www.vhb.com

December 2, 2020

Ref: 12970.00/14424.00

Sudbury Planning Board
Flynn Building
278 Old Sudbury Road
Sudbury, MA 01776

Re: Supplemental Submission
Applicants' Response to Horsley Witten Peer Review Comment Letter dated November 23, 2020
Sudbury-Hudson Transmission Reliability and Mass Central Rail Trail Project

Sudbury Planning Board Members,

The Applicants, the Massachusetts Department of Conservation and Recreation ("DCR") and NSTAR Electric Company d/b/a Eversource Energy ("Eversource"), are providing this response to the specific items in the peer review letter provided by Horsley Witten, dated November 23, 2020, that presented further comment. For those items, the full comment thread is presented below, with BETA's comments in italics, both sets of Horsley Witten's comments in bold, and VHB's response in plain text. These responses also address comments from the Planning Board's public hearing on November 18, 2020.

SW1. Clarify justification for abandonment of existing culvert pipes such that local drainage patterns will not be impaired.

Sept. 18, 2020 (HW): In its response to BETA, VHB has identified two culverts that were previously noted to be abandoned. The pipes have been relabeled to be retained on the July 2020 plan set. BETA referenced a Culvert Structure Assessment Memorandum from 2017, HW was not able to locate this document however agrees that BETA's request appears reasonable to update the assessment and locate any structures mentioned.

November 2020 (HW): HW recommends that the Planning Board consider a condition of approval stating that "a structural engineer is to inspect the culverts as noted in the Culvert Structure Assessment Memorandum from 2017 prior to any land disturbance. The Assessment is to be updated and culverts noted to be retained shall be protected and cleaned. Culverts found that require replacement shall be replaced with a crossing that meets the MA Stream Crossing Standards as accepted by the Conservation Commission."

VHB: The Applicants can agree to this special condition.

Engineers | Scientists | Planners | Designers

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

SW3. See WPA1. BETA recommends the Commission determine if this combined project qualifies as a Limited Project 310 CMR 10.53(3)(d).

<u>Sept. 18, 2020 (HW)</u>: BETA and VHB are discussing this issue under the purview of the Conservation Commission. As BETA has noted the applicability of Limited Project provisions for a given project may only be determined by the issuing authority which is the Sudbury Conservation Commission.

For the Planning Board's information, 310 CMR 10.53 General Provisions (3)(d) states, "The construction, reconstruction, operation and maintenance of underground and overhead public utilities, such as electrical distribution or transmission lines, or communication, sewer, water and natural gas lines, may be permitted, in accordance with the following general conditions and any additional conditions deemed necessary by the issuing authority:

1. the issuing authority may require a reasonable alternative route with fewer adverse effects for a local distribution or connecting line not reviewed by the Energy Facilities Siting Council;

2. best available measures shall be used to minimize adverse effects during construction;

3. the surface vegetation and contours of the area shall be substantially restored; and

4. all sewer lines shall be constructed to minimize inflow and leakage."

Regarding the DCR bike path, the Massachusetts Stormwater Handbook (MSH) Volume 1, Chapter 1, page 3, sates that, the Stormwater Management Standards shall apply to the maximum extent practicable to footpaths, bike paths and other paths for pedestrian and/or nonmotorized vehicle access.

Furthermore 310CMR 10.53 General Provisions (6) states "Notwithstanding the provisions of 310 CMR 10.58 (Riverfront Area), the issuing authority may issue an Order of Conditions for the construction, rehabilitation, and maintenance of footpaths, bike paths, and other pedestrian or nonmotorized vehicle access to or along riverfront areas but outside other resource areas, provided that adverse impacts from the work are minimized and that the design specifications are commensurate with the projected use and are compatible with the character of the riverfront area. Generally, the width of the access shall not exceed ten feet of pavement, except within an area that is already altered (e.g., railroad beds within rights of way). Access shall not be located in vernal pools or fenced in a manner which would impede the movement of wildlife."

It is HW's opinion that the Stormwater Management Standards are associated with an increase in impervious area and significant alteration to surface topography. The 10-foot wide bike path will increase impervious area and are required to apply the Massachusetts Stormwater Standards to the maximum extent practicable. The majority of the Eversource transmission line is below the surface and therefore does not significantly impact the stormwater except in areas where the proposed grades create steep slopes and where large areas of vegetation is cleared from woods to grass. To minimize any increase in runoff the cleared landscape should be

replanted with hearty vegetation. The Eversource proposal includes replacing the existing 11-foot wide railroad ballast with a 14-foot wide gravel path that will be used to access the transmission line by vehicles. The anticipated frequency of vehicles using this gravel road should be provided to the Town of Sudbury as well as an explanation detailing the need for the 14-foot wide path to replace the 11-foot wide railroad ballast.

November 2020 (HW): The Applicant has stated that Eversource requires a 14-foot wide access way for maintenance purposes. After construction is complete, the 14-foot wide gravel path will be utilized by Eversource once every three years. The gravel base material will stabilize the path and reduce erosion and rutting within the corridor.

The cross sections provided on Sheets 14-17 of the Eversource plan set indicate that 4" of loam and seed will be installed over the entire width of the disturbed area with the exception of a 10 foot wide section of 4" pavement to be installed by DCR for the bike path. Sheets 102-122 illustrate the various plantings to be installed as part of the Eversource project. Sheet 161 lists the planting schedule for the corridor.

It is HW's understanding that typical multi-use paths in Massachusetts require a minimum width of 10 feet for the comfort of the bike riders and pedestrians using the path at the same time. Furthermore, a typical multi-use path requires 2-3-foot-wide shoulders on both sides of the path. Therefore the 14-foot wide gravel base appears to be reasonable for the bike path.

Volume 3, Chapter 1, page 15 of the 2008 Massachusetts Stormwater Handbook states that impervious surfaces include roads, rooftops, parking lots, and sidewalks, when they are paved with concrete, asphalt, or brick pavers.

With the understanding that the Massachusetts Stormwater Handbook does not consider gravel to be impervious, it is HW's opinion that the proposed stormwater management design for the proposed Eversource Transmission phase of the project complies with the Massachusetts Stormwater Standards.

The Town of Sudbury Stormwater Management Bylaw Regulations defines IMPERVIOUS SURFACE: Any material or structure on, above or below the ground that prevents water from infiltrating through the underlying soil. Impervious surface is defined to include, without limitation: paved surfaces (parking lots, sidewalks, driveways), roof tops, swimming pools, patios, and paved, gravel and compacted dirt surfaced roads.

With the understanding that the Town of Sudbury Stormwater Management Bylaw Regulations considers gravel to be impervious, it is HW's opinion that the stormwater management for the proposed Eversource Transmission phase of the project with a 14 foot wide gravel road is not in full compliance with the Town of Sudbury Stormwater Management Bylaw Regulations because there is an increase in peak discharge rates at several design points, and the Applicant does not provide the required recharge volume or water quality volume for the total impervious area.

The Planning Board may choose to consider a condition of approval to guarantee that the bike path phase of the project is constructed or in the event it is not that the stormwater management design for the Eversource phase is brought into full compliance with the Town of Sudbury Stormwater Regulations.

VHB: The Applicants do not understand the recent comment from HW and would need clarification before any response can be given.

SW8. Consider installing infiltration (trench) swale the entire length on the downslope side of the path to facilitate meeting the standards 2,3,4 and 6 more fully.

Sept. 18, 2020 (HW): VHB has suggested in its response that the stormwater management system has been designed to the maximum extent practicable. BETA has developed a Summary Table of the Areas without Treatment and provided low, medium, and high priority Recommendations. HW has reviewed BETA's Summary Table provided at the end of BETA's August 31, 2020 peer review letter and Tables 3-8 in VHB's Sudbury Stormwater Management Plan Narrative dated July 2020. It is HW's opinion that out of the 87 proposed watershed areas the following areas should be reevaluated at a minimum for additional treatment because the increase in flow is relatively significant and the practices discharge to cold water fisheries or vernal pools that may be impacted by an increase in flow or volume: Watersheds 5.14, 8.5, 9.1, 10.4, and 10.14. The table below illustrates these 5 watersheds with the peak flows in cubic feet per second (cfs) and peak volumes in acre-feet (af) for a 100-year storm event. Values for the other watershed areas and storm events can be found on pages 37-49 of the VHB Sudbury Stormwater Management Plan Narrative.

Watershed	Ex Peak Flow (cfs)	Prop Peak Flow (cfs)	Ex Volume (af)	Prop Volume (af)
5.14	20.1	25.2	2.555	2.568
8.5	13.6	17.6	1.571	1.803
9.1	8.5	10.3	1.296	1.363
10.4	13.8	18.8	1.628	1.676
10.14	22.9	31.2	3.182	3.150

November 2020 (HW): The Applicant has evaluated 69 design points.

- **The peak discharge rate for 33 of the 69 either remains the same or is reduced under proposed conditions.**
- **The peak discharge rate for 28 of the 69 will increase by less than 1.0 cfs for the 100-year storm event.**
- **The flow to 6 design points will increase by less than 1.8 cfs.**
- **Two design points will increase by less than 2.4 cfs.**

The Applicant has proposed 16 stormwater practices of approximately 6,900 linear feet along the 4.3-mile corridor.

In our September 2020 review, HW highlighted 5 watersheds/design points which we requested that the Applicant reevaluate. Stormwater practices are proposed for four of the design points originally questioned 5.14, 8.5, 10.4 and 10.14, as well as design point 5.13. HW reached out to the Applicant on November 4 and asked for additional clarification regarding how these watersheds/design points were reevaluated. The Applicant submitted an additional document dated November 10, 2020 as clarification.

During the November 18, 2020 Planning Board hearing the Applicant described the 5 design points and the stormwater management proposed for each. The Board requested that the Applicant revisit watershed 10.14 and the size of the proposed basin. If feasible the Board requested that the proposed basin be increased to further reduce the discharge to the design point. The Board also requested that the Applicant revisit watershed 9.1 and consider sloping the bike path towards Sudbury Lumber and install a stormwater practice to reduce the discharge towards Hop Brook at this location.

It is HW's opinion that once the Applicant has revisited these two locations and provided its findings, the proposed stormwater management design for the proposed bike path complies with the Massachusetts Stormwater Standards to the maximum extent practicable.

The revised Stormwater Management Report includes the following values:

Watershed	Ex Peak Flow (cfs)	Prop Peak Flow (cfs)	Ex Volume (af)	Prop Volume (af)
5.14 (1.1 ac)	1.1	1.6	0.152	0.184
8.5 (4.2 ac)	13.2	13.3	1.305	1.295
9.1 (2.2 ac)	8.0	9.5	1.207	1.230
10.4 (4.8 ac)	6.3	7.4	0.627	0.627
10.14 (7.0 ac)	9.7	11.7	1.320	1.282

VHB: The following information is provided to address the two watersheds.

Watershed 10.14

The Applicant has revisited watershed 10.14 and revised the design to increase the size of the proposed basin. The larger proposed basin results in a reduction of peak flow as compared to the previous submission and compared to existing conditions, as shown in the table below. This revised design increases the size of the stormwater basin by removing the previous conveyance swale between the bike path and the basin. The previous conveyance swale was not accounted for in previous water quality treatment calculations. The proposed basin now captures the swale flow within the basin while utilizing the space for increased detention and treatment. Updated treatment results and design calculations are shown in the table below and revised Appendix A and B attached.

Watershed 10.14 (7.0 ac)	Existing Condition	Proposed Revision 2	Proposed Dec 2020 Revision
100 Year Design Storm Peak Flow (cfs)	9.7	11.7	11.0
100 Year Design Storm Discharge Volume (af)	1.320	1.282	0.832
TSS Removal* (%)	-	27	89
Water Quality Volume Provided (cu-ft)	-	414	2,589
Recharge Volume Provided (cu-ft)	-	414	2,589

*Runoff Volume Reduction is determined from the EPA's Massachusetts MS4 General Permit Appendix F, Attachment 2, BMP Performance Tables for Infiltration Trenches (Tables 3-4 through 3-8), and Infiltration Basins (Tables 3-10 and 3-14). TSS Removal rates were conservatively assumed to equal reported runoff volumes.

Watershed 9.1

The Applicant has also revisited the bike path design within watershed 9.1. The Applicant conducted a field visit in the area of watershed 9.1 on November 21, 2020, to further understand the existing conditions and determine if there were feasible solutions to implementing stormwater controls. As a result of this visit, the design of the bike path has been revised to be crowned from STA 704+00 to 709+75, which will result in half the width of the bike path (five feet), instead of the full width of the bike path, discharging directly into the adjacent tributary to Hop Brook. The other five feet of the bike path along this length will take advantage of the adjacent pervious area to infiltrate the sheet flow from the southerly portion of the bike path. Allowing the flow to infiltrate in the adjacent pervious area (i.e., an area of "impervious disconnection") will minimize tree removal and impact to abutting properties.

During the site visit it was also confirmed that the drainage from the abutting commercial properties to the south of the proposed bike path does not run onto the MBTA right-of-way, but rather is either collected through a closed drainage system or runs off to an existing depression on the Sudbury Lumber property.

Pictures from the site visit performed by the Applicant as well as specific limitations and opportunities are detailed below, broken out by stationing.

STA 700+00 to STA 704+00

Within this portion of watershed 9.1, there is limited area between the proposed bike path and the existing development (Sudbury Lumber) to implement structural stormwater controls. This narrow area can be seen in Figure 1 below which was taken standing at approximately STA 700+00. Figure 2 shows another example of the limited space between the existing railbed and fencing at approximately STA 703+50.

It was also infeasible to change the pitch of the bike path in this area between STA 700+00 and 704+00 without additional impacts to riverfront area, buffer zone and/or Bordering Land Subject to Flooding (BLSF). These limitations are dictated by existing topographic constraints and the proximity of the abutting property. Examples of the topographic constraints described can be seen in Figure 3.

Figure 1. This picture, taken standing west of Sudbury Lumber (red buildings) at approx. STA 602+50 and facing east shows the proximity of the existing tracks circled in red, to the lumberyard parking lot.

Figure 2. Picture taken at approximately 703+50 facing southwesterly.

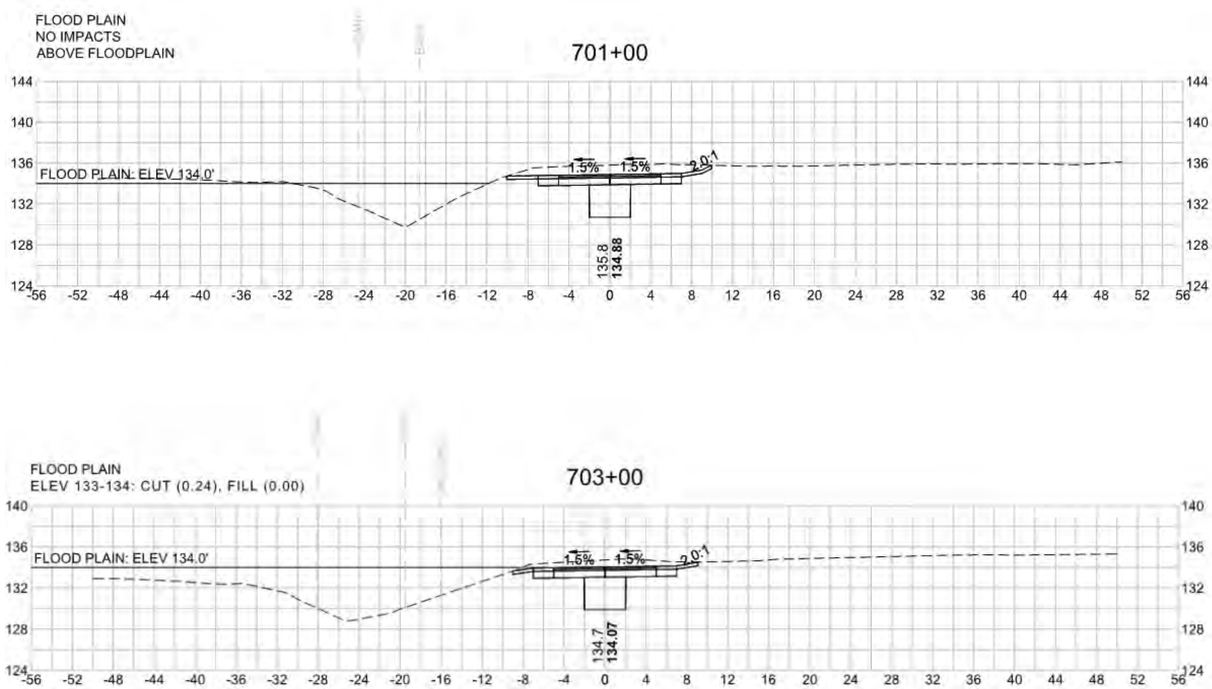


Figure 3. Bike path cross sections demonstrating topographic constraints to changing pitch of bike path in the area of STA 700+00 to 704+00. Changing the pitch of the bike path would require cutting and land disturbance, increasing buffer zone impacts to the south of the bike path or reduce flood storage capacity to the north.

Concerning the potential for run-on from the lumberyard to the proposed bike path, the field visit confirmed that water from the abutting property either discharges to a catch basin in the parking lot or collects at a low point within a gravel portion of the lumberyard property. A picture of the low point as well as a marked-up plan view of this area can be seen in Figures 4 and 5 respectively.

Figure 4. Low point where water is collected from Sudbury Lumber at approximately STA 701+00, facing northerly.

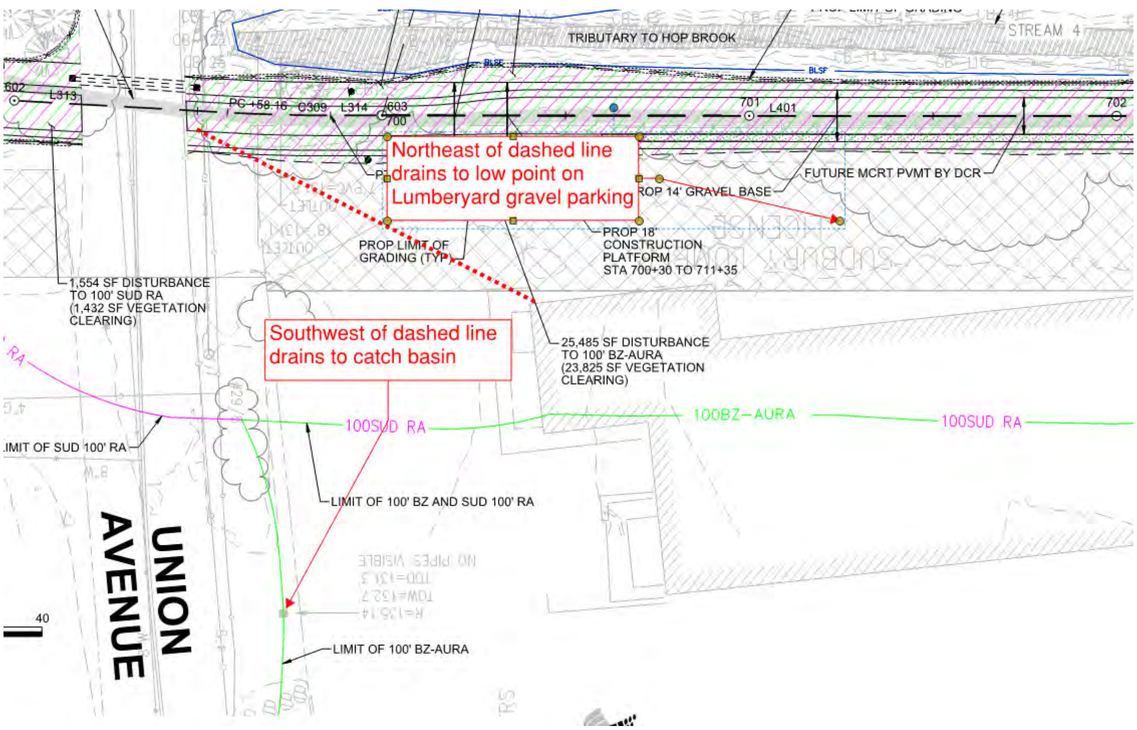


Figure 5. Plan view of westerly portion of watershed 9.1 with drainage pattern markups.

STA 704+00 to STA 709+75

The design of the bike path has been revised to be crowned from STA 704+00 to 709+75, which will result in half the width of the bike path (five feet) discharging directly into the adjacent Tributary to Hop Brook instead of the full width of the bike path. The other five feet of the bike path along this length will take advantage of the adjacent pervious area to infiltrate the sheet flow from the southerly portion of the bike path. Allowing the flow to infiltrate in the adjacent pervious area (i.e., impervious disconnection) will minimize tree removal and impact to abutting properties. In this portion of watershed 9.1 it was also confirmed through the November 21st site visit that the catch basin in the lumberyard property drains directly to the Tributary to Hop Brook. Figures 6 and 7 show the pervious portions between STA 704+00 and STA 709+75 where impervious disconnection is achievable. As seen in the pictures, these areas are heavily vegetated and would require clearing in order to implement other structural stormwater controls.

Figure 6. Picture of the pervious area adjacent to existing rail bed, facing easterly. Picture taken in the area of STA 704+00 to 706+00.

Figure 7. Picture of the pervious area adjacent to existing rail bed, facing easterly Picture taken in the area of STA 706+00 to 708+00.

In addition to the benefits of impervious disconnection, a natural depression exists within this length of watershed 9.1 from STA 706+75 to 707+00 that serves to detain and treat stormwater. Figure 8 highlights this depression in a cross section view.

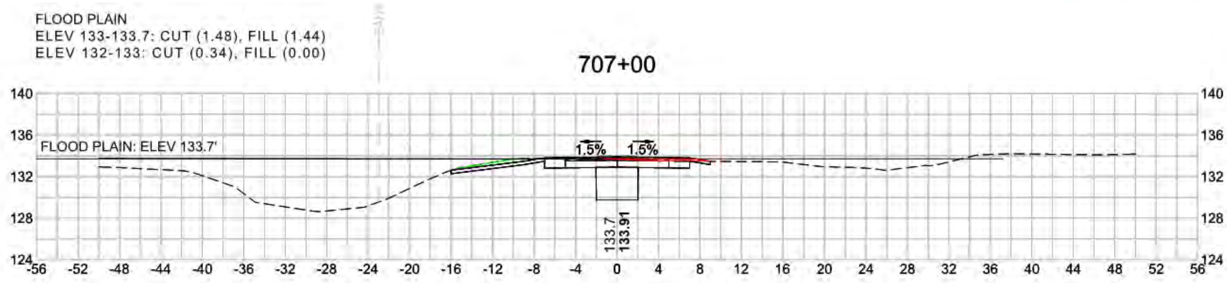
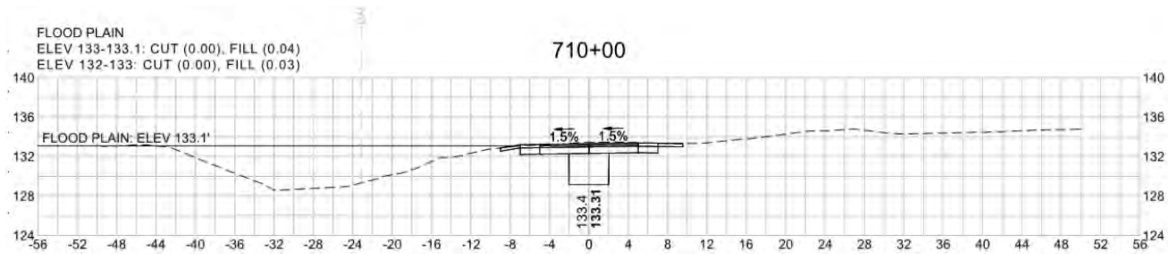


Figure 8. Cross section view of existing depression on southern side of proposed bike path and STA 707+00.

