

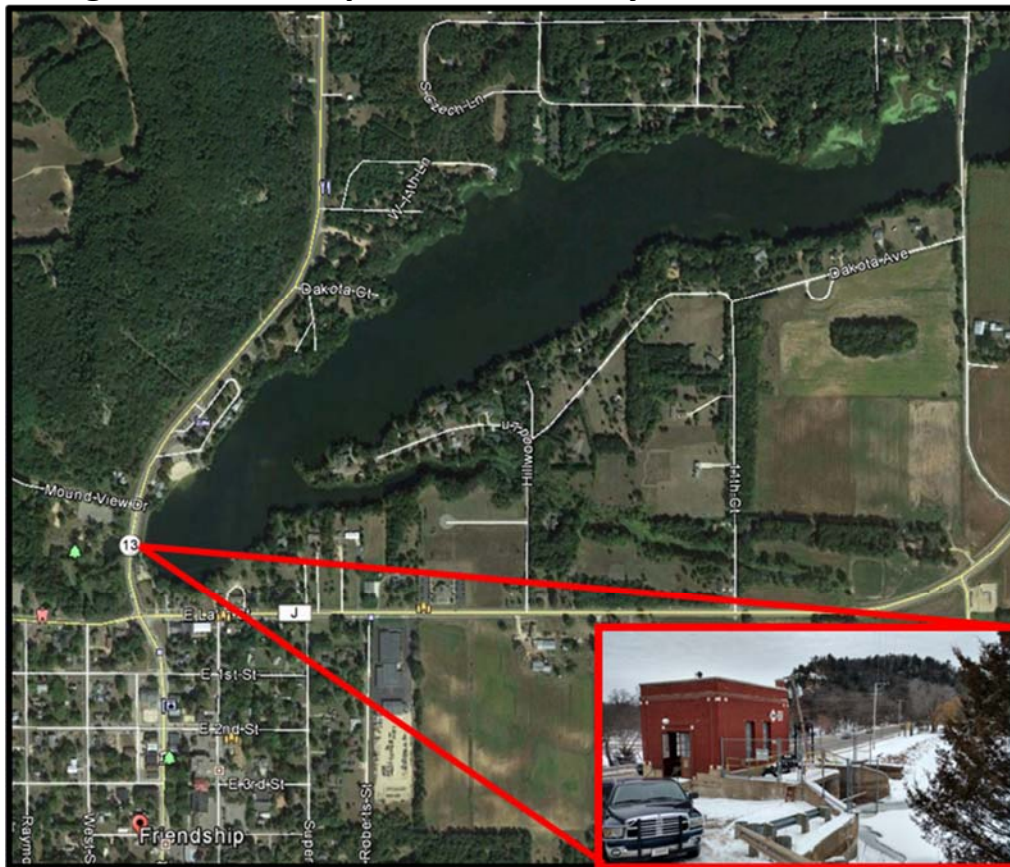
Inspection, Operation, and Maintenance Plan

Adams County

Field File No. 01.01

Key Sequence No. 62

Village of Friendship, Adams County, Wisconsin



Prepared for:

**Friendship Lake District
404 Hillwood Lane
Friendship, WI 53934
April 2018**

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Inspection, Operation, and Maintenance Plan

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(Last Revised April 2018)

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Inspection, Operation, and Maintenance Plan

LITTLE ROCHE A CRI CREEK DAM

FRIENDSHIP LAKE DAM

APPROX. 6.5 MILES DOWNSTREAM OF THE CHARLES LANDIS DAM ON THE LITTLE ROCHE A CRI CREEK,
IN THE VILLAGE OF FRIENDSHIP, ADAMS COUNTY, WISCONSIN

DNR FIELD FILE NUMBER: 01.01

DAM KEY SEQUENCE NUMBER: 62

COUNTY: ADAMS COUNTY

DAM OWNER: FRIENDSHIP LAKE DISTRICT

REPRESENTATIVE: BOB BERRY, CHAIRMAN

OFFICE: 608.548.2191

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Friendship Lake District
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Friendship, WI 53934

DAM OPERATOR: FRIENDSHIP LAKE DISTRICT

REPRESENTATIVE: BOB BERRY

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PLAN PREPARED BY:



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1.0 Introduction and Definition of General Responsibilities

This document describes a plan of inspection, operation and maintenance for the Friendship Lake Dam. This plan should be periodically reviewed and modified to reflect operational and structural changes. The inspection and maintenance forms and other applicable figures are designed for easy revision.

