

Culvert Assessment and Prioritization Report

Framingham, MA

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Executive Summary

The City of Framingham (the City) contracted VHB to perform an assessment of city-owned culverts to evaluate their condition and create a prioritization for repairs in order to extend the service life of these culverts and prevent potential failures. A culvert is defined as a structure that conveys a stream, river, or channel under a road or railway to allow the stream to maintain its natural flow path without flooding or damaging the surrounding roadway infrastructure. The project was deemed necessary because culvert failures have the potential to significantly impact traffic, public safety, and cause property damage. In addition, many culverts throughout the City do not meet the latest environmental standards for stream crossing, resulting in poor aquatic passage and environmental health, as well as insufficient hydraulic capacity which can cause flooding impacts. While there are privately-owned culverts and culverts owned by other government agencies within the city's boundary, the project evaluated only city-owned culverts, as the City of Framingham is responsible for their maintenance as well as impacts associated with culvert failures.

VHB performed the field assessments of city-owned culverts from January 2020 through March 2021 evaluating various culvert criteria. The City created electronic work orders for each culvert, via the VUEworks asset management software and VHB performed field assessments and desktop review at each culvert location. All assessment data and pictures were collected electronically using the City's work order system. As part of the field and office review, VHB identified specific culverts that were difficult to evaluate due to poor visibility. These poor visibility culverts were then revisited and evaluated using CCTV in order to collect additional assessment data.

VHB and the City created a scoring matrix to assist in the prioritization of culverts. This scoring matrix created a "Risk Score" for each culvert assessed that incorporated the data collected as well as additional criteria including roadway classification and watershed area. High-level cost estimates were then developed for the ten (10) culverts which received the highest risk score.

- › In summary, VHB evaluated a total of 98 culverts and gave them overall ratings of "adequate", "poor," or "critical" based on the conditions of individual culvert components and the potential impact of culvert failure at each location. The ratings generally were defined as:
 - Adequate: The overall condition of the culvert is an acceptable condition exhibiting no observed significant deficiencies and the culvert is performing adequately. Regular inspection frequency is recommended to monitor changes in condition.
 - Poor: The culvert is exhibiting significant deficiencies of one or more of its components and its performance may be partially impaired, but the findings were not critical. Increased inspection frequency is necessary.
 - Critical: One or more key components of the culvert are exhibiting partial or complete failures that significantly impair the culvert's performance or impact adjacent infrastructure or property. Maintenance and repair efforts are required to mitigate current and potential impacts. Frequent inspections and monitoring is necessary until mitigations are completed.

- › As previously stated, the evaluation included 98 city-owned culverts. Of the evaluated culverts, the following results were found:

Condition	Number of Culverts
Critical	9
Poor	33
Adequate*	56
Total (City-owned Culverts)	98

*Millwood Street culvert (Asset ID 2511576) was recently replaced and is assumed to be adequate.

Culverts rated poor and critical have the potential to impact adjacent infrastructure or property. These impacts can include flooding of adjacent properties and roadways, damage to other utilities, roadway collapse, more frequent and costly maintenance/repairs, traffic impacts, and reduced longevity of roadway.

- Culvert conditions, risk scores and locations are viewable in an ArcGIS Online dashboard (<https://vhb.maps.arcgis.com/apps/opsdashboard/index.html#/d78585b8a8454c069d1647d166036e9a>) and Figure 7 in the report.

- › Culverts were evaluated for actions that require immediate action including debris and vegetation blockage, critical scour and erosion, and unstable structures. The following results were found:

Immediate Action Item	Number of Culverts
Debris/Vegetation Blockage*	22
Critical Scour/Erosion	0
Unstable Structure	8

*There were 5 culverts where blockage was the only issue

- › The conditions of the culvert and the culvert parts, such as footings, joints and seams, and headwalls, were used to develop a risk score for all evaluated culverts to determine culverts with the highest risk of failure. High-level cost estimates, which can be seen in Appendix 4, were then developed for the ten (10) culverts which received the highest risk score. The ten culverts which received the highest risk scores were the 9 critical culverts and the Fountain St (Asset ID:2506913) culvert, which was rated poor.

- › The highest scored culverts and their associated cost estimates are:

High Risk Culverts and Cost Estimates

Risk Score	Asset ID	Approximate Location	Summary of Condition	Approximate Replacement Cost and Resolution	
83.0	2505652	172 Hartford St	Collapsed stone culvert causing blockage	\$755,000	Concrete culvert
77.0	2511942	82 Herbert St	Collapsed stone culvert and sediment causing blockage	\$285,000	Concrete culvert
76.2	2515114	65 Bates Rd	Severe deterioration and crushing of corrugated metal pipes	\$1,067,000 \$273,000	20' Bridge or Open Channel
75.1	2506907	15 Gates St	Severe deterioration of corrugated metal pipe and outlet control structure	\$988,000	Concrete culvert
74.3	2511788	38 Wayside Inn Rd	Unstable stone structure and embankment erosion	\$303,000	Concrete culvert
71.3	2511831	704 Salem End Rd	Unstable stone structure with partial roof collapse	\$964,000	Concrete culvert
71.1	2511778	93 Parmenter Rd	Collapsed stone culvert causing blockage	\$244,000	Concrete culvert
69.2	2506912	14 Badger Rd	Severe blockage caused by collapsed stone headwalls	\$449,000	Concrete culvert
61.5	2506913	250 Fountain St	Significant debris blockage and unstable headwall	\$412,000	Concrete culvert
60.3	2511728	43 Garvey Rd	Displaced outlet control structure	\$228,000	Outlet control structure only

- › Flooding occurs in areas throughout the City:
 - Several culverts and channels need routine maintenance. This includes channel clearing, dredging and blockage removal. These maintenance items are likely contributing to flooding issues.
 - In other areas flooding is complex and likely requires further evaluation and study to evaluate alternatives for improvements
- › VHB provides the following recommendations:
 - The City should develop a capital program to improve priority culverts. Critical culverts should be replaced as soon as possible in order to reduce the risk of adverse effects. These impacts can include flooding of adjacent properties and roadways, damage to other utilities, roadway collapse, more frequent and costly maintenance/repairs, traffic impacts, and reduced longevity of roadway. These culvert improvements should be coupled with other projects/efforts to achieve cost efficiencies where possible.
 - The City should develop a city-specific inspection frequency of culverts; at a minimum, critical culverts should be evaluated yearly, and poor culverts should be evaluated every two years.
 - The City's Department of Public Works should address "immediate actions" flagged during the inspections and then develop a routine channel and culvert maintenance program for culverts and channels to reduce blockages and increase hydraulic capacity.
 - For areas with known flooding issues, the City should complete a site-specific evaluation of each area to determine if maintenance and/or further evaluation is needed.



1

Introduction

The City of Framingham (the City) contracted VHB to perform an assessment of culverts to evaluate their condition and create a prioritization for repairs in order to extend the service life of these culverts and prevent potential failures. The project's goals are to identify culverts with poor structural integrity, create a scoring matrix to identify risk of each culvert, prioritize culverts for improvements, and develop cost estimates for high priority culverts.

In summary this report will:

- › Describe background information including the City's GIS database, culvert evaluation methodology, data collection methods, and CCTV evaluation,
- › Present data from field evaluations,
- › Identify locations with known flooding issues,
- › Provide a prioritization of improvements of culverts based on their risk score, and
- › Provide cost estimates to perform repairs and replacements for high risk culverts.

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Background Information

A culvert is defined as a structure that conveys a stream, river, or channel under a road or railway to allow the stream to maintain its natural flow path without flooding or damaging the surrounding roadway infrastructure. For the purposes of this assessment, a stream crossing was considered a culvert if the span of the crossing was less than 10 feet in width. Crossings with spans of 10 feet or greater are considered bridges by the Massachusetts Chapter 85 regulations and are subject to additional regulations and require certified bridge inspectors. Bridges were not included in this report.

This section details the City's existing GIS data, the culvert evaluation criteria, and field collection processes used for the culvert assessments.

City of Framingham GIS Database

The City of Framingham's culvert and stormwater drainage data is currently stored electronically in a Geographic Information Systems (GIS) geodatabase. The City's geodatabase stores the culvert and drainage data geospatially, based on their location. Each culvert, catch basin, pipe, manhole and outlet are stored as unique assets in the geodatabase. Each unique asset has attributes associated with it, providing details on the structure's characteristics such as length, shape, material, year installed, and a unique identifier. VHB found that some culverts are further broken up into separate assets depending on length, layout, or material changes in the culverted segment. An example is a culvert that is stone at the upstream opening and concrete in the downstream section. Such a culvert may be in GIS as two separate assets, one for the upstream segment, with the material described as "Stone" and one for the downstream segment, with the material as

“Concrete”. For culvert evaluations at a location with multiple assets, this report names the asset whose AssetID was populated in the associated work order. VHB did a high-level review of the culvert data confirming no duplicate work orders, culverts were city-owned, and assets were associated with each work order, though VHB relied on the accuracy of culvert asset attributes provided by the City to complete the culvert assessments.

The data is accessible to VHB through the City’s VUEWorks web application and the VUEWorks MobileVue mobile application. VHB was assigned 98 work orders by the City in VUEWorks to evaluate 155 of the City’s culvert assets. Each work order has an associated culvert asset or assets, depending on potential segmentation in the GIS data, as described above. For example, one work order may have 3 culvert assets associated with it because the culvert is composed of 3 segments with different materials and there is a separate asset for each material segment. Because the three assets compose one culvert crossing, they are included in the same work order. The work order evaluation considers the condition of each asset that composes the total culvert and bases the overall culvert condition on the condition of the multiple parts of the culvert. The notes section of the work order was used to describe conditions of the individual assets if the conditions varied significantly. While the culvert asset includes attributes to describe constant characteristics, the work orders are where the field assessment data is recorded. The work order data records condition information at the time of the field visit. Fifteen assessment locations were initially included in the assigned work orders but were found to be previously included in the 2013 Bridge Master Plan. Prior to learning the locations were bridges and were included in the Bridge Master Plan, VHB completed field inspections on 9 of the locations. These locations were not included in the findings of this report as they have been previously evaluated. VHB also did not include a potentially collapsed culvert (Asset ID 2511576) on Millwood Street, directly south of Callahan State Park South Entrance. This culvert was evaluated by the developer of a nearby development and has been replaced as of September 29, 2020.

Culvert Evaluation Methodology

Prior to the start of VHB’s culvert assessments, the City of Framingham had completed 37 culvert assessments within the City. The City’s assessments and their workorder template were based upon the “Culvert Condition Assessment Manual”¹ 2017 Edition. Since the development of this 2017 Assessment Manual, subsequent culvert assessment guidance has been developed by Massachusetts Department of Transportation (MassDOT) and the recently released (August 2020) American Association of State Highway and Transportation Officials (AASHTO) Culvert and Storm Drain System Inspection Guide². VHB and the City of Framingham project manager and stormwater engineer worked with the City’s GIS group to update the previously used rating system to incorporate the applicable evaluation criteria

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- 1 The Center for Agriculture, Food, and the Environment, North Atlantic Aquatic Connectivity Collaborative, The Nature Conservancy, and UMass Amherst Transportation Center. “Culvert Condition Assessment Manual”. https://streamcontinuity.org/sites/streamcontinuity.org/files/pdf-doc-ppt/CulvertManual_2019_082919.pdf
 - 2 AASHTO, Culvert and Storm Drain System Inspection Guide, 1st Edition, 2020. <https://aashtojournal.org/2020/08/14/aashto-releases-culvert-storm-drain-inspection-guide/>

from the new MassDOT and initial AASHTO guidance into a new work order template. The fields that were added to the new work order template include:

Features

- › Channel Width Upstream
- › Channel Width Downstream
- › Depth to Roadway

Condition

- › Evidence of flooding
- › Embankment erosion

Immediate Action Items

- › Debris/Vegetation Blockage
- › Structure Unstable
- › Critical Scour/Erosion

The new work order template was created in VUEWorks (Appendix 5) to balance the need to efficiently evaluate nearly one hundred culverts while obtaining sufficient condition information in order to properly prioritize culvert repairs. VHB reevaluated the 37 previously evaluated culverts as part of the city-wide assessments using the updated assessment criteria to create consistency across all evaluated culverts and allow for a consistent ranking methodology. VHB evaluated the following criteria of each culvert:

General Criteria

- › **Channel Width Downstream/Upstream:** These fields document the average width of the stream channel, in feet, upstream and downstream of the culvert.
- › **Culvert Shape:** The shape of the culvert
- › **Culvert Size:** Size of the culvert. For circular culverts, the width field was used to document the diameter, in inches. For rectangular or ellipse culverts, height and width were documented in the appropriate field
- › **Culvert Material:** Material the length of culvert is composed of.
- › **Number of Culvert Crossings:** Number of culvert pipes at the crossing location.
- › **Depth to Roadway:** Depth from the top of the culvert opening to the roadway surface above.
- › **Inlet Grade:** Describes if the upstream end of the culvert invert is buried under sediment, debris, or vegetation, level to the streambed, or perched above the streambed with separation between with culvert invert and the streambed.
- › **Outlet Grade:** Describes if the downstream end of the culvert invert is buried under sediment, debris, or vegetation, level to the streambed, or perched above the streambed with separation between with culvert invert and the streambed.
- › **Inlet Type:** Describes the type of structure present at the upstream end of the culvert.

