

LAKE WATATIC DAM
PHASE I
INSPECTION / EVALUATION REPORT



Dam Name: Lake Watatic Dam
NID#: MA00004
Owner: Town of Ashburnham
Town: Ashburnham, Massachusetts
Consultant: Tighe & Bond, Inc.
Date of Inspection: April 16, 2024

Executive Summary

This Phase I Inspection/Evaluation Report details the inspection and evaluation of Lake Watatic Dam located in Ashburnham, Massachusetts. The inspection was conducted on April 16, 2024, by Tighe & Bond of Worcester, Massachusetts. Lake Watatic Dam is classified as a Large, High (Class I) hazard potential dam.

The overall physical condition of Lake Watatic Dam was found to be **Fair** based on the Office of Dam Safety's June 2021 rating guidelines. The primary reasons for the Fair condition rating are the cracking and spalling of the concrete outlet structure and spillway, the brush growing from the embankment, and the trees growing within 20 feet of the embankment. The following deficiencies were noted during the inspection and evaluation:

- Trees are present adjacent to the left spillway training wall, on the left embankment, and along the downstream right groin, and trees are present within 20 feet of the dam and its appurtenances in many areas.
- Minor depressions and rutting are present on the dam crest, likely from vehicular traffic. Roots are present on the crest at the right abutment.
- The riprap on the upstream slope is small, subangular or rounded, displaced in areas, does not extend to the crest, and may not extend very far below the waterline.
- The downstream slope appears to be overly steep in areas. The slope is irregular with stumps, stones and cobbles present.
- A bare game trail was noted from the crest to the toe of the downstream slope.
- A wet area was observed at the right end of the downstream toe.
- The spillway concrete is spalled, cracked, and efflorescing. Concrete cracking was observed along the flashboards slot of the spillway.
- A depression was observed behind the spillway right training wall.
- The spillway weir may be undermined at the downstream end.
- The low-level intake structure is deteriorating; with spalled, eroded, and cracked concrete on the exterior; cracks on the interior; bent and rusting handrails; a poorly made and deteriorating internal ladder; deteriorating grate over the top; and an inadequate wooden bridge with no handrails.
- The gate valve in the intake structure has been previously observed to be leaking. The upper operator stem guide is broken, and the stem bent. The gate may not be functional.
- The downstream channel creates a tailwater condition that partially submerges the toe of the embankment and the low-level outlet discharge conduit. The downstream end of the low-level outlet discharge conduit is cracked. The concrete near the downstream end of the outlet pipe was observed to be spalled, undermined and potentially displaced.
- Seepage with iron staining is present at the downstream toe near the low-level outlet pipe.
- The spillway has insufficient discharge capacity to safely pass the spillway design flood.

- The left side of the dam and the downstream area are owned by private parties, which is an obstacle to access, maintenance, and future repairs.

Tighe & Bond recommends the following actions be taken to address the deficiencies found at the dam during this inspection and evaluation. The tasks listed below are divided into two categories: short range tasks and long-range tasks. The short-range tasks are higher priority tasks that the dam owner should include in budget development for the near future. The long-range tasks are lower priority tasks where conditions do not currently warrant immediate action, but will require attention in the future. The priority of long-range tasks may increase, if conditions worsen.

Short Range Tasks

- Remove brush and regularly mow the embankment
- Remove trees and brush within 20 feet of the dam
- Replace or supplement riprap on the upstream slope with properly bedded, adequately sized, angular riprap.
- Perform minor surface repair of concrete at spillway and training walls. Add fence or railing for fall protection.
- Fill localized depressions and animal burrows
- Repair the crack in the outlet pipe
- Assess the legal status of dam access and ownership
- Prepare an updated H&H analysis and IDA
- Perform a geotechnical investigation and seepage and slope stability analysis for the dam (required for High-hazard dams)
- Update the O&M plan
- Update the EAP

Long Range Tasks

- Repair or replace the intake structure and gate valve, including safety improvements and access bridge
- Replace the spillway with an expanded spillway (to be determined by additional analysis)
- Overtopping protection (in conjunction with spillway design)
- Regrade the downstream slope
- Provide erosion protection at the outlet pipe discharge
- Install toe drains to collect and discharge seepage in a controlled manner
- Provide filtered collection and a discharge for the seepage observed adjacent to the outlet pipe.

These recommendations should be performed under the direction of a registered professional engineer familiar with the methods and materials used in the design, construction, and repair of dams.

Conditions during the April 16, 2024 Phase I inspection were similar to conditions observed during the May 11, 2022 Phase I inspection, the most recent inspection report obtained for review.

Dam Evaluation Summary Detail Sheet

1. NID ID:	MA00004	4. Inspection Date:	April 16, 2024
2. Dam Name:	Lake Watatic Dam	5. Last Insp. Date:	May 11, 2022
3. Dam Location:	Ashburnham, MA	6. Next Inspection:	April 16, 2029
7. Inspector:	Jessica DeBellis, PE		
8. Consultant:	Tighe & Bond., Inc.		
9. Hazard Code:	Significant	9a. Is Hazard Code Change Requested?:	Yes
10. Insp. Frequency:	5 Years	11. Overall Physical Condition of Dam:	FAIR
12. Spillway Capacity (% SDF)	50-90% of the SDF		
E1. Design Methodology:	3	E7. Low-Level Discharge Capacity:	2
E2. Level of Maintenance:	4	E8. Low-Level Outlet Physical Condition:	2
E3. Emergency Action Plan:	4	E9. Spillway Design Flood Capacity:	2
E4. Embankment Seepage:	3	E10. Overall Physical Condition of the Dam:	3
E5. Embankment Condition:	3	E11. Estimated Repair Cost:	\$1,880,000
E6. Concrete Condition:	3		

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 following three paragraphs were excerpted from the sample dam inspection format provided by the Massachusetts Department of Conservation and Recreation. The paragraphs are valid for the dam inspection and assessment provided in this report.

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 noted 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 dynamic 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.



Jessica DeBellis, P.E.
Massachusetts License No.: 51853
License Type: Civil
Senior Engineer
Tighe & Bond, Inc.

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Executive Summary

Dam Evaluation Summary Detail Sheet

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Section 1

Description of Project

1.1 General

1.1.1 Authority

The Town of Ashburnham retained Tighe & Bond to perform a visual inspection and prepare a report of the observed conditions at Lake Watatic Dam in Ashburnham, Massachusetts. This inspection and report were performed in general 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 is to inspect and evaluate the present condition of the dam and appurtenant structures in general accordance with 302 CMR 10.07 to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation is 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 potential classification; and 5) miscellaneous. Reference to left and right directions assume an orientation facing downstream.

1.1.4 Figures

Figures were created for this report to aid the reader in understanding the dam, its features, and the surrounding area. Figure 1 presents a topographic image showing the site locus and downstream area. Figure 2 presents an aerial overview of the dam and surrounding area. Figure 3 presents a topographic image showing the watershed area associated with the dam.

1.2 Description of Project

1.2.1 Location

Lake Watatic Dam is located at the upstream limit of the Millers River in Ashburnham, MA in Worcester County. The structure and impoundment are shown on the Ashburnham USGS quadrangle map at coordinates 42.68038808°, -71.9380310°. The dam is located approximately 1,000 feet north of Cross Road, which intersects Lake Road approximately

3.1 miles north of Route 12. Access to the dam from Cross Road is over private property. See Figures 1 and 2 in the Figures section of this report for the USGS site locus map and the aerial photograph, respectively.

1.2.2 Owner/Caretaker

The dam is owned and operated by the Town of Ashburnham, although portions of the dam may be on property that is privately owned. See Table 1.1 for current owner/caretaker data (names and contact information).

1.2.3 Purposes of the Dam

The dam impounds Lake Watatic for recreational purposes.

1.2.4 Description of the Dam and Appurtenances

Lake Watatic Dam is an earthen embankment dam of approximately 300 feet in length. The downstream slope is vegetated and sloped at approximately 2 units horizontal run to 1-unit vertical rise (2H:1V), although it may be steeper in some areas. The upstream slope slopes is at approximately 2H:1V and is generally vegetated, except near the waterline, where it is partially covered with riprap slope protection. The dam crest is vegetated and approximately 10 feet in width. Construction plans for the dam from 1954 show a core wall running the length of the embankment.

The dam has a 40-foot-long spillway at the left abutment with a concrete weir and concrete training walls. The water level is raised seasonally with the addition of 1-foot-tall flashboards that are supported with triangular wooden braces (not pins as flashboards typically are). Flow from the spillway discharges to the Millers River downstream of the dam.

The low-level outlet consists of a 24-inch-diameter conduit with a gate valve for closure that is mounted in a concrete intake structure. The intake structure has a grated top. The elevation of the top of the intake structure is approximately the same as the dam crest. The conduit discharges to a flat, slow-moving channel that combines with the spillway discharge channel a short distance downstream from the dam.

The dam has a maximum structural height of approximately 20 feet, and the hydraulic height of the dam is approximately 15 feet based on the elevation of the spillway crest (e.g., no flashboards in place).

1.2.5 Operations and Maintenance

An Operations and Maintenance Manual for Lake Watatic Dam was prepared in 2002. The plan outlines operations and maintenance activities to be implemented.

