

-- COLBURN STREET DAM --
PHASE I
INSPECTION / EVALUATION REPORT



Dam Name: Colburn Street Dam
NID ID#: MA02571
Owner: Town of Dedham, MA
Town: Dedham
Consultant: GEI Consultants, Inc.
Date of Inspection: January 26, 2018

EXECUTIVE SUMMARY

This Inspection/Evaluation Report details the inspection and evaluation of Colburn Street Dam located in Dedham, Massachusetts. The inspection was conducted on January 26, 2018 by GEI Consultants, Inc. of Woburn, Massachusetts. Colburn Street Dam is currently classified as a small size, significant (Class II) hazard potential dam. There is no formal emergency action plan for Colburn Street Dam.

In general, Colburn Street Dam was found to be in **Satisfactory** condition with the following deficiencies noted:

- There are small trees and brush growing adjacent to the left abutment. The grass cover on the right abutment is growing in following the rehabilitation construction.
- There were tree limbs and other debris accumulating at the crest of the spillway that should be removed during regular maintenance.

The deficiencies noted in the last inspection in July 2013 have been addressed through a rehabilitation construction project that was completed in December 2017.

<i>Previously Identified Deficiency (July 2013)</i>	<i>Resolution or Current Condition</i>
Seepage was observed through the unmortared masonry downstream face of the dam, approximately six feet from the top of the dam.	Addressed during 2017 rehabilitation by repairs to the upstream face, downstream face, grouting, and construction of a concrete cutoff.
Scour of up to approximately 5 feet was observed via probing immediately downstream of the sluiceway, as well as two to four feet downstream of the face of the dam, for the length of the dam.	Added a graded filter and riprap scour protection at the toe.
The timber stop logs appeared to be quite old and are likely inoperable. There is no access to the stop logs under normal flow conditions.	The stop logs were replaced with new aluminum stop logs. Access to the stop logs remains limited by flow conditions.
Sediment was found to have accumulated to within approximately one foot of the top of the stop logs. Leakage through the installed timber stop logs was also observed.	The accumulated sediment was removed and the stop logs were replaced.
Voids were found in the downstream face of the dam which suggested that large stones may have been displaced from the structure. There was not a general connection between the location of the voids and the location of seepage.	The stone masonry structure was grouted and the upstream and downstream faces of the dam were repaired.
Any previously present mortar and most of the smaller chink stones are no longer in place along the downstream face of the structure.	The downstream face of the dam was grout packed and repointed.
The concrete cap on top of the overflow section of the dam was seen to exhibit shallow scour of concrete paste resulting in exposed aggregate over fundamentally the full area of the cap.	The concrete cap at the top of the dam was encased in additional concrete.

GEI Consultants, Inc. recommends the following actions be taken to address the deficiencies observed at the dam during this inspection and evaluation:

1. Regular maintenance activities should be performed to control growth of unwanted vegetation on the abutments and remove accumulated debris at the spillway. Grass cover should be maintained on the abutment slopes.
2. Perform an inspection of the dam during the annual brush clearing to observe and document dam conditions.

Dam Evaluation Summary Detail Sheet

1. NID ID:	MA02571	4. Inspection Date:	January 26, 2018
2. Dam Name:	Colburn Street Dam	5. Last Insp. Date:	5/23/2006 (full); 7/15/13 (partial)
3. Dam Location:	Dedham, MA	6. Next Inspection:	January 26, 2023
7. Inspector:	Jeanne A. LeFebvre, P.E.		
8. Consultant:	GEI Consultants, Inc.		
9. Hazard Code:	Significant	9a. Is Hazard Code Change Requested?:	No
10. Insp. Frequency:	5 Years	11. Overall Physical Condition of Dam:	SATISFACTORY
12. Spillway Capacity (% SDF)	>100% SDF w/ no actions by Caretaker		
E1. Design Methodology:	4	E7. Low-Level Discharge Capacity:	3
E2. Level of Maintenance:	2	E8. Low-Level Outlet Physical Condition:	1
E3. Emergency Action Plan:	2	E9. Spillway Design Flood Capacity:	5
E4. Embankment Seepage:	N/A	E10. Overall Physical Condition of the Dam:	4
E5. Embankment Condition:	N/A	E11. Estimated Repair Cost:	\$1,000
E6. Concrete Condition:	5		

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.




Jeanne A. LeFebvre
Massachusetts License No.: 45485
License Type: Civil

Senior Project Manager
GEI Consultants, Inc.

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SECTION 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The Town of Dedham has retained GEI Consultants, Inc. (under contract to Dewberry) to perform a visual inspection and develop a report of conditions for the Colburn Street Dam along the Mother Brook in Dedham, Norfolk 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

Colburn Street Dam is located on Mother Brook in Dedham, Massachusetts. Figure 1 shows the dam location on the Newton, MA USGS topographic map. Mother Brook is a stream that conveys water from the Charles River to the Neponset River. The dam is about 200 feet east of the intersection of Colburn Street and Bussey Street and adjacent to Condon Park, which has a baseball field and small playground. The Colburn Street Dam is located on Mother Brook approximately 1.25 miles downstream of the Mother Brook Diversion at Charles River. The dam is located at N 42.2490, W 71.1598, in a residential area of Dedham.

1.2.2 Owner/Caretaker

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

1.2.3 Purpose of the Dam

As noted in Table 1.1, the current purpose of the dam is to provide a recreational impoundment, known as Mill Pond.

1.2.4 Description of the Dam and Appurtenances

Colburn Street Dam is a concrete and stone masonry dam. The dam is approximately 100 feet long and 11 feet high at its tallest point with a vertical downstream face. During periods of lower flow, water passes through a sluiceway notch in the crest of the dam with the stop logs installed. During periods of higher flow, the dam is inundated.

The crest of the dam is at about El. 78.2 (NAVD-88) and the invert of the sluiceway notch is at about El. 71.8. The upstream face of the dam has an upper sloped section, and transitions to a vertical face below grade. The crest and upstream face are concrete, and the downstream face is mortared stone masonry.

Based on a July 2013 inspection, the condition of the dam was downgraded to “fair” and the hazard classification of the dam was changed to “Significant” consistent with Massachusetts Department of Conservation and Recreation (DCR) Office of Dam Safety guidelines. The downgraded condition of the dam was based on several deficiencies including downstream scour, seepage through the masonry face of the dam, large voids between masonry stones, and leakage through the stop logs in the sluiceway.

Following this assessment, the Town of Dedham performed a rehabilitation project to address these issues. The rehabilitation project consisted of repairs to the existing dam, including the application of pneumatically applied mortar to the upstream face, replacement of the existing stop logs, grouting and pointing the existing stone masonry, construction of a concrete cutoff, and installing a graded filter with riprap scour protection from the face of the dam downstream for approximately 30 feet. The rehabilitation project was completed in December 2017. The as-built drawings for the rehabilitation project are included in Appendix C. Figure 5 shows a schematic section through the dam, based on rehabilitation design. Photo 20 in Appendix A shows the stop log sluiceway.

1.2.5 Operations and Maintenance

There are no operations carried out at Colburn Street Dam. There appears to be very little maintenance required. Brush is cleared from the abutments periodically by the Town. The stop logs can only be used to drain the impoundment during periods of lower flow when the water level is below the crest.

1.2.6 DCR Size Classification

Colburn Street Dam has a maximum structural height of approximately 11 ft and a maximum storage capacity of about 30 acre-ft. 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, Colburn Street Dam is a Small size structure.

1.2.7 DCR Hazard Potential Classification

Colburn Street Dam is located upstream of residences. Dewberry performed a dam break analysis in 2016. Based on the results of the 100-year flood dam breach analysis, Dewberry confirmed that Colburn Street Dam should be listed as a Significant Hazard Potential dam per the Massachusetts Office of Dam Safety. Two structures are located within the inundation area, 186-188 Colburn Street and 17 Emmett Avenue.

The Hazard Potential Classification recommendation is consistent with the Hazard Potential Classification on record with the Office of Dam Safety for Colburn Street Dam (which is Significant).

1.3 Pertinent Engineering Data

1.3.1 Drainage Area

The drainage area for Colburn Street Dam extends up the Mother Brook to the confluence with the Charles River and is approximately 0.6 square miles in Dedham (Fig. 3).

Mother Brook also conveys water from the Charles River to the Neponset River. Flow from the Charles River to Mother Brook is not included in the drainage area estimate, but contributes to the flow at the Colburn Street Dam.

1.3.2 Reservoir

See Table 1.1 for data about normal, maximum, and spillway design flood (SDF) pools. These data were calculated based on Conic Method for Reservoir Values.

1.3.3 Discharges at the Dam Site

Discharges at the dam site are not recorded.

