

-- SAW MILL POND DAM --
PHASE I
INSPECTION / EVALUATION REPORT



Dam Name: Saw Mill Pond Dam
State Dam ID#: 3-14-45-1
NID ID#: MA00098
Owner: Town of Brookfield
Town: Brookfield, MA
Consultant: Fuss & O'Neill, Inc.
Date of Inspection: July 20, 2010



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EXECUTIVE SUMMARY

Saw Mill Pond Dam is an *Intermediate Size, Significant Hazard* (Class II) potential dam located in Brookfield, Massachusetts on Trout Brook. Fuss & O'Neill, Inc., of West Springfield, Massachusetts, completed a Phase I inspection of the dam on July 20, 2010. Based on the inspection the dam was found to be in *Poor* condition, with deficiencies including the following:

1. Ability of spillway to pass the design (100-year) flood is unknown.
2. No low-level outlet control.
3. Debris collecting on spillway.
4. Severe deterioration of the visible portion of the low-level outlet pipe.
5. Dense vegetation, steep slopes, and evidence of sloughing/scour on the downstream face and right abutment of the dam.
6. Deteriorated downstream stone masonry wall, including formation of cracks and undermining of the toe.
7. Vegetation growing from cracks in the upstream stone masonry walls.
8. Sinkhole on the crest of the dam over a deteriorated road drainage CMP (Road drainage Corrugated Metal Pipes (CMPs) are located within the dam embankment).
9. Undulations along portions of the downstream side of the dam crest.
10. Minor down stream toe seepage; seepage through weep holes in the bridge abutment.

Fuss & O'Neill recommends the following actions be taken to address the deficiencies identified during the course of the investigation:

1. A hydrologic and hydraulic (H&H) study should be completed to assess adequacy of the spillway to safely convey the spillway design flood.
2. A detailed structural stability analysis should be performed for the embankment and non-embankment portions of this Dam.
3. Remove road drainage CMPs from the dam embankment and repair sinkhole.
4. Replace the low-level outlet.
5. Remove woody vegetation from dam embankment and the downstream area within 20 feet of the dam toe.
6. Remove trees and vegetation from upstream stone masonry walls.
7. Re-grade portions of the embankment crest where undulations are present.
8. Establish vegetative cover in bare areas.

Dam Evaluation Summary Detail Sheet

1. NID ID:	MA00098	4. Inspection Date:	July 20, 2010
2. Dam Name:	Saw Mill Pond Dam	5. Last Insp. Date:	NA
3. Dam Location:	Brookfield, MA	6. Next Inspection:	July 20, 2015
7. Inspector:	Christopher J. Cullen, PE		
8. Consultant:	Fuss & O'Neill, Inc		
9. Hazard Code:	Significant	9a. Is Hazard Code Change Requested?:	No
10. Insp. Frequency:	5 Years	11. Overall Physical Condition of Dam:	POOR
12. Spillway Capacity (% SDF)	0-50% of the SDF or Unknown		
E1. Design Methodology:	1	E7. Low-Level Discharge Capacity:	2
E2. Level of Maintenance:	2	E8. Low-Level Outlet Physical Condition:	1
E3. Emergency Action Plan:	1	E9. Spillway Design Flood Capacity:	1
E4. Embankment Seepage:	5	E10. Overall Physical Condition of the Dam:	2
E5. Embankment Condition:	1	E11. Estimated Repair Cost:	\$300,000 - \$600,000
E6. Concrete Condition:	4		

Evaluation Description

E1: DESIGN METHODOLOGY

1. Unknown Design – no design records available
2. No design or post-design analyses
3. No analyses, but dam features appear suitable
4. Design or post design analysis show dam meets most criteria
5. State of the art design – design records available & dam meets all criteria

E2: LEVEL OF MAINTENANCE

1. Dam in disrepair, no evidence of maintenance, no O&M manual
2. Dam in poor level of upkeep, very little maintenance, no O&M manual
3. Dam in fair level of upkeep, some maintenance and standard procedures
4. Adequate level of maintenance and standard procedures
5. Dam well maintained, detailed maintenance plan that is executed

E3: EMERGENCY ACTION PLAN

1. No plan or idea of what to do in the event of an emergency
2. Some idea but no written plan
3. No formal plan but well thought out
4. Available written plan that needs updating
5. Detailed, updated written plan available and filed with MADCR, annual training

E4: SEEPAGE (Embankments, Foundations, & Abutments)

1. Severe piping and/or seepage with no monitoring
2. Evidence of monitored piping and seepage
3. No piping but uncontrolled seepage
4. Minor seepage or high volumes of seepage with filtered collection
5. No seepage or minor seepage with filtered collection