STA 709+75 to 711+60

The portion of the proposed bike path between STA 709+75 and 711+60 was not crowned to avoid additional riverfront area and buffer zone impacts. These impacts are dictated by existing topographic constraints and the proximity of the abutting property. Examples of the topographic constraints described can be seen in cross section view (Figure 9) and pictures (Figure 10) below).



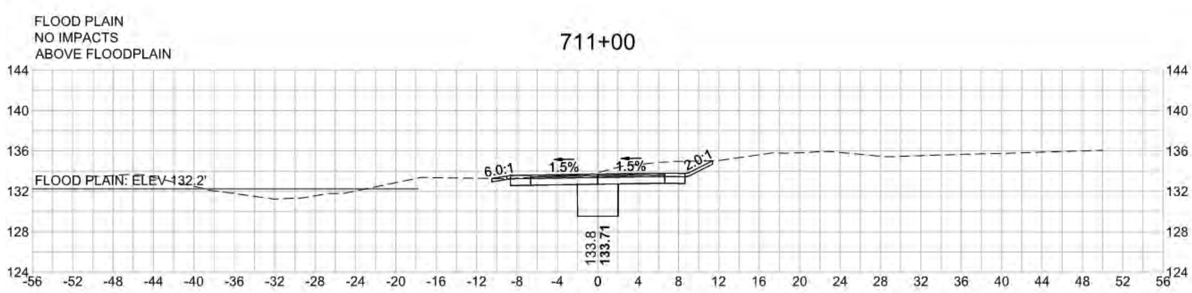


Figure 9. Bike path cross sections demonstrating topographic constraints to changing pitch of bike path in the area of STA 709+75 to 711+60. Changing the pitch of the bike path would require cutting and land disturbance to the south of the bike path, increasing resource area impacts.

Figure 10. Picture of topographic and spatial constraint of abutting property to altering bike path design (facing northeasterly). Modifications to the bike path design would require additional land disturbance and vegetation removal. Picture taken at approximately STA 709+25.

SW21. Tabulate comparison of runoff volume to each watershed for pre- and post-development conditions. The Site is abutted by low-lying areas and thus risk of flooding must be considered (8.0(A)(3)(i)).

Sept. 18, 2020 (HW): VHB provided the runoff volumes in a table as requested. BETA has suggested that there are numerous watersheds with an increase in volume that should be reevaluated. It is HW's opinion that at a minimum the following watershed areas be reevaluated for additional treatment because the increase in flow is relatively significant and the practices discharge to cold water fisheries or vernal pools that may be impacted by an increase in flow or volume. This is a concern for Watersheds 5.14, 8.5, 9.1, 10.4, and 10.14.

November 2020 (HW): The Applicant has reevaluated the watersheds as requested. See response to SW8.

VHB: Please see response to SW8.

SW28. Conduct test pit/borings at the location of each proposed "area of increased infiltration" to verify soil conditions, infiltration rates, and groundwater levels.

Sept. 18, 2020 (HW): VHB has provided some test borings conducted along the 4.8-mile length of corridor to be developed. BETA has recommended additional testing be conducted to verify

the soils for a few of the areas of increased infiltration. Furthermore, BETA has recommended that a condition be included requiring that additional soil testing be conducted during construction and provided to the Town for review. HW agrees that additional soil testing during construction is valuable and requiring the testing as a condition of approval is appropriate.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval requiring additional soil testing be conducted during construction in the vicinity of Station 502+00, Station 511+00, Station 570+00, and Station 579+00.

VHB: The Applicants can agree to a condition to conduct additional soil testing during construction to confirm assumptions relative to soil conditions, infiltration rates, and groundwater levels in the vicinity of Station 505+00, Station 511+00, Station 570+00, and Station 579+00.

SW35. Provide draft copy Stormwater Pollution Prevention Plan SWPPP for review.

<u>Sept. 18, 2020 (HW)</u>: VHB has provided a draft copy of the SWPPP as requested. BETA has recommended that the final SWPPP be provided to the Town prior to construction and has listed several items to be included. HW agrees that the final SWPPP should be provided to the Town with all applicable attachments.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval requiring the Applicant to provide a final SWPPP prior to land disturbance.

VHB: The Applicants can agree to a special condition requiring submission of the final SWPPP to the Planning Board prior to start of construction.

SW39. Provide perimeter erosion controls along the south side of the Site near stations 391+50, 405, 516, 545 through 555, 557, 565, and 753, and the north side of the Site near stations 565 through 569 and 580 through 585.

<u>Sept. 18, 2020 (HW)</u>: VHB is not in agreement with BETA's need for additional erosion controls. HW recommends that a preconstruction visit be a condition of approval at which time the acceptance of the location of the erosion control barrier along the perimeter can be finalized. However, it should be clear in the bid documents that a representative from the Town of Sudbury may require additional perimeter controls at numerous locations.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval requiring the Applicant to conduct a preconstruction meeting with a Town Representative to confirm the final placement of erosion controls.

VHB: The Applicants can agree to this condition.

SW40. Provide a construction phasing plan that limits the area of the Site disturbed at any one time to mitigate environmental impacts and risk of erosion.

<u>Sept. 18, 2020 (HW)</u>: VHB stated that the construction schedule will be determined by the Contractor once one is engaged. BETA defers to the Town as to the need for a construction

schedule. HW recommends that a preconstruction visit be a condition of approval at which time the construction schedule and acceptance of erosion control barrier can be finalized.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval requiring the Applicant to conduct a preconstruction meeting with a Town Representative to confirm the construction schedule and the final placement of erosion controls.

VHB: The Applicants can agree to a condition requiring a preconstruction visit at which time the construction schedule and acceptance of erosion control barriers can be finalized.

SW41. Provide measures to protect infiltration systems during construction.

<u>Sept. 18, 2020 (HW)</u>: VHB has stated that the infiltration basins will not be used as sediment basins during construction. BETA has requested additional assurance and a construction schedule. To verify that the infiltration basins do not receive excessive sediment during construction, HW recommends that the basins be protected by an erosion control barrier or constructed after the gravel base layer is complete.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval requiring the Applicant to protect the infiltration areas with erosion control barriers during construction.

VHB: The Applicants can agree to a condition to protect the infiltration areas with erosion control barriers during construction.

SW51. Provide illicit discharge compliance statement signed by the Owner.

<u>Sept. 18, 2020 (HW)</u>: VHB has agreed to provide a signed illicit discharge statement once construction is complete. The MSH Volume 1, Chapter 1, page 25 states that the illicit discharge statement should be provided prior to the discharge of stormwater runoff to the post-construction stormwater best management practices. HW recommends that the signed statement be provided prior to any land disturbance.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board include a condition of approval stating that the Applicant will provide a signed illicit discharge statement prior to land disturbance.

VHB: The Applicants can agree to provide the signed statement prior to any land disturbance.

Additional HW comment Sept. 18, 2020:

During the site walk, HW observed the two 36-inch corrugated metal culverts at approximately Station 539 + 50, to allow the passage of Dudley Brook. The metal culverts were showing signs of deterioration. HW recommends that further investigation be conducted to verify the long term functionality of these culverts and the possibility of repairing them be considered.

<u>November 2020 (HW)</u>: HW recommends that the Planning Board consider a condition of approval stating that "a structural engineer is to inspect the culverts as noted in the Culvert Structure Assessment Memorandum from 2017 prior to any land disturbance. The Assessment is to be updated and culverts noted to be retained shall be protected and cleaned. Culverts found that require replacement shall be replaced with a crossing that meets the MA Stream Crossing Standards as accepted by the Conservation Commission."

VHB: The Applicants can agree to this special condition.

Sincerely,

Katie Kinsella and Gene Crouch

CC: Denise Bartone, Eversource
Paul Jahnige, DCR

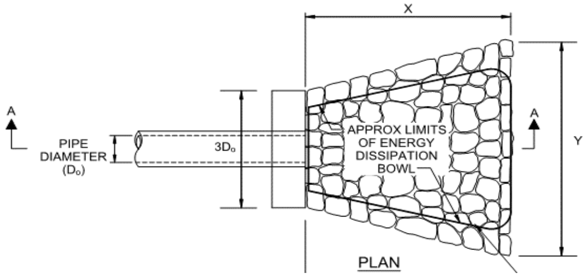
Attachments:

Revised Appendix A & B
Updated Eversource Plan Sheets
Updated DCR Plan Sheets

Appendix A – Standard 1 Computations and Supporting Information

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: Sudbury Hudson Eversource
Proj. No.: 14009.00
Date: July 2020
Project Location: Sudbury/Hudson, MA
Calculated by: AHF
Checked by: MAC
Oct 2020 REV.: AHF



FES 10 STA 533+46, 14.9' RT

Calculations completed using FHWA Hydraulic Toolbox 4.1

Riprap Analysis

Structure type: Culvert Outlet Protection   Geotextile/Granular Filter Design...

Parameter	Value	Units	Notes
Channel Parameters			
Select Channel	<Define Local Data>		
	Channel Calculator...		
Input Parameters			
	Transfer Values From Channel Calculator		
Flow	0.400	cfs	
Culvert Diameter	1.000	ft	
Normal Depth in Culvert	0.269	ft	
Tailwater Depth	0.000	ft	If tailwater is unknown, use 0.4D
Flow Type	subcritical		
Results			
D50	0.175	in	
D50	0.015	ft	The sizing equation assumes a rock s.g.=2.65. If s.g. is not 2.65, rock size (D...
Riprap Shape	Riprap shape should be angular		
Riprap Class			
Riprap Class Name	CLASS I		
Riprap Class Order	1		
D15	4.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D50	6.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D85	9.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
D100	12.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
Layout			
Apron Length	4.000	ft	
Apron Depth	0.000	ft	
Apron Width (at apron end)	5.667	ft	
Computation Variables			
Tailwater Depth Used in Computations	0.400	ft	
Culvert Diameter Used in Calculations	1.000	ft	

OK   Cancel

Stone Protection Dimensions:

X = 4.0 ft.
Y = 5.7 ft.
Z = 12.0 in. (Minimum)
d_{50} = 6.5 in.

HW 11 STA 713+63, 10.0' LT

Headwall 11 is replacing an existing headwall which is currently stable from erosion. Riprap is not proposed given there is no erosion under existing conditions and to reduce impacts to the abutting wetland.

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: Sudbury Hudson Eversource
Proj. No.: 14009.00
Date: July 2020
Project Location: Sudbury/Hudson, MA
Calculated by: AHF
Checked by: MAC
Oct 2020 REV.: AHF

HW 12

STA 713+63, 10.0' RT

Headwall 12 is replacing an existing headwall which is currently stable from erosion. Riprap is not proposed given there is no erosion under existing conditions and to reduce impacts to the abutting wetland.

HW 13

STA 738+77, 12.0' LT

Headwall 13 is replacing an existing headwall which is currently stable from erosion. The existing headwall does not experience erosion under existing conditions. The headwall is an upstream inlet of a low point along the right-of-way and is not expected to experience erosion as a result of the project.

HW 14

STA 738+77, 15.4' RT

Calculations completed using FHWA Hydraulic Toolbox 4.1

Riprap Analysis - HW 14

Structure type: Culvert Outlet Protection

Geotextile/Granular Filter Design...

Parameter	Value	Units	Notes
Channel Parameters			
Select Channel	<Define Local Data>		
	Channel Calculator...		
Input Parameters			
	Transfer Values From Channel Calculator		
Flow	5.500	cfs	
Culvert Diameter	1.500	ft	
Normal Depth in Culvert	0.992	ft	
Tailwater Depth	0.000	ft	If tailwater is unknown, use 0.4D
Flow Type	subcritical		
Results			
D50	2.236	in	
D50	0.186	ft	The sizing equation assumes a rock s.g.=2.65. If s.g. is not 2.65, rock size (D...
Riprap Shape	Riprap shape should be angular		
Riprap Class			
Riprap Class Name	CLASS I		
Riprap Class Order	1		
D15	4.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D50	6.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D85	9.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
D100	12.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
Layout			
Apron Length	6.000	ft	
Apron Depth	0.000	ft	
Apron Width (at apron end)	8.500	ft	
Computation Variables			
Tailwater Depth Used in Computations	0.600	ft	
Culvert Diameter Used in Calculations	1.500	ft	

OK Cancel

Stone Protection Dimensions:

X = 6.0 ft.
Y = 8.5 ft.
Z = 12.0 in. (Minimum)
d_{50} = 6.5 in.

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: Sudbury Hudson Eversource
Proj. No.: 14009.00
Date: July 2020
Project Location: Sudbury/Hudson, MA
Calculated by: AHF
Checked by: MAC
Oct 2020 REV.: AHF

DP-10.4A

STA 722+27, 17' RT

Stone Protection with an energy dissipation bowl will be placed following the terminating check dam out of the swale. Energy dissipation blow is sized using U.S. Department of Transportation Federal Highway Administration: Hydraulic Engineering Circular No. 14, Third Edition. Hydraulic Design of Energy Dissipators for Culverts and Channels; Equation 10.6

HEC 14. Equation 10.6

$$D_{50} = \frac{0.692}{S-1}\left(\frac{V^2}{2g}\right)$$

where,
D_{50} = median rock size, m (ft)
V = velocity at the exit of the dissipator, m/s (ft/s)
S = riprap specific gravity

v =	2.64	ft/second
v =	0.8	meter/second
S =	2.65	
d_{50} =	0.00	meter
d_{50} (in) =	**0.17**	***Use 6.5" D50 minimum***
X =	6.0	ft. (Minimum)
Y =	8.5	ft. (Minimum)
Z =	14.0	in. (Minimum)

DP-10.4B

STA 720+00

Flow stability calculation for DP-10.14B conveyance swale was provided in Appendix A of the previous submission. This calculation was very conservative as the full watershed is routed through the 100-foot swale on edge of watershed; based on the existing grade in the area, only a small portion of this watershed is expect to reach this swale. This conservative calculation showed that although the flow of this watershed is higher than that of other Design Points, the calculated erosive velocities are less than that of the erosion-resisting capacity of the proposed vegetation. This swale is considered stable to possible erosion and will remain as is.

DP-10.13A

STA 753+48, 9' LT

Stone Protection with an energy dissipation bowl will be placed following the terminating check dam out of the swale. Energy dissipation blow is sized using U.S. Department of Transportation Federal Highway Administration: Hydraulic Engineering Circular No. 14, Third Edition. Hydraulic Design of Energy Dissipators for Culverts and Channels; Equation 10.6

HEC 14. Equation 10.6

$$D_{50} = \frac{0.692}{S-1}\left(\frac{V^2}{2g}\right)$$

where,
D_{50} = median rock size, m (ft)
V = velocity at the exit of the dissipator, m/s (ft/s)
S = riprap specific gravity

v =	2.96	ft/second
v =	0.9	meter/second
S =	2.65	
d_{50} =	0.01	meter
d_{50} (in) =	**0.21**	***Use 6.5" D50 minimum***
X =	6.0	ft. (Minimum)
Y =	8.5	ft. (Minimum)
Z =	14.0	in. (Minimum)

Project Name:	Sudbury Hudson Eversource	**Proj. No.:**	14009.00
		Date:	July 2020
Project Location:	Sudbury/Hudson, MA	**Calculated by:**	AHF
		Checked by:	MAC
		Oct 2020 REV.:	AHF

DP-10.14B

STA 763+13, 10' RT

A riprap apron will be placed following the swale. The riprap apron is sized using U.S. Department of Transportation Federal Highway Administration: Hydraulic Engineering Circular No. 14, Third Edition. Hydraulic Design of Energy Dissipators for Culverts and Channels; as shown by the FHWA Hydraulic Toolbox 4.1

Riprap Analysis - 10.14B

Structure type: Culvert Outlet Protection

Geotextile/Granular Filter Design...

Parameter	Value	Units	Notes
Channel Parameters			
Select Channel	<Define Local Data>		
	Channel Calculator...		
Input Parameters			
	Transfer Values From Channel Calculator		
Flow	1.600	cfs	
Culvert Diameter	1.500	ft	
Normal Depth in Culvert	0.083	ft	
Tailwater Depth	0.083	ft	If tailwater is unknown, use 0.4D
Flow Type	subcritical		
Results			
D50	0.431	in	
D50	0.036	ft	The sizing equation assumes a rock s.g.=2.65. If s.g. is not 2.65, rock size (D...
Riprap Shape	Riprap shape should be angular		
Riprap Class			
Riprap Class Name	CLASS I		
Riprap Class Order	1		
D15	4.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D50	6.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D85	9.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
D100	12.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
Layout			
Apron Length	6.000	ft	
Apron Depth	0.000	ft	
Apron Width (at apron end)	8.500	ft	
Computation Variables			
Tailwater Depth Used in Computations	0.600	ft	
Culvert Diameter Used in Calculations	1.500	ft	

OK Cancel

Stone Protection Dimensions:

X = 6.0 ft.

Y = 8.5 ft.

Z = 14.0 in. (Minimum)

d_{50} = 6.5

DP-10.15A

STA 767+10, 10' RT

A riprap apron will be placed following the swale. The riprap apron is sized using U.S. Department of Transportation Federal Highway Administration: Hydraulic Engineering Circular No. 14, Third Edition. Hydraulic Design of Energy Dissipators for Culverts and Channels; as shown by the FHWA Hydraulic Toolbox 4.1

Riprap Analysis - 10.15A

Structure type: Culvert Outlet Protection

Geotextile/Granular Filter Design...

Parameter	Value	Units	Notes
Channel Parameters			

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: Sudbury Hudson Eversource
Proj. No.: 14009.00
Date: July 2020
Project Location: Sudbury/Hudson, MA
Calculated by: AHF
Checked by: MAC
Oct 2020 REV.: AHF

Select Channel	<Create New>		
	Channel Calculator...		
Input Parameters			
	Transfer Values From Channel Calculator		
Flow	0.800	cfs	
Culvert Diameter	1.500	ft	
Normal Depth in Culvert	0.500	ft	
Tailwater Depth	0.500	ft	If tailwater is unknown, use 0.4D
Flow Type	subcritical		
Results			
D50	0.171	in	
D50	0.014	ft	The sizing equation assumes a rock s.g.=2.65. If s.g. is not 2.65, rock size (D...
Riprap Shape	Riprap shape should be angular		
Riprap Class			
Riprap Class Name	CLASS I		
Riprap Class Order	1		
D15	4.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D50	6.50	in	This value is an 'average' of the size fraction range for the selected ripraap class
D85	9.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
D100	12.00	in	This value is an 'average' of the size fraction range for the selected ripraap class
Layout			
Apron Length	6.000	ft	
Apron Depth	0.000	ft	
Apron Width (at apron end)	8.500	ft	
Computation Variables			
Tailwater Depth Used in Computations	0.600	ft	
Culvert Diameter Used in Calculations	1.500	ft	

OK Cancel

Stone Protection Dimensions:

X = 6.0 ft.
Y = 8.5 ft.
Z = 14.0 in. (Minimum)
d_{50} = 6.5 in.

Flow Stability Calculations: Conveyance Swales

Project Name: Sudbury Hudson Eversource
Project Location: Sudbury/Hudson, MA

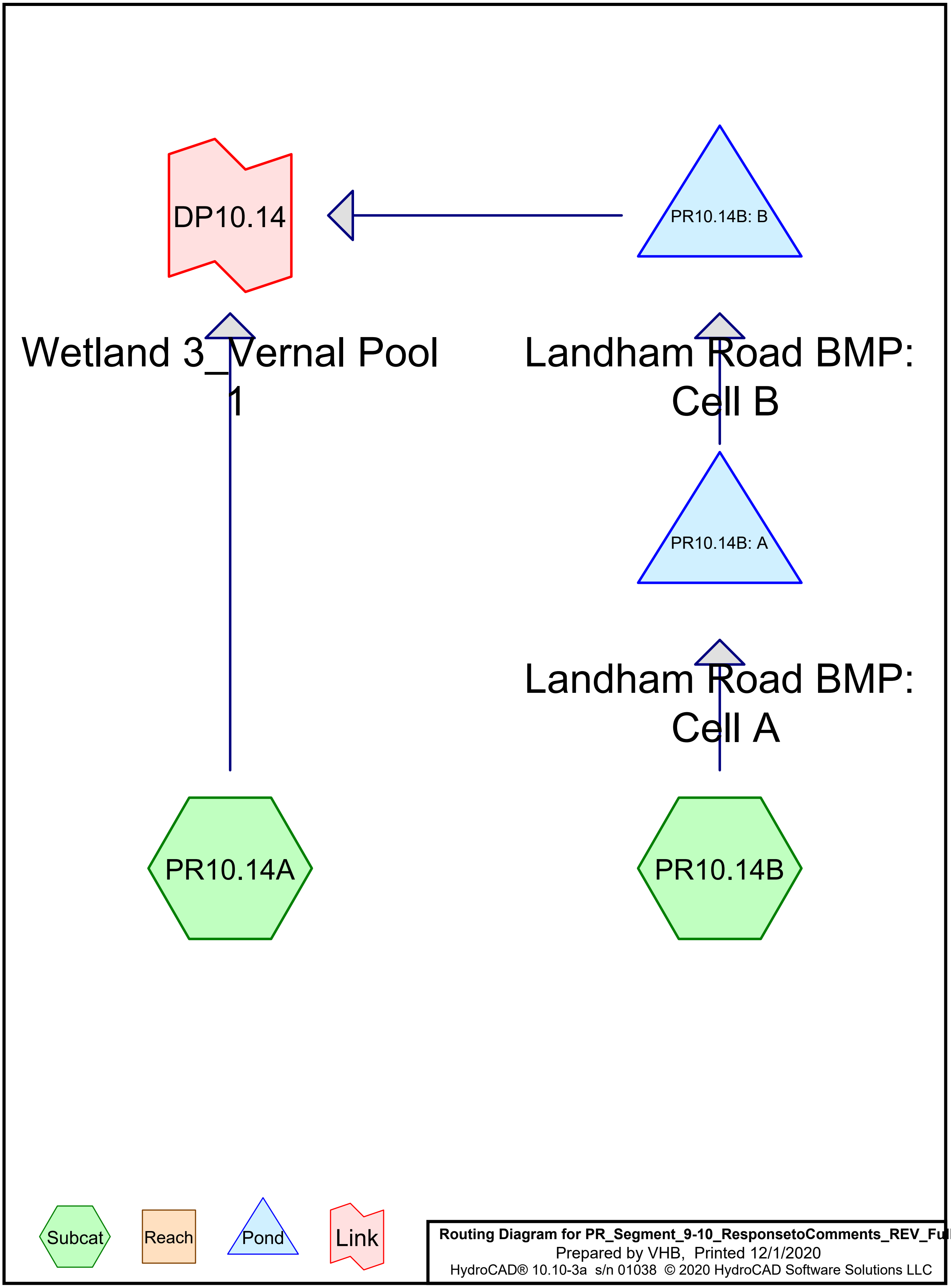
Proj. No.: 14009.00
Date: July 2020
Calculated by: RPL
Checked by: AHF
Oct 2020 REV.: AHF