1.3.4 General Elevations (feet, NAVD-88)

A. Top of Dam	78.2 ft
B. Spillway Design Flood Pool	81.2 ft
C. Normal Pool	78.2 ft
D. Spillway Crest	78.2 ft
E. Upstream Water at Time of Inspection	~78.5 ft
F. Downstream Water at Time of Inspection	~72 ft
G. Streambed at Toe of the Dam	~72.5 ft
H. Low Point along Toe of the Dam	~72.5 ft

1.3.5 Main Spillway Data

A. Type	concrete, broad-crested weir
B. Weir Length	100 ft
C. Weir Crest Elevation	78.2 ft
D. Upstream Channel	silt
E. Downstream Channel	riprap
F. Downstream Channel Bottom Elevation	~72 ft

1.3.6 Additional Data

A. Sluiceway notch outlet invert	El. 71.8
B. Material	aluminum stop logs

1.3.7 Design and Construction Records and History

Although the date of origin for the Colburn Street Dam is unknown, it is over 100 years old. A stone marker at the project site indicated the first mill in Dedham was built on this site in 1640. The mill likely included a wooden dam. The Colburn Street Dam was later improved to a stone masonry and concrete dam. However, no design or construction records were located for the original construction.

A drawing dated August 1976 (Appendix C) indicates that some rehabilitation work was performed on the sluiceway notch. The drawing shows new stop logs, new concrete surfaces in the sluiceway, and rehabilitated slots for the stop logs.

A July 2013 inspection noted the condition of the dam was downgraded to “fair” and the hazard classification of the dam was changed to “Significant.” The downgraded condition of the dam was based on several deficiencies including downstream scour, seepage through the masonry face of the dam, large voids between masonry stones, and leakage through the stop logs in the sluiceway.

Following this assessment, the Town of Dedham performed a rehabilitation project in 2017 to address these issues. As-built drawings for the rehabilitation are provided in Appendix C. The 2017 rehabilitation project consisted of repairs to the existing dam including:

- Removal of sediment accumulated against the upstream face of the dam and construction of a 4- to 5-inch-thick layer of shotcrete with structural reinforcement. This concrete layer was intended to fill any voids in the upstream face and provide a water proofing layer to reduce seepage through the dam structure.
- Grout packing and pointing the stones on the downstream face of the dam to fill voids between the stones and reinforce their structural integrity.
- Construction of a concrete cutoff at the upstream toe of the dam, doweled into bedrock.
- Replacement of the existing wooden stop log system with an aluminum stop log system to improve the condition of the sluiceway outlet and reduce leakage.

- Placement of a graded filter with riprap at the downstream face of the dam and extending approximately 30 feet downstream for scour protection and to dissipate the energy from water flow.

The Town approved bonding of \$755,000 for the design and construction of the Colburn Street Dam Rehabilitation in May 2016. The design was awarded and completed by Dewberry with GEI Consultants as a subcontractor. T. Ford Company, Inc. was the construction contractor and Dewberry performed resident engineering services. Construction was completed in December 2017. Construction reports are provided in Appendix C.

1.3.8 Operating Records

There are no operating records for Colburn Street Dam. Over the past 100 plus years the Colburn Street Dam has been in existence, very little maintenance has been undertaken.

1.4 Summary Data Table

1.1 Summary Data Table

Required Phase I Report Data	Data Provided by the Inspecting Engineer
National ID #	MA02571
Dam Name	Colburn Street Dam
Dam Name (Alternate)	0
River Name	Mother Brook
Impoundment Name	Mill Pond on Mother Brook
Hazard Class	Significant
Size Class	Small
Dam Type	Stone masonry and concrete
Dam Purpose	Recreation
Structural Height of Dam (feet)	10.5
Hydraulic Height of Dam (feet)	13
Drainage Area (sq. mi.)	0.63
Reservoir Surface Area (acres)	6
Normal Impoundment Volume (acre-feet)	28.6
Max Impoundment Volume ((top of dam) acre-feet)	~30
SDF Impoundment Volume* (acre-feet)	30
Spillway Type	Concrete, broad crested weir
Spillway Length (feet)	100
Freeboard at Normal Pool (feet)	5
Principal Spillway Capacity* (cfs)	1600
Auxiliary Spillway Capacity* (cfs)	NA
Low-Level Outlet Capacity* (cfs)	included in spillway capacity
Spillway Design Flood* (flow rate - cfs)	100-year/1,500 (estimated)
Winter Drawdown (feet below normal pool)	NA
Drawdown Impoundment Vol. (acre-feet)	NA
Latitude	42.2490 N
Longitude	-71.1598 W
City/Town	Dedham
County Name	Norfolk
Public Road on Crest	no
Public Bridge over Spillway	no
EAP Date (if applicable)	None
Owner Name	Town of Dedham
Owner Address	36 Bryant Street
Owner Town	Dedham, MA 02026
Owner Phone	(781) 751-9100
Owner Emergency Phone	0
Owner Type	Municipality or Political subdivision
Caretaker Name	Jason Mammone, P.E., Town Engineer
Caretaker Address	55 River Street
Caretaker Town	Dedham, MA 02026
Caretaker Phone	781-751-9352
Caretaker Emergency Phone	0
Date of Field Inspection	1/26/2018
Consultant Firm Name	GEI Consultants, Inc.
Inspecting Engineer	Jeanne A. LeFebvre, P.E.
Engineer Phone Number	781-721-4000

*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

Colburn Street Dam was inspected on January 26, 2018. At the time of the inspection, the weather was sunny with a temperature of about 28 degrees. 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 78.5 ft, about 3 inches above the crest. Underwater areas were not inspected. A copy of the inspection checklist is included in Appendix B.

2.1.1 General Findings

In general, Colburn Street Dam was found to be in **Satisfactory** condition. Specific observations are identified in more detail in the sections below.

2.1.2 Dam

- Abutments

The abutments consist of the stone masonry against bedrock, and appear to have good contact. Beyond the stone masonry contact, the bedrock transitions to earthen slopes grading up into the Condon Park on the right and up to Colburn Street on the left.

Both abutments were in satisfactory condition. The grass on the right bank is being reestablished following the rehabilitation project, which mainly accessed the site from this side. There is some vegetation and small trees along the right abutment. See photos 1 and 16.

- Upstream Face

The upstream face was underwater at time of inspection and therefore not accessible.

Based on observations during the rehabilitation project in October 2017, the concrete cutoff and concrete on the upstream face are in satisfactory condition. See construction documentation provided in Appendix C.

- Crest

The crest was underwater at time of inspection and therefore not accessible. There were several moderately sized tree limbs and other debris at the crest, but they did not appear to be impacting flow. See photos 6 and 16.

- Downstream Face

The downstream face was partially visible through the flow going over the crest. The stone masonry was in good alignment, with no evidence of leakage or seepage (Photos 3 and 17). The mortar visible between the stones appeared to be in good condition.

- Drains

There are no records of drains in the dam.

- Instrumentation

There is no instrumentation at the dam.

- Access Roads and Gates

The dam is accessed from Colburn Street on the left side and Condon Park on the right side. A chain link fence with a gate was installed on the right side as part of the 2017 rehabilitation project.

2.1.3 Appurtenant Structures

- Primary Spillway

The primary spillway (main dam) was underwater at the time of the inspection. Based on our observations and 2017 rehabilitation construction documentation, the spillway appeared to be in good condition. The mortar in the stone masonry was in satisfactory condition. There was no evidence of displaced blocks. Some tree limbs and debris were caught at the crest of the spillway.

The caretaker reports that following the rehabilitation, there is no visible leakage through the dam when the water is below the crest, and no signs of erosion or displaced blocks.

- Low-Level Outlet

The sluiceway notch was rehabilitated in 2017. The concrete was repaired, new aluminum stop logs were installed, and new slots for the stop logs were installed. The sluiceway notch was underwater at the time of the inspection. Some tree limbs and debris were caught in the sluiceway.

- Auxiliary Spillway

Not applicable.

- Dikes

Not applicable.

2.1.4 Downstream Area

The downstream area is the Mother Brook channel, which opens into the impoundment formed by Centennial Dam. The channel banks are moderately steep with heavy vegetation. There are residential buildings along Mother Brook downstream of the dam.

2.1.5 Reservoir Area

The Mill Pond impoundment is about 1,400 feet long and ranges in width from 150 feet to 300 feet. The shoreline slopes are moderate and wooded, with no evidence of slides observed. The axis of the reservoir is oriented approximately southwest to northeast. The top banks of the reservoir are developed as residential and commercial property.

2.2 Caretaker Interview

GEI worked with the Town Engineer, Jason Mammone, for design and construction of the 2017 Rehabilitation project. The Town provided weekly construction summaries and photographs on their website <http://www.dedham-ma.gov/departments/engineering/projects-draft>.

Prior to this work, the Town did not have formal records or information concerning the dam.

2.3 Operation and Maintenance Procedures

No written operation or maintenance procedures were available for the dam. However, there are generally no operations performed at the dam, and maintenance is limited brush clearing.