E5: EMBANKMENT CONDITION (See Note 1)

1. Severe erosion and/or large trees
2. Significant erosion or significant woody vegetation
3. Brush and exposed embankment soils, or moderate erosion
4. Unmaintained grass, rodent activity and maintainable erosion
5. Well maintained healthy uniform grass cover

E6: CONCRETE CONDITION (See Note 2)

1. Major cracks, misalignment, discontinuities causing leaks, seepage or stability concerns
2. Cracks with misalignment inclusive of transverse cracks with no misalignment but with potential for significant structural degradation
3. Significant longitudinal cracking and minor transverse cracking
4. Spalling and minor surface cracking
5. No apparent deficiencies

E7: LOW-LEVEL OUTLET DISCHARGE CAPACITY

1. No low level outlet, no provisions (e.g. pumps, siphons) for emptying pond
2. No operable outlet, plans for emptying pond, but no equipment
3. Outlet with insufficient drawdown capacity, pumping equipment available
4. Operable gate with sufficient drawdown capacity
5. Operable gate with capacity greater than necessary

E8: LOW-LEVEL OUTLET PHYSICAL CONDITION

1. Outlet inoperative needs replacement, non-existent or inaccessible
2. Outlet inoperative needs repair
3. Outlet operable but needs repair
4. Outlet operable but needs maintenance
5. Outlet and operator operable and well maintained

E9: SPILLWAY DESIGN FLOOD CAPACITY

1. 0 - 50% of the SDF or unknown
2. 50-90% of the SDF
3. 90 - 100% of the SDF
4. >100% of the SDF with actions required by caretaker (e.g. open outlet)
5. >100% of the SDF with no actions required by caretaker

E10: OVERALL PHYSICAL CONDITION OF DAM

1. UNSAFE – Major structural, operational, and maintenance deficiencies exist under normal operating conditions
2. POOR - Significant structural, operation and maintenance deficiencies are clearly recognized under normal loading conditions
3. FAIR - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters
4. SATISFACTORY - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.
5. GOOD - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF

E11: ESTIMATED REPAIR COST

Estimation of the total cost to address all identified structural, operational, maintenance deficiencies. Cost shall be developed utilizing standard estimating guides and procedures

Changes/Deviations to Database Information since Last Inspection



PREFACE

The assessment of the general condition of the dam reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the dam was based on observations of field conditions at the time of inspection, along with data available to the inspection team.

It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the reported condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

*Licensed Professional's Signature**

Philip W. Moreschi, P.E.
Massachusetts License No.: 32051
License Type: Civil

Vice President
Fuss & O'Neill, Inc.

*Licensed Professional's Signature**

Christopher J. Cullen, P.E.
Massachusetts License No.: 47018
License Type: Civil

Project Manager
Fuss & O'Neill, Inc.



** 302 CMR 10.00 requires inspecting engineers to be Commonwealth of Massachusetts Registered Professional Engineers with a Civil Engineering license with experience in dam safety inspections and engineering. The Department will also accept inspection by a Commonwealth of Massachusetts Registered Professional Engineer with a Structural or Sanitary Engineering license, provided the Registered Professional Engineer has experience in the field of dam engineering and inspection.*



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SECTION 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The Town of Brookfield retained Fuss & O'Neill, Inc. to perform a visual inspection and develop a report of conditions for the Saw Mill Pond Dam along Trout Brook in Brookfield, Worcester County, Massachusetts. This inspection and report were performed in accordance with MGL Chapter 253, Sections 44-50 of the Massachusetts General Laws as amended by Chapter 330 of the Acts of 2002.

1.1.2 Purpose of Work

The purpose of this investigation was to inspect and evaluate the present condition of the dam and appurtenant structures in accordance with 302 CMR10.07 to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation was divided into four parts: 1) obtain and review available reports, investigations, and data previously submitted to the owner pertaining to the dam and appurtenant structures; 2) perform a visual inspection of the site; 3) evaluate the status of an emergency action plan for the site and; 4) prepare and submit a final report presenting the evaluation of the structure, including recommendations and remedial actions, and opinion of probable costs.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix D. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; and 5) miscellaneous.

1.2 Description of Project

1.2.1 Location

Saw Mill Pond Dam is located on the north end of Rice Pond in the Town of Brookfield, Worcester County, Massachusetts. The coordinates of the dam are 42.198333° North 72.10194° West (WGS 84 Datum), as determined using Google Earth geographic information software. The dam is located along the south side of Lake Road. A locus map is provided as Figure 1.



