DAM SAFETY INSPECTION REPORT
HOLLOWAY DAM
DAM ID 64
FLINT RIVER
GENESEE COUNTY – SECTION 11, T08N, R08E

OWNER/OPERATOR: City of Flint
1101 South Saginaw Street, Suite N102
Flint, Michigan 48505

HAZARD POTENTIAL CLASSIFICATION: High

INSPECTION DATE: August 14, 2018

REPORT DATE: September 17, 2018

INSPECTED AND PREPARED BY:

Lucas A. Trumble, P.E.
Registration Number: 58295
Hydrologic Studies and Dam Safety Unit
Water Resources Division, DEQ
P.O. Box 30458
Lansing, Michigan 48909
517-420-8923

INTRODUCTION

The purpose of this inspection is to evaluate the structural condition and hydraulic capacity of the Holloway Dam pursuant to the requirements of Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. The Department of Environmental Quality (DEQ) conducted this inspection at the request of the dam's owner, the City of Flint (City).

The report is limited to a discussion of observations based on a visual investigation and review of any previous inspection reports, plans, and data that are available. This report should not be considered an in-depth engineering investigation. All references to "upstream" indicate the lakeside of the embankment, and references to "downstream" indicate the outside of the embankment. All references to "right" or "left" are from the viewpoint of the observer facing downstream.

CONCLUSIONS AND RECOMMENDATIONS

The Holloway Dam is in satisfactory overall condition. At the time of the inspection, no structural deficiencies existed that would cause the dam's immediate failure. The dam has adequate spillway capacity to safely convey the design flood. The following recommended actions are listed by priority:

1. Submit a written plan and schedule to remove all trees and brush from the both earthen embankments within 60 days of receiving this report. Remove all trees and brush from the embankments as outlined in the plan and schedule. After clearing, both abutments should be mowed a minimum of two times per year to prevent further establishment of woody vegetation and to facilitate visual inspection.

2. Backfill, compact, and stabilize the minor erosion and rutting occurring along the crest and downstream slopes of both earthen embankments and near the spillway abutment walls within five years.

3. Monitor the condition of the structural concrete of the principal spillway on an annual basis. Implement repairs/sealing as necessary.

4. Consider restoring the banks of the seepage collection ditch at the downstream toe of the right embankment for purposes of monitoring seepage through the embankment and early detection of distress in the embankment.

5. Repair/replace leaking drum gate seals within 10 to 15 years.

6. Continue to maintain and operate all spillway gates to ensure their proper function.

7. Review, and update as necessary, the dam's Emergency Action Plan (EAP) in coordination with Genesee County Emergency Management. Provide the results of this review, and any updates, to the Dam Safety Program by December 31, 2018.

8. Review and update the dams Operation and Maintenance (O&M) plan periodically. Provide updated copies to the Dam Safety Program.

The dam's current high hazard potential rating remains appropriate.

PROJECT INFORMATION

According to our records, the Holloway Dam was originally constructed in 1954 for the purpose of water supply. Currently, the dam creates an impoundment primarily used for recreation, providing fishing, swimming, and boating opportunities. The dam consists of a 1,100-foot long left earthen embankment; a 248-foot wide gated, concrete gravity principal spillway structure; and a 2,000-foot long right earthen embankment. The earthen embankments are zoned in construction, with clay zone along the upstream 1/3 and granular fill along the downstream 2/3 of the embankment section. A 25-foot deep steel sheetpile cutoff wall extends below the clay foundation key at both embankments. A gravel drain runs along the centerline of the embankments, and discharges seepage through 6-inch diameter polyvinyl chloride (PVC) drain pipes, spaced at approximately 15-foot on center, to a seepage collection channel that runs along the downstream toe of the embankments. Both embankments have crest widths of approximately 15 feet, upstream slopes of approximately 3 horizontal to 1 vertical (3H:1V), and downstream slopes of approximately 2H:1V.

The principal spillway contains five spillway bays. Three 20-foot wide radial tainter gates are situated at the center of the spillway structure, flanked at each end by a 90-foot wide drum gate section. The three tainter gates are each 20 feet wide by 10 feet high and are operated by a traveling hoist system situated on a catwalk above the gates. The two drum gates are both 90 feet wide by 4 feet high and are operated by valve control houses situated at each abutment of the spillway structure. Full drawdown of the impoundment, beyond the capability of the three radial gates and two drum gates, is achieved via two 4-foot by 6-foot low-level sluice gates which discharge through 8-foot by 11-foot concrete culverts located in each of the abutments. No auxiliary spillway exists at the dam.