The impoundment water level is lowered seasonally by approximately 1 foot via removal of the flashboards.

1.2.3 DCR Size Classification

Lake Watatic Dam has a maximum structural height of approximately 20 feet and a maximum storage capacity of approximately 1,500 acre-feet. Therefore, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts 302 CMR 10.00 Dam Safety, revised November 4, 2005,

Lake Watatic Dam is a **Large** size structure based on storage. Refer to Appendix D for definitions of height of dam and storage.

1.2.4 DCR Hazard Potential Classification

Lake Watatic Dam is located upstream of several residences and two bridge crossings, as well as Lower Naukeag Lake. Numerous shoreline residences surround Lower Naukeag Lake. In their 2009 inspection report, GZA GeoEnvironmental, Inc. stated that a dam breach analysis model that they prepared shows that a failure of Lake Watatic Dam “may likely” cause a sequential failure of Lower Naukeag Lake dam, a High-hazard dam, if Lake Watatic Dam were to fail during its spillway design flood.

As such, GZA recommended that, in accordance with Department of Conservation and Recreation classification procedures, under the Commonwealth of Massachusetts Regulations 302 CMR 10.00, specifically Section 10.06(4), as revised November 4, 2005, Lake Watatic Dam meets the classification of a **High** (Class I) hazard dam. Tighe & Bond began development of an Incremental Damage Assessment (IDA) in 2016 in support of a planned dam repair project. The IDA would verify the dam’s hazard classification as well as its Spillway Design Flood. The work was not completed; significant property ownership challenges were encountered at the same time, causing the project to be cancelled. However, preliminary conclusions from the study corroborated the High hazard classification. Tighe & Bond understands that the Office of Dam Safety has updated the hazard classification of the dam based on these recommendations.

1.3 Engineering Data

The following sections are based on available information from previously submitted reports listed in Appendix C and are intended to provide an overview of the dam and impoundment.

1.3.1 Drainage Area

The total drainage area contributing to the impoundment is approximately 6.2 square miles, based on a watershed delineated using USGS StreamStats. The drainage consists mainly of forest with sparse residential development and extends into New Hampshire. Figure 3, included in the Figures section of this report, outlines the drainage area boundary for Lake Watatic Dam.

1.3.2 Reservoir

See Table 1.1 for data on normal and maximum pools.

1.3.3 Discharges at the Dam Site

No recorded discharges from the dam were available at the time of the inspection.

1.3.4 General Elevations

Elevations presented in this report are in units of feet and based on the NGVD 1929 datum as reported in the 2009 Phase I inspection.

A.	Top of Dam	1132.0
B.	Spillway Design Flood Pool	1135.2
C.	Normal Pool (with flashboards)	1128.0

D.	Upstream Water at Time of the Inspection	1127.4±
E.	Streambed at Toe of the Dam	1112.0
F.	Low Point along Toe of the Dam	1112.0

1.3.5 Primary Spillway

A.	Type	Concrete broad crested weir
B.	Length of Weir	40 feet
C.	Crest Elevation of Weir	1127.0
D.	Crest Elevation of Flashboards	1128.0 +/-
E.	Upstream Channel	Lake Watatic
F.	Downstream Channel	Millers River
G.	Downstream Water Elevation	1113 ±

1.3.6 Low-Level Outlet

A.	Type	Concrete inlet structure
B.	Size	24-inch-diameter
C.	Closure Type	Gate valve
D.	Inlet Invert Elevation	unknown
E.	Outlet Invert Elevation	1112 +/-

1.3.7 Design and Construction Records

Design plans from the construction of the dam in 1954 are available from the Town.

1.3.8 Operating Records

No known operating records are available for Lake Watatic Dam.

1.4 Summary Data Table

Table 1.1, summarizing the required Phase I Report data collected during the preparation of this report is presented on the following page.

1.1 Summary Data Table

Required Phase I Report Data	Data Provided by the Inspecting Engineer
National ID #	MA00004
Dam Name	Lake Watatic Dam
Dam Name (Alternate)	0
River Name	Unnamed tributary of Millers River
Impoundment Name	Lake Watatic
Hazard Class	Significant
Size Class	Large
Dam Type	Earthen embankment
Dam Purpose	recreation
Structural Height of Dam (feet)	20
Hydraulic Height of Dam (feet)	15
Drainage Area (sq. mi.)	6.1
Reservoir Surface Area (acres)	150
Normal Impoundment Volume (acre-feet)	820
Max Impoundment Volume ((top of dam) acre-feet)	1500
SDF Impoundment Volume* (acre-feet)	1,450
Spillway Type	uncontrolled free overflow
Spillway Length (feet)	40
Freeboard at Normal Pool (feet)	4
Principal Spillway Capacity* (cfs)	1485
Auxiliary Spillway Capacity* (cfs)	Not applicable
Low-Level Outlet Capacity* (cfs)	60
Spillway Design Flood* (flow rate - cfs)	500 yr/1,400; 1/2 PMF 7,900
Winter Drawdown (feet below normal pool)	1
Drawdown Impoundment Vol. (acre-feet)	Not available
Latitude	42.68038808
Longitude	-71.93803103
City/Town	Ashburnham
County Name	Worcester
Public Road on Crest	N/A
Public Bridge over Spillway	N/A
EAP Date (if applicable)	40750
Owner Name	Town of Ashburnham
Owner Address	19 Central Street
Owner Town	Ashburnham, MA 01430
Owner Phone	978-827-4104
Owner Emergency Phone	0
Owner Type	Municipality or Political subdivision
Caretaker Name	Randy Williams
Caretaker Address	17 Central Street/Rt 101
Caretaker Town	Ashburnham, MA 01430
Caretaker Phone	978-827-4120
Caretaker Emergency Phone	911
Date of Field Inspection	4/16/2024
Consultant Firm Name	Tighe & Bond., Inc.
Inspecting Engineer	Jessica DeBellis, PE
Engineer Phone Number	973-856-0713

*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 Inspection

2.1 Visual Inspection

Lake Watatic Dam was visually inspected on April 16, 2024. At the time of the inspection, the weather was clear with temperatures in the 60's °F. Underwater areas were not inspected. Photographs to document the current conditions of the dam were taken during the inspection and are included in Appendix A. A copy of the inspection checklist is included in Appendix B.

2.1.1 General Findings

In general, Lake Watatic Dam was found to be in **Fair** condition as defined by DCR's current rating guidelines. The primary reasons for the Fair condition rating are the cracking and spalling of the concrete intake structure and spillway, the trees growing within 20 feet of the embankment, and seepage at the downstream toe near the low-level outlet pipe. Observations are identified in more detail in the sections below.

2.1.2 Dam

- Abutments (Photos 2, 3, 4)
 - o Contact at the abutments generally appeared stable.
 - o Trees are located near both abutments.
- Upstream Slope (Photos 6, 7, 8, 17, 18)
 - o Riprap is present at the waterline in a narrow band. There are areas of sparse riprap coverage, with gravel and exposed soil. In most areas, the riprap stones are small, subangular or rounded.
 - o The upstream slope above the water line is generally covered with grass.
 - o Left of the spillway, the embankment is wooded and unmaintained with trees.
- Embankment Crest (Photos 2, 9)
 - o The embankment crest is generally level with good alignment, with minor rutting/bare spots (which appear to be from vehicular traffic).
 - o Left of the spillway, the embankment is wooded and unmaintained with trees throughout.
- Downstream Slope (Photos 4, 5, 9, 10, 11, 12, 19)
 - o The downstream slope is generally vegetated with maintained grass. Brush and some trees are present.
 - o The slope appears to be overly steep in some areas.
 - o The slope is irregular with small stumps, stones and cobbles present in some areas, inhibiting maintenance.
 - o A bare path was present from the crest to the toe, apparently from animal passage to the ponded area downstream from the dam.
 - o A wet area was observed at the right end of the downstream toe.

- o Seepage with iron staining was observed adjacent to the left of the low-level outlet discharge.
- Drains
 - o There were no drains observed within this dam.
- Instrumentation (Photo 1)
 - o A staff gauge was mounted to the side of the intake structure. Some of the numbers and markings are damaged and difficult to read.
- Access Roads and Gates (Photos 3, 17)
 - o Access to the right side of the dam crest is via a dirt path extension of Cross Road through a private residence. The left side of the spillway and downstream area are inaccessible by vehicle and on property owned by a third party.

