

Earthen Dam Risk Assessment Assessment & Guidelines for Action

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I. Introduction

Purpose of this report:

In the process of defining our necessary reserve for Lake Waynoka, it was determined that our largest liability would be the failure of our dam. There are different levels of failure but in the end the repairs are usually very similar.

This report is a summary of the experiences of Lake Waynoka and other lakes in Ohio, both private and those owned by the Ohio Department of Natural Resources (ODNR).

- **At the present time, the Lake Waynoka Class 1 Dam is not covered by any insurance other than damage caused downstream of the dam by a dam failure.**
- **It is very important that the Lake Waynoka Operations Manager and the WPOA board be able to make timely decisions to expedite actions related to the issues related to the corrections needed to restore the lake to normal conditions. The WPOA Board must take responsibility of proceeding with the actions necessary to restore the earthen dam and lake for the Lake Waynoka homeowners.**
- **Additionally, insurance does cover damage downstream (with the exception a deductible) of the existing dam location.**
- **It is necessary to provide funds to proceed with those actions. The Hideaway Hills current experience (a private lake community) provides guidance as to the scope and costs needed to proceed with those actions needed for a timely resolution of issues. Other lakes have experienced timeframes as much 1-3 years for resolution of issues prior to the start of construction, and construction could take an additional 1-3 years depending on the nature of the issue related to the earthen dam failure. Time is of the essence to proceed with the resolution of the issues.**
- **A Lake Waynoka risk evaluation was prepared including funds for the investigation, engineering and contract preparation costs for the reconstruction of the dam. Those funds are already planned for in the general reserve (when approved). The physical reconstruction of the dam would follow.**

As a separate matter, earthen dam construction costs will need to be addressed by the WPOA board membership. Financial options are discussed in this paper in Section V.B.

Lake Waynoka Class I Dam Description

Lake Waynoka was built in 1970 with the creation of a 290 acres' lake. The surrounding property was divided into building lots and common areas, recreation areas and water access. The lake is contained by a earthen dam and is surrounded by Lake Waynoka Dr. The dam is 1006.5 feet long and 52.7 feet tall.

Our dam is classified as Class One dam by the ODRN requirements. Dams, which are owned privately, are the responsibility of the owners to maintain a safe dam. A dam failure resulting in uncontrolled release of the reservoir, can have a devastating effect on persons and property downstream. Therefore, proper operation, maintenance, repair and rehabilitation of a dam are key elements in preventing a failure, limiting the WPOA liability, and maintaining a lake. **This responsibly has been fulfilled by the WPOA and is described in Section III Regulations, Lake Waynoka history.**

History of other lake communities has shown that the probability of a dam failure is low, but the consequences of such a failure may be high.

II. Historical Dam Failure:

A. Private Lakes

Hideaway Hills Dam Slippage 2013

A crack was discovered in October of 2013. Prior to that they had found routine issues and were monitoring. Dam is 1100 feet long and 48.5 feet tall. Size of this earthen dam is similar to Lake Waynoka. There is no road running across the dam.

Preventative Measures:

- Operations and Maintenance Improvement Manual is kept in the office for personnel to reference in emergency
- Dams are inspected monthly by general manager and maintenance manager
- They were previously sited for failure to have the lake engineered

Process once problem is found:

- Contact ODNR and follow their lead
- Contact the engineer
- Continue to monitor
- It was then discovered that they should have notified the Fire Department and the Emergency Management Agency since there was a small town downstream.

Recreational Impact

The lake has been down since October 2013 and was completed Jan 2017. The lake water levels have been down by over 8 feet for over three years. Routinely there are 850 boats registered per year.

Financial Impact to Property Owners:

The cost of the initial engineering was \$356,000, which was taken from the reserve account. Engineering and permits took 3 years. The 650 owners voted to create an assessment for repair of the dam. Cost was \$2.49 million. Homeowners were assessed \$3980 per property to pay for the repair. Option was available to make payments over five years or in a lump sum.

Lake Lorelei in Fayetteville, Ohio

This is a private lake community built in 1968 by American Realty. There is a homeowner association and a manager. The lake is 197 acres with three lakes. Dam is 110 feet long and 40 feet tall. It has a road going across the dam.

Preventative Measures:

- Lake Lorelei follows the ODRN inspection process and has an Emergency Action Plan in place.
- There has never been a recorded breach of the dam at Lake Lorelei. There are records of soil erosion under the spillway in one of the lakes that was recognized early and corrected.