The dam has a structural height of 38 feet, a hydraulic height of 30 feet, and maintains approximately 30 feet of head with 8 feet of freeboard, creating a 1,400-acre impoundment under normal flow conditions.

The dam was originally inspected under the National Dam Safety Program by Ellis, Naeyaert, and Genheimer Associates, Inc. in 1978. It has subsequently been inspected under Part 315 by Acres International Corporation in 1993; by Ayres, Lewis, Norris, & May, Inc. in 1996; by Paul C. Rizzo Associates, Inc. in 1999; by the Spicer Group, Inc. in 2002; by Soils and Materials Engineers, Inc. in 2005; by Stantec Consulting Michigan, Inc. in 2008; and by Wade Trim, Inc. in 2011 and 2015. Copies of these inspection reports are on file with the Dam Safety Program. Original construction plans for the dam were not available at the time of this inspection.

FIELD INSPECTION

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

The dam's earthen embankments, shown in Photographs 1 through 18, are in fair condition. No sloughs, slumps, differential settlement, cracking, or major erosion was observed. However, trees and brush were observed to be growing along the upstream and downstream slopes of both embankments, as shown in Photographs 1, 3, 4, and 6. Trees and brush can provide shortened seepage pathways along their root systems, resulting in internal erosion (piping) of abutment fill materials. They can also cause large section losses in the event of a blow down, provide a haven for burrowing animals, and obscure underlying deficiencies. Therefore, all trees and brush should be removed from both embankments. This recommendation is repeated from previous inspection reports and should be completed as soon as practical. The owner should submit a written plan and schedule to address this deficiency to the Dam Safety Program within 60 days of receiving this report. After clearing, both abutments should be mowed a minimum of two times per year to prevent further establishment of woody vegetation and facilitate visual inspection.

Additionally, several areas of minor foot traffic erosion exist along the downstream faces of both embankments and near the spillway abutment walls. These areas, shown in Photographs 7, 40, 41, and 43, do not currently pose a threat to the stability of the embankment. However, if the conditions worsen, a slope stability issue could develop. As such, all eroded areas should be backfilled, compacted, and stabilized within five years to prevent further erosion.

Lastly, minor tire rutting was observed along the gravel vehicle path at the crest of the right embankment. This condition, shown in Photograph 15, does not currently pose a threat to the stability of the embankment; however, it could lead to ponding of water and/or erosion, potentially causing a slope stability issue. As such, the vehicle ruts should be backfilled, compacted, and stabilized in conjunction with filling of the eroded areas along the embankments.

The seepage collection ditch along the downstream toe of the right embankment, shown in Photograph 17, conveys seepage to the Flint River downstream of the dam. In the past, water levels in this ditch were maintained by a concrete weir at its outlet. This weir has since been bypassed by a breach in the ditch bank, as shown in Photograph 18. This condition does not currently pose a threat to the stability of the embankment but does make monitoring of the seepage conditions more difficult. Consideration should be given to restoring the former ditch banks and flow through the notched weir as this would allow for better monitoring of seepage flow rates, color, and sediment transport; all of which could be early indicators of embankment distress.

The principal spillway, shown in Photographs 19 through 43, is in satisfactory condition. No differential settlement, misalignment, or major cracking or deterioration of the structure was observed. Minor cracking, spalling, and efflorescence is present at the abutment walls and piers as shown in Photographs 36 through 39. This condition does not currently pose a threat to the structural integrity of the spillway; however, if left

uncorrected, the deterioration will continue to accelerate through repeated freeze/thaw cycles, eventually leading to instability of the structure. The overall condition of the concrete should be monitored on an annual basis. Concrete repair/sealing should be completed as necessary.

The two drum gates, shown in Photographs 21 through 27 were not operated during the inspection of the dam, but appeared to be in satisfactory structural condition. Both drum gates exhibit minor leakage at the end gate seals and from the base of the gate as shown in Photographs 23, 23, and 27. This condition does not currently impact the integrity or function of the gates, but if left untreated, could result in erosion of the adjacent concrete surfaces and deterioration of the gate function. As such, plans to repair the gate seals should be developed and implemented within 10 to 15 years.

The three radial tainter gates, shown in Photograph 28, were not operated during the inspection of the dam, but also appeared to be in satisfactory structural condition, with only minor leakage at the gate seals. The owner should continue to maintain and operate all spillway gates on a regular basis to ensure their proper function.

STRUCTURAL STABILITY

Based upon observations during the inspection, there were no indicators of any conditions that represent an immediate threat to the dam's stability. No remedial action is required at this time.