2.1.3 Appurtenant Structures

- Primary Spillway (Photos 17-23)
 - o Overall, the spillway and training walls are deteriorating, with eroded, spalled, and cracked concrete areas. Concrete cracking was observed along the flashboard slot of the spillway. There is one large tree growing in the downstream end of the left spillway training wall. A traverse crack is present in the right training wall at the flashboard slot.
 - o Minor efflorescence is present in both training walls and the concrete is eroded at the base of the walls.
 - o The 2009 inspection report states that the toe of the spillway is slightly undermined on the downstream side, although this observation could not be confirmed due to the depth of flowing water.
 - o A floating boom is present in front of the spillway as a safety warning measure.
 - o A depression was observed adjacent to the spillway right training wall.
 - o Woody debris was observed in the spillway channel.
 - o No flashboards were present at the time of the inspection. The wooden braces that support the flashboards when installed were observed on the embankment near the right training wall.
- Auxiliary Spillway
 - o There is no auxiliary spillway associated with this dam.
- Outlets (Photos 1, 11, 13, 14, 15, 16, 24-27)
 - o The exterior of the concrete intake structure above the waterline is eroded, cracked, and spalled. The concrete is particularly spalled along the water line. Surficial crack repairs appear to have been attempted in the past.
 - o The grating on the outlet structure and the bridge to the outlet structure are wood and not well constructed. Plywood boards cover the grating on the outlet structure and are deteriorating and were difficult to safely remove. There are no handrails on the bridge. The interior of the structure was partially obscured due to the plywood boards and wooden grate during this inspection. The following observations were made during previous inspections:

- Cracking has been observed in the interior of the structure, and leakage was observed entering the structure.
- The gate valve appeared to be leaking. It is not known whether the gate is operable.
- The gate stem is bent, and the upper stem bracket appears to be broken.
- Minor debris are present inside the outlet structure.
- The ladder within the intake structure is constructed of bent rebar and tires. It may not be safe to use.
- o The handrail on the outlet structure and gate valve handwheel are rusted.
- o The downstream end of the outlet pipe projects from the embankment approximately five feet. There is a circumferential crack approximately 2 feet from the end.
- o Downstream water filled the downstream pipe about halfway up.
- o The concrete near the downstream end of the outlet pipe was observed to be spalled, undermined and potentially displaced.
- Dikes
 - o There are no dikes associated with this dam.

2.1.4 Downstream Area

(Photo 5, 12, 21)

- o Beaver debris in the downstream area creates a tailwater condition that submerges the lower portion of the low-level outlet conduit and the downstream toe of the dam's maximum section.

2.1.5 Impoundment Area

(Photo 1)

- o The impoundment is irregularly shaped with the dam located at the southern end.
- o The surrounding area is moderately sloped and is generally wooded with some residential developments.

2.2 Caretaker Interview

Randy Williams, the Department of Public Works Superintendent for the Town of Ashburnham, and Mark Dymek and Frank Fiorentino with the Lake Watatic Association were available to answer questions related to the history, operation, and maintenance of the dam during previous inspections. Randy Williams was available by email to answer questions regarding this inspection. Information provided by these parties have been incorporated into this report.

2.3 Operation and Maintenance Procedures

2.3.1 Operational Procedures

An Operations and Maintenance Manual for Lake Watatic Dam was prepared in 2002. The plan outlines operations and maintenance activities to be implemented.

2.3.2 Maintenance of Dam and Operating Facilities

Vegetation on the embankment is mowed when needed. The spillway flashboards are removed in the fall and replaced in the spring.

2.4 Emergency Warning System

An Emergency Action Plan (EAP) is available for Lake Watatic Dam. The EAP includes procedures for responding to emergency conditions at the dam, procedures for contacting emergency personnel, local and State officials and downstream residents, and a downstream inundation map. The EAP was reportedly last updated in 2011.

2.5 Hydrologic/Hydraulic Data

Lake Watatic Dam is a Large size dam that should be provisionally classified as **High** hazard structure. In accordance with current state dam safety regulations, the spillway design flood (SDF) is the ½ PMF. A Hydraulic & Hydrologic (H&H) Analysis was performed as part of the 2009 Phase I inspection report (inspection date October 7, 2009), prepared by GZA GeoEnvironmental.

The following values were estimated in the analysis:

A.	Spillway Design Flood (SDF) Return Period	½ PMF
B.	SDF Peak Inflow (cfs)	9,200
C.	SDF Peak Outflow (cfs)	7,900
D.	Primary Spillway Capacity (cfs)	1,450
E.	Auxiliary Spillway Capacity (cfs)	N/A
F.	Total Spillway Capacity (cfs)	1,450
G.	SDF Peak Impoundment Elevation (ft)	1135.2
H.	SDF Freeboard (ft)	None – 3.2 feet of overtopping

The estimated capacity of the primary spillway is approximately 18% of the SDF, and the spillway is considered hydraulically inadequate.

2.6 Awareness of Potential Dam Related Safety Hazards at, near, and on Dams

During the Lake Watatic Dam inspection safety hazards that may exist at, near, and on the dam were identified.

Observations related to dam related safety hazards at Lake Watatic Dam are identified below:

- On the dam (Photos 1, 15, 16, 17, 18, 19, 22, 24)
 - o The bridge to the intake structure operating platform has no railings. The concrete platform has been deteriorated. The guardrail and operator wheel are

rusted. The ladder within the outlet structure is constructed of bent rebar and ties. It may not be safe to use.

- o The spillway training walls pose a potential fall hazard.
- Near dam on land
 - o No safety hazards were observed at the time of the inspection.
- Areas immediately upstream and downstream of dam (Photo 13)
 - o No safety hazards were observed at the time of the inspection.
 - o There is a boom in front of the spillway to warn boaters.
- Downstream of dam along the stream channel (Photo 11)
 - o The low-level outlet capacity is not anticipated to cause a significant increase in downstream flow rates if there is a deliberate release of water.

Recommendations to limit or prevent exposure to safety hazards are identified below:

- Install guardrails on outlet structure, bridge to outlet structure, and spillway training walls.
- Install a new ladder within the intake structure to provide safe access.

Implementation of any recommendations may require local, state, or federal permits as well as securing property rights if subject areas are not owned by the dam owner. Securing such permits and/or land rights is the sole responsibility of the dam owner. The recommendations to limit or prevent exposure to safety hazards are excluded from Section 3 since they are not structural deficiencies of the dam.

The dam owner is reminded that the Dam Safety Regulations 302 CMR Section 10.13: Liability (1), states: *The owner shall be responsible and liable for damage to property of others or injury to persons, including but not limited to, loss of life resulting from the operation, failure of or mis-operation of a dam.*

2.7 Structural Stability/Overtopping Potential

2.7.1 Structural Stability

There are no records of a stability analysis of the structure available for review during the inspection and preparation of this report. Visual observations made at the time of the inspection indicate that the structure appears to be stable, although the downstream slope is steeper in some areas than usual dam engineering practice. A more comprehensive analysis would need to be performed to confirm this observation.

2.7.2 Overtopping Potential

Based on the H&H information presented in Section 2.4, the spillways have insufficient capacity to safely pass the SDF. It is estimated that there will be over 3 feet of overtopping during the ½ PMF, which is the SDF.

Section 3

Assessments and Recommendations

3.1 Assessments

On the basis of the visual inspection and a review of available information, Lake Watatic Dam is generally considered in **Fair** condition as defined by current DCR rating guidelines. The primary reasons for the Fair condition rating are the cracking and spalling of the concrete intake structure and spillway, the trees growing within 20 feet of the embankment, and seepage at the downstream toe near the low-level outlet pipe. Observations are identified in more detail in the sections below.

The dam was found to have the following deficiencies:

1. Trees are present adjacent to the left spillway training wall, on the left embankment, and along the downstream right groin, and trees are present within 20 feet of the dam and its appurtenances in many areas.
2. Minor depressions and rutting are present on the dam crest, likely from vehicular traffic. Roots are present on the crest at the right abutment.
3. The riprap on the upstream slope is small, subangular or rounded, displaced in areas, does not extend to the crest, and may not extend very far below the waterline.
4. The downstream slope appears to be overly steep in areas. The slope is irregular with stumps, stones and cobbles present.
5. A bare game trail was noted from the crest to the toe of the downstream slope.
6. A wet area was observed at the right end of the downstream toe.
7. The spillway concrete is spalled, cracked, and efflorescing. Concrete cracking was observed along the flashboards slot of the spillway.
8. A depression was observed behind the spillway right training wall.
9. The spillway weir may be undermined at the downstream end.
10. The low-level intake structure is deteriorating; with spalled, eroded, and cracked concrete on the exterior; cracks on the interior; bent and rusting handrails; a poorly made and deteriorating internal ladder; deteriorating grate over the top; and an inadequate wooden bridge with no handrails.
11. The gate valve in the intake structure has been previously observed to be leaking. The upper operator stem guide is broken, and the stem bent. The gate may not be functional.
12. The downstream channel creates a tailwater condition that partially submerges the toe of the embankment and the low-level outlet discharge conduit. The downstream end of the low-level outlet discharge conduit is cracked. The concrete near the downstream end of the outlet pipe was observed to be spalled, undermined and potentially displaced.
13. Seepage with iron staining is present at the downstream toe near the low-level outlet pipe.

14. The spillway has insufficient discharge capacity to safely pass the spillway design flood.
15. The left side of the dam and the downstream area are owned by private parties, which is an obstacle to access, maintenance, and future repairs.

