.

Photograph No. 21:

View of one of the joints in the principal spillway outlet pipe.

	Photograph No. 22: View of the principal spillway and lake drain outlet pipes. The red arrow points to the lake drain outlet pipe.
	Photograph No. 23: View inside the lake drain outlet pipe. Note the corrosion of the metal pipe and the litter in the pipe.
	Photograph No. 24: View of the plunge pool for the principal spillway and lake drain outlets. The arrows point to where heavy discharges had caused new erosion in the plunge pool noted at the last inspection. These areas appear to have stabilized.

Dam Classification Checklist

Name of Dam:	Upper Girard Lake Dam			File Number:	1105-001
County:	Trumbull	Date:	May 4, 2016	Engineer:	TMG

The classification of a dam is based on three factors: the dam's height, storage capacity, and potential downstream hazard. The height of the dam is the vertical distance from the crest to the downstream toe. The storage capacity is the volume of water that the dam can impound at the top of dam (crest) elevation. The downstream hazard consists of roads, buildings, homes, and other structures that would be damaged in the event of a dam failure. Potential for loss of life is also evaluated. Various dam failure scenarios must be considered, and they include failures when the dam is at normal pool level and failures during significant flood events. Each of the three factors is evaluated, and the final classification of the dam is based on the highest individual factor. Class I is the highest and Class IV is the lowest. The classification of a dam can change based on future development along the downstream channel.

This checklist is intended to establish or verify the appropriate classification in accordance with the Ohio Administrative Code – it does not necessarily show all potential hazards or the full extent of inundation. In addition, elevations are estimated.

HEIGHT CLASSIFICATION		***STORAGE CLASSIFICATION***		***EXEMPT~NON-REGULATED***	
Dam Height = 54.6 feet		Stor. Capacity (top of dam)= 4289 acre-feet			
____	> 60' - Class I	____	> 5000 acre-feet - Class I	____	Height ≤ 6 feet
X	> 40' - Class II	X	> 500 acre-feet - Class II	____	Storage ≤ 15 acre-feet
____	> 25' - Class III	____	> 50 acre-feet - Class III	____	6 ft. < Height < 10 ft. & Stor. ≤ 50 ac-ft
____	≤ 25' - Class IV	____	≤ 50 acre-feet - Class IV		

Height Class:	II		
Storage Class:	II		
Hazard Class (see next page):	I	**Estimated Population at Risk:**	+15
Final Class:	I		

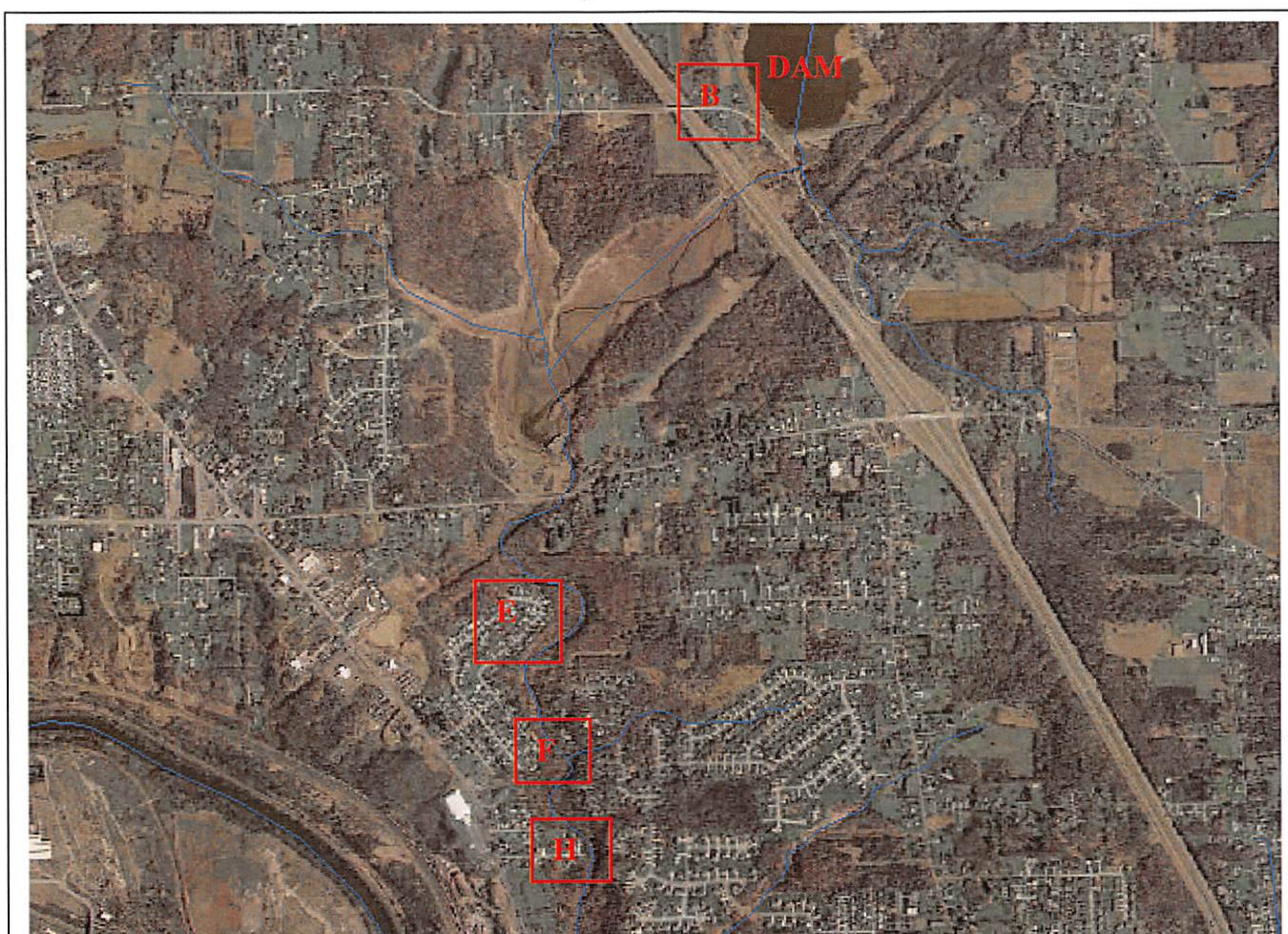
Class Changed (Yes, No)

