Stormwater Management Report

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Prepared for: City of Waltham, MA

Project Title: Chester Brook Flood Mitigation

Project No.: 160123

Stormwater Management Report

Subject: Stormwater Management Report

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To: Bob Winn, City of Waltham, MA

From: Scott Simpson, Brown and Caldwell

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Limitations:

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Table of Contents

List of Appendices

Section 1: Project Overview

Chester Brook flows through the City of Waltham (City) and is a tributary to the Charles River. Chester Brook's headwater begins at Hardy Pond, then the brook flows south, roughly following Lexington St. Chester Brook's tributary, West Chester Brook, discharges into Chester Brook immediately south of the cross streets of Lexington St and Beaver St. Continuing downstream, Chester Brook converges with Beaver Brook immediately downstream of Lyman Pond, which then flows to the Charles River.

Based on City and property owner information, Chester Brook causes flooding roughly two to three times per year for the businesses and residents adjacent to the brook along Lexington St and Oakley Ln. Flooding of the Quick and Clean Car Wash, located at 209 Lexington St, is shown in Figure 1. Figure 2 provides a map of Chester Brook, it's 100-year flood zone, the natural waterbodies along the Chester Brook system, and highlights the area of flooding between Lexington Street and Oakley Lane.

Figure 1. Flooding at the Quick and Clean Car Wash located at 209 Lexington St

To mitigate flooding along Lexington St and Oakley Ln and provide environmental co-benefits, the City was awarded a state funded Municipal Vulnerability Preparedness (MVP) action grant. The overall scope of the project is as follows:

1. Collect discharge and stage-storage data along Chester Brook;
2. Calibrate the existing model of Chester Brook with the measured discharge and stage-storage data;
3. Identify a wetlands/pond on Chester Brook that could provide additional stormwater detention to reduce flooding caused by Chester Brook during wet weather, focusing on Lexington St and Oakley Ln;
4. Design a flow control structure at the selected site along Chester Brook that reduces downstream flooding;
5. Perform education public outreach activities.

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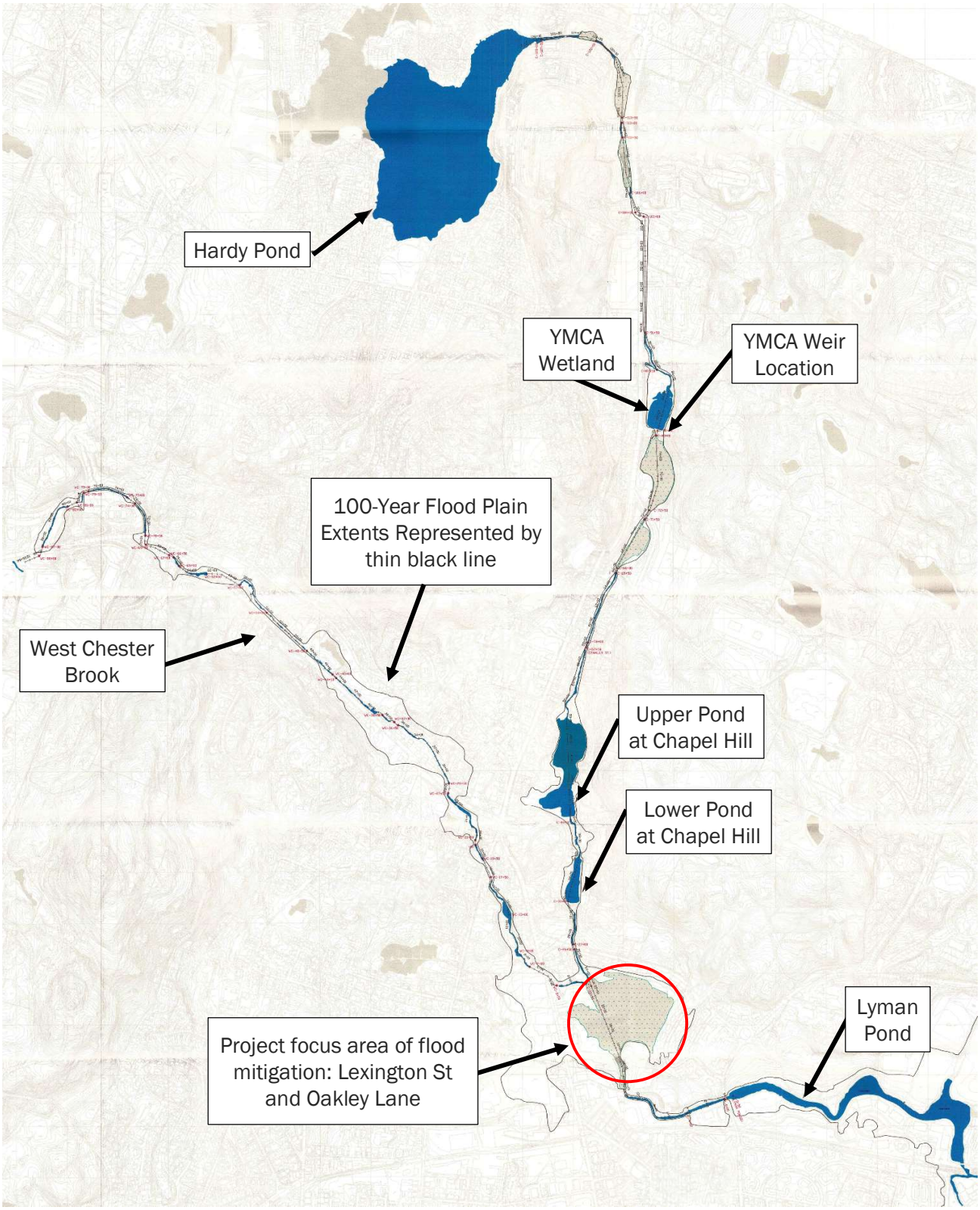

Figure 2. Chester Brook Extents and 100-Year Flood Map

Section 2: Data Collection

A field data collection program was developed to gather the measurements needed to track water levels, discharge, and rainfall along Chester Brook. This data was used in subsequent modeling, site selection, and design activities. Water level and discharge was continuously measured at four points along Chester Brook and a rain gauge was installed on Waltham's DPW facility rooftop. Data collection encompassed a three-month long period from September through November 2022. The data collection sites are shown in Figure 3 and Table 1 summarizes the data collected at each site.

Table 1. Data Collection Site Summary

Site ID	Data Collection Parameters
CB-JFK Middle School	Water level[1] Discharge[2]
CB-Chapel Hill	Water level[1] Discharge[2]
CB-West Chester Brook	Water level[1] Discharge[2]
CB-Lyman	Water level[1] Discharge[2]
RG-DPW	Precipitation[3]

Notes:

1. *Measurements collected by a Solinst Levelogger 5 pressure transducer. Calibrated the pressure transducer by collecting manually collecting water level measurements measured with a staff gauge.*
2. *The discharge was estimated from the continuous water level measurements and a stage-discharge rating curve. The stage discharge rating curve was developed from manual water level and flow measurements. The flow measurements were estimated from manual velocity measurements with a SonTek FlowTracker handheld acoustic doppler velocimeter and the measured cross-sectional areas of the stream segments.*
3. *Measured by Texas Electronics TR-525USW rain gauge.*

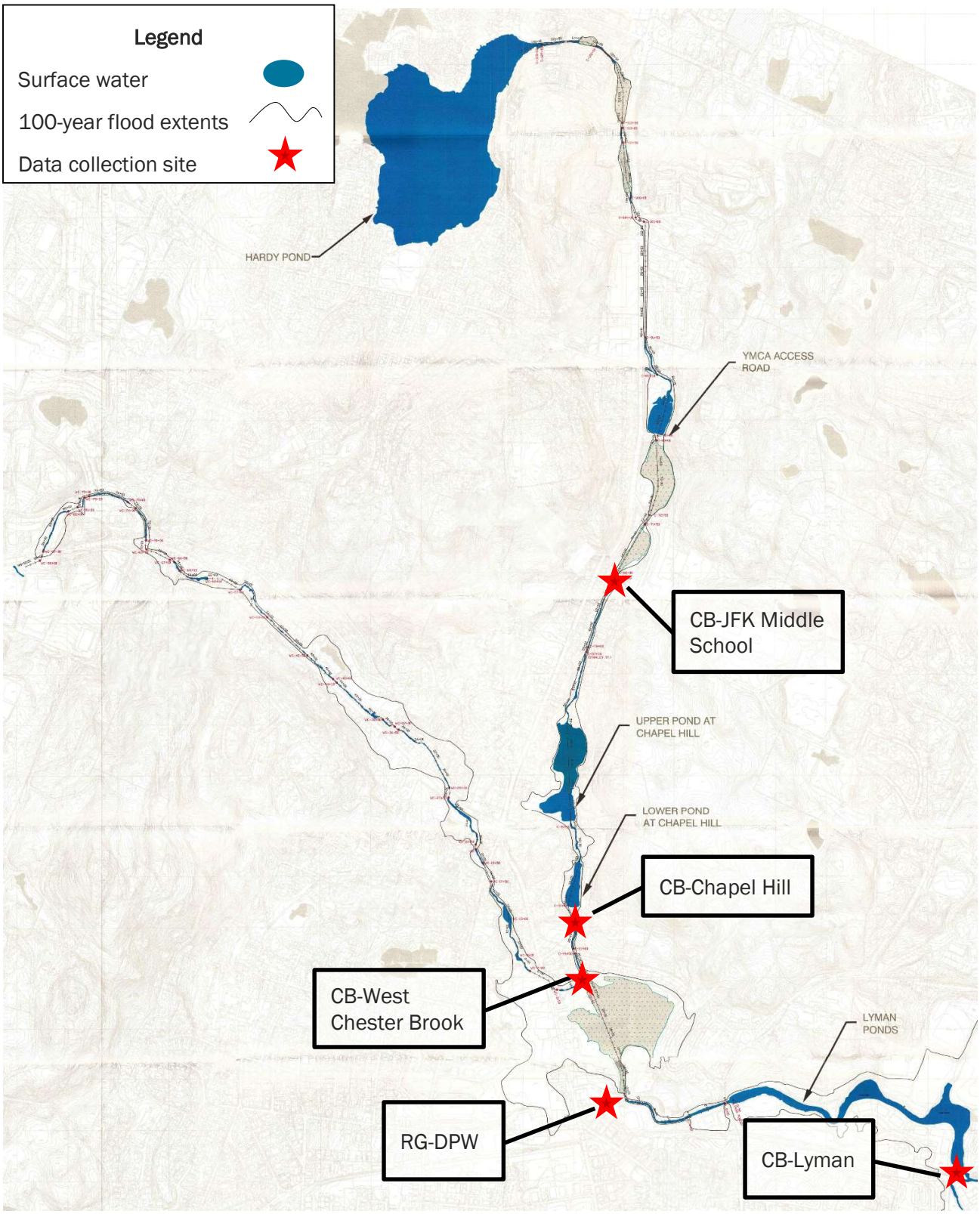

Figure 3. Monitoring Sites

BC installed Solinst Levelogger 5 datalogging pressure transducers at each of the monitoring sites. Each pressure transducers records water level measurements every 2 minutes and was calibrated and validated against a staff gauge that BC installed at each site. To develop the rating curve at each site, BC manually measured streamflow, during dry and wet weather, following the midsection method using a SonTek FlowTracker handheld acoustic doppler velocimeter. By applying the stage-discharge rating curve to the measured water levels, a continuous record of discharge was generated at each site. The stage-discharge curves for the collection sites can be found in Figure 4, 5 and 6. Discharge data for CB-Chapel Hill was not computed as the school alters the configuration of the weir based on the weather forecast, which resulted in changes in the reach's stage-discharge relationship over the course of the monitoring period.

Figure 4 shows the rating curve for CB-Lyman. For each site, two curves were created to categorize high and low flow. For CB-Lyman, a linear relationship was developed for normal to higher flow (water level>1.46 ft). A polynomial relationship was developed for low flow (water levels <1.46 ft) as the linear relationship could not accurately represent low flow at the CB-Lyman monitoring point accurately.

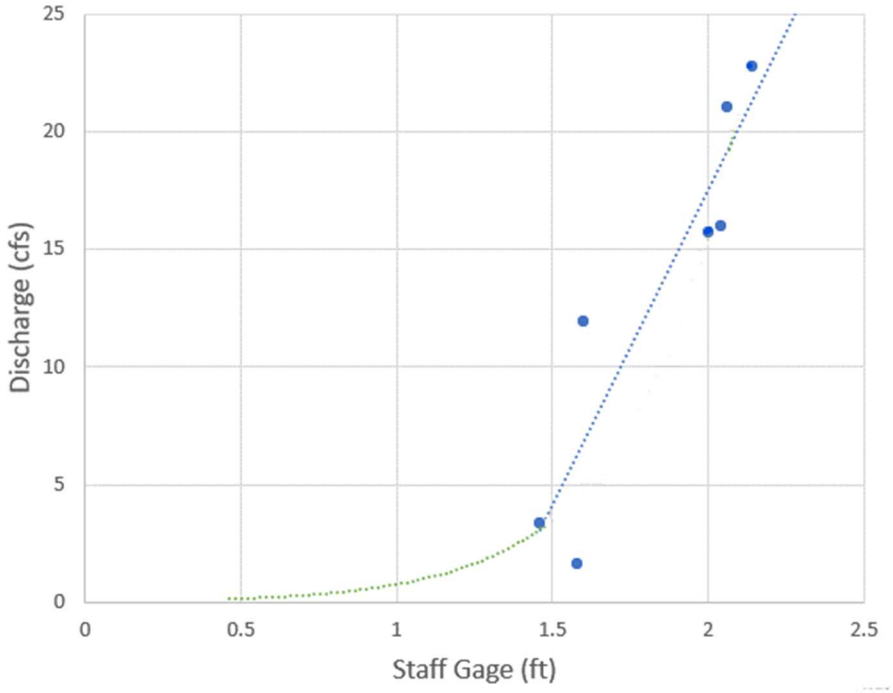

Figure 4. CB-Lyman Stage-Discharge Curve

For water levels ≤ 1.46 ft, the discharge was estimated as follows:

$$Q = 0.0394e^{2.9924d}$$

and for water levels > 1.46 ft, the discharge was estimated as follows:

$$Q = 26.6d - 35.801$$

where *Q* is the discharge from site CB-Lyman in cfs and *d* is the depth at site CB-Lyman in feet.

Figure 5 shows the rating curve for CB-JFK Middle School. For CB-JFK Middle School, a linear relationship was developed for normal to higher flow (water level>0.03 ft). A polynomial relationship was developed for low flow (water levels <0.03 ft) as the linear relationship could not accurately represent low flow at the CB-JFK Middle School monitoring point accurately.

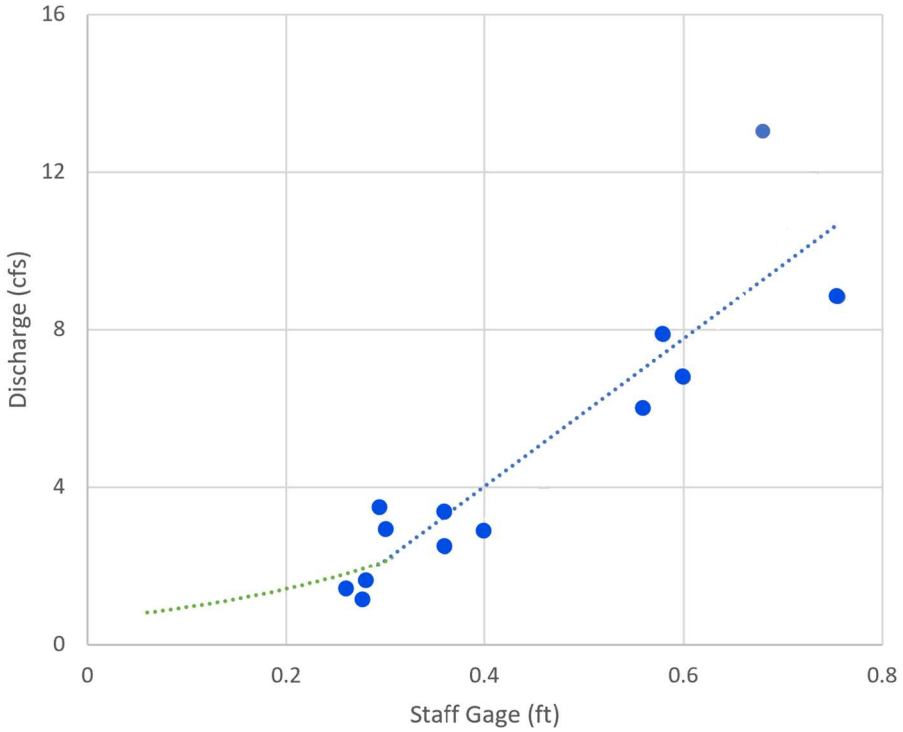

Figure 5. CB-JFK Middle School Stage-Discharge Curve

For water levels ≤ 0.03 ft, the discharge was estimated as follows:

$$Q = 0.6401e^{3.99}$$

and for water levels > 0.03 ft, the discharge was estimated as follows:

$$Q = 18.71d - 3.4611$$

where *Q* is the discharge from site CB-JFK Middle School in cfs and *d* is the depth at site CB-JFK Middle School in feet.

Figure 6 shows the rating curve for CB-West Chester Brook. For CB-West Chester Brook, a linear relationship was developed for normal to higher flow (water level>1.32 ft). A polynomial relationship was developed for low flow (water levels <1.32 ft) as the linear relationship could not accurately represent low flow at the CB-West Chester Brook monitoring point accurately.

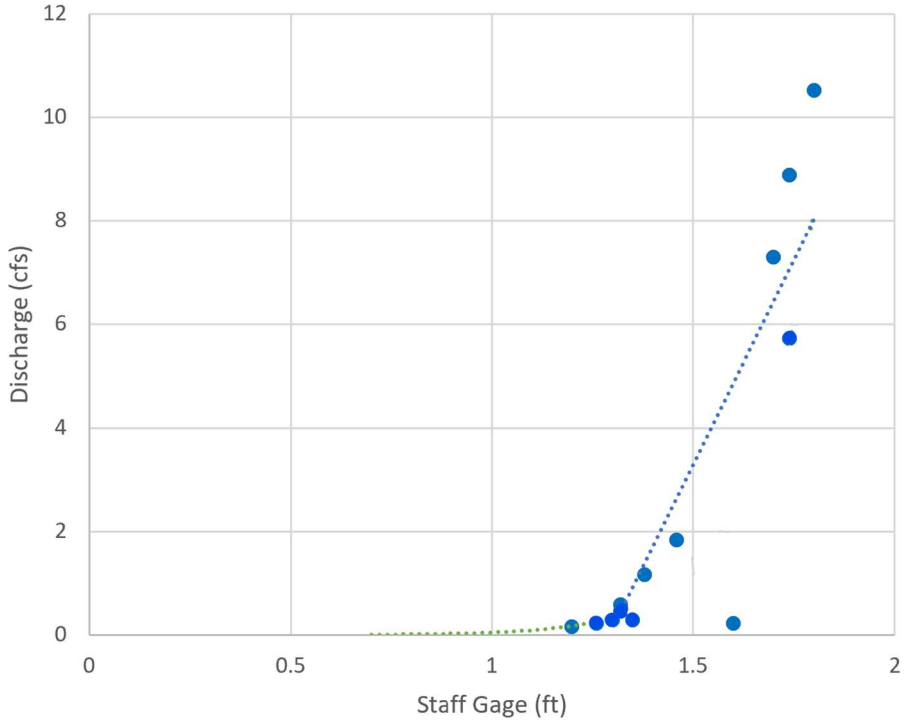

Figure 6.CB-West Chester Brook Stage-Discharge Curve

For water levels ≤ 1.32 ft, the discharge was estimated as follows:

$$Q = 8E - 5e^{6.4269}$$

and for water levels > 1.32 ft, the discharge was estimated as follows:

$$Q = 18.71d - 3.4611$$

where *Q* is the discharge from site CB-West Chester Brook in cfs and *d* is the depth at site CB-West Chester Brook in feet.

Water levels measured during the data collection period are provided in Figure 7, with Figure 8 showing the corresponding discharge information from the data collection sites.

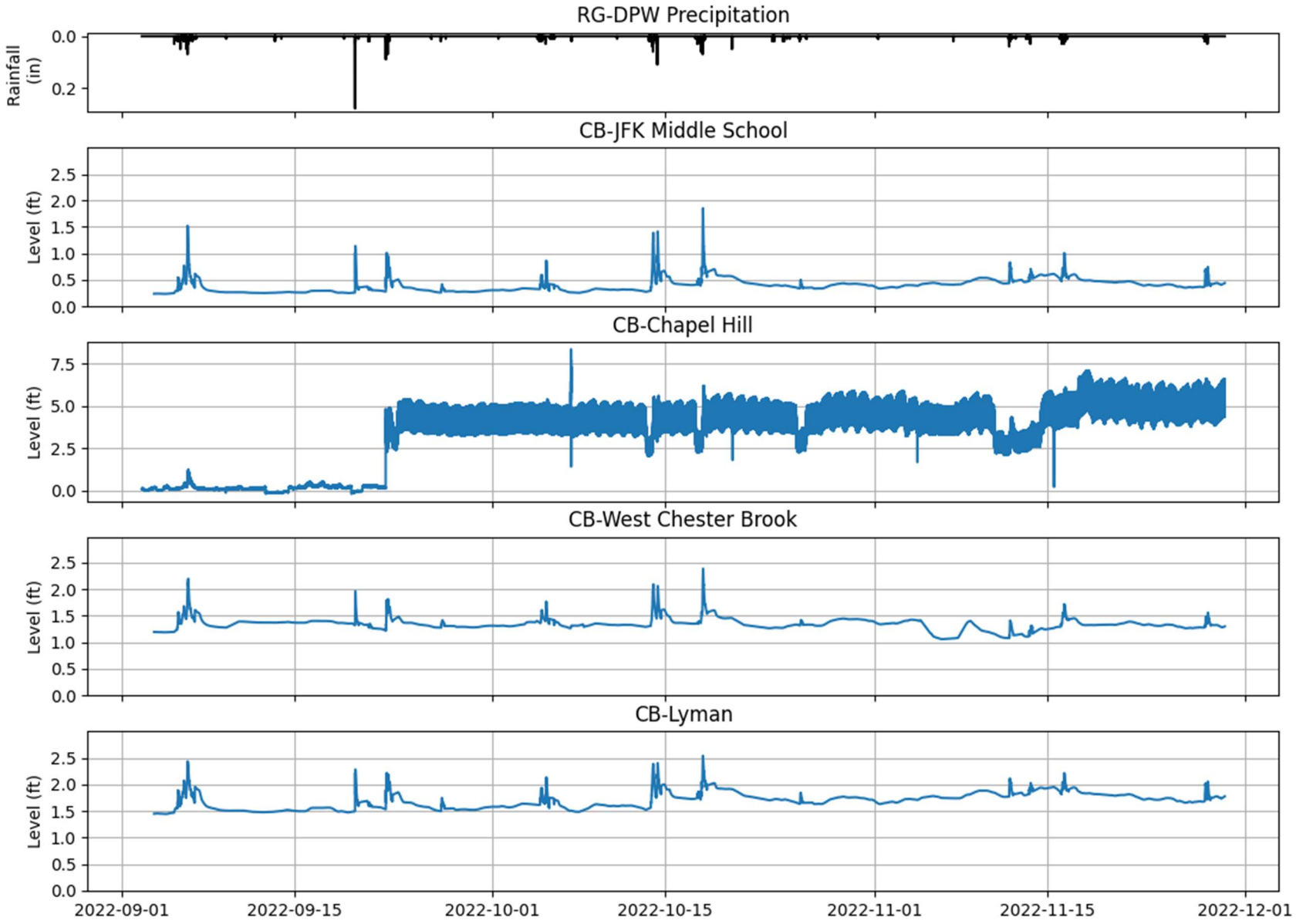

Figure 7. Water levels during the data collection period

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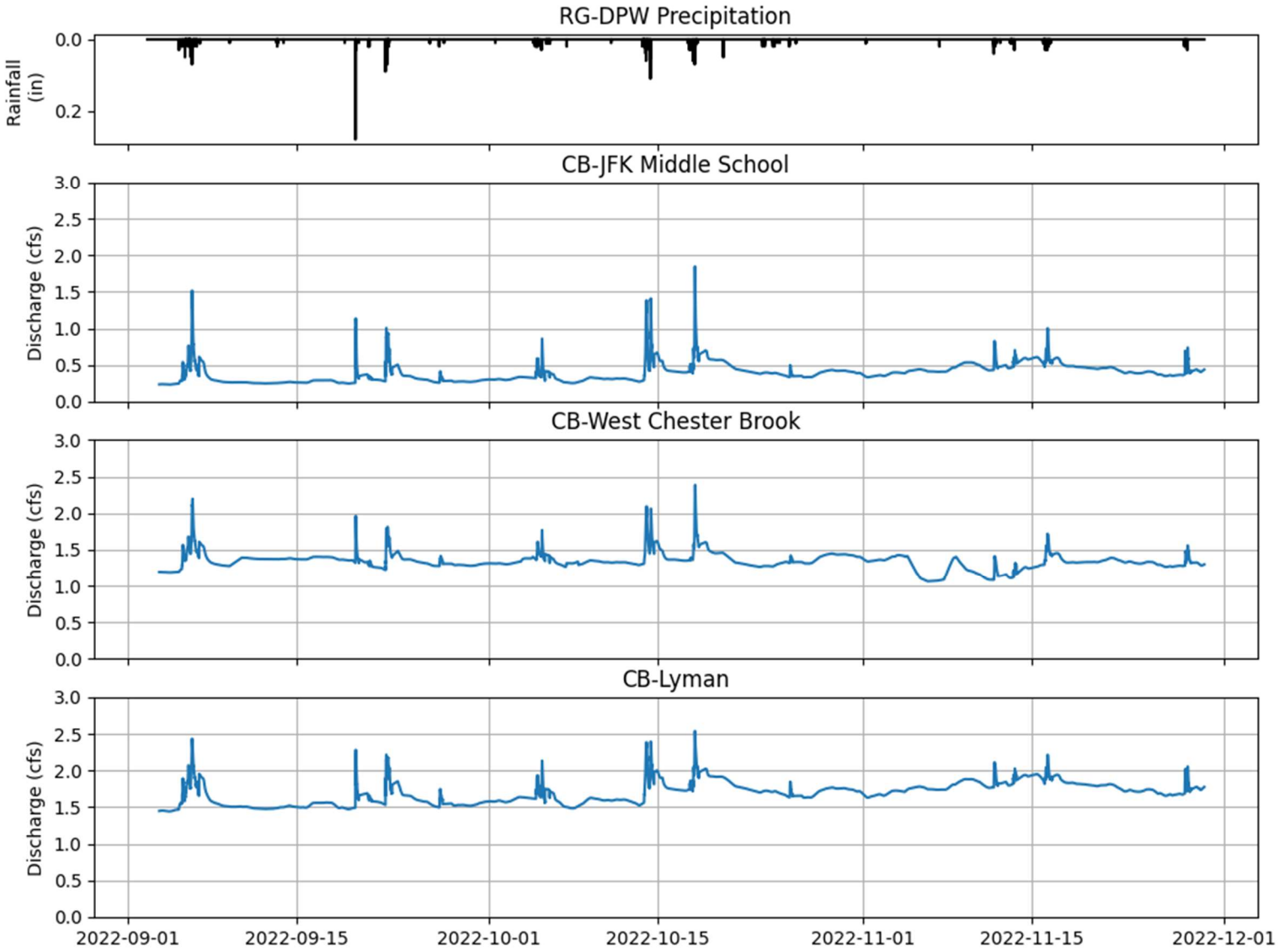

Figure 8. Discharge during the data collection period

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Section 3: Modeling

The City provided BC with a copy of its SWMM model of the City's surface drainage network The model was developed under a previous MVP grant. The Chester Brook portion of the model was extracted to a new model. The extent of the SWMM model is displayed in Figure 9. The model was further calibrated to collected data, which will be detailed in this section.

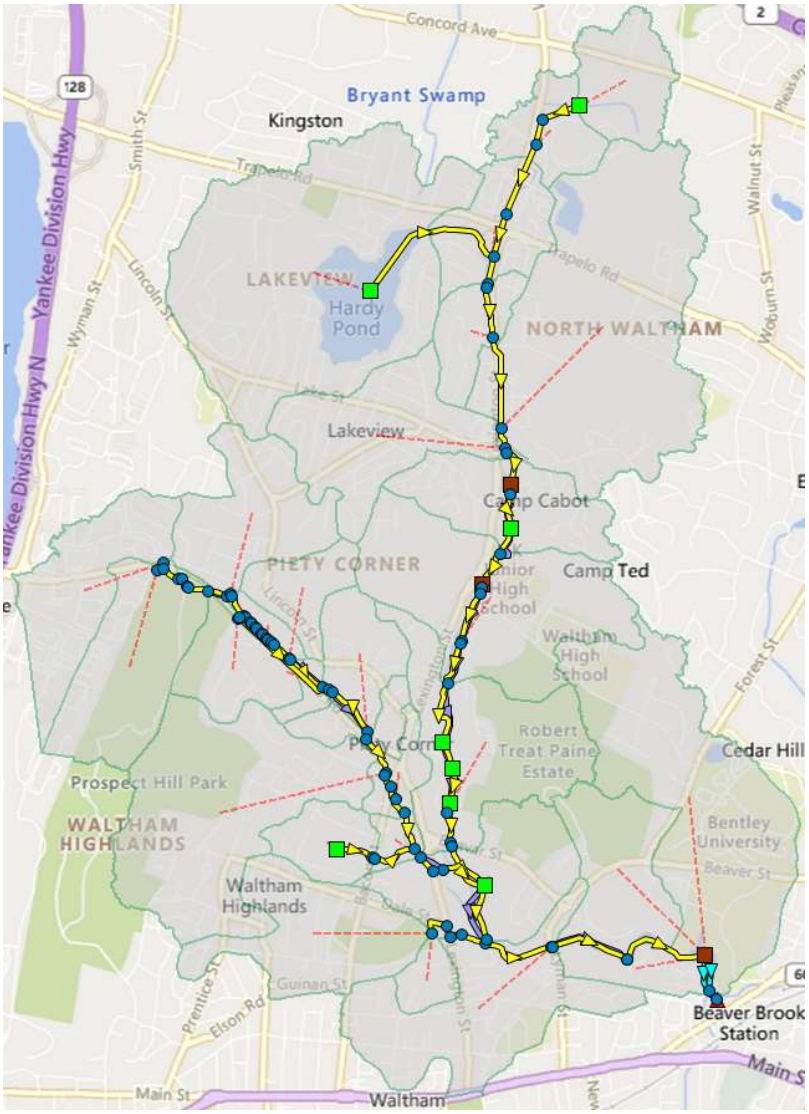

Figure 9. Extent of SWMM model

The model represents approximately 2,500 acres of drainage area, with 560 acres of impervious area directly connected to the modeled Chester Brook system. This area is split into 30 sub-watersheds that drain to 5 miles of modeled channels. 11 natural storage areas are represented by storage nodes.

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3.1 Hydraulic Updates

It was assumed that model adequately represents junction elevations, stream channel shape and slope, subcatchment shape and outlet, and overall system configuration. Areas around the monitoring sites had minor conveyance updates to reflect observed conditions.

3.1.1 Site Storage Updates

The storage curves for wetlands and ponds along Chester Brook were updated. The JFK Middle School Wetland, Upper Pond at Chapel Hill, and Lyman Pond were updated using GPS survey data acquired during the monitoring period. The YMCA wetland storage curve was re-developed using survey data collected and processed by Doucet Survey LLC, as shown in Appendix A. Figure 10 shows the measured storage curves for the water bodies being investigated for flood mitigating potential along Chester Brook.

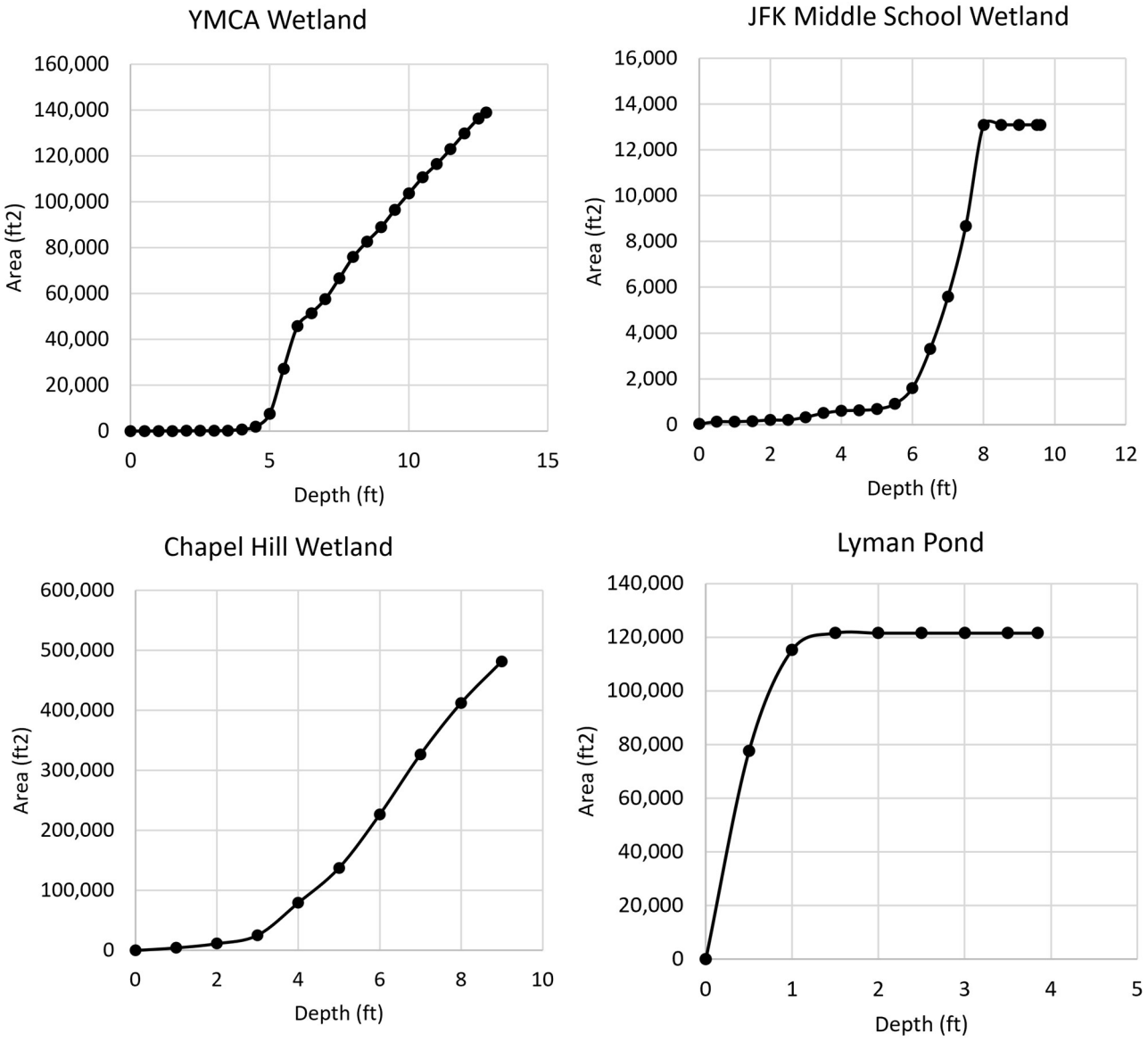


Figure 10. Storage Curves

3.1.2 Conveyance Updates

The weirs immediately upstream and downstream of Lyman Pond and the outlet structure in the downstream end of the YMCA wetland were not represented in the original model. These structures were created in the model to better represent current conditions.

After the storage curves for the surveyed sites were updated, the conveyance features to and from the storage nodes were updated to represent field conditions and configuration of the storage nodes. Storage nodes that were not part of the surveyed areas were not updated.

3.2 Hydrologic Updates

After completing the hydraulic updates discussed in Section 3.1, the model was used to simulate conditions during the monitoring period and the results were compared against measured values. The comparison found that the model was overestimating the streamflow peaks and volumes. As a result, the hydrology of the model was updated to improve its ability to simulate streamflow rates.

Adjustments were made to the hydrologic parameters of the model to better represent runoff routed to pervious area, infiltration, and groundwater inflow. Impervious area was adjusted to represent impervious surfaces connected to the stream channels as opposed to total impervious area. An upstream larger subcatchment was split to represent runoff loading at a finer degree.

For convenience, the following terminology will be used to refer to stages of the model as it was refined during the course of the project:

- Intermediate Model – The original model with the hydraulic updates discussed in Section 3.1. The hydrology of this model has not been recalibrated.
- Final Model – The original model with the hydraulic updates discussed in Section 3.1 and the hydrologic updates discussed in this section. This is the final, recalibrated model that was used for subsequent analysis of the City's surface drainage network.

The simulated flows from the models are compared to the measured flows at CB-JFK Middle School in Figure 11 andFigure 12. As can be seen in Figure 11, the Intermediate Model flows overestimate the measured flows. The recalibrated flows shown in Figure 12 for the Final Model are much closer to the measured flows. A comparison of the peak flows for storm events is provided in Figure 13. The dashed lines represents a perfect 1:1 correspondence between simulated and measured flows. As shown in the Figure, the Final Model peak flows are well clustered around this line, indicating a good calibration.

A similar series of figures are presented for the two other sites where flows were measured: CB-West Chester Brook (Figures 14, 15 and 16) and CB-Lyman (Figures 17, 19 and 19). The observations discussed for the CB-JFK site apply to these sites as well. The Intermediate Model overestimates the measured flows while the Final is well-calibrated.

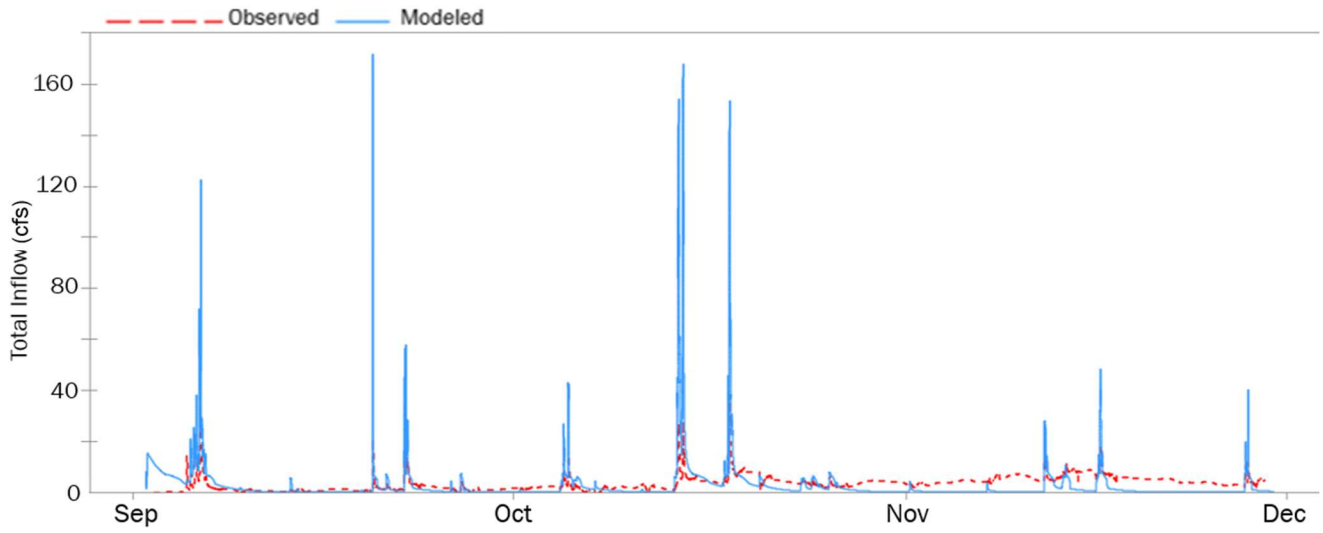


Figure 11. CB-JFK Middle School
Intermediate Model Flows vs Measured Flows

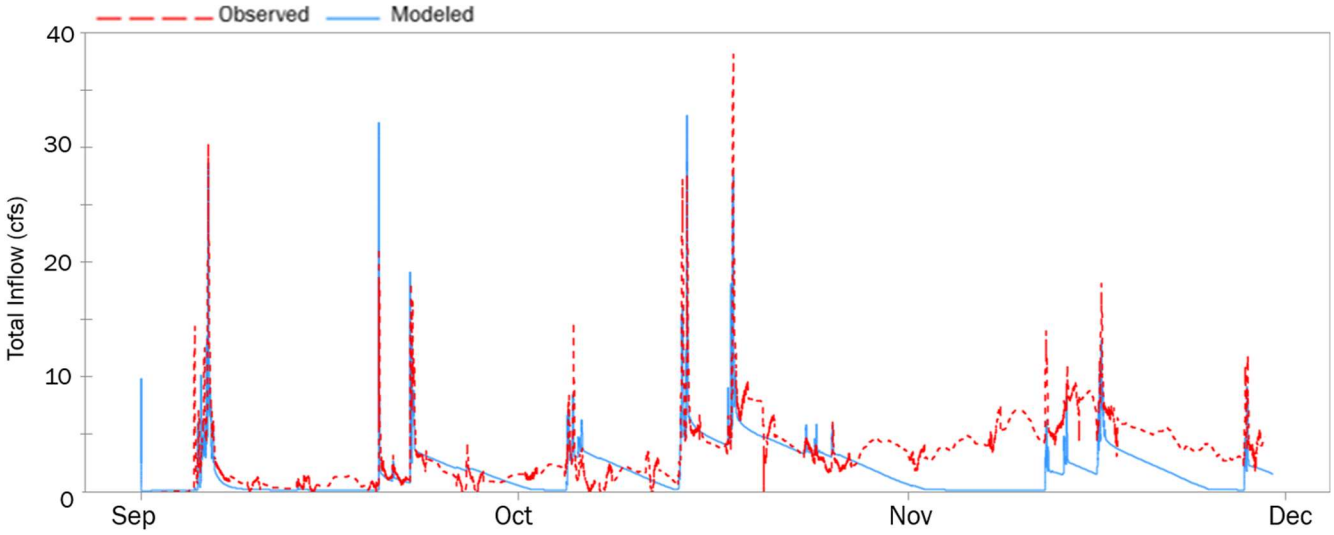


Figure 12. CB-JFK Middle School
Final Model Flows vs Measured Flows

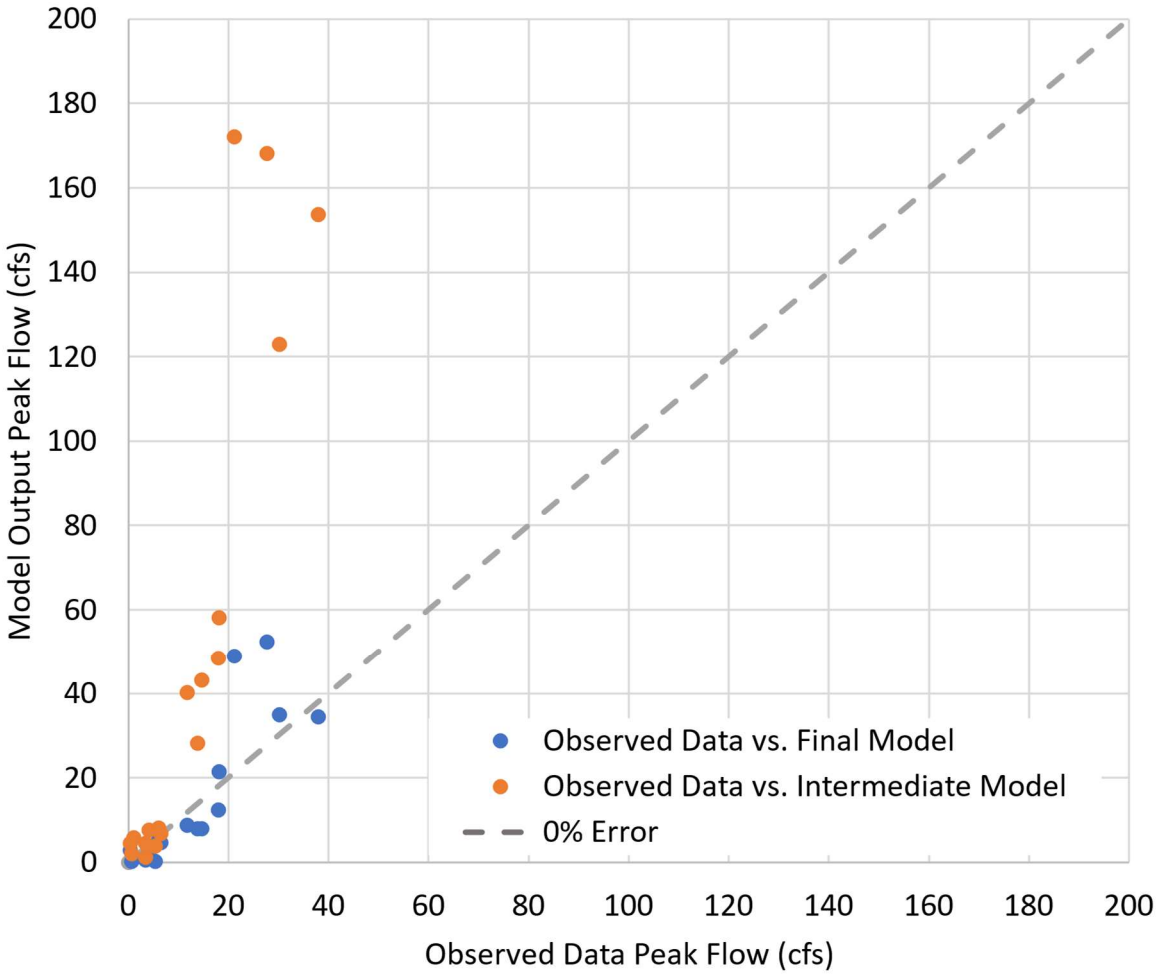


Figure 13. CB-JFK Middle School
Comparison of Simulated vs Measured Peak Flows during Storm Events

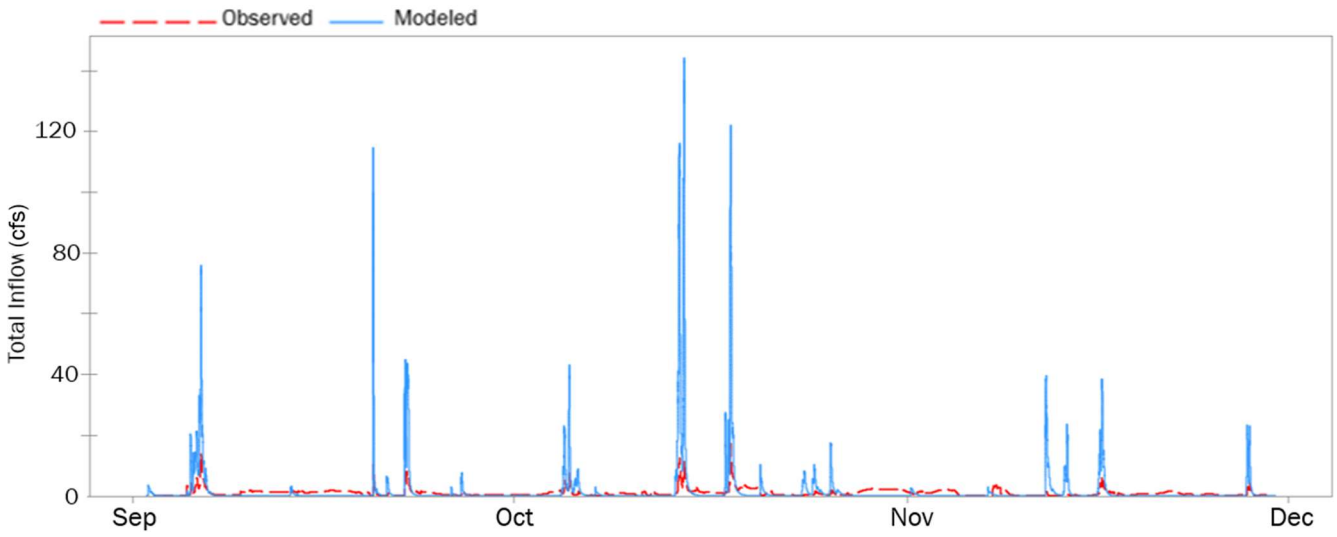


Figure 14. CB-West Chester Brook
Intermediate Model Flows vs Measured Flows

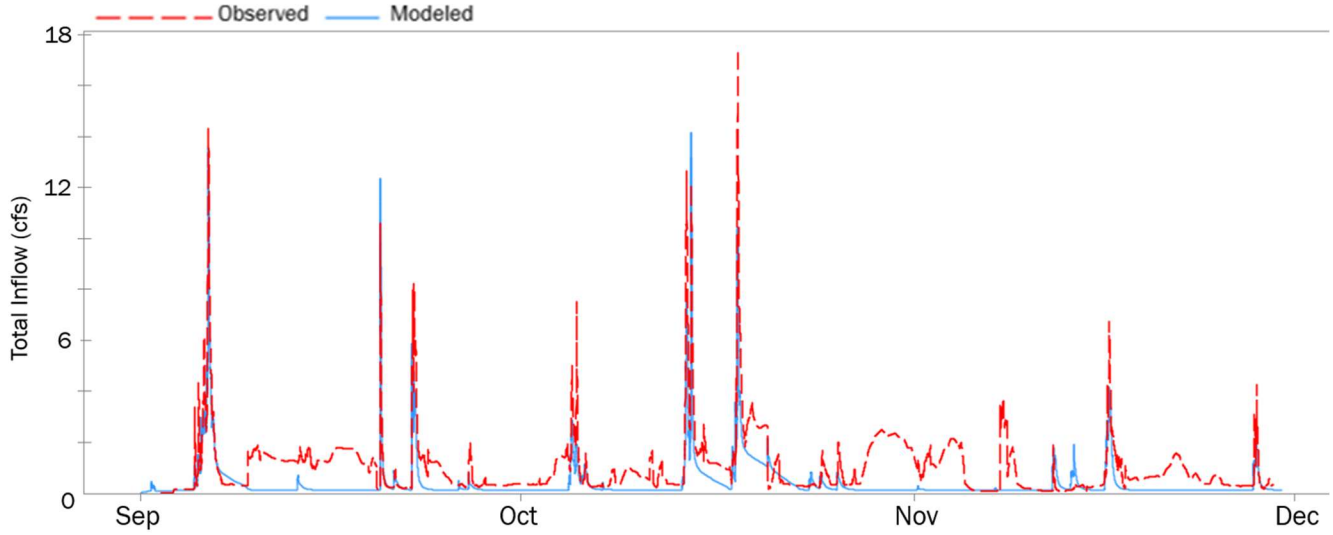


Figure 15. CB-West Chester Brook
Final Model Flows vs Measured Flows

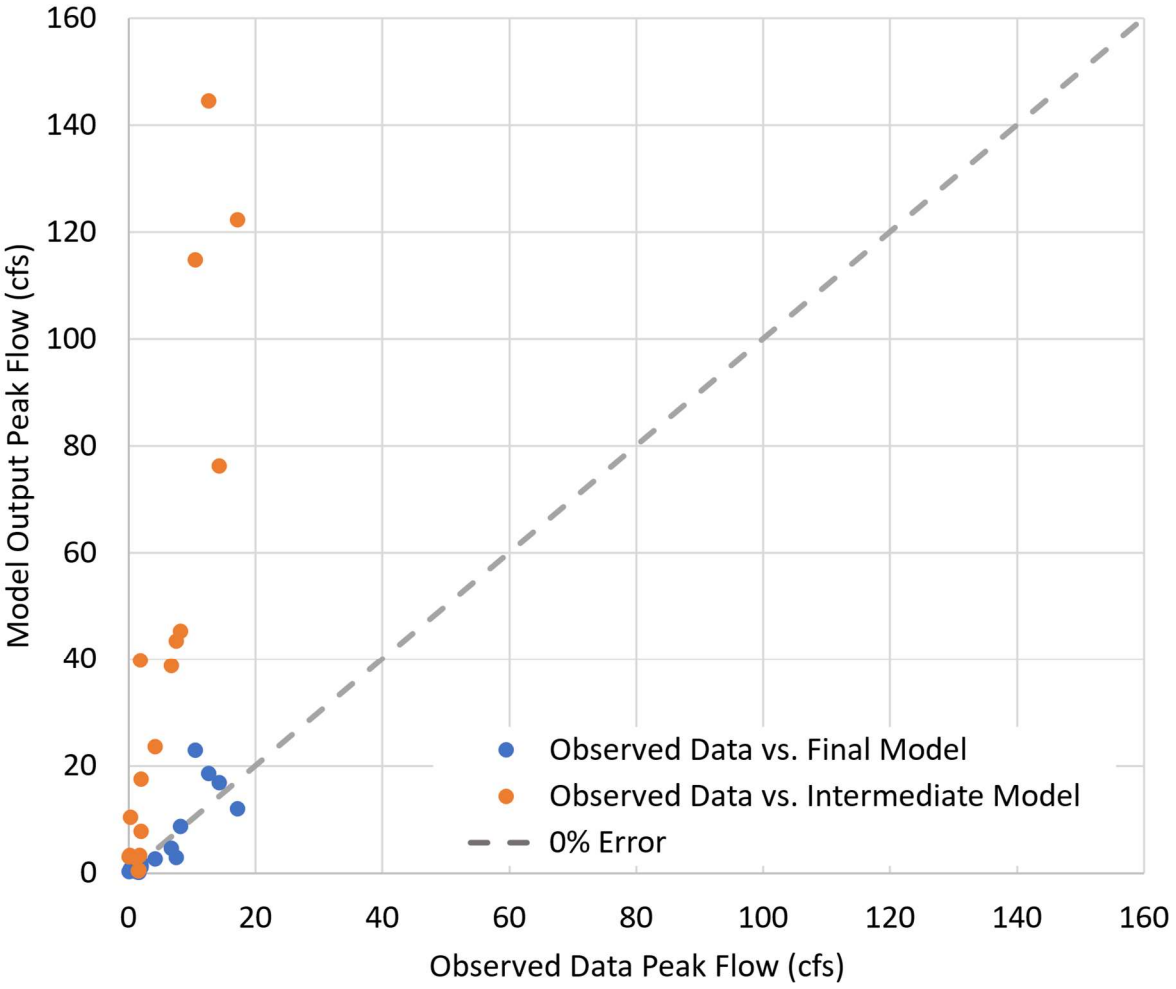


Figure 16. CB-West Chester Brook

Comparison of Simulated vs Measured Peak Flows during Storm Events

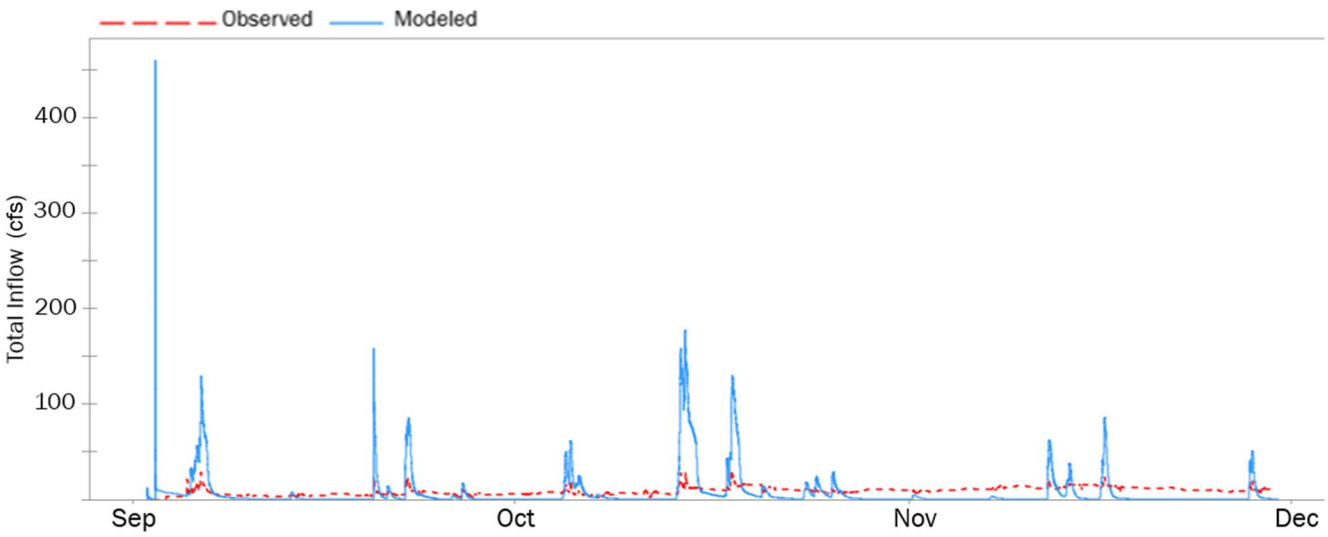


Figure 17. CB-Lyman
Intermediate Model Flows vs Measured Flows

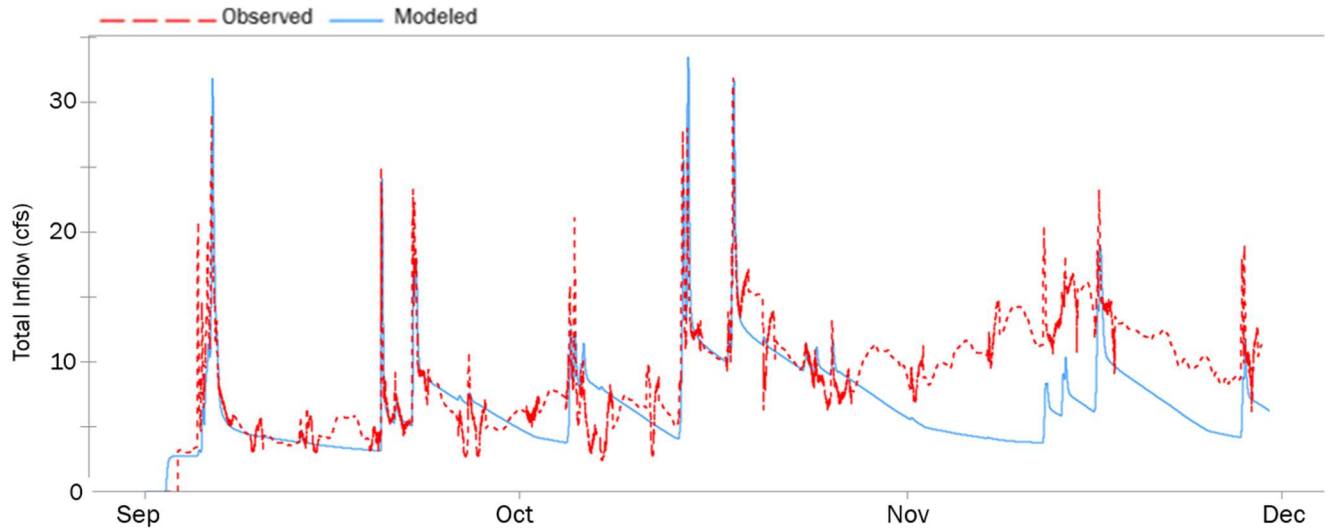


Figure 18. CB-Lyman
Final Model Flows vs Measured Flows

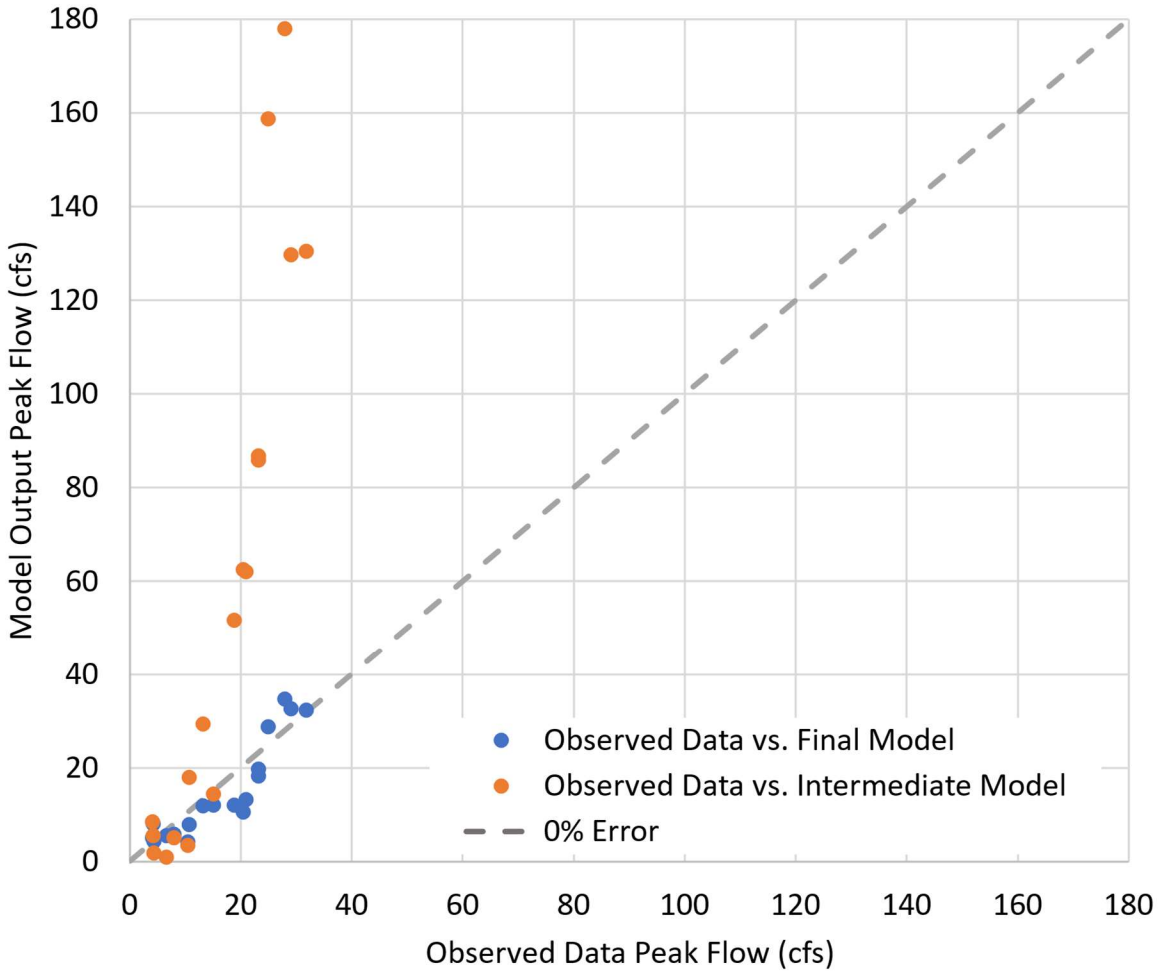


Figure 19. CB-Lyman
Comparison of Simulated vs Measured Peak Flows during Storm Events

There is a large rise in baseflow in the monitoring data beginning in late October that does not correspond to storm events or rainfall-based groundwater recharge. As the City had been experiencing a drought in the beginning of the monitoring period, upstream waterbodies may have had controls limiting their discharge to keep the waterbodies from drying out. The way in which these upstream controls were operated during the monitoring period was not known, so the calibration focused on the events before 10/25/22.

The Final Model adequately represents the peak flow for each of the three monitoring sites where discharge was calculated from water level measurements. The Final Model displays greater accuracy in peak flow and total volume than the original model. The Final Model was determined to be adequately calibrated to estimate peak flow, water surface elevations, and flooding volumes for the design storms.

The modeling included design storms up to an including the 100-year 24-hour storm. Storm events of greater intensity and/or depth are likely to produce higher peak flow rates and water surface elevations and can result in more extensive flooding.

Section 4: Site Selection for Design Improvements

Following the calibration of the model, four sites along Chester Brook were investigated for their potential to decrease flooding along Lexington Street and Oakley Lane by temporarily storing streamflow during large storm events and releasing it once capacity becomes available downstream. The goal of this analysis was to select the site with the greatest potential to reduce downstream flooding. The design of the selected site's outlet structure to control the flows for the waterbody is discussed Section 5.

4.1 JFK Middle School Wetland

The JFK Middle School wetland is located next to Waltham's JFK Middle School at the cross street of Lexington St and Jack's Way. Figure 20 shows the JFK Middle School wetland and its outlet structure. The wetland is relatively narrow and shallow. It has an outlet control structure that was constructed in 2011. It does not pose a barrier to fish passage. Due to its limited storage capacity, adequate fish passage, and relatively new outlet control structure, the JFK Middle School's wetland was not selected for subsequent design activities.

Figure 20. JFK Middle School wetland and outlet structure

4.2 Upper Pond at Chapel Hill

The upper pond at Chapel Hill is one of the largest ponds by surface area along Chester Brook and is shown in Figure 21. The pond is located adjacent to Lexington St and is on property owned by Chapel Hill-Chauncy Hall School. There is a private access road for Chapel Hill-Chauncy Hall School located next to the outlet weir of the pond that is very close in elevation to the top of the weir, having only roughly three feet of freeboard.

The limited freeboard between the existing water surface elevation and the roadway limits its ability to provide additional storage during storm events. Due to limited existing freeboard and property ownership considerations, the upper pond at Chapel Hill was not selected for subsequent design activities.

Figure 21. Upper Pond at Chapel Hill and discharge weir

4.3 Lyman Pond

Lyman Pond is the terminal pond on Chester Brook. After water discharges over the outlet weir at Lyman Pond it converges with Beaver Brook and then flows to the Charles River. Lyman pond was the only site considered that was downstream of the area of flooding along Lexington St and Oakley Ln. Lyman Pond is displayed in Figure 22.

Based on analysis with the model and the City's experience operating the weir at Lyman Pond, some reductions in upstream flooding can be achieved by removing the stoplogs at the pond's outlet structure and letting Chester Brook flow freely through Lyman Pond. However, this action empties Lyman Pond, which is viewed by the community as an aesthetic and environmental resource. For these reasons, this site was removed from further consideration. However, it is recommended that the inlet weir to Lyman Pond, which is already partially removed, be demolished and removed entirely to alleviate the flow restriction into the pond. Modeling indicates the removing the weir modestly decreases upstream flooding volumes.

Figure 22. Lyman Pond

4.4 YMCA Wetland

The YMCA wetland is adjacent to Lexington St, between Bishop Forest Dr and the access drive to the YMCA at 725 Lexington St, as shown in Figure 23. The YMCA wetland is one of the deeper basins along Chester Brook. In addition, adjacent structures and roadways are more than seven feet higher than the wetlands dry weather water surface elevation.

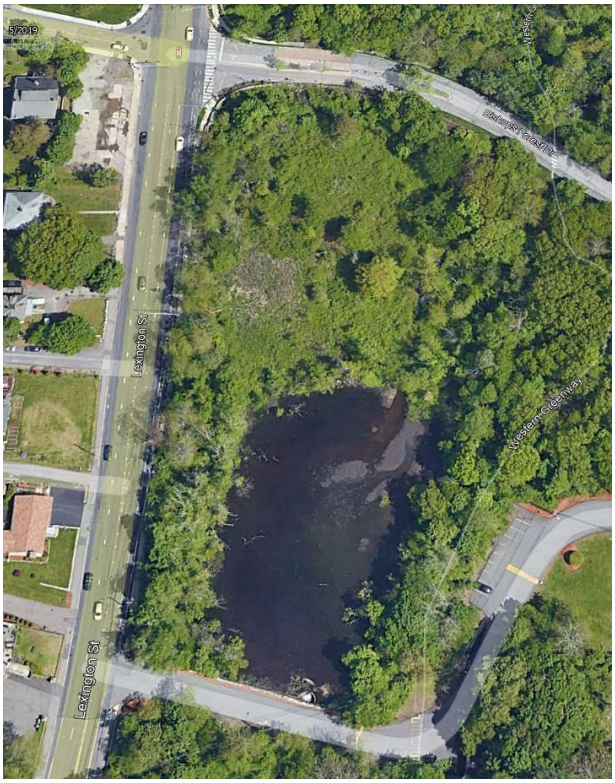


Figure 23. Chester Brook YMCA Wetland

The site's existing outlet structure is a 5.5-ft high 24-ft long semi-circular weir with a 1-ft wide opening in the center of the weir. Prior to August 2022, the weir was filled with stoplogs as shown in Figure 24. This resulted in year-round inundation of the upstream basin.

Figure 24. Chester Brook YMCA Wetland Existing Outlet Structure

In August 2022, the stoplogs were removed due to safety concerns as the metal frame that holds the stoplogs was severely deteriorated and leaking significantly. Water was also observed short-circuiting the outlet structure by flowing through a gap that has formed at the joint where the structure ends and the headwall for the roadway begins.

The YMCA site was selected for design based on the following considerations: significant storage capabilities; the need to replace the existing, deteriorating outlet structure; and the potential for improving fish passage into the wetland.

Section 5: Flood Mitigation Potential of Selected Site

The Final Model was used to evaluate the ability of the YMCA Wetland to mitigate downstream flooding, particularly around Lexington St and Oakley Ln.

Different outlet configurations were evaluated for the YMCA Wetland. Based on the modeling, a new outlet control structure is proposed. The proposed outlet structure is 1 foot taller and 6 feet wider than the existing structure. The proposed outlet structure has a 3x3 ft opening with a stainless steel slide gate.

This analysis assumed that the gate will be operated manually, although the option for real-time controls is possible in the future. Modeling indicated that a 1 foot opening of the gate is optimal for most storms (making the proposed outlet's structure orifice 1x3 ft). Unless stated otherwise, all model runs with the proposed outlet used a 1 foot gate opening.

In order to compare flooding for past, current and proposed conditions, three different model configurations were used:

- Existing outlet structure with stoplogs in place – This represents conditions before August 2022.
- Existing outlet structure with stoplogs removed – This represents conditions from August 2002 through present day.
- Proposed outlet structure – This represents conditions after installation of the proposed outlet structure and gate for the YMCA wetland.

The sections that follow present the modeling results.

5.1 Flood Volume

The model runs were analyzed to determine the volume of flooding at Lexington St and Oakley Ln for the 2, 10, 25, and 100-year 24-hour storms. The results are summarized in Table 2.

Table 2. Simulated Flooding Volumes volume for Design Storms at Lexington St and Oakley Ln during Design Storms

Design Storm	Total Rainfall (in)	Flood Volume (ft^3)		
Storm	Rainfall (in)	Existing Outlet Structure with Stoplogs	Existing Outlet Structure with Stoplogs Removed	Proposed Outlet Structure
2-Year 24-Hour	3.24	127,300	127,800	113,200
10-Year 24-Hour	4.29	330,500	330,400	319,200
25-Year 24-Hour	6.28	681,100	679,900	673,000
100-Year 24-Hour	8.08	1,203,000	1,203,000	1,119,000

The proposed outlet structure decreases flooding for all four modeled storm scenarios.

A 9-year continuous simulation was run to determine how the different outlet configurations impact downstream flooding over a long period of time. The rainfall data used for the analysis was downloaded from the nearby Stony Brook Dam USGS rain gage (USGS site 01104480) from June of 2013 to June of 2023.[1]

Table 3 summarizes the modeled flooding at Lexington St and Oakley Ln during the 9 years of simulation.

Table 3. Long Term Simulation Model Flooding Summary

	Existing Structure with Stoplogs	Existing Structure with Stoplogs Removed	Proposed Structure
Number of Flooding Events	40	43	38
Avg. Annual Number of Flooding Events	4.5	4.9	4.3
Total Flood Volume	2,141,000	2,225,000	1,843,000
Avg. Annual Flood Volume	242,000	252,000	209,000

On all metrics, the proposed structure reduces flood volumes over the existing structure (with and without stop logs). It has fewer flooding events and less flooding volume.

5.2 Flood Duration

The length of time that flooding occurs at Lexington St and Oakley Ln for the 2, 10, 25, and 100-year 24-hour storms is shown in Table 4 below. There is very little variation in flooding durations across all of the model configurations and storm events.

Table 4. Simulated Flooding Duration at Lexington St and Oakley Ln during Design Storms

		Flood Duration (hr)		
Storm	Rainfall (in)	Existing Outlet Structure with Stoplogs	Existing Outlet Structure with Stoplogs Removed	Proposed Outlet Structure
2-Year 24-Hour	3.24	3.7	3.7	3.7
10-Year 24-Hour	4.29	7.6	7.9	7.8
25-Year 24-Hour	6.28	12.1	12.1	12.2
100-Year 24-Hour	8.08	17.9	18.2	17.8

5.3 Peak Water Surface Elevation

The peak water surface elevation of the YMCA wetland was evaluated. Peak water surface elevation results for the 2, 10, 25, and 100-year 24-hour storms are summarized in Table 5.

[1] Data was not available for the rain gage from late May 2019 to early June 2020, so this period was excluded from the long-term analysis.

Table 5. Simulated Peak Water Surface Elevation at YMCA Wetland Site				
		Peak Water Surface Elevation (ft)		
Storm	Rainfall (in)	Existing Outlet Structure with Stoplogs	Existing Outlet Structure with Stoplogs Removed	Proposed Outlet Structure
2-Year 24-Hour	3.24	145.4	145.0	145.9
10-Year 24-Hour	4.29	146.1	146.0	146.6
25-Year 24-Hour	6.28	146.4	146.1	147.0
100-Year 24-Hour	8.08	147.1	146.9	147.7

Notes:

- *All elevation are referenced to NAVD88 vertical datum.*
- *The roadway over the culvert adjacent to the wetland is at an elevation of 150 ft. Water elevations above this level would flood the roadway.*

The proposed outlet structure for the YMCA Wetland is 1 ft taller than the existing outlet structure in order to provide more storage during large storm events. As a result, it does increase the water surface elevation for all design storms.

The access drive to the YMCA is the lowest known structure that could be impacted by elevated water levels in the wetland. The elevation of the road surface is 150 ft. The water surface elevation remains below the road surface for all the design storms. Even during the 100-year storm, the proposed outlet structure is expected to maintain a water level that is at least 2.3 feet below the roadway surface.

5.4 Peak Discharge

The peak discharge rate was evaluated at the YMCA Wetland outlet structure. The peak flows for the 2, 10, 25, and 100-year 24-hour storms are summarized in Table 6.

Table 6. Simulated Peak Flows Discharged from YMCA Wetland				
Design Storm	Total Rainfall (in)	Peak Flow (cfs)		
		Existing Outlet Structure with Stoplogs	Existing Outlet Structure with Stoplogs Removed	Proposed Outlet Structure
2-Year 24-Hour	3.24	164.2	155.5	137.7
10-Year 24-Hour	4.29	271.4	267.7	257.8
25-Year 24-Hour	6.28	344.5	342.6	336.9
100-Year 24-Hour	8.08	493.6	492.2	492.7

The proposed outlet structure decreases peak discharge from the YMCA wetland under the 2-, 10-, and 25-year storm events. For the 100-year event, the peak discharge rate for the proposed outlet structure is 0.5 cfs greater than the existing outlet structure with all its stoplogs installed, and 0.9 cfs lower than the existing outlet structure with no stoplogs. The differences in these discharge rates is minor and the proposed solution maintains a lower volume of flooding than either existing scenario, making the differences not a point of concern.

5.5 Mean Water Surface Elevation

The long-term simulation described in section 5.1.1 was analyzed to assess the water surface elevation over the 9-year simulation period. Figure 25 summarizes the results of the analysis.

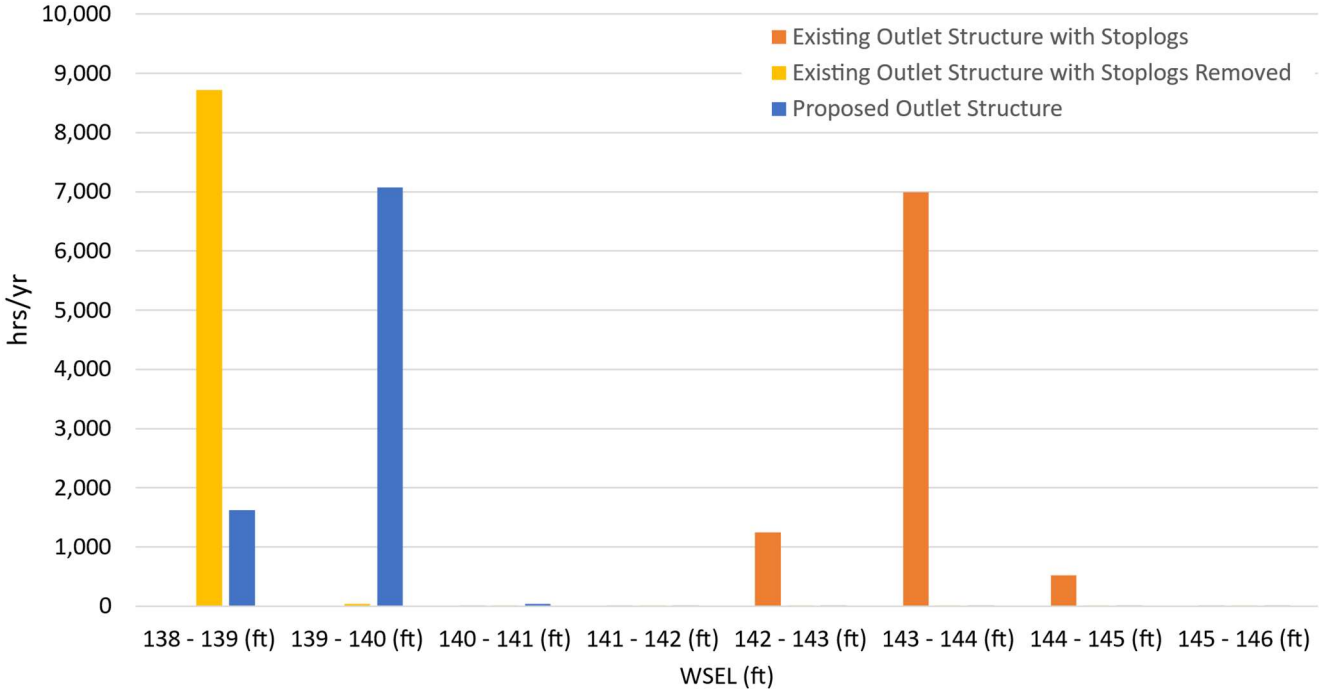


Figure 25. WSEL (ft) makeup over the 9-year simulation

The mean WSEL in the proposed conditions is lower than the pre-August 2022 conditions, but slightly higher than the post-August 2022 conditions. This allows the wetland area to remain wet while allowing greater volume for flood capture prior to a storm.

Section 6: Proposed Improvements at Selected Site

This Section provides an overview of the proposed improvements at the YMCA wetland, permitting considerations and the estimated cost.

6.1 Design

A 70% design was developed for the proposed outlet structure and gate. The design drawings for the site are provided in Appendix B.

6.2 Environmental Impacts and Permit Requirements

The YMCA wetland was delineated. The wetland delineation report is included in Appendix C.

An analysis of the environmental constraints and permitting requirements for the proposed improvements was performed, which is documented in Appendix D.

As discussed in Appendix D, a review of regulatory codes and standards was performed to identify applicable approvals and permits required for construction of the proposed improvements. The only expected permit required for construction is a Conservation Commission Notice of Intent (NOI). Consultation with US Forest and Wildlife Service (USFWS) should also be undertaken as the project site is within a federally listed rare species territory for the Northern Long Eared Bat, an endangered species, and potential habitat for the Monarch Butterfly, a candidate species. Considering the limited project impacts, a no effect determination for impacts to endangered species is likely.

6.3 Opinion of Probable Cost

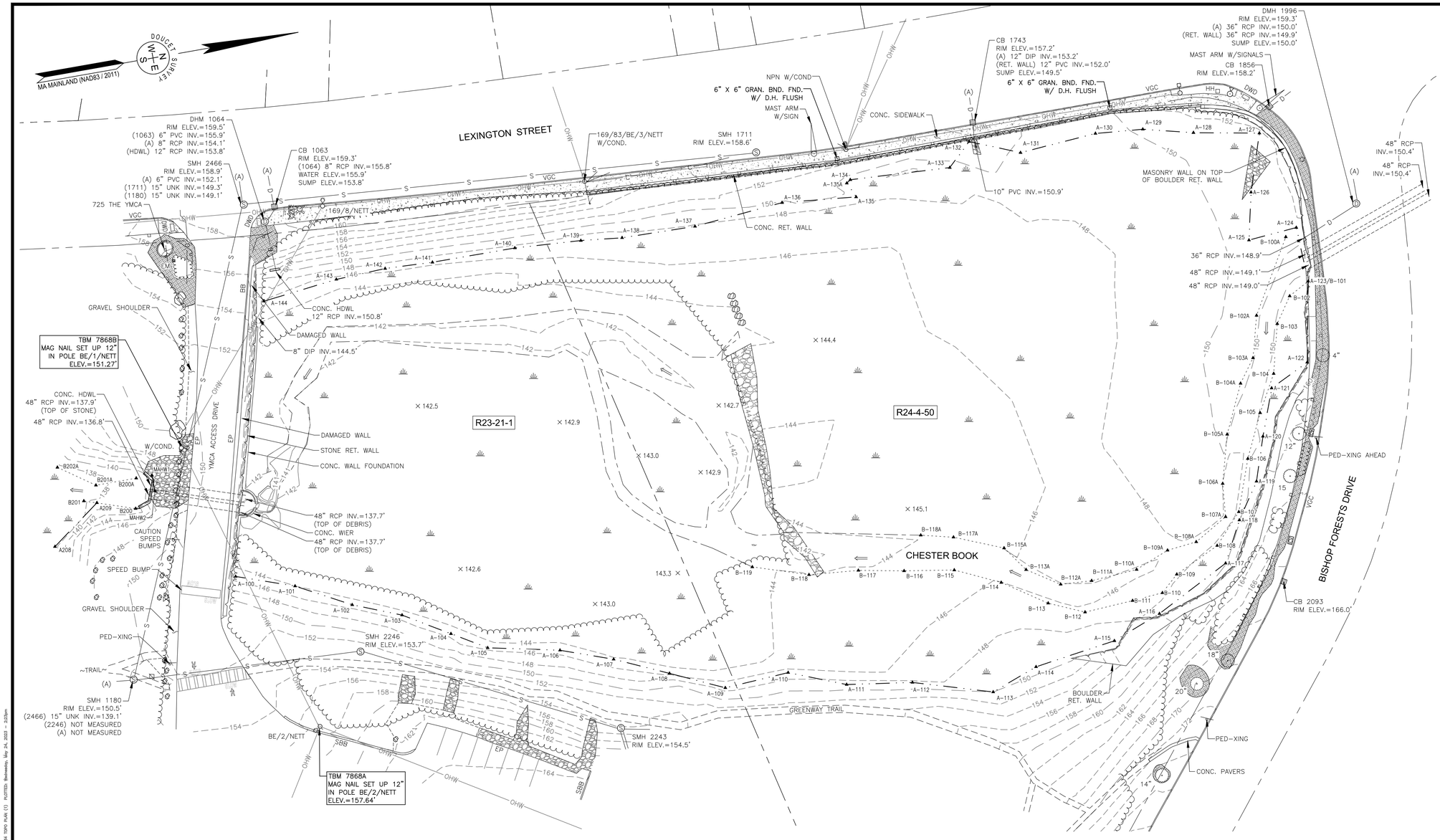
An opinion of probable construction costs was developed for the project which is currently estimated at approximately $349,000. The construction costs are considered a Class 3 estimate as defined by the Associate for the Advancement of Cost Engineering International (AACE) to be accurate within -20 to +30 percent of the total actual capital costs. These costs are based upon June 2023 dollars and reference the appropriate Engineering News Record Construction Cost Index (ENR-CCI) These costs will vary with economic changes and should be adjusted according to changes in the ENR-CCI. Appendix E contains the supporting documentation for the estimate of probable construction cost.

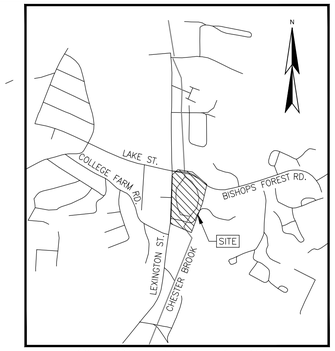
The estimated costs are defined by the design drawings included in this Stormwater Management Report and are based on the following assumptions:

- Costs for change orders, design engineering, construction oversight, client costs, finance or funding costs, legal fees, land acquisition, or temporary/permanent easements are not included.
- Construction contingencies were estimated to be approximately 30% of the project cost.
- Contaminated and/or hazardous materials are not encountered at the project site.

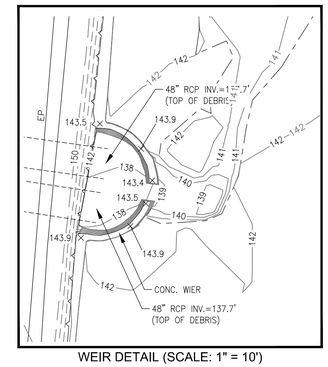
The estimate was prepared using BC's estimating system, which consists of a commercial estimating software using BC's material and labor database, historical project data, the latest vendor and material cost information, and other costs specific to the project locale. The estimated costs represent BC's best engineering judgement. However, actual construction costs are largely dictated by market conditions at the time of bidding. Accordingly, BC cannot guarantee that bids and actual construction costs will not vary from the opinion of probable construction costs presented herein.

Appendix A: YMCA Wetland Existing Conditions Topographic Survey





LOCATION MAP (SCALE: 1" = 1000')



WEIR DETAIL (SCALE: 1" = 10')

30 0 30 60

SCALE: 1 INCH = 30 FT.

NOTES:

1. REFERENCE: CHESTER BROOK OUTLET
LEXINGTON STREET & BISHOP FOREST DRIVE
WALTHAM, MASSACHUSETTS

1. FIELD SURVEY PERFORMED BY J.H.H. & A.K.H. (DOUCET SURVEY) DURING MAY 2023 USING A TOTAL STATION AND A SURVEY GRADE GPS WITH A DATA COLLECTOR AND AN AUTO LEVEL. TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.

2. HORIZONTAL DATUM BASED ON NAD83(2011) MASSACHUSETTS STATE PLANE MAINLAND COORDINATE ZONE (2001) DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.

3. VERTICAL DATUM IS BASED ON APPROXIMATE NAVD88(GEOID18) (±.2') DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.

4. JURISDICTIONAL WETLANDS DELINEATED BY EPSILON ASSOCIATES, INC DURING APRIL 2023 IN ACCORDING TO THE:
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   - REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL: NORTHCENTRAL AND NORTHEAST REGION (2012).
   - NEW ENGLAND HYDRIC SOILS TECHNICAL COMMITTEE. 2018 VERSION 4, FIELD INDICATORS FOR IDENTIFYING HYDRIC SOILS IN NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION, LOWELL, MA.
   - NORTH AMERICAN DIGITAL FLORA: NATIONAL WETLAND PLAN LIST, CURRENT VERSION

5. THIS MAP WAS PREPARED FROM RECORD RESEARCH, OTHER MAPS, LIMITED FIELD MEASUREMENTS AND OTHER SOURCES. IT IS NOT TO BE CONSTRUED AS A PROPERTY / BOUNDARY SURVEY AND IS SUBJECT TO SUCH FACTS AS SAID SURVEYS MAY DISCLOSE.

6. PROPER FIELD PROCEDURES WERE FOLLOWED IN ORDER TO GENERATE CONTOURS AT 2' INTERVALS. ANY MODIFICATION OF THIS INTERVAL WILL DIMINISH THE INTEGRITY OF THE DATA, AND DOUCET SURVEY WILL NOT BE RESPONSIBLE FOR ANY SUCH ALTERATION PERFORMED BY THE USER.

7. UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON OBSERVED PHYSICAL EVIDENCE AND PAINT MARKS FOUND ON-SITE.

8. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES/TYPES IS SUBJECT TO NUMEROUS FIELD CONDITIONS, INCLUDING; THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS, MANHOLE CONFIGURATION, ETC.

9. ALL UNDERGROUND UTILITIES (ELECTRIC, GAS, TEL. WATER, SEWER DRAIN SERVICES) ARE SHOWN IN SCHEMATIC FASHION, THEIR LOCATIONS ARE NOT PRECISE OR NECESSARILY ACCURATE. NO WORK WHATSOEVER SHALL BE UNDERTAKEN USING THIS PLAN TO LOCATE THE ABOVE SERVICES. CONSULT WITH THE PROPER AUTHORITIES CONCERNED WITH THE SUBJECT SERVICE LOCATIONS FOR INFORMATION REGARDING SUCH. CALL DIG-SAFE AT 1-888-DIG-SAFE.

10. OVERALL PARCEL BOUNDARIES AS SHOWN HEREON ARE BASED ON GIS DATA FROM THE "BUREAU OF GEOGRAPHIC INFORMATION (MassGIS), COMMONWEALTH OF MASSACHUSETTS, EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SERVICES". AND ARE IN THEIR ORIGINAL LOCATION. THE PARCEL BOUNDARIES HAVE NOT BEEN ADJUSTED TO MATCH FOUND PROPERTY MONUMENTS OR THE EDGE OF RIGHT OF WAY AS DETERMINED BY THE SURVEYOR.

LEGEND

- APPROXIMATE LOT LINE (SEE NOTE 10)
- 150 MAJOR CONTOUR LINE (2-FOOT)
- 148 MINOR CONTOUR LINE (2-FOOT)
- 140 CONTOUR LINE (1-FOOT)
- RETAINING WALL
- WOODEN GUARDRAIL
- METAL GUARDRAIL
- OHW OVERHEAD WIRE
- D DRAIN LINE
- DRAIN CULVERT
- S SEWER LINE
- G GAS LINE
- C CABLE/INTERNET LINE
- TREE LINE
- SHRUB LINE
- EDGE OF DELINEATED WETLAND (SEE NOTE 5)
- TOP OF DELINEATED BANK (SEE NOTE 5)
- WATERCOURSE
- WETLAND AREA
- CONCRETE
- RIP RAP
- LANDSCAPED AREA

- × 145.1 SPOT GRADE
- BOUND FOUND (BND. FND.)
- UTILITY POLE W/LIGHT & GUY WIRE
- LIGHT POST
- LIGHT POLE W/ARM
- DRAIN MANHOLE
- CATCH BASIN
- SEWER MANHOLE
- FIRE HYDRANT
- WATER GATE VALVE
- IRRIGATION CONTROL VALVE
- HH HAND HOLE
- EM ELECTRIC METER
- SIGN
- SIGN (TWO POSTS)
- MAST ARM
- TRAFFIC SIGNAL
- ROCK/BOULDER
- DECIDUOUS TREE
- FLOW DIRECTION
- A-100 WETLAND FLAG
- B-200 BANK FLAG

- R23-21-1 TAX MAP & LOT NUMBER
- BC BITUMINOUS CURB
- CONC. CONCRETE
- DIP DUCTILE IRON PIPE
- DWD DETECTABLE WARNING DEVICE
- EP EDGE OF PAVEMENT
- HDWL HEADWALL
- PVC POLYVINYL CHLORIDE PIPE
- RCP REINFORCED CONCRETE PIPE
- RET. WALL RETAINING WALL
- SBB SLOPED BITUMINOUS BERM
- SYL SINGLE YELLOW LINE

TOPOGRAPHIC PLAN
FOR
BROWN AND CALDWELL
OF THE
CHESTER BROOK OUTLET
LEXINGTON STREET & BISHOP FOREST DRIVE
WALTHAM, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

DRAWN BY:	M.T.L.	DATE:	MAY 19, 2023
CHECKED BY:	S.V.M.	DRAWING NO.	7868A
JOB NO.	7868	SHEET	1 OF 1

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FILE NAME: N:\PROJECTS\7868 CSK\DRAWS\ DWG\CVR\2023-05-19\7868A Topo Plan (2023-06-24).dwg LAYOUT NAME: 22X36 TOPO PLAN (1) PLOTTED: Wednesday, May 24, 2023 - 2:23pm

Appendix B: Waltham YMCA Wetland Proposed Condition Design Drawings

CITY OF WALTHAM, MASSACHUSETTS

CHESTER BROOK YMCA
WETLAND FLOOD MITIGATION

70% DESIGN - NOT FOR CONSTRUCTION

JUNE 2023

PROJECT NO: 160123

VICINITY MAP
SCALE: NO SCALE

INDEX OF SHEETS

DWG	SHEET	DESCRIPTION
G-00-000	1	COVER SHEET
C-00-001	2	EXISTING SITE CONDITIONS (SURVEY)
C-00-002	3	EROSION AND SEDIMENT CONTROL PLAN
C-00-003	4	EROSION CONTROL DETAILS
C-00-004	5	PROPOSED SITE AND GRADING PLAN
C-00-005	6	CIVIL DETAILS
SD-01-101	7	DEMOLITION PLAN, SECTION, PHOTO
S-00-001	8	STRUCTURAL NOTES
S-00-002	9	SPECIAL INSPECTION NOTES
S-00-003	10	STANDARD DETAILS
S-01-101	11	OUTLET WEIR STRUCTURE PLANS
S-01-301	12	OUTLET WEIR STRUCTURE SECTIONS
S-01-501	13	DETAILS

Robert S. Winn, P.E. - City Engineer
Jeanette A. McCarthy - Mayor

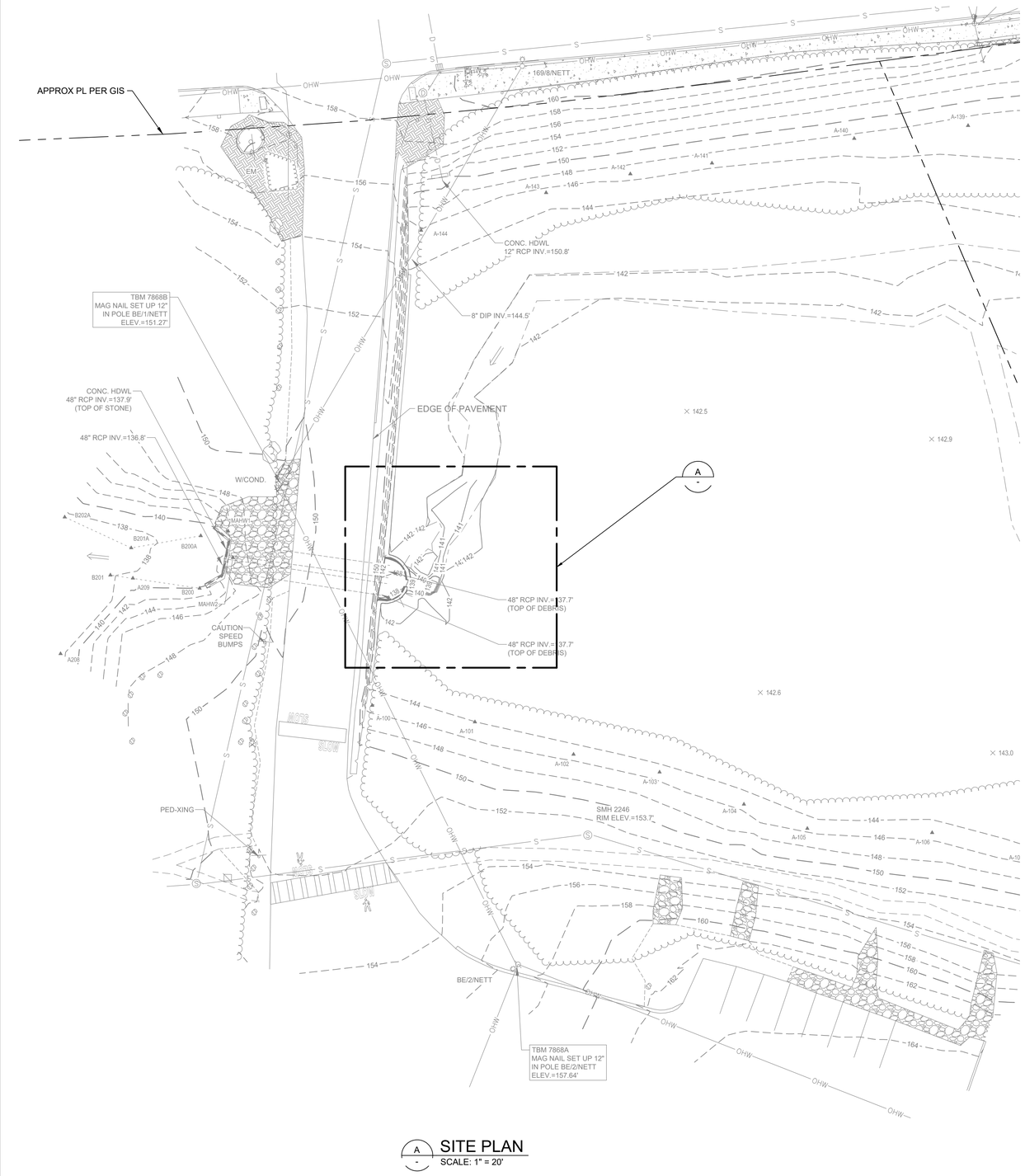
Brown AND Caldwell

200 BRICKSTON SQUARE, SUITE 403
ANDOVER, MA 01810

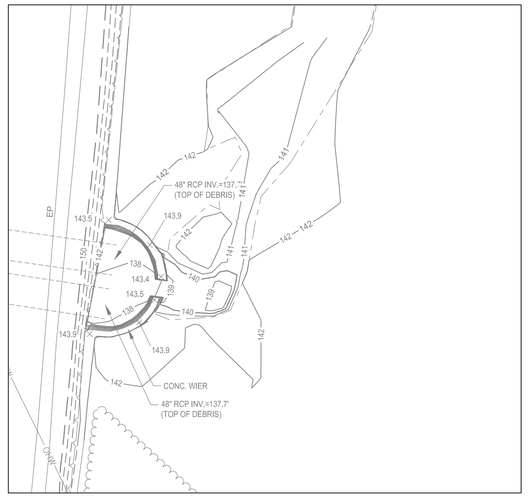
LOCATION MAP
SCALE: 1" = 150'

ENGR P.E. SEAL AND STAMP DESIGNATED LOCATION

Path: C:\BGPW\D3249937 FILENAME: G-00-000.DWG PLOT DATE: 6/29/2023 4:38 PM CAD USER: BEN HAWES



A - SITE PLAN
SCALE: 1" = 20'



A - WEIR DETAIL
SCALE: 1" = 10'

LEGEND

- APPROXIMATE LOT LINE (SEE NOTE 10)
- MAJOR CONTOUR LINE (2-FOOT)
- MINOR CONTOUR LINE (1-FOOT)
- 140 CONTOUR LINE (1-FOOT)
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- METAL GUARDRAIL
- OHW OVERHEAD WIRE
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- DRAIN CULVERT
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- WATER GATE VALVE
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- HH HAND HOLE
- EM ELECTRIC METER
- SIGN
- SIGN (TWO POSTS)
- MAST ARM
- TRAFFIC SIGNAL
- ROCK/BOULDER
- DECIDUOUS TREE
- FLOW DIRECTION
- A-100 WETLAND FLAG
- B-200 BANK FLAG
- R23-21-1 TAX MAP & LOT NUMBER

BC	BITUMINOUS CURB
CONC	CONCRETE
DIP	DUCTILE IRON PIPE
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EP	EDGE OF PAVEMENT
HDWL	HEADWALL
PVC	POLYVINYL CHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RET WALL	RETAINING WALL
SBB	SLOPED BITUMINOUS BERM
SYL	SINGLE YELLOW LINE
SMH	SINGLE YELLOW LINE

GENERAL NOTES:

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LEXINGTON STREET & BISHOP FOREST DRIVE, WALTHAM, MASSACHUSETTS

1. FIELD SURVEY PERFORMED BY J.H.H. & A.K.H. (DOUCET SURVEY) DURING MAY 2023 USING A TOTAL STATION AND A SURVEY GRADE GPS WITH A DATA COLLECTOR AND AN AUTO LEVEL. TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.

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   - NORTH AMERICAN DIGITAL FLORA: NATIONAL WETLAND PLAN LIST, CURRENT VERSION

5. THIS MAP WAS PREPARED FROM RECORD RESEARCH, OTHER MAPS, LIMITED FIELD MEASUREMENTS AND OTHER SOURCES. IT IS NOT TO BE CONSTRUED AS A PROPERTY / BOUNDARY SURVEY AND IS SUBJECT TO SUCH FACTS AS SAID SURVEYS MAY DISCLOSE.

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7. UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON OBSERVED PHYSICAL EVIDENCE AND PAINT MARKS FOUND ON-SITE.

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KEY NOTES:

1. -

0 10' 20'
SCALE: 1" = 10'

0 10' 20' 40'
SCALE: 1" = 20'

Brown AND Caldwell
200 BRICKSTON SQUARE, SUITE 403
ANDOVER, MA 01810

THIS DRAWING IS NOT VALID FOR CONSTRUCTION PURPOSES UNLESS IT BEARS THE SEAL OF A DULY REGISTERED PROFESSIONAL

70% SUBMITTAL
NOT FOR CONSTRUCTION

INCORPORATED A TOWN 1738 · WALTHAM · INCORPORATED A CITY 1884

CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

DESIGNED:	KEV/SAS
DRAWN:	BWH
CHECKED:	TVA
CHECKED:	
APPROVED:	SAS
FILENAME	C-00-001.dwg
BC PROJECT NUMBER	PROJECT 160123

CIVIL

EXISTING SITE CONDITIONS (SURVEY)

DRAWING NUMBER
C-00-001

SHEET NUMBER 2 OF 13

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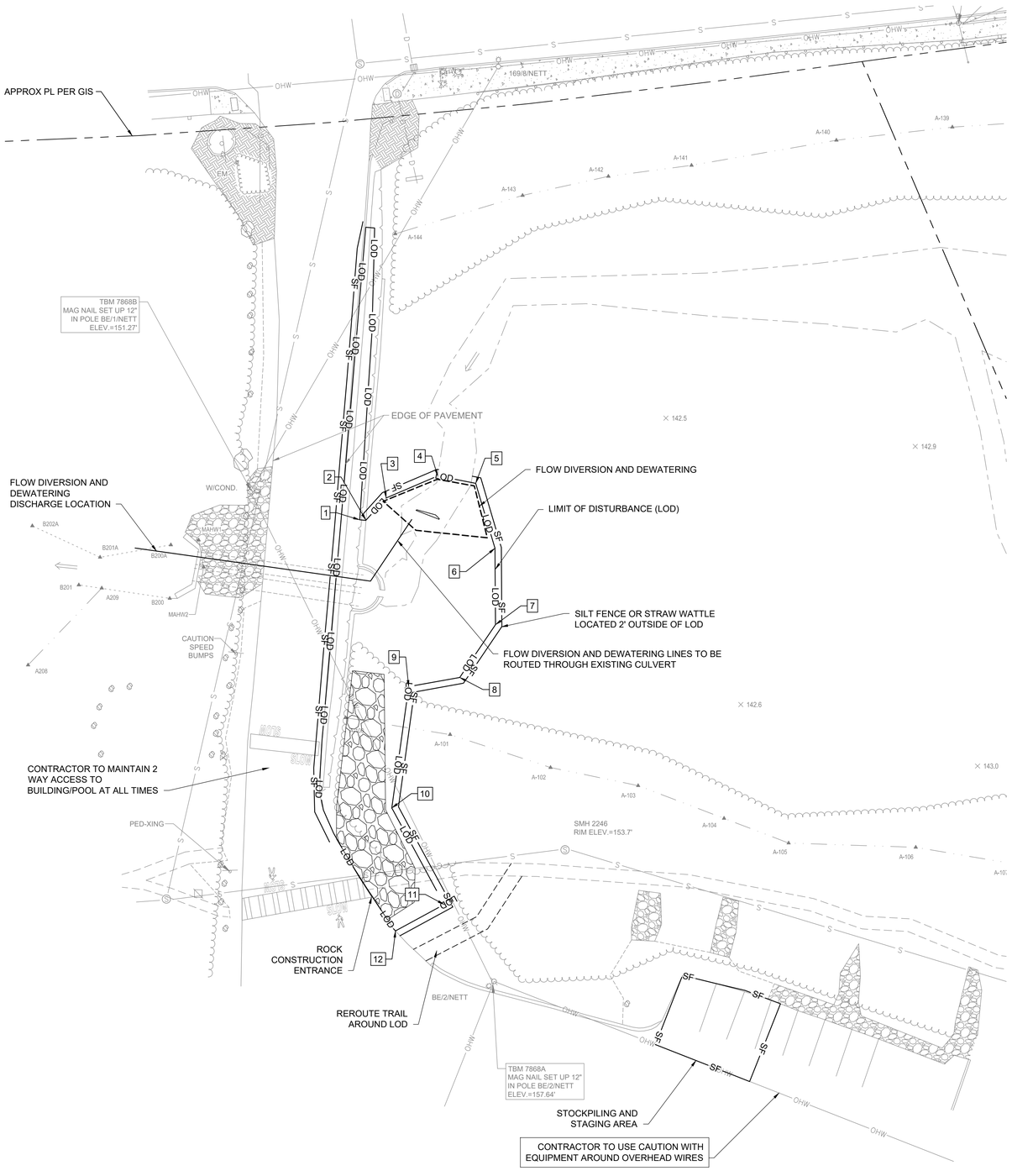

A
-
SITE PLAN
SCALE: 1" = 20'

GENERAL NOTES:

1. THE INFORMATION PROVIDED IN THESE PLANS IS SOLELY TO ASSIST THE CONTRACTOR IN ASSESSING THE NATURE AND EXTENT OF CONDITIONS WHICH WILL BE ENCOUNTERED DURING THE COURSE OF WORK. THE CONTRACTORS ARE DIRECTED, PRIOR TO BIDDING, TO CONDUCT WHATEVER INVESTIGATIONS THEY DEEM NECESSARY TO ARRIVE AT THEIR OWN CONCLUSION REGARDING THE ACTUAL CONDITIONS THAT WILL BE ENCOUNTERED AND UPON WHICH THEIR BIDS WILL BE BASED.
2. THE CONTRACTOR SHALL BE RESPONSIBLE TO MAKE A REVIEW OF THE SITE TO DETERMINE EXISTING CONDITIONS. ANYTHING NOT SHOWN ON THE CONTRACT DOCUMENTS SHALL BE BROUGHT TO THE ATTENTION OF THE CITY OF WALTHAM IMMEDIATELY AND SHALL NOT CONSTITUTE GROUNDS FOR AN EXTRA, UNLESS APPROVED BY THE CITY.
3. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH CITY OF WALTHAM PERMITS AND REQUIREMENTS. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT CONDITIONS.
4. ANY AND ALL AREAS NOT SPECIFIED FOR CONSTRUCTION WHICH ARE DISTURBED AND OR DAMAGED BY THE CONTRACTOR SHALL BE RESTORED TO THE STANDARDS OF THE CONTRACT DOCUMENTS TO THE EXISTING LOCATION, ELEVATION, AND DIMENSION TO THE SATISFACTION OF THE CITY.
5. CONTRACTOR SHALL PROVIDE BYPASS PUMPING OF NORMAL FLOWS IN THE WETLAND TO ISOLATE WORK AREAS FROM FLOWING WATER. THE CONTRACTOR SHALL ALSO STABILIZE THE SITE AT THE END OF EACH WORK DAY SO ALL WORK AREAS WILL BE STABLE IN THE EVENT OF A 10-YEAR STORM. THE 10-YEAR PEAK FLOW RATE IN THE WETLAND IS 320 CFS.
6. CONTRACTOR SHALL USE PUMPS WHICH MINIMIZE AMBIENT NOISE.
7. CONTRACTOR SHALL PROVIDE ALL DEWATERING EQUIPMENT NECESSARY TO KEEP EXCAVATIONS DRY AND SHALL PROVIDE ALL SHEETING, SHORING, AND BRACING NECESSARY TO PROTECT ADJACENT STRUCTURES, UTILITIES, EXISTING PAVEMENT, OR TO MINIMIZE TRENCH WIDTH.
8. ALL MATERIALS SHALL BE NEW.
9. FINISHED GRADE SHOWN ON THE DRAWINGS REFERS TO THE FINAL GRADE AFTER THE INSTALLATION OF FINAL EROSION CONTROL MEASURES AND GROUND TREATMENT.
10. THE CONTRACTOR SHALL PROTECT ALL UTILITIES THROUGHOUT THE CONSTRUCTION PERIOD.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL REQUIRED MAINTENANCE OF TRAFFIC AS NEEDED FOR PROJECT CONSTRUCTION.
12. THIS PROJECT IS LOCATED WITHIN THE 100-YEAR FLOODPLAIN ASSOCIATED WITH CHESTER BROOK, ZONE AE, WITH BASE FLOOD ELEVATIONS RANGING BETWEEN 134 FEET AND 152 FEET NAVD88 (PER FEMA FIRM COMMUNITY PANEL NUMBER 25017C0413E DATED 06/4/2010).
13. LOCATIONS OF STRUCTURES AND OTHER FEATURES MAY BE ADJUSTED BY THE ENGINEER OF RECORD OR CITY OF WALTHAM STORMWATER ENGINEER DURING CONSTRUCTION DUE TO FIELD CONDITIONS.

CONSTRUCTION SEQUENCE:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ARRANGING THE PRE-CONSTRUCTION MEETING. THE CONTRACTOR MUST GIVE THE CITY OF WALTHAM 48 HOURS NOTIFICATION TO SCHEDULE THE PRE-CONSTRUCTION MEETING.
2. CLEAR AND GRUB ONLY AS NECESSARY TO INSTALL PERIMETER SILT FENCE OR STRAW WATTLE AND CONSTRUCTION ENTRANCE.
3. INSTALL SILT FENCE OR STRAW WATTLE ON THE PERIMETER OF ALL STOCKPILE/STAGING AREAS AND MUST REMAIN IN PLACE THROUGH THE DURATION OF CONSTRUCTION ACTIVITIES.
4. FIELD VERIFY EXISTING STRUCTURE CONDITION AND EXISTING DIMENSIONS.
5. STRIP TOPSOIL AROUND EXISTING STRUCTURE. STOCKPILE FOR LATER USE AT THE LOCATION SHOWN ON THE PLANS OR REMOVE AND DISPOSE OF SPOILS OFFSITE.
6. EXCAVATE AROUND EXISTING STRUCTURE AND PROVIDE TEMPORARY SHORING SYSTEM AND BYPASS PIPE IF NECESSARY.
7. DEMOLISH EXISTING STRUCTURE AND EXCAVATE TO PROPOSED GRADE.
8. PREPARE SUBSOILS FOR CAST IN PLACE CONCRETE WEIR STRUCTURE AS SPECIFIED ON STRUCTURAL SHEETS.
   8.1. NOTIFY ENGINEER OF RECORD AND THE CITY OF WALTHAM STORMWATER ENGINEER. SUBSOILS MUST BE APPROVED PRIOR TO CONTINUATION.
9. PREPARE EXISTING STONE WALL AND CONCRETE WALL FOR PROPOSED WEIR WALL CONCRETE STRUCTURE AS SPECIFIED ON STRUCTURAL SHEETS.
10. CONSTRUCT AND INSTALL FORMWORK FOR CONCRETE WEIR WALL AND INSTALL REBAR AS SPECIFIED ON STRUCTURAL SHEETS.
    10.1. NOTIFY ENGINEER OF RECORD AND THE CITY OF WALTHAM STORMWATER ENGINEER. ALL FORMWORK MUST BE CERTIFIED PRIOR TO CONCRETE POUR.
11. POUR IN PLACE CONCRETE.
12. BACKFILL INTERIOR STRUCTURE WITH CAST-IN-PLACE CONCRETE OR GRADED ROCK.
13. REMOVE FORMWORK FROM PROPOSED WEIR WALL STRUCTURE.
14. INSTALL SLIDE GATE.
15. BACKFILL AND GRADE AREA TO ELEVATIONS AS SPECIFIED ON PROPOSED CONDITIONS PLAN.
16. INSTALL GEOTEXTILE FABRIC AND SEED WITH WOODLAND SEED MIX FOR ALL NEWLY GRADED AREAS.
17. LEAVE TEMPORARY FLOW DIVERSION IN PLACE FOR A MINIMUM OF THREE (3) MONTHS TO ALLOW FOR VEGETATION TO STABILIZE.
18. REMOVE ALL EROSION AND SEDIMENT CONTROLS.
19. STABILIZE DISTURBED SLOPE WITH GEOTEXTILE AND SEED.
20. THREE MONTHS POST-CONSTRUCTION - REMOVE FLOW DIVERSION AND DEWATERING CONTROLS.

COORDINATE CONTROL POINTS

POINT	NORTHING	EASTING	REF	DESCRIPTION
1	2971033.02	728137.72	LOD	LOD
2	2971034.91	728138.20	LOD	LOD
3	2971042.39	728132.39	LOD	LOD
4	2971059.55	728128.40	LOD	LOD
5	2971070.91	728132.77	LOD	LOD
6	2971073.31	728153.92	LOD	LOD
7	2971069.32	728177.57	LOD	LOD
8	2971055.37	728191.95	LOD	LOD
9	2971039.07	728192.01	LOD	LOD
10	2971027.23	728228.64	LOD	LOD
11	2971038.16	728261.36	LOD	LOD
12	2971021.67	728266.89	LOD	LOD

LEGEND

- SF — STRAW WATTLE
- LOD — LIMIT OF DISTURBANCE
- FLOW DIVERSION AND DEWATERING
- ROCK CONSTRUCTION ENTRANCE

EROSION AND SEDIMENT CONTROL NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO ANY OTHER WORK ON SITE. EROSION CONTROL SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION.
2. THE LIMIT OF DISTURBANCE WORK LINE SHALL SERVE AS THE STRICT LIMIT OF DISTURBANCE FOR THE PROJECT WITHIN OR ADJACENT TO REGULATED WETLAND AREAS.
3. THE LIMITS OF CLEARING, GRADING, AND DISTURBANCE SHALL BE KEPT TO A MINIMUM WITHIN THE PROPOSED AREA OF CONSTRUCTION. ALL AREAS OUTSIDE OF THESE LIMITS, AS DEPICTED ON THE PLAN SHALL BE UNDISTURBED, TO REMAIN IN NATURAL CONDITION.
4. STOCKPILES OF TOPSOIL SHALL BE LOCATED WITHIN STAGING AREA AND HAVE SIDE SLOPES NO GREATER THAN 2:1 AND TEMPORARILY STABILIZED DURING CONSTRUCTION.

0 5' 10'
SCALE: 1" = 5'

0 10' 20' 40'
SCALE: 1" = 20'

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ANDOVER, MA 01810

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70% SUBMITTAL
NOT FOR CONSTRUCTION

CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

DESIGNED: KEV/SAS
DRAWN: BWH
CHECKED: TVA
CHECKED:
APPROVED: SAS

FILENAME
C-00-002.dwg
BC PROJECT NUMBER
PROJECT 160123

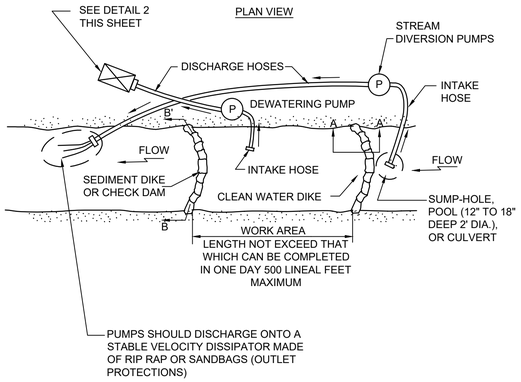
CIVIL

EROSION AND SEDIMENT CONTROL PLAN

DRAWING NUMBER
C-00-002

SHEET NUMBER 3 OF 13

Path: C:\BCPWD\3249940 FILENAME: C-00-002.DWG PLOT DATE: 6/29/2023 3:42 PM CAD USER: BEN HAWES

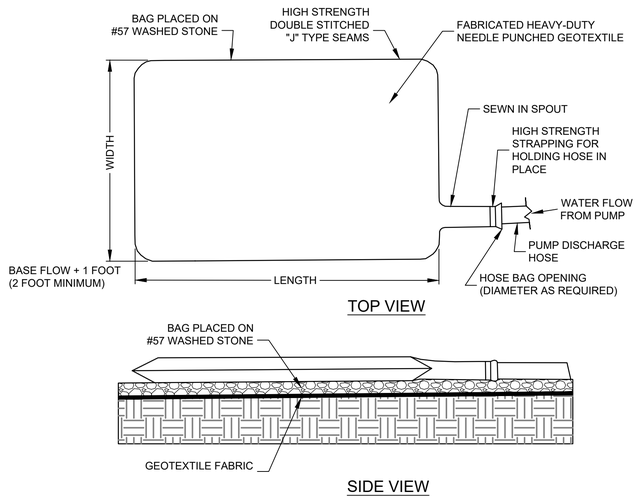


NOTES:

1. SET UP PUMP AND HOSE AS SHOWN, OR USE OTHER PRACTICAL ALTERNATIVES. PUMP SHOULD HAVE TWICE THE PUMPING CAPACITY OF ANTICIPATED FLOW.
2. ALL INTAKE HOSES WILL BE SCREENED.
3. DISMANTLE DOWNSTREAM DAM, THEN UPSTREAM DAM. KEEP PUMP RUNNING TO MAINTAIN STREAM FLOW.
4. PUMP AROUND MAY NOT BE LEFT IN PLACE FOR MORE THAN 24 HOURS.
5. REFER TO SECTION 31 23 19. 10, DEWATERING - PUMP BYPASS.

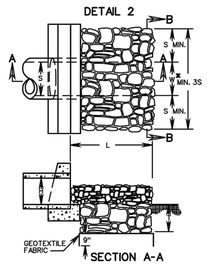
1 PUMP AROUND AND VELOCITY DISSIPATER DETAIL

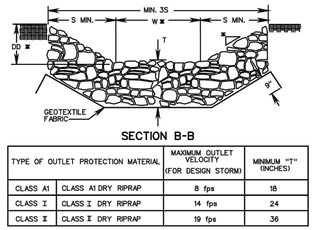
SCALE: NOT TO SCALE



2 SILT BAG DEWATERING DEVICE DETAIL

SCALE: NOT TO SCALE





TYPE OF OUTLET PROTECTION MATERIAL		MAXIMUM OUTLET VELOCITY (FOR DESIGN STORM)	MINIMUM "T" (INCHES)
CLASS A1	CLASS A1 DRY RIPRAP	8 fps	18
CLASS I	CLASS I DRY RIPRAP	14 fps	24
CLASS II	CLASS II DRY RIPRAP	19 fps	36

NOTES:

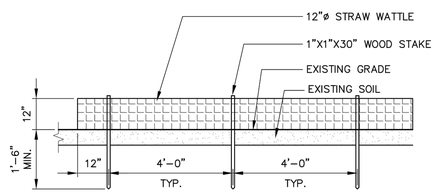
1. FOR MULTIPLE LINE INSTALLATIONS, DIMENSION S IS TO GOVERN THE PROTECTION OUTSIDE THE CHANNEL WIDTH (W).
2. ON ANY INSTALLATION REQUIRING CULVERT OUTLET PROTECTION WHERE NO ENDWALL OR ENDSECTION IS SPECIFIED ON THE PLANS, CONSTRUCTION IS TO BE IN ACCORDANCE WITH DETAIL 2 SHOWN ABOVE.
3. GEOTEXTILE FABRIC TO BE INSTALLED UNDER CLASS A1,I, AND II MATERIALS IN ACCORDANCE WITH THE SPECIFICATIONS.
4. S = DIAMETER OF CIRCULAR CULVERT OR SPAN FOR BOX, ELLIPTICAL OR ARCH CULVERT. H = DIAMETER OF CIRCULAR CULVERT OR RISE/HEIGHT FOR BOX, ELLIPTICAL OR ARCH CULVERT.

* USE TYPICAL SECTION SHOWN ON PLANS FOR SIDE SLOPE, BOTTOM WIDTH AND DEPTH OF CHANNEL OR MATCH EXISTING DITCH OR NATURAL GROUND.

OUTLET PROTECTION MINUMUM LENGTH (L)	
TYPE A INSTALLATION	3H
TYPE B INSTALLATION	5H

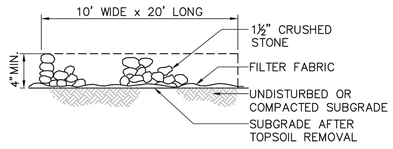
3 INLET PROTECTION DETAIL

SCALE: NOT TO SCALE



4 STRAW WATTLE DETAIL

SCALE: NOT TO SCALE



5 STABILIZED TEMPORARY CONSTRUCTION ENTRANCE

SCALE: NOT TO SCALE

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CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

DESIGNED: KEV/SAS
DRAWN: BWH
CHECKED: TVA
CHECKED:
APPROVED: SAS

FILENAME
C-00-003.dwg
BC PROJECT NUMBER
PROJECT 160123

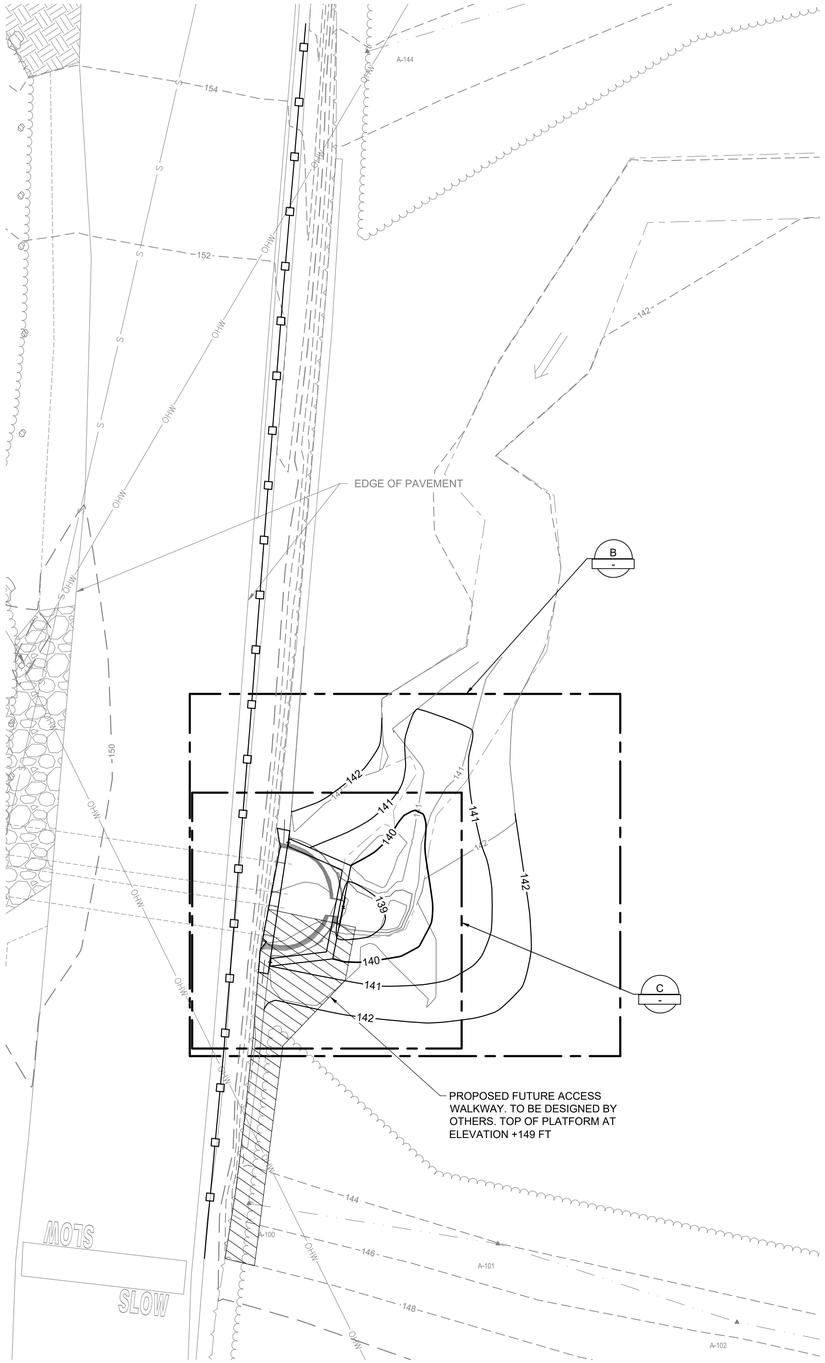
CIVIL

EROSION CONTROL DETAILS

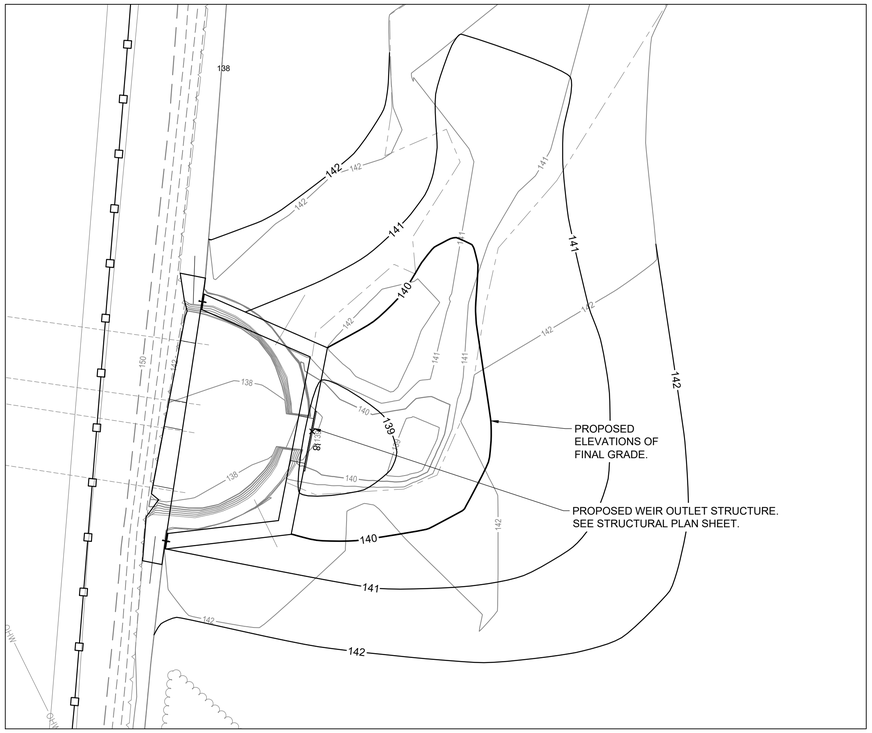
DRAWING NUMBER
C-00-003

SHEET NUMBER 4 OF 13

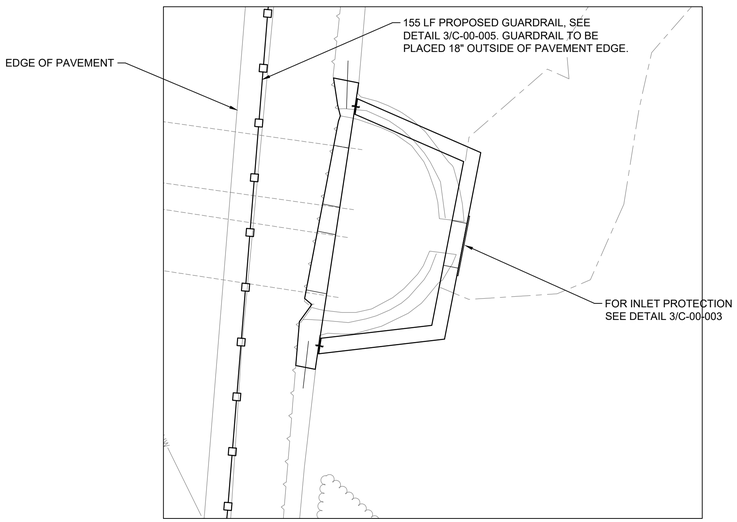
Path: C:\BCPW\D3249940 FILENAME: C-00-003.DWG PLOT DATE: 6/29/2023 3:25 PM CAD USER: BEN HAWES



A GUARDRAIL AND ACCESS PLATFORM PLAN
SCALE: 1" = 10'



B PROPOSED SITE GRADING AT WEIR
SCALE: 1" = 5'



B STRUCTURE PROPOSED SITE GRADING AT WEIR
SCALE: 1" = 5'

LEGEND

WOOD GUARDRAIL

FUTURE PROPOSED ACCESS WALKWAY BY OTHERS

PROPOSED CONDITIONS NOTES:

1. REFER TO CONSTRUCTION SEQUENCE AND DETAIL SHEETS.
2. RESTORE GRADED AREAS WITH WOODLAND SEED MIX.

0 5' 10'
SCALE: 1" = 5'

0 10' 20'
SCALE: 1" = 10'

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CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

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CHECKED:
APPROVED: SAS

FILENAME
C-00-004.dwg
BC PROJECT NUMBER
PROJECT 160123

CIVIL

PROPOSED SITE AND GRADING PLAN

DRAWING NUMBER
C-00-004

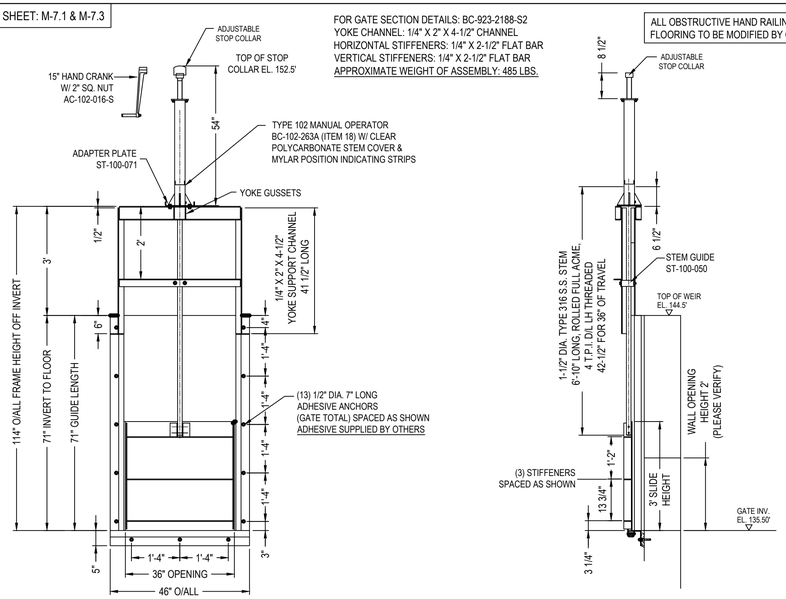
5 SHEET NUMBER OF 13

Path: C:\BCPW\D3249940 FILENAME: C-00-004.DWG PLOT DATE: 6/29/2023 4:00 PM CAD USER: BEN HAWES

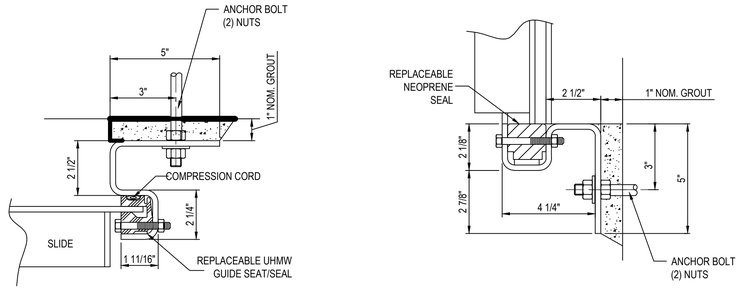
REF. PLAN SHEET: M-7.1 & M-7.3

FOR GATE SECTION DETAILS: BC-923-2188-S2
YOKE CHANNEL: 1/4" X 2" X 4-1/2" CHANNEL
HORIZONTAL STIFFENERS: 1/4" X 2-1/2" FLAT BAR
VERTICAL STIFFENERS: 1/4" X 2-1/2" FLAT BAR
APPROXIMATE WEIGHT OF ASSEMBLY: 485 LBS.

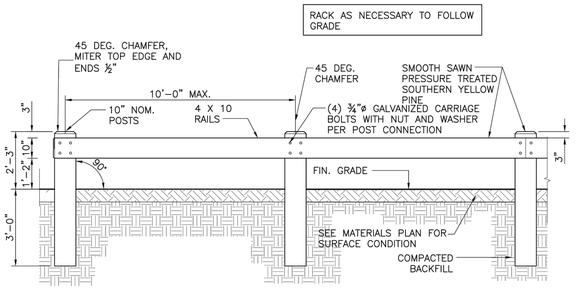
ALL OBSTRUCTIVE HAND RAILING OR FLOORING TO BE MODIFIED BY OTHERS



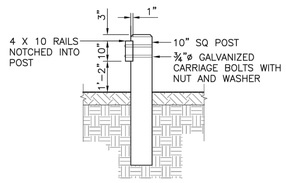
1 - WHIPPS GATE INSTALLATION DETAIL
SCALE: NOT TO SCALE



2 - WHIPPS GATE CONNECTION SECTION DETAILS
SCALE: NOT TO SCALE



3 - WOOD GUARDRAIL DETAIL
SCALE: NOT TO SCALE



SCALE: 1" = 20'

Rev.	Description	Date	Eng.	Chk.
A	Original Issue	03/21/18	KS	
Rev.	Rev. Record	Date	Eng.	Chk.

370 SOUTH ATHOL RD. ATHOL MA 01331
Whipps, Inc.

DO NOT SCALE THIS DRAWING
Work to Dimensions
Linear Dimensions are Inches
Scale: FD
THIRD ANGLE PROJECTION

Quantity: 2	Scale: FD		
Tag No's: 701 & 702		Unseating	3.0"
ITEM: F5		Seating	3.0"
Design Head			0.1
Leakage Rate (GPM/ft of seal)			
Loc: CC TANK			
Dwg No: BC-923-2188			

Title: SERIES 923 SLIDE GATE INSTALL 36" X 36"
Project: WEST VILLAGES WRF NORTH PORT, FL

Material	STAINLESS STEEL GRADE 304L		
Dwg No:	BC-923-1255-S2	S.O. No:	23795

Title: SERIES 923 SLIDE GATE SECTION DETAILS

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CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

DESIGNED: KEV/SAS
DRAWN: BWH
CHECKED: TVA
CHECKED:
APPROVED: SAS

FILENAME
C-00-005.dwg
BC PROJECT NUMBER
PROJECT 160123

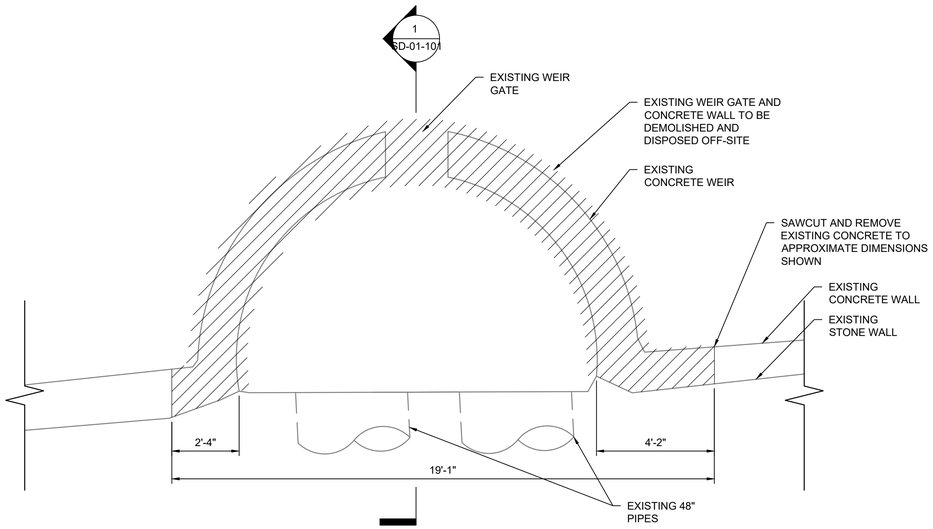
CIVIL

CIVIL DETAILS

DRAWING NUMBER
C-00-005

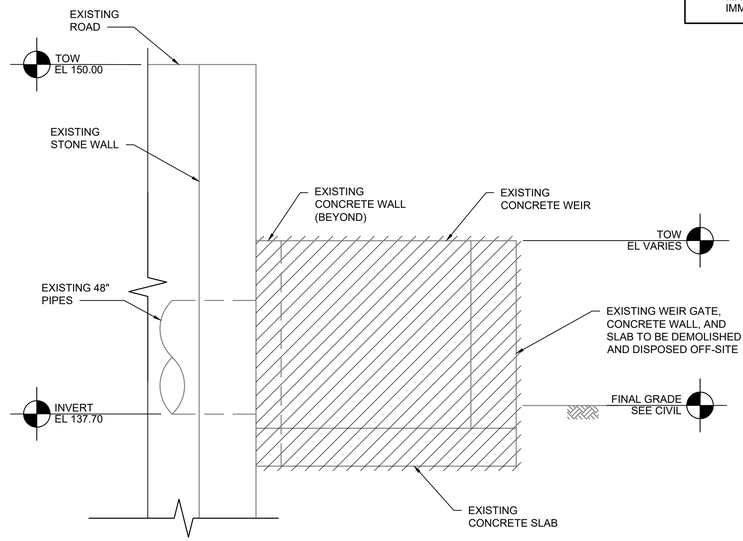
SHEET NUMBER 6 OF 13

Path: C:\BCPW\D3249940 FILENAME: C-00-005.DWG PLOT DATE: 6/29/2023 4:06 PM CAD USER: BEN HAWES



DEMOLITION PLAN

SCALE: 3/8" = 1'-0"



1
SD-01-101

SECTION

SCALE: 3/8" = 1'-0"

SITE PHOTO

KEY PLAN

DEMOLITION AND SITE PREPARATION NOTES:

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED PRIOR TO ANY OTHER WORK ON SITE. EROSION CONTROL SHALL BE MAINTAINED THROUGHOUT CONSTRUCTION.
2. THE LIMIT OF DISTURBANCE (LOD) LINE SHALL SERVE AS THE STRICT LIMIT OF DISTURBANCE FOR THE PROJECT WITHIN OR ADJACENT TO REGULATED WETLAND AREAS. REFER TO EROSION AND SEDIMENT CONTROL PLAN FOR LOD.
3. ALL VEGETATION IS TO BE CLEARED AND GRUBBED WITHIN THE LOD.
4. THE LIMITS OF CLEARING, GRADING, AND DISTURBANCE SHALL BE KEPT TO A MINIMUM WITHIN THE PROPOSED AREA OF CONSTRUCTION, ALL AREAS OUTSIDE OF THESE LIMITS, AS DEPICTED ON THE PLAN, SHALL BE UNDISTURBED AND REMAIN IN NATURAL CONDITION.
5. DIMENSIONS OF EXISTING STRUCTURE ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS PRIOR TO ORDERING OR FABRICATING MATERIALS. IN EVENT OF DISCREPANCIES, NOTIFY CONSTRUCTION MANAGER IMMEDIATELY.

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CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

DESIGNED: KP
DRAWN: JAB
CHECKED: TVA
CHECKED:
APPROVED: SAS

FILENAME
SD-01-101.dwg
BC PROJECT NUMBER
PROJECT 160123
CLIENT PROJECT NUMBER
CLIENT 160123

STRUCTURAL

DEMOLITION PLAN, SECTION, PHOTO

DRAWING NUMBER
SD-01-101

7 SHEET NUMBER OF 13

Path: C:\BCPWD3249944 FILENAME: SD-01-101.DWG PLOT DATE: 6/22/2023 1:36 PM CAD USER: BEN HAWES

GENERAL

G 1 SCOPE
THE GENERAL NOTES AND STANDARD DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT EXCEPT WHERE THERE ARE SPECIFIC INDICATIONS TO THE CONTRARY.

G 2 PRECEDENCE
IF THERE IS A CONFLICT BETWEEN STRUCTURAL NOTES AND STRUCTURAL DRAWINGS, CONTACT THE STRUCTURAL ENGINEER OF RECORD FOR CLARIFICATION. SPECIFIC NOTES AND DETAILS ON DRAWINGS TAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS.

G 3 DIMENSIONS
STRUCTURAL DIMENSIONS CONTROLLED BY OR RELATED TO ELECTRICAL EQUIPMENT AND DIMENSIONS RELATED TO EXISTING FACILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR CONFIRMING ALL CONSTRUCTION DIMENSIONS AND NOTIFYING OWNER'S CONSTRUCTION MANAGER OF DISCREPANCIES IN A TIMELY FASHION.

G 4 MEANS, METHODS & CONSTRUCTION LOADS
CONTRACT DRAWINGS REPRESENT THE FINISHED STRUCTURE. CONTRACTOR IS RESPONSIBLE FOR MEANS, METHODS AND SEQUENCE OF CONSTRUCTION, AND SHALL MAKE ADEQUATE PROVISIONS TO MAINTAIN THE INTEGRITY OF STRUCTURES AT ALL STAGES OF CONSTRUCTION. DETERMINATION OF AND PROVISIONS FOR CONSTRUCTION LOADING SHALL BE PROVIDED BY THE CONTRACTOR.

G 6 SAFETY
CONTRACTOR SHALL TAKE ADEQUATE PRECAUTIONS TO ENSURE THE SAFETY OF WORKERS AND VISITORS TO THE SITE, INCLUDING BUT NOT LIMITED TO, PROVIDING ADEQUATE SHORING, BRACING AND ACCESS RESTRICTIONS. COMPLY WITH FEDERAL, STATE AND LOCAL SAFETY CODES AND STANDARDS.

G 7 DRAINAGE SURFACES
SLOPE DRAINAGE SURFACES UNIFORMLY TO DRAIN. SLOPE SHALL BE 1/8" TO 1/4" PER FOOT.

DESIGN CRITERIA

D 1 GOVERNING BUILDING CODE
CONSTRUCTION AND DESIGN SHALL BE IN ACCORDANCE WITH MASSACHUSETTS STATE BUILDING CODE 780, 9TH ED. (2015 INTERNATIONAL BUILDING CODE WITH AMENDMENTS). THIS CODE SHALL GOVERN EXCEPT WHERE OTHER APPLICABLE CODES OR CONTRACT PROVISIONS ARE MORE RESTRICTIVE.

D 2 LIVE LOADS
WALKWAY AND ACCESS PLATFORM ..... 100 PSF

D 4 SNOW LOADS
GROUND SNOW LOAD ..... p_g = 40 PSF
SNOW LOAD IMPORTANCE FACTOR ..... I_s = 1.10

D 5 WIND
BASIC WIND SPEED (ULTIMATE) ..... 127 MPH
RISK CATEGORY III
EXPOSURE CATEGORY C
TOPOGRAPHIC FACTOR ..... K_{ZT} = 1.0

D 6 SEISMIC
MCE ACCELERATION, SHORT PERIOD ..... S_s = 0.214 g
MCE ACCELERATION, 1-SEC PERIOD ..... S_1 = 0.069 g
SITE CLASS ..... D
DESIGN ACCEL, SHORT PERIOD ..... S_{DS} = 0.228 g
DESIGN ACCEL, 1-SEC PERIOD ..... S_{D1} = 0.111 g
RISK CATEGORY III
SEISMIC IMPORTANCE FACTOR ..... I_e = 1.25
SEISMIC DESIGN CATEGORY ..... B
NONBUILDING SELF-SUPPORTING STRUCTURES (ASCE 7-10, TABLE 15.4-2). R = 2 Ω_o = 2

FOUNDATION

F 1 HIGH GROUND WATER: ASSUME AT TOP OF BANK DURING STORM EVENTS.

F 2 ALLOWABLE BEARING PRESSURE
SHALLOW FOUNDATIONS SHALL BEAR ON AT LEAST 2 FEET OVER-EXCAVATED STRUCTURAL FILL AND HAVE BEEN DESIGNED FOR AN ALLOWABLE BEARING PRESSURE OF 1,500 PSF.

F 3 FOUNDATION
NEW CONTAINMENT CUT-OFF WALL AND LIGHT POLE BASE SHALL BEAR IN A DENSE, UNDISTURBED CLAY LAYER. SIDEWALK SLAB SHALL BEAR ON COMPACTED STRUCTURAL FILL.

F 4 DIFFERING CONDITIONS
FOUNDATION CONDITIONS NOTED DURING CONSTRUCTION WHICH DIFFER FROM THOSE INDICATED SHALL BE BROUGHT TO THE ATTENTION OF THE CONSTRUCTION MANAGER. CONTRACTOR IS RESPONSIBLE FOR REPLACING WORK CONDUCTED AFTER SUCH NOTIFICATION BUT BEFORE CONSTRUCTION MANAGER PROVIDES ADDITIONAL DIRECTIONS.

F 5 EXCAVATION, DE-WATERING, & SAFETY
DESIGN / PROVIDE CRIBBING, SHORING, AND BRACING AS NEEDED FOR SAFETY AND TO ALLOW CONSTRUCTION OF THE WORK PRESENTED HEREIN.

F 6 STRUCTURAL BACKFILL
PLACE IN UNIFORM LAYERS BROUGHT UP UNIFORMLY ON BOTH SIDES OF STRUCTURES.

F 7 CONTRACTOR IS RESPONSIBLE TO COORDINATE EXCAVATION FOR CUT-OFF WALL CONSTRUCTION TO MAINTAIN A DRY/STABLE EXCAVATION SUBGRADE PRIOR TO PLACEMENT OF CONCRETE. PROVIDE FOR DEWATERING OF EXCAVATION AND REMOVAL OF SATURATED SUBGRADE MATERIAL. CONCRETE TO BE PLACED ON DRY/STABLE SUBGRADE.

F 8 FROST DEPTH ..... 48"

CONCRETE

C 1 APPLICABLE CODES
ACI 301 "SPECIFICATIONS FOR STRUCTURAL CONCRETE"
ACI 318 "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE"
ACI 350 (FOR LIQUID CONTAINING STRUCTURES) - "CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES"

C 2 REINFORCING STEEL DETAILS
DETAILING, FABRICATION AND ERECTION OF REINFORCING BARS IN ACCORDANCE WITH ACI DETAILING MANUAL (ACI SP-66), LATEST EDITION.

C 3 DESIGN STRENGTH
1. STRUCTURAL CAST-IN-PLACE CONCRETE ..... f'c = 4,500 PSI
2. REINFORCED STEEL ..... ASTM A615, GRADE 60 DEFORMED BARS

C 4 CONCRETE COVER
1. CONCRETE CAST AGAINST EARTH ..... 3"
2. CONCRETE EXPOSED TO EARTH, WASTEWATER, CHEMICALS OR WEATHER ..... 2"
3. CONCRETE NOT EXPOSED TO EARTH, WASTEWATER, CHEMICALS OR WEATHER ..... 1-1/2"

C 5 BAR DEVELOPMENT AND LAP SPLICE LENGTH
SEE TABLE AT THE END OF THESE STRUCTURAL NOTES. IN SLABS, BEAMS, GIRDERS AND HORIZONTAL REINFORCING AT WALLS, SPLICES OF ADJACENT REINFORCING STEEL BARS SHALL BE STAGGERED AT LEAST ONE SPLICE LENGTH.

C 6 WELDING REINFORCING BARS
NOT ALLOWED.

C 7 STANDARD HOOKS
BARS ENDING IN RIGHT ANGLE BENDS OR HOOKS SHALL CONFORM TO REQUIREMENTS OF ACI 318. PROVIDE STANDARD HOOK IN BARS WHICH TERMINATE AT WALL OR SLAB EDGES / INTERSECTIONS THAT PROVIDE LESS THAN THE SPECIFIED DEVELOPMENT LENGTH.

C 8 CHAMFERS
EXPOSED CONCRETE CORNERS AND EDGES SHALL HAVE 3/4" CHAMFERS. RE-ENTRANT CORNERS SHALL NOT HAVE FILLETS.

C 9 ANCHOR BOLTS
STAINLESS STEEL TYPE 316 MATERIAL UNLESS OTHERWISE NOTED (SEE SPECIFICATIONS).

C 10 INSERTS
PROVIDE ANCHORAGE INSERTS ON CONCRETE WALLS AND CONCRETE CEILINGS IN GALLERIES, PIPE CHASES, TUNNELS AS REQUIRED BY MECHANICAL AND ELECTRICAL INSTALLATIONS. USE UNISTRUT P3200 SERIES HOT DIP GALVANIZED OR EQUAL UNLESS OTHERWISE SPECIFIED.

C 11 COMPATIBLE FINISHES
CURING COMPOUNDS AND OTHER SURFACE TREATMENTS, CONCRETE ADMIXTURES AND SUB-SLAB DRAINAGE SHALL BE REVIEWED BY CONTRACTOR AND CERTIFIED COMPATIBLE WITH FINISHES TO BE APPLIED LATER IN THE CONSTRUCTION SEQUENCE.

C 12 VAPOR BARRIER BELOW SLAB ON GRADE
VAPOR BARRIER, WHERE NOTED ON THE DRAWINGS, SHALL BE 10 MIL MINIMUM CLASS A OR B PLASTIC WATER VAPOR RETARDER PER ASTM E1745. INSTALL PER ASTM E1643. LAP JOINTS 6" AND SEAL WITH MANUFACTURER'S RECOMMENDED TAPE OR ADHESIVE.

C 13 EXPOSED ENDS OF REINFORCING BARS AT SAWCUT OPENINGS IN EXISTING CONCRETE
REMOVE REINFORCING BARS 1 1/2 INCHES BACK FROM FACE OF OPENING BY FLAME GOUGING. FILL HOLE AND REPAIR SURFACE WITH CONCRETE REPAIR MORTAR.

SPECIAL INSPECTIONS

SI 1 AN INDEPENDENT TESTING COMPANY RETAINED BY THE OWNER AND APPROVED BY THE BUILDING OFFICIAL SHALL INSPECT THE FOLLOWING
(SEE EXPANDED LIST ON DRAWING S-00-002, SPECIFICATIONS AND GOVERNING CODE):

1. SOIL COMPACTION AT FOUNDATIONS.
2. REINFORCING BAR, CONCRETE PLACEMENT AND TAKING OF CONCRETE TEST SPECIMENS.
3. ANCHOR BOLTS.
4. ANCHORS INSTALLED USING ADHESIVE.

SI 2 CONTRACTOR SHALL NOTIFY THE TESTING COMPANY FOR ALL INSPECTIONS.

STRUCTURAL OBSERVATIONS

SO 1 THE OWNER SHALL RETAIN A REGISTERED DESIGN PROFESSIONAL TO PERFORM STRUCTURAL OBSERVATIONS. THE CONSTRUCTION MANAGER SHALL NOTIFY THE OWNER AT LEAST 48 HOURS BEFORE A DESIGNATED WORK IS TO BE COVERED. REFER TO SPECIFICATION 01 45 23 FOR ADDITIONAL REQUIREMENTS.

SO 2 REQUIRED STRUCTURAL OBSERVATIONS INCLUDE:
1. STRUCTURAL FILL.
2. FOUNDATIONS PREPARED FOR CONCRETE PLACEMENT.

STRUCTURAL DEFERRED SUBMITTALS

SDS 1 THE CONTRACTOR SHALL SUBMIT DRAWINGS AND CALCULATIONS BEARING THE SEAL OF A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF MASSACHUSETTS TO THE ENGINEER FOR REVIEW AND/OR RECORD FILES. STRUCTURAL DEFERRED SUBMITTALS INCLUDE:
3. ANCHOR BOLTS FOR ALL EQUIPMENT ANCHORAGE.
4. GUARDRAILS AND HANDRAILS.
5. ACCESS PLATFORMS AS SPECIFIED.
6. CONSTRUCTION SHORING.

TENSION DEVELOPMENT AND LAP SPLICE LENGTHS (IN INCHES)

BAR SIZE	APPLICATION	CONCRETE COVER = 2.00 IN.			CONCRETE COVER = 3.00 IN.		
		TOP	OTHER	MIN C/C SPACING	TOP	OTHER	MIN C/C SPACING
#3	DEVELOPMENT LAP SPLICE	12 16	12 16	4.50 4.75	12 16	12 16	6.50 6.75
#4	DEVELOPMENT LAP SPLICE	15 20	12 16	4.50 5.00	15 20	12 16	6.50 7.00
#5	DEVELOPMENT LAP SPLICE	19 24	15 19	4.75 5.25	19 24	15 19	6.75 7.25
#6	DEVELOPMENT LAP SPLICE	22 29	17 22	4.75 5.50	22 29	17 22	6.75 7.50
#7	DEVELOPMENT LAP SPLICE	33 42	25 33	5.00 5.75	33 42	25 33	7.00 7.75
#8	DEVELOPMENT LAP SPLICE	37 48	29 37	5.00 6.00	37 48	29 37	7.00 8.00

NOTES:
1. TOP BARS ARE HORIZONTAL BARS WITH MORE THAN 12 IN. OF FRESH CONCRETE CAST BELOW THE BARS.

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CHESTER BROOK YMCA WETLAND FLOOD MITIGATION

REVISIONS

REV	DATE	DESCRIPTION

LINE IS 2 INCHES AT FULL SIZE

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CHECKED: TVA
CHECKED:
APPROVED: SAS

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CLIENT 160123

STRUCTURAL

STRUCTURAL NOTES

DRAWING NUMBER
S-00-001

SHEET NUMBER 8 OF 13

Path: C:\BCPWD3249944 FILENAME: S-00-001.DWG PLOT DATE: 6/22/2023 1:04 PM CAD USER: BEN HAWES

TABLE 1

REQUIRED SPECIAL INSPECTIONS - STRUCTURAL SYSTEMS

SYSTEM OR MATERIAL	REQUIRED INSPECTION	FREQUENCY OF INSPECTION		REMARKS
		CONTINUOUS	PERIODIC	
SOILS	VERIFY EXCAVATIONS ARE EXTENDED TO PROPER DEPTH AND HAVE REACHED PROPER MATERIAL		X	
	VERIFY SOIL MATERIALS BELOW FOOTINGS ARE ADEQUATE TO ACHIEVE DESIGN BEARING CAPACITY		X	
	PRIOR TO PLACEMENT OF CONTROLLED FILL, OBSERVE SUBGRADE AND VERIFY THAT SITE HAS BEEN PREPARED PROPERLY		X	
	PERFORM CLASSIFICATION AND TESTING OF CONTROLLED FILL MATERIALS		X	SEE TABLE 2
	VERIFY USE OF PROPER MATERIALS, DENSITIES AND LIFT THICKNESSES DURING PLACEMENT AND COMPACTION OF CONTROLLED FILL	X		SEE TABLE 2
CONCRETE	INSPECT FORMWORK FOR LOCATION AND DIMENSIONS OF MEMBER BEING FORMED		X	
	VERIFY MATERIAL FOR REINFORCEMENT		X	CONTRACTOR TO SUBMIT CERTIFIED MILL TEST REPORTS
	REINFORCING STEEL PLACEMENT		X	
	INSPECT POST-INSTALLED CONCRETE ANCHORS: - HORIZONTAL AND UPWARDLY INCLINED ADHESIVE ANCHORS - OTHER ANCHORS UNLESS ICC REPORT REQUIRED CONTINUOUS INSPECTION	X	X	INSPECTION TO CONFORM TO IBC AND TO ANCHOR MANUFACTURER'S RECOMMENDATIONS AND ICC REPORTS
	VERIFY USE OF REQUIRED CONCRETE MIX DESIGN(S)		X	
	AT THE TIME FRESH CONCRETE IS SAMPLED TO FABRICATE SPECIMENS FOR STRENGTH TESTS, PERFORM SLUMP AND AIR CONTENT TESTS, AND TEMPERATURE OF CONCRETE	X		CONTINUOUS DURING PREPARATION OF SAMPLES
	CONCRETE PLACEMENT	X		
	INSPECTION FOR MAINTENANCE OF CURING PROCEDURES AND TEMPERATURE		X	VERIFY APPROPRIATE CURING METHOD HAS BEEN IMPLEMENTED AFTER EACH POUR
	VERIFY IN-SITU CONCRETE STRENGTH PRIOR TO REMOVAL OF SHORES AND FORMS FROM STRUCTURAL SLABS AND BEAMS		X	
	CEMENTITIOUS GROUTING OF BASE PLATES AND EPOXY GROUTING FOR EQUIPMENT MOUNTING	X		

TABLE 2

REQUIRED TESTING FOR SPECIAL INSPECTIONS

SYSTEM OR MATERIAL	TESTING		
	CODE OR STANDARD REFERENCE	FREQUENCY	
GEOTECHNICAL			
PREPARED SUBGRADE DENSITY	ASTM D6938	EACH 300 SF OF PREPARED SUBGRADE	
FILL IN-PLACE DENSITY	ASTM D6938	EACH 300 SF OF EACH LIFT PLACED EACH DAY	
CONCRETE			
CONCRETE COMPRESSIVE STRENGTH	ASTM C31,ASTM C39,ASTM C172	SEE SPECIFICATION 03305	
CONCRETE SLUMP	ASTM C143	WHENEVER CYLINDERS ARE CAST	
CONCRETE AIR CONTENT	ASTM C231	WHENEVER CYLINDERS ARE CAST	
CONCRETE TEMPERATURE	ASTM C1064	WHENEVER CYLINDERS ARE CAST	
CEMENTITIOUS AND EPOXY GROUT COMPRESSIVE STRENGTH	ASTM C942 (CEMENTITIOUS) ASTM C579 (EPOXY)		TEST 2" CUBES FOR EACH GROUT SHIPMENT TO THE FIELD

QUALITY ASSURANCE NOTES

1. QUALITY OF WORKMANSHIP AND MATERIALS OF CONSTRUCTION ARE GOVERNED BY THE INTERNATIONAL BUILDING CODE..
2. STRUCTURAL TESTS, SPECIAL INSPECTION AND STRUCTURAL OBSERVATION WILL BE PERFORMED IN ACCORDANCE WITH IBC, CHAPTER 17.
3. WHERE FREQUENCY OF INSPECTION IS SPECIFIED TO BE CONTINUOUS, THE SPECIAL INSPECTOR IS EXPECTED TO BE PRESENT IN THE AREA WHERE THE WORK IS BEING PERFORMED AND PROVIDING FULL-TIME OBSERVATION OF THE WORK REQUIRING SPECIAL INSPECTION.
4. WHERE FREQUENCY OF INSPECTION IS SPECIFIED TO BE PERIODIC, THE SPECIAL INSPECTOR IS EXPECTED TO BE PRESENT IN THE AREA WHERE THE WORK HAS BEEN OR IS BEING PERFORMED AND AT THE COMPLETION OF THE WORK (PRIOR TO THE NEXT CONSTRUCTION TASK).
5. SPECIAL INSPECTIONS ARE IN ADDITION TO INSPECTIONS BY THE BUILDING OFFICIALS. CONSTRUCTION IS SUBJECT TO INSPECTION BY THE BUILDING OFFICIAL. COORDINATE WITH BUILDING DEPARTMENT TO DETERMINE REQUIRED INSPECTIONS.
6. CONTRACTOR SHALL PROVIDE ACCESS TO THE WORK FOR REQUIRED INSPECTIONS. CONTRACTOR SHALL PROVIDE NOTIFICATION IN ADVANCE OF REQUIRED INSPECTIONS, TESTING AND STRUCTURAL OBSERVATIONS.

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REV	DATE	DESCRIPTION

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STRUCTURAL

SPECIAL INSPECTION NOTES

DRAWING NUMBER
S-00-002

SHEET NUMBER 9 OF 13

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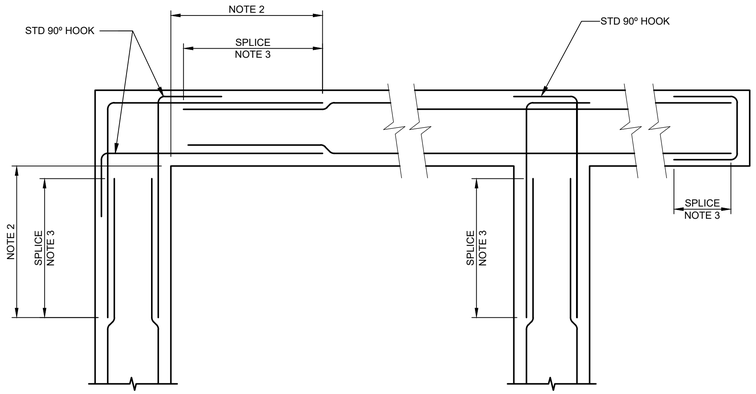


NOTES (FOR HORIZONTAL WALL REINFORCING):

1. SIZE AND SPACING OF CORNER OR INTERSECTION REINFORCING SHALL MATCH REINFORCING SHOWN IN SPECIFIC SECTIONS OR DETAILS. VERTICAL REINFORCING NOT SHOWN FOR CLARITY.

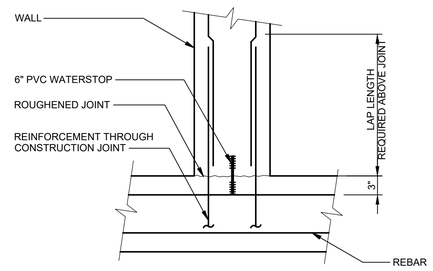
2. UNLESS NOTED OTHERWISE, BAR SPLICE SHALL BE LOCATED OUTSIDE OF CORNER OR INTERSECTION AREA TO AVOID CONGESTION. CONTRACTORS OPTION TO PROVIDE SINGLE BENT BAR IN LIEU OF SPLICE CONFIGURATION.

3. SEE GENERAL STRUCTURAL NOTES FOR SPLICE LENGTH. HORIZONTAL WALL BARS SHALL BE CONSIDERED TOP BARS FOR DEVELOPMENT AND SPLICE LENGTHS.

CONCRETE - TYPICAL HORIZONTAL WALL REINFORCING

DETAIL S0101

NO SCALE

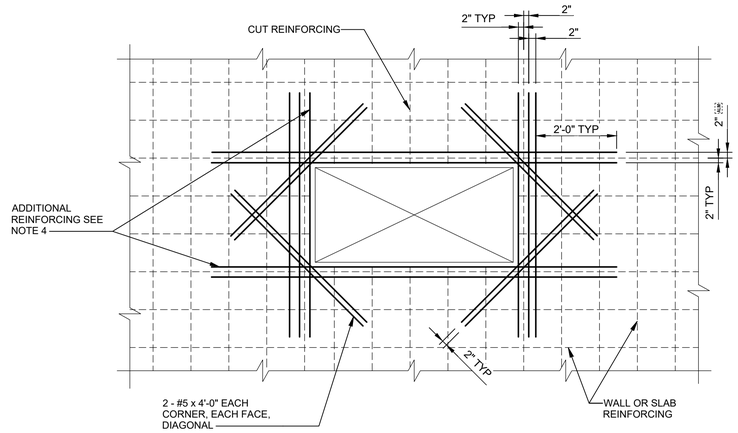


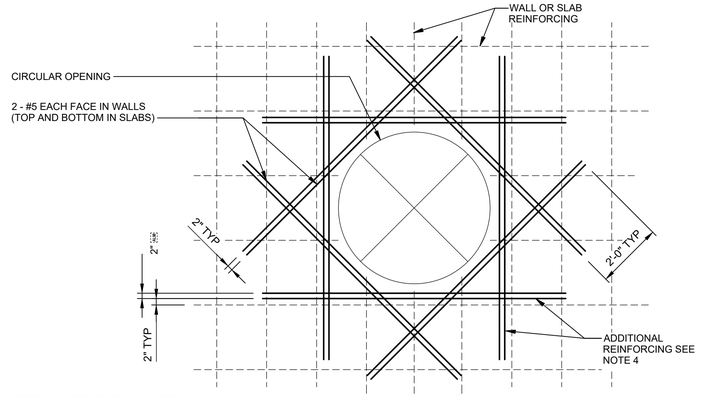
JOINT WITH PVC WATERSTOP

CONCRETE - TYPICAL HORIZONTAL CONSTRUCTION JOINT

DETAIL S0102

NO SCALE





ADDITIONAL REINFORCING NOTES:

1. AT OPENINGS 12" OR LESS, NO ADDITIONAL REINFORCING IS REQUIRED. OFFSET REINFORCING, AS NEEDED.

2. OPENINGS ARE NOT ALL SHOWN ON STRUCTURAL DRAWINGS. PROVIDE OPENINGS IN ACCORDANCE WITH ARCHITECTURAL, MECHANICAL, AND OTHER CONTRACT DRAWINGS.

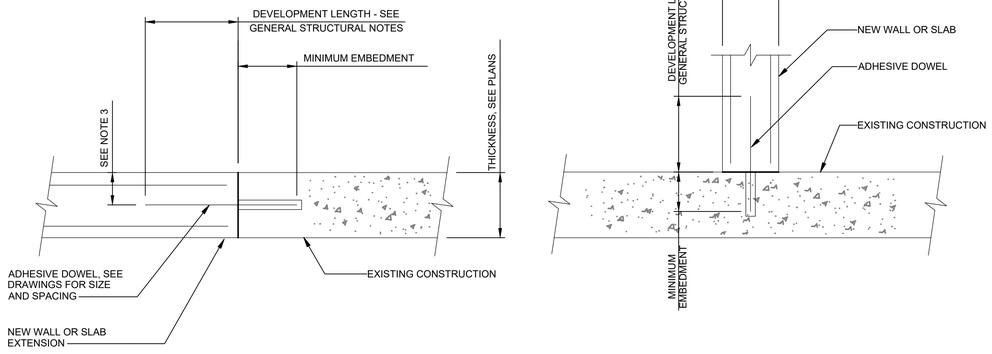
3. ADDITIONAL REINFORCEMENT MAY BE OMITTED WHERE OPENING IS FRAMED BY BEAMS OR WALLS.

4. ADDITIONAL REINFORCING (4) SIDES OF OPENING, EACH FACE, EQUAL TO NUMBER AND SIZE OF CUT REINFORCING / 2 (MIN 2 ADDITIONAL BARS EACH SIDE). WHERE AN ODD NUMBER OF REBAR ARE CUT, PROVIDE (ODD NO. +1) / 2 EACH SIDE OF OPENING.

CONCRETE - ADDITIONAL REINFORCING AT OPENINGS

DETAIL S0103

NO SCALE



DOWEL SIZE	MINIMUM EMBEDMENT
#3	5"
#4	7"
#5	8"
#6	10"
#7	12"
#8	14"
#9	16"

NOTES:

1. EMBEDMENT LENGTH IS BASED ON DOWELS SET WITH HILTI HIT-RE 500 V3 ADHESIVE ANCHOR SYSTEM. SUBMIT ICC EVALUATION SERVICE REPORT (ES REPORT) FOR ALTERNATE PRODUCTS.

2. INSTALL DOWELS IN ACCORDANCE WITH MANUFACTURER'S INSTALLATION INSTRUCTIONS AND ICC ES REPORT ESR-3814.

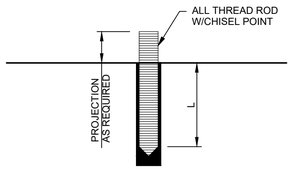
3. LOCATE DOWELS CENTERED IN WALL OR SLAB UNLESS NOTED OTHERWISE ON DRAWINGS. WHERE 2 ROWS OF DOWELS ARE INDICATED, STAGGER SPACING AND LOCATE ALTERNATING DOWELS AT MINIMUM EDGE DISTANCE FROM OPPOSITE FACES.

4. SPECIAL INSPECTION IS REQUIRED FOR ADHESIVE DOWEL INSTALLATION.

CONCRETE - REBAR DOWELS SET WITH ADHESIVE

DETAIL S0104

NO SCALE



ADHESIVE ANCHOR

MINIMUM EMBEDMENT LENGTH, L		
DIAMETER	ADHESIVE ANCHOR	EXPANSION ANCHOR
3/8"	4 1/2"	3 1/2"
1/2"	6"	4 3/4"
5/8"	7 1/2"	5 1/2"
3/4"	9"	6 1/2"
7/8"	10 1/2"	-
1"	12"	-

NOTES:

1. CONFORM TO ICC EVALUATION SERVICE REPORT (ES REPORT REQUIREMENTS AND MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION.

2. PROVIDE TYPE 316 STAINLESS STEEL MATERIAL

3. PROVIDE HOLE DIAMETER IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION.

4. EXPANSION ANCHOR EMBEDMENT LENGTHS ARE BASED ON HILTI KWIK BOLT TZ STAINLESS STEEL ANCHORS IN 4000 PSI NORMAL WEIGHT CONCRETE, SUBMIT ICC EVALUATION SERVICE REPORT (ES REPORT) FOR ALTERNATE PRODUCTS.

5. ADHESIVE ANCHOR EMBEDMENT LENGTHS ARE BASED ON HILTI HIT-RE 500-SD ADHESIVE IN 4000 PSI CONCRETE. SUBMIT ICC ES REPORT FOR ALTERNATE PRODUCTS.

CONCRETE - CONCRETE ANCHORS

DETAIL S0105

NO SCALE

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REVISIONS

REV	DATE	DESCRIPTION

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PROJECT 160123
CLIENT PROJECT NUMBER
CLIENT 160123

STRUCTURAL

STANDARD DETAILS

DRAWING NUMBER
S-00-003

SHEET NUMBER 10 OF 13

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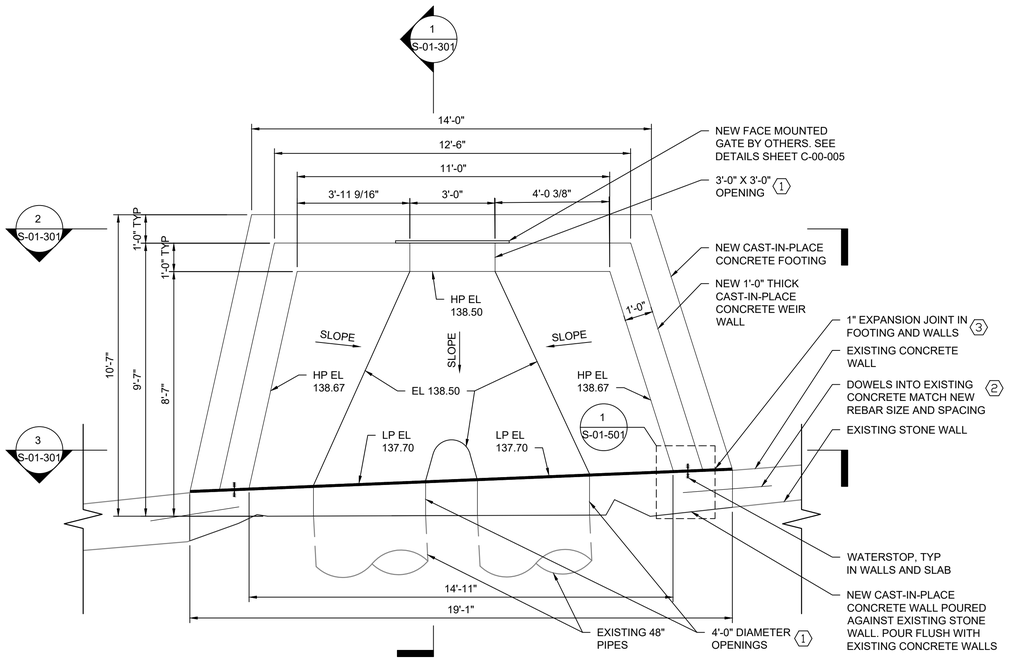
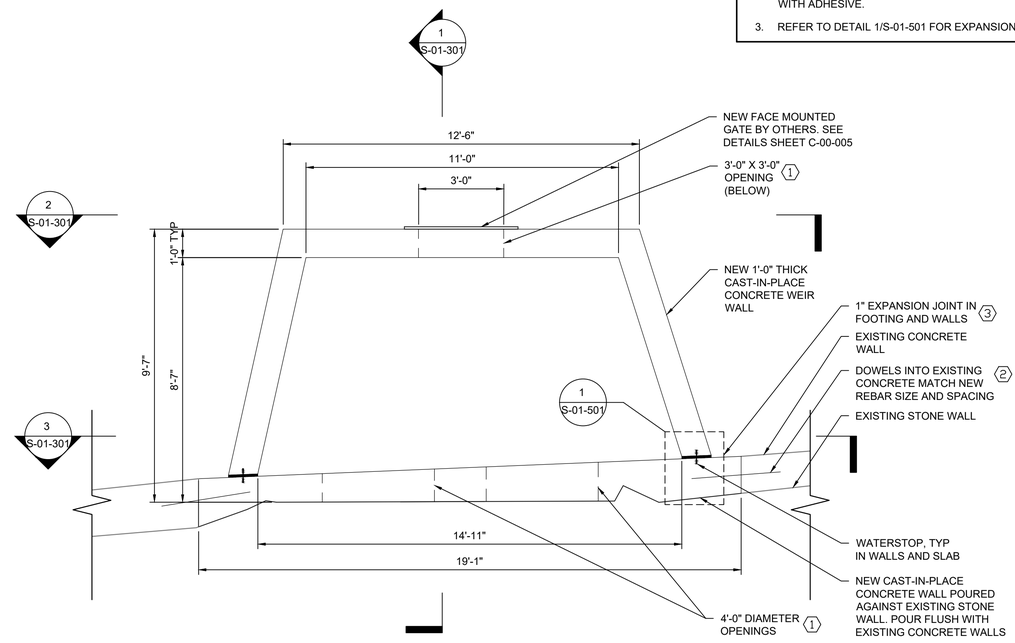


FOUNDATION PLAN

SCALE: 3/8" = 1'-0"



TOP PLAN

SCALE: 3/8" = 1'-0"

GENERAL NOTES:

1. DIMENSIONS OF EXISTING STRUCTURE ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY EXISTING CONDITIONS PRIOR TO ORDERING OR FABRICATING MATERIALS. IN EVENT OF DISCREPANCIES, NOTIFY CONSTRUCTION MANAGER IMMEDIATELY.

2. CONSTRUCTION SEQUENCE
   - A. FIELD VERIFY EXISTING STRUCTURE CONDITION AND EXISTING DIMENSIONS.
   - B. EXCAVATE AROUND EXISTING STRUCTURE AND PROVIDE TEMPORARY SHORING SYSTEM AND BYPASS PIPE IF NECESSARY.
   - C. DEMOLISH EXISTING STRUCTURE AND EXCAVATE TO PROPOSED SOIL ELEVATION.
   - D. PREPARE SUBGRADE FOR FOUNDATION AND PLACE CAST-IN-PLACE CONCRETE FOUNDATION AND WALL.
   - E. BACKFILL INTERIOR STRUCTURE WITH CIP CONCRETE OR GRADED ROCK.
   - F. INSTALL THE GATE AND ACCESS PLATFORM.
   - G. BACKFILL AND RE-GRADE SOIL ELEVATION AROUND STRUCTURE.

⬡ KEY NOTES:

1. CAST-IN-PLACE FORMED OPENING. PROVIDE ADDITIONAL REINFORCEMENT AT OPENING PER STANDARD DETAIL S0103.
2. REFER TO STANDARD DETAIL S0104 FOR DOWELS SET WITH ADHESIVE.
3. REFER TO DETAIL 1/S-01-501 FOR EXPANSION JOINTS INFO.

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PROJECT 160123

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CLIENT 160123

STRUCTURAL

OUTLET WEIR STRUCTURE PLANS

DRAWING NUMBER
S-01-101

11 SHEET NUMBER OF 13

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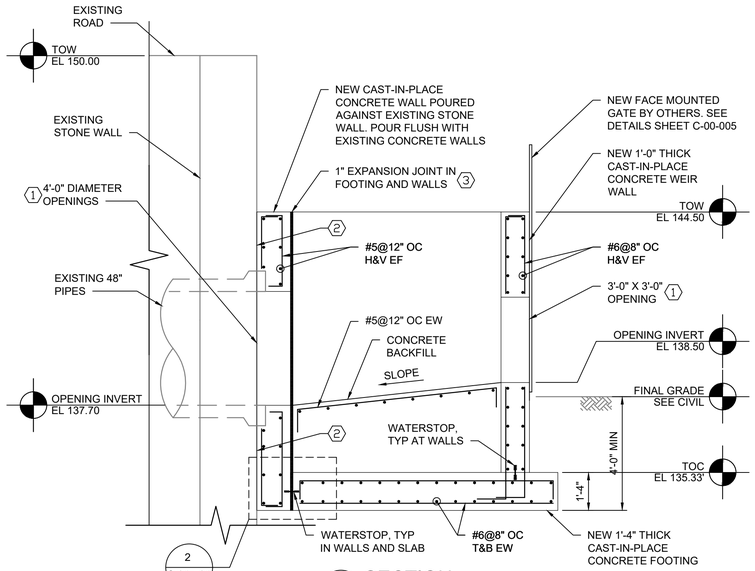
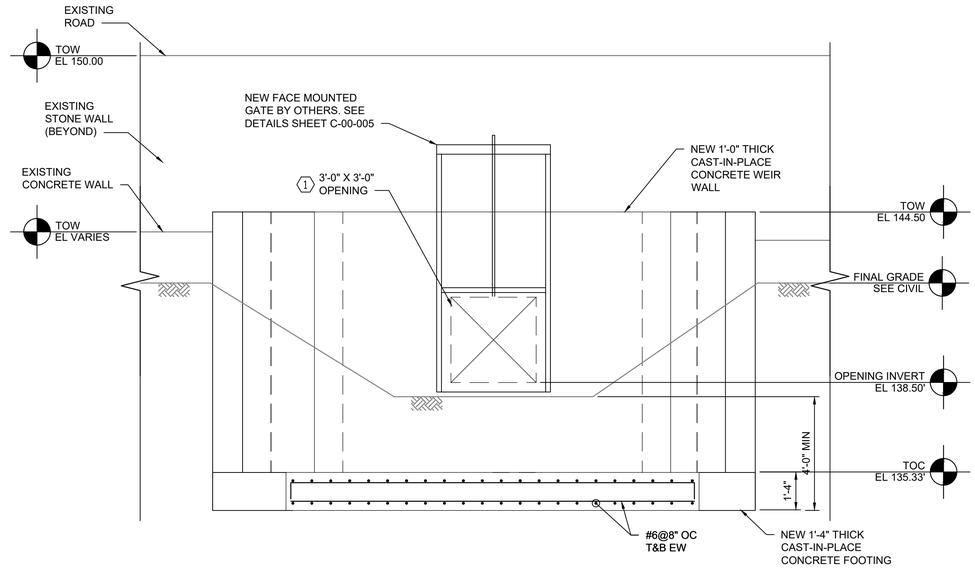


1 S-01-101 SECTION
SCALE: 3/8" = 1'-0"



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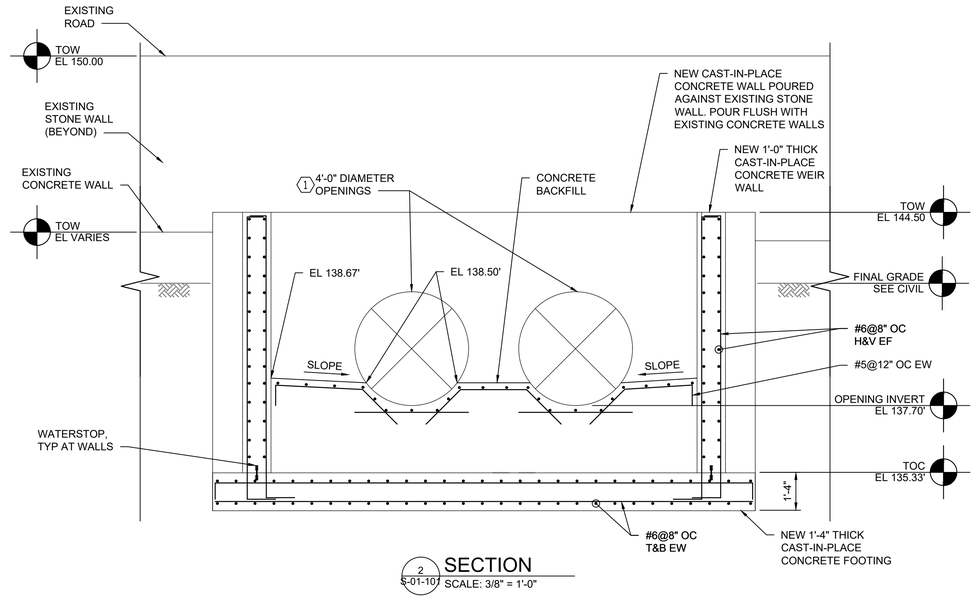

2 S-01-101 SECTION
SCALE: 3/8" = 1'-0"

GENERAL NOTES:

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2. CONSTRUCTION SEQUENCE
   - A. FIELD VERIFY EXISTING STRUCTURE CONDITION AND EXISTING DIMENSIONS.
   - B. EXCAVATE AROUND EXISTING STRUCTURE AND PROVIDE TEMPORARY SHORING SYSTEM AND BYPASS PIPE IF NECESSARY.
   - C. DEMOLISH EXISTING STRUCTURE AND EXCAVATE TO PROPOSED SOIL ELEVATION.
   - D. PREPARE SUBGRADE FOR FOUNDATION AND PLACE CAST-IN-PLACE CONCRETE FOUNDATION AND WALL.
   - E. BACKFILL INTERIOR STRUCTURE WITH CIP CONCRETE OR GRADED ROCK.
   - F. INSTALL THE GATE AND ACCESS PLATFORM.
   - G. BACKFILL AND RE-GRADE SOIL ELEVATION AROUND STRUCTURE.

KEY NOTES:

1. CAST-IN-PLACE FORMED OPENING. PROVIDE ADDITIONAL REINFORCEMENT AT OPENING PER STANDARD DETAIL S0103.
2. CLEAN AND ABRASIVE BLAST THE EXISTING SURFACE BEFORE PLACEMENT OF CONCRETE.
3. REFER TO DETAIL 1/S-01-501 FOR EXPANSION JOINTS INFO.

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CLIENT PROJECT NUMBER
CLIENT 160123

STRUCTURAL

OUTLET WEIR STRUCTURE SECTIONS

DRAWING NUMBER
S-01-301

SHEET NUMBER 12 OF 13

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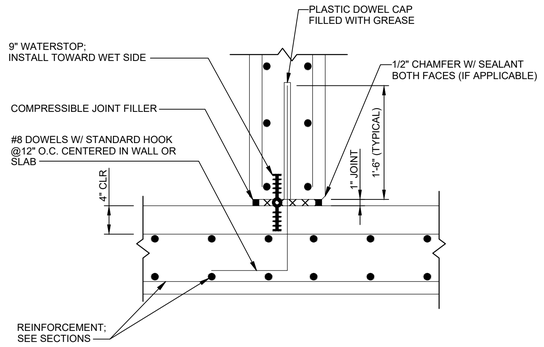

1 S-01-101 DETAIL
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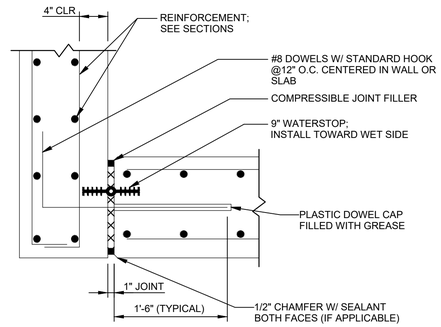

2 S-01-301 DETAIL
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BC PROJECT NUMBER
PROJECT 160123
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CLIENT 160123

STRUCTURAL

DETAILS

DRAWING NUMBER
S-01-501

13 SHEET NUMBER OF 13

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Appendix C: YMCA Wetland Delineation Memo

MEMORANDUM

Date: June 6, 2023

To: Mr. Scott Simpson, P.E., and Mr. Matt Davis, P.E., Brown and Caldwell

From: Rhianna Sommers, Epsilon Associates, Inc.

Subject: Wetland Delineation – 725 Lexington Street, Waltham, MA.

Overview

Epsilon Associates, Inc. ("Epsilon") has prepared the following memorandum for a wetland resource area delineation conducted at 725 Lexington Street in Waltham, MA (the "Study Area") on April 28, 2023. Specifically, Epsilon delineated wetland resource areas within the western portion of the property, west of the entrance drive to the YMCA facility, beginning at Bishops Forest Drive and extending to a point approximately 200 feet south of the entrance drive (adjacent to the intersection of College Farm Road and Lexington Street). Epsilon identified and delineated wetland resource areas subject to jurisdiction under Section 404 of the federal Clean Water Act and the Massachusetts Wetlands Protection Act. The City of Waltham does not have a local wetlands protection bylaw or ordinance.

Existing Site Conditions

Attachment A includes USGS topographic and aerial locus figures depicting the Study Area, and site photographs documenting existing conditions at the time of the delineation are provided in Attachment B. The Study Area consists of forested land including MassDEP-mapped wetlands (shallow marsh meadows) and Chester Brook, which flows in a southerly direction through the site starting at Bishops Forest Drive (see Figure 3 in Attachment A). A walking trail that is part of the Western Greenway exists along the east side of the Study Area. The Study Area is bordered to the north by Bishops Forest Drive, to the west by Lexington Street, to the south by additional forested wetlands and Chester Brook, and to the east by the YMCA facility.

The current FEMA FIRM Community Panel Number 25017C0413E for the City of Waltham, dated 6/4/2010, indicates that the Study Area is located within the 100-year floodplain associated with Chester Brook, specifically Zone AE, with base flood elevations ranging between 134 feet and 152 feet NAVD 88 (see Figure 3 in Attachment A).

The USDA Natural Resources Conservation Service maps soils within the Study Area as Freetown muck, ponded, 0 to 1 percent slopes. Soils east of the Study Area within the adjacent uplands are mapped as Narragansett-Hollis-Rock outcrop complex, 15 to 25 percent slopes (see Figure 4 in Attachment A).

According to the Natural Heritage and Endangered Species Program (NHESP) (Natural Heritage Atlas, 2023), the Study Area is not located within mapped Priority or Estimated Habitat for state-protected rare species. There are no NHESP-mapped potential or certified vernal pools within the vicinity of the Study Area.

Wetland Delineation Methodology

As noted above, wetland resource areas within the Study Area were delineated by Epsilon on April 28, 2023. Vegetated wetlands were delineated in accordance with the U.S. Army Corps of Engineers Wetland Delineation Manual (USACE, 1987), the "Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0" (2012), the Massachusetts Wetlands Protection Act and implementing regulations (310 CMR 10.00), and the Massachusetts Department of Environmental Protection's handbook, Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act (MADEP, 2023). The state and federal delineation methodologies generally prescribe a multi-parameter approach, where hydrophytic vegetation and hydrology (including hydric soils) are reviewed in conjunction with one another when delineating a wetland boundary.

The wetland boundaries were delineated in the field with pink and blue survey flagging. Each wetland series was given a unique alphanumeric sequence for ease of identification. Wetland flags will be survey-located for the purpose of depiction on the project site plans. A sketch of the approximate wetland boundaries is included in Attachment D.

Wetland Resource Areas

Epsilon delineated one Bordering Vegetated Wetland ("BVW") system and two streams: Chester Brook, and an unnamed intermittent tributary.

Bordering Vegetated Wetlands

BVW Series A (Flags A-100 to A-144, A-200 to A-209, and A-200A to A-208A):

This palustrine forested/emergent wetland system borders on Chester Brook and is located south of Bishops Forest Drive, adjacent to Lexington Street. Wetland flags A-100 through A-144 delineate the BVW edge on the northern side of the entrance drive to the YMCA, and wetland flags A-200 through A-209 and A-200A through A-208A delineate the wetland boundary on the south side of the entrance drive. Dominant vegetation within the wetland on the north side of the entrance drive included red

maple (*Acer rubrum*), speckled alder (*Alnus incana*), black willow (*Salix nigra*), buttonbush (*Cephalanthus occidentalis*), silky dogwood (*Cornus amomum*), skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), and arrow arum (*Peltandra virginica*). Dominant species along the south side of the entrance drive included red maple, box elder (*Acer negundo)*, spicebush (*Lindera benzoin*), skunk cabbage, and cattails (*Typha latifolia*).

Muck soils and saturation at the soil surface were observed in the wetland at the time of the delineation.

This wetland has an associated 100-foot buffer zone that is protected under the Wetlands Protection Act.

Inland Bank

Bank Series B (Chester Brook) (Flags B-100 to B-119, B-100A to B-118A, B-200 to B-210, B-200A to B-208A, B-200B to B-203B, and B-200C to B-203C):

This bank series delineates the eastern and western banks of Chester Brook. This stream flows south out of two approximately 36-inch concrete culverts located at Bishops Forest Drive into the Study Area, and continues south of the Study Area. It is not mapped as a USGS perennial stream, however, it meets the definition of a perennial stream under the Wetlands Protection Act. According to 310 CMR 10.58 (2)(a)1(c)i., "A stream shown as intermittent or not shown on the current USGS map or more recent map provided by the Department, that has a watershed size less than one square mile, is intermittent unless the stream has a watershed size of at least ½ square mile…". According to the USGS Stream Stats Program, the stream has an estimated watershed size of 1.73 square miles (see Attachment E). Because the stream has a watershed size greater than ½ square mile, it would be considered perennial.

On the north side of the entrance drive, Chester Brook is approximately 15 to 20 feet wide and has a sandy substrate with cobbles. The stream had rapid flow and was 4 to 6 inches deep at the time of the delineation. Dominant vegetation along the bank included multiflora rose (*Rosa multiflora*), Japanese knotweed (*Reynoutria japonica*), Asian bittersweet (*Celastrus orbiculatus*), silky dogwood, box elder, skunk cabbage, and common reed (*Phragmites australis*). The channel becomes less defined just north of the entrance drive near its outlet structure in the deepest portion of the wetland. The wetland is mucky in this area and inundation is visible on aerial imagery.

On the south side of the entrance drive, Chester Brook is approximately 12 to 15 feet wide and has a cobble substrate with boulders. The stream had rapid flow at the time of the delineation. Dominant bank species on the south side of the entrance drive included silky dogwood, Japanese knotweed, box elder, spicebush, and skunk cabbage.

This stream has an associated 100-foot buffer zone. Additionally, perennial streams have an associated 200-foot Riverfront Area ("RFA") under the Wetlands Protection Act.

Bank Series C (Flags C-100 to C-103, C-100A to C-103A):

This series delineates an upgradient intermittent stream channel that flows into BVW Series A. The channel receives discharge from a headwall located off Lexington Street, near its intersection with College Farm Road. Dominant species along the bank included boxelder, bush honeysuckle (*Lonicera tatarica*), black cherry (*Prunus serotina*), and Japanese barberry (*Berberis thunbergii*). The channel is approximately 2 to 5 feet wide and contained approximately 4 inches of water at the time of the delineation, with no discernable flow. The stream is not mapped as a USGS perennial stream and is not mapped within the USGS Stream Stats Program. Thus, the stream is intermittent.

According to 310 CMR 10.04, definition of a Stream, "…a body of running water which does not flow throughout the year (i.e., which is intermittent) is a stream except for that portion upgradient of all bogs, swamps, wet meadows and marshes." Thus, the portion of the stream upgradient of BVW Series A is not jurisdictional as a resource area (Inland Bank) under the Wetlands Protection Act.

Bordering Land Subject to Flooding

The current FEMA FIRM Community Panel Number 25017C0413E for the City of Waltham, dated 6/4/2010, indicates that the Study Area is located within the 100-year floodplain associated with Chester Brook, specifically Zone AE, with base flood elevations ranging between 134 feet and 152 feet NAVD 88. The 100-year floodplain is jurisdictional as Bordering Land Subject to Flooding ("BLSF") under the Wetlands Protection Act.

Riverfront Area

Chester Brook has an associated 200-foot Riverfront Area. The RFA within the Study Area consists of the BVW system, undeveloped forested land adjacent to the wetland, and the adjacent walking trail.

Representative photographs are provided in Attachment B. Wetland determination data forms are provided in Attachment C.

Attachment A

Locus Maps

G:\Projects2\MA\Waltham\6619\MXD\1_USGS_20230511.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

725 Lexington Street Waltham, Massachusetts

Epsilon Associates Inc.

Figure 1

USGS Locus Map

G:\Projects2\MA\Waltham\6619\MXD\2_Aerial_20230511.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

725 Lexington Street Waltham, Massachusetts

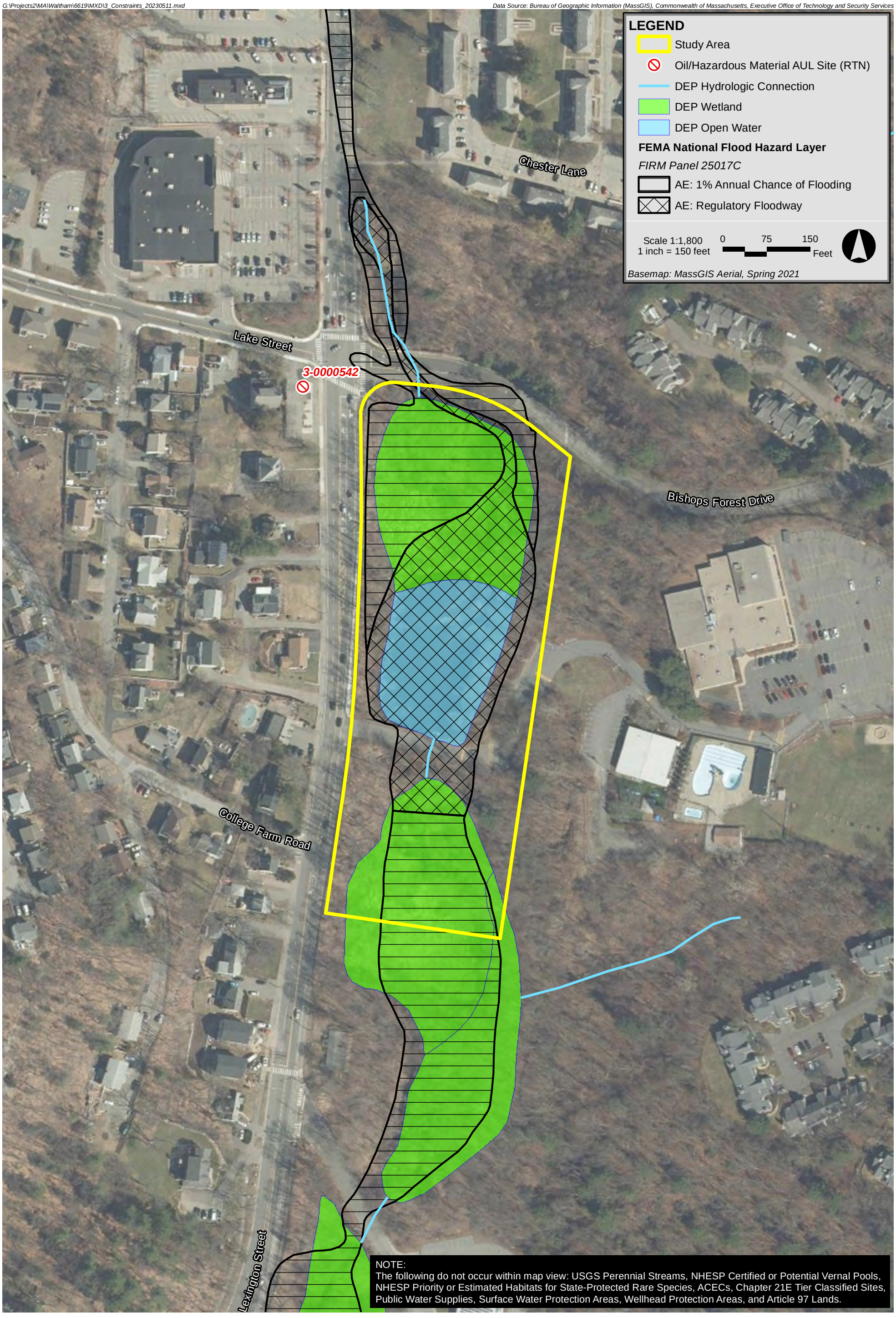
Epsilon Associates Inc.

Figure 2

Aerial Locus Map

G:\Projects2\MA\Waltham\6619\MXD\3_Constraints_20230511.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services



725 Lexington Street Waltham, Massachusetts

Epsilon Associates Inc.

Figure 3

Environmental Constraints

G:\Projects2\MA\Waltham\6619\MXD\4_SSURGO_Soils_20230511.mxd

Data Source: Bureau of Geographic Information (MassGIS), Commonwealth of Massachusetts, Executive Office of Technology and Security Services

Map Unit Symbol	Map Unit Name
53A	Freetown muck, ponded, 0 to 1 percent slopes
106D	Narragansett-Hollis-Rock outcrop complex, 15 to 25 percent slopes
629C	Canton-Charlton-Urban land complex, 3 to 15 percent slopes

725 Lexington Street Waltham, Massachusetts

Epsilon Associates Inc.

Figure 4

NRCS SSURGO Soils

Attachment B

Site Photographs

Photo 1: View of the outlet structure on the northern side of the entrance drive to the YMCA.

Photo 2: View of Wetland Series A.

Photo 3: View of Chester Brook (Bank Series B), near flag B-112.

Photo 4: View near Data Plot A1W, looking East.

Photo 5: Culvert near flag A-132.

Photo 6: Overview of Chester Brook (Bank Series B-2), looking Northwest.

Photo 7: Soil samples obtained at Data Plot A1-U.

Photo 8: Overview of Wetland Series A-2, looking east.

Attachment C

U.S. Army Corps of Engineers Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Waltham Flood Mitigation Support City/County: Waltham Sampling Date: 4/28/2023

Applicant/Owner: City of Waltham, MA State: MA Sampling Point: A1W

Investigator(s): Epsilon Associates, Inc. Section, Township, Range: Waltham

Landform (hillside, terrace, etc.): Terrace Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR or MLRA): LRR R Lat: Long: Datum:

Soil Map Unit Name: Freetown Muck NWI classification: PEM1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area**
Hydric Soil Present?	Yes ____	No X	**within a Wetland?** **Yes** ____ **No** X
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)
Data plot was conducted near wetland flag A-203A on the southern side of the entrance drive to the YMCA. Precipitation in the area is lower than usual within the past month.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: A1W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	60	Yes	FAC
2. *Salix nigra*	20	Yes	OBL
3.			
4.			
5.			
6.			
7.			
	80	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. *Lonicera morrowii*	20	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	
Herb Stratum (Plot size: 5')			
1. *Symplocarpus foetidus*	70	Yes	OBL
2. *Alliaria petiolata*	10	No	FACU
3. *Reynoutria japonica*	15	No	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	95	=Total Cover	
Woody Vine Stratum (Plot size: 30')			
1. *Toxicodendron radicans*	5	Yes	FAC
2.			
3.			
4.			
	5	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80.0% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	90	x 1 =	90
FACW species	0	x 2 =	0
FAC species	65	x 3 =	195
FACU species	45	x 4 =	180
UPL species	0	x 5 =	0
Column Totals:	200 (A)		465 (B

Prevalence Index = B/A = 2.33

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportir data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamet at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardles of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft i height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: A1W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/2	100					Loamy/Clayey	Sandy Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Waltham Flood Mitigation Support City/County: Waltham Sampling Date: 4/28/2023

Applicant/Owner: City of Waltham, MA State: MA Sampling Point: A1U

Investigator(s): Epsilon Associates, Inc. Section, Township, Range:

Landform (hillside, terrace, etc.): Hillside Local relief (concave, convex, none): Concave Slope (%): 20

Subregion (LRR or MLRA): LRR R Lat: Long: Datum:

Soil Map Unit Name: Canton fine sandy loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**	
Hydric Soil Present?	Yes ____	No X	**within a Wetland?**	**Yes** ____ **No** X
Wetland Hydrology Present?	Yes X	No ____	If yes, optional Wetland Site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)
Data plot was conducted beforePrecipitation in the area is lower than usual within the past month.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ____	Depth (inches): ____
Water Table Present?	Yes ____	No ____	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes X	No ____	Depth (inches): 10

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: A1U

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Quercus rubra*	60	Yes	FACU
2. *Acer rubrum*	20	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	80	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. *Lonicera morrowii*	20	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	20	=Total Cover	
Herb Stratum (Plot size: 5')			
1. *Alliaria petiolata*	25	Yes	FACU
2. *Onoclea sensibilis*	15	Yes	FACW
3. *Reynoutria japonica*	10	No	FACU
4. *Symplocarpus foetidus*	10	No	OBL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	60	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40.0% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	15	x 2 =	30
FAC species	20	x 3 =	60
FACU species	115	x 4 =	460
UPL species	0	x 5 =	0
Column Totals:	160 (A)		560 (B

Prevalence Index = B/A = 3.50

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportir data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamet at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardles of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft i height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: A1U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 4/4	100					Loamy/Clayey	Sandy Loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Waltham Flood Mitigation Support City/County: Waltham Sampling Date: 4/28/2023

Applicant/Owner: City of Waltham, MA State: MA Sampling Point: A2W

Investigator(s): Epsilon Associates, Inc. Section, Township, Range:

Landform (hillside, terrace, etc.): Hillside Local relief (concave, convex, none): Concave Slope (%): 45

Subregion (LRR or MLRA): LRR R Lat: Long: Datum:

Soil Map Unit Name: Freetown Muck NWI classification: PEM1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ___ No X (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	**Is the Sampled Area**	
Hydric Soil Present?	Yes X	No ___	**within a Wetland?**	**Yes** X **No** ___
Wetland Hydrology Present?	Yes X	No ___	If yes, optional Wetland Site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)
Data plot was conducted near Wetland Flag A-100. Precipitation in the area is lower than usual within the past month.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ___	Depth (inches): ___
Water Table Present?	Yes ___	No ___	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: A2W

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	15	=Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1. *Cornus amomum*	30	Yes	FACW
2. *Acer saccharinum*	20	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	50	=Total Cover	
Herb Stratum (Plot size:)			
1. *Typha latifolia*	60	Yes	OBL
2. *Impatiens capensis*	10	No	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	70	=Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	60	x 1 =	60
FACW species	60	x 2 =	120
FAC species	15	x 3 =	45
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	135 (A)		225 (B

Prevalence Index = B/A = 1.67

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportir data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamet at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardles of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft i height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: A2W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/1	100					Loamy/Clayey	Clay loam
8-20	10YR 2/1	100					Muck	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- X Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Waltham Flood Mitigation Support City/County: Waltham Sampling Date: 4/28/2023

Applicant/Owner: City of Waltham, MA State: MA Sampling Point: A2U

Investigator(s): Epsilon Associates, Inc. Section, Township, Range: Waltham

Landform (hillside, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope (%): 45

Subregion (LRR or MLRA): LRR R Lat: Long: Datum:

Soil Map Unit Name: Canton fine sandy loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area**	
Hydric Soil Present?	Yes ____	No X	**within a Wetland?**	**Yes** ____ **No** X
Wetland Hydrology Present?	Yes ____	No X	If yes, optional Wetland Site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)
Precipitation in the area is lower than usual within the past month.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ____	Depth (inches): ____
Water Table Present?	Yes ____	No ____	Depth (inches): ____
Saturation Present? (includes capillary fringe)	Yes ____	No ____	Depth (inches): ____

Wetland Hydrology Present? **Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: A2U

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Malus micromalus*	40	Yes	UPL
2. *Acer saccharum*	30	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	70	=Total Cover	
Sapling/Shrub Stratum (Plot size: 10')			
1. *Rosa multiflora*	40	Yes	FACU
2. *Frangula alnus*	20	Yes	FAC
3. *Acer saccharum*	10	No	FACU
4.			
5.			
6.			
7.			
	70	=Total Cover	
Herb Stratum (Plot size: 5')			
1. *Persicaria maculosa*	10	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	10	=Total Cover	
Woody Vine Stratum (Plot size: 30')			
1. *Lonicera periclymenum*	10	Yes	NL
2.			
3.			
4.			
	10	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	80	x 4 =	320
UPL species	40	x 5 =	200
Column Totals:	150 (A)		610 (B

Prevalence Index = B/A = 4.07

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supportir data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diamet at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardles of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft i height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL Sampling Point: A2U

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/4	100					Loamy/Clayey	Sandy loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Rock

Depth (inches): 6

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

Attachment D

Wetland Delineation Sketch

Epsilon Associates, Inc.

Wetland Delineation Sketch

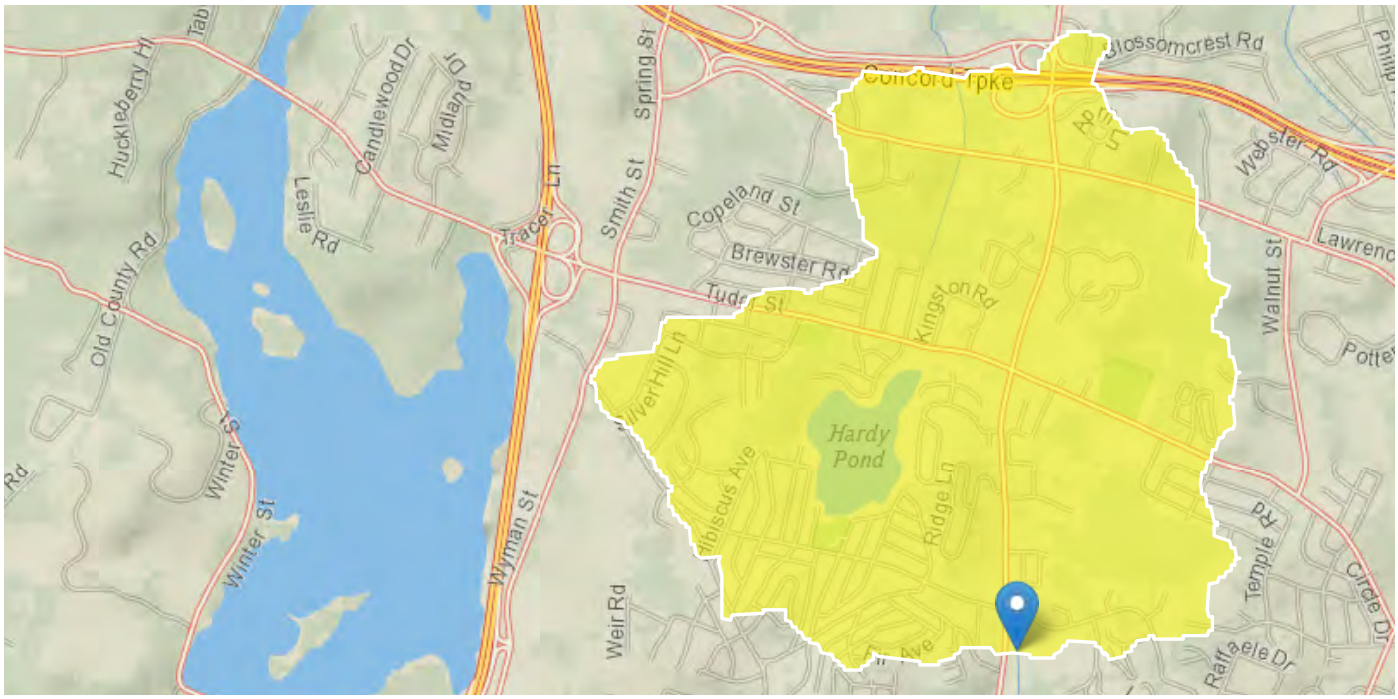
725 Lexington Street, Waltham, MA

Attachment E

Stream Stats Report – Chester Brook

StreamStats Report

Region ID: MA
Workspace ID: MA20230501175925853000
Clicked Point (Latitude, Longitude): 42.40052, -71.23356
Time: 2023-05-01 13:59:47 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BSLDEM10M	Mean basin slope computed from 10 m DEM	6.724	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	2.838	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.0558	square mile per mile
DRNAREA	Area that drains to a point on a stream	1.73	square miles
ELEV	Mean Basin Elevation	231	feet
FOREST	Percentage of area covered by forest	14.55	percent
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	7.78	percent
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless

Parameter Code	Parameter Description	Value	Unit
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	13.05	percent

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	0.16	512
ELEV	Mean Basin Elevation	231	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	7.78	percent	0	32.3

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	ASEp
50-percent AEP flood	59.5	ft^3/s	30.3	117	42.3
20-percent AEP flood	99.1	ft^3/s	49.8	197	43.4
10-percent AEP flood	130	ft^3/s	63.7	265	44.7
4-percent AEP flood	176	ft^3/s	83.4	372	47.1
2-percent AEP flood	214	ft^3/s	98.1	467	49.4
1-percent AEP flood	255	ft^3/s	113	574	51.8
0.5-percent AEP flood	299	ft^3/s	129	693	54.1
0.2-percent AEP flood	362	ft^3/s	149	880	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics

Low-Flow Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	1.61	149

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
BSLDEM250	Mean Basin Slope from 250K DEM	2.838	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0558	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

Low-Flow Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
7 Day 2 Year Low Flow	0.0866	ft^3/s	0.0239	0.302	49.5	49.5
7 Day 10 Year Low Flow	0.029	ft^3/s	0.00642	0.122	70.8	70.8

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.0558	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	2.838	percent	0.32	24.6

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
50 Percent Duration	1.67	ft^3/s	0.619	4.48	17.6	17.6
60 Percent Duration	1.08	ft^3/s	0.408	2.84	19.8	19.8
70 Percent Duration	0.562	ft^3/s	0.198	1.58	23.5	23.5
75 Percent Duration	0.412	ft^3/s	0.146	1.15	25.8	25.8

Statistic	Value	Unit	PII	PIu	SE	ASEp
80 Percent Duration	0.305	ft^3/s	0.108	0.85	28.4	28.4
85 Percent Duration	0.215	ft^3/s	0.0743	0.611	31.9	31.9
90 Percent Duration	0.144	ft^3/s	0.0478	0.424	36.6	36.6
95 Percent Duration	0.0794	ft^3/s	0.0239	0.255	45.6	45.6
98 Percent Duration	0.0488	ft^3/s	0.0129	0.175	60.3	60.3
99 Percent Duration	0.0343	ft^3/s	0.00847	0.131	65.1	65.1

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics

August Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	2.838	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.0558	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1

August Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SE	ASEp
August 50 Percent Duration	0.227	ft^3/s	0.0788	0.642	33.2	33.2

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics

Bankfull Statistics Parameters [Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	6.724	percent	2.2	23.9

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Bankfull Statewide SIR2013 5155]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	18.5	ft	21.3
Bankfull Depth	1.1	ft	19.8
Bankfull Area	20.2	ft^2	29
Bankfull Streamflow	53.7	ft^3/s	55

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	19.1	ft
Bieger_D_channel_depth	1.31	ft
Bieger_D_channel_cross_sectional_area	25.4	ft^2

Bankfull Statistics Disclaimers [New England P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	29.5	ft
Bieger_P_channel_depth	1.55	ft
Bieger_P_channel_cross_sectional_area	45.8	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	15	ft
Bieger_USA_channel_depth	1.35	ft
Bieger_USA_channel_cross_sectional_area	23	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

PIl: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	ASEp
Bankfull Width	18.5	ft	21.3
Bankfull Depth	1.1	ft	19.8
Bankfull Area	20.2	ft^2	29
Bankfull Streamflow	53.7	ft^3/s	55
Bieger_D_channel_width	19.1	ft	
Bieger_D_channel_depth	1.31	ft	
Bieger_D_channel_cross_sectional_area	25.4	ft^2	
Bieger_P_channel_width	29.5	ft	
Bieger_P_channel_depth	1.55	ft	
Bieger_P_channel_cross_sectional_area	45.8	ft^2	
Bieger_USA_channel_width	15	ft	
Bieger_USA_channel_depth	1.35	ft	
Bieger_USA_channel_cross_sectional_area	23	ft^2	

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFC

Probability Statistics

Probability Statistics Parameters [Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.73	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	13.05	percent	0	100
FOREST	Percent Forest	14.55	percent	0	100
MAREGION	Massachusetts Region	0	dimensionless	0	1

Probability Statistics Flow Report [Perennial Flow Probability]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PC
Probability Stream Flowing Perennially	0.959	dim	71

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.14.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

Appendix D: YMCA Wetland Proposed Condition Environmental Constraints Analysis

Environmental Conditions Summary: Flood Mitigation Project - 725 Lexington Street, Waltham, MA

Environmental / Permit Consideration	Yes/No	Comments/Notes
Project within an area subject to MWPA jurisdiction	☒ Yes ☐ No	The following wetland resource areas are located on or adjacent to the Project site: Bordering Vegetated Wetlands (BVW), Riverfront Area, Bank, Bordering Land Subject to Flooding (BLSF), Land Under Water, and applicable 100-foot buffer zone.
Waterbodies / Riverfront Area (I) = Intermittent (P) = Perennial Trib= Tributary	☒ Yes ☐ No	Unnamed stream shown on USGS map as intermittent with a watershed size of 1.73 square miles deemed perennial in accordance with 310 CMR 10.58 (2)(a)1(c)i. Stream locally known as “Chester Brook”. Pond shown on USGS map to the north of driveway to YMCA Camp.
Outstanding Resource Waters	☐ Yes ☒ No	According to MassGIS, Chester Brook is not an Outstanding Resource Water (ORW).
Coldwater Fish Resources (CFR)	☐ Yes ☒ No	According to MassGIS data, Chester Brook has not been identified as a CFR by MassWildlife.
Certified (CVP) and/or Potential Vernal Pools (PVP) within area of interest	☐ Yes ☒ No	According to MassGIS data, there are no CVPs or PVPs located within the Project site.
CVP and/or PVP within 100–750 feet of ROW	☐ Yes ☒ No	According to MassGIS data, there are no CVPs or PVPs located within 750 feet of the Project site.
Subject to Chapter 91 jurisdiction	☐ Yes ☒ No	This reach of Chester Brook is not navigable, and the impoundment is not a great pond.
Special Aquatic Sites as defined in USACE MA General Permit	☒ Yes ☐ No	There are wetlands located within the Project site, however the Project is not within the following: areas managed by local, state or federal government principally for the preservation of fish and wildlife; mud flat; vegetated shallow; coral reef; and riffle-pool complexes.
Areas of Critical Environmental Concern (ACECs)	☐ Yes ☒ No	The Project is not located within an ACEC.
Within MA Coastal Zone	☐ Yes ☒ No	The Project is not located within the coastal zone.
State-Listed Rare Species (Estimated Habitat/Priority Habitat)	☐ Yes ☒ No	According to 2021 NHESP data, the Project is not located within Estimated or Priority Habitat.
Federally-Listed Rare Species	☒ Yes ☐ No	According to IPaC, the Project is located within the Northern Long-eared Bat (NLEB) territory, and potential habitat for the Monarch Butterfly. Likely to get a no effect determination.
Essential Fish Habitat (EFH)	☐ Yes ☒ No	According to online data resources (i.e., www.greateratlantic.fisheries.noaa.gov/habitat), the Project does not appear to be located near a waterbody listed by NOAA as EFH.
Within 0.25 miles of the main stem of or tributary to a Wild and Scenic River	☐ Yes ☒ No	According to General Condition 13 of the USACE General Permit, the Project is located greater than 0.25 miles from a Wild and Scenic River (WSR) and Chester Brook is not a WSR.
National Lands	☐ Yes ☒ No	The Project is not located within or across land owned by the federal government.
Floodplains and Floodways	☒ Yes ☐ No	The project is proposed in a Zone AE floodplain (with base flood elevations ranging between 134 feet and 152 feet NAVD 88) and a Regulatory Floodway.
Federal Navigation Channels	☐ Yes ☒ No	The Project does not cross any area identified as a federal navigation channel.

Environmental Permit Assessment: Flood Mitigation Project - 725 Lexington Street, Waltham, MA

Permit/Regulatory Review	Rationale for Need for Permit/Review
Federal Permit/Review	
Section 404 Federal Clean Water Act—Self-Verification	The project will require the submission of a Self-Verification Notification (SVN) under Section 404 of the Clean Water Act for coverage under the MA General Permits. The project appears to be applicable for coverage under GP 23 – Linear Transportation Projects and Wetland/Stream Crossings. It is our understanding that the modeling done by Brown and Caldwell confirmed that the project will not raise the floodplain elevation within the mapped FEMA Regulatory Floodway.
Federal Endangered Species Review	As part of the USACE Section 404 permit application process, a formal Information Planning and Conservation report (IPAC) will be required to support and expedite the USACE review process to ensure compliance with General Condition 10 of the current General Permit for Massachusetts dated June 2, 2023. The draft IPAC report for the Project Site lists two species including: Monarch Butterfly (*Danaus plexippus*), a candidate species, and Northern Long-eared Bat (*Myotis septentrionalis*), an endangered species. Consultation with the USFWS will be required to ensure the project will not adversely affect the Northern Long-eared Bat.
Section 106 National Historic Preservation Act Compliance Review	The structure does not appear on the MassHistoric Commission Inventory area data layer in MassGIS or the National Register of Historic Places. However, Section 106 compliance will need to be documented in accordance with General Condition 14 of the Massachusetts General Permits as part of the USACE Section 404 permit application process.
USEPA NPDES Construction General Permit Coverage	**This permit will likely not be required.** The project will not likely result in a total disturbance to the ground of more than one acre of land. Therefore, the Project will not require the development of a SWPPP under the NPDES Construction General Permit.
State Permit/Review	
Chapter 254, Project Notification Form (PNF)	Projects requiring state licenses, permits or approvals, or utilizing state funding, are subject to review by the MHC in accordance with Massachusetts General Laws Chapter 9, subsection 26-27C, as amended by the Chapter 254 of the Acts of 1988 (950 CMR 71.00). MHC review is initiated with the filing of a Project Notification Form (PNF). PNFs are intended to provide MHC with an understanding of the proposed project, identify required licenses, permits, approvals and funding sources, and identify historic and archaeological resources that may be potentially impacted by the proposed project.
Section 401 Individual Water Quality Certificate	The project will not require the submission of an application for an Individual Water Quality Certificate as the total cubic yards dredged is below 100 CY and total cumulative Bordering Vegetated Wetlands and Land Under Water alterations are below 5,000 SF.
Massachusetts Wetlands Protection Act (MWPA) Filing	The project will require filing a Notice of Intent with the Waltham Conservation Commission to receive an Order of Conditions for activities within wetland resource areas.
MADEP Chapter 91 Jurisdiction	The project is not within Chapter 91 jurisdiction.
Massachusetts Environmental Policy Act Review (MEPA)—Environmental Notification Form (ENF & EIR)	The project involves state funding; however, the proposed work does not exceed a review threshold because there is no state permit associated with the work in the BVW and/or regulatory floodway according to 301 CMR 11.03(3)(b)1.d.& e. Please note that if the WPA Order is appealed, and a Superseding Order of Conditions (SOC) is issued, an ENF & mandatory EIR would be required for: - New fill or structure or expansion of existing fill or structure within a regulatory floodway - Within 1 mile of an Environmental Justice Community The wetlands review threshold is the only MEPA threshold which includes this language before the ENF and EIR thresholds: *"Provided that a Permit is required …".* No other MEPA threshold includes that language. Permits related to the subject matter of the wetlands review threshold would include 401 WQC, SOC, Ch.91, etc. This project can make this argument should consultation with MEPA occur as to why an ENF filing should not be required. While there is state funding involved, the proposed work to our knowledge does not exceed a review threshold including wetlands because there is no state permit associated with the work in the floodplain or buffer zone (unless the WPA Order was appealed).
Local Permit/Review	
Waltham Conservation Commission (joint filing with MWPA)	The project will require filing a Notice of Intent with the Waltham Conservation Commission to receive an Order of Conditions for work within wetlands under the MWPA.

** This assessment is based on preliminary information provided by Brown and Caldwell and is meant for planning purposes only.

Appendix E: Basis of Estimate of Probable Construction Cost

Memorandum

Date:	June 30, 2023
To:	Scott Simpson, Boston
From:	Steve Payne, Atlanta
Reviewed by:	Bill Agster, Denver
Project No.:	160123.600.620
Subject:	Waltham Flood Mitigation Support 70-Percent Design Completion Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

Enclosures (3):

1. Basis of Estimate Report
2. Summary Estimate
3. Detailed Estimate

Basis of Estimate Report

Waltham Flood Mitigation Support

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the City of Waltham's Flood Mitigation Support, Waltham, Massachusetts.

Estimated Project Costs

Based on the typical accuracy of a Class 1 estimate, the expected range of costs is:

Upper Range	Estimated Cost	Lower Range
+ 30 %		- 20 %
$ 454,000	$ 349,000	$ 279,000

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

The scope of work for this project includes the following:

- Clearing and grading of the work area.
- Demolition of the existing concrete outlet structure.
- Construction of a new concrete outlet structure.
- Installation of a timber guardrail along the adjacent road.
- Construction of an observation deck.
- Bypass pumping.

Background of this Estimate

No previous estimates have been prepared for this project by BC's Estimating and Scheduling Group (ESG).

The attached estimate of probable construction cost is based on documents dated June 2023, received by the Estimating and Scheduling Group (ESG). These documents are described as 90 percent complete based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

Class of Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 3 estimate. A Class 3 estimate is defined as a Project Budget Estimate or Funding Request Estimate. Typically, engineering is from 40 to 70 percent complete. Class 3 estimates are used to prepare budget funding request or to evaluate design options and form the base work for the Class 2 Design Baseline or Control Estimate.

Expected accuracy for Class 3 estimates typically range from -20 to +30 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of Sage Construction and Real Estate 300 estimating software engine (formerly Timberline) using RS Means database, historical project data, the latest vendor and material cost information, and other costs specific to the project location.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator's interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel) and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and worker's compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

Local sales tax has been applied to material and equipment rentals. A percentage allowance for contractor's home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor's cost for builder's risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor's credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions, or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work.

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on vendor supplied price quotes obtained by the project design team and/or estimators and on historical pricing of like equipment.
6. Bulk material quantities are based on manual quantity take-offs.
7. Soils are of adequate nature to support the structures. No piles have been included in this estimate.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. Hazardous materials remediation and/or disposal.
2. O&M costs for the project except for the vendor supplied O&M manuals.
3. Utility agency costs for incoming power modifications.
4. Permits beyond those normally needed for the type of project and project conditions.

Allowances for Known but Undefined Work

No allowances were made in the development of this estimate.

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 1. Estimate Markups

Item	Rate (%)
Net Cost Markups	
Labor markup	15
Materials and process equipment	10
Equipment (construction-related)	10
Subcontractor	10
Other – Process Equipment	8
Sales Tax (State and local for materials, process equipment and construction equipment rentals, etc.)	6.25
Sales Tax (Excise-Gross Receipts-Contract Value)	0
Material Shipping and Handling	2
Gross Cost Markups	
Contractor General Conditions	15
Start-up, Training and O&M	2
Construction Contingency	30
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Escalation to Midpoint of Construction	0

Labor Markup

The labor rates used in the estimate were derived from RS Means latest national average wage rate tables and city cost indexes. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising, and owner profit.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all the equipment needed for the job, but to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is like the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax (Materials, Process Equipment and Construction Equipment)

This is the tax that the contractor must pay according to state and local tax laws. The percentage is applied to both the material and equipment the GC purchases as well as the cost for rental equipment. The percentage is based on the local rates in place at the time the estimate was prepared.

Contractor Startup, Training, and O&M Manuals

This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup, and O&M manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and troubleshoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and the contractor's insurability at the time the project is bid.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paperwork, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the value of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors

In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material, and equipment costs beyond values at the time the estimate is prepared. For this project, the anticipated rate of escalation is six percent per annum.

The estimated construction duration for this project has not been specified. However, due the stage of the design and the limited size of the project, it is assumed that the project will be completed within the next 12 months. As such, no escalation has been included.

Undesigned/Undeveloped Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity, and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.

Estimate Summary Report

6/30/2023 9:59 AM

BC Project Number: 160123
Estimate Version Number: 1
Estimate Date: 6-27-2023
Lead Estimator: Steve Payne

Flood Mitigation Support

City of Waltham, MA
Flood Mitigation Support
Class 3 Estimate - 70% Design

Estimator	Steve Payne
BC Project Manager	Scott Simpson
BC Office	Boston
Est Version Number	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	6/23/2023
BC Project Number	160123

Flood Mitigation Support

Phase	Description	Gross Total Cost with Markups
01 TOTALS		
01 Mob & Demob		
02 Civil		16,825
01 Mob & Demob		16,825
02 Clearing and Grubbing		
02 Civil		3,815
02 Clearing and Grubbing		3,815
03 Tree Removal and Stump Grinding		
02 Civil		5,726
03 Tree Removal and Stump Grinding		5,726
04 Erosion and Sediment Control		
02 Civil		3,998
04 Erosion and Sediment Control		3,998
05 Bypass Pumping and Dewatering		
02 Civil		56,552
05 Bypass Pumping and Dewatering		56,552
06 Demo Existing Structure		
01 Demolition		31,741
06 Demo Existing Structure		31,741
07 Excavation and Grading		
02 Civil		17,851
07 Excavation and Grading		17,851

Estimate Summary Report

6/30/2023 9:59 AM

BC Project Number: 160123
Estimate Version Number: 1
Estimate Date: 6-27-2023
Lead Estimator: Steve Payne

Flood Mitigation Support

Phase	Description	Gross Total Cost with Markups
08 Access Drive Guardrail		
02 Civil		17,965
08 Access Drive Guardrail		17,965
09 Outlet Structure		
03 Structural		94,797
06 Process Equipment and Piping		35,417
09 Outlet Structure		130,214
10 Riprap		
02 Civil		373
10 Riprap		373
11 Observation Deck		
03 Structural		47,111
11 Observation Deck		47,111
12 Traffic Control		
02 Civil		16,352
12 Traffic Control		16,352
01 TOTALS		348,521

Estimate Detail Report

6/30/2023 9:57 AM

BC Project Number: 160123
Estimate Version Number: 1
Estimate Date: 6-27-2023
Lead Estimator: Steve Payne

Flood Mitigation Support

City of Waltham, MA
Flood Mitigation Support
Class 3 Estimate - 70% Design

Estimator	Steve Payne
BC Project Manager	Scott Simpson
BC Office	Boston
Est Version Number	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	6/23/2023
BC Project Number	160123

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
01 TOTALS											
01 Mob & Demob											
02 Civil											
01999 Mobilization/Demobilization											
01-99-99.99	Mob/demob	MISC	1.00	LS	-	-	-	10,000.00	-	10,000.00	10,000
	Mobilization/Demobilization		**0.00**								**10,000**
	02 Civil										**10,000**
	01 Mob & Demob										**10,000**
02 Clearing and Grubbing											
02 Civil											
31230 Site Clearing											
31-13-13.10	Selective tree and shrub removal, selective clearing brush, medium clearing, to 4" diameter, with dozer and brush rake, excludes removal offsite	0550	0.10	acre	173.50	182.80	-	-	-	356.30	36
31-14-13.23	Topsoil stripping and stockpiling, topsoil, sandy loam, adverse conditions, 200 HP dozer	0100	80.67	cy	0.93	1.27	-	-	-	2.21	178
	Site Clearing		**0.10**	**unit**	**927.00**	**1,208.40**				**2,135.40**	**214**
31999 Construction Entrance											
31-99-99.99	Remove construction entrance	MISC	1.00	LS	300.91	392.04	-		-	692.95	693
31-32-19.16	Geosynthetic soil stabilization, geotextile fabric, woven, 200 lb. tensile strength	1500	125.00	sy	1.25	-	0.65	-	-	1.90	238
31-05-16.10	Aggregate for earthwork,crushed stone,1.40 tons per cy, 1-1/2",spread with 200 dozer,includes load pit and haul,2 miles round trip,excludes compaction	0300	14.00	lcy	21.49	28.00	26.94	-	-	76.44	1,070
	Construction Entrance		**0.00**								**2,001**
	02 Civil										**2,215**
	02 Clearing and Grubbing										**2,215**
03 Tree Removal and Stump Grinding											
02 Civil											
31230 Tree Removal - 5 ea.											
31-13-13.20	Selective clearing and grubbing, 14" to 24" diameter, remove selective trees, on site using chain saws and chipper, excludes stumps	3150	5.00	ea	393.93	199.17	-	-	-	593.11	2,966

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
31230 Tree Removal - 5 ea.											
31-11-10.10	Clearing & grubbing, grinding stumps, to 18" deep, 24" diameter	3080	5.00	ea	54.28	19.93	-	-	-	74.22	371
Tree Removal - 5 ea.			**0.00**								**3,337**
02 Civil											**3,337**
03 Tree Removal and Stump Grinding											**3,337**
04 Erosion and Sediment Control											
02 Civil											
31470 _Erosion Control											
31-25-13.10	Synthetic erosion control, silt fence, polypropylene, adverse conditions, 3' high	1100	408.00	lf	2.42	0.34	0.20	-	-	2.95	1,204
31-25-14.17	Erosion control removal, general, crew hours	BC-0101	2.00	ch	246.70	34.34	-	-	-	281.04	562
31-23-23.19	Loading Trucks, F.E. Loader, 3 C.Y.	BC-0006	10.00	cuyd	1.10	1.36	-	-	-	2.45	25
31-23-23.20	Cycle hlng(,load,travl,unld dump&rtrn) time per cycle,excvt borrw,loose cubic yards,30 min ld/w/,12 cy truck,cycle 20 miles,40 mph,excld loadng eqpmnt	1678	10.00	lcy	6.91	8.68	-	-	-	15.59	156
02-41-19.20	Selective demolition, dump charges, typical urban city, building construction materials, includes tipping fees only	0100	5.00	ton	-	-	-	-	73.11	73.11	366
_Erosion Control			**1.00**	**ls**	**1,560.27**	**306.38**	**79.97**		**365.56**	**2,312.18**	**2,312**
02 Civil											**2,312**
04 Erosion and Sediment Control											**2,312**
05 Bypass Pumping and Dewatering											
02 Civil											
31240 Dewatering Systems											
31-23-19.20	Dewatering, pumping 8 hours, attended 2 hours per day, 4" discharge pump used for 8 hours, includes 20 LF of suction hose and 100 LF of discharge hose	0650	5.00	day	267.24	52.12	-	-	-	319.36	1,597
31-23-19.20	Dewatering,sump hole construction,pit with gravel collar,corrugated,12"gravel collar,24"corrugated pipe,14 gauge,includes excavation and gravel pit	2000	2.00	lf	49.34	7.30	33.54	-	-	90.18	180
31-99-99.99	Filter bag	MISC	1.00	ea	78.55	-	-	300.00	-	378.55	379
32-11-23.23	Base course drainage layers, stone base, compacted, 3/4" stone base, to 6" deep	0100	3.00	sy	0.74	0.89	6.95	-	-	8.57	26

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
31240 Dewatering Systems											
31-32-19.16	Geosynthetic soil stabilization, geotextile fabric, non-woven, 120 lb. tensile strength, includes scarifying and compaction	1550	3.00	sy	0.50	-	1.04	-	-	1.54	5
	Dewatering Systems		**5.00**	**unit**	**303.43**	**55.57**	**18.21**	**60.00**		**437.21**	**2,186**
31999 Bypass Pumping											
46-06-00.00	Sand bags for cofferdams - install	BC-0006	200.00	cuft	6.56	1.83	3.50	-	-	11.89	2,379
01-58-08.00	Pumping system, bypass, 6-in pump, one primary pump, valves and 500 lf discharge piping, weekly rental	BC-0110	10.00	week	-	-	-	2,586.00	-	2,586.00	25,860
	Bypass Pumping		**0.00**								**28,239**
31999 Remove Dewatering and Bypass Pumping Measures											
31-99-99.99	Remove dewatering and bypass measures	MISC	1.00	ls	1,983.18	276.06	-		-	2,259.24	2,259
02-41-19.19	Selective demolition, rubbish handling, dumpster, 40 c.y., 10 ton capacity, weekly rental, includes one dump per week, cost added to demolition cost	0840	1.00	week	-	-	695.95	-	-	695.95	696
	Remove Dewatering and Bypass Pumping Measures		**0.00**								**2,955**
	02 Civil										**33,380**
	05 Bypass Pumping and Dewatering										**33,380**
06 Demo Existing Structure											
01 Demolition											
02225 Outlet Structure Demolition											
02-41-19.16	Selective demolition, cutout, concrete, slab on grade, bar reinforced, to 6" thick, 8-16 S.F., excludes loading and disposal	1250	115.00	sf	21.20	2.20	-	-	-	23.40	2,691
02-41-19.16	Selective demolition, cutout, concrete, walls, bar reinforced, 6-12 C.F., excludes loading and disposal	1450	186.00	cf	45.42	4.72	-	-	-	50.14	9,326
02-41-19.25	Sawcutting, concrete walls, rod reinforcing, per inch of depth	0820	180.00	lf	9.12	8.23	0.05	-	-	17.40	3,131
02-41-19.19	Selective demolition, rubbish handling, loading & trucking, machine loading truck, includes 2 mile haul, cost to be added to demolition cost	3080	12.60	cy	22.08	6.12	-	-	-	28.21	355
31-23-23.18	Hauling,excavated borrow material,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	0560	19.00	lcy	17.01	21.36	-	-	-	38.37	729
02-22-03.30	Dump Charge, typical urban city, fees only, bldg constr mat'ls	BC-0006	26.00	ton	-	-	-	-	83.25	83.25	2,165
	Outlet Structure Demolition		**115.00**	**sf**	**114.15**	**26.93**	**0.07**		**18.82**	**159.97**	**18,397**
	01 Demolition										**18,397**

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
	06 Demo Existing Structure										**18,397**
07 Excavation and Grading											
02 Civil											
31999 Excavate and Grade Topsoil											
31-23-23.19	Loading topsoil, 2.5 C.Y. bucket, front end loader, wheel mounted	BC-0011	80.67	bcy	0.68	0.44	-	-	-	1.12	90
31-23-23.18	Hauling topsoil for disposal, loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	0560	101.00	lcy	17.01	21.36	-	-	-	38.37	3,875
31-23-23.15	Borrow, topsoil or loam, 1 C.Y. bucket, loading and/or spreading, from stockpile, shovel	7000	80.67	bcy	1.68	1.67	18.41	-	-	21.76	1,755
31-23-23.18	Hauling replacement topsoil,loose cubic yards,20 mile round trip,0.4 load/hr,base wide rate,12 cy truck,highway haulers,excludes loading	0560	101.00	lcy	17.01	21.36	-	-	-	38.37	3,875
32-91-19.13	Topsoil placement and grading, loam or topsoil, F.E. loader, 1-1/2 C.Y., remove and stockpile on site, spread from pile to rough finish grade	0400	101.00	cy	5.47	2.45	-	-	-	7.93	801
	Excavate and Grade Topsoil		**0.00**								**10,397**
	02 Civil										**10,397**
	07 Excavation and Grading										**10,397**
08 Access Drive Guardrail											
02 Civil											
32999 Wooden Guardrail - 196'											
32-94-13.20	Landscape edging, pine, pressure treated, 10" x 10" x 5'-3"	1140	21.00	ea.	8.85	-	144.74	-	-	153.59	3,225
32-31-13.30	Chain link fence gates and posts, auger fence post hole, medium soil, 3' deep, by hand, includes excavation	7900	21.00	ea	80.60	-	-	-	-	80.60	1,693
32-94-13.20	Rail, pine, pressure treated, 4" x 10"	1080	196.00	lf	7.67	-	11.19	-	-	18.87	3,698
05-05-23.10	Bolt, hex head, plain steel, 3/4" dia x 15" L, A307, incl nut & washer	2700	80.00	ea	10.06	-	9.69	-	-	19.75	1,580
	Wooden Guardrail - 196'		**0.00**								**10,196**
	02 Civil										**10,196**
	08 Access Drive Guardrail										**10,196**
09 Outlet Structure											
03 Structural											
03330 _Outlet Structure Base Slab - 1'-4" th.											
31-22-16.10	Fine grading, fine grade for slab on grade, machine	1100	17.33	sy	1.33	1.10	-	-	-	2.43	42

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
03330 _Outlet Structure Base Slab - 1'-4" th.											
03-11-13.65	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	3050	48.00	sfca	8.65	-	1.54	-	-	10.19	489
03-15-13.50	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	1300	51.00	lf	7.51	-	8.31	-	-	15.82	807
03-15-13.50	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	5250	4.00	ea	19.54	-	50.59	-	-	70.12	280
03-21-10.60	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0600	0.58	ton	2,275.92	-	1,440.67	-	-	3,716.60	2,148
03-21-10.60	Reinforcing in place, unloading & sorting, add to above - slabs	2005	0.58	ton	87.39	34.62	-	-	-	122.00	71
03-31-05.35	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,includes BC standard additives	0350	8.09	cy	-	-	152.57	-	-	152.57	1,234
03-31-05.70	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	4650	8.09	cy	38.66	6.88	-	-	-	45.53	368
03-35-29.30	Concrete finishing, floors, monolithic, screed, float and hand trowel finish	0200	156.00	sf	2.19	-	-	-	-	2.19	342
03-39-13.50	Curing, waterproof curing paper, 2 ply, reinforced	0200	1.56	csf	24.35	-	21.28	-	-	45.63	71
03-15-16.30	Expansion joint, premolded, bituminous fiber, 1" x 12"	2050	19.00	lf	3.26	-	2.97	-	-	6.23	118
	_Outlet Structure Base Slab - 1'-4" th.		**7.70**	**cy**	**391.97**	**12.30**	**370.80**			**775.07**	**5,971**
03345 _Concrete Wall Against Existing Stone Wall											
03-11-13.85	C.I.P. concrete forms, wall, job built, plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	2400	449.65	sfca	20.59	-	7.14	-	-	27.73	12,468
03-11-13.85	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	0500	23.67	lf	21.76	-	5.70	-	-	27.46	650
03-15-13.50	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	3500	23.67	lf	6.74	-	8.36	-	-	15.10	357
03-15-13.50	Waterstop, rubber, field union, 3/8" x 6" wide, walls	5205	2.00	ea	19.54	-	33.55	-	-	53.09	106
03-11-13.85	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning	0150	25.00	lf	20.59	-	5.59	-	-	26.18	655
03-15-05.95	Form oil, up to 800 S.F. per gallon, coverage, includes material only	3050	1.20	gal	-	-	29.29	-	-	29.29	35
03-21-10.60	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0700	0.69	ton	1,744.87	-	1,440.68	-	-	3,185.55	2,211
03-21-10.60	Reinforcing in place, unloading & sorting, add - walls, cols, beams	2010	0.69	ton	87.39	34.63	-	-	-	122.02	85
03-31-05.35	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,includes BC standard additives	0350	9.71	cy	-	-	152.57	-	-	152.57	1,482
03-31-05.70	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	5350	9.71	cy	59.60	10.60	-	-	-	70.20	682
03-35-29.60	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	0050	199.83	sf	2.13	-	0.02	-	-	2.16	431

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
	_Concrete Wall Against Existing Stone Wall		**9.25**	**cy**	**1,379.75**	**13.73**	**677.78**			**2,071.25**	**19,161**
03345 _Concrete Walls											
03-11-13.85	C.I.P. concrete forms, wall, job built, plywood, over 8' to 16' high, 1 use, includes erecting, bracing, stripping and cleaning	2400	635.25	sfca	20.59	-	7.14	-	-	27.73	17,614
03-11-13.85	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	0500	21.00	lf	21.76	-	5.70	-	-	27.46	577
03-15-13.50	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	3500	21.00	lf	6.74	-	8.36	-	-	15.10	317
03-15-13.50	Waterstop, rubber, field union, 3/8" x 6" wide, walls	5205	2.00	ea	19.54	-	33.55	-	-	53.09	106
03-11-13.85	C.I.P. concrete forms, wall, box out for opening, to 16" thick, over 10 S.F. (use perimeter), includes erecting, bracing, stripping and cleaning	0150	12.00	lf	20.59	-	5.59	-	-	26.18	314
03-15-05.95	Form oil, up to 800 S.F. per gallon, coverage, includes material only	3050	1.69	gal	-	-	29.29	-	-	29.29	50
03-21-10.60	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0700	0.86	ton	1,744.88	-	1,440.68	-	-	3,185.55	2,730
03-21-10.60	Reinforcing in place, unloading & sorting, add - walls, cols, beams	2010	0.86	ton	87.39	34.62	-	-	-	122.01	105
03-31-05.35	Structural concrete,ready mix,normal weight,4500 psi,includes local aggregate,sand,portland cement and water,includes BC standard additives	0350	12.00	cy	-	-	152.57	-	-	152.57	1,831
03-31-05.70	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	5350	12.00	cy	59.60	10.60	-	-	-	70.20	843
03-35-29.60	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	0050	617.25	sf	2.13	-	0.02	-	-	2.16	1,330
03-15-05.25	Expansion joint, premolded, bituminous fiber, 1" x 12"	2050	24.00	lf	3.26	-	2.97	-	-	6.23	149
	_Concrete Walls		**11.43**	**cy**	**1,543.62**	**13.72**	**714.21**			**2,271.55**	**25,966**
03999 Concrete Backfill											
03-31-13.35	Structural concrete, ready mix, flowable fill, structural, 1000 psi, includes ash, Portland cement Type I, aggregate, sand and water, delivered, excludes all additives and treatments	4350	10.00	cy	178.81	31.80	100.38	-	-	310.98	3,110
	Concrete Backfill		**0.00**								**3,110**
	03 Structural										**54,208**
06 Process Equipment and Piping											
46999 Slide Gate - 1 ea. @ 3' x 3'											
35-22-73.16	Slide gates, hydraulic structures, steel, self contained, 36" x 36", incl. anchor bolts & grout	0140	1.00	ea	2,287.26	630.25	17,051.00	-	-	19,968.51	19,969
	Slide Gate - 1 ea. @ 3' x 3'		**1.00**	**LS**	**2,287.26**	**630.25**	**17,051.00**			**19,968.51**	**19,969**

Phase	Description	Item	Takeoff Quantity		Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
	06 Process Equipment and Piping										**19,969**
	09 Outlet Structure										**74,177**
10 Riprap											
02 Civil											
31999 Rip Rap Over Geotextile											
31-37-13.10	Rip-rap and rock lining, random, broken stone, machine placed for slope protection	0100	3.00	lcy	22.81	15.89	28.22	-	-	66.92	201
31-32-19.16	Geosynthetic soil stabilization, geotextile fabric, woven, heavy duty, 600 lb. tensile strength	1510	4.00	sy	0.52	-	2.70	-	-	3.22	13
	Rip Rap Over Geotextile		**0.00**								**214**
	02 Civil										**214**
	10 Riprap										**214**
11 Observation Deck											
03 Structural											
06999 Observation Deck - 280 sf											
06-99-99.99	Observation deck - modular frame and deckboards	MISC	280.00	sf	-	-	-	100.00	-	100.00	28,000
	Observation Deck - 280 sf		**0.00**								**28,000**
	03 Structural										**28,000**
	11 Observation Deck										**28,000**
12 Traffic Control											
02 Civil											
01543 _Traffic Control, One-Lane Closure											
01-54-33.40	Rent reflectorized barrels 1 to 99 barrels		1600	120.00	day	-	2.73	-	-	-	2.73	327
01-54-33.40	Rent barricade, portable with flasher 1 to 6 units		1670	8.00	day	-	2.82	-	-	-	2.82	23
01-54-33.40	Rent illuminated board, trailer mount, with generator		1650	8.00	day	-	89.39	-	-	-	89.39	715
01-51-03.00	Rent traffic control sign, aluminum 36" x 36"	BC-0018		24.00	day	-	3.20	-	-	-	3.20	77
01-51-03.00	Rent traffic control sign stand, for aluminum signs	BC-0022		24.00	day	-	2.13	-	-	-	2.13	51
01-51-03.00	Traffic Control, equipment setup/relocate	BC-0014		2.00	hr	100.97	-	-	-	-	100.97	202
01-51-03.00	Traffic Control, flaggers	BC-0008		8.00	day	807.78	-	-	-	-	807.78	6,462
01-51-03.00	Traffic Control, labor management and breaks	BC-0010		2.00	day	807.78	-	-	-	-	807.78	1,616

Flood Mitigation Support

Phase	Description	Item	Takeoff Quantity	Labor Cost/Unit	Equip Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Amount
	_Traffic Control, One-Lane Closure		4.00 day	2,069.93	298.21				2,368.14	9,473
	02 Civil									9,473
	12 Traffic Control									9,473
	01 TOTALS									202,096

Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		756 hrs	76,814	
Material			44,969	
Subcontract			64,160	
Equipment		1,809 hrs	13,624	
Other			2,530	
			202,096	**202,096**
Labor Mark-up	15.00 %		11,522	
Material Mark-up	10.00 %		4,497	
Subcontractor Mark-up	10.00 %		6,416	
Construction Equipment Mark-up	10.00 %		1,362	
Other - Process Equip Mark-up	8.00 %		202	
			24,000	**226,096**
Material Shipping & Handling	2.00 %		899	
Material Sales Tax	8.00 %		3,597	
Other - Process Eqp Sales Tax	8.00 %		202	
Net Markups			**4,699**	**230,795**
Contractor General Conditions	10.00 %		23,080	
			23,080	**253,875**
Start-Up, Training, O&M	2.00 %		5,077	
			5,077	**258,952**
Undesign/Undevelop Contingency	30.00 %		77,686	
			77,686	**336,638**
Bldg Risk, Liability Auto Ins	2.00 %		6,733	
			6,733	**343,370**
Payment and Performance Bonds	1.50 %		5,151	
			5,151	**348,521**
Escalation to Midpoint (ALL)				
Gross Markups				**348,521**
Total				**348,521**