This plan was prepared for Friendship Lake District by Ayres Associates. This plan was prepared to conform to Dam Design and Construction Standards – “Hydraulic Design and Safety Requirements (3) Safety Measures Requirements”, Chapter NR 333.07(3), Wisconsin Administrative Code.

1.1 Purpose and Intent

The purpose of this inspection, operation, and maintenance plan (IOMP) is to provide the owner/operator of Friendship Lake Dam and other officials with the following:

- Basic Guidelines which assist the operator and officials to:
 - Perform routine and recommended safety inspections
 - Properly document the inspections
 - Define and document normal operation procedures
 - Define operational procedure during extreme events; and
 - Properly document maintenance requirements and activities.
- Guidelines and checklist items for routine inspections; and
- A series of alterable and reproducible master forms which will assist in documenting inspections.

Inspection, operation and maintenance procedures are needed to ensure the overall integrity of the dam and the public’s safety. The operator can only reasonably maintain the dam in working order through active inspection. The following sections should be used to guide routine inspection, operation, maintenance and, emergency actions.

1.2 Description of the Dam

The Friendship Lake Dam is located on the Little Roche a Cri Creek in the SW ¼ of NW ¼ of Section 05, Township 17 North, Range 06 East in the Adams County, WI. The dam is accessed via N Main St./WI-13 Trunk Highway.

Type of dam:

The dam consists of a 400-foot long earthen embankment with flow through the dam controlled by a single 12-foot wide by 10-foot high tainter gate with a dedicated hoist. The sill elevation is approximately 927.5 feet. A 48" x 36" sluice gate is also present but is not considered reliably operable now. The general embankment crest elevation is approximately 939.75 feet. The normal pool as reported by the Wisconsin DNR is 937.49 feet. As surveyed in February 2018, the water surface elevation of the impoundment was approximately 934.5 feet, and the tailwater elevation was 919.39 feet.

Note: below elevations are in NAVD88 datum.

Location of dam:

SW ¼ of NW ¼ of Section 05, Township 17 North, Range 06 East

Height of dam:

The structure height is 27 ft as measured. The hydraulic height is 20 ft as measured.

Size of pool: 114 acres with a maximum depth of 15 feet. The normal impoundment storage is 681 acre-feet.

Use of dam: Recreation and Hydroelectric

Hazard Rating: Estimated Significant

The contributing watershed area at the dam is 60 square miles. The Friendship Lake Dam flows into Little Roche a Cri Creek. Little Roche a Cri Creek flows under WI State Highway 13 (N. Main St.) and into a plunge pool and under a pedestrian bridge in Friendship Park. The river is then impounded slightly by the County Road Z causeway before entering the Castle Rock Lake.

1.3 Key Personnel and Their Responsibilities

Friendship Lake District is the Owner and Operator of Friendship Lake Dam. It is the Owner's responsibility to operate, inspect and maintain the dam. The Owner may have an operator who manages the dam on a day-to-day basis, but the owner is ultimately responsible and liable for any damages should the dam not be operated correctly or fail.

Only assigned personnel may operate the dam. The operator shall notify adjacent upstream and downstream dam operators about changes to the timing of gate openings and resulting pool levels and flows. High water levels in the impoundment may require the operator to change the operation of the gates or the level of the pool.

As agreed by the Friendship Lake District:

- i. The dam will be only operated by trained staff who live within ten minutes of the dam.
- ii. More than one person will be trained to operate the gate.
- iii. Sufficient equipment will be available to operate the gate at any time.
- iv. The dam operators will be on-call 24-7, 365 days a year so that at least one trained person is always available to open the gate at any time.