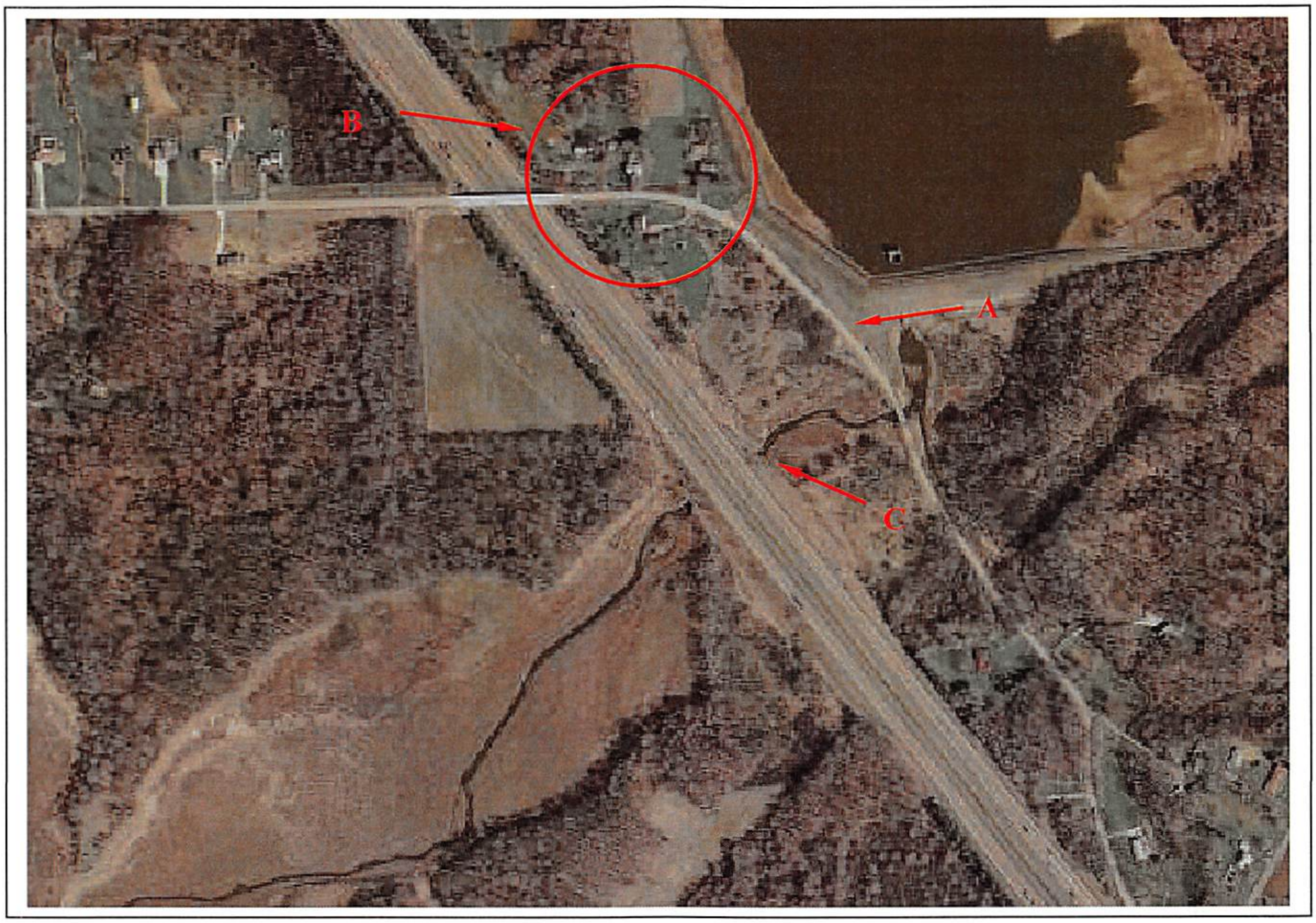
POTENTIAL DOWNSTREAM HAZARD

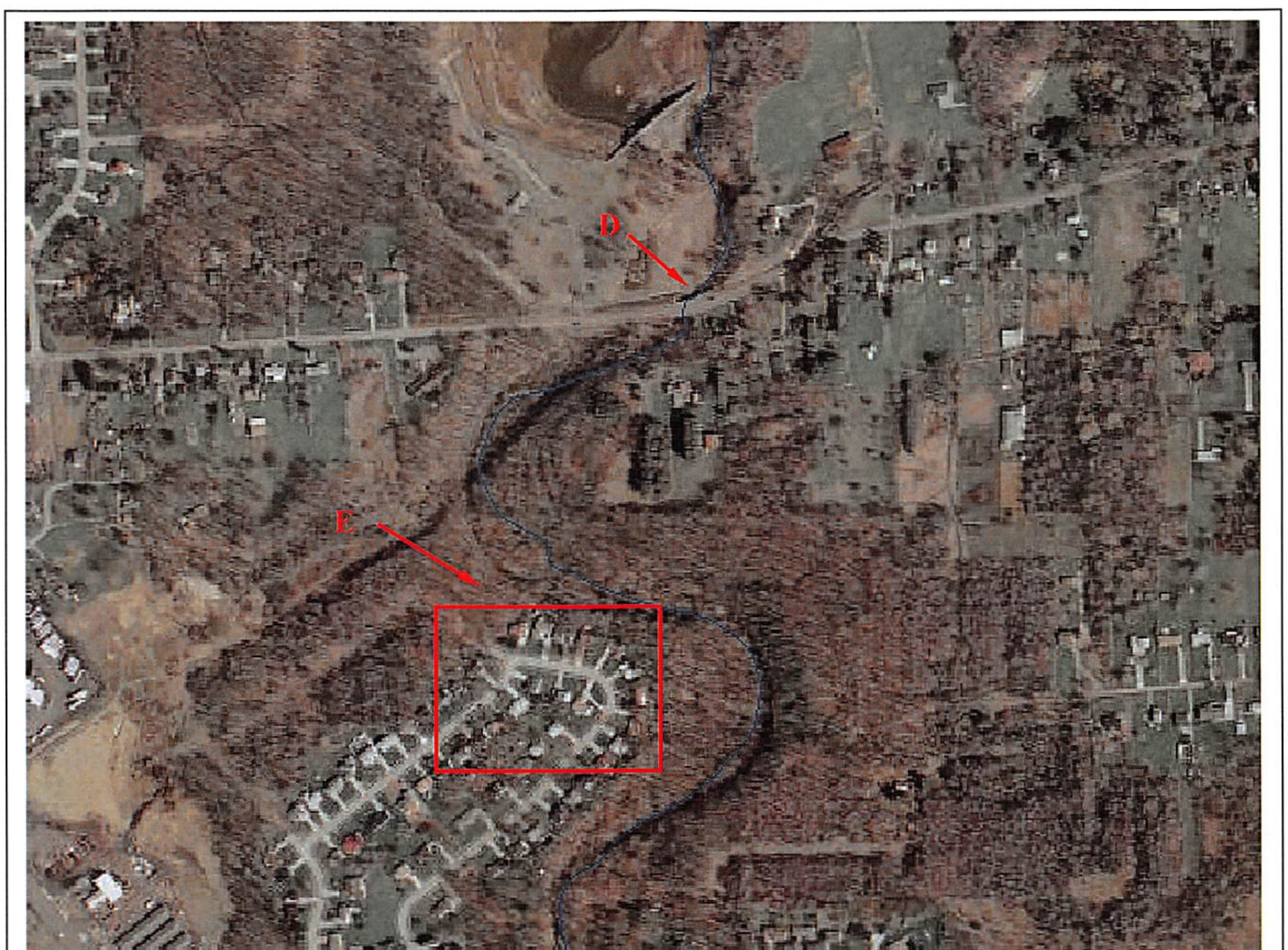
I	II					III		IV	-	-				
Probable loss of human life	Loss of public water supply or wastewater treatment facility, release of health hazardous waste	Flooding of structure or high-value property	Damage to high-value or Class I, II, III dam or levee	Damage to major road (US or state route), disruption of only access to residential or critical facility area	Damage to railroad or public utility	Damage to rural building, not otherwise high-valued property, or Class IV dam or levee	Damage to local road (county and township)	Loss restricted mainly to the dam or agricultural /rural land	No hazard to structure noted	*No hazard assessment; further investigation needed*	Distance downstream of dam to affected structure (feet)	Vertical distance from streambed to base of affected structure (feet)	Horizontal distance from stream to affected structure (feet)	
							A				0	0	0	Road
B											65-450	0	0	Homes
									C		890	35	0	State Route
							D				5500	5	0	Road
									E		6900	30	125	Homes
F											9500	15	130	Homes
							G				9500	5	0	Road
H											11000	15	90-300	Homes

