TOWN OF WESTFORD
ENGINEERING DEPARTMENT

28 North Street
Westford, Massachusetts 01886
TEL (978) 692-5520 FAX (978) 399-2739

REQUEST FOR PROPOSALS

PROFESSIONAL ENGINEERING SERVICES

BEAVER BROOK ROAD CULVERT REPLACEMENT PROJECT (Bridge No. W-26-014, Structure No. W26014-26G-MUN-NBI)

July 20, 2016

The Town of Westford, through its Engineering Department, is seeking proposals from qualified firms to provide professional engineering design services for the replacement of existing culverts that convey Beaver Brook under Beaver Brook Road in Westford, Massachusetts.

Below is a description of the existing site conditions, project objectives, anticipated scope of services, reference materials as well as other information to be considered in the preparation of the proposal.

SITE DESCRIPTION AND BACKGROUND

The existing culvert is located on Beaver Brook Road approximately 1,800' southwest of the Beaver Brook Road and Route 225 intersection. Beaver Brook Road is approximately 23' wide at the culvert and carries two lanes of traffic. There are minimal paved shoulders on both sides of the road and there are no sidewalks at the culvert. Beaver Brook Road is a public way that is owned and maintained by the Town of Westford. There is also a Massachusetts Department of Conservation and Recreation (DCR) gravel boat ramp located directly adjacent to the culvert's downstream outlet.

Beaver Brook flows in a general south to north direction at the site before discharging into Forge Pond approximately 700 feet downstream of the culvert. The existing culvert consists of two, side by side, elliptical corrugated metal pipe culverts each with a 7'-4" rise by 10'-5" span and a length of approximately 40'-0". The culvert headwalls consist of sloped mortared granite stone masonry. The cover over the top of the existing culvert is less than 2'-0". The culverts are in poor condition with many small areas of 100% section loss along the waterline. The culverts are also partially filled with debris and continuously experience beaver activity. Scour has also been observed at the culvert. There are overhead utility lines on the east side of the roadway. No other utilities have been observed at the site. The site is located within the 100-foot wetland buffer zone, a riverfront area, FEMA Floodplain and Massachusetts Natural Heritage & Endangered Species Program (NHESP) area for rare wildlife.

A draft existing conditions plan of the Beaver Brook culvert site was prepared for the town in November 2012. This plan was compiled from an on-the-ground instrument survey performed by LandTech Consultants on July 20, 2012. The wetlands shown on this plan were flagged by Norse Environmental and field located during the survey. The Beaver Brook Road right-of-way

was not established as part of the survey and is shown on the existing conditions plan for illustration purposes only.

OBJECTIVE

A feasibility study for the culvert replacement was prepared by Weston & Sampson in May 2015. Several possible replacement alternatives were analyzed as part of the study including: lining the existing culverts, replacing the culverts with two new culverts and replacing the culverts with a new bridge structure. The study ultimately recommended replacing the existing culverts with two new reinforced pre-cast concrete culverts since that alternative would best met the town's goals and would be the most economical solution over the long term.

The town wishes to pursue the study's recommendations and replace the existing culverts with a new reinforced concrete culvert(s). The overall objective of the culvert design will be to: achieve a minimum service life of 75 years with low maintenance, minimize construction impacts, allow for a wider crossing at Beaver Brook Road to better accommodate pedestrians and bicycles, incorporate provisions for the future installation of a new water main at the crossing, and minimize beaver activity at the culvert if feasible. The town would also like to consider, as part of the design, improving the existing DCR boat ramp and ramp access from Beaver Brook Road. It is also desired to incorporate one or two parking spaces at the ramp if determined feasible and cost effective. The design shall consider the potential traffic impacts and whether a road detour or staged construction would be the best option for this site.

It is anticipated that construction funding for this project will be funded through a local appropriation; however, the town will pursue, if possible, funding under the small bridge program legislation that was recently proposed by the Baker-Polito Administration. The project shall be completed in accordance with any available guidance and requirements of this program.

The selected firm will assist the town in evaluating and balancing all the desired goals, objectives and potential impacts against estimated construction costs in order to select the most appropriate design for the project.

SCOPE OF WORK

The following is an anticipated scope of work that the town believes necessary to complete the project. Additional work or tasks not identified below may be required to complete the project and must be included in the selected firm's proposal and fee.

1) Attend a kick-off meeting with town officials to review the project scope, review existing field conditions and to discuss project requirements, objectives, goals and projected construction budget.

2) Identify and delineate all local, state and federally regulated wetland resource areas in the vicinity of the project area necessary for project permitting.

3) Conduct an existing conditions field survey of the existing culvert, roadway and surrounding area that will supplement the existing survey previously prepared for the town. The survey limits shall be sufficient enough to include all information necessary to complete the project. The horizontal survey control shall be based on the Massachusetts State Plane Coordinate

system (feet) datum and the NAVD 88 (feet) datum for the vertical control. Establish both horizontal and vertical survey control within the survey area that can be used during project construction. The survey shall also include the collection of any and all other information that may be necessary to complete the design, hydrologic and hydraulic analysis, and shall comply with the MassDOT Bridge Manual as applicable.

4) Prepare an updated existing conditions plan of the project area using available plans, information collected during the field survey and project research. The plan shall include: detailed dimensions of the existing culvert, invert elevations, cross sections of Beaver Brook as necessary, one foot contours, elevation spot grades where appropriate, locations of all regulated wetland resource areas, FEMA floodplain, edge of pavement, pavement markings, signs, utilities, walls, trees and any other features considered significant to the project. The plan shall also determine and demarcate the location of the Beaver Brook Road right of way, private property boundaries and any existing easements within the survey limits. All right of way lines shall be identified on the plan with a metes and bounds description. The existing conditions plan shall be signed and stamped by a Professional Licensed Surveyor registered in the state of Massachusetts.

5) Conduct soil borings in the vicinity of Beaver Brook Road and the existing culvert as necessary to support the final design.

6) Conduct a hydrologic and hydraulic (H&H) analysis of Beaver Brook for both existing and post construction conditions. The analysis shall demonstrate that the culvert replacement project is adequate to convey Beaver Brook without scour or adversely impacting the roadway, upstream or downstream properties or the environment. The H&H analysis shall also demonstrate that the culvert replacement project will not increase the existing regulated FEMA flood plain. The limits and proposed scope of the H&H analysis shall be reviewed with the town prior to conducting the analysis. The H&H analysis shall be completed using standard industry practices and FEMA approved modeling software. A final report of the H&H analysis shall be provided to the town.

7) Obtain all necessary permits required to construct the project. The project may require involvement with, but may not be not limited to: the Westford Conservation Commission, Department of Environmental Protection (DEP), DCR, NHESP, Army Corps of Engineers (USACE), Massachusetts Environmental Policy Act (MEPA) and Massachusetts Department of Transportation (MassDOT). The project must comply with the most recent versions of the Massachusetts River and Stream Crossing Standards, MassDOT Standard Specifications for Highways and Bridges and MassDOT Bridge Manual as applicable. The selected firm shall be responsible for determining all necessary regulatory involvement and for assisting the town in obtaining all permits necessary to construct the project. All permitting costs, with the exception of fees, shall be included in the proposed fee.

8) It is anticipated that the project will be subject to MGL Chapter 85 Section 35 and will require review and approval from MassDOT. The proposal and fee shall include all work necessary to successfully complete the Chapter 85 review and approval process if applicable.

9) The design shall conform to AASHTO LRFD HL-93 design live loading. The selected culvert rail system and transitions shall meet the requirements stated in the National

Highway Cooperative Research Project (NHCRP) or AASHTO Manual for Assessing Safety Hardware (MASH) as a Test Level 2 system.

10) Prepare plans for temporary construction easements, permanent easements or takings along the Beaver Brook Road right of way if the anticipated project construction limits extend outside of the existing public right of way. Plans suitable for recording at the registry of deeds and legal descriptions shall also be prepared as necessary.

11) Prepare final design plans, specifications and a construction estimate. The final plans shall be prepared in accordance with MassDOT's format standards. Separate bridge/structural plans shall be prepared detailing the proposed culvert. These plans shall conform to Section 4.2 - PREPARATION OF CONSTRUCTION DRAWINGS of the 2013 MassDOT LRFD Bridge Manual – Part I. The final plans and specifications shall also incorporate all comments made by the town during the design process as well as incorporate any revisions required from the permitting process. The plans and specifications shall be signed and stamped by a Professional Engineer registered in Massachusetts. Provide the town with two (2) mylar copies of the final plans.

12) Prepare contract documents that will be used to publicly bid the project. The contract documents must comply with all permits and public procurement laws.

13) Provide the town with digital copies of final contract documents in Microsoft Word and Adobe pdf format. The final design plans shall also be provided in AutoCAD dwg format.

14) Assist the town with the public bid process including answering requests for information, issuing addenda, attending bid opening, reviewing bids for compliance with the contract documents, checking references and preparing a Notice of Award. The town will be responsible for advertising, distributing bid packages and conducting the bid opening.

REQUIRED ELEMENTS OF PROPOSAL

Each qualified firm shall prepare a proposal outlining the firm's qualifications and experience with projects of similar size and scope. The following elements and information shall be included in the proposal:

1) The firm's history and overall qualifications.
2) A demonstration of clear understanding of the project objectives and work required to complete the project.
3) A timeline of the estimated project schedule.
4) Clearly specify the scope of work to be provided as well as any services or work not included in the firm's proposal.
5) Qualifications of the project manager and key personnel that will be assigned to the project.
6) An outline of the firm's experience with projects of similar size and scope.
7) A list of sub-consultant(s) that will be part of the project team along with their qualifications.
8) Present workload of firm and ability to complete the project without delay.
9) References for both lead firm and sub-consultants.

EVALUATION AND SELECTION CRITERIA

The final selection of the firm will be based on, at a minimum, the following criteria:

1) Firm's history, qualifications and resource capability to perform required services.
2) Quality of the proposal and responsiveness to the needs of the town.
3) Relevant experience.
4) Project Manager's relevant and overall experience.
5) Qualifications of assigned personnel and sub-consultant(s).
6) Demonstrated ability to complete the project in a timely manner.
7) Reference checks.

The town may request firms to meet for an interview if determined to be advantageous to the selection process.

PROJECT FEE

Firms shall submit a detailed fee schedule with the proposal. The fee schedule shall outline and itemize the work and various tasks required to successfully complete the project. The fee shall include billing rates and estimated man-hours required to complete each task and shall provide an estimate of the number of meetings included in the proposal. Direct expenses, reimbursable expenses, administrative fees, and any other anticipated fees shall be included in the fee schedule.

The fee schedule shall include all anticipated tasks and costs necessary to complete the project and may include work or costs that are not identified in the scope services detailed in this request for proposals. The total of all costs provided in the fee schedule shall be considered the overall not to exceed price for the project.

The selected firm will be paid only for the work and tasks that are required to complete the project. Any task or work included in the fee structure that is not completed by the selected firm shall not be eligible for payment. Any additional work determined to be outside of the selected firm's scope of services and fee shall be mutually agreed upon and shall require written authorization from the Town of Westford prior to performing that work. The proposal shall include a schedule of standard personnel hourly billing rates.

SUBMISSION REQUIREMENTS

Firms shall submit five (5) copies of the proposal in a sealed envelope clearly marked as "PROPOSAL - Beaver Brook Culvert Replacement Project". The proposed fee shall be submitted with the proposal in a separate sealed envelope marked as "FEE - Beaver Brook Culvert Replacement Project". Only one copy of the fee schedule and standard hourly billing rates is required for submission. The written proposal only shall also be provided in Adobe pdf format on a USB flash drive.

Proposals shall be submitted to:

Paul Starratt, P.E.
Town Engineer
Westford Highway Facility
28 North Street
Westford, MA 01886

The deadline for submitting a proposal is 3 p.m. on Thursday, August 18, 2016.

TERMS & CONDITIONS

The Town of Westford reserves the right to waive any irregularities in the RFP process and to accept or reject any proposal for any reason.

