FUSS & O'NEILL

MEMORANDUM

TO: Anne Capra, AICP, Director of Planning & Conservation, South Hadley, MA
Rebekah Cornell, Conservation Administrator, South Hadley, MA

FROM: Lara Sup, PE, Fuss & O'Neill, Inc.
Julianne Busa, PhD, CSE, Fuss & O'Neill, Inc.

DATE: June 15, 2022

RE: **Buttery Brook Recommended Downstream Improvements**

The Town of South Hadley (Town) has been awarded a FY22 EEA Municipal Vulnerability Preparedness Program Action Grant to fund a feasibility study for the removal of Queensville Dam, located at Titus Pond on Newton Street, restoration, and ecological enhancement of the Titus Pond impoundment to increase flood storage capacity and habitat function, and downstream watershed improvements along Buttery Brook. The purpose of this memorandum is to summarize the recommendations for the replacement of the existing Mountain Avenue culvert crossing and inlet reconstruction of the Joffre Avenue culvert along Buttery Brook, downstream of Titus Pond. To analyze the impacts of the existing and proposed stream crossings at Newton Street, Mountain Avenue, and Joffre Avenue, both a HEC-HMS hydrologic model and a HEC-RAS hydraulic model were developed. The calculations and analysis have been summarized in the Hydrologic and Hydraulic Report of Queensville Dam Removal Feasibility Study and Buttery Brook Watershed Enhancement, dated April, 2022. The following recommendations are informed by the Report.

Mountain Avenue Culvert Replacement

Downstream of Titus Pond, Buttery Brook crosses Mountain Avenue through a 24" corrugated metal pipe (CMP), measuring approximately 104 feet in length. The crossing was assessed as unable to safely pass the current 10-year storm due to its insufficient hydraulic capacity. The crossing also suffers from poor alignment causing erosion problems along the bank and allowing material to pile up at the inlet, causing blockages. The proposed replacement was designed based on Massachusetts Department of Transportation (MassDOT) Chapter 85 bridge replacement standards and Massachusetts Stream Crossing Standards while also addressing future climate conditions using the guidelines created by the Resilient Massachusetts Action Team (RMAT). The existing 24-inch corrugated metal pipe will be replaced with a 14-foot span x 5-foot rise three-sided frame with an open bottom that will be realigned to better match existing stream geometry. At present, the channel bends approximately 90 degrees to the west before flowing south under Mountain Avenue. The proposed design will realign the channel to reduce erosion, restore the natural stream function and meet future climate conditions. The estimated total project cost is $1.7M, which includes design, permitting, and construction.

Joffre Avenue Inlet Reconstruction

Buttery Brook continues downstream of Mountain Avenue approximately 315 feet through residential backyards. North of Joffre Avenue, the creek enters a storm sewer of unknown size for roughly 650 feet

under several residential properties before daylighting south of Joffre Avenue. While the conditions of the buried pipe are unknown, residents report frequent flooding in the area and the headwall of the Joffre Avenue inlet may have collapsed. A standpipe at the inlet has been set as an emergency measure.

After reviewing parcel maps and easements, it was determined that it is not feasible to daylight the conveyance pipe under Joffre Avenue. The pipe runs under several constructed residential properties as well as across undeveloped private land which would need to be purchased to daylight Buttery Brook along this stretch. Due to the length of the buried pipe, meeting the openness ratio required by the Massachusetts Stream Crossing Standards would require a very wide and/or tall structure, which is not feasible in the already constrained space. Even construction of an in-kind replacement pipe in this location would likely be extremely disruptive to the adjacent structures and residential land use because of the proximity of built-up uses and the presumed depth of the existing culvert. Instead of removal and construction of a new culvert, it is recommended that the Town reconstruct the inlet upstream of Joffre Avenue, enhance the existing wetland resource area between Mountain Avenue and Joffre Avenue, and conduct closed circuit television investigation of the conveyance pipe to determine if additional repairs may be needed. This suite of improvements should improve stormwater management and reduce localized flooding. The estimated total project cost is $400,000, which includes design, permitting, and construction.

Recommended Replacement Structure

The choice of structure type often depends on cost considerations, site limitations and access, foundations, geographical location, geometric considerations and aesthetic or historic requirements. The following considerations were evaluated in the selection of the most cost-effective structure type that will meet the project objectives (i.e., increase hydraulic capacity, improve habitat connectivity and facilitate aquatic and terrestrial organism passage, and enhance flood resilience) and site conditions for the Mountain Avenue crossing replacement and Joffre Avenue inlet structure.

- Cost Considerations – Overall cost of the proposed replacement culvert is one of the most important factors in selecting the structure type, including costs associated with engineering design and permitting, materials, and construction. For span lengths of less than 20 feet, a pre-cast reinforced concrete box culvert, a three-sided structure (box or arch), or prestressed slab unit are the most economical superstructure types used in the Northeast.

- Site Considerations – Common site considerations that affect the selection of an appropriate structure type include available roadway cover, vehicle traffic, utilities, and environmental resources. Key constraints at the Mountain Avenue crossing include the height of the roadway above Buttery Brook, natural resources areas, and residential infrastructure.

- Hydraulic Considerations – Hydraulic considerations include embedment and substrate, water depth and velocity. Open-bottom structures with a substrate that matches the natural stream channel and flow characteristics are the preferred crossing type under the Massachusetts River and Stream Crossing Standards.

- Geotechnical Considerations – Common geotechnical considerations include foundation design and vertical adjustment potential due to stream degradation. Potential degradation and scour are

concerns with open-bottom structures; the foundations should be protected and set at the appropriate elevation based on Chapter 85 standards.