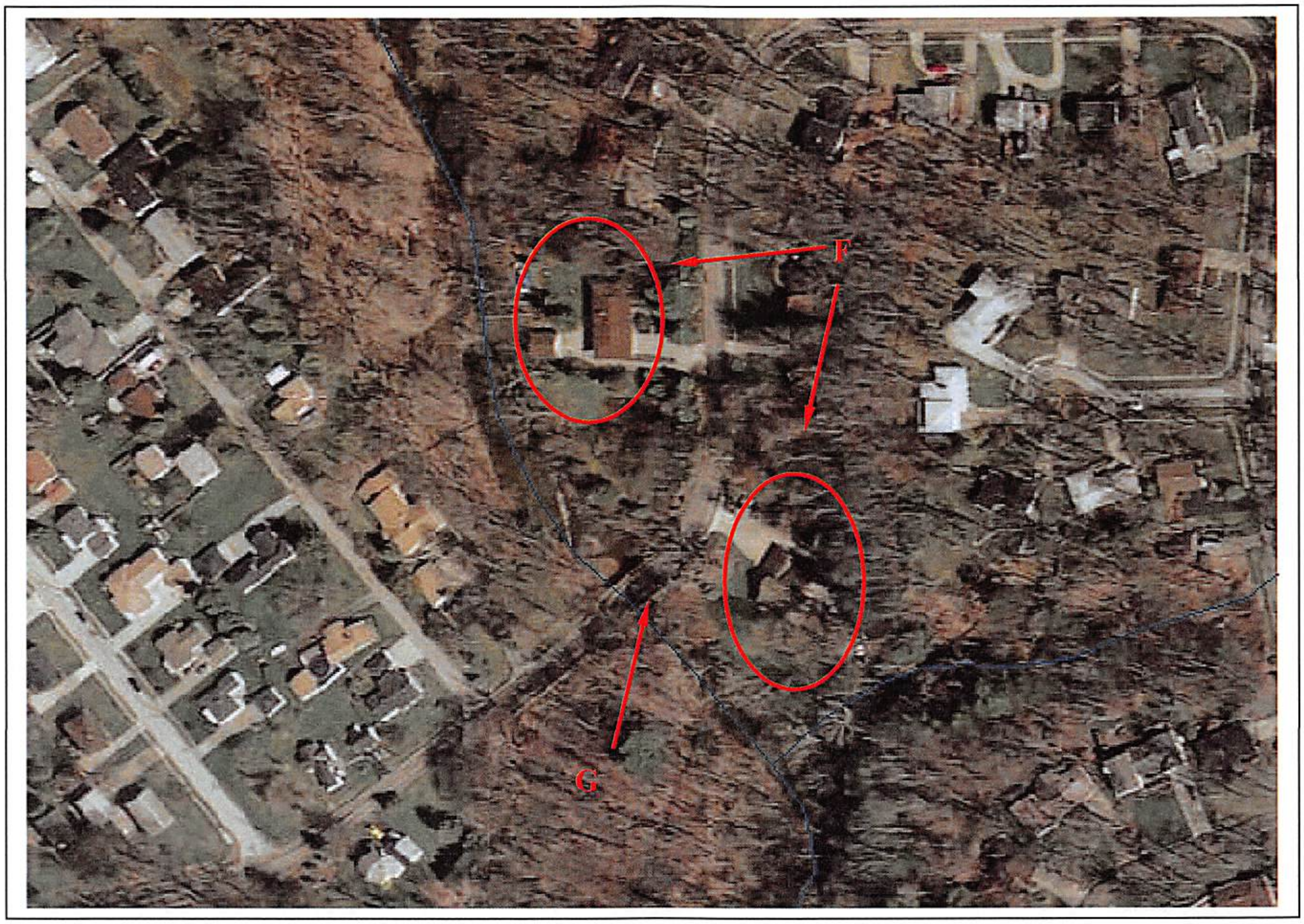
This checklist is intended to establish or verify the appropriate classification in accordance with the OAC – it does not necessarily show all potential hazards or the full extent of inundation.

Sketch of Developments Downstream of Dam




B
A
C


D
E


F
G


H

Flood Routing Summary

A dam must be able to safely pass severe flood events. A dam uses a combination of reservoir storage capacity and spillway discharge to prevent floodwater from overtopping the embankment crest. As part of this inspection, the Division of Water Resources did not thoroughly investigate the ability of this dam to safely pass the required design flood. In 1981 Burgess & Niple, Inc. performed hydrologic and hydraulic calculations to estimate the size of the design flood and the total spillway discharge capacity of the dam. These calculations combined with the reservoir storage capacity were used in the flood routings to determine the maximum water surface elevation in the reservoir for various flood events (see Table I).

Upper Girard Lake Dam is a Class I dam; therefore, in accordance with OAC Rule 1501:21-13-02, the required design flood is 100% of the Probable Maximum Flood (PMF) or the critical flood. This dam and its spillway system must safely pass the design flood without overtopping the embankment crest. Flood routing calculations indicate that the dam can pass 45% of the PMF; Upper Girard Lake Dam does not appear to be able to safely pass the design flood.

Table I - Flood Routing Summary

Flood Event	Maximum Inflow (cubic feet per second)	Maximum WSEL[1] (feet)	Overtopping Depth[2] (feet)	Overtopping Duration (hours)
PMF	11196	1029.0	1.4	10.0
75% PMF	8397	1028.5	0.9	7.0
50% PMF	5598	1027.9	0.3	3.8
25% PMF	2799	1025.0	-2.6	0
12% PMF[3]	1343	1023.5	-4.1	0

1. WSEL – water surface elevation, in feet above the mean sea level
2. A negative number indicates that the dam does not overtop and represents the elevation difference between the Maximum WSEL and the Top of Dam Elevation (freeboard)
3. 12% PMF is similar to the 100-year flood. The 100-year flood event has a 1% chance of occurring in any given year. This is only an approximation.

