Memorandum

To: Rebecca Gendreau, Conservation Agent
Sturbridge Conservation Commission
Town Hall
308 Main Street
Sturbridge, MA 01566

Date: October 18, 2023

Project #: 14961.06 / 15592.67

From: Luke Boucher, PE

Re: Sturbridge Route 20 Drainage Repair Project
Response to MassDEP Comments
DEP File No. 300-1175

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The purpose of this memorandum is to provide responses to the Massachusetts Department of Environment Protection (MassDEP) comments on the Notice of Intent (NOI) submitted for the Sturbridge Route 20 Drainage Repair Project (DEP File # 300-1175).

## *MassDEP Technical Comments*

1. As the project is located within a critical area (Zone II Wellhead Protection Area), specific source control and pollution prevention measures, and specific structural Stormwater Control Measures (SCMs) determined by MassDEP to be suitable for managing discharges to such areas are required. Opportunities to daylight the proposed pipes from Drainage Manholes 4 and 5 to their outlets and incorporate pretreatment and/or treatment SCMs suitable for critical areas (ex, sediment forebay and water quality swale) need to be fully evaluated as part of the stormwater complete evaluation. Per 310 CMR 10.58(4)(d)1.a., stormwater management measures may be allowed within the required 100-foot-wide corridor of undisturbed natural vegetation when there is no practicable alternative location. Suitable SCMs where natural vegetation can be incorporated should be included in the evaluation.

   ***VHB Response: The project is proposed to address slope erosion, as described in the enforcement order issued to MassDOT District 3 on January 31, 2019. The slope downgradient of the existing discharge is currently unstable, with exposed erodible soils. The proposed riprap slope at the proposed outfall will stabilize the slope and minimize downgradient erosion.***

   ***In addition to the slope stabilization work, the project also proposes to replace both existing MassDOT-owned catch basins, located along the south side of Route 20 (Main Street), with deep-sump catch basins, which will improve the level of pretreatment within the system. Replacement of catch basins that are part of the municipal system are beyond the project scope.***

   ***VHB investigated the following additional alternatives to provide additional treatment prior to discharge into the Quinebaug River.***

   - ***Leaching basin with surface grate overflow discharge in lieu of proposed headwall***



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P 617.924.1770

Memorandum

- ***Introduction of water to subsurface area near the top of slope would result in a risk of breakout along the slope. Breakout to the riprap slope would result in water running along the interface between under the riprap slope and underlying soils, increasing risk of slope failure.***
- ***This option was deemed not viable.***

- ***Daylighted pipes with swale between headwall and top of slope***
  - ***The proposed design maintains an existing cart path at the top of slope that runs down to the river. Daylighting the pipes to the north would eliminate the ability for the private property owner(s) to utilize the path. Relocating this portion of cart path to the north of a proposed daylight location is infeasible due to the existing topography.***
  - ***Introducing surface flow to this location at the top of the slope would increase the risk of breakout and/or short-circuiting along the slope, both of which could result in water running along the interface between under the riprap slope and underlying soils, increasing risk of slope failure.***
  - ***This option was deemed not viable.***

2. As the Riverfront Area being altered is forested, native tree and shrub plantings following construction should be considered where practicable throughout the limit of disturbance to comply with 310 CMR 10.58(4)(d)1.a. notwithstanding the allowance for SCMs as previously noted.

   ***VHB Response: See the attached planset, which has been revised to include proposed plantings in this area.***

3. Placement of loam and plantings such as live willow stakes should be considered within the proposed modified rock fill for the stone slope protection.

   ***VHB Response: As this is a riprap spillway that will be receiving discharged stormwater, not just a riprap stabilized slope, we would not recommend placing loam in the modified rock fill, as the loam would be susceptible to washout into the river. The steepness of the proposed slope precludes the velocities from being low enough to prevent erosion.***



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4. A construction-period stormwater management plan (CP/PP) is required to be developed and implemented per Stormwater Management Standard 8 regardless of whether an Environmental Protection Agency Construction General Permit is required. The plan must include provisions to capture, bypass and treat stormwater from the roadway while the catch basins and pipes are being removed, and the new infrastructure is being installed.

   ***VHB Response: As control of water procedure will need to be developed by the contractor as part of their means and methods, the Stormwater Checklist has been revised to check the option under Standard 8 that states "The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has not been included in the Stormwater Report but will be submitted before land disturbance begins." See Attachment 1 of the revised Stormwater Memo, attached.***

5. Sizing calculations should be provided for the proposed level spreader.

   ***VHB Response: See attached level spreader calculations, which indicate that the flow depth will be approximately 4 inches for the 10-year design storm. Please note that the purpose of the level spreader design guidance included in the MassDEP Stormwater Handbook is to reduce velocities, thereby minimizing soil erosion on relatively flat (<6%) downgradient vegetated areas. As the proposed slope downgradient of the level spreader is proposed with a steep riprap surface, prevention of soil erosion is not the purpose of the level spreader. The proposed level spreader is only intended to evenly distribute flows to the riprap slope.***

6. An illicit discharge statement is required to be submitted prior to the discharge of any stormwater to post-construction SCMs.

   ***VHB Response: An illicit discharge statement is now included in Attachment 2 of the revised Stormwater Memo, attached.***



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**Attachments:**

- Revised Plans, last revised October 17, 2023
- Planting Plan Narrative
- Revised Stormwater Memo, last revised October 17, 2023
- Level Spreader HydroCAD Printout



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# MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
# HIGHWAY DIVISION

PLAN OF

## STURBRIDGE ROUTE 20 DRAINAGE REPAIR

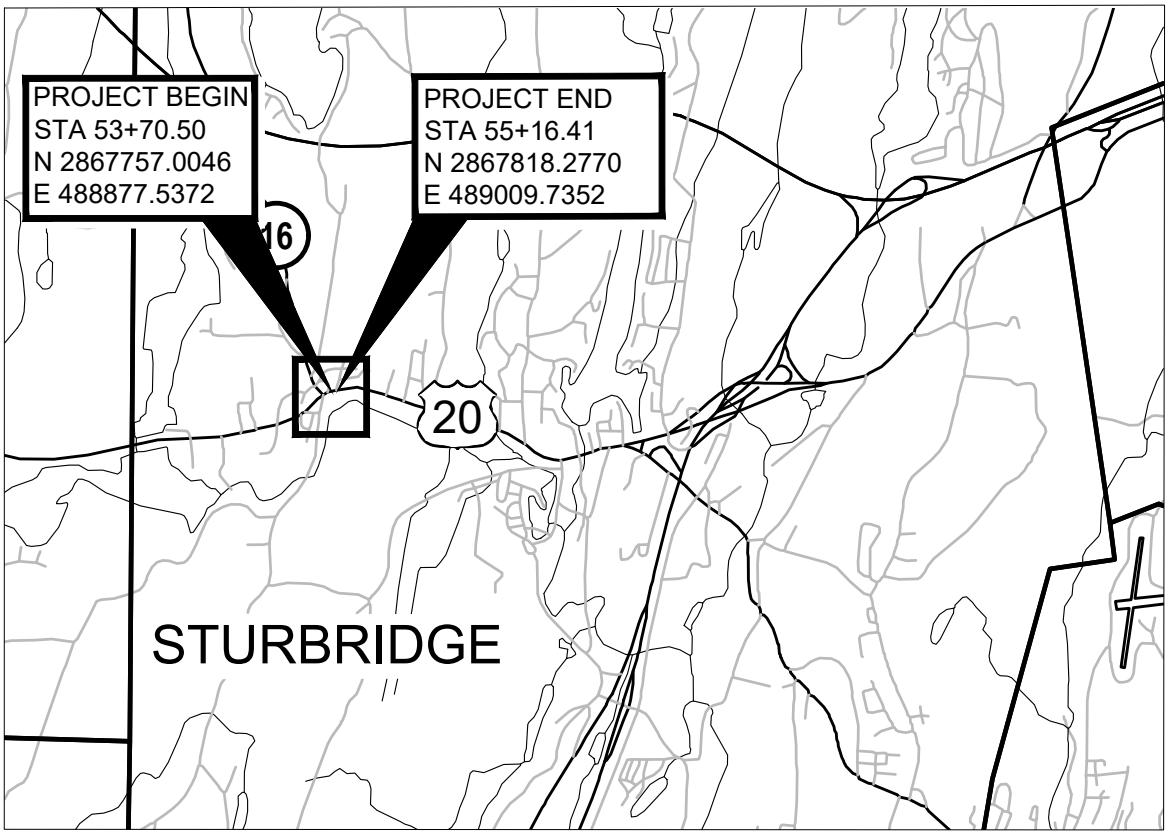
## 100% DESIGN SUBMISSION

IN THE TOWN OF

STURBRIDGE

WORCESTER COUNTY

FEDERAL AID PROJECT NO. N/A

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SCALE IN FEET

## INDEX



| DATE | DESCRIPTION | REV # |
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COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

massDOT
Massachusetts Department of Transportation
Highway Division

**RECOMMENDED FOR APPROVAL**

CHIEF ENGINEER _____ DATE _____

**APPROVED**

HIGHWAY ADMINISTRATOR _____ DATE _____

THESE PLANS ARE SUPPLEMENTED BY THE OCTOBER 2017 CONSTRUCTION STANDARD DETAILS, THE 2015 OVERHEAD SIGNAL STRUCTURE AND FOUNDATION STANDARD DRAWINGS, MASSDOT TRAFFIC MANAGEMENT PLANS AND DETAIL DRAWINGS, THE 1990 STANDARD DRAWINGS FOR SIGNS AND SUPPORTS, THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK.