Project payments will be made monthly based on work completed and the fees detailed in the fee schedule submitted by the firm as part of the proposal.

All survey and design work and supporting analyses completed as part of this project shall become property of the Town of Westford and shall be delivered to the town in hard copy and the software format that it was developed in (i.e. AutoCAD, HydroCAD, WORD, EXCEL, HEC-RAS, etc.).

REFERENCES MATERIALS

The following reference materials have been attached to aid in proposal preparation:

- USGS Locus Map
- Ortho Image
- Representative Site Photographs
- Draft Existing Conditions Plan Beaver Brook (November 2012)
- Beaver Brook Road Culvert/Bridge Replacement Feasibility Study (May 2015)
- Bridge Inspection Reports

The Town of Westford's Geographic Information System (GIS) may also be considered a useful source of information and is available for public viewing at: www.westfordma.gov/gis.

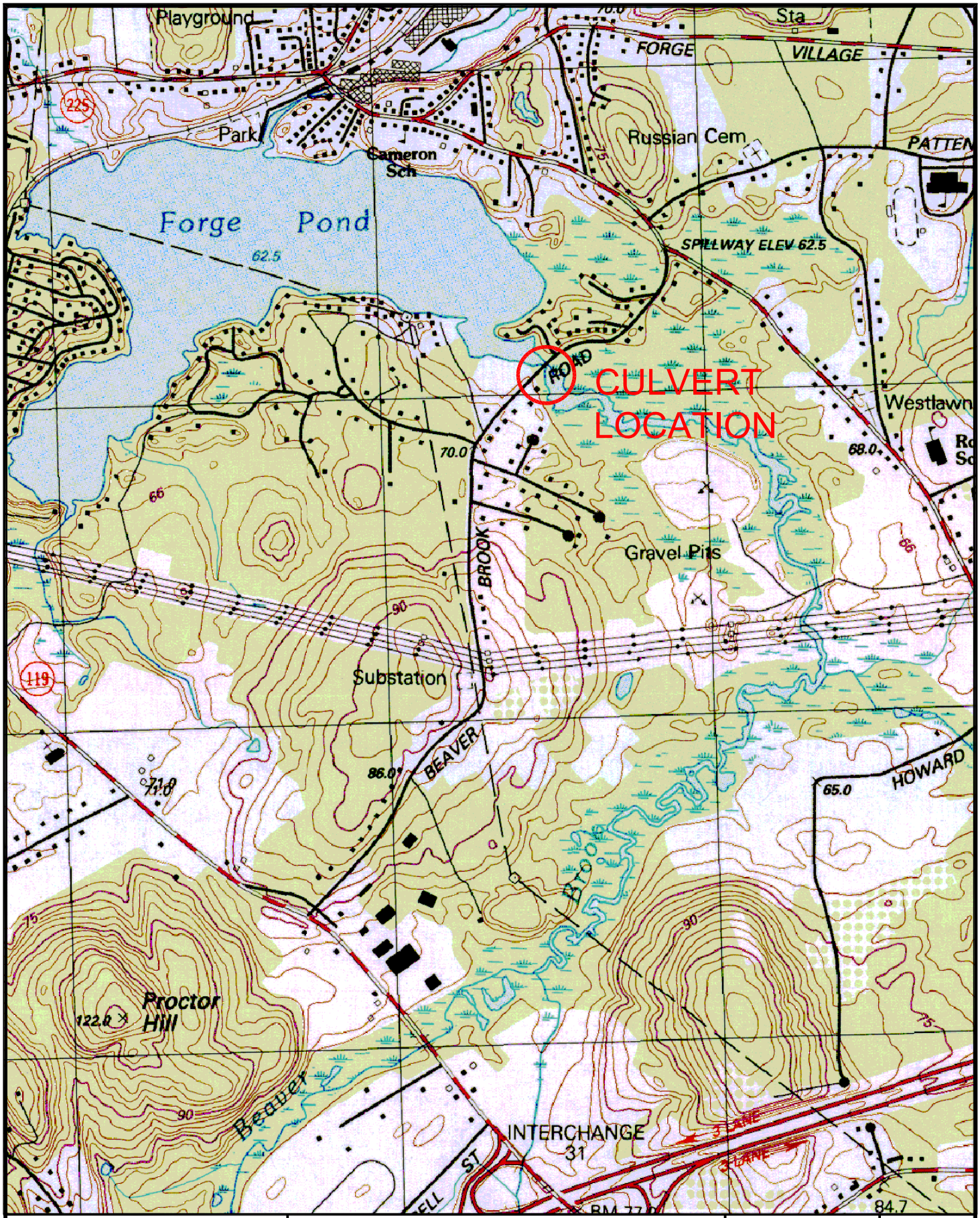
GIS data layers will be made available to the selected firm in ArcGIS or AutoCAD file format upon request once the project is awarded. The AutoCAD dwg file for the Draft Existing Conditions Plan is also available upon request.

REQUESTS FOR INFORMATION

Any questions or requests for additional information shall be directed to the Paul Starratt, Town Engineer, at 978-399-2716 or pstarratt@westfordma.gov .

REFERENCE MATERIALS

LOCUS MAPS



TOWN OF WESTFORD *ENGINEERING DEPARTMENT* *28 NORTH STREET* *WESTFORD, MASSACHUSETTS*	USGS MAP BEAVER BROOK ROAD CULVERT REPLACEMENT PROJECT WESTFORD, MA	*SCALE: 1"=1,300'* *DATE: 6/29/16*	

IMAGES OBTAINED FROM: "OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS"

TOWN OF WESTFORD **ENGINEERING DEPARTMENT** 28 NORTH STREET WESTFORD, MASSACHUSETTS	AERIAL LOCUS MAP BEAVER BROOK ROAD CULVERT REPLACEMENT PROJECT WESTFORD, MA	SCALE: 1"=250' DATE: 6/29/16	

IMAGES OBTAINED FROM: "OFFICE OF GEOGRAPHIC AND ENVIRONMENTAL INFORMATION (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS"

REPRESENTATIVE SITE PHOTOGRAPHS

Beaver Brook Road

DCR Boat Ramp

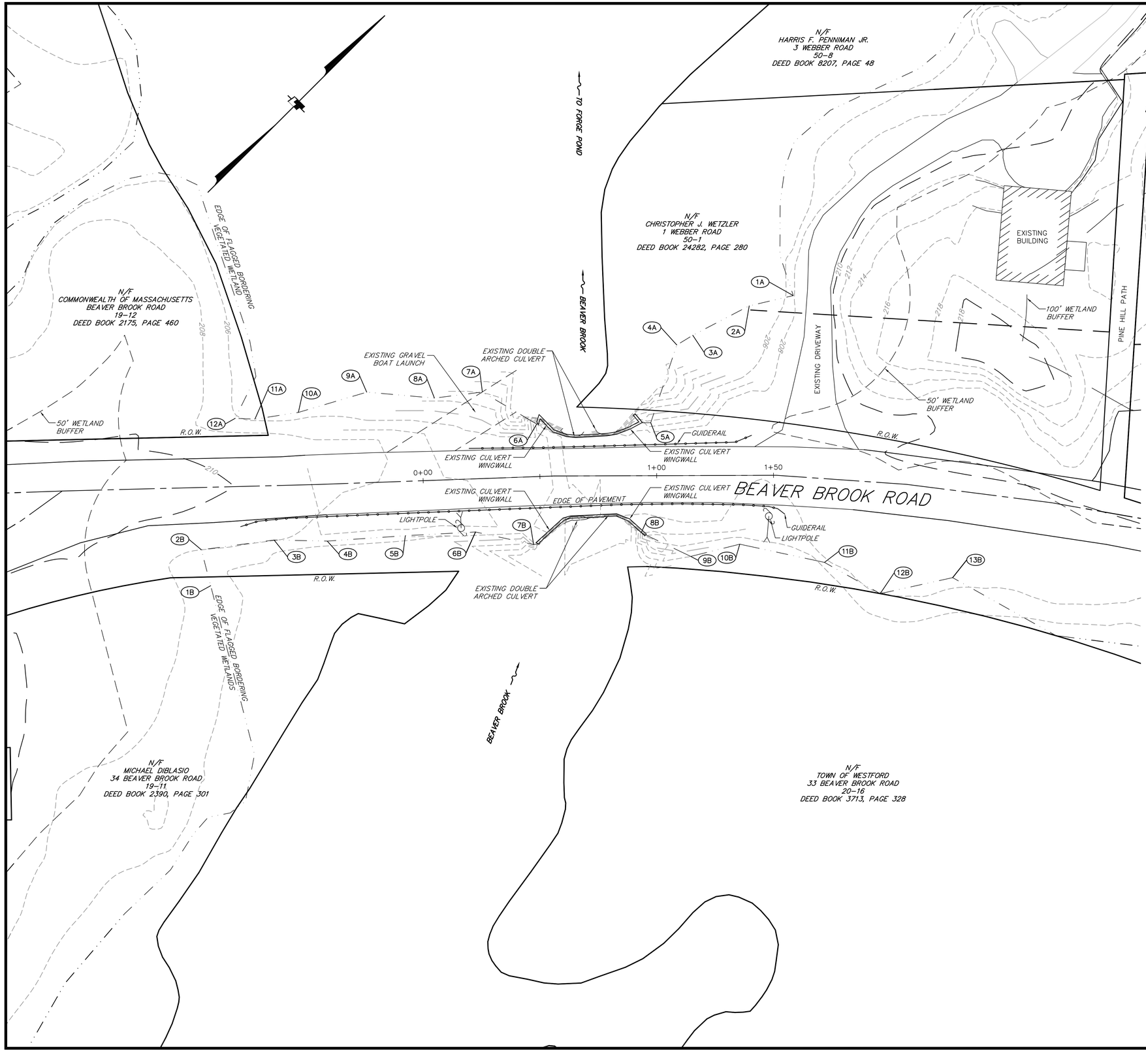
Culvert Upstream Inlet

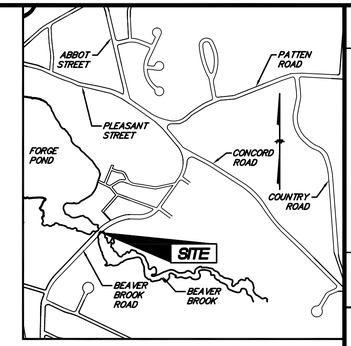
Culvert Downstream Outlet

Culvert Interior

Culvert Interior with Beaver Activity

DRAFT EXISTING CONDITIONS PLAN





LOCUS MAP
SCALE: 1" = 1,000'

NOTES:

1. TOPOGRAPHIC AND PLANOMETRIC INFORMATION OBTAINED FROM A GROUND SURVEY CONDUCTED BY LANDTECH CONSULTANTS, INC. ON JULY 20, 2012.
2. FLAGGED WETLAND LOCATIONS SHOWN ON THIS MAP WERE PROVIDED BY A FIELD STUDY CONDUCTED BY NORSE ENVIRONMENTAL SERVICES, INC., 130 MIDDLESEX ROAD, SUITE 15, TYNGSBORO, MA 01879, IN JULY, 2012 AND FIELD LOCATED BY LANDTECH CONSULTANTS, INC. ON JULY 23, 2012.
3. THE SUBJECT PARCEL IS LOCATED IN ZONE AE AS DEFINED ON THE FEMA FLOOD INSURANCE RATE MAP, COMMUNITY PANEL NO. 25017C 0228E, EFFECTIVE DATE JUNE 4, 2010.