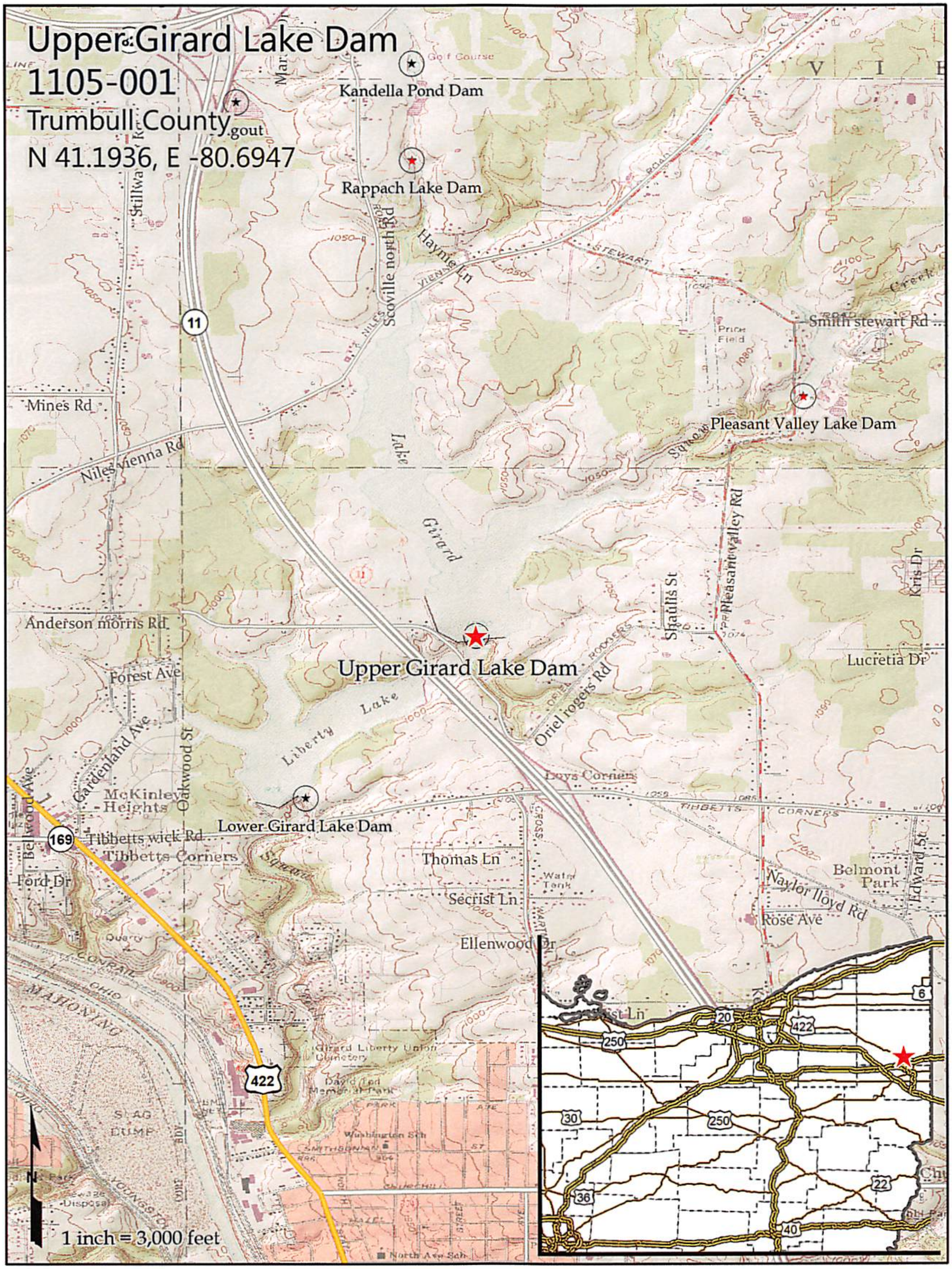
Top of Dam Elevation:	1027.60 feet above msl
Normal Pool Elevation:	1020.60 feet above msl

History of Upper Girard Lake Dam

Date	Event
1929	Dam constructed.
1930	Upstream slope failure due to rapid drawdown
Approx. 1931	Drains installed to control seepage; Repair of upstream slope
1978	Dam safety inspection by Burgess & Niple, Inc.
1978	Phase I inspection
1980	Burgess & Niple, Inc. flood hazard evaluation
1983	Dam safety inspection by the Division of Water Resources
1991	Dam safety inspection by the Division of Water Resources
1999	Principal Spillway access bridge removed
2001	Dam safety inspection by the Division of Water Resources
2006	Dam safety inspection by the Division of Water Resources
2011	Dam safety inspection by the Division of Water Resources
May 4, 2016	Dam safety inspection by the Division of Water Resources

Section 3

LOCATION MAP



Dam Inventory Sheet

Name: UPPER GIRARD LAKE DAM
File No: 1105-001
National #: OH00634
Reservoir:
Permit No.: EXEMPT
Class (Ht-Vol): I (II - II)

Owner Information

Owner: City of Girard
Owner Type: Public, Local
Address: 100 West Main Street
Multi-Dams: -
Parcel No.:
City: Girard
State: OH
Zip: 44420
Contact: Jerry Lambert, Service Director
Phone No.: 330/545-3306

Location Information

County: Trumbull
Latitude Deg.: 41 **Min.:** 11 **Sec.:** 37
Township: Liberty
Longitude Deg.: 80 **Min.:** 41 **Sec.:** 41
Stream: Squaw Creek
USGS Quad.: Girard
USGS Basin No.: 05030103

Design/Construction Information

Designed By: Public Works Corporation, New York, New York
Constructed By: A. Guthrie And Co., Inc., St. Paul, Minnesota
Completed: 1929 **Plan Available:** YES **At:** ODNR, DOW & OWSC
Failure/Incident/Breach:

Structure Information

Purpose: Water Supply, Industrial; Recreation, Public
Type of Impound.: Dam And Spillway
Type of Structure: Earthfill
Drainage Area (sq. miles): 13.03 **or (acres):** 8339

Embankment Data

Length (ft): 2720
Upstream Slope: 2H:1V
Height (ft): 54.6
Downstream Slope: 2H:1V
Top Width (ft): 15
Volume of Fill (cub. yds.): 189108

Spillway Outlet Works Data

Lake Drain: FOUR 30-IN PIPES AT SPILLWAY
Principal: 17-FT CONCRETE PIPE W/126-FT CIRCUMFERENCE MORNING GLORY TYPE RISER
Emergency: NONE
Maximum Spillway Discharge (cfs): 8500 **Design Flood:** 1.0 **Flood Capacity:** 0.45

Dam Reservoir Data	Elevation (ft-MSL)*	Area (acres)	Storage (acre-feet)
Top of Dam:	1027.6	210	4289
Emergency Spillway:			
Principal Spillway:	1020.6	175	2760
Streambed:	973		
Foundation:			

*Elevations are not necessarily related to a USGS benchmark

Inspection Information

Inspection History:
5/4/2016 TMG
5/4/2011 TMG
6/15/2006 PMG
5/29/2001 DLC
5/30/1991
10/23/1983
10/24/1980
4/20/1978

Phase I: 7/6/1978
Other Visits:
Inspection Year: D

GIRA

Operation Information/Remarks

PHASE I: UNSAFE - NON-EMERGENCY

Emergency Action Plan: Approved **Format:** ICODS **OMI:** No
Last Entry: 5/6/2016

Dam Safety Inspection Checklist

Complete All Portions of This Section (Pre-inspection)

Name of Dam: Upper Girard Lake Dam — Trumbull County

Date of Inspection: MAY 4, 2016

File Number: 1105-001

Class: I — Design Flood: 1.0 — Flood Capacity: 0.45

Required Action: None ☐ Mon. ☐ Maint. ☐ Eng. ☒

Interview with Owner (at the site):

Owner/Representative present: (Yes, No) Name(s): JERRY PLANNED ON MEETING US, BUT THERE WAS A MISCOMMUNICATION.

Owner's Name(s): City of Girard

Address: 100 West Main Street, ,

City: Girard — State: OH — Zip (+4): 44420

Contact Person: Jerry Lambert, Service Director — Telephone: 330/545-3306

Email Address:

Purpose of dam: Water Supply, Industrial; Recreation, Public

Owner Dam Safety Program

Emergency Action Plan

EAP (document): Approved — ICODS — Up-to-date? (yes, no) — None ☒ Mon. ☐ Maint. ☐ Eng. ☐

Exercised: NO

Downstream development: NO NEW DEVELOPMENT

Security: NONE

Operation, Maintenance, and Inspection

OMI (document): No — Up-to-date? (yes, no) — None ☐ Mon. ☐ Maint. ☒ Eng. ☐

Operation of drains/gates

All operable? (yes, no) 4 SLUICE GATES. OPERABLE BY DIVERS ONLY. TOP ONE WORKS, UNSURE ABOUT LOWER GATES

Normal rate of drawdown: UNKNOWN — Emerg. rate of drawdown: USING TOP GATE NP CAN BE LOWERED TO 975' IN ≈ 19 DAYS

Accessibility for operation: BY DIVER

Maintenance

Frequency of mowing: 2/YEAR FOR MOST. BUT WEST EMBANKMENT AND FAR LEFT END OF SOUTH EMBANKMENT OVERGROWN.

