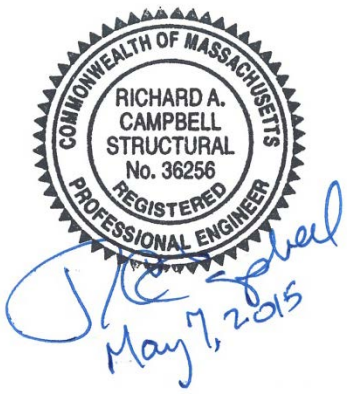
REPORT

Westford, MA

Beaver Brook Road Culvert/Bridge Replacement Feasibility Study

CONTRACT NO: 2150097

May 2015



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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.

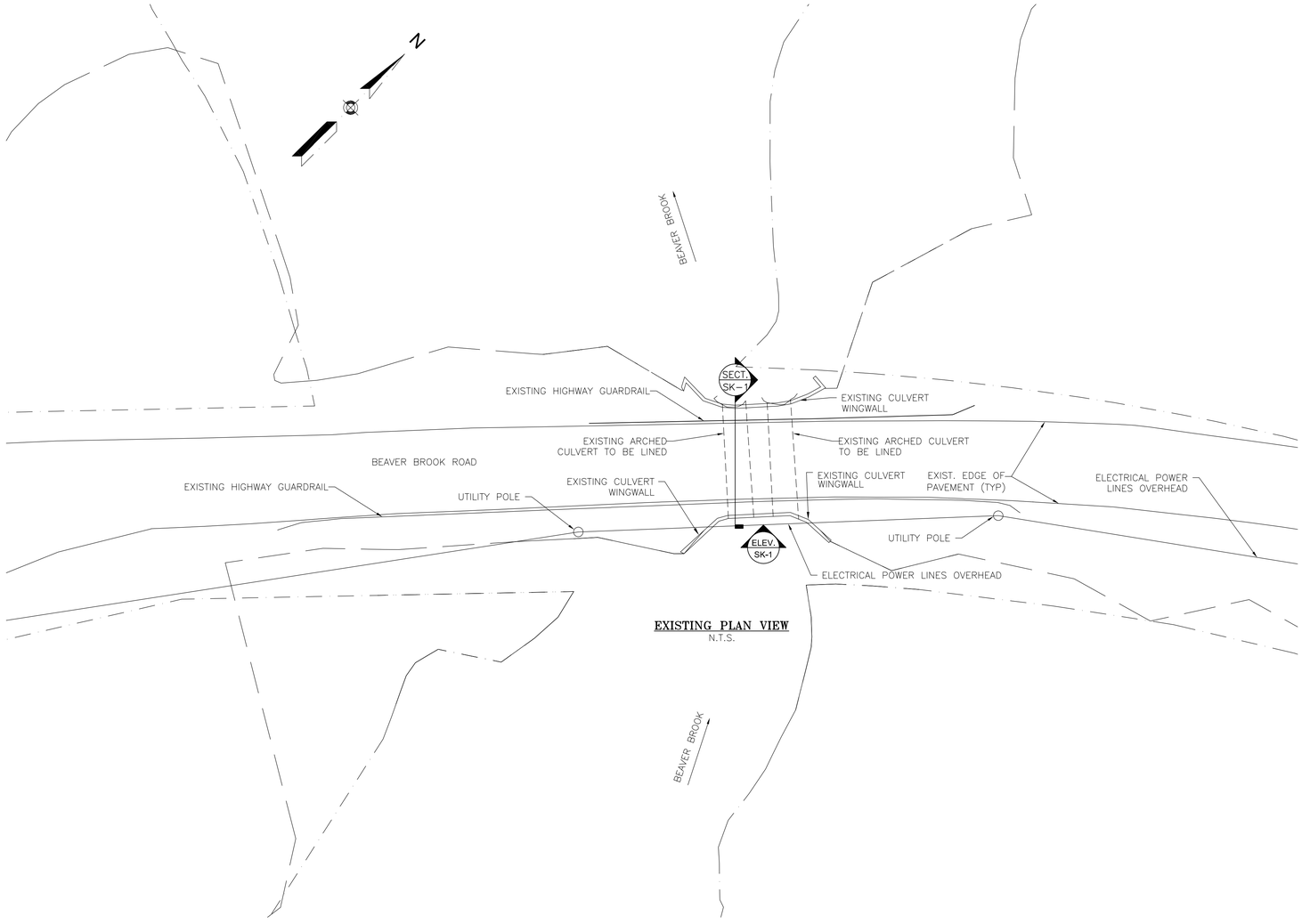
Alternative 2 is the recommended since this alternative can meet more of the Town's goals than Alternative 1 and can more economically meet the Town's goals compared to Alternative 3.