Friendship Lake District, as owner/operator, of Friendship Lake Dam is responsible for routine daily, monthly and annual inspections, for routine maintenance (e. g. mowing or burrowing animal removal) and other preventative maintenance (e. g. painting or seal repair) of the dam. The owner/operator is also responsible for day by day monitoring when high or low flow conditions exist. More thorough inspections are required after high river flow conditions or other emergency conditions have subsided.

Friendship Lake District is also responsible for day by day monitoring when high or low flow conditions exist. More thorough inspections are required after high water conditions or other emergency conditions have subsided.

The Friendship Lake Dam does not have an "Early Warning System Device". The operators from the Friendship Lake District have been trained to identify potentially dangerous flow conditions. Potential flood conditions at the Friendship Lake Dam are characterized by the following:

- Extended periods of greater than average precipitation or combined melting periods with greater than average precipitation;
- Rapidly increasing headwater levels (greater than 2" increase per hour) or other water level issues specific to the dam; or
- Other site-specific conditions such as ice jams, etc.

The operator for the Friendship Lake Dam has been trained to identify other conditions indicating a possible emergency situation and the potential for dam failure. These include, but are not limited to:

- Serious rain events with the water level above the dam rising quickly;
- Slumping or sloughing of the dam's embankment;
- Excessive erosion on the embankment below the spillway or at the abutments;
- Excessive seepage or cloudy seepage through the abutments or the embankments;
- Settlement or cracking in the embankment;
- Piping or boils in the embankment or immediately downstream;
- Noticeable movement of any portion of the outlet structure;
- Vandalism activity near the dam; or
- Ice build-up at the dam inlet.

During an emergency, the dam operator will follow the procedures outlined in the Friendship Lake Dam Emergency Action Plan as approved by the DNR on _____, 2018.

Staff Contact Information

Friendship Lake District

Dam Owner, Friendship Lake District	608.235.8901
Dam Operator, Friendship Lake District	608.235.8901

Village of Friendship

Village Clerk, Village of Friendship	608.339.3243
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Adams County

Sheriff's Office Sheriff Sam Wollin	608.339.3304
Non-Emergency	608.339.3304
Emergency	9-1-1

DNR Water Management Engineer

State Dam Safety Engineer	608.266.8033 (Alt: Meg Galloway 608.266.7014 O 607.733.0269 C)
Duty Officer	608.576.5358 or 608.376.9049

2.0 Inspection

Routine inspections are a necessary part of owning and operating a dam, since early detection of gradual changes can not only reduce maintenance and repair costs, but also protect public safety. Routine inspections provide a way to monitor a dam's performance and identify changed conditions at the dam. All routine inspections shall be performed by properly trained persons. Records of completed inspections will be kept on file at the office of the Friendship Lake District.

2.1 Inspection Program

Persons doing routine inspections should refer to the checklists in Appendix C for the periodic inspection being performed (i.e. weekly, monthly, etc.). Listed below are the categories of recommended routine inspections to be conducted by the dam owner:

Weekly

Mowing should be done on a weekly or as-needed basis from April through September and will include a cursory inspection for seepage, unwanted vegetation and burrowing animals. The height of growth on the non-overflow embankment should not exceed 6 inches at any time. The height of growth on the auxiliary spillway should be maintained between 4 and 12 inches always. Observations of river flow, water level, and precipitation will be made. If any observations are concerning, the dam operator will be contacted for further investigation.

Monthly

Monthly inspections will generally be performed whenever conditions allow access to the dam. Monthly inspections will be more thorough than the weekly inspections, but will be confined to those areas that are normally accessible without a drawdown. Maintenance or repair should be scheduled as soon as possible if conditions are found that warrant further attention.

Annually or post-flood

It is not necessary that annual inspections be performed at exact one-year intervals. Rather, the annual inspections should be performed, as much as possible, to coincide with a dry period while temperatures are moderate. Historically, early Spring and October are most likely to provide such conditions, but current conditions and a long-term forecast will provide the best guidance on when to plan the annual inspection.