Financial Impact to Property Owners:

- It is often said an earthen dam, if maintained, should have an indefinite lifespan. The question of financial planning for an event likely may not occur, might be as general emergency funds – i.e. funds set aside for any unanticipated event. Of course, the problem of how much and where to get the funds needs to be defined. The best model to argue for being prepared and how much may be involved is, obviously, Hide-Away-Hills. They have lots of hard won information.”

B. ODNR Lakes

Many reservoirs /dams were built around the same time as Lake Waynoka (1970s).

Other Class 1 failures included Ravens Wood Lake Dam in Medina County, Lake Litchfield Dam, Lake Seneca Dam in Williams County,

Athens Fish and Game Club Lake Dam and Brimfield Lake Dam in Portage County in the State of Ohio.

ODNR dam repairs 2017 Projects

There are 14 ODNR owned lakes that have required repair as of 2017. Some are just in need of repair to come into compliance with newest standards and others have failures. This is just a brief summary of some of them that are in progress at the time of this report.

Buckeye Lake in Millersport, Ohio

- This is a lake owned and managed by ODNR. Buckeye lake was built over 200 years ago, Lake is 4.1 miles' long. There are 3,030 acres of water.
- Buckeye Lake has long been one of the state's most popular lakes for its recreational value and is vital to economic development and tourism in the region. Gov. Kasich announced plans to replace the dam after the nation's foremost dam safety experts at the U. S. Army Corps of Engineers released an alarming report detailing unacceptable deficiencies in the dam, which could lead to a catastrophic failure putting lives at risk.
- Beginning October 1, 2016 ODRN began to actively manage Buckeye Lake to maintain the target at water elevation of "winter pool". In March 2017 Stop logs will be put back in place and the lake will be allowed to refill to no more than a foot below normal "summer pool".
- Phase 2 dam construction is expected to begin in early 2017 following completion and approval of final design. Lake level management will return to normal levels after dam construction is completed.

Preventative Measures

- The dam inspections were done per policy and areas were being monitored. Multiple studies were made prior to failure.
- The Army Corps of Engineers were called in when the issue was progressing. Once there was a known issue ODNR left the lake at its lower winter pool water level to reduce the pressure on the dam.

Process once Problem identified:

- The agency immediately began working on plans to fix the dam as quickly and safely as possible. ODNR has been exploring best engineering methods to replace Buckeye Lake Dam.
- ODNR engineers and hydrologists have been working to identify a safe, efficient option for replacing the dam and consulting with industry experts across the country, including the U.S. Army Corps of Engineers.

Financial Impact to the State of Ohio

- This is very popular State Park for recreation.
- Construction could begin as early as this year (2016).
- Original estimates were that a new dam could cost \$150 million, but this technology has the potential for achieving considerable cost savings. Thanks to \$25 million in funding through the newly signed state budget, Ohio now has funding in place to start construction once formal plans have been developed.
- This funding will enable ODNR to quickly secure a construction manager and not waste any time in beginning construction. Pending approval from the state's Controlling Board, construction could start by the end of this year.
- Initial funding for engineering was "10's of millions" according to the representative at ODNR in charge of the project.
- Funds come from OH Capital Improvement Funds \$100 million
- It took a 4-5 year mediation period
- Completion is expected in 2019

Portage Lakes State in Akron Ohio

This is an ODNR owed lake. The lake is 1500 acres. There are three separated sections of the dam, of 200 feet and 925 feet and 275 feet totaling 1400 feet total. Reservoir is 900 acres. There is no emergency spillway.

Preventative Measures

- Routine inspections had been completed and in 2013 inspection revealed deficiencies include insufficient storage/discharge capacity and it cannot pass the required design storm safely. Excessive and uncontrolled seepage through and under the embankment, especially at higher lake levels, along with severe concrete deterioration on the north spillway and lake drain structure also are present. A slippage was reported.

Process after Problem identified

- ODNR contracted with Tetra Tech to provide investigations, preliminary design and final design alternatives. Their investigations of the dam structure in 2013 and subsequent study revealed various deficiencies that require remediation.
- Final design will be completed in early 2017 and include risk reduction measures intended to bring the dam and its appurtenances into compliance with dam safety standards and industry best management practices.

Culter Lake Dam Muskingum County Ohio

The site is in Muskingum County at Blue Rock State Park

- The Ohio Department of Natural Resources (ODNR) is improving the Blue Rock State Park dam due to concerns pertaining to the integrity of the existing structures and not meeting current ODNR Dam Safety regulations. The purpose of this project is to bring the dam into compliance with current ODNR Dam Safety regulations.
- The project is currently in the final design stages.

Indian Lake: Lakeview Ohio

Located in southwestern Ohio, 5,000-acre Indian Lake offers a variety of water-related recreational opportunities. Length of Dam: 3,960 feet

- Investigation determined that ODNR should repair or replace the 160-year-old spillway.
- The cost is predicted to be \$7.6 million to repair this spillway at Indian Lake.