Conditions during the April 16, 2024 Phase I inspection were similar to conditions observed during the May 11, 2022 Phase I inspection, the most recent inspection report obtained for review. Some additional deterioration was noted, including further establishment of the displaced riprap and the animal burrows observed. Presented below is a comparison of previously reported conditions to current conditions at the dam:

Previously Identified Deficiency	Resolution or Current Condition
Stumps from cut woody vegetation are present on the crest and downstream slope.	No observed in 2024.
Trees are present adjacent to the left spillway training wall, on the left embankment, and along the downstream right groin, and trees are present within 20 feet of the dam and its appurtenances in many areas.	Condition remains.
Minor depressions are present on the embankment crest. Roots are present on the crest at the right abutment.	Condition remains.
The riprap on the upstream slope is small, subangular, displaced in areas, does not extend to the crest, and may not extend very far below the waterline.	Condition remains.
The downstream slope appears to be overly steep in areas.	Condition remains.
A bare game trail was noted from the crest to the toe on the downstream slope.	Condition remains.
An inactive animal burrow was observed along the downstream right groin.	Not observed in 2024. Potentially self-healed or obscured by vegetation.
Seepage with iron staining is present near the low-level outlet pipe and along the left downstream groin.	Condition remains.
The embankment left of the spillway is covered with trees.	Condition remains.
The spillway concrete is spalled, cracked, and efflorescing.	Condition remains.
The spillway weir may be undermined at the downstream end.	No observed in 2024 due to downstream water levels. Condition likely remains.
The flashboards are not supported by pins as intended, but instead by wooden braces.	Flashboards were not installed during the 2024 inspection; this condition remains based on the presence of the wooden braces on embankment crest near the right spillway training wall.

Previously Identified Deficiency	Resolution or Current Condition
The low-level outlet structure is deteriorating; with spalled, eroded, and cracked concrete on the exterior; cracks on the interior; bent and rusting handrails; a poorly made and deteriorating internal ladder; and an inadequate wooden bridge with no handrails and deteriorating grate over the top.	Condition remains.
The gate valve in the outlet structure has been previously observed to be leaking. The upper operator stem guide is broken, and the stem bent. The gate may not be functional.	Unable to be observed in 2024; condition likely remains.
The downstream channel creates a tailwater condition that partially submerges the toe of the embankment and the low-level outlet discharge conduit.	Condition remains.
The downstream end of the low-level outlet discharge conduit is cracked.	Condition remains.
The spillway has insufficient discharge capacity to safely pass the spillway design flood.	Condition remains.
The left side of the dam and the downstream area are owned by private parties, which is an obstacle to access, maintenance, and future repairs.	Condition remains.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs, and remedial measures, the applicability of environmental permits needs to be determined to assess those activities that may occur within resource areas under the jurisdiction of local conservation commissions, MassDEP, or other regulatory agencies.

3.2 Studies and Analyses

The following analyses should be initiated:

1. Review, update, and follow the 2002 Operation and Maintenance Plan.
2. Update the H&H analysis for the dam, update the Incremental Damage Assessment, and confirm the dam's hazard class and spillway design flood.
3. Perform a geotechnical investigation and seepage and slope stability analysis for the dam (required for High-hazard dams).
4. Obtain easements or acquire additional property to facilitate maintenance and repairs.

3.3 Recurrent Maintenance Recommendations

The following recommended activities should be performed on a regular, or yearly, basis and recorded:

1. Clear brush on the dam and more regularly mow the dam to better manage the vegetation.

2. Reset lost and displaced riprap.
3. Perform minor surface repairs of the concrete structures.
4. Regularly monitor the embankment for animal burrows, localized depressions, bare spots, and any other type of unusual activity.
5. Fill localized depressions and animal burrows.
6. Update the Emergency Action Plan annually.
7. Remove debris from downstream of the spillway and downstream of the low-level outlet pipe.

3.4 Recommended Minor Repairs

The following repairs and maintenance items are recommended to improve the overall condition of the dam; many of the minor repairs would be addressed through implementation of the remedial modifications presented in Section 3.5:

1. Remove trees, brush, and stumps on the embankment, abutments, and within 20 feet of the dam in accordance with the Massachusetts Office of Dam Safety's Policy on Trees on Dams. It is recommended that stumps and roots be removed in their entirety, as roots can shrink as they decay, which could cause preferential seepage paths. Backfill all voids with appropriate material, which would vary based on the location on the dam.
2. Supplement the riprap on the upstream slope, providing full coverage from the crest to below the waterline with properly bedded, adequately sized, angular riprap.
3. Properly repair the spillway concrete, including the training walls and weir. Add fencing or railings along the training walls for fall protection.
4. Repair the crack in the outlet pipe.

3.5 Recommended Remedial Modifications

The following recommended modifications to the dam would alter the current configuration or design of the dam:

1. Upgrade the dam to safely pass its Spillway Design Flood, such as expansion of the spillway or installation of overtopping protection as determined by the updated H&H analysis and Incremental Damage Assessment.
2. Regrade the downstream slope to a consistent 2.5H:1V, or as determined by a stability analysis if one is performed.
3. Install toe drains to collect and discharge seepage in a controlled manner.
4. Add riprap for erosion protection at the outlet pipe discharge.
5. Provide filtered collection and a discharge for the seepage observed adjacent to the outlet pipe.
6. Repair or replace the intake structure concrete, replace the gate valve with a new valve or a sluice gate with an appropriate, secure operator, replace the ladder.
7. Replace the footbridge with a prefabricated bridge with integrated handrails.

3.6 Alternatives

No repair alternatives have been developed at this time. Depending on the results of the H&H analysis and IDA, less costly alternatives to spillway replacement may be identified.

3.7 Opinion of Probable Costs

The following opinion of probable costs has been developed for the studies, analyses, recommendations, and remedial measures noted above. The probable construction costs are an approximation based on limited investigations and our experience on other similar sized projects and are not based on detailed quantity takeoffs or designs. Once further detailed investigations are performed, the scope of work may change, affecting the actual construction costs. The estimates include engineering, permits and contingencies where applicable. Tasks that likely could be carried out by the dam owner/caretaker are noted as Force Account.

The tasks listed below are divided into two categories: short range tasks and long-range tasks. The short-range tasks are higher priority tasks that the dam owner should include in budget development for the near future. They may improve the condition of the dam for the short term period but may not address underlying deficiencies. The long-range tasks are lower priority tasks where conditions do not currently warrant immediate action but will require attention in the future. The priority of the long-range tasks may increase if conditions worsen. It is important to understand that it is the dam owner's responsibility to evaluate the costs and risks of each task and to determine the appropriate priority as the dam owner is ultimately liable for any damages resulting from the operation or failure of the dam.

Recommendation		Probable Cost ⁽¹⁾
Short Range Tasks		
1	Remove brush and regularly mow the embankment	Force Account
2	Remove trees and brush within 20 feet of the dam	\$70,000
3	Replace or supplement riprap on the upstream slope with properly bedded, adequately sized, angular riprap	Force Account
4	Perform minor surface repair of concrete at spillway and training walls. Add fence or railing for fall protection	Force Account
5	Fill localized depressions and animal burrows	Force Account
6	Repair the crack in the outlet pipe	\$5,000
7	Assess the legal status of dam access and ownership	Unknown
8	Prepare an updated H&H analysis and IDA	\$12,000
9	Perform a geotechnical investigation and seepage and slope stability analysis for the dam (required for High-hazard dams)	\$25,000
10	Update the O&M plan	\$6,000
11	Update the EAP annually	\$6,000
Short Range Task Total		\$124,000
Long Range Tasks		
1	Repair or replace the intake structure and gate valve, including safety improvements and access bridge	\$550,000