2.3.1 Operational Procedures

No written operation procedures were available for review. No operations are performed at the dam.

2.3.2 Maintenance of Dam and Operating Facilities

No written maintenance procedures were available for review.

2.4 Emergency Warning System

There is no written Emergency Action Plan for Colburn Street Dam.

2.5 Hydrologic/Hydraulic Data

A 1973 report by Anderson-Nichols & Company included a flood control feasibility study. This study indicated that a design flow of 1,275 cfs was used for improvements to upstream reaches of Mother Brook. Based on this, the capacity of the Colburn Street Dam spillway with three feet of water flowing over the crest was estimated to be 1,375 cfs from the 2006 inspection.

Based on the USGS Streamstats website, the drainage area is 0.6 sq. mi. (Figure 3). This does not include the drainage area from the Charles River. Dewberry performed a dam breach analysis using HEC-RAS in 2016 (Appendix C) that included a peak flow rate of 1,500 cfs for the 100-year flood event. The peak value of 1,509 cfs was taken from the Norfolk County, Massachusetts FEMA Effective FIS Report dated July 16, 2015 (FIS Study #25021CV001C). The pool elevation at this flow rate (El. 81.1) was consistent with the flood level assumed in the spillway design (El. 81.2).

2.6 Structural and Seepage Stability

2.6.1 Embankment Structural Stability

Not applicable.

2.6.2 Structural Stability of Non-Embankment Structures

The condition of the dam appears to be satisfactory, with good alignment and smooth flow across the crest. Observations at the end of rehabilitation construction showed the dam to be in good condition.

GEI performed stability analyses of the dam as part of the rehabilitation design. Calculation packages from the design phase of work, and an updated calculations package based on conditions observed during construction are included in Appendix C. Following the rehabilitation work, the factors of safety are consistent with the inspection rating of 'Satisfactory'.

2.6.3 Seepage Stability

Following the 2017 rehabilitation, there is no evidence of seepage and piping of the dam.

As part of the rehabilitation work, a graded filter was installed on the downstream side of the dam adjacent to the foundation soil (Figure 5). Dewberry observed the installation of the graded filter during construction.

SECTION 3

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, the overall condition of Colburn Street Dam is **Satisfactory**. The dam was found to have the following deficiencies:

1. There are small trees and brush growing adjacent to the left abutment. The grass cover on the right abutment is growing in following the rehabilitation construction.
2. There were tree limbs and other debris accumulating at the crest of the spillway that should be removed during regular maintenance.

The deficiencies noted in the last inspection in July 2013 have been addressed.

<i>Previously Identified Deficiency (July 2013)</i>	<i>Resolution or Current Condition</i>
Seepage was observed through the unmortared masonry downstream face of the dam, approximately six feet from the top of the dam.	Addressed during 2017 rehabilitation by repairs to the upstream face, downstream face, grouting, and construction of a concrete cutoff.
Scour of up to approximately 5 feet was observed via probing immediately downstream of the sluiceway, as well as two to four feet downstream of the face of the dam, for the length of the dam.	Added a graded filter and riprap scour protection at the toe.
The timber stop logs appeared to be quite old and are likely inoperable. There is no access to the stop logs under normal flow conditions.	The stop logs were replaced with new aluminum stop logs. Access to the stop logs remains limited by flow conditions.
Sediment was found to have accumulated to within approximately one foot of the top of the stop logs. Leakage through the installed timber stop logs was also observed.	The accumulated sediment was removed and the stop logs were replaced.
Voids were found in the downstream face of the dam which suggested that large stones may have been displaced from the structure. There was not a general connection between the location of the voids and the location of seepage.	The stone masonry structure was grouted and the upstream and downstream faces of the dam were repaired.
Any previously present mortar and most of the smaller chink stones are no longer in place along the downstream face of the structure.	The downstream face of the dam was grout packed and repointed.
The concrete cap on top of the overflow section of the dam was seen to exhibit shallow scour of concrete paste resulting in exposed aggregate over fundamentally the full area of the cap.	The concrete cap at the top of the dam was encased in additional concrete.

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

3.2 Studies and Analyses

The following studies should be performed to address concerns and meet current regulations:

None.

3.3 Recurrent Maintenance Recommendations

The following activities should be performed by the dam owner/caretaker on a yearly basis:

1. Regular maintenance activities should be performed to control growth of unwanted vegetation on the abutments and remove accumulated debris at the spillway. Grass cover should be maintained on the abutment slopes.
2. Perform an inspection of the dam during the annual brush clearing to observe and document dam conditions.

3.4 Minor Repair Recommendations

None.

3.5 Remedial Modifications Recommendations

None.

3.6 Alternatives

No alternatives to the recommendations above are necessary.

3.7 Opinion of Probable Construction Costs

The following conceptual opinions of probable construction costs have been developed for the recommendations and remedial measures noted above. The costs shown herein are based on a limited analysis and are provided for general information only. This should not be considered an engineer's estimate, as actual construction costs may vary from the costs indicated.

- Studies and Analyses
 - None
- Yearly Recommendations
 - Annual Clearing of Brush and Debris \$500-1000/year
- Recommendations, Maintenance, and Minor Repairs
 - None

- Remedial Measures
 - None

- Alternatives
 - None

TOTAL \$500 - \$1,000/year

SECTION 4

4.0 LIMITATIONS

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no other warranty, express or implied, is made. Limitations on our recommendations are contained in the attached “Important Information about your Geotechnical Engineering Report.”

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be, and, in general, if you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying it.* A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old*.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

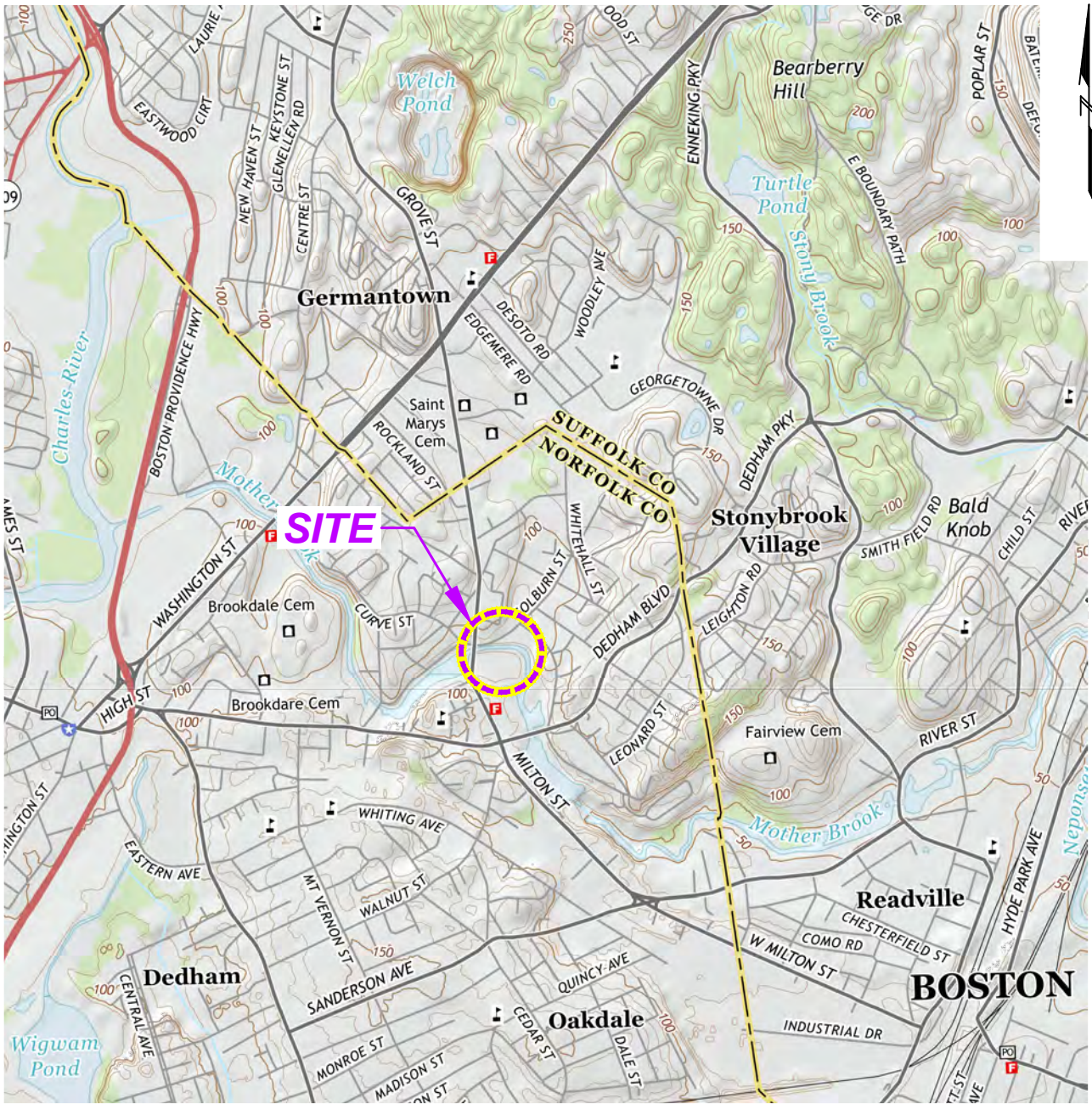
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration*. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists*.