| ABBREVIATIONS | |
|---|---|
| GENERAL | |
| ABAN | ABANDON |
| APPROX | APPROXIMATE |
| BF | BANK FLAG |
| CB | CATCH BASIN |
| CBCI | CATCH BASIN WITH CURB INLET |
| CEM | CEMENT |
| CIP | CAST IRON PIPE |
| CLF | CHAIN LINK FENCE |
| CMP | CORRUGATED METAL PIPE |
| CONST | CONSTRUCTION |
| CONT | CONTINUOUS |
| CPP | CORRUGATED PLASTIC PIPE |
| DBHW | DOUBLE BARREL HEADWALL |
| DEC | DECIDUOUS TREE |
| DGCB | DOUBLE GRATE CATCH BASIN |
| DGCBCI | DOUBLE GRATE CATCH BASIN WITH CURB INLET |
| DIP | DUCTILE IRON PIPE |
| DMH | DRAIN MANHOLE |
| ELEV (OR EL) | ELEVATION |
| EXC | EXCAVATION |
| EXIST (OR EX) | EXISTING |
| FES | FLARED END SECTION |
| GD | GROUND |
| HDPE | HIGH-DENSITY POLYETHYLENE PIPE |
| HMA | HOT MIX ASPHALT |
| HWY | HIGHWAY |
| HYD | HYDRANT |
| IC | IMPERVIOUS COVER |
| INFIL | INFILTRATION |
| INV | INVERT |
| MAX | MAXIMUM |
| MIN | MINIMUM |
| MUNI | MUNICIPAL |
| NO. | NUMBER |
| OC | ON CENTER |
| OHW | OVERHEAD WIRES |
| OT | OTHER |
| PB | PULL BOX |
| PROJ | PROJECT |

| | |
|---|---|
| PROP | PROPOSED |
| PVC | POLYVINYL CHLORIDE |
| PWW | PAVED WATERWAY |
| R&R | REMOVE AND RESET |
| RCP | REINFORCED CONCRETE PIPE |
| RD | ROAD |
| RDWY | ROADWAY |
| REM | REMOVE |
| RET | RETAIN |
| ROW | RIGHT OF WAY |
| RR | RAILROAD |
| SHLO | STATE HIGHWAY LAYOUT LINE |
| ST | STREET |
| STA | STATION |
| STD | STANDARD |
| SWL | SOLID WHITE LINE |
| TEMP | TEMPORARY |
| TP | TEST PIT |
| TS | TRAFFIC SIGNAL |
| TYP | TYPICAL |
| UPL (OR UP) | UTILITY POLE |
| VAR | VARIES |
| VCP | VITRIFIED CLAY PIPE |
| WF | WETLAND FLAG |
| WG | WATER GATE VALVE |
| X-SECT | CROSS SECTION |

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LUKE L. BOUCHER
CIVIL
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10-18-2023

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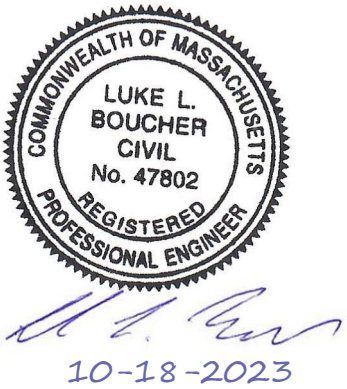
STURBRIDGE
STURBRIDGE ROUTE 20 DRAINAGE REPAIR
100% DESIGN SUBMISSION

LEGEND

| SHEET NO. | TOTAL SHEETS |
|---|---|
| 2 | 21 |
| PROJECT FILE NO. 612991 | |

## GENERAL SYMBOLS

| | DESCRIPTION |
|---|---|
| | EXISTING CONTOUR |
| | PROPOSED MINOR CONTOUR |
| | PROPOSED MAJOR CONTOUR |
| | EXISTING HEADWALL |
| | EXISTING WETLAND BOUNDARY |
| WF#### | EXISTING WETLAND FLAG |
| 25'NDZ | 25-FOOT NO DISTURB ZONE |
| 50'NSB | 50-FOOT NO STRUCTURE BUFFER |
| 100'BZ | 100-FOOT WETLAND BUFFER |
| 200'RA | 200-FOOT RIVERFRONT AREA |
| | APPROXIMATE PROPERTY BOUNDARY |
| | PROPOSED SEDIMENT CONTROL BARRIER |
| | PROPOSED DRAINAGE PIPE |
| | PROPOSED DMH |
| | PROPOSED CB |
| | PROPOSED FLARED END SECTION |
| | PROPOSED SILT SACK |
| | PROPOSED RIPRAP |
| | PROPOSED LIMIT OF WORK |
| | PROPOSED STONE SLOPE PROTECTION |
| | PROPOSED SAWCUT |

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LEGEND - SYMBOLS

| SHEET NO. | TOTAL SHEETS |
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# GENERAL NOTES

1. THE EXISTING CONDITIONS AND TOPOGRAPHICAL INFORMATION WERE COMPILED FROM AN ACTUAL FIELD SURVEY CONDUCTED BY VHB (NAD83 HORIZONTAL DATUM, NAVD88 VERTICAL DATUM) IN DECEMBER OF 2020.
2. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL MAKE ALL ARRANGEMENTS FOR THE ALTERATION AND ADJUSTMENT OF GAS, ELECTRIC, TELEPHONE AND ANY OTHER PRIVATE UTILITIES WITH THE UTILITY COMPANIES. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES. CONTRACTOR SHALL NOTIFY "DIG-SAFE" (1-888-344-7233) AT LEAST 72 HOURS BEFORE EXCAVATING.
3. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, THE LOCATION, ELEVATION AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED TO THE ENGINEER FOR RESOLUTION OF THE CONFLICT. IF NECESSARY, ALL PRIVATE UTILITIES WILL BE ADJUSTED BY OTHERS, SUCH AS CABLE, ELECTRIC, GAS, AND TELEPHONE.
4. THE RIGHT-OF-WAY LINES AND BASELINES SHOWN ON THIS PLAN ARE BASED ON STATE HIGHWAY LAYOUT 2274 DATED 1925, LAYOUT 2348 DATED 1926, AND LAYOUT 6694 DATED 1989. THE MONUMENTS FOUND ON THIS PLAN WERE FIELD LOCATED AND USED TO ESTABLISH THE RIGHT-OF-WAY LINES. THE PROPERTY LINES OF INDIVIDUAL OWNERS ALONG THE RIGHT-OF-WAY SHOWN ON THIS PLAN ARE FROM RECORD DEEDS AND PLANS, INDIVIDUAL ABUTTERS PROPERTIES WERE NOT FIELD SURVEYED.
5. THE CONTRACTOR SHALL ALTER THE MASONRY OF THE TOP SECTION OF ALL EXISTING DRAINAGE STRUCTURES AS NECESSARY FOR CHANGES IN GRADE, AND RESET ALL FRAMES, GRATES AND BOXES FOR ALL PUBLIC UTILITIES TO THE PROPOSED FINISH SURFACE GRADE. REQUIRED NEW MASONRY SHALL BE CLAY BRICK CONFORMING TO M4.05.2.
6. TREES AND SHRUBS WITHIN THE LIMITS OF GRADING SHALL BE REMOVED ONLY UPON APPROVAL OF THE ENGINEER.
7. ALL AREA WITHIN THE LIMITS OF GRADING AND LIMITS OF WORK THAT DOES NOT INCLUDE PROPOSED GRADING SHALL BE RESTORED TO MATCH EXISTING ELEVATIONS
8. ALL AREA WITHIN LIMITS OF GRADING AND LIMITS OF WORK SHALL INCLUDE AT A MINIMUM 4 INCHES OF ITEM 751. LOAM BORROW FOR ROADSIDES.
9. AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT NO EXPENSE TO THE OWNER.
10. THE TERM "PROPOSED" (PROP) MEANS WORK TO BE CONSTRUCTED USING NEW MATERIALS OR, WHERE APPLICABLE, RE-USING EXISTING MATERIALS IDENTIFIED AS "REMOVE AND RESET" (R&R).
11. ALL LATERAL DRAIN PIPES SHALL BE INSTALLED WITH A PITCH OF 0.01 FOOT PER FOOT (MINIMUM) UNLESS NOTED OTHERWISE ON THE DRAWINGS.
12. DRAINAGE ELEVATIONS ARE PROVIDED FOR DESIGN PURPOSES ONLY. THE CONTRACTOR SHALL VERIFY BY TEST PIT, THE LOCATIONS OF EXISTING UTILITIES WHICH MAY CONFLICT WITH THE PROPOSED DRAINAGE DESIGN. ANY FIELD ADJUSTMENTS REQUIRED WILL BE MADE AS APPROVED OR DIRECTED BY THE ENGINEER. ONLY AFTER THE CONTRACTOR VERIFIES ELEVATIONS FOR THE CONSTRUCTABILITY OF THE DRAINAGE SYSTEM SHALL ANY STRUCTURES BE ORDERED. ANY FIELD ADJUSTMENTS TO LINE & GRADE UP TO A DEPTH OF 5' SHALL BE INCLUDED IN THE COST OF THE PIPE. PIPE EXCAVATION GREATER THAN 5' WILL BE PAID FOR UNDER CLASS B TRENCH EXCAVATION.
13. ALL EXISTING STATE, COUNTY, CITY, AND TOWN LOCATION LINES AND PRIVATE PROPERTY LINES HAVE BEEN ESTABLISHED FROM AVAILABLE INFORMATION AND THEIR EXACT LOCATION ARE NOT GUARANTEED.
14. WETLAND BOUNDARIES ARE BASED ON WETLANDS FLAGS THAT WERE FLAGGED BY A VHB ENVIRONMENTAL SCIENTIST IN DECEMBER 2020. THE JURISDICTIONAL STATUS OF THE WETLAND RESOURCE AREAS WAS DETERMINED DURING THE FIELD INVESTIGATION.
15. ALL SAWCUTTING COSTS ARE INCIDENTAL AND ASSOCIATED WITH THEIR RESPECTIVE WORK.
16. ALL CATCH BASINS WITHIN THE LIMIT OF WORK SHALL HAVE SILT SACKS INSTALLED TO PREVENT SEDIMENT INFLOW.
17. ALL NON-PRECAST CEMENT CONCRETE USED ON THIS PROJECT SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI OR AS OTHERWISE SPECIFIED ON THE PLANS OR IN THE SPECIAL PROVISIONS.
18. FOR A LIST OF INVASIVE AND OTHER UNACCEPTABLE PLANT SPECIES REFER TO THE MASSACHUSETTS INVASIVE PLANT ADVISORY GROUP (MIPAG) EVALUATION OF NON-NATIVE PLACE SPECIES FOR INVASIVENESS IN MASSACHUSETTS (APRIL 1, 2005). PLANT MATERIALS LISTED AS AN INVASIVE SPECIES OR UNACCEPTABLE PLANT SPECIES SHOULD NOT BE USED ON THIS PROJECT. SEE ITEM 102.3 IN THE SPECIAL PROVISIONS FOR MORE DETAILS.
19. DOWN GRADIENT SEDIMENT CONTROL PRACTICES SHALL BE MAINTAINED TO PREVENT SEEDS OF INVASIVE SPECIES FROM LEAVING THE SITE. SOIL MATERIAL BROUGHT TO THE SITE SHALL NOT BE FROM SOURCES KNOWN TO CONTAIN INVASIVE SPECIES.
20. TO THE EXTENT POSSIBLE, ALL TREES AND BRUSH SHALL BE DISPOSED OF ON SITE, TYPICALLY CHIPPED AND SPREAD IN PLACE.
21. CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT ALL EXPOSED SOIL IS STABILIZED AT THE END OF THE GROWING SEASON. IF SOIL IS NOT COVERED, OR GRASS/GROUND COVER IS NOT ESTABLISHED AT THE ONSET OF WINTER SHUT DOWN OF CONSTRUCTION ACTIVITIES, CONTRACTOR SHALL TAKE MEASURES TO TEMPORARILY STABILIZE EXPOSED SOIL AT THE CONTRACTOR'S EXPENSE. MEASURES SHALL BE APPROVED BY MASSDOT ENGINEER.
22. CONTRACTOR SHALL PROTECT THE EXISTING PAVEMENT MARKINGS. ANY DAMAGE TO EXISTING PAVEMENT MARKINGS SHALL BE REPAIRED BY THE CONTRACTOR AT HIS OWN EXPENSE.