HYDROLOGY AND HYDRAULICS

The contributing drainage area to the Flint River at the Holloway Dam is approximately 515 square miles. The design flood for this high hazard potential dam is the 0.5-percent annual chance (200-year) flood discharge, which is estimated to be 9,900 cubic feet per second (cfs). When all gates are operated, the principal spillway has a maximum combined capacity of approximately 40,000 cfs with no freeboard at the earthen embankments and can convey the design flood discharge of 9,900 cfs with a headwater elevation of approximately 755 feet NGVD29 and 8 feet of freeboard, which is essentially equal to the normal summer level of Holloway Reservoir. Therefore, the dam is considered to have more than adequate spillway capacity to safely convey the design flood.

Copies of the spillway rating curve used to make this determination are on file with the Dam Safety Program.

OPERATION AND MAINTENANCE

A written O&M Plan titled "Holloway Reservoir Operation and Maintenance Plan" has been developed for the dam and is on file with the Dam Safety Program. It is recommended that the O&M Plan be reviewed periodically and updated as necessary. Updated copies should be provided to the Dam Safety Program.

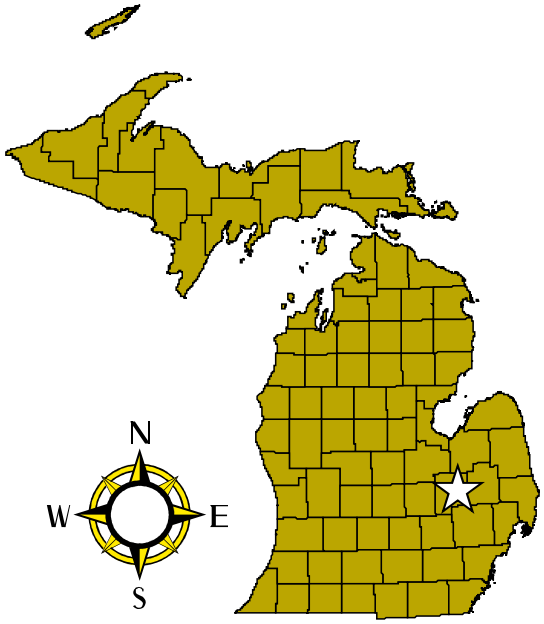
EMERGENCY ACTION PLAN

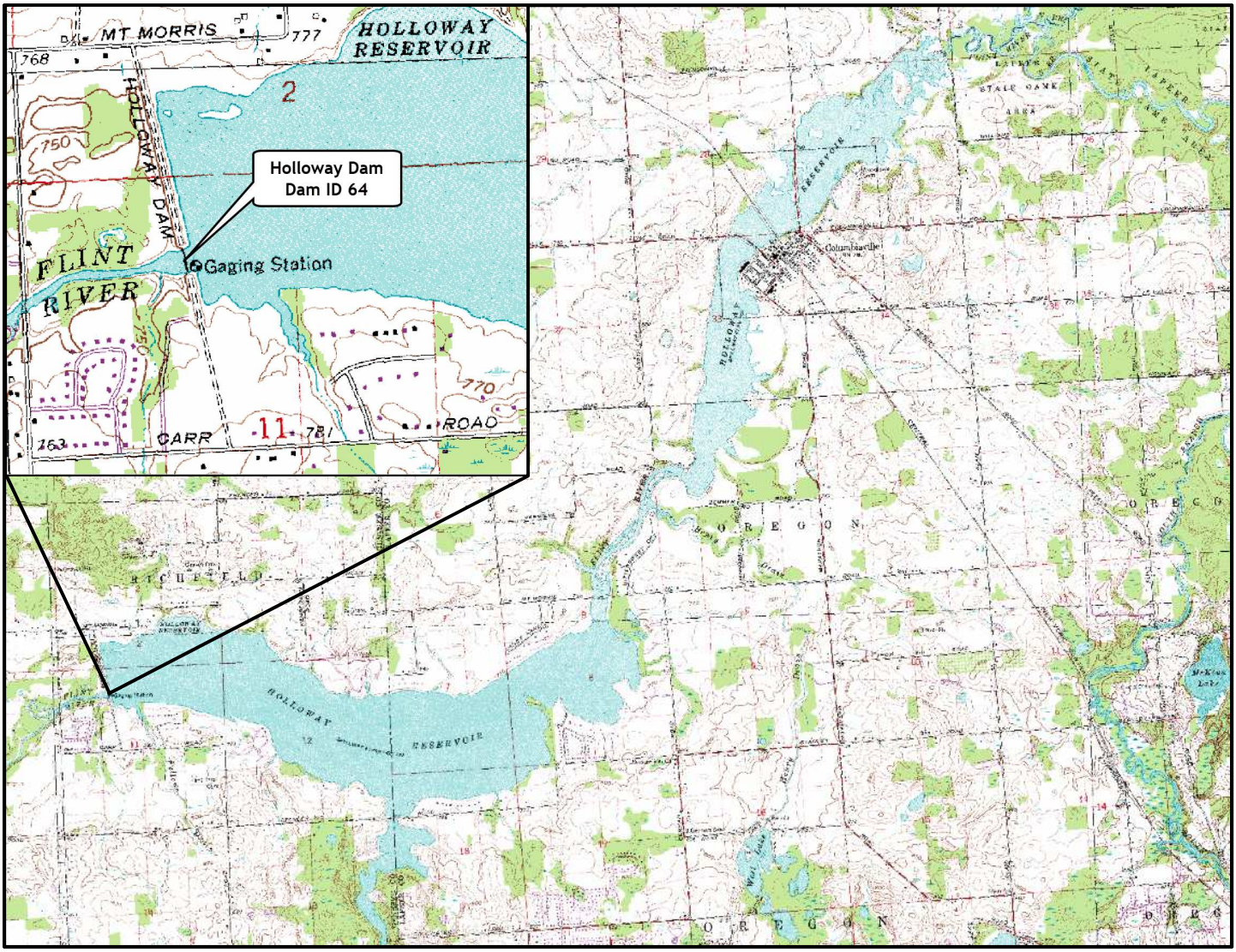
The Holloway Dam has been assigned a high hazard potential rating. As such, the owner is required to prepare, and keep up-to-date, and EAP for the dam, in coordination with Genesee County Emergency Management. An EAP has been prepared for the dam and was last updated in May 2015. **The owner shall review, and update as necessary, the dam's EAP and provide the results of this review, and any updates, to the Dam Safety Program by December 31, 2018.**