Other maintenance: NONE

Inspection

Frequency and thoroughness of day-to-day & routine inspections: NONE

Frequency and thoroughness of event-driven inspections: NONE

Problems found during inspections: N/A

Field Information

Pool Elevation (during inspection): SLIGHTLY ABOVE NORMAL POOL — Time: 330 (a.m., p.m.)

Site Conditions(temp., weather, ground moisture): 75°, SUNNY, DRY

Inspection Party: TINA GRIFFIN + NATHAN LIEBERUM

Maximum Height: 54.6 Feet (measured or inventory appears correct)

Normal Pool Surface Area: 175 Acres (measured or inventory appears correct)

Lake drain - 4 sluice gates. Only operational by diver. Last operated in July 2016. City believes that all gates can open but are afraid that they may not be able to get bottom gates closed and fear draining reservoir. Gate that does work flows into a 30" diam CIP that outlets to the right of the principal spillway outlet. Two of the four gates outlet into the principal spillway outlet tunnel. Water level can be lowered from normal pool to elevation 997 (Centerline of upper gate) in about 19 days	Phase I: Unsafe - Non-emergency

Required Action

None Monitor Maintenance Engineer

UPSTREAM SLOPE Gradient: Horizontal: 2 Vertical: 1 (esl, meas.)

☒ *VEGETATION* [no problem]

☒ Trees: Quantity: (<5, sparse, dense) ☐ ☐ ☒ ☐
Diameter: (<6", 6-12", >12")
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes:

☒ Brush: Quantity: (sparse, dense) + MODERATE ☐ ☐ ☒ ☐
Location:(adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes:

☒ Ground Cover: Type: (grass, crown vetch) Other: MIXTURE OF GRASS + WEEDS. ☐ ☐ ☒ ☐
Quantity: (bare, sparse, adequate, dense) DEVELOP BETTER COVER.
Appearance: (too tall, too short, good) MOW SLOPE.
Notes:

☒ *SLOPE PROTECTION* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ None ☐ ☐ ☒ ☐
☒ Riprap: Average Diameter: FLAT STONES ≈ 12" x 18"
(adequate, sparse, displaced, weathered, vegetation) (bedding/fabric noted - yes, no)
Notes: Saplings growing between stones are causing stones to become displaced. Need to replenish

☐ Wave Berm: ☐ ☐ ☐ ☐
Vegetation: (adequate, bare, sparse, improper vegetation)
Notes:

☐ Concrete Slabs: (cracked, settlement, undermined, voids, deteriorated, vegetation) ☐ ☐ ☐ ☐
Notes:

☐ Other: ☐ ☐ ☐ ☐
Notes:

☒ *EROSION* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Wave Erosion (Beaching): Scarp: Length: Height:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes:

☐ Runoff Erosion (Gullies): Quantity: ☐ ☐ ☐ ☐
Depth: Width: Length:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes/Causes:

☒ *INSTABILITIES* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Slides: Transverse Length: Longitudinal Length:
Scarp: Width: Length:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Crack: Width: Depth:
Notes/Causes

☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other ☐ ☐ ☐ ☐
Quantity: Length: Width: Depth:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes/Causes:

None Monitor Maintenance Engineer
Required Action

Required Action

None | Monitor | Maintenance | Engineer

☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other ☐ ☐ ☐ ☐
Quantity: Length: Width: Depth:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐
Size: Height: Depth:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐
Size: Height: Depth:
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes/Causes:

☒ *OTHER* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Rodent Burrows: (few, numerous)
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Notes:

☐ Ruts: ☐ ☐ ☐ ☐
Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)
Depth: Width Length:
Notes/Causes: (truck/auto, motorcycle, ATV, animals, pedestrian)

☐ Other: ☐ ☐ ☐ ☐
Notes:

CREST Length: 2720' Width: 15' (est, meas.)

☒ *VEGETATION* [no problem] ☐ ☐ ☐ ☐
☒ Trees: Quantity: (<5, sparse, dense)
Diameter: (<6", 6-12", >12")
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes:

☒ Brush: Quantity: (sparse, dense) ☐ ☐ ☐ ☐
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes:

☒ Ground Cover: Type: (grass, crown vetch) Other: R END TREES + BRUSH ☐ ☐ ☒ ☐
Quantity: (bare, sparse, adequate, dense) CENTER - GOOD GRASS COVER
Appearance: (too tall, too short, good) L END - BARE
Notes:

☒ *EROSION* [no problem, could not inspect thoroughly] → R END ☐ ☐ ☐ ☐
☐ Runoff Erosion (Gullies): Quantity: Depth: Width: Length:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

None | Monitor | Maintenance | Engineer

Required Action

Required Action

None Monitor Maintenance Engineer

☑ ALIGNMENT [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
ertical: Low Area:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Elevation Difference: Length:
Notes/Causes:

☐ ☐ ☐ ☐
☐ Horizontal:
Notes/Causes:

☑ WIDTH [no problem] ☐ ☐ ☐ ☐
☐ Too Narrow
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

☑ INSTABILITIES [no problem, could not inspect thoroughly] R END ☐ ☐ ☐ ☐
☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other
Quantity: Length: Width: Depth:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other ☐ ☐ ☐ ☐
Quantity: Length: Width: Depth:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐
Size: Height: Depth:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐
Size: Height: Depth:
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes/Causes:

☒ OTHER [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Rodent Burrows: (few, numerous)
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Notes:

☒ Ruts: DEEP RUTS @ LEFT END ☐ ☐ ☒ ☐
Location: (adj. to structure, entire crest, lt end, rt end, middle, see dwg)
Depth: 18" Width 12" Length: 200' PONDED WATER WAS NOTED IN THE RUTS.
Notes/Causes: (truck/auto, motorcycle, ATV, animals, pedestrian)

☐ Other: ☐ ☐ ☐ ☐
Notes:

None Monitor Maintenance Engineer

Required Action

Required Action

None | Monitor | Maintenance | Engineer

DOWNSTREAM SLOPE Gradient: Horizontal: 2 Vertical: 1 (est, meas.)

☒ *VEGETATION* [no problem]

☒ Trees: Quantity: (<5, sparse, dense) - (R) END MODERATE (L) END ☐ ☐ ☒ ☐

Diameter: (<6", 6-12", >12")

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes:

☒ Brush: Quantity: (sparse, dense) - (R) END MODERATE (L) END ☐ ☐ ☒ ☐

Location:(adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes:

☒ Ground Cover: Type: (grass, crown vetch) Other: THERE WAS A SPARSE GRASS ☐ ☐ ☒ ☐

Quantity: (bare, sparse, adequate, dense) COVER OVER THE ENTIRE EMBANKMENT.

Appearance: (too tall, too short, good) CENTER SECTION HAD RECENTLY BEEN MOWED.

Notes: LENGTH OF GRASS ≈ 2".

☒ *EROSION* [no problem, could not inspect thoroughly]

☒ Runoff Erosion (Gullies): Quantity: 1 Depth: 24" Width: 36" Length: ☐ ☐ ☒ ☐

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes/Causes: LOWER LEFT GROIN, FROM BENCH TO TOE.