- › **Outlet Type:** Describes the type of structure present at the downstream end of the culvert.
- › **Roadway Condition:** Describes the condition of the roadway directly above the culvert through visual evaluation of cracking or sinking.
- › **Overall Culvert Condition:** Overall condition of the culvert considering the condition of all individual parts of the culvert evaluated

Structural Criteria

- › **Headwall/Wingwall:** Condition of the headwall/wingwall, if present, structure depending on visual evidence of cracking, spalling, exposed rebar, and settlement of structure.
- › **Footings:** Condition of the culvert footing, if present.
- › **Invert Deterioration:** Condition of the culvert's bottom material, if not an open bottom culvert. Condition assessment considers evidence of corrosion, perforations, spalling, etc. depending on visual evidence of cracking, weathering, settlement or undermining.
- › **Buoyancy or Crushing:** Degree to which the culvert has been deformed by the weight of the pipe, weight of the fill material above the pipe or the weight of the water in the pipe.
- › **Cross-Section Deformation:** Degree to which the culvert is deformed or distorted resulting in flattening of the invert and/or crown of the pipe.
- › **Structural Integrity of Barrel:** Condition of the culvert barrel depending on the presence of cracking and deterioration around bolts and seam or tearing of material.
- › **Level of Blockage:** Degree of debris, sediment, or vegetation blockage of the interior of the culvert.
- › **Utility Encroachment:** If other utilities are within or adjacent to the culvert crossing that would require additional coordination if work was to be performed on the culvert.
- › **Joints and Seams:** Condition of the joints and seams, if present, based on visual evidence of separation of joints and seams.

Hydrology/Hydraulic Criteria

- › **Longitudinal Alignment:** the angle measured from the upstream channel to the centerline of the culvert barrel at the culvert opening.
- › **Embankment Erosion:** If there is evidence of erosion from the ground material surrounding the culvert.
- › **Embankment Piping:** If there is presence of water seeping through the culvert barrel into the surrounding embankment material
- › **Evidence of Flooding:** If there is evidence the stream bank has flooded, including debris lines or discoloration on trees.
- › **Apron/Scour Protection:** Condition of the apron or scour protection, if present, based on evidence of undermining of culvert, deterioration of joint between apron and headwall, and presence of a scour hole downstream of the apron.

- › **Armoring:** This field was used in the field evaluation to document the presence of scour at the culvert.

Immediate Maintenance Items

Evidence of the following are noted to require immediate action:

- › **Critical Scour/Erosion:** Presence of scour or erosion that creates an immediate hazard.
- › **Debris/Vegetation Blockage:** Presence of vegetation or debris that blocks the culvert opening, creating an immediate flooding hazard.
- › **Structure Unstable:** If the structure's condition is unstable and could cause an immediate collapse of the culvert.

Culvert shape, size, and material fields required text or numerical descriptions for their responses. All other criteria above utilized set domains for responses with either a check box for a "yes" or "no" domain or a domain of "adequate", "poor", "critical", and "N/A" to describe the culvert criteria's condition. To create consistency across all culvert assessments and with varying team members performing the assessments, VHB followed the Culvert Assessment Manual Methodology to assign ranking to each criteria included in the field assessments.

Collection Methods

The City of Framingham created and assigned work orders for each assessment location using the City's VUEWorks account. VHB collected data in the field using the VUEWorks MobileVue mobile application (Figure 1). Utilizing the mobile application allowed for streamlined data management, with data, both evaluations and photographs, being loaded directly from the mobile application into the City's geodatabase and associated with the culvert assets.

All culvert assessments were evaluated by two-person teams consisting of one water resource engineer and one structural engineer to evaluate the culverts for performance and functionality from both the hydrologic and structural perspectives. Culvert assessments were completed between January 2020 and March 2021. VHB's field teams provided details about criteria rated poor or critical in the "notes" field of the culvert's assessment and included additional pictures to show the poor or critical feature.

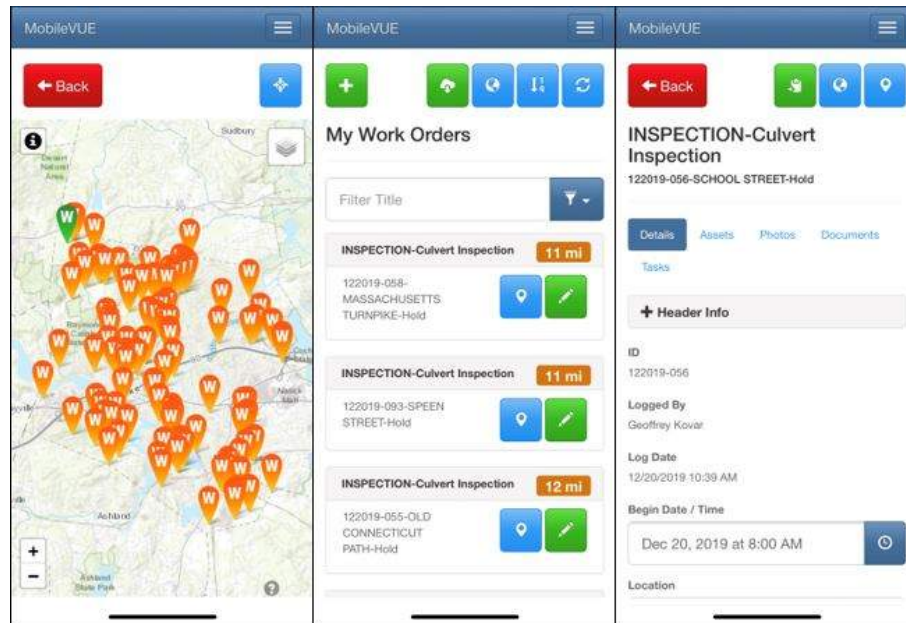


Figure 1 Screenshots of the VUEWorks MobileVUE application

In addition to the above criteria evaluated in the field, VHB also found the watershed area to each culvert using U.S. Geological Survey (USGS) StreamStats³ web application for available streams and the roadway functional classification at each culvert using the MassDOT Roadway Inventory⁴ web application. Both the criteria collected in the field and the criteria supplemented through the above web applications were used in ranking the risk of failure for each culvert.

At the completion of each field assessment, VHB's field staff updated the culvert's work order status from "Open" to "Hold" to signify the field evaluation was completed and allow VHB's office staff to perform a quality review of the data collected. The quality reviewers utilized the photos attached to the culvert assessment in the VUEWorks web application to determine if the assigned criteria aligned with what was visible in the photos. Once final review was complete, the work order statuses were set to "Closed". In the VUEWorks web application, users can access the work orders by selecting "Find / Manage / Report" under "Work Orders" in the left pane of the map viewer. Once the "Manage Work Order" pop-up appears, the user can filter by setting Department to be "Engineering", Program to "Inspection", Activity Description to "Culvert Inspection" and Status to "Closed". Once the filter is applied, the list of work orders is shown under the "Table View" tab. When a work order is selected in the "Table View" tab the details of the work order are viewable under the "Form View" tab, photos are saved under the "Documents" subtab. A specific asset can also be viewed by selecting "Find/Manage/Report" under "GIS Assets" in the left pane of the map viewer. Once the "GIS Assets" pop-up appears populated the field "Table / Layer" with "Drain Pipe", set "Field" to "ASSETID", "Operator" to "Equal To" and type the culvert's Asset ID

3 U.S. Geological Survey (USGS). StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water Resource Applications. https://www.usgs.gov/mission-areas/water-resources/science/streamstats-streamflow-statistics-and-spatial-analysis-tools?qt-science_center_objects=0#qt-science_center_objects

4 Massachusetts Department of Transportation. Roadway Inventory Web Application. <https://gis.massdot.state.ma.us/roadinventory/>

referenced in this report into the fourth box and “Apply Filter”. The reviewers noted if additional data or photos were needed from the field. If additional information was needed, VHB’s field staff revisited the culvert location and updated the evaluation form with the additional information. In addition to revisiting structures for additional information, all critical structures were revisited with a senior engineer and utility engineer to review potential constructability issues.

CCTV Evaluation

Through field culvert evaluations and office review, VHB identified culvert locations where the inside of the culvert couldn’t be fully evaluated due to length, alignment, or high-water levels. These culverts were identified as locations to perform video evaluations using closed circuit television (CCTV) cameras to record the inside of the culvert where the structure’s condition was not visible in the field. Twenty-one culverts were identified to have a CCTV evaluation be performed (Table 1). Nine (9) of the culverts were identified as having high-water levels that would require dewatering of the culvert prior to performing the CCTV evaluation.

Table 1 Culvert Locations for CCTV Evaluation

Culvert Work Order	Asset ID	Nearby Address	Dewatering Needed
122019-087	2511831	704 Salem End Road	No
122019-088	2511840	635 Salem End Road	No
122019-054	2508317	121 A Street	No
122019-045	2517849	45 Leland Street	Yes
122019-078	2511681	132 Millwood Street	No
122019-080	2511778	68 Parmenter Road	No
122019-060	2506913	250 Fountain Street	No
122019-052	2508663	118 Howe Street	Yes
122019-051	2508218	183 Wilson Street	Yes
122019-113	2511638	3 Chicatawbut Road.	No
122019-032	2501693	106 Dudley Road	Yes
122019-102	2511205	7 Sloane Drive	Yes
122019-070	2511187	20 Knight Road	Yes
122019-077	2511660	33 Grove Street	Yes
122019-120	2511130	4 Frost Street	Yes
122019-119	2511122	10 Scott Drive	No
122019-083	2511788	689 Edmands Road	No
122019-095	2511577	155 Millwood Street	No
122019-114	2520964	6 Lyman Way	No
122019-124	2508880	26 Hickory Hill Lane	No
122019-027	2505652	172 Hartford Street	Yes
		Total # of Culverts =	21

VHB coordinated with the City of Framingham Conservation Commission and was administratively approved for CCTV evaluations to be performed within jurisdictional areas. VHB subcontracted Truax Corporation to complete the CCTV evaluations. All CCTV evaluation were completed between July and September 2020 by Truax with a VHB engineer present. Once CCTV video was collected in the field, Truax provided VHB with the culvert videos and summary of the evaluations. The CCTV evaluations resulted in some minor updates to culvert dimensions and material as well as providing additional information about the culvert condition that allowed VHB to more accurately evaluate the culvert. The final condition ratings and risk scores for culverts which received CCTV incorporate the conditions found during CCTV.



3

Culvert Evaluation Summary

VHB completed the field assessments of culverts at 98 locations in the City from January 2020 to March 2021. The data collected during the field evaluations was reviewed in the office by VHB to confirm completeness of the evaluation and accuracy of the conditions assigned to each culvert and its parts. CCTV video evaluation was performed on culverts which were not able to be fully evaluated during the initial field evaluation due to inability to see the interior condition of the culvert.

Findings of Assessment

Upon review of the collected data, 56 culverts were rated and received overall culvert conditions of "Adequate", 33 culverts were rated as "Poor", and 9 culverts were rated as "Critical" (Figure 2). As noted above, the Millwood Street culvert (Asset ID 2511576) has been replaced as of September 2020. The new culvert is assumed to be in adequate condition. For the individual parts of the culvert that were evaluated, the differences between adequate, poor, and critical were defined in the NAACC Culvert Condition Assessment Manual. The overall condition ratings used for the field assessments were determined based on the condition of the individual parts and engineering judgment. The overall condition ratings are defined as:

- Adequate: The overall condition of the culvert is an acceptable condition exhibiting no observed significant deficiencies and the culvert is performing adequately. Regular inspection frequency is recommended to monitor changes in condition.