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
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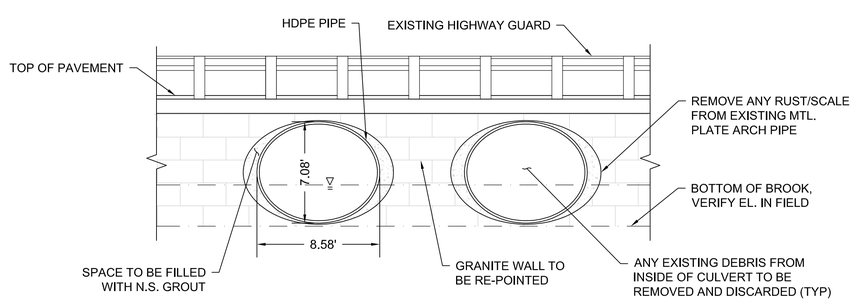
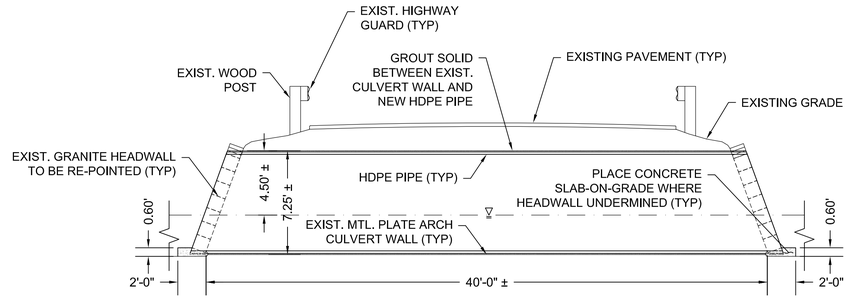


ELEVATION



SECTION THROUGH CULVERT

BEAVER BROOK CULVERT REPAIR ALTERNATIVE #1 – HDPE PIPE

N.T.S.

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

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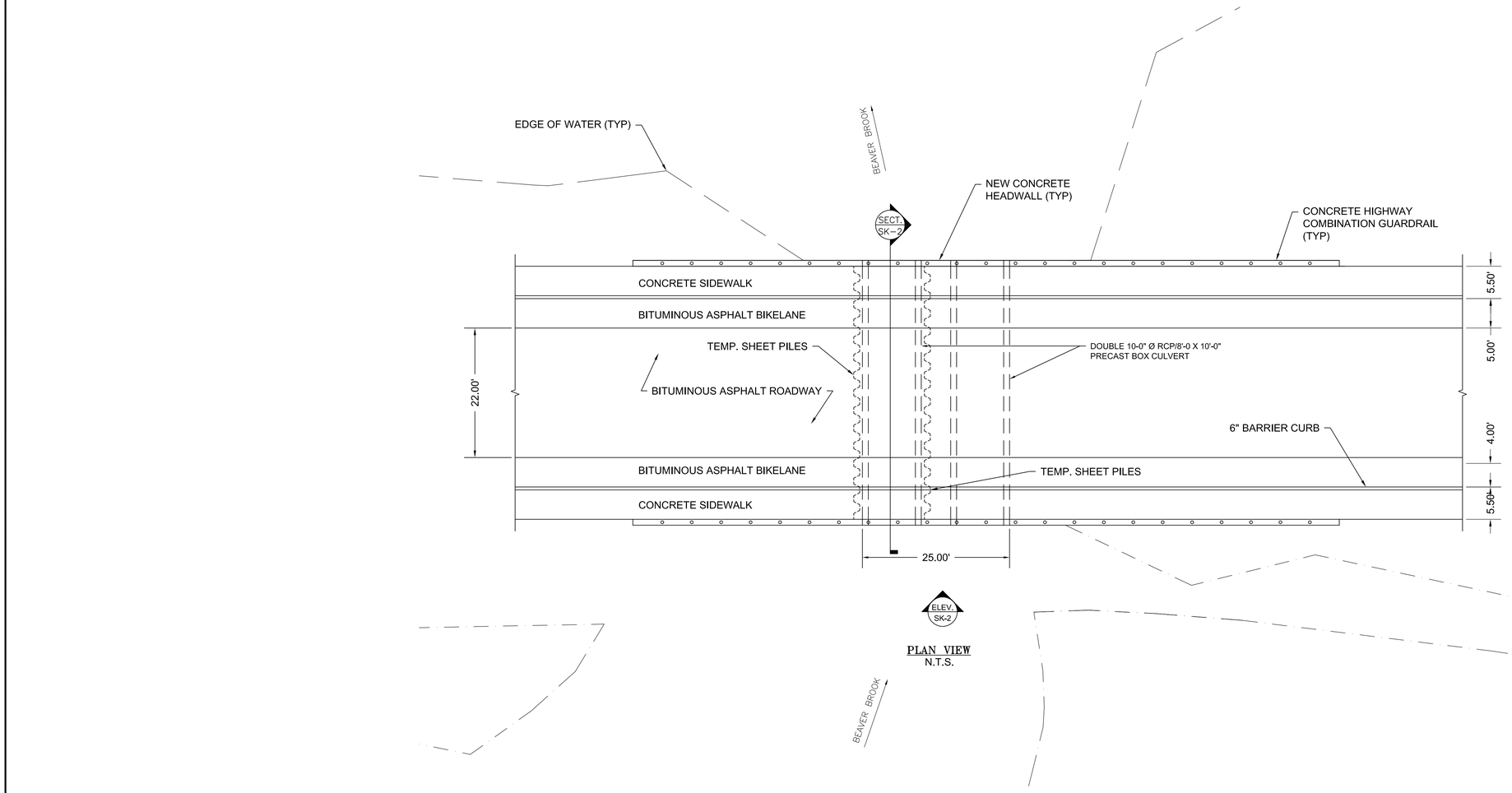

