DAM SAFETY INSPECTION REPORT

BOARDMAN DAM
DAM ID NO. 512

BOARDMAN RIVER
GRAND TRAVERSE COUNTY
SECTION 34, T27N, R11W

OWNER: Grand Traverse County
400 Boardman Avenue
Traverse City, Michigan 49684-2577
231-946-0921

OPERATOR: Grand Traverse County
Department of Public Works
2650 LaFranier Road
Traverse City, Michigan 49684

HAZARD POTENTIAL CLASSIFICATION: High

INSPECTION DATE: September 8, 2015
REPORT DATE: October 6, 2015

PREPARED AND INSPECTED BY:

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Department of Environmental Quality
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INTRODUCTION

The purpose of this inspection report was to evaluate the structural condition and hydraulic capacity of the Boardman Dam as required by Part 315, Dam Safety (Part 315), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This inspection was conducted by the Department of Environmental Quality (DEQ) in response to a request from the owner of the dam, Grand Traverse County (County). The report is limited to a discussion of observations based on a visual investigation and review of any available previous inspection reports, plans, and data. This report should not be considered an in-depth engineering investigation.

All references to “right” and “left” in this report are based on the observer facing downstream.

CONCLUSIONS AND RECOMMENDATIONS

The Boardman Dam remains in poor condition. This means a dam safety deficiency is recognized for a loading condition that may realistically occur. Specifically, the Boardman Dam has inadequate spillway capacity. There were no deficiencies observed during the inspection that would lead to the dam’s immediate failure.

Conditions have changed very little at the Boardman Dam since the last inspection in 2012. Therefore, much of the language in this report is similar or identical to the previous report.

The following recommended actions should be completed by the dates indicated:

1. Review the Emergency Action Plan (EAP) with the Emergency Services Coordinator for the County and update it as appropriate. In accordance with Part 315, provide a copy of the EAP review findings and any updates to the plan to the Dam Safety Program and the County Emergency Management Coordinator by December 31, 2015.

2. Continue to plan for the dam’s removal in accordance with the consent agreement and the County Board of Commissioner’s resolution.

3. Submit a written request to this office to have the consent agreement between the County and the DEQ amended to reflect the proposed schedule for the dam’s removal.

4. Continue to maintain the dam’s water level at the current elevation in accordance with the 2007 consent agreement between the County and the DEQ.

5. Remove small trees and light brush from the embankment as they develop.

The current high hazard rating is appropriate.
PROJECT INFORMATION

The Boardman Dam consists of a detached earth embankment, which spans the original river channel; an auxiliary spillway section; a concrete dam/bridge structure containing a spillway structure and the penstock intake that leads to the powerhouse; and a short earth embankment. The powerhouse is located approximately 73 feet downstream from the intake structure.

The detached embankment is a compacted sand-fill structure with an upstream concrete core wall that extends into the foundation with steel sheet piling. The upstream slope is vertical (core wall) and the downstream slope is 2 horizontal to 1 vertical (2H: 1V). The embankment is 650 feet long and has a crest width of 14 feet. The maximum height of the embankment is 56 feet.

The auxiliary spillway consists of a sheet pile wall driven into local granular soils that directs flow into the area between the detached embankment and the Cass Road embankment. The spillway directs flow along the roadside ditch and into a basin area between the detached embankment and the road embankment. Water would eventually overtop the road embankment during a design flood event due to the restricted capacity of the road culverts. Therefore, it was determined that this spillway was not reliable to handle water discharge during a design flood event. For this reason and the overall lack of spillway capacity during the design flood event, the impoundment was temporarily drawn down approximately 17 feet via a consent agreement between the County and the DEQ.

The powerhouse is a reinforced concrete structure that previously contained the power-generating equipment. The concrete overflow spillway is located left of the penstock intakes and is controlled by a single roller gate that is operated with a fixed electric cable hoist. The penstock intake has two slide gates and feeds the two ten-foot diameter steel penstocks. A single lane concrete bridge spans the spillway and penstock intake structure and provides a roadway for Cass Road across the dam.

The 2005 Supporting Technical Information Document, authored by Gannett Fleming, Incorporated, which was prepared as a part of the Potential Failure Modes Analysis required by the Federal Energy Regulatory Commission, was used as the primary reference for this report.

