is critically undersized. The crossing lacks sufficient hydraulic capacity to pass the 10-year peak flow under existing conditions, and is therefore also undersized for larger peak flows as well as expected increases in extreme flows under projected future climate conditions.

Proposed Concept

Replace the existing undersized culvert with a 7.5-foot wide open-bottom arch to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Realign the crossing to better match the existing stream channel alignment. Reconstruct the stream banks and channel at and within the crossing to match the existing stream channel up and downstream of the crossing.

- Provide increased hydraulic capacity to reduce flooding risk
- Reduce geomorphic risk associated with poor crossing alignment and freefall condition
- Protect outlet and surrounding intersection from scour

4.1.3 Blood Road

Site Description

Blood Road crosses an unnamed stream approximately 0.6 miles north of Saundersdale Road. The crossing consists of a single, 30-foot long, 1.5-foot diameter smooth plastic pipe (Figure 15). There is a small dam, approximately 2-feet in height located 10-feet upstream of the crossing. Bankfull width could not be measured at this location due to the density of invasive multiflora rose on the downstream side of the crossing; however based on visual assessment, the degree of constriction was rated as moderate. The structure had both an inlet drop, and a freefall condition at the outlet, with a drop of 1.2 feet from the pipe to the stream bottom. Structural condition was not a major concern at this crossing, but geomorphic risks were considered moderate, and the crossing was rated poorly for hydraulic capacity. The existing structure is undersized for the 10-year peak flow under existing conditions, and is therefore also undersized for larger peak flows as well as expected increases in extreme flows under projected future climate conditions.

Figure 15. View of freefall condition at existing crossing outlet taken during field assessment on October 16, 2018.

Proposed Concept

Evaluate removal of the upstream, non-jurisdictional dam and replace the existing undersized culvert with an embedded box culvert sized to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards (based on available information, it is estimated that the structure will need to be approximately 4-feet wide).

- Provide increased hydraulic capacity to reduce risks from road overtopping
- Reduce geomorphic risk associated with inlet drop and freefall conditions
- Reduce risk of flooding associated with potential dam failure

4.1.4 Center Depot Road

Site Description

Center Depot Road crosses an unnamed stream approximately just northwest of Stafford Street. At the time of field assessment, the structure inlet was completely submerged, and the outlet was partially submerged (Figure 16). The outlet was observed to be a 2-foot diameter concrete pipe, representing a severe constriction relative to the stream's 6-foot bankfull width (note that in the immediate vicinity of the crossing, the bankfull width was measured at approximately 12 feet, likely due to backwatering from the nearby, downstream Stafford Street crossing). In addition to the geomorphic risk and barriers to wildlife passage associated with this level of constriction, the existing structure is undersized for the 10-year peak flow under existing conditions, and is therefore also undersized for larger peak flows as well as expected increases in extreme flows under projected future climate conditions.

Proposed Concept

Replace the existing undersized culvert with a 7.5-foot wide embedded box culvert to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards.

- Provide increased hydraulic capacity to reduce risks from road overtopping
- Eliminate the observed backwater condition which is resulting from insufficient structure capacity
- Improve aquatic and terrestrial passage

Figure 16. View of partially-submerged outlet at existing crossing taken during field assessment on October 31, 2018.

4.1.5 Freeman Road

Site Description

Freeman Road crosses an unnamed stream just south of Mugget Hill Road and approximately 600 feet from Wabash Pond. The crossing consists of a 2.5-foot wide, corrugated metal elliptical arch pipe set into a concrete headwall (Figure 17). The structure is severely constricting relative to the stream's 8-foot bankfull width. The constricted condition has led to the formation of a large downstream scour pool and deposition of sediment both upstream and downstream of the crossing. Structural condition was rated as adequate for all assessed features. The existing crossing is sized to pass the 10-year peak flow, but is undersized for larger peak flows and for future climate conditions.

Proposed Concept

Replace the existing undersized culvert with a 10-foot wide embedded box culvert to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Restore the stream banks and stream channel to repair scour.

- Provide increased hydraulic capacity to reduce risks of flooding
- Reduce the potential for scour and erosion and associated geomorphic risk by reducing constriction
- Improve hydrologic connectivity of the upstream and downstream ecosystems

Figure 17. View of outlet and scour pool at existing crossing taken during field assessment on October 18, 2018.

4.2 Top Priority Crossings—Town of Spencer

4.2.1 Wire Village Road

Site Description

Wire Village Road crosses an unnamed tributary to Turkey Hill Brook (xy42267367198603). The crossing consists of a single, 37-foot long, 2-foot diameter corrugated metal pipe which projects out from the embankment at the outlet and terminates in a 3.7 foot freefall onto a cascade of rocks to reach the stream bottom (Figure 18). The structure severely constricts the stream's 14-foot bankfull width. These combined conditions present significant barriers to aquatic passage at a site which has a high Index of Ecological Integrity rating, an indicator of stream habitat quality and overall ecological benefit of removing an existing barrier. Embankment piping was also noted during the field assessment,

Figure 18. View of outlet freefall condition looking downstream from existing crossing outlet during field assessment on November 6, 2018.

which resulted in an elevated structural risk score. The existing structure is undersized for all evaluated return interval peak flows, including the existing 10-year peak flow.

Proposed Concept

Replace the existing undersized culvert with a 17-foot span bridge to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Reconstruct the stream channel and banks through the crossing to match the existing channel and banks, including stream substrate and slope.

- Provide increased hydraulic capacity to reduce risks from flooding and road overtopping
- Reduce geomorphic risk associated with freefall conditions and the fact that the crossing slope is significantly less than that of the natural channel
- Eliminate a significant barrier to aquatic passage in a high-value habitat area

4.2.2 Elm Street

Site Description

Elm Street crosses an unnamed tributary to the Sevenmile River approximately 300 feet south of Route 9. Because of its location in a densely developed town center area, the crossing received one of the highest scores for flood impact potential across all assessed structures. The crossing consists of two concrete box culverts, each of which is 5 feet wide and 3.3 feet high. The structures outlet to a freefall of nearly 12 feet to reach the stream bottom (Figure 19). This creates an insurmountable barrier for aquatic wildlife. The stream is also channelized between concrete walls in the area immediately downstream of the crossing. There were no concerns recorded relative to structural condition, and the crossing's two structures provide adequate width to approximately match the stream's bankfull width. Hydraulically, however, the existing crossing is undersized for all evaluated return interval peak flows, including the existing 10-year peak flow. There is a mapped FEMA 100-year flood zone located approximately 2,500 feet downstream of the crossing.

Figure 19. View of freefall condition at existing crossing outlet during field assessment on November 12, 2018.

Proposed Concept

Replace the existing undersized culvert with a bridge of minimum 12-foot span to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Reconstruct the stream channel and banks through the crossing to match the

existing channel and banks, including stream substrate and slope. Lower the invert to facilitate limited aquatic passage.

- Provide increased hydraulic capacity to accommodate peak flows and reduce risks from flooding
- Reduce geomorphic risk associated with freefall conditions and the fact that the crossing slope is significantly less than that of the natural channel
- Provided limited improvements to aquatic passage

4.2.3 Water Street

Site Description

Water Street crosses an unnamed tributary to the Sevenmile River approximately 500 feet southeast of Route 9 (as the crow flies), and just west of the intersection of Water Street and Valley Street. The crossing's outlet consists of a 4-foot diameter, round concrete pipe. The inlet was unassessed, as the culvert is buried under an adjacent factory/warehouse building located at 1 Water Street. Based on aerial imagery, the inlet appears to be located on private property at or near the rear of the building. Field assessment indicates that the structure changes material approximately 30 feet from the outlet. The material further inside could not be identified with certainty, but appeared to be metal. It was noted that rock and sediment are collapsing in on the structure; structural integrity of the culvert barrel was therefore rated as critical and deformation was evident within the structure. The crossing severely constricts the channel's 15-foot bankfull width, and both a large scour pool and downstream sediment deposition were present at the crossing. The structure length is estimated from aerial imagery to be at minimum 120 feet; there is a freefall condition at the outlet with a drop of 1.2 feet to the stream bottom (Figure 20). Hydraulic capacity could not be calculated due to the limited data available at this site. However, based on the partial information collected for the outlet and the estimated peak flow rates at the crossing, it is anticipated that the existing crossing is undersized for the 10-year and larger peak flows, as well as for future climate conditions. Because of its location in Spencer's densely developed town center area, the crossing received one of the highest scores for flood impact potential across all assessed structures. There is a mapped FEMA 100-year flood zone located approximately 950 feet downstream of the crossing.

Figure 20. View of freefall condition at existing crossing outlet during field assessment on November 15, 2018.

Proposed Concept

Due to the nature of the site, it is likely that any proposed replacement of the Water Street crossing will need to be done in conjunction with redevelopment of the site at 1 Water Street. If such redevelopment were to occur in the future, the Town should evaluate a stream re-alignment and/or daylighting project that allows the stream to flow at its full 15-foot bankfull width. The proposed replacement crossing at Water Street should consist of an 18-foot span bridge or open-bottom arch to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. The stream channel and banks should be reconstructed to match the existing upstream and downstream channel and banks, including stream substrate and slope.

- Provide increased hydraulic capacity to accommodate peak storm flows and reduce risks from flooding
- Eliminate a significant barrier to aquatic passage and improve habitat quality
- Provide green space in the town center area
- Provide additional flood storage and slow flows upstream of a FEMA-designated 100-year flood zone

4.2.4 Mill Street

Site Description

Mill Street crosses an unnamed tributary to the Sevenmile River approximately 270 feet from Route 9, and 125 feet west of Valley Street. The crossing consists of a 4-foot diameter, round concrete pipe which severely constricts the channel's 10-foot bankfull width (Figure 21). A freefall onto cascade at the outlet, downstream scour pool, and high bank erosion along the channelized stream contribute to high geomorphic risk at this crossing. The channel banks have been armored with large rip rap in an attempt to control erosion. Hydraulically, the structure is undersized for all evaluated return interval peak flows, including the 10-year peak flow and is expected to become further undersized relative to future climate conditions. Because of its location in Spencer's densely developed town center area (and between adjacent high priority crossings both upstream and downstream), the crossing received one of the highest scores for flood impact potential across all assessed structures. There is a mapped FEMA 100-year flood zone located approximately 1,500 feet downstream of the crossing.

Figure 21. View of existing crossing inlet during field assessment on November 15, 2018.

Proposed Concept

Replace the existing undersized culvert with a 12-foot wide open-bottom arch to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing

Standards. Reconstruct the stream channel and banks through the crossing to match the existing channel and banks, including stream substrate and slope.

- Provide increased hydraulic capacity to accommodate peak flows and reduce risks from flooding
- Reduce the potential for scour and erosion and associated geomorphic risk by reducing constriction

4.2.5 May Street

Site Description

May Street crosses an unnamed tributary to the Sevenmile River mid-way between Cherry Street and Holmes Street, approximately 1,000 feet south of Route 9. This crossing is not located on a mapped stream, but was identified by field staff while conducting assessments at other crossings in the neighborhood. The crossing is located approximately 1,000 feet upstream of Muzzy Lake, which is mapped as a FEMA-designated 100-year flood zone. The crossing consists of two corrugated metal pipes, one of 1.5-foot diameter, and a second pipe which appeared to be a round pipe, but had been crushed, yielding effective dimensions of 3-feet wide by 2-feet high (Figure 22). The combined 4.5-foot width of the two culverts is severely constricting relative to the 8-foot bankfull width of the channel. A freefall at the outlet of the smaller pipe drops 1 foot to the stream bottom. There is an additional drainage pipe which empties into the smaller culvert inside the pipe; its origin could not be determined. A downstream scour pool, and sediment deposition both upstream and downstream of the crossing are indicative of high geomorphic risk at this location. Hydraulically, the crossing is significantly undersized for all evaluated return interval peak flows, including the 10-year peak flow. Note that the peak flow estimates and hydraulic capacity analysis do not account for additional flows entering the smaller culvert from the contributing storm drainage pipe. Because of its location in Spencer's densely developed town center area, the crossing received one of the highest scores for flood impact potential across all assessed structures.

Figure 22. View of existing crossing inlet during field assessment on November 8, 2018.

Proposed Concept

Replace the existing undersized culvert with a 10-foot wide embedded box culvert to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Reconstruct the stream channel and banks through the crossing to match the existing channel and banks, including stream substrate and slope. Determine the contributing drainage area for the drainage pipe that empties into the smaller of the two stream

culverts and investigate green infrastructure opportunities to infiltrate or retain this water upstream.

- Provide increased hydraulic capacity to accommodate peak flows and reduce risks from flooding
- Reduce the potential for scour and erosion and associated geomorphic risk by reducing constriction
- Reduce additional pressure on the crossing capacity from contributing drainage flows, decrease peak flows, and potentially improve water quality in the stream.

4.2.6 Valley Street

Site Description

Valley Street crosses an unnamed tributary to the Sevenmile River approximately 300 feet from Route 9, and 220 feet west of Elm Street. The Valley Street crossing is just 200 feet downstream of the high-priority Elm Street crossing. The crossing consists of a 6.5-foot wide by 5.5 foot tall concrete box/bridge (Figure 23). The stream enters the inlet at a sharp bend due to poor alignment of the structure, roadway, and stream. Bankfull width at this location was measured to be 28 feet, although this assessment may be unduly influenced by the proximity of the adjacent crossings and the extensive channelization and armoring of the stream; although the true bankfull width may be narrower, the crossing is believed to severely constrict the stream. A secondary structure enters just below the crossing outlet (at left in Figure 23); that structure's origination point is unknown. Both the crossing and secondary structure are flanked by concrete wingwalls and there is considerable bank armoring downstream of the crossing. The upstream channel is also directed into the crossing inlet by concrete wingwalls and armored with large riprap. Hydraulically, the structure is sized to pass the existing 25-year peak flow, but is undersized for the larger return interval peak flows that were evaluated, and is expected to be undersized for all but the 10-year peak flow under future climate conditions. The crossing also received high structural risk scores due to erosion and undermining of the concrete footings (Figure 24), poor alignment, and condition of the wingwalls and armoring. Because of its location in Spencer's densely developed town center area (and between adjacent high priority crossings both upstream and downstream), the crossing received one of the highest scores for flood impact potential across all assessed structures. There is a mapped FEMA 100-year flood zone located approximately 2,200 feet downstream of the crossing.

Figure 24. View of undermining and erosion of concrete structure during field assessment on November 12, 2018.

Proposed Concept

Replace the existing undersized crossing with a 12-foot span bridge (this value should be adjusted to match more detailed assessment of bankfull width) to accommodate the 1.2 times bankfull width design standard of the Massachusetts River and Stream Crossing Standards. Reconstruct the stream channel and banks through the crossing to match the existing channel and banks, including stream substrate and slope. Determine the origin of the secondary pipe and evaluate green infrastructure or other opportunities to infiltrate or retain this water upstream, and redesign the crossing to better integrate the two structures.

- Improve alignment of the stream with the crossing to reduce geomorphic risk
- Provide increased hydraulic capacity to accommodate peak flows and reduce risks from flooding
- Alleviate failure risks due to undermining of the structure
- Explore potential to decrease peak flows by reducing contributions from the secondary structure

Appendix A

Stream Crossing Survey Field Data Form (blank)

FUSS & O'NEILL

Road-Stream Crossing Assessment Field Data Form

QA/QC INITIALS: _____ DATE: _____

Status ___ FINAL ___ FOLLOW-UP

CROSSING DATA

pp. 4-5

Crossing Code _____ State or Local ID/Name _____ Date _____ Start Time _____ AM / PM

Lead Field Data Collector _____ Asst. Field Data Collectors _____ End Time _____ AM / PM

Municipality _____ County _____ Stream _____

Road _____ Type ☐ MULTI-LANE ☐ PAVED ☐ UNPAVED ☐ DRIVEWAY ☐ TRAIL ☐ RAILROAD

GPS Coordinates (Decimal degrees) ☐☐.☐☐☐☐☐ °N Latitude — ☐☐.☐☐☐☐☐ °W Longitude

Location Description _____

pp. 5-7

Crossing Type ☐ BRIDGE ☐ CULVERT ☐ MULTIPLE CULVERT ☐ FORD ☐ NO CROSSING ☐ REMOVED CROSSING ☐ BURIED STREAM ☐ INACCESSIBLE ☐ PARTIALLY INACCESSIBLE ☐ NO UPSTREAM CHANNEL ☐ BRIDGE ADEQUATE

Number of Culverts / Cells

Photo #_____ INLET Photo #_____ OUTLET Photo #_____ _____ Photo #_____ _____

Photo #_____ UPSTREAM Photo #_____ DOWNSTREAM Photo #_____ _____ Photo #_____ _____

Photo #_____ ROADWAY Photo #_____ _____ Photo #_____ _____ Photo #_____ _____

Flow Condition ☐ NO FLOW ☐ TYPICAL-LOW ☐ MODERATE ☐ HIGH

Road-Killed Wildlife _____ or None

Visible Utilities ☐ OVERHEAD WIRES ☐ WATER/SEWER PIPES ☐ GAS LINE ☐ NONE ☐ OTHER _____

pp. 9-12

Alignment ☐ SHARP BEND ☐ MILD BEND ☐ NATURALLY STRAIGHT ☐ CHANNELIZED STRAIGHT

Road Fill Height _____ Road Crest Height _____

Bankfull Width_____ Confidence ☐ HIGH ☐ LOW/ESTIMATED

Constriction ☐ SEVERE ☐ MODERATE ☐ SPANS ONLY BANKFULL/ACTIVE CHANNEL ☐ SPANS FULL CHANNEL & BANKS

Tailwater Scour Pool ☐ NONE ☐ SMALL ☐ LARGE

HY-8

pp. 8, 13-15

Using HY-8? ☐ YES ☐ NO

Estimated Overtopping Length _____ Crest Width _____

Road Surface Type ☐ PAVED ☐ GRAVEL ☐ GRASS

Channel Slope_____

Side Slope ☐ 5:1 ☐ 4:1 ☐ 3:1 ☐ 2:1 ☐ 1:1 ☐ 0.5:1 ☐ steeper than 0.5:1

Stream Substrate ☐ MUCK/SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

GEO.

pp. 13

Bank Erosion ☐ HIGH ☐ LOW ☐ ESTIMATED ☐ NONE

Significant Break in Valley Slope ☐ YES ☐ NO ☐ UNKNOWN

Sediment Deposition ☐ UPSTREAM ☐ DOWNSTREAM ☐ WITHIN STRUCTURE ☐ NONE

Elevation of Sediment Deposits >= 1/2 Bankfull Height ☐ YES ☐ NO

TIDAL

pp. 16-18

Tidal? ☐ YES ☐ NO ☐ UNKNOWN

Tide Chart Location _____

Tide Prediction _____:_____ AM / PM

Tide Stage ☐ LOW SLACK TIDE ☐ LOW EBB TIDE ☐ LOW FLOOD TIDE ☐ UNKNOWN ☐ OTHER _____

Vegetation Above/Below ☐ COMPARABLE ☐ SLIGHTLY DIFFERENT ☐ MODERATELY DIFFERENT ☐ VERY DIFFERENT ☐ UNKNOWN

Tide Gate Type ☐ NONE ☐ STOP LOGS ☐ FLAP GATE ☐ SLUICE GATE ☐ SELF-REGULATING ☐ OTHER _____

Tide Gate Severity ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE ☐ NO AQUATIC PASSAGE

CROSSING COMMENTS

pp. 5

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FORM PUBLISHED: OCTOBER 18, 2018

FORM ADAPTED BY FUSS & O'NEILL, INC. (WITH PERMISSION) FROM THE NAACC AQUATIC CONNECTIVITY STREAM CROSSING SURVEY DATA FORM

STRUCTURE 1

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

pp. 44

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FORM PUBLISHED: OCTOBER 18, 2018

STRUCTURE 2

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

pp. 44

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FORM PUBLISHED: OCTOBER 18, 2018

STRUCTURE 3

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

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STRUCTURE 4

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

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STRUCTURE 5

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

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STRUCTURE 6

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

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STRUCTURE 7

pp. 19-35

OUTLET

Structure Material ☐ SMOOTH PLASTIC ☐ CORRUGATED PLASTIC ☐ SMOOTH METAL ☐ CORRUGATED METAL ☐ CONCRETE ☐ WOOD ☐ ROCK/STONE ☐ FIBERGLASS ☐ COMBINATION

Outlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED Outlet Armoring ☐ NONE ☐ NOT EXTENSIVE ☐ EXTENSIVE

Outlet Grade (Pick one) ☐ AT STREAM GRADE ☐ FREE FALL ☐ CASCADE ☐ FREE FALL ONTO CASCADE ☐ UNKNOWN

Outlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

Outlet Drop to Water Surface_____.____ Outlet Drop to Stream Bottom_____.____ E. Abutment Height (Type 7 bridges only)_____.____

L. Structure Length (Overall length from inlet to outlet)_____.____

INLET

pp. 35-43

Inlet Shape ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ FORD ☐ UNKNOWN ☐ REMOVED

Inlet Type ☐ PROJECTING ☐ HEADWALL WITH SQUARE EDGE ☐ HEADWALL WITH GROOVED EDGE ☐ HEADWALL WITH SQUARE EDGE AND WINGWALLS ☐ HEADWALL WITH GROOVED/BEVELED EDGE AND WINGWALLS ☐ MITERED TO SLOPE ☐ OTHER ☐ NONE

Inlet Grade (Pick one) ☐ AT STREAM GRADE ☐ INLET DROP ☐ PERCHED ☐ CLOGGED/COLLAPSED/SUBMERGED ☐ UNKNOWN

Inlet Dimensions A. Width_____.____ B. Height_____.____ C. Substrate/Water Width_____.____ D. Water Depth_____.____

ADDITIONAL CONDITIONS

pp. 43-56

Slope % _____ Slope Confidence ☐ HIGH ☐ LOW Internal Structures ☐ NONE ☐ BAFFLES/WEIRS ☐ SUPPORTS ☐ OTHER_____

Structure Substrate Matches Stream ☐ NONE ☐ COMPARABLE ☐ CONTRASTING ☐ NOT APPROPRIATE ☐ UNKNOWN

Structure Substrate Type (Pick one) ☐ NONE ☐ SILT ☐ SAND ☐ GRAVEL ☐ COBBLE ☐ BOULDER ☐ BEDROCK ☐ UNKNOWN

Structure Substrate Coverage ☐ NONE ☐ 25% ☐ 50% ☐ 75% ☐ 100% ☐ UNKNOWN

Physical Barriers (Pick all that apply) ☐ NONE ☐ DEBRIS/SEDIMENT/ROCK ☐ DEFORMATION ☐ FREE FALL ☐ FENCING ☐ DRY ☐ OTHER

Severity (Choose carefully based on barrier type(s) above) ☐ NONE ☐ MINOR ☐ MODERATE ☐ SEVERE

Water Depth Matches Stream ☐ YES ☐ NO-SHALLOWER ☐ NO-DEEPER ☐ UNKNOWN ☐ DRY

Water Velocity Matches Stream ☐ YES ☐ NO-FASTER ☐ NO-SLOWER ☐ UNKNOWN ☐ DRY

Dry Passage through Structure? ☐ YES ☐ NO ☐ UNKNOWN Height above Dry Passage_____

STRUCTURAL CONDITION ASSESSMENT

pp. 57-70

	INLET					OUTLET				
	Adequate	Poor	Critical	Unknown	N/A	Adequate	Poor	Critical	Unknown	N/A
Longitudinal Alignment										
Level of Blockage										
Flared End Section										
Invert Deterioration										
Buoyancy or Crushing										
Cross-Section Deformation										
Structural Integrity of Barrel										
Joints and Seams										
Footings										
Headwall/Wingwalls										
Armoring										
Apron/Scour Protection										
Embankment Piping										

STRUCTURE COMMENTS

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Structure Shape & Dimensions

1) Select the Structure Shape number from the diagrams below and record it on the form for Inlet and Outlet Shape.

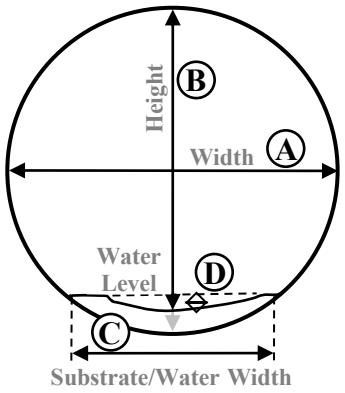
2) Record on the form in the appropriate blanks dimensions **A, B, C** and **D** as shown in the diagrams;
C captures the width of water or substrate, whichever is wider; for dry culverts without substrate, C = 0.
D is the depth of water -- be sure to measure inside the structure; for dry culverts, D = 0.

3) Record Structure Length (**L**) . (Record abutment height (**E**) only for Type 7 Structures.)

4) For multiple culverts, also record the Inlet and Outlet shape and dimensions for each additional culvert.

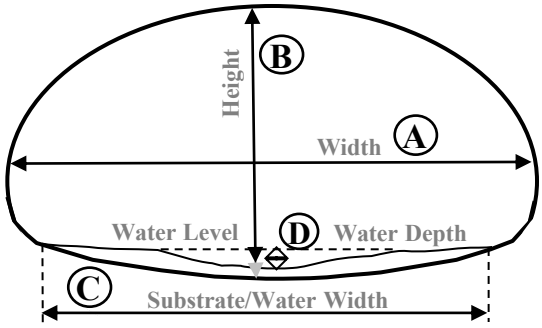
NOTE: Culverts 1, 2 & 4 may or may not have substrate in them, so height measurements (B) are taken from the level of the "stream bed", whether that bed is composed of substrate or just the inside bottom surface of a culvert (grey arrows below show measuring to bottom, black arrows show measuring to substrate).