- Poor: The culvert is exhibiting significant deficiencies of one or more of its components and its performance may be partially impaired, but the findings were not critical. Increased inspection frequency is necessary.
- Critical: One or more key components of the culvert are exhibiting partial or complete failures that significantly impair the culvert’s performance or impact adjacent infrastructure or property. Maintenance and repair efforts are required to mitigate current and potential impacts. Frequent inspections and monitoring is necessary until mitigations are completed.

All culverts and their evaluation results are detailed in the following graphics and are also available in to view interactively via the ArcGIS Online Dashboard at <https://vhb.maps.arcgis.com/apps/opsdashboard/index.html#/d78585b8a8454c069d1647d166036e9a>. The online Dashboard allows the data to be shown geospatially, allowing the user to see where the culvert is located within the city. The Dashboard also symbolizes culverts by their overall condition and allows you to click on the culvert to view the complete results from the field evaluation as well as their final risk scores.

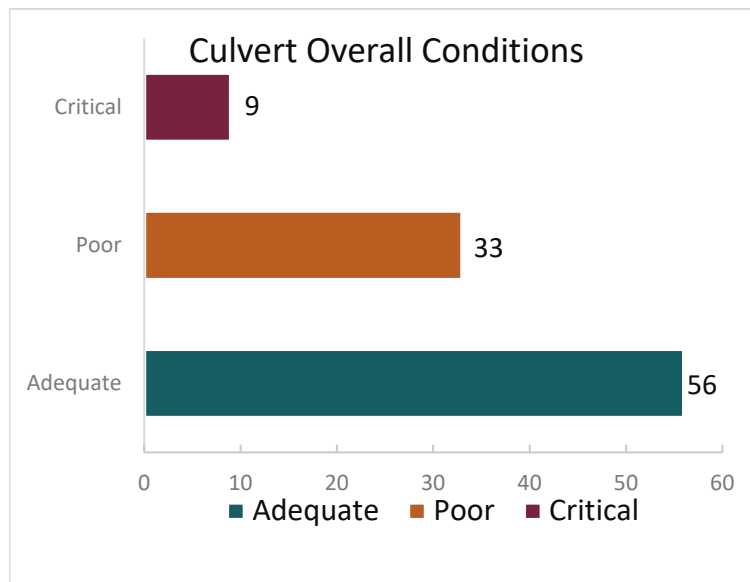


Figure 2 Culvert Overall Conditions

In addition to culverts receiving an overall condition rating, the culverts were evaluated for condition of 12 individual parts of each culvert, if applicable to the culvert. Overall, the City’s culverts were found to be mostly in adequate condition. Condition ratings for “Headwall/Wingwalls” and “Level of Blockage” had the most poor and critical conditions of the culvert parts. Debris and vegetation blockage was also found to be the most needed immediate action item.

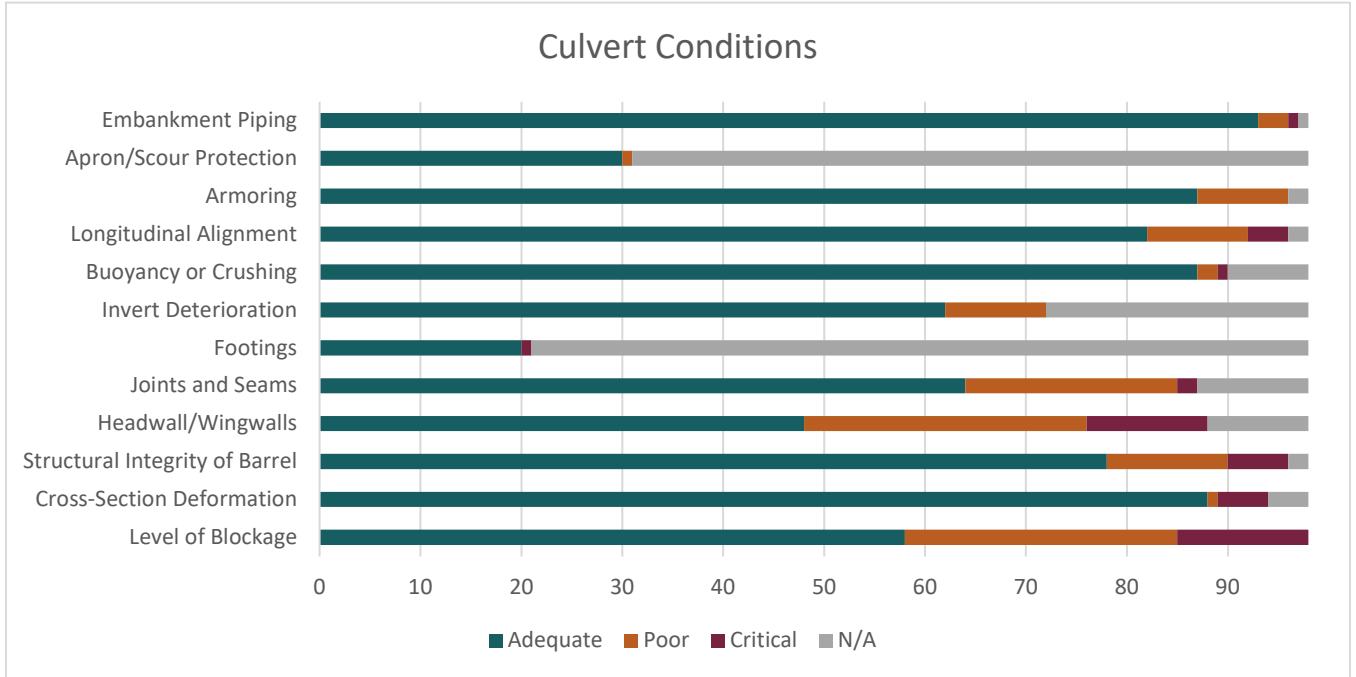


Figure 3 Culvert Conditions

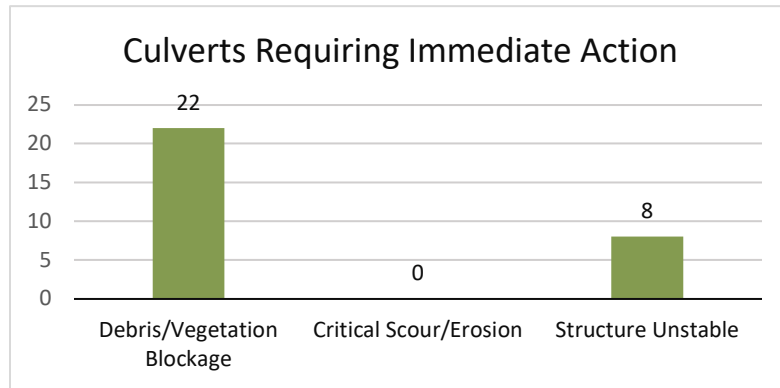


Figure 4 Culverts Requiring Immediate Action

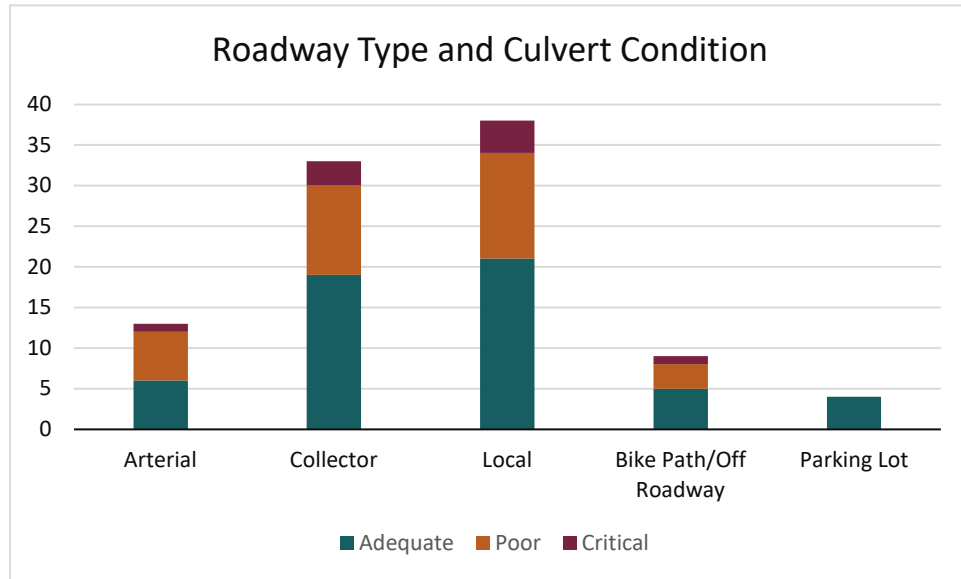


Figure 5 Culvert Condition by Roadway Type

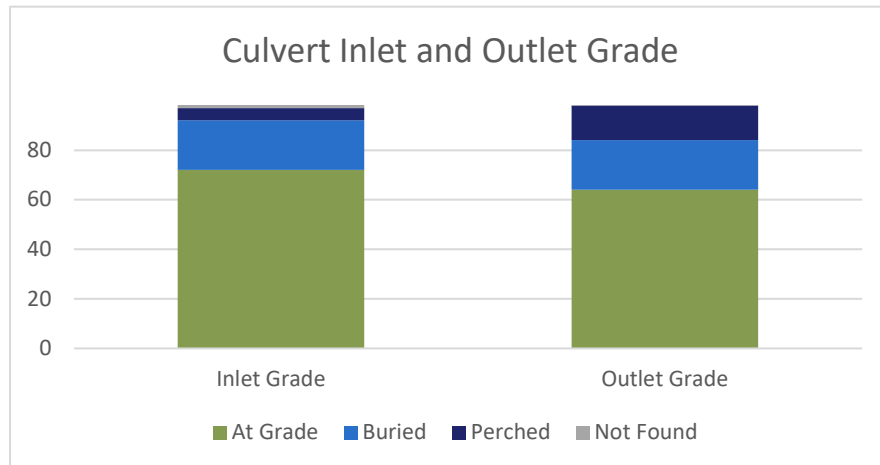
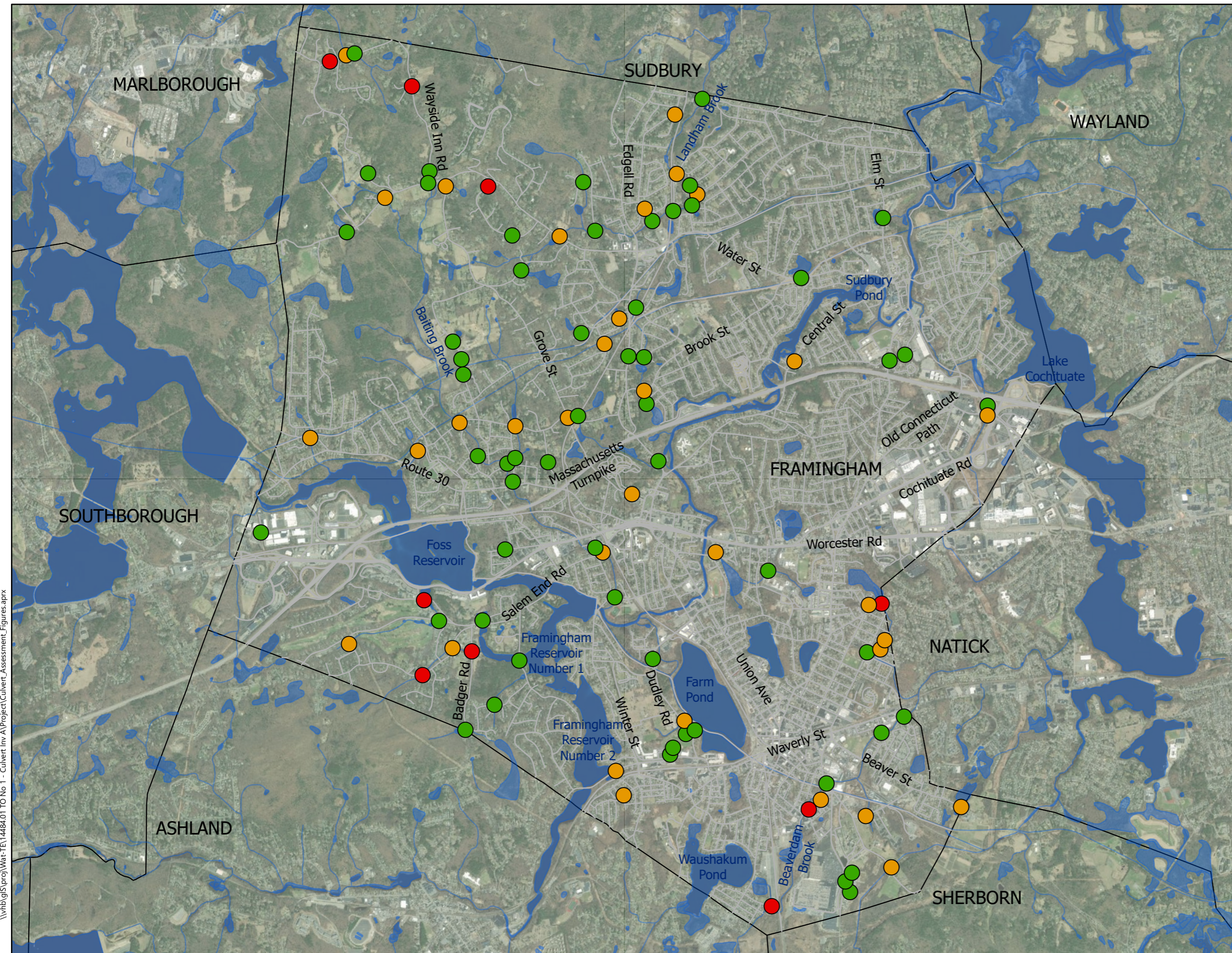