		Channel Geometry																		
BMP ID:	Design Flow 'Q' (cfs)	Avg. Bottom Width 'B' (ft)	Channel Side Slope 'Z_1' (ft)	Channel Side Slope 'Z_2' (ft)	Channel Slope 'S_o' (ft/ft)	Channel Depth 'd' (ft) [1]	Cross Sectional Area 'A' (sq. ft)	Wetted Perimeter 'P' (ft)	Hydraulic Radius 'R' (ft)	Mean Boundary Shear Stress 'τ_o' (lb/sq. ft)	Grass Roughness Coefficient 'C_n' [2]	Mannings Roughness 'n' [3]	Flow 'Q_1' (cfs)	Is Q1 within 5% of Q?	Max. Shear Stress in Channel @ depth 'τ_d' (lb/sq. ft)	Permissible Soil Shear Stress '$\tau_{p,soil}$' (lb/sq. ft) [4]	Cover Factor Values for Uniform Strands of Grass 'C_f' [5]	Soil Grain Roughness 'n_s' [6]	Permissible Vegetation/Soil Shear Stress 'τ_p' (lb/sq. ft)	Is the lining Stable? (Y/N)
DP-5.6	1.10	1.0	6.0	2.0	0.0160	0.387	0.99	4.22	0.23	0.23	0.168	0.064	1.10	YES	0.386	0.020	0.700	0.016	1.07	YES
DP-5.7	0.10	7.5	6.0	2.0	0.0032	0.115	0.91	8.45	0.11	0.02	0.168	0.166	0.10	YES	0.023	0.020	0.700	0.016	7.19	YES
DP-5.9	0.00	7.0	6.0	2.0	0.0045		0.00	7.00	0.00	0.00	0.168				0.000	0.020	0.700	0.016		Flow = 0.0
DP-5.11	0.00	5.0	6.0	2.0	0.0100		0.00	5.00	0.00	0.00	0.168				0.000	0.020	0.700	0.016		Flow = 0.0
DP-5.12	1.90	8.5	6.0	2.0	0.0340	0.157	1.43	9.80	0.15	0.31	0.168	0.057	1.90	YES	0.332	0.020	0.700	0.016	0.85	YES
DP-5.13	1.90	1.0	6.0	2.0	0.0062	0.659	2.40	6.48	0.37	0.14	0.168	0.078	1.86	YES	0.255	0.020	0.700	0.016	1.58	YES
DP-6.1B	0.00	5.5	6.0	2.0	0.0270		0.00	5.50	0.00	0.00	0.168				0.000	0.020	0.700	0.016		Flow = 0.0
DP-6.7	1.10	7.5	6.0	2.0	0.0225	0.153	1.24	8.77	0.14	0.20	0.168	0.068	1.10	YES	0.215	0.020	0.700	0.016	1.22	YES
DP-6.7	1.10	3.0	6.0	2.0	0.0387	0.186	0.70	4.55	0.15	0.37	0.168	0.053	1.10	YES	0.450	0.020	0.700	0.016	0.74	YES
DP-7.2	0.10	1.0	6.0	2.0	0.0400	0.099	0.14	1.82	0.08	0.19	0.168	0.070	0.10	YES	0.246	0.020	0.700	0.016	1.27	YES
DP-8.1B	0.00	5.0	6.0	2.0	0.0024		0.00	5.00	0.00	0.00	0.168				0.000	0.020	0.700	0.016		Flow = 0.0
DP-10.4A	4.00	3.0	6.0	2.0	0.0083	0.614	3.35	8.10	0.41	0.21	0.168	0.066	3.80	YES	0.318	0.020	0.700	0.016	1.15	YES
DP-10.4B	6.40	3.0	6.0	2.0	0.0173	0.566	2.98	7.71	0.39	0.42	0.168	0.051	6.10	YES	0.611	0.020	0.700	0.016	0.67	YES
DP-10.14B	1.60	5.0	6.0	2.0	0.0103	0.310	1.93	7.58	0.26	0.16	0.168	0.074	1.60	YES	0.199	0.020	0.700	0.016	1.42	YES

1) Channel Depth 'd' is determined by the iteritive process as shown in Chapter 3: General Design Procedures in HEC-15.
2) Grass Roughness Coefficient 'C_n' determined from Table 4.3 in HEC-15.
3) Manning's Roughness 'n' is determined from Equation 4.2 in HEC-15 and is a function of the Mean Boundary Shear Stress 'τ_o'.
4) Permissible Soil Shear Stress '$\tau_{p,soil}$' is conservatively estimated as 0.02 lb/sq.ft per section 4.3.2.1 Non-Cohesive Soils in HEC-15, as site soils are found to be silty sands.
5) Cover Factor Values for Uniform Strands of Grass 'Cf' is selected from Table 4.5 in HEC-15 for 'Mixed in Fair Condition'.
6) 'Soil Grain Roughness 'ns' is conservatively estimated as 0.016 for D_{75} < 0.05 inches per Section 4.3.1 Effective Shear Stress in HEC-15

Appendix B – Standard 2 Computations and Supporting Information

The rainfall-runoff response of the Site under existing and proposed conditions was evaluated for storm events with recurrence intervals of 2, 10, 25 and 100-years. Rainfall volumes used for this analysis were based on the Stormwater Management Bylaw Regulations for the Town of Sudbury: 3.2, 4.8, 6.0, and 8.6 inches, respectively. Runoff coefficients for the pre- and post-development conditions, as previously shown in Tables 1 and 2 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD. Drainage areas used in the analyses were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology.


DP10.14
Wetland 3_Vernal Pool 1
PR10.14B: B
Landham Road BMP: Cell B
PR10.14B: A
Landham Road BMP: Cell A
PR10.14A
PR10.14B
Subcat
Reach
Pond
Link
Routing Diagram for PR_Segment_9-10_ResponsetoComments_REV_Full
Prepared by VHB, Printed 12/1/2020
HydroCAD® 10.10-3a s/n 01038 © 2020 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR10.14A: Runoff Area=4.071 ac 13.44% Impervious Runoff Depth=0.00"
Flow Length=123' Tc=19.0 min CN=40 Runoff=0.0 cfs 0.000 af

SubcatchmentPR10.14B: Runoff Area=2.916 ac 33.15% Impervious Runoff Depth=0.00"
Flow Length=664' Tc=11.9 min CN=56 Runoff=0.0 cfs 0.000 af

Pond PR10.14B: A: Landham Road BMP: Cell A Peak Elev=140.00' Storage=0 cf Inflow=0.0 cfs 0.000 af
Discarded=0.0 cfs 0.000 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.000 af

Pond PR10.14B: B: Landham Road BMP: Cell B Peak Elev=139.00' Storage=0 cf Inflow=0.0 cfs 0.000 af
Discarded=0.0 cfs 0.000 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.000 af

Link DP10.14: Wetland 3_Vernal Pool 1 Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Total Runoff Area = 6.987 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
78.33% Pervious = 5.473 ac 21.67% Impervious = 1.514 ac

Summary for Subcatchment PR10.14A:

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Rainfall=1.00"

Area (ac)	CN	Description
0.391	39	>75% Grass cover, Good, HSG A
0.031	30	Meadow, non-grazed, HSG A
0.547	98	Paved parking, HSG A
3.101	30	Woods, Good, HSG A
4.071	40	Weighted Average
3.524		86.56% Pervious Area
0.547		13.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	50	0.0340	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
1.9	73	0.0658	0.64		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
19.0	123	Total			

Summary for Subcatchment PR10.14B:

Runoff = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 1" Rainfall=1.00"

Area (ac)	CN	Description
0.872	39	>75% Grass cover, Good, HSG A
0.044	76	Gravel roads, HSG A
0.135	30	Meadow, non-grazed, HSG A
0.967	98	Paved parking, HSG A
0.898	30	Woods, Good, HSG A
2.916	56	Weighted Average
1.950		66.85% Pervious Area
0.967		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2120	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
0.1	11	0.3270	2.86		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	603	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
11.9	664	Total			

Summary for Pond PR10.14B: A: Landham Road BMP: Cell A

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 0.00" for 1" event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 140.00' @ 0.00 hrs Surf.Area= 533 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	140.00'	2,363 cf	**Cell A (West) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.00	533	0	0
141.00	1,148	841	841
141.50	1,460	652	1,493
142.00	2,023	871	2,363

Device	Routing	Invert	Outlet Devices
#1	Primary	141.50'	**8.0' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	140.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=140.00' (Free Discharge)
└─**2=Exfiltration** (Passes 0.0 cfs of 0.0 cfs potential flow)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=140.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond PR10.14B: B: Landham Road BMP: Cell B

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 0.00" for 1" event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 139.00' @ 0.00 hrs Surf.Area= 350 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	139.00'	1,097 cf	**Cell B (Eastern) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
139.00	350	0	0
140.00	849	600	600
140.50	1,140	497	1,097

Device	Routing	Invert	Outlet Devices
#1	Primary	140.50'	**5.5' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	139.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=139.00' (Free Discharge)
2=Exfiltration (Passes 0.0 cfs of 0.0 cfs potential flow)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=139.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.0 cfs)

Summary for Link DP10.14: Wetland 3_Vernal Pool 1

Inflow Area = 6.987 ac, 21.67% Impervious, Inflow Depth = 0.00" for 1" event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR10.14A: Runoff Area=4.071 ac 13.44% Impervious Runoff Depth=0.01"
Flow Length=123' Tc=19.0 min CN=40 Runoff=0.0 cfs 0.002 af

SubcatchmentPR10.14B: Runoff Area=2.916 ac 33.15% Impervious Runoff Depth=0.31"
Flow Length=664' Tc=11.9 min CN=56 Runoff=0.4 cfs 0.076 af

Pond PR10.14B: A: Landham Road BMP: Cell Peak Elev=141.51' Storage=1,510 cf Inflow=0.4 cfs 0.076 af
Discarded=0.0 cfs 0.066 af Primary=0.1 cfs 0.009 af Outflow=0.1 cfs 0.076 af

Pond PR10.14B: B: Landham Road BMP: Cell B Peak Elev=139.44' Storage=203 cf Inflow=0.1 cfs 0.009 af
Discarded=0.0 cfs 0.009 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.009 af

Link DP10.14: Wetland 3_Vernal Pool 1 Inflow=0.0 cfs 0.002 af
Primary=0.0 cfs 0.002 af

Total Runoff Area = 6.987 ac Runoff Volume = 0.078 af Average Runoff Depth = 0.13"
78.33% Pervious = 5.473 ac 21.67% Impervious = 1.514 ac

Summary for Subcatchment PR10.14A:

Runoff = 0.0 cfs @ 23.20 hrs, Volume= 0.002 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.30"

Area (ac)	CN	Description
0.391	39	>75% Grass cover, Good, HSG A
0.031	30	Meadow, non-grazed, HSG A
0.547	98	Paved parking, HSG A
3.101	30	Woods, Good, HSG A
4.071	40	Weighted Average
3.524		86.56% Pervious Area
0.547		13.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	50	0.0340	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
1.9	73	0.0658	0.64		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
19.0	123	Total			

Summary for Subcatchment PR10.14B:

Runoff = 0.4 cfs @ 12.39 hrs, Volume= 0.076 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.30"

Area (ac)	CN	Description
0.872	39	>75% Grass cover, Good, HSG A
0.044	76	Gravel roads, HSG A
0.135	30	Meadow, non-grazed, HSG A
0.967	98	Paved parking, HSG A
0.898	30	Woods, Good, HSG A
2.916	56	Weighted Average
1.950		66.85% Pervious Area
0.967		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2120	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
0.1	11	0.3270	2.86		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	603	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
11.9	664	Total			

Summary for Pond PR10.14B: A: Landham Road BMP: Cell A

```
Inflow Area =       2.916 ac, 33.15% Impervious, Inflow Depth =  0.31"   for 2-yr event
Inflow      =        0.4 cfs @  12.39 hrs, Volume=         0.076 af
Outflow     =        0.1 cfs @  15.49 hrs, Volume=         0.076 af, Atten= 79%, Lag= 186.3 min
Discarded   =        0.0 cfs @  15.49 hrs, Volume=         0.066 af
Primary     =        0.1 cfs @  15.49 hrs, Volume=         0.009 af
```

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 141.51' @ 15.49 hrs Surf.Area= 1,473 sf Storage= 1,510 cf

Plug-Flow detention time= 495.2 min calculated for 0.076 af (100% of inflow)
Center-of-Mass det. time= 495.3 min (1,442.2 - 947.0)

Volume	Invert	Avail.Storage	Storage Description
#1	140.00'	2,363 cf	**Cell A (West) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.00	533	0	0
141.00	1,148	841	841
141.50	1,460	652	1,493
142.00	2,023	871	2,363

Device	Routing	Invert	Outlet Devices
#1	Primary	141.50'	**8.0' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	140.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 15.49 hrs HW=141.51' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 15.49 hrs HW=141.51' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.42 fps)

Summary for Pond PR10.14B: B: Landham Road BMP: Cell B

```
Inflow Area =       2.916 ac, 33.15% Impervious, Inflow Depth =  0.04"   for 2-yr event
Inflow      =        0.1 cfs @  15.49 hrs, Volume=         0.009 af
Outflow     =        0.0 cfs @  18.09 hrs, Volume=         0.009 af, Atten= 74%, Lag= 155.8 min
Discarded   =        0.0 cfs @  18.09 hrs, Volume=         0.009 af
Primary     =        0.0 cfs @   0.00 hrs, Volume=         0.000 af
```

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 139.44' @ 18.09 hrs Surf.Area= 571 sf Storage= 203 cf

Plug-Flow detention time= 176.3 min calculated for 0.009 af (100% of inflow)
Center-of-Mass det. time= 176.3 min (1,192.1 - 1,015.8)

Volume	Invert	Avail.Storage	Storage Description
#1	139.00'	1,097 cf	**Cell B (Eastern) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
139.00	350	0	0
140.00	849	600	600
140.50	1,140	497	1,097

Device	Routing	Invert	Outlet Devices
#1	Primary	140.50'	**5.5' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	139.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 18.09 hrs HW=139.44' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=139.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.0 cfs)

Summary for Link DP10.14: Wetland 3_Vernal Pool 1

Inflow Area = 6.987 ac, 21.67% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.0 cfs @ 23.20 hrs, Volume= 0.002 af
Primary = 0.0 cfs @ 23.20 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR10.14A: Runoff Area=4.071 ac 13.44% Impervious Runoff Depth=0.26"
Flow Length=123' Tc=19.0 min CN=40 Runoff=0.2 cfs 0.087 af

SubcatchmentPR10.14B: Runoff Area=2.916 ac 33.15% Impervious Runoff Depth=1.09"
Flow Length=664' Tc=11.9 min CN=56 Runoff=2.5 cfs 0.266 af

Pond PR10.14B: A: Landham Road BMP: Cell Peak Elev=141.67' Storage=1,754 cf Inflow=2.5 cfs 0.266 af
Discarded=0.0 cfs 0.070 af Primary=2.1 cfs 0.196 af Outflow=2.1 cfs 0.266 af

Pond PR10.14B: B: Landham Road BMP: Cell Peak Elev=140.67' Storage=1,097 cf Inflow=2.1 cfs 0.196 af
Discarded=0.0 cfs 0.052 af Primary=1.5 cfs 0.032 af Outflow=1.5 cfs 0.084 af

Link DP10.14: Wetland 3_Vernal Pool 1 Inflow=1.6 cfs 0.120 af
Primary=1.6 cfs 0.120 af

Total Runoff Area = 6.987 ac Runoff Volume = 0.353 af Average Runoff Depth = 0.61"
78.33% Pervious = 5.473 ac 21.67% Impervious = 1.514 ac

Summary for Subcatchment PR10.14A:

Runoff = 0.2 cfs @ 12.62 hrs, Volume= 0.087 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=5.10"

Area (ac)	CN	Description
0.391	39	>75% Grass cover, Good, HSG A
0.031	30	Meadow, non-grazed, HSG A
0.547	98	Paved parking, HSG A
3.101	30	Woods, Good, HSG A
4.071	40	Weighted Average
3.524		86.56% Pervious Area
0.547		13.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	50	0.0340	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
1.9	73	0.0658	0.64		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
19.0	123	Total			

Summary for Subcatchment PR10.14B:

Runoff = 2.5 cfs @ 12.19 hrs, Volume= 0.266 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=5.10"

Area (ac)	CN	Description
0.872	39	>75% Grass cover, Good, HSG A
0.044	76	Gravel roads, HSG A
0.135	30	Meadow, non-grazed, HSG A
0.967	98	Paved parking, HSG A
0.898	30	Woods, Good, HSG A
2.916	56	Weighted Average
1.950		66.85% Pervious Area
0.967		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2120	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
0.1	11	0.3270	2.86		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	603	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
11.9	664	Total			

Summary for Pond PR10.14B: A: Landham Road BMP: Cell A

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 1.09" for 10-yr event
Inflow = 2.5 cfs @ 12.19 hrs, Volume= 0.266 af
Outflow = 2.1 cfs @ 12.30 hrs, Volume= 0.266 af, Atten= 15%, Lag= 6.3 min
Discarded = 0.0 cfs @ 12.30 hrs, Volume= 0.070 af
Primary = 2.1 cfs @ 12.30 hrs, Volume= 0.196 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 141.67' @ 12.30 hrs Surf.Area= 1,650 sf Storage= 1,754 cf

Plug-Flow detention time= 154.5 min calculated for 0.266 af (100% of inflow)
Center-of-Mass det. time= 154.6 min (1,047.2 - 892.6)

Volume	Invert	Avail.Storage	Storage Description
#1	140.00'	2,363 cf	**Cell A (West) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.00	533	0	0
141.00	1,148	841	841
141.50	1,460	652	1,493
142.00	2,023	871	2,363

Device	Routing	Invert	Outlet Devices
#1	Primary	141.50'	**8.0' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	140.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 12.30 hrs HW=141.67' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.1 cfs @ 12.30 hrs HW=141.67' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 2.1 cfs @ 1.56 fps)

Summary for Pond PR10.14B: B: Landham Road BMP: Cell B

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 0.80" for 10-yr event
Inflow = 2.1 cfs @ 12.30 hrs, Volume= 0.196 af
Outflow = 1.5 cfs @ 12.39 hrs, Volume= 0.084 af, Atten= 28%, Lag= 5.7 min
Discarded = 0.0 cfs @ 12.39 hrs, Volume= 0.052 af
Primary = 1.5 cfs @ 12.39 hrs, Volume= 0.032 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 140.67' @ 12.39 hrs Surf.Area= 1,140 sf Storage= 1,097 cf

Plug-Flow detention time= 446.6 min calculated for 0.084 af (43% of inflow)
Center-of-Mass det. time= 311.0 min (1,201.4 - 890.4)

Volume	Invert	Avail.Storage	Storage Description
#1	139.00'	1,097 cf	**Cell B (Eastern) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
139.00	350	0	0
140.00	849	600	600
140.50	1,140	497	1,097

Device	Routing	Invert	Outlet Devices
#1	Primary	140.50'	**5.5' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	139.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 12.39 hrs HW=140.67' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.5 cfs @ 12.39 hrs HW=140.67' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.5 cfs @ 1.57 fps)

Summary for Link DP10.14: Wetland 3_Vernal Pool 1

Inflow Area = 6.987 ac, 21.67% Impervious, Inflow Depth = 0.21" for 10-yr event
Inflow = 1.6 cfs @ 12.39 hrs, Volume= 0.120 af
Primary = 1.6 cfs @ 12.39 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR10.14A: Runoff Area=4.071 ac 13.44% Impervious Runoff Depth=0.57"
Flow Length=123' Tc=19.0 min CN=40 Runoff=0.9 cfs 0.194 af

SubcatchmentPR10.14B: Runoff Area=2.916 ac 33.15% Impervious Runoff Depth=1.73"
Flow Length=664' Tc=11.9 min CN=56 Runoff=4.4 cfs 0.421 af

Pond PR10.14B: A: Landham Road BMP: Cell Peak Elev=141.77' Storage=1,930 cf Inflow=4.4 cfs 0.421 af
Discarded=0.0 cfs 0.071 af Primary=4.3 cfs 0.350 af Outflow=4.3 cfs 0.421 af

Pond PR10.14B: B: Landham Road BMP: Cell Peak Elev=140.65' Storage=1,097 cf Inflow=4.3 cfs 0.350 af
Discarded=0.0 cfs 0.052 af Primary=1.3 cfs 0.011 af Outflow=1.3 cfs 0.063 af

Link DP10.14: Wetland 3_Vernal Pool 1 Inflow=1.6 cfs 0.205 af
Primary=1.6 cfs 0.205 af

Total Runoff Area = 6.987 ac Runoff Volume = 0.616 af Average Runoff Depth = 1.06"
78.33% Pervious = 5.473 ac 21.67% Impervious = 1.514 ac

Summary for Subcatchment PR10.14A:

Runoff = 0.9 cfs @ 12.50 hrs, Volume= 0.194 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.23"

Area (ac)	CN	Description
0.391	39	>75% Grass cover, Good, HSG A
0.031	30	Meadow, non-grazed, HSG A
0.547	98	Paved parking, HSG A
3.101	30	Woods, Good, HSG A
4.071	40	Weighted Average
3.524		86.56% Pervious Area
0.547		13.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	50	0.0340	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
1.9	73	0.0658	0.64		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
19.0	123	Total			

Summary for Subcatchment PR10.14B:

Runoff = 4.4 cfs @ 12.18 hrs, Volume= 0.421 af, Depth= 1.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=6.23"

Area (ac)	CN	Description
0.872	39	>75% Grass cover, Good, HSG A
0.044	76	Gravel roads, HSG A
0.135	30	Meadow, non-grazed, HSG A
0.967	98	Paved parking, HSG A
0.898	30	Woods, Good, HSG A
2.916	56	Weighted Average
1.950		66.85% Pervious Area
0.967		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2120	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
0.1	11	0.3270	2.86		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	603	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
11.9	664	Total			

Summary for Pond PR10.14B: A: Landham Road BMP: Cell A

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 1.73" for 25-yr event
Inflow = 4.4 cfs @ 12.18 hrs, Volume= 0.421 af
Outflow = 4.3 cfs @ 12.21 hrs, Volume= 0.421 af, Atten= 2%, Lag= 1.6 min
Discarded = 0.0 cfs @ 12.21 hrs, Volume= 0.071 af
Primary = 4.3 cfs @ 12.21 hrs, Volume= 0.350 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 141.77' @ 12.21 hrs Surf.Area= 1,765 sf Storage= 1,930 cf