1



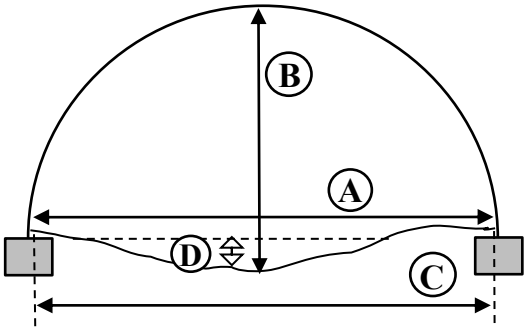
Round Culvert

2



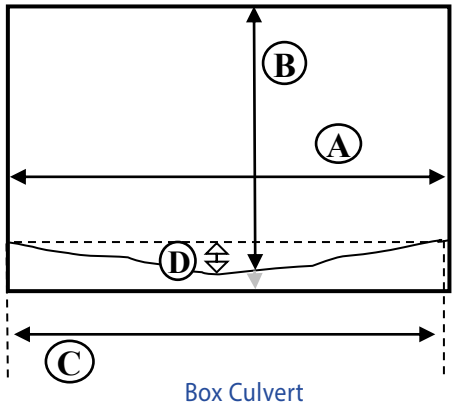
Pipe Arch/Elliptical Culvert

3



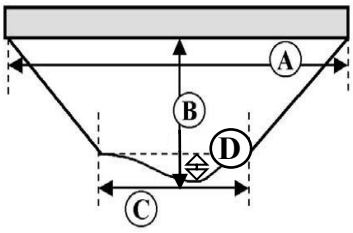
Open Bottom Arch Bridge/Culvert

4



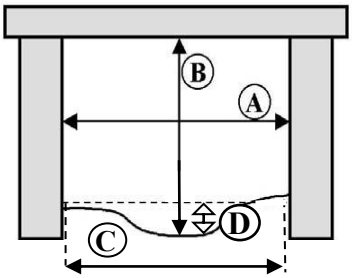
Box Culvert

5



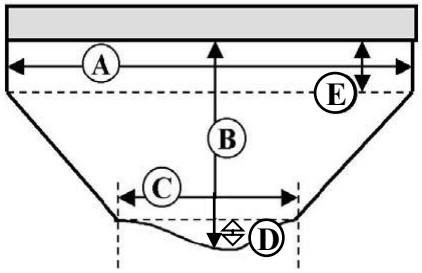
Bridge with Side Slopes

6



Box/Bridge with Abutments

7



Bridge with Abutments and Side Slopes

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Appendix B

Road-Stream Crossing Scoring and Prioritization Results

Appendix B—Table 1. Road-Stream Crossing Scoring and Prioritization Results, organized by watershed and overall crossing priority scores. (Page 1 of 4)

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Existing Hydraulic Risk Score-Binned	Future Hydraulic Risk Score-Binned	Geomorphic Vulnerability Score	Structural Condition Score	Transportation Disruption Score	Flood Impact Potential Score	AOP Score	Ecological Benefit Score	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42162777192843	A Young Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	3	5	3	3	15	15	12	15	15	15	30	0.6	High
xy42165477195502	Cemetery Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	1	3	5	3	3	15	15	9	15	15	15	30	0.6	High
xy42142557192428	Richardson Corner Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	3	5	1	3	5	3	3	9	12	9	15	15	15	30	0.6	High
xy42136897194127	Morton Station Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	3	5	1	2	5	3	2	6	8	6	10	15	10	27.5	0.55	High
xy42161267193605	Dodge Rd	Charlton	Unnamed	Buffumville Lake-Little R.	4	5	3	5	1	3	3	3	3	12	15	9	15	9	15	27	0.54	Medium
xy42165247193920	Dodge Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	3	3	3	3	15	15	9	6	9	15	27	0.54	Medium
xy42111087192074	Private driveway	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	2	2	1	3	3	3	3	15	15	6	6	9	15	27	0.54	Medium
xy42164887195042	Stafford St	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	3	2	3	3	3	15	15	9	15	9	15	27	0.54	Medium
xy42178517192861	Stafford St	Charlton	Unnamed into Tucker Pond	Buffumville Lake-Little R.	5	5	3	5	3	2	3	3	3	15	15	9	15	9	15	27	0.54	Medium
xy42137617192118	Turner Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	1	3	2	4	3	15	15	9	15	8	15	26.5	0.53	Medium
xy42165297194876	Stafford St	Charlton	Little River	Buffumville Lake-Little R.	2	3	4	5	3	2	2	4	3	6	9	12	15	8	15	26.5	0.53	Medium
xy42175037195644	Cemetery Road	Charlton	Little River	Buffumville Lake-Little R.	5	5	4	5	1	1	4	4	1	5	5	4	5	16	5	26.5	0.53	Medium
xy42158387195549	Northside Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	3	2	3	3	15	15	12	15	6	15	25.5	0.51	Medium
xy42158147196473	J Hammond Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	4	5	1	3	2	3	3	9	12	12	15	6	15	25.5	0.51	Medium
xy42153827193982	Carroll Hill Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	1	5	3	1	5	5	4	5	15	5	25	0.5	Medium
xy42183977195290	Gould Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	1	5	3	1	5	5	4	5	15	5	25	0.5	Medium
xy42141577195023	Old Worcester Rd	Charlton	Unnamed	Buffumville Lake-Little R.	1	1	4	5	1	1	5	3	1	1	1	4	5	15	5	25	0.5	Medium
xy42128277194621	Bond Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	2	1	1	5	3	1	5	5	4	2	15	5	25	0.5	Medium
xy42152637195905	Northside Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	5	3	1	5	5	3	2	15	5	25	0.5	Medium
xy42162427193267	Hammond Hill Rd	Charlton	Little River	Buffumville Lake-Little R.	1	1	3	5	2	3	1	3	3	3	3	9	15	3	15	24	0.48	Medium
xy42161027196751	Stafford St	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	3	2	3	2	3	3	3	9	12	9	6	9	12	22.5	0.45	Medium
xy42110777191657	AF Putnam Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	4	2	1	3	2	3	3	9	12	12	6	6	12	21	0.42	Medium
xy42131187192927	Richardson Corner Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	2	1	3	3	2	10	10	6	10	9	10	19.5	0.39	Medium
xy42134547194385	Mugget Hill Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	2	2	2	3	2	10	10	6	10	6	10	18	0.36	Medium
xy42132337193594	Oxford Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	2	1	2	3	2	10	10	6	10	6	10	18	0.36	Medium
xy42145557192463	Richardson Corner Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	2	1	1	5	2	1	5	5	4	2	10	5	17.5	0.35	Medium
xy42119277190458	Old Oxford Rd	Charlton	unamed	Buffumville Lake-Little R.	1	1	2	5	1	2	2	2	2	2	2	4	10	4	10	17	0.34	Low
xy42166777192888	Meadow lane	Charlton	Unnamed	Buffumville Lake-Little R.	1	1	3	1	1	3	2	3	3	3	3	9	3	6	9	16.5	0.33	Low
xy42141177195195	Old Worcester Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	4	5	1	2	1	3	2	6	8	8	10	3	10	16.5	0.33	Low
xy42177627196108	Jones Rd	Charlton	Little River	Buffumville Lake-Little R.	1	1	4	5	1	2	1	3	2	2	2	8	10	3	10	16.5	0.33	Low
xy42140307195328	Old Worcester Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	1	2	1	3	2	10	10	6	10	3	10	16.5	0.33	Low
xy42132677194633	Bond Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	2	1	3	2	10	10	6	4	3	10	16.5	0.33	Low
xy42168537194808	Brook Drive	Charlton	Little River	Buffumville Lake-Little R.	5	5	3	2	1	2	1	3	2	10	10	6	4	3	10	16.5	0.33	Low
xy42085247195198	Lallys Lane	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	1	3	3	1	5	5	4	5	9	5	16	0.32	Low
xy42174177196244	Gould Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	4	5	1	1	3	3	1	5	5	4	5	9	5	16	0.32	Low
xy42162747192455	A Young Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	1	1	3	3	1	5	5	3	5	9	5	16	0.32	Low
xy42164797196567	Little Mugget Road	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	3	3	1	5	5	3	2	9	5	16	0.32	Low
xy42202787197525	Bacon Hill Road	Spencer	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	3	3	1	5	5	3	2	9	5	16	0.32	Low
xy42195177197446	East Charlton Road	Spencer	Unnamed	Buffumville Lake-Little R.	5	5	4	1	1	1	3	3	1	5	5	4	1	9	5	16	0.32	Low
xy42112417194562	Bond Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	3	4	2	1	1	3	3	1	3	3	4	2	9	4	15.5	0.31	Low
xy42202297197478	East Charlton Rd	Spencer	Unnamed	Buffumville Lake-Little R.	4	4	3	2	1	1	3	3	1	4	4	3	2	9	4	15.5	0.31	Low
xy42114437193875	Colburn Rd	Charlton	Unnamed	Buffumville Lake-Little R.	2	3	2	2	1	2	2	4	2	4	6	4	4	8	6	15	0.3	Low
xy42149017192219	Bay Path Rd	Charlton	Unnamed	Buffumville Lake-Little R.	3	4	3	2	1	2	2	3	2	6	8	6	4	6	8	15	0.3	Low
xy42142097194565	Old Worcester Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	0	0	1	2	0	0	2	10	10	0	0	0	10	15	0.3	Low
xy42104307192832	Partridge Hill Rd	Charlton	Unnamed	Buffumville Lake-Little R.	4	4	3	1	2	2	1	4	2	8	8	6	2	4	8	14	0.28	Low
xy42095057191520	Potter Village Rd	Charlton	South Fork River	Buffumville Lake-Little R.	3	4	3	1	1	2	1	4	2	6	8	6	2	4	8	14	0.28	Low
xy42111197190203	Dolge Ct	Charlton	Unnamed	Buffumville Lake-Little R.	1	1	3	2	1	2	2	3	2	2	2	6	4	6	6	12	0.24	Low
xy42101607193669	Daniels Road	Charlton	Unnamed	Buffumville Lake-Little R.	2	3	2	2	1	2	2	3	2	4	6	4	4	6	6	12	0.24	Low
xy42164017196151	Stafford St	Charlton	Unnamed	Buffumville Lake-Little R.	2	3	2	1	1	2	2	3	2	4	6	4	2	6	6	12	0.24	Low
xy42109487194331	Daniels Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	5	1	1	2	3	1	5	5	3	5	6	5	11.5	0.23	Low
xy42095727194446	Ramshorn Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	2	3	1	5	5	3	2	6	5	11.5	0.23	Low
xy42157407191542	Oxbow Rd	Charlton	Little River	Buffumville Lake-Little R.	1	1	3	2	1	2	1	4	2	2	2	6	4	4	6	11	0.22	Low
xy42090427193746	Daniels Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	2	2	1	5	5	3	2	4	5	9.5	0.19	Low
xy42112137193176	Colburn Rd	Charlton	Unnamed	Buffumville Lake-Little R.	5	5	3	2	1	1	2	2	1	5	5	3	2	4	5	9.5	0.19	Low
xy42138547191196	Turner Rd	Charlton	Little River	Buffumville Lake-Little R.	5	5	3	1	1	1	1	4	1	5	5	3	1	4	5	9.5	0.19	Low
xy42157197191487	Glenmere	Charlton	Little River	Buffumville Lake-Little R.	1	1	2	1	1	2	1	4	2	2	2	4	2	4	4	8	0.16	Low

Appendix B—Table 1 (continued). Road-Stream Crossing Scoring and Prioritization Results, organized by watershed and overall crossing priority scores. (Page 2 of 4)

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Existing Hydraulic Risk Score-Binned	Future Hydraulic Risk Score-Binned	Geomorphic Vulnerability Score	Structural Condition Score	Transportation Disruption Score	Flood Impact Potential Score	AOP Score	Ecological Benefit Score	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42087307198010	East Baylies Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	4	3	3	4	20	20	12	20	9	20	34.5	0.69	High
xy42156087197349	Stafford St.	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	3	4	3	3	4	20	20	16	8	9	20	34.5	0.69	High
xy42096677198620	Blood Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	4	3	3	4	20	20	12	8	9	20	34.5	0.69	High
xy42156627197367	Center Depot Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	3	4	3	3	4	20	20	12	8	9	20	34.5	0.69	High
xy42130987196310	Freeman rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	4	5	3	1	1	4	3	3	4	16	20	12	4	9	20	34.5	0.69	High
xy42161187200811	Brookfield Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	2	4	2	3	4	20	20	12	20	6	20	33	0.66	High
xy42111857201283	Rt 169/ Southbridge Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	1	4	5	4	3	3	2	4	4	4	16	20	6	20	33	0.66	High
xy42149767198830	City depot rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	3	4	3	5	3	4	1	4	4	12	16	12	20	4	20	32	0.64	High
xy42087757198556	Saundersdale Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	2	1	1	4	1	4	4	20	20	8	4	4	20	32	0.64	High
xy42106617201530	Southbridge Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	2	3	3	5	4	2	2	2	4	8	12	12	20	4	20	32	0.64	High
xy42106447196847	Baylies Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	5	1	3	5	3	3	15	15	12	15	15	15	30	0.6	High
xy42167467200810	Fitzgerald Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	5	1	3	5	3	3	15	15	12	15	15	15	30	0.6	High
xy42162337201150	Jennings Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	0	0	4	5	1	3	5	3	3	0	0	12	15	15	15	30	0.6	High
xy42140167196908	L Stevens rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	1	3	5	3	3	15	15	12	6	15	15	30	0.6	High
xy42114817197758	Flint Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	3	5	3	3	15	15	9	6	15	15	30	0.6	High
xy42086917197636	Saundersdale Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	2	4	2	1	3	5	3	3	3	6	12	6	15	12	28.5	0.57	High
xy42111057198161	Flint Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	3	3	4	3	15	15	9	15	12	15	28.5	0.57	High
xy42132677196532	Old Mugget Hill Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	3	4	3	3	15	15	9	6	12	15	28.5	0.57	High
xy42173857197799	Rt 31	Charlton	Unnamed	Cady Brook-Quinebaug R.	0	0	4	5	1	2	5	3	2	0	0	8	10	15	10	27.5	0.55	High
xy42126877195771	Freeman Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	5	1	3	3	3	3	15	15	12	15	9	15	27	0.54	Medium
xy42161017197470	French Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	3	3	3	3	15	15	9	15	9	15	27	0.54	Medium
xy42162687200688	Fitzgerald Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	3	1	3	3	3	3	15	15	12	9	9	15	27	0.54	Medium
xy42112547197955	Flint Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	1	3	3	3	3	15	15	12	6	9	15	27	0.54	Medium
xy42091887197995	East Baylies Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	3	3	3	3	15	15	9	6	9	15	27	0.54	Medium
xy42142517198085	Masonic Home Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	3	2	3	3	3	15	15	12	6	9	15	27	0.54	Medium
xy42113347200846	Harrington Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	2	3	3	5	1	3	4	2	3	6	9	9	15	8	15	26.5	0.53	Medium
xy42133017196236	Old Muggett Hill Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	5	1	3	2	3	3	15	15	12	15	6	15	25.5	0.51	Medium
xy42131217196233	Mugget Hill Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	2	3	5	2	3	2	3	3	3	6	9	15	6	15	25.5	0.51	Medium
xy42106537197190	Baylies Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	3	2	3	3	15	15	9	6	6	15	25.5	0.51	Medium
xy42189937198728	Charlton Rd	Spencer	Pratt Brook	Cady Brook-Quinebaug R.	5	5	3	1	2	3	2	3	3	15	15	9	3	6	15	25.5	0.51	Medium
xy42130787200373	Rt 169/Southbridge rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	3	4	2	5	3	2	3	2	3	9	12	6	15	6	15	25.5	0.51	Medium
xy42121127199192	T Hall Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	5	1	1	5	3	1	5	5	4	5	15	5	25	0.5	Medium
xy42182517197340	Old Spencer Road	Charlton	Unnamed	Cady Brook-Quinebaug R.	4	5	4	5	1	1	5	3	1	4	5	4	5	15	5	25	0.5	Medium
xy42136907196850	Old Worcester Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	0	0	3	5	1	3	1	3	3	0	0	9	15	3	15	24	0.48	Medium
xy42121757195680	Freeman Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	2	5	1	3	1	3	3	15	15	6	15	3	15	24	0.48	Medium
xy42148377198910	Brookfield Rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	5	5	2	1	3	3	1	3	3	15	15	6	3	3	15	24	0.48	Medium
xy42138947200830	Capen	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	2	4	3	2	10	10	6	4	12	10	23	0.46	Medium
xy42158627197801	J Davis Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	0	0	1	3	0	0	3	15	15	0	0	0	15	22.5	0.45	Medium
xy42083537198917	Saundersdale Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	3	4	2	1	1	3	2	4	3	9	12	6	3	8	12	22	0.44	Medium
xy42177687201045	North Sturbridge Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	5	5	1	1	4	3	1	5	5	5	5	12	5	20.5	0.41	Medium
xy42095477196408	Number 6 Schoolhouse Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	1	1	4	3	1	5	5	4	2	12	5	20.5	0.41	Medium
xy42099757197835	E Baylies Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	1	3	4	1	5	5	3	2	12	5	20.5	0.41	Medium
xy42161437198682	City Depot Rd	Charlton	unnnamed	Cady Brook-Quinebaug R.	1	1	4	1	3	2	2	2	3	3	3	12	3	4	12	20	0.4	Medium
xy42170647198216	City Depot Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	1	4	1	3	3	1	3	3	3	3	12	3	3	12	19.5	0.39	Medium
xy42106337201203	Harrington Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	5	5	1	2	3	3	2	10	10	10	10	9	10	19.5	0.39	Medium
xy42114917198523	Burlingame Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	2	3	3	5	1	2	3	3	2	4	6	6	10	9	10	19.5	0.39	Medium
xy42172927198463	N. Sturbridge Rd.	Charlton	Unnamed	Cady Brook-Quinebaug R.	4	5	2	5	1	2	3	3	2	8	10	4	10	9	10	19.5	0.39	Medium
xy42174737197712	Old Spencer Road	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	1	3	2	1	3	3	3	3	3	3	9	6	9	9	18	0.36	Medium
xy42105187198986	Guelphwood Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	2	2	3	2	10	10	6	10	6	10	18	0.36	Medium
xy42112477195971	off Freeman Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	2	2	3	2	10	10	6	10	6	10	18	0.36	Medium
xy42112277196178	Private road, off Freeman Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	2	5	1	2	2	3	2	10	10	4	10	6	10	18	0.36	Medium
xy42142567198722	Gillespie road	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	2	2	3	2	10	10	6	4	6	10	18	0.36	Medium
xy42107057197112	Dresser Hill Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	4	5	2	1	2	2	2	3	2	8	10	4	2	6	10	18	0.36	Medium
xy42102267198637	Blood Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	5	1	2	2	2	2	10	10	6	10	4	10	17	0.34	Low
xy42131277196352	Muggett Hill Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	2	3	1	2	3	2	3	3	3	6	9	3	6	9	16.5	0.33	Low
xy42145297199404	S Sturbridge Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	2	5	1	2	1	3	2	10	10	4	10	3	10	16.5	0.33	Low
xy42154847200829	North Sullivan Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	2	5	1	1	3	3	1	5	5	2	5	9	5	16	0.32	Low
xy42126987197546	Burlingame Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	1	3	3	1	5	5	3	2	9	5	16	0.32	Low
xy42144697200588	Sullivan Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	2	3	3	1	1	3	1	3	3	6	9	9	3	3	9	15	0.3	Low
xy42105957201225	Harrington Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	4	2	1	1	4	2	1	5	5	4	2	8	5	14.5	0.29	Low
xy42090427198544	Blood Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	1	2	1	1	4	1	4	4	4	4	8	4	4	8	14	0.28	Low
xy42110377201340	Rt 169/ Southbridge Rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	1	1	2	1	4	3	1	4	4	4	4	8	4	4	8	14	0.28	Low
xy42119347200890	Southbridge Rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	1	1	2	1	4	1	1	4	4	4	4	8	4	4	8	14	0.28	Low
xy42120787198245	Burlingame Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	2	3	4	5	1	1	2	3	1	2	3	4	5	6	5	11.5	0.23	Low
xy42108997199566	Pumpkin Lane	Charlton	Unnamed	Cady Brook-Quinebaug R.	5	5	3	2	1	1	2	3	1	5	5	3	2	6	5	11.5	0.23	Low

Appendix B—Table 1 (continued). Road-Stream Crossing Scoring and Prioritization Results, organized by watershed and overall crossing priority scores. (Page 3 of 4)

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Existing Hydraulic Risk Score-Binned	Future Hydraulic Risk Score-Binned	Geomorphic Vulnerability Score	Structural Condition Score	Transportation Disruption Score	Flood Impact Potential Score	AOP Score	Ecological Benefit Score	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42175207199213	North Sturbridge rd	Charlton	Pratt Brook	Cady Brook-Quinebaug R.	5	5	3	2	1	1	2	3	1	5	5	3	2	6	5	11.5	0.23	Low
xy42092937198533	Blood Rd	Charlton	Unnamed	Cady Brook-Quinebaug R.	1	1	2	1	1	3	1	4	3	3	3	6	3	4	6	11	0.22	Low
xy42138917199911	Southbridge Rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	1	1	2	1	3	2	1	4	3	3	3	6	3	4	6	11	0.22	Low
xy42104877198197	Mcintyre Rd	Charlton	Unnamed (outflow Mcintyre Pond)	Cady Brook-Quinebaug R.	1	1	2	1	1	2	1	4	2	2	2	4	2	4	4	8	0.16	Low
xy42126357200530	Snake Hill Rd	Charlton	Cady Brook	Cady Brook-Quinebaug R.	1	1	2	1	1	1	1	4	1	1	1	2	1	4	2	7	0.14	Low
xy42287607202967	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	3	5	1	4	3	3	4	20	20	12	20	9	20	34.5	0.69	High
xy42294267202555	Northwest Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	4	2	1	3	4	3	3	15	15	12	6	12	15	28.5	0.57	High
xy42303717203221	Northwest Rd	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	4	2	1	2	5	3	2	10	10	8	4	15	10	27.5	0.55	High
xy42286837202473	Northwest Rd	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	3	5	1	3	3	2	3	15	15	9	15	6	15	25.5	0.51	Medium
xy42278987202485	Northwest Rd.	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	4	5	1	2	4	3	2	10	10	8	10	12	10	23	0.46	Medium
xy42292877203452	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	5	4	2	1	2	4	3	2	8	10	8	4	12	10	23	0.46	Medium
xy42305827203527	Northwest Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	5	4	5	1	2	2	3	2	8	10	8	10	6	10	18	0.36	Medium
xy42258927202459	Norcross Rd	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	3	5	1	1	3	3	1	5	5	3	5	9	5	16	0.32	Low
xy42273107202839	Thornberry Circle	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	1	1	3	2	1	2	2	3	2	2	2	6	4	6	6	12	0.24	Low
xy42296207203571	Washburn Terrace	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	5	5	3	5	1	1	2	3	1	5	5	3	5	6	5	11.5	0.23	Low
xy42113157203585	N Ayers Rd	Charlton	Unnamed	McKinstry Brook-Quinebaug R.	5	5	3	2	1	1	4	3	1	5	5	3	2	12	5	20.5	0.41	Medium
xy42120387202379	Berry Corner Rd	Charlton	Unnamed	McKinstry Brook-Quinebaug R.	5	5	2	2	1	2	3	3	2	10	10	4	4	9	10	19.5	0.39	Medium
xy42164257202448	Brookfield Rd	Charlton	McKinstry Brook	McKinstry Brook-Quinebaug R.	5	5	4	2	2	1	3	3	2	10	10	8	4	9	10	19.5	0.39	Medium
xy42127177203084	Hill rd	Charlton	McKinstry brook	McKinstry Brook-Quinebaug R.	5	5	3	5	1	2	2	3	2	10	10	6	10	6	10	18	0.36	Medium
xy42129607202680	Hill Rd	Charlton	Unnamed	McKinstry Brook-Quinebaug R.	5	5	4	5	1	1	3	3	1	5	5	4	5	9	5	16	0.32	Low
xy42242817199556	Elm St	Spencer	Unnamed	Sevenmile River	5	5	2	1	1	5	5	3	5	25	25	10	5	15	25	45	0.9	High
xy42267367198603	Wire Village Road	Spencer	Unnamed	Sevenmile River	5	5	4	5	2	3	5	5	3	15	15	12	15	25	15	45	0.9	High
xy42240257199930	Water St	Spencer	Unnamed	Sevenmile River	0	0	3	5	2	5	4	3	5	0	0	15	25	12	25	43.5	0.87	High
xy42241537199888	Mill St	Spencer	Unnamed	Sevenmile River	5	5	5	3	1	5	3	3	5	25	25	25	15	9	25	42	0.84	High
xy42243777198653	May St	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	5	2	3	5	25	25	20	10	6	25	40.5	0.81	High
xy42242787199625	Valley St	Spencer	Unnamed	Sevenmile River	3	4	2	5	1	5	1	3	5	15	20	10	25	3	25	39	0.78	High
xy42272437198670	Gold Nugget Rd	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	4	4	3	4	20	20	16	8	12	20	36	0.72	High
xy42270727198232	Wire village Rd	Spencer	Unnamed	Sevenmile River	1	2	4	5	2	4	3	3	4	4	8	16	20	9	20	34.5	0.69	High
xy42263087199328	Wire Village Road, Hastings Roa	Spencer	Turkey Hill Brook	Sevenmile River	5	5	3	3	2	4	1	4	4	20	20	12	12	4	20	32	0.64	High
xy42239757200792	Meadow Rd	Spencer	Unnamed	Sevenmile River	4	5	3	1	3	4	1	4	4	16	20	12	4	4	20	32	0.64	High
xy42268137195837	Howard Hurley Road	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	3	5	3	3	15	15	12	15	15	15	30	0.6	High
xy42305577198908	Browning Pond Rd	Spencer	Unnamed	Sevenmile River	1	1	4	5	1	3	5	3	3	3	3	12	15	15	15	30	0.6	High
xy42294187200495	Unnamed road	Spencer	Unnamed	Sevenmile River	1	1	3	5	1	3	5	3	3	3	3	9	15	15	15	30	0.6	High
xy42304087198719	Route 31	Spencer	Unnamed	Sevenmile River	1	1	3	5	2	3	5	3	3	3	3	9	15	15	15	30	0.6	High
xy42199857200814	Jolicouer Rd	Spencer	Unnamed	Sevenmile River	5	5	4	2	2	3	5	3	3	15	15	12	6	15	15	30	0.6	High
xy42238157200544	Old Main Street	Spencer	Unnamed	Sevenmile River	1	1	3	1	2	4	5	3	4	4	4	12	4	15	12	28.5	0.57	High
xy42208937201200	South Spencer Rd	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	2	5	3	2	10	10	8	10	15	10	27.5	0.55	High
xy42254367199108	Hastings St	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	2	5	3	2	10	10	8	10	15	10	27.5	0.55	High
xy42238587202619	Smithville Rd	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	2	5	3	2	10	10	6	10	15	10	27.5	0.55	High
xy42300367199122	Route 31	Spencer	Unnamed	Sevenmile River	1	1	3	5	2	1	5	3	2	2	2	6	10	15	10	27.5	0.55	High
xy42284237198810	McCormick Rd	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	3	3	3	3	15	15	12	15	9	15	27	0.54	Medium
xy42201697200513	Hebert road	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	3	3	3	3	15	15	12	6	9	15	27	0.54	Medium
xy42303767198648	Old N Spencer Road	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	3	3	3	3	15	15	12	6	9	15	27	0.54	Medium
xy42203117200432	Cranberry Meadow Rd	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	3	3	3	3	15	15	9	6	9	15	27	0.54	Medium
xy42256987201284	Terkanian Dr	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	3	3	3	3	15	15	9	6	9	15	27	0.54	Medium
xy42275017198713	McCormick Rd	Spencer	Unnamed	Sevenmile River	5	5	4	1	1	3	3	3	3	15	15	12	3	9	15	27	0.54	Medium
xy42246907200739	Meadow Rd	Spencer	Unnamed	Sevenmile River	4	5	3	5	3	2	2	4	3	12	15	9	15	8	15	26.5	0.53	Medium
xy42200137200815	Cranberry Meadow road	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	3	2	3	3	15	15	12	15	6	15	25.5	0.51	Medium
xy42236057200384	Bixby Road	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	3	2	3	3	15	15	12	6	6	15	25.5	0.51	Medium
xy42201497199404	Gauthier Rd	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	3	3	2	3	15	15	9	6	6	15	25.5	0.51	Medium
xy42203977200329	Cranberry Meadow Rd	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	3	2	3	3	15	15	9	6	6	15	25.5	0.51	Medium
xy42291727200054	Route 31	Spencer	Sevenmile River	Sevenmile River	1	1	2	5	2	3	1	5	3	3	3	6	15	5	15	25	0.5	Medium
xy42264517200766	Cooney Rd	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	3	2	2	3	15	15	9	15	4	15	24.5	0.49	Medium
xy42229927198732	Charlton Rd	Spencer	Unnamed	Sevenmile River	5	5	2	2	3	3	2	2	3	15	15	6	6	4	15	24.5	0.49	Medium
xy42265067200832	North Spencer Road	Spencer	Unnamed	Sevenmile River	5	5	4	1	2	3	4	1	3	15	15	12	3	4	15	24.5	0.49	Medium
xy42185207199955	Ethier Drive	Spencer	Unnamed	Sevenmile River	4	5	3	5	1	2	4	3	2	8	10	6	10	12	10	23	0.46	Medium
xy42293737200320	road to Trappist monastery, fro	Spencer	Sevenmile River	Sevenmile River	5	5	4	2	1	2	3	4	2	10	10	8	4	12	10	23	0.46	Medium
xy42227287201523	Condon Dr	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	1	4	3	1	5	5	3	5	12	5	20.5	0.41	Medium
xy42272957197449	Paxton Rd	Spencer	Shaw Brook	Sevenmile River	2	3	2	1	2	4	1	4	4	8	12	8	4	4	12	20	0.4	Medium
xy42213797201533	Gale Dr	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	2	5	2	2	10	10	8	10	10	10	20	0.4	Medium
xy42280417199470	Hastings Rd	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	2	5	2	2	10	10	8	10	10	10	20	0.4	Medium
xy42271257198105	Wire Village Road	Spencer	Unnamed	Sevenmile River	5	5	4	5	2	2	3	3	2	10	10	8	10	9	10	19.5	0.39	Medium
xy42250947201116	Smithville Road	Spencer	Unnamed	Sevenmile River	0	0	4	5	1	2	3	3	2	0	0	8	10	9	10	19.5	0.39	Medium
xy42228277199149	Dufault Road	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	2	3	3	2	10	10	6	10	9	10	19.5	0.39	Medium
xy42275157196572	Overlook Drive	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	2	3	3	2	10	10	6	10	9	10	19.5	0.39	Medium