The culvert size was selected based on the optimum openness ratio, minimum height requirements, topography of the site and future climate conditions. The recommended replacement structure for the Mountain Avenue stream crossing is a 14-foot wide, by approximately 5-foot high by 84-foot long precast reinforced concrete open-bottom three-sided frame supported by shallow spread footings. This alternative is the preferred option for the site considering costs, site constraints, hydraulic and geotechnical factors. The recommended replacement structure for Joffre Avenue will be a reinforced concrete headwall that is set into the existing storm sewer. The exact design will be informed during the next phase of this project after CCTV footage has been completed and the exact size and dimensions of the existing sewer is determined.

Relative Opinion of Cost

We have developed an order of magnitude opinion of cost based on review of construction costs for similar items in past projects, applicable reference cost data, and design and construction costs from recent similar stream crossing replacement projects in Massachusetts. The total project cost for recommended downstream improvements at Mountain Avenue and Joffre Avenue is estimated to be $2.1M. Detailed preliminary cost estimates are attached.

Permitting Requirements

The following permits and approvals are anticipated to be required for this project:

- Wetlands Protection Act NOI submission to Belchertown Conversation Commission and DEP
- Massachusetts Endangered Species Act (MESA) Project Review
- Army Corps of Engineers Pre-Construction Notification
- 401 Water Quality Certification
- MassDOT Chapter 85 Bridge Review

Next Steps

As the project moves forward in conjunction with the Titus Pond Restoration, additional calculations and modeling will be completed with the FY23 MVP grant to inform the design concept for the Mountain Avenue culvert and Joffre Avenue Inlet. We intend to move forward with designs that enhance resiliency and utilize nature-based approaches, including full compliance with the Massachusetts Stream Crossing Standards for the replacement crossing at Mountain Avenue, and adherence to the Division of Ecological Restoration and Wetlands Protection Act guidance and requirements for ecological restoration projects, including consideration of downstream impacts, improvement on existing conditions, etc. There is no *a priori* reason to expect that this project would not be able to advance through permitting for a successful implementation project in future phases. Additional necessary due diligence information and field data already requested by the regulatory agencies during the early coordination meeting has been incorporated into the project scope for the next project phase and will be submitted with permitting applications.

ORDER OF MAGNITUDE OPINION OF CONSTRUCTION COST	DATE PREPARED:	6/13/2022	
PROJECT: South Hadley MVP, Mountain Avenue/Buttery Brook Crossing			
LOCATION: South Hadley, MA	ESTIMATOR:	LTS	CHECKED BY: DD/JB
DESCRIPTION: 14'x5' three sided structure culvert	JOB NO.	20170390.V30	

This is an order of magnitude cost estimate, as defined by the American Association of Cost Engineers, that is expected to be within -30 to +50 percent of the actual project cost. Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others or market conditions. Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry. Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill.

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
EROSION AND SEDIMENT CONTROL	LS	1	$10,000.00	$10,000.00
PRECAST CONCRETE 3-SIDED STRUCTURE (14 FT SPAN) AND FOOTINGS	LF	84	$8,000.00	$672,000.00
EXCAVATION, GRADING, PAVING WITH ROADWAY	LS	1	$100,000.00	$100,000.00
CONCRETE FOOTINGS	CY	42	$1,200.00	$50,400.00
TEMPORARY SHORING AND EXCAVATION	LS	1	$250,000.00	$250,000.00
BRIDGE RAIL AND GUARDRAIL	LF	90	$40.00	$3,600.00
WATER CONTROL	LS	1	$50,000.00	$50,000.00
EXCAVATE AND REGRADE CHANNEL	SY	500	$10.00	$5,000.00
GRADING OF STREAMBANK	SY	500	$10.00	$5,000.00
STREAMBANK STABILIZATION AND RESTORATION	SY	1000	$7.00	$7,000.00
		SUBTOTAL		$1,153,000.00
CONTRACTOR MOBILIZATION AND DEMOBILIZATION, TESTING, BONDS/INSURANCE	LS	10%	1	$115,300.00
		CONSTRUCTION SUBTOTAL		$1,268,300.00
DESIGN	LS		$80,000.00	$80,000.00
PERMITTING	LS		$30,000.00	$30,000.00
CONSTRUCTION ADMINISTRATION	LS		$50,000.00	$50,000.00
		SUBTOTAL		$1,428,300.00
		20% Contingency		$285,660.00
		TOTAL		**$1,713,960.00**
		(-30%)		$1,199,772.00
		(+50%)		$2,570,940.00

ORDER OF MAGNITUDE OPINION OF CONSTRUCTION COST	DATE PREPARED:	6/13/2022	
PROJECT: South Hadley MVP, Joffre Avenue Inlet Reconstruction	BASIS:		
LOCATION: South Hadley, MA	ESTIMATOR:	LTS	CHECKED BY: DD/JB
DESCRIPTION: Joffre Avenue and Buttery Brook Inlet Reconstruction and Wetland Restoration	JOB NO.	20170390.V30	

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ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Inlet Protection Measures, new headwall, pipe connection to existing pipe, wetland restoration	LS	1	$200,000.00	$200,000.00
		SUBTOTAL		$200,000.00
CONTRACTOR MOBILIZATION AND DEMOBILIZATION, TESTING, BONDS/INSURANCE	LS	10%	1	$20,000.00
		CONSTRUCTION SUBTOTAL		$220,000.00
DESIGN	LS		$50,000.00	$50,000.00
PERMITTING	LS		$20,000.00	$20,000.00
CONSTRUCTION ADMINISTRATION	LS		$50,000.00	$50,000.00
		SUBTOTAL		$340,000.00
		20% Contingency		$68,000.00
		TOTAL		**$408,000.00**
		(-30%)		$285,600.00
		(+50%)		$612,000.00