

# North Dakota State Water Commission

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June 13, 2013

Ben Varnson, Chairman  
Nelson County Water Resource Board  
P.O. Box 446  
Lakota, ND 58344-0446

RE: Inspection of McVile Dam

Dear Mr. Varnson:

McVile Dam was inspected by our dam safety program on June 3, 2013. The findings from the inspection are contained in the enclosed report. Please note the recommendations on page 2.

McVile Dam is in poor condition overall. The stilling basin at the spillway outlet is severely deteriorated. If the stilling basin walls were to fail, flow through the dam's spillway could result in erosion of the downstream toe of the dam and erosion of the railroad embankment immediately downstream, which could endanger both structures. Uncontrolled seepage through the dam raises concerns regarding the stability of the downstream slope, as well as the potential for a seepage related failure of the dam due to piping of soil particles. The seepage through the dam also keeps the soil around the spillway pipe saturated. This corrugated metal pipe has reached the end of the typical design life for such a structure. The pipe's age, combined with the saturated conditions around the pipe and the seepage into the pipe, raises concerns regarding the long-term integrity of the spillway. The spillway capacity also does not meet current dam safety standards.

Significant engineering work will be necessary to design feasible repair alternatives. Action is needed soon to repair the dam, or consideration should be given to removing the dam.

If you have any questions about any of the information in this report, please contact Karen Goff of my staff at (701) 328-4953.

Sincerely,

Bruce Engelhardt, P.E.  
Director of Water Development Division

BE:kg/616  
Enclosure

c: Renae Arneson, Auditor, City of McVile  
Randy Hiltner, ND Game and Fish Department – Devils Lake  
Wade Swensen, District Engineer, ND Department of Transportation – Grand Forks  
BNSF Railroad - Fargo  
Randy Gjestvang, SWC West Fargo Office

## NORTH DAKOTA STATE WATER COMMISSION

### INSPECTION OF MCVILLE DAM JUNE 3, 2013

#### SUMMARY OF KEY INSPECTION FINDINGS:

- 1) The stilling basin is in very poor condition.
  - Both the east and west walls of the stilling basin are failing structurally and are deflecting inward. Braces were placed across the stilling basin to support the walls in 1990, but two of the three braces are no longer functioning at all because the concrete has deteriorated so much that the braces no longer have any support. Both concrete walls have extensive cracking and deterioration.
  - There are large eroded areas behind both stilling basin walls. Because the walls are leaning inward, there is a large gap between each stilling basin wall and the headwall of the railroad culvert. These gaps allow water flowing through the dam's spillway to circulate behind the stilling basin walls and cause the erosion. Surface runoff and seepage around the stilling basin are also likely contributors to the erosion, carrying soil through the gaps in the walls.
  - If the stilling basin walls were to fail, flow through the dam's spillway could result in erosion of the downstream toe of the dam and erosion of the railroad embankment, which could endanger both structures.
  - There are five concrete baffle blocks on the floor of the stilling basin. Two of these baffle blocks are badly deteriorated and another one is damaged. These baffle blocks are important for energy dissipation in the stilling basin and the damage to these baffle blocks will further decrease the ability of the stilling basin to function properly.
- 2) The dam has a history of concerns regarding uncontrolled seepage through the dam. At the time of this inspection, there was a lot of standing water and cattails at the downstream toe of the dam. Three piezometers installed in the dam in 1991 have been read by the State Water Commission several times each year since their installation. One piezometer is located at the downstream toe of the dam, west of the stilling basin, and it has consistently shown water elevations in the range of 1417-1420 feet. At the time of this inspection, the water elevation in this piezometer was 1419.5 feet. For comparison, the floor of the stilling basin is at elevation 1411, and the lowest sections of the stilling basin walls are at 1417 feet. A geotechnical report completed in 1992 by Twin City Testing concluded that the high water table at the downstream toe is most likely from the reservoir. There is no drainage collection system in the dam.
- 3) The 8-foot diameter pipe under the highway functions as the dam's only spillway. The interior of this pipe was inspected, and no major problems were observed at present. There is seepage around many of the bolts in the pipe and there are also a few pinhole leaks in the pipe. The pipe has a history of seepage and past investigations have found saturated soil conditions around the pipe. Given these conditions, the outside of the pipe that cannot be seen may be in worse condition than the inside of the pipe. The design life for metal conduits in dams is typically around 50 years, so this pipe is at the end of its design life.
- 4) The upper half of the slope at the east end of the embankment is very uneven with several depressions running vertically up and down the slope, the largest of which is approximately 6 feet wide by 1.5 feet deep, most likely due to erosion of the steep slope. The grass cover in this area is poor.