DATE	REVISION	BY

PREPARED FOR:
TOWN OF WESTFORD
ENGINEERING DEPARTMENT
28 NORTH STREET
WESTFORD, MA 01886

DESIGN	DRAFT	CHECK
INT	APH	INT

EXISTING CONDITIONS PLAN
BEAVER BROOK
BEAVER BROOK ROAD
WESTFORD, MA

NOVEMBER 28, 2012

SCALE: 1" = 20'

Landtech Consultants
Engineering/Design/Surveying/Permitting
515 Groton Road, – Westford, MA 01886
Ph: (978) 692-6100 – landtechinc.com

JOB NO.	DWG. NO.	SHEET
12-156	9606	1 OF 1

FEASIBILITY STUDY

REPORT

Westford, MA

Beaver Brook Road Culvert/Bridge Replacement Feasibility Study

CONTRACT NO: 2150097

May 2015

Weston & Sampson Engineers, Inc.
Five Centennial Drive
Peabody, MA 01960-7985
www.westonandsampson.com
Tel: 978-532-1900 Fax: 978-977-0100

Table of Contents

1.0 DESCRIPTION OF EXSITING SITE CONDITIONS

1.1 Description of Existing Bridge Structure:
Bridge Number (BIN): W-26-014 (26G)
Structure Number: W26014-26G-MUN-NBI

Beaver Brook Road is approximately 23'-0" wide at the culvert location. The road carries two lanes of traffic and approximately 1'-0" wide paved shoulders each side. There are no sidewalks. Steel W-beam guardrail with timber posts are installed on each side of the roadway.

The existing culvert consists of two, side by side, 7'-4" rise by 10'-5" span elliptical corrugated metal pipe culverts with a length of approximately 40'-0". The culvert headwalls consist of sloped mortared granite stone masonry. The cover over the top of the existing culvert is less than 2'-0".

The culverts are in poor condition with many small areas of 100% section loss of the metal pipe culvert along the waterline. The culverts are also partially filled with debris.

1.2 Description of Approach Roadway:
The approach roadway sections are similar to the culvert crossing roadway section. The approach roadways are approximately 23'-0" wide with approximately 1'-0" wide shoulders each side. The approach roadways carry two travel lanes and no sidewalks are present. The horizontal alignment of the roadway appears to be on a large radius curve. The vertical alignment appears to be shallow.

1.3 Description of Feature Under the Bridge Structure:
The culverts carry Beaver Brook Road over Beaver Brook. Beaver Brook flows from east to west at the bridge site. The upstream and downstream channels are wider than the culvert openings. There are piles of debris at the east ends of both culverts which have hindered inspection of the culverts at these locations.

1.4 Description of Existing Hydraulics at the Bridge Site:
The existing hydraulic opening provided by each culvert is 7'-5" rise by 10'-5" span ellipse. Scour has been observed on the upstream end of the northern most culvert. Some dumped riprap was placed in this location as a scour countermeasure.

1.5 Description of All Utilities within the Bridge Site:
There are overhead utility lines on the east side of the roadway. No other utilities have been observed at the bridge site.

1.6 Description of Environmentally Sensitive or Cultural Resource Areas Affecting the Bridge Site:
The bridge site is located within the 100-foot wetland buffer zone, a riverfront area, and NHESP area for rare wildlife. See the Environmental Resource Map (Figure1) in Appendix C.

1.7 Hazardous Materials:
No potential hazardous materials or contaminants have been identified at this time.

2.0 ALTERNATIVES CONSIDERED

2.1 Alternative 1 – Line Existing Inside of Culverts:
This alternative includes lining the inside of the existing culverts with a new pipe material such as HDPE and grouting the voids between the new pipe and the existing culvert. Infill at each headwall will be installed consistent with existing stone cover to cap the grout void. The existing length of the culvert and the existing roadway cross section over the culvert will remain the same.

2.2 Alternative 2 – Replace the Existing Culverts with Two New Culverts:
This alternative includes removing the two existing culverts and replacing them with two new precast concrete box culverts or reinforced concrete pipes. 2'-0 of natural stream bed material will be placed at the base of the culvert in accordance Massachusetts River and Stream Crossing Standards. Under this alternative the length of the culvert would be increased to accommodate a roadway cross section allowing for two 11'-0" travel lanes, two 5'-0" bike lanes, with 5'-0" sidewalks on each side. The increase in the width of the roadway cross section is necessary to be consistent with the MassDOT Engineering Healthy Transportation Policy for pedestrian and bicycle access. This alternative also includes provisions for a steel pipe sleeve under the culverts to carry a future water main.

2.3 Alternative 3 – Replace the Existing Culverts with a Bridge:
This alternative includes removing the two existing culverts and replacing them with a single span bridge structure. The span length of the bridge structure would be selected to provide an equivalent cross sectional waterway area as the existing. For this study the span length was determined to be approximately 30'-0" in order to provide the equivalent area. This span length takes into consideration riprap slope protection along the length of the abutments. Under this alternative the roadway cross section would be increased to accommodate a roadway cross section allowing for two 11'-0" travel lanes, two 5'-0" bike lanes, with 5'-0" sidewalks on each side. The increase in the width of the roadway cross section is necessary to be consistent with the MassDOT Engineering Healthy Transportation Policy for pedestrian and bicycle access. This alternative also includes provisions for installation of a future water main within the bridge superstructure.

3.0 DESCRIPTION OF PROJECT PARAMETERS AND CONSTRAINTS

3.1 Description of Proposed Roadway Cross Section:
Refer to Section 4.0 for description of roadway cross sections assumed for each alternative.

3.2 Proposed Clearances:
The proposed clearances for the culvert should be such that the open area provided is similar to the open area that currently exists.

3.3 Hydraulic Data:
At a minimum, any culvert replacement is to provide an equivalent open area to the existing.

3.4 Preliminary Geotechnical Data:
No preliminary geotechnical information was available at the time this study was performed.

3.5 Constraints Imposed by Approach Roadway Features:
There are driveways close by on both the north and south approaches.

3.6 Constraints Imposed by Feature Crossed:
Flow of water must be maintained during construction. Staged water control or bypass pumping may be required during construction. Traffic flow must be maintained to at least one lane during construction work. A traffic management plan (TMP) will be required.

3.7 Constraints Imposed by Utilities:
The existing overhead utilities may require relocation for the construction of some of the alternatives considered.

3.8 Constraints Imposed by Environmentally Sensitive Areas:
The culvert is located within wetlands, the 100-year flood zone, NHESP estimated habitats of rare wildlife, and NHESP priority habitat of rare species. Beaver Brook is a perennial stream which puts the culvert location within a riverfront area. Construction of the culvert may only be allowed during low flow times of the year. Filling of the area for construction of some of the alternatives may require significant time to get through the permitting process.

Environmental permits may include Wetlands Notice of Intent, 401 WQC, Chapter 91, and ACOE 404.

3.9 Constraints Imposed by Cultural Resource Areas:
No constraints from cultural resource areas are anticipated.

3.10 Hazardous Material Disposition:
No hazardous material disposition has been identified at this time.

3.11 Beaver Control:

Since a beaver population is present in the pond, beaver controls will have to be imposed during construction. For example an appropriately sized welded wire fabric may be used to fence off the site to prevent beavers from disrupting construction.

For permanent beaver control, vertical bar grates shall be installed on both ends of the culvert to prevent beavers from placing debris inside the culvert. This will require regular maintenance to clear the bar grates when debris builds up.

3.12 DCR Boat Ramp:

The existing DCR boat ramp is located on the southeast side of the culvert. With alternatives 2 and 3 the road will be widened which will likely cause the boat ramp to be removed and replaced. If replacement is necessary, the ramp shall be located on the east side of the culvert to provide access to Forge pond. A maximum of two temporary off-loading spaces seems to be a feasible option at for Alternatives 2 and 3. A 10' wide structural shoulder could be constructed to allow for the two temporary off-loading spaces. The boat ramp may be temporarily inaccessible during construction.

3.13 Inlet Controls:

Inlet controls such as stop logs are feasible with Alternate 2. However, this will require a watershed and flooding analysis and will require extensive DEP and Army Corp of Engineers permitting.

4.0 ALTERNATIVES ANALYSIS

4.1 Alternative 1 – Line Existing Inside of Culverts:

4.1.1 *Pros:*

- Minimizes disruptions to traffic. Construction will require minimal lane closures that can be coordinated with off-peak times of traffic.
- Construction of this alternative is relatively simple.
- Minimizes work required within the water.
- Existing culverts can be utilized to maintain flow of water.
- Does not affect the existing overhead utilities.
- Lowest relative construction cost of all alternatives.

4.1.2 *Cons:*

- Reduces the existing hydraulic opening but the new lining material will have a smoother surface with a lower roughness coefficient allowing an equivalent flow. May require a hydraulic analysis to show any potential impacts from the reduced opening and confirm post flow conditions anticipated.
- Does not allow for future widening of the roadway to accommodate potential bike lanes and sidewalks.

- Does not allow for provisions to be made for installation of a future water main.
- Does not allow for potential installation of inlet controls.

4.2 Alternative 2 - Replace the Existing Culverts with Two New Culverts:

4.2.1 *Pros:*

- Maintains a similar hydraulic opening as the existing culverts.
- Allows for installation of a steel sleeve to install a future water main under the culverts.
- Allows the roadway to be widened to accommodate bike lanes and sidewalks.
- Existing culverts can be used to maintain flow of water during staged construction.
- Allows for staged construction to maintain the flow of traffic.
- Allows potential for installation of inlet controls.

4.2.2 *Cons:*

- Construction duration will be increased to accommodate staged construction.
- Increase in the length of culvert will require filling in of wetlands which may trigger wetland replication and an Environmental Impact Report (EIR) if over 5,000 square feet.
- Will require more effort for environmental permitting.
- Requires existing overhead utilities to be relocated.
- More expensive than Alternative 1.

4.3 Alternative 3 – Replace the Existing Culverts with a Bridge:

4.3.1 *Pros:*

- Allows for similar hydraulic opening to be achieved.
- Will be able to accommodate installation of a future water main and other utilities.
- Allows the roadway to be widened to accommodate bike lanes and sidewalks.
- Existing culverts can be used to maintain flow of water during staged construction.
- Staged construction can be used to maintain flow of traffic.

4.3.2 *Cons:*

- Construction duration will be increased to accommodate staged construction.
- Increase in the width of the roadway will require filling in of wetlands which may trigger wetland replication an Environmental Impact Report (EIR) if over 5,000 square feet.
- Will require more effort for environmental permitting.
- Requires existing overhead utilities to be relocated.

- Will require structural review by MassDOT increasing the design schedule.
- Does not allow for installation of inlet controls.
- More expensive than Alternatives 1 and 2.

5.0 FUNDING

5.1 The four methods of funding this project are as follows:

1. Transportation Bond Bill
2. Town Capital Expenditures
3. Chapter 90 Program
4. Private Entity with Department of Conservation and Recreation (DCR) (Public, Private Partnership)

All four of these sources of funding are viable options that may be used for this project. The town should apply for Chapter 90 program as well as for the transportation bond bill to cover the majority of the project costs. Any leftover funding will need to be accounted for in the town's capital budget.

The fourth method of potential funding is based on a discussion with DCR. We contacted DCR to inquire about their policy for funding the upgrading of gravel boat ramps similar to the one at Beaver Brook in our study area. The funding for this type of boat ramp rehabilitation is typically paid for under the scope of a larger project that happens to include the ramp, such as a park project. They are not usually a stand-alone project. However, there have been instances where a Public, Private, Partnership (3P) has been set up to fund such a project. A private party, in this case, teams with DCR to split the funding between the two entities for the good of the public. This is an avenue the Town may pursue if an interested local party were to show interest in the project.

6.0 DETOUR VERSUS STAGED CONSTRUCTION ANALYSIS

6.1 Detouring Traffic

The associated costs with detouring traffic are less significant. Detouring of traffic involves installation and maintenance of detour signage for the duration of the construction period. Detouring of traffic will also reduce the construction duration and overall costs of the project. However, all viable detour routes will add a long time element to the motoring public.

6.2 Staged Construction

Stage construction allows for the road to be to traffic during construction. Staged construction however increases the construction duration and requires additional work to accommodate traffic during construction. The overall project costs are increased due to the longer construction duration and additional work required for maintaining traffic. Staged construction typically increases the overall cost of the project by 25% - 30%.