10-18-2023

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| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>GENERAL NOTES | SHEET NO. | TOTAL SHEETS |
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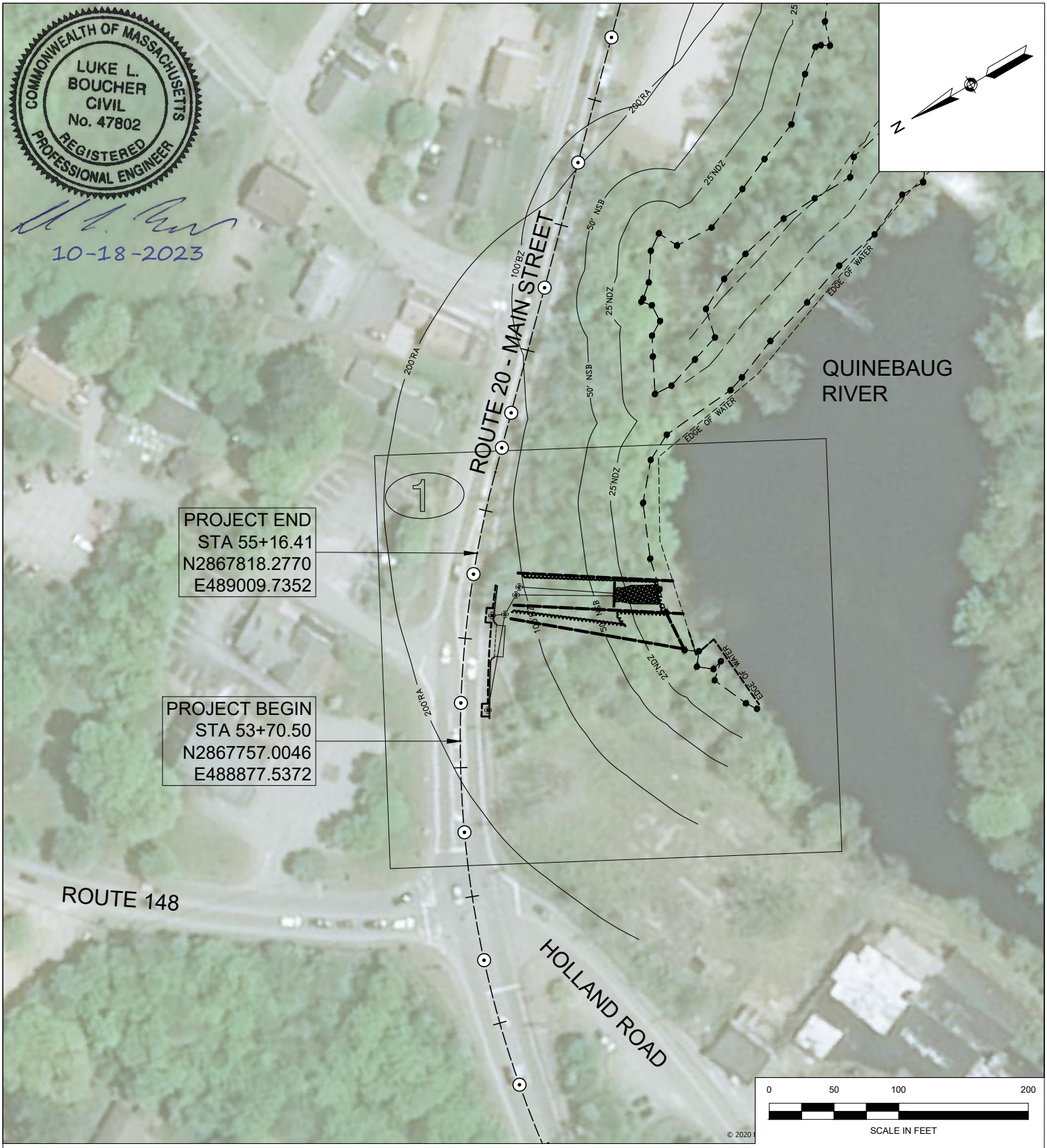




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KEY PLAN

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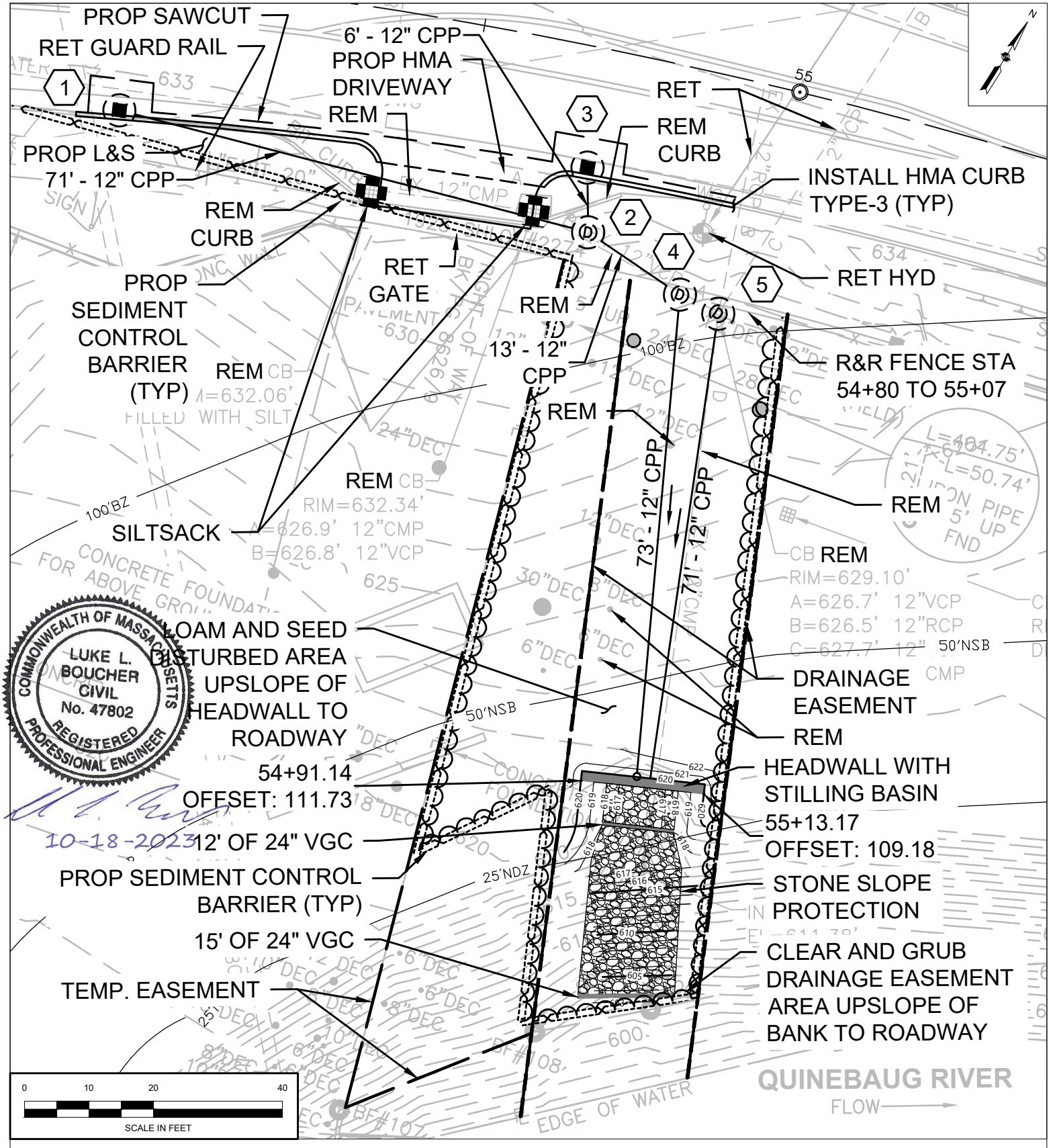


COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
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CONSTRUCTION PLAN

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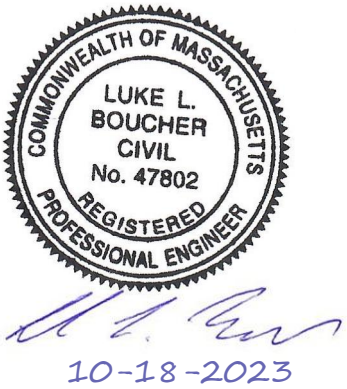
## DRAINAGE STRUCTURE DATA

| NO. | TYPE | RIM ELEV. | INV. IN | INV. OUT | REMARKS |
|---|---|---|---|---|---|
| 1 | CBCI | 632.69 | | 629.20 | CATCH BASIN WITH CURB INLET |
| 2 | DMH | 632.49 | (1) 628.50<br>(3) 628.50 | 628.40 | WITH SUMP |
| 3 | GI | 633.20 | | 628.60 | GUTTER INLET |
| 4 | DMH | 630.27 | (2) 626.80 | 624.10 | |
| 5 | DMH | 629.08 | EXIST | 625.30 | |
| 6 | DBHW | | | (4) 618.50<br>(5) 618.50 | DOUBLE BARREL HEADWALL |

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STURBRIDGE
STURBRIDGE ROUTE 20 DRAINAGE REPAIR
NOTICE OF INTENT SUBMISSION

DRAINAGE TABLE

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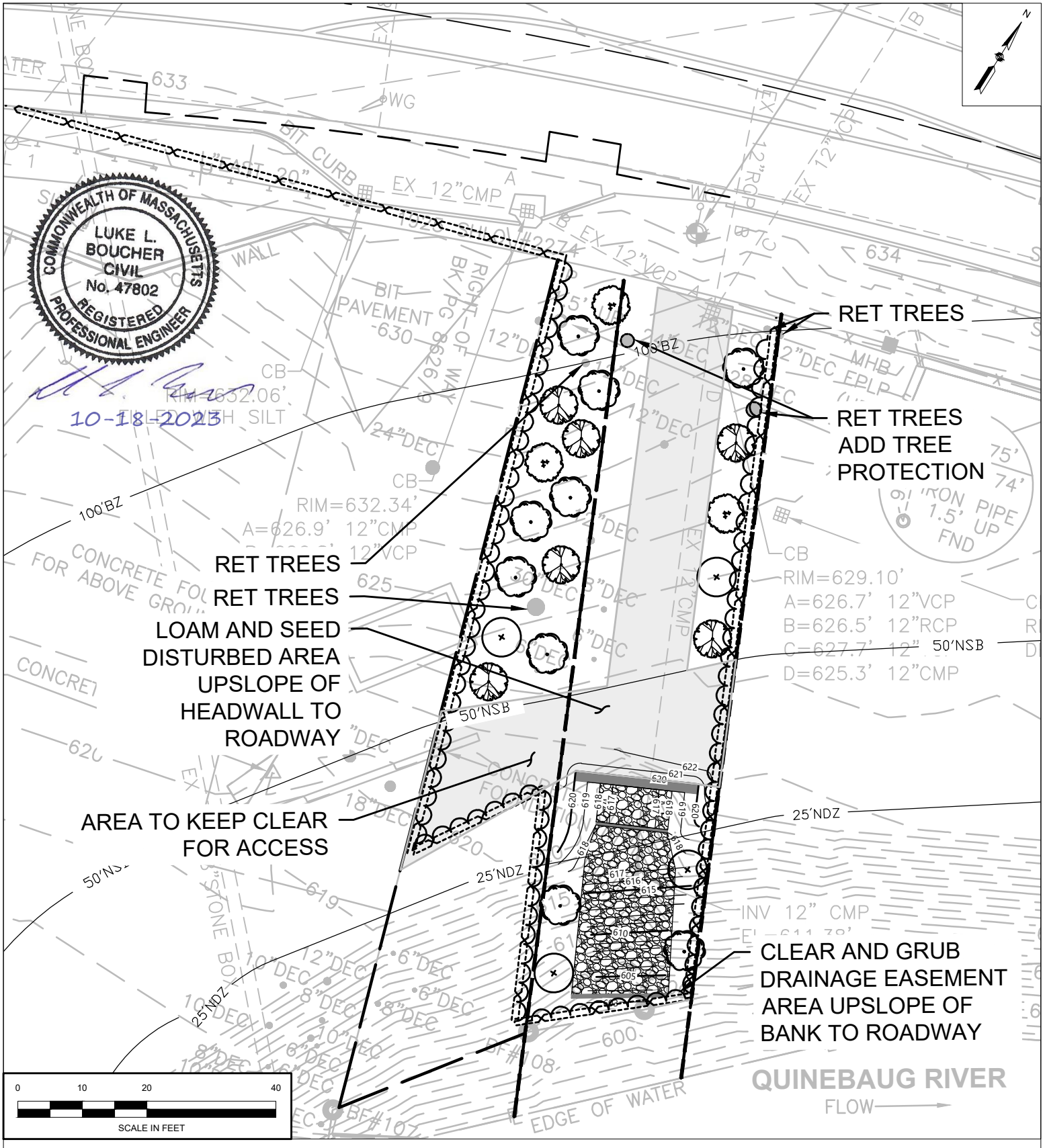


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STURBRIDGE
STURBRIDGE ROUTE 20 DRAINAGE REPAIR
100% DESIGN SUBMISSION

PLANTING PLAN

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# PLANT SCHEDULE

| TREES | QTY | BOTANICAL NAME | COMMON NAME | SIZE |
|---|---|---|---|---|
|  | 3 | Quercus rubra | Northern Red Oak | 2 - 3' |
|  | 4 | Carya cordiformis | Bitternut Hickory | 2 - 3' |
|  | 9 | Acer saccharum | Sugar Maple | 2 - 3' |
|  | 6 | Populus grandidentata | Big-tooth Aspen | 2 - 3 ' |


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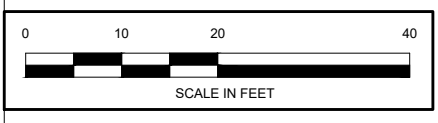


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STURBRIDGE
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100% DESIGN SUBMISSION

PLANTING SCHEDULE

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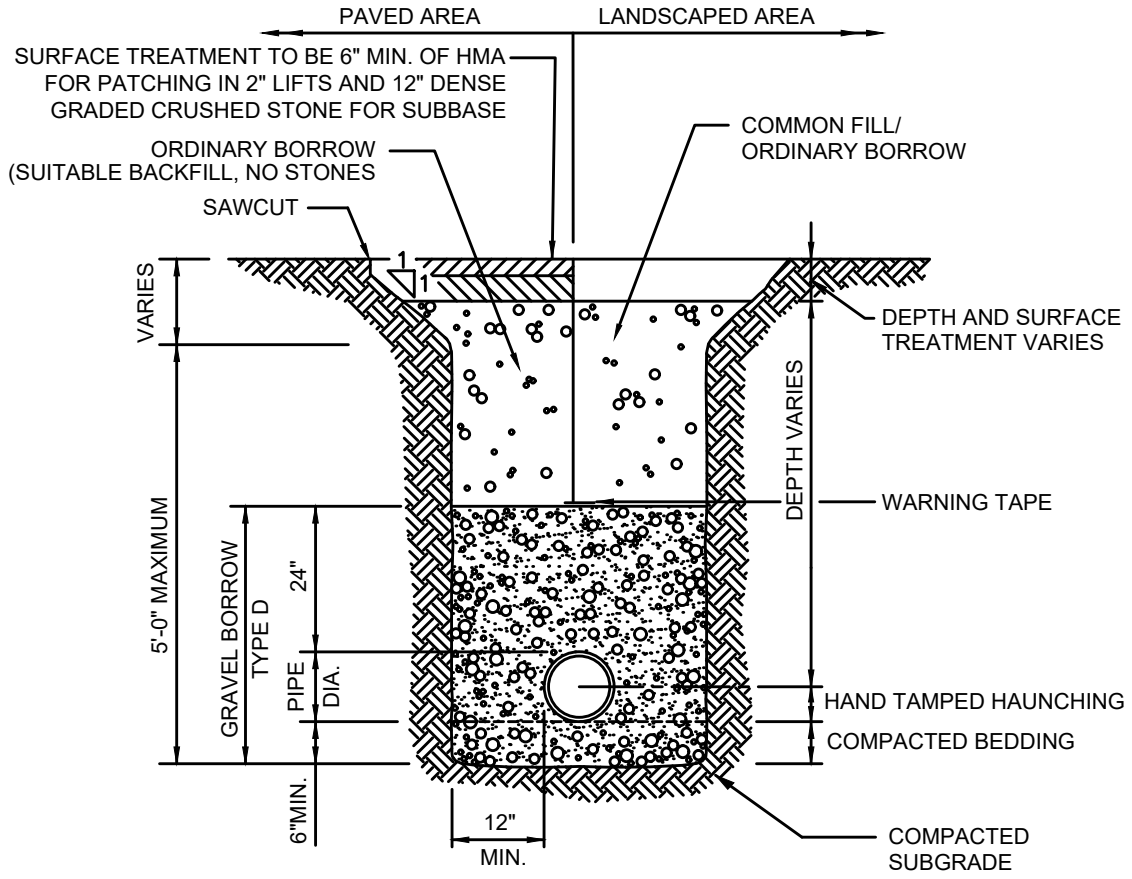