Appendix B—Table 1 (continued). Road-Stream Crossing Scoring and Prioritization Results, organized by watershed and overall crossing priority scores. (Page 4 of 4)

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Existing Hydraulic Risk Score-Binned	Future Hydraulic Risk Score-Binned	Geomorphic Vulnerability Score	Structural Condition Score	Transportation Disruption Score	Flood Impact Potential Score	AOP Score	Ecological Benefit Score	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42308507197236	West Ave	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	2	3	3	2	10	10	6	10	9	10	19.5	0.39	Medium
xy42205567198530	Charlton Road	Spencer	Unnamed	Sevenmile River	1	1	3	5	2	2	3	3	2	2	2	6	10	9	10	19.5	0.39	Medium
xy42281107199475	Hastings Rd	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	2	3	3	2	10	10	8	4	9	10	19.5	0.39	Medium
xy42216117198192	I Capen Road	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	2	3	3	2	10	10	6	4	9	10	19.5	0.39	Medium
xy42199597201527	S. Spencer	Spencer	Unnamed	Sevenmile River	5	5	4	1	1	2	3	3	2	10	10	8	2	9	10	19.5	0.39	Medium
xy42303177196551	Pine Acres Rd	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	2	2	4	2	10	10	6	10	8	10	19	0.38	Medium
xy42272047196057	Donnelly Cross Rd	Spencer	Shaw Brook	Sevenmile River	2	3	3	5	1	2	2	4	2	4	6	6	10	8	10	19	0.38	Medium
xy42264767200487	Cooney Rd	Spencer	Sevenmile River	Sevenmile River	4	5	2	1	1	2	2	4	2	8	10	4	2	8	10	19	0.38	Medium
xy42201717202002	Tom Casey Rd	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	2	3	2	2	10	10	6	4	6	10	18	0.36	Medium
xy42260657196861	Donnelly Rd	Spencer	Unnamed	Sevenmile River	4	5	3	2	1	2	2	3	2	8	10	6	4	6	10	18	0.36	Medium
xy42247397201674	Smithville Road	Spencer	Unnamed	Sevenmile River	5	5	2	2	1	2	2	3	2	10	10	4	4	6	10	18	0.36	Medium
xy42260997201315	North Brookfield Road	Spencer	Unnamed	Sevenmile River	3	4	3	2	2	2	3	3	2	6	8	6	4	9	8	17.5	0.35	Medium
xy42232837198227	Ash st	Spencer	Unnamed	Sevenmile River	5	5	4	5	1	2	2	2	2	10	10	8	10	4	10	17	0.34	Low
xy42303367196556	Pine Acres Rd	Spencer	Turkey Hill Brook	Sevenmile River	5	5	3	5	1	2	1	4	2	10	10	6	10	4	10	17	0.34	Low
xy42197057200456	William Casey Rd	Spencer	Unnamed	Sevenmile River	1	1	3	1	1	2	3	3	2	2	2	6	2	9	6	16.5	0.33	Low
xy42193307200113	Cranberry Meadow Rd	Spencer	Cranberry River	Sevenmile River	5	5	2	1	2	2	1	3	2	10	10	4	2	3	10	16.5	0.33	Low
xy42210937198505	Rt 31/Charlton Rd	Spencer	Unnamed	Sevenmile River	5	5	2	5	2	1	1	3	2	10	10	4	10	3	10	16.5	0.33	Low
xy42219927198461	E Charlton Rd	Spencer	Unnamed	Sevenmile River	5	5	3	5	1	1	3	3	1	5	5	3	5	9	5	16	0.32	Low
xy42290757199790	Hastings Rd	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	1	3	3	1	5	5	4	2	9	5	16	0.32	Low
xy42182467200949	Casey Rd	Charlton	Unnamed	Sevenmile River	5	5	3	2	1	1	3	3	1	5	5	3	2	9	5	16	0.32	Low
xy42207027199959	Gauthier Road	Spencer	Cranberry River	Sevenmile River	1	1	3	1	1	3	1	3	3	3	3	9	3	3	9	15	0.3	Low
xy42272807197888	Gold Nugget Rd	Spencer	Turkey Hill Brook	Sevenmile River	1	1	2	1	1	4	1	5	4	4	4	8	4	5	8	14.5	0.29	Low
xy42250337200809	Smithville Road	Spencer	Sevenmile River	Sevenmile River	1	1	2	1	1	4	1	4	4	4	4	8	4	4	8	14	0.28	Low
xy42265567198812	Wire Village Rd	Spencer	Turkey Hill Rd	Sevenmile River	1	1	2	1	2	4	1	4	4	4	4	8	4	4	8	14	0.28	Low
xy42228237201256	S. Spencer Rd	Spencer	Cranberry River	Sevenmile River	4	4	2	1	2	1	1	4	2	8	8	4	2	4	8	14	0.28	Low
xy42237777200419	Main St (Rt 9)	Spencer	Unnamed	Sevenmile River	1	1	2	1	4	3	1	3	4	4	4	8	4	3	8	13.5	0.27	Low
xy42309397200824	Browning Pond Rd	Spencer	Unnamed	Sevenmile River	5	5	2	5	1	1	2	3	1	5	5	2	5	6	5	11.5	0.23	Low
xy42299977197076	Thompson Pond Road	Spencer	Unnamed	Sevenmile River	5	5	3	3	1	1	2	3	1	5	5	3	3	6	5	11.5	0.23	Low
xy42288707199641	Hastings Rd	Spencer	Unnamed	Sevenmile River	5	5	4	2	1	1	2	3	1	5	5	4	2	6	5	11.5	0.23	Low
xy42218447199671	Howe Rd	Spencer	Unnamed	Sevenmile River	5	5	3	2	1	1	2	3	1	5	5	3	2	6	5	11.5	0.23	Low
xy42243597198244	Holmes St	Spencer	Unnamed	Sevenmile River	1	2	2	1	1	3	1	3	3	3	6	6	3	3	6	10.5	0.21	Low
xy42255867200411	Pleasant St (Rt 31)	Spencer	Sevenmile River	Sevenmile River	1	1	2	1	3	3	1	3	3	3	3	6	3	3	6	10.5	0.21	Low
xy42215717200032	Howe Rd	Spencer	Unnamed	Sevenmile River	2	3	3	1	1	1	2	3	1	2	3	3	1	6	3	10.5	0.21	Low
xy42216267199982	Howe Rd	Spencer	Cranberry River	Sevenmile River	5	5	3	1	1	1	1	4	1	5	5	3	1	4	5	9.5	0.19	Low
xy42235117195800	Greenville St	Spencer	Unnamed	Upper French R.	5	5	3	2	2	4	3	3	4	20	20	12	8	9	20	34.5	0.69	High
xy42210397196698	Marble Rd	Spencer	Unnamed	Upper French R.	5	5	4	1	1	4	3	3	4	20	20	16	4	9	20	34.5	0.69	High
xy42216107196594	GH Wilson Rd	Spencer	Unnamed	Upper French R.	5	5	3	5	1	4	2	3	4	20	20	12	20	6	20	33	0.66	High
xy42219257195030	Chickering Rd	Spencer	Unnamed	Upper French R.	5	5	4	2	2	1	5	3	2	10	10	8	4	15	10	27.5	0.55	High
xy42186187191771	Stafford street	Charlton	Unnamed	Upper French R.	5	5	4	5	3	3	3	3	3	15	15	12	15	9	15	27	0.54	Medium
xy42230047196304	R Jones rd	Spencer	Unnamed	Upper French R.	5	5	3	2	1	3	3	3	3	15	15	9	6	9	15	27	0.54	Medium
xy42182137192179	Stafford St	Charlton	Unnamed	Upper French R.	5	5	2	5	3	1	2	3	3	15	15	6	15	6	15	25.5	0.51	Medium
xy42202327194820	Wilson Ave	Spencer	Unnamed	Upper French R.	4	4	4	5	1	1	5	3	1	4	4	4	5	15	5	25	0.5	Medium
xy42237067196301	Greenville St	Spencer	Unnamed	Upper French R.	5	5	3	5	2	2	4	3	2	10	10	6	10	12	10	23	0.46	Medium
xy42243857197039	Garrett Ln	Spencer	Unnamed	Upper French R.	4	5	3	5	1	2	4	3	2	8	10	6	10	12	10	23	0.46	Medium
xy42200797194993	Clark Road	Spencer	Unnamed	Upper French R.	5	5	4	5	1	1	4	3	1	5	5	4	5	12	5	20.5	0.41	Medium
xy42207977195437	Clark Road	Spencer	Unnamed	Upper French R.	5	5	3	5	1	2	3	3	2	10	10	6	10	9	10	19.5	0.39	Medium
xy42206457196685	Clark Road	Spencer	Unnamed	Upper French R.	5	5	4	2	1	2	3	3	2	10	10	8	4	9	10	19.5	0.39	Medium
xy42235187196071	Greenville st	Spencer	Unnamed	Upper French R.	5	5	3	2	2	2	2	3	2	10	10	6	4	6	10	18	0.36	Medium
xy42217157196004	G H Wilson rd	Spencer	unamed	Upper French R.	5	5	3	1	1	2	2	3	2	10	10	6	2	6	10	18	0.36	Medium
xy42226517197364	R Joned Rd	Spencer	Unnamed	Upper French R.	3	4	3	2	1	2	3	3	2	6	8	6	4	9	8	17.5	0.35	Medium
xy42185247192643	Applewood Ln	Charlton	Unnamed	Upper French R.	0	0	3	1	1	2	3	3	2	0	0	6	2	9	6	16.5	0.33	Low
xy42209657195437	Wilson	Spencer	Unnamed	Upper French R.	1	2	3	5	1	1	2	3	1	1	2	3	5	6	5	11.5	0.23	Low
xy42199547194538	Clark Rd	Spencer	Unnamed	Upper French R.	0	0	2	1	1	1	1	3	1	0	0	2	1	3	2	5.5	0.11	Low
xy42190507201969	South Spencer Rd	Spencer	Unnamed	Upper Quaboag R.	5	5	3	2	1	2	3	3	2	10	10	6	4	9	10	19.5	0.39	Medium

Appendix B—Table 2. Top-ranked crossings based on hydraulic risk score under existing conditions.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42242817199556	Elm St	Spencer	Unnamed	Sevenmile River	5	25	25	10	5	15	25	45	0.9	High
xy42241537199888	Mill St	Spencer	Unnamed	Sevenmile River	5	25	25	25	15	9	25	42	0.84	High
xy42243777198653	May St	Spencer	Unnamed	Sevenmile River	5	25	25	20	10	6	25	40.5	0.81	High
xy42272437198670	Gold Nugget Rd	Spencer	Unnamed	Sevenmile River	4	20	20	16	8	12	20	36	0.72	High
xy42087307198010	East Baylies Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42096677198620	Blood Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42156087197349	Stafford St.	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	16	8	9	20	34.5	0.69	High
xy42156627197367	Center Depot Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42287607202967	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42210397196698	Marble Rd	Spencer	Unnamed	Upper French R.	4	20	20	16	4	9	20	34.5	0.69	High
xy42235117195800	Greenville St	Spencer	Unnamed	Upper French R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42161187200811	Brookfield Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	6	20	33	0.66	High
xy42216107196594	GH Wilson Rd	Spencer	Unnamed	Upper French R.	4	20	20	12	20	6	20	33	0.66	High
xy42087757198556	Saundersdale Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	8	4	4	20	32	0.64	High
xy42263087199328	Wire Village Road, Hastings Road	Spencer	Turkey Hill Brook	Sevenmile River	4	20	20	12	12	4	20	32	0.64	High

Appendix B—Table 3. Top-ranked crossings based on future hydraulic risk score under projected future climate (precipitation and peak flow) conditions.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42242817199556	Elm St	Spencer	Unnamed	Sevenmile River	5	25	25	10	5	15	25	45	0.9	High
xy42241537199888	Mill St	Spencer	Unnamed	Sevenmile River	5	25	25	25	15	9	25	42	0.84	High
xy42243777198653	May St	Spencer	Unnamed	Sevenmile River	5	25	25	20	10	6	25	40.5	0.81	High
xy42242787199625	Valley St	Spencer	Unnamed	Sevenmile River	5	15	20	10	25	3	25	39	0.78	High
xy42272437198670	Gold Nugget Rd	Spencer	Unnamed	Sevenmile River	4	20	20	16	8	12	20	36	0.72	High
xy42087307198010	East Baylies Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42096677198620	Blood Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42156087197349	Stafford St.	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	16	8	9	20	34.5	0.69	High
xy42156627197367	Center Depot Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42287607202967	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42210397196698	Marble Rd	Spencer	Unnamed	Upper French R.	4	20	20	16	4	9	20	34.5	0.69	High
xy42235117195800	Greenville St	Spencer	Unnamed	Upper French R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42130987196310	Freeman Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	16	20	12	4	9	20	34.5	0.69	High
xy42161187200811	Brookfield Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	6	20	33	0.66	High
xy42216107196594	GH Wilson Rd	Spencer	Unnamed	Upper French R.	4	20	20	12	20	6	20	33	0.66	High
xy42087757198556	Saundersdale Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	8	4	4	20	32	0.64	High
xy42263087199328	Wire Village Road, Hastings Road	Spencer	Turkey Hill Brook	Sevenmile River	4	20	20	12	12	4	20	32	0.64	High
xy42239757200792	Meadow Rd	Spencer	Unnamed	Sevenmile River	4	16	20	12	4	4	20	32	0.64	High

Appendix B—Table 4. Top-ranked crossings based on geomorphic risk score.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42241537199888	Mill St	Spencer	Unnamed	Sevenmile River	5	25	25	25	15	9	25	42	0.84	High
xy42243777198653	May St	Spencer	Unnamed	Sevenmile River	5	25	25	20	10	6	25	40.5	0.81	High
xy42272437198670	Gold Nugget Rd	Spencer	Unnamed	Sevenmile River	4	20	20	16	8	12	20	36	0.72	High
xy42156087197349	Stafford St.	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	16	8	9	20	34.5	0.69	High
xy42210397196698	Marble Rd	Spencer	Unnamed	Upper French R.	4	20	20	16	4	9	20	34.5	0.69	High
xy42270727198232	Wire village Rd	Spencer	Unnamed	Sevenmile River	4	4	8	16	20	9	20	34.5	0.69	High
xy42111857201283	Rt 169/ Southbridge Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	4	4	16	20	6	20	33	0.66	High
xy42240257199930	Water St	Spencer	Unnamed	Sevenmile River	5	0	0	15	25	12	25	43.5	0.87	High

Appendix B—Table 5. Top-ranked crossings based on structural risk score.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42240257199930	Water St	Spencer	Unnamed	Sevenmile River	5	0	0	15	25	12	25	43.5	0.87	High
xy42242787199625	Valley St	Spencer	Unnamed	Sevenmile River	5	15	20	10	25	3	25	39	0.78	High
xy42270727198232	Wire village Rd	Spencer	Unnamed	Sevenmile River	4	4	8	16	20	9	20	34.5	0.69	High
xy42087307198010	East Baylies Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42287607202967	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42111857201283	Rt 169/ Southbridge Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	4	4	16	20	6	20	33	0.66	High
xy42161187200811	Brookfield Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	6	20	33	0.66	High
xy42216107196594	GH Wilson Rd	Spencer	Unnamed	Upper French R.	4	20	20	12	20	6	20	33	0.66	High
xy42149767198830	City depot Rd	Spencer	Cady Brook	Cady Brook-Quinebaug R.	4	12	16	12	20	4	20	32	0.64	High
xy42106617201530	Southbridge Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	8	12	12	20	4	20	32	0.64	High

Appendix B—Table 6. Top-ranked crossings based on aquatic organism passage benefit score.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42267367198603	Wire Village Road	Spencer	Unnamed	Sevenmile River	3	15	15	12	15	25	15	45	0.9	High
xy42175037195644	Cemetery Road	Spencer	Little River	Buffumville Lake-Little R.	1	5	5	4	5	16	5	26.5	0.53	Medium
xy42242817199556	Elm St	Spencer	Unnamed	Sevenmile River	5	25	25	10	5	15	25	45	0.9	High
xy42162777192843	A Young Rd	Spencer	Unnamed	Buffumville Lake-Little R.	3	15	15	12	15	15	15	30	0.6	High
xy42106447196847	Baylies Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	15	15	12	15	15	15	30	0.6	High
xy42167467200810	Fitzgerald Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	15	15	12	15	15	15	30	0.6	High
xy42268137195837	Howard Hurley Road	Spencer	Unnamed	Sevenmile River	3	15	15	12	15	15	15	30	0.6	High
xy42305577198908	Browning Pond Rd	Spencer	Unnamed	Sevenmile River	3	3	3	12	15	15	15	30	0.6	High
xy42162337201150	Jennings Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	0	0	12	15	15	15	30	0.6	High
xy42165477195502	Cemetery Rd	Spencer	Unnamed	Buffumville Lake-Little R.	3	15	15	9	15	15	15	30	0.6	High
xy42142557192428	Richardson Corner Rd	Spencer	Unnamed	Buffumville Lake-Little R.	3	9	12	9	15	15	15	30	0.6	High
xy42294187200495	Unnamed road	Spencer	Unnamed	Sevenmile River	3	3	3	9	15	15	15	30	0.6	High
xy42304087198719	Route 31	Spencer	Unnamed	Sevenmile River	3	3	3	9	15	15	15	30	0.6	High
xy42140167196908	L Stevens Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	15	15	12	6	15	15	30	0.6	High
xy42199857200814	Jolicouer Rd	Spencer	Unnamed	Sevenmile River	3	15	15	12	6	15	15	30	0.6	High
xy42114817197758	Flint Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	15	15	9	6	15	15	30	0.6	High
xy42238157200544	Old Main Street	Spencer	Unnamed	Sevenmile River	4	4	4	12	4	15	12	28.5	0.57	High
xy42086917197636	Saundersdale Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	3	3	6	12	6	15	12	28.5	0.57	High
xy42208937201200	South Spencer Rd	Spencer	Unnamed	Sevenmile River	2	10	10	8	10	15	10	27.5	0.55	High
xy42254367199108	Hastings St	Spencer	Unnamed	Sevenmile River	2	10	10	8	10	15	10	27.5	0.55	High
xy42173857197799	Rt 31	Spencer	Unnamed	Cady Brook-Quinebaug R.	2	0	0	8	10	15	10	27.5	0.55	High
xy42238587202619	Smithville Rd	Spencer	Unnamed	Sevenmile River	2	10	10	6	10	15	10	27.5	0.55	High
xy42136897194127	Morton Station Rd	Spencer	Unnamed	Buffumville Lake-Little R.	2	6	8	6	10	15	10	27.5	0.55	High
xy42300367199122	Route 31	Spencer	Unnamed	Sevenmile River	2	2	2	6	10	15	10	27.5	0.55	High
xy42303717203221	Northwest Rd	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	2	10	10	8	4	15	10	27.5	0.55	High
xy42219257195030	Chickering Rd	Spencer	Unnamed	Upper French R.	2	10	10	8	4	15	10	27.5	0.55	High
xy42153827193982	Carroll Hill Rd	Spencer	Unnamed	Buffumville Lake-Little R.	1	5	5	4	5	15	5	25	0.5	Medium
xy42183977195290	Gould Rd	Spencer	Unnamed	Buffumville Lake-Little R.	1	5	5	4	5	15	5	25	0.5	Medium
xy42121127199192	T Hall Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	1	5	5	4	5	15	5	25	0.5	Medium
xy42182517197340	Old Spencer Road	Spencer	Unnamed	Cady Brook-Quinebaug R.	1	4	5	4	5	15	5	25	0.5	Medium
xy42202327194820	Wilson Ave	Spencer	Unnamed	Upper French R.	1	4	4	4	5	15	5	25	0.5	Medium
xy42141577195023	Old Worcester Rd	Spencer	Unnamed	Buffumville Lake-Little R.	1	1	1	4	5	15	5	25	0.5	Medium
xy42128277194621	Bond Rd	Spencer	Unnamed	Buffumville Lake-Little R.	1	5	5	4	2	15	5	25	0.5	Medium
xy42152637195905	Northside Rd	Spencer	Unnamed	Buffumville Lake-Little R.	1	5	5	3	2	15	5	25	0.5	Medium

Appendix B—Table 7. Top-ranked crossings based on impact score.