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FIGURES



Map provided by the United States Geologic Survey.
 7.5-Minute Series
 Newton, MA Quadrangle, 2015
 Datum is North American Vertical Datum of 1988 (NAVD88).
 Contour Interval is 40 feet.



Colburn Street Dam
 Inspection/Evaluation Report
 Dedham, Massachusetts

Dewberry
 Boston, Massachusetts



Project 1610921

SITE LOCATION MAP

January 2018

Fig. 1

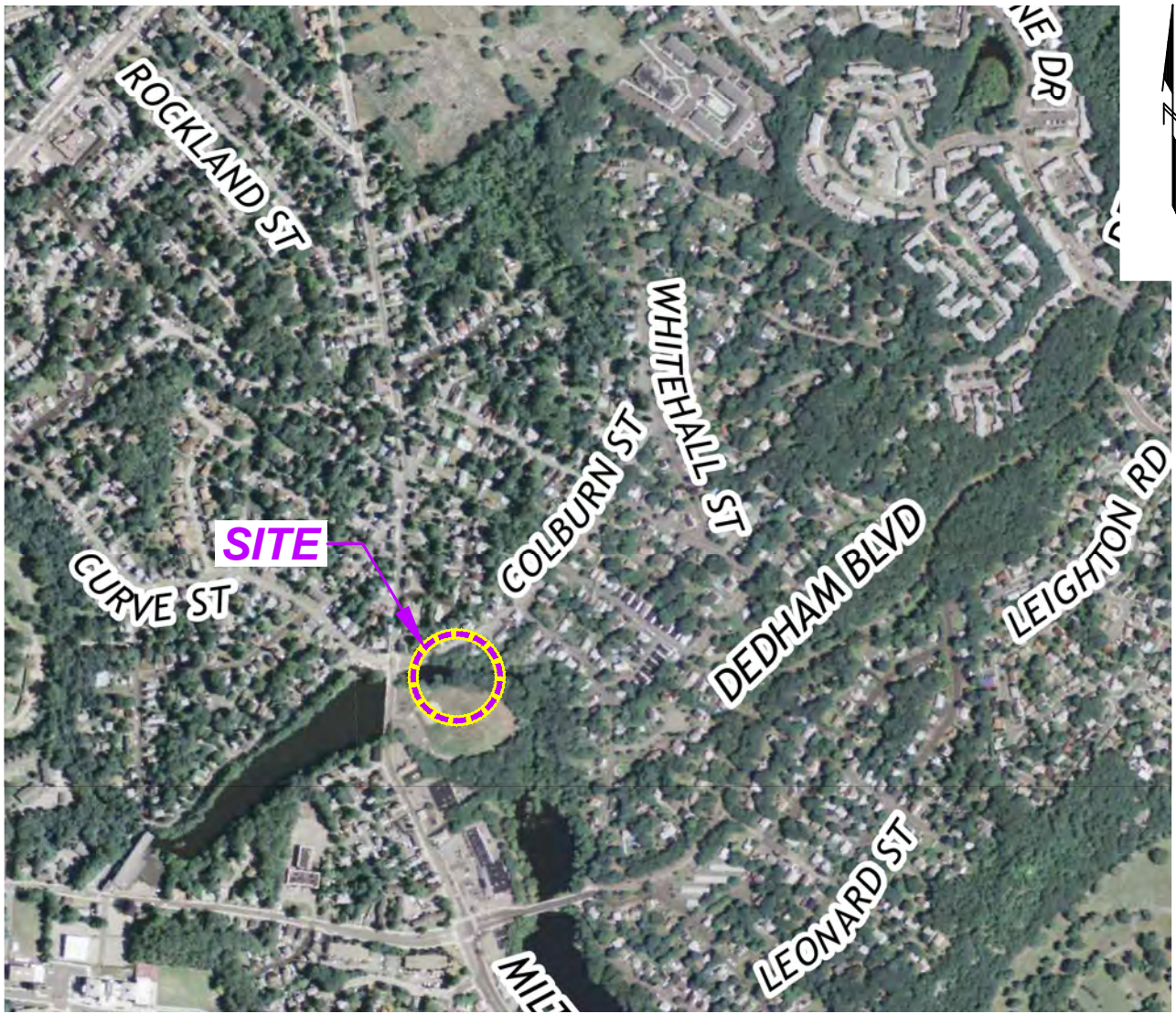


Image provided by the National Agriculture Imagery Program.
 Imagery dated 2014.
 Imagery embedded in USGS Newton, MA Quadrangle, 2015.



Colburn Street Dam
 Inspection/Evaluation Report
 Dedham, Massachusetts

Dewberry
 Boston, Massachusetts

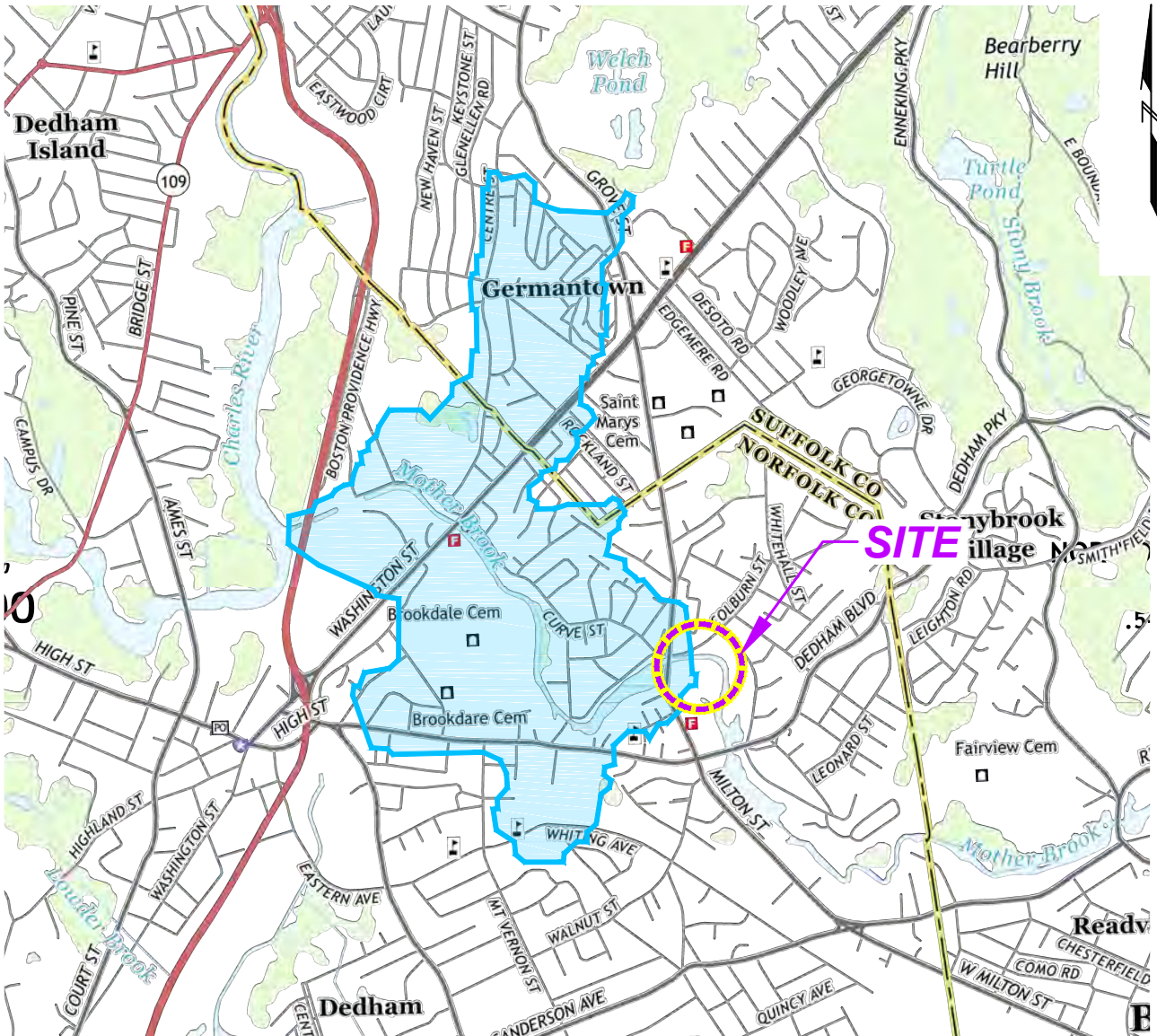


Project 1610921

AERIAL PHOTOGRAPH

January 2018

Fig. 2



Drainage area based on StreamStats Report provided by the United States Geologic Survey (USGS).
 Latitude: 42.25089°N
 Longitude: 71.15474°W
 Map also provided by the USGS.
 7.5-Minute Series
 Newton, MA Quadrangle, 2015