7.0 PRELIMINARY- PROJECT COST ESTIMATE

	Alternative 1 Line Existing Culvert	**Alternative 2** Install New Culverts	**Alternative 3** Install Bridge Structure
Construction Cost	$ 155,300.00	$ 273,800.00	$ 621,000.00
Construction Contingency (25%)	$ 38,800.00	$ 68,500.00	$ 156,200.00
Total Construction Cost	$ 194,100.00	$ 342,300.00	$ 776,200.00
Engineering Fee	$ 30,000.00	$ 85,000.00	$ 150,000.00
Engineering Contingency (20%)	$ 6,000.00	$ 17,000.00	$ 30,000.00
Total Engineering Fee	$ 36,000.00	$ 102,000.00	$ 180,000.00
Total Project Cost	**$ 230,100.00**	**$ 444,300.00**	**$ 956,200.00**

Notes:
1. Cost estimates do not include any escalation factors.
2. Costs are based on MassDOT average weighted bid prices.
3. Cost does not include construction administration services.
4. Actual permits may impact engineering fee.
5. Engineering design fees do not include and hydrologic and hydraulic analysis.

8.0 LIFE CYCLE COST ANALYSIS

8.1 Life Cycle Cost Analysis Parameters

The following parameters were used for the life cycle cost analysis.

- Real discount rate (d) = 1.4% *(Based on OMB Circular No. A-94, 12/2014)*
- Nominal Discount Rate (D) = 3.4% *(Based on OMB Circular No. A-94, 12/2014)*
- Inflation Rate (i) = 0.83%
- Analysis Period = 40 years for Alternative 1; 75 years for Alternative 2 and 3
- Base Date = 2015

8.2 Alternative 1 – Line Existing Inside of Culverts:

Lining the inside of the culvert with HDPE pipe will provide the least amount of repair over its service life. With that being said it also has by far the shortest life cycle at only 50 years. Maintenance and repair would involve cleaning out the culvert of any debris, repairs of voids in the grout lining, and masonry repair of the headwalls. This work is estimated to cost $1000 every 10 years.

Expenditure	Year	Cost	Future Value	Present Value
Initial Construction	0	$230,100.00	-	$230,100.00
Maintenance	10	$1,000.00	$1,086.00	$777.00
Maintenance	20	$1,000.00	$1,180.00	$605.00
Maintenance	30	$1,000.00	$1,281.00	$470.00
Maintenance	40	$1,000.00	$1,392.00	$365.00
Total				**$232,317.00**

8.3 Alternative 2 - Replace the Existing Culverts with Two New Reinforced Concrete Culverts:

Replacing the culvert with two new reinforced concrete box culverts or RCP pipes will provide a much longer service life than Alternative 1. AASHTO predicts a 75 year life cycle for culverts. This alternative will provide a greater service life but will have higher maintenance costs than Alternative 1. Repairs and maintenance would include cleaning out the structure, repairing spalled and delaminated concrete surfaces, and inspections. Maintenance and repairs are assumed to be completed every 20 years.

Expenditure	Year	Cost	Future Value	Present Value
Initial Construction	0	$444,300.00	-	$444,300.00
Maintenance	20	$5,000.00	$5,899.00	$3,023.00
Maintenance	40	$40,000.00	$55,674.00	$14,616.00
Maintenance	60	$80,000.00	$131,364.00	$17,670.00
Total				**$479,609.00**

8.4 Alternative 3 – Replace the Existing Culverts with a Bridge:

Replacing the culvert with a bridge will provide the same life cycle as the culverts at 75 years according to AASHTO. This alternative will require the most maintenance. Maintenance and repairs will include items such as repainting the bridge, repair concrete surfaces, wearing surface replacement, bridge deck repairs, and bridge inspections. These maintenance and repairs are assumed to be completed every 20 years.

Expenditure	Year	Cost	Future Value	Present Value
Initial Construction	0	$956,200.00	-	$956,200.00
Maintenance	20	$16,000.00	$18,876.00	$9,672.00
Maintenance	40	$50,000.00	$69,592.00	$18,270.00
Maintenance	60	$110,000.00	$180,625.00	$24,297.00
Total				**$1,008,439.00**

9.0 RECOMMENDED ALTERNATIVE

The recommended alternative is Alternative 2: Replace the Existing Culverts with Two New Culverts.

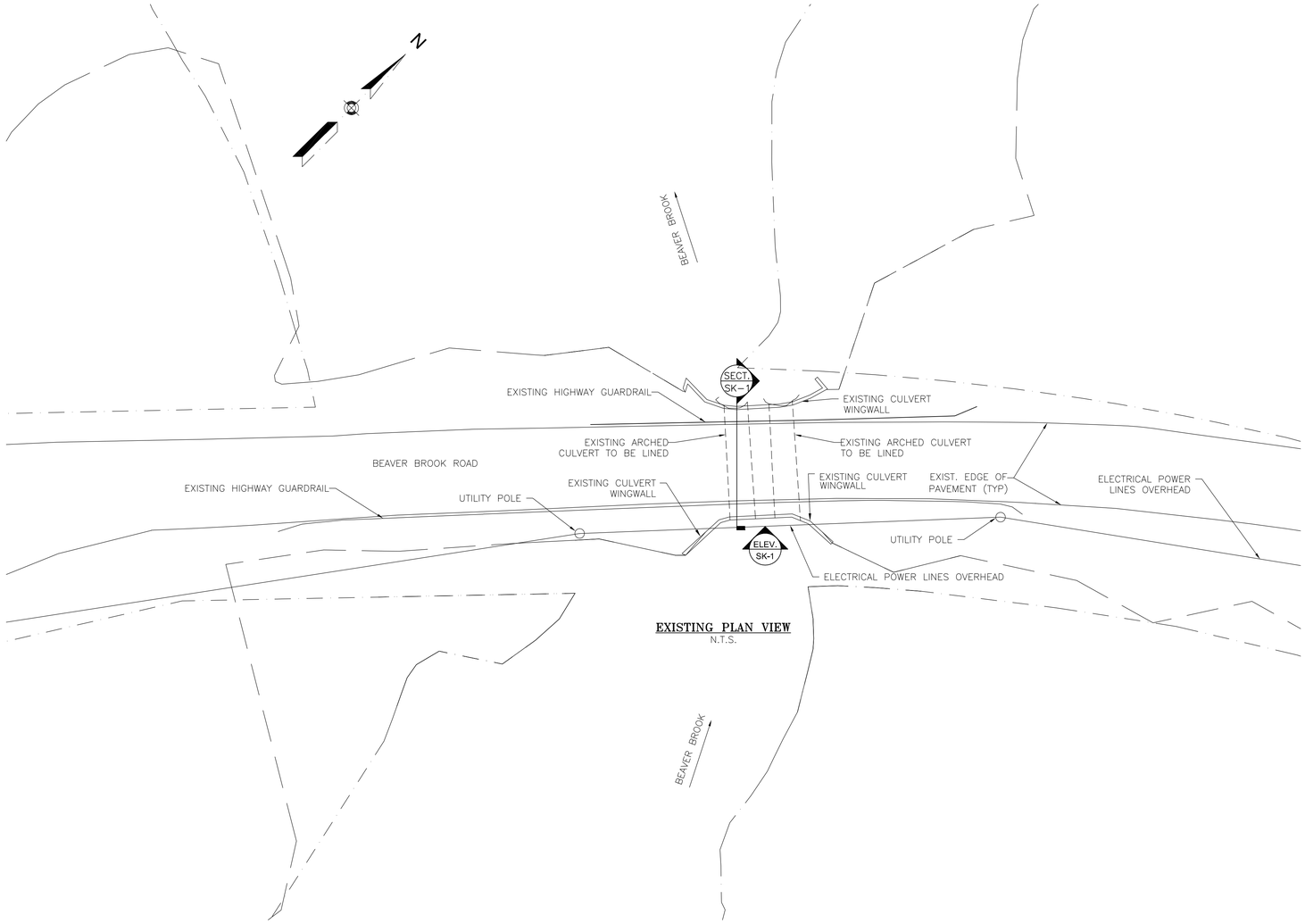
Alternative 2 is the recommended since this alternative can meet more of the Town's goals than Alternative 1 and can more economically meet the Town's goals compared to Alternative 3.

Alternative 2 allows the following Town goals to be met:

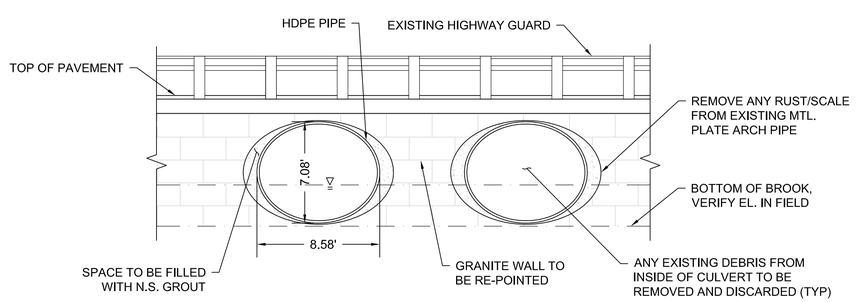
- Provides a long service life with low maintenance.
- Allows for widening of the existing roadway to accommodate bike lanes, sidewalks, and improve access and temporary parking to the DRC boat ramp.
- Allows for provisions to be made for installation of a future water line.
- Allows for inlet controls to be incorporated.
- The conceptual estimated cost of the project is less than the $725,000 amount included in the most recent Transportation Bond Bill for this project providing the potential for Town to receive full funding for the project without additional Town capital expenditure.
- The conceptual estimate cost can reasonably be funded by a combination of Chapter 90 funds and Town Capital Expenditures.

Alternative 1, however, would allow for the Town to economically rehabilitate and extend the service life of the existing culvert if the Town determines that a low cost solution is the most important goal at this time. This alternative will also cause less disruption to the public and require much less time to complete.

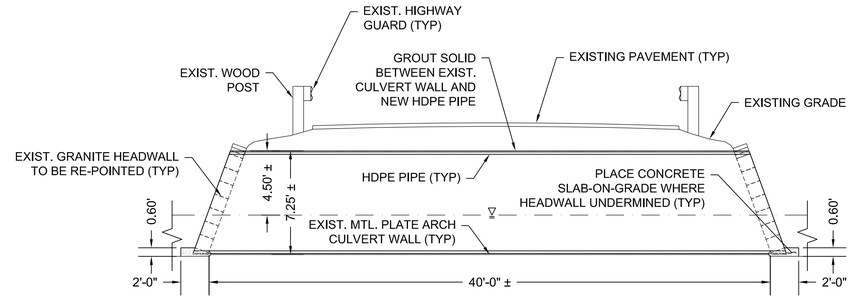
APPENDIX A – DRAWINGS



EXISTING PLAN VIEW
N.T.S.



ELEVATION



SECTION THROUGH CULVERT

BEAVER BROOK CULVERT REPAIR ALTERNATIVE #1 – HDPE PIPE

N.T.S.