## **RECOMMENDATIONS:**

**Priority 1** – It is recommended that the following items be completed as soon as possible:

- 1) Replace the existing stilling basin with a new stilling basin. Additional study will be required to evaluate design options for a new stilling basin.
- 2) Install a drainage collection system in the dam, including a drain at the downstream toe of the embankment as recommended in the 1992 geotechnical report Twin City Testing. The installation of a filter diaphragm around the spillway pipe should also be considered. Additional design work will be required for the drainage system.

**Priority 2** - It is recommended that the following items be completed to improve the long-term safety of the dam:

- 1) Fill the depressions on the upper portion of the downstream slope at the east end of the embankment and re-seed the area with grass.

**Maintenance and Monitoring** - It is recommended that the following items be addressed as part of a regular maintenance and monitoring plan:

- 1) Remove the small trees growing on the upstream slope and the bushes growing adjacent to the east wall of the stilling basin.
- 2) Attempt to control gopher activity on the dam embankment. Many gopher holes were found on the upper portion of the downstream slope near the east end of the embankment, as well as some at the west end of the upstream slope.

**Additional Studies or Analyses** - It is recommended that the following additional studies or analyses be completed:

- 1) Additional study will be required to evaluate design options for a new stilling basin.
- 2) Additional design work will be required for a drainage system for the dam embankment.
- 3) Based on analyses done by the State Water Commission in 2003, the spillway capacity at McVile Dam does not meet current standards. The spillway capacity should be verified, and the feasibility of alternatives for increasing the spillway capacity should be investigated.
- 4) Prepare an Emergency Action Plan (EAP) for the dam.

**NORTH DAKOTA STATE WATER COMMISSION  
INSPECTION CHECKLIST FOR EMBANKMENT DAMS**

Name of Dam: McVile Dam

Date Inspected: 06/03/13

Hazard Classification: Medium

Pool Elevation: 0.30 ft above normal pool

Inspected By: Karen Goff - Dam Safety Engineer, Jeff Berger - Dam Safety Technician

Accompanied By: N/A

UPSTREAM SLOPE	Status	Comments
Erosion	No	
Wave erosion / scarp at waterline	Yes	minor
Riprap inadequate	No	
Grass cover inadequate	No	bare area just above inlet bare where pile of gravel/dirt appears to have been pushed down slope from road
Trees / bushes	Yes	a few small trees, including 1 above inlet
Animal burrows	Yes	a few gopher holes at right end of embankment
Cracks	No	
Settlement / depressions	No	
Sinkholes	No	
Slides / bulges	No	
Additional Comments:		see photos 1-3
CREST	Status	Comments
Erosion	No	
Trees / bushes	No	
Animal burrows	No	
Visible settlement / low areas	No	
Sinkholes	No	
Misalignment	No	
Cracks	No	
Grass cover inadequate	No	
Ruts or puddles	No	
Additional Comments:		State Highway 15 crosses dam crest, see photo 4

DOWNSTREAM SLOPE	Status	Comments
Erosion	Yes	minor gullies at bottom of left groin
Grass cover inadequate	Yes	dead grass and some bare ground in area of depressions (see below) and extending to left end of embankment
Trees / bushes	Yes	2 bushes adjacent to left stilling basin wall, buckbrush left groin
Animal burrows	Yes	many gopher holes in bare areas
Livestock damage	No	
Cracks	No	
Settlement / depressions	Yes	slope has several depressions starting just right of outlet and extending to the left end of the slope; the depressions run vertically up and down slope, starting at the shoulder of the highway and extending about halfway down the slope; the worst areas are at the left end of the slope – the largest depression is about 6 ft wide x 1.5 ft deep; likely due to past surface erosion or could be settlement related
Sinkholes	No	
Slides / bulges	No	
Seepage	Yes	cattail area with standing water 50 ft long x 22 ft wide at downstream toe immediately right of stilling basin; hole about 1 ft deep with standing water at toe about 15 ft left of west piezometer; area of dead grass and rough ground above this at bottom of slope
Boils visible	No	
Toe drains flowing Left _____ gpm (est.)	N/A	
Right _____ gpm (est.)	N/A	
Abutment drain flow	N/A	
Relief wells flowing _____ gpm (est.)	N/A	
Additional Comments:		see photos 5-9
PRINCIPAL SPILLWAY Not Applicable <input type="checkbox"/>	Status	Comments
<b>A. Inlet</b>		
Inlet clogged or obstructed	No	
Trash rack damaged or corroded	No	
Concrete cracking	N/A	unknown
Concrete spalling	N/A	unknown
Concrete reinforcement exposed	N/A	unknown
Metal corroding / rusting	N/A	
Separation / displacement of joints	N/A	
Gates damaged	N/A	
Gates leaking	N/A	
Additional Comments		not much of inlet visible due to flow into inlet, see photo 10