If unusual items are noted during a post-flood self-inspection, contact should be made with the owner's consultant and the WDNR Water Management Engineer for the county in which the dam is located.

If any items are found deficient during an inspection, the following tasks should be initiated:

- Photograph any abnormal conditions and monitor the situation more frequently.
- Prepare a sketch of the condition observed.
- Measure the dimension of the deficiency.
- Locate the site of the deficiency at the dam or along the bank.

A systematic, regularly scheduled, and documented inspection will allow for efficient monitoring the condition of the dam and advance planning for required maintenance. If the inspector is unsure as to whether a particular condition poses a threat to the safety of the dam, an experienced and qualified engineer should be consulted.

2.2 Equipment

Below is a generic list of the equipment necessary to adequately perform a dam inspection. This list can be subject to change depending on the dam. The goal is to adequately portray the site conditions to those who are not on site.

The Dam Owner/Operator and qualified persons should/shall be adequately equipped for inspection. The following are recommended inspection related equipment items:

- Camera with flash.
- Ruler with graduations large enough to be identified on photos
- Knives for prying cracks and removing materials
- Copy of site map to note locations of problems and changing conditions.
- Life jacket
- Radio
- Crack gauges
- Inspection forms
- Other tools or equipment specifically needed to inspect dam

2.3 Inspection Procedures

The following sections briefly discuss the inspection procedures that pertain to components of the Friendship Lake Dam.

2.3.1 Concrete Components

Concrete components, including the concrete broad outlet, and fixed crest spillways should be inspected at least annually and also after periods of high flow conditions have occurred. The inspection should be performed in a systematic manner so that no components are overlooked. Pertinent items of the inspection include, but are not limited to, cracking or spalling concrete, scour, deteriorated joints, undermining and erosion near the structure.

Concrete components that show signs of deterioration should be monitored by measurement and dated photographs to determine if the deterioration is advancing.

Deterioration of concrete can lead to failure of the structure. Minor spalling, cracks, or joint displacement should be monitored and repairs made before damage becomes severe. Spalling concrete may lead to exposed reinforcing steel. Cracking can indicate excessive stress or lead to seepage through the structure. Deteriorated joints can indicate excessive stresses behind the structure or differential settlement, and may result in uncontrolled seepage. Scour beneath a concrete slab or wall may cause it to crack or collapse.

2.3.2 Downstream Area - Riprap

Any displaced riprap downstream of the dam, including downstream of the concrete broad-crested spillway and around the perimeter of the stilling basin, can lead to scour and erosion problems near the structure. If the structure is undermined, a potential instability of the structure would exist. Erosion in the channel downstream from the structure may affect the channel flow capacity further downstream where the sediment is deposited. Scour and undermining downstream of the dam should be evaluated as soon as possible after high flow conditions have occurred as well as on an annual basis. The depth and lateral extent of the scour should be determined and monitored.

2.3.3 Upstream Area – Riprap

Any displaced riprap upstream of the dam, including along the upstream face of the earthen spillway and near the outlet, can lead to scour and erosion problems near the structure. If the structure is undermined, a potential instability of the structure would exist. Erosion upstream of the dam should be evaluated as soon as possible after high flow conditions have occurred as well as on an annual basis. The depth and lateral extent of the erosion should be determined and monitored.

2.3.4 Embankments and Spillway

The embankment surface should be inspected for slumps, sloughs, cracks, and boils. Slumps, sloughs, cracks, and boils may indicate instability, internal erosion, or loose material in the embankment that could lead to failure. Cracks in the embankments may indicate movement of the dam or foundation. Cracks can weaken the structure, leading to potential failure. Settlement indicates a loss of material or compression of material either within the dam or the foundation. If the settlement is not uniform, cracks may form or depressions may result. Observable settlement or settlement that changes with time should be documented.