Weston&Sampson®
100 Foxborough Blvd., S.250, Foxborough, MA
(508) 698-3034 (800) SAMPSON
www.westonandsampson.com

No.	Date	Description	Dr.By	Ck.By	App.By
		APPROVED			

REGISTERED PROFESSIONAL ENGINEER

DATE

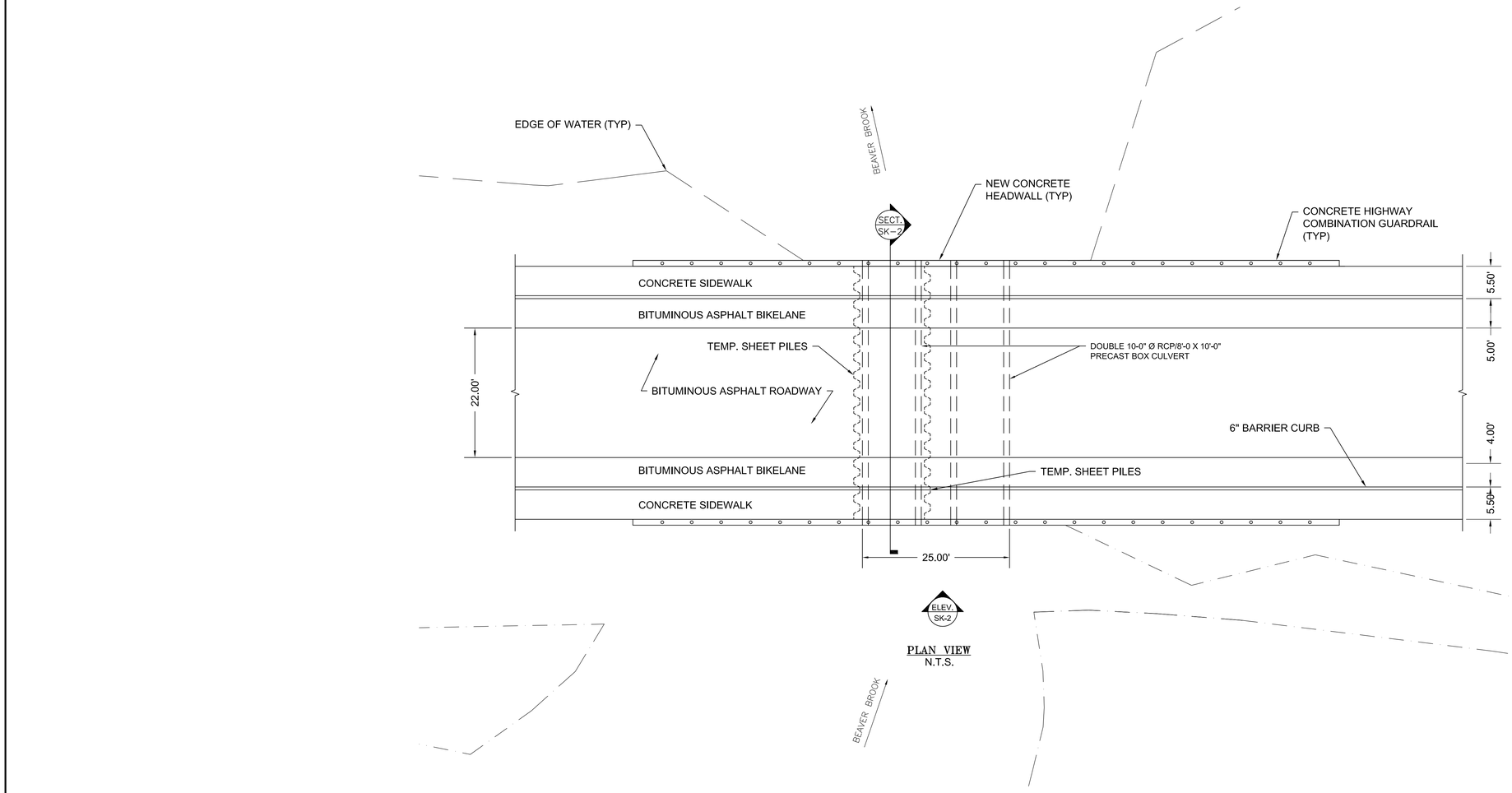
WESTFORD, MA
DEPARTMENT OF PUBLIC WORKS
BEAVER BROOK ROAD CULVERT OVER BEAVER BROOK

EXIST. SITE PLAN AND REPAIR ALTERNATIVE 1 - HDPE PIPE

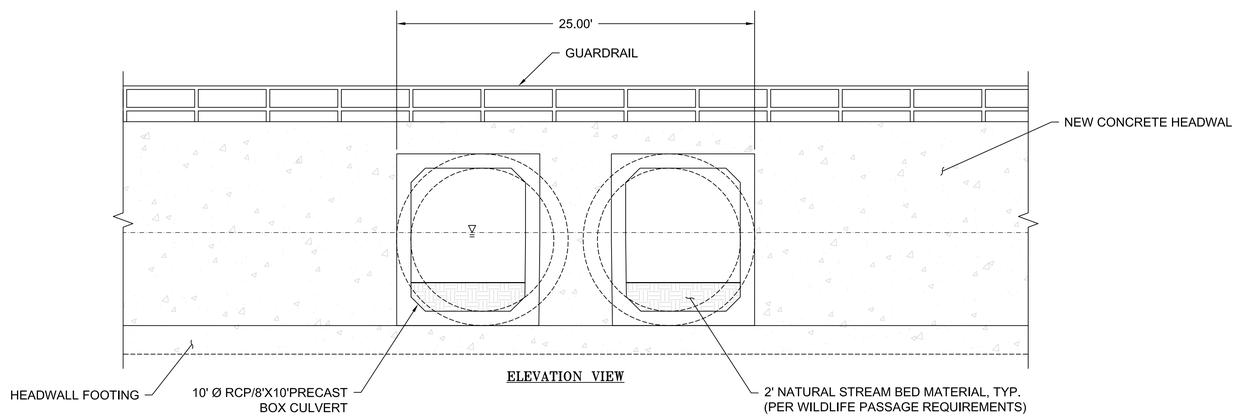
CADD NO.	SCALE:	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
-	N.T.S.	-	2150097	KMC	SRB	SRB	RAC

SK-1

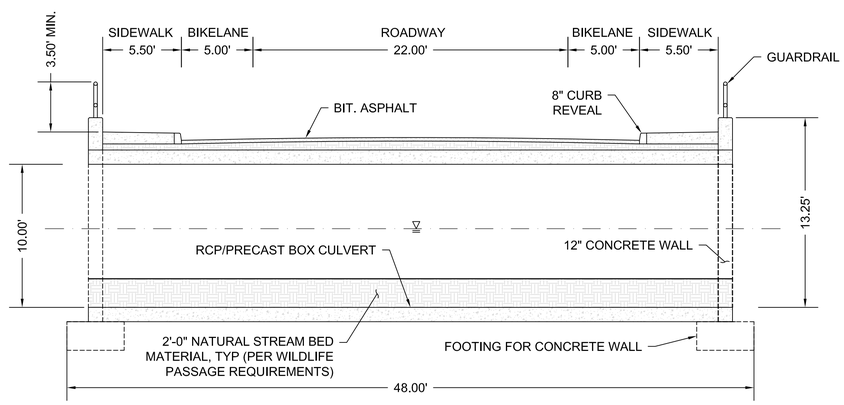
FILE NO. -



PLAN VIEW
N.T.S.



ELEVATION VIEW



SECTION THROUGH CULVERT

BEAVER BROOK CULVERT REPAIR ALTERNATIVE #2 – RCP/PRECAST BOX CULVERT

N.T.S.

Weston&Sampson®
100 Foxborough Blvd., S.250, Foxborough, MA
(508) 698-3034 (800) SAMPSON
www.westonandsampson.com

No.	Date	Dr.By	Ck.By	App.By	Description
					APPROVED

DATE

REGISTERED PROFESSIONAL ENGINEER

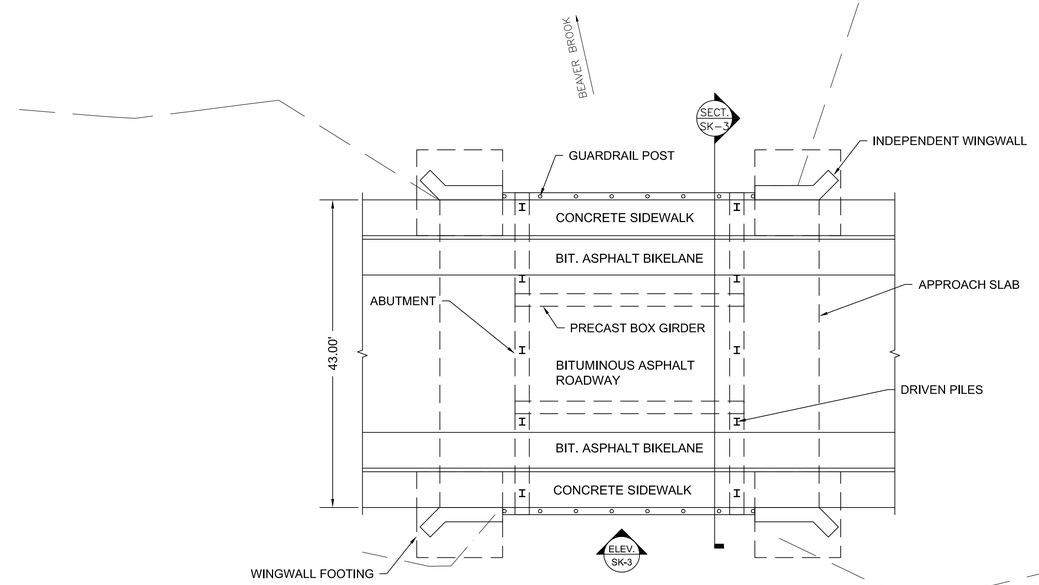
WESTFORD, MA
DEPARTMENT OF PUBLIC WORKS
BEAVER BROOK ROAD CULVERT OVER BEAVER BROOK

REPAIR ALTERNATIVE 2 - RCP/PRECAST BOX CULVERT

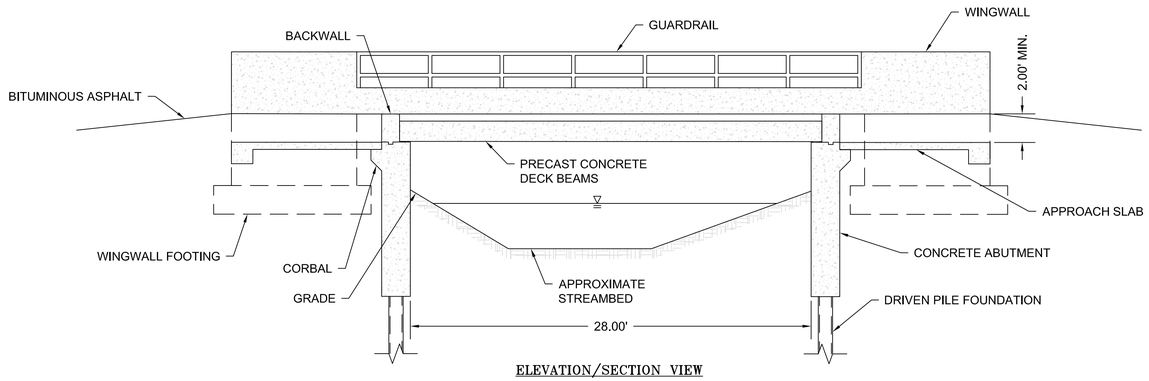
CADD NO.	SCALE:	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
-	N.T.S.	-	2150097	KMC	SRB	SRB	RAC

SK-2

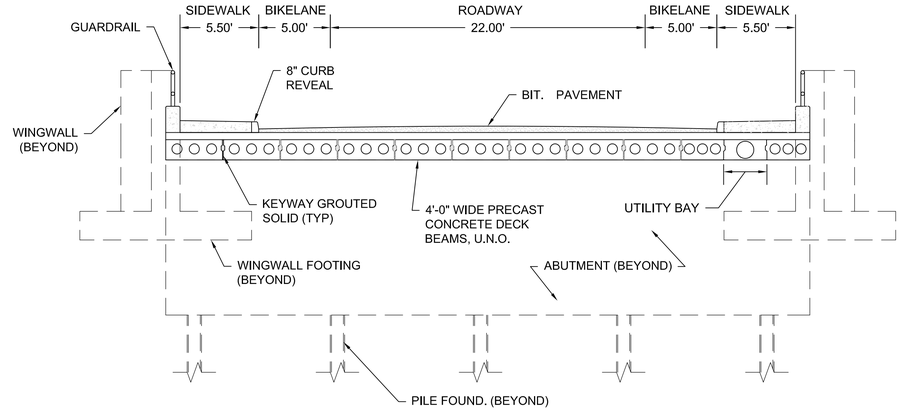
FILE NO. -



PLAN VIEW



ELEVATION/SECTION VIEW



SECTION VIEW

BEAVER BROOK CULVERT REPAIR ALTERNATIVE #3 – PRECAST BOX BEAM BRIDGE

N.T.S.