Lake Loramie

- Notice to Proceed, which was issued by ODNR to Miller Bros. Construction, Inc. last fall, workers have established haul roads and material laydown areas, removed trees and stumps along the dam and outlet channel, started preparations for the bank floodwall and began construction of a cofferdam adjacent to the existing spillway.
- Preparation to construct a new dam spillway for the lake has started. Substantial project completion is scheduled for December, 2017 with final completion expected in Spring, 2018.

Lake Waynoka is a privately owned lake. The next section of the report describes the regulations that govern a privately owned lake.

III. Regulations of Dams ODNR

ODNR regulates more than 1,500 publicly and privately owned dams through the Division of Water Resource's Dam Safety Program. Most of these dams are either privately owned or owned by local governments and have a wide variety of uses including water supplies and recreation.

There are about 30 federally owned dams in Ohio that are regulated through the U.S. Army Corps of Engineers (USACE). The goal of ODNR's Dam Safety Program is to enhance public safety by ensuring that dams do not present unacceptable risks to people, property and the environment.

One step in meeting this goal is to perform periodic dam safety inspections. These certified inspections may result in program officials directing dam owners, including the State of Ohio, to implement needed repairs or other risk-reduction measures and prepare for dam emergencies.

Classification of Dams:

- Dams having a total storage volume greater than five thousand acre-feet or a height of greater than sixty feet shall be placed in class I. A dam shall be placed in class I when sudden failure of the dam would result in one of the following conditions.
 - Probable loss of human life.
 - Structural collapse of at least one residence or one commercial or industrial business.

- Dams having a total storage volume greater than five hundred acre-feet or a height of greater than forty feet shall be placed in class II. A dam shall be placed in class II when sudden failure of the dam would result in at least one of the following conditions, but loss of human life is not probable.
 - Possible disruption of a public water supply or wastewater treatment facility, release of health hazardous industrial or commercial waste, or other health hazards.
 - Flooding of residential, commercial, industrial, or publicly owned structures. At the request of the dam owner, the chief may exempt dams from the criterion of this paragraph if the dam owner owns the potentially affected property.
 - Flooding of high-value property. At the request of the dam owner, the chief may exempt dams from the criterion of this paragraph if the dam owner owns the potentially affected property
 - Damage or disruption to major roads including but not limited to interstate and state highways, and the only access to residential or other critical areas such as hospitals, nursing homes, or correctional facilities as determined by the chief.
 - Damage or disruption to railroads or public utilities.

- Damage to downstream class I, II or III dams or levees, or other dams or levees of high value. Damage to dams or levees can include, but is not limited to, overtopping of the structure. At the request of the dam owner, the chief may exempt dams from the criterion of this paragraph if the dam owner owns the potentially affected property.
- Dams having a total storage volume greater than fifty acre-feet or a height of greater than twenty-five feet shall be placed in class III. A dam shall be placed in class III when sudden failure of the dam would result in at least one of the following conditions, but loss of human life is not probable.
 - Property losses including but not limited to rural buildings not otherwise described in paragraph (A) of this rule, and class IV dams and levees not otherwise listed as high-value property in paragraph (A) of this rule. At the request of the dam owner, the chief may exempt dams from the criterion of this paragraph if the dam owner owns the potentially affected property.
 - Damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in paragraph (A) of this rule.
- Dams which are twenty-five feet or less in height and have a total storage volume of fifty acre-feet or less may be placed in class IV. When sudden failure of the dam would result in property losses restricted mainly to the dam and rural lands, and loss of human life is not probable, the dam may be placed in class IV. Class IV dams are exempt from the permit requirements of section [1521.06](#) of the Revised Code pursuant to paragraph (C) of rule [1501:21-19-01](#) of the Administrative Code.
- All pertinent information including any unusual circumstances shall be considered by the chief in establishing an appropriate classification for a dam. Probable future development of the area downstream from the dam that would be affected by its failure shall be considered. Completed downstream hazard mitigation such as acquisition, removal or protection of downstream property may also be considered. However, the above criteria shall in no way preclude the chief's requirement of greater safety in the interest of life, health, or property.