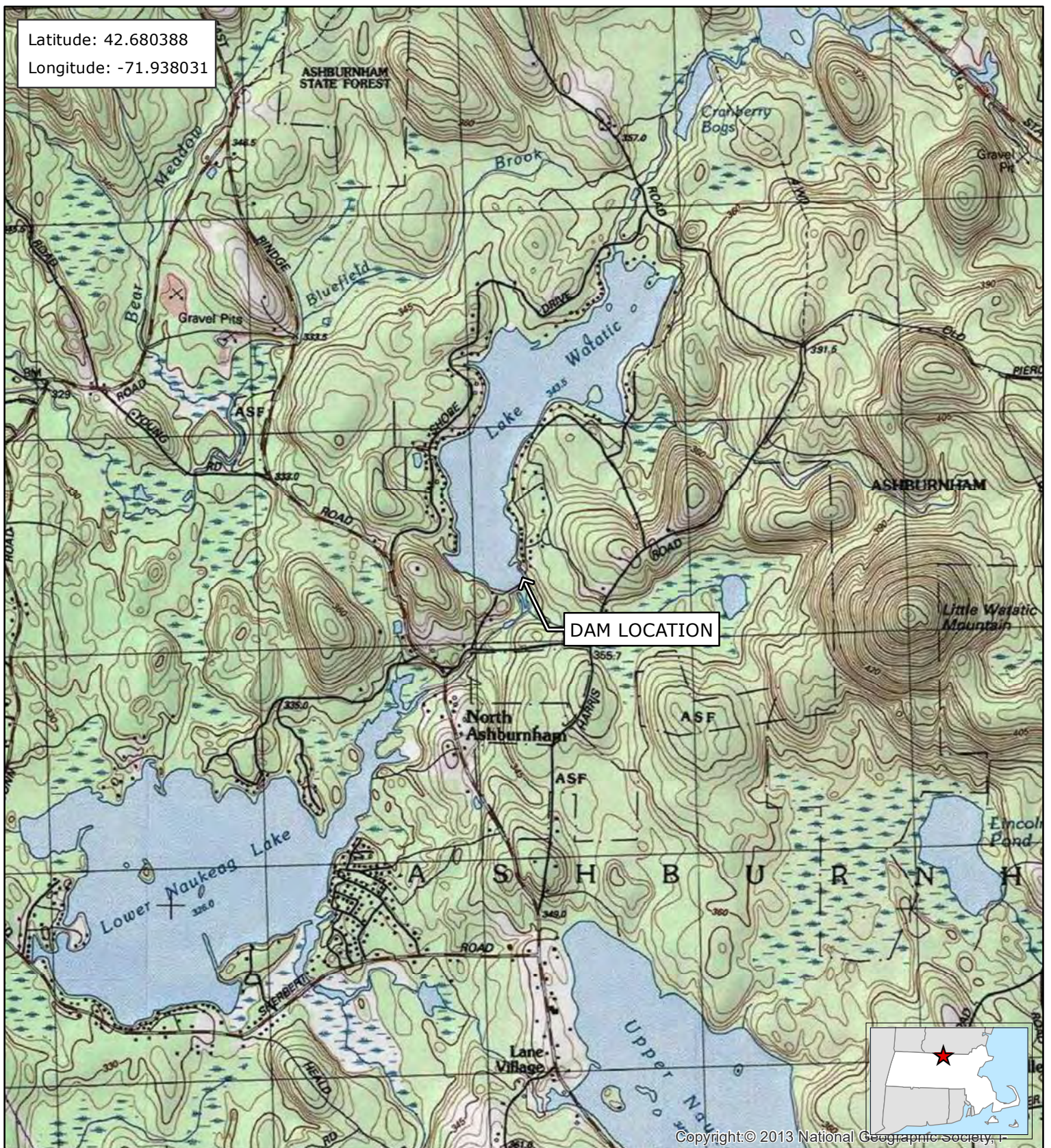
2	Replace the spillway with an expanded spillway (to be determined by additional analysis)	\$830,000
3	Overtopping protection (in conjunction with spillway design)	\$150,000
4	Regrade the downstream slope	\$100,000
5	Provide erosion protection at the outlet pipe discharge	\$50,000
6	Install toe drains to collect and discharge seepage in a controlled manner	\$100,000
7	Provide filtered collection and a discharge for the seepage observed adjacent to the outlet pipe	\$100,000
Long Range Task Total (reported in checklist)		\$1,880,000
Design and Permitting		\$284,000
Construction Engineering (15%)		\$282,000
Construction Contingency (10%)		\$188,000
Material and Bidding Contingency (20%)		\$376,000
Total		\$3,010,000

⁽¹⁾ The probable costs shown assume that the tasks are completed as part of one rehabilitation project, which results in significant savings on engineering, permitting, and contractor mobilization.

\\tighebond.com\data\Data\Projects\A\A5002 Ashburnham\022 - 2024 Dam Inspections\Lake Watatic Dam\Report\2024\Lake Watatic - Report Text.docx

Figures

Latitude: 42.680388
Longitude: -71.938031



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Tighe&Bond

Based on USGS Topographic Map for
Ashburnham, MA Revised 1988.
Contour Interval Equals 3-Meters

1:24,000
0 1,000 2,000
Feet



FIGURE 1
SITE LOCUS AND DOWNSTREAM
AREA MAP

Lake Watatic Dam
Ashburnham, Massachusetts
Dam ID: MA00004

April 2024

Latitude: 42.680388
Longitude: -71.938031



Tighe&Bond

Based on MassGIS Color Orthophotography (2021)

1:3,600
0 150 300
Feet

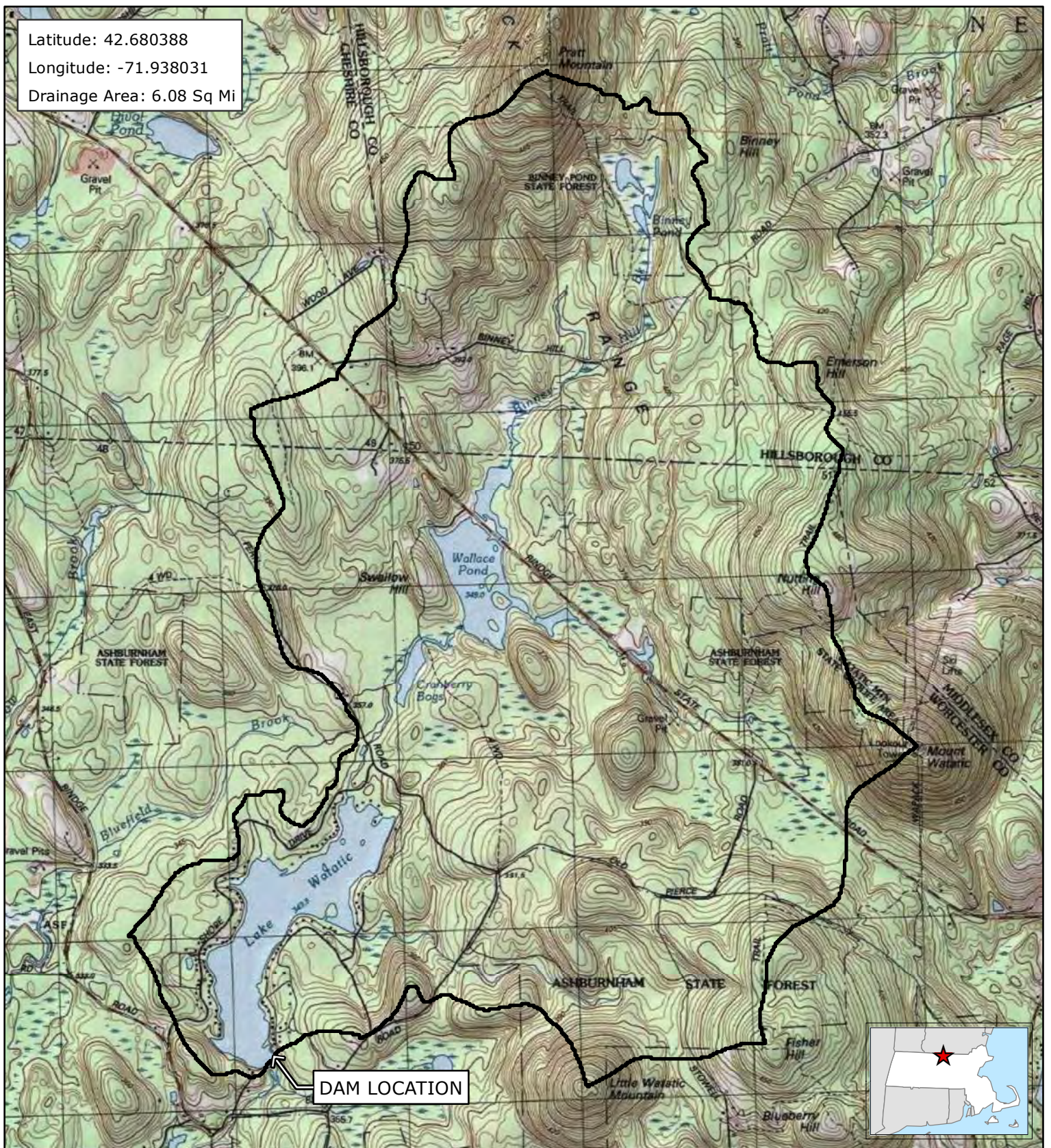


FIGURE 2 ORTHOPHOTOGRAPH

Lake Watatic Dam
Ashburnham, Massachusetts
Dam ID: MA00004

April 2024

Latitude: 42.680388
Longitude: -71.938031
Drainage Area: 6.08 Sq Mi



DAM LOCATION

Legend

 Drainage Area

Tighe&Bond

Based on USGS Topographic Map for
Ashburnham, MA Revised 1988.
Contour Interval Equals 3-Meters
Drainage Area Calculated in USGS StreamStats V4.9: MA