Notes:

1. USE METALLIC TRACING/WARNING TAPE OVER ALL PIPES.

COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

# TRENCH DETAIL

NOT TO SCALE

20160320_MassDOT

MassDOT Massachusetts Department of Transportation Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
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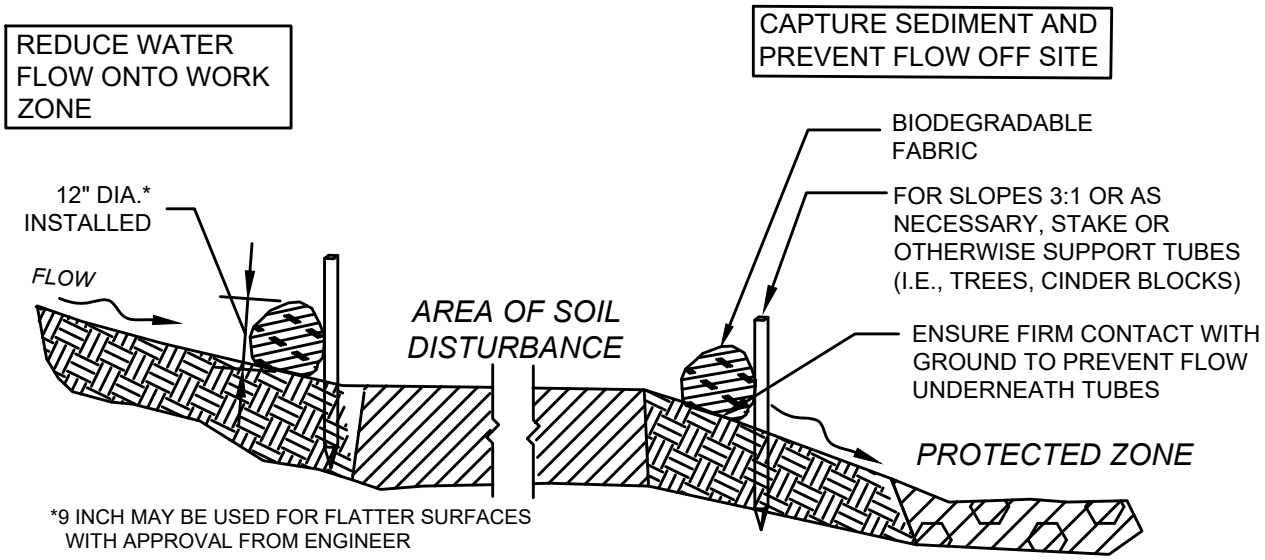
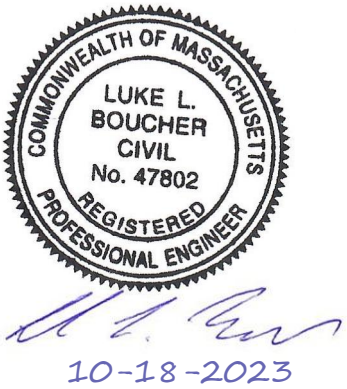



*SECTION*

# SEDIMENT BARRIERS - COMPOST FILTER TUBES (SECTION 1 OF 2)

NOT TO SCALE




massDOT Massachusetts Department of Transportation Highway Division

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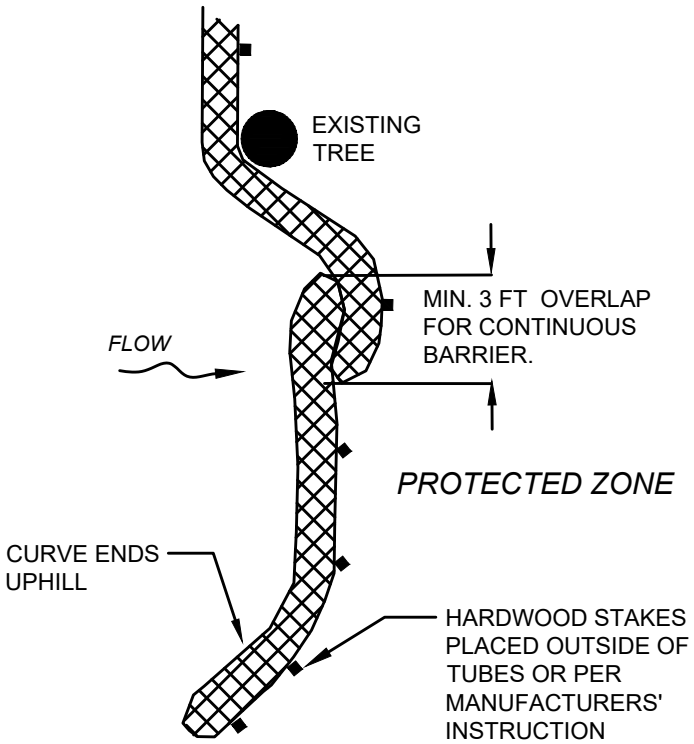



PLACE TUBE ALONG CONTOURS AND PERPENDICULAR TO FLOW.

PLACE AS CLOSE TO LIMIT OF SOIL DISTURBANCE AS POSSIBLE

ADJUST LOCATION AS REQUIRED FOR OPTIMUM EFFECTIVENESS. DO NOT INSTALL IN WATERWAYS.

PLACE STAKES AS NEEDED TO SECURE TUBES IN PLACE.

*PLAN VIEW*

# SEDIMENT BARRIERS (SECTION 2 OF 2)

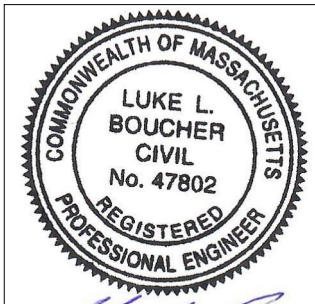
NOT TO SCALE

COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

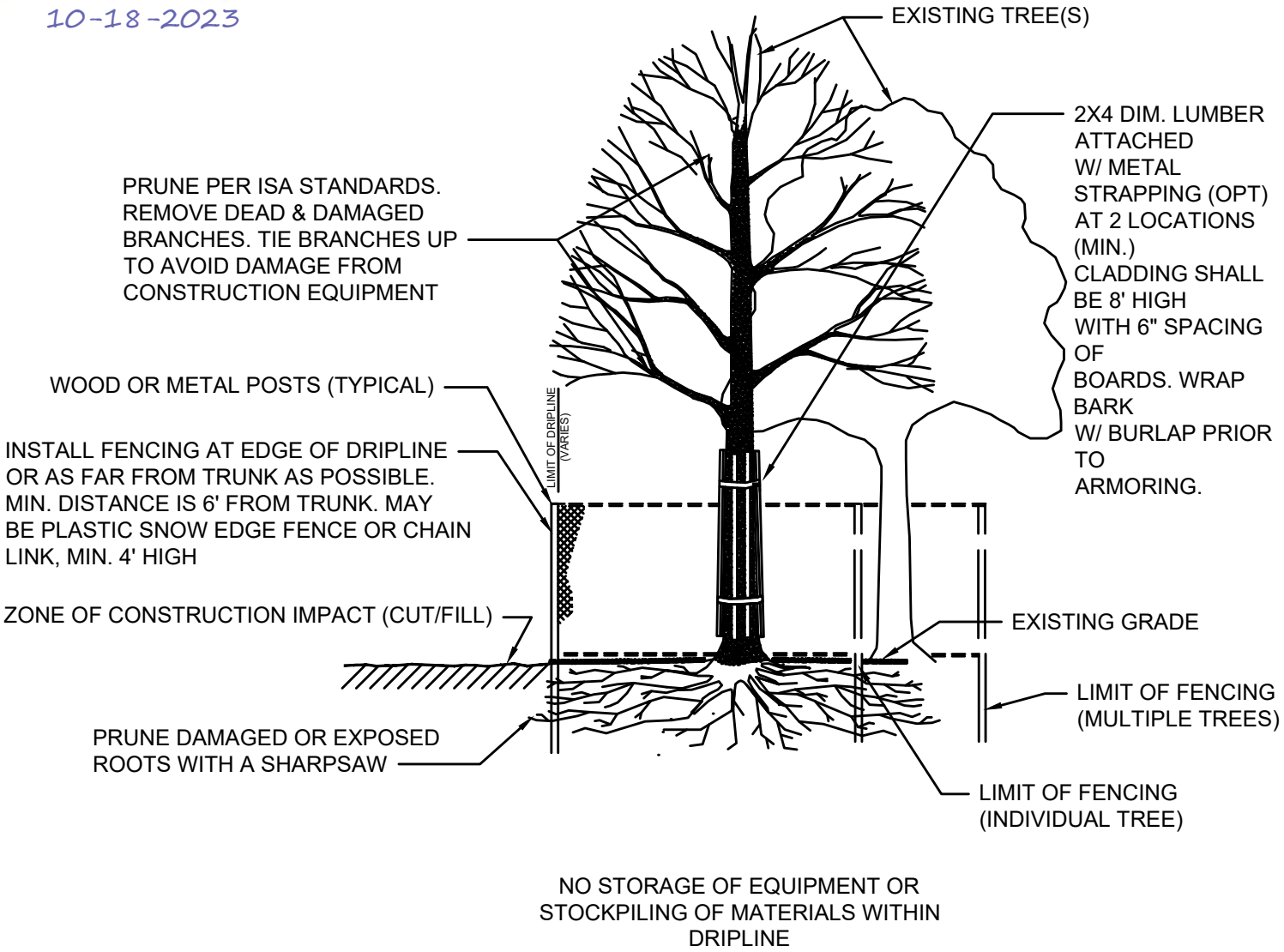
10-18-2023

massDOT
Massachusetts Department of Transportation
Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 12 | 21 |
| | PROJECT FILE NO. 612991 | |