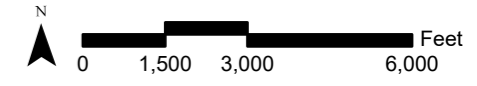
Figure 6 Culvert Inlet and Outlet Grades

FIGURE 1



Culvert Condition

- Adequate
- Poor
- Critical
- Municipal Boundary
- Roadways
- Waterbodies



City-Owned Culvert Assessment
Culvert Condition Ratings

Framingham, MA
March 18, 2021

Source: City of Framingham VueWorks Culvert Work Order Data

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Locations with Known Flooding Issues

Part of the culvert evaluations included assessing if there was visible evidence of flooding. VHB's field team spoke with Framingham residents who lived near some of the culvert locations to learn if the residents were aware of any flooding issues at the culverts. These conversations with residents helped provide experiential knowledge of the culvert over time. VHB documented these occasions of resident-reported flooding, as well as visual evidence, in the comments section of the associated work order. Visual flooding evidence was documented with photos, if possible. The cause of flooding at culverts is often complex, with multiple factors influencing the flooding. Further study of the locations noted below is needed before mitigation methods can be recommended. The following culvert locations were noted to have flooding issues by resident's anecdote. While this list includes culverts where residents noted flooding during the field evaluation, this list is not comprehensive of all culverts with flooding issues throughout the City.

Asset ID: 2515114 - CC Beaver Dam Brook

Flooding reported by neighbor when culvert is not maintained. Flooding is likely the result of culvert blockage and failure.

Asset ID: 2511184 - Knight Road

Flooding reported by neighbor. Neighbor routinely clears debris from culvert. Poor alignment upstream. Stagnant water is present downstream of the culvert indicate downstream backwater conditions which is likely resulting in flooding.

Asset ID: 2511840 - Salem End Road

Flooding on roadway at catch basin reported by neighbor. Based on a preliminary desktop review, this catch basin is not connected to the culvert. Further evaluation is required to determine the cause of flooding at this location.

Asset ID: 2508898 - Willowbrook Road

Resident says upstream area does not drain well and backs up into the yards. Upstream channel is littered with tree debris. Based on field evaluation, flooding may be result of low point in the area. Further evaluation is required to determine the cause of flooding.

Neighborhood Flooding – Tributary to Beaverdam Brook

Asset ID: 2508218 - Wilson Street and Asset ID: 2508663 - Howe Street

Stagnant water is present at both culvert locations, likely due to backwater conditions. Downstream channel is overgrown and filled with sediment.

Neighborhood Flooding – Landham Brook

Asset ID: 2511207 Gregory Road and Asset ID: 2511205 - Sloane Drive

Flooding along this segment of Landham Brook was noted in discussion with the City's Conservation Agent. Additional discussion with the Conservation Agent is recommended to further identify the flooding source and potential fixes.

In addition to the culvert location listed above, which had experiential knowledge of flooding, there were other culverts where VHB's field staff noted potential evidence of flooding. These locations are noted in the completed work orders by "Flooding Evidence" being marked "Yes". The work order notes and pictures also help document potential evidence of flooding. Further evaluation is needed for these culverts to better understand the flooding risk of the culvert locations and potential mitigation.



4

Prioritization of Culvert Improvements

VHB developed a method for assigning a risk score to each culvert based on the various culvert characteristics. The risk score of culverts based on various conditions allows the City to evaluate and prioritize improvements for culverts with the highest risk score. The following sections describe the process used to develop the risk score methodology and subsequent findings.

Risk Score Methodology

After completion of all field culvert assessments, VHB compiled the results in order to compare the culvert conditions and develop a methodology for scoring the risk of the culverts to assist the City in future capital planning efforts. To develop the scores, VHB took the raw data exported from the VUEWorks assessment forms and simplified it to only the fields using the condition rating domain of Adequate, Poor, Critical, and N/A and inlet and outlet grade which used the domain of Perched, At Grade, and Buried. Each field received a certain weight to determine the influence the criteria would have on the overall score of the culvert. In addition to the weight allotted to each field, each individual condition rating was designated a percentage to determine what percent of the criteria weight the culvert would receive. A criteria which received a condition rating of "Critical" receives the highest percentage of weight possible for the criteria, "Poor" and "Adequate" each received an increasingly smaller percentage. A criteria that received a rating of "N/A" or was left blank did not receive any percentage of weight for that criteria and the total possible weight was removed from the total potential risk score for that asset. Removing the N/A or blank fields from the overall total potential weight for the asset helped more accurately show how the applicable criteria effects the culvert's overall condition.

The City reviewed and commented on the proposed risk score points prior to their finalization. The final risk score points used were updated based on the discussion with the City.

In addition to the fields which use the condition domain, the risk scoring considered roadway functional classification, and drainage area to the culvert. Roadway functional classification was determined by VHB using the MassDOT Roadway Inventory web application. The roadways were broken into the classes of: Freeway, Major Collector, Minor Arterial, Local, Parking Lot, and Bike Path. No culverts evaluated were on freeways, but the classification was kept in the possible domain for consistency with the MassDOT Roadway layer and to be adaptable if the risk scoring methodology is used in the future. The scoring shows freeways receiving the highest percentage of weight due to the high traffic of the roadway, followed by collectors, and each classification after receiving a smaller percentage of weight as they receive less traffic. Drainage area to each culvert was determined for available streams using USGS Stream Stats web application. For condition weight percentage groupings, the drainage areas were broken into thirds, with culverts in the top third, with the largest drainage area, receiving the highest percentage of the weight. Larger drainage areas were given a higher percentage of weight because a culvert failure could potentially cause more damage than for a culvert with a smaller drainage area.

The final weights for each criteria and percentages of weight associated with each condition are as follows:

Culvert Criteria	Criteria Weight	Condition Percentage of Weight
Overall Culvert Condition	40	Critical – 100% Poor – 70% Adequate – 0 N/A – 0
Roadway Classification	10	Freeway – 100% Arterial – 80% Collector – 60% Local – 40% Parking Lot – 20% Bike Path – 20%
Structural Integrity of Barrel	10	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Watershed Area	5	Largest 1/3 of watershed areas – 100% Middle 1/3 of watershed areas – 50% Smallest 1/3 of watershed areas - 0
Blockage	5	Critical – 100 % Poor – 50% Adequate – 0 N/A – 0
Headwalls	5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0

Culvert Criteria	Criteria Weight	Condition Percentage of Weight
Footings	5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Cross Section Deformation	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Joints and Seams	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Invert Deterioration	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Buoyancy or Crushing	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Armoring (Scour)	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Embankment Piping	2.5	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Longitudinal Alignment	1.25	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Apron/Scour Protection	1.25	Critical – 100% Poor – 50% Adequate – 0 N/A – 0
Inlet Grade	1.25	Perched – 100% Buried – 50% At Grade – 0
Outlet Grade	1.25	Perched – 100% Buried – 50% At Grade – 0
Total Possible Risk Score	100.00	

The final culvert risk scores were found by dividing total score of the asset by the total potential score, removing the weight for any criteria rated N/A or blank. The culvert risk scores can range from zero to 100. The risk scoring methodology used gives culverts with the highest risk the highest score. The lower the score, the better condition the culvert, and the less risk associated with it. For example, a culvert with a risk score of 100 implies the highest potential risk, while a culvert with a risk score of 0 implies the lowest potential risk.

Risk Scoring Results

While the available range of risk is from zero to 100, the risk scores for the evaluated culverts ranged from 0.0 to 83.0.

In accordance with the scope of work VHB performed a detailed review of the 10 culverts with the highest risk scores. The following list provides notable details about the ratings of these culverts and includes cost estimates. Construction cost estimates are conceptual and generally include culvert/headwall replacement and incidental costs. See Appendix 4 for construction cost estimate breakdowns.

1. Hartford Street, Asset ID: 2505652, Associated Work Order: 122019-027

- Total Risk Score: 83.0
- Cost Estimate for Construction: \$755,000
 - Assumptions for Cost Estimate:* Replacement of culvert with a 6' x 3' concrete box culvert, replacement of headwalls, dredging adjacent property
- Roadway Classification: Arterial
- Criteria Rated Critical: Level of Blockage, Cross-Section Deformation, Structural Integrity of Barrel, and Buoyancy or Crushing
- Summary of Culvert Condition: The culvert is half stone and half reinforced concrete. CCTV indicates a collapse in center of the stone culvert blocking flow though the culvert (Photo 1). Downstream headwall and wingwall have loose stones and are leaning outward.



Photo 1 Hartford Street culvert, interior collapse

2. Herbert Street, Asset ID: 2511942, Associated Work Order: 122019-034

- Total Risk Score: 77.0
- Cost Estimate for Construction: \$285,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 42" x 24" concrete box culvert, replacement of headwalls
- Roadway Classification: Local
- Criteria Rated Critical: Level of Blockage, Cross-Section Deformation, Structural Integrity of Barrel, and Joints and Seams
- Summary of Culvert Condition: Stone collapse within culvert blocking flow through the culvert (Photo 2). The upstream invert is completely buried causing stagnant water at the upstream headwall (Photo 3).



Photo 2 Herbert Street culvert, interior collapse



Photo 3 Herbert Street culvert, upstream blockage

3. **Bates Road Extension, Asset ID: 2515114, Associated Work Order: 122019-030**

- Total Risk Score: 76.2
- Cost Estimate for Construction: \$1,067,000 (Bridge) or \$273,000 (Removal of crossing, restoration of Waushakum Brook)

Cost Estimate Assumptions: Costs were estimated for 2 scenarios- replacement of the culvert with a 20' Bridge or removal of crossing and restoration of Waushakum Brook with a rip rap lined open channel. Both estimates include FEMA no-rise certificate permitting.
- Roadway Classification: Bike Path/Off Roadway
- Criteria Rated Critical: Level of Blockage, Cross-section Deformation, Structural Integrity of Barrel, and Joints and Seams
- Summary of Culvert Condition: The culvert is composed of four (4) corrugated metal pipes (CMP). The culvert, second from left, is partially deformed, reducing hydraulic capacity (Photo 4). The upstream left-most pipe is completely collapsed and filled with sediment and debris (Photo 5). All CMP is significantly rusted, and there is cracking in the downstream headwall. Residents have noted flooding.
- Additional Notes:
 - It is our understanding, an 8" insulated ductile iron water main is present above the culverts. Replacement or removal of the culvert will require reconstruction of the water main.
 - According to City officials, the upstream Washakum Pond ecosystem supports a rare form of sedge that requires controlled water levels in the pond. Updates to the culvert will need to include water level control measures to maintain the sedge species.
 - The open channel cost estimate is provided for reference if the City identifies another access route for the adjacent sewer system.