1:30,000
0 1,250 2,500
Feet



FIGURE 3
DRAINAGE AREA MAP

Lake Watatic Dam
Ashburnham, Massachusetts
Dam ID: MA00004

April 2024

APPENDIX A
Photo Location Plan & Photographs

Lake Watatic Dam

Ashburnham,
Massachusetts

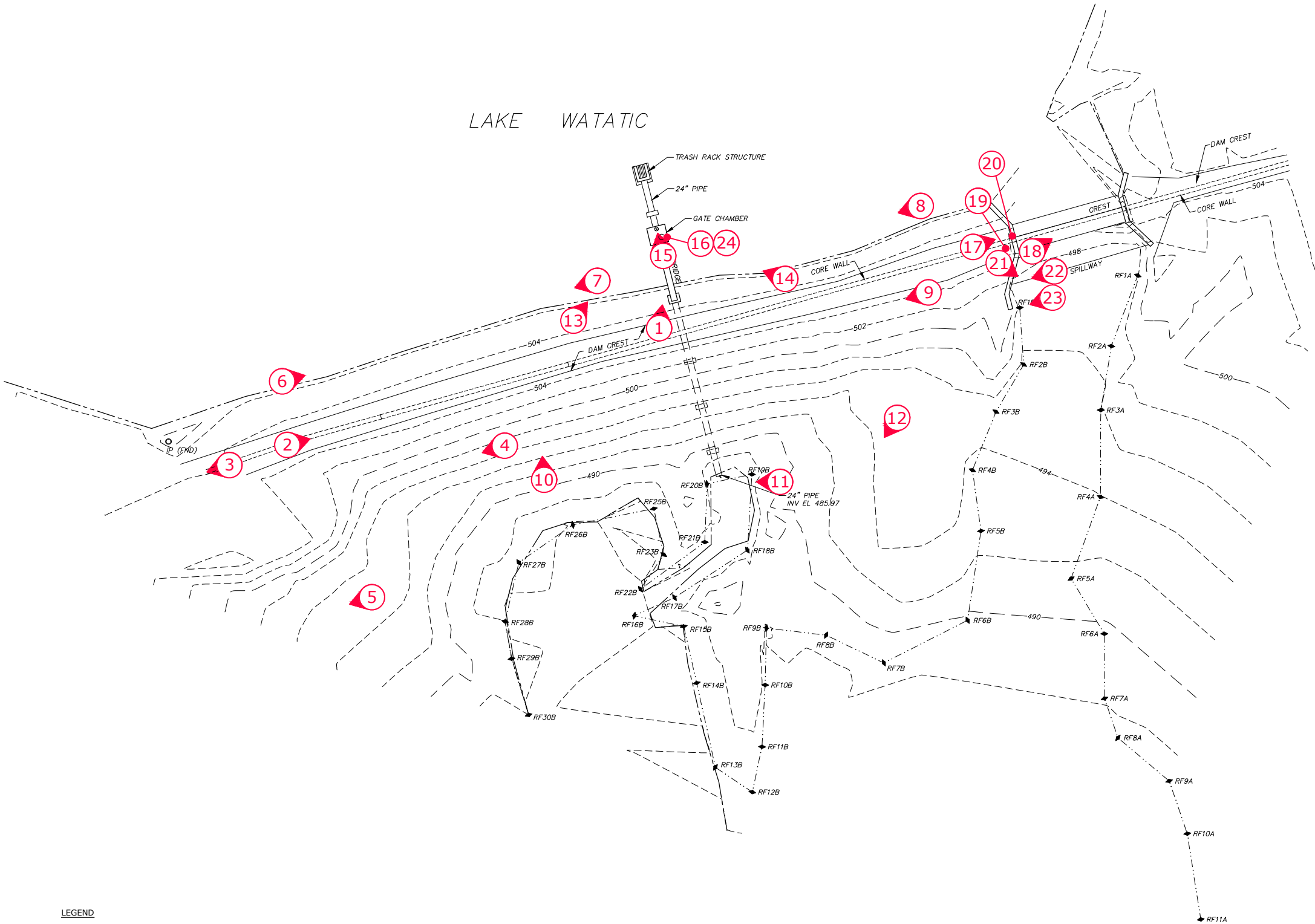
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PROJECT NO:		A0660/1
FILE:		A5002-Task018-LakeWatatic-SISk
DRAWN BY:		AI
CHECKED:		AI
APPROVED BY:		JD

PHOTO LOCATION PLAN

SCALE: NO SCALE



LAKE WATATIC



LEGEND

- ◆ RF11A WETLANDS FLAG
- WETLANDS BOUNDARY
- EDGE OF WATER
- 500 --- EXISTING 10' CONTOUR LINE
- 502 --- EXISTING 2' CONTOUR LINE
- ② PHOTO NUMBER, LOCATION AND DIRECTION



Photo 1 - Overview of impoundment and low-level outlet structure; note mounted staff gauge and absence of handrails on footbridge



Photo 2 – Overview of dam crest from right abutment; note trees within 20 feet of embankment and minor rutting (tire tracks)



Photo 3 – Access to dam from private property at right abutment



Photo 4 – Downstream slope near right abutment; note cobbles and areas of bare vegetation on slope and trees within 20 feet of dam



Photo 5 – Wet area at downstream toe near right abutment



Photo 6 – Upstream slope from right abutment



Photo 7 – Upstream slope; note small, rounded riprap extending to just above water line



Photo 8 – Upstream slope from left abutment



Photo 9 – Crest and downstream slope from spillway; note trees within 20 feet of the dam



Photo 10 – Bare game trail on downstream slope

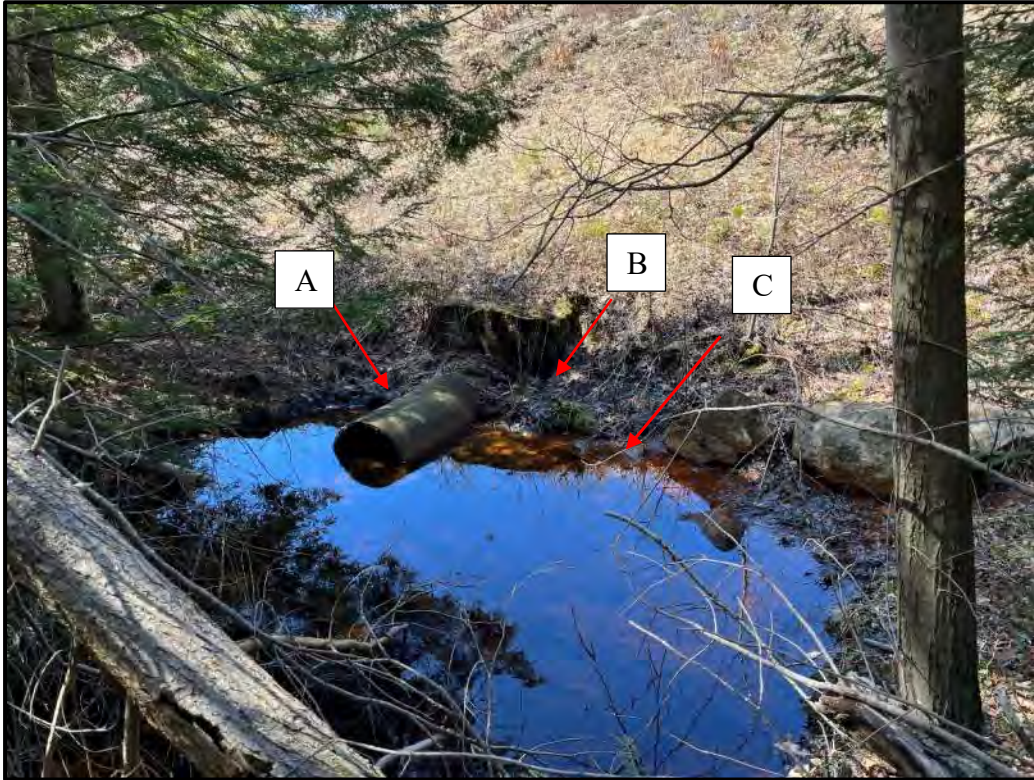


Photo 11 – Outlet structure discharge conduit; note that outlet has a crack “A” (see Photo 25), concrete is undermined and displaced “B”, and seepage with iron staining “C”



Photo 12 – Overview of tailwater pool at toe of downstream slope



Photo 13 – Right side of intake structure; note spalls and concrete erosion; see Photo 26 from Oct 2023 with lower reservoir level



Photo 14 – Left side of intake structure; note spalls and concrete erosion; see Photo 27 from Oct 2023 with lower reservoir level



Photo 15 – Top of low-level intake structure. Wood grating and deteriorating plywood boards partially obscured interior of structure



Photo 16 – Interior of the low-level outlet's intake structure; note ladder constructed of bent rebar



Photo 17 – Spillway and left training wall; note trees on downstream left training wall and flashboard/support slots



Photo 18 – Left spillway training wall; note cracking, efflorescence, and trees growing adjacent to the wall



Photo 19 – Downstream embankment behind right spillway training wall; note depression behind wall



Photo 20 – Transverse crack in right training wall at the flashboard slot



Photo 21 – Spillway and downstream area



Photo 22 – Photo from previous Tighe & Bond inspection, taken on 5/11/22, showing right training wall with minor cracking and efflorescence



Photo 23 – Photo from previous Tighe & Bond inspection, taken on 5/11/22 showing downstream section of right training wall with concrete deterioration and vegetation near the wall



Photo 24 – Photo from previous Tighe & Bond inspection, taken on 10/27/15 showing interior of low-level outlet's intake structure and gate valve; note minor leakage, ladder constructed of rebar, gate stem appears bent



Photo 25 – Outlet structure discharge conduit with crack (Photo taken by Tighe and Bond on 10-30-23)



Photo 26 – Right side of intake structure; note spalls and concrete erosion, especially near water line (Photo taken by Tighe and Bond on 10-30-23)



Photo 27 – Left side of intake structure; note spalls and concrete erosion, especially near water line (Photo taken by Tighe and Bond on 10-30-23)