10-18-2023




# TREE PROTECTION OF EXISTING TREE(S) (SECTION 1 OF 2)

NOT TO SCALE

massDOT Massachusetts Department of Transportation Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 13 | 21 |
| | PROJECT FILE NO. 612991 | |

COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
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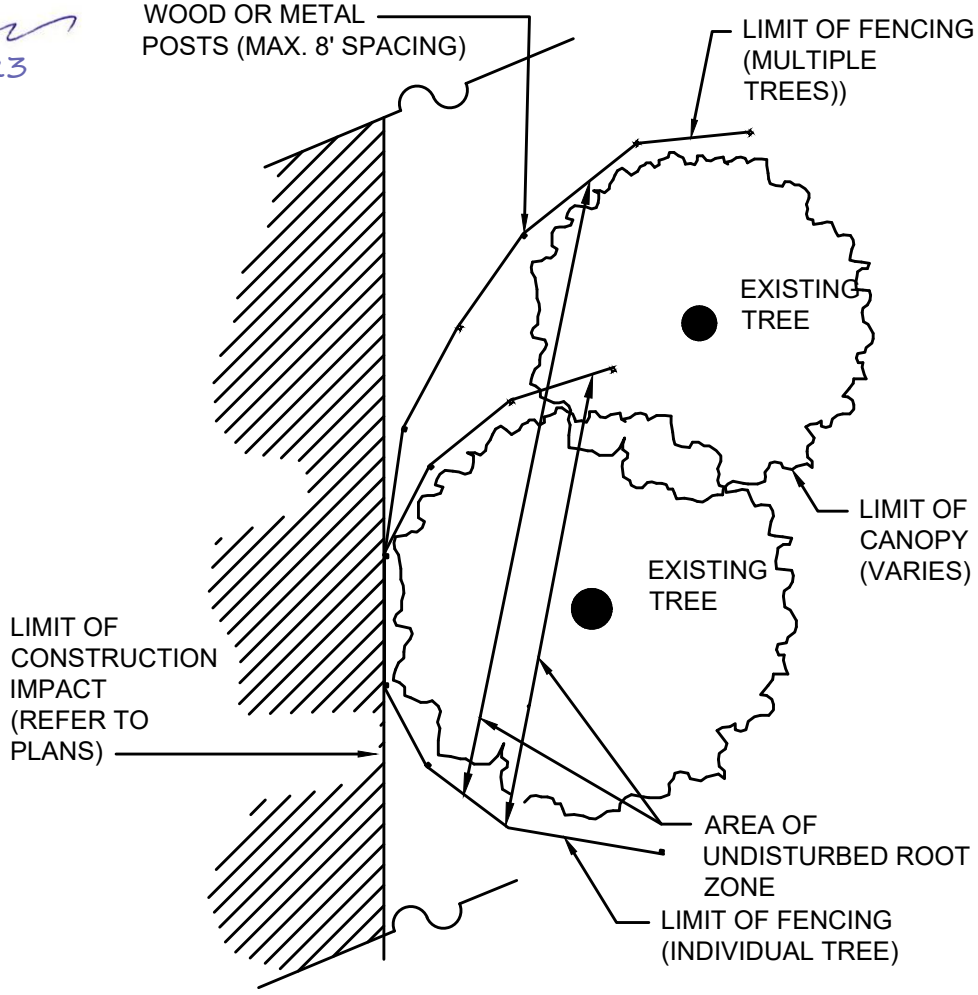
10-18-2023




PLAN VIEW

# TREE PROTECTION OF EXISTING TREE(S) (SECTION 2 OF 2)

NOT TO SCALE

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Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
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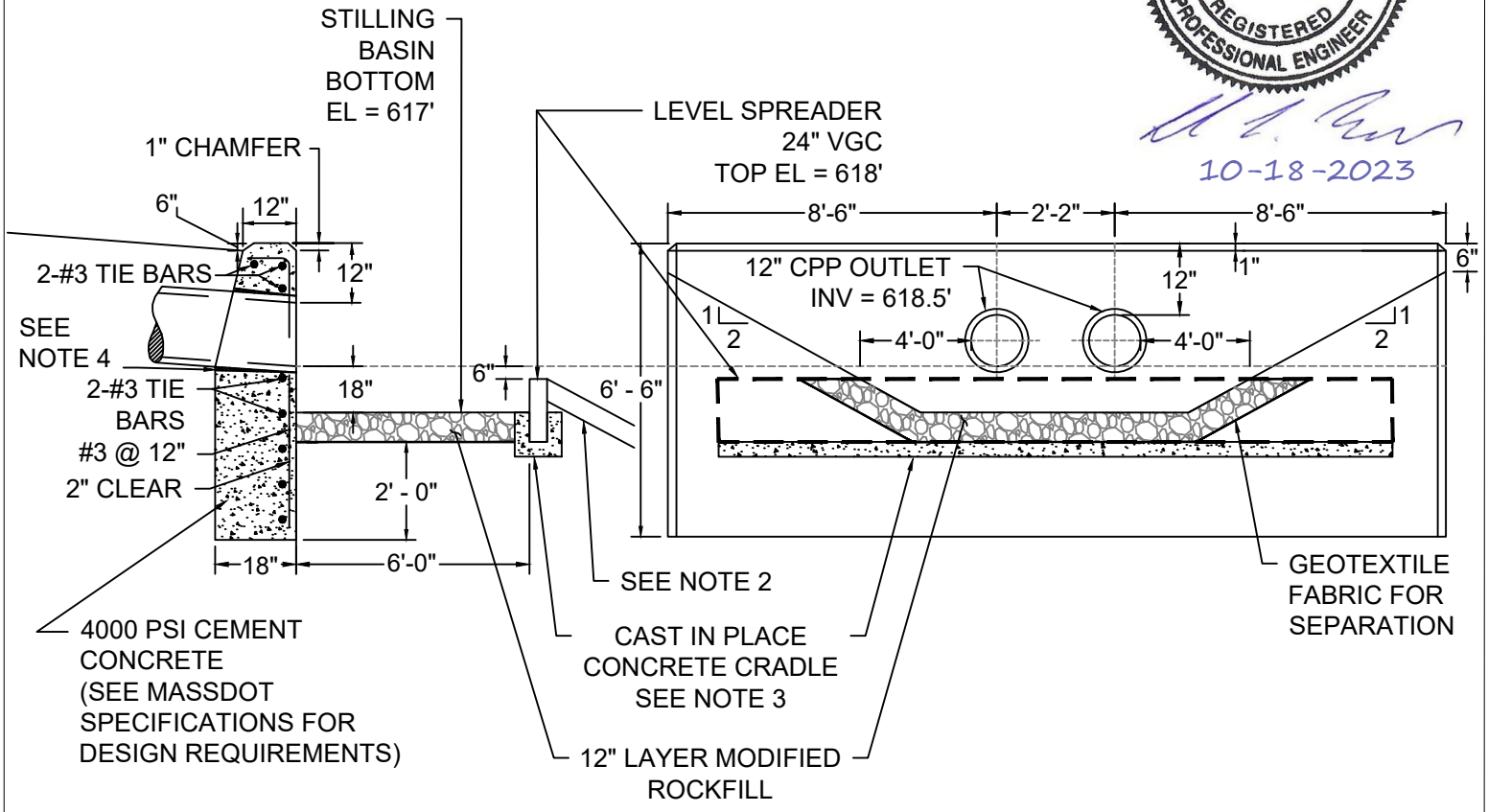
| | PROJECT FILE NO. 612991 | |




END ELEVATION

FRONT ELEVATION

COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

NOTE:

1. FOR DESCRIPTIONS, MATERIALS, AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS
2. STONE SLOPE PROTECTION. SEE DETAIL ON SHEET 14 FOR CONTINUATION.
3. INSTALL TOP OF CAST IN PLACE CONCRETE CRADLE FLUSH WITH TOP OF MODIFIED ROCKFILL LAYER. SEE SHEET 15.
4. PROVIDE OPENINGS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.