Plug-Flow detention time= 99.2 min calculated for 0.421 af (100% of inflow)
Center-of-Mass det. time= 99.3 min (976.1 - 876.8)

Volume	Invert	Avail.Storage	Storage Description
#1	140.00'	2,363 cf	**Cell A (West) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.00	533	0	0
141.00	1,148	841	841
141.50	1,460	652	1,493
142.00	2,023	871	2,363

Device	Routing	Invert	Outlet Devices
#1	Primary	141.50'	**8.0' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	140.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 12.21 hrs HW=141.77' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=4.3 cfs @ 12.21 hrs HW=141.77' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 4.3 cfs @ 1.98 fps)

Summary for Pond PR10.14B: B: Landham Road BMP: Cell B

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 1.44" for 25-yr event
Inflow = 4.3 cfs @ 12.21 hrs, Volume= 0.350 af
Outflow = 1.3 cfs @ 12.21 hrs, Volume= 0.063 af, Atten= 70%, Lag= 0.0 min
Discarded = 0.0 cfs @ 12.20 hrs, Volume= 0.052 af
Primary = 1.3 cfs @ 12.21 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 140.65' @ 12.21 hrs Surf.Area= 1,140 sf Storage= 1,097 cf

Plug-Flow detention time= 616.7 min calculated for 0.063 af (18% of inflow)
Center-of-Mass det. time= 475.1 min (1,349.6 - 874.5)

Volume	Invert	Avail.Storage	Storage Description
#1	139.00'	1,097 cf	**Cell B (Eastern) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
139.00	350	0	0
140.00	849	600	600
140.50	1,140	497	1,097

Device	Routing	Invert	Outlet Devices
#1	Primary	140.50'	**5.5' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	139.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 12.20 hrs HW=140.65' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=1.3 cfs @ 12.21 hrs HW=140.65' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.3 cfs @ 1.49 fps)

Summary for Link DP10.14: Wetland 3_Vernal Pool 1

Inflow Area = 6.987 ac, 21.67% Impervious, Inflow Depth = 0.35" for 25-yr event
Inflow = 1.6 cfs @ 12.22 hrs, Volume= 0.205 af
Primary = 1.6 cfs @ 12.22 hrs, Volume= 0.205 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentPR10.14A: Runoff Area=4.071 ac 13.44% Impervious Runoff Depth=1.52"
Flow Length=123' Tc=19.0 min CN=40 Runoff=3.8 cfs 0.516 af

SubcatchmentPR10.14B: Runoff Area=2.916 ac 33.15% Impervious Runoff Depth=3.32"
Flow Length=664' Tc=11.9 min CN=56 Runoff=9.1 cfs 0.807 af

Pond PR10.14B: A: Landham Road BMP: Cell Peak Elev=141.94' Storage=2,247 cf Inflow=9.1 cfs 0.807 af
Discarded=0.0 cfs 0.075 af Primary=8.9 cfs 0.732 af Outflow=9.0 cfs 0.807 af

Pond PR10.14B: B: Landham Road BMP: Cell Peak Elev=141.03' Storage=1,097 cf Inflow=8.9 cfs 0.732 af
Discarded=0.0 cfs 0.053 af Primary=8.1 cfs 0.316 af Outflow=8.2 cfs 0.369 af

Link DP10.14: Wetland 3_Vernal Pool 1 Inflow=11.0 cfs 0.832 af
Primary=11.0 cfs 0.832 af

Total Runoff Area = 6.987 ac Runoff Volume = 1.323 af Average Runoff Depth = 2.27"
78.33% Pervious = 5.473 ac 21.67% Impervious = 1.514 ac

Summary for Subcatchment PR10.14A:

Runoff = 3.8 cfs @ 12.33 hrs, Volume= 0.516 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=8.60"

Area (ac)	CN	Description
0.391	39	>75% Grass cover, Good, HSG A
0.031	30	Meadow, non-grazed, HSG A
0.547	98	Paved parking, HSG A
3.101	30	Woods, Good, HSG A
4.071	40	Weighted Average
3.524		86.56% Pervious Area
0.547		13.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	50	0.0340	0.05		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.30"
1.9	73	0.0658	0.64		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
19.0	123	Total			

Summary for Subcatchment PR10.14B:

Runoff = 9.1 cfs @ 12.17 hrs, Volume= 0.807 af, Depth= 3.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=8.60"

Area (ac)	CN	Description
0.872	39	>75% Grass cover, Good, HSG A
0.044	76	Gravel roads, HSG A
0.135	30	Meadow, non-grazed, HSG A
0.967	98	Paved parking, HSG A
0.898	30	Woods, Good, HSG A
2.916	56	Weighted Average
1.950		66.85% Pervious Area
0.967		33.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2120	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.30"
0.1	11	0.3270	2.86		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	603	0.0090	1.42		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
11.9	664	Total			

Summary for Pond PR10.14B: A: Landham Road BMP: Cell A

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 3.32" for 100-yr event
Inflow = 9.1 cfs @ 12.17 hrs, Volume= 0.807 af
Outflow = 9.0 cfs @ 12.19 hrs, Volume= 0.807 af, Atten= 1%, Lag= 1.1 min
Discarded = 0.0 cfs @ 12.19 hrs, Volume= 0.075 af
Primary = 8.9 cfs @ 12.19 hrs, Volume= 0.732 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 141.94' @ 12.19 hrs Surf.Area= 1,957 sf Storage= 2,247 cf

Plug-Flow detention time= 54.2 min calculated for 0.806 af (100% of inflow)
Center-of-Mass det. time= 54.3 min (911.0 - 856.6)

Volume	Invert	Avail.Storage	Storage Description
#1	140.00'	2,363 cf	**Cell A (West) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
140.00	533	0	0
141.00	1,148	841	841
141.50	1,460	652	1,493
142.00	2,023	871	2,363

Device	Routing	Invert	Outlet Devices
#1	Primary	141.50'	**8.0' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	140.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 12.19 hrs HW=141.94' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=8.9 cfs @ 12.19 hrs HW=141.94' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 8.9 cfs @ 2.53 fps)

Summary for Pond PR10.14B: B: Landham Road BMP: Cell B

Inflow Area = 2.916 ac, 33.15% Impervious, Inflow Depth = 3.01" for 100-yr event
Inflow = 8.9 cfs @ 12.19 hrs, Volume= 0.732 af
Outflow = 8.2 cfs @ 12.19 hrs, Volume= 0.369 af, Atten= 9%, Lag= 0.0 min
Discarded = 0.0 cfs @ 11.98 hrs, Volume= 0.053 af
Primary = 8.1 cfs @ 12.19 hrs, Volume= 0.316 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 141.03' @ 12.19 hrs Surf.Area= 1,140 sf Storage= 1,097 cf

Plug-Flow detention time= 110.0 min calculated for 0.369 af (50% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	139.00'	1,097 cf	**Cell B (Eastern) (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
139.00	350	0	0
140.00	849	600	600
140.50	1,140	497	1,097

Device	Routing	Invert	Outlet Devices
#1	Primary	140.50'	**5.5' long (Profile 30) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.80 3.86 3.86
#2	Discarded	139.00'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.0 cfs @ 11.98 hrs HW=140.71' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.0 cfs)

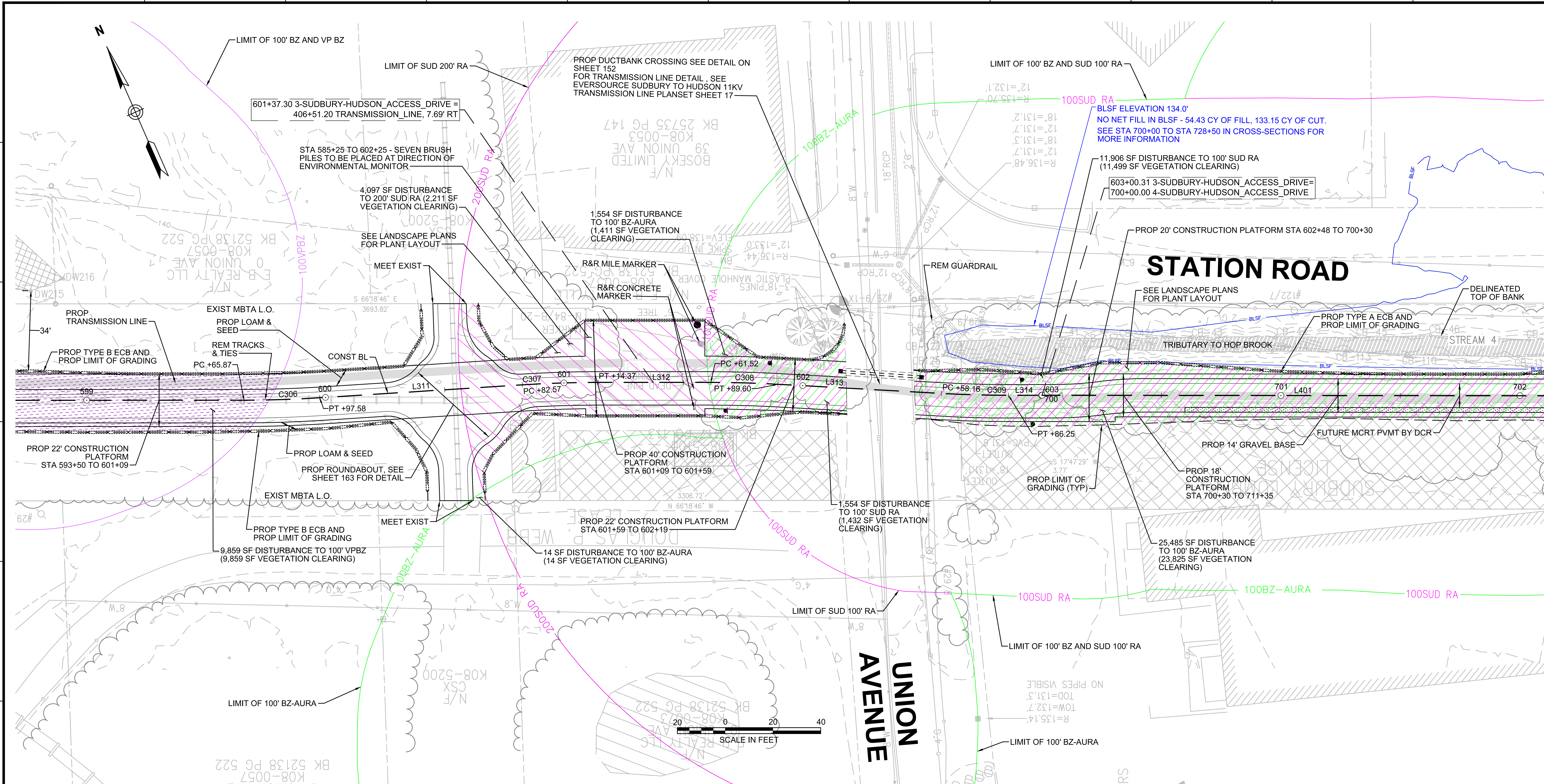
Primary OutFlow Max=8.1 cfs @ 12.19 hrs HW=141.03' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 8.1 cfs @ 2.78 fps)

Summary for Link DP10.14: Wetland 3_Vernal Pool 1

Inflow Area = 6.987 ac, 21.67% Impervious, Inflow Depth = 1.43" for 100-yr event
Inflow = 11.0 cfs @ 12.22 hrs, Volume= 0.832 af
Primary = 11.0 cfs @ 12.22 hrs, Volume= 0.832 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

EVERSOURCE PLANS - WATERSHED 9.1



NOTES:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).
2. CONTRACTOR TO INSTALL GEOTEXTILE FABRIC UNDERNEATH 12" GRAVEL BORROW WITHIN LIMITS SHOWN.
3. SYNCOPATED SILT FENCE (TYPE B ECB) TO BE USED WITHIN PRIORITY HABITAT AREA AND 100' VP BZ. SEE DETAIL ON SHEET 154.

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100'RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	TEMPORARY DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO BLSF
	TEMPORARY DISTURBANCE TO LAND UNDER WATER (LUW)		EXISTING TREE LINE
	TEMPORARY DISTURBANCE TO BANK		LIMIT OF GRADING
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		

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NO.	DESCRIPTION	BY	DATE	APPR.
	REVISION			

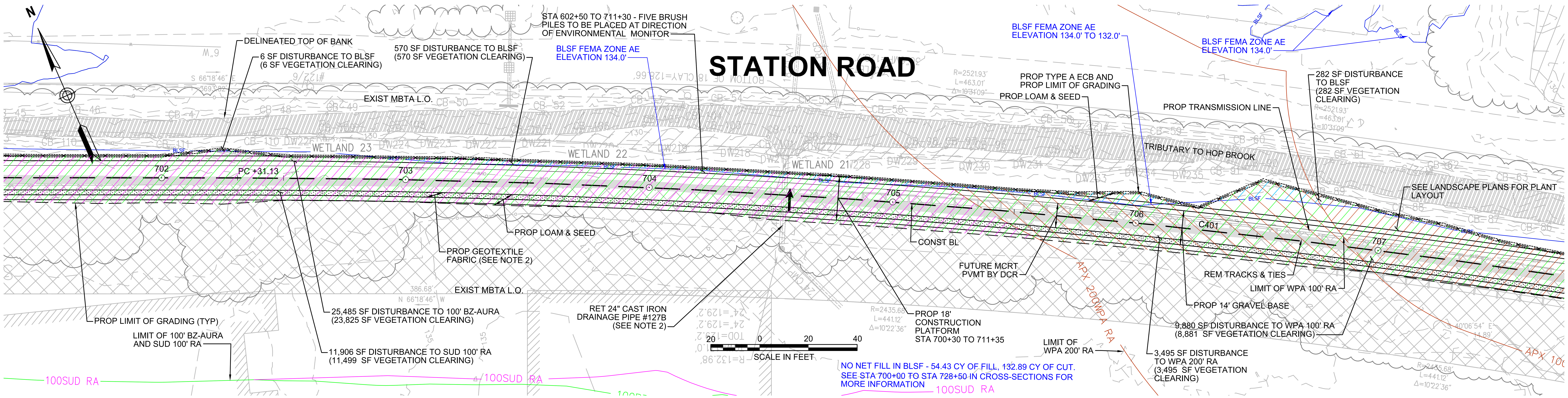
EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT

HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS

CONSTRUCTION PLANS

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=20'	DEC 2020	MS	SK	MES	.	.



NOTES:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).
2. TRANSMISSION LINE TO RUN UNDERNEATH DRAINAGE PIPE (SEE DETAIL ON SHEET 157).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	TEMPORARY DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO BLSF
	TEMPORARY DISTURBANCE TO LAND UNDER WATER (LUW)		EXISTING TREE LINE
	TEMPORARY DISTURBANCE TO BANK		LIMIT OF GRADING
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		

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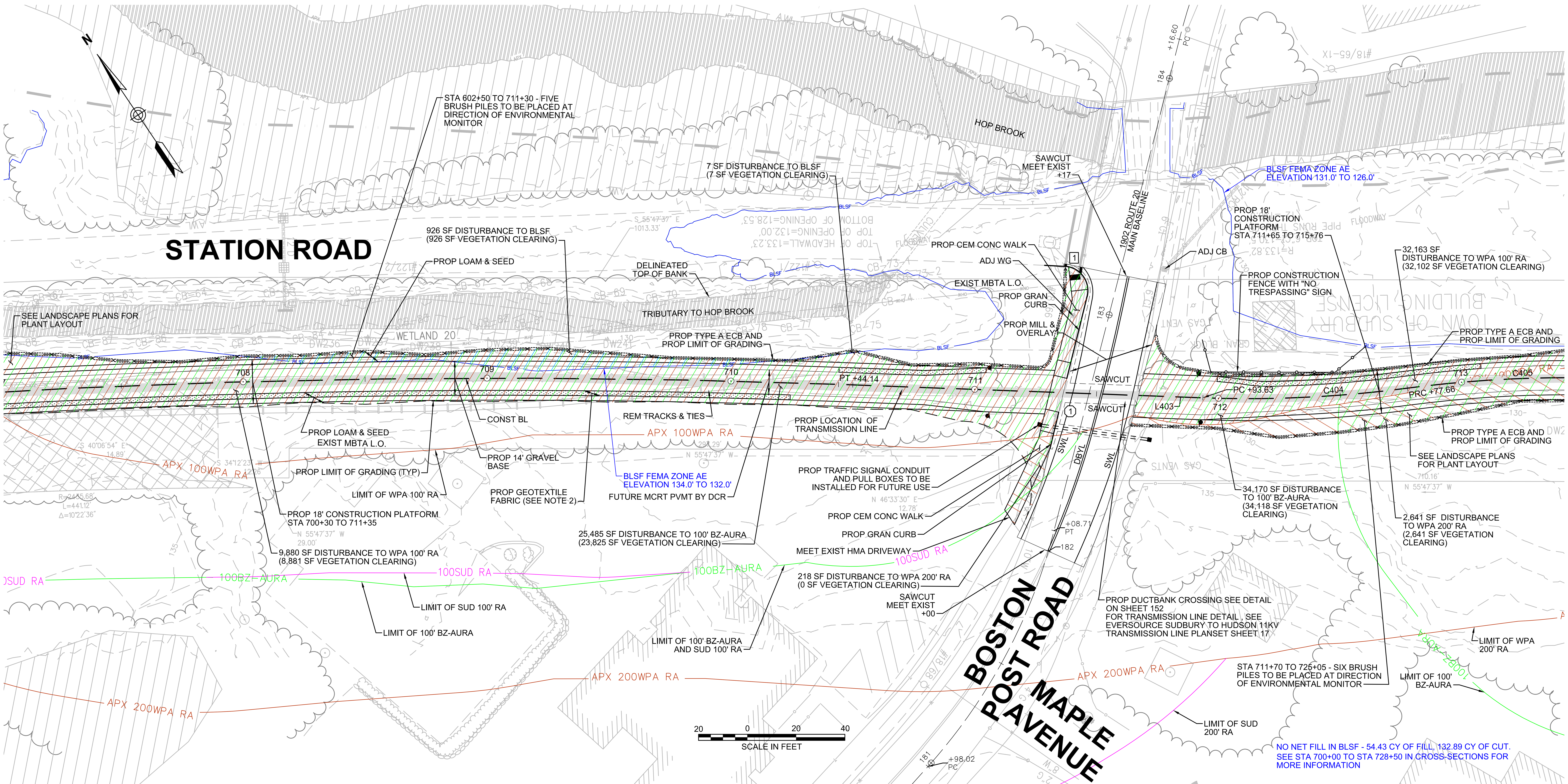
SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT

HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS

CONSTRUCTION PLANS

PLAN 62 OF 348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=20'	DEC 2020	MS	SK	MS	.	.



NOTES:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).
2. CONTRACTOR TO INSTALL GEOTEXTILE FABRIC UNDERNEATH 12" GRAVEL BORROW WITHIN LIMITS SHOWN.

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	TEMPORARY DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO BLSF
	TEMPORARY DISTURBANCE TO LAND UNDER WATER (LUW)		EXISTING TREE LINE
	TEMPORARY DISTURBANCE TO BANK		LIMIT OF GRADING
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		

LEGEND:

Ⓧ ACCESS ROAD CROSSING NUMBER

☒ WHEELCHAIR RAMP NUMBER

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	REVISION			

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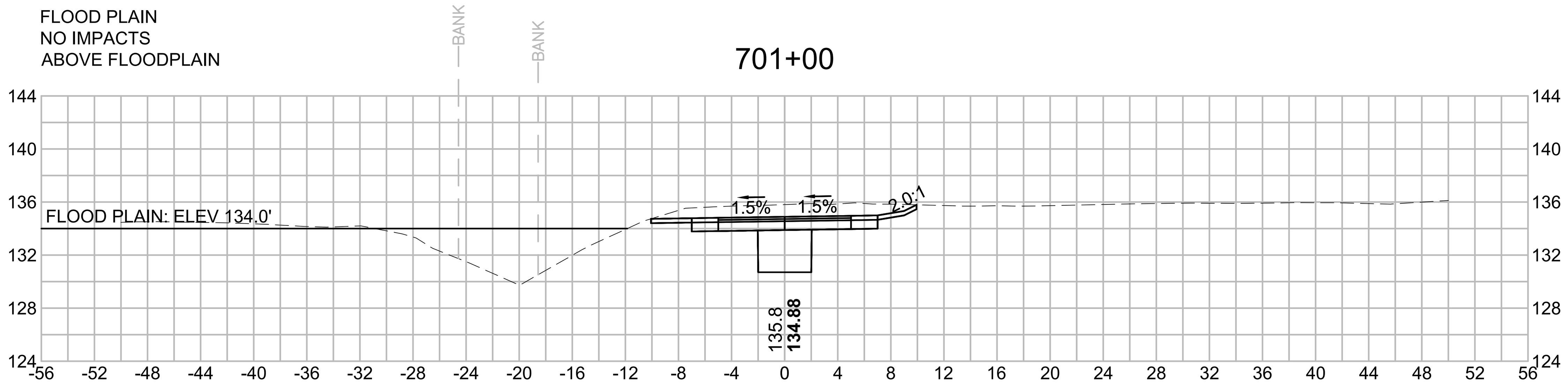
SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT

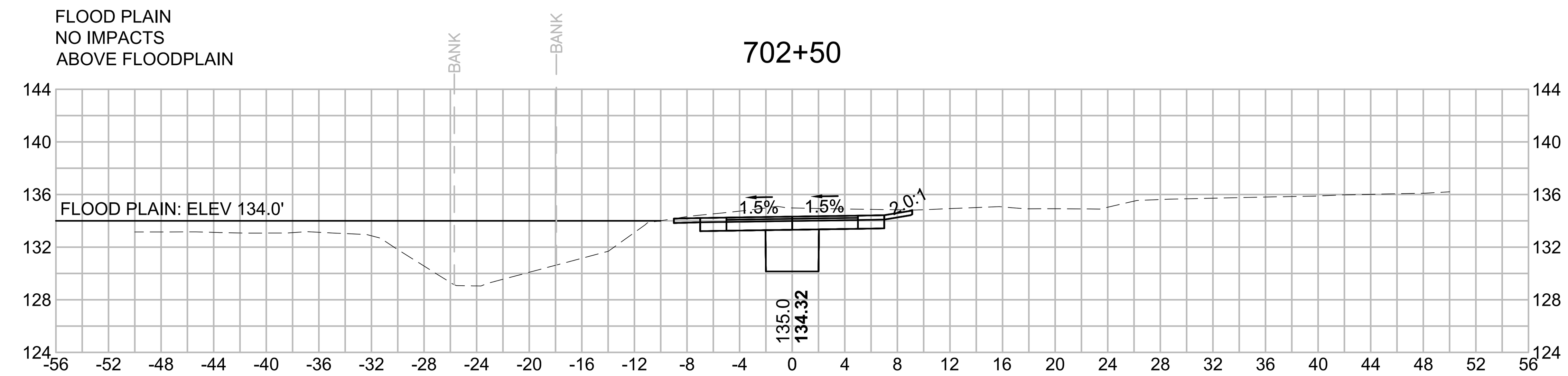
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS

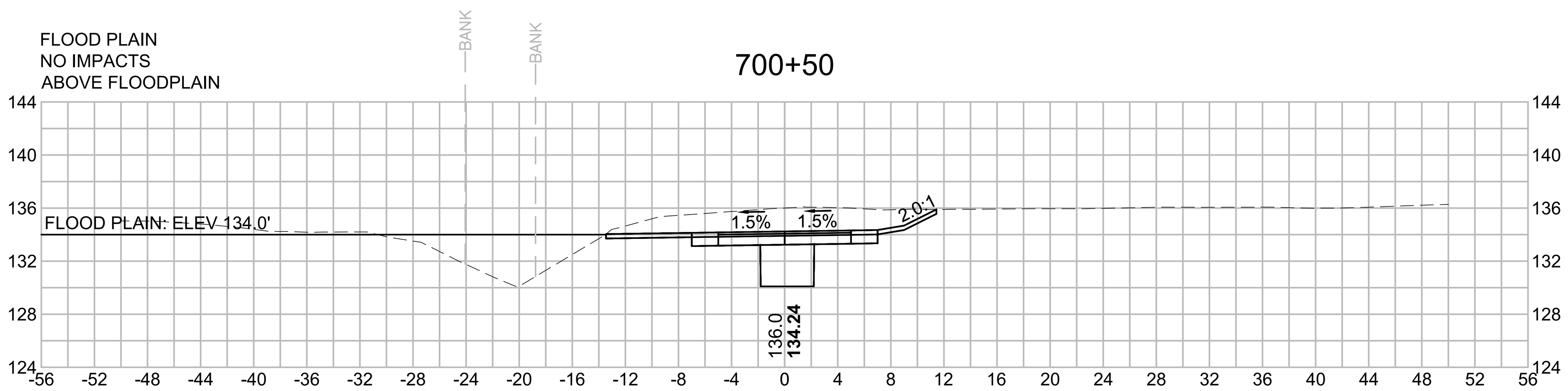
CONSTRUCTION PLANS

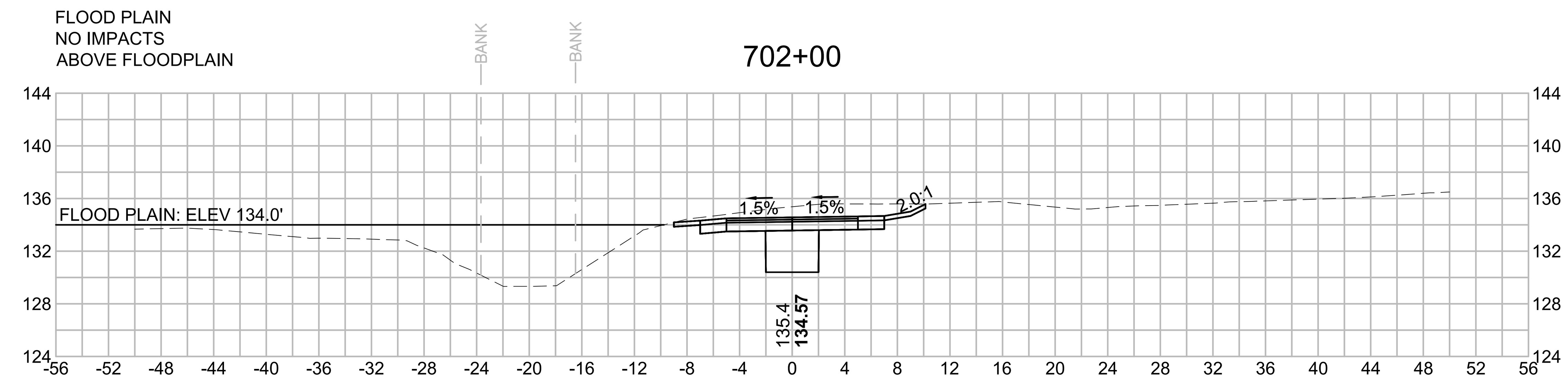
PLAN 63 OF 348

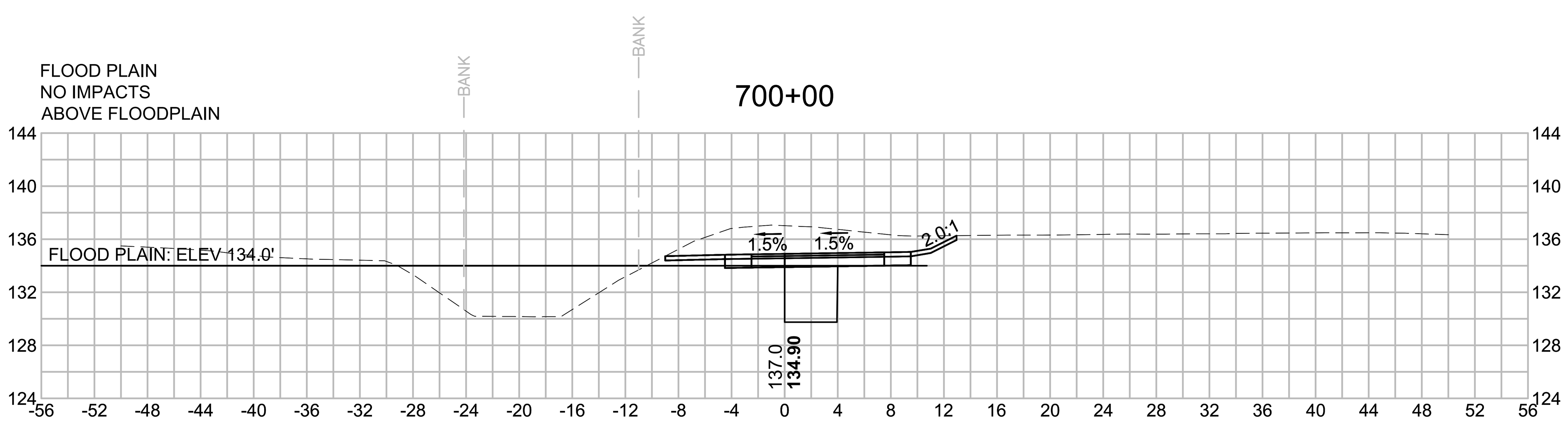
SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=20'	DEC 2020	MS	SK	MS	.	.

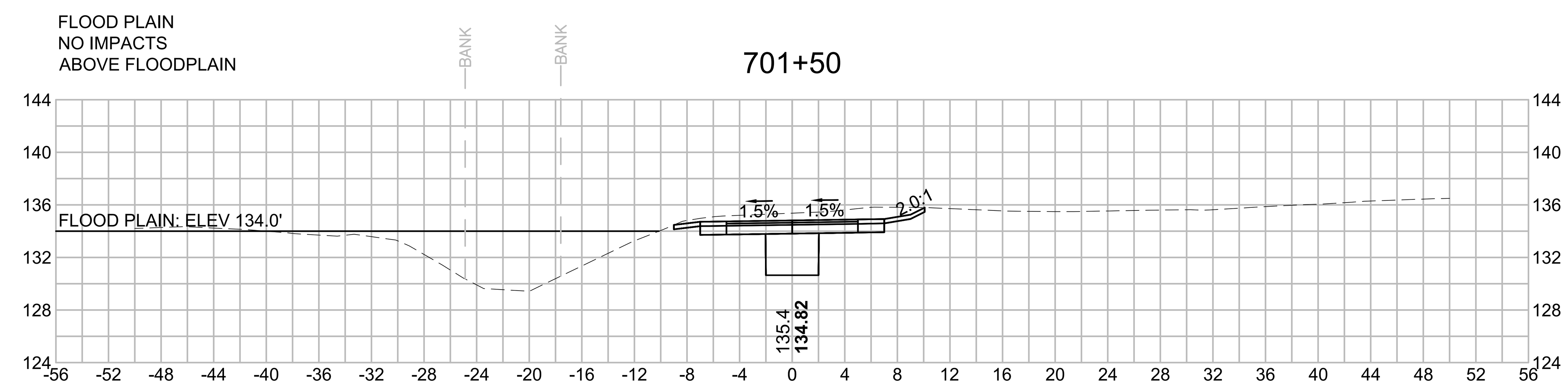












BLSF CROSSING STA 700 TO STA 740 - FEMA ZONE AE - TRIBUTARY TO HOP BROOK AND HOP BROOK
FEMA ELEVATION VARIES

FILL:		CUT:	
133'-134':	17.00 CY	133'-134':	46.91 CY
132'-133':	16.13 CY	132'-133':	20.22 CY
131'-132':	1.70 CY	131'-132':	5.50 CY
126'-127':	14.96 CY	126'-127':	17.00 CY
125'-126':	13.81 CY	125'-126':	67.04 CY
124'-125':	1.37 CY	124'-125':	6.11 CY
123'-124':	0.00 CY	123'-124':	0.43 CY

8 0 8 16
SCALE IN FEET

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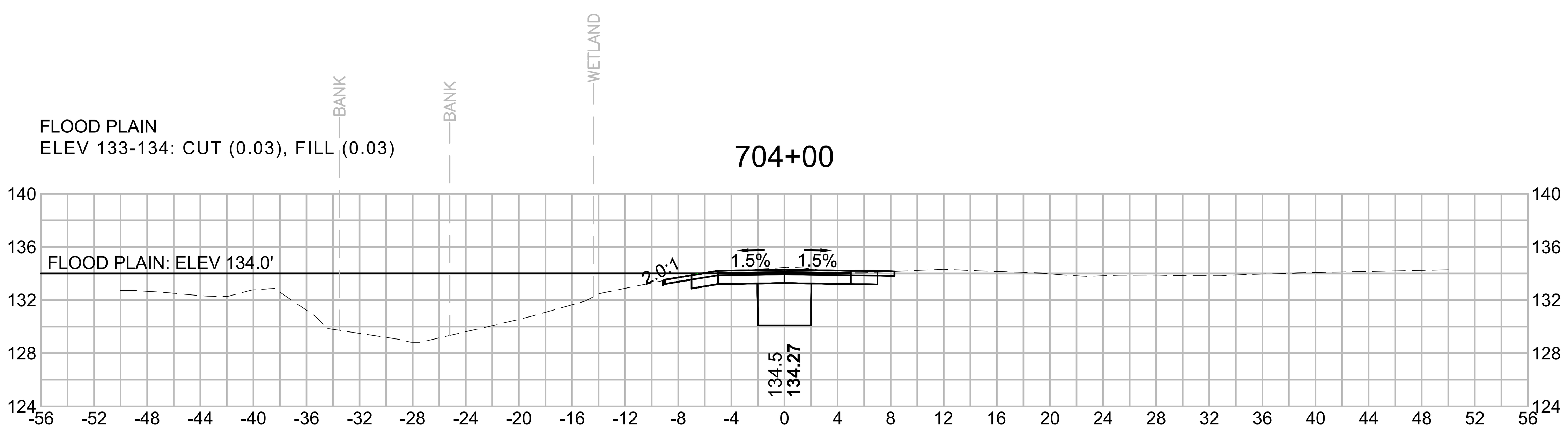
EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS
PLAN 322 OF 348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=8'	NOV 2020	MS	SK	MES	.	.

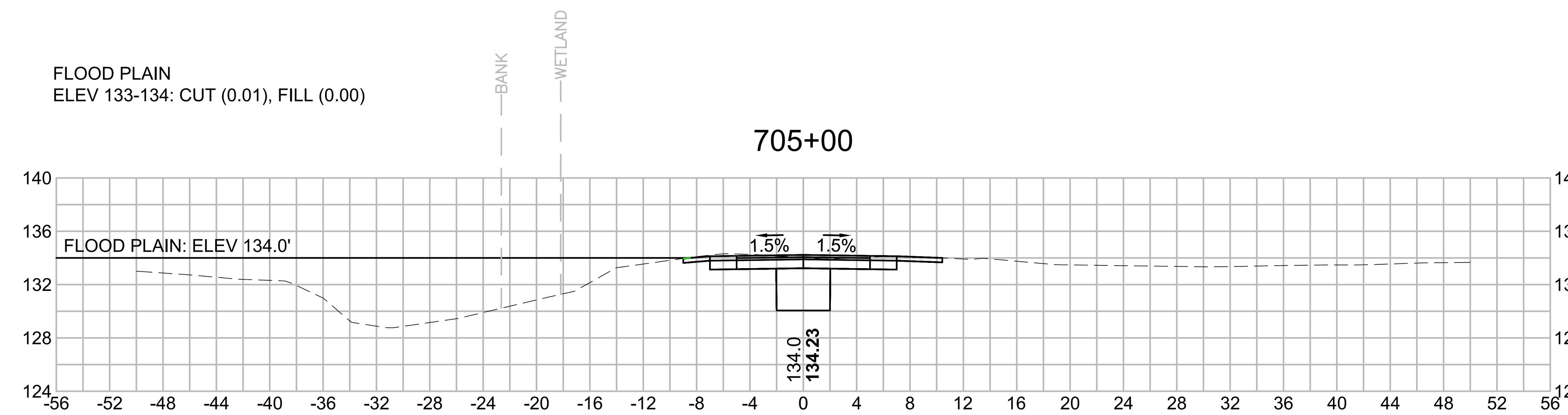
FLOOD PLAIN
ELEV 133-134: CUT (0.03), FILL (0.03)

704+00



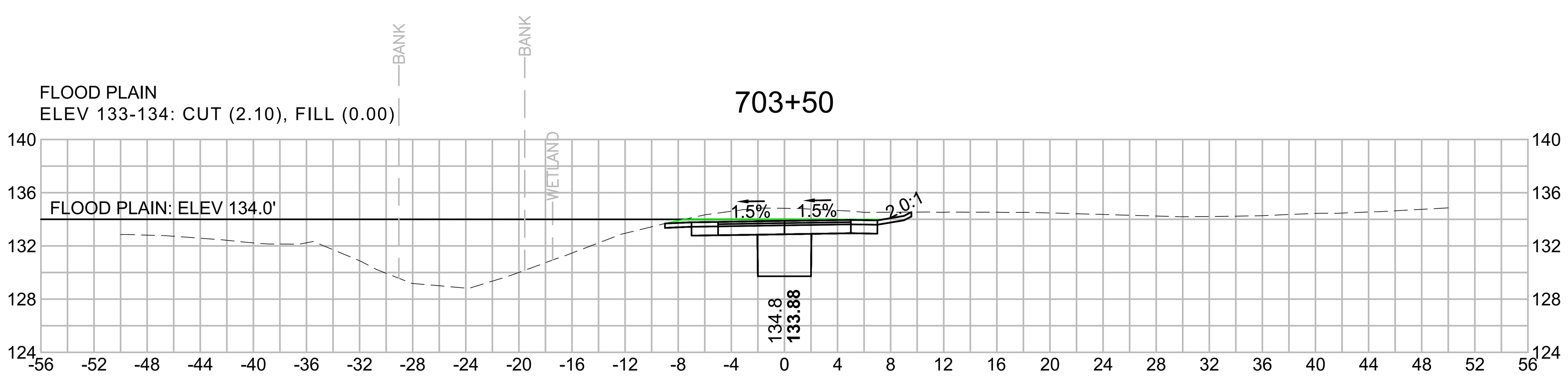
FLOOD PLAIN
ELEV 133-134: CUT (0.01), FILL (0.00)

705+00

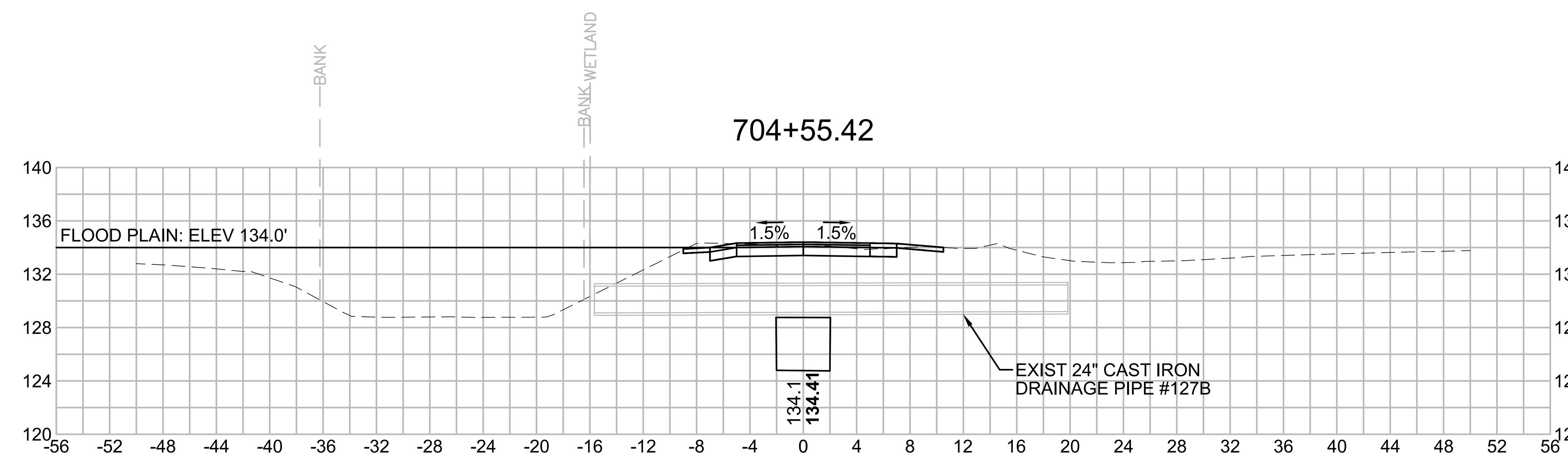


FLOOD PLAIN
ELEV 133-134: CUT (2.10), FILL (0.00)

703+50

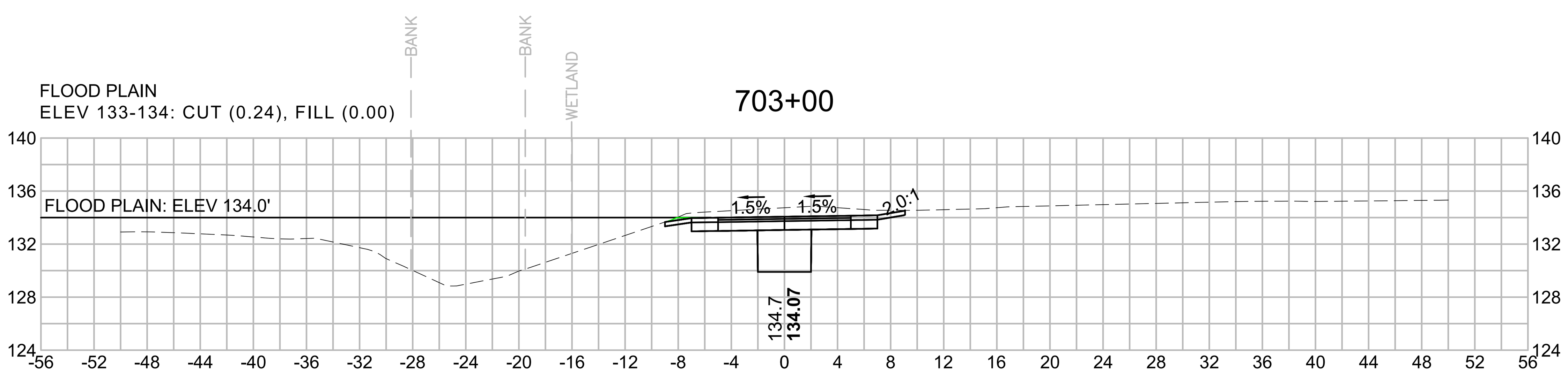


704+55.42



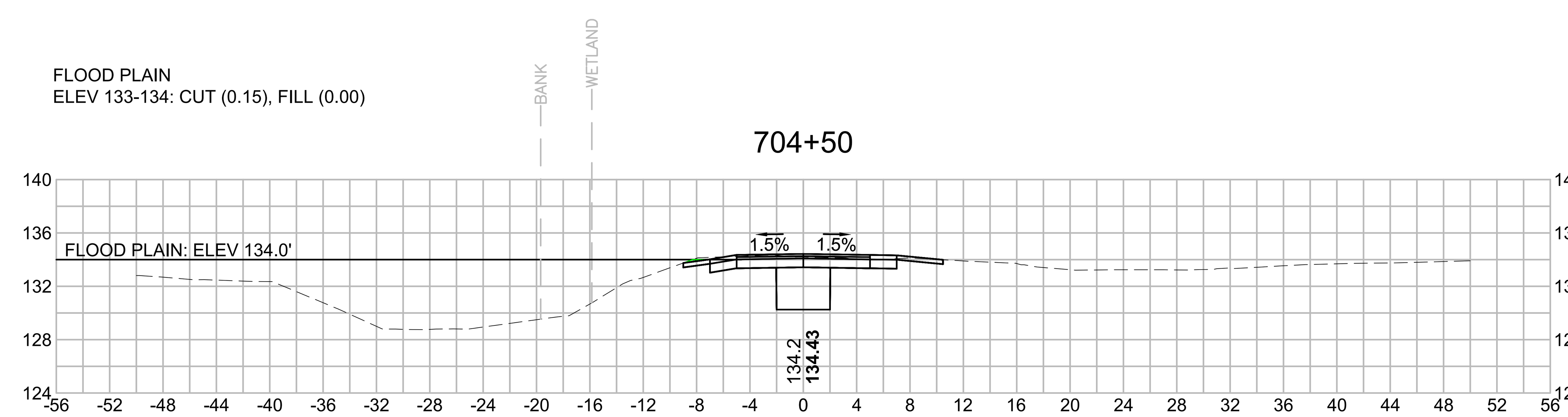
FLOOD PLAIN
ELEV 133-134: CUT (0.24), FILL (0.00)

703+00



FLOOD PLAIN
ELEV 133-134: CUT (0.15), FILL (0.00)

704+50



8 0 8 16
SCALE IN FEET

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NO.	DESCRIPTION	BY	DATE	APPR.

REVISION

EVERSOURCE

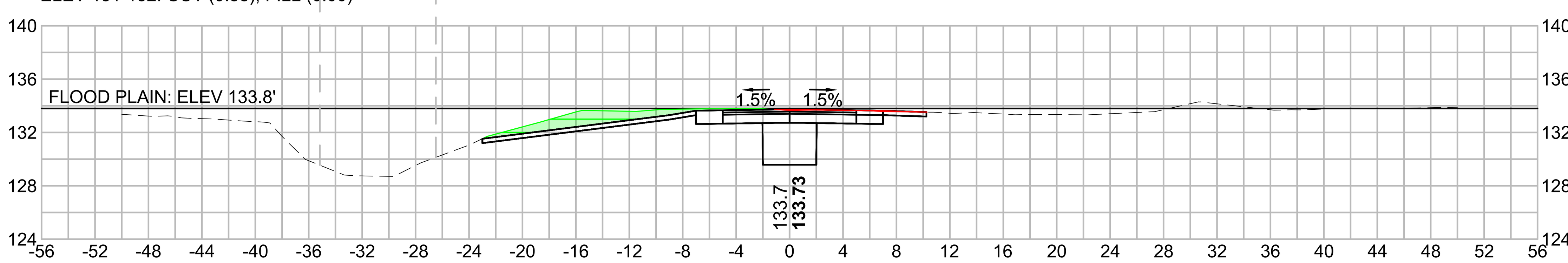
SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS

PLAN 3230F348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=8'	NOV 2020	MS	SK	MES	.	.