Seepage is the passage of water through or underneath the embankments or at the contact between the embankments and the concrete spillway. Seepage must be monitored for the presence of soil particles at the exit point. If soil particles are moving, a piping condition may exist. This is a dangerous condition that requires immediate attention. The flow rate of all seepage must be monitored. Any increase in seepage may indicate a potentially hazardous situation. The reservoir elevation must be noted at the time any seepage measurements are taken.

Woody vegetation such as brush, trees, and shrubs are undesirable on the embankments. Tree, brush, and uncut herbaceous vegetation can obscure visual inspection and harbor rodents; large tree roots can create seepage paths; and large trees could blow over during a storm and potentially critically damage the dam. It is important that grass be cut and brush and trees not be allowed to grow on the embankments or within 20 ft. of the embankment toe.

2.3.5 Railings Fences, Gates, Signs, and Restricted Access Features

The railings, fences, gates, signs, and walkway that are used to restrict access to portions of the dam should be inspected for, corrosion, loose components, cracking/loose paint and other defects that may indicate instability of the structures. Defects in the structures that are intended to restrict access to the dam pose a threat to dam operators. These features should be inspected annually.

3.0 Operation

To operate the dam properly, the owner/operator needs to monitor flow conditions and precipitation rates. Under certain conditions some dam owners will need to notify downstream dams of changes in operation.

The Friendship Lake Dam is routinely observed each month and inspected once a year. Thorough inspections also occur after high flow conditions have subsided. Flow conditions are monitored weekly and day by day when high flow conditions exist. Routine and required preventive maintenance is performed by the Friendship Lake District. Site inspection, operation and flow monitoring records are kept on file by the Friendship Lake District's secretary.

Per the DNR database, the Normal Pool Level is 937.49 NGVD29 (937.39 NAVD88). No maximum or Minimum pool levels are approved for this dam.

3.1 Gate Operation

Principal outlet is a 10-foot-high by 12-foot-wide tainter gate underneath the power house. The tainter gate is operated by a manual tainter gate hoist located above the tainter gate. This hoist is located to the west of the powerhouse and is accessed through a gated fence. Per the 2018 DFA, the 48"x36" sluice gate is not considered reliable.

3.2 Upstream Dam

The Charles Landis Dam is controlled gravity dam owned by Charles Landis is located approximately 6.5 miles upstream of the Friendship Lake Dam. This is a small, low hazard with a hydraulic height of 4 feet. The Dam Key Sequence No. is 1103 and Field File No. is 01.24.

3.3 Downstream Dam

The next downstream dam is Castle Rock Dam. The structure is approximately 20 miles downstream of the Friendship Lake Dam. This structure is a large, high hazard dam regulated by the Federal Energy Regulatory Commission (FERC). The structure has a hydraulic height of 30 feet. The Dam Key Sequence No. is 669 and the Field File No. is 01.17.

3.4 Early Warning System Operation

The Friendship Lake Dam does not have an early warning system.

3.5 High or Low Water Operations

A broken back sluiceway (3'x3' on the downstream end, and 4'x3' on the upstream end) is included in the dam's construction drawings but has not been operated since. This sluiceway has an outfall located on the bottom right toe of the tainter gate ogee. The sluiceway is controlled by a single stoplog panel listed as 40"x55" in size. No operating device was located at the time of the 2018 ORIP.

3.6 Response during Periods of Darkness

The dam is equipped with some exterior lights. Hand-held flashlights could provide minimal additional night illumination. The Adams County Sheriff's Departments have vehicles equipped with floodlights and spotlights if additional illumination is necessary during an emergency and can be contacted by dialing 9-1-1.