XY Code	Road Name	Town	Stream Name	HUC 12 Watershed Name	Impact Score	Existing Hydraulic Risk Score	Future Hydraulic Risk Score	Geomorphic Risk Score	Structural Risk Score	AOP Benefit Score	Crossing Risk Score	Crossing Priority Value	Scaled Crossing Priority	Relative Priority Rating
xy42242817199556	Elm St	Spencer	Unnamed	Sevenmile River	5	25	25	10	5	15	25	45	0.9	High
xy42240257199930	Water St	Spencer	Unnamed	Sevenmile River	5	0	0	15	25	12	25	43.5	0.87	High
xy42241537199888	Mill St	Spencer	Unnamed	Sevenmile River	5	25	25	25	15	9	25	42	0.84	High
xy42243777198653	May St	Spencer	Unnamed	Sevenmile River	5	25	25	20	10	6	25	40.5	0.81	High
xy42242787199625	Valley St	Spencer	Unnamed	Sevenmile River	5	15	20	10	25	3	25	39	0.78	High
xy42272437198670	Gold Nugget Rd	Spencer	Unnamed	Sevenmile River	4	20	20	16	8	12	20	36	0.72	High
xy42270727198232	Wire village Rd	Spencer	Unnamed	Sevenmile River	4	4	8	16	20	9	20	34.5	0.69	High
xy42087307198010	East Baylies Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42287607202967	Brooks Pond Road	Spencer	Unnamed	Lake Lashaway-East Brookfield R.	4	20	20	12	20	9	20	34.5	0.69	High
xy42156087197349	Stafford St.	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	16	8	9	20	34.5	0.69	High
xy42096677198620	Blood Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42156627197367	Center Depot Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42235117195800	Greenville St	Spencer	Unnamed	Upper French R.	4	20	20	12	8	9	20	34.5	0.69	High
xy42210397196698	Marble Rd	Spencer	Unnamed	Upper French R.	4	20	20	16	4	9	20	34.5	0.69	High
xy42130987196310	Freeman Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	16	20	12	4	9	20	34.5	0.69	High
xy42111857201283	Rt 169/ Southbridge Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	4	4	16	20	6	20	33	0.66	High
xy42161187200811	Brookfield Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	12	20	6	20	33	0.66	High
xy42216107196594	GH Wilson Rd	Spencer	Unnamed	Upper French R.	4	20	20	12	20	6	20	33	0.66	High
xy42149767198830	City depot Rd	Spencer	Cady Brook	Cady Brook-Quinebaug R.	4	12	16	12	20	4	20	32	0.64	High
xy42106617201530	Southbridge Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	8	12	12	20	4	20	32	0.64	High
xy42263087199328	Wire Village Road, Hastings Road	Spencer	Turkey Hill Brook	Sevenmile River	4	20	20	12	12	4	20	32	0.64	High
xy42239757200792	Meadow Rd	Spencer	Unnamed	Sevenmile River	4	16	20	12	4	4	20	32	0.64	High
xy42087757198556	Saundersdale Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	20	20	8	4	4	20	32	0.64	High
xy42238157200544	Old Main Street	Spencer	Unnamed	Sevenmile River	4	4	4	12	4	15	12	28.5	0.57	High
xy42272957197449	Paxton Rd	Spencer	Shaw Brook	Sevenmile River	4	8	12	8	4	4	12	20	0.4	Medium
xy42272807197888	Gold Nugget Rd	Spencer	Turkey Hill Brook	Sevenmile River	4	4	4	8	4	5	8	14.5	0.29	Low
xy42090427198544	Blood Rd	Spencer	Unnamed	Cady Brook-Quinebaug R.	4	4	4	8	4	4	8	14	0.28	Low
xy42110377201340	Rt 169/ Southbridge Rd	Spencer	Cady Brook	Cady Brook-Quinebaug R.	4	4	4	8	4	4	8	14	0.28	Low
xy42119347200890	Southbridge Rd	Spencer	Cady Brook	Cady Brook-Quinebaug R.	4	4	4	8	4	4	8	14	0.28	Low
xy42250337200809	Smithville Road	Spencer	Sevenmile River	Sevenmile River	4	4	4	8	4	4	8	14	0.28	Low
xy42265567198812	Wire Village Rd	Spencer	Turkey Hill Rd	Sevenmile River	4	4	4	8	4	4	8	14	0.28	Low
xy42237777200419	Main St (Rt 9)	Spencer	Unnamed	Sevenmile River	4	4	4	8	4	3	8	13.5	0.27	Low

Appendix C

Road-Stream Crossing Scoring and Prioritization Methods

Hydraulic Capacity Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Table 1: Headwater Depth at $Q_{failure}$

Road-Stream Crossing Structure Type and Material	Allowable Headwater Depth[1]
Stone Masonry or Wood Culvert	HW = 1.0 x D
Smooth or Corrugated Metal or Plastic Culvert[2]	HW = 1.2 x D
Concrete Culvert	HW = 1 foot below lowest point in roadway surface
Bridge	HW = 1 foot below lowest point of bottom of bridge deck

Table 2: Tailwater Depth used in Calculating Hydraulic Capacity ($Q_{failure}$)

Crossing Type	Crossing Structure Slope	Tailwater Depth
Non-Tidal Crossings	> 2%	TW = 0.75 x D
	< 2%	TW = 0.75 x D when HW/D < 1.3 TW = 1.0 x D when HW/D ≥ 1.3
Tidal Crossings	Not Applicable	TW = 1.0 x D
Crossings discharging directly into a lake, pond, or wetland[1]	Not Applicable	Based on elevation of receiving water body or wetland
Crossings with cascade or free fall at the outlet with a significant drop to the normal elevation of the downstream channel	Not Applicable	Based on elevation drop at outlet

[1] Situations where the tailwater depth is dictated by the water elevation in the downstream receiving water body or wetland and does not vary with flow, where available.

Table 3: Hydraulic Capacity Score

Hydraulic Capacity Rating (Capacity Ratio > 1.0 for listed Return Interval)	Hydraulic Capacity Score
100-Year	1
50 Year	2
25-Year	3
10 Year	4
< 10-Year	5

Equation 1: Hydraulic Capacity Ratio

$$Capacity\ Ratio_{R.I.} = \frac{HW_{failure}}{HW_{R.I.}}$$

$Capacity\ Ratio_{R.I.} > 1.0$

Crossing has sufficient capacity to convey the return interval peak discharge

$Capacity\ Ratio_{R.I.} \leq 1.0$

Crossing is undersized for the return interval peak discharge

Geomorphic Vulnerability Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
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Table 1: Crossing Alignment Impact Potential Ratings

Impact Rating	Alignment
1	Naturally straight
2	Mild bend
3	--
4	Channelized straight
5	Sharp bend

Table 2: Bankfull Width Impact Potential Ratings When Confident Width Measurements are Available

Impact Rating	Inlet Width/Bankfull Width Ratio (ft/ft)
1	≥1.0
2	1.0-0.85
3	0.85-0.7
4	0.7-0.5
5	≤0.5

Table 3: Bankfull Width Impact Potential Ratings When No Confident Width Measurements are Available

Impact Rating	Constriction
1	None – Spans full channel and banks
2	Slight – Spans only bankfull/active channel
3	--
4	Moderate
5	Severe

Table 4: Channel and Crossing Structure Slope Impact Potential Ratings

Impact Rating	Slope Conditions at Crossing
1	No natural break in slope AND crossing structure slope = channel slope
2	No natural break in slope but crossing structure slope greater than channel slope
3	Natural break in slope present but crossing structure = channel slope
4	No natural break in slope but crossing structure slope less than channel slope
5	Natural slope break present AND crossing structure slope different from channel slope (less than or greater than)

Table 5: Sediment Continuity Impact Ratings

Impact Rating	Sediment Deposition, Elevation of Sediment Deposits, and Tailwater Scour Pool
1	No deposition upstream AND no tailwater scour pool
2	Deposition upstream <½ bankfull height OR small tailwater pool
3	No deposition upstream AND large tailwater scour pool downstream
	Deposition upstream <½ bankfull height AND small tailwater pool
	Deposition upstream ≥½ bankfull height AND no tailwater scour pool
4	Both deposition AND tailwater pool present with either deposition ≥½ bankfull height OR a large tailwater scour large pool
5	Deposition upstream ≥½ bankfull height AND large tailwater pool

Table 6: Bank Erosion and Outlet Armoring Impact Ratings

Impact Rating	Bank Erosion and Outlet Armoring
1	No bank erosion or outlet armoring
2	--
3	Low levels of bank erosion and/or Outlet armoring not extensive
4	--
5	High levels of bank erosion and/or extensive outlet armoring

Table 7: Inlet and Outlet Grade Impact Ratings

Impact Rating	Character of Inlet and Outlet Grade
1	Both inlet and outlet at stream grade
2	Inlet drop OR cascade at outlet
3	Inlet drop AND cascade at outlet
4	Perched or clogged/collapsed/submerged inlet
	Free fall or free fall onto cascade at outlet
5	Inlet drop AND either free fall or free fall onto cascade at outlet

Table 8: Combined Geomorphic Potential Impact Ratings

Combined Potential Impact Rating	Likelihood for Geomorphic Impacts
3	Very unlikely
4-6	Unlikely
7-9	Possible
10-12	Likely
13-15	Very likely

Table 9: Combined Observed Geomorphic Impact Ratings

Combined Impact Rating	Degree of Observed Geomorphic Impacts
3	None
4-6	Minor
7-9	Moderate
10-12	Significant
13-15	Severe

Table 10: Overall Geomorphic Impact Score

Sum of Geomorphic Potential Impact Ratings and Observed Geomorphic Impact Ratings	Geomorphic Impact score
6	1
7-12	2
13-18	3
19-24	4
25-30	5

Structural Condition Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Table 1: Level 1 Variables

Number of Variables Marked "Critical" (Inlet, Outlet, or Both)	Condition Score
Any one of the following variables: • Cross Section Deformation • Barrel Condition/Structural Integrity • Footing Condition • Level of Blockage	0.0
None of the above variables are marked "Critical"	1.0

Table 2A: Level 2 Variables – Part I

Number of Variables Marked "Critical"	Condition Score
Any three of the following variables (inlet, outlet, or both): • Buoyancy or Crushing • Invert Deterioration • Joints and Seams Condition • Longitudinal Alignment • Headwall/Wingwall Condition • Flared End Section Condition • Apron/Scour Protection Condition (outlet only) • Armoring Condition • Embankment Piping	0.0
Any two of the following variables (inlet, outlet, or both): • Buoyancy or Crushing • Invert Deterioration • Joints and Seams Condition • Longitudinal Alignment • Headwall/Wingwall Condition • Flared End Section Condition • Apron/Scour Protection Condition (outlet only) • Armoring Condition • Embankment Piping	0.1
Any one of the following variables (inlet/outlet/both): • Buoyancy or Crushing • Invert Deterioration • Joints and Seams Condition • Longitudinal Alignment • Headwall/Wingwall Condition • Flared End Section Condition • Apron/Scour Protection Condition (outlet only) • Armoring Condition • Embankment Piping	0.2
None of the above variables are marked "Critical"	1.0

Table 2B: Level 2 Variables – Part II

Number of Variables Marked "Poor"	Condition Score
Any three of the following variables (inlet, outlet, or both): • Cross Section Deformation • Barrel Condition/Structural Integrity • Footing Condition • Level of Blockage	0.0
Any two of the following variables (inlet, outlet, or both): • Cross Section Deformation • Barrel Condition/Structural Integrity • Footing Condition • Level of Blockage	0.1
Any one of the following variables (inlet, outlet, or both): • Cross Section Deformation • Barrel Condition/Structural Integrity • Footing Condition • Level of Blockage	0.2
None of the above variables are marked "Poor"	1.0

Table 3: Level 3 Variables

Variables marked as "Poor" (inlet, outlet, or both)
Buoyancy or Crushing
Invert Deterioration
Joints and Seams Condition
Longitudinal Alignment
Headwall/Wingwall Condition
Flared End Section Condition
Apron/Scour Protection Condition (outlet only)
Armoring Condition
Embankment Piping

Table 4: Structural Condition Binned Score

Lowest Score Resulting from Level 1, Level 2, and Level 3 Variable Assessment	Structural Condition Binned Score
0.81 - 1.00	1
0.61 - 0.80	2
0.41 - 0.60	3
0.21 - 0.40	4
0.0 - 0.20	5

Equation 1: Level 3 Condition Score

$$Score = 1.0 - (0.1 \times N)$$
$$N = number\ of\ variables\ from\ Table\ 3\ marked\ "Poor"$$

Aquatic Organism Passage Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Table 1: Component Scores for AOP Field Variables

Field Variable	Level	Component Score
Constriction	Severe	0
	Moderate	0.5
	Spans Only Bankfull/Active Channel	0.9
	Spans Full Channel and Banks	1
Inlet Grade	Inlet Drop	0
	Perched	0
	Clogged/Collapsed/Submerged	1
	Unknown	1
	At Stream Grade	1
Internal Structures	Baffles/Weirs	0
	Supports	0.8
	Other	1
	None	1
Outlet Apron	Extensive	0
	Not Extensive	0.5
	None	1
Physical Barriers	Severe	0
	Moderate	0.5
	Minor	0.8
	None	1
Scour Pool	Large	0
	Small	0.8
	None	1
Substrate Coverage	None	0
	25%	0.5
	50%	0.5
	75%	0.7
	100%	1
Substrate Matches Stream	None	0
	Not Appropriate	0.25
	Contrasting	0.75
	Comparable	1
Water Depth	No (Significantly Deeper)	0.5
	No (Significantly Shallower)	0
	Yes (Comparable)	1
	Dry (Stream Also Dry)	1
Water Velocity	No (Significantly Faster)	0
	No (Significantly Slower)	0.5
	Yes (Comparable)	1
	Dry (Stream Also Dry)	1

Equation 1: Openness Measurement (feet)

$$Openness\ Measurement = \frac{Structure\ Cross\ Sectional\ Area}{Structure\ Length}$$

Equation 2: Openness Score (S_o), for openness measurement (x) in feet

$$S_o = (1 - e^{-5.7x})^{2.6316}$$

Equation 3: Height Score (S_h) for height measurement (x) in feet

$$S_h = min\left(\frac{1.1x^2}{4.84 + x^2}\right), 1)$$

Table 2: Weights associated with each variable in the component scoring algorithm

Parameter	Weight
Outlet Drop	0.161
Physical Barriers	0.135
Constriction	0.090
Inlet Grade	0.088
Water Depth	0.082
Water Velocity	0.080
Scour Pool	0.071
Substrate Matches Stream	0.070
Substrate Coverage	0.057
Openness	0.052
Height	0.045
Outlet Apron	0.037
Internal Structures	0.032

Table 3: Binned Aquatic Passability Score

Aquatic Passability Score	Descriptor	Binned Aquatic Passability Score
1.00	No Barrier	1
0.80 - 0.99	Insignificant Barrier	1
0.60 - 0.79	Minor Barrier	2
0.40 - 0.59	Moderate Barrier	3
0.20 - 0.39	Significant Barrier	4
0.0 - 0.19	Severe Barrier	5

Table 4: Binned Ecological Integrity Score

Aquatic Index of Ecological Integrity (IEI) Value	Binned Ecological Integrity Score
0.0-0.3	1
0.31-0.5	2
0.51-0.7	3
0.71-0.9	4
0.91-1.0	5

Equation 4: Outlet Drop Score (S_{od}) for outlet drop measurement (x) in feet

$$S_{od} = 1 - \frac{1.029412x^2}{0.26470588 + x^2}$$

Equation 5: Aquatic Passability Score

$$Aquatic\ Passability\ Score = Minimum\ [Composite\ Score, Outlet\ Drop\ score]$$

Transportation Services Disruption Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Table 1: Transportation Disruption Component Scores

Disruption Rating	Road Classification (Highway Functional Classification)
1	Local Roads, Trails, Driveways
2	Major and Minor Collectors
3	Minor Arterials
4	Other Principal Arterials
5	Interstates, Freeways, and Expressways

Flood Impact Potential Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Equation 1: Stream Buffer Distance as a Function of Bankfull Width (for use where bankfull width available)

$$Stream\ Buffer\ Distance = 2 \times Bankfull\ Width$$

Table 1: Stream Buffer Distance as a Function of Crossing Structure Width and Degree of Constriction

(for use where bankfull width not available)

Crossing Structure Constriction Rating	Stream Buffer Distance (Substitute for Equation 8-1)
Severe	4 x Structure Width
Moderate	3 x Structure Width
Spans Only Bankfull Active Channel	2 x Structure Width
Spans Full Channel and Banks	2 x Structure Width

Table 2: Flood Impact Rating – Developed Area

Flood Impact Rating	Percent Developed Area within Potential Flood Impact Area Buffer Polygon
1	<5% developed area
2	<10% developed area
3	<25% developed area
4	<50% developed area
5	>50% developed area

Table 3: Flood Impact Rating – Upstream and Downstream Crossings

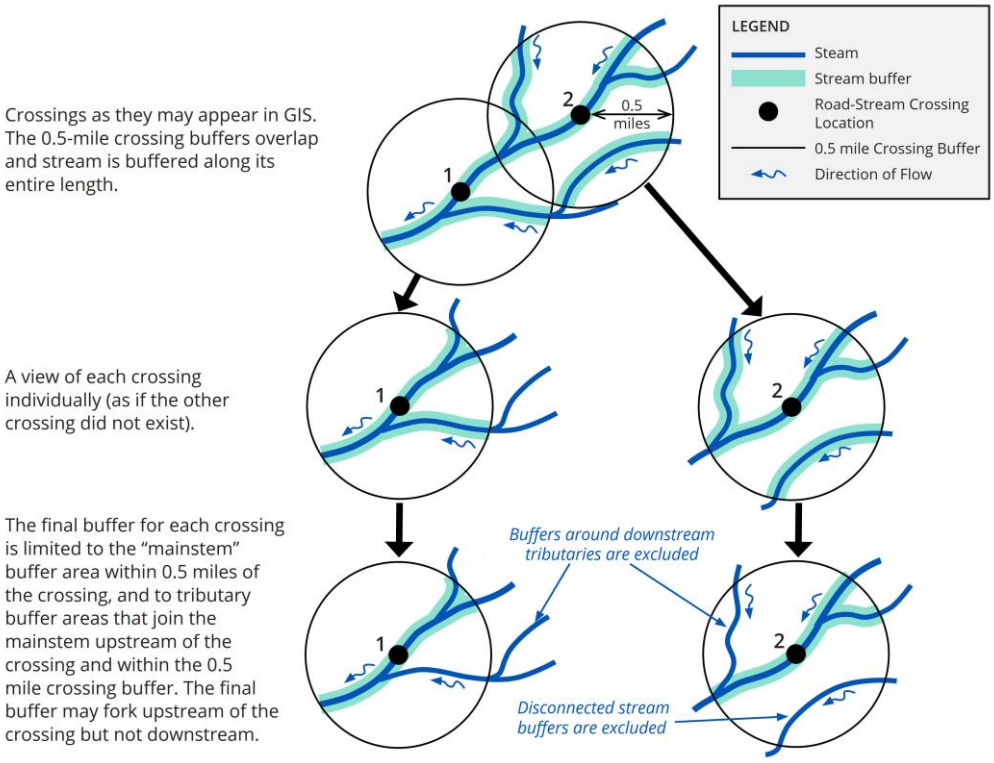
Flood Impact Rating	Number of Upstream and Downstream Crossings within Potential Flood Impact Area Buffer Polygon
1	0
2	--
3	1
4	--
5	>1

Note: -- indicates category not used

Table 4: Binned Flood Impact Potential Scores

Binned Flood Impact Potential Score	Sum of Component Flood Impact Ratings
1	1 – 2
2	3 – 4
3	5 – 6
4	7 – 8
5	9 – 10

Figure 1: Stream Crossing Buffer Diagram



Prioritization Worksheet
Massachusetts Road-Stream Crossing Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan – Town of Charlton and Town of Spencer
May 2019

Equation 1: Crossing Failure Risk

$$Failure\ Risk = Probability\ of\ Failure \times Magnitude\ of\ the\ Impact\ of\ Failure$$

Equation 2: Impact Score

$$Impact\ Score = Maximum\begin{bmatrix} Binned\ Transportation\ Disruption\ Score, \\ Binned\ Flood\ Impact\ Potential\ Score \end{bmatrix}$$

Equation 3: Existing Hydraulic Risk Score

$$Existing\ Hydraulic\ Risk\ Score = Binned\ Existing\ Hydraulic\ Capacity\ Score \times Impact\ Score$$

Equation 4: Future Hydraulic Risk Score

$$Future\ Hydraulic\ Risk\ Score = Binned\ Future\ Hydraulic\ Capacity\ Score \times Impact\ Score$$

Equation 5: Geomorphic Risk Score

$$Geomorphic\ Risk\ Score = Binned\ Geomorphic\ Vulnerability\ Score \times Impact\ Score$$

Equation 6: Structural Risk Score

$$Structural\ Risk\ Score = Binned\ Structural\ Condition\ Score \times Impact\ Score$$

Equation 7: Crossing Risk Score

$$Crossing\ Risk\ Score = Maximum\begin{bmatrix} Existing\ Hydraulic\ Risk\ Score, \\ Climate\ Change\ Risk\ Score, \\ Geomorphic\ Risk\ Score, \\ Structural\ Risk\ Score \end{bmatrix}$$

Equation 8: Aquatic Passage Benefit Score

$$Aquatic\ Passage\ Benefit\ Score = Binned\ Aquatic\ Passability\ Score \times Binned\ Ecological\ Integrity\ Score$$

Equation 9: Crossing Priority Score

$$Crossing\ Priority\ Score = Maximum[Aquatic\ Passage\ Benefit\ Score, Crossing\ Risk\ Score] + Average[Aquatic\ Passage\ Benefit\ Score, Crossing\ Risk\ Score]$$

Table 1: Relative Priority Ratings

Crossing Priority Score (normalized)	Priority Rating
0.55 – 1.00	High
0.35 - 0.54	Medium
0.00 - 0.34	Low

Appendix C

Dams Assessment Technical Memorandum

FUSS & O'NEILL

MEMORANDUM

TO: Project Steering Committee

FROM: Erik Mas, PE and Rachael Weiter, EIT
Fuss & O'Neill, Inc.
1550 Main Street, Suite 400
Springfield, MA 01103

DATE: June 20, 2019

RE: Dams Assessment
Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
MVP Action Grant – Town of Charlton & Town of Spencer

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1 Introduction

The Town of Charlton and the Town of Spencer were awarded a FY18 EEA Municipal Vulnerability Preparedness (MVP) Program Action Grant to conduct a comprehensive, regional climate change vulnerability assessment and develop an associated management plan that addresses the major types of water infrastructure in both communities including transportation systems (culverts and bridges), dams and natural impoundments, wastewater collection and treatment systems, water supply, and storm infrastructure. The project consists of a series of technical assessments focused on each type of water infrastructure and associated climate change vulnerabilities. A key goal of this project is to promote resiliency measures that consider both infrastructure and natural system solutions. The integrated plan is intended to help local decision-makers think more strategically about ways to utilize natural systems to provide more effective strategies to reduce flooding, while also benefitting water quality and ecological health.

Based on information available from MassGIS, there are 51 state-registered dams in Charlton and Spencer, four of which are Town-owned. Many of these are relatively small dams built to power industrial mills of the 17th and 18th centuries, are no longer used for their original purpose, and are in poor or deteriorating condition. Some of these dams could pose upstream flooding hazards by backing up water during floods. Dams also present a hazard to downstream areas in the event of a breach or failure, which can result from aging infrastructure, insufficient maintenance and changes in upstream flow regimes. Dam failure can release large quantities of flow, sediment (sometimes contaminated), and debris and is therefore a threat to property, ecosystems, and public safety. Dams have also fragmented the riverine systems in the watershed, preventing the movement of fish and other aquatic life to feed, spawn, or migrate past the dams.

The objective of the technical assessment described in this memorandum is to assess the structural condition of 20 dams and evaluate potential management alternatives and provide recommendations for each dam to increase flood resilience and provide ecological benefits.

2 Dam Assessments

2.1 Selection of Dams for Assessment

Dams to be included in the assessment were initially identified based on review of database files provided by the Massachusetts Department of Conservation and Recreation Office of Dam Safety (ODS). Dams categorized as High or Significant Hazard dams were prioritized, as were municipally-owned dams. Staff from the Town of Charlton and the Town of Spencer (the Towns) supplied information on which dams were already slated for repair activities and which were of greater concern to the Towns. The number of dams selected for assessment was also dictated by the available project budget and the need to assess road-stream crossings and potential sites for the implementation of green infrastructure and low impact development that are included in the study and are documented in additional technical memoranda.

Twenty dams in the Towns were ultimately selected for field surveys and vulnerability assessment, though four additional dams were added to this selection after discovery in the field (see Section 2.3). The locations of the selected dams are shown on the maps in Figures 1 and 2. Table 1 provides summary information on each dam, including hazard classifications, which are defined in Table 2.

The dams initially selected for assessment include two (2) dams owned by the Town of Spencer, three (3) dams owned wholly or partially by the Town of Charlton, and three (3) dams owned by the Massachusetts Department of Conservation and Recreation (MADCR). The remaining twelve (12) dams are either privately owned or of unknown ownership. Ten (10) dams retain recreational impoundments and one (1) dam is used for flood control and as an emergency water supply for the Town of Spencer; two additional dams are used for both recreation and flood control. Five (5) of the dams originally selected for assessment and all ten of the dams discovered in the field (including the four dams added to the assessment) have no known use.

2.2 Office of Dam Safety File Review

Files maintained by the ODS were reviewed to gather available information on each dam selected for assessment. The files requested included the most recent one or two inspection reports and the most recent Emergency Action Plan (if available) for each dam. Dams owned by either the Town of Spencer or the Town of Charlton were excluded from the request, as these reports were available from the towns.

Hazard classification, flood hazard mapping, upstream and downstream development and infrastructure, and current condition identified from previous dam inspection reports were considered in the analysis described in Section 3.