Photo 4 Waushakum Brook, deformation, second from left culvert



Photo 5 Waushakum Brook, interior collapse in left culvert

4. Gates Street, Asset ID: 2506907, Associated Work Order: 122019-059

- Total Risk Score: 75.1
- Cost Estimate for Construction: \$988,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 12' x 6' concrete box culvert, replacement of headwalls, replacement of outlet control, hydraulic study and flood analysis
- Roadway Classification: Collector
- Criteria Rated Critical: Structural Integrity of Barrel
- Summary of Culvert Condition: The CMP culvert has significant rusting throughout entire barrel (Photo 6). The upstream headwall includes an outlet control structure (OCS) with gate and a 6" opening at the bottom of gate (Photo 7). The gate opening tracks are significantly deteriorated. Some exposed rebar is visible on the structure. On the downstream side, the top of projecting CMP is completely deteriorated. The downstream end of culvert is submerged in stagnant water. The Massachusetts Water Resources Authority (MWRA) operates the downstream reservoir, so upgrades to this culvert may require MWRA approval.



Photo 6 Gates Street culvert, interior deterioration



Photo 7 Gates Street culvert, rusted OCS gate

5. Wayside Inn Road, Asset ID: 2511788, Associated Work Order: 122019-083

- Total Risk Score: 74.3
- Cost Estimate for Construction: \$303,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 8' x 4' concrete box culvert, replacement of upstream headwall
- Roadway Classification: Collector
- Criteria Rated Critical: Footings
- Summary of Culvert Condition: Many stones in the culvert have fallen out of place (Photo 8). Although the culvert is currently functioning, the fallen stones have left voids in the wall which reduces the structural stability of the stone culvert. Embankment erosion is present along downstream headwall (Photo 9).



Photo 8 Wayside Inn Road culvert, fallen interior stones



Photo 9 Wayside Inn Road culvert, downstream embankment erosion

6. Salem End Road, Asset ID: 2511831, Associated Work Order: 122019-087

- Total Risk Score: 71.3
- Cost Estimate for Construction: \$964,000

Assumptions for Cost Estimate: Replacement of culvert is 12' x 6' concrete box culvert, replacement of headwalls

- Roadway Classification: Local
- Criteria Rated Critical: Cross-section Deformation and Structural Integrity of Barrel
- Summary of Culvert Condition: The stone culvert is lined with a concrete pipe in the upstream section. There is a failure near the downstream end of the culvert, where there is a collapse of the roof of the stone culvert (appears to be located on private property) (Photo 10). A hole, approximately a foot in diameter, can be seen at the surface (Photo 11). The downstream stone headwall has portions of loose mortar.



Photo 10 Salem End Road culvert, interior stone roof collapse



Photo 11 Salem End Road culvert, exterior hole in culvert roof

7. Parmenter Road, Asset ID: 2511778, Associated Work Order: 122019-080

- Total Risk Score: 71.1
- Cost Estimate for Construction: \$244,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 7' x 4' concrete box culvert, replacement of headwalls
- Roadway Classification: Local
- Criteria Rated Critical: Cross-section Deformation and Structural Integrity of Barrel
- Summary of Culvert Condition: The upstream headwall is composed of wood being held in place by a steel post. The downstream headwall is stone that shows beginning signs of settlement. CCTV indicates the stone culvert is beginning to collapse internally (Photo 12). The small hydraulic opening creates high potential for blockage to occur.

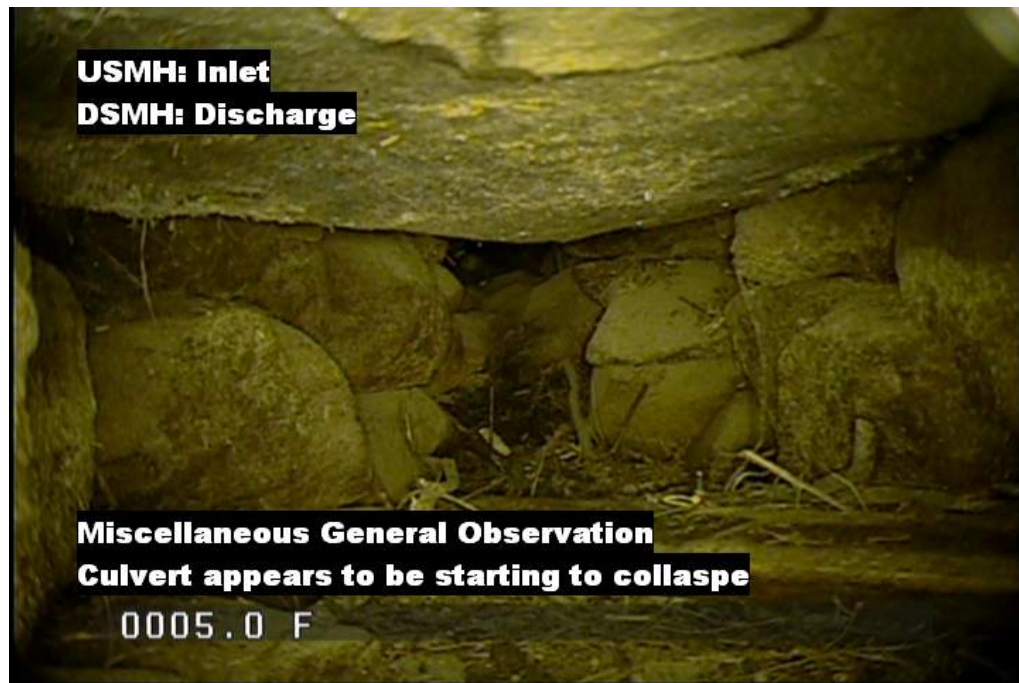


Photo 12 Parmenter Road culvert, interior collapse (CCTV)

8. Badger Road, Asset ID: 2506912, Associated Work Order: 122019-094

- Total Risk Score: 69.2
- Cost Estimate for Construction: \$449,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 9' x 5' concrete box culvert, replacement of headwalls
- Roadway Classification: Collector
- Criteria Rated Critical: Level of Blockage and Headwall/Wingwalls
- Summary of Culvert Condition: The upstream stone headwall is collapsed, causing a small hydraulic opening. Erosion is present from the roadway at the upstream headwall (Photo 13). The stream runs parallel to the roadway before entering the stone culvert and flowing perpendicular under the roadway. The downstream stone headwall has a major failure (Photo 14).



Photo 13 Badger Road culvert, upstream headwall collapse and erosion



Photo 14 Badger Road culvert, downstream headwall collapse

9. Fountain Street, Asset ID: 2506913, Associated Work Order: 122019-060

- Total Risk Score: 61.5
- Cost Estimate for Construction: \$412,000
 - Assumptions for Cost Estimate:* Replacement of culvert with 8' x 4' concrete box culvert, replacement of headwalls
- Roadway Classification: Collector
- Criteria Rated Critical: Level of Blockage, Headwall/Wingwalls
- Summary of Culvert Condition: The upstream invert of the stone culvert is buried. The upstream channel is dry and filled with debris (Photo 15). The downstream invert has backwater from the downstream lake. The downstream headwall has loose stones. The downstream wingwall has missing stones which have fallen into the channel.



Photo 15 Fountain Street culvert, upstream headwall

10. Garvey Road, Asset ID: 2511728, Associated Work Order: 122019-115

- Total Risk Score: 60.3
- Cost Estimate for Construction: \$228,000
 - Assumptions for Cost Estimate:* Replacement of outlet control structure
- Roadway Classification: Local
- Criteria Rated Critical: Headwall/Wingwall
- Summary of Culvert Condition: The outlet control structure at the inlet superstructure has dislodged outward, approximately one foot from the substructure with minimal headwall backfill (Photo 16). It is our understanding that proposed nearby roadway improvements or pump station project can be coupled with the culvert repair, which would likely reduce the cost of replacement.



Photo 16 Garvey Road culvert, inlet dislodged OCS superstructure

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5

Recommendations and Conclusions

VHB completed field and desktop evaluations of 98 culverts owned by the City of Framingham. VHB worked with the City to develop a methodology for scoring the risk of each culvert. The findings of the evaluations and the associated risk scores can help the City develop a better understanding of the condition and functionality of their culverts. The evaluation results and risk scores identify culverts with the highest potential of failure. The following section provides conclusions reached from the culvert evaluation and risk scoring and VHB's recommendations for the City moving forward.

The evaluation findings show that majority of the City's culverts (55 culverts out of 98 evaluated) are in overall adequate condition. Thirty-three culverts were deemed to be in poor condition and nine (9) were rated as critical, requiring maintenance or reconstruction to prevent failure.

The field evaluations considered the condition of various individual parts of the culvert in determining the culverts overall condition (Figure 3). The criteria that received the most poor and critical ratings was "Level of Blockage", with 13 culverts rating critical in this category and 27 rating poor. Culverts which have high levels of blockages have a reduced hydraulic capacity which can cause flooding during major storm events. The criteria that receive the second-most poor and critical ratings was "Headwall/Wingwalls" with 12 culverts rating critical and 28 culverts rating poor. Failing headwalls and wingwalls has the potential to block the culvert's openings, creating a risk of flooding. Collapsed headwalls and wingwalls also creates the potential for significant erosion and potentially undermining the roadway above.

VHB developed risk scores for each evaluated culvert, factoring in the overall condition of culvert, individual parts of the culvert, drainage area and roadway classification. This risk

scoring identified the culverts with the greatest risk associated with them. VHB further evaluated the ten culverts with the highest risk scores, scores of 60.3 to 83.0, to determine the estimated cost associated with the replacement of the culverts or the culvert parts. In total, the estimated costs for the top 10 culverts is \$5,695,000.

To address the conditions and risk identified during the culvert evaluations, VHB provides the following recommendations:

- › The city should develop a capital program to improve priority culverts. Critical culverts should be replaced as soon as possible in order to reduce the risk of adverse effects. These impacts can include flooding of adjacent properties and roadways, damage to other utilities, roadway collapse, more frequent and costly maintenance/repairs, traffic impacts, and reduced longevity of roadway. These culvert improvements should be coupled with other projects/efforts to achieve cost efficiencies where possible.
- › Culverts that are rated poor or critical require continued monitoring to evaluate further degradation of the culvert. The City should develop a city-specific inspection frequency of culverts, especially those rated poor or critical that are not upgraded; at a minimum, critical culverts should be evaluated yearly, and poor culverts should be evaluated every two years.
- › The City's Department of Public Works should address "immediate actions" flagged during the inspections and then develop a routine channel and culvert maintenance program for culverts and channels to reduce blockages and increase hydraulic capacity. For areas with known flooding issues, the City should complete a site-specific evaluation of each area to determine if maintenance and/or further evaluation is needed.

Implementation of these recommendations can assist the City with improving culverts that are currently high risk and allow the city to maintain all culverts to reduce the deterioration of the infrastructure in the future. While there are upfront costs associated with the recommendations, improving culvert maintenance can help reduce likelihood of expensive culvert repairs and replacements in the future.

Appendices

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Appendix 1 – List of Risk Scores

WorkOrderID	ASSETID	Location	Culvert Condition	Total Risk Score
122019-027*	2505652	CC HARTFORD STREET	03 - Critical	83.0
122019-034	2511942	HERBERT STREET	03 - Critical	77.0
122019-030	2515114	CC BEAVER DAM BROOK	03 - Critical	76.2
122019-059	2506907	GATES STREET	03 - Critical	75.1
122019-083	2511788	WAYSIDE INN ROAD	03 - Critical	74.3
122019-087*	2511831	SALEM END ROAD	03 - Critical	71.3
122019-080*	2511778	PARMENTER ROAD	03 - Critical	71.1
122019-094	2506912	BADGER ROAD	03 - Critical	69.2
122019-060*	2506913	FOUNTAIN STREET	02 - Poor	61.5
122019-115	2511728	GARVEY ROAD	03 - Critical	60.3
122019-040	2511895	KENDALL AVENUE	02 - Poor	56.8
122019-072	2511192	BELKNAP ROAD	02 - Poor	55.9
122019-052*	2508663	HOWE STREET	02 - Poor	54.5
122019-081	2511783	PARMENTER ROAD	02 - Poor	54.5
122019-099	2511613	CC RUTHELLEN ROAD	02 - Poor	52.7
122019-106	2511214	HEMENWAY SCH FT PATH	02 - Poor	52.7
022421-025	2512189	MAIN STREET	02 - Poor	52.3
122019-074	2511558	GROVE STREET	02 - Poor	52.3
122019-028	2506893	BELKNAP ROAD	02 - Poor	51.8
122019-127	2508334	CENTRAL STREET	02 - Poor	51.8
122019-045*	2517849	LELAND STREET	02 - Poor	51.0
122019-118	2511120	BROOK STREET	02 - Poor	50.3
122019-041	2506936	MERCHANT ROAD	02 - Poor	50.1
122019-053	2506896	WAVENEY ROAD	02 - Poor	50.1
122019-033	2511947	HERBERT STREET	02 - Poor	49.4
122019-067	2511171	BELKNAP ROAD	02 - Poor	49.0
122019-075	2511569	GROVE STREET	02 - Poor	48.9
122019-051*	2508218	CC WILSON DRIVE	02 - Poor	48.7
122019-107	2511486	HEMENWAY ROAD	02 - Poor	48.2
122019-079	2511735	EDMANDS ROAD	02 - Poor	47.7
122019-093	2508594	SPEEN STREET	02 - Poor	47.7
042320-027	2508898	WILLOWBROOK ROAD	02 - Poor	47.5
122019-049	2508225	UNDERWOOD AVENUE	02 - Poor	47.4
122019-097	2509452	LYMAN ROAD	02 - Poor	47.4
122019-077*	2511660	GROVE STREET	02 - Poor	46.2
122019-101	2511055	EDMANDS ROAD	02 - Poor	45.7
122019-032*	2501693	CC DUDLEY ROAD	02 - Poor	45.7
122019-086	2511811	SALEM END ROAD	02 - Poor	45.6
122019-102*	2511205	SLOANE DRIVE	02 - Poor	44.7