APPENDICES

A location map, inspection photographs, and the 2018 DEQ estimated flood flows are attached.

Holloway Dam
Dam ID 64
Section 11, T 08N, R 08E
Genesee County





HOLLOWAY DAM
GENESEE COUNTY
DAM ID 64

Photograph 1 – Upstream face of left embankment viewed from right
Note: trees and brush

Photograph 2 – Crest of left embankment viewed from right

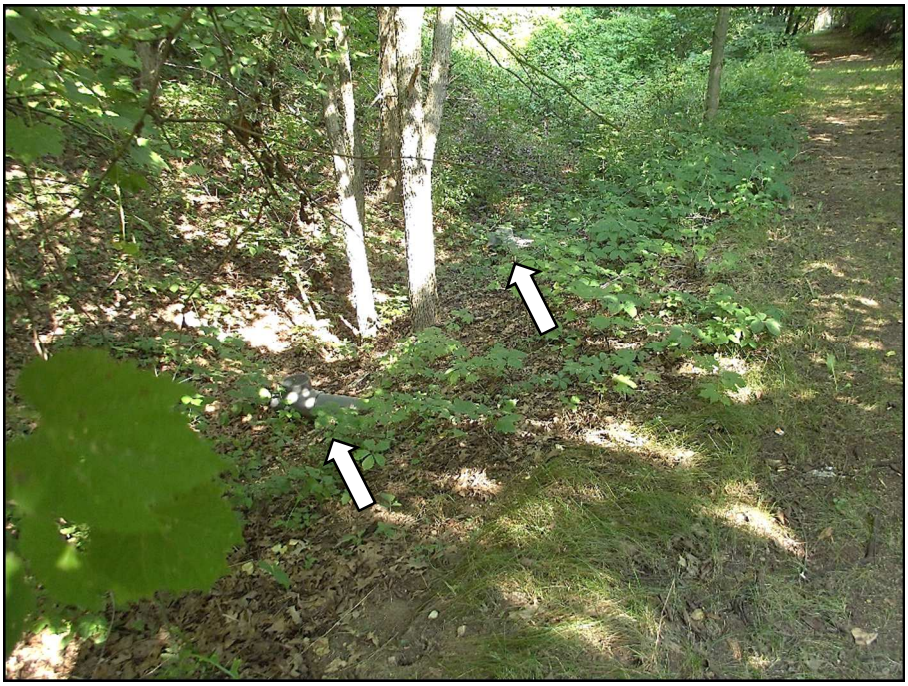
Photograph 3 – Downstream face of left embankment viewed from right
Note: trees and brush