1.2.2 Owner/Caretaker

See Table 1.1 for current owner and caretaker data (names and contact information).

1.2.3 Purpose of the Dam

Saw Mill Pond Dam was originally built to supply power for a local mill. The pond is now used for recreational and fire protection purposes.

1.2.4 Description of the Dam and Appurtenances

Saw Mill Pond Dam is an earth embankment dam of approximately 170 feet in length and 11 feet in height. A public road (Lake Road) is located on the embankment crest. Discharge from the spillway is conveyed under a bridge crossing on the roadway. Outflow from the Dam forms Trout Brook, which flows north for approximately 3,500 feet until its confluence with the Quaboag River. There are no other bridge/culvert crossings on Trout Brook between the Dam and the confluence with the Quaboag River.

The crest width is approximately 40 feet. The roadway is approximately 30 feet wide. Grass covered shoulders are located on both sides of the road. Guardrails are installed along the portions of the upstream and downstream face. There is a dry hydrant located on the crest left of the spillway on the upstream side of the road, presumably for use by the local fire department. A small unpaved parking area/pull-off is located to the left of the bridge crossing on the downstream side of the crest.

The upstream embankment is supported by stone masonry walls to the left and right of the spillway. The left downstream slope varies from approximately 4H:1V to 2H:1V and is covered with dense vegetation, including trees up to 2 feet in diameter. The right downstream slope is very steep with side slopes 2H:1V or greater and is also covered with dense vegetation and trees.

The spillway is located approximately 50 feet from the right abutment and consists of a 22.5 foot long concrete ogee weir. Discharge from the spillway is conveyed under the bridge crossing. The concrete spillway apron extends through the entire length of the bridge opening. Concrete training walls are located upstream of the spillway. A single stone masonry training wall is located immediately downstream of the bridge on the left side on the channel. The spillway was constructed with an integral low-level outlet, consisting of a 24 inch corrugated metal pipe that protrudes through the ogee weir. There are no other known outlets. See the attached field sketches.

1.2.5 Operations and Maintenance

The dam is owned by the Town of Brookfield. The Brookfield Highway Department is responsible for maintenance of the dam.



1.2.6 DCR Size Classification

The Dam has a maximum structural height of approximately 11 feet and a maximum storage capacity of approximately 71 acre-feet. Therefore, in accordance with Department of Conservation and Recreation Office of Dam Safety classification, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Saw Mill Pond Dam is an **Intermediate** size structure.

1.2.7 DCR Hazard Potential Classification

A public road (Lake Road), which includes a bridge crossing, is located on the crest of the Dam. Therefore, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Saw Mill Pond Dam is classified as a **Significant** hazard potential dam.

1.3 Pertinent Engineering Data

1.3.1 Drainage Area

The drainage area for Saw Mill Pond Dam is approximately 3.77 square miles as determined using USGS mapping and is located within the communities of Brookfield and Sturbridge. The watershed is lightly developed with residential, commercial and industrial facilities. The drainage area is depicted in Figure 3.

1.3.2 Reservoir

See Table 1.1 for data about normal, maximum, and spillway design flood (SDF) pools. These data were estimated based on dam height and impoundment surface area, which was determined using USGS mapping and aerial photography. Rice Pond has an estimated average depth of 2 to 3 feet.

1.3.3 Discharges at the Dam Site

No records of flood discharges exist for Saw Mill Pond Dam.

1.3.4 General Elevations (feet)

All elevations are approximate and are relative to an assumed spillway invert (normal pool) elevation of 605 feet NGVD29, based on USGS topographic mapping.

A. Top of Dam	609.9
B. Spillway Design Flood Pool	Unknown
C. Normal Pool	605.0
D. Spillway Crest	605.0
E. Upstream Water at Time of Inspection	605.1
F. Downstream Water at Time of Inspection	599.5
G. Streambed at Toe of the Dam	599.3
H. Low Point along Toe of the Dam	599.3 at streambed



1.3.5 Spillway Data

A. Type	Uncontrolled ogee-crest
B. Weir Length	22.5 feet
C. Weir Crest Elevation	605.0
D. Upstream Channel	NA
E. Downstream Channel	599.3

1.3.6 Design and Construction Records and History

No design or construction records are available for Saw Mill Pond Dam.

1.3.7 Operating Records

No operating records were available for this dam.

1.4 Summary Data Table

See Table 1.1, Summary Data Table, on the next page.