Boardman River Dams Committee

From 2005 through 2009, a local coalition of interested parties called the Boardman River Dams Committee (BRDC) studied the Brown Bridge, Boardman, Sabin, and Union Street Dams on the Boardman River to determine what the eventual fate of the dams should be. The Brown Bridge, Boardman, and Sabin Dams had been power-producing dams, but power production was discontinued by Traverse City Light and Power, operator of the dams. When power production ceased, the owner requested, and was granted, the surrender of their license issued by the Federal Energy Regulatory Commission and they were no longer exempted from regulation by state dam safety regulations. As part of the negotiations of the license surrender, Grand Traverse County entered into a Consent Agreement with the Michigan DEQ to address the fact
that the dam did not meet the spillway capacity requirements of Part 315. The Consent Agreement was signed in January 2007 and, in part, included language that called for the upgrade of the dam to meet the spillway requirements by December 31, 2010, or its removal by December 31, 2012.

The BRDC entered a split recommendation: either remove three power-producing dams, or continue to study them further to reenergize them. They also recommended maintaining and modifying the Union Street Dam. The owners of the dams, the City of Traverse City (Brown Bridge and Union Street Dams) and Grand Traverse County (Boardman and Sabin Dams) each resolved to remove the dams (with the exception of the Union Street Dam). The BRDC continues to be involved with this process and has retained design and construction professionals to implement the removal decisions made by the community.

Since the Boardman Dam has not been removed as called for by the Consent Agreement, the County should make a formal request of the DEQ to have the agreement amended to reflect the revised schedule.

SITE INVESTIGATION

The following discussion of the dam’s physical condition and appurtenances is based on observations and photographs obtained on the date of the inspection.

The detached embankment is generally in good condition, as shown in Photographs 1 through 8. There were no indications of settlement, sinkholes, or other deficiencies in the embankment. There is some light brush and small trees beginning to encroach on the embankment. These should all be removed as soon as practical. The embankment should be maintained in a grass-covered condition. There is some history of significant seepage occurring on the right side of the embankment. Embankment repairs were completed in 1997 to control the seepage and they have been effective.

The auxiliary spillway is in fair condition, as shown in Photograph 9. The spillway is simply a steel sheet pile wall driven into the local soils to provide a control section, as shown in Photograph 10. There is no erosion protection designed into the spillway except for the sparse grass cover on the granular soils. The spillway directs flow from the power canal to a roadside ditch along Cass Road and into the “basin” area (shown in Photograph 8) between the detached embankment and the Cass Road embankment. Under Cass Road are two concrete culverts, both of which are partially obstructed with debris. If a flood event were to occur that caused a discharge into the auxiliary spillway channel, extensive erosion would be expected in the channel due to the lack of erosion protection. Furthermore, water would eventually fill the “basin,” due to the lack of flow capacity under Cass Road, and eventually cause overtopping and likely failure of the Cass Road embankment.

The overflow spillway is in fair condition. There are numerous cracks, widespread efflorescence (white deposits on concrete surfaces), and several areas of spalling, both on the spillway concrete and the bridge concrete. Various features of the spillway are shown in Photographs 11 through 25. The gate appears to be in good condition, is operable, and is maintained in an open condition to keep the water level in the
impoundment at the level outlined in the consent agreement. Dozens of cracks are apparent, as shown in the photographs, and there is extensive efflorescence. None of the cracks appeared displaced or opened at the time of the inspection. There were significant areas of concrete spalling, especially on the downstream face of the bridge. The spillway has a history of voids beneath the slab, and seepage and boils in the embankment adjacent to the spillway and powerhouse. In 1950, undermining beneath the spillway floor was observed, holes were cut in the spillway floor, and 90 cubic yards of gravel were placed in the void. In 2000 and 2001, boils were observed on the left side of the powerhouse. A steel sheet pile wall was installed in this area in 2000 to help cut off the seepage.

The penstock intake structure is in good condition, as shown in Photographs 23 through 25. The trash racks are functional and were cleaned by maintenance personnel during the inspection. The penstocks are in good condition, as shown in Photographs 27 through 30. The powerhouse also appears to be in good condition, as shown in Photograph 26. The downstream face of the powerhouse is shown in Photograph 33.

There is significant efflorescence and cracking in the concrete below the access deck to the powerhouse, as shown in Photographs 31 and 32. While there is no cause for immediate concern, these areas will eventually require maintenance if the dam is left in operation. If the dam is not removed, consideration and funding should be given to long-term maintenance that has been ignored during the past ten years.