PLAN VIEW
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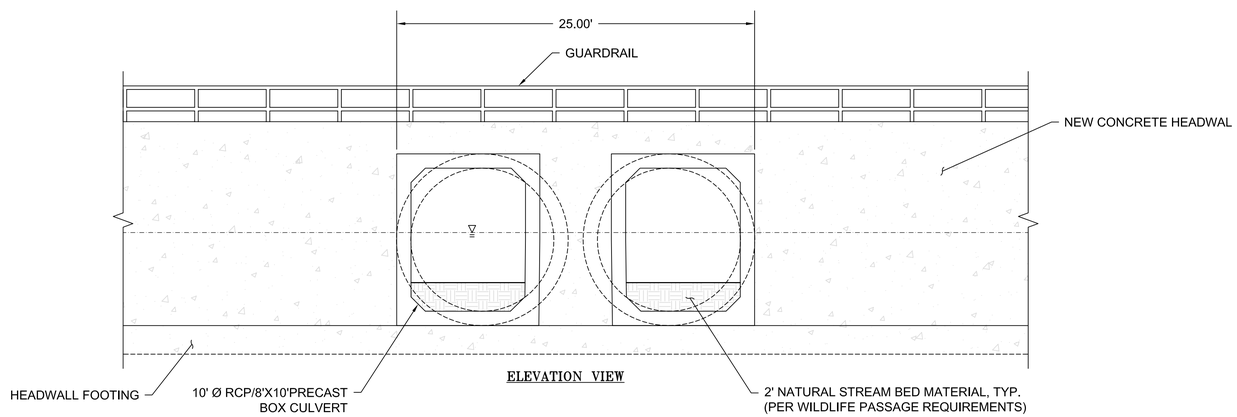
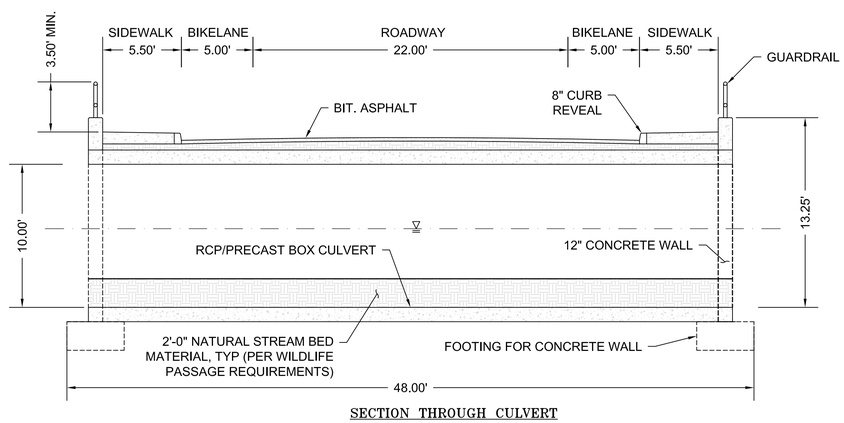


ELEVATION VIEW



SECTION THROUGH CULVERT

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

N.T.S.