<b>B. Conduit</b> Not Applicable <input type="checkbox"/>		<b>Status</b>	<b>Comments</b>
Visible Damage		Yes	bottom right side a few feet from outlet - several pinholes rusted through with seepage
Visible seepage		Yes	numerous bolts seeping
Interior Inspected		Yes	
Additional Comments			bottom of pipe could not be inspected due to flow through the pipe, pipe appears to be in acceptable condition overall, see photos 11-13
<b>C. Outlet / Stilling Basin</b>		<b>Status</b>	<b>Comments</b>
Erosion		Yes	right side – erosion area behind right wall up to 8 ft wide x 15 ft measured from RR headwall and extending full depth of stilling basin wall; left side - erosion area behind left wall up to 5 ft wide, extends 15 ft from RR headwall and full depth of wall
Riprap inadequate		N/A	
Outlet channel obstructed		No	
Energy dissipators deteriorated		Yes	right 2 baffle blocks are badly deteriorated, left one is damaged
Seepage		Yes	seepage visible in the erosion holes behind both walls; on the right side there is seepage visible at the upstream end of the hole that appears to be coming from the cattail area right of the outlet
Additional Comments			see photos 14-26; both stilling basin walls are deflecting inward - right wall has 0.45 ft deflection at the RR headwall, left wall has 0.9-1 ft deflection at the RR headwall; both walls have a lot of fine cracking with efflorescence; both walls have deteriorated concrete with rebar exposed, the worst areas on both walls are at the top of the walls at the bottom of the sloped wall sections; the cross braces are losing support due to the deteriorated concrete - the most upstream cross brace has no support on the left side, the middle cross brace has no support on the right side; spalling of concrete around downstream end of principal spillway conduit
<b>LOW LEVEL DRAWDOWN</b> Not Applicable <input type="checkbox"/>		<b>Status</b>	<b>Comments</b>
Valve/Stem damage		N/A	unknown
Valve Leaking		N/A	unknown
Stoplogs damaged		N/A	unknown
Stoplogs leaking		N/A	unknown
Low-level operated		No	
Additional Comments			valve and stoplogs in inlet could not be seen well due to flow into inlet

EMERGENCY SPILLWAY	Not Applicable <input checked="" type="checkbox"/>	Status	Comments
Grass cover inadequate			
Erosion			
Slides on spillway slopes			
Obstructions			
Additional Comments			
<b>ADDITIONAL COMMENTS:</b>			
<p>1) McVile Dam is currently classified as a Class III, medium hazard dam. Current dam safety standards require a Class III dam to pass flows resulting from 30% of the Probable Maximum Precipitation (PMP) without overtopping the dam. Analyses done by the State Water Commission in 2003 showed that the spillway at McVile Dam does not have the capacity to meet this requirement and that 30% of the PMP would overtop the dam.</p>			

**PHOTOS:**



Photo #1 – Upstream slope, looking west.



Photo #2 – Small trees growing on upstream slope.



Photo #3 – Upstream slope, looking east.



Photo #4 – Crest, looking east.



Photo #5 – Downstream slope, looking east.



Photo #6 – Downstream slope, looking west. Note large cattail area at the downstream toe to the west of the stilling basin.



Photo #7 – Area on upper half of downstream slope at east end of embankment with large depressions, dead grass, bare ground, and many gopher holes.



Photo #8 – Depressions on upper half of downstream slope at east end of embankment.



Photo #9 – Area at downstream toe west of stilling basin with cattails, standing water, and rough uneven ground.



Photo #10 – Principal spillway inlet.



Photo #11 – Interior of principal spillway conduit.