3.7 Identification of Emergency

The Friendship Lake Dam does not have remote sensors to help identify an emergency. The Dam Operator and will need to monitor seasonal weather conditions to help identify flood conditions. The Dam Operator will help identify potential flood conditions by inspecting the dam regularly. Flood conditions are characterized by significant increases in depth over relatively short periods of time. Water depth increases more than 2 inches per hour need to be carefully evaluated and the following factors will require careful consideration considering potential emergency flood situations:

- Initial Water Elevation
- Previous Weather History (days and weeks) which includes past rainfall
- Predicted Weather

3.8 Emergency Repair Supplies and Resources

Emergency supplies and dam repair materials are not stockpiled at the dam for emergencies. Minor repairs should be evaluated by the Dam Operator. The Dam Operator shall coordinate repairs. Heavy equipment is available from the Adams County Highway Department and local contractors. Repair materials will need to be obtained from nearby sources. The Dam Operator should have an identified source of embankment repair materials for emergency use. Major repairs shall be coordinated through the Dam Operator. Detailed information on the location repair supplies and resources is documented in the EAP.

3.9 Coordination of Flows

Friendship Lake Dam should coordinate with the upstream dam to regulate flows. There are no downstream structures between Friendship Lake dam and Castle Rock Lake.

4.0 Maintenance

A good maintenance program will prolong the life of the dam. Lack of proper maintenance will hasten deterioration and could lead to potential failure of the dam. Friendship Lake District is responsible for seeing that the dam is properly maintained. A record should be kept of all maintenance activities; a maintenance log can be found in Appendix D.

Since dams hold back water under pressure, repairs often need to be done differently than at other types of structures. Most items can be repaired by the Dam Owner/Operator. Larger repair items may need to be completed by qualified contractors. Large repairs may also require the submittal of plans and specifications to the WDNR for approval prior to starting any work. Generally, questionable repair items should be inspected by a qualified engineer and, if required, repaired by contractors. All proposed repairs must be presented to the regional WDNR water management engineer for a determination if any formal approval is required.

Periodic maintenance and item replacement is expected, and preventative maintenance activities will increase with time. Maintenance should be routinely performed. Some items require more frequent attention than others. Routine maintenance should include activities such as mowing, tree removal, filling rodent holes on embankments, and patching concrete. Waterproof filler materials can be removed from construction joints by high waters, differential settling of the structure, or freeze/thaw action. Waterproof filler materials should be maintained as outlined by the contractor's or product suppliers' specifications.

4.1 Embankments

Trees and brush should not be allowed to grow on the embankments. At least annual cutting or controlling of the vegetation is recommended. This will prevent the growth of trees and brush. Any eroded or settled areas should be filled to maintain uniform crest or slopes. Plant grass if needed to maintain a good vegetative cover. Any displaced riprap should be replaced to prevent erosion or ice damage.

4.2 Ancillary Features

Railings and the staff gauge should be repaired or replaced as needed.

4.3 Maintenance Frequency

Maintenance should be performed and documented routinely. Some components of the dam require more frequent attention than others.

4.4 Budget Considerations

The replacement and maintenance of various components of the dam are expected throughout the life of the dam. Contractor and component fabricators will be able to provide guidelines for routine maintenance and replacement. The operator should expect to use expendable items as fencing, paint, riprap materials, and other necessary materials. Other expendable items should be budgeted for based on manufacturer recommendations and owner experience. Funds should be allocated for larger overhaul items and repairs, even though they may not always be predicted.

4.5 Emergency Action Plan

An Emergency Action Plan (EAP) was created to comply with Wisconsin Administrative Code, Department of Natural Resources Chapter NR 383. This code requires an EAP to be prepared by the local unit of government and concurred by the Division of Emergency Government. The purpose of this EAP is to provide Adams County and Emergency Warning Agency designated officials with specific guidelines for emergency action if high water conditions or a dam failure occurs. The intent of this plan is primarily to protect the lives of downstream citizens and secondarily to reduce property damage.

The underlying intent of the plan is to provide a specific schedule of events to do the following:

1. Monitor/assess dam structure conditions to help predict dam behavior at all water level conditions.
2. Provide basic levels of required communication for various water level conditions (Including dam overflow, dam failure, etc.)
3. Provide for a required yearly coordination meeting between all emergency contacts, landowners directly affected by immediate dam failure, and designated safety officials.
4. Define the duty of each agency/person for public notification securing.
5. Provide detailed response actions for the emergency.