## DOUBLE BARREL HEADWALL WITH STILLING BASIN

NOT TO SCALE

massDOT Massachusetts Department of Transportation Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
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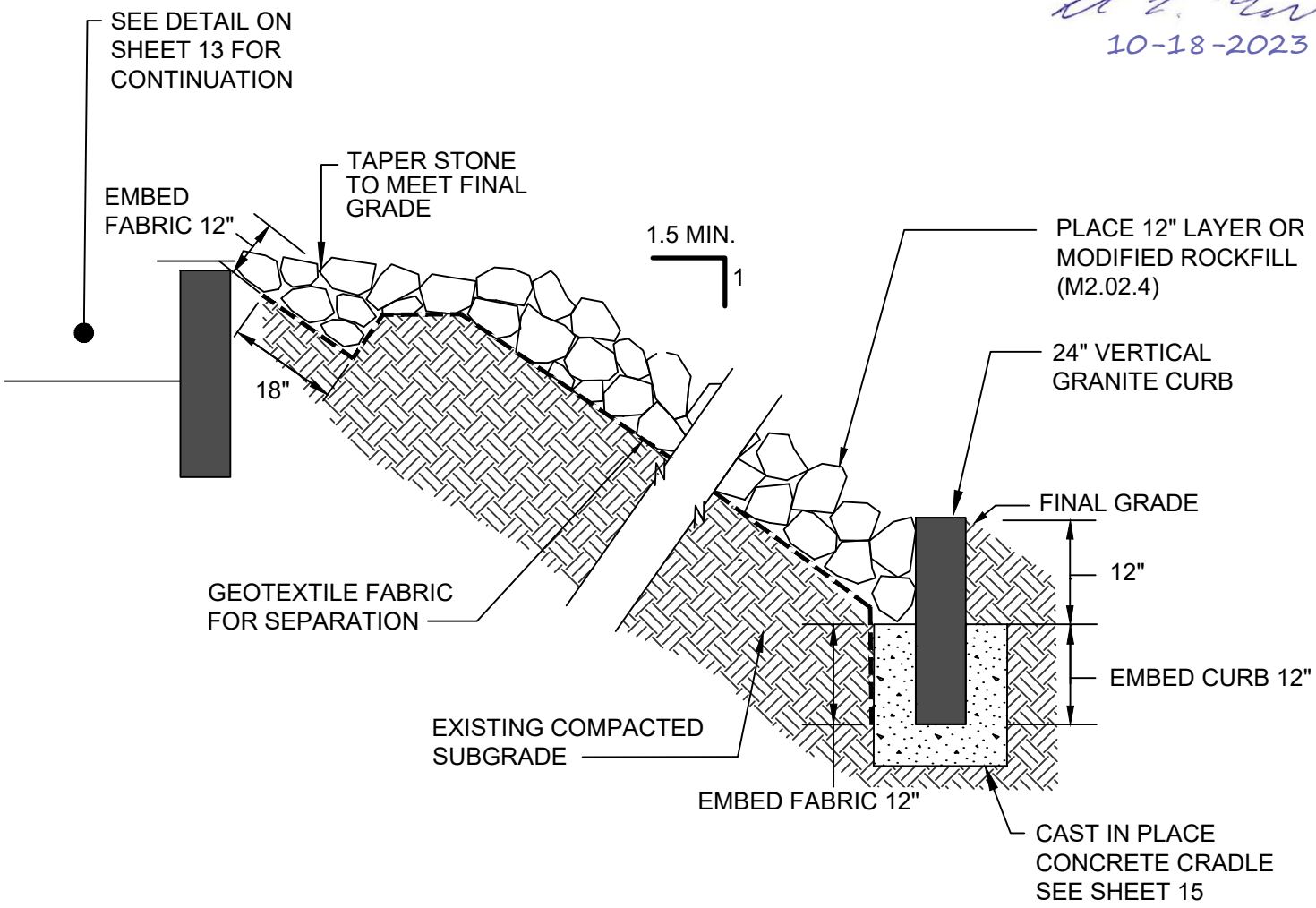
| | PROJECT FILE NO. 612991 | |

COMMONWEALTH OF MASSACHUSETTS
LUKE L. BOUCHER
CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023




## STONE SLOPE PROTECTION

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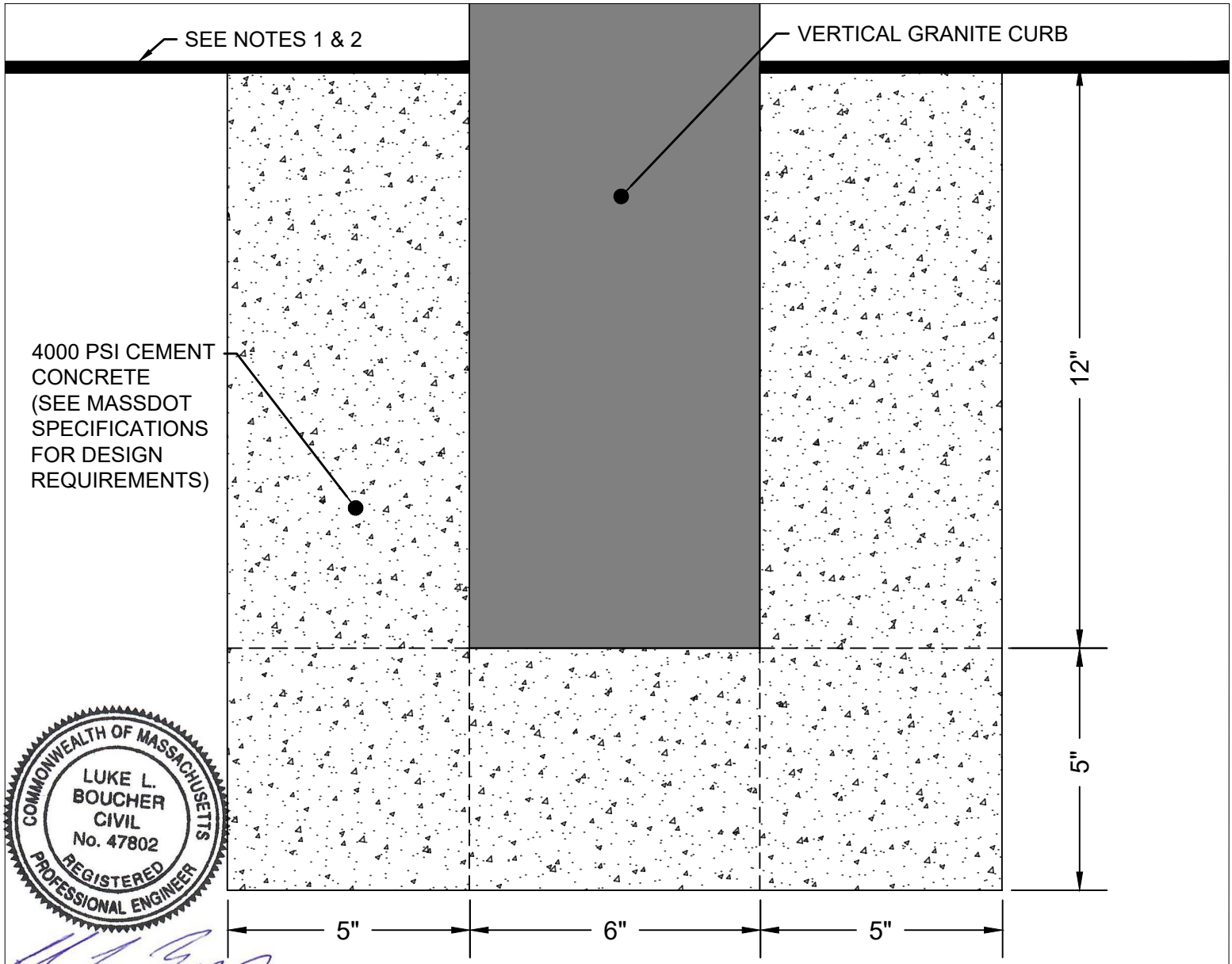
STURBRIDGE
STURBRIDGE ROUTE 20 DRAINAGE REPAIR
100% DESIGN SUBMISSION

CONSTRUCTION DETAILS

| SHEET NO. | TOTAL SHEETS |
|---|---|
| 16 | 21 |
| PROJECT FILE NO. 612991 | |

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CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

NOTES:

1. INSTALL TOP OF CAST IN PLACE CONCRETE CRADLE FLUSH WITH TOP OF MODIFIED ROCKFILL LAYER FOR STILLING BASIN WITH LEVEL SPREADER. SEE SHEET 13.

2. INSTALL TOP OF CAST IN PLACE CONCRETE CRADLE FLUSH WITH BOTTOM OF MODIFIED ROCKFILL LAYER FOR STONE SLOPE PROTECTION. SEE SHEET 14.

## CAST IN PLACE CONCRETE CRADLE

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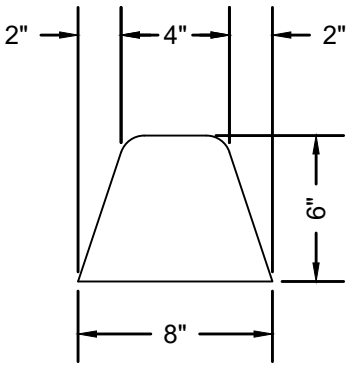
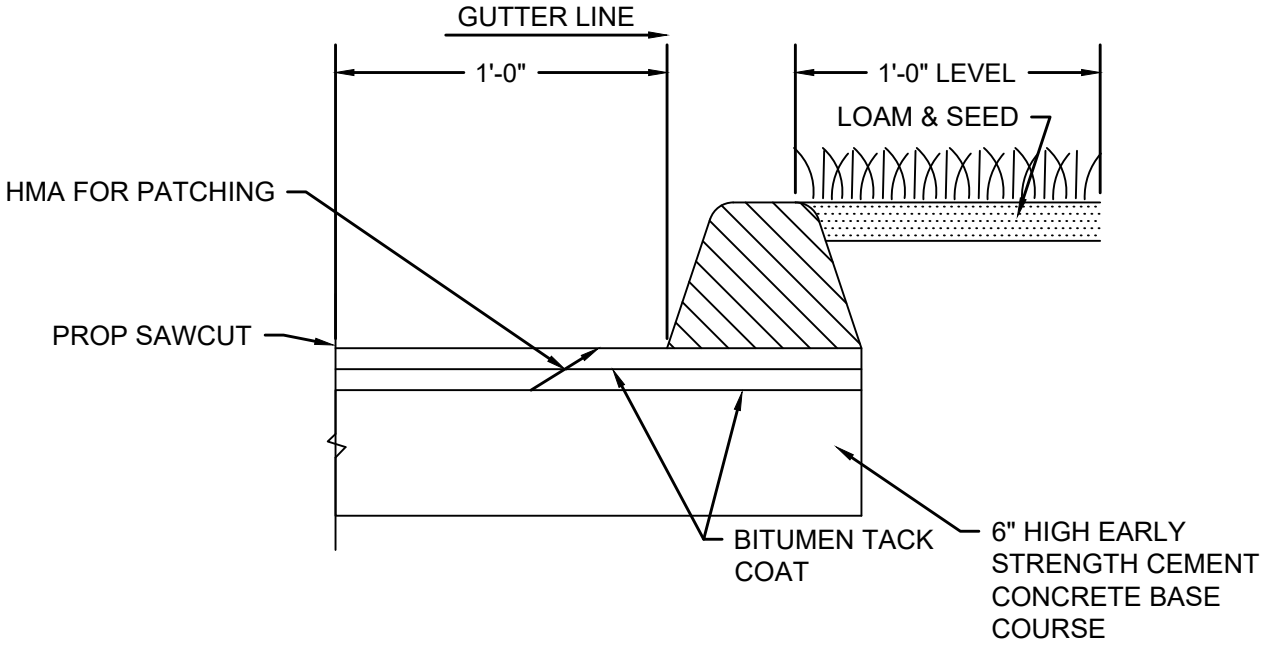
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 17 | 21 |
| | PROJECT FILE NO. 612991 | |