Weston&Sampson®
100 Foxborough Blvd., S.250, Foxborough, MA
(508) 698-3034 (800) SAMPSON
www.westonandsampson.com

No.	Date	Description	Dr.By	Ck.By	App.By
A	P	P R O V E D			

DATE

REGISTERED PROFESSIONAL ENGINEER

WESTFORD, MA
DEPARTMENT OF PUBLIC WORKS
BEAVER BROOK ROAD CULVERT OVER BEAVER BROOK

REPAIR ALTERNATIVE 3 - CONCRETE DECK BEAM BRIDGE

CADD NO.	SCALE:	CONTRACT:	JOB NO.	DR.BY	DSN.BY	CHK.BY	APP.BY
-	N.T.S.	-	2150097	KMC	SRB	SRB	RAC

SK-3

FILE NO. -

SHEET 3 OF 3

APPENDIX B – PRELIMINARY COST ESTIMATE

Beaver Brook Road Culvert - Alternative 1
Westford, MA
Feasibility COST ESTIMATE
March, 2015

TOWN	Westford			CLASS	
STATION		ROAD	Beaver Brook Rd	OVER	Beaver Brook
TYPE	x	ROADWAY	x	SIDEWALKS	x
SPANS	x	LENGTH	x	VERTICAL CL.	x

ITEM	QUANTITY	UNITS	DESCRIPTION	UNIT PRICE	AMOUNT
472	1	TON	HOT MIX ASPHALT FOR MISCELLANEOUS WORK	$175.00	$175.00
748	1	LS	MOBILIZATION (±3%)	$5,000.00	$5,000.00
852	170	SF	SAFETY SIGNING FOR TRAFFIC MANAGEMENT	$17.00	$2,890.00
859	300	DD	REFLECTORIZED DRUM	$0.25	$75.00
901	4	CY	4000 PSI, 1-1/2 IN., 565 CEMENT CONCRETE	$800.00	$3,200.00
908	25	BAG	CEMENT FOR POINTING	$250.00	$6,250.00
991.1	1	LS	CONTROL OF WATER	$5,000.00	$5,000.00
995.011	1	LS	CULVERT STRUCTURE, LINING	$122,788.00	$122,788.00
999.81	240	HOUR	POLICE DETAIL - UP TO 8 HOURS	$42.00	$10,080.00

	$155,283.00
Contingency 25% =	$38,820.75
Total Construction Cost =	**$194,103.75**
Engineering Cost =	$30,000.00
Contingency 20% =	$6,000.00
Total Engineering Cost =	**$36,000.00**
Total Project Cost =	**$230,103.75**

ESTIMATED BY: CJW/NP CHECKED BY: SRB/MK APPROVED BY: RAC/LFK

Beaver Brook Road Culvert - Alternative 2
Westford, MA
Feasibility COST ESTIMATE
March, 2015

TOWN	Westford			CLASS	
STATION		ROAD	Beaver Brook Rd	OVER	Beaver Brook
TYPE	x	ROADWAY	x	SIDEWALKS	x
SPANS	x	LENGTH	x	VERTICAL CL.	x

ITEM	QUANTITY	UNITS	DESCRIPTION	UNIT PRICE	AMOUNT
103	2	EA	TREE REMOVED <24 INCHES	$1,000.00	$2,000.00
120.1	240	CY	UNCLASSIFIED EXCAVATION	$45.00	$10,800.00
129	360	SY	PAVEMENT MILLING	$20.00	$7,200.00
141.1	10	CY	TEST PIT FOR EXPLORATION	$80.00	$800.00
143	10	CY	CHANNEL EXCAVATION	$50.00	$500.00
151.	630	CY	GRAVEL BORROW	$40.00	$25,200.00
151.2	330	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	$42.00	$13,860.00
170	360	SY	FINE GRADING AND COMPACTING	$4.00	$1,440.00
402	100	CY	DENSE GRADED CRUSHED STONE FOR SUB-BASE	$75.00	$7,500.00
460	3	TON	HOT MIX ASPHALT	$1,500.00	$4,500.00
464	287	GAL	BITUMEN FOR TACK COAT	$10.00	$2,870.00
472	1	TON	HMA MISCELLANEOUS WORK	$175.00	$175.00
482.3	90	LF	SAWING ASPHALT PAVEMENT	$2.00	$180.00
504	120	LF	GRANITE CURB TYPE VA4 - STRAIGHT	$38.00	$4,560.00
697.3	175	LF	COMPOST FILTER TUBES	$3.00	$525.00
701	67	SY	CEMENT CONCRETE SIDEWALK	$70.00	$4,666.90
734	5	EA	SIGN REMOVED & RESET	$400.00	$2,000.00
748	1	LS	MOBILIZATION	$8,000.00	$8,000.00
751	40	CY	LOAM BORROW	$60.00	$2,400.00
765	360	SY	SEEDING	$2.50	$900.00
852	170	SF	SAFETY SIGNING FOR TRAFFIC MANAGEMENT	$17.00	$2,890.00
859	1200	DD	REFLECTORIZED DRUM	$0.25	$300.00
874.2	1	EA	TRAFFIC SIGN REMOVED & RESET	$100.00	$100.00
965	100	SY	MEMBRANE WATERPROOFING FOR BRIDGE DECKS	$35.00	$3,500.00
970	200	SY	BITUMINOUS DAMP-PROOFING	$20.00	$4,000.00
983.1	110	TON	RIPRAP	$60.00	$6,600.00
991.1	1	LS	CONTROL OF WATER	$10,000.00	$10,000.00
995.011	1	LS	CULVERT STRUCTURE, CULVERT NO.	$126,000.00	$126,000.00
999.81	480	HOUR	POLICE DETAIL - UP TO 8 HOURS	$42.00	$20,160.00

Beaver Brook Road Culvert - Alternative 2
Westford, MA
Feasibility COST ESTIMATE
March, 2015

TOWN	Westford			CLASS	
STATION		ROAD	Beaver Brook Rd	OVER	Beaver Brook
TYPE	x	ROADWAY	x	SIDEWALKS	x
SPANS	x	LENGTH	x	VERTICAL CL.	x

ITEM	QUANTITY	UNITS	DESCRIPTION	UNIT PRICE	AMOUNT
					$273,626.90
				Contingency 25% =	$68,406.73
				Total Construction Cost =	**$342,033.63**
				Engineering Cost =	$85,000.00
				Contingency 20% =	$17,000.00
				Total Engineering Cost =	**$102,000.00**
				Total Project Cost =	**$444,033.63**

ESTIMATED BY: CJW/NP CHECKED BY: SRB/MK APPROVED BY: RAC/LFK

Beaver Brook Road Culvert - Alernative 3
Westford, MA
Feasibility COST ESTIMATE
March, 2015

TOWN	Westford			CLASS	
STATION		ROAD	Beaver Brook Rd	OVER	Beaver Brook
TYPE	x	ROADWAY	x	SIDEWALKS	x
SPANS	x	LENGTH	x	VERTICAL CL.	x

ITEM	QUANTITY	UNITS	DESCRIPTION	UNIT PRICE	AMOUNT
103	5	EA	TREE REMOVED <24 INCHES	$1,000.00	$5,000.00
120.1	430	CY	UNCLASSIFIED EXCAVATION	$45.00	$19,350.00
129	360	SY	PAVEMENT MILLING	$20.00	$7,200.00
141.1	10	CY	TEST PIT FOR EXPLORATION	$80.00	$800.00
143	6	CY	CHANNEL EXCAVATION	$50.00	$296.30
151.	410	CY	GRAVEL BORROW	$40.00	$16,400.00
151.2	30	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	$42.00	$1,260.00
170	0	SY	FINE GRADING AND COMPACTING	$4.00	$0.00
402	0	CY	DENSE GRADED CRUSHED STONE FOR SUB-BASE	$75.00	$0.00
460	3	TON	HOT MIX ASPHALT	$1,500.00	$4,500.00
464	287	GAL	BITUMEN FOR TACK COAT	$10.00	$2,870.00
472	1	TON	HMA MISCELLANEOUS WORK	$175.00	$175.00
482.3	90	LF	SAWING ASPHALT PAVEMENT	$2.00	$180.00
504	120	LF	GRANITE CURB TYPE VA4 - STRAIGHT	$38.00	$4,560.00
620.1	120	LF	STEEL W BEAM HIGHWAY GUARD (SINGLE FACED)	$23.00	$2,760.00
627.1	4	EA	STEEL W BEAM TERMINAL SECTION (SINGLE FACED	$58.00	$232.00
697.3	175	LF	COMPOST FILTER TUBES	$3.00	$525.00
701	67	SY	CEMENT CONCRETE SIDEWALK	$70.00	$4,666.90
734	5	EA	SIGN REMOVED & RESET	$400.00	$2,000.00
748	1	LS	MOBILIZATION	$16,000.00	$16,000.00
751	30	CY	LOAM BORROW	$60.00	$1,800.00
765	240	SY	SEEDING	$2.50	$600.00
852	190	SF	SAFETY SIGNING FOR TRAFFIC MANAGEMENT	$17.00	$3,230.00
859	1200	DD	REFLECTORIZED DRUM	$0.25	$300.00
874.2	1	EA	TRAFFIC SIGN REMOVED & RESET	$100.00	$100.00
901	67	CY	4000 PSI, 1-1/2 IN., 565 CEMENT CONCRETE	$800.00	$53,600.00
910.2	3800	LB	STEEL REINFORCEMENT FOR STRUCTURES - EPOXY COATED	$4.00	$15,200.00
930.1	1	LS	PRESTRESSED CONCRETE DECK BEAMS	$240,000.00	$240,000.00

Beaver Brook Road Culvert - Alernative 3
Westford, MA
Feasibility COST ESTIMATE
March, 2015

TOWN	Westford			CLASS	
STATION		ROAD	Beaver Brook Rd	OVER	Beaver Brook
TYPE	x	ROADWAY	x	SIDEWALKS	x
SPANS	x	LENGTH	x	VERTICAL CL.	x

ITEM	QUANTITY	UNITS	DESCRIPTION	UNIT PRICE	AMOUNT
942.124	600	FT	STEEL PILE HP 12x84	$175.00	$105,000.00
965	130	SY	MEMBRANE WATERPROOFING FOR BRIDGE DECKS	$35.00	$4,550.00
970	30	SY	BITUMINOUS DAMP-PROOFING	$20.00	$600.00
983.1	110	TON	RIPRAP	$60.00	$6,600.00
991.1	1	LS	CONTROL OF WATER	$20,000.00	$20,000.00
999.81	1920	HOUR	POLICE DETAIL - UP TO 8 HOURS	$42.00	$80,640.00
					$620,995.20
				Contingency 25% =	$155,248.80
				Total Construction Cost =	**$776,244.00**
				Engineering Cost =	$150,000.00
				Contingency 20% =	$30,000.00
				Total Engineering Cost =	**$180,000.00**
				Total Project Cost =	**$956,244.00**

ESTIMATED BY: CJW/NP CHECKED BY: SRB/MK APPROVED BY: RAC/LFK

APPENDIX C – ENVIRONMENTAL RESOURCE MAP (FIGURE 1)

FIGURE 1
Westford, MA
Beaver Brook Culvert Replacement

ENVIRONMENTAL RESOURCES MAP

250 0 250

Scale In Feet

Weston&Sampson

BRIDGE INSPECTION REPORTS

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, Secretary & CEO
Thomas J. Tinlin, Administrator

MassDOT
Massachusetts Department of Transportation
Highway Division

December 24, 2015

Town of Westford
Board of Selectmen
55 Main St.
Westford, Ma. 01886

Attn: Richard Barrett, Highway Supt.

SUBJECT: NATIONAL BRIDGE INSPECTION STANDARDS (NBIS)
UNDERWATER BRIDGE INSPECTION

BEAVER BK RD / BEAVER BROOK
Bridge No. W-26-014
Structure No. W26014-26G-MUN-NBI

Dear Mr. Barrett:

Enclosed for your information is a copy of an Underwater Inspection Report of 8/7/15 for the bridge that carries the BEAVER BK RD over the BEAVER BROOK.