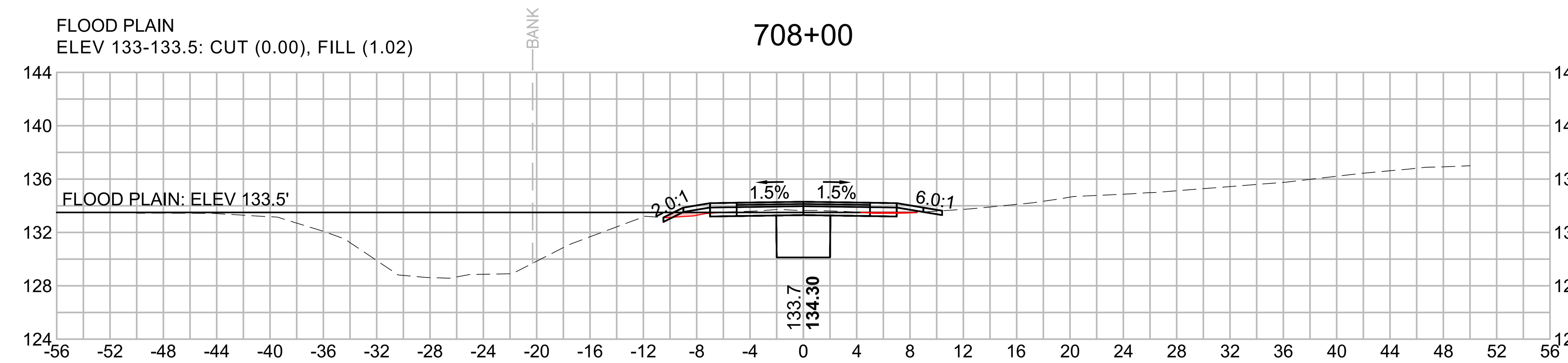
FLOOD PLAIN
ELEV 133-133.8: CUT (5.79), FILL (0.38)
ELEV 132-133: CUT (4.39), FILL (0.00)
ELEV 131-132: CUT (0.58), FILL (0.00)

706+50



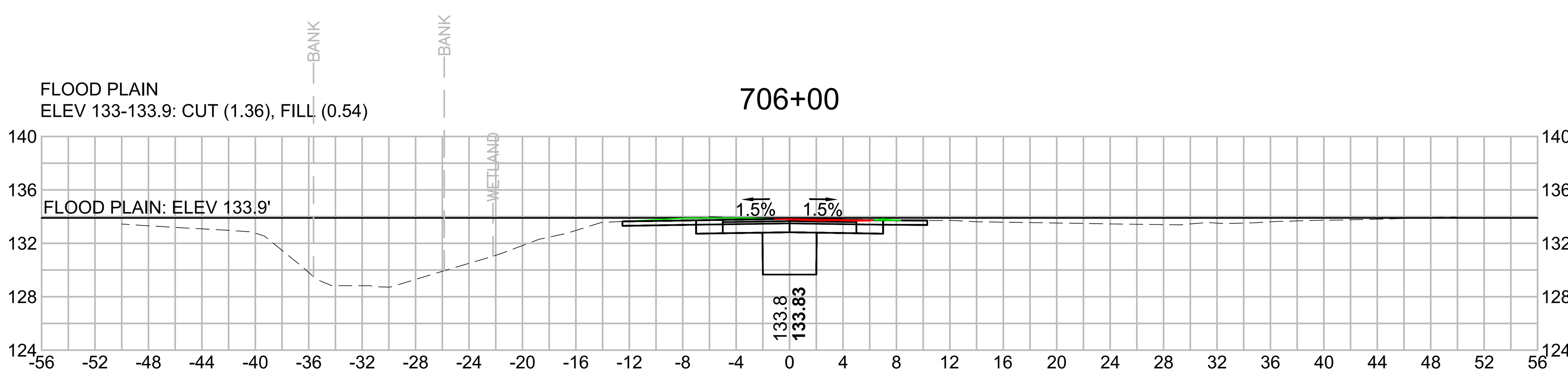
FLOOD PLAIN
ELEV 133-133.5: CUT (0.00), FILL (1.02)

708+00



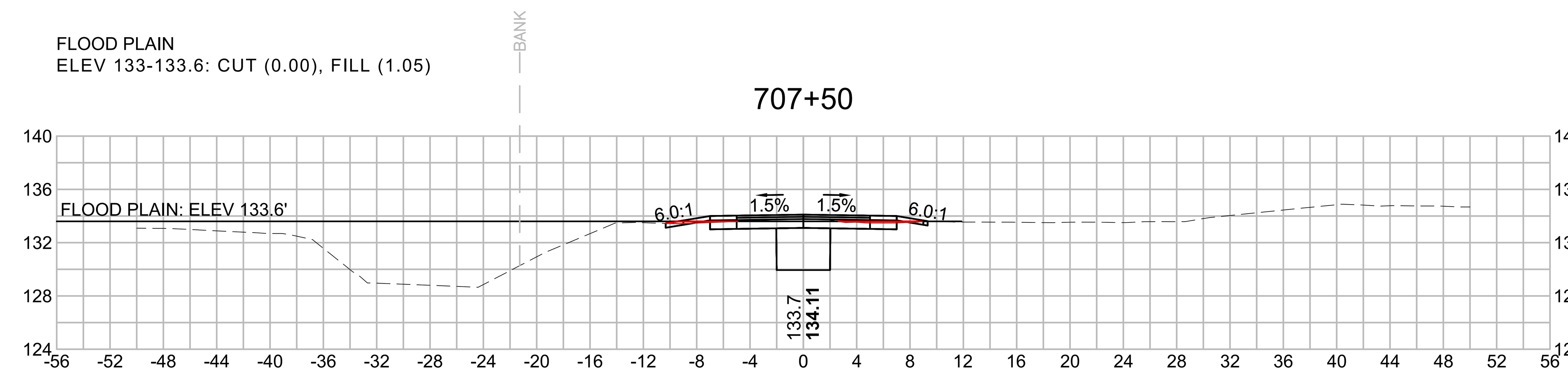
FLOOD PLAIN
ELEV 133-133.9: CUT (1.36), FILL (0.54)

706+00



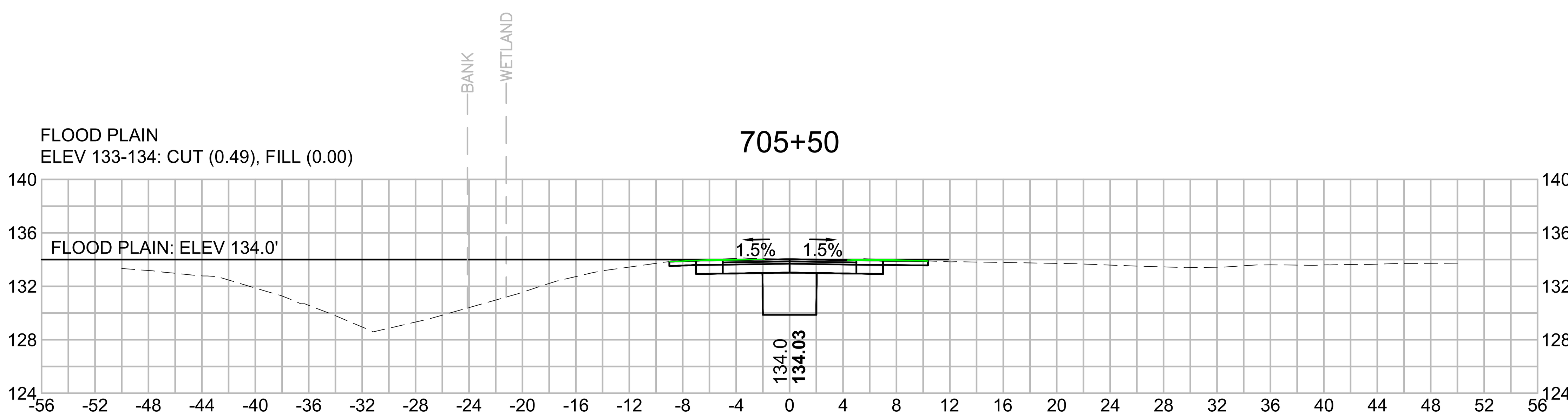
FLOOD PLAIN
ELEV 133-133.6: CUT (0.00), FILL (1.05)

707+50



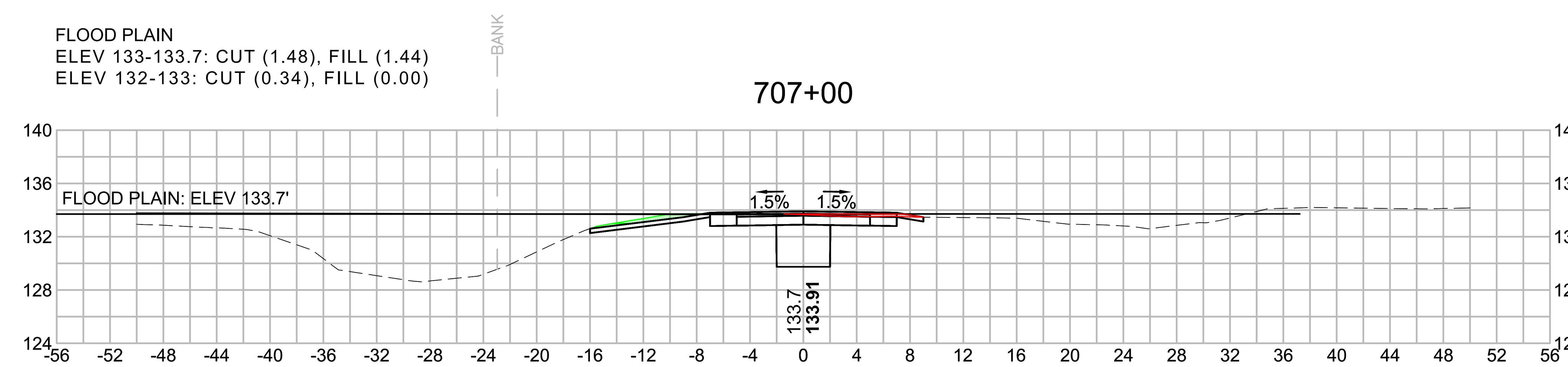
FLOOD PLAIN
ELEV 133-134: CUT (0.49), FILL (0.00)

705+50



FLOOD PLAIN
ELEV 133-133.7: CUT (1.48), FILL (1.44)
ELEV 132-133: CUT (0.34), FILL (0.00)

707+00



8 0 8 16
SCALE IN FEET

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NO.	DESCRIPTION	BY	DATE	APPR.

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EVERSOURCE

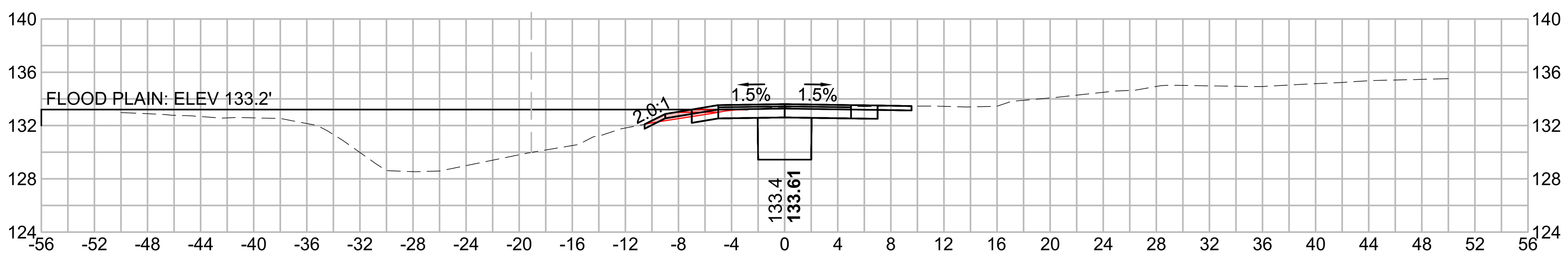
SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS

PLAN 324 OF 348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=8'	NOV 2020	MS	SK	MES	.	.

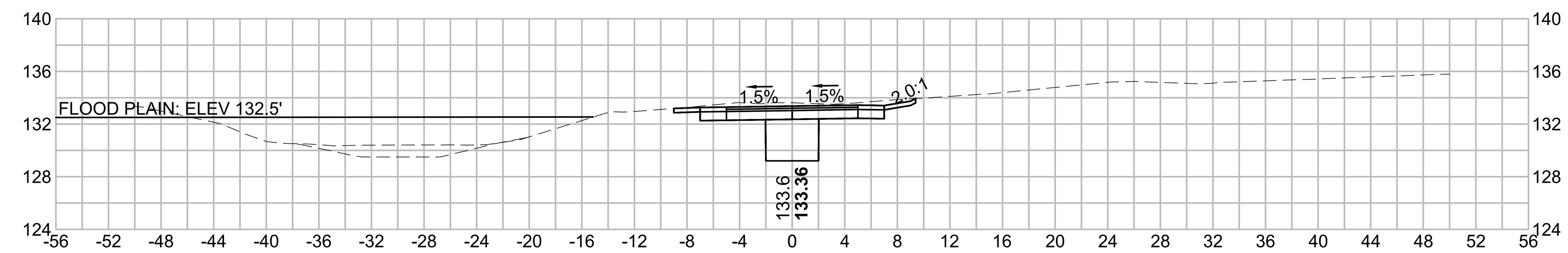
FLOOD PLAIN
ELEV 133-133.2: CUT (0.00), FILL (0.68)
ELEV 132-133: CUT (0.00), FILL (1.65)

709+50



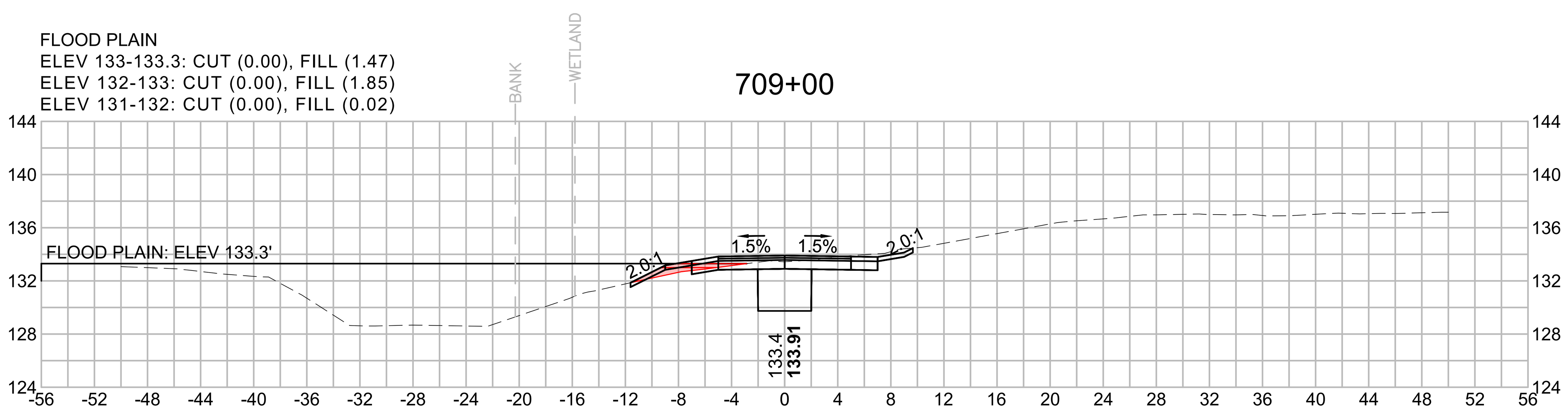
FLOOD PLAIN
NO IMPACTS
ABOVE FLOODPLAIN

710+75



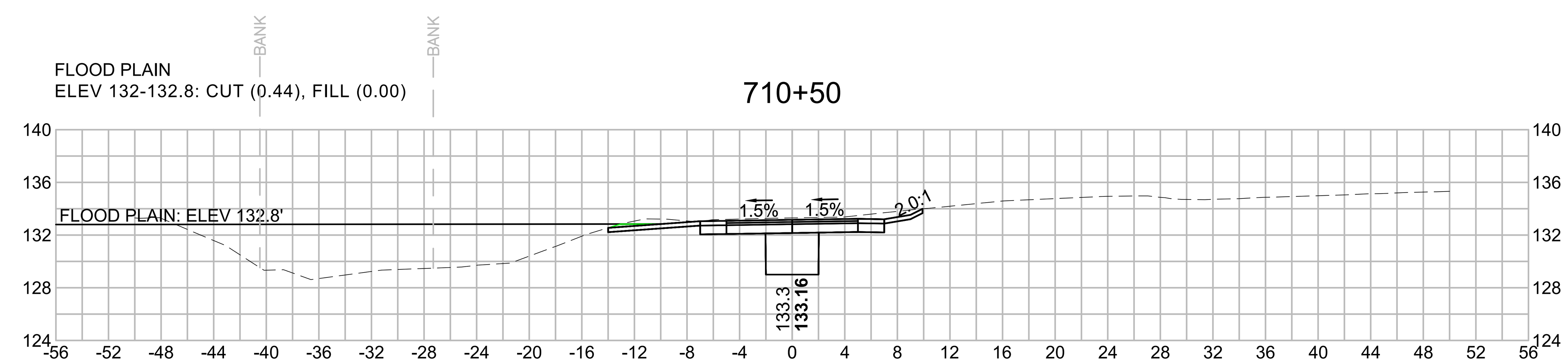
FLOOD PLAIN
ELEV 133-133.3: CUT (0.00), FILL (1.47)
ELEV 132-133: CUT (0.00), FILL (1.85)
ELEV 131-132: CUT (0.00), FILL (0.02)

709+00



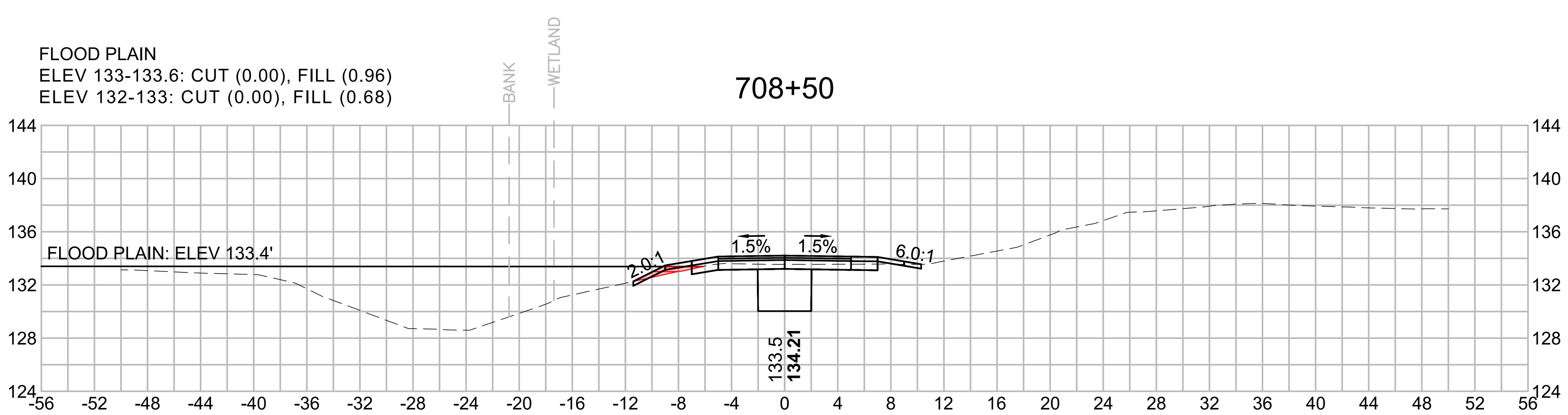
FLOOD PLAIN
ELEV 132-132.8: CUT (0.44), FILL (0.00)

710+50



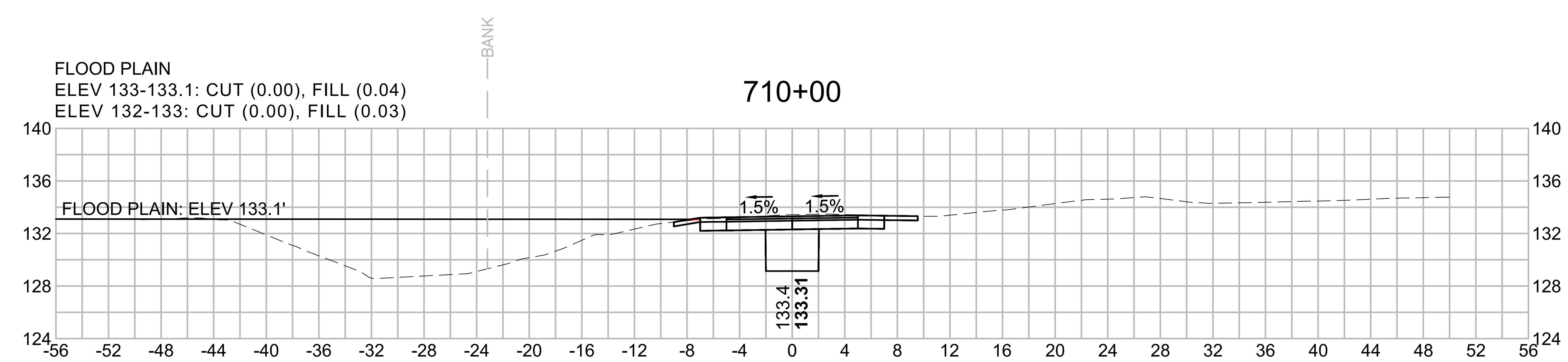
FLOOD PLAIN
ELEV 133-133.6: CUT (0.00), FILL (0.96)
ELEV 132-133: CUT (0.00), FILL (0.68)

708+50



FLOOD PLAIN
ELEV 133-133.1: CUT (0.00), FILL (0.04)
ELEV 132-133: CUT (0.00), FILL (0.03)

710+00



8 0 8 16
SCALE IN FEET

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101 Walnut St., PO Box 9151
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NO.	DESCRIPTION	BY	DATE	APPR.