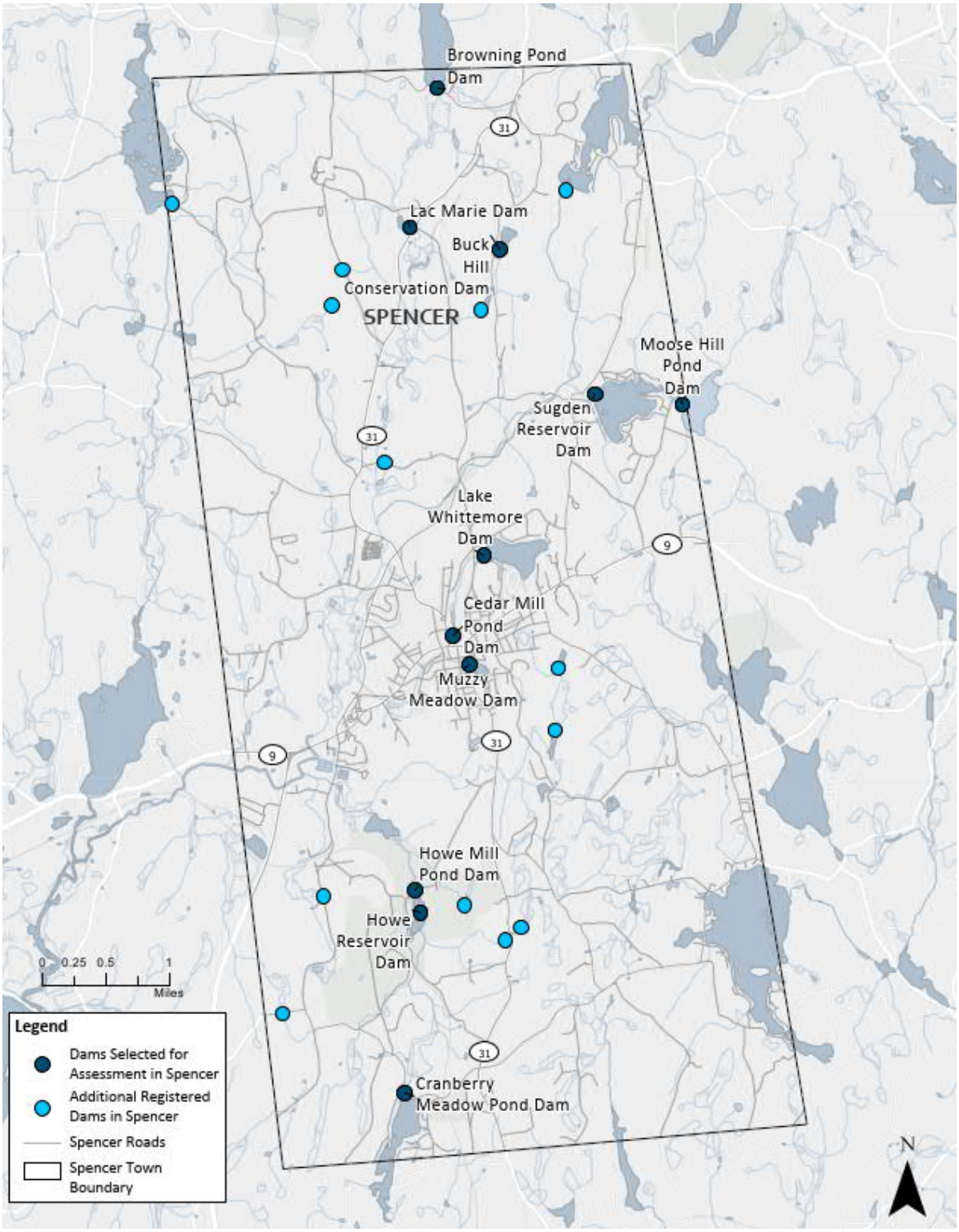

Figure 1. Registered Dams and Dams Assessed in the Town of Spencer

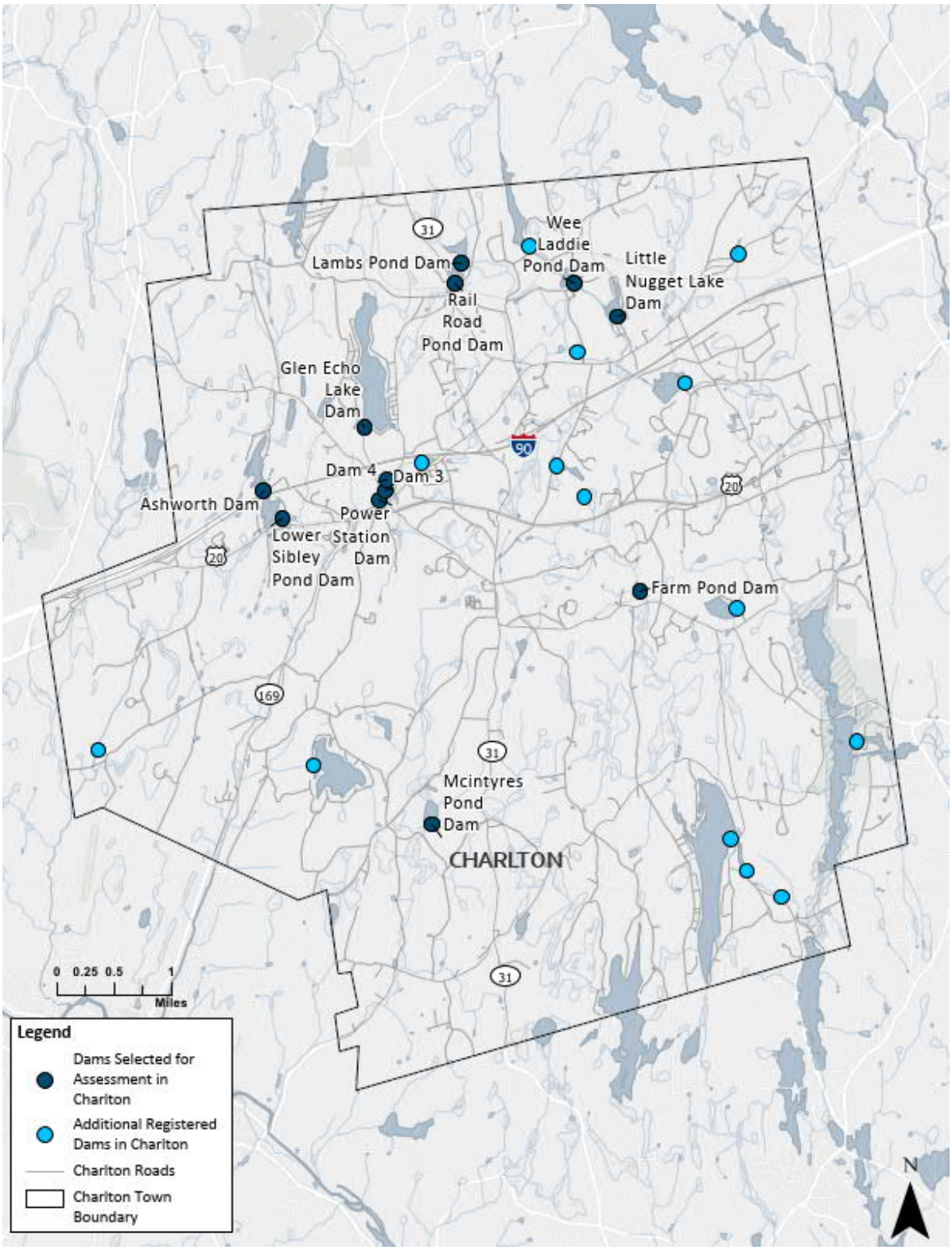

Figure 2. Registered Dams and Dams Assessed in the Town of Charlton

Table 1. Dams Selected for Assessment in the Towns of Charlton and Spencer

Dam ID Number	Dam Name	Impoundment Name	Stream Name	Ownership	Current Use(s)	Hazard Class
Town of Charlton						
MA00101	Glen Echo Dam	Glen Echo Lake	Cady Brook Headwaters	Town of Charlton	Flood Control; Lakeside Property	High
MA00103	Little Nugget Lake Dam	Little Nugget Lake	Little Nugget Brook	Town of Charlton	Recreation	Significant
MA01829	Lambs Pond Dam	Lambs Pond		Blair Builders Inc.	Recreation	Significant
MA00100	Ashworth Dam	Upper Sibley Pond	Ashworth Brook	Orrin J. Sisco	Unknown	Significant
MA00099	Lower Sibley Pond Dam	Lower Sibley Pond	Ashworth Brook	Catherine C. Gauthier; in probate as of Spring 2019 according to Todd Girard	None Known	Significant
MA01827	Wee Laddie Pond Dam	Wee Laddie Pond	Little River	St. Mark Coptic Orthodox Church	None Known; Current or past uses may include Conservation and/or Recreation	Significant
MA01838	Farm Pond Dam	Dodge Pond	Unnamed Tributary to the South Charlton Reservoir	Frank and Donna Robert	Recreation	N/A
MA01835	Mcintyres Pond Dam	McIntyre Pond	Deans Brook Headwaters	Thaddeus Mroczkowski	Unknown	N/A
MA01830	Rail Road Pond Dam	Rail Road Pond	Unnamed Tributary to Cady Brook	Town of Charlton (half); Anthony Kestigan (half)	Supports Public Road (Old Spencer Road)	Significant
MA03428	Carpenter Mill Pond Dam	Carpenter Mill Pond	Cady Brook		None Known	N/A
	Power Station Dam		Cady Brook		None Known	N/A
	Dam 3		Cady Brook		None Known	N/A
	Dam 4		Cady Brook		None Known	N/A
Town of Spencer						
MA01997	Lac Marie Dam	Lac Marie Pond	Seven Mile River	Cistercian Abbey of Spencer, Inc.	Recreation	Significant
MA02379	Muzzy Meadow Dam	Spencer Pond	Unnamed Tributary to Seven Mile River	Town of Spencer	Aesthetics, Future Skating Pond/Trails	High
MA02583	Moose Hill Pond Dam	Moose Hill Pond	Shaw Brook	MADCR	Flood Control, Emergency Water Supply	High
MA00700	Cranberry Meadow Pond Dam	Cranberry Meadow Pond	Cranberry River	Private - Unknown. Town of Spencer states they do	Recreation	Significant

Table 1. Dams Selected for Assessment in the Towns of Charlton and Spencer

Dam ID Number	Dam Name	Impoundment Name	Stream Name	Ownership	Current Use(s)	Hazard Class
				not own this dam		
MA00699	Lake Whittemore Dam	Lake Whittemore	Tributary of Seven Mile River	Worcester County Electric Company	Recreation	High
MA00698	Sugden (Reservoir) Dam	Sugden Reservoir	Shaw Brook	Town of Spencer	Flood Control, Recreation	High
MA00695	Browning Pond Dam	Browning Pond	Seven Mile River	Great Trails Council, BSA	Recreation	Significant
MA00901	Buck Hill Conservation Dam	Buck Hill Pond	Seven Mile River	Worcester County 4H Center, Inc.	Conservation and Recreation	Significant
MA01995	Cedar (or Cider) Millpond Dam	Cider Mill Pond	Outflow brook below Whittemore Dam;	Walter and Suzanne Mendala	Supports Parking Lot	N/A
MA01175	Howe Mill Pond Dam	Howe Mill Pond (lower portion of Howe Pond)	Cranberry River	MADCR	Recreation, Aesthetics, Cultural	Significant
MA02542	Howe Reservoir Dam	Howe Reservoir (upper portion of Howe Pond)	Cranberry River	MADCR	Recreation	Significant

Table 2. Dam Hazard Class Definitions

Dam Hazard Class	Definition
Low	The dam is located where failure may cause minimal property damage and loss of life is not expected
Significant	The dam is located where failure may cause loss of life and damage to property
High	The dam is located where failure will likely cause loss of life and serious damage to property.

2.3 Field Data Collection

Limited visual condition assessments of the selected dams were conducted on November 27, November 29, December 5, and December 12, 2018 using visual dam inspection forms adapted from ODS's standard dam inspection forms. Digital photographs were also taken at each site. A blank copy of the field data collection form is provided in Attachment A.

Access to the sites was facilitated by staff at each of the Towns, who contacted dam owners to secure permission to access the dams. Access was granted to ten (10) of the eleven (11) dams in Spencer and four (4) of the nine (9) dams originally selected for assessment in Charlton. Access permissions could not be obtained to four (4) dams in Charlton due to owner refusal, lack of reply from the owner, or lack of information to contact the owner. Access to the Cranberry Meadow Dam in Spencer could not be

obtained as the dam is buried beneath a parking lot. Access to one (1) dam in Charlton (McIntyre's Pond Dam) was granted too late in the field season to complete a visual assessment. Therefore a total of thirteen (13) dams were visually assessed in the field.

The visual dam assessments were performed by a two-person field crew led by a water resources engineer experienced in performing state dam inspections in Massachusetts. During the visual dam assessments conducted in the Town of Spencer, the field crew was accompanied by the Town Planner, Paul Dell'Aquila. Following the visual assessments, field data were checked against previous dam inspection reports when available. Completed visual assessment forms are provided in Attachment B.

In addition to the dams initially selected for visual assessment and vulnerability analysis, nine (9) unregistered dams (three in Spencer and six in Charlton) were discovered and observed from the public-right-of way during the field assessments. These dams are not included in the ODS databases. Three of these dams are located within 0.5 miles of each other along Cady Brook as it flows through Charlton City. All three may be large enough to be considered jurisdictional, and are situated upstream of other infrastructure such that they may pose a significant hazard: Dam 1 is located upstream of a non-jurisdictional dam (Carpenter Mill Dam), while Dam 2 and 3 are each located immediately upstream of Route 31; all three are also located upstream of commercial and residential buildings. The failure of either of the two upper dams may result in significant damage and flooding in Charlton City and the failure of any of the three could result in the sequential failure of the downstream dam(s). For this reason, Power Station Dam, Dam 3, and Dam 4 were included in the vulnerability assessment and prioritization described in Section 3, although limited visual condition assessments could not be completed due to lack of access to the dam sites.

2.4 Visual Assessment Findings Summary

Table 3 summarizes key field data and findings of the limited visual condition assessments. Dam condition ratings are defined in Table 4.

Table 3. Summary of Dam Visual Assessment Findings

Dam ID Number	Dam Name	Visually Assessed?	Condition	Comments
Town of Charlton				
MA00101	Glen Echo Dam	Yes	Fair	
MA00103	Little Nugget Lake Dam	Yes	Good	Signs of beaver activity observed near dam
MA01829	Lambs Pond Dam	Yes	Fair	Beaver dam at spillway has raised impoundment level
MA00100	Ashworth Dam	No – Permission Denied	Unknown	
MA00099	Lower Sibley Pond Dam	No - Unable to Contact Owner	Poor	
MA01827	Wee Laddie Pond Dam	Yes	Poor	Beaver dam at spillway has raised impoundment level
MA01838	Farm Pond Dam	No – Permission Denied	Fair	
MA01835	Mcintyres Pond Dam	No – Permission Granted too late in Winter Season	Unknown	Beaver dam observed on top of original dam in June 2006. At same time, original stone wall was observed to be damaged or breached and no spillway was visible.

Table 3. Summary of Dam Visual Assessment Findings

Dam ID Number	Dam Name	Visually Assessed?	Condition	Comments
MA01830	Rail Road Pond Dam	No – No response from Owner	Poor	
MA03428	Carpenter Mill Pond Dam	No – Added to Assessment after three additional dams found in field upstream of this structure	Probably Fair or Poor	
	Power Station Dam	No – Found in Field	Unsafe	
	Dam 3	No – Found in Field	Unsafe	
	Dam 4	No – Found in Field	Unsafe	
Town of Spencer				
MA01997	Lac Marie Dam	Yes	Good	
MA02379	Muzzy Meadow Dam	Yes	Fair	
MA02583	Moose Hill Pond Dam	Yes	Satisfactory	
MA00700	Cranberry Meadow Pond Dam	Yes	Poor	
MA00699	Lake Whittemore Dam	Yes	Satisfactory	
MA00698	Sugden (Reservoir) Dam	Yes	Fair	
MA00695	Browning Pond Dam	Yes	Fair	
MA00901	Buck Hill Conservation Dam	Yes	Fair	Debris from beaver dam at spillway has blocked spillway inlet
MA01995	Cedar (or Cider) Millpond Dam	No – buried beneath Price Chopper Parking Lot	Fair	
MA01175	Howe Mill Pond Dam	Yes	Fair	
MA02542	Howe Reservoir Dam	Yes	Fair	Beaver dam at spillway has raised impoundment level

Table 4. Dams Condition Rating Definitions

Dam Condition	Definition
Good	No operational or maintenance deficiencies recognized. Safe performance is expected under all loading conditions.
Satisfactory	Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.
Fair	Significant operational and maintenance deficiencies are present, but no structural deficiencies. Potential deficiencies exist under unusual loading conditions. This rating may be used when uncertainties exist as to critical parameters
Poor	Significant structural, operational, and maintenance deficiencies are clearly recognized under normal operating conditions
Unsafe	Major structural, operational, and maintenance deficiencies exist under normal operating conditions

The following issues were observed at the dams:

- Beaver Activity: Several of the dams (Wee Laddie Pond Dam, Buck Hill Conservation Dam, Lambs Pond Dam, Howe Reservoir Dam, and Little Nugget Lake Dam) were observed to have beaver activity impacting the spillway. In addition, a beaver dam was reported at the spillway of McIntyre's Pond Dam in 2006, though it is unclear if the beaver dam still exists. Beaver dams built at dam spillways have raised the impoundment level by one (1) foot or more at Wee Laddie Pond Dam and Lambs Pond Dam, raising the risk that the dam(s) will overtop during wet periods. Todd Girard, Conservation Agent for the Town of Charlton, has also reported that beaver activity is a problem at the majority of the dams he manages in the Town of Charlton.
- Trees and Vegetation on the Embankment: The majority of the assessed dams have vegetation encroaching on or growing directly on the dam embankment. Vegetation, especially large trees, can promote the formation of voids in the dam embankment, leading to seepage and piping through the dam, thereby accelerating the degradation of the dam. Trees and vegetation should be cleared back to a distance of 20 feet from any dam and a cover of healthy grass should be maintained on dam embankments.
- Lack of Operation and Maintenance (O&M) Plans: Previous inspection reports stated that O&M Plans were not in place for the majority of the dams as of the last inspection. Maintenance is critical at dams to prevent small problems from accumulating and leading to failure of the dam. Dam owners should be encouraged to develop and follow O&M plans to maintain the stability and safety of the dam(s) under their care.

3 Evaluation and Prioritization of Management Alternatives

3.1 Evaluation Method

Using data from the limited visual condition assessments and available ODS file data, various management alternatives were evaluated for each dam to identify and prioritize management actions that would enhance flood resiliency and provide ecological benefits. Dam management alternatives were assessed using the flowchart in Figure 3.

The following dam management alternatives were evaluated:

- Removal/Breach: Full removal or partial breach of a dam, thereby eliminating or lowering the impoundment, reducing the risk of failure or breach, and restoring free-flowing conditions. Dam removal eliminates flood risk due to failure or breach, potentially reduces flood risk in upstream areas, meets aquatic organism passage objectives, and eliminates significant liability and costly maintenance for dam owners.

- Repair: Repair of structural components of a dam to address existing deficiencies that threaten the structural integrity of the dam, thereby reducing the potential for failure or breach during large storms. The dam repair alternative alone does not eliminate the risk of failure nor does it improve aquatic organism passage. In some cases, the repair option, potentially combined with provision of aquatic organism passage, may be the only viable alternative if removal is not feasible. Dam repair involves the up-front cost of the repairs and a long-term financial commitment to inspect and maintain the dam following the initial repairs. It also assumes that the owner has the willingness, ability, and financial resources to adequately maintain the dam.

- Modification / Repurposing: Modification of an existing dam to provide increased storage during floods. For example, repurposing could include increasing the elevation of the dam, dredging of the impoundment, or modification of the outlet structure to significantly reduce the impoundment size and normal pool elevation, allowing the river to flow freely under normal conditions (i.e., a dry impoundment), but allowing the impoundment to fill up and store floodwaters during larger storms. Repurposing of dams for hydropower was not considered because hydropower is generally not economically viable at the scale of the dams located within these towns.

- Aquatic Organism Passage Structure: Construction of an engineered structure at a dam to provide for passage of fish and other aquatic organisms, including fishways such as fish ladders, rock ramps, or bypass channels. This option provides enhanced stream continuity if dam removal is not feasible.

- No Action / Maintain: Maintain the dam in its current condition.

Factors considered qualitatively in the alternatives evaluation included current uses and recreational / cultural value of the dam and impoundment, the owner's ability to maintain the dam, failure risk (based on hazard classification and structural condition), flood mitigation potential, and stream continuity and aquatic habitat quality. These factors are discussed in more detail below.

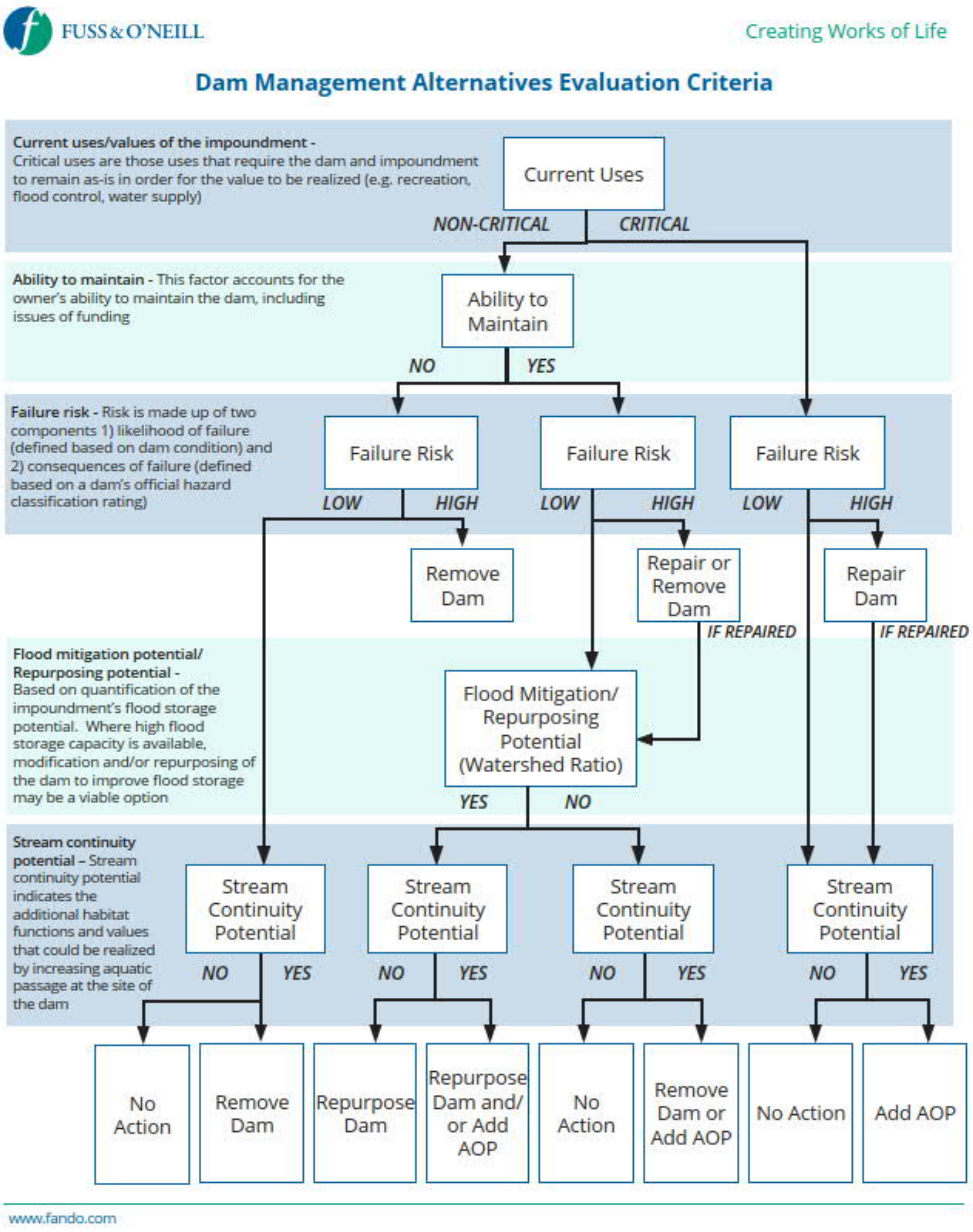

Figure 3. Dam Management Alternatives Evaluation Criteria Flowchart

Current Uses/Values of the Impoundment

Uses of impoundments may include flood control, water supply, recreation, conservation, or aesthetics/culture. Critical uses are those uses that required the dam and impoundment to remain in place without removal, breaching, or lowering of the dam in order for the value to be realized. Dams may have multiple uses, including multiple critical uses.

3.1.1 Ability to Maintain

The ability to maintain a dam was determined based on visual evidence of maintenance (or lack thereof) observed during the visual assessments, supplemented with information from previous dam inspection reports. For dams where vegetation consisted of mowed grass and deficiencies were relatively few and

minor, and where the dam owner was known, the Ability to Maintain was entered as "Yes". For dams covered in tall grasses, shrubs, and/or trees and/or dams without a known owner, the Ability to Maintain was entered as "No". Where the Ability to Maintain was unclear, the most appropriate answer was entered, with supplemental notes.

3.1.2 Failure Risk

Failure risk was estimated for each dam based on the hazard class of the dam (i.e., a rating system based on the magnitude of potential impacts in the event of dam failure) and the structural condition of the dam (i.e., likelihood of dam failure) based on the limited visual condition assessments and/or dam inspection information from the ODS file review (Figure 4). A dam may be at risk if the probability of failure is high, if the consequences of failure are high, or both.

		Dam Condition				
		Good	Satisfactory	Fair	Poor	Unsafe
Dam Hazard Class[1]	Low	Low	Low	Low	Moderate	Moderate
	Significant	Low	Low	Moderate	Moderate	Severe
	High	Low	Moderate	Moderate	Severe	Severe

Figure 4. Dam Failure Risk Assignment Matrix

3.1.3 Flood Mitigation Potential

Dams may provide flood mitigation services if they have sufficient available volume to attenuate flood flows from upstream and slow their release to downstream areas. Flood mitigation potential was assessed based on the ratio of the dam's impoundment area to the dam's drainage area. A higher ratio reflects an impoundment that is large in relation to the size of the watershed, and is therefore more likely to provide significant flood protection benefits to downstream properties and infrastructure (assuming adequate freeboard is available above the normal pool elevation). For each dam, the watershed area was obtained from the USGS StreamStats web tool, and the impoundment area was obtained from file review information or estimated from aerial imagery in Google Earth. Dams with a watershed ratio greater than 0.1 (i.e., where the impoundment area is 10% or greater of the watershed area) were designated as having flood mitigation potential.