An observer other than the designated officials may notice unexpected high flows, potential dam failure or a dam failure. Further action/response will depend on whether Condition 1, 2, or 3 exists, as described below:

- Condition 1: Urgent; dam failure appears imminent or is in progress. An observer should immediately notify 911, followed by the remainder on the Level 1 Notification Flowchart.
- Condition 2: A potential dam failure situation; rapidly developing. An observer should immediately notify the contacts on the Level 2 Notification Flowchart.
- Condition 3: Nonemergency unusual event, slowly developing; high water. An observer should notify the Friendship Lake District.

Friendship Lake District and other EAP participants each have a copy of the EAP.

4.6 Summary of Maintenance Plan

Prompt maintenance by the Friendship Lake District of deficiencies identified during the inspection will help ensure continued safety at and downstream of the Friendship Lake Dam and will prolong the life of all dam components. A poorly maintained dam will deteriorate more quickly. The cost of continued maintenance is small compared to the cost of major repairs. In addition, lack of maintenance can lead to potential liability problems.

Appendix A
Location Map

Appendix B
Plan View Drawing of Dam

Appendix C
Inspection Checklist

Friendship Lake Dam Inspection Checklist

DNR Field File Number 01.01

Inspector(s):

Date of Inspection:

Water Elevation:

Weather/Site Conditions:

Check Items as Inspected

Note Conditions and Observations + Actions Required

Benchmark:

- Check for disturbance/vandalism
- Condition:

Vandalism

- Check for damage/vandalism on dam components
- Condition:
- Action:

Signage

- Condition and visibility:
- Action:

Railings

- Check for broken welds, severe rust, or other deterioration. Repair as needed.
- Condition:
- Action:

Concrete Spillway, Concrete Walkway above spillway

- Check concrete surfaces for cracks and spalls. Take photos of significant cracks.
 - Concrete deterioration may be patched through maintenance procedures.
 - Extreme deterioration should be examined by an engineer.
 - Severe cracking or rapid changes require immediate notification to the State Dam Safety Engineer.
- Check that joints in concrete surfaces are water tight.
- Check apron for undermining and downstream scour.
- Condition:
- Action:

Upstream and Downstream Riprap

- Elevation/location/extent of riprap:
- Condition:
- Action:

Downstream Channel Erosion

- Check for erosion downstream at spillway sill, near training walls, and near the riser pipe structure outlet, especially after high flows.
- Condition:
- Action:

Earth Embankments

- Check vegetative cover. The embankment should have a suitable cover of grass with no woody vegetation such as brush, shrubs or trees. Mow regularly to maintain a 6-inch or shorter grass stand on non-overflow embankments. Mow regularly to maintain a 4-inch to 12-inch grass stand on the earthen auxiliary spillway. Do not mow auxiliary spillway grasses shorter than 4-inches.
- Check for animal burrows. Remove animals and backfill holes with soil.
- Check for surface erosion on grassed slopes
- Replace riprap as required, and topsoil and re-seed eroded areas as required.
- Check for slumps (slides or sloughs)
 - Slow or sudden movement of earth embankment is an indication of instability and requires immediate response. Contact State Dam Safety Engineer for advice.
- Check for settlement of embankment. Settlement may be uniform or at isolated depressions
 - Settlement indicates loss of material or compression of material either within the dam embankment or foundation. Settlement should be documented and evaluated by an engineer.
- Check for seepage and boils on the downstream slope and at the toe of the slope. If present, monitor for presence of soil particles.
 - If soil is moving, a piping condition (internal erosion) may exist and required immediate contact with the State Dam Safety Engineer.
- Condition:
- Action:

Appendix D
Maintenance Log

Friendship Lake Dam Maintenance Log

Activity	Date	Person	Action Taken	Comments
Mowing				
Trees/Woody Vegetation Removal				
Floating Debris Removal				
Rodent Removal/Hole Repair				
Concrete Patching				
Joint Sealing				
Riprap Replacement				
Painting				
Other:				
Other:				
Other:				