APPENDIX B
Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM:	<u>Lake Watatic Dam</u>	STATE ID #:	<u>3-14-11-10</u>
REGISTERED:	☐ YES ☐ NO	NID ID #:	<u>MA00004</u>
STATE SIZE CLASSIFICATION:	<u>Large</u>	STATE HAZARD CLASSIFICATION:	<u>Significant</u>
		CHANGE IN HAZARD CLASSIFICATION REQUESTED?:	<u>Yes</u>
<u>DAM LOCATION INFORMATION</u>			
CITY/TOWN:	<u>Ashburnham</u>	COUNTY:	<u>Worcester</u>
DAM LOCATION: (street address if known)	<u>900 feet north of Cross Road</u>	ALTERNATE DAM NAME:	<u>N/A</u>
USGS QUAD.:	<u>Ashburnham</u>	LAT.:	<u>42.68038808</u>
		LONG.:	<u>-71.93803103</u>
DRAINAGE BASIN:	<u>Millers</u>	RIVER:	<u>Unnamed tributary of Millers River</u>
IMPOUNDMENT NAME(S):	<u>Lake Watatic</u>		
<u>GENERAL DAM INFORMATION</u>			
TYPE OF DAM:	<u>Earthen embankment</u>	OVERALL LENGTH (FT):	<u>300</u>
PURPOSE OF DAM:	<u>recreation</u>	NORMAL POOL STORAGE (ACRE-FT):	<u>820</u>
YEAR BUILT:	<u>1955</u>	MAXIMUM POOL STORAGE (ACRE-FT):	<u>1,500</u>
STRUCTURAL HEIGHT (FT):	<u>20</u>	EL. NORMAL POOL (FT):	<u>1128 (w/ 1 foot boards)</u>
HYDRAULIC HEIGHT (FT):	<u>15</u>	EL. MAXIMUM POOL (FT):	<u>1132.0</u>
<u>FOR INTERNAL MADCR USE ONLY</u>			
FOLLOW-UP INSPECTION REQUIRED:	☐ YES ☐ NO	CONDITIONAL LETTER:	☐ YES ☐ NO

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>	
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>	
<u>INSPECTION SUMMARY</u>			
DATE OF INSPECTION: <u>April 16, 2024</u>		DATE OF PREVIOUS INSPECTION: <u>May 11, 2022</u>	
TEMPERATURE/WEATHER: <u>60s deg F</u>		ARMY CORPS PHASE I: ☐ YES ☒ NO If YES, date _____	
CONSULTANT: <u>Tighe & Bond., Inc.</u>		PREVIOUS DCR PHASE I: ☒ YES ☐ NO If YES, date <u>5/06; 10/09; 10/15; 5/22</u>	
BENCHMARK/DATUM: <u>Spillway crest el. 1127.0 feet w/o flashboards</u>			
OVERALL PHYSICAL CONDITION OF DAM: <u>FAIR</u>		DATE OF LAST REHABILITATION: <u>Unknown</u>	
SPILLWAY CAPACITY: <u>50-90% of the SDF</u>			
EL. POOL DURING INSP.: <u>1,127.4 +/-</u>		EL. TAILWATER DURING INSP.: <u>1113 +/-</u>	
<u>PERSONS PRESENT AT INSPECTION</u>			
<u>NAME</u>	<u>TITLE/POSITION</u>	<u>REPRESENTING</u>	
Jessica DeBellis, PE	Senior Engineer	Tighe & Bond	
Amanda Isak	Staff Engineer	Tighe & Bond	
<u>EVALUATION INFORMATION</u>			
Click on box to select E-code		Click on box to select E-code	
E1) TYPE OF DESIGN	3	E8) LOW-LEVEL OUTLET CONDITION	2
E2) LEVEL OF MAINTENANCE	4	E9) SPILLWAY DESIGN FLOOD CAPACITY	2
E3) EMERGENCY ACTION PLAN	4	E10) OVERALL PHYSICAL CONDITION	3
E4) EMBANKMENT SEEPAGE	3	E11) ESTIMATED REPAIR COST	\$1,880,000
E5) EMBANKMENT CONDITION	3	ROADWAY OVER CREST	NO
E6) CONCRETE CONDITION	3	BRIDGE NEAR DAM	NO
E7) LOW-LEVEL OUTLET CAPACITY	2		
NAME OF INSPECTING ENGINEER: <u>Jessica DeBellis, PE</u>		SIGNATURE: <u>Jessica DeBellis</u>	

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>	
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>	
OWNER: ORGANIZATION <u>Town of Ashburnham</u> NAME/TITLE <u>Board of Selectmen</u> STREET <u>19 Central Street</u> TOWN, STATE, ZIP <u>Ashburnham, MA 01430</u> PHONE <u>978-827-4104</u> EMERGENCY PH. # <u></u> FAX <u>978-827-4105</u> EMAIL <u>bdoheny@ashburnham-ma.gov</u> OWNER TYPE <u>Municipality or Political subdivision</u>		CARETAKER: ORGANIZATION <u>Ashburnham DPW</u> NAME/TITLE <u>Randy Williams</u> STREET <u>17 Central Street/Rt 101</u> TOWN, STATE, ZIP <u>Ashburnham, MA 01430</u> PHONE <u>978-827-4120</u> EMERGENCY PH. # <u>911</u> FAX <u></u> EMAIL <u>rwilliams@ashburnham-ma.gov</u>	
PRIMARY SPILLWAY TYPE <u>uncontrolled free overflow</u>			
SPILLWAY LENGTH (FT) <u>40</u>		SPILLWAY CAPACITY (CFS) <u>1,485</u>	
AUXILIARY SPILLWAY TYPE <u>None</u>		AUX. SPILLWAY CAPACITY (CFS) <u>Not applicable</u>	
NUMBER OF OUTLETS <u>1</u>		OUTLET(S) CAPACITY (CFS) <u>60</u>	
TYPE OF OUTLETS <u>Gated 24 inch diameter concrete pipe</u>		TOTAL DISCHARGE CAPACITY (CFS) <u>1,500</u>	
DRAINAGE AREA (SQ MI) <u>6.1</u>		SPILLWAY DESIGN FLOOD (PERIOD/CFS) <u>500 yr/1,400; 1/2 PMF 7,900</u>	
HAS DAM BEEN BREACHED OR OVERTOPPED ☒ YES ☐ NO IF YES, PROVIDE DATE(S) <u>1955 dam was breached and reconstructed</u>			
FISH LADDER (LIST TYPE IF PRESENT) <u>None</u>			
DOES CREST SUPPORT PUBLIC ROAD? ☐ YES ☒ NO		IF YES, ROAD NAME: <u></u>	
PUBLIC BRIDGE WITHIN 50' OF DAM? ☐ YES ☒ NO		IF YES, ROAD/BRIDGE NAME: <u></u>	
MHD BRIDGE NO. (IF APPLICABLE) <u></u>			

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
EMBANKMENT (CREST)					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Earthen	x		
	2. SURFACE CRACKING	None observed	x		
	3. SINKHOLES, ANIMAL BURROWS	None observed	x		
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	Minor depressions in areas		x	
	5. HORIZONTAL ALIGNMENT	Generally straight	x		
	6. RUTS AND/OR PUDDLES	Minor rutting from traffic		x	
	7. GRASS COVER CONDITION	Generally good coverage and maintained	x		
	8. WOODY VEGETATION (TREES/BRUSH)	Trees and brush within 20 feet; roots are present on the crest near the right abutment	x		
	9. ABUTMENT CONTACT	Appears stable	x		
ADDITIONAL COMMENTS: <u>Left embankment covered in trees and inaccessible</u> 					

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
EMBANKMENT (D/S SLOPE)					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	Wet area left of outlet pipe toe and along left groin; and right end of downstream toe			x
	2. SEEPAGE	Seepage along toe and left groin			x
	3. SLIDE, SLOUGH, SCARP	None observed	x		
	4. EMB.-ABUTMENT CONTACT	Appears stable	x		
	5. SINKHOLE/ANIMAL BURROWS	Game trail from crest to toe along downstream slope; one inactive burrow noted			x
	6. EROSION	None observed	x		
	7. UNUSUAL MOVEMENT	None observed, although slope is overly steep			x
	8. GRASS COVER CONDITION	Mixture of vegetation types with fair coverage		x	
	9. WOODY VEGETATION (TREES/BRUSH)	Trees and brush within 20 feet; small woody plant roots potentially present		x	
ADDITIONAL COMMENTS: <u>Slope surface is irregular which interferes with maintenance</u> <u>Left embankment covered in trees and inaccessible</u> 					

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
EMBANKMENT (U/S SLOPE)					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	Minor scarp along waterline			x
	2. SLOPE PROTECTION TYPE AND COND.	Riprap to at least 2 ft below crest; displaced in areas			x
	3. SINKHOLE/ANIMAL BURROWS	None observed	x		
	4. EMB.-ABUTMENT CONTACT	Appeared stable	x		
	5. EROSION	None observed	x		
	6. UNUSUAL MOVEMENT	None observed	x		
	7. GRASS COVER CONDITION	Mixture of herbaceous material; sparse coverage in areas, eg, near spillway			x
	8. WOODY VEGETATION (TREES/BRUSH)	Trees and brush within 20 feet	x		
ADDITIONAL COMMENTS: <u>Left embankment covered with trees and inaccessible</u> 					

NAME OF DAM: Lake Watatic Dam

STATE ID #: 3-14-11-10

INSPECTION DATE: April 16, 2024

NID ID #: MA00004

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None observed	X		
	2. OBSERVATION WELLS	None observed	X		
	3. STAFF GAGE AND RECORDER	Staff gauge present on outlet structure		X	
	4. WEIRS	None observed	X		
	5. INCLINOMETERS	None observed	X		
	6. SURVEY MONUMENTS	None observed	X		
	7. DRAINS	None observed	X		
	8. FREQUENCY OF READINGS	Unknown	X		
	9. LOCATION OF READINGS	Unknown	X		