A copy of the report is on file at our District 3 office located in Worcester. Please feel free to contact the District with any questions you may have concerning the bridge.

Sincerely,

Alexander K. Bardow, P.E.
State Bridge Engineer

REB/reb
cc: BBC
DHD, D-3
Enclosure

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

3 | B.I.N. 26G

UNDERWATER OPERATIONS TEAM
UNDERWATER SPECIAL MEMBER INSPECTION

BR. DEPT. NO. W-26-014

CITY/TOWN	8-STRUCTURE NO.	93b-U/W ROUTINE INSP DATE	U/W-SPECIAL MEMBER INSP DATE
WESTFORD	W26014-26G-MUN-NBI	Aug 7, 2014	AUG 7, 2015

7-FACILITY CARRIED	ACCESS TO BRIDGE	UNDERWATER OPERATIONS ENGINEER
HWY BEAVER BK RD	NW EMBANKMENT	RANDI E. BONICA Randi E. Bonica

6-FEATURES INTERSECTED	CURRENT	TEAM LEADER (DIVE MASTER)
WATER BEAVER BROOK	SLIGHT	STEVEN R. FINCK

BOTTOM CONDITION	DEPTH	VISIBILITY	*Report submitted by:*
GRAVEL, BOULDERS AND SAND	1 m	1 m	Steven R Finck

NEXT U/W ROUTINE INSPECTION DATE	92b-U/W ROUTINE FREQ	TEAM MEMBERS
AUG 7, 2017	Y36	G. BROZ, B. FITZGERALD

MEMBER / CONDITION Requiring Special Member Inspection

ITEM	MEMBER	REMARKS	CONDITION PREVIOUS (0-9)	CONDITION PRESENT (0-9)	Deficiencies
61.3.	Debris	See remarks in comments section.	5	5	M-P
62.6.	Pipe	See remarks in comments section.	3	3	S-A
62.17.	Nuts and Bolts	See remarks in comments section.	4	4	S-A

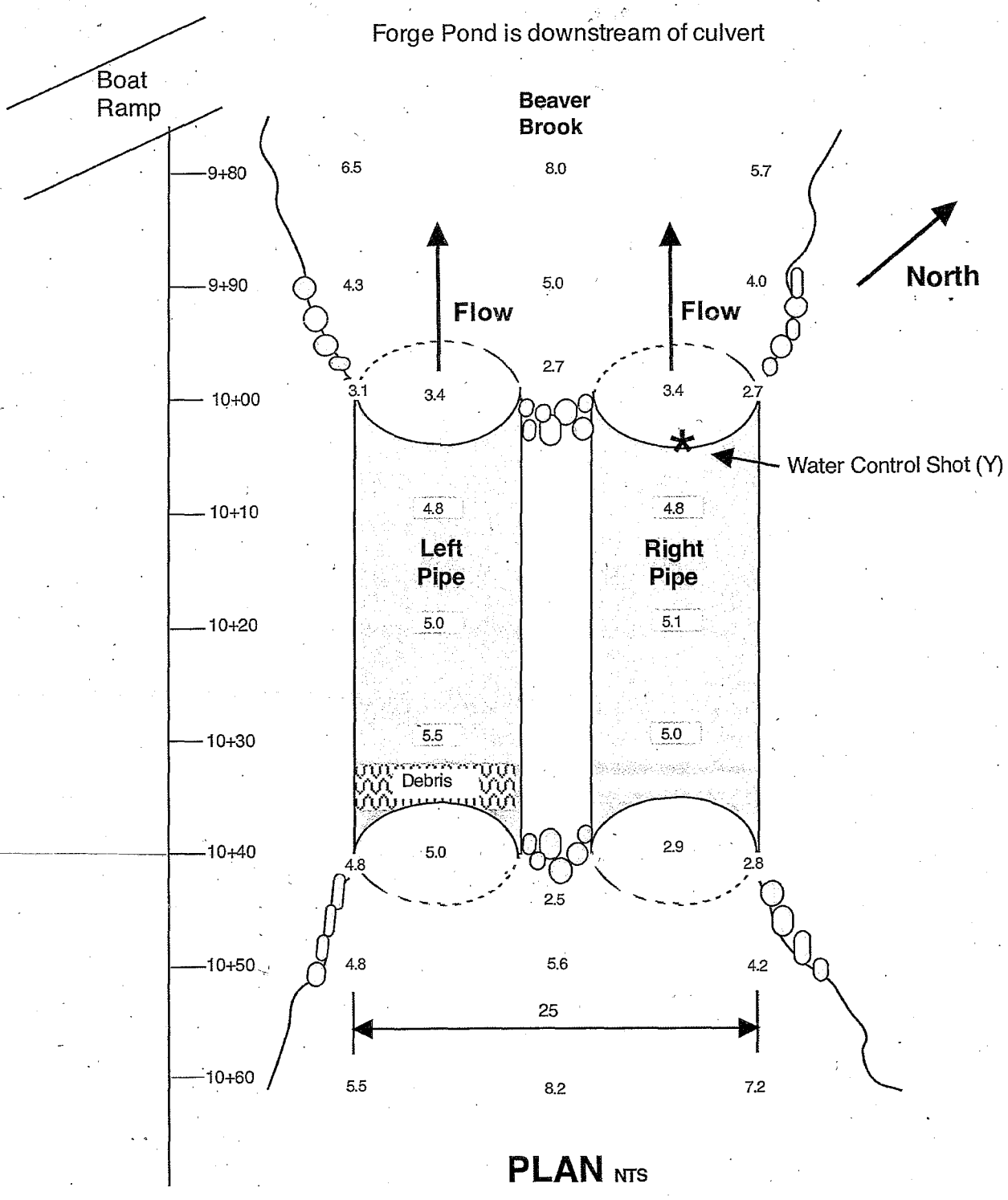
	I-59	I-60	I-61	I-62
(Overall Previous Condition)	-	-	6	3
(Overall Current Condition)	-	-	6	3

CONDITION RATING GUIDE

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condtion.

TOWN / TFORD	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
	26G	W-26-014	W26014-26G-MUN-NBI	AUG 7, 2015

SKETCHES



PLAN NTS

Note: All soundings & measurements are in feet and taken from the 1990 Underwater Inspection Report. Water Control Shot taken from top of Right pipe to water.

Sketch 1: Plan View (Not to Scale)

OWN / FORD	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
	26G	W-26-014	W26014-26G-MUN-NBI	AUG 7, 2015

REMARKS

GENERAL REMARKS

1) Orientation - When facing downstream looking at bridge, pipes are labeled "Left Pipe" and "Right Pipe".
2) Reference Station 10+00 is at the downstream end.
3) The two ACCM culverts are 42' long.
4) Dumped stone has been placed in front of the upstream end of the right pipe, as a scour countermeasure for the undermining mentioned in the report of 04/05/94.
5) The inverts appear to be paved with bituminous concrete.

ITEM 61 - CHANNEL AND CHANNEL PROTECTION

Item 61.3 - Debris

Left pipe. at the upstream end is partially plugged with timber debris.
Most of the timber debris was removed during this inspection, so pipe could be inspected.
See Sketch 1.

ITEM 62 - CULVERT

Item 62.6 - Pipe

Both pipes have numerous rust holes along the waterline. Some loss of fill was visible, particularly at the downstream end.
See Sketch 2 showing detailed locations section loss.

The remainder of each pipe along the waterline area (1' above to 1' below) has heavy rust delamination.

Right pipe at the upstream end has an area of undermining (2.6' L x 0.7' H x 4'+ P).
See Sketch 2.

Right pipe, at the downstream left side has severe section loss, and is beginning to crush with up to 1/2" vertical displacement.
Penetration into these rust holes at this location is up to 3.0'.

Item 62.17 - Nuts and Bolts

Several of the nuts and bolts have moderate to severe section loss.

Sketch / Chart Log

Sketch 1 : Plan View (Not to Scale)
Sketch 2 : Deterioration locations of pipes (Not to Scale)
Chart 1 : Scour Monitoring Chart

TOWN	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
STFORD	26G	W-26-014	W26014-26G-MUN-NBI	AUG 7, 2015

CHARTS

SCOUR MONITORING CHART @ DOWNSTREAM END OF PIPES

OFFSETS	9/7/06	9/23/11	8/16/12	8/13/13	8/7/14	8/7/15
LEFT SIDE , LEFT BARREL	2.7	2.9	3.2	2.9	2.9	2.9
CL OF LEFT BARREL	2.8	3.3	3.2	3.1	3.2	3.3
CL OF PIER	2.0	2.5	2.5	2.7	2.5	2.5
CL OF RIGHT BARREL	3.1	3.4	3.3	3.7	3.3	3.4
RIGHT SIDE, RIGHT BARREL	2.6	3.4	3.4	3.6	3.4	3.4
Y	3.4	3.2	3.4	3.3	3.0	3.3
CORRECTION	-	-0.2	-	-0.1	-0.4	-0.1

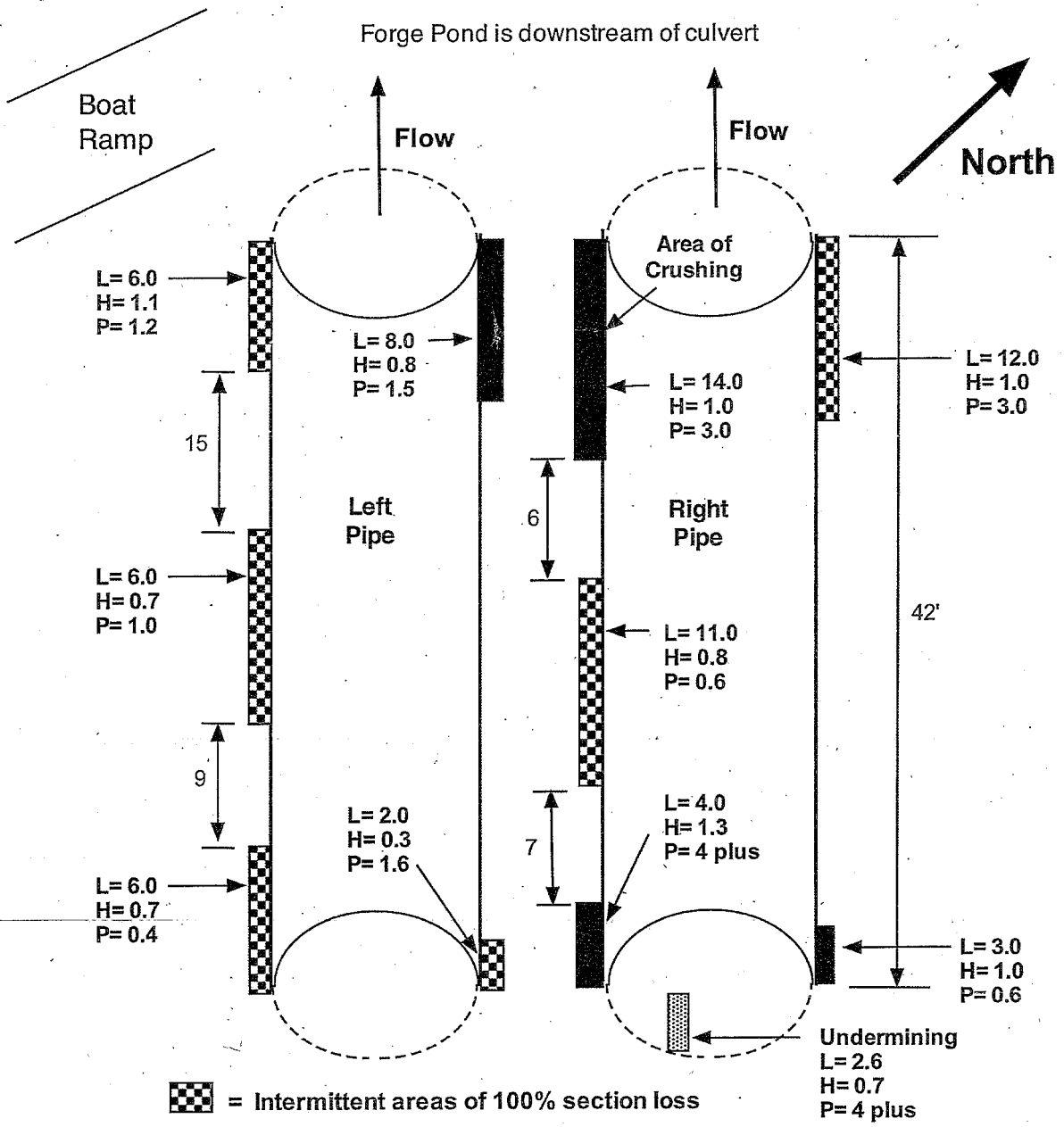
NOTES

1) Due to the amount of debris across the upstream channel, the sounding location was changed to the downstream end of the pipes in 2006.
2). Water control shot (Y) = waterline to top of pipe, right barrel, downstream end.
3) Station 10+00 is located at the downstream end.
4) All soundings are in Feet.
5) For comparison all soundings are adjusted to 2006 water level.