Photo #12 – Small pinholes with seepage in principal spillway conduit.



Photo #13 – Seepage at bolts inside principal spillway conduit, typical.



Photo #14 – Principal spillway outlet.



Photo #15 – Principal spillway stilling basin, looking downstream.



Photo #16 – Baffle blocks in the stilling basin. The two on the west side are badly deteriorated and the one on the east side is damaged.



Photo #17 – Cracking and deterioration of the west stilling basin wall. Also note the cattail area west of the stilling basin.



Photo #18 – Cracking and deterioration of the east stilling basin wall.



Photo #19 – Deterioration at the top of the west stilling basin wall.



Photo #20 – Deterioration at the top of the west stilling basin wall. The middle cross brace is no longer supported on the west side.



Photo #21 – Deterioration at the top of the east stilling basin wall. The most upstream cross brace is no longer supported on the east side.



Photo #22 – Erosion behind the west stilling basin wall.



Photo #23 – Erosion behind the west stilling basin wall.



Photo #24 – Erosion behind the east stilling basin wall.

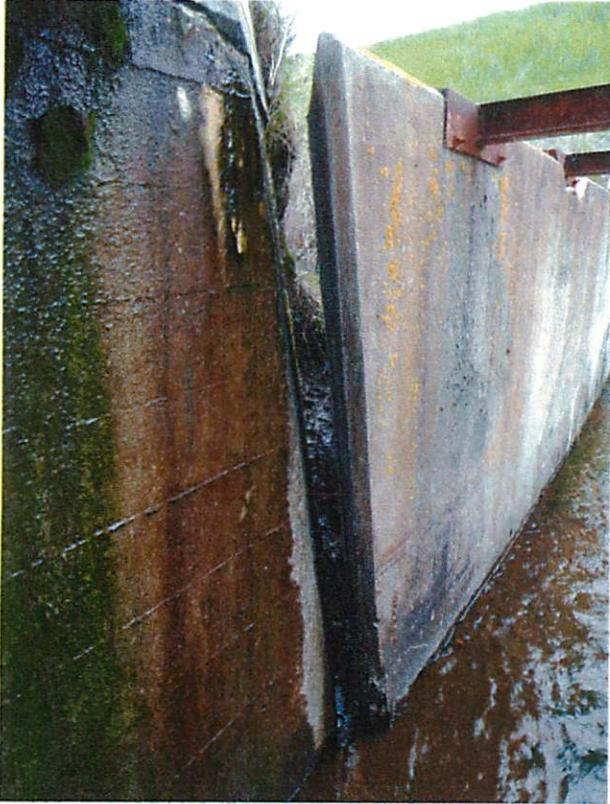


Photo #25 – Deflection of the west stilling basin wall.

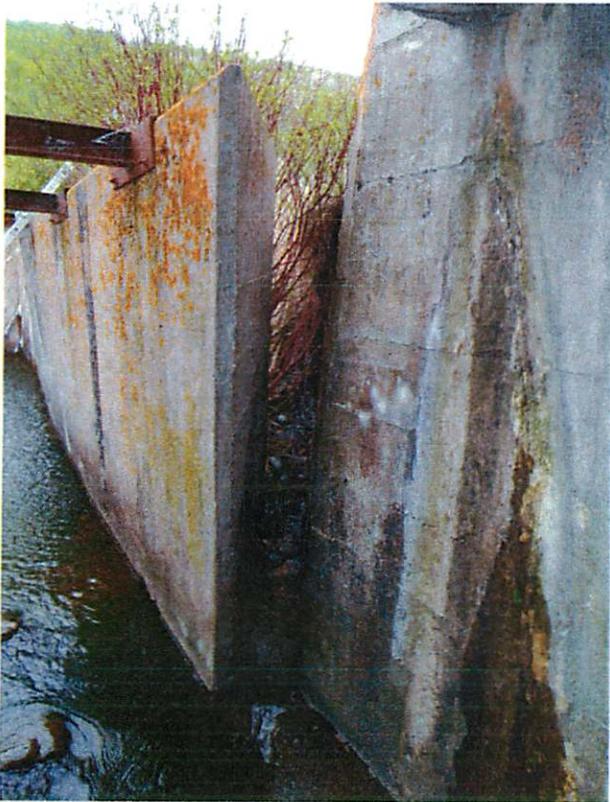


Photo #26 – Deflection of the east stilling basin wall.