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		APPROVED			

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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

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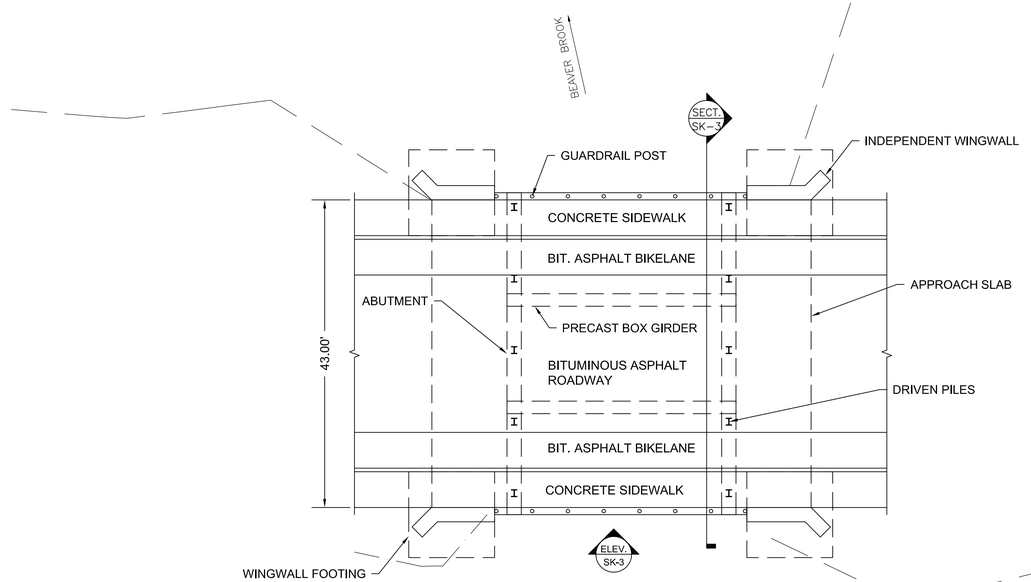
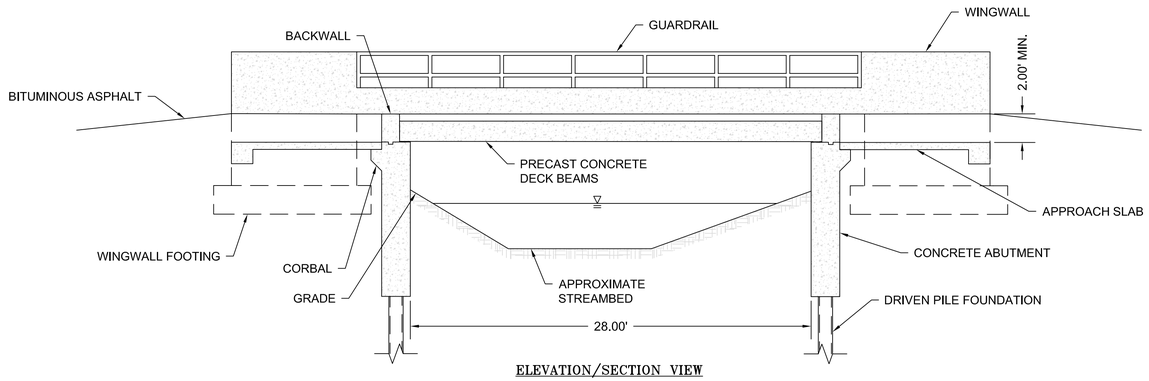
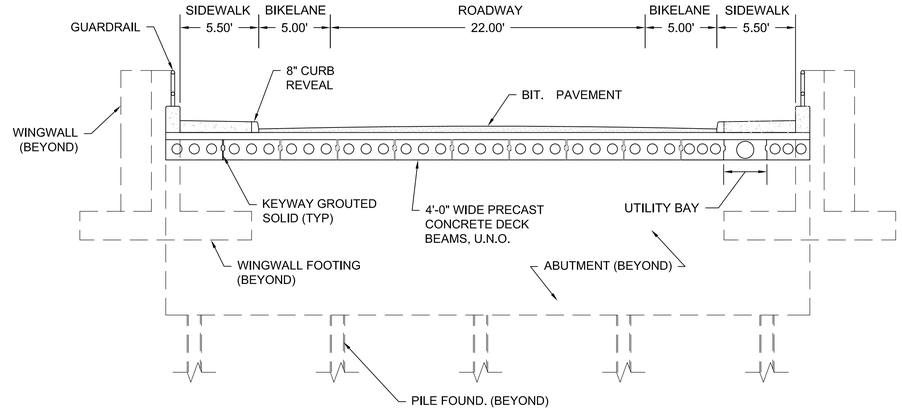


PLAN VIEW



ELEVATION/SECTION VIEW



SECTION VIEW

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

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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