3.1.4 Stream Continuity Potential

Stream continuity refers to the connectedness of different reaches of the stream and the ecological benefits associated with that connectedness. Stream Continuity Potential was estimated for each dam using the Restoration Potential Model (RPM) Tool, developed by the Division of Ecological

Restoration, MA Department of Fish and Game (MADER). This statewide analysis tool is used to evaluate the ecological benefits of dam removal. The RPM Tool evaluates environmental and stream health data upstream and downstream of a dam in order to assess how its removal may improve habitat in the stream and its local watershed. The result is a percentile ranking (0-100) of ecological benefit potential for the dam if it were removed.

The RPM Tool relies on three main environmental indicators:

1. Watershed Position. The Tool adds a scoring weight for dams located in reaches with unique ecological characteristics that particularly benefit from dam removal (head-of-tide habitats, coastal stream habitats, and headwaters ecosystems).

2. Ecological Integrity. The effect of dam removal is measured by four indicators:
    a. The presence of rare species and aquatic habitats habitat upstream or downstream of a dam. Places of high ecological value and integrity have been designated by BioMap2 (https://www.mass.gov/service-details/biomap2-conserving-the-biodiversity-of-massachusetts-in-a-changing-world), a project of the MassWildlife's Natural Heritage & Endangered Species Program.
    b. The percent cover of impervious surfaces upstream from the dam
    c. The presence of mapped coldwater habitat upstream or downstream of a dam, indicating suitable year-round habitat for aquatic life such as trout.
    d. The alteration of August stream flow due to water withdrawals, with higher alterations indicating higher stress on the aquatic ecosystem.

3. Connectivity. The improvement in stream connectivity (upstream and downstream) that would be gained if the dam were removed.

The data supplied in the tool and used for this analysis was last updated on April 28, 2017. For more information about DER's Restoration Potential Model Tool or how these indicators are scored, or to access the interactive map viewer of statewide dam assessments, go to www.mass.gov/service-details/ders-restoration-potential-model-tool-description.

3.1.5 Management Recommendations

Each of the above factors was considered in determining the most appropriate recommendation(s) for each dam using the dam management alternatives evaluation criteria flowchart (Figure 2). Feedback from the Towns was also considered in developing final management recommendations.

3.2 Prioritization Method

As human health and safety is the first and foremost concern when it comes to dams, priority he management recommendations for each dam were assigned a relative priority (low, moderate, or high) based on whether the dam is considered a low, moderate, or severe failure risk, respectively.

3.3 Assessment and Prioritization Results

Table 5 summarizes the Ability to Maintain, Failure Risk, Flood Mitigation Potential, and Stream Continuity Potential, as well as the management recommendations and relative priority, for each dam. The dam assessment and prioritization worksheet and priority category are provided in Attachment C.

Table 5. Dam Assessment and Prioritization Results Summary

Dam ID Number	Dam Name	Failure Risk/Priority[1]	Ability to Maintain	Flood Mitigation Potential	Stream Continuity Potential	Management Recommendations
Town of Charlton						
MA00101	Glen Echo Dam	Moderate	Yes	No	Moderate	Repair/Maintain
MA00103	Little Nugget Lake Dam	Low	Yes	No	Moderate	Consider adding AOP
MA01829	Lambs Pond Dam	Moderate	Yes, but owner has not removed beaver dam at spillway	No	Moderate	Remove to increase stream continuity and to address beaver problems, or Repair and remove beaver debris.
MA00100	Ashworth Dam	Unknown	Unknown	No	Moderate	Remove or No Action
MA00099	Lower Sibley Pond Dam	Severe	No	No	Low	Remove
MA01827	Wee Laddie Pond Dam	Severe	No	No	Low	Remove
MA01838	Farm Pond Dam	Low	Unknown	No	Moderate	Repair/Maintain and Consider adding AOP
MA01835	Mcintyres Pond Dam	Unknown	Unknown	No	Moderate	Consider removal; More information needed
MA01830	Rail Road Pond Dam	Severe	No	No	Not Assessed	Remove
MA03428	Carpenter Mill Pond Dam	Moderate	Unknown	No	Not Assessed	Consider removal; More information needed
	Power Station Dam	Severe	No	No	Not Assessed	Remove
	Dam 3	Severe	No	No	Not Assessed	Remove
	Dam 4	Severe	No	No	Not Assessed	Remove
Town of Spencer						
MA01997	Lac Marie Dam	Low	Yes	No	High	Consider adding AOP within limited space
MA02379	Muzzy Meadow Dam	Moderate	Yes	No	Low	No Action
MA02583	Moose Hill Pond Dam	Low/ Moderate	Yes	No	Moderate	Consider adding AOP
MA00700	Cranberry Meadow Pond Dam	Severe	Yes	Yes	Low	Repair
MA00699	Lake Whittemore Dam	Low/ Moderate	Yes	Yes	Low	No Action

Table 5. Dam Assessment and Prioritization Results Summary

Dam ID Number	Dam Name	Failure Risk/Priority[1]	Ability to Maintain	Flood Mitigation Potential	Stream Continuity Potential	Management Recommendations
MA00698	Sugden (Reservoir) Dam	Moderate	Yes	No	Moderate	Consider modifying to allow drawdown for additional flood capacity; Consider adding AOP
MA00695	Browning Pond Dam	Moderate	No	No	High	Consider removal, or Repair/Maintain and add AOP
MA00901	Buck Hill Conservation Dam	Moderate/ Severe	Yes but owner has not removed beaver dam or debris from spillway	No	Moderate	Repair/Maintain and consider adding AOP
MA01995	Cedar Millpond Dam (a.k.a. Cider Mill Pond Dam)	Low/ Unknown	No	No	Low	More information needed
MA01175	Howe Mill Pond Dam	Moderate	Yes	No	Low	Repair/Maintain
MA02542	Howe Reservoir Dam	Moderate	Yes	No	Low	Study Removal to possibly address beaver problems and provide stream/lake continuity

[1]Failure risk correlates with dam priority (low failure risk = low priority, moderate failure risk medium priority, and severe failure risk = high priority). For high priority dams, a severe failure risk is indicated in bold.

3.3.1 Ability to Maintain

Visual evidence of maintenance was observed at only half of the dams that were assessed (12 out of 24 dams). Two other dams were mowed regularly but had not been cleared of debris or beaver dams building up at the spillway. All of these dams are privately owned or of unknown ownership; town-owned dams and dams owned by DCR were better maintained.

3.3.2 Failure Risk

Eight (8) of the 24 dams assessed fell into the Severe or Moderate/Severe Failure Risk category. These dams should be considered among the highest priorities for action, as they are the most likely to fail and/or have significant impacts upon failure.

Ten (10) of the 24 dams are considered a Moderate or Low/Moderate Failure Risk and two (2) are considered a low failure risk. One dam (Cedar Mill Pond Dam) is categorized as low/unknown as the dam is obscured by the parking lot above it but possibly also protected by the lot.

3.3.3 Flood Mitigation Potential

Only two (2) dams (Cranberry Meadow Pond Dam, and Lake Whittemore Dam) are considered to have Flood Mitigation Potential based on the ratio of watershed area to impoundment area. The flood mitigation benefits of a dam and associated impoundment can be enhanced by increasing the available storage volume of the impoundment. This can typically be accomplished by: 1) raising the height of the

dam, 2) dredging the impoundment, or 3) modifying the dam's low-level outlet structure to reduce the impoundment size and normal pool elevation. Cranberry Meadow Pond Dam, and Lake Whittemore Dam are both surrounded by lakeside properties and/or roads that would be negatively impacted by raising the dam elevation. Dredging of the assessed impoundments, to the extent required to appreciably enhance flood storage, is likely to be cost-prohibitive given the permitting requirements, the high cost of implementation, including sediment disposal, and the high cost of maintaining the impoundment depth through repeated dredging.

3.3.4 Stream Continuity Potential

Only two (2) dams are considered to have a high stream continuity potential. An additional nine (9) dams are considered to have a moderate stream continuity potential. Eight (8) are considered to have low stream continuity potential, and five were not assessed using the DER Restoration Potential Model.

Of the three major factors considered, ecological integrity carries the most weight, followed by connectivity. Few dams in the Charlton and Spencer receive points for watershed position, as none are coastal dams and few of the dams assessed are headwaters dams. Thus, the high number of dams with a low or moderate Stream Continuity Potential are explained primarily by low ecological integrity scores and low connectivity scores. Low connectivity scores were common due to the large number of dams and culverts within the stream networks in both towns, which limit the gain in net length of open stream that can be gained through removal of a single structure. Improvements in water quality and habitat connectivity of streams and lakes through other concurrent work by each town (such as green infrastructure and road-stream crossing replacement projects) would also increase the benefit of dam removal and increased aquatic organism passage.

4 Management Recommendations

The following is a summary of management recommendations for the 24 dams assessed.

- Removal is recommended for 11 of the 24 dams assessed, due to the high failure risk and lack of ability to maintain these structures, as well as the potential gains in aquatic connectivity upon removal.

  A feasibility study for removal of Howe Reservoir Dam is also recommended to further assess the potential benefits to aquatic connectivity in Howe Pond and the Cranberry River, to address ongoing beaver problems, and to eliminate a significant hazard dam and the inspection and maintenance requirements associated with the structure.

- Repair and maintenance is recommended for five dams (Glen Echo Lake Dam, Farm Pond Dam, Cranberry Meadow Pond Dam, Buck Hill Conservation Dam, and Howe Mill Pond Dam). These dams are structures with intrinsic cultural and historic value, or that retain recreational impoundments, but that also require some repair work and maintenance to correct structural deficiencies. The addition of a fishway is also recommended for Farm Pond Dam and Buck Hill Conservation Dam.

  Repair is included as a potential alternative to dam removal for Lambs Pond Dam and Browning Pond Dam. Repair of these dams would require

- Modification of Sugden (Reservoir) Dam should be considered to provide additional flood storage capacity. Modification or repurposing for flood storage or other uses is not recommended for any of the other dams, for the reasons listed under Section 3.3.3.

- Addition of a fishway (e.g., a fish ladder, eel ladder, rock ramp, and/or nature-like fishway) is recommended for Little Nugget Lake Dam, Farm Pond Dam, Lac Marie Dam, Moose Hill Pond Dam, Sugden Reservoir Dam, and Buck Hill Conservation Dam.

  If repair is chosen over removal for Browning Pond Dam, the addition of a fishway or replacement of the culvert with a passage-friendly design is recommended.

- The No Action alternative is recommended for Muzzy Meadow Dam and Lake Whittemore Dam.

Eight dams were determined to be high priority dams (dams with a Severe Risk of Failure): six dams in Charlton and two dams in Spencer. Removal is recommended for all six dams located in Charlton, and repairs are recommended for the two dams located in Spencer. All eight of these dams are entirely or partially privately owned, but the municipalities can play a role in contacting the dam owners and helping connect them with funding and technical resources. More detailed site-specific recommendations were developed for these eight dams in order to provide a blueprint for future work and are described in Sections 4.2-4.7. These planning-level recommendations are intended to enhance the resilience of in-stream infrastructure and the river system to withstanding extreme flood events and to provide for passage of aquatic organisms under normal flow conditions. At one of the dams, we also recommend culvert replacement and upgrade along with the proposed dam management action to enhance flood resilience, water quality, and aquatic habitat using a combination of natural and infrastructure-based approaches.

4.1 Lower Sibley Pond Dam (MA#00099, Town of Charlton)

Existing Conditions

- The structure is currently considered to be in poor condition due to a five-foot long slide (area of soil that has collapsed and fallen down the dam embankment) on the downstream slope with seepage observed flowing from the right side of the slide.
- Trees, brush, stumps, and other vegetation are present on the embankment
- Many of the concrete appurtenances are displaced, cracked, spalled, and/or delaminated.
- Additional details on conditions at the dam are available from the follow-up inspection conducted January 14, 2019.
- The dam and its impoundment do not currently have any known use, and have a low flood mitigation potential.
- The dam has a low stream continuity potential as measured by DER's Restoration Potential Model tool.
- The dam has a Significant Hazard class.
- The dam is privately owned. As of April 2019, the dam is believed to be in probate.

Lower Sibley Pond Dam Spillway

Recommendations

- Remove Lower Sibley Pond Dam to improve flood resiliency, eliminate the need for maintenance, and improve aquatic connectivity.
    - Contact and coordinate with the dam owner to complete engineering design and permitting and removal of the dam.
    - Leverage grant funding and partnerships with state and federal agencies and non-profit organizations to streamline dam removal.

4.2 Wee Laddie Pond Dam (MA#01827, Town of Charlton)

Existing Conditions

- The structure was determined to be in poor condition due to the presence of a beaver dam at the dam spillway that has raised the level of the impoundment by approximately one foot. Additional debris is caught in the spillway.
- Large and small trees, brush, stumps, and other vegetation are present on the embankment.
- The concrete appurtenances on the dam are delaminated, displaced, cracked, and/or spalled. The left training wall is leaning inward.
- Additional details on conditions at the dam are available from the Phase I inspection conducted December 2, 2014.
- The dam and its impoundment do not currently have any known use, and have a low flood mitigation potential. The impoundment was historically used for irrigation and as an ice pond.
- The dam has a low stream continuity potential as measured by DER's Restoration Potential Model tool.
- The dam has a Significant Hazard class.

Wee Laddie Pond Dam Spillway. Note the beaver dam, which has caused the level of the impoundment to rise by approximately one foot.

Trees on the crest of Wee Laddie Pond Dam.

Water from the spillway of Wee Laddie Pond Dam flows directly into a culvert under Gould Road.

Recommendations

- Remove Wee Laddie Pond Dam to improve flood resiliency, eliminate the need for maintenance, and improve aquatic connectivity.
    - Contact and coordinate with the dam owner to complete engineering design and permitting and removal of the dam
    - Leverage grant funding and partnerships with state and federal agencies and non-profit organizations to streamline dam removal.
    - Coordinate the removal of Wee Laddie Pond Dam with the replacement and upgrade of the culvert under Gould Road, immediately downstream of the spillway.

4.3 Rail Road Pond Dam (MA#01830, Town of Charlton)

Existing Conditions

- The structure was determined to be in poor condition due to the presence of heavy vegetation and tree growth on the dam, including both the upstream and downstream embankments, and the presence of debris clogging the spillway on both sides of the trash rack.
- Additional details on conditions at the dam and photos are available from the follow-up inspections conducted November 19, 2018 and January 8, 2016 and the Phase I inspection conducted June 15, 2015.

- The dam and its impoundment do not currently have any known use and have a moderate flood mitigation potential.
- The dam was not assessed by DER's Restoration Potential Model tool.
- The dam has a Significant Hazard class.
- Half of the dam is owned by the Town of Charlton; the other half of the dam is privately owned. The dam owner is unknown to ODS.

2015 photo of the upstream embankment of Rail Road Pond Dam.

The crest of Rail Road Pond Dam carries Old Spencer Road (photo from 2015).

Rail Road Pond Dam spillway structure (photo from 2015).

Recommendations

- Remove Rail Road Pond Dam
    - Contact and coordinate with the private owner of the non-municipally owned half of the dam to complete engineering design and permitting and removal of the dam,
    - Leverage grant funding and partnerships with state and federal agencies and non-profit organizations to streamline dam removal.

4.4 Power Station Dam, Dam 3, and Dam 4 (Town of Charlton)

Existing Conditions

- The structures are in poor or unsafe condition due to lack of maintenance and various deficiencies.
    - The masonry at Power Station Dam is crumbling, and large voids are present under the structure, which may lead to collapse of the structure. The spillway may have failed (the spillway was obscured by trees), but is not passable for aquatic organisms.
    - The spillway of Dam 3 appears to have failed. Vegetation is growing on the remainder of the dam. Dam 3 is located approximately 20 feet upstream of Route 31/Brookfield Road. Failure of Dam 3 could plug the Route 31 crossing, causing failure of the crossing structure.
    - The spillway of Dam 4 is located approximately 15-20 feet upstream of Route 31/City Depot Road. Failure of Dam 4 could plug the Route 31 crossing, causing failure of the crossing structure. The water level in an adjacent pond (immediately to the east), which is likely a separate section of or hydrologically connected to the dam's impoundment, is within 1-3 feet of the top of the embankment facing the road.
- All three dams are located within 0.4 miles of each other along Cady Brook. A fourth dam (Carpenter Mill Pond Dam) is located approximately 600 feet downstream of Power Station Dam.
- The dams and their impoundments do not currently have any known uses.
    - Power Station Dam historically provided electricity to Charlton City.
    - Dam 3 was historically associated with the Charlton Woolen Mill.

  - Dam 4 was formerly owned by the Red Cross and the impoundment was used for swimming lessons.
- Flood mitigation potential was not calculated for the three dams but is likely low due to the small size of the impoundments.
- The dams were not assessed by DER's Restoration Potential Model tool.
- None of the three dams are registered with the Office of Dam Safety. Therefore, none of the dams have been assigned a hazard classification.

Power Station Dam

Dam 3

Panoramic view of Dam 4, including the spillway and a masonry wall to the right of the spillway. Route 31/City Depot Road is shown at the left but is actually parallel to the dam spillway (right).

Recommendations

- Remove the Power Station Dam, Dam 3, and Dam 4.
  - Contact and coordinate with the dam owners to complete engineering design and permitting and removal of all three dams

- Leverage grant funding and partnerships with state and federal agencies and non-profit organizations to streamline dam removals.
- Consider coordinating with the owner of the Carpenter Mill Pond Dam to remove that dam in conjunction with these three dams. Removal of this fourth dam will further reduce risk to downstream infrastructure (including Route 20) and improve aquatic connectivity.
- Consider coordinating the removals of these dams with the replacement and upgrade of the road-stream crossings at Route 31 to further improve flood resilience in Charlton City and to augment improvements to aquatic connectivity in Cady Brook.

4.5 Cranberry Meadow Pond Dam (MA#00700, Town of Spencer)

Existing Conditions

- The structure was determined to be in poor condition due to the presence of a severe erosional scarp and undermining at the end of the paved spillway apron, and due to tree growth on the upstream left and right abutments of the dam and in the downstream channel.
- Large and small trees, brush, stumps, and other vegetation are present on the embankment, as well as deep rotting stumps.
- The upstream embankment has eroded and is nearly vertical.
- Debris appeared to have been dumped on the right abutment.
- The right training wall is deteriorated and a stone masonry wall left of the downstream end of the spillway has failed.
- Additional details on conditions at the dam are available from the follow-up inspection conducted April 26, 2018 and the Phase I inspection conducted June 30, 2013.
- Cranberry Meadow Pond is a recreational impoundment lined with residential properties, and therefore is not a candidate for alteration to increase flood storage, despite its high flood mitigation potential.
- The stop logs are inaccessible due to their location beneath the bridge. Debris has accumulated at the stop logs.
- The dam has a low stream continuity potential as measured by DER's Restoration Potential Model tool.
- The dam has a Significant Hazard class.
- The dam is privately owned. The dam owner is unknown to ODS.

Cranberry Meadow Pond Road Dam spillway. Note the voids beneath and on either side of the spillway, and vegetation on the embankment and left abutment.

Outlet of the stone culvert under Cranberry Meadow Road, approximately 200 feet downstream of the Cranberry Meadow Pond Dam spillway.

Recommendations

- Repair and maintain Cranberry Meadow Pond Dam.
    - Repair the spillway training walls
    - Fill the eroded scarp at the end of the spillway with riprap and blend into the channel to protect against further erosion.
    - Regrade the upstream and downstream slope into a stable slope, and protect the upstream slope with riprap.
    - Move the gravel parking lot back from the crest and delineate with wheel stops to prevent traffic from driving on the dam crest.
    - Remove the brush, trees, and other vegetation from the faces of the dam and to a distance of twenty (20) feet from the dam.
    - Develop an Operations and Maintenance (O&M) Plan for the dam.
    - Develop an Emergency Action Plan (EAP) for the dam (required for significant hazard dams as of 2019).

4.6 Buck Hill Conservation Dam (MA#00901, Town of Spencer)

Existing Conditions

- The structure was determined to be in poor condition due to the blockage of the spillway inlet by beaver activity and debris, and the boil at the foot of the dam, which is most likely due to submergence of the outlet pipe, should be investigated to determine the source. The Phase I Inspection completed on November 26, 2013 rated the dam in fair condition and also noted that the inlet pipe had partially collapsed and the outlet pipe had nearly rusted through. These deficiencies do not appear to have been corrected since the inspection, which is over five years old at the time of this report.
- The secondary spillway has not been maintained
- The trash rack at the primary spillway is severely damaged.
- Brush and other vegetation are present on the embankment. The downstream face of the dam appeared to exhibit signs of seepage, although it was difficult to be certain during the visual assessment due to snowmelt and rain.
- Additional details on conditions at the dam are available from the Phase I inspection conducted November 26, 2013.
- Buck Hill Pond is a recreational and conservation impoundment. The impoundment is not suitable for alteration to increase flood storage, despite its moderate flood mitigation potential as the surrounding topography and the length of the dam would make this strategy cost-prohibitive.
- The dam has a moderate stream continuity potential as measured by DER's Restoration Potential Model tool.
- The dam has a Significant Hazard class.
- The dam is privately owned (by Worcester County 4-H Center, Inc.).

Embankment and spillway inlet at Buck Hill Conservation Dam. Note debris in spillway and vegetation on upstream bank.

Close-up of Buck Hill Conservation Dam Spillway, showing debris and beaver activity at spillway. The damaged inlet and trash rack are difficult to see through the debris and vegetation.

Beaver Lodges in Buck Hill Pond.

Outlet of Buck Hill Pond Spillway. Note the boil at the bottom right of the image, which may be due to submergence of the outlet pipe, should be investigated to confirm that seepage and piping are not threatening the dam. The outlet pipe and downstream channel should be cleared.

Recommendations

- Repair and maintain Buck Hill Pond Dam.
    - Investigate the source of the boil at the base of the dam. Asses the dam under drier conditions to further determine whether seepage is an issue at the dam.
    - Clear the downstream channel such that the outlet is not submerged.
    - Replace the primary spillway and trash rack.
    - Remove the brush, trees, and other vegetation from the faces of the dam and to a distance of twenty (20) feet from the dam.
    - Develop an Operations and Maintenance (O&M) Plan for the dam.
    - Develop an Emergency Action Plan (EAP) for the dam (required for significant hazard dams as of 2019).

4.7 Beaver Assessments

Existing Conditions

- In addition to the beaver dams observed at Wee Laddie Pond Dam and Buck Hill Conservation Dam, beaver dams were also observed at the spillways of Lambs Pond Dam and Howe Reservoir Dam. Beaver activity was observed at the Little Nugget Lake dike.
- Todd Girard, Conservation Agent for the Town of Charlton, stated at the April 22, 2019 Steering Committee meeting that beaver activity is a problem at all Town-owned dams except Prindle Lake Dam.
- Beaver activity was identified as a major concern for Charlton during the Community Resilience Building Workshop held on April 7, 2018. Beaver-influenced areas identified included:
    - Guelphwood Road, Dresser Hill Road, and North Sturbridge Road, all of which have experienced flooding during major precipitation events due to beaver activity.
    - Wetlands in the vicinity of the uncapped landfill on Flint Road.

Beaver dam at the spillway of Lambs Pond Dam. Note that the presence of the beaver dam has caused the surface of the impoundment to rise nearly to the crest of the dam.

View of the Lambs Pond Dam Spillway and beaver dam from downstream.

Debris placed by beavers in an effort to form a dam at the spillway of Howe Reservoir Pond. Note that the debris has caused the level of the impoundment to rise.

Tree felled by beaver near the dike at Little Nugget Lake Dam.

Recommendations

- Develop comprehensive beaver management plan to mitigate unpredictable flooding/impoundment impacts in undesirable locations while taking advantage of beaver-driven flood storage and resiliency benefits in locations where impacts to property and infrastructure can be minimized. Establish beaver management zones and appropriate management techniques for application in each zone. Develop protocols for assessing new areas of beaver activity, and apply creative engineering solutions to discourage problematic beaver activity and/or encourage beavers to reside in areas where their benefits outweigh their impacts. Consider the development of local regulatory mechanisms to give each Town authority to address problematic beaver dams on private property. Focus on known areas of problematic activity and beaver dams in the vicinity of Guelphwood Road, Dresser Hill Road, and North Sturbridge Road in the Town of Chartlton.
- Develop education and outreach efforts to establish citizen support for and participation in Town efforts to manage forests and beavers. Involve neighboring towns in these efforts to increase success rates.