Chart 1: Scour Monitoring Chart

TOWN	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
STFORD	26G	W-26-014	W26014-26G-MUN-NBI	AUG 7, 2015

SKETCHES



Note: All measurements are in Feet.
L = Length
H = High
P = Penetration

W-26-014 (26G)
Pipe Deterioration Sketch
NTS

Sketch 2: Deterioration locations of pipes (Not to Scale)

Deval L. Patrick, Governor
Richard A. Davey, Secretary & CEO
Frank DePaola, Administrator

MassDOT
Massachusetts Department of Transportation
Highway Division

August 7, 2014

RECEIVED

AUG 05 2014

OFFICE OF TOWN MANAGER

Town of Westford
Board of Selectmen
55 Main St.
Westford, Ma. 01886

Attn: Richard Barrett, Highway Supt.

SUBJECT: NATIONAL BRIDGE INSPECTION STANDARDS (NBIS)
UNDERWATER BRIDGE INSPECTION

BEAVER BK RD / BEAVER BROOK
Bridge No. W-26-014
Structure No. W26014-26G-MUN-NBI

Dear Mr. Barrett:

Enclosed for your information is a copy of an Underwater Inspection Report of 2/21/14 for the bridge that carries the BEAVER BK RD over the BEAVER BROOK.

A copy of the report is on file at our District 3 office located in Worcester. Please feel free to contact the District with any questions you may have concerning the bridge.

Sincerely,

Alexander K. Bardow, P.E.
State Bridge Engineer

REB/reb
cc: BBC
DHD, D-3
Enclosure

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TTY: 857-368-0655
www.mass.gov/massdot

2-DIST	B.I.N.
03	26G

UNDERWATER OPERATIONS TEAM
UNDERWATER SPECIAL MEMBER INSPECTION

BR. DEPT. NO.
W-26-014

CITY/TOWN	8-STRUCTURE NO.	93b-U/W ROUTINE INSP DATE	U/W-SPECIAL MEMBER INSP DATE
WESTFORD	W26014-26G-MUN-NBI	Sep 23, 2011	FEB 21, 2014

7-FACILITY CARRIED	ACCESS TO BRIDGE	UNDERWATER OPERATIONS ENGINEER
HWY BEAVER BK RD	NW EMBANKMENT	RANDI E. BONICA Randi E. Bonica

6-FEATURES INTERSECTED	CURRENT	TEAM LEADER (DIVE MASTER)
WATER BEAVER BROOK	SLIGHT	SHARON A. BEGLEY

BOTTOM CONDITION	DEPTH	VISIBILITY	*Report submitted by:*
GRAVEL, BOULDERS AND SAND	1.3 m	0.3 m	S. Begley

NEXT U/W ROUTINE INSPECTION DATE	92b-U/W ROUTINE FREQ	TEAM MEMBERS
SEP 23, 2014	Y36	B. COURVILLE

MEMBER / CONDITION Requiring Special Member Inspection

ITEM	MEMBER	REMARKS	CONDITION PREVIOUS (0-9)	CONDITION PRESENT (0-9)	Deficiencies
61.3.	Debris	See remarks in comments section.	2	3	M-A
62.6.	Pipe	See remarks in comments section.	4	4	S-A
62.17.	Nuts and Bolts	See remarks in comments section.	N	4	M-A

	I-59	I-60	I-61	I-62
(Overall Previous Condition)	-	-	4	4
(Overall Current Condition)	-	-	4	4

CONDITION RATING GUIDE

	CODE	CONDITION	DEFECTS
	N	NOT APPLICABLE	
G	9	EXCELLENT	Excellent condtion.
G	8	VERY GOOD	No problem noted.
G	7	GOOD	Some minor problems.
F	6	SATISFACTORY	Structural elements show some minor deterioration.
F	5	FAIR	All primary structural elements are sound but may have mior section loss,cracking,spalling or scour.
P	4	POOR	Advance section loss, deterioration, spalling or scour.
P	3	SERIOUS	Loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
C	2	CRITICAL	Advance deterioriation of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close bridge until corrective action is taken.
C	1	"IMMINENT" FAILURE	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put it back in light serivce.
	0	FAILED	Out of service - beyond corrective action.

X=UNKNOWN N=NOT APPLICABLE H=HIDDEN/INACCESSIBLE R=REMOVED

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
WESTFORD	26G	W-26-014	W26014-26G-MUN-NBI	FEB 21, 2014

REMARKS

GENERAL REMARKS

1) Orientation - When facing downstream looking at bridge, pipes are labeled left and right.
2) Sta 10+00 is at the downstream end.
3) Two A.C.C.M. pipe culverts, 40 feet long.
4) Dumped stone has been placed in front of the upstream end of the right pipe, as a scour countermeasure for the undermining mentioned in the report of 04/05/94.
5) The invert appears to be paved with bituminous concrete.

ITEM 61 - CHANNEL AND CHANNEL PROTECTION

Item 61.3 - Debris

The upstream end of the left pipe could not be inspected due to the severe accumulation of debris. There is a moderate amount of debris in and across the upstream end of the right pipe.

ITEM 62 - CULVERT

Item 62.6 - Pipe

Both pipes were struck with a hammer.
There is intermittent 100% section loss along the waterline throughout both barrels, up to 0.4' in diameter x 0.8' deep, with loss of fill (to the downstream 7 feet of both pipes). The remainder of the pipes have heavy rust flaking at the waterline area, 1' above to 1' below. Maximum penetration is 3.0' +, located downstream left side of right barrel.

Item 62.17 - Nuts and Bolts

Several of the nuts and bolts have up to 75% section loss.

Sketch / Chart Log

Sketch 1 : PLAN VIEW
Chart 1 : SCOUR MONITORING CHART

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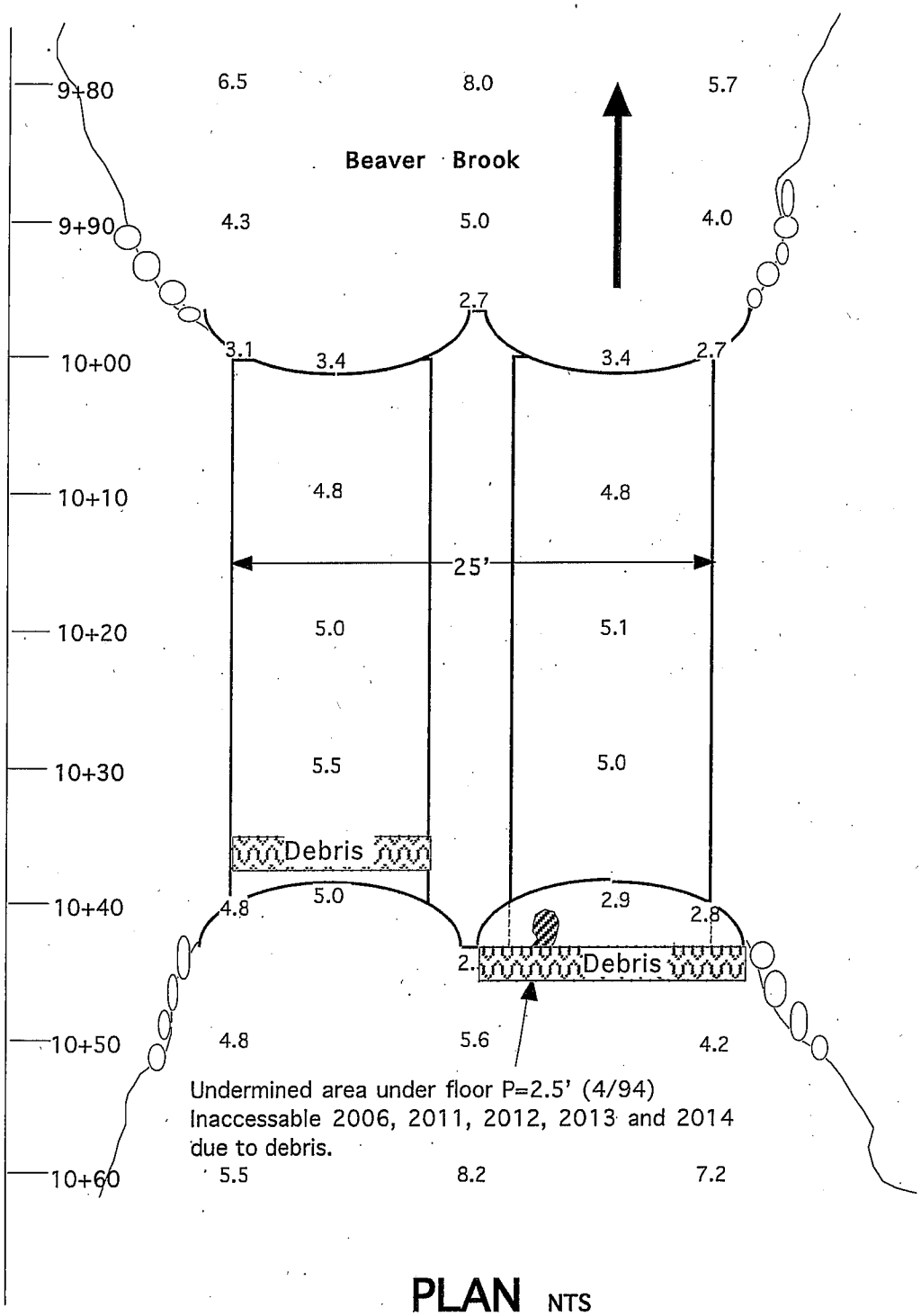
SKETCHES



PLAN NTS

Note : All soundings and measurements are in feet and taken from the 1990 underwater inspection report.

Sketch 1: PLAN VIEW

CITY/TOWN	B.I.N.	BR. DEPT. NO.	8.-STRUCTURE NO.	INSPECTION DATE
WESTFORD	26G	W-26-014	W26014-26G-MUN-NBI	FEB 21, 2014

CHARTS

SCOUR MONITORING CHART
@ DOWNSTREAM END

MEASUREMENTS ARE IN FEET

OFFSETS	09/07/2006	09/23/2011	08/16/2012	08/13/2013	
LEFT SIDE , LEFT BARREL	2.7	2.9	3.2	2.9	
CL OF LEFT BARREL	2.8	3.3	3.2	3.1	
CL OF PIER	2.0	2.5	2.5	2.7	
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RIGHT SIDE, RIGHT BARREL	2.6	3.4	3.4	3.6	
	-				
	-				
Y	3.4	3.2	3.4	3.3	
CORRECTION	-	-0.2	-	-0.1	

Notes:

1. Due to the amount of debris across the upstream channel, the sounding location was changed to the downstream end, in 09/07/2006.
2. Water control shot (Y) = waterline to top of pipe, right barrel,downstream end.
3. For comparison all soundings are now adjusted to 2006 water level.
4. Station 10+00 is located at downstream end.

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