ADDITIONAL COMMENTS: _____

NAME OF DAM: Lake Watatic DamSTATE ID #: 3-14-11-10INSPECTION DATE: April 16, 2024NID ID #: MA00004**DOWNSTREAM AREA**

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	Seepage with iron staining along left groin			X
	2. FOUNDATION SEEPAGE	Seepage with iron staining within ponded water at toe			X
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. WEIRS	None observed	X		
	5. DRAINAGE SYSTEM	None observed	X		
	6. INSTRUMENTATION	None observed	X		
	7. VEGETATION WITHIN 15 FT	Brush and trees within 20 feet of toe			X
	8. ACCESSIBILITY	No access roads to downstream area		X	
	9. DOWNSTREAM HAZARD DESCRIPTION	Several residences, two bridge crossings, and Lower Naukeag Dam downstream			
		26-Jul-11			

ADDITIONAL COMMENTS: Debris in the downstream area creates a tailwater condition that submerged the lower portion of the low-level outlet conduit and the downstream toe of the dam's maximum section

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>
MISCELLANEOUS		
AREA INSPECTED	CONDITION	OBSERVATIONS
MISC.	1. RESERVOIR DEPTH (AVG)	15 feet
	2. RESERVOIR SHORELINE	Wooded and residences
	3. RESERVOIR SLOPES	Gentle
	4. ACCESS ROADS	Easement over private driveway to right abutment
	5. SECURITY DEVICES	Lock on outlet operator; boom in front of spillway
	6. WATER PUBLIC HAZARDS & PROTECTION	Possible fall hazards at outlet structure bridge
	7. LAND-SIDE PUBLIC HAZARDS & PROTECTION	Possible fall hazards at spillway training walls
	7. VANDALISM OR TRESPASS	☐ YES ☒ NO WHAT:
	8. AVAILABILITY OF PLANS	☒ YES ☐ NO DATE: Partial design drawings
	9. AVAILABILITY OF DESIGN CALCS	☐ YES ☒ NO DATE:
	10. AVAILABILITY OF EAP/LAST UPDATE	☒ YES ☐ NO DATE: Jul-11
	11. AVAILABILITY OF O&M MANUAL	☐ YES ☒ NO DATE:
	12. CARETAKER/OWNER AVAILABLE	☒ YES ☐ NO DATE: During previous inspection
	13. CONFINED SPACE ENTRY REQUIRED	☐ YES ☒ NO PURPOSE:
ADDITIONAL COMMENTS: _____ _____ _____ _____		

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
PRIMARY SPILLWAY					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete broad crested weir	x		
	WEIR TYPE	Uncontrolled with flashboard slot	x		
	SPILLWAY CONDITION	Spalling and cracking of concrete. Primary overflow area obscured by flow*			x
	TRAINING WALLS	Minor efflorescence; slight erosion at base of wall. Right training wall at base**			x
	SPILLWAY CONTROLS AND CONDITION	Uncontrolled; no flashboards present at time of inspection		x	
	UNUSUAL MOVEMENT	None observed	x		
	APPROACH AREA	Clear; boom present	x		
	DISCHARGE AREA	Clear	x		
	DEBRIS	Woody debris was observed in the spillway channel	x		
ADDITIONAL COMMENTS: * Surface erosion with exposed coarse aggregate. ** of spillway badly spalled. The left training wall is cracked in some areas. Cracking at stoplog slot observed. _____ _____ _____					

NAME OF DAM: Lake Watatic Dam

STATE ID #: 3-14-11-10

INSPECTION DATE: April 16, 2024

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AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Page not applicable			
	WEIR TYPE				
	SPILLWAY CONDITION				
	TRAINING WALLS				
	SPILLWAY CONTROLS AND CONDITION				
	UNUSUAL MOVEMENT				
	APPROACH AREA				
	DISCHARGE AREA				
	DEBRIS				

ADDITIONAL COMMENTS: _____

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
OUTLET WORKS					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	Concrete intake structure with 4' gate on 24" diameter pipe	x		
	INTAKE STRUCTURE	Past crack repairs attempted			x
	TRASHRACK	Submerged; could not be observed		x	
	PRIMARY CLOSURE	Bent stem on gate valve, unsupported			x
	SECONDARY CLOSURE	None observed		x	
	CONDUIT	End of pipe cracked; pipe partially submerged		x	
	OUTLET STRUCTURE/HEADWALL	Concrete, spalled; pipe extends 5 feet beyond headwall	x		
	EROSION ALONG TOE OF DAM	None observed	x		
	SEEPAGE/LEAKAGE	Seepage with iron staining in area			x
	DEBRIS/BLOCKAGE	None observed	x		
	UNUSUAL MOVEMENT	None observed	x		
	DOWNSTREAM AREA	Open channel	x		
	MISCELLANEOUS	No handrail on bridge; grating in poor condition			x
ADDITIONAL COMMENTS: <u>Gate not routinely exercised</u> 					

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>			
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>			
CONCRETE/MASONRY DAMS (CREST)					
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	Not applicable			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				
ADDITIONAL COMMENTS: _____ _____ _____ _____					

NAME OF DAM: <u>Lake Watatic Dam</u>		STATE ID #: <u>3-14-11-10</u>	
INSPECTION DATE: <u>April 16, 2024</u>		NID ID #: <u>MA00004</u>	
CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)			
AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION MONITOR REPAIR
D/S FACE	TYPE	Not applicable	
	SURFACE CONDITIONS		
	CONDITIONS OF JOINTS		
	UNUSUAL MOVEMENT		
	ABUTMENT CONTACT		
	LEAKAGE		
ADDITIONAL COMMENTS: _____ _____ _____ _____			

NAME OF DAM: Lake Watatic DamSTATE ID #: 3-14-11-10INSPECTION DATE: April 16, 2024NID ID #: MA00004

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	Not applicable			
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACTS				

ADDITIONAL COMMENTS:

APPENDIX C
Previous Reports and References

PREVIOUS REPORTS AND REFERENCES

The following is a list of reports and drawings that were located during the preparation of this report, or were referenced in previous reports:

1. Phase I Inspection Report – Lake Watatic Dam, prepared by Tighe & Bond dated May 11, 2022 (date of inspection)
2. Phase I Inspection Report – Lake Watatic Dam, prepared by Tighe & Bond dated October 27, 2015 (date of inspection)
3. Lake Watatic Dam Emergency Action Plan, prepared by GZA GeoEnvironmental, dated April 2011.
4. Phase I Inspection Report, prepared by GZA GeoEnvironmental, dated October 7, 2009 (date of inspection).
5. 6-month Follow-Up Inspection Report, prepared by GZA GeoEnvironmental, dated May 23, 2006.
6. Technical Memorandum for Repairs of Lake Watatic Dam, Tighe & Bond, dated February 12, 2001.
7. Hydrologic and Hydraulic Analysis of Lower Naukeag Dam, prepared by Howland Engineering, Inc. August 15, 1989.

APPENDIX D
Definitions

COMMON DAM SAFETY DEFINITIONS

To provide a better understanding of this report, definitions of commonly used terms associated with dams are provided below. The terms are presented under the following common categories:

- 1) Orientation;
- 2) Dam components;
- 3) Size classification;
- 4) Hazard classification; and
- 5) General.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of the valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean any ancillary feature of a dam and shall include but not be limited to, such structures as training walls, spillways, either in the dam or separate there from and low level outlet works; also water conduits such as tunnels, channels, pipelines, or penstocks, either through the dam or its abutments.

Riprap – Shall mean a loose assemblage of broken stones erected in water or soft ground as erosion protection.

Toe – Shall mean the protruding base of the dam on the downstream side either natural or man-made.

Weir – Shall mean the top of the spillway where the water flows to the downstream side

Size Classification

(as listed in Commonwealth of Massachusetts, 302 CMR *Dam Safety Rules and Regulations*, revised 11/04/05)

Large – Structure with a height greater than 40 feet and/or a storage capacity greater than 1,000 acre-feet.

Intermediate – Structure with a height between 15 and 40 feet and/or a storage capacity of 50 to 1,000 acre-feet.

Small – Structure with a height between 6 and 15 feet and/or a storage capacity of 15 to 50 acre-feet.

Non-Jurisdictional – Structure less than 6 feet in height and having a storage capacity of less than 15 acre-feet.

Hazard Classification

(as listed in Commonwealth of Massachusetts, 302 CMR *Dam Safety Rules and Regulations*, revised 11/04/05)

High Hazard (Class I) – Shall mean dams located where failure or misoperation will likely cause loss of life and/or serious damage to homes, industrial or commercial facilities, important public utilities, or major transportation arteries.

Significant Hazard (Class II) – Shall mean dams located where failure or misoperation may cause loss of life and/or damage to homes, industrial or commercial facilities, secondary highways or railroads, or cause the interruption of the use or service of important facilities.

Low Hazard (Class III) – Dams located where failure or misoperation may cause minimal property damage to others and loss of life is not expected.

General

DCR – Department of Conservation and Recreation, formerly the Department of Environmental Management (DEM).

EAP – Emergency Action Plan; shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a volume equal to one foot of water over a one-acre area.

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works.