1.1 Summary Data Table

Required Phase I Report Data	Data Provided by the Inspecting Engineer
National ID #	MA00098
Dam Name	Saw Mill Pond Dam
Dam Name (Alternate)	0
River Name	Trout Brook
Impoundment Name	Saw Mill Pond; Rice Pond
Hazard Class	Significant
Size Class	Intermediate
Dam Type	Earthen Embankment
Dam Purpose	Recreational
Structural Height of Dam (feet)	10.67
Hydraulic Height of Dam (feet)	5.75
Drainage Area (sq. mi.)	3.77
Reservoir Surface Area (sq. mi.)	0.02
Normal Impoundment Volume (acre-feet)	23.42
Max Impoundment Volume ((top of dam) acre-feet)	70.79
SDF Impoundment Volume* (acre-feet)	No H&H
Spillway Type	Concrete Ogee Weir
Spillway Length (feet)	22.5
Freeboard at Normal Pool (feet)	5
Principal Spillway Capacity* (cfs)	976
Auxiliary Spillway Capacity* (cfs)	NA
Low-Level Outlet Capacity* (cfs)	47
Spillway Design Flood* (flow rate - cfs)	100-year
Winter Drawdown (feet below normal pool)	NA
Drawdown Impoundment Vol. (acre-feet)	NA
Latitude	42 11' 54"
Longitude	72 06' 07"
City/Town	Brookfield
County Name	Worcester
Public Road on Crest	Yes
Public Bridge over Spillway	Yes
EAP Date (if applicable)	None
Owner Name	Town of Brookfield
Owner Address	6 Central Street
Owner Town	Brookfield, MA 01506
Owner Phone	(508)-867-2930
Owner Emergency Phone	911
Owner Type	Municipality or Political subdivision
Caretaker Name	Herb Chaffee
Caretaker Address	6 Central Street
Caretaker Town	Brookfield, MA 01506
Caretaker Phone	(508)-867-2930
Caretaker Emergency Phone	911
Date of Field Inspection	7/20/2010
Consultant Firm Name	Fuss & O'Neill, Inc
Inspecting Engineer	Christopher J. Cullen, PE
Engineer Phone Number	(800)-286-2469

*In the event a hydraulic and hydrologic analysis has not been completed for the dam, indicate "No H&H" in this table, recommendation section shall include specific recommendation to hire a qualified dam engineering consultant to conduct analysis to determine spillway adequacy in conformance with 302 CMR 10.00.



SECTION 2

2.0 INSPECTION

2.1 Visual Inspection

Saw Mill Pond Dam was inspected on July 20, 2010. The weather was clear with a temperature of approximately 85°F. Photographs to document the current conditions of the dam were taken during the inspection and are included in Appendix A. The level of the impoundment was approximately at spillway elevation, i.e. at normal pool elevation. Underwater areas were not inspected. A copy of the inspection checklist is included in Appendix B, and a site sketch of the dam and appurtenances is included as Figure 5.

2.1.1 General Findings

In general, Saw Mill Pond Dam was found to be in Poor condition. Deficiencies identified included unknown spillway capacity; inadequate low-level outlet access, sinkhole on the crest near the upstream face; woody vegetation growing out of the upstream stone masonry walls; extensive woody vegetation and tree growth on the downstream slopes of the dam; steep downstream embankment slopes; deteriorated downstream stone masonry training wall; downstream seepage; weep holes in the dam foundation; partial embankment penetration by storm drains; and debris in spillway.

The specific concerns are identified in more detail in the sections below:

2.1.2 Dam

- Abutments
 - Trees are located on both downstream abutments. A small tree is located on the upstream embankment.
- Upstream Face
 - Woody vegetation growth through cracks in the stone masonry walls along the entire upstream face.
 - Underwater features were not inspected.
- Crest
 - Sinkhole under woody shrub on the upstream dam crest right of the spillway. This sinkhole is likely the result of a CMP storm drain outlet pipe that has rusted and collapsed, allowing the soil to fall into the pipe.
 - Undulations of portions of the downstream side of the crest.



- Downstream Face
 - The stone masonry wall immediately downstream and left of the bridge crossing is severely deteriorated.
 - Trees and brush are prevalent all along the downstream slope of the dam.
 - Some portions of the left embankment are sloped at approximately 2H:1V.
 - Some portions of the right embankment are sloped greater than 2H:1V.
 - Sloughing/sliding evident on the right embankment slope.
 - Sloughing/sliding evident on the left embankment slope adjacent to the downstream channel.
 - Minor seepage at the right downstream toe of the dam adjacent to the spillway.
- Drains
 - No dam drains were noted during the inspection.
 - Weep holes were observed at the base of the bridge abutment walls that also serve as the spillway training walls.
- Instrumentation
 - There is no instrumentation associated with this dam.
- Access Roads and Gates
 - There are no gates or dedicated access roads associated with this Dam.