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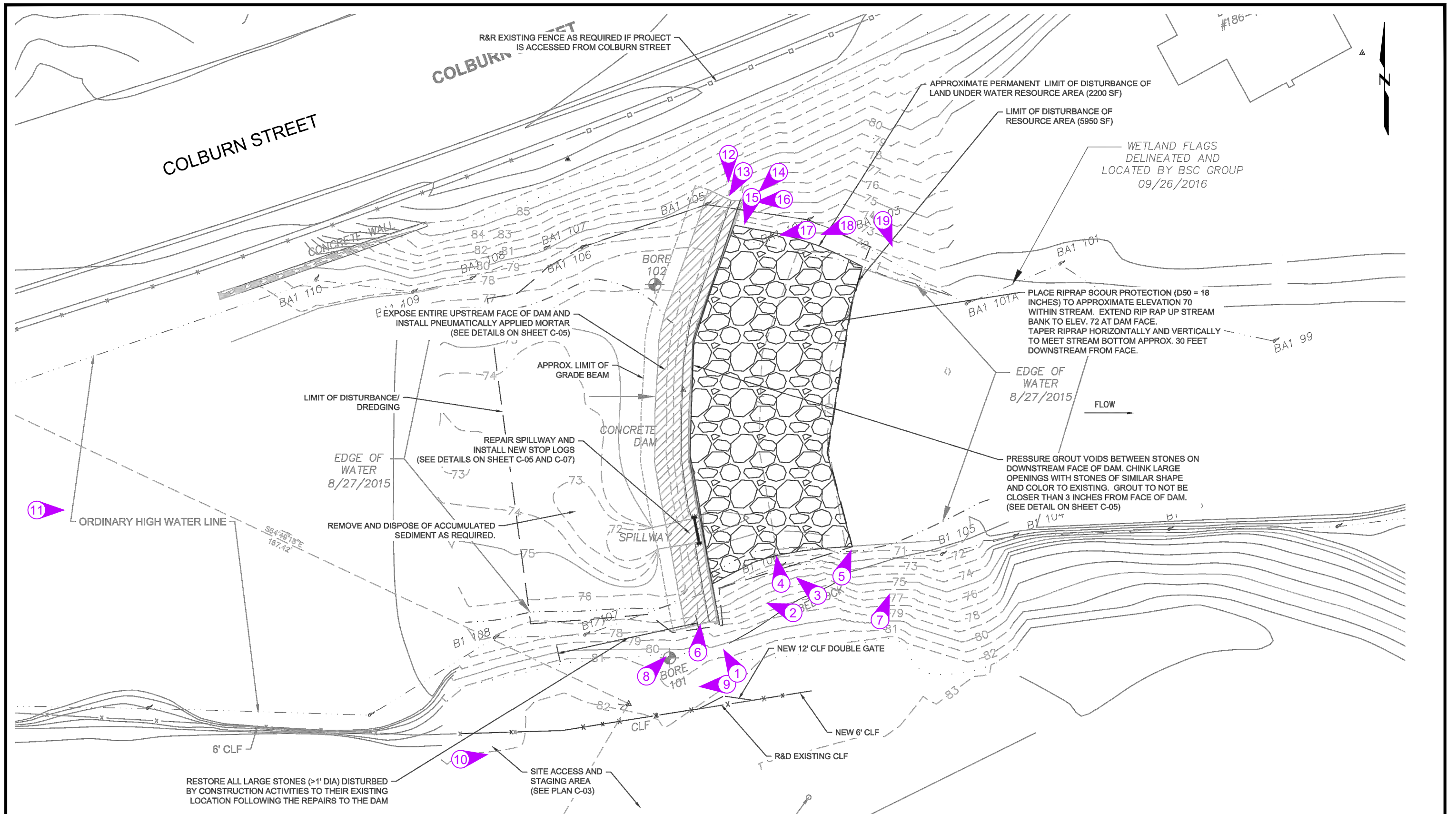


Project 1610921

DRAINAGE AREA

January 2018

Fig. 3

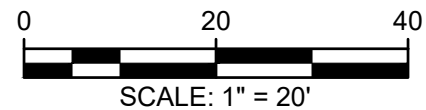


NOTES:

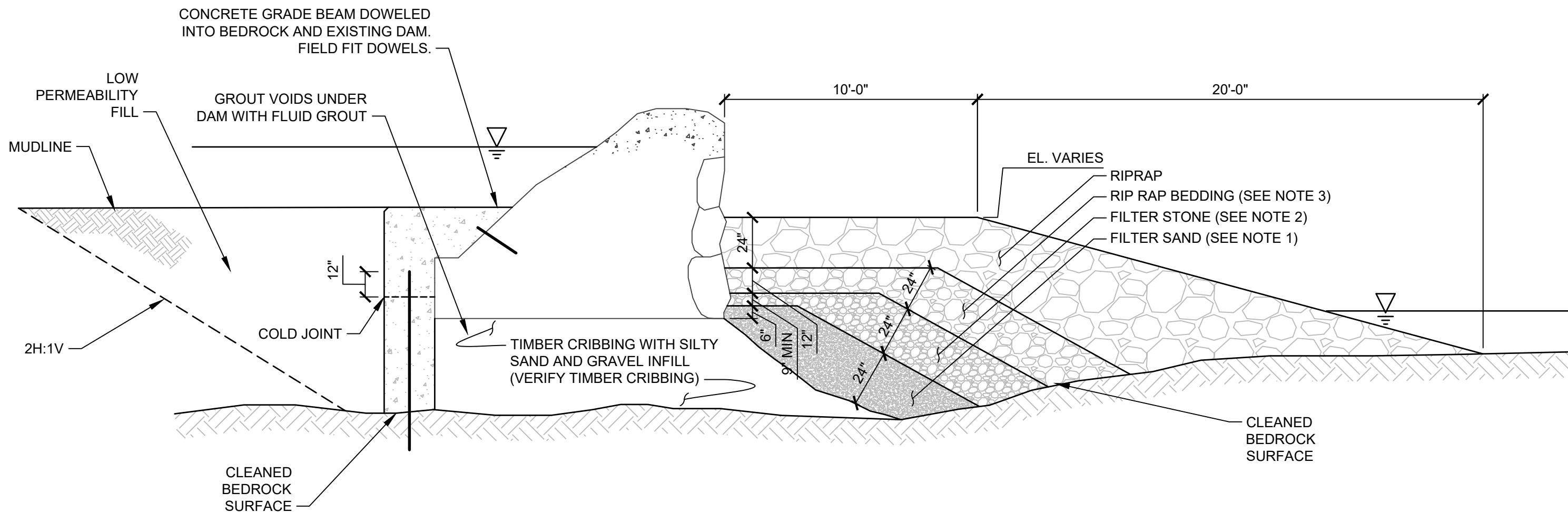
1. PLAN BASED ON BASED ON AS-BUILT DRAWINGS DATED DECEMBER 2017.

LEGEND:

- 1 PHOTOGRAPH NUMBER AND DIRECTION




<p>Colburn Street Dam Inspection/Evaluation Report Dedham, Massachusetts</p> <p>Dewberry Boston, Massachusetts</p>		<p>SITE PLAN WITH PHOTO LOCATIONS</p>	
		<p>Project 1610921</p>	<p>January 2018</p>



NOTES:

1. FILTER SAND: HARD, DURABLE, FREE-DRAINING, ANGULAR SAND MEETING THE REQUIREMENTS AND GRADATION OF ASTM C33 FINE AGGREGATE FOR CONCRETE
2. FILTER STONE: HARD, DURABLE, FREE-DRAINING, ANGULAR STONE MEETING THE REQUIREMENTS AND GRADATION OF MASSDOT STANDARD SPECIFICATION SECTION M2, M2.01.5, 1/2 IN STONE.
3. RIP RAP BEDDING: HARD, DURABLE, FREE-DRAINING, ANGULAR STONE, MEETING REQUIREMENTS AND GRADATION OF ASTM C33 NUMBER 2 STONE.
4. CONCRETE GRADE BEAM MINIMUM 1 FT THICK, EXTENDING 1 FT ABOVE LEVEL SHELF. REINFORCING NOT REQUIRED.
5. LOW PERMEABILITY FILL: SOIL MEETING THE REQUIREMENTS OF MASSDOT M1.08.0, IMPERVIOUS SOIL BORROW.