☒ *INSTABILITIES* [no problem, could not inspect thoroughly] - (R) END

☐ Slides: Transverse Length: Longitudinal Length: ☐ ☐ ☐ ☐

Scarp: Width: Length:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Crack: Width: Depth:

Notes/Causes

☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other ☐ ☐ ☐ ☐

Quantity: Length: Width: Depth:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes/Causes:

☐ Cracks: ☐ Transverse ☐ Longitudinal ☐ Other ☐ ☐ ☐ ☐

Quantity: Length: Width: Depth:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐

Size: Height: Depth:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes/Causes:

☐ Bulges ☐ Depressions ☐ Hummocky ☐ ☐ ☐ ☐

Size: Height: Depth:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Notes/Causes:

None | Monitor | Maintenance | Engineer

Required Action

Required Action
None / Monitor / Maintenance / Engineer

☒ OTHER [no problem, could not inspect thoroughly] ☐ ☐ ☒ ☐

☐ ~~Rodent Burrows~~: (few, numerous) WALKING PATH

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg) THERE IS A BARE FOOT PATH

Notes: LEADING FROM CREST TO OUTLET PIPE. RESEED + DEVELOP GRASS COVER ☐ ☐ ☒ ☐

☒ Ruts:

Location: (adj. to structure, entire slope, lt end, rt end, middle, see dwg)

Depth: 12" Width 18" Length: VARY

Notes/Causes: (truck/auto, motorcycle, ATV, animals, pedestrian) ☐ ☐ ☒ ☐

☒ Other: IT APPEARS THAT PEOPLE USE THE LEFT END OF DAM AS

Notes: DIRT BIKE TRAIL. THREE ROADS HAD BEEN CUT INTO THE SLOPE LEADING TO THE CREST.

☒ SEEPAGE [no problem, could not inspect thoroughly] ☐ ☒ ☐ ☐

☒ Wet Area ☐ Flow ☐ Boil ☐ Sinkhole Size: ≃ 50' ∅

Flow Rate 0

Location: LEFT END OF DAM

☐ Aquatic Vegetation ☒ None

☐ Rust Colored Deposits ☒ None

☐ Sediment in Flow ☒ None

☒ Other: STANDING WATER. IT APPEARS WET AREAS ARE RUTTED AREAS

Notes/Causes: FROM ATV'S HOLDING WATER, NOT SEEPAGE.

☒ Wet Area ☒ Flow ☐ Boil ☐ Sinkhole (OBSERVATION FROM 2006 INSPECTION REPORT) ☐ ☒ ☐ ☐

Size:

Flow Rate < 1 GPM

Location: LEFT GROIN * NOT NOTED @ THIS INSPECTION. BUT MONITOR AFTER ATV TRAILS REPAIRED.

☒ Aquatic Vegetation ☐ None

☒ Rust Colored Deposits ☐ None

☐ Sediment in Flow ☒ None

☐ Other:

Notes/Causes:

☒ EMBANKMENT DRAINS [none, none found, no problem, could not inspect thoroughly] ☐ ☐ ☐ ☒

Type: Toe Drain ☐ Relief Wells ☒ Other: SLAG DRAINS Number: MANY

Flow Rate: 0 Size:

Location: UP + DOWN THE DOWNSTREAM SLOPE. STARTING NEAR LEFT END OF SW EMBANKMENT +

Notes: WRAPPING AROUND SOUTH EMBANKMENT. END NEAR CENTER OF S EMBANKMENT.

PLANS INDICATE THAT THERE ARE NO DEFINED OUTLETS FOR THESE DRAINS.

☒ MONITORING INSTRUMENTATION [none, none found, no problem, could not inspect thoroughly] ☐ ☐ ☒ ☐

☐ None Found ☒ Piezometers ☐ Weirs/Flumes ☒ Other STAFF GAGE

☒ Periodic Inspections by: NO ONE

Notes: STAFF GAGE WAS ATTACHED TO LAKE DRAIN ABUTMENT @ LAST INSPECTION. IT WAS NOT THERE @ THIS INSPECTION.

None / Monitor / Maintenance / Engineer
Required Action

PIEZOMETER: THERE WAS ONE PIEZOMETER BELOW TOE NEAR ROAD. UNSURE IF IT IS OPERABLE ☐ ☐ ☐ ☒

(Upstream Slope, Crest, Downstream Slope, Seepage, Principal Spillway, Emergency Spillway, Lake Drain)

Required Action

None Monitor Maintenance Engineer

PRINCIPAL SPILLWAY

☒ *GENERAL INLET* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐

☒ Anti-Vortex Plate [None] Dimensions: (adequate, too small,)

Type: (steel, concrete, aluminum, stainless steel, corrugated metal wood, other):

Deterioration: (missing sections, rusted, collapsed)

Notes:

☒ Flash Boards [None] ☐ ☐ ☐ ☐

Type: (metal, wood):

Deterioration:

Notes:

☒ Trashrack [None] Opening Size: (adequate, too small, too large) ☐ ☐ ☐ ☐

Type: (metal bars, fence, screen, concrete, baffle, other):

Deterioration: (broken bars, missing sections, rusted, collapsed)

Notes:

☒ *INLET OBSTRUCTION* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐

☐ Debris: (leaves, trash, logs, branches, ice) ☐ ☐ ☐ ☐

☐ Trees: Quantity: (<5, sparse, dense)

Diameter: (<6", 6-12", >12")

Location: (entire inlet, lt side, rt side, middle, see dwg)

Notes:

☐ Brush: Quantity: (sparse, dense) ☐ ☐ ☐ ☐

Location: (entire inlet, lt side, rt side, middle, see dwg)

Notes:

☐ Other:(beaver activity, trashrack opening too small, partially/completely blocked, i.e.) ☐ ☐ ☐ ☐

Notes:

☒ *INLET MATERIALS* [no problem, could not inspect thoroughly]

☐ Metal ☐ ☐ ☐ ☐

(loss of coating/paint, surface rust, corrosion (pitting, scaling), rusted out, pipe deformation)

Dimensions:

Location:

Notes/Causes:

☒ Concrete MORNING GLORY

(bug holes, hairline crack, efflorescence) ☐ ☐ ☒ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) (NOTED ON INSIDE OF RISER) ☐ ☐ ☒ ☐

(isolated crack, exposed rebar, disintegration, other) (NOTED ON INSIDE OF RISER) ☐ ☐ ☐ ☐

Dimensions/Location: UPPER PORTION OF RISER

Notes/Causes: * THIS COMMENT IS FROM 2006 REPORT.