IV. Inspections Procedures ODNR Regulations

[1521.062 - Lake Waynoka falls within this regulation.](#)

- Each periodic inspection shall consist of, but not limited to the following:

- Review and analysis of available data on the design, construction, operation and maintenance of the dam or levee and its appurtenances;
 - Visual Inspection of the dam or levee, its appurtenances, the downstream area, and all other areas potentially affected by the structure;
 - Evaluation of the general conditions of the dam or levee, and its appurtenances which may include assessment of the hydrologic and hydraulic capabilities, structural stabilities and any other conditions which constitute or could constitute a hazard to the integrity of the structure;
 - Evaluation of operation, maintenance and inspection procedures for the structure and
 - Evaluation of the emergency Action plan for the structure
- The findings of the periodic inspection shall be present in a written report that shall consist of, but not be limited to, the following:
 - The assessment of the conditions of the dam or levee based on the visual observations, available data on the design, construction, operation, and maintenance of the structure, and hydrologic, hydraulic, stability and other evaluations;
 - Recommendations for any emergency measures and or actions;
 - Recommendations for remedial and corrective measures and/or actions relating to design, construction, operation and maintenance and inspections of the structure;
 - Recommendations for any detailed studies, investigations and analysis;
 - Recommendations for time periods appropriate for implementing any necessary emergency, remedial, or corrective measures and /or actions and any necessary additional studied, investigations, or analysis.
 - The chief shall furnish a copy of the written report of the periodic inspections to the owner, detailing any required repairs, improvements, maintenance, investigations, studies, analyses, tests or other remedial measures to the dam or levee needed to safeguard life, health or property. The chief shall advise the owner of the time period in which all required measure and actions should be accomplished.

Lake Waynoka History

Lake Waynoka has followed these regulations and the last ODNR inspection occurred in August 28, 2012 (Letter dated 12/12/12 and 18, Jan 2013). The

next inspection is due in 2017. The lake has received some recommendations and executed the 2012 recommendations. A summary of those recommendations include:

The Maintenance and Inspection process includes a summary of the events that will take place annually. The details of the changes requested by the Dam Safety Engineering Program are outlined in two letters cited above and are available in the administrative office of the WPOA.

- The Ohio Division of Soil & Water Resources, Dam Safety Engineering Program, Mia Kannik P.E., Project Manager provided comments to Mr. O'Farrell and Mr. Cahill in Dec 2012 and Jan 2013. These comments were also shared with Buckeye Engineering, Mr. J. Stock P.E.
- Comments include 9 actions related to the Operation, Maintenance and Inspection (OMI) Manual
- Comments included 6 changes to the Emergency Action Plan (EAP).
- Comments included 4 changes to the Inundation (Areas downstream of the Lake Waynoka Dam impacted by a breach.

The inspection process executed by the includes a summary of the events that take place annually including:

- Repairing the expansion joints located in the weir area of the primary spillway.
- Expanding the rip Rap at the entrance to the primary spillway
- Annual inspection of the primary spillway for defects such as seepage, cracks, vegetation growth in concrete cracks
- Movement of the 2 valves to check their workability
- Inspection of the toe of the dam for seepage
- Inspection of the shoreline twice a year

V. How do we prepare for a dam failure?

A. History of other dam leads us to be how to be prepared

As you can see from the data included that a dam **will fail** at some point. Our goal has to be multifaceted. We need to learn from what other Lake Communities have experienced and we must prepare financially for a dam failure.

- **Administrative**

- We also need to have an updated Emergency Action Plan (currently available in the Administration office).

- The Lake Waynoka Operations Manager will be leading the initial response along with the Brown County Emergency Management assisting.
- ORNR is notified immediately for guidance and intervention. Interventions depend on the type of failure that has occurred

B. What steps does the Action Plan advise that must take place

● **Engineering**

Hideaway Hills is a good example of the process to be followed once a problem has been found.

- Contact ODNR and follow their lead
- Contact the engineer
- Continue to monitor
- Additionally the Fire Department and the Brown County EMA should be notified.
- Additional steps are included in the Lake Waynoka Action Plan

● **Financial Impact**

- Information from the state of Ohio has been received. This information helps to understand the costs associated with different repairs. This information is included in the appendix, Section VI.
- Possible financing options for a private lake:
 - The Ohio Water Development Dam Safety Loan Program (DSLPL):
 - Obtain a commercial loan from a bank.
 - At the present time (March 2017) the State of Ohio has passed a law that protects homeowner associations (WPOA) from borrowing funds from a bank. The only way that a loan is allowed is allow the WPOA to approve a special assessment based upon a 75% approval of the members in a special vote.
 - Details of such a vote is explained in a Rules and Regulations known as the Yellow Book.
- Link Deposit is available to private lakes from ODNR. ODNR Link program works with the lake and back get a reduced rate for the private lake. This is all done through CDs and public bank.

VI. Appendix

For further information

<http://engineering.ohiodnr.gov/portals/engineering/PDFs/Buckeye Lake Fact Sheet 071615.pdf>

<http://engineering.ohiodnr.gov/project-updates>