Colburn Street Dam Inspection/Evaluation Report Dedham, Massachusetts Dewberry Boston, Massachusetts	 GEI Consultants	SCHEMATIC REHABILITATION CROSS SECTION
	Project 1610921	January 2018

APPENDIX A
Photographs

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



<i>Photo No. 1 – Dam and impoundment viewed from right abutment.</i>	<i>1</i>
<i>Photo No. 2 – Right abutment contact.</i>	<i>1</i>
<i>Photo No. 3 – Downstream face and notch (sluiceway).</i>	<i>2</i>
<i>Photo No. 4 – Downstream toe area.</i>	<i>2</i>
<i>Photo No. 5 – Downstream area looking toward 188 Colburn Street.</i>	<i>3</i>
<i>Photo No. 6 – View of crest from right abutment.</i>	<i>3</i>
<i>Photo No. 7 - View of downstream channel from right bank.</i>	<i>4</i>
<i>Photo No. 8 – View of impoundment and crest from right bank.</i>	<i>4</i>
<i>Photo No. 9 – Bank adjacent to right abutment.</i>	<i>5</i>
<i>Photo No. 10 – Chain link fence installed between Condon Park and right bank.</i>	<i>5</i>
<i>Photo No. 11 – Impoundment looking downstream from Bussey Street.</i>	<i>6</i>
<i>Photo No. 12 – View along crest from left abutment.</i>	<i>6</i>
<i>Photo No. 13 – Looking upstream from left abutment.</i>	<i>7</i>
<i>Photo No. 14 – Crest at left abutment.</i>	<i>7</i>
<i>Photo No. 15 – Downstream face, view from left abutment.</i>	<i>8</i>
<i>Photo No. 16 – Left abutment interface with bedrock. Note small brush.</i>	<i>8</i>
<i>Photo No. 17 – Downstream face view from left downstream toe.</i>	<i>9</i>
<i>Photo No. 18 – Downstream toe and face from left side.</i>	<i>9</i>
<i>Photo No. 19 – Downstream area viewed from left bank.</i>	<i>10</i>
<i>Photo No. 20 – Photo taken in November 2017 at the completion of rehabilitation construction.</i>	<i>10</i>

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 1 – Dam and impoundment viewed from right abutment.



Photo No. 2 – Right abutment contact.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 3 – Downstream face and notch (sluiceway).



Photo No. 4 – Downstream toe area.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 5 – Downstream area looking toward 188 Colburn Street.



Photo No. 6 – View of crest from right abutment.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 7 - View of downstream channel from right bank.



Photo No. 8 – View of impoundment and crest from right bank.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 9 – Bank adjacent to right abutment.



Photo No. 10 – Chain link fence installed between Condon Park and right bank.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 11 – Impoundment looking downstream from Bussey Street.



Photo No. 12 – View along crest from left abutment.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 13 – Looking upstream from left abutment.



Photo No. 14 – Crest at left abutment.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 15 – Downstream face, view from left abutment.



Photo No. 16 – Left abutment interface with bedrock. Note small brush.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

GEI Project No.: 1610921

Client: Town of Dedham



Photo No. 17 – Downstream face view from left downstream toe.



Photo No. 18 – Downstream toe and face from left side.

Colburn Street Dam – Inspection Photos

Date: 01/26/2018

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Client: Town of Dedham



Photo No. 19 – Downstream area viewed from left bank.



Photo No. 20 – Photo taken in November 2017 at the completion of rehabilitation construction.

APPENDIX B
Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST INSTRUCTION PAGE

The checklist (Excel file) includes sections applicable to a variety of dam structure types. Carefully follow the instructions on the first tab of the checklist. Complete those pages pertaining to each structure and omit pages that are not relevant or mark them "Not Applicable." The Checklist must be signed by the inspecting engineer and a clean, neat copy included in the final inspection report. Use the checklist to generate the Dam Evaluation Summary Detail Sheet (should immediately follow the Executive Summary) and Table 1.1 (should immediately follow Section 1.0).

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 analyses 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, filed with MADCR, annual training

E4: EMBANKMENT SEEPAGE (Embankment, Foundation & Abutments)

1. Severe piping and/or seepage with no monitoring
2. Evidence of monitored piping and seepage
3. No piping but monitored 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. 51- 90% of the SDF
3. 91- 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 THE 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 for 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

Guidelines and Notes for Evaluations

Each of the evaluation categories has 5 rating levels. In general, the rating levels in each category are intended to reflect the following conditions:

1. Unsafe
2. Poor
3. Fair
4. Satisfactory
5. Good

E10-Overall Safety Rating Guideline

Unless the inspecting engineer presents compelling data, analyses, and observations that justify a higher rating, E10-Overall Safety Rating of the Dam shall not be higher than the lowest ranking in these high importance categories:

-E4-Seepage,

-E5-Embankment Condition (for embankment dams), and

-E6-Concrete Condition (for dams where concrete structures retain water).

Note 1 - Embankment Condition Factor of Safety Criteria

In addition to the inspection conditions listed, the embankment condition rating should consider the slope stability Factor of Safety (FS) according to the following guidelines for downstream (D/S) and upstream slopes (U/S).

	Normal Pool	SDF	Seismic	Rapid Drawdown
Rating	D/S & U/S FS	D/S FS	D/S & U/S FS	U/S FS
1	<1.3	<1.1	<1.0	<1.0
2	<1.5	<1.4	<1.0	<1.1
3	>1.5	<1.5	<1.1	<1.2
4	>1.5	>1.5	>1.1	>1.2
5	>1.5	>1.5	>1.1	>1.2

In the absence of stability analyses, use the following factors to evaluate the stability component of the embankment rating. The inspecting engineer will need to consider all factors in combination as the exact combination of conditions listed will rarely occur. For slopes, > indicates “steeper than.”

Rating	Slopes	Seepage	Material	Compaction
1	>2H:1V	>5' above toe	SP, ML*, SM*	Loose or unknown
2	>2.5H:1V	>2' above toe	ML**, MH	Loose or unknown
3	>3H:1V	at toe	SM**, SW, CH	Likely compacted
4	<3H:1V	DS of toe	SC, CL	Compacted
5	<3H:1V	None	Suitably Zoned	Compacted

ML* - Non-plastic silt or any silt or clay susceptible to dispersion

ML** - Silt with some plasticity (non-dispersive)

SM* - Uniform silty fine sand

SM** - Widely graded silty sand

Note 2 - Concrete Condition Factor of Safety Criteria

In addition to the inspection conditions listed, ratings should consider the sliding stability Factors of Safety (FS) for any concrete structures that retain water according to the following guidelines.

FS Criteria for Dams with Limited Structure and Foundation Information and Testing

Rating	Normal Pool FS	SDF FS	Ice Loading FS	Seismic FS
1	<2.0	<1.3	<1.3	<1.0
2	<3.0	<2.0	<2.0	<1.3
3	>3.0	>2.0	>2.0	<1.5
4	>3.0	>2.0	>2.0	>1.5
5	>3.0	>2.0	>2.0	>1.5

FS Criteria for Dams with Well Defined Structure and Foundation Information and Testing

Rating	Normal Pool FS	SDF FS	Ice Loading FS	Seismic FS
1	<1.5	<1.3	<1.3	<1.0
2	<2.0	<1.7	<1.7	<1.0
3	<3.0	<2.0	<2.0	<1.1
4	>3.0	>2.0	>2.0	<1.3
5	>3.0	>2.0	>2.0	>1.3

See Appendix D for a complete listing of dam orientation and terminology definitions.

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.