(bug holes, hairline crack, efflorescence) ☐ ☐ ☐ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) ☐ ☐ ☐ ☐

(isolated crack, exposed rebar, disintegration, other) ☐ ☐ ☐ ☐

Dimensions/Location:

Notes/Causes:

☐ Plastic ☐ ☐ ☐ ☐

(deterioration, cracking, deformation)

Dimensions:

Location:

Notes/Causes:

None Monitor Maintenance Engineer

Required Action

Required Action

None | Monitor | Maintenance | Engineer

☐ Earthen

☐ Ground Cover: Type: (grass, crown vetch) Other: ☐ ☐ ☐ ☐
Quantity: (bare, sparse, adequate, dense)
Appearance: (too tall, too short, good)
Notes:

☐ Erosion: (wave, surface runoff) ☐ ☐ ☐ ☐
Description (height/depth/length/etc):
Notes:

☐ Ruts: ☐ ☐ ☐ ☐
Location: (entire inlet, lt side, rt side, middle, see dwg)
Depth: Width Length:
Notes/Causes: (truck/auto, motorcycle, ATV, animals, pedestrian)

☐ Riprap: Average Diameter: ☐ ☐ ☐ ☐
(adequate, sparse, displaced, weathered, vegetation) (bedding/fabric noted - yes, no)
Notes:

☐ Rock-Cut (weathered, erosion) ☐ ☐ ☐ ☐
Description:
Notes:

☐ Other: ☐ ☐ ☐ ☐

☒ *OTHER INLET PROBLEMS* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Mis-Alignment:(pipe, chute, sidewall, headwall) ☐ Pipe Deformation
Location/Description:
Notes/Causes:

☐ Separated Joint ☐ Loss of Joint Material ☐ ☐ ☐ ☐
Location/Description:
Notes/Causes:

☐ Undermining: ☐ ☐ ☐ ☐
Location/Description:
Notes/Causes:

☒ Other: THE WALKWAY TO ACCESS LAKE DRAIN + SPILLWAY INLET COLLAPSED SEVERAL YEARS AGO + NEEDS REPLACED. ☐ ☐ ☐ ☒

☐ *OPEN CHANNEL CONTROL SECTION* [no problem, could not inspect] Width (est., ms.) Brdth (est., ms.) ☐ ☐ ☐ ☐
Notes:

☒ *OUTLET OBSTRUCTION* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐
☐ Debris: (leaves, trash, logs, branches, ice) ☐ ☐ ☐ ☐
☐ Trees: Quantity: (<5, sparse, dense)
Diameter: (<6", 6-12", >12")
Location: (entire outlet, lt side, rt side, middle, see dwg)
Notes:

☐ Brush: Quantity: (sparse, dense) ☐ ☐ ☐ ☐
Location:(entire outlet, lt side, rt side, middle, see dwg)
Notes:

Required Action

☐ Other:(beaver activity, partially/completely blocked, i.e.) ☐ ☐ ☐ ☐

Notes:

None | Monitor | Maintenance | Engineer

{Upstream Slope, Crest, Downstream Slope, Seepage, **Principal Spillway-Inlet/Outlet**, Emergency Spillway, Lake Drain}

Required Action

None Monitor Maintenance Engineer

☒ **OUTLET MATERIALS** [no problem, could not inspect thoroughly]

☐ Metal (loss of coating/paint, surface rust, corrosion (pitting, scaling), rusted out, pipe deformation) ☐ ☐ ☐ ☐

Dimensions:

Location:

Notes/Causes:

☒ Concrete

(bug holes, hairline crack, efflorescence) ☐ ☐ ☐ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) ☐ ☐ ☐ ☐

(isolated crack, exposed rebar, disintegration, other) ☐ ☒ ☒ ☐

Dimensions/Location:

Notes/Causes:

(bug holes, hairline crack, efflorescence) ☐ ☐ ☐ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) ☐ ☐ ☐ ☐

(isolated crack, exposed rebar, disintegration, other) ☐ ☐ ☐ ☐

Dimensions/Location:

Notes/Causes:

☐ Plastic (deterioration, cracking, deformation) ☐ ☐ ☐ ☐

Dimensions:

Location:

Notes/Causes:

☐ Earthen

☐ Ground Cover: Type: (grass, crown vetch) Other: ☐ ☐ ☐ ☐

Quantity: (bare, sparse, adequate, dense)

Appearance: (too tall, too short, good)

Notes:

☐ Erosion: (other, surface runoff) ☐ ☐ ☐ ☐

Description (width/depth/length/etc):

Notes:

☐ Ruts: ☐ ☐ ☐ ☐

Location: (entire inlet, lt side, rt side, middle, see dwg)

Depth: Width Length:

Notes/Causes: (truck/auto, motorcycle, ATV, animals, pedestrian)

☐ Riprap: Average Diameter: ☐ ☐ ☐ ☐

(adequate, sparse, displaced, weathered, vegetation) (bedding/fabric noted - yes, no)

Notes:

☐ Rock-Cut (weathered, erosion) ☐ ☐ ☐ ☐

Description/Notes:

☐ Other: ☐ ☐ ☐ ☐

☒ **OTHER OUTLET PROBLEMS** [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☐

☐ Mis-Alignment:(pipe, chute, sidewall, headwall) ☐ Pipe Deformation

Location/Description:

Notes/Causes:

None Monitor Maintenance Engineer

☐ Separated Joint ☒ Loss of Joint Material 2006 INSPECTION NOTED SEEPAGE ☐ ☐ ☐ ☒

Location/Description: ALONG A NUMBER OF JOINTS WHERE JOINT

Notes/Causes: SEALANT WAS MISSING. THIS WAS NOT NOTED @ THIS INSPECTION.

☐ Undermining: ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

☐ Other: ☐ ☐ ☐ ☐

(Upstream Slope, Crest, Downstream Slope, Seepage, **Principal Spillway-Outlet**, Emergency Spillway, Lake Drain)

Required Action

Required Action

OUTLET EROSION CONTROL STRUCTURE (Stilling Basins)

☐ None

☒ (endwall/headwall, plunge pool, impact basin, flip bucket, USBR, baffled chute, rock lined channel)

Notes:

Components (baffle blocks, chute blocks, endsill)

☒ *MATERIAL* [no problem, could not inspect thoroughly]

☒ Riprap: Average Diameter: THE ROCK WAS SHALE BEDROCK.

(adequate, sparse, displaced, weathered, vegetation) (bedding/fabric noted - yes, no)

Notes:

☐ Concrete

(bug holes, hairline crack, efflorescence)

(spalling, popouts, honeycombing, scaling, craze/map cracks)

(isolated crack, exposed rebar, disintegration, other)

Dimensions/Location:

Notes/Causes:

(bug holes, hairline crack, efflorescence)

(spalling, popouts, honeycombing, scaling, craze/map cracks)

(isolated crack, exposed rebar, disintegration, other)

Dimensions/Location:

Notes/Causes:

☐ *OTHER* [no problem, could not inspect thoroughly]

☐ Mis-Alignment:(sidewall, headwall)

Location:

Description:

Notes/Causes:

☐ Separated Joint ☐ Loss of Joint Material

Location:

Description:

Notes/Causes:

☐ Undermining:

Location:

Description:

Notes/Causes:

☒ Other: NEW EROSION FROM RECENT HEAVY RAINS NOTED @ LAST INSPECTION APPEAR TO HAVE STABILIZED.

☒ *DRAINS* [none, none found, no problem, could not inspect thoroughly] (See *SEEPAGE* Section for Toe Drains & Relief Wells)

Type: ☐ Weep Holes ☐ Relief Drains ☐ Other:

Flow Rate: Size: Number:

Location:

Notes:

Type: ☐ Weep Holes ☐ Relief Drains ☐ Other:

Flow Rate: Size: Number:

Location:

Notes:

Required Action

Required
Action

	None	Monitor	Maintenance	Engineer
EMERGENCY SPILLWAY				
☒ None Found Notes: AN EMERGENCY SPILLWAY IS REQ'D FOR THIS DAM.	☐	☐	☐	☒

Required Action

None | Monitor | Maint. | Engineer

LAKE DRAIN

☑ *GENERAL*

☐ None Found ☐ Does not have one

☑ Type of Lake Drain (isolated control/intake tower, valve vault w/ outlet conduit, valve in riser/drop inlet, siphon)

Notes: ONLY OPERATIONABLE W/DIVER, OWNER BELIEVES ALL GATES CAN OPEN, BUT FEAR BOTTOM GATES NOT BEING ABLE TO CLOSE. THERE A 4 GATES.