Photograph 4 – Upstream face of left embankment viewed from left
Note: trees and brush

Photograph 5 – Crest of left embankment viewed from left

Photograph 6 – Downstream face of left embankment viewed from left
Note: trees and brush

Photograph 7 – Foot traffic erosion adjacent to concrete stairway



Photograph 8 – Seepage drain outlet pipes

Photograph 9 – Upstream face of right embankment viewed from left
Note: trees and brush

Photograph 10 – Crest of right embankment viewed from left

Photograph 11 – Downstream face of right embankment viewed from left
Note: trees and brush

Photograph 12 – Upstream face of right embankment viewed from right
Note: trees and brush

Photograph 13 – Crest of right embankment viewed from right

Photograph 14 – Downstream face of right embankment viewed from right
Note: trees and brush

Photograph 15 – Minor rutting at embankment crest

Photograph 16 – Seepage drain outlet pipe

Photograph 17 – Seepage collection ditch

Photograph 18 – Seepage collection ditch monitoring weir
Note: flow is bypassing the weir through a breach

Photograph 19 – Principal spillway viewed from downstream

Photograph 20 – Spillway crest and catwalk viewed from left

Photograph 21 – Left drum gate bay viewed from downstream

Photograph 22 – Left drum gate crest viewed from right

Photograph 23 – Leakage at left gate seal

Photograph 24 – Leakage at right gate seal

Photograph 25 – Right drum gate bay viewed from downstream

Photograph 26 – Right drum gate crest viewed from left

Photograph 27 – Leakage at base of drum gate

Photograph 28 – Three tainter gate bays viewed from downstream left

Photograph 29 – Tainter gate hoist mechanism

Photograph 30 – Drum gate control house

Photograph 31 – Drawdown gate operator

Photograph 32 – Left drawdown gate bypass culvert

Photograph 33 – Right drawdown gate bypass culvert

Photograph 34 – Not photographed – left upstream abutment wall

Photograph 35 – Right upstream abutment wall

Photograph 36 – Spalling at top of wall

Photograph 37 – Spalling and delamination at upstream wing

Photograph 38 – Spalling at right abutment near drawdown gate operator

Photograph 39 – Left downstream abutment wall
Note: minor efflorescence

Photograph 40 – Foot traffic erosion at left abutment wall

Photograph 41 – Erosion at downstream abutment wall

Photograph 42 – Right downstream abutment wall

Photograph 43 – Foot traffic erosion at abutment

Photograph 44 – Holloway Reservoir viewed from spillway crest

Photograph 45 – Downstream Flint River viewed from spillway crest

Tue 2/27/2018 5:59 PM
deq-wrd-qreq deq-wrd-qreq@michigan.gov
RE: flood or low flow discharge request (ContentID - 168812)
To: Trumble, Luke (DEQ) TrumbleL@michigan.gov

We have estimated the flood frequency discharges requested in your email of February 7, 2018 (Process No. 20180109), as follows:

Flint River at Holloway Dam, Dam ID 64, Section 11, T8N, R8E, Richfield Township, Genesee County, has a total drainage area of 522 square miles and a contributing drainage area of 515 square miles. The design discharge for this dam is the 0.5% chance (200-year) flood. The 0.5% chance peak flow is estimated to be 9900 cubic feet per second. (Watershed Basin No. 32B Flint).

Please include a copy of this letter with your inspection report or any subsequent application for permit. These estimates should be confirmed by our office if an application is not submitted within one year. If you have any questions concerning the discharge estimates, please contact Ms. Susan Greiner, Hydrologic Studies and Dam Safety Unit, at 517-284-5579, or by email at: GreinerS@michigan.gov.

From: trumblel@michigan.gov [mailto:trumblel@michigan.gov]
Sent: Wednesday, February 07, 2018 11:44 AM
To: deq-wrd-qreq <deq-wrd-qreq@michigan.gov>
Subject: flood or low flow discharge request (ContentID - 168812)

Requestor: Luke Trumble
Company: MDEQ
Address: 525 W Allegan
City: Lansing, MI
Zip: 48933
Phone: 5174208923
Date: 2018-02-07
F0.5percent: Yes
ContactAgency: None Selected
ContactPerson:
Watercourse: Flint River
LocalName: Holloway Reservoir
CountyLocation: Genesee
CityorTownship: Richfield Twp.
Section: 11
Town: 08N
Range: 08E
Location: Request is for the Flint River at the Holloway Dam, Dam ID 64, Genesee County. Previous request was made in 2015 by Wade Trim and processed by Susan Greiner, File No. 20150234.
FFR1: Dam