WorkOrderID	ASSETID	Location	Culvert Condition	Total Risk Score
122019-061	2508141	VICTORY STREET	02 - Poor	44.3
122019-098	2511200	NOB HILL DRIVE	02 - Poor	44.0
122019-088*	2511840	SALEM END ROAD	02 - Poor	38.9
122019-121	2511139	EDGELL ROAD	01 - Adequate	26.2
122019-078*	2511681	MILLWOOD STREET	01 - Adequate	25.5
122019-125	2511816	WINTER STREET	01 - Adequate	21.9
122019-065	2510409	EDGELL ROAD	01 - Adequate	21.0
122019-084	2511798	NIXON ROAD	01 - Adequate	21.0
122019-124*	2508880	HICKORY HILL LANE	01 - Adequate	20.8
122019-120*	2511130	FROST STREET	01 - Adequate	19.5
122019-071	2511190	BERKELEY ROAD	01 - Adequate	18.8
122019-026	2502862	DUDLEY ROAD	01 - Adequate	18.2
122019-031	2512689	DUDLEY ROAD	01 - Adequate	17.8
122019-048	2508221	BISHOP STREET	01 - Adequate	16.8
122019-073	2511557	EDMANDS ROAD	01 - Adequate	16.8
122019-047	2518282	CC FRASER ROAD	01 - Adequate	16.7
122019-029	2509026	WAYSIDE INN ROAD	01 - Adequate	16.2
122019-085	2511802	EDMANDS ROAD	01 - Adequate	16.2
122019-057	2506849	ELM STREET	01 - Adequate	15.8
122019-090	2511887	SINGLETARY LANE	01 - Adequate	15.4
122019-054*	2508317	CC A STREET	01 - Adequate	14.9
122019-066	2511169	MILL STREET	01 - Adequate	14.9
122019-104	2511209	HEMENWAY ROAD	01 - Adequate	14.8
122019-070*	2511187	KNIGHT ROAD	01 - Adequate	14.7
122019-063	2508339	WATER STREET	01 - Adequate	14.2
122019-095*	2511577	MILLWOOD STREET	01 - Adequate	14.1
122019-062	2508274	OLD WORCESTER ROAD	01 - Adequate	14.0
122019-082	2511788	PARMENTER ROAD	01 - Adequate	14.0
122019-089	2511864	BADGER ROAD	01 - Adequate	14.0
122019-112	2511560	WINCH STREET	01 - Adequate	13.4
122019-116	2511729	GARVEY ROAD	01 - Adequate	13.4
122019-096	2521199	CONCORD STREET	01 - Adequate	13.0
122019-100	2508280	NEW YORK AVENUE	01 - Adequate	12.6
122019-103	2511207	GREGORY ROAD	01 - Adequate	12.6
122019-043	2515102	IRVING STREET	01 - Adequate	12.4
122019-039	2514070	SECOND STREET	01 - Adequate	12.3
122019-123	2506908	SALEM END ROAD	01 - Adequate	12.2
122019-092	2511669	MAPLE STREET	01 - Adequate	11.9
122019-119*	2511122	SCOTT DRIVE	01 - Adequate	11.5
122019-111	2511546	JUNIPER LANE	01 - Adequate	11.3
122019-069	2511186	LITTLE TREE LANE	01 - Adequate	11.2
122019-064	2508881	PARKER ROAD	01 - Adequate	11.0
122019-114*	2520964	LYMAN WAY	01 - Adequate	10.8

WorkOrderID	ASSETID	Location	Culvert Condition	Total Risk Score
122019-068	2511184	KNIGHT ROAD	01 - Adequate	10.5
122019-036	2515315	CC DUDLEY ROAD	01 - Adequate	10.4
122019-105	2511212	CC APPELDO'R ROAD	01 - Adequate	10.4
122019-109	2511495	GREGORY ROAD	01 - Adequate	10.1
122019-108	2511488	COLONIAL DRIVE	01 - Adequate	9.9
122019-042	2515095	TARALLI TERRACE	01 - Adequate	9.6
122019-113*	2511638	CHICATAWBUT ROAD	01 - Adequate	9.5
122019-117	2511116	MCLEAN DRIVE	01 - Adequate	9.5
122019-091	2511571	CC GROVE STREET	01 - Adequate	8.1
042320-028	2522006	CC FOUNTAIN STREET	01 - Adequate	8.0
042320-029	2522007	CC FOUNTAIN STREET	01 - Adequate	7.8
122019-058	2506853	MASSACHUSETTS TURNPIKE	01 - Adequate	7.5
122019-122	2521337	CC WESTERN AVENUE	01 - Adequate	7.4
122019-038	2517767	CC WESTERN AVENUE	01 - Adequate	0.0
122019-046	2518019	CC WESTERN AVENUE	01 - Adequate	0.0

* Asterisks next to the work order ID notes that the culvert received CCTV evaluation

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Appendix 2 – Inspection Results Table

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122019-096	2521199	01 - Adequate	Arterial		01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	CONCORD STREET	
122019-097	2509452	02 - Poor	Local	0.11	01 - Adequate	01 - Adequate	01 - Adequate	03 - Critical	02 - Poor	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	LYMAN ROAD	
122019-098	2511200	02 - Poor	Local	0.28	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	3 - Buried	2 - At Grade	NOB HILL DRIVE	
122019-099	2511613	02 - Poor	Bike Path	0.12	03 - Critical	01 - Adequate	01 - Adequate	03 - Critical	02 - Poor	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	02 - Poor	2 - At Grade	2 - At Grade	CC RUTHELLEN ROAD	
122019-100	2508280	01 - Adequate	Local	0.04	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	NEW YORK AVENUE	
122019-101	2511055	02 - Poor	Collector	1.5	01 - Adequate	01 - Adequate	01 - Adequate	03 - Critical	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	EDMANDS ROAD	
122019-102*	2511205	02 - Poor	Local	1.64	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	3 - Buried	3 - Buried	SLOANE DRIVE	
122019-103	2511207	01 - Adequate	Local	1.4	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	GREGORY ROAD	
122019-104	2511209	01 - Adequate	Collector	1.39	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	02 - Poor	01 - Adequate	01 - Adequate	02 - Poor	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	HEMENWAY ROAD
122019-105	2511212	01 - Adequate	Bike Path	1.33	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	03 - Critical	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	1 - Perched	CC APPELDO'R ROAD
122019-106	2511214	02 - Poor	Bike Path		02 - Poor	02 - Poor	02 - Poor	01 - Adequate	02 - Poor	04 - N/A	02 - Poor	02 - Poor	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	3 - Buried	2 - At Grade	HEMENWAY SCH FT PATH
122019-107	2511486	02 - Poor	Collector	1.8	01 - Adequate	01 - Adequate	01 - Adequate	02 - Poor	02 - Poor	04 - N/A	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	HEMENWAY ROAD
122019-108	2511488	01 - Adequate	Local	2.32	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	COLONIAL DRIVE
122019-109	2511495	01 - Adequate	Local	1.66	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	GREGORY ROAD
122019-111	2511546	01 - Adequate	Local	1.16	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	02 - Poor	01 - Adequate	02 - Poor	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	JUNIPER LANE
122019-112	2511560	01 - Adequate	Collector	0.07	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	03 - Critical	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	WINCH STREET
122019-113*	2511638	01 - Adequate	Local	0.39	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	CHICATAWBUT ROAD
122019-114*	2520964	01 - Adequate	Local	0.1	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	1 - Perched	LYMAN WAY
122019-115	2511728	03 - Critical	Local		02 - Poor	01 - Adequate	01 - Adequate	03 - Critical	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	1 - Perched	1 - Perched	GARVEY ROAD
122019-116	2511729	01 - Adequate	Local	0.06	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	1 - Perched	2 - At Grade	GARVEY ROAD
122019-117	2511116	01 - Adequate	Local	0.89	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	MCLEAN DRIVE
122019-118	2511120	02 - Poor	Collector	0.87	01 - Adequate	01 - Adequate	02 - Poor	02 - Poor	02 - Poor	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	BROOK STREET
122019-119*	2511122	01 - Adequate	Local	0.42	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	SCOTT DRIVE
122019-120*	2511130	01 - Adequate	Collector	0.26	02 - Poor	01 - Adequate	02 - Poor	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	FROST STREET
122019-121	2511139	01 - Adequate	Arterial	0.38	02 - Poor	01 - Adequate	02 - Poor	02 - Poor	01 - Adequate	04 - N/A	02 - Poor	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	3 - Buried	2 - At Grade	EDGELL ROAD
122019-122	2521337	01 - Adequate	Parking Lot		01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	CC WESTERN AVENUE
122019-123	2506908	01 - Adequate	Collector	0.086	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	SALEM END ROAD
122019-124*	2508880	01 - Adequate	Local	0.47	02 - Poor	01 - Adequate	02 - Poor	02 - Poor	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	HICKORY HILL LANE	
122019-125	2511816	01 - Adequate	Arterial	3.29	01 - Adequate	01 - Adequate	02 - Poor	02 - Poor	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	2 - At Grade	2 - At Grade	WINTER STREET
122019-127	2508334	02 - Poor	Arterial	0.064	01 - Adequate	01 - Adequate	01 - Adequate	02 - Poor	02 - Poor	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	02 - Poor	04 - N/A	01 - Adequate	2 - At Grade	1 - Perched	CENTRAL STREET
042320-027	2508898	02 - Poor	Local	0.14	02 - Poor	01 - Adequate	01 - Adequate	03 - Critical	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	3 - Buried	WILLOWBROOK ROAD
042320-028	2522006	01 - Adequate	Parking Lot		01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	04 - N/A	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	CC FOUNTAIN STREET
042320-029	2522007	01 - Adequate	Parking Lot		01 - Adequate	01 - Adequate	01 - Adequate	04 - N/A	01 - Adequate	04 - N/A	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	01 - Adequate	2 - At Grade	2 - At Grade	CC FOUNTAIN STREET

Appendix 3 – Immediate Action Culverts

Number of Structures Requiring Immediate Action Type

Debris/Vegetation Blockage	Critical Scour/Erosion	Structure Unstable
22	0	8

Culverts with Debris/Vegetation Blockage

Work Order ID	Asset ID	Street Name
122019-094	2506912	BADGER ROAD
122019-030	2515114	CC BEAVER DAM BROOK
122019-032	2501693	CC DUDLEY ROAD
122019-047	2518282	CC FRASER ROAD
122019-027	2505652	CC HARTFORD STREET
122019-051	2508218	CC WILSON DRIVE
122019-026*	2502862	DUDLEY ROAD
122019-031*	2512689	DUDLEY ROAD
122019-060	2506913	FOUNTAIN STREET
122019-106	2511214	HEMENWAY SCH FT PATH
122019-034	2511942	HERBERT STREET
122019-052	2508663	HOWE STREET
122019-040	2511895	KENDALL AVENUE
122019-070	2511187	KNIGHT ROAD
122019-045	2517849	LELAND STREET
122019-076	2511576	MILLWOOD STREET
122019-100*	2508280	NEW YORK AVENUE
122019-039	2514070	SECOND STREET
122019-093*	2508594	SPEEN STREET
122019-049	2508225	UNDERWOOD AVENUE
122019-061*	2508141	VICTORY STREET
122019-029	2509026	WAYSIDE INN ROAD

Culverts in blue appear in both immediate action lists.