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.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent 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 a 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 structures, either in dams or separate therefrom, including but not be limited to, spillways; reservoirs and their rims; low-level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: <u>Colburn Street Dam</u>		STATE ID #: <u>6-11-73-2</u>	
REGISTERED: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	NID ID #: <u>MA02571</u>		
STATE SIZE CLASSIFICATION: <u>Small</u>	STATE HAZARD CLASSIFICATION: <u>Significant</u>		CHANGE IN HAZARD CLASSIFICATION REQUESTED?: <u>No</u>
<u>DAM LOCATION INFORMATION</u>			
CITY/TOWN: <u>Dedham</u>		COUNTY: <u>Norfolk</u>	
DAM LOCATION: <u>Colburn Street</u> (street address if known)		ALTERNATE DAM NAME: _____	
USGS QUAD.: <u>Newton</u>	LAT.: <u>42.2490 N</u>	LONG.: <u>-71.1598 W</u>	
DRAINAGE BASIN: <u>Charles</u>	RIVER: <u>Mother Brook</u>		
IMPOUNDMENT NAME(S): <u>Mill Pond on Mother Brook</u>			
<u>GENERAL DAM INFORMATION</u>			
TYPE OF DAM: <u>Stone masonry and concrete</u>	OVERALL LENGTH (FT): <u>100</u>		
PURPOSE OF DAM: <u>Recreation</u>	NORMAL POOL STORAGE (ACRE-FT): <u>28.6</u>		
YEAR BUILT: <u>Unknown</u>	MAXIMUM POOL STORAGE (ACRE-FT): <u>~30</u>		
STRUCTURAL HEIGHT (FT): <u>11</u>	EL. NORMAL POOL (FT): <u>78.2</u>		
HYDRAULIC HEIGHT (FT): <u>13</u>	EL. MAXIMUM POOL (FT): <u>81.2</u>		
<u>FOR INTERNAL MADCR USE ONLY</u>			
FOLLOW-UP INSPECTION REQUIRED: <input type="checkbox"/> YES <input type="checkbox"/> NO		CONDITIONAL LETTER: <input type="checkbox"/> YES <input type="checkbox"/> NO	

NAME OF DAM: <u>Colburn Street Dam</u>		STATE ID #: <u>6-11-73-2</u>		
INSPECTION DATE: <u>January 26, 2018</u>		NID ID #: <u>MA02571</u>		
<u>INSPECTION SUMMARY</u>				
DATE OF INSPECTION: <u>January 26, 2018</u>		DATE OF PREVIOUS INSPECTION: <u>5/23/2006 (full); 7/15/13 (partial)</u>		
TEMPERATURE/WEATHER: <u>28 degrees F, sunny</u>		ARMY CORPS PHASE I: <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO If YES, date _____		
CONSULTANT: <u>GEI Consultants, Inc.</u>		PREVIOUS DCR PHASE I: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO If YES, date <u>5/23/2006</u>		
BENCHMARK/DATUM: <u>NAVD 1988</u>				
OVERALL PHYSICAL CONDITION OF DAM: <u>SATISFACTORY</u>		DATE OF LAST REHABILITATION: <u>Oct-17</u>		
SPILLWAY CAPACITY: <u>>100% SDF w/ no actions by Caretaker</u>				
EL. POOL DURING INSP.: <u>~78.7</u>		EL. TAILWATER DURING INSP.: <u>~72</u>		
<u>PERSONS PRESENT AT INSPECTION</u>				
<u>NAME</u>	<u>TITLE/POSITION</u>	<u>REPRESENTING</u>		
<u>Jeanne LeFebvre, P.E.</u>	<u>Project Manager</u>	<u>GEI Consultants, Inc.</u>		
_____	_____	_____		
_____	_____	_____		
_____	_____	_____		
_____	_____	_____		
<u>EVALUATION INFORMATION</u>				
		Click on box to select E-code		
E1) TYPE OF DESIGN	4	E8) LOW-LEVEL OUTLET CONDITION	1	
E2) LEVEL OF MAINTENANCE	2	E9) SPILLWAY DESIGN FLOOD CAPACITY	5	
E3) EMERGENCY ACTION PLAN	2	E10) OVERALL PHYSICAL CONDITION	4	
E4) EMBANKMENT SEEPAGE	N/A	E11) ESTIMATED REPAIR COST	\$1,000	
E5) EMBANKMENT CONDITION	N/A	ROADWAY OVER CREST	NO	
E6) CONCRETE CONDITION	5	BRIDGE NEAR DAM	NO	
E7) LOW-LEVEL OUTLET CAPACITY	3			
NAME OF INSPECTING ENGINEER: <u>Jeanne A. LeFebvre, P.E.</u>		SIGNATURE: <u><i>Jeanne LeFebvre</i></u>		

NAME OF DAM: <u>Colburn Street Dam</u>		STATE ID #: <u>6-11-73-2</u>	
INSPECTION DATE: <u>January 26, 2018</u>		NID ID #: <u>MA02571</u>	
OWNER: ORGANIZATION	<u>Town of Dedham</u>	CARETAKER: ORGANIZATION	<u>Town of Dedham</u>
NAME/TITLE	<u>James Kern, Town Manager</u>	NAME/TITLE	<u>Jason Mammone, P.E., Town Engineer</u>
STREET	<u>36 Bryant Street</u>	STREET	<u>55 River Street</u>
TOWN, STATE, ZIP	<u>Dedham, MA 02026</u>	TOWN, STATE, ZIP	<u>Dedham, MA 02026</u>
PHONE	<u>(781) 751-9100</u>	PHONE	<u>781-751-9352</u>
EMERGENCY PH. #	<u></u>	EMERGENCY PH. #	<u></u>
FAX	<u></u>	FAX	<u></u>
EMAIL	<u>jkern@dedham-ma.gov</u>	EMAIL	<u>jmammone@dedham-ma.gov</u>
OWNER TYPE	<u>Municipality or Political subdivision</u>		
PRIMARY SPILLWAY TYPE <u>Concrete, broad crested weir</u>			
SPILLWAY LENGTH (FT)	<u>100</u>	SPILLWAY CAPACITY (CFS)	<u>1,600</u>
AUXILIARY SPILLWAY TYPE	<u>None</u>	AUX. SPILLWAY CAPACITY (CFS)	<u>NA</u>
NUMBER OF OUTLETS	<u>One</u>	OUTLET(S) CAPACITY (CFS)	<u>included in spillway capacity</u>
TYPE OF OUTLETS	<u>Sluiceway notch in spillway</u>	TOTAL DISCHARGE CAPACITY (CFS)	<u>1,600</u>
DRAINAGE AREA (SQ MI)	<u>0.63</u>	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	<u>100-year/1,500 (estimated)</u>
HAS DAM BEEN BREACHED OR OVERTOPPED	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	IF YES, PROVIDE DATE(S)	<u>Dam is designed for continuous flow over top</u>
FISH LADDER (LIST TYPE IF PRESENT)	<u>None</u>		
DOES CREST SUPPORT PUBLIC ROAD?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	IF YES, ROAD NAME:	<u></u>
PUBLIC BRIDGE WITHIN 50' OF DAM?	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	IF YES, ROAD/BRIDGE NAME:	<u></u>
		MHD BRIDGE NO. (IF APPLICABLE)	<u></u>

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO	ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE					
	2. SURFACE CRACKING					
	3. SINKHOLES, ANIMAL BURROWS					
	4. VERTICAL ALIGNMENT (DEPRESSIONS)					
	5. HORIZONTAL ALIGNMENT					
	6. RUTS AND/OR PUDDLES					
	7. VEGETATION (PRESENCE/CONDITION)					
	8. ABUTMENT CONTACT					
ADDITIONAL COMMENTS:						

Not Applicable to this Structure

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)				
	2. SEEPAGE				
	3. SLIDE, SLOUGH, SCARP				
	4. EMB.-ABUTMENT CONTACT				
	5. SINKHOLE/ANIMAL BURROWS				
	6. EROSION				
	7. UNUSUAL MOVEMENT				
	8. VEGETATION (PRESENCE/CONDITION)				

ADDITIONAL COMMENTS:

Not Applicable to this Structure

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP				
	2. SLOPE PROTECTION TYPE AND COND.				
	3. SINKHOLE/ANIMAL BURROWS				
	4. EMB.-ABUTMENT CONTACT				
	5. EROSION				
	6. UNUSUAL MOVEMENT				
	7. VEGETATION (PRESENCE/CONDITION)				

ADDITIONAL COMMENTS:

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO	ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None				
	2. OBSERVATION WELLS	None				
	3. STAFF GAGE AND RECORDER	None				
	4. WEIRS	None				
	5. INCLINOMETERS	None				
	6. SURVEY MONUMENTS	None				
	7. DRAINS	None				
	8. FREQUENCY OF READINGS	NA				
	9. LOCATION OF READINGS	NA				

ADDITIONAL COMMENTS:

Not Applicable to this Structure

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE				
	2. WALL ALIGNMENT				
	3. WALL CONDITION				
	4. HEIGHT: TOP OF WALL TO MUDLINE				
	5. SEEPAGE OR LEAKAGE				
	6. ABUTMENT CONTACT				
	7. EROSION/SINKHOLES BEHIND WALL				
	8. ANIMAL BURROWS				
	9. UNUSUAL MOVEMENT				
	10. WET AREAS AT TOE OF WALL				
ADDITIONAL COMMENTS:					

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR	
U/S WALLS	1. WALL TYPE					
	2. WALL ALIGNMENT					
	3. WALL CONDITION					
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: _____	max: _____	avg: _____		
	5. ABUTMENT CONTACT					
	6. EROSION/SINKHOLES BEHIND WALL					
	7. ANIMAL BURROWS					
	8. UNUSUAL MOVEMENT					

ADDITIONAL COMMENTS:

Not Applicable to this Structure

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	None observed	X		
	2. FOUNDATION SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. WEIRS	None	X		
	5. DRAINAGE SYSTEM	None	X		
	6. INSTRUMENTATION	None	X		
	7. VEGETATION	Small trees and woody brush		X	
	8. ACCESSIBILITY	Accessible from gate in fence of Condon Park	X		
9. DOWNSTREAM HAZARD DESCRIPTION	Downstream residence on left downstream bank.				
10. DATE OF LAST EAP UPDATE	None				

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS
MISC.	1. RESERVOIR DEPTH (AVG)	Mother Brook impoundment to Maverick Street. Depth not measured.
	2. RESERVOIR SHORELINE	Earth slopes with trees and brush
	3. RESERVOIR SLOPES	Mild to moderate
	4. ACCESS ROADS	Paved
	5. SECURITY DEVICES	Gate in fence at Condon Park is not locked. Access from Colburn Street limited by guard rail.
	6. VANDALISM OR TRESPASS	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO WHAT:
	7. AVAILABILITY OF PLANS	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO DATE: As Built plans dated December 2017
	8. AVAILABILITY OF DESIGN CALCS	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO DATE: Calculation updated August 2017
	9. AVAILABILITY OF EAP/LAST UPDATE	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO DATE: None
	10. AVAILABILITY OF O&M MANUAL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO DATE: None
	11. CARETAKER/OWNER AVAILABLE	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO DATE: Throughout rehabilitation project in 2017.
	12. CONFINED SPACE ENTRY REQUIRED	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO PURPOSE:

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete and stone masonry	X		
	WEIR TYPE	Broad crested weir	X		
	SPILLWAY CONDITION	Satisfactory	X		
	TRAINING WALLS	none			
	SPILLWAY CONTROLS AND CONDITION	none			
	UNUSUAL MOVEMENT	none observed			
	APPROACH AREA	clear with vegetated bank	X		
	DISCHARGE AREA	Riprap and bedrock in brook channel.	X		
	DEBRIS	Some debris (limbs, branches, etc) caught on spillway crest		X	
	WATER LEVEL AT TIME OF INSPECTION	3 inches over spillway			

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO	ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE					
	WEIR TYPE					
	SPILLWAY CONDITION					
	TRAINING WALLS					
	SPILLWAY CONTROLS AND CONDITION					
	UNUSUAL MOVEMENT					
	APPROACH AREA					
	DISCHARGE AREA					
	DEBRIS					
	WATER LEVEL AT TIME OF INSPECTION					

ADDITIONAL COMMENTS:

Not Applicable to this Structure

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	Sluiceway notch in crest of dam.			
	INTAKE STRUCTURE	Open notch in crest of dam.	X		
	TRASHRACK	None	X		
	PRIMARY CLOSURE	Aluminum stop logs (Note 1)	X		
	SECONDARY CLOSURE	None	X		
	CONDUIT	Sluiceway notch	X		
	OUTLET STRUCTURE/HEADWALL	Downstream face of dam	X		
	EROSION ALONG TOE OF DAM	Repaired in 2017 using graded filter and riprap scour protection	X		
	SEEPAGE/LEAKAGE	None observed.	X		
	DEBRIS/BLOCKAGE	Tree branches, limbs, and debris caught on stop logs		X	
	UNUSUAL MOVEMENT	None observed.	X		
	DOWNSTREAM AREA	Riprap scour protection placed in 2017	X		
MISCELLANEOUS					

ADDITIONAL COMMENTS: 1. No access to stop logs under normal flow conditions.

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

CONCRETE/MASONRY DAMS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE	Mortared stone masonry and concrete			
	AVAILABILITY OF PLANS	As-built plans dated December 2017	X		
	AVAILABILITY OF DESIGN CALCS	Calculation package updated 8/24/17	X		
	PIEZOMETERS	None	X		
	OBSERVATION WELLS	None	X		
	INCLINOMETERS	None	X		
	SEEPAGE GALLERY	None	X		
	UNUSUAL MOVEMENT	None observed.	X		

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	Concrete cap (also referred to as primary spillway)			
	SURFACE CONDITIONS	Newly rehabilitated, no deficiencies observed	X		
	CONDITIONS OF JOINTS	Newly rehabilitated, no deficiencies observed	X		
	UNUSUAL MOVEMENT	None observed	X		
	HORIZONTAL ALIGNMENT	Good - no evidence of misalignment	X		
	VERTICAL ALIGNMENT	No vertical misalignment observed	X		

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	Stone masonry			
	SURFACE CONDITIONS	Satisfactory	X		
	CONDITIONS OF JOINTS	Satisfactory	X		
	UNUSUAL MOVEMENT	None observed	X		
	ABUTMENT CONTACT	Satisfactory	X		
	LEAKAGE	None observed	X		

ADDITIONAL COMMENTS: _____

NAME OF DAM: Colburn Street Dam

STATE ID #: 6-11-73-2

INSPECTION DATE: January 26, 2018

NID ID #: MA02571

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	Concrete facing			
	SURFACE CONDITIONS	Satisfactory	X		
	CONDITIONS OF JOINTS	Satisfactory	X		
	UNUSUAL MOVEMENT	None observed	X		
	ABUTMENT CONTACTS	Satisfactory	X		

ADDITIONAL COMMENTS: _____

APPENDIX C
Previous Reports and References

PREVIOUS REPORTS AND REFERENCES

The following is a list of reports that were located during the file review, or were referenced in previous reports.

1. Anderson-Nichols & Co., Inc. (1973). "Mother Brook Flood Control Feasibility Study," February.
2. Anderson-Nichols & Co., Inc. (1976). "Mother Brook Flood Control Project, Reach 2, Colburn Street Dam Rehabilitation, Plans, Sections, & Details," August.
3. Weston & Sampson (2006). "Colburn Street Dam, Phase I, Inspection/Evaluation Report," May 23.
4. GZA GeoEnvironmental, Inc. (2013). "Colburn Street Dam, Follow-Up Inspection/Evaluation Report," July 15.
5. GEI Consultants, Inc. (2016). "Colburn Street Dam Geotechnical Services Report," March 31.
6. Dewberry (2016). "Colburn Street Dam, Phase II Investigation Report," March 31.
7. GEI Consultants, Inc. (2017). "Colburn Street Dam, Stability Analysis – Final Design," March 20.
8. GEI Consultants, Inc. (2017). "Colburn Street Dam, Stability Analysis – Revised Calculations," August 24.
9. As-Built Construction Drawings for "Colburn Street Dam Rehabilitation Project," December 2017.
10. Dewberry Inspector's Daily Reports, Colburn Street Dam Rehabilitation, August 17, 2017 to October 30, 2017.
11. Dewberry, Construction Photo Log, Colburn Street Dam Rehabilitation, December 2017.

The following references were used during the preparation of this report and the development of recommendations herein.

1. U.S. Bureau of Reclamation. (1987). "Design of Small Dams," U.S. Department of the Interior, Third Edition.

APPENDIX D
Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to 302 CMR 10.00 Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA. Please note should discrepancies between definitions exist, those definitions included within 302 CMR 10.00 govern for dams located within the Commonwealth of Massachusetts.

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 permanent 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 a 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 structures, either in dams or separate therefrom, including but not be limited to, spillways; reservoirs and their rims; low-level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

Size Classification

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

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

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

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

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

Hazard Classification

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

High Hazard (Class I) – Shall mean dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

Significant Hazard (Class II) – Shall mean dams located where failure may cause loss of life and damage to home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause the interruption of the use or service of relatively important facilities.

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

General

EAP – Emergency Action Plan – Shall mean a predetermined (and properly documented) 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 failure.

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 unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre feet.

Height of Dam (Structural Height) – 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 lowest point on the crest of the dam.

Hydraulic Height – means the height to which water rises behind a dam and the difference between the lowest point in the original streambed at the axis of the dam and the maximum controllable water surface.

Maximum Water Storage Elevation – means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.

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, and for determining maximum temporary storage and height of dam requirements.

Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation.

Normal Storage Capacity – The volume of water contained in the impoundment at normal water storage elevation.

Condition Rating

Unsafe – Major structural*, operational, and maintenance deficiencies exist under normal operating conditions.

Poor – Significant structural*, operation and maintenance deficiencies are clearly recognized for normal loading conditions.

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.

Satisfactory – Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.

Good – No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.

* Structural deficiencies include but are not limited to the following:

- Excessive uncontrolled seepage (e.g., upwelling of water, evidence of fines movement, flowing water, erosion, etc.)
- Missing riprap with resulting erosion of slope
- Sinkholes, particularly behind retaining walls and above outlet pipes, possibly indicating loss of soil due to piping, rather than animal burrows
- Excessive vegetation and tree growth, particularly if it obscures features of the dam and the dam cannot be fully inspected
- Deterioration of concrete structures (e.g., exposed rebar, tilted walls, large cracks with or without seepage, excessive spalling, etc.)
- Inoperable outlets (gates and valves that have not been operated for many years or are broken)