REVISION

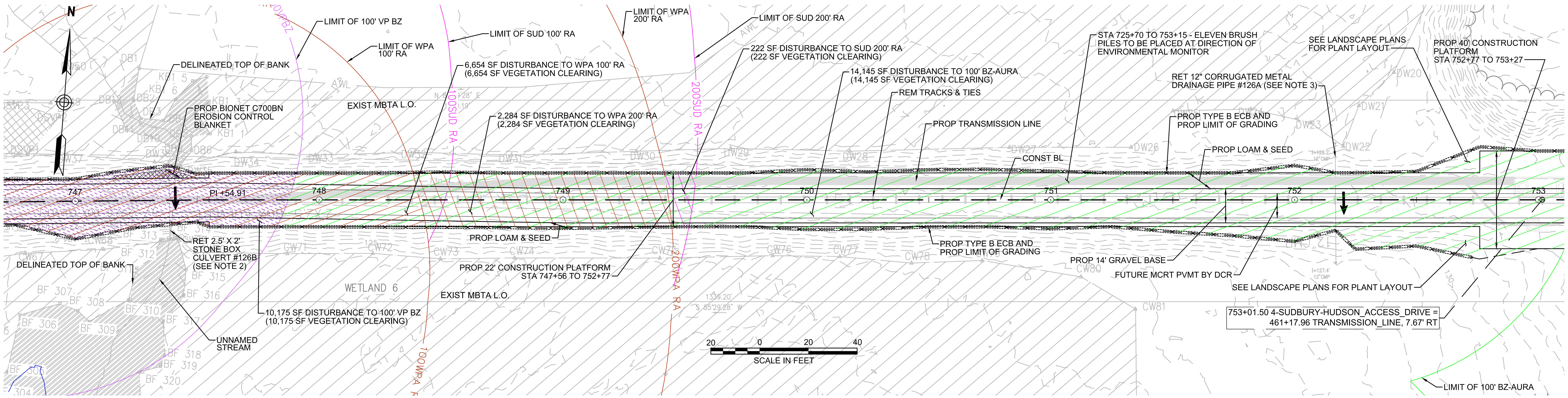
EVERSOURCE

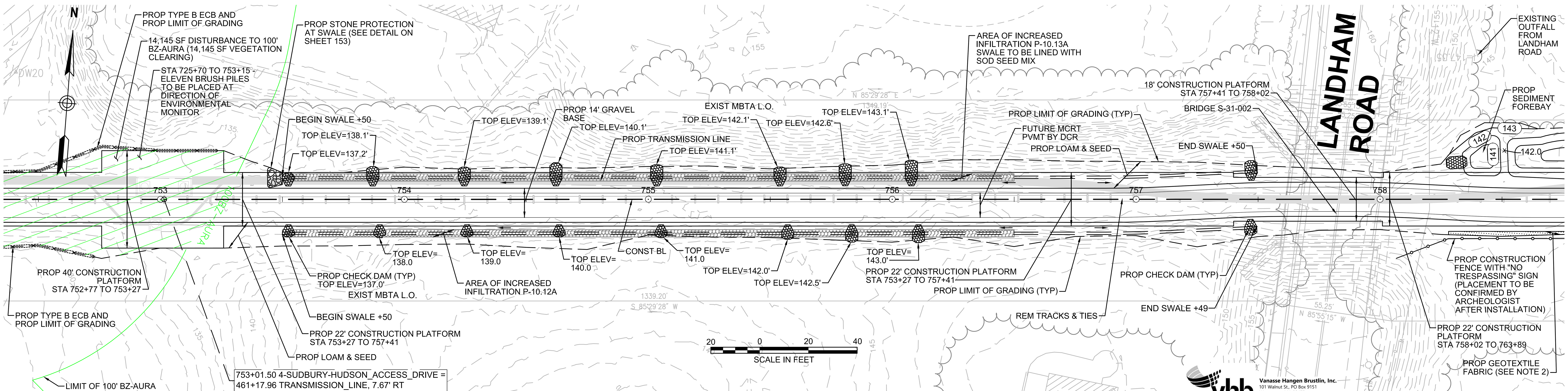
SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS

PLAN 325 OF 348

SCALE: unless noted 1"=8'	DATE NOV 2020	DRAWN MS	CH'K D. SK	APPR. MES	DRAWING NO. .	REV. .

EVERSOURCE PLANS - WATERSHED 10.14





NOTES:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).
2. CONTRACTOR TO CUT VEGETATION ON NORTHEAST WINGWALL OF STONE BOX CULVERT. NO GRUBBING SHALL BE PERFORMED OUTSIDE LIMITS OF GRADING.
3. CONTRACTOR TO CLEAR SEDIMENT IN DRAINAGE PIPE BY HAND.
4. SYNCOPATED SILT FENCE (TYPE B ECB) TO BE USED WITHIN PRIORITY HABITAT AREA AND 100' VP BZ. SEE DETAIL ON SHEET 154.

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND
	BORDERING VEGETATED WETLAND
	LAND UNDER WATER
	VERNAL POOL
	PERMANENT DISTURBANCE TO VEGETATED WETLAND
	TEMPORARY DISTURBANCE TO VEGETATED WETLAND
	TEMPORARY DISTURBANCE TO LAND UNDER WATER (LUW)
	TEMPORARY DISTURBANCE TO BANK
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)
	DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO BLSF
	EXISTING TREE LINE
	LIMIT OF GRADING

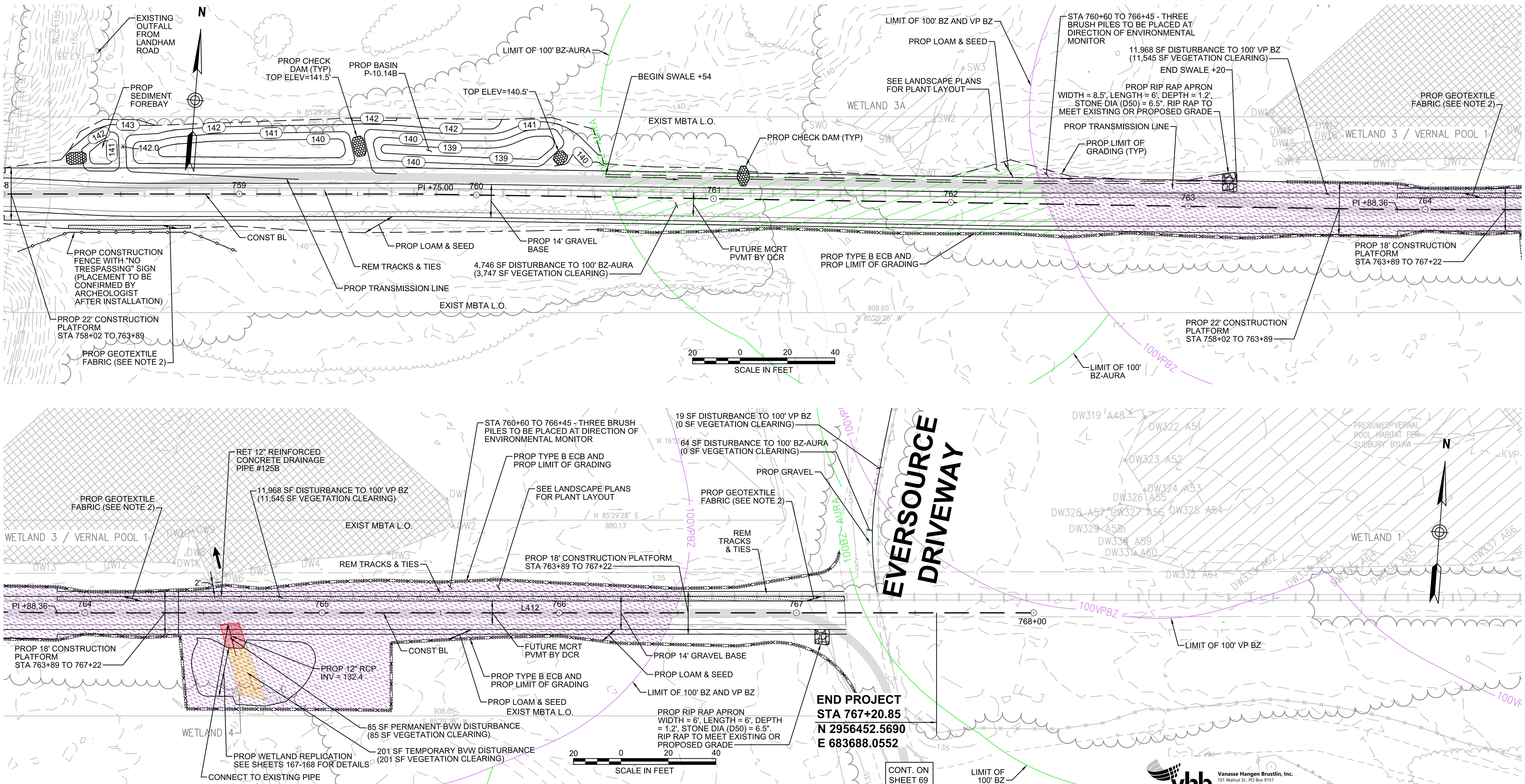
vhb Vanasse Hangen Brustlin, Inc.
101 Walnut St., PO Box 9151
Watertown, MA 02472
617.924.1770 FAX 617.924.2286

NO.	DESCRIPTION	BY	DATE	APPR.
	REVISION			

EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CONSTRUCTION PLANS

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=20'	DEC 2020	MS	SK	MS	.	.



NOTES:
1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).
2. CONTRACTOR TO INSTALL GEOTEXTILE FABRIC UNDERNEATH 12" GRAVEL BORROW WITHIN LIMITS SHOWN.
3. SYNCOPATED SILT FENCE (TYPE B ECB) TO BE USED WITHIN PRIORITY HABITAT AREA AND 100' VP BZ. SEE DETAIL ON SHEET 154.

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	TEMPORARY DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO BLSF
	TEMPORARY DISTURBANCE TO LAND UNDER WATER (LUW)		EXISTING TREE LINE
	TEMPORARY DISTURBANCE TO BANK		LIMIT OF GRADING
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		

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NO.	DESCRIPTION	BY	DATE	APPR.
REVISION				

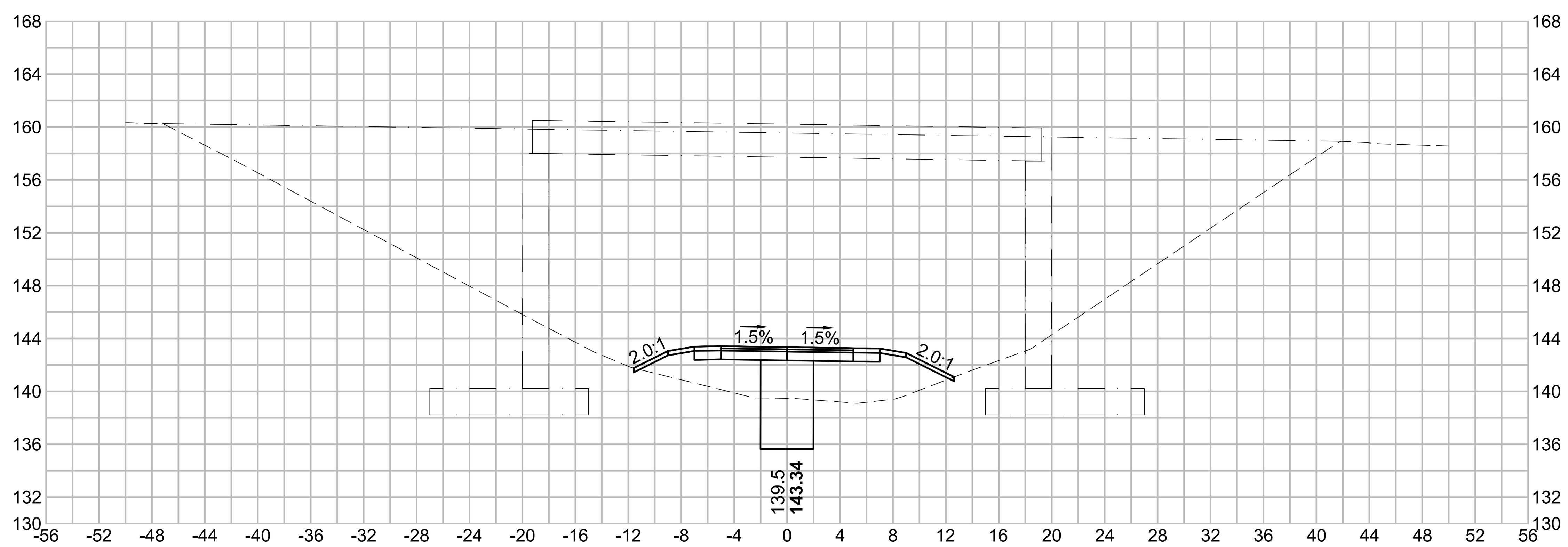
EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CONSTRUCTION PLANS

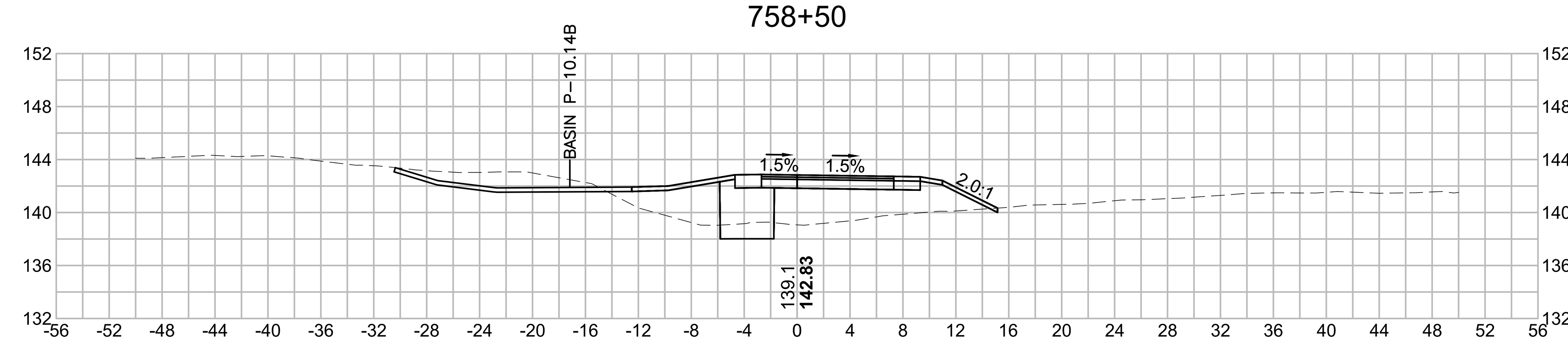
PLAN 68 OF 348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=20'	DEC 2020	MS	SK	MES	.	.

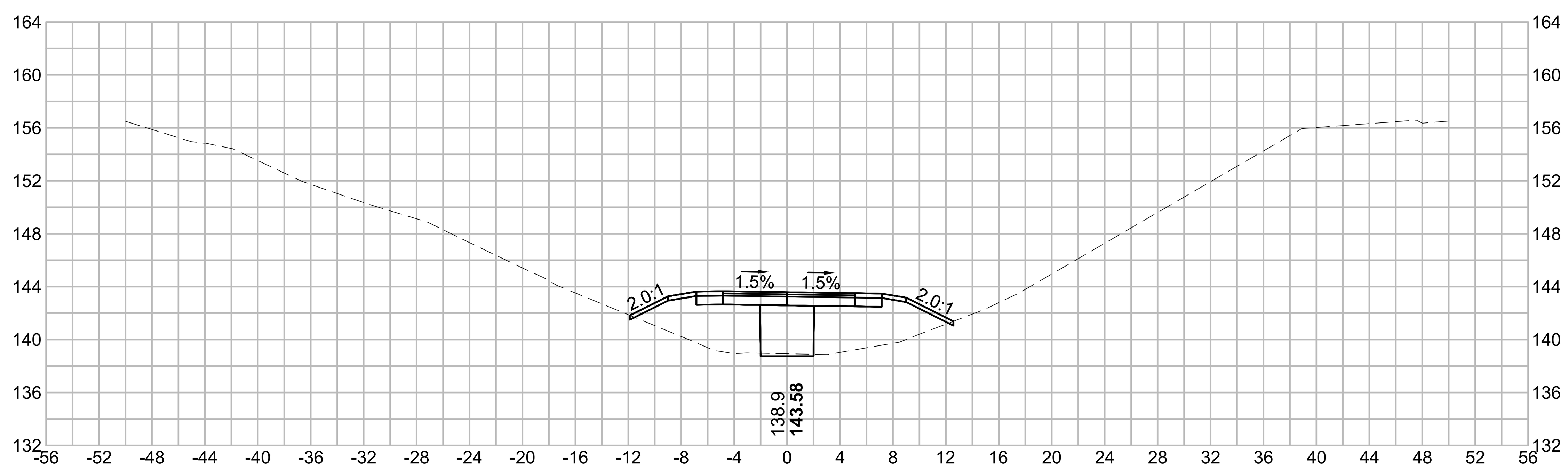
757+82.17



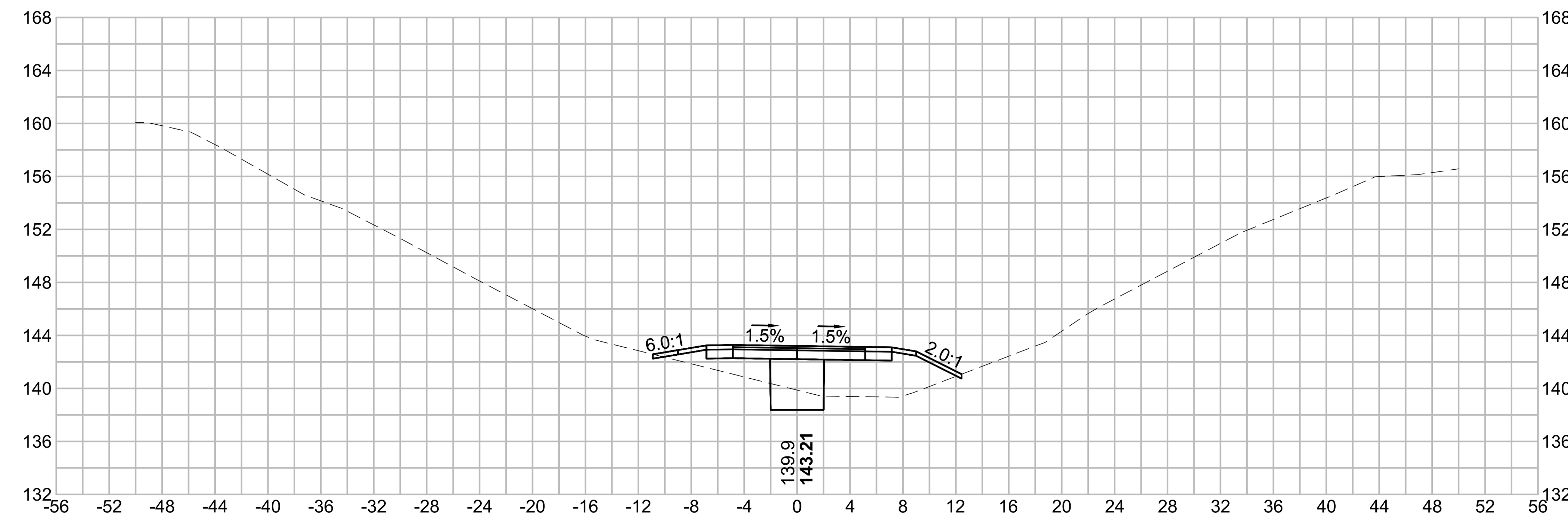
758+50



757+50



758+00



8 0 8 16
SCALE IN FEET

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NO.	DESCRIPTION	BY	DATE	APPR.

REVISION

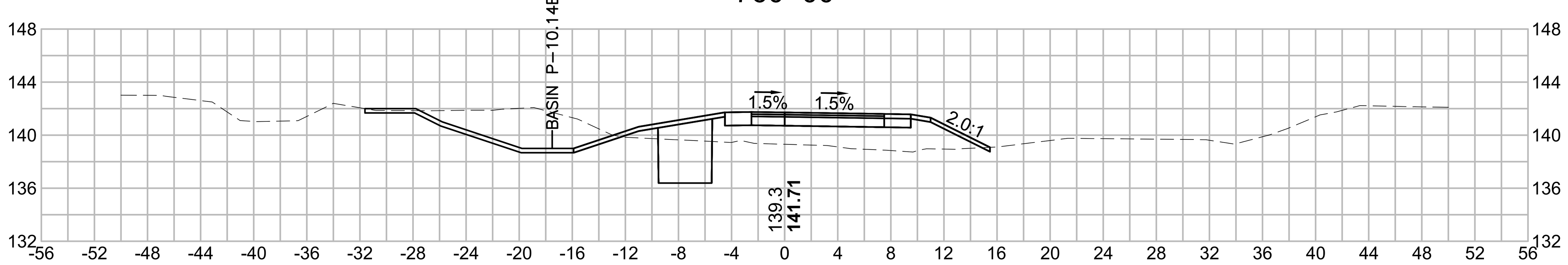
EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS

PLAN 3430F348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=8'	DEC 2020	MS	SK	MES	.	.