*Culverts marked with an asterisk have debris/vegetation blockage as the only issue.

Culverts with Unstable Structure

Work Order ID	Asset ID	Street Name
122019-094	2506912	BADGER ROAD
122019-028	2506893	BELKNAP ROAD
122019-027	2505652	CC HARTFORD STREET
122019-099	2511613	CC RUTHELLEN ROAD
122019-034	2511942	HERBERT STREET
122019-097	2509452	LYMAN ROAD
122019-080	2511778	PARMENTER ROAD
122019-087	2511831	SALEM END ROAD

Culverts in blue appear in both immediate action lists.

Appendix 4 – Cost Estimate

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Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Hartford St Culvert Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	20	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$600.00
141	400	CY	CLASS A TRENCH EXCAVATION	\$45	\$18,000.00
148.	20	CY	DREDGING AND DISPOSING OF MATERIAL	\$350.00	\$7,000.00
151.	1	CY	GRAVEL BORROW	\$45	\$45.00
151.1		CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$7,250.00
	145				
151.2	45	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$2,565.00
156.1	120	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$6,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	25	TON	HMA FOR PATCHING	\$225	\$5,625.00
482.01	60	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$180.00
482.3	60	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$210.00
580.	20	FT	CURB REMOVED AND RESET	\$27	\$530.00
631.	20	FT	GUARDRAIL	\$30	\$600.00
657.	260	FT	TEMPORARY FENCE	\$19	\$4,940.00
657.5	260	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$3,900.00
698.1	270	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$1,485.00
701.	1	TON	HMA SIDEWALK	\$210	\$210.00
767.121	260	FT	SEDIMENT CONTROL BARRIER	\$7	\$1,778.40
767.9	20	SY	MATTING FOR EROSION CONTROL	\$7	\$132.60
983.1	115	TON	RIP RAP	\$65	\$7,475.00
995.011	1	LS	CULVERT STRUCTURE	\$159,000	\$159,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALLS/WINGWALLS	\$80,000	\$80,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	CONTROL OF WATER	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$7,500	\$7,500.00
				<hr/>	
				Subtotal	\$344,326
				Mobilization (Assumed 5%)	\$17,216
				Police Detail & Traffic Control (Assumed 10%)	\$34,433
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$34,433
				Contingency (35%)	\$120,514
				<hr/>	
				Subtotal	\$550,922
				Permitting & Design (Assumed 25%)	\$137,730
				Construction Observation (Assumed 12%)	\$66,111
				<hr/>	
				Total	\$754,763
				SAY	\$755,000

Assumptions:

- Replacement of culvert with 6' x 3' concrete box culvert
- Control of water is necessary
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 5.5-feet
- Headwalls to be installed on upstream and downstream ends
- Assume dredging limits to back of adjacent property (75-foot long) by 1-foot deep by 6-feet wide



Preliminary Construction Cost Estimate

101 Walnut Street
Watertown
Massachusetts 02272
617 924 1770
FAX 617 924 2286

Date: 8/18/2020

Job Number: 14484.01

Project: Herbert St Culvert Replacement

Location: Framinham, MA

Estimator: JAD

Checked By: MAC

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
101.	0.1	A	CLEARING AND GRUBBING	\$34,000	\$3,400.00
103.	10	EA	TREE REMOVED - DIAMETER UNDER 24 INCHES	\$1,500	\$15,000.00
120.1	200	CY	UNCLASSIFIED EXCAVATION	\$40	\$8,000.00
125.	10	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$300.00
141	100	CY	CLASS A TRENCH EXCAVATION	\$45	\$4,500.00
148.	20	CY	DREDGING AND DISPOSING OF MATERIAL	\$350	\$7,000.00
151.	2	CY	GRAVEL BORROW	\$45	\$90.00
151.1	50	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$2,500.00
151.2	15	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$855.00
156.1	40	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$2,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	60	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$5,400.00
415.1	45	SY	PAVEMENT MILLING STANDARD	\$8	\$337.50
451.	20	TON	HMA FOR PATCHING	\$225	\$4,536.00
482.01	70	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$210.00
482.3	70	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$245.00
580.	30	FT	CURB REMOVED AND RESET	\$27	\$795.00
631.	30	FT	GUARDRAIL REMOVED AND RESET	\$23	\$690.00
657.	120	FT	TEMPORARY FENCE	\$19	\$2,280.00
657.5	120	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,800.00
698.1	100	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$550.00
701.	15	SY	CEMENT CONCRETE SIDEWALK	\$61	\$915.00
765.	15	SY	SEEDING	\$2	\$30.00
767.121	120	FT	SEDIMENT CONTROL BARRIER	\$7	\$820.80
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	20	TON	RIP RAP	\$65	\$1,300.00
995.01	1	LS	CULVERT STRUCTURE	\$30,000	\$30,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALL	\$20,000	\$20,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
				Subtotal	\$129,654
				Mobilization (Assumed 5%)	\$6,483
				Police Detail & Traffic Control (Assumed 10%)	\$12,965
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$12,965
				Contingency (35%)	\$45,379
				Subtotal	\$207,446
				Permitting & Design (Assumed 25%)	\$51,862
				Construction Observation (Assumed 12%)	\$24,894
				Total	\$284,201
				SAY	\$285,000

Assumptions:

- Given existing culvert is clogged and does not carry dry weather flow no control of water costs included
- Culvert size to match existing culvert (42-inch x 24-inch)
- Headwalls to be installed on upstream and downstream ends



Preliminary Construction Cost Estimate

Option A

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 12/8/2020

Job Number: 14484.01

Project: Waushakum Brook Culvert
 Replacement

Location: Framingham, MA

Estimator: JAD, KMS

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
120.1	100	CY	UNCLASSIFIED EXCAVATION	\$40	\$4,000.00
125.	10	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$300.00
151.1	60	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$3,000.00
151.2	20	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$1,140.00
156.1	40	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$2,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
302.08	122	FT	8" DUCTILE IRON WATER PIPE	\$128	\$15,616.00
631.	60	FT	GUARDRAIL	\$30	\$1,800.00
657.	85	FT	TEMPORARY FENCE	\$19	\$1,615.00
657.5	85	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,275.00
698.1	95	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$522.50
767.121	85	FT	SEDIMENT CONTROL BARRIER	\$7	\$581.40
767.9	20	SY	MATTING FOR EROSION CONTROL	\$7	\$132.60
983.1	70	TON	RIP RAP	\$65	\$4,550.00
995.01	1	LS	BRIDGE STRUCTURE (includes walls)	\$380,000	\$380,000.00
	1	LS	MISCELLANEOUS PIPE FITTINGS	\$3,000	\$3,000.00
	1	LS	CONTROL OF WATER	\$25,000	\$25,000.00
	1	LS	NO RISE CERTIFICATE PERMITTING	\$25,000	\$25,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES,	\$7,500	\$7,500.00
				<hr/>	
				Subtotal	\$486,333
				Mobilization (Assumed 5%)	\$24,317
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 20%)	\$97,267
				Contingency (35%)	\$170,216
				<hr/>	
				Subtotal	\$778,132
				Permitting & Design (Assumed 25%)	\$194,533
				Construction Observation (Assumed 12%)	\$93,376
				<hr/>	
				Total	\$1,066,041
				SAY	\$1,067,000

Assumptions:

- Replacement of culvert with 20' Bridge
- Control of water is necessary
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 20-feet
- Located within FEMA Floodway, No-rise certificate required.
- Assume no cost for police detail or traffic control as project is not within a roadway.



Preliminary Construction Cost Estimate

Option B

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 12/8/2020

Job Number: 14484.01

Project: Waushakum Brook Culvert
 Replacement

Location: Framingham, MA

Estimator: JAD, KMS

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
120.1	235	CY	UNCLASSIFIED EXCAVATION	\$40	\$9,400.00
125.	15	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$450.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
302.08	122	FT	8" DUCTILE IRON WATER PIPE	\$128	\$15,616.00
657.	110	FT	TEMPORARY FENCE	\$19	\$2,090.00
657.5	110	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,650.00
698.1	110	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$605.00
767.121	140	FT	SEDIMENT CONTROL BARRIER	\$7	\$957.60
767.9	20	SY	MATTING FOR EROSION CONTROL	\$7	\$132.60
983.1	100	TON	RIP RAP	\$65	\$6,500.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	MISCELLANEOUS PIPE FITTINGS	\$3,000	\$3,000.00
	1	LS	CONTROL OF WATER	\$25,000	\$25,000.00
	1	LS	NO RISE CERTIFICATE PERMITTING	\$25,000	\$25,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES,	\$7,500	\$7,500.00
			Subtotal		\$117,201
			Mobilization (Assumed 5%)		\$5,860
			Police Detail & Traffic Control (Assumed 10%)		\$11,720
			Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 20%)		\$23,440
			Contingency (35%)		\$41,020
			Subtotal		\$199,242
			Permitting & Design (Assumed 25%)		\$49,811
			Construction Observation (Assumed 12%)		\$23,909
			Total		\$272,962
			SAY		\$273,000

Assumptions:

- Removal of crossing and restoration of Beaver Dam Brook with a rip rap lined open channel
- Control of water is necessary
- Located within FEMA Floodway, No-rise certificate required.
- Assume no cost for police detail or traffic control as project is not within a roadway.



Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Gates St Culvert Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	20	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$600.00
141	420	CY	CLASS A TRENCH EXCAVATION	\$45	\$18,900.00
151.	170	CY	GRAVEL BORROW	\$45	\$7,650.00
151.1	50	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$2,500.00
151.2	15	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$855.00
156.1	40	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$2,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	30	TON	HMA FOR PATCHING	\$225	\$6,750.00
482.01	40	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$120.00
482.3	40	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$140.00
657.	120	FT	TEMPORARY FENCE	\$19	\$2,280.00
657.5	120	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,800.00
698.1	90	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$495.00
631.	55	FT	GUARDRAIL REMOVED AND RESET	\$23	\$1,265.00
767.121	120	FT	SEDIMENT CONTROL BARRIER	\$7	\$820.80
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	135	TON	RIP RAP	\$65	\$8,775.00
995.011	1	LS	CULVERT STRUCTURE	\$135,000	\$135,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALLS/WINGWALLS	\$82,000	\$82,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$5,000	\$5,000.00
	1	LS	REPLACEMENT OF OUTLET CONTROL	\$20,000	\$20,000.00
	1	LS	COFFERDAM- CONTROL OF WATER	\$50,000	\$50,000.00
	1	LS	H&H STUDY	\$50,000	\$50,000.00

Subtotal **\$423,850**

Mobilization (Assumed 5%) **\$21,193**

Police Detail & Traffic Control (Assumed 10%) **\$42,385**

Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 20%) **\$84,770**

Contingency (35%) **\$148,348**

Subtotal **\$720,546**

Permitting & Design (Assumed 25%) **\$180,136**

Construction Observation (Assumed 12%) **\$86,465**

Total **\$987,147**

SAY \$988,000

Assumptions:

- Replacement of culvert with 12' x 6' concrete box culvert

- Control of water is necessary

- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 12-feet. This assumes need to meet Stream Crossings Standards for grant funding, however proposed culvert could be smaller if City-funded.

- Headwalls to be installed on upstream and downstream ends

- The replacement of this culvert will likely require coordination of a hydrologic and hydraulic study and a flood analysis. An approximate cost of \$50,000 is carried for this analysis

- Additional contingency was provided for potential utility relocations (Assumed 20% of costs) given the proximity of the sewer force main, water main, and sewer pump station to the culvert



Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Wayside Inn Rd Culvert
 Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	5	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$150.00
141	115	CY	CLASS A TRENCH EXCAVATION	\$45	\$5,175.00
151.	6	CY	GRAVEL BORROW	\$45	\$270.00
151.1	55	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$2,750.00
151.2	20	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$1,140.00
156.1	45	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$2,250.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	20	TON	HMA FOR PATCHING	\$225	\$4,500.00
482.01	40	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$120.00
482.3	40	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$140.00
631.	15	FT	GUARDRAIL REMOVED AND RESET	\$23	\$345.00
657.	100	FT	TEMPORARY FENCE	\$19	\$1,900.00
657.5	100	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,500.00
698.1	100	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$550.00
767.121	100	FT	SEDIMENT CONTROL BARRIER	\$7	\$684.00
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	50	TON	RIP RAP	\$65	\$3,250.00
995.011	1	LS	CULVERT STRUCTURE	\$50,000	\$50,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALL/WINGWALLS	\$25,000	\$25,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES,	\$1,500	\$1,500.00
	1	LS	CONTROL OF WATER	\$10,000	\$10,000.00
				<hr/>	
				Subtotal	\$138,124
				Mobilization (Assumed 5%)	\$6,906
				Police Detail & Traffic Control (Assumed 10%)	\$13,812
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$13,812
				Contingency (35%)	\$48,343
				<hr/>	
				Subtotal	\$220,998
				Permitting & Design (Assumed 25%)	\$55,249
				Construction Observation (Assumed 12%)	\$26,520
				<hr/>	
				Total	\$302,767
				SAY	\$303,000

Assumptions:

- Replacement of the culvert with a 8' x 4' concrete box culvert
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 8-feet
- Headwalls to be installed on upstream end only



Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Salem End Rd Culvert
 Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
120.1	690	CY	UNCLASSIFIED EXCAVATION	\$40	\$27,600.00
125.	30	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$900.00
151.	15	CY	GRAVEL BORROW	\$45	\$675.00
151.1	270	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$13,500.00
151.2	80	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$4,560.00
156.1	200	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$10,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	50	TON	HMA FOR PATCHING	\$225	\$11,250.00
482.01	80	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$240.00
482.3	80	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$280.00
657.	290	FT	TEMPORARY FENCE	\$19	\$5,510.00
657.5	290	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$4,350.00
691.	50	FT	STONE WALL REMOVED AND REBUILT	\$150	\$7,500.00
698.1	460	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$2,530.00
767.121	290	FT	SEDIMENT CONTROL BARRIER	\$7	\$1,983.60
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	255	TON	RIP RAP	\$65	\$16,575.00
995.011	1	LS	CULVERT STRUCTURE	\$251,000	\$251,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALLS/WINGWALLS	\$82,000	\$82,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$7,500	\$7,500.00
				Subtotal	\$439,753
				Mobilization (Assumed 5%)	\$21,988
				Police Detail & Traffic Control (Assumed 10%)	\$43,975
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$43,975
				Contingency (35%)	\$153,914
				Subtotal	\$703,605
				Permitting & Design (Assumed 25%)	\$175,901
				Construction Observation (Assumed 12%)	\$84,433
				Total	\$963,939
				SAY	\$964,000

Assumptions:

- Replacement of culvert with 12' x 6' concrete box culvert
- Control of water is necessary
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 12-feet, assumes grant funding. If project is City-funded proposed replacement culvert could be smaller to save cost.
- Headwalls to be installed on upstream and downstream ends
- Pavement restoration assumes road and driveway restoration



Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Parmenter Rd Culvert

Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	5	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$150.00
141	95	CY	CLASS A TRENCH EXCAVATION	\$45	\$4,275.00
151.	5	CY	GRAVEL BORROW	\$45	\$225.00
151.1	45	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$2,250.00
151.2	15	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$855.00
156.1	35	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$1,750.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	15	TON	HMA FOR PATCHING	\$225	\$3,375.00
482.01	35	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$105.00
482.3	35	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$122.50
657.	90	FT	TEMPORARY FENCE	\$19	\$1,710.00
657.5	90	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,350.00
698.1	80	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$440.00
767.121	90	FT	SEDIMENT CONTROL BARRIER	\$7	\$615.60
767.9	20	SY	MATTING FOR EROSION CONTROL	\$7	\$132.60
983.1	35	TON	RIP RAP	\$65	\$2,275.00
995.011	1	LS	CULVERT STRUCTURE	\$39,000	\$39,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALL/WINGWALLS	\$24,000	\$24,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$1,500	\$1,500.00

Subtotal	\$110,931
Mobilization (Assumed 5%)	\$5,547
Police Detail & Traffic Control (Assumed 10%)	\$11,093
Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$11,093
Contingency (35%)	\$38,826
Subtotal	\$177,489
Permitting & Design (Assumed 25%)	\$44,372
Construction Observation (Assumed 12%)	\$21,299
Total	\$243,160
SAY	\$244,000

Assumptions:

- Replacement of culvert with 7' x 4' concrete box culvert
- Given existing culvert does not carry dry weather flow no control of water costs included
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 7-feet
- Headwalls to be installed on upstream and downstream ends



Preliminary Construction Cost Estimate

101 Walnut Street
Watertown
Massachusetts 02272
617 924 1770
FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Badger Rd Culvert Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	10	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$300.00
141	200	CY	CLASS A TRENCH EXCAVATION	\$45	\$9,000.00
151.	10	CY	GRAVEL BORROW	\$45	\$450.00
151.1	85	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$4,250.00
151.2	25	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$1,425.00
156.1	65	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$3,250.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	20	TON	HMA FOR PATCHING	\$225	\$4,500.00
482.01	40	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$120.00
482.3	40	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$140.00
657.	130	FT	TEMPORARY FENCE	\$19	\$2,470.00
657.5	130	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,950.00
691.	15	FT	STONE WALL REMOVED AND REBUILT	\$150	\$2,250.00
698.1	150	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$825.00
767.121	130	FT	SEDIMENT CONTROL BARRIER	\$7	\$889.20
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	70	TON	RIP RAP	\$65	\$4,550.00
995.011	1	LS	CULVERT STRUCTURE	\$76,000	\$76,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALLS/WINGWALL	\$64,000	\$64,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$1,500	\$1,500.00
				Subtotal	\$204,769
				Mobilization (Assumed 5%)	\$10,238
				Police Detail & Traffic Control (Assumed 10%)	\$20,477
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$20,477
				Contingency (35%)	\$71,669
				Subtotal	\$327,630
				Permitting & Design (Assumed 25%)	\$81,907
				Construction Observation (Assumed 12%)	\$39,316
				Total	\$448,853
				SAY	\$449,000

Assumptions:

- Replacement of culvert with 9' x 5' concrete box culvert
- Control of water is necessary
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 9-feet

- Headwalls to be installed on upstream and downstream ends



Preliminary Construction Cost Estimate

101 Walnut Street
 Watertown
 Massachusetts 02272
 617 924 1770
 FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Fountain St Culvert Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
125.	10	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$300.00
141	160	CY	CLASS A TRENCH EXCAVATION	\$45	\$7,200.00
151.	10	CY	GRAVEL BORROW	\$45	\$450.00
151.1	80	CY	GRAVEL BORROW FOR BACKFILLING STRUCTURES AND PIPES	\$50	\$4,000.00
151.2	25	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$1,425.00
156.1	60	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$3,000.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
451.	25	TON	HMA FOR PATCHING	\$225	\$5,625.00
482.01	50	FT	HOT APPLIED ASPHALTIC CRACK SEALER	\$3	\$150.00
482.3	50	FT	SAWCUTTING ASHALT PAVEMENT	\$4	\$175.00
631.	25	FT	GUARDRAIL REMOVED AND RESET	\$23	\$575.00
657.	130	FT	TEMPORARY FENCE	\$19	\$2,470.00
657.5	130	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$1,950.00
698.1	140	SY	GEOTEXTILE FABRIC FOR STABILIZATION	\$6	\$770.00
767.121	130	FT	SEDIMENT CONTROL BARRIER	\$7	\$889.20
767.9	20	SY	MATTING FOR EROSION CONTROL	\$7	\$132.60
983.1	65	TON	RIP RAP	\$65	\$4,225.00
995.011	1	LS	CULVERT STRUCTURE	\$68,000	\$68,000.00
996.03	1	LS	REINFORCED CONCRETE HEADWALLS/WINGWALLS	\$48,000	\$48,000.00
996.04	1	LS	SUPPORT OF EXCAVATION	\$10,000	\$10,000.00
	1	LS	CONTROL OF WATER	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES, SEEDING)	\$1,500	\$1,500.00
				Subtotal	\$187,637
				Mobilization (Assumed 5%)	\$9,382
				Police Detail & Traffic Control (Assumed 10%)	\$18,764
				Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)	\$18,764
				Contingency (35%)	\$65,673
				Subtotal	\$300,219
				Permitting & Design (Assumed 25%)	\$75,055
				Construction Observation (Assumed 12%)	\$36,026
				Total	\$411,300
				SAY	\$412,000

Assumptions:

- Replacement of culvert with 8' x 4'
- Control of water is necessary
- Culvert sized to meet Stream Crossing Standards (1.2 x bankfull width) = Approximately 8-feet
- Headwalls to be installed on upstream and downstream ends



Preliminary Construction Cost Estimate

101 Walnut Street
Watertown
Massachusetts 02272
617 924 1770
FAX 617 924 2286

Date: 10/13/2020

Job Number: 14484.01

Project: Garvey Rd OCS Replacement

Location: Framingham, MA

Estimator: JAD

Checked By: MC, SK

<u>Item No.</u>	<u>Qty</u>	<u>Unit</u>	<u>Description</u>	<u>Unit Price</u>	<u>Amount</u>
120.1	20	CY	UNCLASSIFIED EXCAVATION	\$40	\$800.00
125.	5	CY	TOPSOIL EXCAVATED AND STACKED	\$30	\$150.00
151.	5	CY	GRAVEL BORROW	\$45	\$225.00
151.2	2	CY	GRAVEL BORROW FOR BRIDGE FOUNDATION	\$57	\$114.00
156.1	5	TON	CRUSHED STONE FOR BRIDGE FOUNDATIONS	\$50	\$250.00
180.1	1	LS	HEALTH AND SAFETY PLAN	\$6,000	\$6,000.00
180.2	120	HR	IMPLEMENTATION OF HEALTH AND SAFETY PLAN	\$90	\$10,800.00
657.	200	FT	TEMPORARY FENCE	\$19	\$3,800.00
657.5	200	FT	TEMPORARY FENCE REMOVED AND RESET	\$15	\$3,000.00
767.121	200	FT	SEDIMENT CONTROL BARRIER	\$7	\$1,368.00
767.9	15	SY	MATTING FOR EROSION CONTROL	\$7	\$99.50
983.1	10	TON	RIP RAP	\$65	\$650.00
	1	LS	CONTROL OF WATER	\$10,000	\$10,000.00
	1	LS	VARIOUS SITE WORK (CLEARING & GRUBBING, LANDSCAPING, TREES,	\$7,500	\$7,500.00
	1	LS	OUTLET CONTROL STRUCTURE	\$60,000	\$60,000.00
Subtotal					\$103,957
Mobilization (Assumed 5%)					\$5,198
Police Detail & Traffic Control (Assumed 10%)					\$10,396
Potential Utility Relocations (Water, Sewer, Gas, etc. - Assumed 10%)					\$10,396
Contingency (35%)					\$36,385
Subtotal					\$166,330
Permitting & Design (Assumed 25%)					\$41,583
Construction Observation (Assumed 12%)					\$19,960
Total					\$227,873
SAY					\$228,000

Assumptions:

- Replacement of outlet control structure
- Control of water is necessary
- Replacement of outlet control structure only, existing 2-foot by 2-foot culvert to remain
- Assume approx. quantity 20 cubic yards of excavation

Appendix 5 – VUEWork MobileVue App

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8:51

MobileVUE

← Back

INSPECTION-Culvert Inspection

122019-057-ELM STREET-Hold

Details Assets Photos Documents

Tasks

+ Header Info

ID
122019-057

Logged By
Geoffrey Kovar

Log Date
12/20/2019 10:40 AM

Begin Date / Time
Mar 5, 2020 at 10:36 AM

Location

8:51

MobileVUE

Location
ELM STREET

GIS Shape

Culvert Shape
Round

GIS Material
XXX

GIS Number of Crossings
1

Number of Culvert Crossings
1

GIS Height
0

Height (inches)
30

GIS Width
0

8:51

MobileVUE

Outlet Type
8 - Other

Outlet Type
5 - Projecting

Channel Width (Upstream) (Feet)
300

Channel Width (Downstream) (Feet)
4

Depth to Roadway
4-10 Feet

Utility Encroachment
Yes No

Longitudinal Alignment
01 - Adequate

Level of Blockage

8:51

MobileVUE

Headwall/Wingwalls

04 - N/A

Armoring

01 - Adequate

Apron/Scour Protection

04 - N/A

Embankment Piping

01 - Adequate

Inlet Grade

2 - At Grade

Outlet Grade

3 - Buried

Roadway Condition

01 - Adequate

8:52

MobileVUE

Evidence of Flooding

Embarkment Erosion

Requires Immediate Action:

Debris/Vegetation Blockage

Structure Unstable

Critical Scour/Erosion

Culvert Condition

01 - Adequate

Comments:

Concrete culvert. Outlet control