Attachments: Attachment A: Dam Visual Assessment Field Form (Blank)
Attachment B: Dam Visual Assessment Field Forms (Completed)
Attachment C: Dam Assessment Scoring and Prioritization Results

Attachment A

Dam Visual Assessment Field Form (Blank)

DAM SAFETY INSPECTION

NAME OF DAM: _____ STATE ID #: _____

AKA NAME: _____ WATERCOURSE NAME: _____

DAM LOCATION INFORMATION

CITY/TOWN: _____ LAT. / LONG.: _____

STATE: _____ HAZARD CLASS: _____

GENERAL DAM INFORMATION

TYPE OF DAM: _____

PURPOSE OF DAM: _____

YEAR BUILT: _____

INSPECTION SUMMARY

DATE OF INSPECTION: _____ NAME OF INSPECTOR: _____

TIME OF INSPECTION: _____ OTHER ATTENDEES: _____

WEATHER CONDITIONS: _____

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE: _____ AUXILIARY SPILLWAY TYPE: _____

NUMBER OF OUTLETS: _____ TYPE OF OUTLETS: _____

HAS THE DAM BEEN BREACHED OR OVERTOPPED? _____

IS THERE A FISH LADDER? (LIST TYPE IF PRESENT) _____

DOES THE CREST SUPPORT A PUBLIC ROAD? _____

ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM? _____

ACCESS CONDITIONS TO THE SITE: _____

SECURITY DEVICES? _____

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (D/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	
	WET AREAS (NO FLOW)	
	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	
	SLIDE, SLOUGH, SCARP	
	EMBANKMENT-ABUTMENT CONTACT	
	SINKHOLE/ANIMAL BURROWS	
	EROSION	
	UNUSUAL MOVEMENT	
	VEGETATION (PRESENCE/CONDITION)	
	CONDITION OF JOINTS (CONCRETE)	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (U/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	
	SLIDE, SLOUGH, SCARP	
	SLOPE PROTECTION TYPE AND COND.	
	SINKHOLE/ANIMAL BURROWS	
	EMBANKMENT-ABUTMENT CONTACT	
	EROSION	
	UNUSUAL MOVEMENT	
	VEGETATION (PRESENCE/CONDITION)	
	CONDITION OF JOINTS (CONCRETE)	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (CREST)		
AREA INSPECTED	CONDITION	OBSERVATIONS
CREST	SURFACE TYPE	
	SURFACE CRACKING	
	SINKHOLES, ANIMAL BURROWS	
	VERTICAL ALIGNMENT (DEPRESSIONS)	
	HORIZONTAL ALIGNMENT	
	RUTS AND/OR PUDDLES	
	VEGETATION (PRESENCE/CONDITION)	
	ABUTMENT CONTACT	
	CONDITION OF JOINTS (CONCRETE)	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE		
DOWNSTREAM WALLS				
AREA INSPECTED	CONDITION	OBSERVATIONS		
D/S WALLS	1. WALL TYPE			
	2. WALL ALIGNMENT			
	3. WALL CONDITION			
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:	max:	
	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			
	11. VEGETATION			
	12. SCOUR/EROSION AT BASE OF WALL			

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE		
UPSTREAM WALLS				
AREA INSPECTED	CONDITION	OBSERVATIONS		
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			
	9. VEGETATION			
	10. SCOUR/EROSION AT BASE OF WALL			

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM AREA		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S AREA	ABUTMENT LEAKAGE	
	FOUNDATION SEEPAGE	
	SLIDE, SLOUGH, SCARP	
	WEIRS	
	DRAINAGE SYSTEM	
	INSTRUMENTATION	
	VEGETATION	
	ACCESSIBILITY	
	DOWNSTREAM HAZARD DESCRIPTION	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
PRIMARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
	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:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
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:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

DAM NAME		INSPECTION DATE
OUTLET WORKS		
AREA INSPECTED	CONDITION	OBSERVATIONS
OUTLET WORKS	TYPE	
	INTAKE STRUCTURE	
	TRASHRACK	
	PRIMARY CLOSURE	
	SECONDARY CLOSURE	
	CONDUIT	
	OUTLET STRUCTURE/HEADWALL	
	EROSION ALONG TOE OF DAM	
	SEEPAGE/LEAKAGE	
	DEBRIS/BLOCKAGE	
	UNUSUAL MOVEMENT	
	DOWNSTREAM AREA	
	MISCELLANEOUS	

ADDITIONAL COMMENTS: _____

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

Potential Recommendation Notes

Removal?

Breach/Spillway Adjustments?

Repurposing?

Fish/eel passage?

Notes:

PHOTOS

PHOTOGRAPHS INSTRUCTION PAGE:

All photographs shall be color photographs. Photographs shall be clear and include scale references where applicable. Photographs shall include, but not be limited to the following:

1. ***Overview of dam from upstream***
2. ***Overview of dam from downstream***
3. ***Overview of upstream face from right abutment***
4. ***Overview of upstream face from left abutment***
5. ***Overview of dam crest from right abutment***
6. ***Overview of dam crest from left abutment***
7. ***Overview of downstream face from right abutment***
8. ***Overview of downstream face from left abutment***
9. ***Overview of spillway from upstream***
10. ***Overview of spillway from downstream (tailrace or channel area)***
11. ***Overview of right training wall***
12. ***Overview of left training wall***
13. ***Overview of weir***
14. ***Overview of stilling basin***
15. ***Overview of downstream channel***
16. ***Overview of gatehouse exterior***
17. ***Overview of gatehouse interior***
18. ***Overview of operators***
19. ***Outlet inlets and discharge points***
20. ***Overview of reservoir***
21. ***Areas of specific deficiencies (e.g., cracks, erosion, displacement, seeps, deterioration, etc.)***

Each photograph shall include a caption indicating the subject of the photograph as well as highlighting any specific deficiencies pictured. All photographs shall be presented with no more than two (2) photos per page. Photo location and orientation shall be indicated on the site plan included in the section entitled "Figures". Alternatively, for clarity, a separate figure can be provided in this appendix to show figure locations.

SKETCH

Attachment B

Dam Visual Assessment Field Forms (Completed)

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

Filled out after return to office

DAM SAFETY INSPECTION

NAME OF DAM:	Glen Echo Dam	STATE ID #:	
AKA NAME:		WATERCOURSE NAME:	

DAM LOCATION INFORMATION

CITY/TOWN:	Charlton	LAT. / LONG.:	
STATE:	MA	HAZARD CLASS:	

GENERAL DAM INFORMATION

TYPE OF DAM:	Earth
PURPOSE OF DAM:	Recreation
YEAR BUILT:	

INSPECTION SUMMARY

DATE OF INSPECTION:	12/12/18	NAME OF INSPECTOR:	Rachael Weiter
TIME OF INSPECTION:	~2 PM	OTHER ATTENDEES:	Helena Farrell
WEATHER CONDITIONS:	cloudy, partly sunny, mid-30s, breezy		

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE:	concrete ogee	AUXILIARY SPILLWAY TYPE:	/
NUMBER OF OUTLETS:	1	TYPE OF OUTLETS:	unknown
HAS THE DAM BEEN BREACHED OR OVERTOPPED?	possibly - check history		
IS THERE A FISH LADDER? (LIST TYPE IF PRESENT)	No		
DOES THE CREST SUPPORT A PUBLIC ROAD?	No		
ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM?	No		
ACCESS CONDITIONS TO THE SITE:	access thru private property only; drive or walk down access path		
SECURITY DEVICES?	chain link fence on tr. walls; padlocks/chains on gate, access - manhole; other trapdoor security type - no obvious handle - gate to D/S area from D/S embankment		

Observations apply mainly to left side of dam (main body of dam)
could not access right abutment

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (D/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S SLOPE 1	TYPE (EARTH, CONCRETE, MASONRY)	earth
2	WET AREAS (NO FLOW)	N/O, mass growing on most of bank unknown if due
3	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	N/O, → to seepage or shade
4	SLIDE, SLOUGH, SCARP	areas where soil has sloughed observed along crest/bank edge, now...
5	EMBANKMENT-ABUTMENT CONTACT	fair - no major contact problems observed
6	SINKHOLE/ANIMAL BURROWS	N/O - may have been covered by thatch of mown grass
7	EROSION	~~N/O~~ former erosion around gate struct. grown over w/ grass
8	UNUSUAL MOVEMENT	N/O
9	VEGETATION (PRESENCE/CONDITION)	mainly moss in shaded area, grass closer to left tr. wall, moved...
	CONDITION OF JOINTS (CONCRETE)	~~good~~ N/A

ADDITIONAL COMMENTS:
④... grassed over
⑨... w/ thatch left on top

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME GELD		INSPECTION DATE
EMBANKMENT (U/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth
	SLIDE, SLOUGH, SCARP	N/O
	(3) SLOPE PROTECTION TYPE AND COND.	large stone blocks set into soil - starting to slide down face...
	SINKHOLE/ANIMAL BURROWS	N/O - may have been obscured between stones
	EMBANKMENT-ABUTMENT CONTACT	fair, ~~good, no major problems observed~~
	EROSION	N/O
	UNUSUAL MOVEMENT	N/O
	VEGETATION (PRESENCE/CONDITION)	grass growing between rocks, mowed
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS: (3) ...of embankment, leaving inch-wide gaps along top of stone

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (CREST)		
AREA INSPECTED	CONDITION	OBSERVATIONS
CREST	SURFACE TYPE	earth
	SURFACE CRACKING	N/O
	SINKHOLES, ANIMAL BURROWS	N/O
	VERTICAL ALIGNMENT (DEPRESSIONS)	minor undulations + depressions
	HORIZONTAL ALIGNMENT	good; dam curves to meet left abutment
	RUTS AND/OR PUDDLES	ruts observed near left abutment
	VEGETATION (PRESENCE/CONDITION)	grass, mowed
	ABUTMENT CONTACT	good
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME GELD		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	N/O
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM WALLS		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S WALLS	1. WALL TYPE	
	2. WALL ALIGNMENT	
	3. WALL CONDITION	
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: / max:
	5. SEEPAGE OR LEAKAGE	N/O
	6. ABUTMENT CONTACT	
	7. EROSION/SINKHOLES BEHIND WALL	
	8. ANIMAL BURROWS	
	9. UNUSUAL MOVEMENT	
	10. WET AREAS AT TOE OF WALL	
	11. VEGETATION	
	12. SCOUR/EROSION AT BASE OF WALL	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME GELD		INSPECTION DATE		
UPSTREAM WALLS - see training walls / otherwise N/O				
AREA INSPECTED	CONDITION	OBSERVATIONS		
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			
	9. VEGETATION			
	10. SCOUR/EROSION AT BASE OF WALL			

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM AREA		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S AREA	ABUTMENT LEAKAGE	N/O
	FOUNDATION SEEPAGE	N/O
	SLIDE, SLOUGH, SCARP	N/O
	WEIRS	concrete weir below spillway @ end of To. walls forms stilling basin
	DRAINAGE SYSTEM	N/O
	INSTRUMENTATION	N/O
	VEGETATION	grass; trees + shrubs encroaching on discharge area
	ACCESSIBILITY	walk thru gate from D/S embank. (left side); foot access clearly avail on right side (up creek, or from right abut). ~~slide off~~
	DOWNSTREAM HAZARD DESCRIPTION	~~by~~ not visible from Dam; check maps + aerial photos; dam is upstream of Charlton City + other dams on Cady Brook, + I-90
ADDITIONAL COMMENTS:		

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	GELD	INSPECTION DATE	
PRIMARY SPILLWAY			
AREA INSPECTED	CONDITION	OBSERVATIONS	
	SPILLWAY TYPE	concrete ogee w/ stilling basin	
	WEIR TYPE	concrete broad-crested	
	SPILLWAY CONDITION	fair-poor. Large + small cracks in spillway face allowing seepage/flow	wood or joint sealant popping out of largest cracks
(4)	TRAINING WALLS	~~good~~ satisfactory - minor cracks observed @ tops; larger cracks D/S of....	
(5)	SPILLWAY CONTROLS AND CONDITION	mechanical/hydraulic? gate - partly open - controls appears to be in good condition	
	UNUSUAL MOVEMENT	N/O	
	APPROACH AREA	unable to observe ~~closed~~ due to buildup of ice	
(8)	DISCHARGE AREA	trees growing D/S of stilling basin; sediment (up to cobbles) deposited....	
	DEBRIS	garbage observed that likely washed over spillway; minimal woody debris	
	WATER LEVEL AT TIME OF INSPECTION	1-3" below spillway (estimate); unable to determine more precisely due to ice cover	
(11)	Stilling basin	Stones in stilling basin pushed into windrow across center of basin	

ADDITIONAL COMMENTS:

(4) Dam face; largest cracks located above weir @ end of stilling basin; on left side, @ crack being worsened by growth of thick POISON IVY vine

(5) condition of controls below crest unknown; concrete pad housing controls ~~beg~~ spalling but not structurally

(8) in this area by high flows

(11) condition of bottom - unable to observe. Streambed scoured just downstream of + along end weir due to flows dropping over weir

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
SPILLWAY	SPILLWAY TYPE	
	WEIR TYPE	
	SPILLWAY CONDITION	
	TRAINING WALLS	
	SPILLWAY CONTROLS AND CONDITION	
	UNUSUAL MOVEMENT	N/O
	APPROACH AREA	
	DISCHARGE AREA	
	DEBRIS	
	WATER LEVEL AT TIME OF INSPECTION	

ADDITIONAL COMMENTS:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

DAM NAME	GELD	INSPECTION DATE	
OUTLET WORKS			
AREA INSPECTED	CONDITION	OBSERVATIONS	
OUTLET WORKS	TYPE	unable to observe; fully gated	
	INTAKE STRUCTURE	unable to observe	
	TRASHRACK	unknown	
	PRIMARY CLOSURE	gate - type unknown	
	SECONDARY CLOSURE	unknown - may be none	
	CONDUIT		
	OUTLET STRUCTURE/HEADWALL	large concrete wall retaining dam embankment	
	EROSION ALONG TOE OF DAM	N/O	
	SEEPAGE/LEAKAGE	N/O - see note below about sinkholes	
	DEBRIS/BLOCKAGE	N/O - could not observe U/S side	
	UNUSUAL MOVEMENT	N/O	
	DOWNSTREAM AREA	cobble/gravel streambed	
	MISCELLANEOUS	2 shallow sinkholes above conduit immediately behind headwall	
ADDITIONAL COMMENTS:		gate mostly closed (judging by mount on gate stem) @ time of observation	

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

Potential Recommendation Notes

Removal? No - too many lakeside properties

Breach/Spillway Adjustments?

- cannot raise for flood control due to lakeside properties
- Spillway cracks/seepage should be repaired!

Repurposing?

Fish/eel passage?

May be room for a fish ladeler
No room for natural passage
Not feasible - fish elevator, trap + truck

Notes: Multiple dams D/S

Check history of overtopping/failure leading to D/S flooding
- lessons to be learned?

PHOTOS

PHOTOGRAPHS INSTRUCTION PAGE:

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2. *Overview of dam from downstream*
3. *Overview of upstream face from right abutment*
4. *Overview of upstream face from left abutment*
5. *Overview of dam crest from right abutment*
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7. *Overview of downstream face from right abutment*
8. *Overview of downstream face from left abutment*
9. *Overview of spillway from upstream*
10. *Overview of spillway from downstream (tailrace or channel area)*
11. *Overview of right training wall*
12. *Overview of left training wall*
13. *Overview of weir*
14. *Overview of stilling basin*
15. *Overview of downstream channel*
16. *Overview of gatehouse exterior*
17. *Overview of gatehouse interior*
18. *Overview of operators*
19. *Outlet inlets and discharge points*
20. *Overview of reservoir*
21. *Areas of specific deficiencies (e.g., cracks, erosion, displacement, seeps, deterioration, etc.)*

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Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

SKETCH

Little Nugget Lake Dam

DAM SAFETY INSPECTION

NAME OF DAM: actual LNLD STATE ID #:

AKA NAME: WATERCOURSE NAME:

DAM LOCATION INFORMATION

CITY/TOWN: Charlton LAT. / LONG.:

STATE: MA HAZARD CLASS:

GENERAL DAM INFORMATION

TYPE OF DAM: earth

PURPOSE OF DAM: Rec

YEAR BUILT:

INSPECTION SUMMARY

DATE OF INSPECTION: Dec 5 NAME OF INSPECTOR: RW

TIME OF INSPECTION: 1043 OTHER ATTENDEES: WF

WEATHER CONDITIONS: Sunny 36°F

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE: concrete masonry? AUXILIARY SPILLWAY TYPE: /

NUMBER OF OUTLETS: 1 TYPE OF OUTLETS: concrete riser w/ gate

HAS THE DAM BEEN BREACHED OR OVERTOPPED? unknown

IS THERE A FISH LADDER? (LIST TYPE IF PRESENT) N/O

DOES THE CREST SUPPORT A PUBLIC ROAD? No

ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM? N/O

ACCESS CONDITIONS TO THE SITE: drive to either abut (Roy Road, Little Nugget Rd)

SECURITY DEVICES? N/O

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE	
EMBANKMENT (D/S SLOPE)			
AREA INSPECTED	CONDITION	OBSERVATIONS	
D/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth; on left side, covered in cobble-sized riprap	
	WET AREAS (NO FLOW)	R- N/O; L- N/O but area w/in 20' of L Tr. Wall obscured by veg	
	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	R- N/O; L- N/O	
	SLIDE, SLOUGH, SCARP	L- Minor slide in riprap ~ 2' wide	
	EMBANKMENT-ABUTMENT CONTACT	R- fair - some erosion ~~undetation; reinforced as aux spillway~~? L- good	
	SINKHOLE/ANIMAL BURROWS	R- N/O; L- N/O but slope obscured	
	EROSION	R- some @ R. abut; L- N/O	
	UNUSUAL MOVEMENT	N/O	
	VEGETATION (PRESENCE/CONDITION)	grass- mowed; small + LARGE trees; brambles + brush L of spillway	
	CONDITION OF JOINTS (CONCRETE)	N/A	

ADDITIONAL COMMENTS: crest + D/S bank @ right reinforced w/ perm. erosion control fabric
~~- poss. concrete~~

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME UNLD		INSPECTION DATE
EMBANKMENT (U/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	Earth (see D/S walls for rest)
	SLIDE, SLOUGH, SCARP	R-N/O; L-steep scarp along entire bank
	SLOPE PROTECTION TYPE AND COND.	R- scattered stones from displaced Stone armor @ waterline
	SINKHOLE/ANIMAL BURROWS	R- mult 2"-4" burrows; Lt N/O
	EMBANKMENT-ABUTMENT CONTACT	R- fair - needs soil added to make uniform; L- crest higher...
	EROSION	Rt-N/O; L- erosion @ collapsing wall see bions
	UNUSUAL MOVEMENT	N/O
	VEGETATION (PRESENCE/CONDITION)	R-grass, mowed; tall grass in clumps @ waterline; Rt same;
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS: (8) + one small tree growing out of stone wall

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE	
EMBANKMENT (CREST)			
AREA INSPECTED	CONDITION	OBSERVATIONS	
CREST (4)	SURFACE TYPE	~~R~~ earth, reinforced w/green ECM	
	SURFACE CRACKING	R-N/O ; L- N/O	
	SINKHOLES, ANIMAL BURROWS	R-N/O ; L-N/O	
	VERTICAL ALIGNMENT (DEPRESSIONS)	R- undulations ; reinforced as poss. aux spillway? ; ~~dig~~	
	HORIZONTAL ALIGNMENT	R- good ; L - good	
	RUTS AND/OR PUDDLES	R-N/O ; L-N/O	
	VEGETATION (PRESENCE/CONDITION)	R- grass- mowed ; L - same	
	ABUTMENT CONTACT	R- good - L- ~~abutment~~ slightly lower than crest	
	CONDITION OF JOINTS (CONCRETE)	N/A	

ADDITIONAL COMMENTS:

poss concrete curtain wall buried on right side, extending from right Tr Wall
- same on left ~~Tr, just not exposed by prior erosion?~~ Not buried
(4) depression extending 6' from L Tr. wall

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LN LD		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

N/A

ADDITIONAL COMMENTS:

LNLD

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE	
DOWNSTREAM WALLS		N/D	
AREA INSPECTED	CONDITION	OBSERVATIONS	
D/S WALLS	1. WALL TYPE		
	2. WALL ALIGNMENT		
	3. WALL CONDITION		
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:	max:
	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		
	11. VEGETATION		
	12. SCOUR/EROSION AT BASE OF WALL		

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE		
UPSTREAM WALLS				
AREA INSPECTED	CONDITION	OBSERVATIONS		
U/S WALLS	1. WALL TYPE	concrete block + stone masonry		
	2. WALL ALIGNMENT	poor; ~~blocks~~ lots collapsed		
	3. WALL CONDITION			
	4. HEIGHT: TOP OF WALL TO MUDLINE est	min: 3	max: 4	avg: ~~≈~~ 3.75 ft
	5. ABUTMENT CONTACT ~~est~~	wall ends before abut		
	6. EROSION/SINKHOLES BEHIND WALL	N/O		
	7. ANIMAL BURROWS	N/O		
	8. UNUSUAL MOVEMENT	N/O		
	9. VEGETATION	small tree/woody shrub growing from crack has shifted		
	10. SCOUR/EROSION AT BASE OF WALL	N/O; aggregate of concrete exposed at waterline		

ADDITIONAL COMMENTS: (9) blocks

wall only extends ~~6-8 feet along U/S ends from left to right~~ to ~ outlet
collapsed into pond for most of length

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE	
DOWNSTREAM AREA			
AREA INSPECTED	CONDITION	OBSERVATIONS	
D/S AREA	ABUTMENT LEAKAGE	N/O	
	FOUNDATION SEEPAGE	poss on left near outlet (or could be leakage from outlet	
	SLIDE, SLOUGH, SCARP	N/O	
	WEIRS	N/O	
	DRAINAGE SYSTEM	N/O	
	INSTRUMENTATION	N/O	
	VEGETATION	range - grass to large trees	
	ACCESSIBILITY	walk from base of dam	
	DOWNSTREAM HAZARD DESCRIPTION	residences + Little Nugget Rd	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LNLD		INSPECTION DATE
PRIMARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
	SPILLWAY TYPE	concrete block-stacked masonry w/ wood 4"x4"'s secured to top
	WEIR TYPE	broad crested
3	SPILLWAY CONDITION	fair - masonry appears well aligned but wood in poor alignm., rotting
4	TRAINING WALLS	concrete - good condition; some aggregate exposure near
	SPILLWAY CONTROLS AND CONDITION	N/O except secured wood beams
	UNUSUAL MOVEMENT	N/O
	APPROACH AREA	shallow silted w/ pond veg. growing in silt; debris caught against weir
	DISCHARGE AREA	rocky pool between training walls narrows to creek channel upon exit
	DEBRIS	~~debris~~ - sticks, leaves, etc trapped against weir
	WATER LEVEL AT TIME OF INSPECTION	~2" below top board/beam, 6-7 ft min below top of Tr Walls

ADDITIONAL COMMENTS:
③ Water leaking through top 3 rows of blocks
④ base @ spillway

LNLD

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LNLD		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
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:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

DAM NAME	LNLD	INSPECTION DATE

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS
OUTLET WORKS	TYPE	concrete riser w/ manual gate
	INTAKE STRUCTURE	Concrete riser
	TRASHRACK	vertical Steel rack w - 1"-2" spacing, good condition
	PRIMARY CLOSURE	manual gate - closed
	SECONDARY CLOSURE	N/D
	CONDUIT	~~Smooth concrete~~ plastic conduit ~ 1.5' Ø (Exposed from D/S end)
	OUTLET STRUCTURE/HEADWALL (7)	concrete, good condition. Stone blocks stacked around headwall
	EROSION ALONG TOE OF DAM	eroded/sunken area left of outlet - due to seepage
	SEEPAGE/LEAKAGE	possible near outlet structure (based on D/S area evidence)
	DEBRIS/BLOCKAGE	~~of debris~~ grass, poss. debris btwn trash rack + gate; unsure behind gate
	UNUSUAL MOVEMENT	N/O
	DOWNSTREAM AREA	wooded swamp; rocky due to movement of d/s bank armor off of slope
	MISCELLANEOUS	

ADDITIONAL COMMENTS: (7) Starting to bulge/flow out on left side of headwall

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

Potential Recommendation Notes

Removal?

likely opposed by residents

Breach/Spillway Adjustments?

Rock ramp?

Repurposing?

can't raise - see false LND

Fish/eel passage?

possible - would be tall fish ladder; no room for nature-like fishway except rock ramp up spillway

Notes:

Training walls appear fairly new

~~Long~~. Pond clearly used for recreation by all/most shore residents

PHOTOS

PHOTOGRAPHS INSTRUCTION PAGE:

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19. *Outlet inlets and discharge points*
20. *Overview of reservoir*
21. *Areas of specific deficiencies (e.g., cracks, erosion, displacement, seeps, deterioration, etc.)*

Each photograph shall include a caption indicating the subject of the photograph as well as highlighting any specific deficiencies pictured. All photographs shall be presented with no more than two (2) photos per page. Photo location and orientation shall be indicated on the site plan included in the section entitled "Figures". Alternatively, for clarity, a separate figure can be provided in this appendix to show figure locations.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

SKETCH

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM SAFETY INSPECTION

NAME OF DAM: Lamb's Pond Dam STATE ID #: MA 01829

AKA NAME: _____ WATERCOURSE NAME: _____

DAM LOCATION INFORMATION

CITY/TOWN: Charlton LAT. / LONG.: _____

STATE: MA HAZARD CLASS: _____

GENERAL DAM INFORMATION

TYPE OF DAM: Earth

PURPOSE OF DAM: unknown

YEAR BUILT: _____

INSPECTION SUMMARY

DATE OF INSPECTION: 12/5/18 NAME OF INSPECTOR: RW

TIME OF INSPECTION: 08:40 OTHER ATTENDEES: HF

WEATHER CONDITIONS: Sunny, 23°F

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE: concrete broad crest AUXILIARY SPILLWAY TYPE: ~~⊘~~ weir boards

NUMBER OF OUTLETS: 0 TYPE OF OUTLETS: /

HAS THE DAM BEEN BREACHED OR OVERTOPPED? ~~Unknown~~ Yes - clear from erosion; probably due to beaver dam

IS THERE A FISH LADDER? (LIST TYPE IF PRESENT) No

DOES THE CREST SUPPORT A PUBLIC ROAD? No

ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM? No

ACCESS CONDITIONS TO THE SITE: walk - easement btwn 2 Houses

SECURITY DEVICES? None / 0

could not access left side (~~NOA~~ "NAL")

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (D/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth
	WET AREAS (NO FLOW)	N/O ; L - NAL
	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	N/O ; L - NAL
	SLIDE, SLOUGH, SCARP	
	EMBANKMENT-ABUTMENT CONTACT	R - good ; L appears good (NAL) hidden by veg
	SINKHOLE/ANIMAL BURROWS	R - ~~N/O~~ 2" burrow ; more prob L - NAL
	EROSION	R - ~~minor~~, assoc w/ veh, rainfall L - NAL
	UNUSUAL MOVEMENT	N/O ; NAL
	VEGETATION (PRESENCE/CONDITION)	R - grass - mand ; taller grasses shrubs @ ~~app~~ TW ; Left - veg + shrubs
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS: sign. erosion either side of spillway TW of D/S slope

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	LPD	INSPECTION DATE	
EMBANKMENT (U/S SLOPE)			
AREA INSPECTED	CONDITION	OBSERVATIONS	
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth	
	SLIDE, SLOUGH, SCARP	~~some~~ R- minor scarping	
	SLOPE PROTECTION TYPE AND COND.	N/O	
	SINKHOLE/ANIMAL BURROWS	R-N/O; NOL	
	EMBANKMENT-ABUTMENT CONTACT	R-fair/good; v. minor erosion ; L-unknown (NAL)	
	EROSION	minor erosion ~~covered~~ along waters edge entire right side; NAL	
	UNUSUAL MOVEMENT	N/O	
	VEGETATION (PRESENCE/CONDITION)	R-grass(mowed) + tall grasses; L- tall grasses, many in clumps	
	CONDITION OF JOINTS (CONCRETE)	N/A.	