760+00



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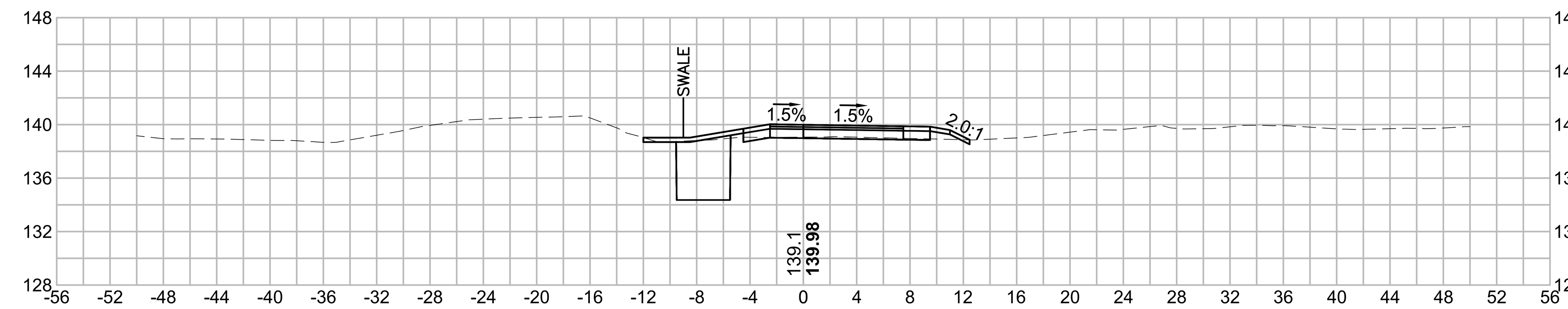
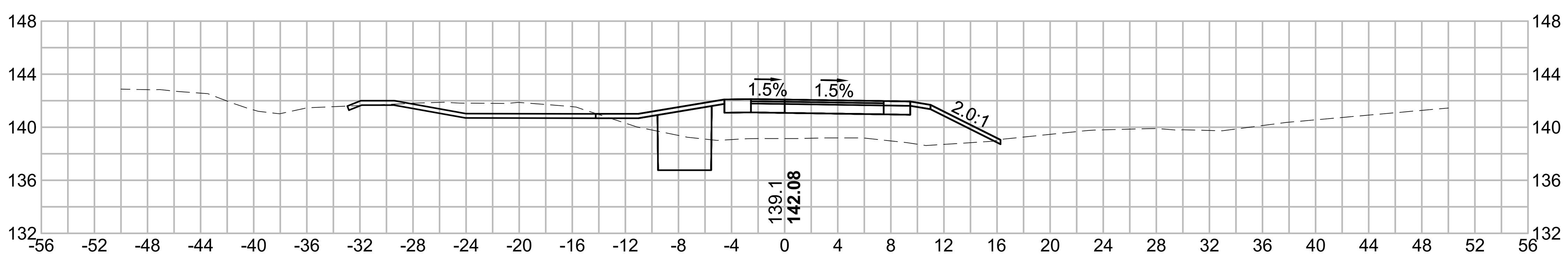
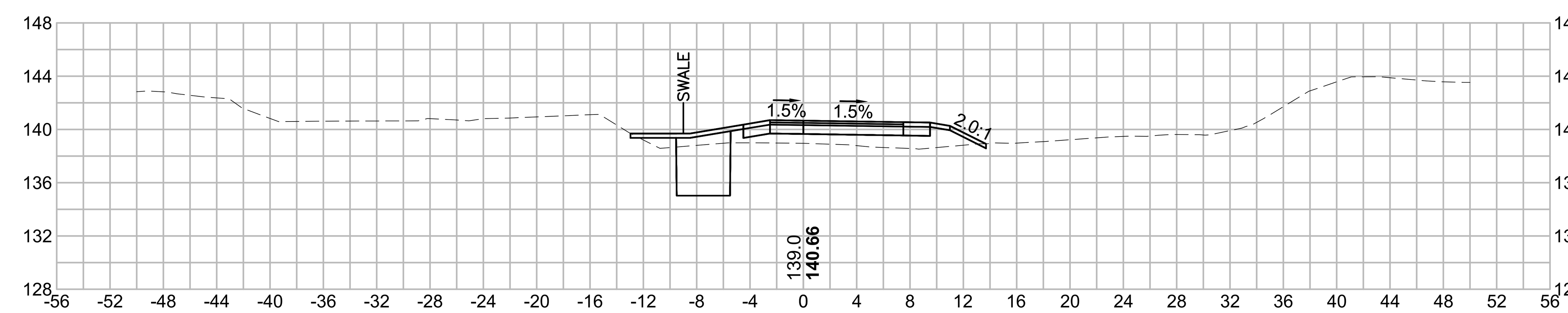


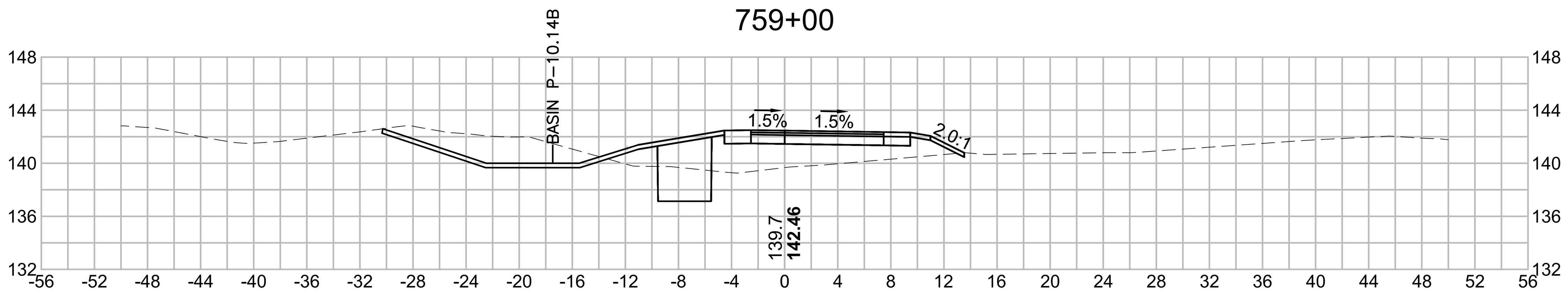
759+50



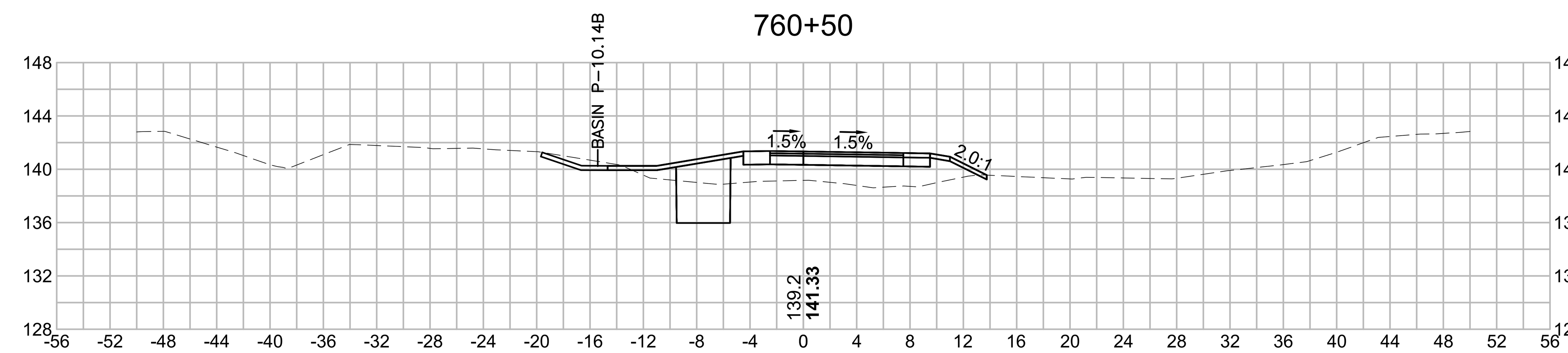
761+00



759+00



760+50



8 0 8 16
SCALE IN FEET

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Watertown, MA 02472
617.924.1770 FAX 617.924.2286

NO.	DESCRIPTION	BY	DATE	APPR.

REVISION

EVERSOURCE

SUDBURY–HUDSON TRANSMISSION RELIABILITY PROJECT
HUDSON, STOW, MARLBOROUGH & SUDBURY MASSACHUSETTS
CROSS SECTIONS

PLAN 344 OF 348

SCALE: unless noted	DATE	DRAWN	CH'K D.	APPR.	DRAWING NO.	REV.
1"=8'	DEC 2020	MS	SK	MES	.	.

DCR PLANS - WATERSHED 9.1

Plotted on 1-Dec-2020 7:29 PM
14424_HD(CONST-3).DWG

NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

vhb
Transportation Land Development Environmental Services
101 Walnut St., P.O. Box 9151
Watertown, MA 02472
617 924 1770 FAX 617 924 2286

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING

MASS CENTRAL RAIL TRAIL - WAYSIDE

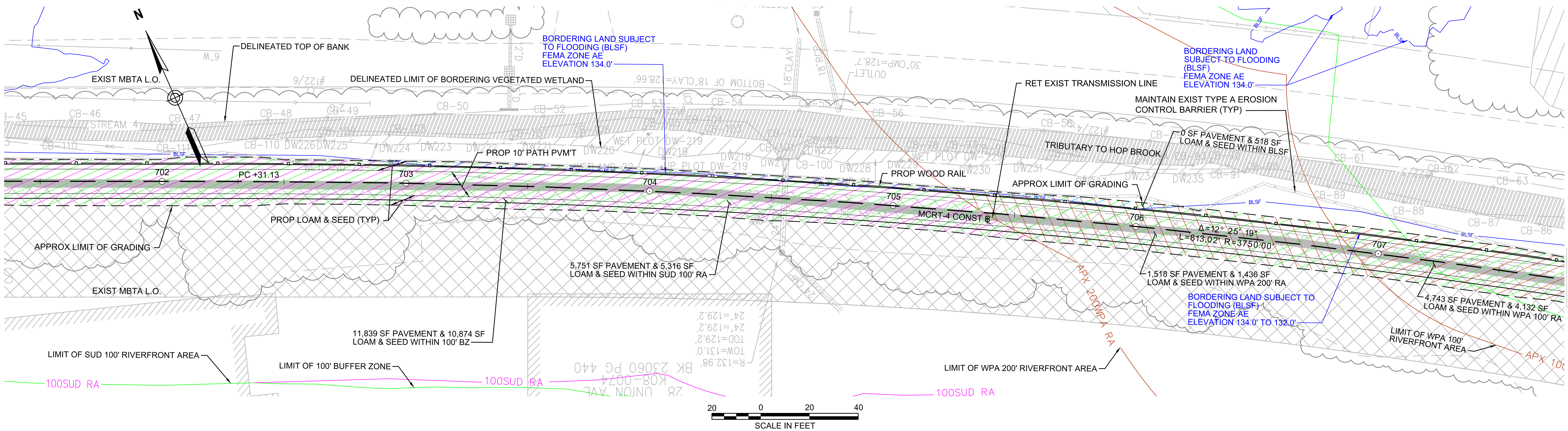
MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

DESIGNER: JCR
CHECKED: SHK
DRAWN: JCR
CHECKED: TAL

CONSTRUCTION PLANS

CONT. P19-3295-D1A
SCALE: 1" = 20'-0"
ACC. XXXXXXx
DATE: JULY 2020

SHEET NO. C-38
38 OF 46



NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

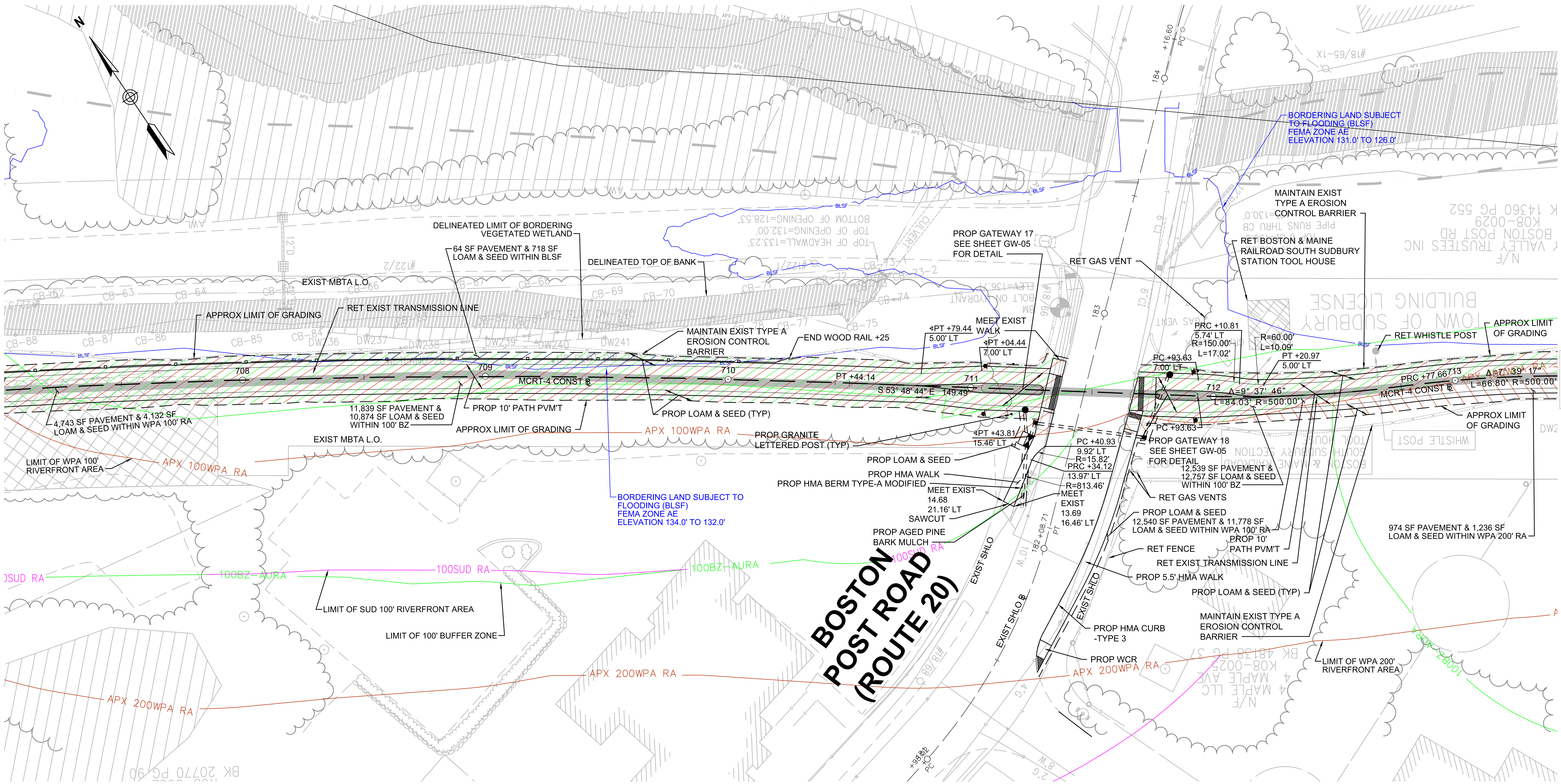
vhb
Transportation Land Development Environmental Services
101 Walnut St., P.O. Box 9151
Watertown, MA 02472
617 924 1770 FAX 617 924 2286

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING

MASS CENTRAL RAIL TRAIL - WAYSIDE

MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

DESIGNER: JCR	CONSTRUCTION PLANS		SHEET NO.
CHECKED: SHK			C-39
DRAWN: JCR	CONT. P19-3295-D1A	SCALE: 1" = 20'-0"	
CHECKED: TAL	ACC. XXXXXXx	DATE: JULY 2020	39 OF 46



NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

vhb
Transportation Land Development Environmental Services
101 Walnut St., P.O. Box 9151
Watertown, MA 02472
617 924 1770 FAX 617 924 2286

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING

MASS CENTRAL RAIL TRAIL - WAYSIDE

MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

DESIGNER: JCR	CONSTRUCTION PLANS	SHEET NO. C-40
CHECKED: SHK		
DRAWN: JCR	CONT. P19-3295-D1A	SCALE: 1" = 20'-0"
CHECKED: TAL	ACC. XXXXXXx	DATE: JULY 2020

DCR PLANS - WATERSHED 10.14

NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

vhb
Transportation Land Development Environmental Services
101 Walnut St., P.O. Box 9151
Watertown, MA 02472
617 924 1770 FAX 617 924 2286

**COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING**

MASS CENTRAL RAIL TRAIL - WAYSIDE

MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

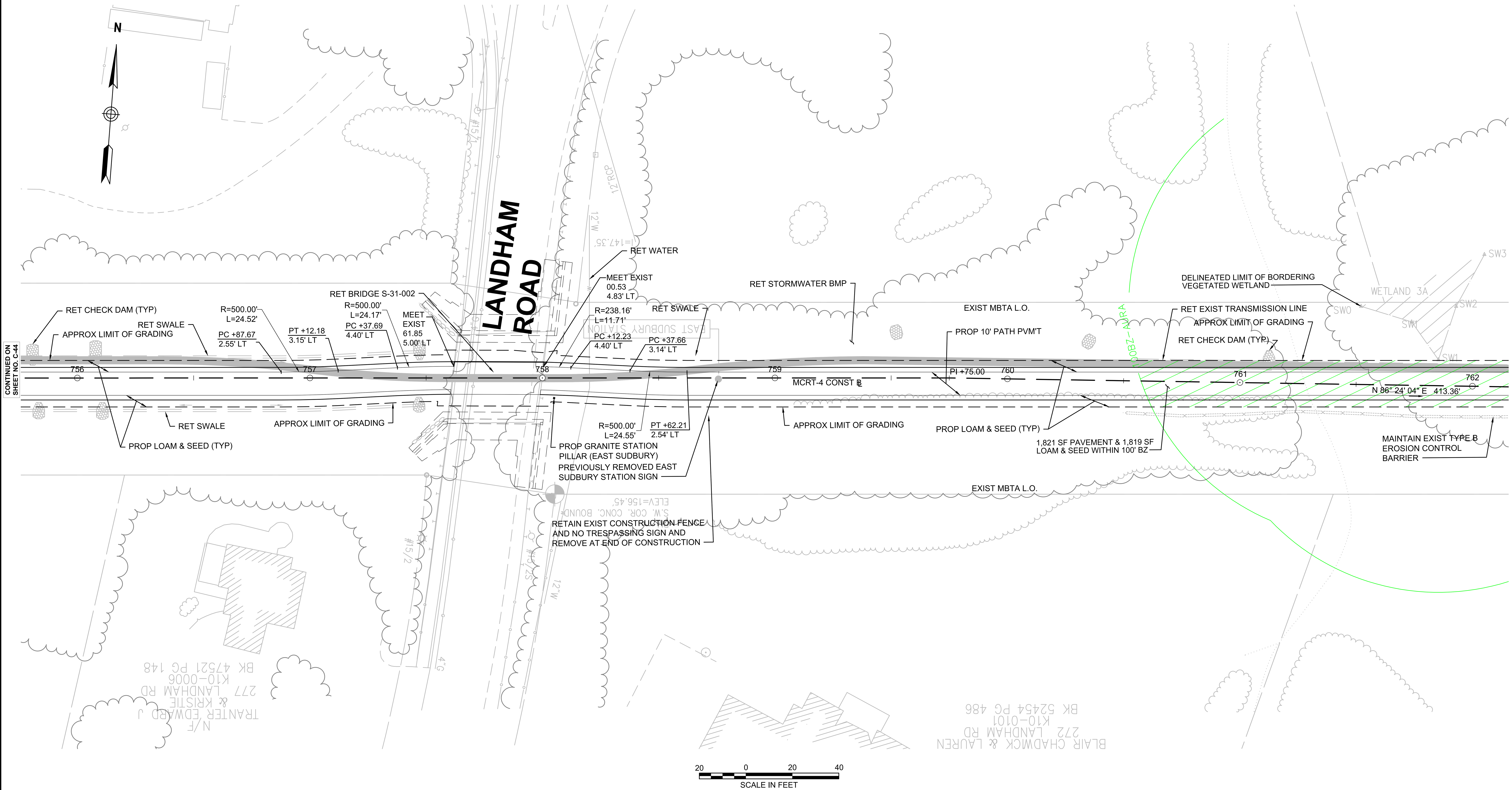
DESIGNED: JCR
CHECKED: SHK
DRAWN: JCR
CHECKED: TAL

CONSTRUCTION PLANS

CONT. P19-3295-D1A
ACC. XXXXXXx
SCALE: 1" = 20'-0"
DATE: JULY 2020

SHEET NO. C-44
44 OF 46

14424_HD(CONST-4).DWG Plotted on 1-Dec-2020 4:53 PM



NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

vhb
Transportation Land Development Environmental Services
101 Walnut St., P.O. Box 9151
Watertown, MA 02472
617 924 1770 FAX 617 924 2286

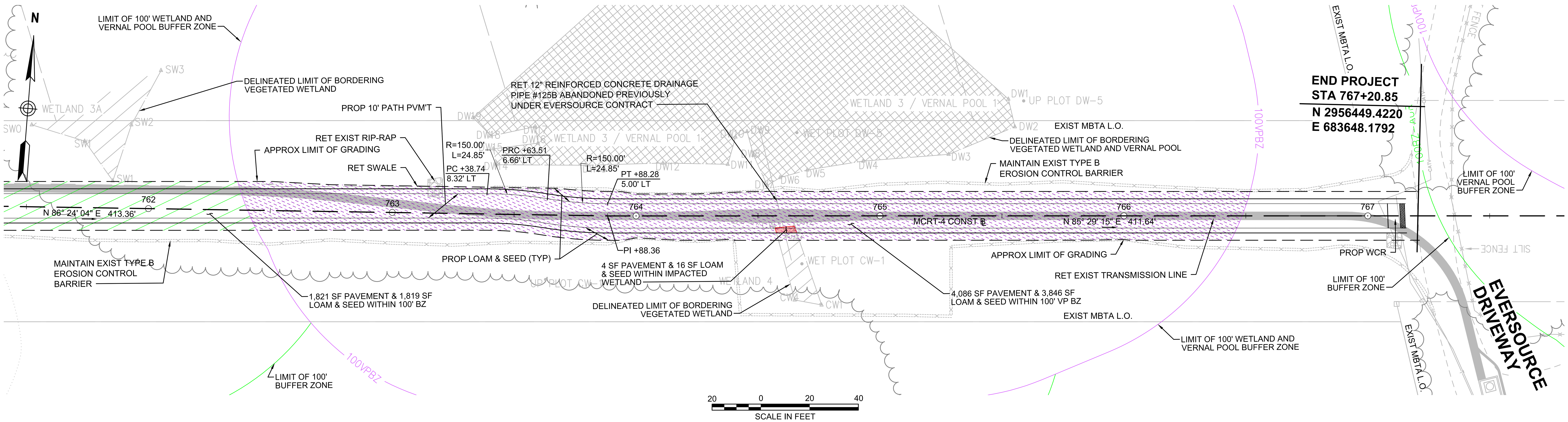
COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING

MASS CENTRAL RAIL TRAIL - WAYSIDE

MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

DESIGNER: JCR	CONSTRUCTION PLANS		SHEET NO. C-45
CHECKED: SHK			
DRAWN: JCR	CONT. P19-3295-D1A	SCALE: 1" = 20'-0"	
CHECKED: TAL	ACC. XXXXXXx	DATE: JULY 2020	45 OF 46

14424_HD(CONST-4).DWG Plotted on 1-Dec-2020 4:54 PM



NOTE:

1. WETLAND RESOURCE AREA BOUNDARIES SHOWN HEREIN WERE APPROVED IN AN ORAD DATED AUGUST 27, 2018 (MADEP FILE NO. 301-1227).

ENVIRONMENTAL IMPACTS LEGEND

HATCH	DESCRIPTION	HATCH	DESCRIPTION
	ISOLATED VEGETATED WETLAND		DISTURBANCE TO WPA 200' RIVERFRONT AREA (WPA 200' RA)
	BORDERING VEGETATED WETLAND		DISTURBANCE TO SUDBURY 200' RIVERFRONT AREA (SUD 200' RA)
	LAND UNDER WATER		DISTURBANCE TO WPA 100' RIVERFRONT AREA (WPA 100' RA)
	VERNAL POOL		DISTURBANCE TO SUDBURY 100' RIVERFRONT AREA (SUD 100' RA)
	PERMANENT DISTURBANCE TO VEGETATED WETLAND		DISTURBANCE TO 100' BUFFER ZONE (100' BZ-AURA)
	DISTURBANCE TO 100' VERNAL POOL BUFFER ZONE (100' VP BZ)		DISTURBANCE TO BLSF
			EXISTING TREE LINE
			LIMIT OF GRADING

REV.	DATE	DESCRIPTION	BY

vhb
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COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF PLANNING AND ENGINEERING

MASS CENTRAL RAIL TRAIL - WAYSIDE

MASS CENTRAL RAIL TRAIL
HUDSON, STOW, MARLBOROUGH & SUDBURY, MA

DESIGNER: JCR
CHECKED: SHK
DRAWN: JCR
CHECKED: TAL

CONSTRUCTION PLANS

CONT. P19-3295-D1A
ACC. XXXXXXx
SCALE: 1" = 20'-0"
DATE: JULY 2020

SHEET NO. C-46
46 OF 46

14424_HD(CONST-4).DWG Plotted on 1-Dec-2020 4:55 PM