**STRUCTURAL STABILITY**

Based on the conditions observed during the field inspection, the dam appears to be stable. No further structural stability analysis is warranted at this time. However, the dam has had several concerns with embankment stability over the years. Significant seepage in the detached embankment was monitored and addressed in 1997. Seepage adjacent to the powerhouse, on both sides, has been and still is monitored on a routine basis. A steel sheet pile cutoff wall was installed on the downstream slope adjacent to the powerhouse in 2000, and appears to have improved conditions there. Voids were detected under the concrete spillway slab in 1950 and were eventually repaired.

**HYDRAULICS AND HYDROLOGY**

The total drainage area of the Boardman River at the dam is 286 square miles, and the contributing drainage area is 209 square miles. The design discharge for this dam is the one-half probable maximum flood (1/2 PMF) discharge, which is estimated to be 6,100 cubic feet per second (cfs).

The existing spillway capacity is estimated to be approximately 5,600 cfs, with no freeboard. Therefore, the dam does not have adequate spillway capacity. Spillway capacity calculations include flow through the gated overflow concrete spillway and both penstocks, but not the auxiliary spillway adjacent to Cass Road, for reasons mentioned previously. Spillway capacity calculations are on file with the Dam Safety program.
OPERATION AND MAINTENANCE

Grand Traverse County Department of Public Works operates and maintains the dam. Staff visit the site daily during the workweek and as necessary on weekends. A written Operation and Maintenance Plan is on file.

EMERGENCY ACTION PLAN

Since this dam has a high hazard potential rating, an EAP is required. An EAP dated December 2012 is on file with the Dam Safety Program. In accordance with Part 315, the EAP should be reviewed and updated annually. Please provide a copy of the EAP review findings and any updates to the plan to the Dam Safety Program and the County Emergency Management Coordinator by December 31, 2015.

APPENDICES

A location map and inspection photographs are attached.
Photograph 1 – Upstream slope of the detached embankment viewed from the left abutment.

Photograph 2 – Embankment crest viewed from the left abutment.
Photograph 3 – Downstream slope of the embankment viewed from the left abutment.

Photograph 4 – Seepage monitoring flume at the embankment’s toe.
Photograph 5 – Upstream slope of the embankment viewed from the right abutment.

Photograph 6 – Embankment crest viewed from the right abutment.
Photograph 7 – Downstream embankment slope viewed from the right abutment.

Photograph 8 – “Basin” area between the detached embankment and the Cass Road embankment.
Photograph 9 – Auxiliary spillway entrance.

Photograph 10 – Auxiliary spillway crest.
Photograph 11 – Spillway and penstock intake structure viewed from the left bank.

Photograph 12 – Penstock intake trash racks (typical).
Photograph 13 – Spillway gate viewed from the deck.

Photograph 14 – Spillway channel viewed from the deck. Intake structure.
Photograph 15 – Spillway channel viewed from downstream. Left upstream wing wall of the intake structure.

Photograph 16 – Spillway gate and entrance viewed from downstream. Right upstream wing wall of the intake structure.
Photograph 17 – Efflorescence on the right spillway channel wall. Left penstock.

Photograph 18 – Efflorescence on the left spillway channel wall. Right penstock.
Photograph 19 – Outlet end of the spillway and plunge pool. Powerhouse viewed from the Cass Road Bridge.

Photograph 20 – Spalling on the downstream face of the bridge over the spillway.
Photograph 21 — Spalling on the downstream face of the bridge over the spillway.

Photograph 22 – Access road to the powerhouse.
Photograph 23 — Intake structure.

Photograph 24 — Right upstream retaining wall of the intake structure.
Photograph 25 — Left upstream retaining wall of the intake structure.

Photograph 26 — Powerhouse viewed from the bridge.
Photograph 27 — Left penstock.

Photograph 28 — Right penstock.
Photograph 29 — Close view of the left penstock.

Photograph 30 — Close view of the right penstock.
Photograph 31 — Spalling and efflorescence on the structural concrete under the access deck.

Photograph 32 — Deteriorating structural steel.
Photograph 33 — Downstream face of the powerhouse.

Photograph 34 — Left downstream retaining wall.
Photograph 35 — Downstream slope of the right embankment adjacent to the powerhouse.