ADDITIONAL COMMENTS: Impoundment v. high due to beaver dam

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (CREST)		
AREA INSPECTED	CONDITION	OBSERVATIONS
CREST	SURFACE TYPE	earth, grassed
	SURFACE CRACKING	N/O
	(3) SINKHOLES, ANIMAL BURROWS	R- multiple sinkholes near spillway ~~2~~ 1-6"ϕ, 1-12"ϕ,
	VERTICAL ALIGNMENT (DEPRESSIONS)	R- minor undulations; L- larger undulations
	HORIZONTAL ALIGNMENT	R- fair; Left - ~~poor~~ fair
	RUTS AND/OR PUDDLES	R- minor lawn tractor ruts; L- NAL
	VEGETATION (PRESENCE/CONDITION)	R- grass- mowed; L- tall grasses, shrubs, small trees
	ABUTMENT CONTACT	R- good/fair; L- unknown but ~~probably~~ possibly poor
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS: (3) L- unknown but likely

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LPD		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
	DOWNSTREAM WALLS	
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S WALLS	1. WALL TYPE	
	2. WALL ALIGNMENT	
	3. WALL CONDITION	
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: max:
	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	
	11. VEGETATION	
	12. SCOUR/EROSION AT BASE OF WALL	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LPD		INSPECTION DATE
UPSTREAM WALLS		
AREA INSPECTED	CONDITION	OBSERVATIONS
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	
	9. VEGETATION	
	10. SCOUR/EROSION AT BASE OF WALL	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
	DOWNSTREAM AREA	
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S AREA	ABUTMENT LEAKAGE	N/O ; NAL
	FOUNDATION SEEPAGE	N/O but may be obscured by leaves + debris; NAL
	SLIDE, SLOUGH, SCARP	N/O
	WEIRS	N/O
	DRAINAGE SYSTEM	N/O
	INSTRUMENTATION	N/O
	VEGETATION	tall grasses; shrubs; large + small trees
	ACCESSIBILITY	walking
	DOWNSTREAM HAZARD DESCRIPTION	~~no human hazard~~ 3 successive beaver dams + another dam downstream

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME LPD		INSPECTION DATE
PRIMARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
	SPILLWAY TYPE	concrete ~~BC Weir~~
	WEIR TYPE	bc weir
	SPILLWAY CONDITION	good
	TRAINING WALLS	~~S~~ small crack to of left TW; RW appears to be leaning into
	SPILLWAY CONTROLS AND CONDITION	N/o
	UNUSUAL MOVEMENT	N/o
	APPROACH AREA	Beaver dam
	DISCHARGE AREA	TW pool impounded by another beaver dam; discharge area is wooded
	DEBRIS	debris from beaver dam
	WATER LEVEL AT TIME OF INSPECTION	flow over spillway ~2-4" but impoundment ~ 2' above due to Beaver Dam

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
SPILLWAY	SPILLWAY TYPE	concrete slot w/ weir boards
	WEIR TYPE	wooden weir boards
	SPILLWAY CONDITION	good - conc; ~~weir boards (unable to observe)~~
	TRAINING WALLS	good - no cracks observed; could not see if walls were leaning
	SPILLWAY CONTROLS AND CONDITION	unable to observe wooden weirboards
	UNUSUAL MOVEMENT	N/O
	APPROACH AREA	beaver dam - same as primary spillway
	DISCHARGE AREA	same as primary spillway
	DEBRIS	same as prim. spillway
	WATER LEVEL AT TIME OF INSPECTION	same as prim. spillway

ADDITIONAL COMMENTS:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

DAM NAME LPD		INSPECTION DATE
OUTLET WORKS		
AREA INSPECTED	CONDITION	OBSERVATIONS
OUTLET WORKS	TYPE	
	INTAKE STRUCTURE	
	TRASHRACK	
	PRIMARY CLOSURE	
	SECONDARY CLOSURE	
	CONDUIT	
	OUTLET STRUCTURE/HEADWALL	
	EROSION ALONG TOE OF DAM	
	SEEPAGE/LEAKAGE	
	DEBRIS/BLOCKAGE	
	UNUSUAL MOVEMENT	
	DOWNSTREAM AREA	
	MISCELLANEOUS	

ADDITIONAL COMMENTS: _____

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

Potential Recommendation Notes

Removal? Good candidate!

Breach/Spillway Adjustments?

Repurposing? No

Fish/eel passage?
Provide through removal; otherwise - possible natural fishway?
Beavers would likely block any technical or nature-like fishway installed, as well as dam.

Notes:

Appears to be some rec usage but not same level as other impoundments. Houses surrounding impoundment separated from waterline by wooded buffer

Dam is a hazard to dam d/s, + beaver dams are increasing risk of failure

PHOTOS

PHOTOGRAPHS INSTRUCTION PAGE:

All photographs shall be color photographs. Photographs shall be clear and include scale references where applicable. Photographs shall include, but not be limited to the following:

1. *Overview of dam from upstream*
2. *Overview of dam from downstream*
3. *Overview of upstream face from right abutment*
4. *Overview of upstream face from left abutment*
5. *Overview of dam crest from right abutment*
6. *Overview of dam crest from left abutment*
7. *Overview of downstream face from right abutment*
8. *Overview of downstream face from left abutment*
9. *Overview of spillway from upstream*
10. *Overview of spillway from downstream (tailrace or channel area)*
11. *Overview of right training wall*
12. *Overview of left training wall*
13. *Overview of weir*
14. *Overview of stilling basin*
15. *Overview of downstream channel*
16. *Overview of gatehouse exterior*
17. *Overview of gatehouse interior*
18. *Overview of operators*
19. *Outlet inlets and discharge points*
20. *Overview of reservoir*
21. *Areas of specific deficiencies (e.g., cracks, erosion, displacement, seeps, deterioration, etc.)*

Each photograph shall include a caption indicating the subject of the photograph as well as highlighting any specific deficiencies pictured. All photographs shall be presented with no more than two (2) photos per page. Photo location and orientation shall be indicated on the site plan included in the section entitled "Figures". Alternatively, for clarity, a separate figure can be provided in this appendix to show figure locations.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

SKETCH

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM SAFETY INSPECTION

NAME OF DAM: Wee Laddie Pond Dam STATE ID #: MA01827

AKA NAME: _____ WATERCOURSE NAME: _____

DAM LOCATION INFORMATION

CITY/TOWN: Charlton LAT. / LONG.: _____

STATE: MA HAZARD CLASS: _____

GENERAL DAM INFORMATION

TYPE OF DAM: concrete + earth

PURPOSE OF DAM: _____

YEAR BUILT: _____

INSPECTION SUMMARY

DATE OF INSPECTION: 12/5/18 NAME OF INSPECTOR: RW

TIME OF INSPECTION: 9:30 AM OTHER ATTENDEES: HF

WEATHER CONDITIONS: sunny, 32°F, no wind

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE: concrete/S AUXILIARY SPILLWAY TYPE: /

NUMBER OF OUTLETS: / TYPE OF OUTLETS: /

HAS THE DAM BEEN BREACHED OR OVERTOPPED? Unknown

IS THERE A FISH LADDER? (LIST TYPE IF PRESENT) No

DOES THE CREST SUPPORT A PUBLIC ROAD? No

ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM? Yes

ACCESS CONDITIONS TO THE SITE: walk-up; dam @ side of road

SECURITY DEVICES? chain link fence around spillway + road culv. to prevent entry / falls

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (D/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S SLOPE 1	TYPE (EARTH, CONCRETE, MASONRY)	earth
2	WET AREAS (NO FLOW)	N/O - debris
3	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	N/O
4	SLIDE, SLOUGH, SCARP	Soil displaced from embank. left of spillway
	EMBANKMENT-ABUTMENT CONTACT	g fair/good
	SINKHOLE/ANIMAL BURROWS	~~g~~ N/O but probable
	EROSION	see 4; additional migor erosion of soil
	UNUSUAL MOVEMENT	yes - see 4
	VEGETATION (PRESENCE/CONDITION)	brambles, brush, grass, small trees
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	WLPD	INSPECTION DATE	
EMBANKMENT (U/S SLOPE)			
AREA INSPECTED	CONDITION	OBSERVATIONS	
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth	
2	SLIDE, SLOUGH, SCARP	sloughed + scarped to nearly vertical in some places	
3	SLOPE PROTECTION TYPE AND COND.	stone armor right of spillway + assoc wall - no longer intact	
	SINKHOLE/ANIMAL BURROWS	yes - likely	
	EMBANKMENT-ABUTMENT CONTACT	good	
	EROSION	See 2	
	UNUSUAL MOVEMENT	N/O	
	VEGETATION (PRESENCE/CONDITION)	brush, brambles, small trees, large trees (some ~~tooted~~ leaning over impoundment ready to topple	
	CONDITION OF JOINTS (CONCRETE)	~~n/a~~ see U/S walls	
ADDITIONAL COMMENTS:			

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (CREST)		
AREA INSPECTED	CONDITION	OBSERVATIONS
	SURFACE TYPE	earth
	SURFACE CRACKING	N/O
3	SINKHOLES, ANIMAL BURROWS	yes - At least one sinkhole 2'Ø where tree removed; 4"Ø burrow nearby...
4	VERTICAL ALIGNMENT (DEPRESSIONS)	large undulations + depressions
CREST	HORIZONTAL ALIGNMENT	~~poor~~ puddles
	RUTS AND/OR PUDDLES	likely under brush - see 4
	VEGETATION (PRESENCE/CONDITION)	brush, brambles, small + large trees
	ABUTMENT CONTACT	good/fair
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS: 3 to right of spillway

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME WLPD		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM WALLS		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S WALLS	1. WALL TYPE	masonry
	2. WALL ALIGNMENT	poor - stones misaligned
	3. WALL CONDITION	poor - voids; see 2
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: max: 4'
	5. SEEPAGE OR LEAKAGE	yes - wet areas, ice on stone?
	6. ABUTMENT CONTACT	~~o~~ N/A; only present w/in 3 ft of spillway TWalls
	7. EROSION/SINKHOLES BEHIND WALL	probable - could n
	8. ANIMAL BURROWS	unable to observe
	9. UNUSUAL MOVEMENT	N/O
	10. WET AREAS AT TOE OF WALL	possible
	11. VEGETATION	
	12. SCOUR/EROSION AT BASE OF WALL	unable to observe

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME	WLPD	INSPECTION DATE		
UPSTREAM WALLS				
AREA INSPECTED	CONDITION	OBSERVATIONS		
1	1. WALL TYPE	concrete, extension of training walls to protect approach r...		
	2. WALL ALIGNMENT	appears to match orig alignment		
	3. WALL CONDITION			
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: 2'	max: 3'	avg: 2.5'
	5. ABUTMENT CONTACT estimated			
U/S WALLS	6. EROSION/SINKHOLES BEHIND WALL	R-N/O; L-N/O		
	7. ANIMAL BURROWS	R-N/O; Left - small burrows poss. where concrete cracked		
	8. UNUSUAL MOVEMENT	R-N/O; L-N/O		
	9. VEGETATION	moss on wall		
	10. SCOUR/EROSION AT BASE OF WALL	N/O		

ADDITIONAL COMMENTS: ① U/S Embankment

concrete spalled; aggregate exposed; ~~high~~ left side surface badly

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM AREA		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S AREA	ABUTMENT LEAKAGE	
	FOUNDATION SEEPAGE	
	SLIDE, SLOUGH, SCARP	
	WEIRS	
	DRAINAGE SYSTEM	
	INSTRUMENTATION	
	VEGETATION	
	ACCESSIBILITY	
	DOWNSTREAM HAZARD DESCRIPTION	

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
WLPD		
PRIMARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
	SPILLWAY TYPE	concrete chute
	WEIR TYPE	unknown
	SPILLWAY CONDITION	Poor
4	TRAINING WALLS	training walls spalled, cracked, flacking off; left training wall large portion
	SPILLWAY CONTROLS AND CONDITION	unknown - N/A?
	UNUSUAL MOVEMENT	see ④ (left training wall)
	APPROACH AREA	beaver dam surrounds entire approach, raises impoundment
8	DISCHARGE AREA	discharges directly to culvert (poor condition) under Gould
	DEBRIS	debris (wood, mud) from beaver dam caught ~~in~~ in spillway
	WATER LEVEL AT TIME OF INSPECTION	~2" over spillway @ spillway, ~1' over weir due to Dam B

ADDITIONAL COMMENTS: ④ cracked + leaving, w/ rebar exposed; moss growing on top of TW

⑧ Road, which discharges to open stream channel. D/S ~~side~~ headwall ~~has~~ developing large sinkholes, erosion; Dam breach would cause failure + erosion back into roadway or overtopping

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
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:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

DAM NAME WLPD		INSPECTION DATE
OUTLET WORKS		
AREA INSPECTED	CONDITION	OBSERVATIONS
OUTLET WORKS	TYPE	
	INTAKE STRUCTURE	
	TRASHRACK	
	PRIMARY CLOSURE	
	SECONDARY CLOSURE	
	CONDUIT	
	OUTLET STRUCTURE/HEADWALL	
	EROSION ALONG TOE OF DAM	
	SEEPAGE/LEAKAGE	
	DEBRIS/BLOCKAGE	
	UNUSUAL MOVEMENT	
	DOWNSTREAM AREA	
	MISCELLANEOUS	

ADDITIONAL COMMENTS:

Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

Potential Recommendation Notes

Removal? good candidate
Remove in conjunction w/ culvert replacement

Breach/Spillway Adjustments?
alt to removal; perform in conjunction w/ culvert replacement

Repurposing? emb. too low; not enough room to extend D/S slope

Fish/eel passage? Not a good site - no room, road + culvert in way

Notes: impound appears to be unused; no controls, rec access, houses on impoundment.
Dam in v. poor condition + a hazard

PHOTOS

PHOTOGRAPHS INSTRUCTION PAGE:

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1. *Overview of dam from upstream*
2. *Overview of dam from downstream*
3. *Overview of upstream face from right abutment*
4. *Overview of upstream face from left abutment*
5. *Overview of dam crest from right abutment*
6. *Overview of dam crest from left abutment*
7. *Overview of downstream face from right abutment*
8. *Overview of downstream face from left abutment*
9. *Overview of spillway from upstream*
10. *Overview of spillway from downstream (tailrace or channel area)*
11. *Overview of right training wall*
12. *Overview of left training wall*
13. *Overview of weir*
14. *Overview of stilling basin*
15. *Overview of downstream channel*
16. *Overview of gatehouse exterior*
17. *Overview of gatehouse interior*
18. *Overview of operators*
19. *Outlet inlets and discharge points*
20. *Overview of reservoir*
21. *Areas of specific deficiencies (e.g., cracks, erosion, displacement, seeps, deterioration, etc.)*

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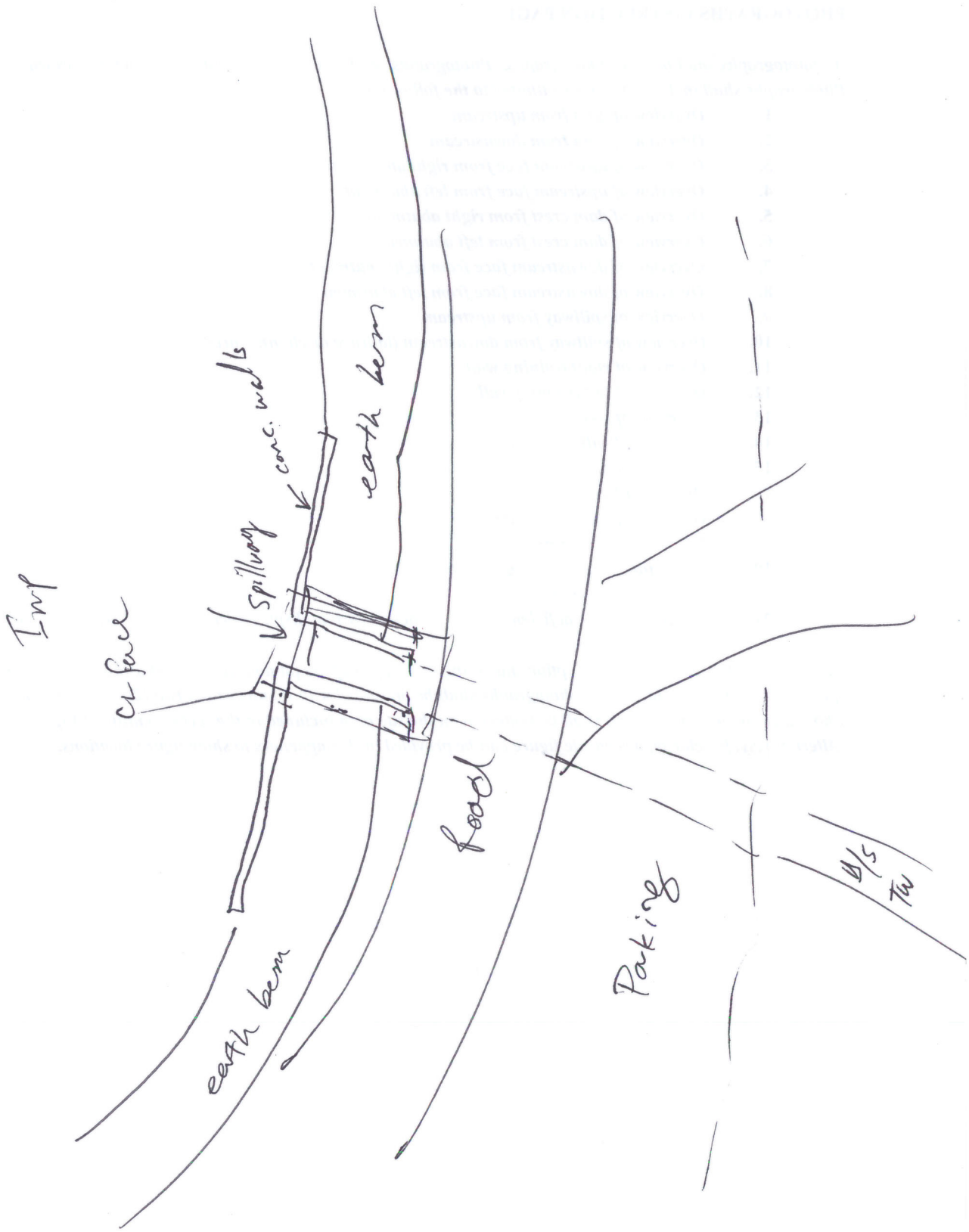
Wood-Pawcatuck Watershed Flood Resiliency Management Plan
DAM INSPECTION FIELD ASSESSMENT

SKETCH



Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM SAFETY INSPECTION

NAME OF DAM: Lac Marie Dam STATE ID #: _____

AKA NAME: _____ WATERCOURSE NAME: _____

DAM LOCATION INFORMATION

CITY/TOWN: Spencer LAT. / LONG.: _____

STATE: MA HAZARD CLASS: _____

GENERAL DAM INFORMATION

TYPE OF DAM: earth

PURPOSE OF DAM: unknown

YEAR BUILT: _____

INSPECTION SUMMARY

DATE OF INSPECTION: 11/29/18 NAME OF INSPECTOR: RLW

TIME OF INSPECTION: 11:11AM OTHER ATTENDEES: HF, PD

WEATHER CONDITIONS: cloudy, cold, windy

GENERAL DAM DATA

PRIMARY SPILLWAY TYPE: conc. AUXILIARY SPILLWAY TYPE: _____

NUMBER OF OUTLETS: _____ TYPE OF OUTLETS: _____

HAS THE DAM BEEN BREACHED OR OVERTOPPED? UN

IS THERE A FISH LADDER? (LIST TYPE IF PRESENT) No

DOES THE CREST SUPPORT A PUBLIC ROAD? No

ROADS/DRIVEWAY IMMEDIATELY DOWNSTREAM OF DAM? Road -

ACCESS CONDITIONS TO THE SITE: walk up

SECURITY DEVICES? ~~no~~ gated access road to right side of dam

pump

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (D/S SLOPE)		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	earth
	WET AREAS (NO FLOW)	N/O
	SEEPAGE (EARTH) OR LEAKAGE (CONCRETE)	N/O
	SLIDE, SLOUGH, SCARP	N/O
	EMBANKMENT-ABUTMENT CONTACT	good
	SINKHOLE/ANIMAL BURROWS	N/O
	EROSION	N/O
	UNUSUAL MOVEMENT	N/O
	VEGETATION (PRESENCE/CONDITION)	mowed grass ; small amount moss
	CONDITION OF JOINTS (CONCRETE)	N/A

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
	EMBANKMENT (U/S SLOPE)	see D/S slope
AREA INSPECTED	CONDITION	OBSERVATIONS
U/S SLOPE	TYPE (EARTH, CONCRETE, MASONRY)	
	SLIDE, SLOUGH, SCARP	some slumping @ edge of stone armor in the u/s end of wall
	SLOPE PROTECTION TYPE AND COND.	stone armor - poor
	SINKHOLE/ANIMAL BURROWS	
	EMBANKMENT-ABUTMENT CONTACT	
	EROSION	
	UNUSUAL MOVEMENT	
	VEGETATION (PRESENCE/CONDITION)	grass, small shrubs, tall grasses
	CONDITION OF JOINTS (CONCRETE)	good

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
EMBANKMENT (CREST)		
AREA INSPECTED	CONDITION	OBSERVATIONS
CREST	SURFACE TYPE	earth
	SURFACE CRACKING	N/O
	SINKHOLES, ANIMAL BURROWS	N/O
	VERTICAL ALIGNMENT (DEPRESSIONS)	good / N/O
	HORIZONTAL ALIGNMENT	good
	RUTS AND/OR PUDDLES	N/O
	VEGETATION (PRESENCE/CONDITION)	grass- mowed; some moss; large trees encroaching abutts
	ABUTMENT CONTACT	good
	CONDITION OF JOINTS (CONCRETE)	N/O

ADDITIONAL COMMENTS: Possible former outlet controls
- manhole cover on crest

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
INSTRUMENTATION		
AREA INSPECTED	CONDITION	OBSERVATIONS
INSTR.	1. PIEZOMETERS	
	2. OBSERVATION WELLS	
	3. STAFF GAGE AND RECORDER	
	4. WEIRS	
	5. INCLINOMETERS	
	6. SURVEY MONUMENTS	
	7. DRAINS	
	8. FREQUENCY OF READINGS	
	9. LOCATION OF READINGS	

ADDITIONAL COMMENTS:

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VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM WALLS		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S WALLS	1. WALL TYPE	
	2. WALL ALIGNMENT	
	3. WALL CONDITION	
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: max:
	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	
	11. VEGETATION	
	12. SCOUR/EROSION AT BASE OF WALL	

ADDITIONAL COMMENTS:

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VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE		
		UPSTREAM WALLS - ~~left~~ side on LV right		
AREA INSPECTED	CONDITION	OBSERVATIONS		
U/S WALLS	1. WALL TYPE	concrete		
	2. WALL ALIGNMENT	good - vert		
	3. WALL CONDITION	good		
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: 3'	max: 4.5'	avg: 4 Ft
	5. ABUTMENT CONTACT	good		
	6. EROSION/SINKHOLES BEHIND WALL	some soil loss		
	7. ANIMAL BURROWS	NO		
	8. UNUSUAL MOVEMENT	NO		
	9. VEGETATION	NO		
	10. SCOUR/EROSION AT BASE OF WALL	~~NO~~ minor erosion near end of wall ~~(left)~~ (rt)		

ADDITIONAL COMMENTS:

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VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
DOWNSTREAM AREA		
AREA INSPECTED	CONDITION	OBSERVATIONS
D/S AREA	ABUTMENT LEAKAGE	N/O
	FOUNDATION SEEPAGE	N/O
	SLIDE, SLOUGH, SCARP	N/O
	WEIRS	N/O
	DRAINAGE SYSTEM	N/O
	INSTRUMENTATION	N/O
	VEGETATION	grass, trees
	ACCESSIBILITY	walk only; low face
	DOWNSTREAM HAZARD DESCRIPTION	Rte 31 bridge - in very poor condition
ADDITIONAL COMMENTS:		scour pool, bank erosion, sediment deposition d/s of tailrace

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VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
PRIMARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
	SPILLWAY TYPE	concrete
	WEIR TYPE	broad crest
	SPILLWAY CONDITION	good
	TRAINING WALLS	good - concrete
	SPILLWAY CONTROLS AND CONDITION	N/O
	UNUSUAL MOVEMENT	N/O
	APPROACH AREA	clear
	DISCHARGE AREA	narrow stone - masonry tailrace
	DEBRIS	N/O
	WATER LEVEL AT TIME OF INSPECTION	~2-3" over spillway

ADDITIONAL COMMENTS:

Charlton-Spencer Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan
VISUAL DAM ASSESSMENT

DAM NAME		INSPECTION DATE
AUXILIARY SPILLWAY		
AREA INSPECTED	CONDITION	OBSERVATIONS
SPILLWAY	SPILLWAY TYPE	concrete
	WEIR TYPE	broad crested
	SPILLWAY CONDITION	good
	TRAINING WALLS	same as primary
	SPILLWAY CONTROLS AND CONDITION	N/O
	UNUSUAL MOVEMENT	N/O
	APPROACH AREA	same as primary
	DISCHARGE AREA	same as primary
	DEBRIS	N/O
	WATER LEVEL AT TIME OF INSPECTION	1" over spillway

ADDITIONAL COMMENTS: