July 31, 2018

Ref: 12815.00

Mr. Craig P. Dixon, Chairman
New Bedford Conservation Commission
133 William Street, Room 304
New Bedford, MA 02740

Re: DEP File No. SE 049-0805
Revised Notice of Intent: South Coast Rail – New Bedford Main Line NOI
New Bedford, Massachusetts
Responses to Nitsch Engineering, Inc. Comments of July 16, 2018

Dear Chairman Dixon,

On behalf of the Massachusetts Department of Transportation, VHB respectfully submits the following responses to comments received from Nitsch Engineering, Inc. (by letter to the Commission dated July 16, 2018) for the proposed South Coast Rail Project (DEP File No. SE 049-0805). Attached with this letter are the following:

- Attachment A: New Bedford Notice of Intent Plans
  Track and Whale's Tooth Station Infrastructure
  Revised: July 27, 2018
  - Plan Sheets TK-3057, TK-3059, TK-3062, TK-3063, TK-3065, TK-3068, TK-3070
  - Detail Sheets CV-308, CV-309, and CV-312
- Attachment B: Illicit Discharge Statements
  - Whale's Tooth Station
  - New Bedford Main Line Track Infrastructure
- Attachment C: Culvert CV-NB-4 Sizing Calculations
- Attachment D: NHESP approved Conservation Management Plan
- Attachment E: Whale's Tooth Station Operations and Maintenance Plan
- Attachment F: Excerpt from MADEP Stormwater Handbook Vol. 2 Ch. 2.

Comment #1(a): *The plans submitted for permitting are 30% plans. Therefore, there is detail that is not included on the plans that is customarily submitted. For instance, there is limited grading shown on the plans for the rail improvements. Although swales are depicted graphically and shown on the cross sections, they are not graded in plan views. The narrative also describes the inclusion of water quality best*

www.vhb.com
Engineers | Scientists | Planners | Designers
101 Walnut Street
PO Box 9151
Watertown, Massachusetts 02471
P 617.924.1770
F 617.924.2286

management practices at stormwater discharge points and sediment forebays that are not shown on the plans.

Response #1(a): The track plans, profiles and cross sections provide the design level of detail required to construct the railroad improvements and are per the MBTA standards for construction design plans. Details and cross references have been updated to address this concern. 30% design level is in reference to the percent complete for the Construction Contract Documents, not the design. The design is near 90% and MassDOT will provide the DEP and Conservation Commission the 100% Construction Contract Documents when complete for record under this file number.

Comment #1(b): *Fill of Bordering Land Subject to Flooding is shown graphically but not graded. The Applicant has responded that grading is not typically shown on railway plans and that the contractor builds from the profile. The rail cross sections do show drainage swales adjacent to proposed tracks. However, the sediment forebays described in the stormwater report do not appear in the plans or cross sections. Given the information provided, with cross sections every 100 feet, it is difficult to quantify or verify the amount of floodplain fill.*

Response #1(b): The plans have been revised to clearly show the location of swale forebays and check dams with cross references to the appropriate detail (found on Sheet CV-309). Cross referencing for the under drain outlet protection detail found on Sheet CV-308 has also been provided. The majority of the compensatory storage mitigation is accomplished with 'shoulder shaving' which involves fine grading just outside the limit of the track section. This fine grading is typically less than 1-foot and can only be shown in the cross sections because grading on the plan views would not show up clearly with 1-foot contouring. The limits of BLSF mitigation are identified on the plans with reference to the applicable cross sections. The mitigation area that requires construction in addition to shoulder shaving (in the vicinity of Station 2670+00 RT) has been graded in plan view and can be found on Sheet TK-3068.

Comment #2: *The stormwater report describes the project as a redevelopment project since the rail bed has previously been disturbed and there does not appear to be any additional impervious surfaces proposed. We do not have details regarding the increase in rail trips on this line. We expect there will be more activity on the line once the South Coast Rail is active, which could have increased impacts than are typically experienced now. The Applicant has responded that the project satisfies the maximum extent practicable standard by providing sedimentation basins 25% upstream of resource areas. However, these basins are not shown on the plans and there is no basis for the 25% TSS removal rate.*

Response #2: The total number of commuter rail trips through New Bedford will be 14 (7 inbound to Boston and 7 outbound back to New Bedford) each week day. Weekend travel will be less. This is the total daily increase above existing Freight traffic and does not represent a significant change that would be expected to result in any quantifiable impacts to wetland resource areas. The project will result in water quality improvements generated by the addition and refurbishment of vegetated swales for track drainage. Overall, the corridor through New Bedford (6.9 miles) will have a total of 7,405 linear feet of new or refurbished vegetated swales constructed for stormwater management purposes. New under drain systems will also enhance stormwater management and all outlet points will be constructed with rip

rap outlet protection to prevent scouring of adjacent resource areas or their buffers. Because this is a pervious area (ballast stone) TSS removal cannot be calculated as it would be for paved areas. Regardless, the protective measures (outlet protection, vegetated swales, swale forebays and check dams) are added that will provide for enhanced water quality over the existing conditions found along the track corridor today in conformance with the Stormwater Management Standards.

Comment #3: *The project involves the replacement of three cross culverts under the proposed tracks. The plans have not included any details for the cross culverts. We recommend that culvert details be included on the plans. The Applicant has responded that two of the culverts are exempt and do not require details. The fourth culvert (CV-NB-4), near Pig Farm Road, is not exempt. A plan and cross-section are provided. The culvert is a 24-inch Reinforced Concrete Pipe. Sizing information for the culvert has not been provided.*

Response #3: Sizing calculations for CV-NB-4 are included as Attachment C to this letter.

Comment #4: *As described above, the plans do not clearly show the water quality measures described in the stormwater report. It is unclear whether the proposed measures, including sediment forebays with check dams that are described in the Stormwater Report, are proposed to treat water generated by all areas of the tracks. Underdrains with filter fabric are not acknowledged by the Stormwater Management Guidelines as a TSS removal best management practice. We recommend that the Applicant clearly show which areas of the proposed rail bed are receiving additional TSS removal and also quantify the removal rates.*

Response #4: See response to question 1 and 2 above.

Comment #5: *The Stormwater Report acknowledges the presence of a vernal pool near station 2553 of the proposed rail and identifies this resource as an Outstanding Resource Water. There does not appear to be any special consideration given to this area. No water quality Best Management Practices are proposed to provide additional protection to this critical area. The Notice of Intent (NOI) also identifies Priority Habitat in the vicinity of the rail. The impacts to this Priority Habitat are unclear. It does not appear that there are any measures proposed to protect this Habitat. The Applicant has responded that no water quality measures will be proposed to protect the vernal pools since they feel this will create more disturbance and channel flows to the vernal pool.*

Response #5: Stormwater runoff from the existing track corridor adjacent to the vernal pool currently sheet flows off the track area. This condition is proposed to be maintained under the proposed track improvements. The design has been developed to minimize the width of the construction footprint in this area to avoid impact to existing vegetation between the tracks and the vernal pool. Changes to the stormwater hydrology have been avoided in this area and redirection of runoff via vegetated swales or underdrains is NOT proposed as this would lead to direct discharge to the vernal pool as opposed to over-land flow as currently proposed. Improving and maintaining the track bed with new, unfouled ballast, and maintaining the existing vegetation and hydrology is the best means of protecting the vernal pool. Priority habitat impacts are addressed in the NHESP approved Conservation Management Plan, included as Attachment D to this letter. Additionally, wildlife crossings have been provided throughout the rail corridor, including within the vicinity of priority habitats, to improve wildlife habitat connectivity.

Comment #6: *The Stormwater Report states that a SWPPP will be prepared prior to construction and that an erosion and sedimentation plan will be included in the NOI Application. The NOI application includes some language regarding erosion controls. This language appears generic in that it describes pavement sweeping and catch basin inlet protection. Neither of these items are part of the rail improvements. To comply with the requirements of the Guidelines, we would expect that an erosion and sedimentation plan would be submitted as part of the Stormwater Report. The NOI also states that a SWPP will be prepared prior to construction. Erosion and Sedimentation control locations are shown on the plans and consist of 12- to 18-inch filter tubes.*

Response #6: We agree to condition that the SWPPP be provided prior to construction. As stated in Comment 6, all erosion and sedimentation control details and locations are shown in the NOI drawings. A site specific Stormwater Pollution Prevention Plan will be developed by the contractor in compliance with the Stormwater Management Standards and the National Pollutant Discharge Elimination System Permit, which will be provided to the commission prior to construction.

Comment #7 T*he Stormwater Report describes that a Long Term Stormwater Operations and Maintenance Plan will be included in the NOI application. The NOI states that a Long-Term Stormwater Operations and Maintenance Plan will be developed during the final design phase of the project. An Operations and Maintenance Plan has not been submitted. An Operations and Maintenance Plan is typically submitted as part of the filing for a NOI and is a requirement of the Stormwater Management Guidelines (Standard 9).*

Response #7: Attached please find the O&M plan for Whale's Tooth Station, which was previously included within the Whales Tooth Station stormwater report. The proposed stormwater management design for the track drainage does not require any additional operation and maintenance beyond the standard operating procedures followed by Keolis/MBTA for maintaining the rail right-of-way. All drainage features along the rail will be inspected on the same schedule detailed in current standards of operation that can provided to the Commission during the final design phase, prior to construction.

Comment #8: *Typically, an Illicit Discharge Statement is included in the Stormwater Report. This statement was not included. This Statement is typically submitted as part of the NOI filing. The Applicant has indicated that this Statement will be submitted prior to discharge of any stormwater to post-Construction BMPs.*

Response #8: Illicit discharge statements (2) are included as Attachment B to this letter.

Comment #9. *The Stormwater Report includes a table showing dimensions for rip-rap pads at the underdrain discharge points. The dimensions shown in this table should be reflected in the plans, either with labels at each location or a table on the detail sheet. The pads should be drawn to scale on the plans. The riprap pads prevent scour and erosion at the discharge points. However, they do not provide TSS removal. The Applicant has indicated that the Flared End Section detail has been revised and submitted but the sheet (CV-308) containing this detail was not resubmitted.*

Response #9: The updated Sheet CV-308 is included with this letter and provides the tabular referencing for each location as suggested. Cross referencing on the plans back to this detail is also included at each outlet location. Also, as previously noted, the same cross referencing and tabulation is provided for the vegetated swale forebay and check dam detail.

Comment #10: *Pipe sizing information for the underdrains has been provided. The Applicant has explained that the sediment forebays were sized for discharge end protection rather than water quality treatment and has assumed a 25% TSS removal rate. In our opinion, sediment forebays for water quality and discharge end protection are different applications. However, given the nature of the project, the placement of sediment forebays at discharge points, if sized, is appropriate for this project. We understand that the sediment forebay sizing guidance in the Stormwater Management Guidelines relies on impervious surface and this project does not include impervious surface as shown on traditional site development or road projects. We recommend the Applicant provide some basis for design for sizing the sediment forebays and demonstrate 25% removal. As described previously, the plans and/or details need to show the locations of the sediment forebays drawn to scale so the Commission can understand their locations and impacts to the buffer zones and/or resource areas.*

Response #10: See previous responses regarding cross referencing between plans and details. It is also important to note that grades along the railroad are extremely flat- in most cases less than 0.5% and less than 1% in all cases in New Bedford. The track swales (in first flush conditions) function as long linear sediment forebays due to their profiles, which follow the track profile. The length of the vegetated swale forebay and check dam is standard for all cases and designed for constructability.

Comment #11: *The Applicant has indicated that the Oil/Water Separator shown on sheet CV-308 has been removed and sheet CV-308 has been resubmitted. This sheet was not resubmitted with the last submittal.*

Response #11: The Oil Water Separator has been removed from Sheet CV-308 (attached).

Comment #12: *The Applicant has indicated the sheet CV-311 has been revised to remove the Stone Diaphragm detail and that this sheet has been resubmitted. Sheet CV-311 was not resubmitted with the last submittal. The Stone Diaphragm Detail remains on Sheet CV-312.*

Response #12: The Stone Diaphragm detail title has been revised to Pretreatment Filter Strip to match the call out references on Sheets GD-300 and 301, which provide the location and layout of this feature. The detail is only included on Sheet CV-312 (attached).

Whale's Tooth Station Comments:

Comment #1: *Bioretention basin 1 provides 9 inches of freeboard for the 100-year storms. The Guidelines require a foot of freeboard in bioretention basins.*

Response #1: Attached is the Bioretention section from the MADEP Stormwater Handbook Vol. 2 Ch. 2. We have highlighted the paragraph that describes the need for 3" of freeboard when adjacent to a parking area. This document was hand delivered to the Commission at the 7/17/18 public hearing.

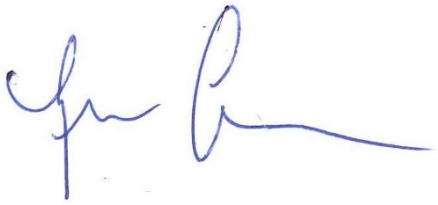
Comment #2: *A Stormwater Pollution Prevention Plan (SWPPP) was not provided for review. The Applicant has indicated that the SWPPP will be provided to the contractor prior to construction and has requested a Special Condition be included with any Order of Conditions that is submitted.*

Response #2: We concur.

We look forward to reviewing these responses with the Commission at the public hearing schedulked for next week. If you have any questions or require additional information before then, please contact me via email at lcarlson@vhb.com or by phone at (617) 607-6237.

Sincerely,

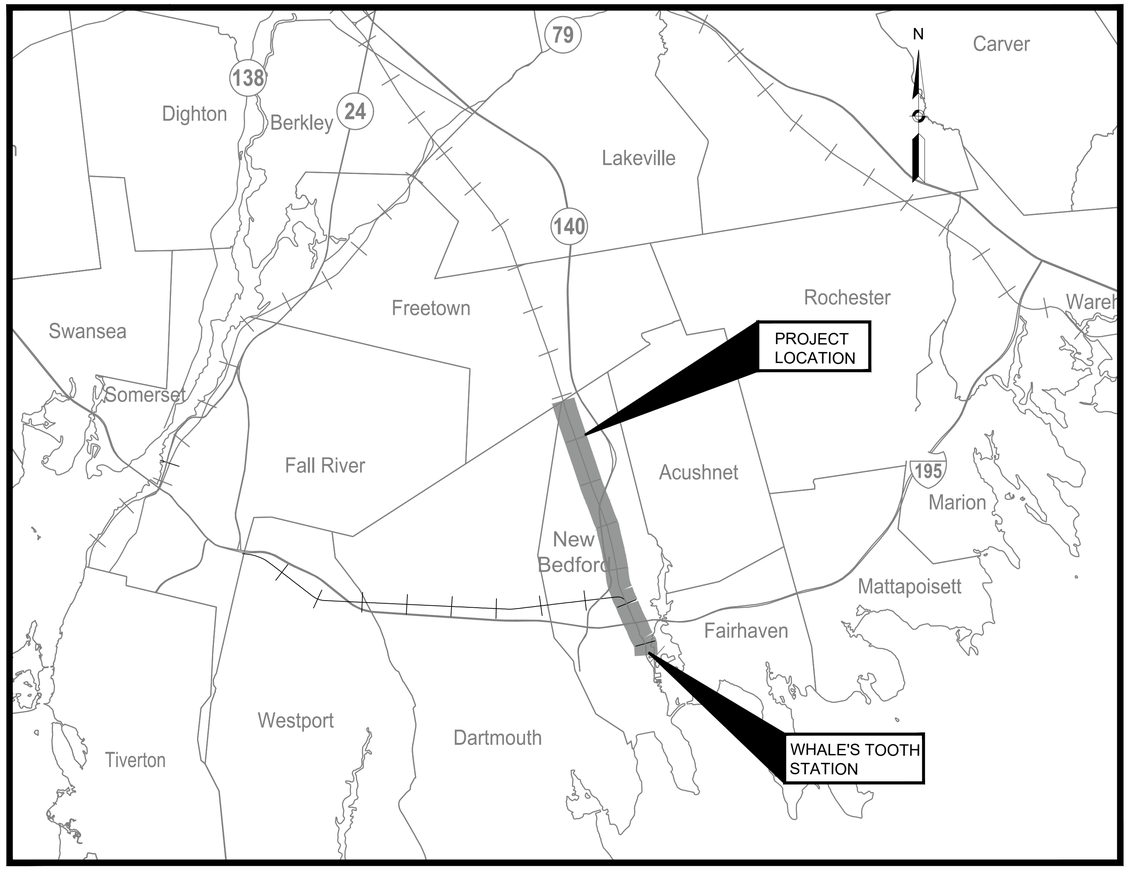
Vanasse Hangen Brustlin, Inc.



Lars Carlson

Senior Project Manager
lcarlson@vhb.com

CC: Jean Fox, MassDOT
Holly Palmgren, MBTA
MassDEP, Southeast Regional Office, Attn: Mark Bartow



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Attachment A
South Coast Rail

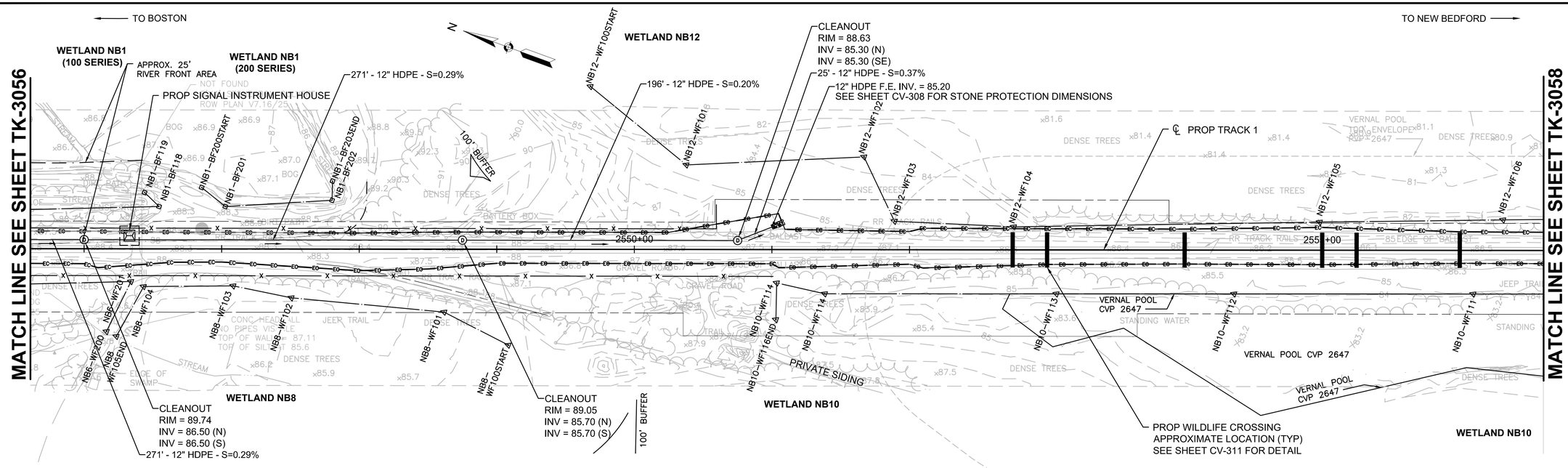
New Bedford Notice of Intent Plans Track and Whales Tooth Station Infrastructure

JUNE 01, 2018
REV: JULY 27, 2018

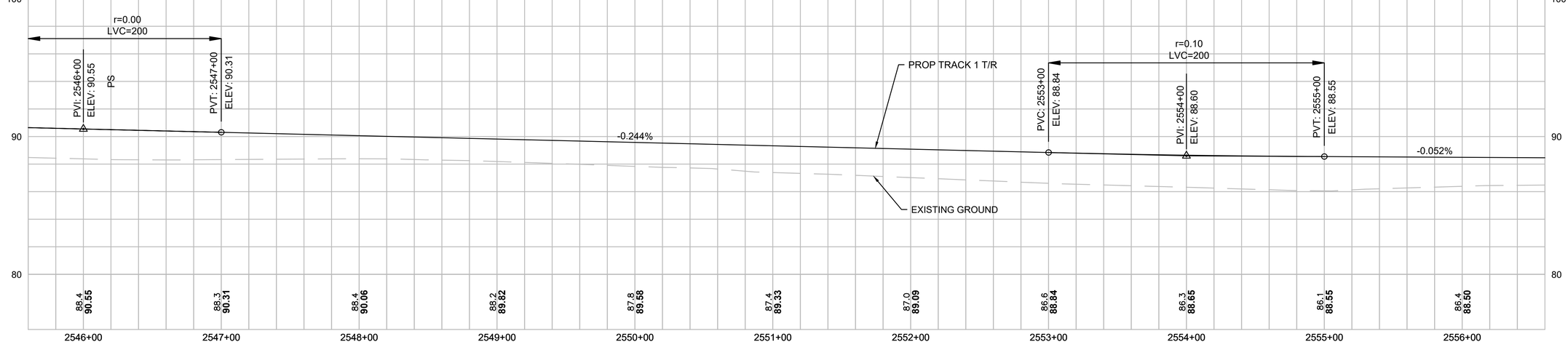
ISSUED FOR NOTICE OF INTENT

SHEET: GN-300

vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB1	
PERMANENT	0 SF
TEMPORARY	0 SF
NB12	
PERMANENT	0 SF
TEMPORARY	0 SF
NB6	
PERMANENT	0 SF
TEMPORARY	0 SF
NB8	
PERMANENT	0 SF
TEMPORARY	0 SF
NB10	
PERMANENT	0 SF
TEMPORARY	0 SF

RIVERFRONT AREA IMPACT (THIS SHEET)	
25' RA	
PREVIOUSLY DISTURBED	1299 SF
UNDISTURBED	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE TRACK PLAN AND PROFILE STA. 2545+60 TO STA. 2556+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

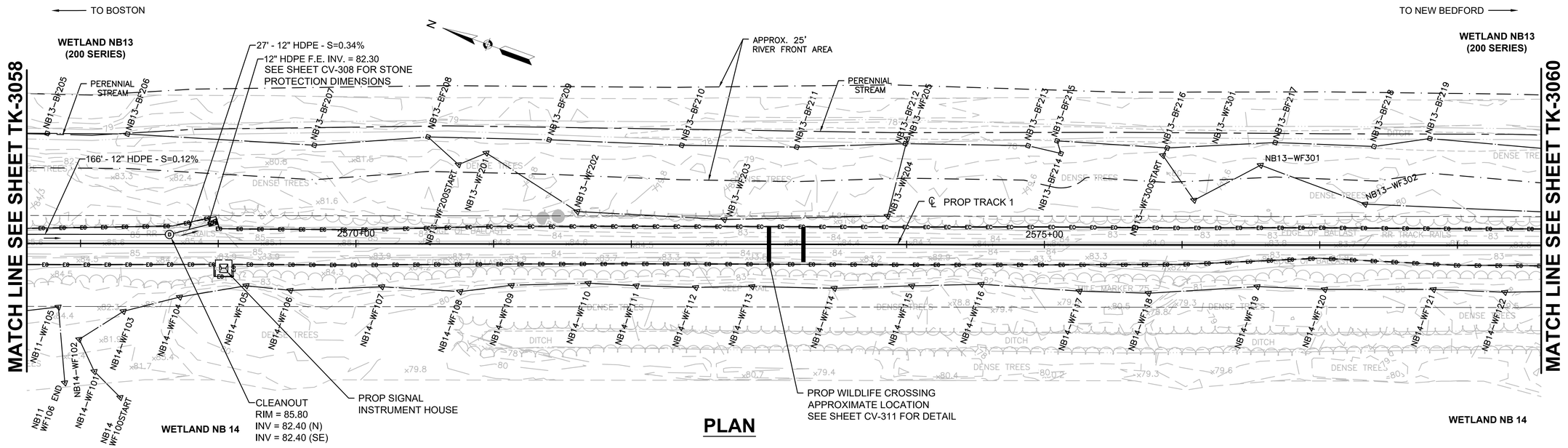
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

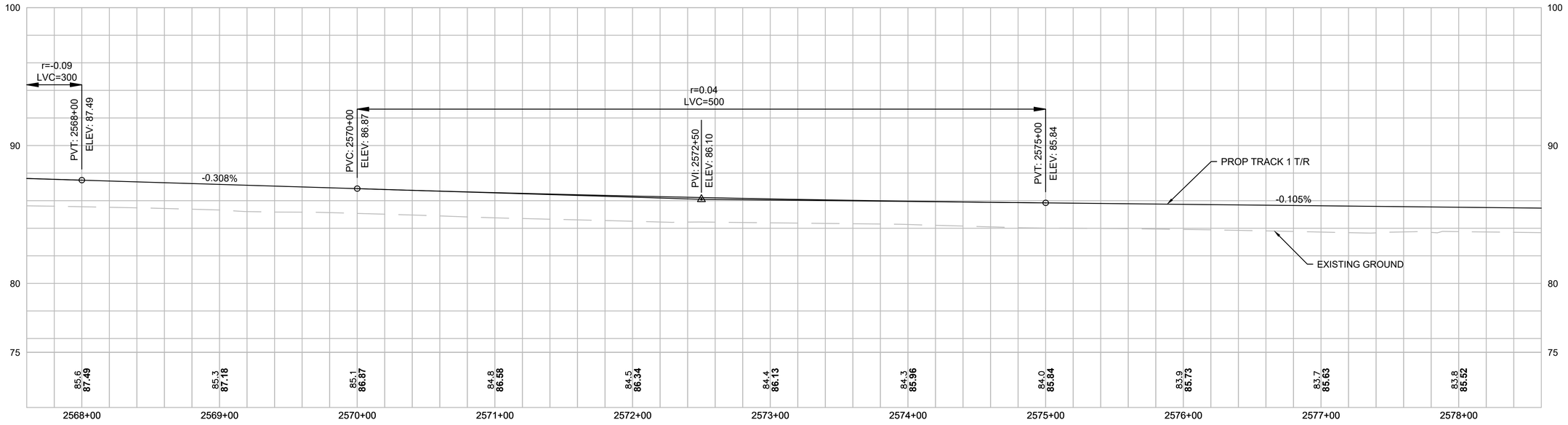
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

HORIZ: AS SHOWN	DES. BY	DR. BY	CHK. BY	ISSUE
VERT: AS SHOWN	ADZ	RRD	KJC	PLAN NO.
DATE: 06/01/2018				SHEET TK-3057

Plotted on: July 31, 2018 9:53 AM
FILE NAME: \\VHBPROJ\BOSTON\12815.00 SCR PM & CM\CAD\SEGMENT3\DWG\EV\NOI NEW BEDFORD\SEGMENT3_EV(NEWBEDFORD_NOI1).DWG



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB13	
PERMANENT	0 SF
TEMPORARY	0 SF
NB11	
PERMANENT	0 SF
TEMPORARY	0 SF
NB14	
PERMANENT	0 SF
TEMPORARY	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE TRACK PLAN AND PROFILE STA. 2567+60 TO STA. 2578+60

ISSUE	DATE	DESCRIPTION	BY	CHKD	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

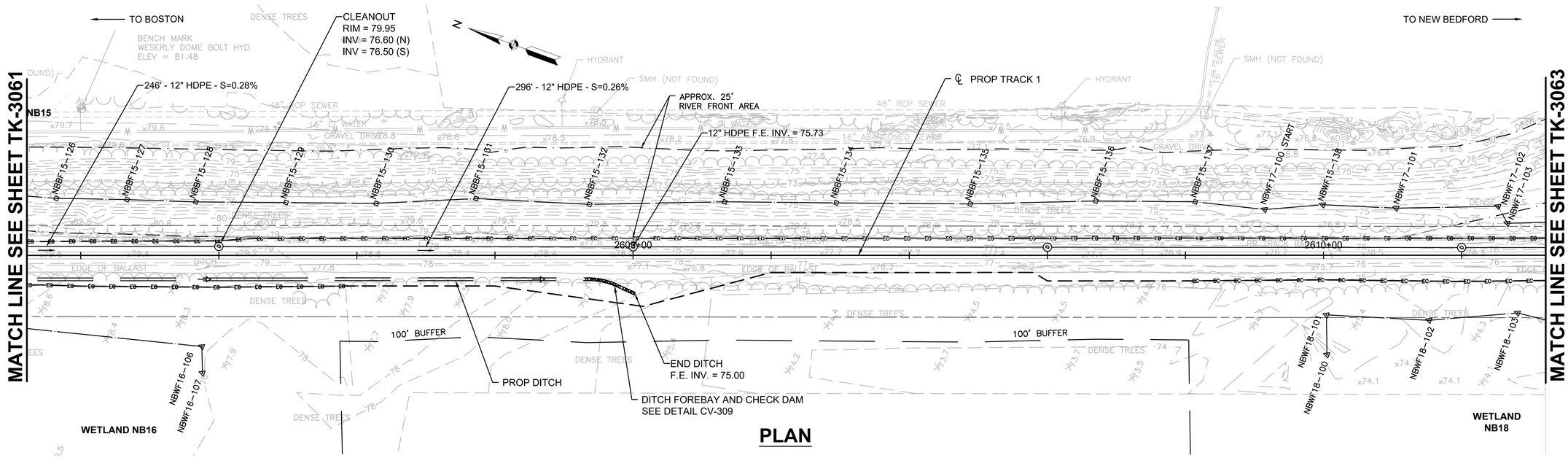
PROJECT MANAGER Date

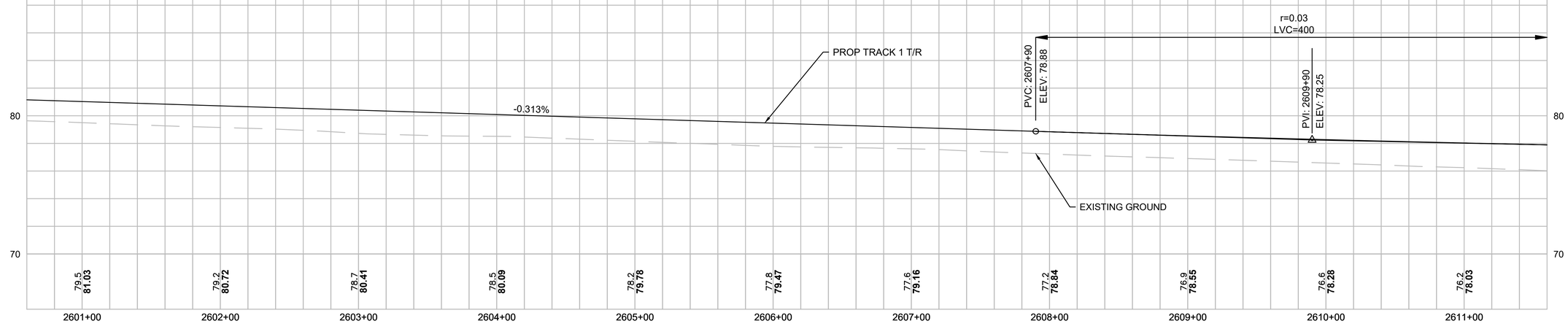
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

HORIZ: AS SHOWN	DES. BY	DR. BY	CHK. BY	PLAN NO.	ISSUE
VERT: AS SHOWN	ADZ	RRD	KJC		
DATE: 06/01/2018				SHEET TK-3059	

FILE NAME: \\VHBPROJ\BOSTON\12815.00 SCR PM & CM\CAD\SEGMENT3\DWG\EV\NOI NEW BEDFORD\SEGMENT3_EV\NEWBEDFORD_NOI1).DWG

Plotted on: July 31, 2018 10:00 AM





LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB15	
PERMANENT	0 SF
TEMPORARY	0 SF
NB17	
PERMANENT	0 SF
TEMPORARY	0 SF
NB16	
PERMANENT	0 SF
TEMPORARY	0 SF
NB18	
PERMANENT	0 SF
TEMPORARY	0 SF

RIVERFRONT AREA IMPACT (THIS SHEET)	
25' RA	
PREVIOUSLY DISTURBED	10082 SF
UNDISTURBED	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE TRACK PLAN AND PROFILE STA. 2600+60 TO STA. 2611+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

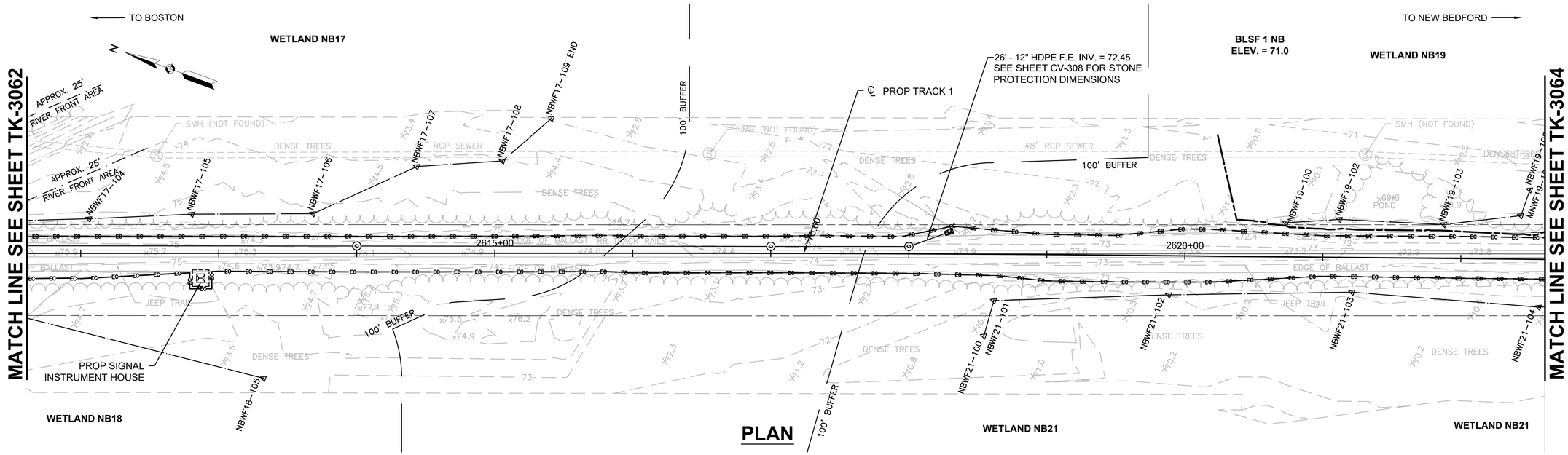
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date
PROJECT MANAGER Date

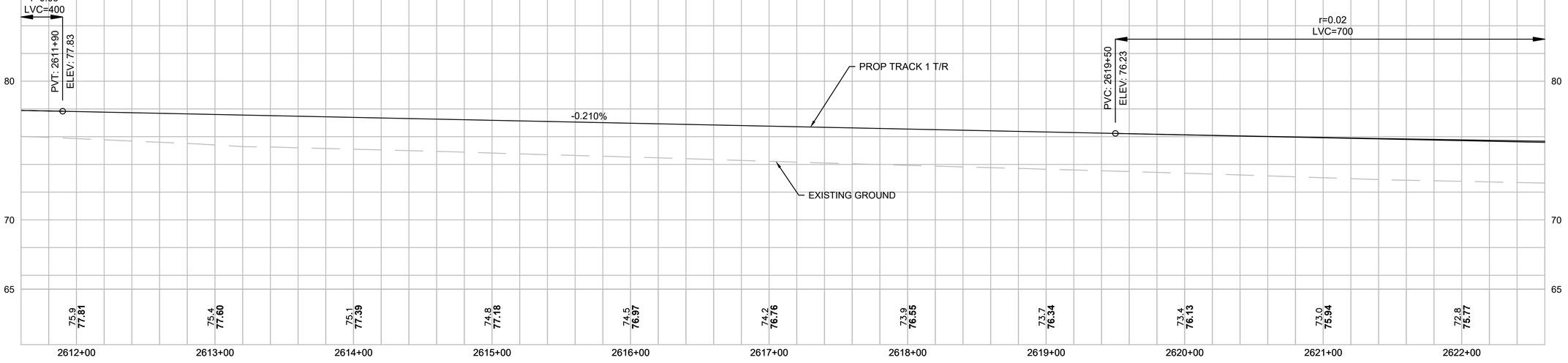
HORIZ: AS SHOWN	DES. BY	DR. BY	CHK. BY	ISSUE
VERT: AS SHOWN	ADZ	RRD	KJC	PLAN NO.
DATE: 06/01/2018				SHEET TK-3062

FILE NAME: \\VHBPROJ\BOSTON\12815.00 SCR PM & CM\CAD\SEGMENT3\DWG\EVNOI NEW BEDFORD\SEGMENT3_EVI(NEWBEDFORD_NOI1).DWG

Plotted on: July 31, 2018 10:05 AM



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB17	
PERMANENT	0 SF
TEMPORARY	0 SF
NB19	
PERMANENT	0 SF
TEMPORARY	0 SF
NB18	
PERMANENT	0 SF
TEMPORARY	0 SF
NB21	
PERMANENT	0 SF
TEMPORARY	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE TRACK PLAN AND PROFILE STA. 2611+60 TO STA. 2622+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

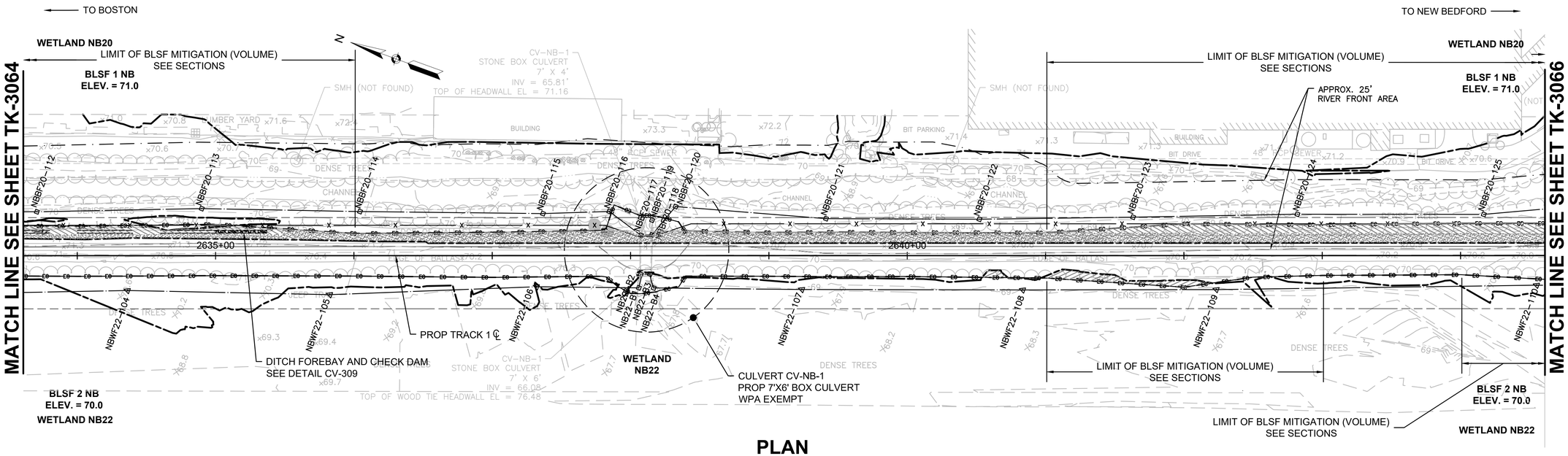
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

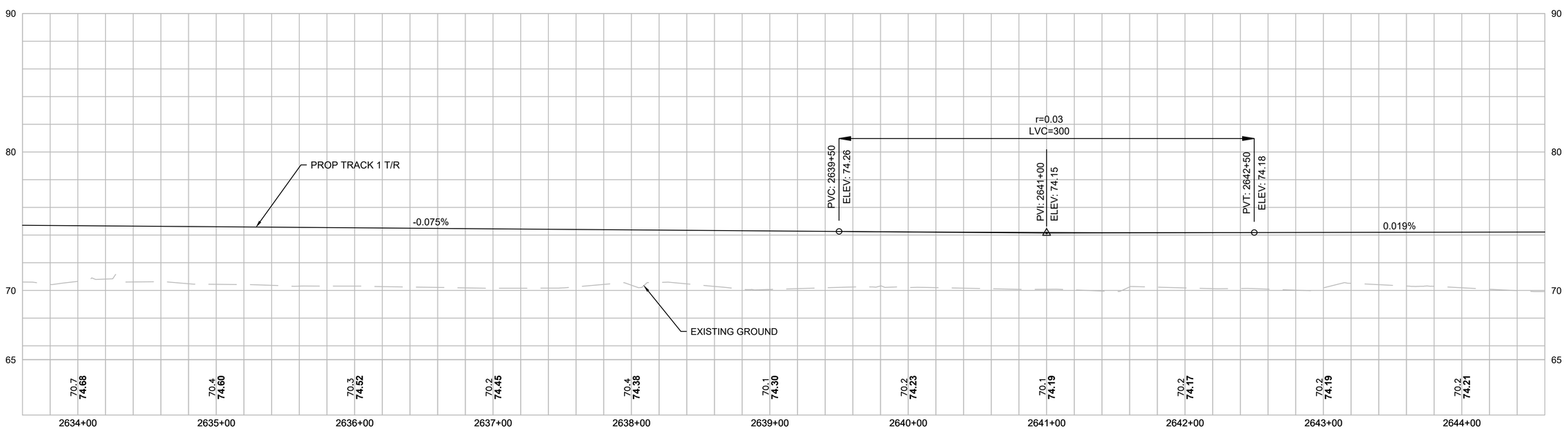
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

	DES. BY	DR. BY	CHK. BY
HORIZ: AS SHOWN	ADZ	RRD	KJC
VERT: AS SHOWN			
DATE: 06/01/2018			

PLAN NO.
SHEET TK-3063
ISSUE



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

BLSF IMPACT (THIS SHEET)	
BLSF 1	
PERMANENT AREA	7238 SF
TEMPORARY AREA	3050 SF
VOLUME 70' TO 71'	351 CF
VOLUME 69' TO 70'	72 CF
BLSF 2	
PERMANENT AREA	0 SF
TEMPORARY AREA	586 SF
VOLUME 69' TO 70'	5 CF

BLSF MITIGATION (THIS SHEET)	
BLSF 1	
VOLUME 70' TO 71'	315 CF
VOLUME 69' TO 70'	510 CF
BLSF 2	
VOLUME 69' TO 70'	422 CF

WETLAND IMPACT (THIS SHEET)	
NB22	
PERMANENT	0 SF
TEMPORARY	0 SF

BANK & LAND UNDER WATER IMPACT (THIS SHEET)	
NB20	
TEMP BANK	0 LF
LAND UNDER WATER	0 SF
TEMP LAND UNDER WATER	0 SF
NB22	
TEMP BANK	0 LF
LAND UNDER WATER	0 SF
TEMP LAND UNDER WATER	0 SF

RIVERFRONT AREA IMPACT (THIS SHEET)	
25' RA	
PREVIOUSLY DISTURBED	15898 SF
UNDISTURBED	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

NOTE: FOR MITIGATION VOLUMES, SEE CROSS SECTIONS

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE
TRACK PLAN AND PROFILE
STA. 2633+60 TO STA. 2644+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

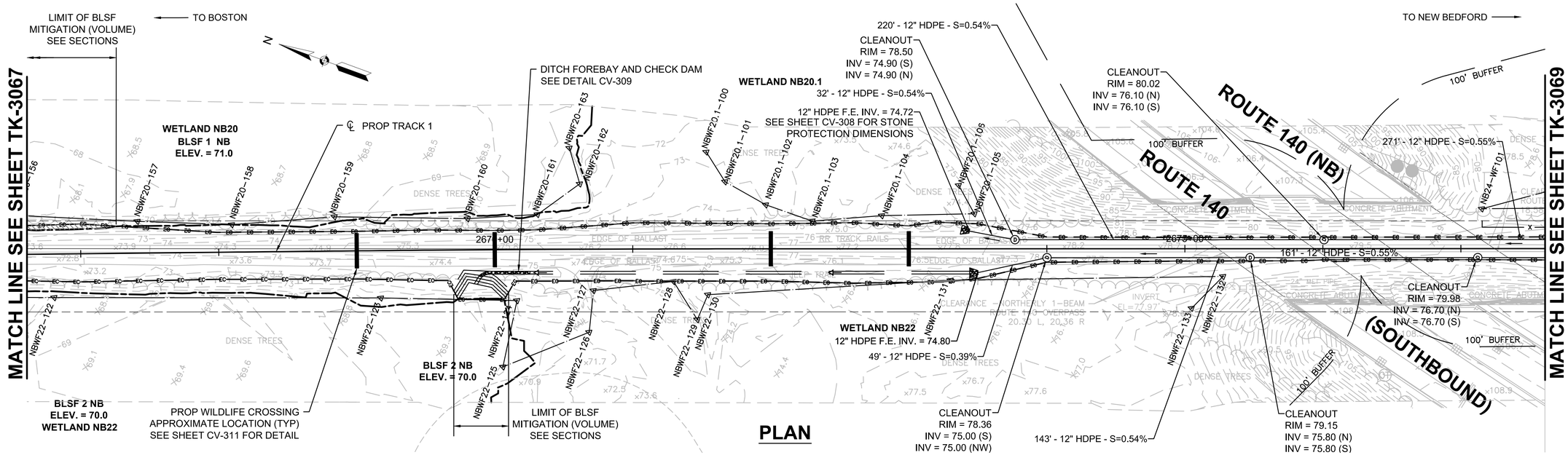
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

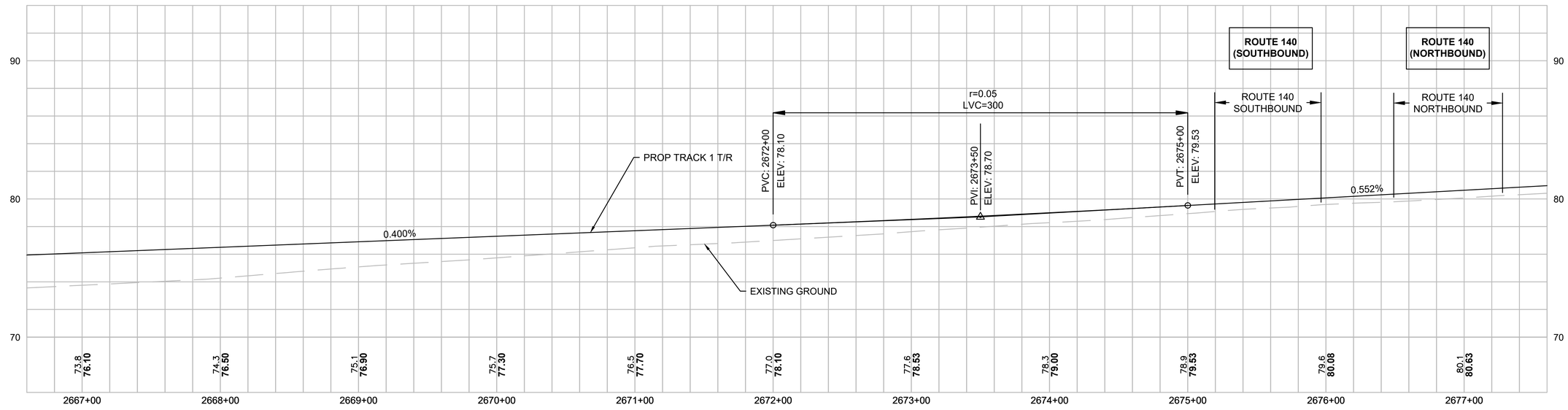
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

	DES. BY	DR. BY	CHK. BY
HORIZ: AS SHOWN	ADZ	RRD	KJC
VERT: AS SHOWN			
DATE: 06/01/2018			

PLAN NO.
SHEET TK-3065
ISSUE



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB20	
PERMANENT	0 SF
TEMPORARY	0 SF
NB20.1	
PERMANENT	0 SF
TEMPORARY	0 SF
NB24	
PERMANENT	0 SF
TEMPORARY	0 SF
NB22	
PERMANENT	16 SF
TEMPORARY	0 SF

BLSF IMPACT (THIS SHEET)	
BLSF 1	
PERMANENT AREA	0 SF
TEMPORARY AREA	199 SF
VOLUME 70' TO 71'	0 CF
BLSF 2	
PERMANENT AREA	0 SF
TEMPORARY AREA	0 SF

BLSF MITIGATION (THIS SHEET)	
BLSF 1	
VOLUME 70' TO 71'	85 CF
BLSF 2	
VOLUME 69' TO 70'	260 CF

NOTE: FOR MITIGATION VOLUMES, SEE CROSS SECTIONS

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE
TRACK PLAN AND PROFILE
STA. 2666+60 TO STA. 2677+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

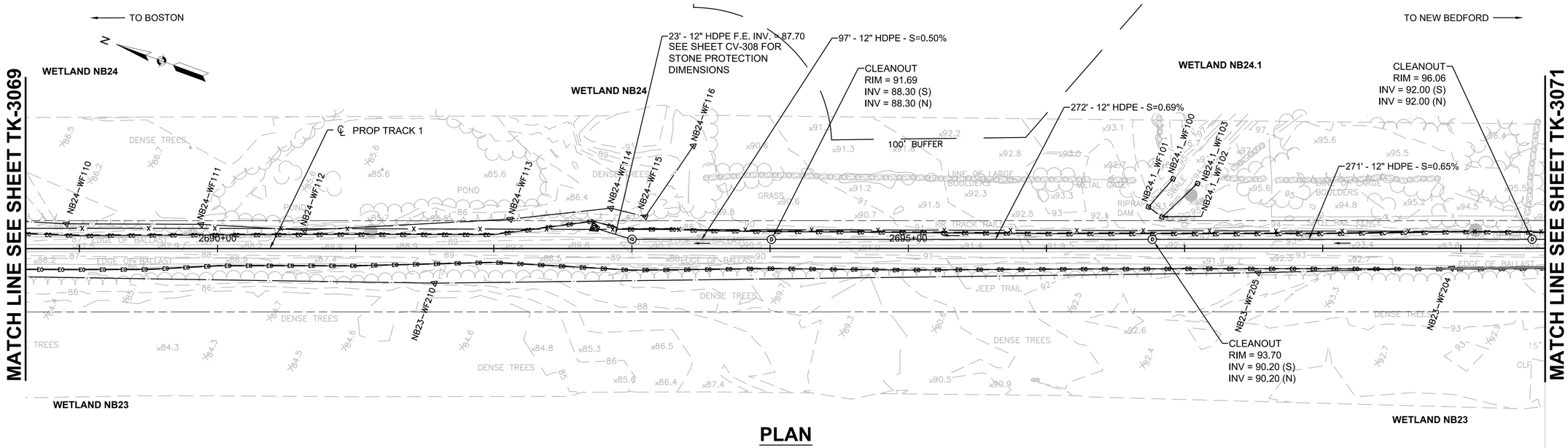
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date
PROJECT MANAGER Date

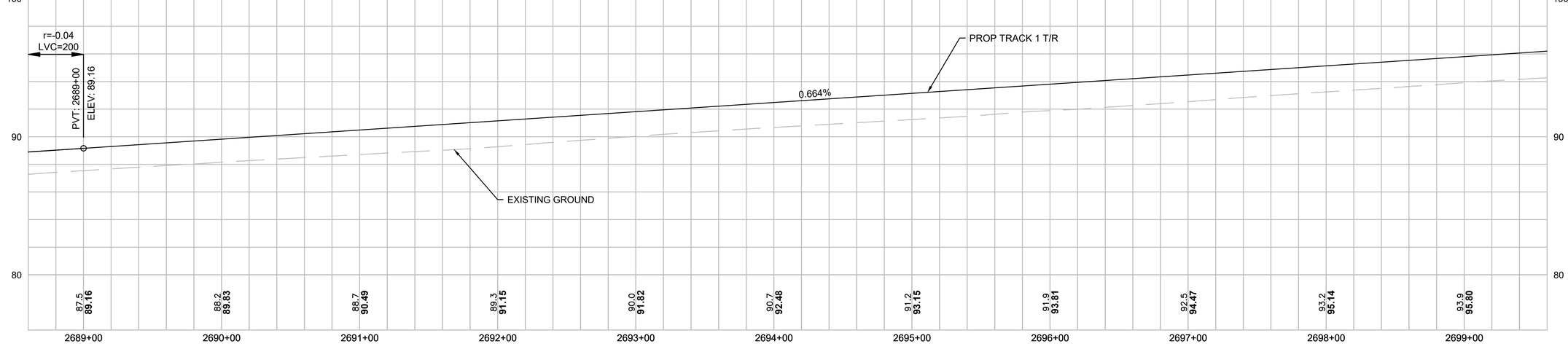
HORIZ: AS SHOWN	DES. BY	DR. BY	CHK. BY	ISSUE
VERT: AS SHOWN	ADZ	RRD	KJC	PLAN NO.
DATE: 06/01/2018				SHEET TK-3068

Plotted on: July 31, 2018 10:18 AM

FILE NAME: \\VHBPROJ\BOSTON\12815.00 SCR PM & CM\CAD\SEGMENT3\DWG\EVNOI NEW BEDFORD\SEGMENT3_EVNEWBEDFORD_NOI1).DWG



PLAN



PROFILE

LEGEND & SYMBOLS

- RIGHT OF WAY
- LIMIT OF GRADING
- 6' HIGH CHAIN LINK FENCE
- EROSION CONTROL / LIMIT OF WORK
- PERMANENT EASEMENT
- BORDERING VEGETATED WETLAND
- FLOOD PLAIN
- BANK
- RIVERFRONT AREA
- 100' BUFFER ZONE
- EDGE OF CHANNEL
- COASTAL BANK
- PERMANENT BVW IMPACT
- TEMPORARY BVW IMPACT
- PERMANENT LUW IMPACT
- TEMPORARY LUW IMPACT
- BLSF IMPACT
- TEMPORARY BLSF IMPACT

WETLAND IMPACT (THIS SHEET)	
NB23	
PERMANENT	103 SF
TEMPORARY	0 SF
NB24	
PERMANENT	0 SF
TEMPORARY	0 SF
NB24.1	
PERMANENT	0 SF
TEMPORARY	0 SF

BANK & LAND UNDER WATER IMPACT (THIS SHEET)	
NB24.1	
TEMP BANK	0 LF
LAND UNDER WATER	0 SF
TEMP LAND UNDER WATER	0 SF

HOR. SCALE IN FEET
40 0 40 80
4 0 4 8
VER. SCALE IN FEET

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE TRACK PLAN AND PROFILE STA. 2688+60 TO STA. 2699+60

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	DRAINAGE REVISION	CSS	KC	KC

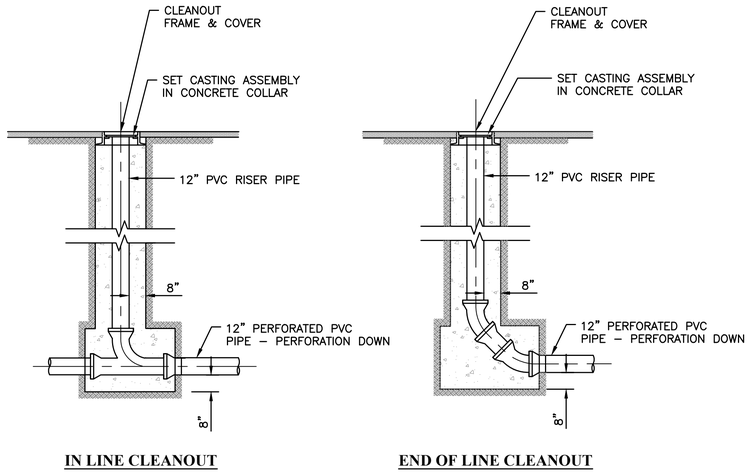
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date
PROJECT MANAGER Date

HORIZ: AS SHOWN	DES. BY	DR. BY	CHK. BY
VERT: AS SHOWN	ADZ	RRD	KJC
DATE: 06/01/2018			

PLAN NO.
SHEET TK-3070
ISSUE

FILE NAME: \\VHBPROJ\BOSTON\12815.00 SCR PM & CM\CAD\SEGMENT3\DWG\EVNOI NEW BEDFORD\SEGMENT3_EVNEWBEDFORD_NOI1).DWG
Plotted on July 31, 2018 10:22 AM



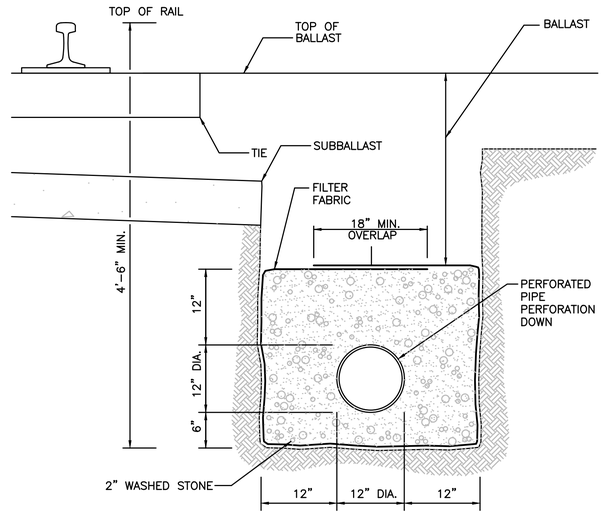
IN LINE CLEANOUT **END OF LINE CLEANOUT**

NOTE:

CLEANOUT TOP SHALL BE ENCLOSED IN CASTING AND/OR FABRICATED COVER ASSEMBLY.

Wye Cleanout - Track Underdrain Detail

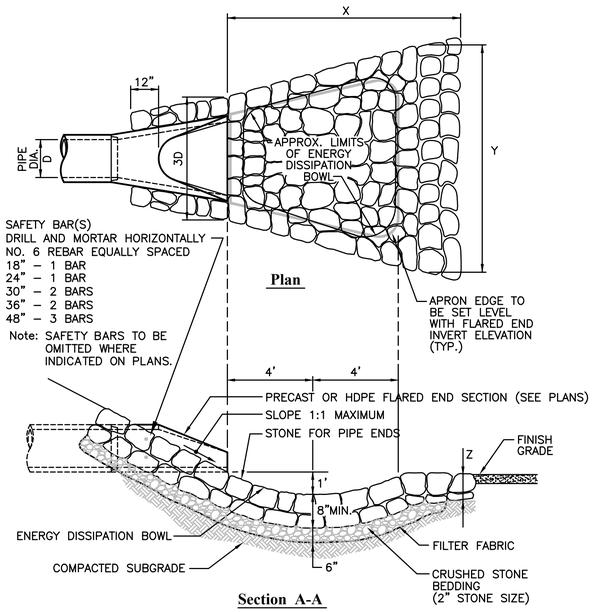
SCALE: N.T.S.



Underdrain (UD)

SCALE: N.T.S.

NOTE: REFER TO GRADING AND UTILITY PLANS FOR OTHER STONE PROTECTION DIMENSIONS

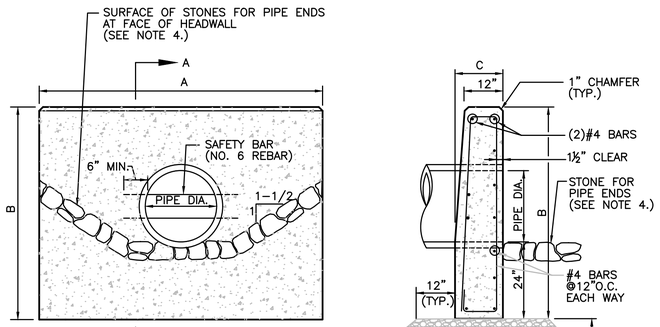


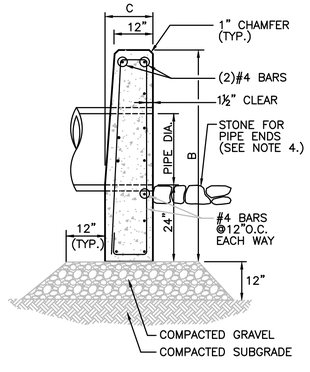
Flared End Section (F.E.) with Stone Protection

SCALE: N.T.S.

PIPE END PROTECTION				
FES STATION	X	Y	Z	STONE DIA (D_{50})
2551+00 LT	6	7	1.13	0.5
2568+85 LT	6	7	1.13	0.5
2618+26 LT	6	7	1.13	0.5
2673+44 LT	6	7	1.13	0.5
2692+76 LT	6	7	1.13	0.5

* WIDTH OF CHANNEL





Dimensional Table				
PIPE DIA.	A	B	C	# OF SAFETY BARS
12"	5'–6"	4'–2"	1'–6"	–
15"	6'–6"	4'–5"	1'–6"	–
18"	7'–6"	4'–9"	1'–6"	1
24"	9'–0"	5'–3"	1'–6"	1
30"	11'–0"	5'–10"	1'–6"	2
36"	13'–0"	6'–4"	1'–9"	2
42"	15'–9"	6'–11"	1'–9"	3
48"	17'–9"	7'–5"	2'–0"	3
60"	21'–9"	8'–6"	2'–6"	4
72"	25'–9"	9'–7"	3'–0"	5

Notes:

1. CONCRETE SHALL BE MINIMUM COMPRESSIVE STRENGTH 4000 PSI, TYPE II CEMENT.
2. SAFETY BARS TO BE OMITTED WHERE INDICATED ON PLANS.
3. SAFETY BARS SHALL BE SET TO CREATE EQUAL OPENING DIMENSIONS.
4. SEE STONE PROTECTION AT FES DETAIL.

Concrete Headwall (HW)

SCALE: N.T.S.

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE
DETAILS 2

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
2	7/27/18	PIPE END PROTECTION TABLE	CSS	KC	KC
1	7/11/18	RESPONSE TO CON COMM COMMENTS	ADZ	KC	KC

vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

APPROVED BY:

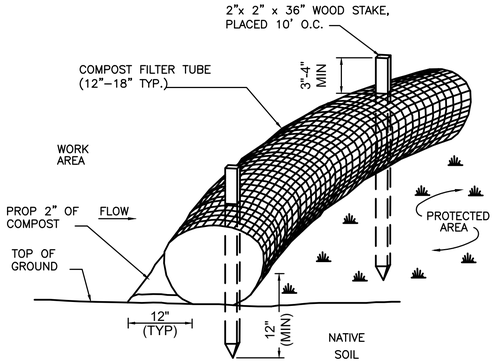
PROJECT MANAGER Date

HORIZ: NONE	DES. BY	DR. BY	CHK. BY
VERT: NONE	ADZ	RRD	KJC
DATE: 06/01/2018			

PLAN NO.

SHEET CV-308

ISSUE

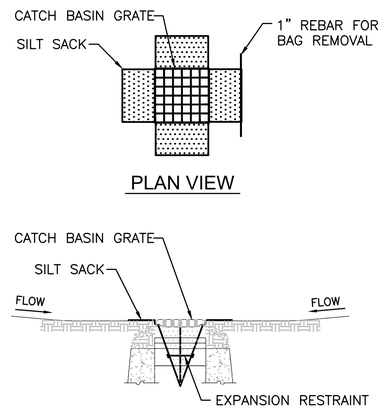


NOTES:

1. FILTER TUBE SHALL BE FILLED BY BLOWN IN ORGANIC COMPOST AND PLACED AS ILLUSTRATED ON THE PROJECT PLANS.
2. COMPOST FILTER TUBES SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS, AND REPAIRED OR REPLACED AS NEEDED.
3. AT COMPLETION OF PROJECT, COMPOST FILTER TUBES SHALL BE CUT OPEN AND COMPOST MATERIAL SHALL BE DISPERSED ON SITE, AS DETERMINED BY THE ENGINEER.
4. THE EMPTY FILTER TUBE FABRIC SHALL BE COLLECTED AND DISPOSED OF PROPERLY.

Linear Sedimentation and Erosion Control

SCALE: N.T.S.

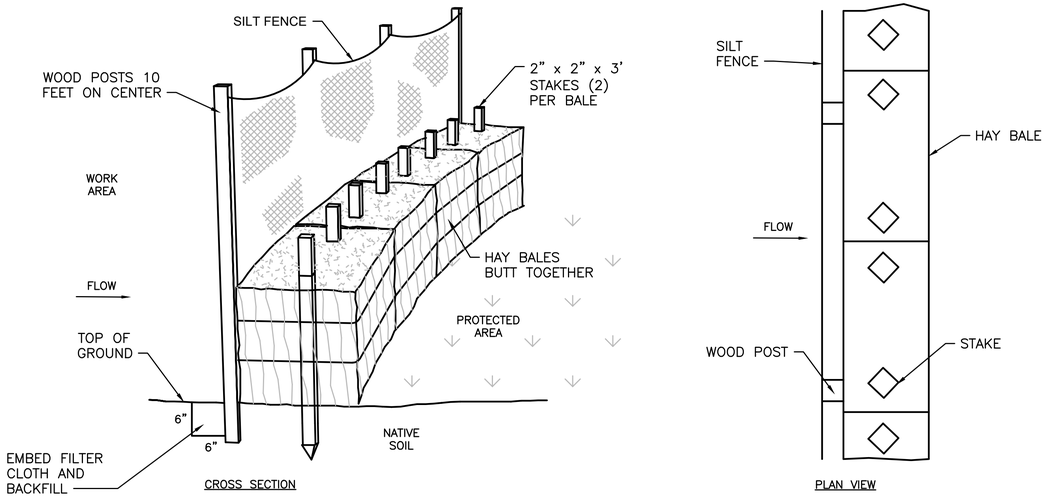


NOTES:

1. INSTALL SILT SACK IN EXISTING CATCH BASINS, BEFORE COMMENCING WORK, AND IN NEW CATCH BASINS IMMEDIATELY AFTER INSTALLATION OF STRUCTURE. MAINTAIN UNTIL BINDER COURSE PAVING IS COMPLETE OR A PERMANENT STAND OF GRASS HAS BEEN ESTABLISHED.
2. GRATE TO BE PLACED OVER SILT SACK.
3. SILT SACK SHALL BE INSPECTED PERIODICALLY AND AFTER ALL STORM EVENTS AND CLEANING OR REPLACEMENT SHALL BE PERFORMED

Inlet Protection - Silt Sack In Catch Basin

SCALE: N.T.S.

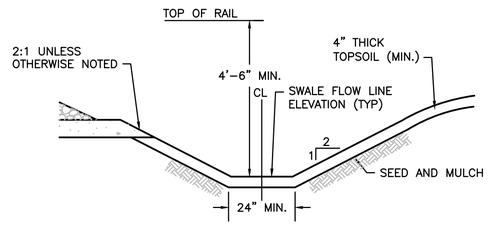


CONSTRUCTION NOTES:

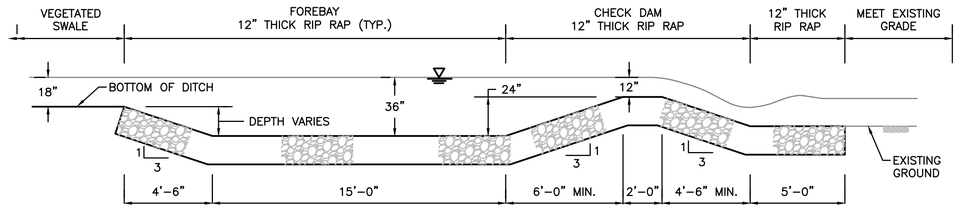
1. FILTER CLOTH SHALL BE FASTENED SECURELY TO POSTS WITH WIRE TIES OR STAPLES AND POSTS SHALL BE SPACED EVERY 10 FEET.
2. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY 6 INCHES AND FOLDED.
3. ENTRENCH SILT FENCE BUT NOT HAY BALES.
4. INSPECTIONS SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS

Erosion Control Barrier

SCALE: N.T.S.



Section

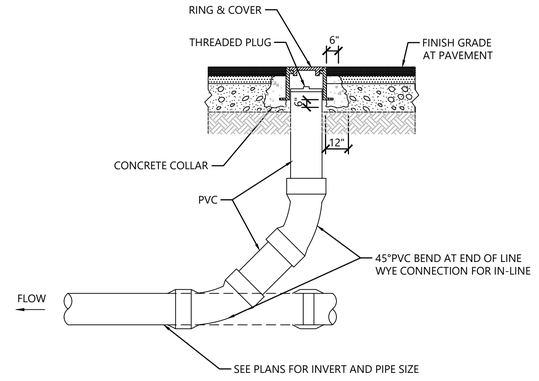


Elevation

Vegetated Swale with Ditch Forebay and Check Dam

SCALE: N.T.S.

DITCH FOREBAY AND CHECK DAM LOCATIONS					
BEGIN	END	LENGTH	BOTTOM ELEV		SLOPE
2589+85 RT	2605+20 RT	1535	79.7	76.1	0.0024
2625+00 RT	2635+20 RT	1020	70.9	70.1	0.0008
2673+50 RT	2669+80 RT	370	74.2	72.2	0.0055



Cleanout - Paved Area

SCALE: N.T.S.

ISSUED FOR NOTICE OF INTENT

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
1	7/27/18	FOREBAY AND CHECK DAM LOCATIONS	CSS	KC	KC

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE
DETAILS 3

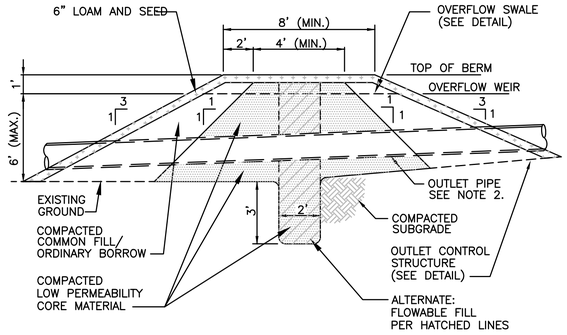
vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

HORIZ: NONE	DES. BY	DR. BY	CHK. BY
VERT: NONE	ADZ	RRD	KJC
DATE: 06/01/2018			

PLAN NO.
SHEET CV-309
ISSUE

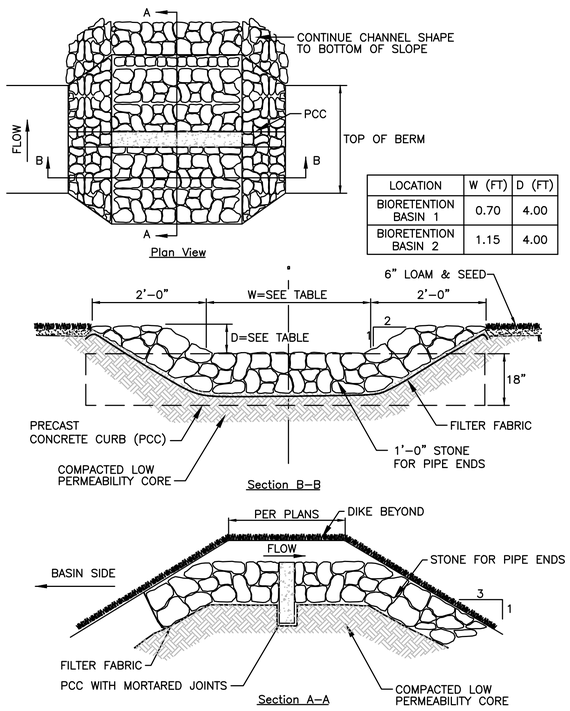


Notes:

1. LOW PERMEABILITY CORE MATERIAL IS CONTINUOUS FOR THE FULL LENGTH OF THE EMBANKMENT.
2. WHERE PIPES PENETRATE THE LOW PERMEABILITY CORE, PIPE SHALL BE BEDDED IN THE LOW PERMEABILITY CORE MATERIAL.
3. THE BERM SECTION IS SUBJECT TO CHANGE AND WILL BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.

Detention Basin Berm Section

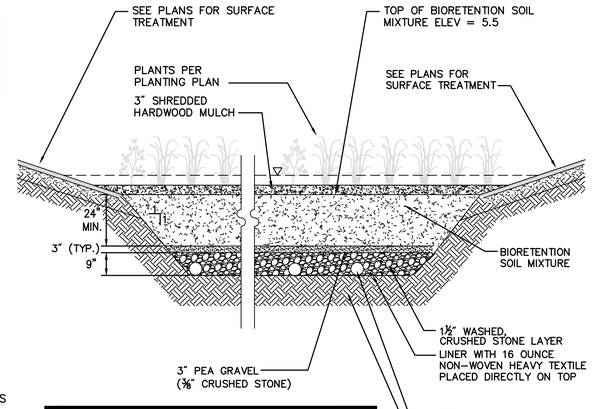
SCALE: N.T.S.



LOCATION	W (FT)	D (FT)
BIORETENTION BASIN 1	0.70	4.00
BIORETENTION BASIN 2	1.15	4.00

Overflow Stone Swale

SCALE: N.T.S.

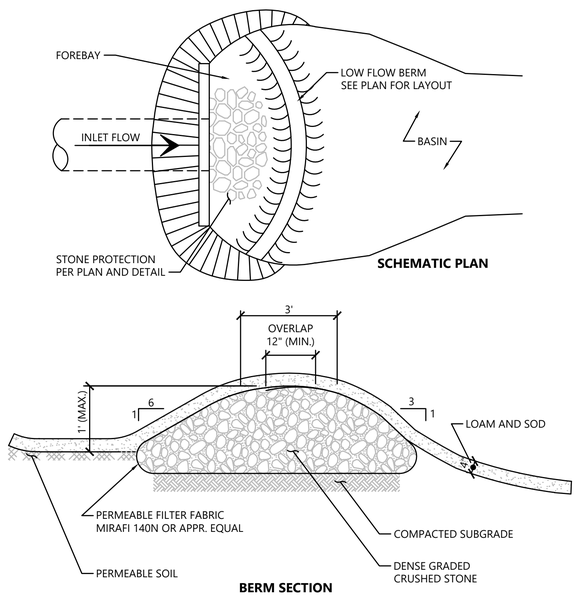


Notes:

1. INSTALL AND CONNECT UNDERDRAINS PER PLANS.
2. SIDE SLOPES SHALL BE 3:1 MAX. 2% MIN.
3. LINER SHALL BE 20 MIL FLEXIBLE PVC MEMBRANE OR APPROVED EQUAL.
4. LINER AND HEAVY TEXTILE SHALL BE PREPARED AND INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.

Lined Bioretention Basin W/ Underdrain

SCALE: N.T.S.

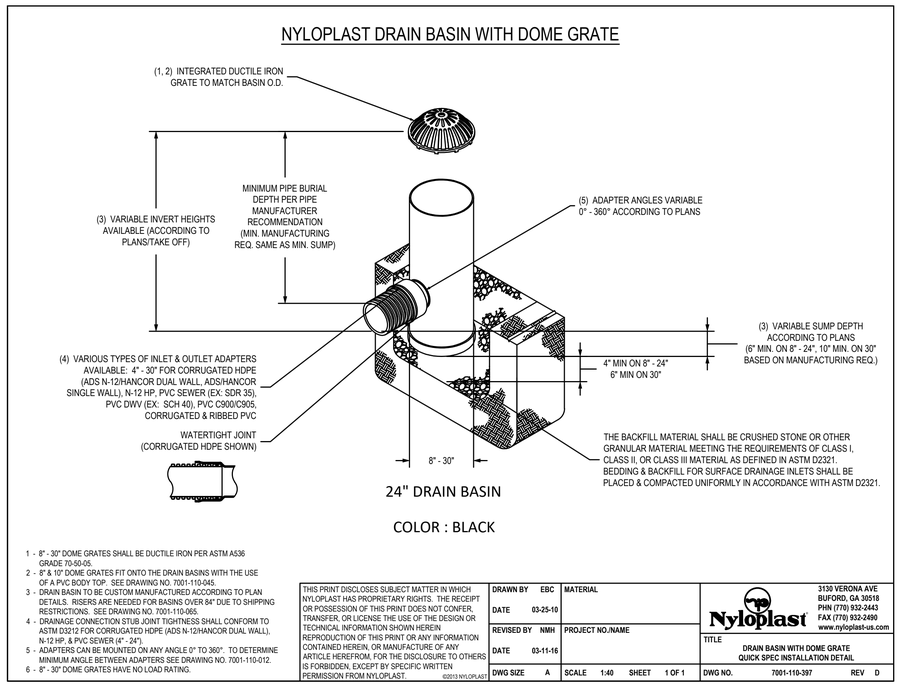


NOTES

1. FOREBAY DESIGNED TO CAPTURE 0.1 INCHES OF RUNOFF FROM IMPERVIOUS SURFACES

Low Flow Sediment Forebay Berm

SCALE: N.T.S.



1 - 8" - 30" DOME GRATES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05.
2 - 8" & 10" DOME GRATES FIT ONTO THE DRAIN BASINS WITH THE USE OF A PVC BODY TOP. SEE DRAWING NO. 7001-110-045.
3 - DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS. RISERS ARE NEEDED FOR BASINS OVER 84" DUE TO SHIPPING RESTRICTIONS. SEE DRAWING NO. 7001-110-065.
4 - DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS N-12/HANCOR DUAL WALL), N-12 HP, & PVC SEWER (4" - 24").
5 - ADAPTERS CAN BE MOUNTED ON ANY ANGLE 0° TO 360°. TO DETERMINE MINIMUM ANGLE BETWEEN ADAPTERS SEE DRAWING NO. 7001-110-012.
6 - 8" - 30" DOME GRATES HAVE NO LOAD RATING.

DRAWN BY	EBC
DATE	03-25-10
REVISED BY	NMH
DATE	03-11-16
DWG SIZE	A
MATERIAL	
PROJECT NO./NAME	
SCALE	1:40
SHEET	1 OF 1

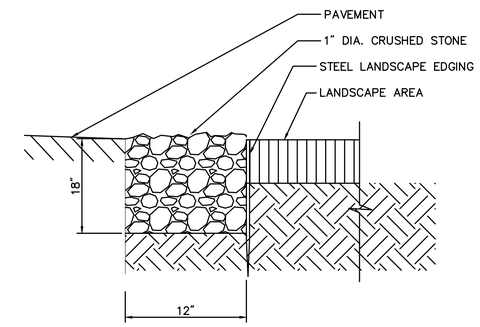
Nyloplast
3130 VERONA AVE
BUFORD, GA 30518
PHN (770) 932-2443
FAX (770) 932-2490
www.nyloplast-us.com

TITLE: DRAIN BASIN WITH DOME GRATE QUICK SPEC INSTALLATION DETAIL

DWG NO. 7001-110-397 REV D

Area Drain (AD)

SCALE: N.T.S.



Pretreatment Filter Strip

SCALE: N.T.S.

ISSUED FOR NOTICE OF INTENT

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SOUTH COAST RAIL - PHASE I
DESIGN ENGINEERING AND PM/CM SERVICES
CONTRACT NO.

NEW BEDFORD MAIN LINE
DETAILS 6

ISSUE	DATE	DESCRIPTION	BY	CHKD.	APP.
2	7/27/18	RENAME FILTER STRIP DETAIL	CSS	KC	KC
1	7/11/18	RESPONSE TO CON COMM COMMENTS	JHC	RTW	KS

vhb HNTB
99 HIGH STREET
BOSTON, MA 02110
(617) 728-7777

PROJECT MANAGER Date

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
APPROVED BY:
PROJECT MANAGER Date

HORIZ: NONE	DES. BY	DR. BY	CHK. BY
VERT: NONE	ADZ	RRD	KJC
DATE: 06/01/2018			

PLAN NO.
SHEET CV-312
ISSUE

Attachment B
Illicit Discharge Statement Letters
Whale's Tooth Station and NBML Track Intrastructure

Prepared for:

Massachusetts Department of Transportation (MassDOT)
10 Park Plaza
Boston, Massachusetts 02116

Prepared by:

The VHB/HNTB Team – a Joint Venture
99 High Street, 10th Floor
Boston, Massachusetts

MassDOT Contract No. 99771
July 31, 2018

www.vhb.com

July 31, 2018

Ref: 12815.00

Mr. Craig P. Dixon, Chairman
New Bedford Conservation Commission
133 William Street- Room 304
New Bedford, Massachusetts 02740

Re: South Coast Rail – New Bedford Main Line NOI – MA DEP No: SE 049-0805
Illicit Discharge Compliance Statement for Whale's Tooth Station

Chairman Dixon,

On behalf of the Massachusetts Department of Transportation, and in accordance with Massachusetts Department of Environmental Protection (MA DEP) Stormwater Management Standards (the Standards), VHB respectfully offers the following Illicit Discharge Compliance Statement for the Whale's Tooth Station (WTS) portion of the above referenced Notice of Intent (NOI). VHB issued a Stormwater Report (the Report) and Design Plans for WTS dated May 2018 and revised thru July 2018 as part of the NOI.

Illicit Discharge Compliance Statement for Whale's Tooth Station: Existing sanitary sewer and storm drainage structures from previous development which are part of the project and located within the WTS redevelopment area will be protected in place. The Design Plans submitted with the Report have been designed in full compliance with the MA DEP Standards. No statement is made regarding the drainage system in portions of the site not included in the redevelopment project area. The Long-Term Pollution Prevention Plan submitted with the Report includes measures to prevent illicit discharges.

Engineers | Scientists | Planners | Designers

101 Walnut Street
PO Box 9151
Watertown, Massachusetts 02471
P 617.924.1770
F 617.924.2286

It is our hope that the Commission finds that this correspondence satisfies Standard #10 of the MA DEP Standards pertaining to the prohibition of illicit discharges for the Project.

Sincerely,

Vanasse Hangen Brustlin, Inc.

Rene L. Gagnon, P.E.

Senior Project Engineer
rgagnon@vhb.com

HNTB Corporation
The HNTB Companies

31 St. James Avenue
Suite 300
Boston, MA 02116

Telephone (617) 542-6900
Facsimile (617) 428-6905
www.hntb.com

July 31, 2018

Mr. Craig P. Dixon, Chairman
New Bedford Conservation Commission
133 William Street- Room 304
New Bedford, Massachusetts 02740

Re: South Coast Rail – New Bedford Main Line NOI – MA DEP No: SE 049-0805
Illicit Discharge Statement for South Coast Rail New Bedford Track Corridor

Chairman Dixon,

On behalf of the Massachusetts Department of Transportation (MassDOT), and in accordance with Massachusetts Department of Environmental Protection (MA DEP) Stormwater Management Standards (the Standards), HNTB respectfully offers the following Illicit Discharge Compliance Statement for the South Coast Rail New Bedford Track Corridor portion of the above referenced Notice of Intent (NOI). HNTB issued a Stormwater Report and Design Plans for the project dated May 2018 and revised through July 2018 as part of the NOI.

Illicit Discharge Compliance Statement for South Coast Rail New Bedford Track Corridor:
The Design Plans submitted with the Report have been designed in full compliance with the MA DEP Standards. To the best of our knowledge, no illicit discharges exist within the redevelopment project area. Measures to prevent illicit discharges will follow those identified in the Long-Term Pollution Prevention Plan submitted with the Report for Whale's Tooth Station as a portion of the above referenced NOI.

It is our hope that the Commission finds that this correspondence satisfies Standard #10 of the MA DEP Standards pertaining to the prohibition of illicit discharges for the Project.

Sincerely,

HNTB Corporation

Christopher T. Naylor, P.E.
Transportation & Infrastructure Department

Attachment C
Report on Culvert CV-NB-4
New Bedford, Track Corridor

Prepared for:

Massachusetts Department of Transportation (MassDOT)

10 Park Plaza

Boston, Massachusetts 02116

Prepared by:

The VHB/HNTB Team – a Joint Venture

99 High Street, 10th Floor

Boston, Massachusetts

MassDOT Contract No. 99771

July 31, 2018

Report Objectives

This report presents design information for a proposed replacement culvert within the South Coast Rail Project (SCR) track corridor in New Bedford. The culvert, designated as CV-NB-4, conveys storm surface runoff flows across Pig Farm Road, from south to north. This culvert crossing is immediately adjacent to the west side of the SCR track, where Pig Farm Road crosses the track at-grade. This report provides the technical information to demonstrate the existing system operation, and the adequacy of the proposed replacement culvert.

Project Description

Description of Proposed Project

This South Coast Rail Project Track Corridor project includes the reconstruction and upgrade of an existing railroad right-of-way corridor to provide improved operation for new passenger and existing freight service. The work of this project is generally contained within the existing narrow railway track corridor. See Figure 1.

Site Description

The existing culvert CV-NB-4 is a north-south aligned pipe, paralleling the SCR New Bedford Main Line (NBML) track about 20-feet to the west, crossing beneath Pig Farm, a local access drive to an industrial site further to the west. Pig Farm Road crosses the NBML, east-west, as an at-grade crossing. See Figure 2. The storm runoff flows carried by this cross-culvert are generated from a predominantly forested area to the south. A small portion of this drainage area includes a length of the west side of the track corridor and some unpaved area of the industrial site.

Although culvert CV-NB-4 serves only to convey storm flows across Pig Farm Road, due to its proximity to the track corridor, its hydraulic operation and specifically its inlet headwater elevation could have a direct impact on the track corridor. Given this situation, MBTA drainage design criteria was used as a guide.

Drainage Design Guidelines / Criteria

The following highlights the key general criteria that have been adopted for the project.

- The proposed project will not increase post-construction peak flows. No additional paved or otherwise impervious surfaces are to be constructed which might cause an increase in post-construction peak flows. The scope of the railroad track corridor work is essentially to remove and replace the existing track, ties and foundation, and any earthwork associated with adjustments to the track alignments and re-establishing trackside ditches.
- Existing drainage patterns will be maintained.

- Existing drainage facilities will be analyzed to determine their ability to meet current MBTA drainage design criteria. To the extent practicable, existing facilities not meeting criteria will be proposed to be replaced.
- The drainage systems for the project have been designed to collect and convey the runoff from the 50-year storm. For this design storm, piped systems must not surcharge and flow depths in ditches are not to exceed 3-feet below top of rail. A 100-year return storm event was used as a check storm, which requires all storm drain systems to maintain flow levels no higher than 18-inches below the top of tie. The criteria also requires that the HW/D ratio not exceed 1.5 for the 50-year return storm event (where HW = the depth of the headwater and D = diameter or height of culvert).

Note: Unless noted otherwise all elevations presented in this document are referenced to the North American Vertical Datum of 1988 (NAVD 88).

Floodplains / Water Surface Elevations

In the vicinity of CV-NB-4 there is no FEMA delineated regulatory flood zone.

Engineering Methods

The data available for the culvert evaluation included 1-foot contour mapping along the corridor, culvert field survey and various other information and sources, including MassGIS (land use), FEMA (floodplains), USDA NRCS (soils) and other sources. The watershed for the culvert was delineated based on 2-foot contour GIS mapping available from MassGIS.

The existing culvert was surveyed in the field to establish its location in relation to the proposed track baseline, inverts, alignment, length, size and material.

An industry standard application, HydroCAD, was utilized to perform the watershed hydrologic analyses and to determine culvert hydraulic operation for the various storm events. HydroCAD is a computer program (hydrologic-hydraulic model) based on the Soils Conservation Service (SCS, now NRCS) methodologies. The model allows for the development of flows for various storm events based on watershed area, land use, soil types, times of concentration (Tc) and other factors. Both the existing and proposed culvert scenarios were modeled. Rainfall data input into the model was based on the recently published NOAA Atlas 14 (Volume 10), 2015. The Type III rainfall distribution recommended by SCS for this area of Massachusetts was used. Culvert data, including inverts, lengths, Manning's coefficients and tailwater (TW) elevations were also entered into the HydroCAD model.

Culvert Analyses

Detailed hydrologic and hydraulic computations along with sketches and other supporting material are included at the end of this Report.

Existing Culvert

Field survey and inspection observations documented the following about the existing CV-NB-4.

- Inlet End (south side): 15-inch HDPE, projecting through embankment.
- Outlet End (north side): 18-inch ACCP, projecting through embankment.
- Length: 52 feet.

The presence of different pipe material and size for each culvert end indicates a replacement and/or extension section may have been installed at some point in time. The HDPE pipe material being a newer type in the industry, versus corrugated metal, the replacement / extension may have taken place on this side. However, not knowing the length of either pipe size, analysis of this existing culvert conservatively assumed a 15-inch size for the entire length of this culvert. Based on field survey and site observations, the ditch downstream of the culvert does not drain adequately, standing water occurs, including within the culvert for a substantial length.

The existing culvert was analyzed to establish its hydraulic adequacy during the 50-year and 100-year design storm events. The existing culvert was determined to be hydraulically adequate to not cause overtopping of the track or roadway. However, computed 50-year and 100-year headwater elevation were slightly greater than that prescribed by design criteria, 0.6-feet and 0.4-feet, respectively. However, due to the unknowns with this existing culvert system, dissimilar pipe materials, and transition connection detail, it is recommended this culvert be replaced. Consideration should be given to raising the culvert profile to mitigate the frequency of standing water in the culvert.

Proposed Replacement Culvert

A 24-inch RCP proposed replacement culvert was analyzed. With an adjacent proposed top-of-rail elevation of 98.4, design criteria requires a 50-year return storm event to produce a water surface elevation for the drainage system at this location of no higher than 95.4. The 50-year headwater at the proposed CV-NB-4 was calculated to be 96.3, exceeding the 3-foot clearance criteria by 0.9-feet. Also, criteria requires a 100-year return storm event to produce a water surface elevation at this location of no higher than 96.3. The computed 100-year headwater at the proposed CV-NB-4 was 96.5, exceeding the 1.5-foot criteria by 0.2-feet. Thus, it was determined the replacement of the existing CV-NB-4 cross-culvert with a 24-inch RCP is acceptable hydraulically, i.e., no overtopping of the track or roadway, however, design exception requests will need to be submitted for the computed headwater elevations. The proposed depth of cover over this proposed culvert was set a 1-foot, meeting the minimum design criteria for culverts crossing beneath local roads.

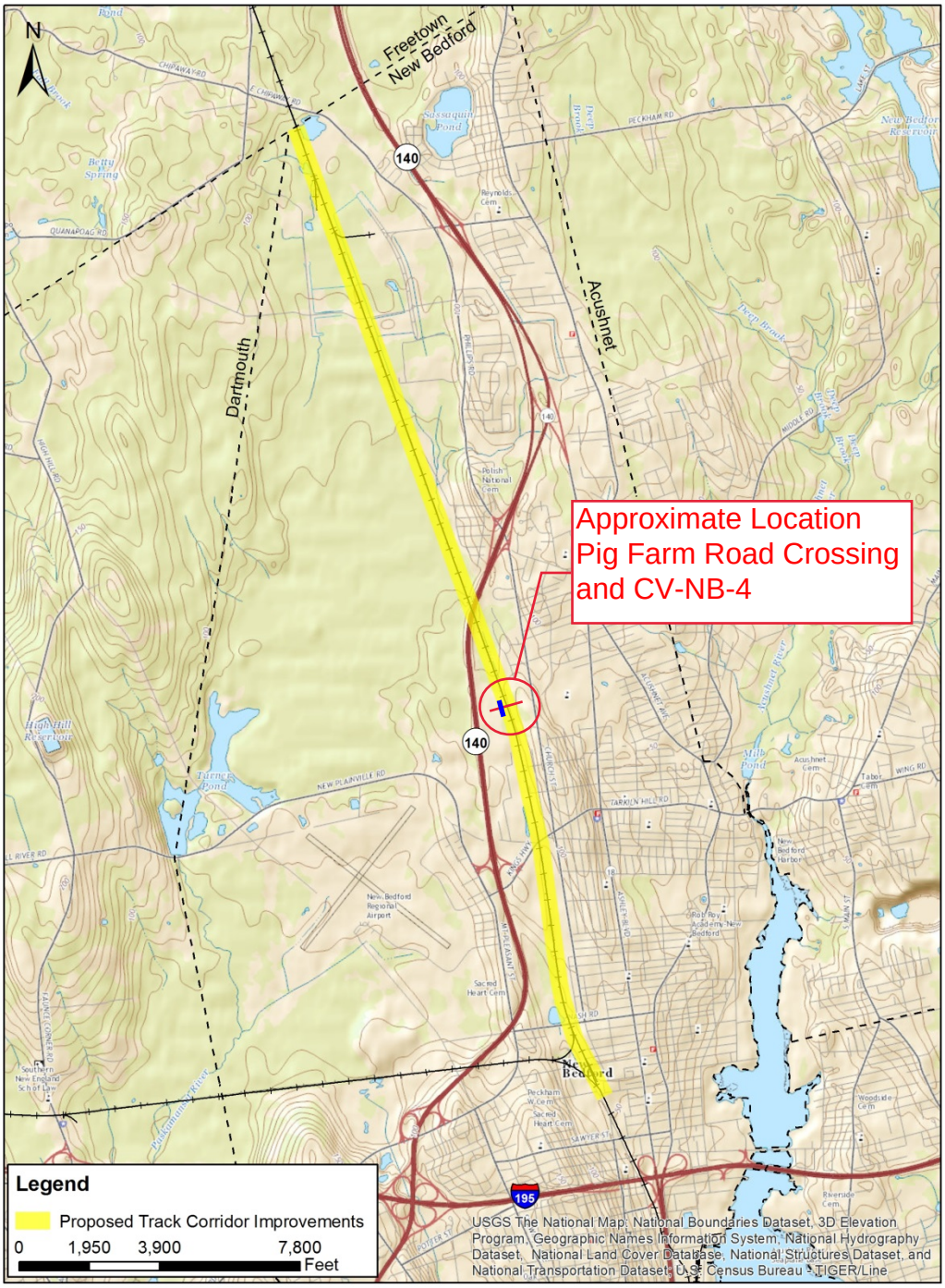


Figure 1 - Site Locus Plan

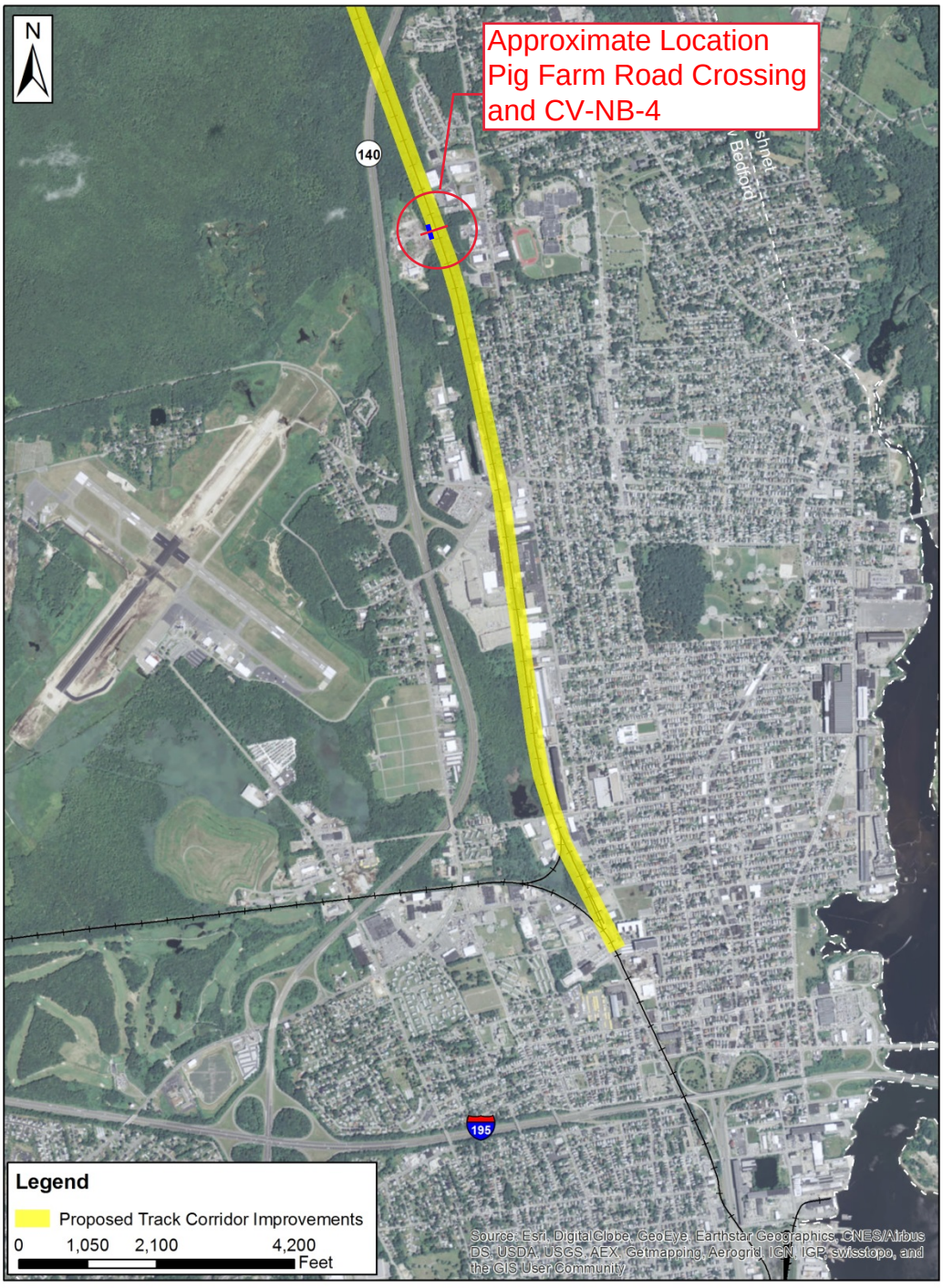


Figure 2 - Project Location Plan, South

Culvert Analyses

and

Supporting Materials

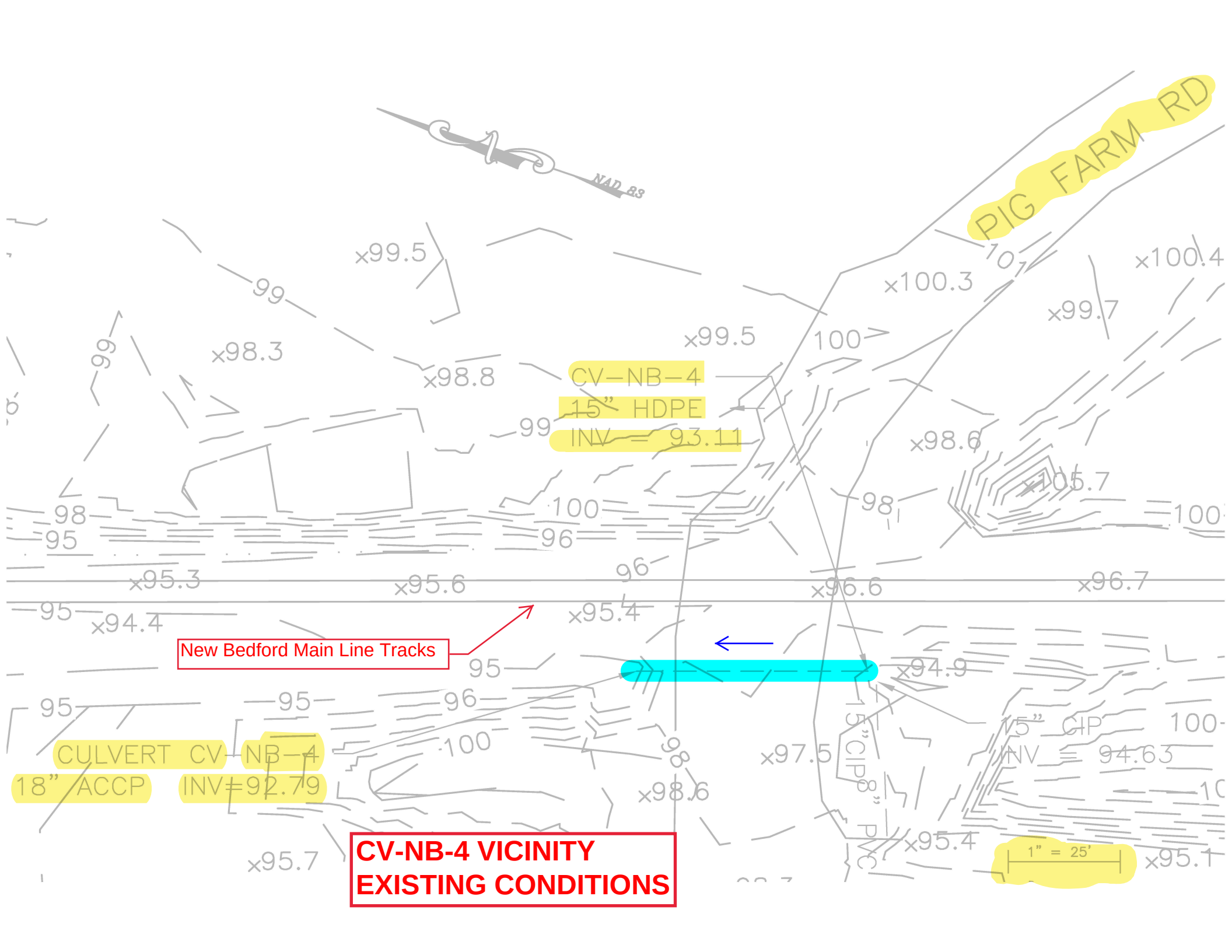
Organization of Calculations / Supporting Materials

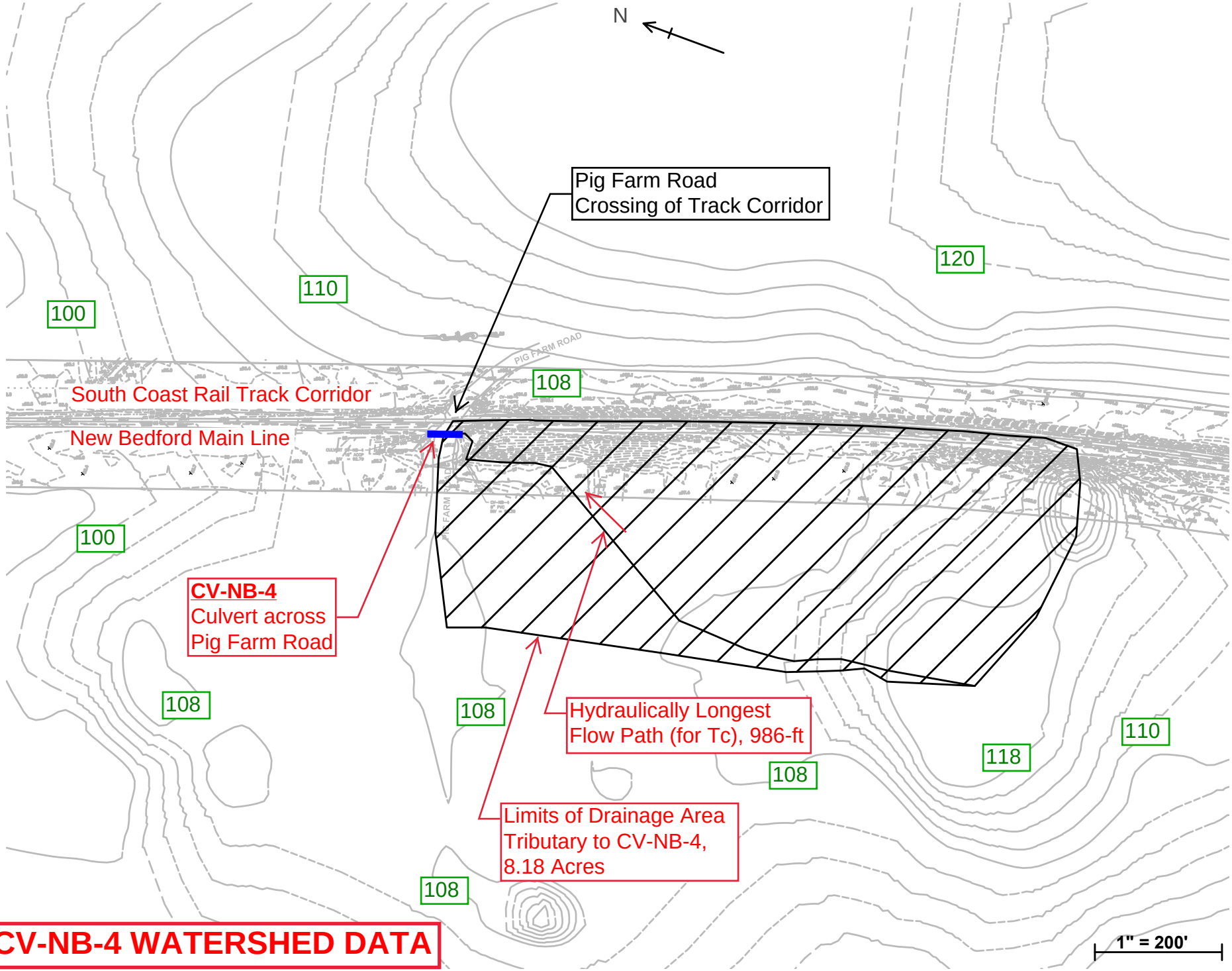
The culvert numbering convention used in CV-NB-X, where CV indicates a culvert structure, NB indicates New Bedford and X represents the unique sequential number assigned to the culvert.

Following are sketches, calculations and supporting materials for the existing and proposed culvert analyses.

Culverts scenario calculations using HydroCAD are presented in the following order:

- HydroCAD calculations for existing culvert (Q10, Q100 and Q50)
- HydroCAD calculations for proposed culvert (Q10, Q100 and Q50)
- NRCS Soil Survey data for the watershed tributary to the culvert

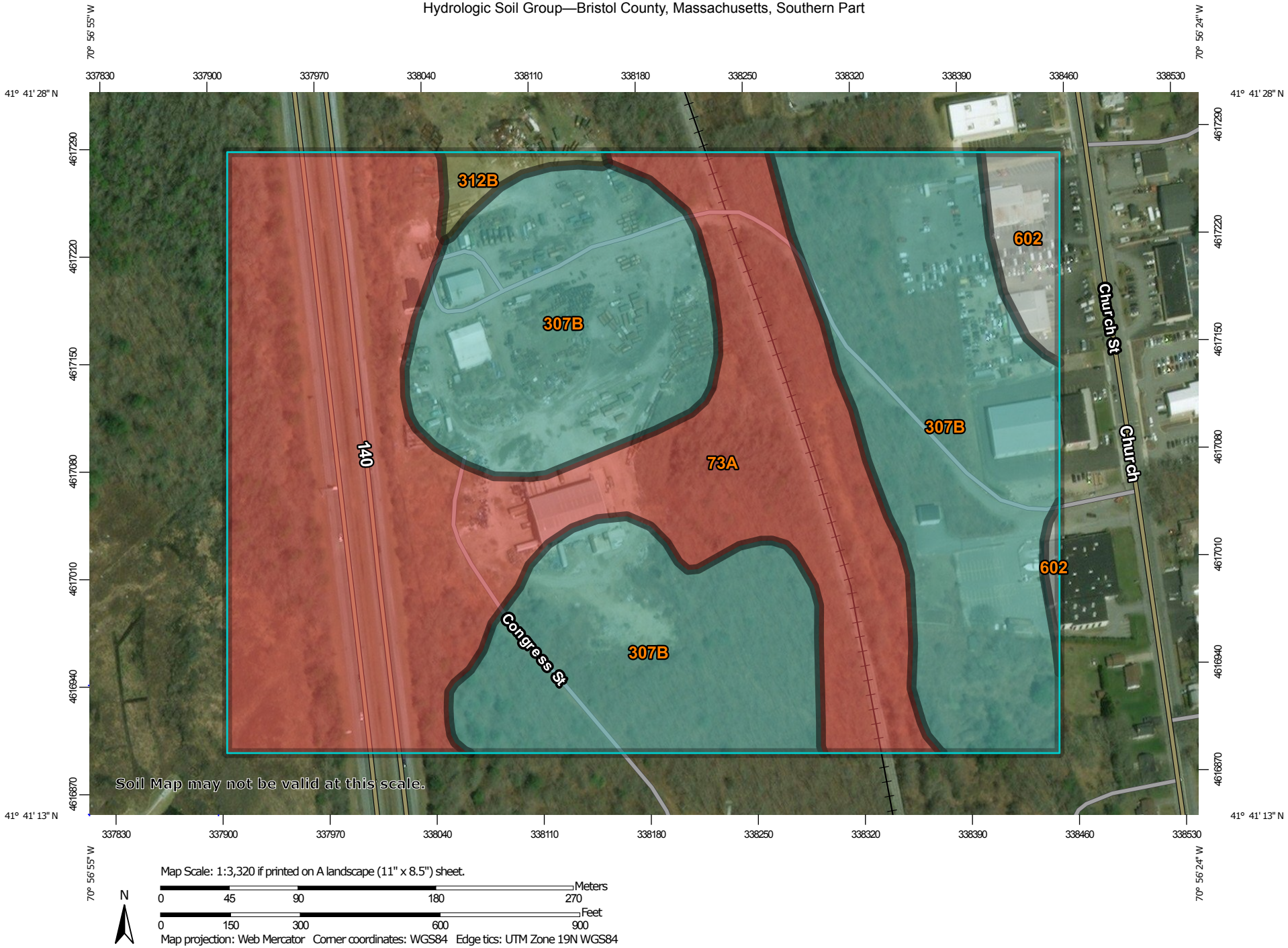

NAD 83
PIG FARM RD
CV–NB–4
15" HDPE
INV = 93.11
New Bedford Main Line Tracks
CULVERT CV–NB–4
18" ACCP
INV=92.79
15" CIP
INV = 94.63
1" = 25'
CV-NB-4 VICINITY
EXISTING CONDITIONS



CV-NB-4 WATERSHED DATA

CV-NB-4 - WATERSHED LAND USE / COVER

not to scale


70° 56' 55" W
70° 56' 24" W
337830
337900
337970
338040
338110
338180
338250
338320
338390
338460
338530
41° 41' 28" N
41° 41' 13" N
4617290
4617220
4617150
4617080
4617010
4616940
4616870
312B
307B
602
307B
73A
140
602
307B
Church St
Church
Congress St
Soil Map may not be valid at this scale.
Map Scale: 1:3,320 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 45 90 180 270
Feet
0 150 300 600 900
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 11, Oct 6, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Jun 7, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	24.2	45.7%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	26.6	50.4%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	0.6	1.1%
602	Urban land		1.5	2.8%
Totals for Area of Interest			**52.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

8.18 AC PIG FARM RD

Exist 15" HDPE/18" CMP

Subcat Reach Pond Link

Routing Diagram for CV-NB-4
Prepared by HNTB, Printed 7/31/2018

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.820	96	Gravel surface, HSG D (1S)
7.360	77	Woods, Good, HSG D (1S)
8.180	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
8.180	HSG D	1S
0.000	Other	
8.180		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.820	0.000	0.820	Gravel surface	1S
0.000	0.000	0.000	7.360	0.000	7.360	Woods, Good	1S
0.000	**0.000**	**0.000**	**8.180**	**0.000**	**8.180**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1E	93.10	92.80	52.0	0.0058	0.013	15.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 8.18 AC PIG FARM RD Runoff Area=8.180 ac 0.00% Impervious Runoff Depth>3.92"
Flow Length=986' Tc=153.8 min CN=79 Runoff=8.90 cfs 2.670 af

Pond 1E: Exist 15" HDPE/18" CMP Peak Elev=96.02' Inflow=8.90 cfs 2.670 af
Outflow=8.90 cfs 2.670 af

Total Runoff Area = 8.180 ac Runoff Volume = 2.670 af Average Runoff Depth = 3.92"
100.00% Pervious = 8.180 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 8.18 AC PIG FARM RD

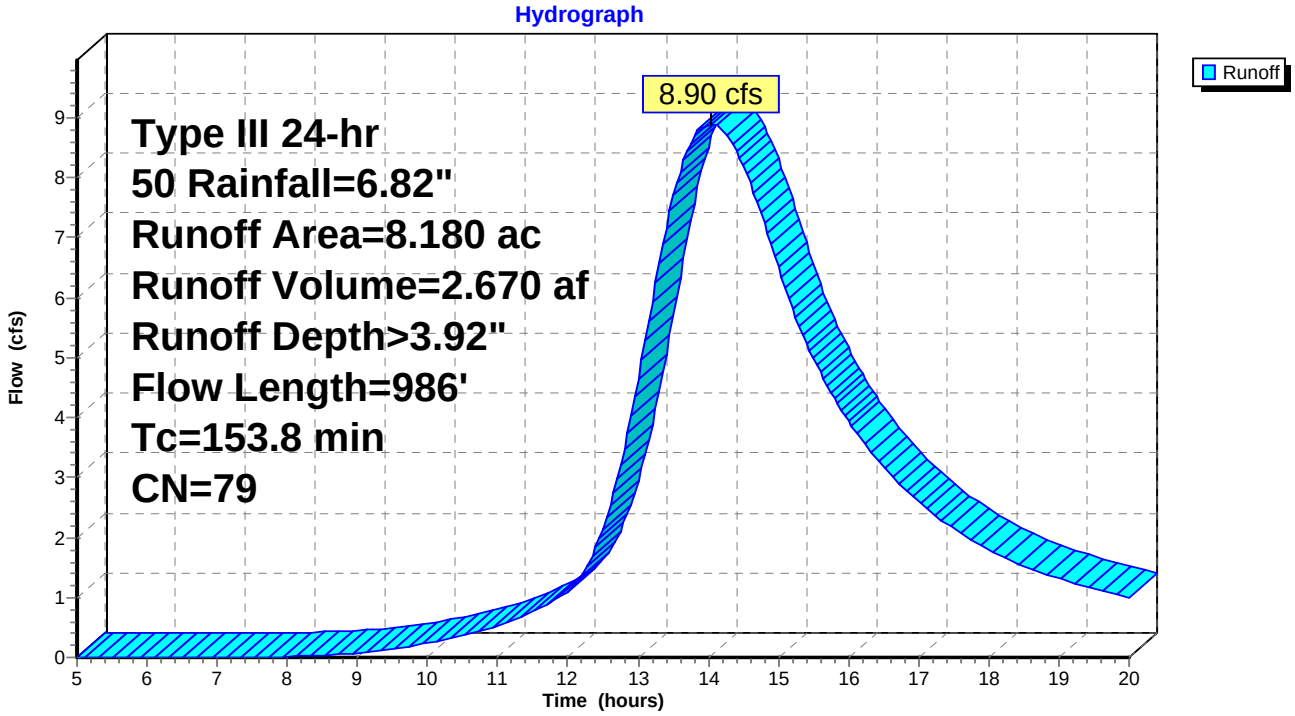
Runoff = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Rainfall=6.82"

Area (ac)	CN	Description
7.360	77	Woods, Good, HSG D
0.820	96	Gravel surface, HSG D
8.180	79	Weighted Average
8.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.2	100	0.0050	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
13.2	250	0.0160	0.32		**Shallow Concentrated Flow,** Kv= 2.5 fps
77.4	636	0.0030	0.14		**Shallow Concentrated Flow,** Kv= 2.5 fps
153.8	986	Total			

Subcatchment 1S: 8.18 AC PIG FARM RD



Summary for Pond 1E: Exist 15" HDPE/18" CMP

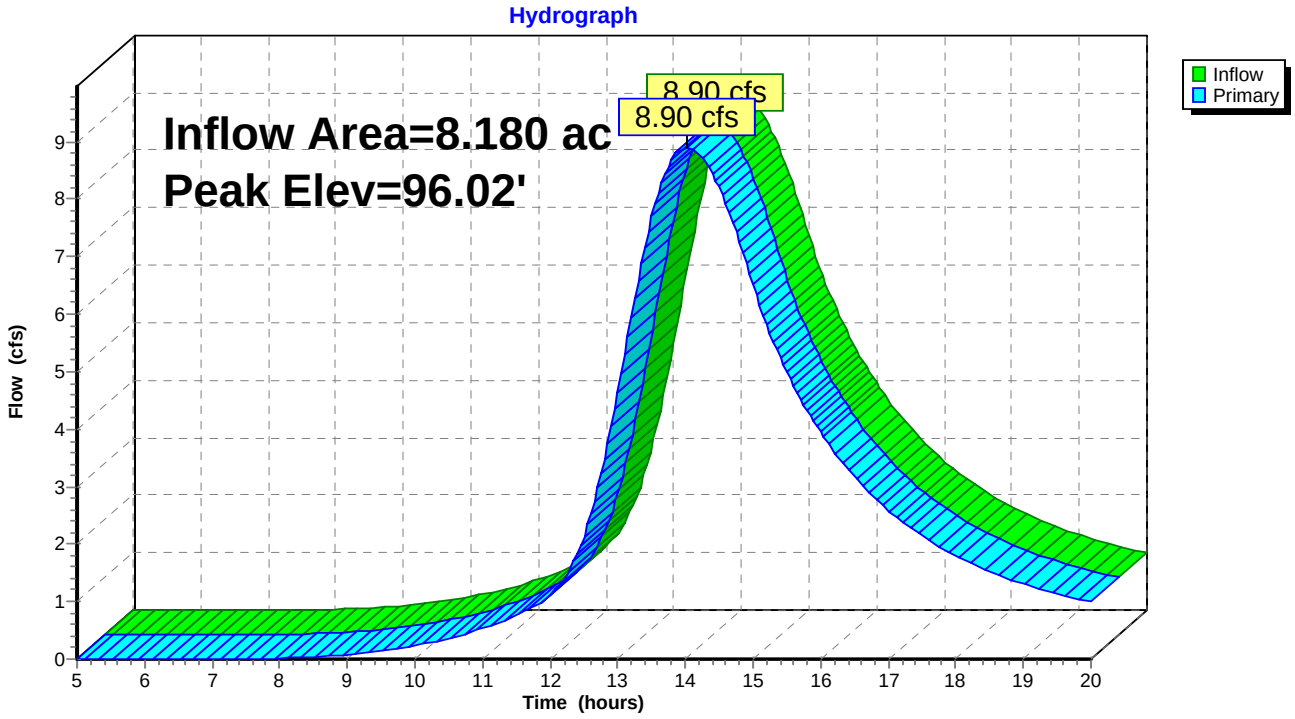
Inflow Area = 8.180 ac, 0.00% Impervious, Inflow Depth > 3.92" for 50 event
Inflow = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af
Outflow = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af, Atten= 0%, Lag= 0.0 min
Primary = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 96.02' @ 14.03 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**15.0" Round Culvert** L= 52.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 93.10' / 92.80' S= 0.0058 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Primary	97.00'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=8.90 cfs @ 14.03 hrs HW=96.02' (Free Discharge)
└**1=Culvert** (Barrel Controls 8.90 cfs @ 7.25 fps)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1E: Exist 15" HDPE/18" CMP



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 8.18 AC PIG FARM RD Runoff Area=8.180 ac 0.00% Impervious Runoff Depth>4.57"
Flow Length=986' Tc=153.8 min CN=79 Runoff=10.33 cfs 3.113 af

Pond 1E: Exist 15" HDPE/18" CMP Peak Elev=96.71' Inflow=10.33 cfs 3.113 af
Outflow=10.33 cfs 3.113 af

Total Runoff Area = 8.180 ac Runoff Volume = 3.113 af Average Runoff Depth = 4.57"
100.00% Pervious = 8.180 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 8.18 AC PIG FARM RD

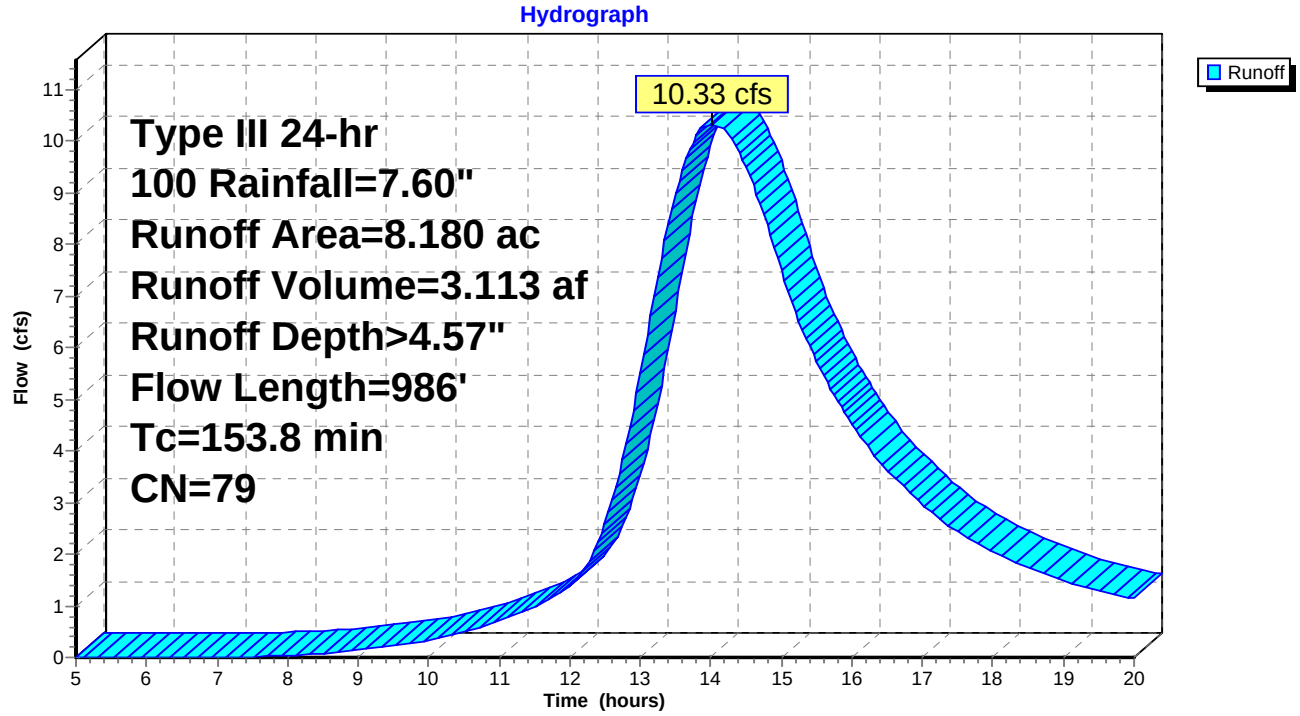
Runoff = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af, Depth> 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=7.60"

Area (ac)	CN	Description
7.360	77	Woods, Good, HSG D
0.820	96	Gravel surface, HSG D
8.180	79	Weighted Average
8.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.2	100	0.0050	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
13.2	250	0.0160	0.32		**Shallow Concentrated Flow,** Kv= 2.5 fps
77.4	636	0.0030	0.14		**Shallow Concentrated Flow,** Kv= 2.5 fps
153.8	986	Total			

Subcatchment 1S: 8.18 AC PIG FARM RD



Summary for Pond 1E: Exist 15" HDPE/18" CMP

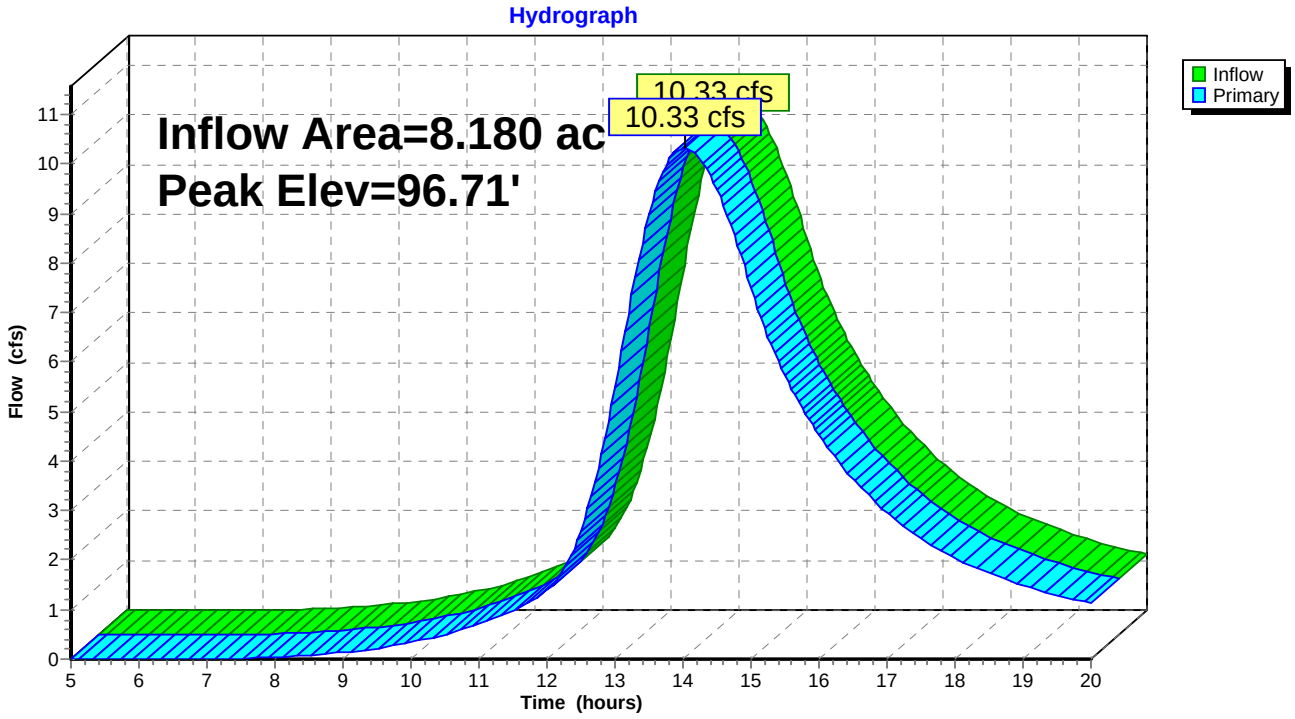
Inflow Area = 8.180 ac, 0.00% Impervious, Inflow Depth > 4.57" for 100 event
Inflow = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af
Outflow = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af, Atten= 0%, Lag= 0.0 min
Primary = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af

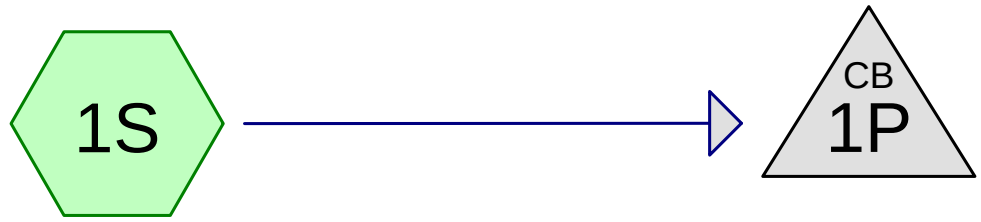
Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 96.71' @ 14.02 hrs
Flood Elev= 97.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	93.10'	**15.0" Round Culvert** L= 52.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 93.10' / 92.80' S= 0.0058 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Primary	97.00'	**60.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=10.33 cfs @ 14.02 hrs HW=96.70' (Free Discharge)
└**1=Culvert** (Barrel Controls 10.33 cfs @ 8.42 fps)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1E: Exist 15" HDPE/18" CMP





8.18 AC PIG FARM RD

Prop 24" RCP

Subcat Reach Pond Link

Routing Diagram for CV-NB-4
Prepared by HNTB, Printed 7/31/2018

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.820	96	Gravel surface, HSG D (1S)
7.360	77	Woods, Good, HSG D (1S)
8.180	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
8.180	HSG D	1S
0.000	Other	
8.180		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.820	0.000	0.820	Gravel surface	1S
0.000	0.000	0.000	7.360	0.000	7.360	Woods, Good	1S
0.000	**0.000**	**0.000**	**8.180**	**0.000**	**8.180**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	94.75	94.50	62.0	0.0040	0.013	24.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 8.18 AC PIG FARM RD Runoff Area=8.180 ac 0.00% Impervious Runoff Depth>3.92"
Flow Length=986' Tc=153.8 min CN=79 Runoff=8.90 cfs 2.670 af

Pond 1P: Prop 24" RCP Peak Elev=96.31' Inflow=8.90 cfs 2.670 af
Outflow=8.90 cfs 2.670 af

Total Runoff Area = 8.180 ac Runoff Volume = 2.670 af Average Runoff Depth = 3.92"
100.00% Pervious = 8.180 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 8.18 AC PIG FARM RD

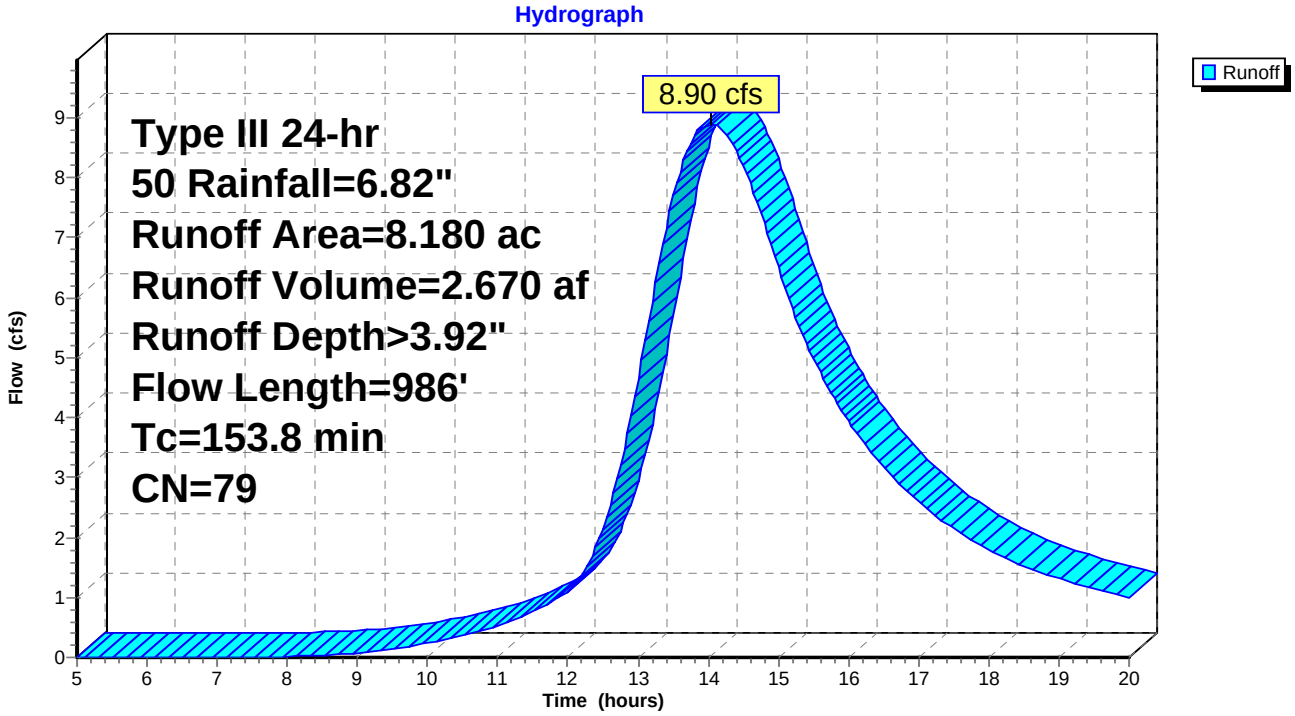
Runoff = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50 Rainfall=6.82"

Area (ac)	CN	Description
7.360	77	Woods, Good, HSG D
0.820	96	Gravel surface, HSG D
8.180	79	Weighted Average
8.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.2	100	0.0050	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
13.2	250	0.0160	0.32		**Shallow Concentrated Flow,** Kv= 2.5 fps
77.4	636	0.0030	0.14		**Shallow Concentrated Flow,** Kv= 2.5 fps
153.8	986	Total			

Subcatchment 1S: 8.18 AC PIG FARM RD



Summary for Pond 1P: Prop 24" RCP

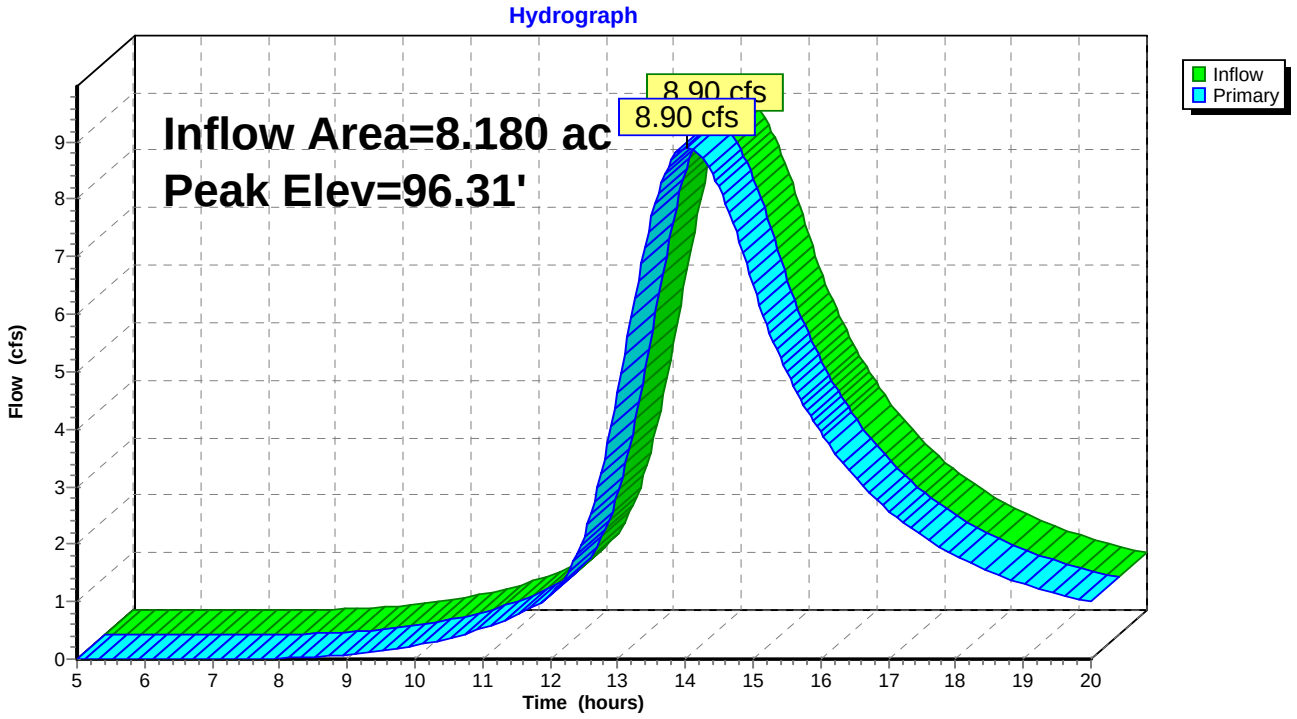
Inflow Area = 8.180 ac, 0.00% Impervious, Inflow Depth > 3.92" for 50 event
Inflow = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af
Outflow = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af, Atten= 0%, Lag= 0.0 min
Primary = 8.90 cfs @ 14.03 hrs, Volume= 2.670 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 96.31' @ 14.03 hrs
Flood Elev= 98.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	94.75'	**24.0" Round Culvert** L= 62.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 94.75' / 94.50' S= 0.0040 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Primary	98.00'	**80.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=8.90 cfs @ 14.03 hrs HW=96.31' (Free Discharge)
└**1=Culvert** (Barrel Controls 8.90 cfs @ 4.67 fps)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Prop 24" RCP



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: 8.18 AC PIG FARM RD Runoff Area=8.180 ac 0.00% Impervious Runoff Depth>4.57"
Flow Length=986' Tc=153.8 min CN=79 Runoff=10.33 cfs 3.113 af

Pond 1P: Prop 24" RCP Peak Elev=96.46' Inflow=10.33 cfs 3.113 af
Outflow=10.33 cfs 3.113 af

Total Runoff Area = 8.180 ac Runoff Volume = 3.113 af Average Runoff Depth = 4.57"
100.00% Pervious = 8.180 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: 8.18 AC PIG FARM RD

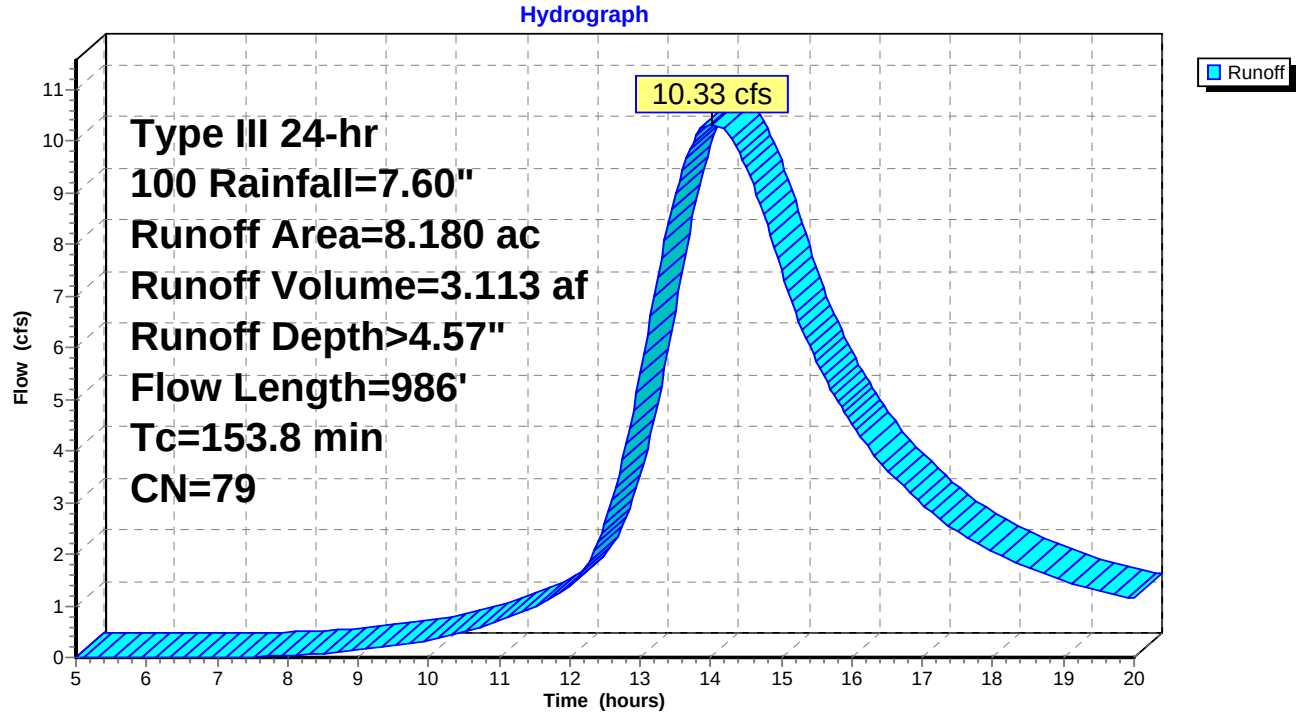
Runoff = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af, Depth> 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Rainfall=7.60"

Area (ac)	CN	Description
7.360	77	Woods, Good, HSG D
0.820	96	Gravel surface, HSG D
8.180	79	Weighted Average
8.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.2	100	0.0050	0.03		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.40"
13.2	250	0.0160	0.32		**Shallow Concentrated Flow,** Kv= 2.5 fps
77.4	636	0.0030	0.14		**Shallow Concentrated Flow,** Kv= 2.5 fps
153.8	986	Total			

Subcatchment 1S: 8.18 AC PIG FARM RD



Summary for Pond 1P: Prop 24" RCP

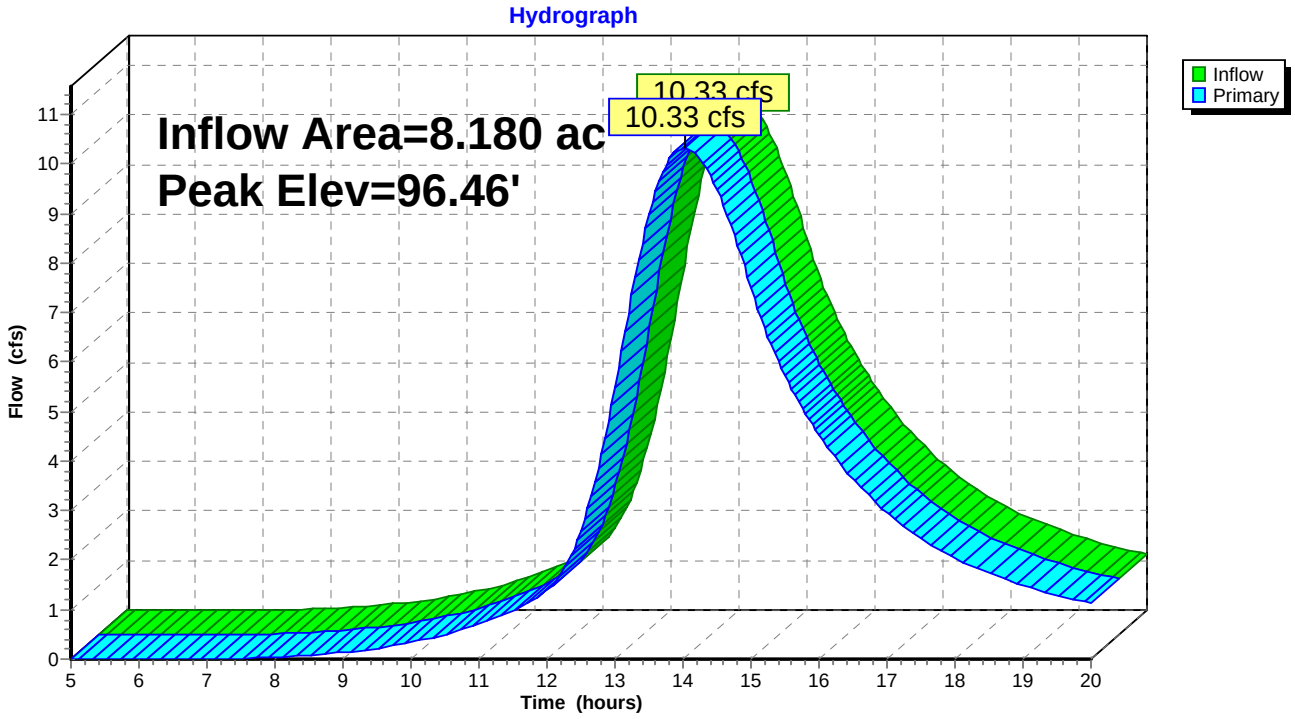
Inflow Area = 8.180 ac, 0.00% Impervious, Inflow Depth > 4.57" for 100 event
Inflow = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af
Outflow = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af, Atten= 0%, Lag= 0.0 min
Primary = 10.33 cfs @ 14.02 hrs, Volume= 3.113 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 96.46' @ 14.02 hrs
Flood Elev= 98.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	94.75'	**24.0" Round Culvert** L= 62.0' Box, headwall w/3 rounded edges, Ke= 0.200 Inlet / Outlet Invert= 94.75' / 94.50' S= 0.0040 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Primary	98.00'	**80.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=10.33 cfs @ 14.02 hrs HW=96.46' (Free Discharge)
└─**1=Culvert** (Barrel Controls 10.33 cfs @ 4.86 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Prop 24" RCP



Attachment D
Conservation Management Plan

Prepared for:

Massachusetts Department of Transportation (MassDOT)

10 Park Plaza

Boston, Massachusetts 02116

Prepared by:

The VHB/HNTB Team – a Joint Venture

99 High Street, 10th Floor

Boston, Massachusetts

MassDOT Contract No. 99771

July 31, 2018

MASSWILDLIFE

DIVISION OF
FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6300 | f: (508) 389-7890
MASS.GOV/MASSWILDLIFE

MA ENDANGERED SPECIES ACT (G.L. c.131A)
CONSERVATION AND MANAGEMENT PERMIT

DATE		June 21, 2018
CONSERVATION PERMIT NO.:		018-324.DFW
NHESP FILE NO.		98-3735
PERMIT HOLDER		Massachusetts Department of Transportation c/o of Jean Fox 10 Park Plaza Boston, MA 02116
PROJECT		South Coast Rail Project, Phase 1 (Interim Commuter Rail Service from Boston to New Bedford, Fall River and Taunton)

Pursuant to the authority granted in the Massachusetts Endangered Species Act ("MESA") (G.L. c. 131A) and its implementing regulations (321 CMR 10.23), the Director of the Massachusetts Division of Fisheries & Wildlife (the "Division") hereby issues a Conservation and Management Permit (the "Permit") to the Massachusetts Department of Transportation (the "Permit Holder"). This Permit authorizes the Take of the State-listed Eastern Box Turtle (*Terrapene carolina*), which is listed as "Special Concern," pursuant to the MESA, arising out of the construction of Phase 1 of the South Coast Rail Project (the "Project"), portions of which are located in the Towns of Middleborough, Raynham, Taunton, Berkley, Lakeville, Freetown, and New Bedford, Massachusetts (the "Property"; see recording information below).

Segment	County	Book	Page
Middleborough Secondary	Plymouth	14597	286
Middleborough Secondary	Bristol	3364	52
New Bedford Main Line	Plymouth	38616	81
New Bedford Main Line	Bristol	9739	48
Fall River Secondary	Plymouth	38616	81
Fall River Secondary	Bristol	10117	207

Provided that the Permit Holder adheres to the conditions outlined in the Division's determination letter (dated March 22, 2018, included herein as Attachment 1), the Project will not result in a prohibited Take of the Wood Turtle (*Glyptemys insculpta*) or Plymouth Gentian (*Sabatia kennedyana*), state-listed as "Special Concern," or the Three-angled Spike-sedge (*Eleocharis tricostata*), state-listed as "Endangered." These conditions include but

are not limited to implementation of Division-approved protection plans to protect state-listed species during and after construction.

The Division has determined that the Project will result in a Take of the Eastern Box Turtle due to the loss of ±6.27 acres of suitable habitat and interference with the feeding, breeding, overwintering and migratory behaviors of this species. The Permit Holder has made the Division aware that it may propose additional work in the future that is part of a common plan or scheme associated with the Project. Said additional work includes Phase 2 of the South Coast Rail Project, which includes provision of commuter rail service from Boston to Taunton via the Stoughton Electric Alternative. In accordance with 321 CMR 10.16, "projects shall not be segmented or phased to evade or defer the review requirements" of MESA. Therefore, the Division will consider the impacts of this Project with the impacts of any future proposed projects that are part of the same common plan or scheme.

Under the authority granted by and in accordance with MGL c131A§3 and 321 CMR 10.23, the Director may permit the Take of a State-listed species for conservation and management purposes provided that there is a long-term Net Benefit to the conservation of the impacted species. If the Director determines that the applicant for a permit has avoided, minimized and mitigated impacts to the State-listed species consistent with the following Performance Standards, then the Director may issue a conservation and management permit, provided:

(a) the applicant has adequately assessed alternatives to both temporary and permanent impacts to State-listed species;
(b) an insignificant portion of the local population would be impacted by the Project or Activity, and;
(c) the applicant agrees to carry out a conservation and management plan that provides a long-term Net Benefit to the conservation of the State-listed species that has been approved by the Director, as provided in 321 CMR 10.23(5), and shall be carried out by the applicant.

The Director has determined that the applicant for this Permit has met the above noted Performance Standards and that the conservation and management plan described herein provides a long-term Net Benefit to the conservation of the Eastern Box Turtle.

Pursuant to this Permit, the Permit Holder is proposing to: (a) provide restricted funding in the amount of $77,961.00 for land protection, conservation research, habitat management, and or conservation planning to benefit the Eastern Box Turtle in Massachusetts; (b) install and maintain appropriate wildlife crossings to improve habitat connectivity for State-listed species and other wildlife; and (c) implement Division-approved plans to protect State-listed species during and after construction.

Therefore, the Project can be permitted pursuant to the MESA. This Permit is issued to condition the Project and to provide a long-term Net Benefit to Eastern Box Turtle.

In accordance with the documents submitted to the Division entitled:

- "Conservation and Management Permit Application" (dated May 24, 2018; prepared VHB, Inc.; the "Application");
- MESA Determination Letter (dated March 22, 2018; issued by the Division; Attachment 1);
- Aerial Maps (thirty-five [35] sheets; April 9, 2016; prepared by VHB, Inc.; the "Project Plans"; Attachment 2);
- Wildlife Crossings (prepared by VHB, Inc.; the "Crossing Plan"; Attachment 3);
- Construction Period Protection Plans (prepared by VHB, Inc.; the "Protection Plans"; Attachment 4);
- Invasive Species Management and Control Plan (prepared by VHB, Inc.; Attachment 5);

and any other plans and documents referenced herein, this Permit is issued with the following conditions:

General Conditions:

1.		The Project authorized by this Permit shall be completed within five (5) years from the date of issuance. If needed, the Permit Holder shall submit a written request to the Division for an extension of time to complete said Project and the Division will review the Project pursuant to MESA for any continuing impacts as described herein and for any new impacts to any State-listed species found subsequent to the issuance date of this Permit.
2.		This Permit shall not preclude the review of future projects on the Property that are subject to the Wetlands Protection Act regulations (310 CMR 10.37, 10.58(4)(b), 10.59), as applicable, by the Natural Heritage & Endangered Species Program ("NHESP") of the Division.
3.		The work authorized by this Permit involves the construction of Phase 1 of the South Coast Rail Project, as shown on the Project Plans (the "Work"; Attachment 2). Phase 1 includes provision of interim commuter rail service from Boston to New Bedford, Fall River and Taunton using the existing, active freight rail corridors known as the Middleborough Secondary, Fall River Secondary and New Bedford Main Line. Work associated with Phase 1 specifically involves (a) track reconstruction and infrastructure improvements on the Southern Triangle; (b) track reconstruction from Pilgrim Junction to Cotley Junction along the Middleborough Secondary; (c) construct maintenance-of-way siding along the Middleborough Secondary in Taunton; and (d) upgrade five railroad at-grade roadway crossings along the Middleborough Secondary. The Work also includes any other on-site activity within Priority Habitat required by the Division as a condition of this Permit.
4.		Division representatives shall have the right to enter and inspect the Property subject to this Permit at reasonable hours to evaluate Permit compliance and require the submittal of any reasonable information not otherwise required by this Permit but deemed necessary by the Division to complete its evaluation. At the Division's request, and in accordance with MassDOT's railway worker safety requirements, the Permit Holder shall provide access to Division representatives to evaluate Permit compliance.
5.		Any proposed change to any plan identified in this Permit, or to the State-listed species conservation plan required by way of this Permit, shall require the Permit Holder to inquire of the Division, in writing, whether the change is significant enough to require the filing of a new Conservation and Management Permit Application, and or require additional long-term Net Benefit for affected State-listed species. The Division retains the right to require the submittal of additional, reasonable information to evaluate the plan change.
6.		This Permit shall apply to, and inure to the benefit of, the Permit Holder and any successor-in-interest of the Permit Holder, or to a subsequent successor-in-control of the Property or portion thereof subject to this Permit should the Permit Holder convey its record ownership of the Property to said successor-in-control, as well as to any contractor or other person performing Work conditioned by this Permit. Within three (3) days of the transfer of an interest in the Property or a portion thereof, any successor-in-interest or subsequent successor-in-control [i.e., subsequent owners or operators] of the Property or a portion thereof shall provide the Division with a letter indicating (1) that the successor is the successor-in-interest of the Permit Holder or the successor-in-control [i.e., current owner or operator] of the Property or a portion thereof, and (2) that said successor will perform the obligations of the Permit Holder as set forth in this Permit.
7.		**Prior to the start of Work**, the Permit Holder shall notify the Division in writing of the name, address, email, business and home telephone numbers of the project supervisor(s) and/or contractor(s) responsible for compliance with this Permit. The Permit Holder shall provide updated information in writing to the Division should new or additional project supervisors and/or contractors be hired after

		Work has commenced. **Within three (3) days of the start of Work**, the Permit Holder shall send a letter to the Division stating the date upon which Work commenced.
8.		**Prior to the start of Work**, the text of this Permit shall be recorded by the Permit Holder in the Registry of Deeds or the Land Court for the district in which the Property is located so as to become a record part of the chain of title of the Property. In the case of recorded land, the Permit shall be noted in the Registry's Grantor Index under the name of the owner of the Property upon which the proposed Work is to be done. In the case of registered land, the Permit shall be noted on the Land Court Certificate of Title of the owner of the Property upon which the proposed Work is done. The Permit Holder shall submit to the Division a date-stamped and signed copy of said recorded Permit showing the date and book and page of recording of said Permit **within five (5) days after recording and/or filing**, as applicable. No Work shall begin on the Property until the Permit is recorded and said recorded copy is submitted to the Division, except as otherwise approved by the Division in writing.
9.		**At the completion of Work** the Permit Holder shall submit to the Division a written request for a Certificate of Permit Compliance, including as-built plans and other supporting materials demonstrating the completion of Work and compliance with all conditions herein.
10.		Any land protected to achieve a long-term Net Benefit associated with this Permit, shall remain undeveloped and protected as habitat for State-listed species in perpetuity.
11.		The Permit Holder shall comply with all Conditions and Special Conditions contained within this Permit and complete the Project consistent with all Division-approved plans and supporting documents except as otherwise approved by the Division in writing.
12.		The Permit Holder shall submit in writing any documents, plans, reports, or other items required for submission in accordance with this Permit, for review and written approval by the Division, unless otherwise stipulated in this Permit or by the Division in writing.
13.		A violation of any condition of this Permit will result in an unauthorized Take pursuant to M.G.L. c. 131A and may be subject to civil and or criminal penalties pursuant to M.G.L. c. 131A.

Special Conditions:

14.		Authorized Construction and Uses: This Permit authorizes construction and uses on the Property as described above. All Work shall be confined to the area of the Property within the limits of Work as shown on the Project Plans (Attachment 2).
15.		Final Project Plans: **Prior to the start of Work**, the Permit Holder shall submit final project plans to the Division for review and approval. The Division's approval shall be limited to verifying that final project plans are consistent with the Project Plans (Attachment 2).
16.		State-listed Species Conservation/Research: In order to provide a Net Benefit to the conservation of the State-listed species impacted by this Project, the Permit Holder has proposed, by way of the Permit Application, to provide funding for land protection, conservation research, habitat management, and or conservation planning to benefit the Eastern Box Turtle. The Permit Holder has chosen to fulfill this obligation by providing restricted funding to the Eastern Box Turtle Mitigation Bank operated by The Nature Conservancy (TNC) (pursuant to the Off-site Mitigation Memorandum of Agreement between the Division and TNC, dated July 16, 2008 and amended October 29, 2009), or to another party designated in

		writing by the Division. Therefore, **prior to the start of Work** the Permit Holder shall (a) deliver $77,961.00 to the Eastern Box Turtle Mitigation Bank; and (b) send a letter to the Division confirming the date funds were delivered and written confirmation of receipt of funds from TNC. Said funds shall be restricted and used exclusively to provide Net Benefit mitigation for the Eastern Box Turtle in Massachusetts.
17.		Construct and Maintain Wildlife Crossings: In order to provide a Net Benefit to the conservation of the State-listed species impacted by this Project, the Permit Holder has proposed, by way of the Permit Application, to install wildlife crossing and signs as shown on the Project Plans (Attachment 2). Said wildlife crossings are designed specifically to enable safe passage of State-listed turtles, as further detailed in the Crossing Plan (Attachment 3). Unless otherwise approved in writing by the Division, wildlife crossing and signs shall be installed **concurrent with the Work associated with that segment of the Project**. Upon completing installation of wildlife crossing and signs, the Permit Holder shall provide written certification to the Division that said structures and signs were installed in accordance with the plans referenced herein. For as long as the Permit Holder maintains active rail service associated with the Project, said structures shall be inspected annually by a qualified, Division-approved wildlife biologist between April 1 and April 30 of each year to ensure that they are maintained in good condition. The wildlife biologist shall work with the Permit Holder to ensure that any necessary cleaning of and repairs to the crossing structures are made by April 30 of each year, unless otherwise approved by the Division. The long-term inspection and maintenance of crossing structures and signs, as detailed in the Crossing Plan (Attachment 3), shall be incorporated into all relevant operations and maintenance plans associated with the Project.
18.		Construction Period Protection Plans: In order to protect State-listed species during construction, the Permit Holder shall implement the Construction Period Protection Plans provided in Attachment 4. Protection Plans related to State-listed plants shall be implemented by a qualified botanist approved in writing by the Division. Protection Plans related to State-listed turtles shall be implemented by a qualified wildlife biologist approved in writing by the Division; the wildlife biologist must be in possession of a valid Scientific Collection Permit and must have extensive field experience with the Eastern Box Turtle and Wood Turtle. The Division-approved botanist and wildlife biologist shall have the authority to halt construction as necessary until all protective measures have been implemented in accordance with, or corrected in order to remain in compliance with, the Protection Plans (Attachment 4). If changes to the Protection Plans are proposed, revised Protection Plans must be submitted to the Division for review and written approval prior to implementation of said changes.
19.		Construction Staff Education: All construction, landscaping, and other sub-contractors associated with the Project shall be informed in writing of the likely presence of State-listed species on the Property and what measures should be implemented to minimize direct harm to State-listed species. Further, no wildlife shall be removed from the Property without approval of a qualified wildlife biologist or the Division except as necessary to receive veterinary treatment in the case of harm during construction.
20.		Additional Protective Measures: **Prior to the start of Work**, or as otherwise approved by the Division, the limits of Work within Priority Habitat, as shown on the Project Plans (Attachment 2), shall be clearly delineated in the field (e.g., snow fencing, colored flagging, erosion controls, or similar). A qualified, Division-approved environmental monitor shall regularly inspect the Work area during construction and ensure that all construction activities are confined to the approved limits of Work. A qualified, Division-approved environmental monitor shall be responsible for verifying locations and installation of appropriate erosion and sedimentation control measures. The monitor shall regularly inspect erosion and sedimentation control measures during construction and facilitate immediate repair

		or replacement as necessary. Additionally, all exposed areas shall be adequately stabilized and protected from erosion at the close of each work day. The monitor shall have the authority to halt construction if failure of erosion and sedimentation control measures appears imminent. After construction is complete and all areas of temporary disturbance are sufficiently stabilized, all erosion and sedimentation controls (as well as symbolic flagging referenced above) shall be removed from the Project site and properly disposed of.
21.		Future Vegetation Management: All future, ongoing vegetation management associated with the Project shall be done in accordance with a Vegetation Management Plan to be prepared by the Permit Holder. Unless otherwise approved in writing by the Division, the Permit Holder shall ensure that the Vegetation Management Plan associated with the Project (as well as any associated Yearly Operating Plans) incorporates the following: a. In order to ensure long-term protection of State-listed species, mechanized vegetation maintenance (e.g., mowing) within Priority Habitat (according to the *Massachusetts Natural Heritage Atlas*) shall occur between November 1 and March 31 of each year. b. In order to ensure long-term protection of State-listed plants, and for as long as the Permit Holder maintains active rail service associated with the Project, the Permit Holder shall monitor and control invasive plant species in the vicinity of Thatcher's Pond (Lakeville/Taunton municipal boundary) pursuant to the Invasive Species Management and Control Plan (Attachment 5). Said Plan shall be implemented by a qualified botanist approved in writing by the Division. If changes to said Plan are proposed, a revised Plan must be submitted to the Division for review and written approval prior to implementation of said changes.
22.		Annual Reporting and Adaptive Management: By December 31st of each year during and after construction, the Permit Holder shall prepare and deliver a monitoring report to the Division. Said report shall: (a) summarize all Work or maintenance that occurred during the associated calendar year; (b) detail compliance with Special Conditions #17, 18, 19, 20 and 21, as appropriate; and (c) detail any recommended modifications of protective measures required by way of Special Conditions #17, 18, 19, 20 and 21 to enhance protection of State-listed species and their habitats. The Permit Holder shall work with the Division to adaptively refine protective measures for State-listed species required by way of Special Conditions #17, 18, 19, 20 and 21, and shall take all reasonable measures necessary to implement any modifications approved in writing by the Division.
23.		Restoration of Temporarily Disturbed Areas: Unless otherwise approved in writing by the Division, all areas of temporary alteration (including wetland establishment areas) shall be restored using seed and/or plantings listed as native to Bristol or Plymouth County, Massachusetts, as provided in *The Vascular Plants of Massachusetts: A County Checklist, First Revision* (Dow Cullina, Connolly, Sorrie & Somers, 2011).
24.		Reporting Rare Species Observations: The Division shall be notified, in the form of an NHESP Rare Animal or Plant Observation Form, within ten (10) days of the observation of any State-listed species within or outside the limits of Work. Preferably notification will be through the Division's data submittal tool, the Vernal Pool & Rare Species (VPRS) Information System. VPRS and our paper observations forms can be found at: http://www.mass.gov/dfw/nhesp/vprs.
25.		Notice of Appeal Rights: This Determination is a final decision of the Division of Fisheries and Wildlife pursuant to 321 CMR 10.23. Any person aggrieved by this decision shall have the right to an adjudicatory hearing at the Division pursuant to M.G.L. c. 30A, s.11 in accordance with the procedures for informal hearings set forth in 801 CMR 1.02 and 1.03.

Any notice of claim for an adjudicatory hearing shall be made in writing and be accompanied by a filing fee in the amount of $500.00. The notice of claim shall be sent to the Division by certified mail, hand delivered or postmarked within twenty-one (21) days of the date of the Division's Determination to:

Director
Division of Fisheries and Wildlife
Field Headquarters
One Rabbit Hill Road
Westborough, MA 01581

Any notice of claim for an adjudicatory hearing shall include the following information:

1. The file number for the project;
2. The complete name, address and telephone number of the person filing the request, and the name, address and telephone number of any authorized representative;
3. The specific facts that demonstrate that a party filing a notice of claim satisfies the requirements of an "aggrieved person," including but not limited to (a) how they have a definite interest in the matters in contention within the scope of interests or area of concern of M.G.L. c. 131A or the regulations at 321 CMR 10.00 and (b) have suffered an actual injury which is special and different from that of the public and which has resulted from violation of a duty owed to them by the Division;
4. A clear statement that an adjudicatory hearing is being requested;
5. A clear and concise statement of facts which are grounds for the proceeding, the specific objections to the actions of the Division and the basis for those objections; and the relief sought through the adjudicatory hearing; and a statement that a copy of the request has been sent by certified mail or hand delivered to the applicant and the record owner, if different from the applicant.

Mark S Tisa, Acting Director
Massachusetts Division of Fisheries & Wildlife

On this 21st day of June, 2018, before me, the undersigned notary public, personally appeared Mark S Tisa, Acting Director, proved to me through satisfactory evidence of identification, which was personal knowledge, to be the person whose name is signed on the preceding or attached document, and who swore or affirmed to me that the contents of the document are truthful and accurate to the best of his/her knowledge and belief.

Emily Melissa Holt, Notary Public
My Commission expires: July 12, 2024

Conservation Permit 018-324.DFW
Issued this 21st day of June, 2018
Work must be completed by: June 21 2023

EMILY MELISSA HOLT
MY COMM. EXPIRES
JULY 12, 2024
NOTARY PUBLIC
COMMONWEALTH OF
MASSACHUSETTS

ACKNOWLEDGEMENT AND ACCEPTANCE OF ALL TERMS OF THIS CONSERVATION PERMIT

The undersigned below agrees that commencement of any work authorized by and described in this Conservation and Management Permit constitutes acknowledgement and acceptance of all terms of this Permit.

Signatory 1 Organization

COMMONWEALTH OF MASSACHUSETTS

On this _____day of _____, 20___, before me, the undersigned notary public, personally appeared _____, proved to me through satisfactory evidence of identification which was _____ to be the person whose name is signed on the preceding or attached document, and who swore or affirmed to me that the contents of the document are truthful and accurate to the best of his/her knowledge and belief.

Notary Public

_____

SEAL

My commission expires: _____

Distribution List

Holly Palmgren, MBTA
Kimberly Dobosz, MBTA
Lars Carlson, VHB, Inc.
Elizabeth Grob, VHB, Inc.
Lealdon Langley & Mike Stroman, MassDEP
Chris Ross, MassDEP Southeast Regional Office
Middleborough Conservation Commission
Raynham Conservation Commission
Taunton Conservation Commission
Berkley Conservation Commission
Lakeville Conservation Commission
Freetown Conservation Commission
New Bedford Conservation Commission
Jason Zimmer, DFW Southeast Wildlife District Office
Purvi Patel, MA Environmental Policy Act Office

Attachment 1

MESA Determination Letter (dated March 22, 2018; issued by the Division)

MASSWILDLIFE

DIVISION OF
FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6300 | f: (508) 389-7890
MASS.GOV/MASSWILDLIFE

Jack Buckley, *Director*

March 22, 2018

Jean Fox
MA Department of Transportation
10 Park Plaza
Boston, MA 02116

RE: Applicant: MA Department of Transportation
Project Location: Middleborough Secondary, Fall River Secondary and New Bedford Main Line (Berkley, Fall River, Freetown, Lakeville, New Bedford, Raynham, Taunton)
Project Description: South Coast Rail Project, Phase 1
NHESP File No.: 98-3735

Dear Applicant:

The Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife (the "Division") received the MESA Project Review Checklist, plans (dated November 13, 2017) and other required materials for review pursuant to the Massachusetts Endangered Species Act (MESA) (MGL c.131A) and its implementing regulations (321 CMR 10.00).

The MESA is administered by the Division, and prohibits the Take of state-listed species. The Take of state-listed species is defined as "in reference to animals...harm...kill...disrupt the nesting, breeding, feeding or migratory activity...and in reference to plants...collect, pick, kill, transplant, cut or process...Disruption of nesting, breeding, feeding, or migratory activity may result from, but is not limited to, the modification, degradation, or destruction of Habitat" of state-listed species (321 CMR 10.02).

The Project, as proposed, includes the phased construction of the South Coast Rail Project. Phase 1 will provide interim commuter rail service from Middleborough to Fall River and New Bedford along the Middleborough Secondary, Fall River Secondary and New Bedford Main Line. More specifically, Phase 1A (State-of-Good-Repair) includes replacement and rehabilitation of failing culverts and bridges along each rail line, whereas Phase 1B includes improvement of track infrastructure, a new station in East Taunton, and a new/relocated/reconstructed station in Middleborough. Phase 2, which is not being proposed at this time, would eventually provide service from Boston to Taunton via the Stoughton Electric Alternative.

Portions of Phase 1 are mapped as *Priority Habitat* for the state-listed species shown below, according to the *Massachusetts Natural Heritage Atlas* (14th Edition). These species and their habitats are protected pursuant to the MESA). Fact Sheets for these species can be found on our website, www.mass.gov/nhesp.

Scientific Name	Common Name	Taxonomic Group	State Status
Ambystoma opacum	Marbled Salamander	Amphibian	Threatened
Enallagma recurvatum	Pine Barrens Bluet	Damselfly	Threatened
Lithophane viridipallens	Pale Green Pinion Moth	Moth	Special Concern

Scientific Name	Common Name	Taxonomic Group	State Status
Papaipema sulphurata	Water-willow Borer Moth	Moth	Threatened
Eleocharis tricostata	Three-angled Spike-sedge	Plant	Endangered
Panicum rigidulum ssp. pubescens	Long-leaved Panic-grass	Plant	Threatened
Sabatia kennedyana	Plymouth Gentian	Plant	Special Concern
Scirpus longii	Long's Bulrush	Plant	Threatened
Glyptemys insculpta	Wood Turtle	Reptile	Special Concern
Terrapene carolina	Eastern Box Turtle	Reptile	Special Concern

Phase 1A: State-of-Good-Repair

Based on the information provided and the information contained in our database, the Division has determined that this portion of the Project, as currently proposed, **must be conditioned** in order to avoid a prohibited Take of state-listed species (321 CMR 10.18(2)(a)). To avoid a prohibited Take of state-listed species, the following conditions must be met:

1. Turtle Protection Plan: Prior to the start of work within *Priority Habitats 599* (Berkley) and *715* (Raynham and Taunton), the Applicant shall submit a Turtle Protection Plan to the Division for review and written approval. Said plan shall detail procedures for protecting state-listed turtles during replacement or repair of culverts and bridges, and be prepared and implemented by a qualified biologist pre-approved by the Division. Please note that any searches for state-listed turtles associated with said Turtle Protection Plan must occur during the turtle active season (April 15 – October 15) unless otherwise approved by the Division.

2. Compliance Report: Within thirty (30) days of the completion of work, a qualified, Division-approved biologist shall submit written confirmation to the Division that: (a) the Division-approved Turtle Protection Plan was implemented during construction as written; and (b) no work or disturbance occurred outside the limits of work shown on the project plans. Said report shall include representative photos demonstrating compliance with the conditions herein.

Provided the above-noted conditions are fully implemented and there are no changes to the project plans, this project will not result in a Take of state-listed species.

Phase 1B: Infrastructure Improvement

A. *Long-leaved Panic-grass, Long's Bulrush, Pine Barrens Bluet, Pale Green Pinion Moth, Water-willow Borer Moth and Marbled Salamander*
Based on the information provided and the information contained in our database, the Division has determined that this portion of the Project, as currently proposed, **will not result in a prohibited Take** of these state-listed species (321 CMR 10.18(2)(a)).

B. *Wood Turtle, Three-angled Spike Sedge and Plymouth Gentian*
Based on the information provided and the information contained in our database, the Division has determined that this portion of the Project, as currently proposed, **must be conditioned** in order to avoid a prohibited Take of the Wood Turtle, Three-angled Spike Sedge and Plymouth Gentian (321 CMR 10.18(2)(a)). To avoid a prohibited Take of these state-listed species, the following conditions must be met:

1. Turtle Protection Plan: Prior to the start of work within *Priority Habitat 599* (Berkley), the Applicant shall submit a Turtle Protection Plan(s) to the Division for review and written approval. Said plan shall detail procedures for protecting state-listed turtles during and after construction, and be prepared and implemented as approved by a qualified biologist pre-approved by the Division. Please note that any searches for state-listed turtles associated with said Turtle Protection Plan must occur during the turtle active season (April 15 – October 15) unless otherwise approved by the Division.

2. Plant Protection Plan: Prior to the start of work within *Priority Habitat 628* (Taunton), the Applicant shall submit a Plant Protection Plan(s) to the Division for review and written approval. Said plan shall detail procedures for protecting state-listed plants associated with Thatcher Pond during and after construction, and be prepared and implemented as approved by a qualified botanist pre-approved by the Division.

3. Restoration of Temporarily Disturbed Areas: Unless otherwise pre-approved in writing by the Division, all areas of temporary alteration shall be restored using seed and/or plantings listed as native to Bristol or Plymouth County, Massachusetts (as appropriate), as provided in *The Vascular Plants of Massachusetts: A County Checklist, First Revision* (Dow Cullina, Connolly, Sorrie & Somers, 2011).

4. Compliance Report: Within thirty (30) days of the completion of work, a qualified, Division-approved biologist shall submit written confirmation to the Division that: (a) the Division-approved protection plans referenced above were implemented during construction as written; and (b) no work or disturbance occurred outside the limits of work shown on the project plans. Said report shall include representative photos demonstrating compliance with the conditions herein.

Provided the above-noted conditions are fully implemented and there are no changes to the project plans, this project will not result in a Take of state-listed species.

C. *Eastern Box Turtle*

Based on the information provided and the information contained in our database, the Division has determined that this portion of the Project, as proposed, **will result in a Take (321 CMR 10.18 (2)(b)) of the Eastern Box Turtle** due to the permanent loss of suitable habitat and interference with the feeding, breeding, nesting and migratory activities of this species.

Projects resulting in a Take of state-listed species may only be permitted if the project and proposed mitigation meet the standards for issuance of a Conservation and Management Permit (CMP; 321 CMR 10.23). In order for a project to qualify for a CMP, the applicant must demonstrate that the project has avoided, minimized and mitigated impacts to state-listed species consistent with the following performance standards: (a) adequately assess alternatives to both temporary and permanent impacts to the state-listed species, (b) demonstrate that an insignificant portion of the local population will be impacted, and (c) develop and agree to carry out a conservation and management plan that provides a long-term net benefit to the conservation of the state-listed species.

Phase 2: Stoughton Electric Alternative

The Division has been involved in ongoing consultations with the Applicant and their representatives to evaluate and address potential impacts to state-listed species and their habitats associated with Phase 2 of

the Project. Phase 2, as currently proposed, still requires review through a formal filing with the Division for compliance with the MESA. Preliminarily, and based on a review of the materials submitted to the Division and ongoing consultations with the Applicant to date, the Division anticipates that Phase 2 will likely result in a Take of state-listed species. Projects resulting in a Take of state-listed species may only be permitted if a project and proposed mitigation meet the standards for issuance of a CMP.

This Determination is a final decision of the Division of Fisheries and Wildlife pursuant to 321 CMR 10.18. Any person aggrieved by this decision shall have the right to an adjudicatory hearing at the Division pursuant to M.G.L. c. 30A, s.11 in accordance with the procedures for informal hearings set forth in 801 CMR 1.02 and 1.03. Any notice of claim for an adjudicatory hearing shall be made in writing, accompanied by a filing fee in the amount of $500.00 and the information specified in 321 CMR 10.25 (3). The notice of claim shall be sent to the Division's Director, Jack Buckley, by certified mail, hand delivered or postmarked within twenty-one (21) days of the date of the Division's Determination.

We note that all work is subject to the anti-segmentation provisions (321 CMR 10.16) of the MESA. **Please note that no soil or vegetation disturbance, work, clearing, grading or other activities associated with Phase 1B of the Project shall be conducted anywhere within the mapped Priority Habitat of Eastern Box Turtle until the MESA permitting process is complete.** Please note that this determination addresses only the matter of state-listed species and their habitats. If you have any questions regarding this letter, please contact Jesse Leddick, Chief of Regulatory Review, at jesse.leddick@state.ma.us or (508) 389-6386.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director

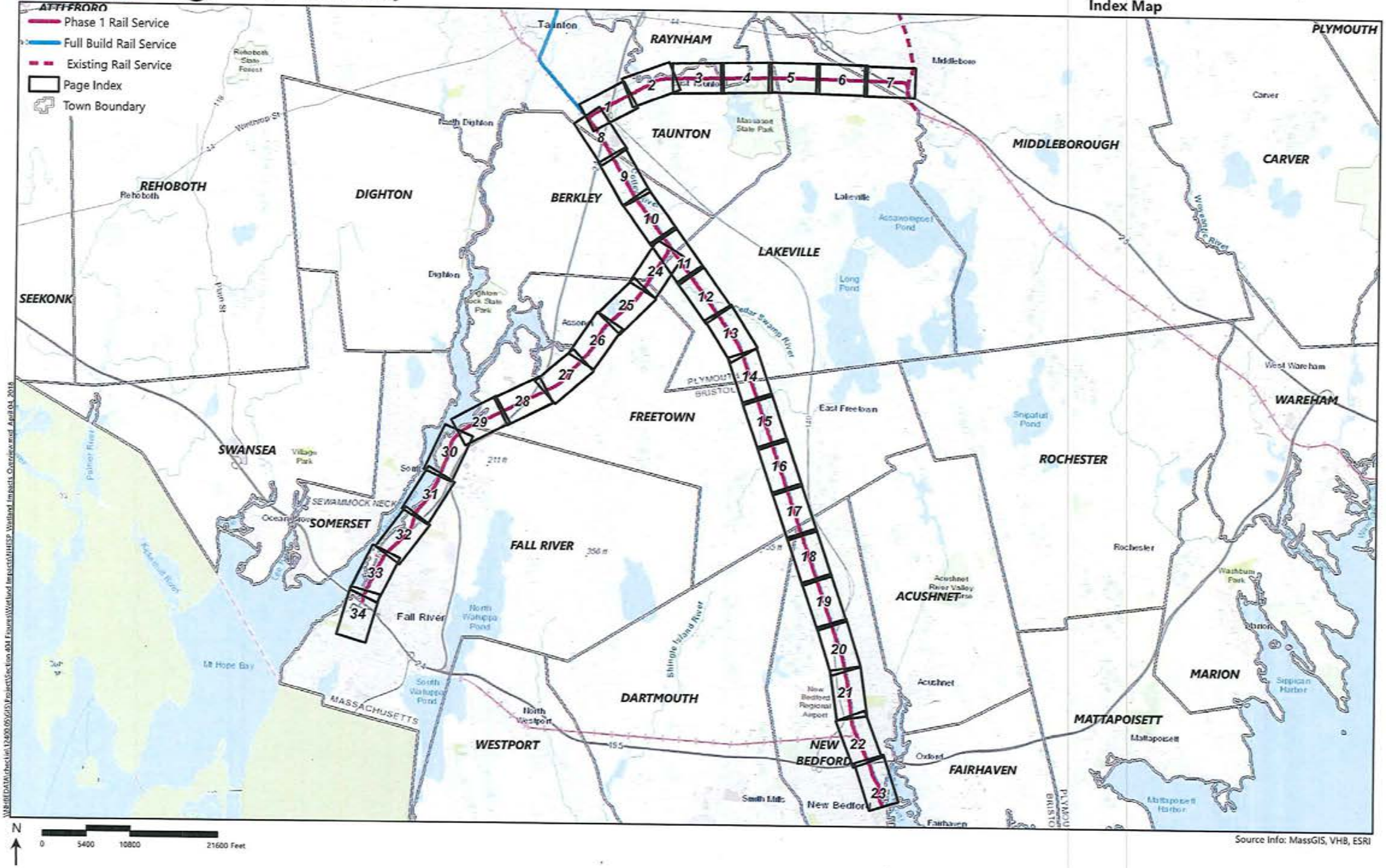
Cc: Holly Palmgren, MBTA
Kimberly Dobosz, MBTA
Lisa Standley, VHB, Inc.
Lars Carlson, VHB, Inc.
Elizabeth Grob, VHB, Inc.
Nancy Putnam & Nat Tipton, DCR
Lealdon Langley, Mike Stroman & Chris Ross, MassDEP Southeast Regional Office

Attachment 2

Aerial Maps (thirty-five [35] sheets; April 9, 2016; prepared by VHB, Inc.; the "Project Plans")

Massachusetts Bay Transportation Authority

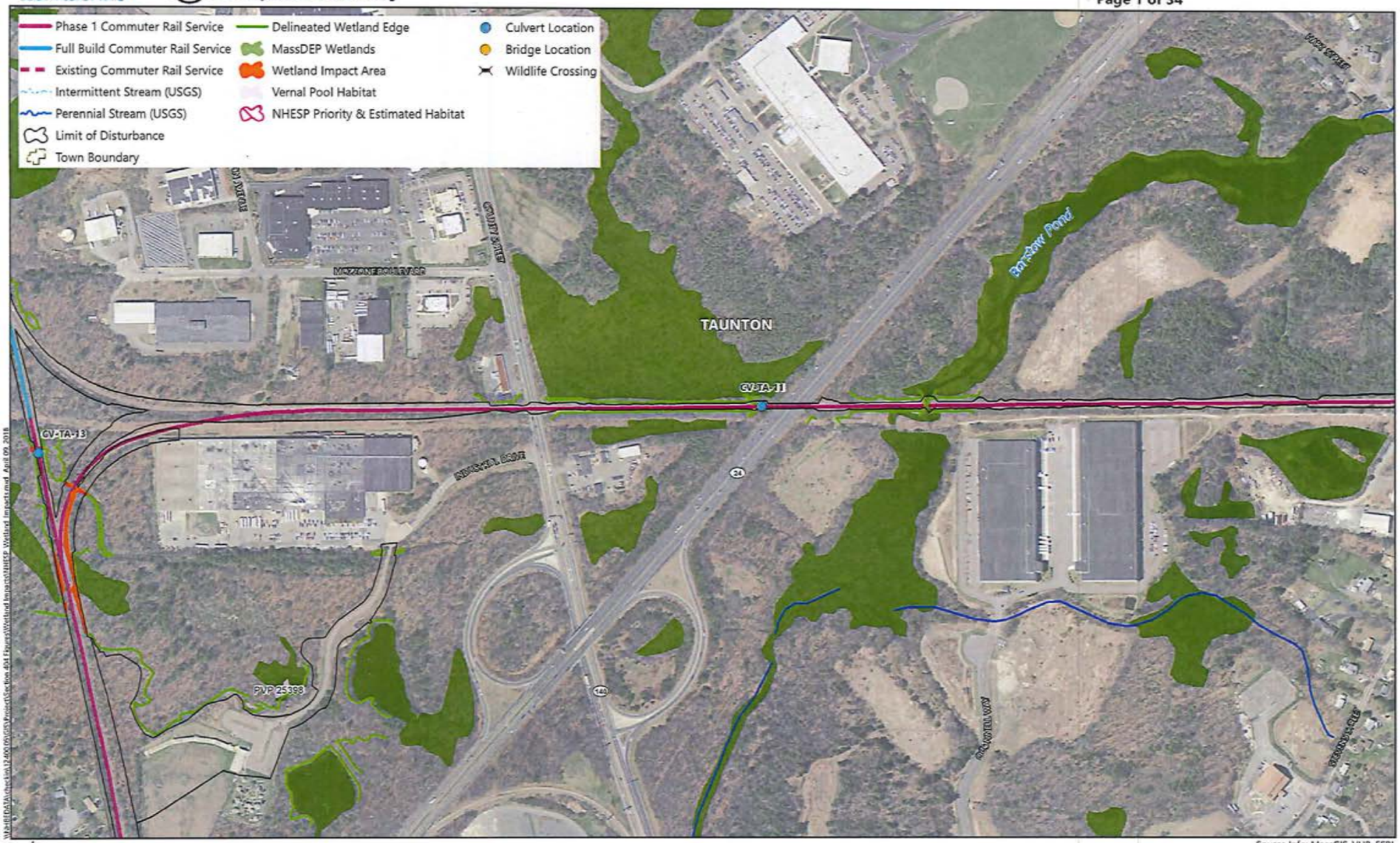
Phase 1 Conservation & Management Plan Index Map



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

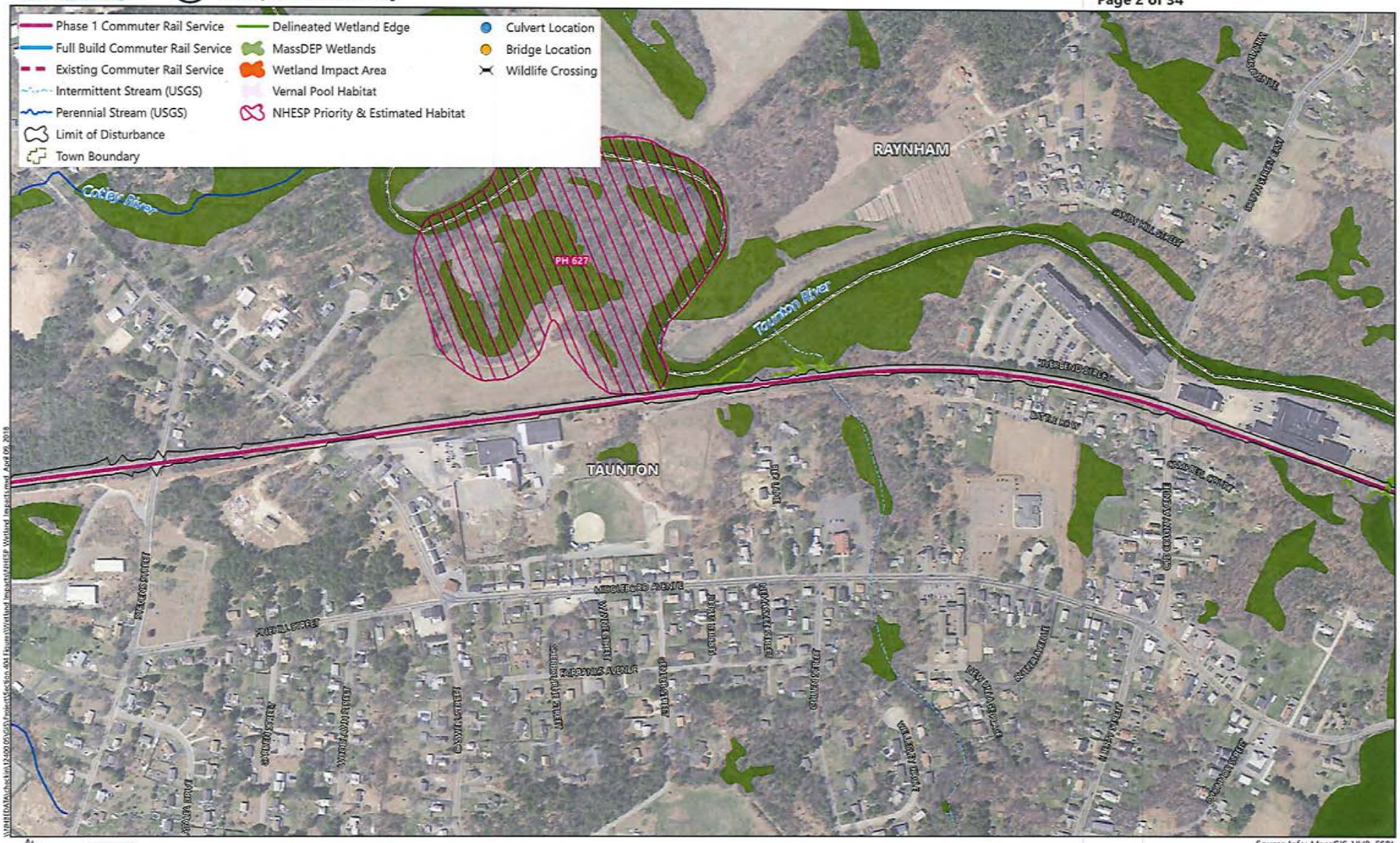
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

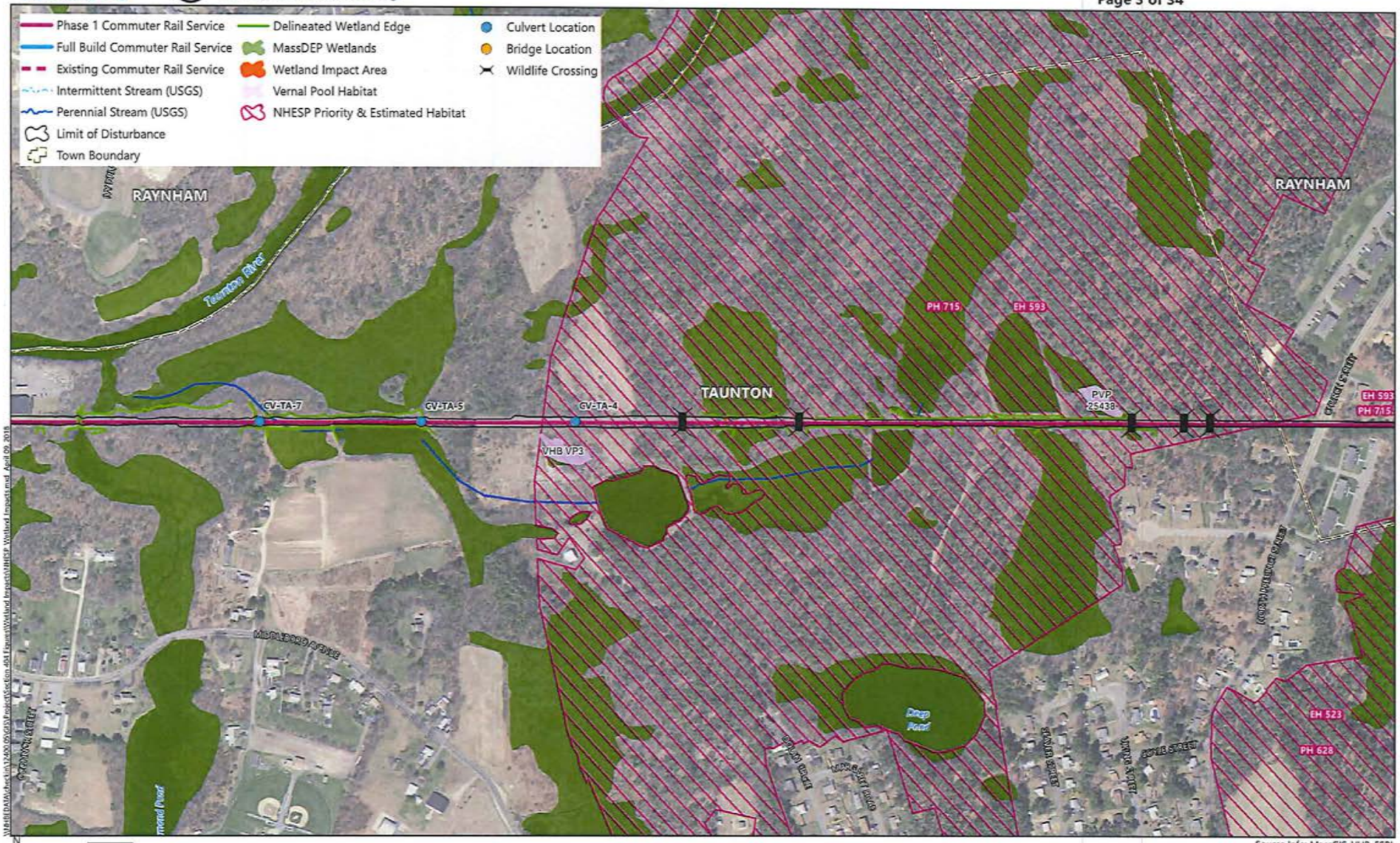
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

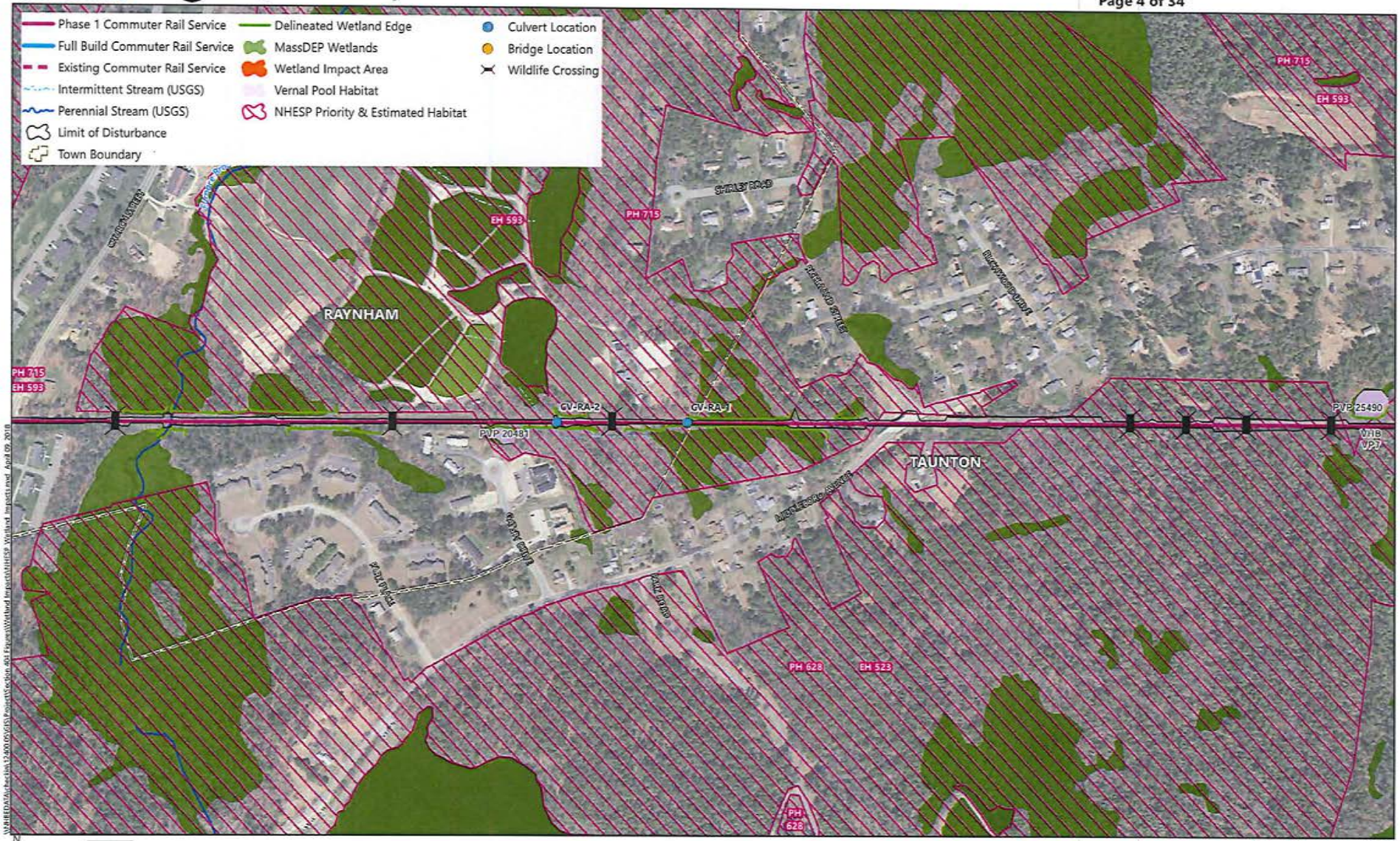
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

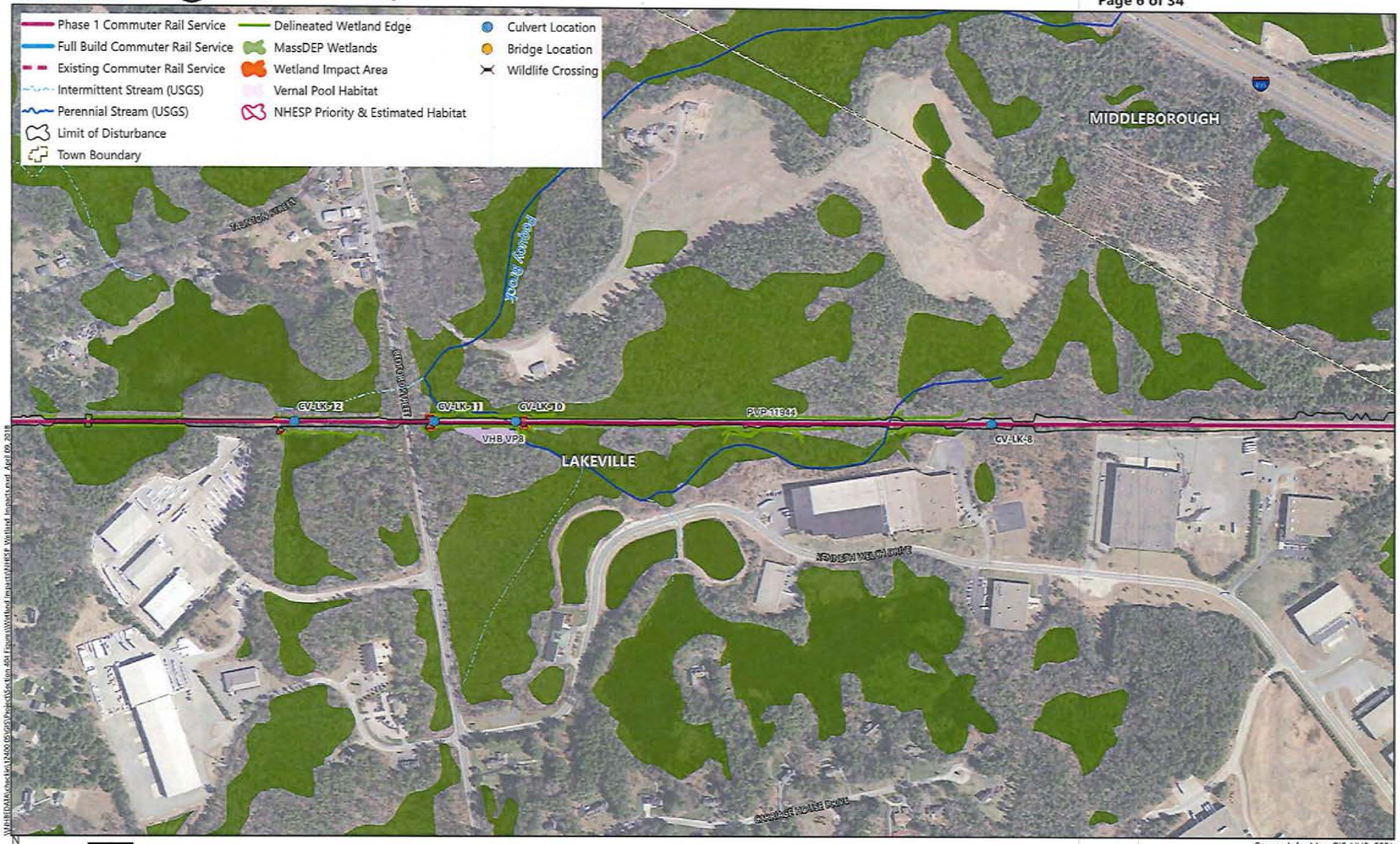
SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority

Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

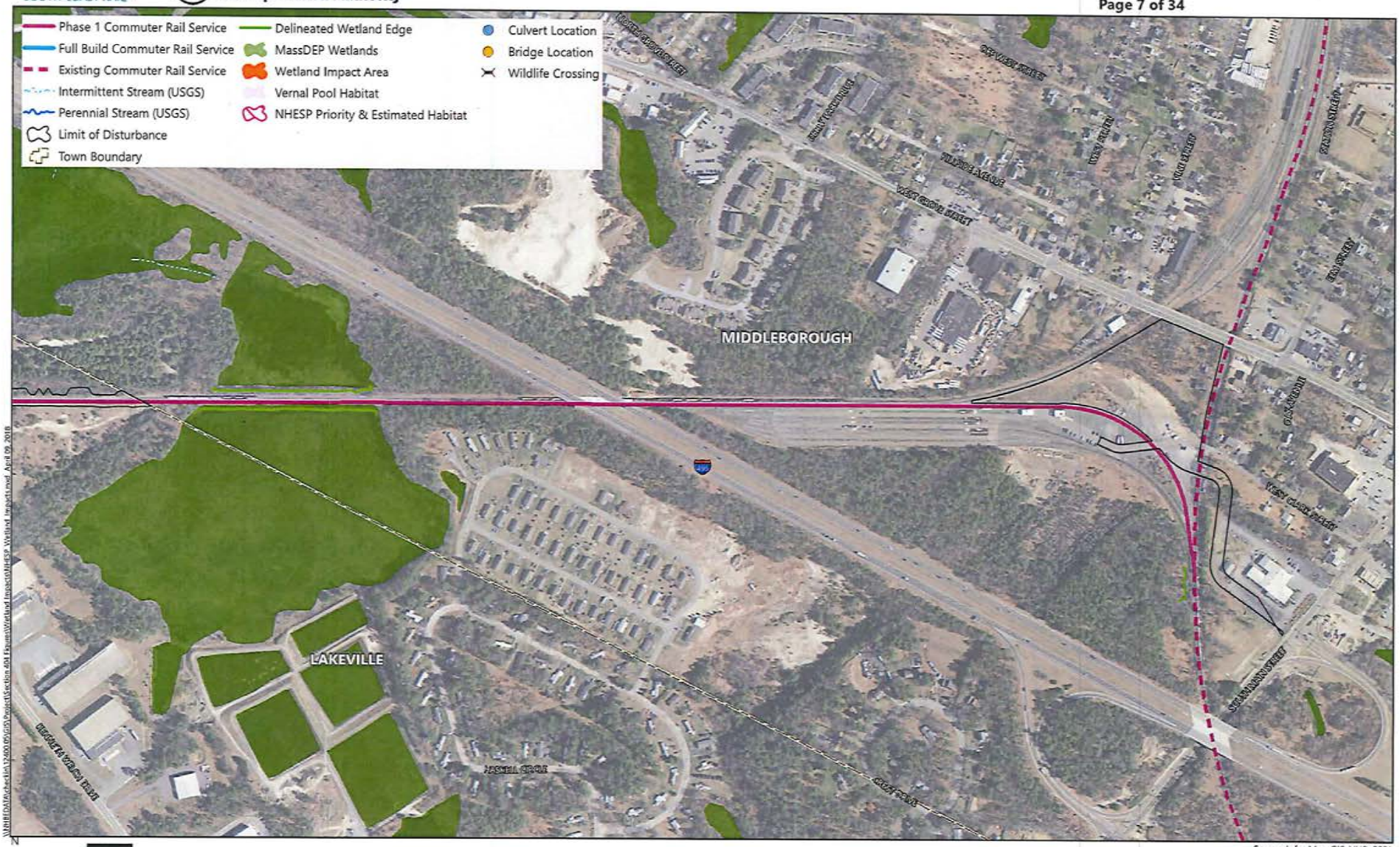
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

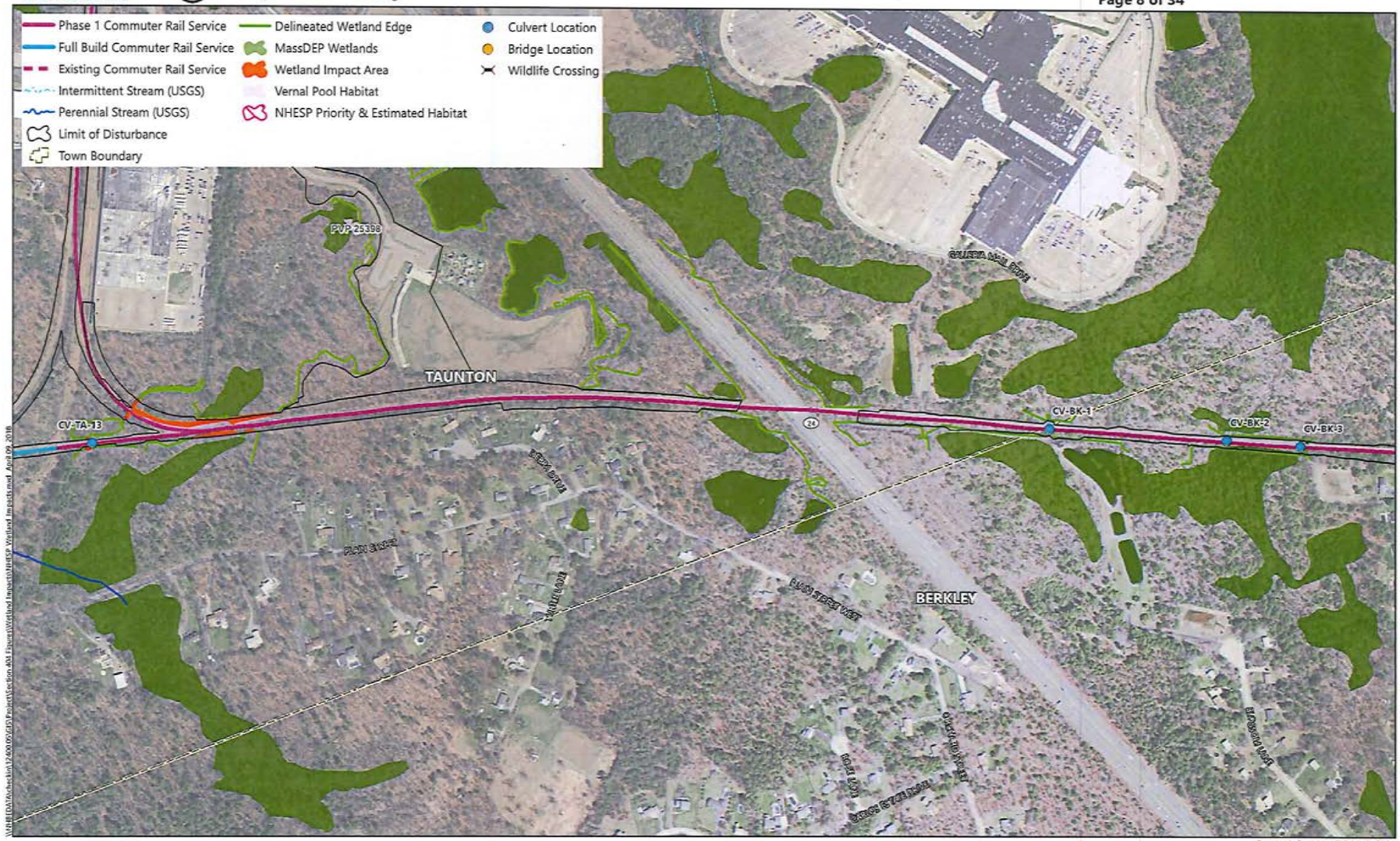
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

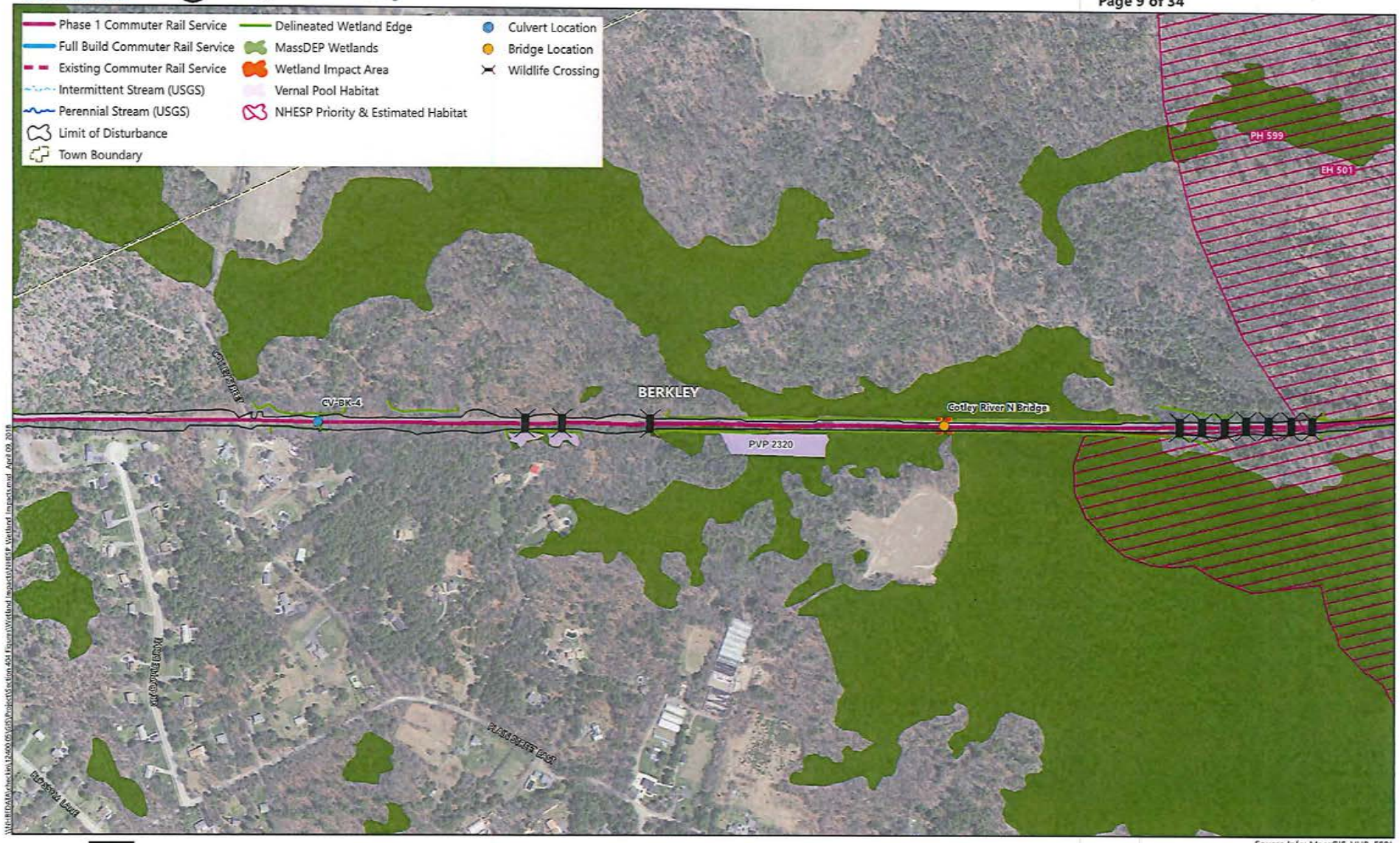
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

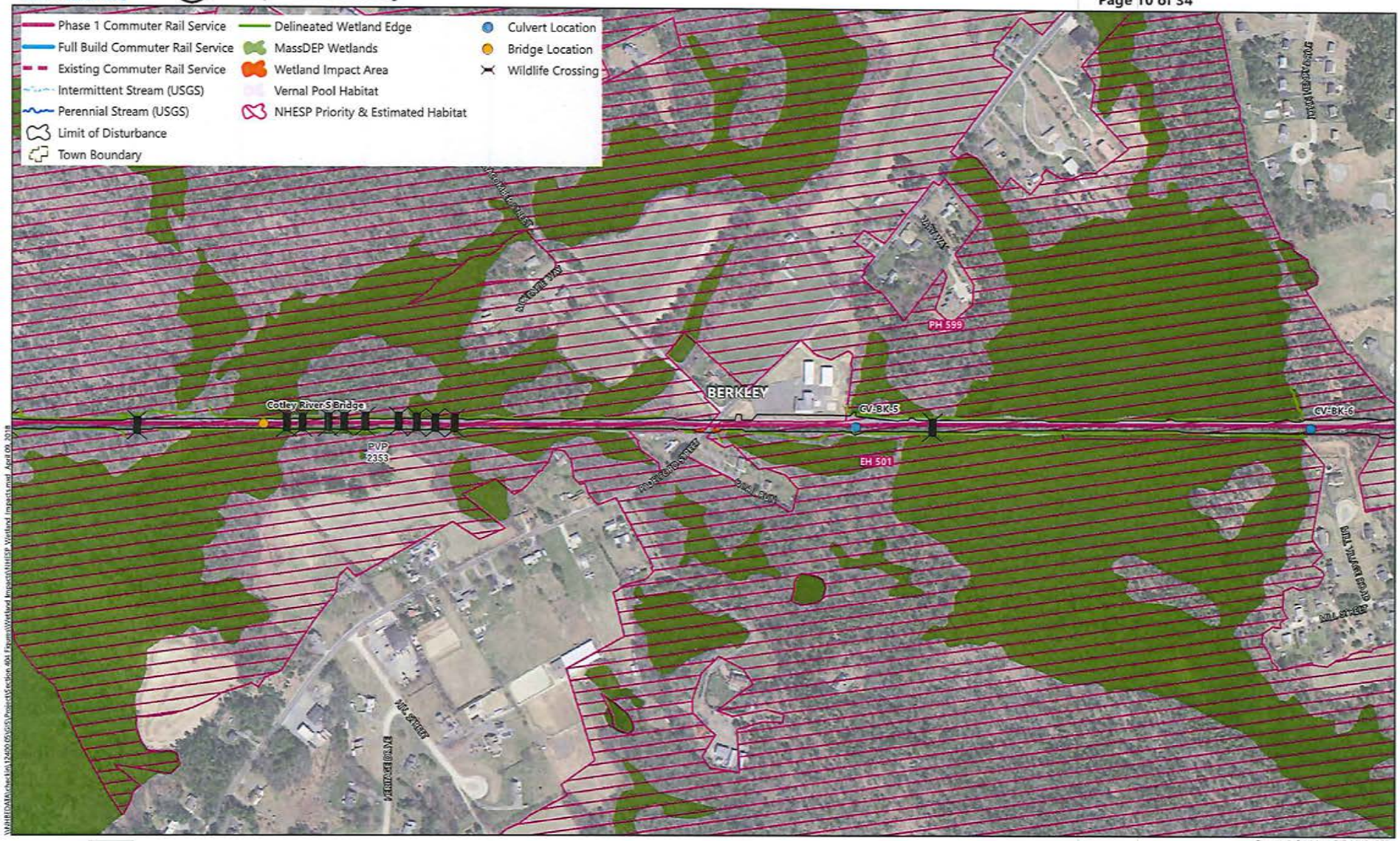
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

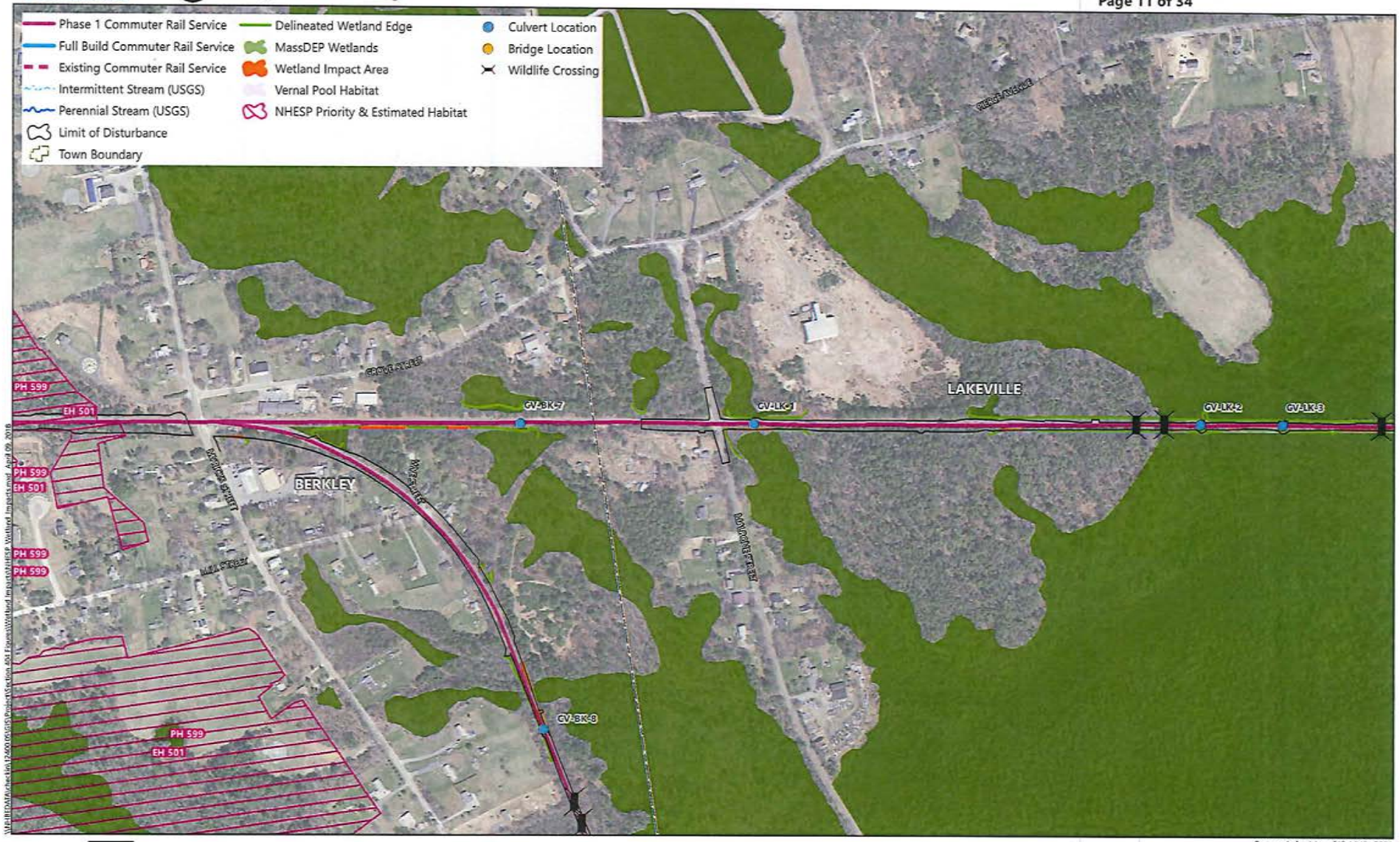
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

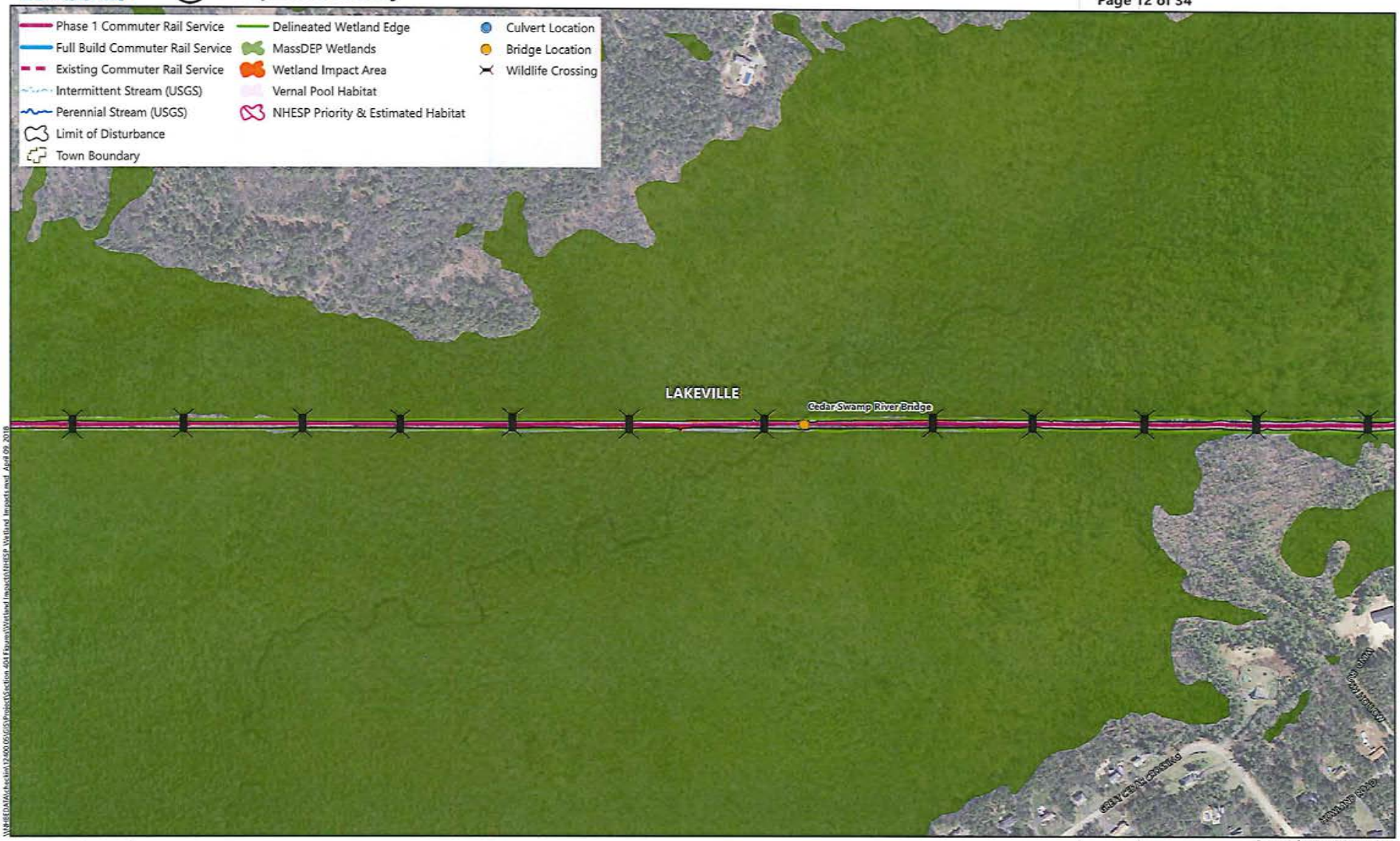
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

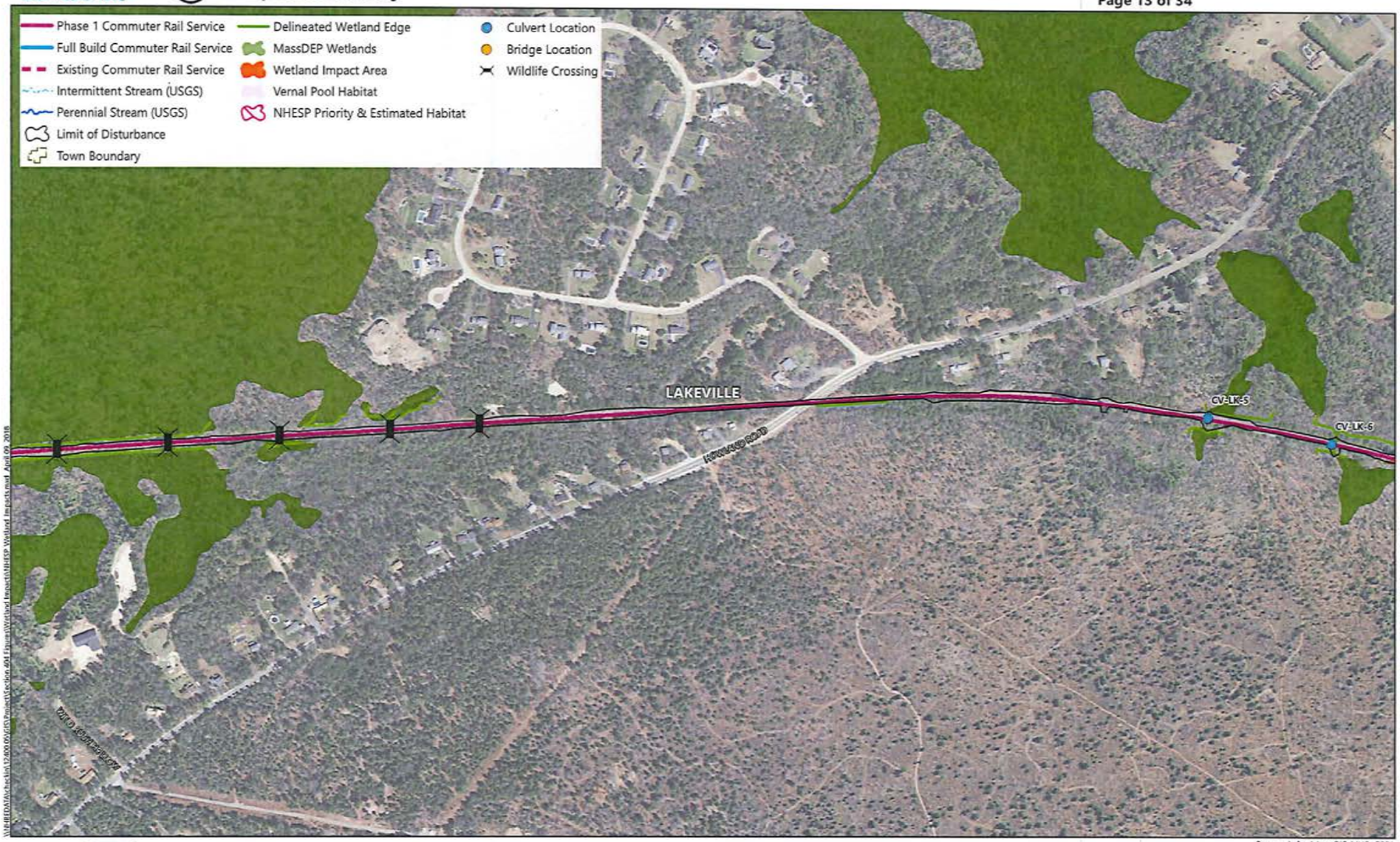
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

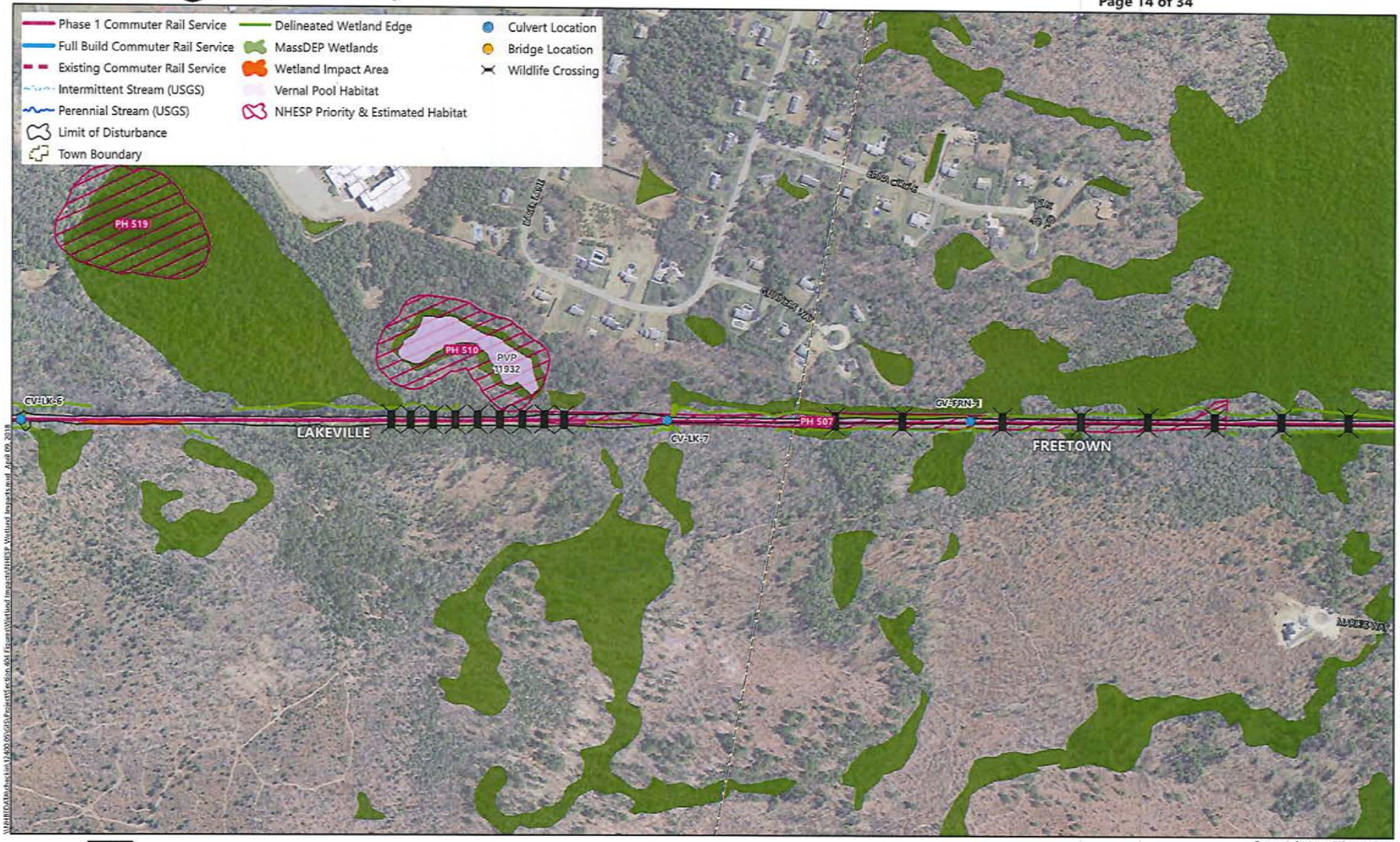
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

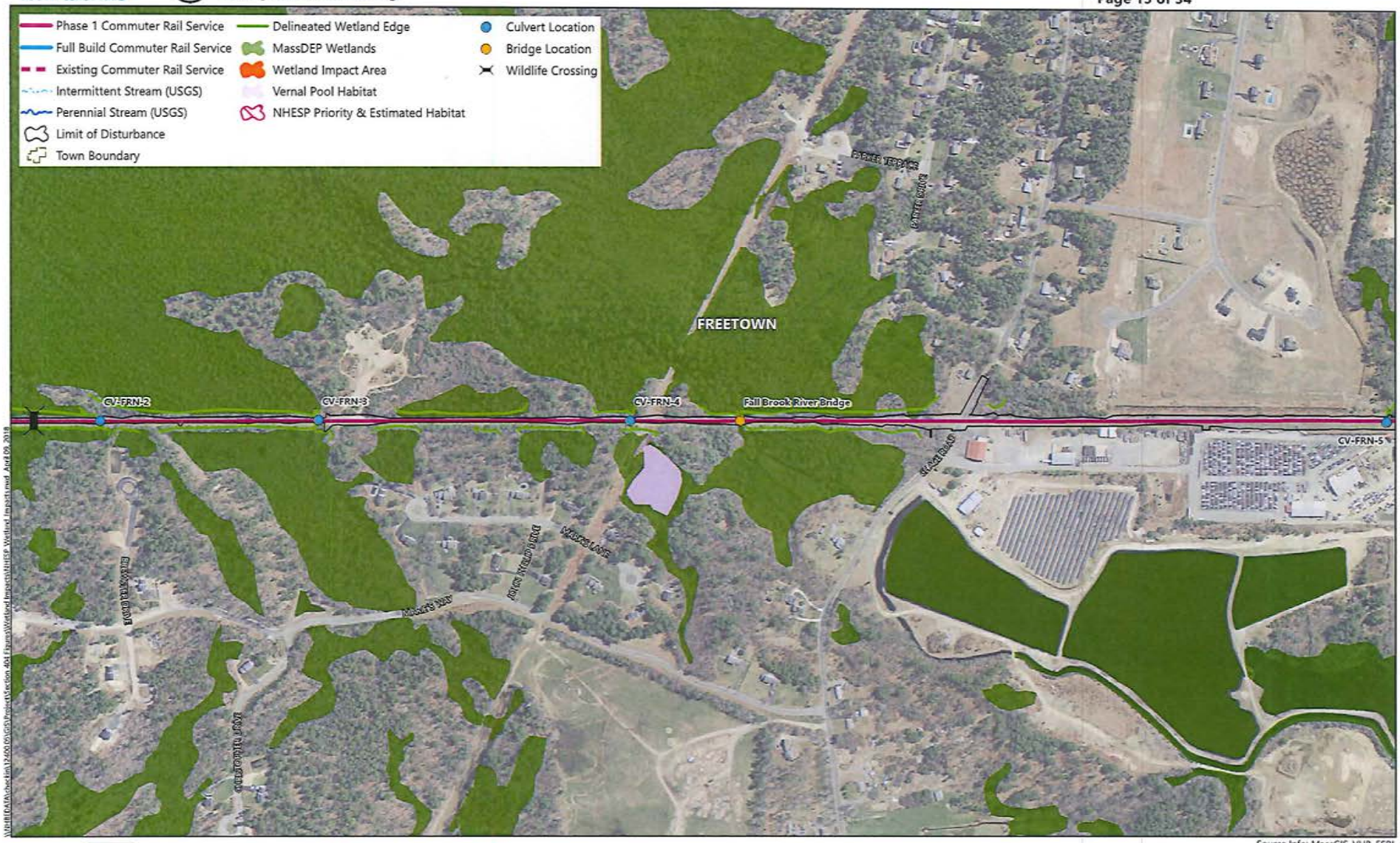
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

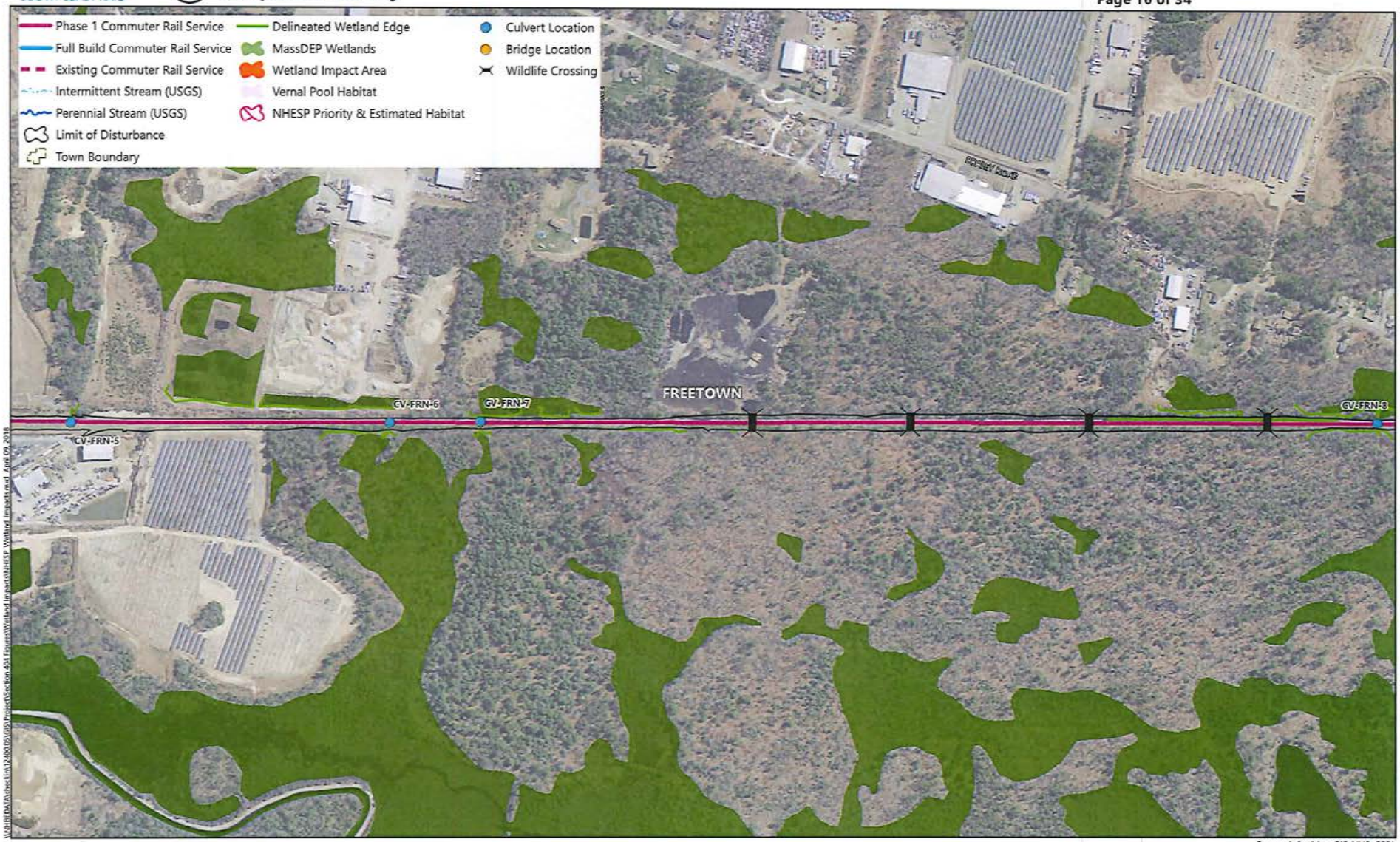
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

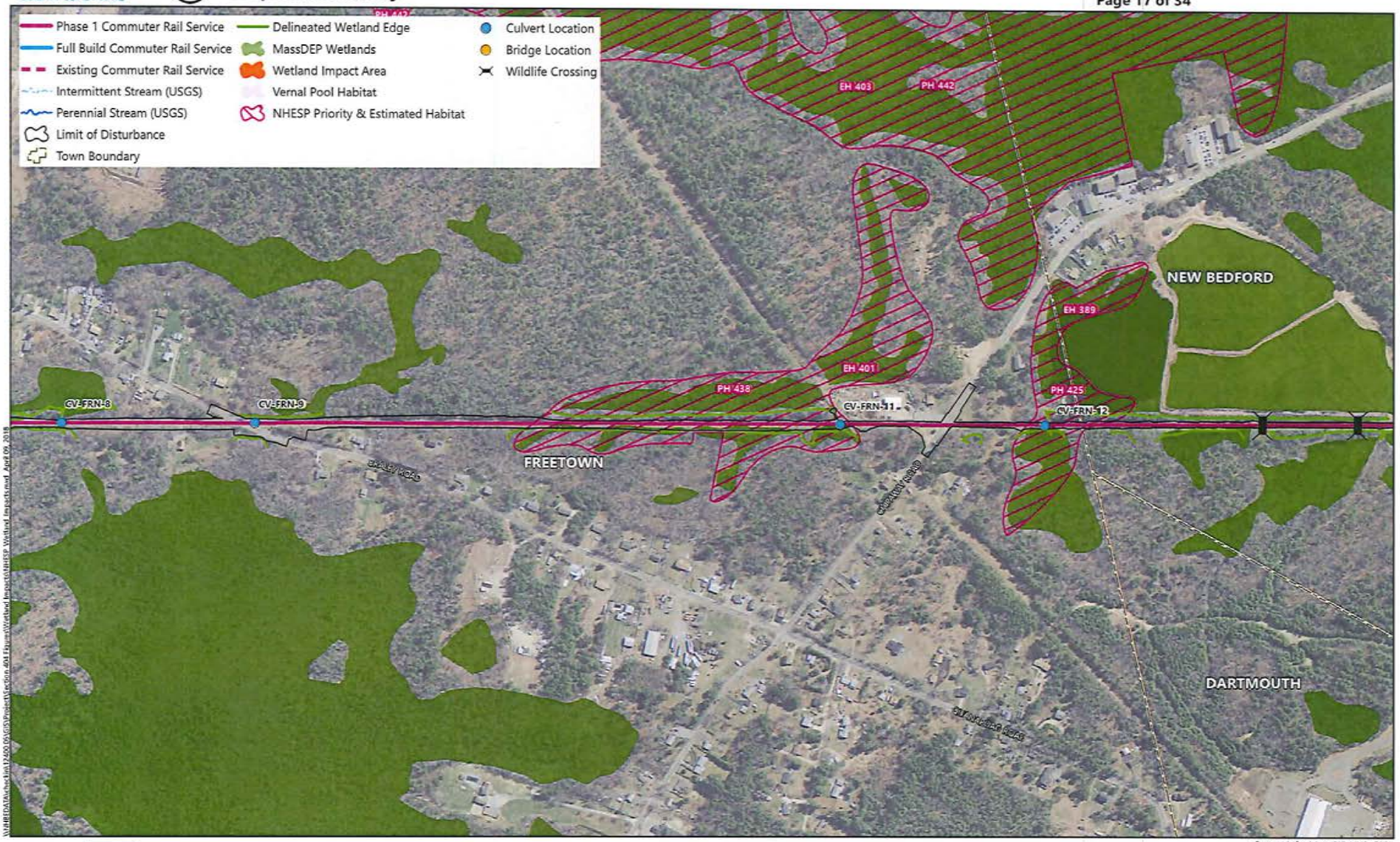
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

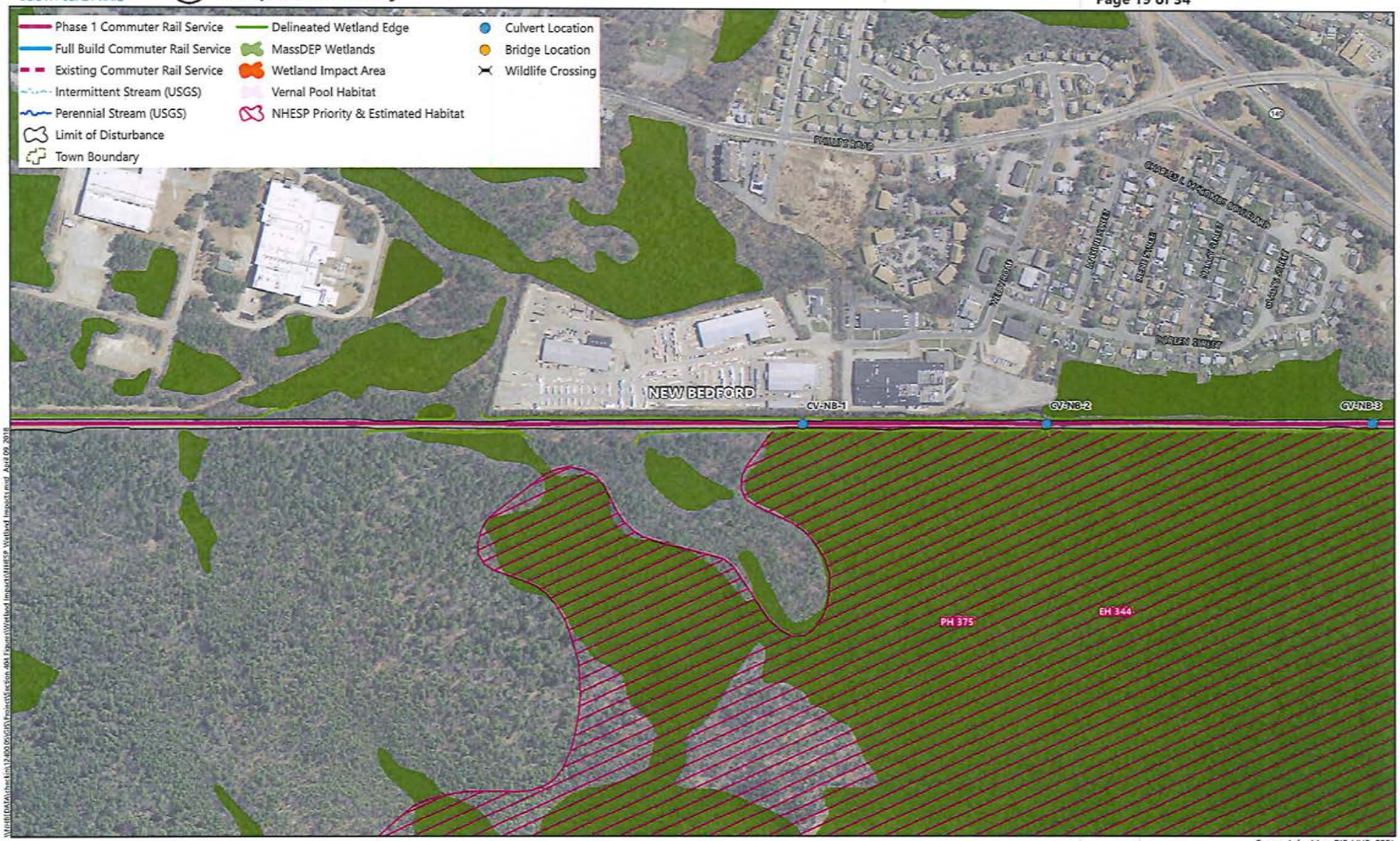
SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority

Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

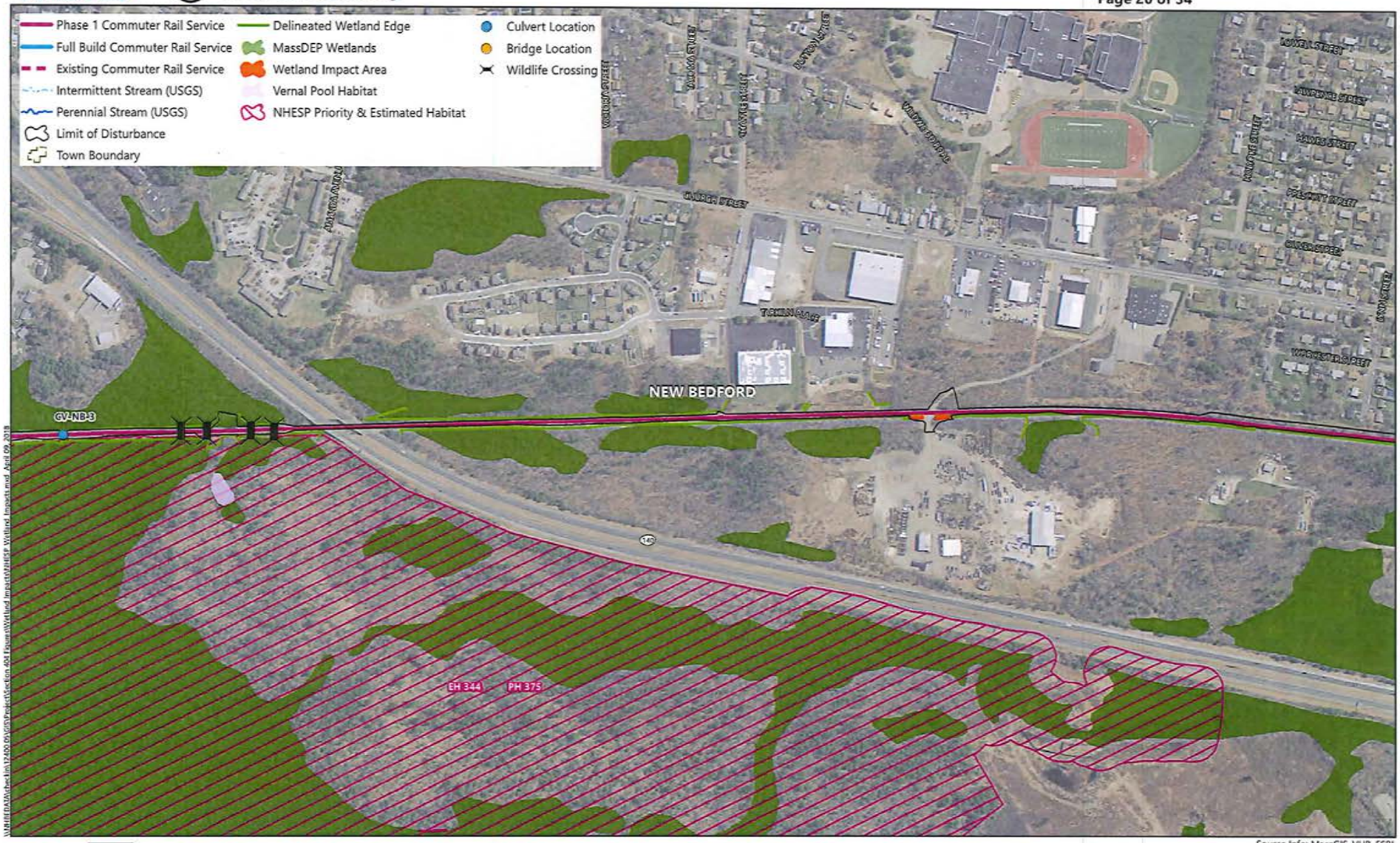
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

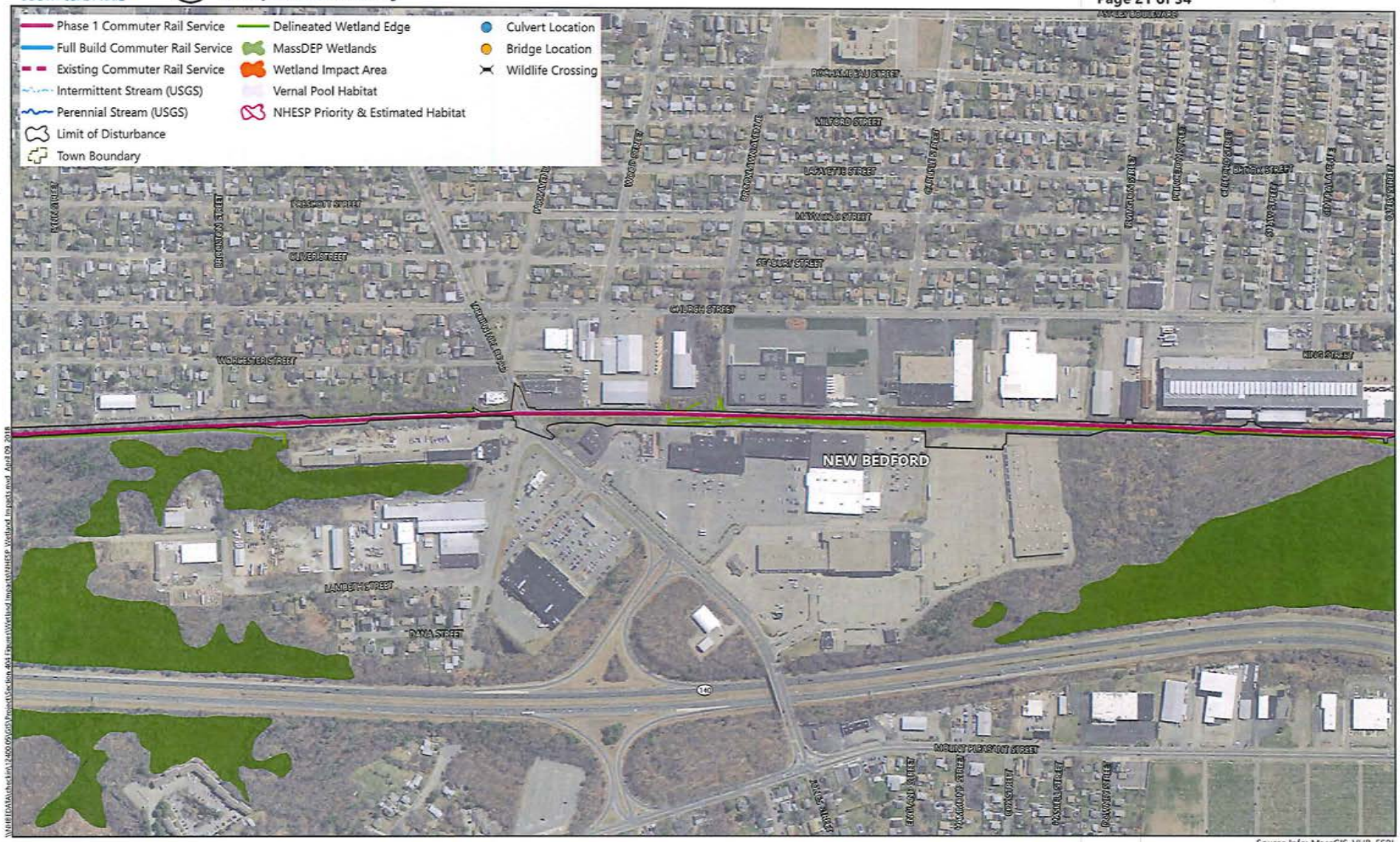
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

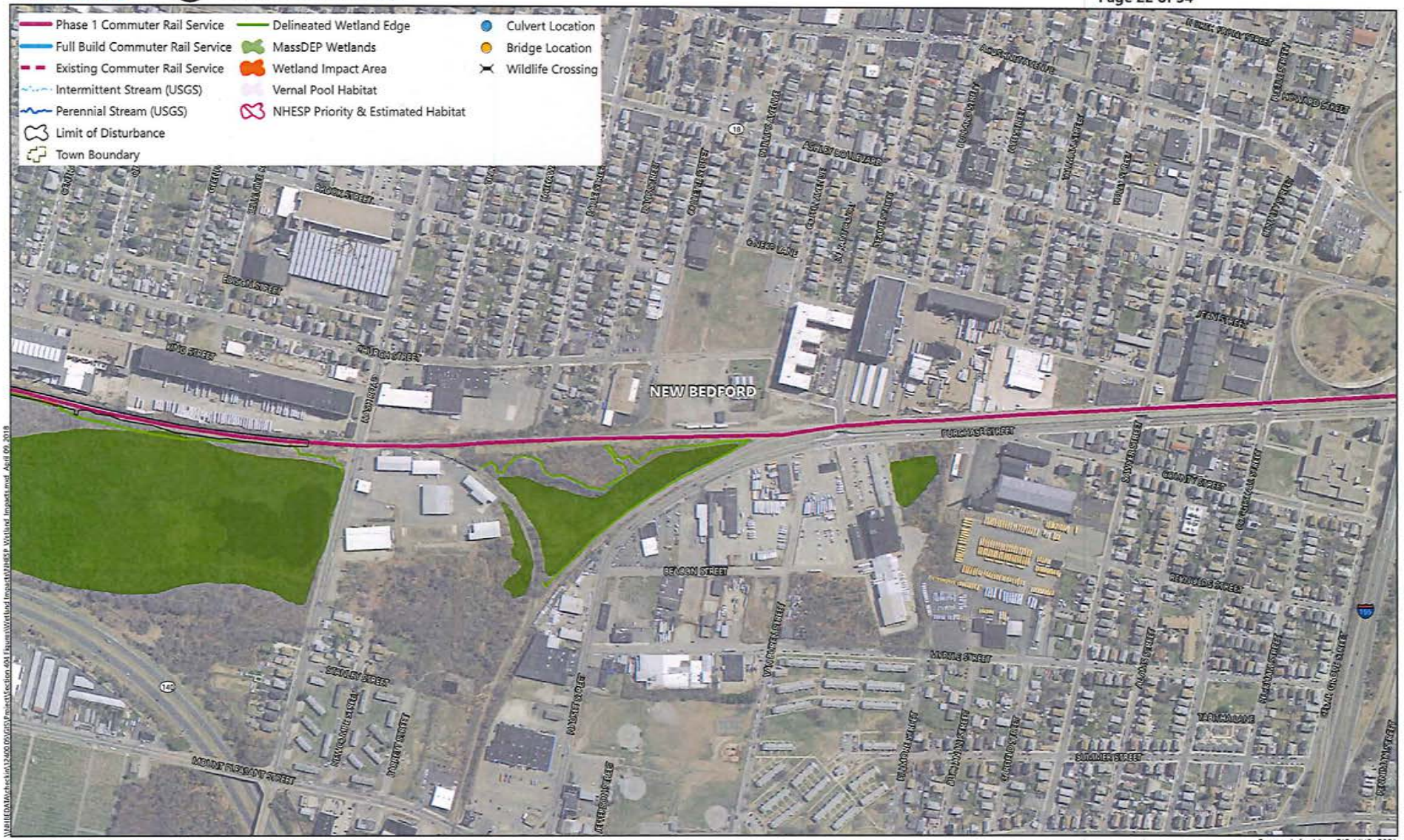
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

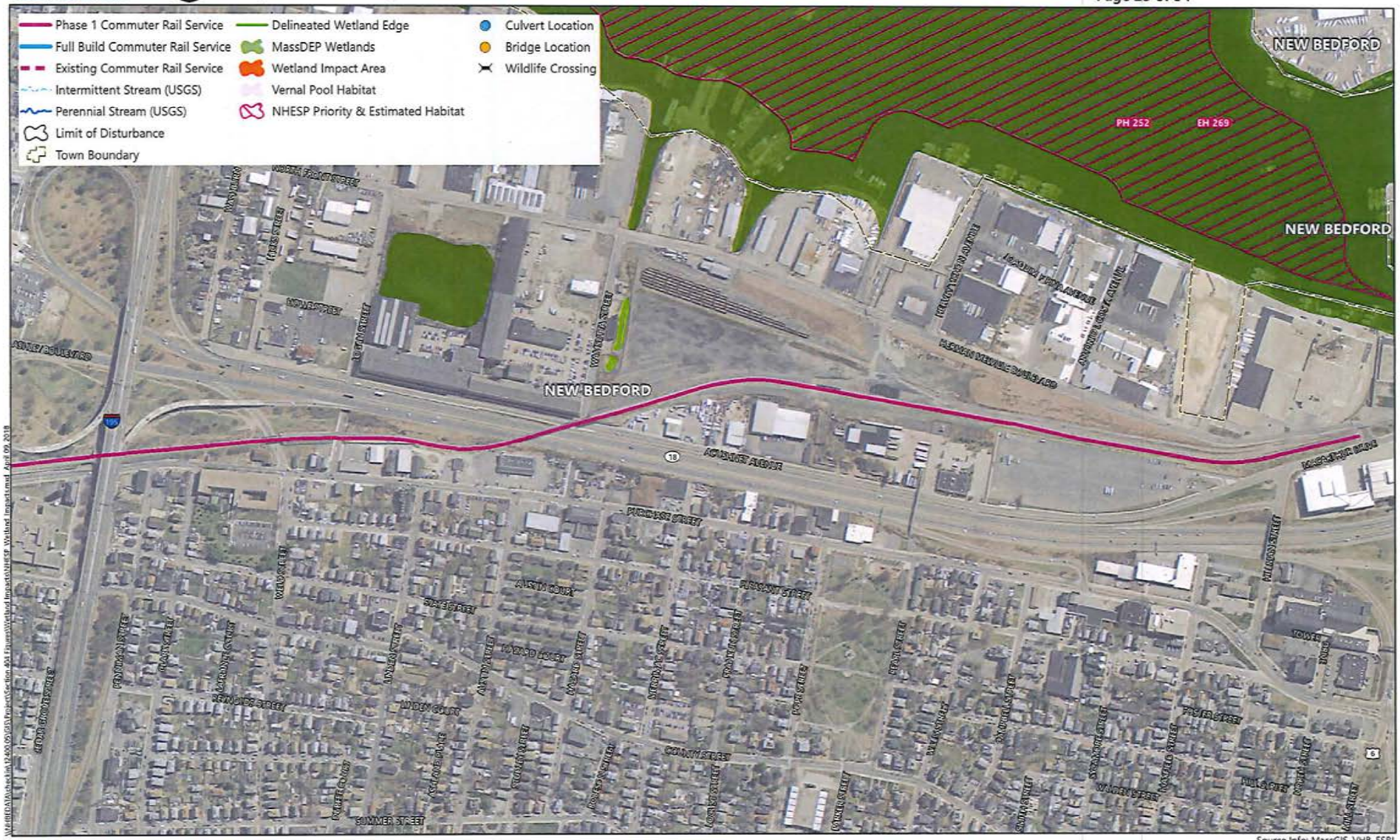
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

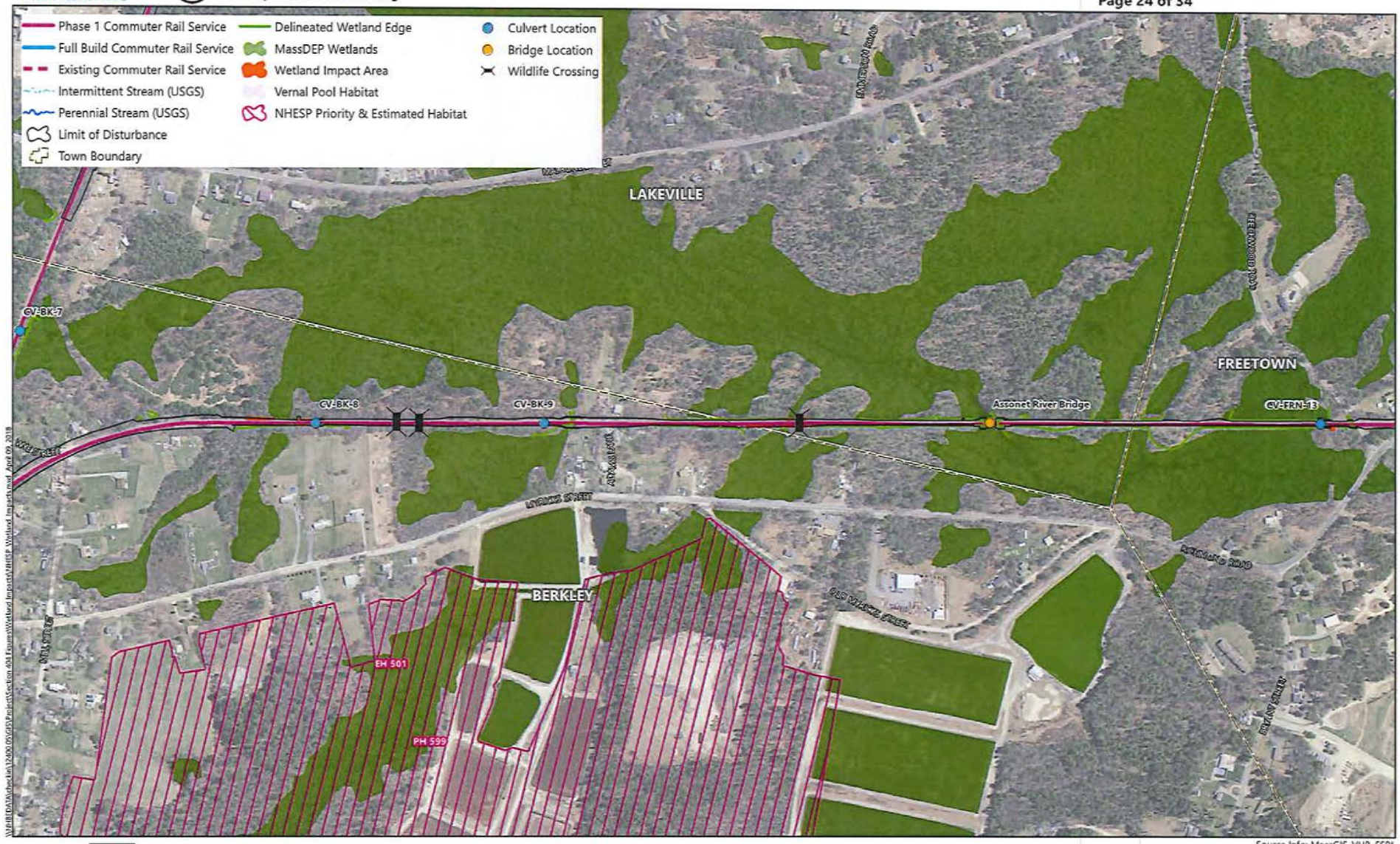
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

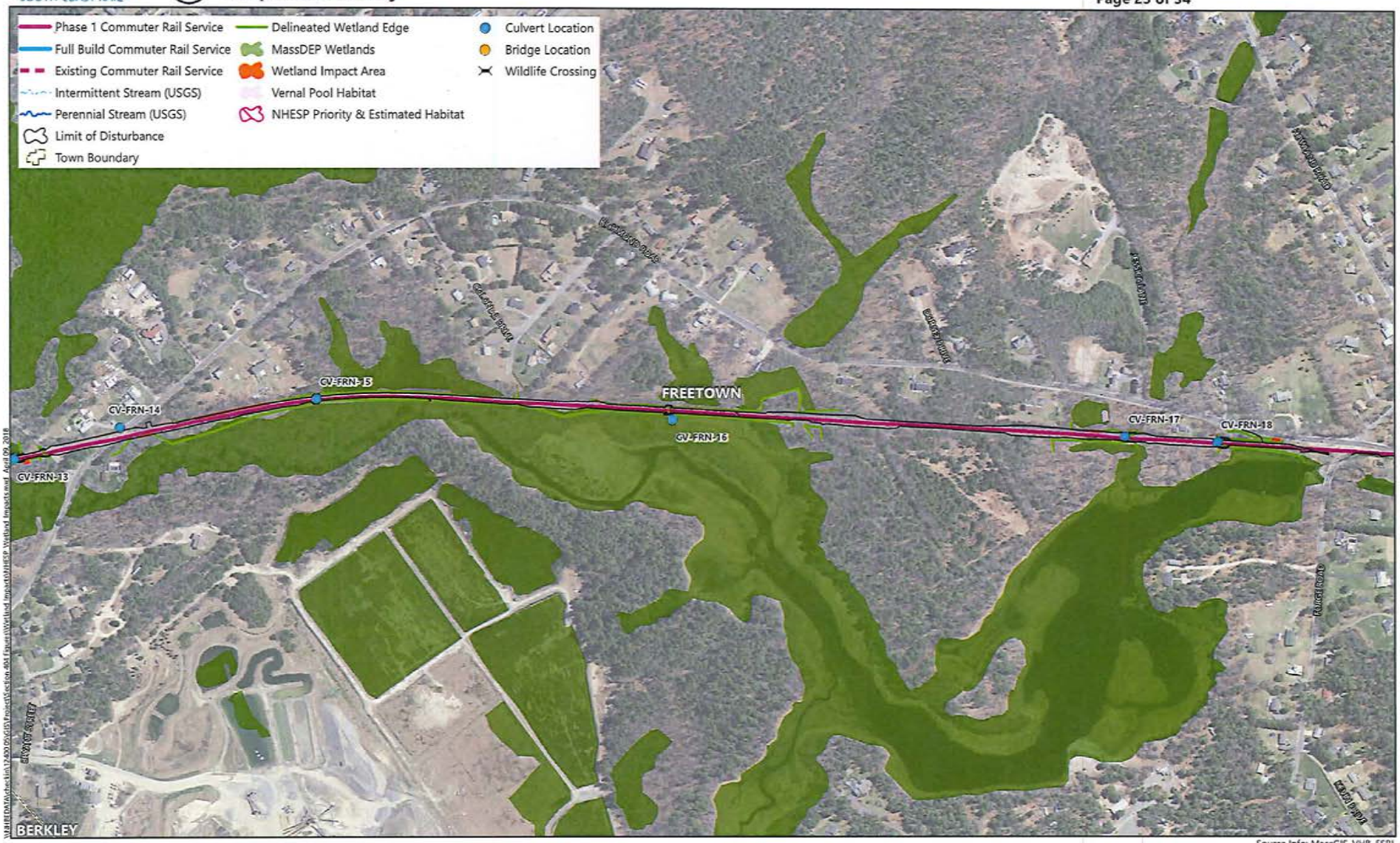
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

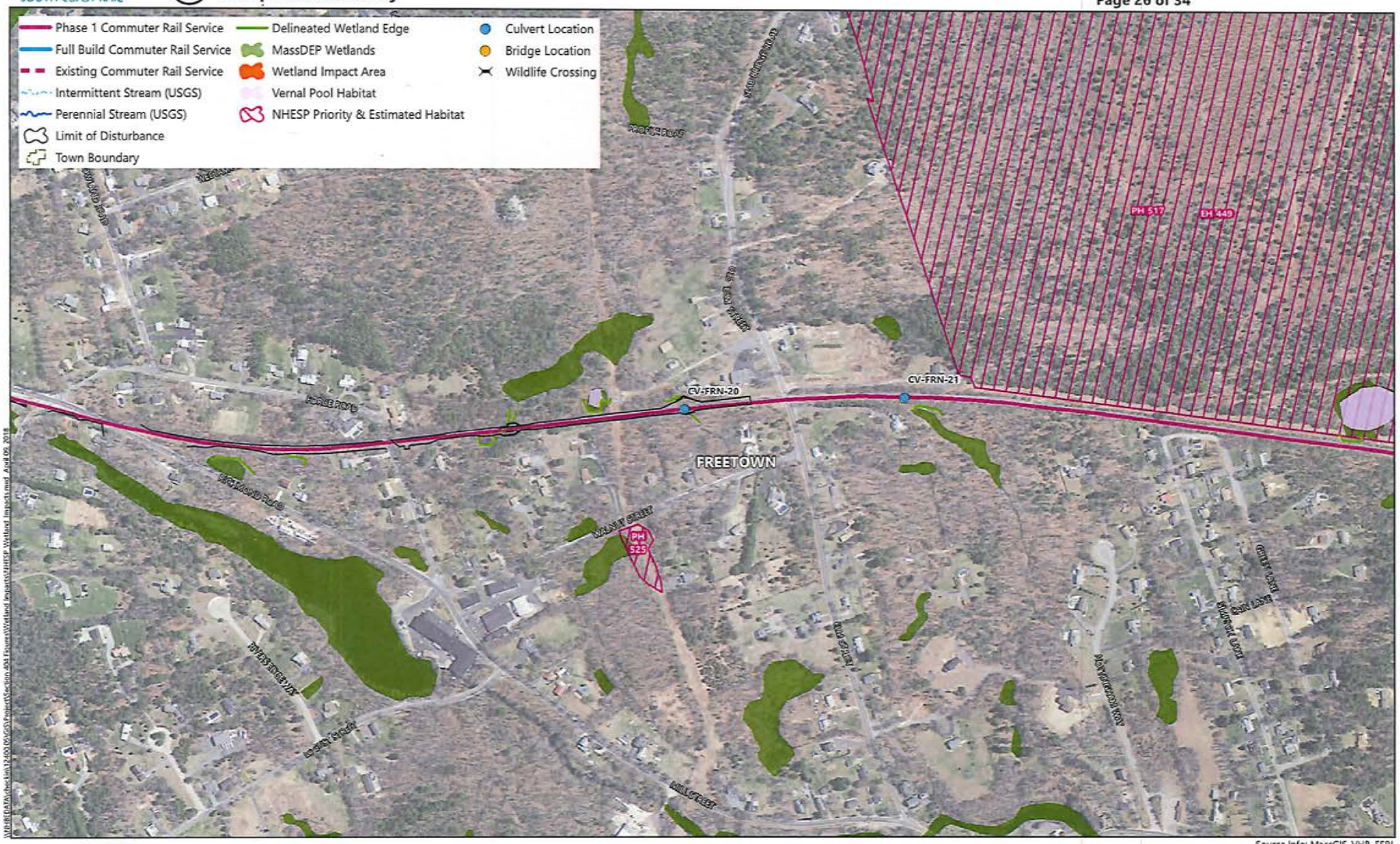
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

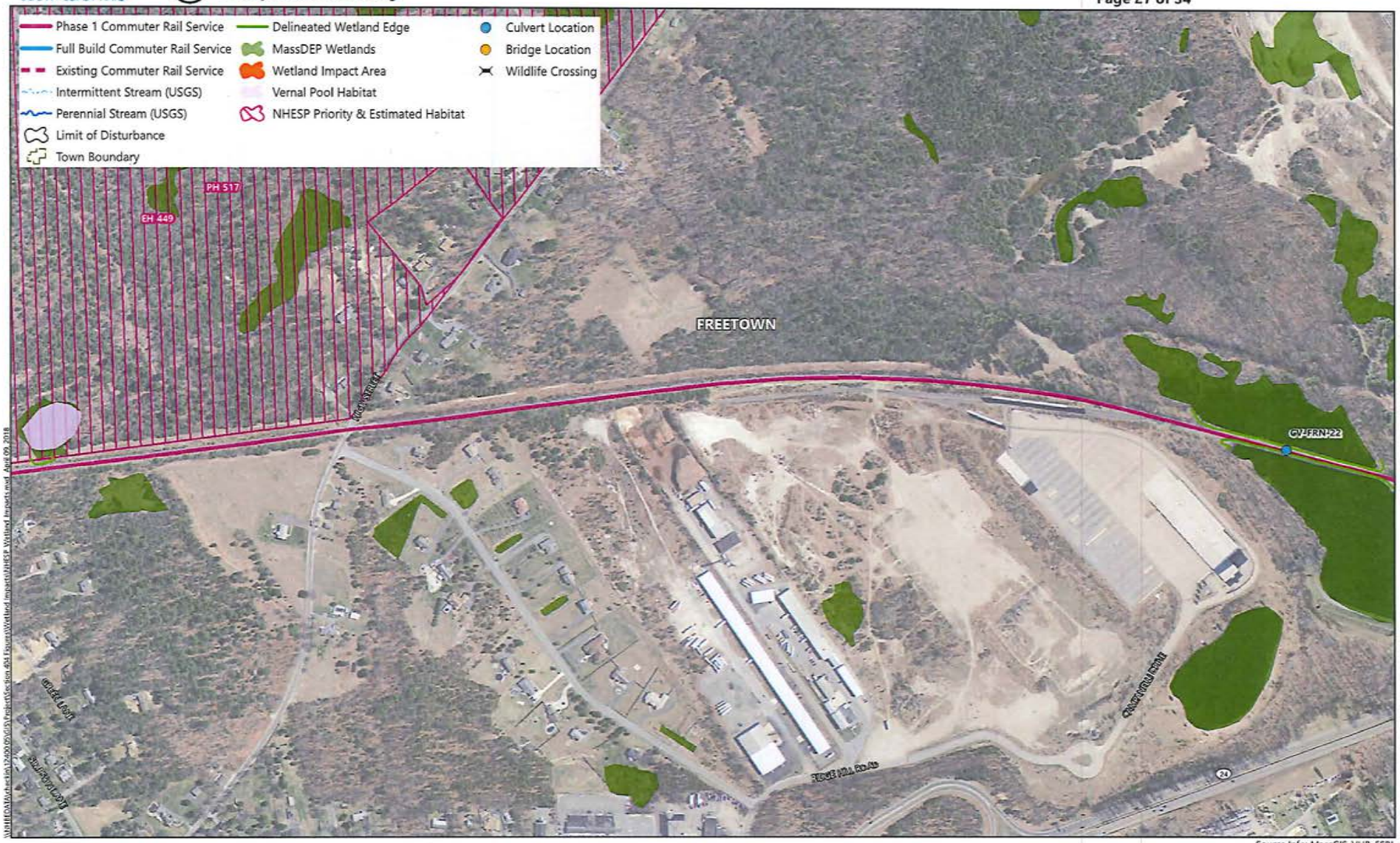
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

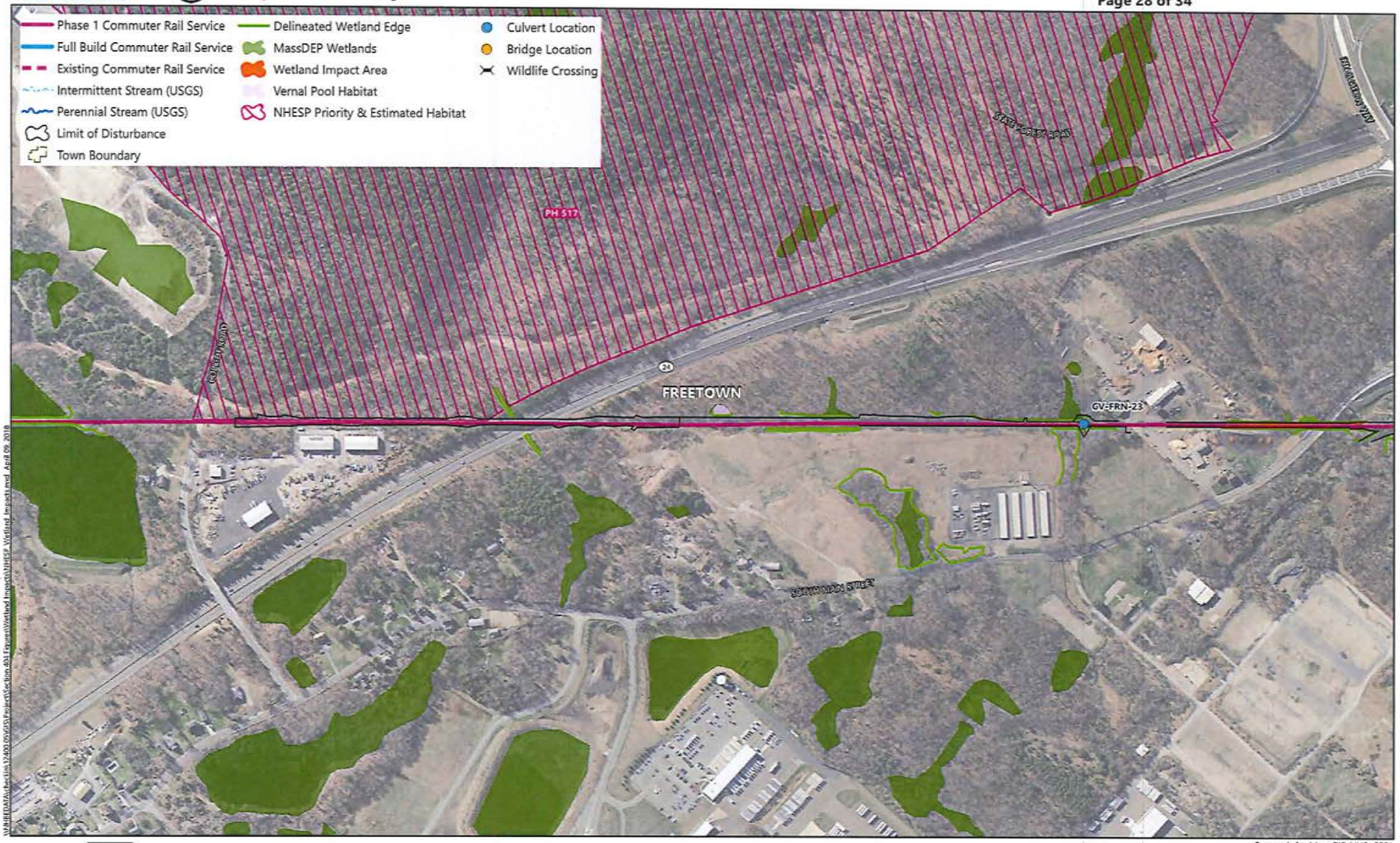
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

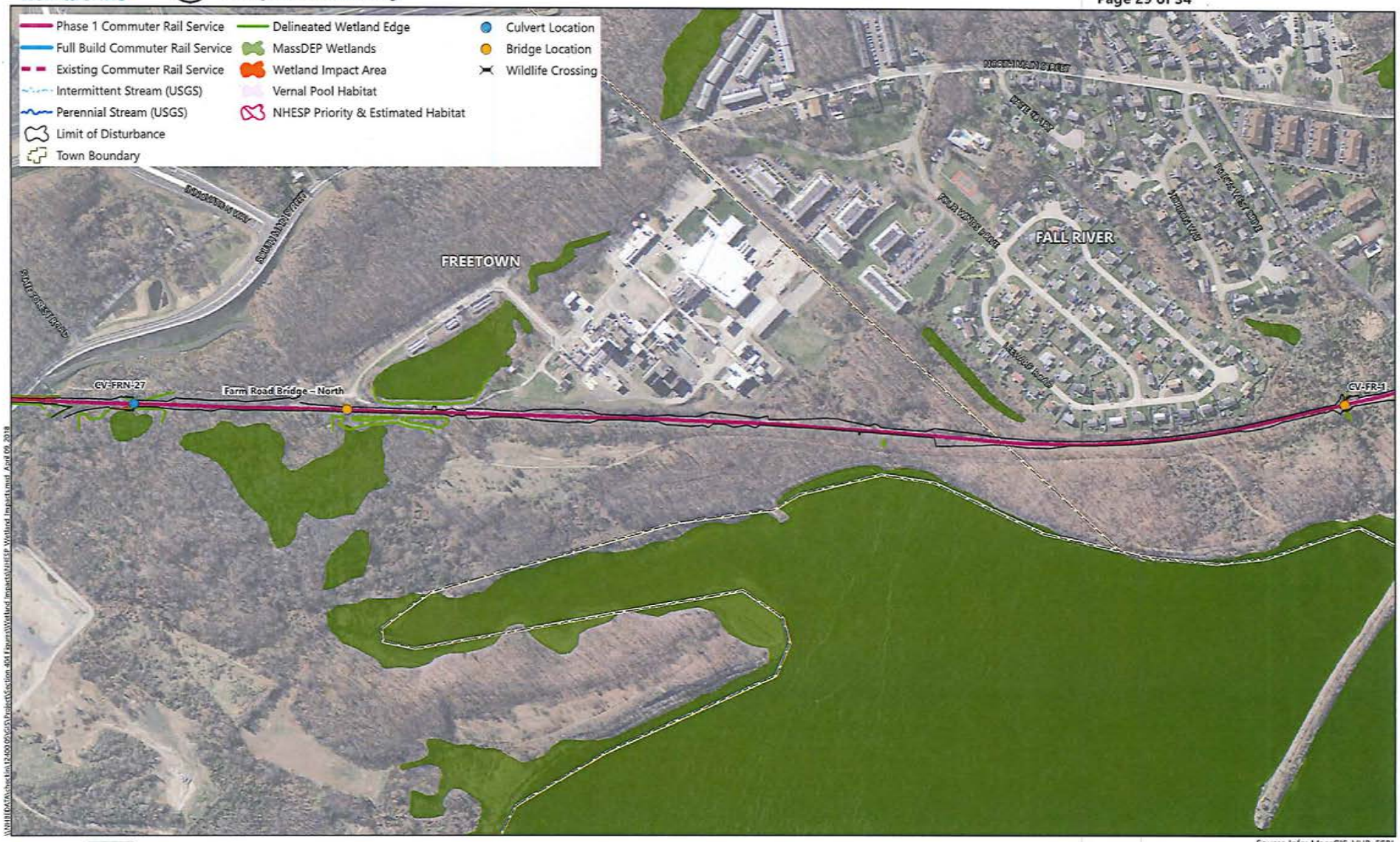
Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

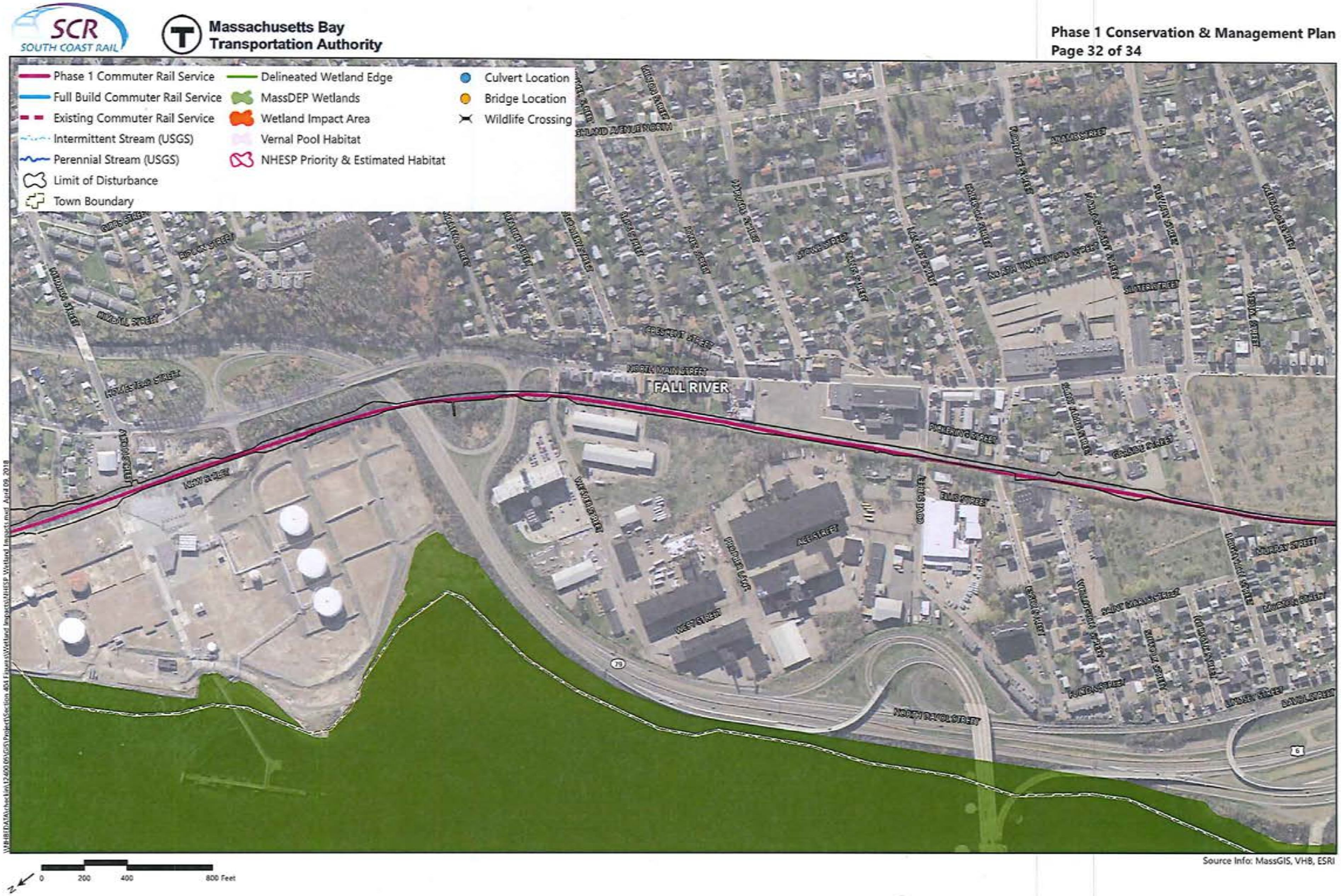
Massachusetts Bay Transportation Authority

Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority

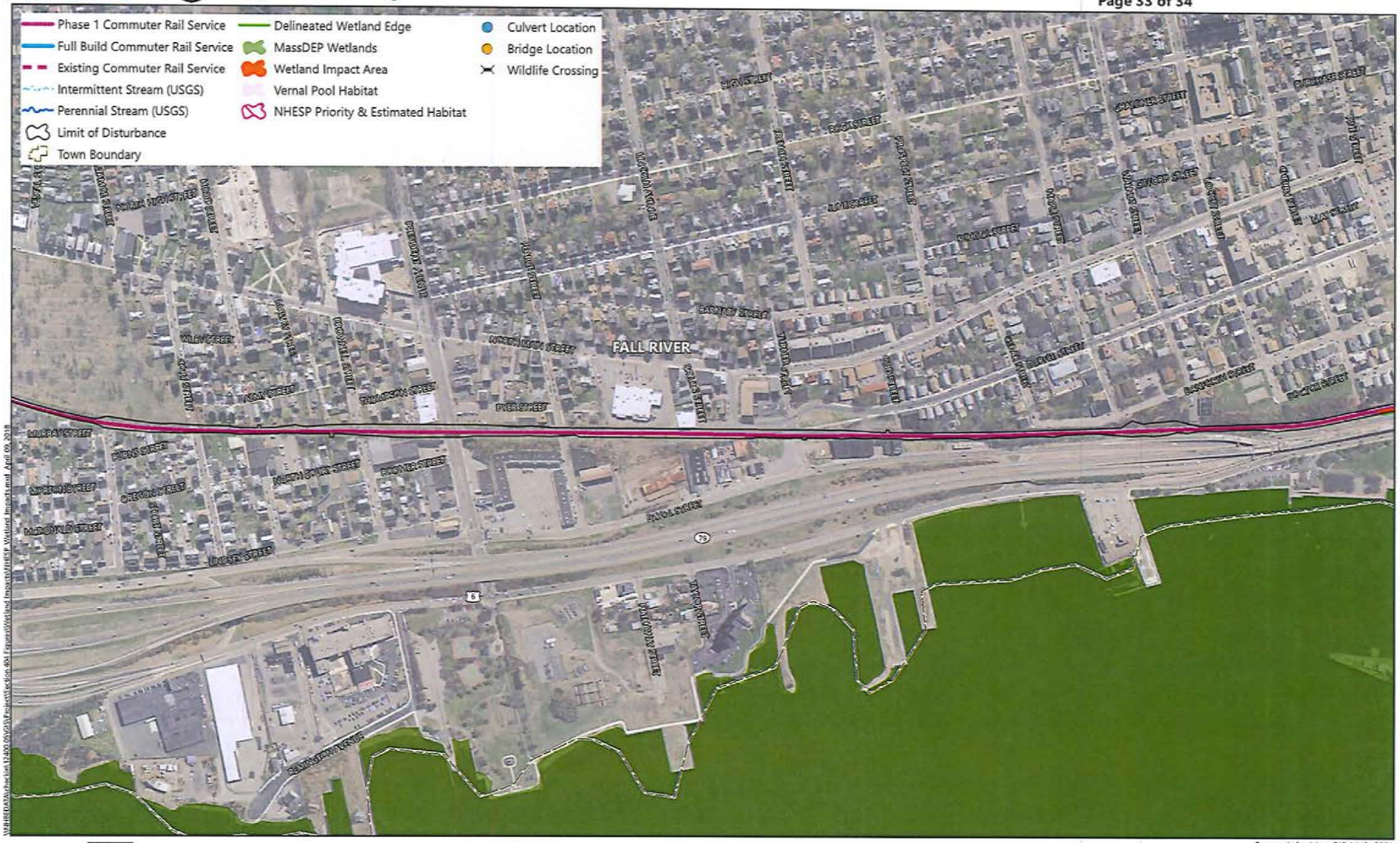
Source Info: MassGIS, VHB, ESRI



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority



Source Info: MassGIS, VHB, ESRI

SCR SOUTH COAST RAIL

Massachusetts Bay Transportation Authority

Source Info: MassGIS, VHB, ESRI

Attachment 3

Wildlife Crossings (prepared by VHB, Inc.; the "Crossing Plan")

Attachment 4 – Wildlife Crossings

MassDOT has committed to installing wildlife crossings within the Priority Habitat areas of state-listed eastern box turtle and wood turtle to improve habitat connectivity. The existing freight rail tracks cannot be crossed by turtles and are a barrier to turtle movement.

Design

Eastern box turtles reach a length of 5 to 7 inches, and a height of up to 7 inches when walking. Wood turtles are longer (5 to 9 inches) but with a lower carapace, and are approximately 4 to 6 inches tall when walking (based on measurement of photographs). Wildlife crossings have been designed to accommodate these heights and allow turtles to walk under the rails. NHESP has expressed a concern that wildlife crossings should be wide enough to allow a turtle to right itself if a turtle was walking along the ties and fell into the trough. To address this concern, the proposed width of troughs is larger than the length or width of a turtle, and should therefore allow a turtle to right itself.

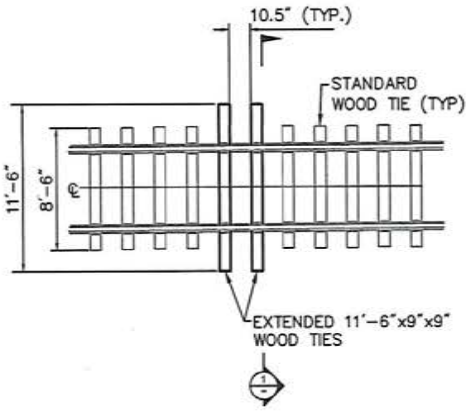
Wildlife crossings will be between-the-ties under-rail troughs. This type of crossing structure has been previously reviewed and approved by regulatory agencies as a successful wildlife crossing structure and has been demonstrated to work well for spotted turtles. As shown on the attached Detail Sheet, the between-the-tracks crossings create a 9-inch height gap underneath the rails, that is 10.5 inches wide. The two ties on either side of the trough will be extended ties (11.5 feet long) rather than the normal 8.5-foot standard timber ties, and will be deeper (7 inches wide by 9 inches high). These extended ties are needed to support the tracks, and will also assist turtles to enter the passage. The substrate within the crossing will be railroad ballast. To mark these locations for construction and maintenance, metal signs will be attached to the ties stating "No Ballast Between Ties" (see attached Detail Sheet).

The approximate locations of wildlife crossings are shown on the project 30% design plans and have been reviewed with NHESP. Attachment 1-D, Track Plans, shows the locations of all proposed wildlife crossings.

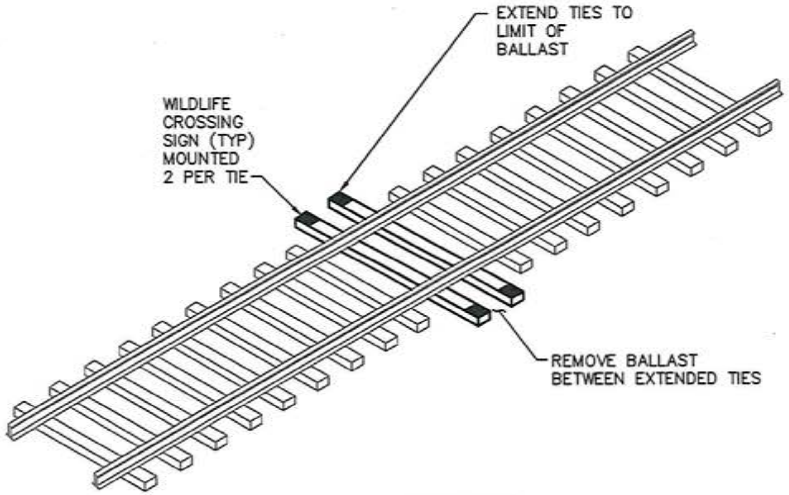
Inspection and Maintenance

MassDOT, or the railroad operator with responsibility for right-of-way maintenance, will inspect the wildlife crossings annually between April 1 and April 30 to ensure that the crossings are maintained in a functional condition. Corrective actions at each inspection include:

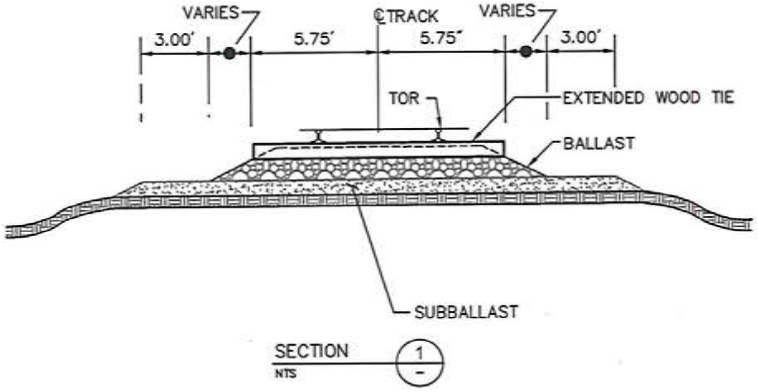
- Removing any sticks or branches that obstruct the passageway.
- Measuring the below-track clearance to ensure that there is a 9-inch high passageway.
- If the passageway is less than 9 inches, remove ballast or other material to restore clearance.



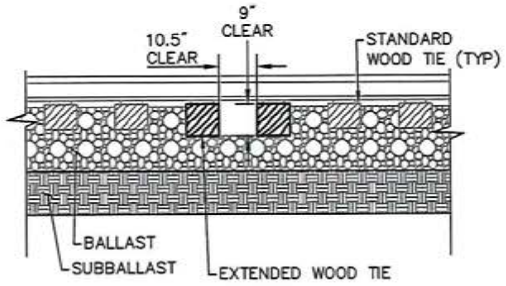
BETWEEN-TIE CROSSING PLAN
NTS



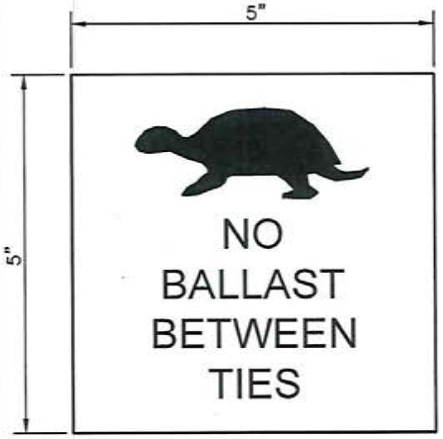
ISOMETRIC VIEW
NTS



SECTION 1
NTS



ELEVATION VIEW
NTS



WILDLIFE CROSSING SIGN
NTS

Wildlife Track Crossing

SCALE: N.T.S.

Attachment 4

Construction Period Protection Plans (prepared by VHB, Inc.; the "Protection Plans")

Attachment 3 – Construction Period Protection Plans

Plymouth Gentian and Three-angled Spike-rush

MassDOT will require the Contractor to implement protective measures to ensure that construction personnel and equipment do not enter the Thatcher's Pond wetland. These measures include:

- Prior to construction, the limit of work line will be marked with straw wattles and orange plastic construction fencing for an approximately 460-foot distance along the ROW (starting approximately 900 feet east of North Precinct Street and extending east).
- Signage will be placed along the construction fence at 50-foot intervals stating that the area is habitat for protected species and that no personnel are allowed beyond the fence.
- Construction supervisors in this area will be briefed on the importance of protecting rare species and the requirements of the Conservation and Management Permit
- MassDOT's Environmental Monitor will inspect the area immediately following installation of the construction fence and weekly during active construction and confirm that protective measures are in place and that the CMP requirements are being observed.

Eastern Box Turtle and Wood Turtle

The following measures would be undertaken during construction in designated Priority Habitat for eastern box turtles and wood turtles. These measures include exclusion barriers, contractor education, inspections and reporting.

Qualified Turtle Ecologist

MassDOT will employ a qualified turtle ecologist through the duration of construction in designated areas. MassDOT will submit the name and qualifications of the turtle ecologist to NHESP for approval.

Turtle Exclusion Barriers

Staked straw bales will be installed at the limits of work to provide an exclusion barrier for eastern box turtles and wood turtles. Exclusion barriers will be installed at the locations listed in the following table.

Turtle Exclusion Barrier Locations

Priority Habitat	Location
PH 715	Middleborough Secondary, Taunton, from Church Street 3,800 feet east
PH 715	Middleborough Secondary, Taunton, between Church Street and Middleborough Avenue
PH 628	Middleborough Secondary, Taunton, from Middleborough Avenue to the Lakeville Town Line (950 feet east of North Precinct Street)
PH 599	New Bedford Main Line, Berkley from Padelford Street 5,200 feet north
PH 599	New Bedford Main Line, Berkley from Padelford Street 700 feet south
PH 438	New Bedford Main Line, Freetown, from power line north of Chipaway Road north 2,100 feet
PH 425	New Bedford Main Line, Freetown/New Bedford, from Chipaway Road 900 feet south
PH 375	New Bedford Main Line, New Bedford, from Route 140 5,200 feet north
PH 517	Fall River Secondary, Freetown, between Copicut Road and Route 24

One-way turtle gates will be installed on the construction side of the barriers in locations determined by the turtle ecologist. These will consist of a sloped plane constructed using clean fill, with plywood wing-walls.

Following installation, the turtle ecologist will inspect the exclusion barriers to ensure that there are no gaps or potential locations of turtle access to the work zone. During this initial inspection, the turtle ecologist will visually survey the work areas for turtles and will remove any turtle found within the work zone in accordance with the protocols defined in the *Inspections and Monitoring* section below. The turtle ecologist will notify NHESP when the exclusion barriers are in place.

The Contractor is responsible for maintaining and repairing the exclusion barrier as directed by the turtle ecologist. Barriers must be removed at the completion of construction.

Inspections and Monitoring

The turtle ecologist will monitor the work areas daily during active construction, between April 1 and October 31. At each inspection, the ecologist will check the exclusion barrier and identify any needed repairs or maintenance. The ecologist will report any problems immediately to the contractor and MassDOT.

The turtle ecologist will visually inspect the work area for turtles on each inspection. If a turtle is found within the work area, the turtle ecologist will record the location using GPS, record the gender and dimensions of the turtle, and place the turtle outside of the exclusion barrier. Within ten days, the turtle ecologist will submit an observation report to NHESP using the on-line VPRS system.

Any mortality observed by the turtle ecologist, contractor or other on-site personnel shall be reported to NHESP by the turtle ecologist within 24 hours. The turtle ecologist will file a report with NHESP that identifies the cause of mortality (if possible), and will work with the Contractor and NHESP to develop additional protective measures if warranted.

Contractor Training

The turtle ecologist will be responsible for educating on-site personnel, including the Contractor's site supervisor, key construction personnel, and project engineers, to recognize the eastern box turtle and wood turtle and to take appropriate steps to protect these species. Identification cards will be prepared and distributed to site personnel (see attached example).

Any turtles found by the Contractor will be placed in a 20-gallon tub (or equivalent) and the turtle ecologist will be notified. The turtle ecologist will be responsible for collecting data, releasing the turtle outside of the exclusion barriers, and submitting an observation report. The Contractor will place any dead turtles found within the construction area in a plastic tray or bucket and notify the turtle ecologist immediately.

Reporting

The turtle ecologist will prepare an inspection log following each daily inspection. The ecologist will prepare a weekly inspection report and submit this report to MassDOT. By December 31 of each construction year, MassDOT will submit an annual inspection report to NHESP.

As described above, the turtle ecologist is responsible for:

- Notifying NHESP when the exclusion barriers have been installed in each location;
- Submitting observation reports to NHESP within 10 days of a turtle encounter, and
- Notifying NHESP within 24 hours of any occurrence of turtle mortality within the construction area.

Attachment 5

Invasive Species Management and Control Plan (prepared by VHB, Inc.)

Attachment 6 – Invasive Species Management and Control Plan

MassDOT has developed this Invasive Species Management and Control Plan to provide long-term protection to the populations of the state-listed plant species (*Sabatia kennedyana*, Plymouth gentian, and *Eleocharis tricostata*, three-angled spike-rush) found in Thatcher's Pond (Priority Habitat 628) in Taunton, MA. As there are no permanent impacts, there are no requirements for measures to provide a long-term net benefit to these species.

Right-of-way maintenance is critical to the protection of the tracks and ties and to maintaining railroad safety. Right-of-way maintenance can only be done in accordance with an approved Vegetated Management Plan (VMP) and Yearly Operating Plan (YOP) that have been reviewed by the Massachusetts Department of Food and Agriculture (DFA) and made available for public comment. These management plans are developed in accordance with the DFA's regulations, which prohibit or restrict the application of herbicide in sensitive areas such as close proximity to wetlands and public or private drinking water supplies.

MassDOT has agreed to restrict the use of herbicides within the ROW adjacent to Thatcher's Pond (an area approximately 460 feet long, starting approximately 900 feet east of North Precinct Street). This area will be marked "No Herbicide Application" using standard metal markers affixed to the ties. This specific location would be identified and shown on detailed project plans during the subsequent final design and permitting phase of the Project, when a VMP is developed.

This designation and signage will prohibit the railroad operator from spraying herbicide from rail-mounted vehicles. Herbicide application by hand (using backpack sprayers) would be used as needed to remove vegetation and control invasive species.

MassDOT or the railroad operator with responsibility for right-of-way maintenance will inspect this area annually for the presence of invasive species within the railroad ballasted area. Invasive species include:

- *Phragmites australis*, common reed
- *Rhamnus frangula*, glossy buckthorn
- *Phalaris arundinacea*, reed canary grass
- *Fallopia japonica*, Japanese knotweed
- *Elaeagnus umbellata*, Autumn olive
- *Celastrus orbiculatus*, oriental bittersweet
- *Rosa multiflora*, multiflora rose

Invasive species will be controlled manually by pulling (autumn olive, oriental bittersweet, multiflora rose, glossy buckthorn) or herbicide application (common reed, reed canary grass, Japanese knotweed). Herbicide (glyphosate) will be applied manually using a backpack sprayer. The herbicide will be colored with a dye so that the applicator can ensure that only the invasive target plants are sprayed. No herbicide will be used outside of the ballast.

Attachment E

Whale's Tooth Station Operations and Maintenance Plan

Prepared for:

Massachusetts Department of Transportation (MassDOT)

10 Park Plaza

Boston, Massachusetts 02116

Prepared by:

The VHB/HNTB Team – a Joint Venture

99 High Street, 10th Floor

Boston, Massachusetts

MassDOT Contract No. 99771

July 31, 2018

SOUTH COAST RAIL

Whale's Tooth Station

New Bedford, Massachusetts

PREPARED FOR

massDOT

Massachusetts Department of Transportation
10 Park Plaza
Boston, Massachusetts

PREPARED BY

vhb

99 High Street
Boston, Massachusetts 02110
617.728.777

May 2018
Resubmitted: July 2018

Stormwater Operation and Maintenance Plan

Project Information

Site

Whale's Tooth Station
Located at 532 Acushnet Avenue
New Bedford, Massachusetts

Owner

Housing 70 Corp
131 William Street
New Bedford, Massachusetts

Site Supervisor

Site Manager Name
Site Manager Address
Site Manager City, State Zip
Site Manager Phone Number

Name: _____

Telephone: _____

Cell phone: _____

Email: _____

Description of Stormwater Maintenance Measures

The following Operation and Maintenance (O&M) program is proposed to ensure the continued effectiveness of the stormwater management system. Attached to this plan are a Construction Stormwater Best Management Practices (BMP) Checklist, Operation and Maintenance Log Form, and BMP Maintenance Figure for use during the long-term operation and maintenance of the stormwater management system.

Area Drains

- All area drains shall be inspected and cleaned a minimum of at least once per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the drain and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the area drain grates must be kept free of snow and ice.
- During warmer periods, the area drain grates must be kept free of leaves, litter, sand, and debris.

Roof Drain Leaders

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets draining to the subsurface bed twice per year as necessary.

Stormwater Outfalls and Sediment Forebays

The stormwater drainage system contains many outfall locations, where treated stormwater is discharged to surface wetlands or existing drainage pipes. Outfall locations are shown on Figure C-1 included herein.

- At a minimum, inspect outfalls annually.
- At a minimum, inspect sediment forebays quarterly and clean them out annually. When mowing grasses, keep the grass height no greater than 6-inches. Set mower blades no lower than 3 to 4 inches. Annual inspections should be supplemented after large storms, when washouts may occur.
- Maintain vegetation around outfalls to prevent blockages at the outfall.
- Maintain rip rap pad below each outfall and replace any washouts.
- Remove and dispose of any trash or debris at the outfall.
- Replace vegetation damaged during the clean-out by either reseeding or resodding. When reseeding, incorporate practices such as hydroseeding with a

tackifier, blanket, or similar practice to ensure no scour occurs in the forebay, while the seeds germinate and develop roots

Bioretention Basins

Mulching is an important part of bioretention basin maintenance. Mulch keeps the soil moist, allowing for easy infiltration of rain water. Un-mulched surfaces may develop into a hardpan, a condition in which the soil surface becomes cemented together, forming a hard, impervious layer. Mulching also protects plants and reduces weed growth.

Initial Post-Construction Inspection

- During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor.
- Any dead vegetation found after the first year must be replaced.
- Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

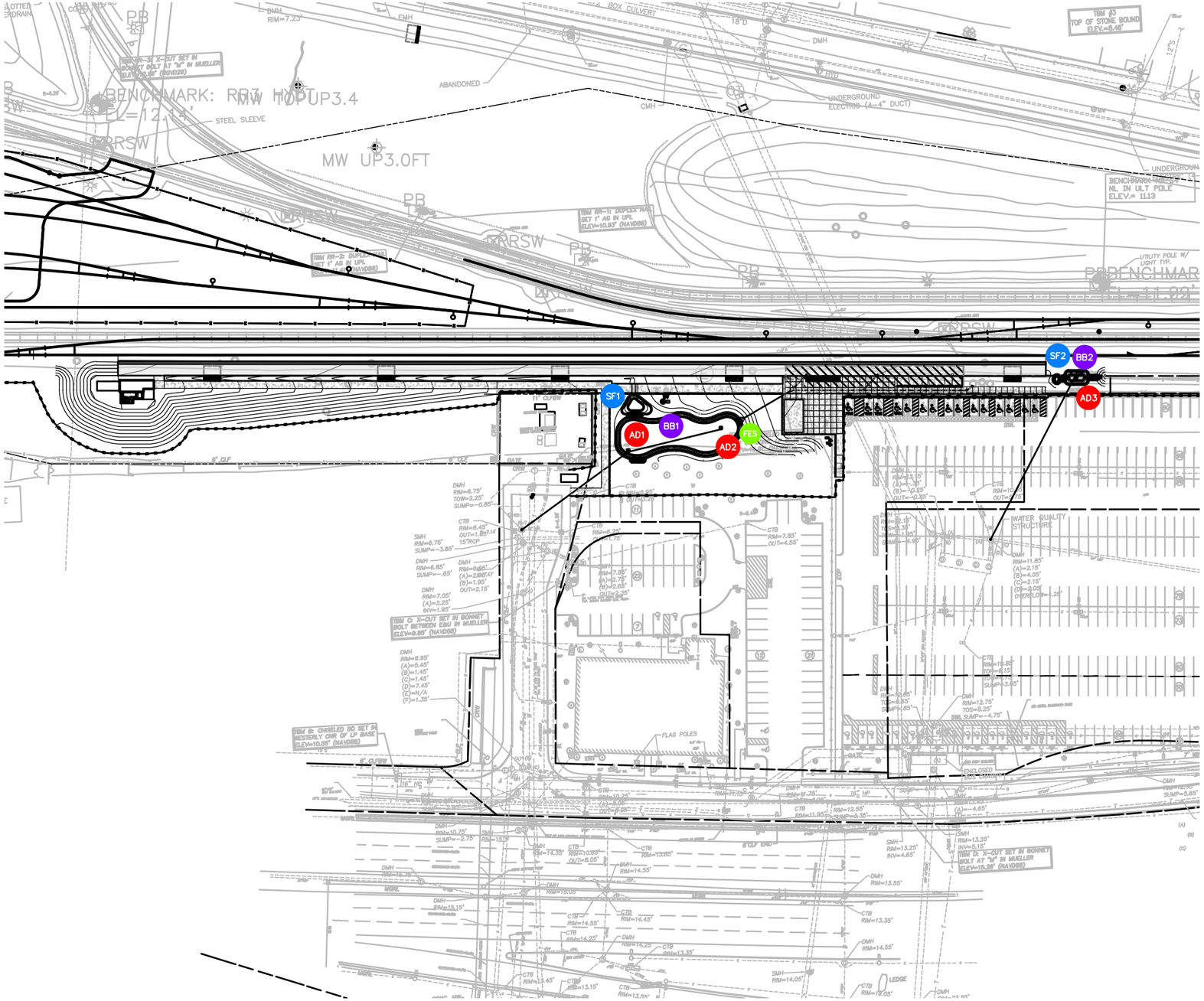
Long-Term Maintenance

- Weeds and invasive plant species shall be removed by hand.
- Leaf litter and other detritus shall be removed twice per year.
- If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.
- Trees and shrubs should be inspected twice per year to evaluate health and attended to as necessary.
- Re-mulch bioretention basins with hardwood mulch to a depth of 3 inches each spring or whenever erosion is evident. The entire area may require mulch replacement once every two to three years. Mulch depth shall not exceed 3 inches.

Inspections and Cleaning

- Bioretention basins shall be inspected twice during for the first year and annually thereafter for sediment buildup, erosion, vegetative conditions, etc. If sediment build-up is found, core aeration or cultivating of un-vegetated areas may be required to ensure adequate filtration.
- The inflow location should be inspected annually for clogging. Sediment build up is a common problem where runoff leaves an impervious surface and enters a vegetative or earthen surface. Any built-up sediment should be removed to prevent runoff from bypassing the facility.
- The overflow structure and underdrain standpipes should be inspected annually to ensure that they are functioning.

BMP Maintenance Figure



BIORETENTION BASINS MAINTENANCE REQUIREMENTS

INITIAL POST-CONSTRUCTION INSPECTION

BIORETENTION BASINS SHOULD BE INSPECTED AFTER EVERY MAJOR STORM FOR THE FIRST FEW MONTHS TO ENSURE PROPER STABILIZATION AND FUNCTION.

DURING THE INITIAL PERIOD OF VEGETATION ESTABLISHMENT, PRUNING AND WEEDING ARE REQUIRED TWICE IN FIRST YEAR BY CONTRACTOR.

ANY DEAD VEGETATION FOUND AFTER THE FIRST YEAR MUST BE REPLACED. PROPER MULCHING IS MANDATORY AND REGULAR WATERING MAY BE REQUIRED INITIALLY TO ENSURE PROPER ESTABLISHMENT OF NEW VEGETATION.

LONG-TERM MAINTENANCE

WEEDS AND INVASIVE PLANT SPECIES SHALL BE REMOVED BY HAND.

LEAF LITTER AND OTHER DETRITUS SHALL BE REMOVED TWICE PER YEAR.

IF NEEDED TO MAINTAIN AESTHETIC APPEARANCE, PERENNIAL PLANTINGS MAY BE TRIMMED AT THE END OF THE GROWING SEASON.

TREES AND SHRUBS SHOULD BE INSPECTED TWICE PER YEAR TO EVALUATE HEALTH AND ATTENDED TO AS NECESSARY.

RE-MULCH BIORETENTION BASINS WITH WELL-AGED HARDWOOD MULCH TO A DEPTH OF 3 INCHES EACH SPRING OR WHENEVER EROSION IS EVIDENT. THE ENTIRE AREA MAY REQUIRE MULCH REPLACEMENT ONCE EVERY TWO TO THREE YEARS. MULCH DEPTH SHALL NOT EXCEED 3 INCHES AND THE DEPTH OF THE DEPRESSION SHALL NOT BE COMPROMISED BY THE ACCUMULATION OF VEGETATION OR OLD MULCH.

SEEDED GROUND COVER OR GRASS AREAS SHALL NOT RECEIVE MULCHING.

FERTILIZERS SHOULD NOT BE USED IN THE BIORETENTION BASINS AS EXCESSIVE NUTRIENTS IN THE BIORETENTION BASINS MAY MIGRATE TO THE UNDERDRAIN AND BE DISCHARGED TO ADJACENT SURFACE WATERS.

TEST PH OF THE SOILS IN THE PLANTING BED ANNUALLY. IF THE PH IS BELOW 5.2, LIMESTONE SHOULD BE APPLIED TO INCREASE IT. IF THE PH IS ABOVE 8.0, IRON SULFATE PLUS SULFUR SHOULD BE ADDED TO REDUCE IT.

BIORETENTION BASINS MAY REQUIRE WATERING DURING PERIODS OF EXTENDED DROUGHT.

STORMWATER OUTFALL AND SEDIMENT FOREBAY MAINTENANCE REQUIREMENTS

INSPECT OUTFALL LOCATIONS MONTHLY FOR THE FIRST THREE MONTHS AFTER CONSTRUCTION TO ENSURE PROPER FUNCTIONING AND CORRECT ANY AREAS THAT HAVE SETTLED OR EXPERIENCED WASHOUTS.

INSPECT OUTFALLS ANNUALLY AFTER INITIAL THREE MONTH PERIOD.

ANNUAL INSPECTIONS SHOULD BE SUPPLEMENTED AFTER LARGE STORMS, WHEN WASHOUTS MAY OCCUR.

MAINTAIN VEGETATION AROUND OUTFALLS TO PREVENT BLOCKAGES AT THE OUTFALL.

MAINTAIN RIP RAP PAD WHERE APPLICABLE AND REPLACE ANY WASHOUTS.

REMOVE AND LEGALLY DISPOSE OF ANY TRASH OR DEBRIS AT THE OUTFALL.

AREA DRAIN MAINTENANCE REQUIREMENTS

ALL AREA DRAINS SHALL BE INSPECTED AT LEAST TWO TIMES PER YEAR AND CLEANED A MINIMUM OF AT LEAST ONCE PER YEAR.

SEDIMENT (IF MORE THAN SIX INCHES DEEP) AND/OR FLOATABLE POLLUTANTS SHALL BE PUMPED FROM THE DRAIN AND DISPOSED OF AT AN APPROVED OFFSITE FACILITY IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS.

ANY STRUCTURAL DAMAGE OR OTHER INDICATION OF MALFUNCTION WILL BE REPORTED TO THE SITE MANAGER AND REPAIRED AS NECESSARY.

DURING COLDER PERIODS, THE AREA DRAIN GRATES MUST BE KEPT FREE OF SNOW AND ICE.

DURING WARMER PERIODS, THE AREA DRAIN GRATES MUST BE KEPT FREE OF LEAVES, LITTER, SAND, AND DEBRIS.

LEGEND

AD	AREA DRAIN
FES	STORMWATER OUTFALL
BB	BIORETENTION BASINS
SF	SEDIMENT FOREBAY

0 50 100 Feet

BMP Maintenance Figure
Whale's Tooth Station
South Coast Rail
New Bedford, MA

Figure F-1

May 2018

Operation and Maintenance Log Form with Inspection Schedule

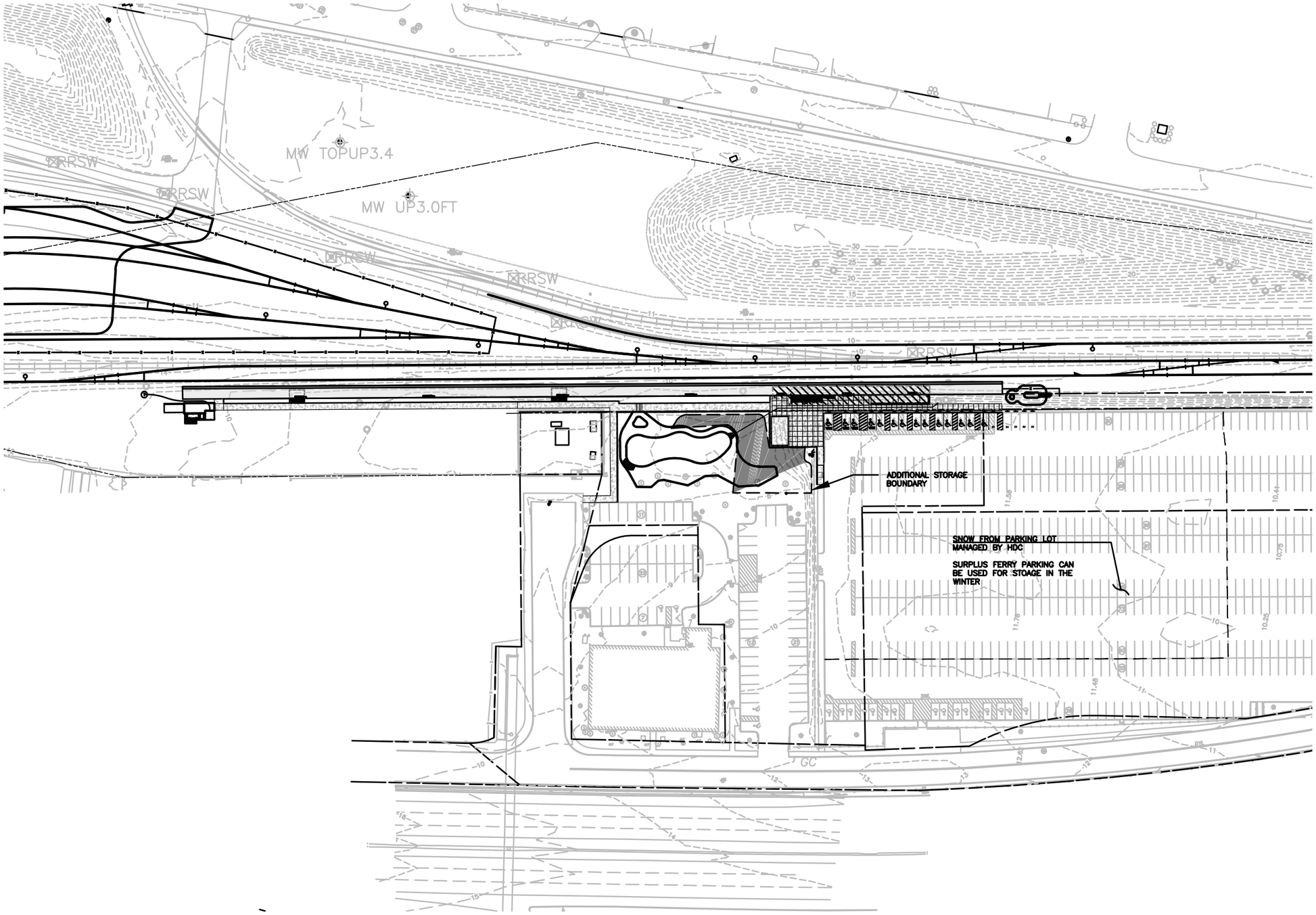
Whale's Tooth Station, New Bedford, MA

Long-Term Best Management Practices –Operation and Maintenance Log Form with Inspection Schedule

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Bioretention Basin 1	Bi-annually				☐yes ☐no		
Sedimentation Forebay 1	Annually				☐yes ☐no		
Area Drain 1	Bi-annually				☐yes ☐no		
Area Drain 2	Bi-annually				☐yes ☐no		
Stormwater Outfall FES-1	Annually				☐yes ☐no		
Bioretention Basin 2	Bi-annually				☐yes ☐no		
Sedimentation Forebay 2	Annually				☐yes ☐no		
Area Drain 2	Bi-annually				☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		
					☐yes ☐no		

Stormwater Control Manager _____

Snow Storage Plan



Legend

Approximate Snow Storage Area

Notes

1. The Whale's Tooth Station area has approximately 0.4 acres of impervious area. The plan does not include snow storage for the roof or pervious areas.

2. The plan depicts approximately 3,500 SF of area available for snow storage within the station area. This area is estimated to accommodate an approximate 4' snowfall, assuming 5:1 compaction and an average snow pile height of 4.0'. Additional snow storage is available in pervious areas throughout the project area.

3. Under no circumstance shall snow be stored in any wetland resource area or proposed stormwater best management practice.

4. Snow storage will be implemented to avoid hydrants, fences, landscaping, and other permanent features.

0 50 100 Feet

Snow Storage Plan
Whale's Tooth Station
South Coast Rail
New Bedford, MA

Figure F-2

July 2018

Attachment F

MassDEP Stormwater Handbook Vol. 2 Ch. 2 Excerpt

Prepared for:

Massachusetts Department of Transportation (MassDOT)

10 Park Plaza

Boston, Massachusetts 02116

Prepared by:

The VHB/HNTB Team – a Joint Venture

99 High Street, 10th Floor

Boston, Massachusetts

MassDOT Contract No. 99771

July 31, 2018

Bioretention Areas & Rain Gardens

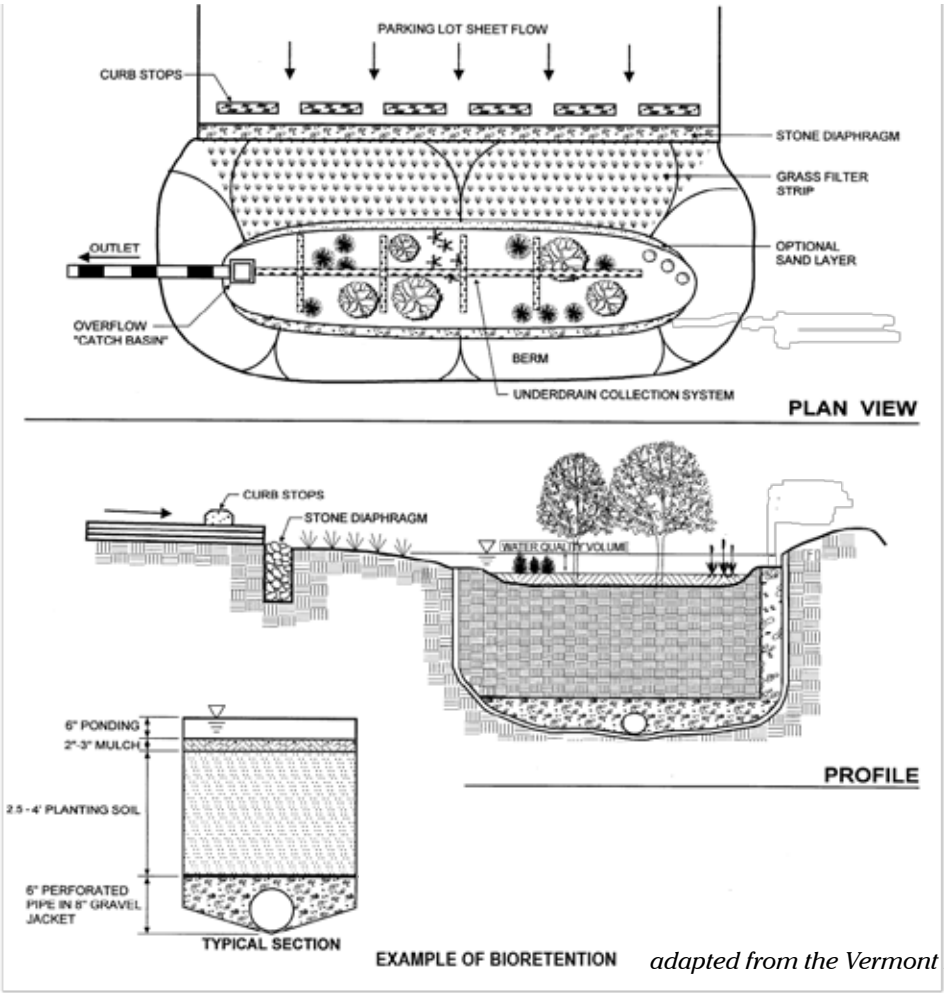
Description: Bioretention is a technique that uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Bioretention cells (also called rain gardens in residential applications) are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted with dense native vegetation. Stormwater runoff is directed into the cell via piped or sheet flow. The runoff percolates through the soil media that acts as a filter.
There are two types of bioretention cells: those that are designed solely as an organic filter filtering bioretention areas and those configured to recharge groundwater in addition to acting as a filter exfiltrating bioretention areas. A filtering bioretention area includes an impermeable liner and underdrain that intercepts the runoff before it reaches the water table so that it may be conveyed to a discharge outlet, other best management practices, or the municipal storm drain system. An exfiltrating bioretention area has an underdrain that is designed to enhance exfiltration of runoff into the groundwater.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	N/A
3 - Recharge	An exfiltrating bioretention area provides groundwater recharge.
4 - TSS Removal	90% TSS removal credit with adequate pretreatment
5 - Higher Pollutant Loading	Can be used for certain land uses with higher potential pollutant loads if lined and sealed until adequate pretreatment is provided. Adequate pretreatment must include 44% TSS removal prior to infiltration. For land uses that have the potential to generate runoff with high concentrations of oil and grease such as high intensity use parking lots and gas stations, adequate pretreatment may also include an oil grit separator, sand filter or equivalent. In lieu of an oil grit separator or sand filter, a filtering bioretention area also may be used as a pretreatment device for infiltration practices exfiltrating runoff from land uses with a potential to generate runoff with high concentrations of oil and grease.
6 - Discharges near or to Critical Areas	Good option for discharges near cold-water fisheries. Should not be used near bathing beaches and shellfish growing areas.
7 - Redevelopment	Suitable with appropriate pretreatment

Pollutant Removal Efficiencies

- Total Suspended Solids (TSS) — 90% with vegetated filter strip or equivalent
- Total Nitrogen — 30% to 50% if soil media at least 30 inches
- Total Phosphorus — 30% to 90%
- Metals (copper, lead, zinc, cadmium) — 40% to 90%
- Pathogens (coliform, e coli) — Insufficient data



EXAMPLE OF BIORETENTION *adapted from the Vermont Stormwater Manual*

Special Features:

- Can be lined and sealed to prevent recharge where appropriate
- Adequate pretreatment is essential
- Not recommended in areas with steep slope
- Depth of soil media depends on type of vegetation that is proposed
- Soil media must be 30 inches deep to achieve removal of nitrogen

Advantages/Benefits:

- Can be designed to provide groundwater recharge and preserves the natural water balance of the site
- Can be designed to prevent recharge where appropriate
- Supplies shade, absorbs noise, and provides windbreaks
- Can remove other pollutants besides TSS including phosphorus, nitrogen and metals
- Can be used as a stormwater retrofit by modifying existing landscape or if a parking lot is being resurfaced
- Can be used on small lots with space constraints
- Small rain gardens are mosquito death traps
- Little or no hazard for amphibians or other small animals

Disadvantages/Limitations:

- Requires careful landscaping and maintenance
- Not suitable for large drainage areas

Maintenance

Activity	Frequency
Inspect and remove trash	Monthly
Mow	2 to 12 times per year
Mulch	Annually
Fertilize	Annually
Remove dead vegetation	Annually
Prune	Annually

Bioretention Areas & Rain Gardens

Not all bioretention cells are designed to exfiltrate. Only the infiltration requirements are applicable to bioretention cells intended to exfiltrate.

Applicability

Bioretention areas can provide excellent pollutant removal for the "first flush" of stormwater runoff. Properly designed and maintained cells remove suspended solids, metals, and nutrients, and can infiltrate an inch or more of rainfall. Distributed around a property, vegetated bioretention areas can enhance site aesthetics. In residential developments they are often described as "rain gardens" and marketed as property amenities. Routine maintenance is simple and can be handled by homeowners or conventional landscaping companies, with proper direction.

Bioretention systems can be applied to a wide range of commercial, residential, and industrial developments in many geologic conditions; they work well on small sites and on large sites divided into multiple small drainage areas. Bioretention systems are often well suited for ultra-urban settings where little pervious area exists. Although they require significant space (approximately 5% to 7% of the area that drains to them), they can be integrated into parking lots, parking lot islands, median strips, and traffic islands. Sites can be retrofitted with bioretention areas by replacing existing parking lot islands or by re-configuring a parking lot during resurfacing. On residential sites, they are commonly used for rooftop and driveway runoff.

Effectiveness

Bioretention areas remove pollutants through filtration, microbe activity, and uptake by plants; contact with soil and roots provides water quality treatment better than conventional infiltration structures. Studies indicate that bioretention areas can remove from 80% to 90% of TSS. If properly designed and installed, bioretention areas remove phosphorus, nitrogen, metals, organics, and bacteria to varying degrees.

Bioretention areas help reduce stress in watersheds that experience severe low flows due to excessive impervious cover. Low-tech, decentralized bioretention areas are also less costly to design, install, and maintain than conventional stormwater technologies that treat runoff at the end of the pipe. Decentralized bioretention cells can also reduce the size of storm drain pipes, a major component of stormwater treatment costs. Bioretention areas enhance the landscape in a variety of ways: they improve the appearance of developed sites, provide windbreaks, absorb noise, provide wildlife habitat, and reduce the urban heat island effect.

Planning Considerations

Filtering bioretention areas are designed with an impermeable liner and underdrain so that the stormwater may be transported to additional BMPs for treatment and/or discharge. Exfiltrating bioretention areas are designed so that following treatment by the bioretention area the stormwater may recharge the groundwater.

Both types of bioretention areas may be used to treat runoff from land uses with higher potential pollutant loads. However, exfiltrating bioretention areas may be used to treat runoff from land uses with higher potential pollutant loads, only if pretreatment has been provided to achieve TSS removal of at least 44%. If the land use has the potential to generate runoff with high concentrations of oil and grease, other types of pretreatment, i.e., a deep sump catch basin and oil grit separator or a sand filter, is required prior to discharge of runoff to an exfiltrating bioretention area. A filtering bioretention area may also be used as a pretreatment device for an exfiltrating bioretention area or other infiltration practice that exfiltrates runoff from land uses with a potential to generate runoff with high concentrations of oil and grease.

To receive 90% TSS removal credit, adequate pretreatment must be provided. If the flow is piped to the bioretention area a deep sump catch catch basin and sediment forebay should be used to provide pretreatment. For sheet flow, there are a number or pretreatment options. These options include:

- A vegetated filter strip, grass channel or water quality swale designed in accordance with the specifications set forth in Chapter 2.
- A grass and gravel combination. This should consist of at least 8 inches of gravel followed by 3 to 5 feet of sod. (source: North Carolina Stormwater Manual, 2007, http://h2o.enr.state.nc.us/su/documents/Ch12-Bioretention_001.pdf)
- Pea diaphragm combined with a vegetated filter strip specially designed to provide pretreatment for a bioretention area as set forth in the following table. (source: Georgia Stormwater Manual and Claytor and Schuler 1996)

Dimensions for Filter Strip Designed Specially to Provide Pretreatment for Bioretention Area

Parameter	Impervious Area				Pervious Areas (lawns, etc.)			
Maximum inflow approach length (feet)	35		75		75		100	
Filter strip slope (max=6%)	<2%	>2%	<2%	>2%	<2%	>2%	<2%	>2%
Filter strip minimum length (feet)	10	15	20	25	10	12	15	18

Bioretention areas must not be located on slopes greater than 20%. When the bioretention area is designed to exfiltrate, the design must ensure vertical separation of at least 2 feet from the seasonal high groundwater table to the bottom of the bioretention cell.

For residential rain gardens, pick a low spot on the property, and route water from a downspout or sump pump into it. It is best to choose a location with full sun, but if that is not possible, make sure it gets at least a half-day of sunlight.

Do not excavate an extensive rain garden under large trees. Digging up shallow feeder roots can weaken or kill a tree. If the tree is not a species that prefers moisture, the additional groundwater could damage it. Size the bioretention area using the methodology set forth in Volume 3.

Design

Size the bioretention area to be 5% to 7% of the area draining to it. Determine the infiltrative capacity of the underlying native soil by performing a soil evaluation in accordance with Volume 3. Do not use a standard septic system (i.e., Title 5) percolation test to determine soil permeability.

The depth of the soil media must be between 2 and 4 feet. This range reflects the fact that most of the pollutant removal occurs within the first 2 feet of soil and that excavations deeper than 4 feet become expensive. The depth selected should accommodate the vegetation. If the minimum depth is used, only shallow rooted plants and grasses my be used. If there is a Total Maximum Daily Load that requires nitrogen to be removed from the stormwater dischrges, the bioretention area should have a soil media with a depth of at least 30 inches, because nitrogen removal takes place 30 inches below the ground surface. If trees and shrubs are to be planted, the soil media should be at least 3 feet.

Size the cells (based on void space and ponding area) at a minimum to capture and treat the required water quality volume (the first 0.5 inch or 1 inch of runoff) if intended to be used for water quality treatment (Stormwater Standard No. 4), the required recharge volume if used for recharge (Stormwater Standard No. 3), or the larger of the two volumes if used to achieve compliance with both Stormwater Standards 3 and 4.

Cover the bottom of the excavation with coarse gravel, over pea gravel, over sand. Earlier designs used filter fabric as a bottom blanket, but more recent experiences show that filter fabric is prone to clogging. Consequently, do not use fabric filters or sand curtains. Use the Engineered Soil Mix below.

Engineered Soil Mix for Bioretention Systems Designed to Exfiltrate

- The soil mix for bioretention areas should be a mixture of sand compost and soil.
  - o 40 % sand,
  - o 20-30% topsoil, and
  - o 30-40% compost.

- The soil mix must be uniform, free of stones, stumps, roots or similar objects larger than 2 inches. Clay content should not exceed 5%.
- Soil pH should generally be between 5.5-6.5, a range that is optimal for microbial activity and adsorption of nitrogen, phosphorus, and other pollutants.
- Use soils with 1.5% to 3% organic content and maximum 500-ppm soluble salts.
- The sand component should be gravelly sand that meets ASTM D 422.

Sieve Size	Percent Passing
2-inch	100
¾-inch	70-100
¼-inch	50-80
U.S. No. 40	15-40
U.S. No. 200	0-3

- The topsoil component shall be a sandy loam, loamy sand or loam texture.
- The compost component must be processed from yard waste in accordance with MassDEP Guidelines (see http://www.mass.gov/dep/recycle/reduce/leafguid.doc). The compost shall not contain biosolids.

On-site soil mixing or placement is not allowed if soil is saturated or subject to water within 48 hours. Cover and store soil to prevent wetting or saturation.

Test soil for fertility and micro-nutrients and, only if necessary, amend mixture to create optimum conditions for plant establishment and early growth.

Grade the area to allow a ponding depth of 6 to 8 inches; depending on site conditions, more or less ponding may be appropriate.

Cover the soil with 2 to 3 inches of fine-shredded hardwood mulch.

The planting plan shall include a mix of herbaceous perennials, shrubs, and (if conditions permit) understory trees that can tolerate intermittent ponding, occasional saline conditions due to road salt, and extended dry periods. A list of plants that are suitable for bioretention areas can be found at the end of this section. To avoid a monoculture, it is a good practice to include one tree or shrub per 50 square feet of bioretention area, and at least 3 species each of herbaceous perennials and shrubs. Invasive and exotic species are prohibited. The planting plan should also meet any applicable local landscaping requirements.

All exfiltrating bioretention areas must be designed to drain within 72 hours. However, rain gardens are typically designed to drain water within a day and are thus unlikely to breed mosquitoes.

Bioretention cells, including rain gardens, require pretreatment, such as a vegetated filter strip. A stone or pea gravel diaphragm or, even better, a concrete level spreader upstream of a filter strip will enhance sheet flow and sediment removal.
Bioretention cells can be dosed with sheet flow, a surface inlet, or pipe flow. When using a surface inlet, first direct the flow to a sediment forebay. Alternatively, piped flow may be introduced to the bioretention system via an underdrain.

For bioretention cells dosed via sheet flow or surface inlets, include a ponding area to allow water to pond and be stored temporarily while stormwater is exfiltrating through the cell. Where bioretention areas are adjacent to parking areas, allow three inches of freeboard above the ponding depth to prevent flooding.

Most bioretention cells have an overflow drain that allows ponded water above the selected ponding depth to be dosed to an underdrain. If the bioretention system is designed to exfiltrate, the underdrain is not connected to an outlet, but instead terminates in the bioretention cell. If the bioretention area is not designed to exfiltrate, the underdrain is connected to an outlet for discharge or conveyance to additional best management practices.

Construction

During construction, avoid excessively compacting soils around the bioretention areas and accumulating silt around the drain field. To minimize sediment loading in the treatment area, direct runoff to the bioretention area only from areas that are stabilized; always divert construction runoff elsewhere.

To avoid compaction of the parent material, work from the edge of the area proposed as the location of an exfiltrationg bioretention cell. Never direct runoff to the cell until the cell and the contributing drainage areas are fully stabilized.

Place planting soils in 1-foot to 2-foot lifts and compact them with minimal pressure until the desired elevation is reached. Some engineers suggest flooding the cell between each lift placement in lieu of compaction.

Maintenance

Premature failure of bioretention areas is a significant issue caused by lack of regular maintenance. Ensuring long-term maintenance involves sustained public education and deed restrictions or covenants for privately owned cells. Bioretention areas require careful attention while plants are being established

Bioretention Maintenance Schedule

Activity	*Time of Year*	*Frequency*
Inspect & remove trash	Year round	Monthly
Mulch	Spring	Annually
Remove dead vegetation	Fall or Spring	Annually
Replace dead vegetation	Spring	Annually
Prune	Spring or Fall	Annually
Replace entire media & all vegetation	Late Spring/early Summer	As needed*

** Paying careful attention to pretreatment and operation & maintenance can extend the life of the soil media*

and seasonal landscaping maintenance thereafter.

In many cases, a landscaping contractor working elsewhere on the site can complete maintenance tasks. Inspect pretreatment devices and bioretention cells regularly for sediment build-up, structural damage, and standing water.

Inspect soil and repair eroded areas monthly. Re-mulch void areas as needed. Remove litter and debris monthly. Treat diseased vegetation as needed. Remove and replace dead vegetation twice per year (spring and fall).

Proper selection of plant species and support during establishment of vegetation should minimize—if not eliminate—the need for fertilizers and pesticides. Remove invasive species as needed to prevent these species from spreading into the bioretention area. Replace mulch every two years, in the early spring. Upon failure, excavate bioretention area, scarify bottom and sides, replace filter fabric and soil, replant, and mulch. A summary of maintenance activities can be found on the previous page.

Because the soil medium filters contaminants from runoff, the cation exchange capacity of the soil media will eventually be exhausted. When the cation exchange capacity of the soil media decreases, change the soil media to prevent contaminants from migrating to the groundwater, or from being discharged via an underdrain outlet. Using small shrubs and plants instead of larger trees will make it easier to replace the media with clean material when needed.

Plant maintenance is critical. Concentrated salts in roadway runoff may kill plants, necessitating removal of dead vegetation each spring and replanting. The operation and maintenance plan must include measures to make sure the plants are maintained. This is particularly true in residential subdivisions, where the operation and maintenance plan may assign each homeowner the legal responsibility to maintain a bioretention cell or rain garden on his or her property. Including the requirement in the property deed for new subdivisions may alert residential property owners to their legal responsibilities regarding the bioretention cells constructed on their lot.

Cold Climate Considerations

Never store snow in bioretention areas. The Operation and Maintenance plan must specify where on-site snow will be stored. All snow dumps must comply with MassDEP's guidance. When bioretention areas are located along roads, care must be taken during plowing operations to prevent snow from being plowed into the bioretention areas. If snow is plowed into the cells, runoff may bypass the cell and drain into downgradient wetlands without first receiving the required water quality treatment, and without recharging the groundwater.

References

Center for Watershed Protection, 2000, Bioretention as a Water Quality Best Management Practice, Article 110 from Watershed Protection Techniques; http://www.cwp.org/Downloads/ELC_PWP110.pdf

Federal Highway Administration , YEAR, Bioretention Fact Sheet, http://www.fhwa.dot.gov/environment/

Low Impact Development Center, 2003, Drainage – Bioretention Specification, http://www.lowimpactdevelopment.org/epa03/biospec.htm

Prince Georges County, 2002, Bioretention Manual, http://www.goprincegeorgescounty.com/der/bioretention.asp

Puget Sound Action Team, 2005, Low Impact Development, Pp. 174 - 184 http://www.psat.wa.gov/Publications/LID_tech_manual05/LID_manual2005.pdf

U.S. Environmental Protection Agency, 1999, Stormwater Technology Fact Sheet, Bioretention, EPA 832-F-99-012, http://www.epa.gov/owm/mtb/biortn.pdf

U.S. Environmental Protection Agency, 2005, National Management Measures to Control Nonpoint Source Pollution from Urban Areas, Publication Number EPA 841-B-05-004, Pp. 5-29 http://www.epa.gov/nps/urbanmm/

University of North Carolina, www.bae.ncsu.edu/topic/bioretention www.bae.ncsu.edu/stormwater/PublicationFiles/DesigningRainGardens2001.pdf

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Agrostis alba redtop	FAC	Mesic-Xeric	1-2	H	–	H	H	Shade	Grass	2-3'	Fiberous Shallow	Yes	High	–
Andropogon gerardi bluejoint	FAC	Dry Mesic-Mesic	1-2	–	–	–	–	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	–
Andropogon virginicus broomsedge	–	Wet meadow	1-2	L	–			Full sun	Grass	1-3'		Yes	High	Tolerant of fluctuating water levels and drought.
Carex vulpinoidea fox sedge	OBL	Freshwater marsh	2-4	L	–			Sun to partial sun	Grass	2-3.5'	Rhizome	Yes	High	–
Chelone glabra														
Deschampsia caespitosa tufted hairgrass	FACW	Mesic to wet Mesic	2-4	H	–	H	H	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	May become invasive.
Glyceria striata fowl mannagrass, nerved mannagrass	OBL	Freshwater marsh, seeps	1-2	L	–			Partial shade to full shade	Grass	2-4'	Rhizome	Yes	High	–
Hedera helix English Ivy	FACU	Mesic	1-2	–	–	–	H	Sun	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Hibiscus palustris														
Iris kaempferi														

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in wetlands and non-wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Occur almost always in wetlands

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Lobelia siphilitica														
Lotus Corniculatus birdsfoot-trefoil	FAC	Mesic-Xeric	1-2	H	L	H	H	Sun	Grass	2-3'	Fiberous Shallow	Yes	High	Member of the legume family.
Onoclea sensibilis sensitive fern, beadfern	FACW							Shade		1-3.5'			H	
Pachysandra terminalis Japanese pachysandra	FACU	Mesic	1-2	–	–	–	M	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Panicum virgatum switch grass	FAC to FACU	Mesic	2-4	H	–	–	H	Sun or Shade	Grass	4-5'	Fiberous Shallow	Yes	High	Can spread fast and reach height of 6'
Vinca major large periwinkle	FACU	Mesic	1-2	–	–	–	H	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	Sensitive to soil compaction and pH changes.
Vinca minor common periwinkle	FACU	Mesic	1-2	–	–	–	H	Shade	Evergreen ground cover	–	Fiberous Shallow	No	Low	–
Indian grass														
Little bluestem														
Deer tongue														
Green coneflower														

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in wetlands and non-wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Occur almost always in wetlands

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Aronia arbutifolia (Pyrus arbutifolia) red chokeberry	FACW	Mesic	1-2	H	_	H	M	Sun to partial sun	Deciduous shrub	6-12'	_	Yes	High	Good bank stabilizer. Tolerates drought.
Clethra alnifolia sweet pepperbush	FAC	Mesic to wet Mesic	2-4	H	_	_	H	Sun to partial sun	Ovoid shrub	6-12'	Shallow	Yes	Med	Coastal plain species.
Cornus Stolonifera (Cornus sericea) red osier dogwood	FACW	Mesic-Hydric	2-4	H	H	H	M	Sun or shade	Arching, spreading shrub	8-10'	Shallow	Yes	High	Needs more consistent moisture levels.
Cornus amomum silky dogwood	FAC	Mesic	1-2	L	_	_	M	Sun to partial sun	Broad-leaved	6-12'	_	Yes	High	Good bank stabilizer
Euonymous europaeus spindle-tree	FAC	Mesic	1-2	M	M	M	M	Sun to partial sun	Upright dense oval shrub	10-12'	Shallow	No	No	_
Hamamelis virginiana witch hazel	FAC	Mesic	2-4	M	M	M	M	Sun or shade	Vase-like compact shrub	4-6'	Shallow	Yes	Low	_
Hypericum densiflorum common St. John's wort	FAC	Mesic	2-4	H	M	M	H	Sun	Ovoid shrub	3-6'	Shallow	Yes	Med	_
Ilex glabra inkberry	FACW	Mesic to wet Mesic	2-4	H	H	_	H	Sun to partial sun	Upright dense shrub	6-12'	Shallow	Yes	High	Coastal plain species.
Ilex verticillata winterberry	FACW	Mesic to wet Mesic	2-4	L	M	_	H	Sun to partial sun	Spreading shrub	6-12'	Shallow	Yes	High	_

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in non-wetlands and wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Almost always occur in wetlands.

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Itea virginica tassel-white, Virginia sweetspire	OBL	Mesic	1-2	M	–	–	M	Sun or shade	Broad-leaved, deciduous shrub	6-12'	–	Yes	Low	–
Juniperus communis "compressa" common juniper	FAC	Dry Mesic-Mesic	1-2	M	H	H	M-H	Sun	Mounded shrub	3-6'	Deep taproot	No	High	Evergreen
Juniperus horizontalis "Bar Harbor" creeping juniper	FAC	Dry Mesic-Mesic	1-2	M	H	H	M-H	Sun	Matted shrub	0-3'	Deep taproot	No	High	Evergreen
Lindera benzoin spicebush	FACW	Mesic to wet Mesic	2-4	H	–	–	H	Sun	Upright shrub	6-12'	Deep	Yes	High	–
Myrica pennsylvanica bayberry	FAC	Mesic	2-4	H	M	M	H	Sun to partial sun	Rounded, compact shrub	6-8'	Shallow	Yes	High	Coastal plain species.
Physocarpus opulifolius ninebark	FAC	Dry Mesic to wet Mesic	2-4	M	–	–	H	Sun	Upright shrub	6-12'	Shallow	Yes	Med	May be difficult to locate.
Viburnum cassinoides northern wild raisin	FACW	Mesic	2-4	H	H	H	H	Sun to partial sun	Rounded, compacted shrub	6-8'	Shallow	Yes	High	–
Viburnum dentatum arrow-wood	FAC	Mesic to wet	2-4	H	H	H	H	Sun to partial sun	Upright, multi-stemmed shrub	8-10'	Shallow	Yes	High	–
Viburnum lentago nannyberry	FAC	Mesic	2-4	H	H	H	H	Sun to partial sun	Upright, mlti-stemmed shrub	8-10'	Shallow	Yes	High	–

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in non-wetlands and wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Almost always occur in wetlands.

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Acer rubrum red maple	FAC	Mesic-Hydric	4-6	H	H	H	H	Partial sun	Single to multi-stem tree	50-70'	Shallow	Yes	High	-
Amelanchier canadensis shadbush	FAC	Mesic	2-4	H	M	-	H	Partial sun	Single to multi-stem tree	35-50'	Shallow	Yes	High	Not recommended for full sun.
Betula nigra river birch	FACW	Mesic-Hydric	4-6	-	M	M	H	Partial sun	Single to multi-stem tree	50-75'	Shallow	Yes	High	Not susceptible to bronze birch borer.
Betula populifolia gray birch	FAC	Xeric-Hydric	4-6	H	H	M	H	Partial sun	Single to multi-stem tree	35-50'	Shallow to deep	No	High	Native to New England area.
Fraxinus americana white ash	FAC	Mesic	2-4	M	H	H	H	Sun	Large tree	50-80'	Deep	Yes	Low	-
Fraxinus Pennsylvanica green ash	FACW	Mesic	4-6	M	H	H	H	Partial sun	Large tree	40-65'	Shallow to deep	Yes	Low	-
Ginko biloba Maidenhair tree	FAC	Mesic	2-4	H	H	H	H	Sun	Large tree	50-80'	Shallow to deep	No	Low	Avoid female species-offensive odor from fruit.
Gleditsia triacanthos honeylocust	FAC	Mesic	2-4	H	M	-	M	Sun	Small caopied large tree	50-75'	Shallow to deep variable taproot	Yes	Low	Select thornless variety.
Juniperus virginiana eastern red cedar	FACU	Mesic-Xeric	2-4	H	H	-	H	Sun	Dense single stem tree	50-75'	Taproot	Yes	Very high	Evergreen
Liquidambar styraciflua sweet gum	FAC	Mesic	4-6	H	H	H	M	Sun	Large tree	50-70'	Deep taproot	Yes	High	Edge and perimeter; fruit is a maintenance problem.
Nyssa sylvatica black gum	FACW	Mesic-Hydric	4-6	H	H	H	H	Sun	Large tree	40-70'	Shallow to deep taproot	Yes	High	-

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in non-wetlands and wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Almost always occur in wetlands.

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Platanus acerifolia London plane-tree	FACW	Mesic	2-4	H	–	–	M	Sun	Large tree	70-80'	Shallow	No	Low	Tree roots can heave sidewalks.
Platanus occidentalis sycamore	FACW	Mesic-Hydric	4-6	M	M	M	M	Sun	Large tree	70-80'	Shallow	Yes	Med	Edge and perimeter; fruit is a maintennance problem; tree is also prone to windthrow.
Populus deltoides eastern cottonnwood	FAC	Xeric-Mesic	4-6	H	H	H	L	Sun	Large tree with spreading branches	75-100'	Shallow	Yes	High	Short lived.
Quercus bicolor Swamp white oak	FACW	Mesic to wet Mesic	4-6	H	–	H	H	Sun to partial sun	Large tree	75-100'	Shallow	Yes	High	One of the faster growing oaks.
Quercus coccinea scarlet oak	FAC	Mesic	1-2	H	M	M	M	Sun	Large tree	50-75'	Shallow to deep	Yes	High	–
Quercus macrocarpa bur oak	FAC	Mesic to wet Mesic	2-4	H	H	H	M	Sun	Large spreading tree	75-100"	Taproot	No	High	Native to Midwest.
Quercus palustris pin oak	FACW	Mesic-Hydric	4-6	H	H	H	M	Sun	Large tree	60-80'	Shallow to deep taproot	Yes	High	–
Quercus phellos willow oak	FACW	Mesic to wet Mesic	4-6	H	–	–	H	Sun	Large tree	55-75'	Shallow	Yes	High	Fast growing oak.
Quercus rubra red oak	FAC	Mesic	2-4	M	H	M	M	Sun to partial sun	Large spreading tree	60-80'	Deep taproot	Yes	High	–
Quercus shumardii Shumard's red oak	FAC	Mesic	2-4	H	H	H	M	Sun to partial sun	Large spreading tree	60-80'	Deep taproot	No	High	Native to Southeast.

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in non-wetlands and wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Almost always occur in wetlands.

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management

Plant Species Suitable for Use in Bioretention - Herbaceous Species

Species	Moisture Regime		Tolerance						Morphology			General Characteristics		Comments
Scientific Name Common Name	Indicator Status	Habitat	Ponding (days)	Salt	Oil/ Grease	Metals	Insects/ Disease	Exposure	Form	Height	Root System	Native	Wildlife	
Sophora japonica Japanese pagoda tree	FAC	Mesic	1-2	M	M	_	M	Sun	Shade tree	40-70'	Shallow	No	Low	Fruit stains sidewalk.
Taxodium distichum bald cypress	FACW	Mesic-Hydric	4-6	_	_	M	H	Sun to partial sun	Typically single stem tree	75-100'	Shallow	Yes	Low	Not well documented for planting in urban areas.
Thuja occidentalis arborvitae	FACW	Mesic to wet Mesic	2-4	M	M	M	H	Sun to partial sun	Dense single stem tree	50-75'	Shallow	No	Low	Evergreen
Zelkova serrata Japanese zelkova	FACU	Mesic	1-2	M	M	_	H	Sun	Dense shade tree	60-70'	Shallow	No	Low	Branches can split easily in storms.

H High Tolerance
M Medium Tolerance
L Low Tolerance

FACU Facultative Upland - Usually occur in non-wetlands, however, occasionally found in wetlands.
FAC Facultative - Equally likely to occur in non-wetlands and wetlands.
FACW Facultative Wetland - Usually occur in wetlands, however, occasionally found in non-wetlands.
OBL Obligate Wetland - Almost always occur in wetlands.

Adapted from the Prince George's County Design Manual & the Center for Watershed Protection for the use of bioretention in Stormwater Management