2.1.3 Appurtenant Structures

- Spillway
 - Minor spalling on the downstream face of the spillway. Some cracking and spalling observed on the concrete training walls.
- Low-Level Outlet
 - There is no visible control structure associated with the low level outlet pipe. Reportedly, there is a gate on the upstream end of the low level outlet pipe that can be lifted with a piece of equipment, such as a backhoe.
 - The 24-inch CMP is deteriorated. The most significant visible deterioration is where the CMP protrudes through the downstream spillway face; several holes have formed in this area.
- Dikes
 - There does not appear to be any dike associated with Saw Mill Pond Dam.



2.1.4 Downstream Area

The following observations were made at the time of inspection:

- Trees and other vegetation are present within 20 feet of the downstream toe, along the entire length of the downstream embankment.
- There is severe erosion along the right downstream bank of the brook. However, it does not appear to be affecting the dam at this time.

2.1.5 Reservoir Area

Saw Mill Pond Dam is approximately 170 feet long and is oriented in the north-west direction. The dam is located at the north end of Rice Pond. Along the west side of the impoundment the shores are forested except in the immediate vicinity of the Dam where a residential property is located. The shore in this area, which extends approximately 220 feet upstream of the Dam, consists of grass, trees, and small vegetation. The shore on the east side of the impoundment also includes grass and forested areas. The grass covered portion of the shore extends approximately 1,300 feet upstream of the Dam; this area includes residential properties and fields. The remaining portion of the east shore is forested. The south shore, where Trout Brook enters Rice Pond, is also forested. The topography immediately adjacent to the pond consists of mild to moderate slopes. An aerial photograph of the reservoir area is shown in [Figure 2](#).

2.2 Caretaker Interview

Mr. Herb Chaffee of the Brookfield Highway Department was contacted regarding the operation, maintenance and history of the dam. Mr. Chaffee indicated the dam was reconstructed after the 1955 flood, and that no maintenance is performed on the dam. He also indicated that the low-level outlet operator was removed some years ago and a manually operated gate was placed over the upstream end of the 24-inch CMP.

2.3 Operation and Maintenance Procedures

No formal Operations and Maintenance (O&M) Manual is available for this dam.

2.3.1 Operational Procedures

No formal operational procedures are available for this dam.

2.3.2 Maintenance of Dam and Operating Facilities

There are no indications of maintenance at the dam.

2.4 Emergency Warning System

There is no Emergency Action Plan (EAP) for this dam.



2.5 Hydrologic/Hydraulic Data

Saw Mill Pond Dam is currently classified as an **Intermediate Size, Significant Hazard** potential dam. As such, in accordance with MGL 302 CMR 10, the required spillway design flood (SDF) for the Dam is the 100-year event.

No detailed hydrologic and hydraulic analysis is available for this dam. We estimated the spillway has a capacity of approximately 976 cfs when the pond water surface elevation is at the top of the crest of the Dam.

Normal pool and maximum pool storage volumes were estimated by Fuss & O'Neill using approximate methods to be 23 acre-feet and 71 acre-feet, respectively.

A. Spillway Design Flood (SDF) Return Period	100-year
B. SDF Inflow (cfs)	Unknown
C. SDF Outflow (cfs)	Unknown
D. Spillway Capacity (cfs)	976 cfs
E. Percent of SDF that can be safely routed without overtopping	Unknown

2.6 Structural and Seepage Stability

2.6.1 Embankment Structural Stability

No design documents or geotechnical data were reviewed as part of this Phase I inspection that would allow a formal structural stability analysis of the dam. Based on the visual observations made during the inspection, some portions of the downstream embankment slopes are 2H:1V or steeper and indications of scour and sloughing are evident.

2.6.2 Structural Stability of Non-Embankment Structures

A structural analysis of the spillway, concrete training walls, or the stone masonry walls has not been performed as part of this analysis.

2.6.3 Seepage Stability

Minor seepage was observed during the inspection at the toe of the right downstream embankment. Water is also seeping through all 6 weep holes at the base of the bridge abutment under the bridge. This is intentional standard retaining wall design to relieve pressures behind the walls of structures. It is likely that there is also coarse-grained backfill beneath the footings and against the walls, assuming standard DOT procedures were adhered to when constructing the bridge. However, since the embankment is a dam and the bridge abutments are an integral part of the dam, coarse-grained backfill, such as crushed stone, and weep holes can provide a preferential pathway for seepage through the embankment. If the flow washes soil out of the embankment (piping), eventual dam failure can result in collapse of the bridge and environmental damage down stream in the brook.