☑ Operated During Inspection (yes, no) TWO GATE DISCHARGE INTO PS OUTLET.

Notes: GATE THAT THEY USE FLOWS INTO 30"Ø CIP THAT OUTLETS THROUGH A 24" Ø PIPE IMMEDIATELY TO Ⓡ OF PS OUTLET.

☑ *ACCESS TO VALVE/SLUICE GATE* [no problem, could not inspect thoroughly] ☐ ☐ ☐ ☑

☑ Type (not accessible, from shore, boat, walkway, other) NOT ACCESSABLE DURING HIGH FLOWS

Notes: BECAUSE IT IS LOCATED ADJACENT TO PRINCIPAL SPILLWAY INLET.

☐ Walkway/Platform:

☐ Concrete Deterioration ☐ Cracks (platform, piers, end supports, railing)

Location:

Notes:

☐ Wood Deterioration

Notes:

☐ Metal Deterioration

(minor, moderate, extensive, other)

Notes:

☑ *LAKE DRAIN COMPONENTS* [no problem, could not inspect thoroughly]

☐ Concrete Structure

Location:

Description: (deterioration, misalignment, cracks):

Notes/Causes:

☐ Valve Control (Operating Device)

☐ No Operating Device ☐ No Stem ☐ Bent/Broken Stem ☐ Other

Notes/Operability:

☑ Valve / Sluice Gate ☐ ☐ ☐ ☑

☐ Metal Deterioration: (surface rust, minor, moderate, extensive, other)

Location: 2006 INSPECTION REPORTED THAT ONLY TOP

Flow Rate: GATE IS OPERABLE.

Notes/Causes:

☐ Misalignment

Notes/Causes:

☐ Leakage - Flow Rate:

Notes/Causes:

☐ Valve / Sluice Gate

☐ Metal Deterioration: (surface rust, minor, moderate, extensive, other)

Location:

Flow Rate:

Notes/Causes:

☐ Misalignment - Notes/Causes:

Required Action

☑ Leakage - Flow Rate: TRICKLE ☐ ☑ ☐ ☐

Notes/Causes:

None | Monitor | Maintenance | Engineer

None	Monitor	Maintenance	Engineer

☒ Outlet Conduit

☒ Metal:(loss of coating/paint, surface rust, corrosion (pitting, scaling), rusted out) ☐ ☐ ☐ ☒

Location: IMMEDIATELY TO RIGHT OF PRINCIPAL SPILLWAY OUTLET.

Notes/Causes: CORROSION IS MUCH WORSE THAN LAST INSPECTION. PIPE HAD LITTER IN IT.

☐ Concrete (bug holes, hairline crack, efflorescence) ☐ ☐ ☐ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) ☐ ☐ ☐ ☐

(isolated crack, exposed rebar, disintegration, other) ☐ ☐ ☐ ☐

Dimensions/Location:

Notes/Causes:

☐ Plastic:(deterioration, cracking) ☐ ☐ ☐ ☐

Location:

Notes/Causes:

☐ Conduit Deformation ☐ Mis-Alignment: ☐ ☐ ☐ ☐

Location:

Notes/Causes:

☐ Separated Joint ☐ Loss of Joint Material ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

☐ Undermining: ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

☐ Vegetation (trees, brush) ☐ ☐ ☐ ☐

Notes:

☐ Other: ☐ ☐ ☐ ☐

Notes:

☒ Energy Dissipator SAME PLUNGE POOL AS PRINCIPAL SPILLWAY OUTLET.

☐ Type (endwall, plunge pool, impact basin, stilling basin, rock-lined channel, none) ☐ ☐ ☐ ☐

Notes:

☐ Riprap: Average Diameter: ☐ ☐ ☐ ☐

(adequate, sparse, displaced, weathered, vegetation) (bedding/fabric noted - yes, no))

Notes:

☐ Concrete (bug holes, hairline crack, efflorescence) ☐ ☐ ☐ ☐

(spalling, popouts, honeycombing, scaling, craze/map cracks) ☐ ☐ ☐ ☐

(isolated crack, exposed rebar, disintegration, other) ☐ ☐ ☐ ☐

Dimensions/Location:

Notes/Causes:

☐ Mis-Alignment: ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

☐ Separated Joint ☐ Loss of Joint Material ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

☐ Undermining: ☐ ☐ ☐ ☐

Location/Description:

Notes/Causes:

Required Action

☐ Other: ☐ ☐ ☐ ☐

Notes:

None	Monitor	Maintenance	Engineer

(Upstream Slope, Crest, Downstream Slope, Seepage, Principal Spillway, Emergency Spillway, Lake Drain)

Ohio Department of Natural Resources

JOHN R. KASICH, GOVERNOR

JAMES ZEHRINGER, DIRECTOR

Division of Water Resources
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614-265-6620
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October 28, 2016

City of Girard
Jerry Lambert, Service Director
100 West Main Street
Girard, OH 44420

RE: Upper Girard Lake Dam
File Number: 1105-001
Trumbull County

Dear Mr. Lambert:

Thank you for allowing Tina Griffin and Nathen Lieberum of the Division of Water Resources to conduct a safety inspection of Upper Girard Lake Dam on May 4, 2016. This inspection was conducted by representatives of the Chief of the Division of Water Resources under the provisions of Ohio Revised Code (ORC) Section 1521.062 to evaluate the condition of the dam and its appurtenances. The Chief has the responsibility to ensure that human life, health, and property are protected from dam failures. Conducting periodic safety inspections and working with dam owners to maintain and improve the overall condition of Ohio dams are vital aspects of achieving this purpose. A copy of the laws and administrative rules for dam safety is available on the division's web site or by request.

The enclosed inspection report was generated based on available information and is hereby provided for your use and study. Listed in the report are several repair, maintenance, and monitoring items that as a dam owner you are required by law to perform. Completion of these required items will improve the safety and overall condition of the dam. The Chief must approve any plans for modifications or repairs to the dam. Modifying or repairing a dam includes, but is not limited to, installing or replacing a spillway pipe or a portion of a spillway, raising the embankment crest elevation, raising the normal pool level, and placement of fill and/or piping in an open channel spillway. Following approval of the engineered plans, all necessary repairs must be implemented by the owner under the supervision of a registered professional engineer.

To gain information that will help improve the inspection program, a short survey has been developed and is enclosed. Please complete the survey and return it in the self-addressed envelope provided. Your feedback is important.

It is the Division's understanding that you are the owner(s) of this dam. Under Ohio's dam safety regulations, "owners" are "those who own, or propose to construct a dam or levee." OAC Rule 1501:21-3-01(V). A "dam" is defined as "any artificial barrier together with any appurtenant works, which either does or may impound water or other liquefied material ..." OAC Rule 1501:21-3-01(F). "Appurtenant works" include but are not limited to outlet works and spillway channels.

If you are not an owner of this dam, or believe that there are additional owners of the dam not addressed in this communication, please contact Tina Griffin. Please note that ORC Section 1521.062 requires a dam owner to notify the Chief of the Division of Water Resources in writing of a change in ownership of a dam prior to the exchange of the property.

Your cooperation in improving the overall condition of this dam is appreciated. Please contact Tina Griffin at 614/265-6634 if you have any questions.

Sincerely,

Mia Kannik

Mia P. Kannik, P.E.
Program Manager
Dam Safety Program
Division of Water Resources

MPK:tmg

Enclosures