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CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

# HMA CURB TYPE-3 WITH CEMENT CONCRETE BASE COURSE

NOT TO SCALE

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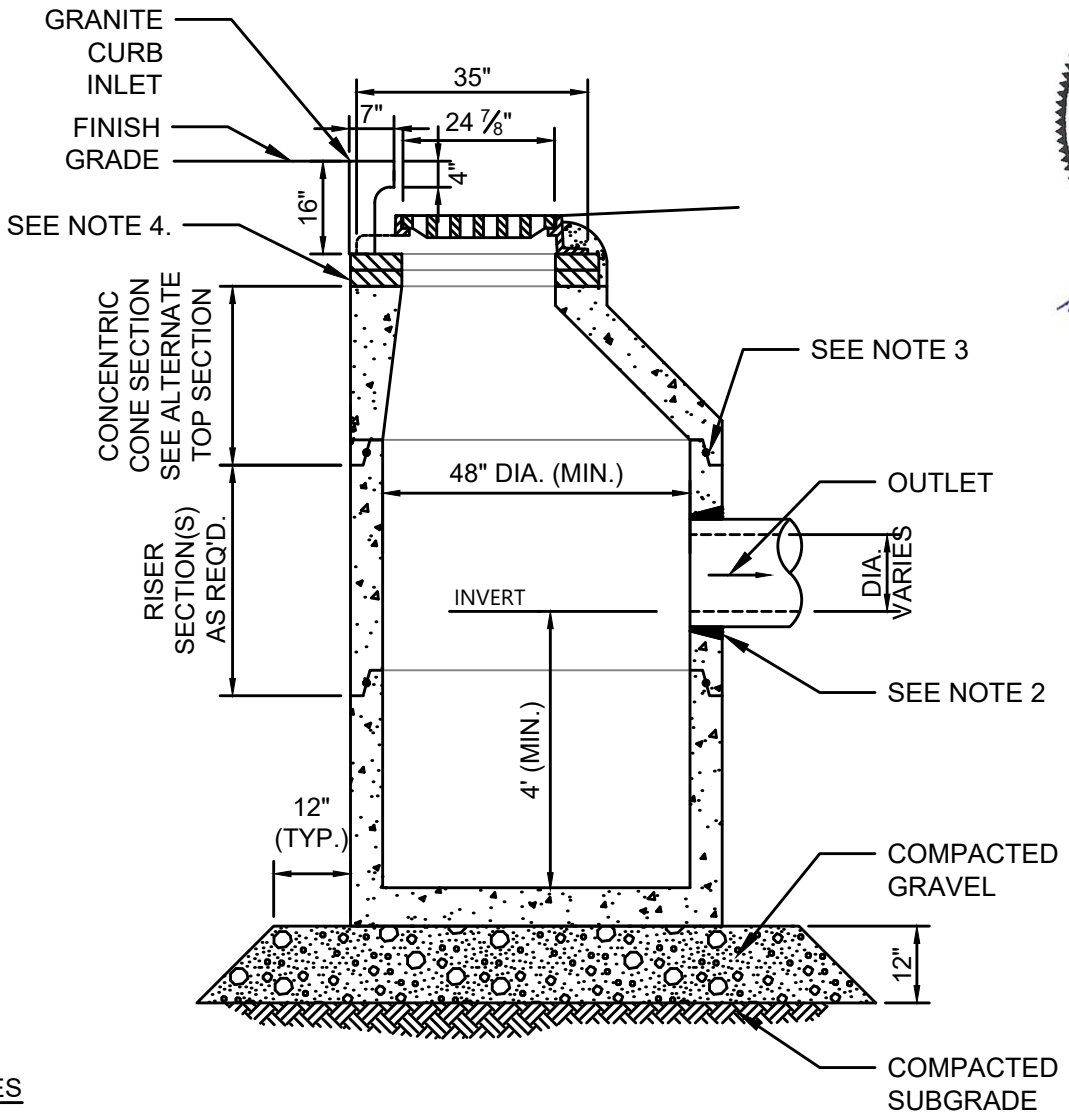
| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 18 | 21 |
| | PROJECT FILE NO. 612991 | |

DET.DWG Plotted on 17-Oct-23 11:36 AM




COMMONWEALTH OF MASSACHUSETTS
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CIVIL
No. 47802
REGISTERED PROFESSIONAL ENGINEER

10-18-2023

NOTES

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. FOR HDPE, PVC, AND DI PIPE, PROVIDE FLEXIBLE BOOT CONNECTION INSTALLED PER MANUFACTURER'S RECOMMENDATIONS. FOR RCP, PROVIDE OPENINGS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE AND MORTAR CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
4. CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM).

## CATCH BASIN WITH CURB INLET

NOT TO SCALE

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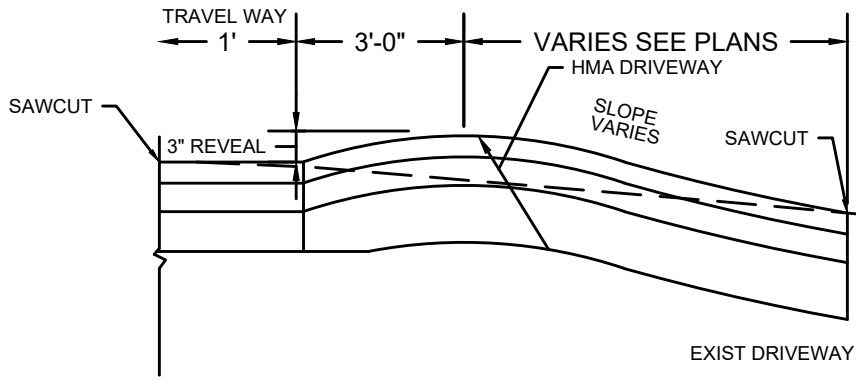
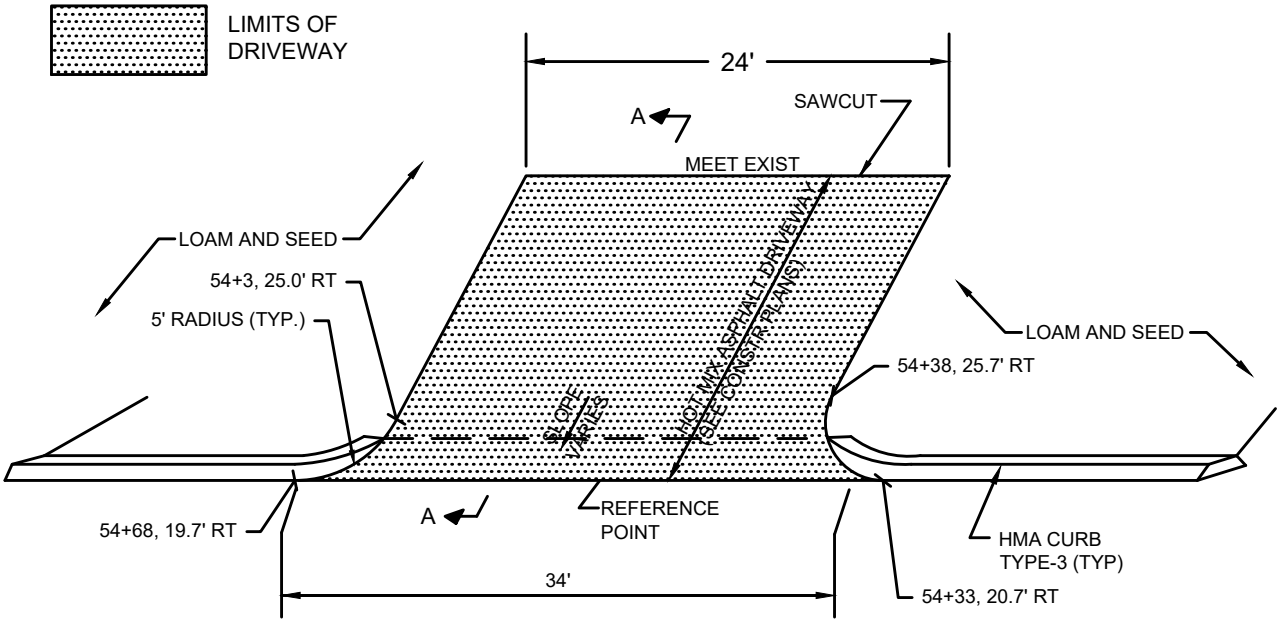
| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 19 | 21 |
| | PROJECT FILE NO. 612991 | |




SECTION A-A




TOLERANCE FOR CONSTRUCTION ±0.5%
*

OBLIQUE VIEW

PROPOSED HOT MIX ASPHALT DRIVEWAY

SURFACE: 1.5" SUPERPAVE SURFACE COURSE 9.5 (SSC-9.5) OVER
2.5" SUPERPAVE INTERMEDIATE COURSE 12.5 (SIC-12.5) OVER

SUBBASE: 8" GRAVEL BORROW, TYPE B

# TYPICAL HOT MIX ASPHALT DRIVEWAY WITH HMA BERM & WITHOUT SIDEWALK

NOT TO SCALE

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10-18-2023

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STURBRIDGE
STURBRIDGE ROUTE 20 DRAINAGE REPAIR
100% DESIGN SUBMISSION

CONSTRUCTION DETAILS

| SHEET NO. | TOTAL SHEETS |
|---|---|
| 20 | 21 |
| PROJECT FILE NO. 612991 | |

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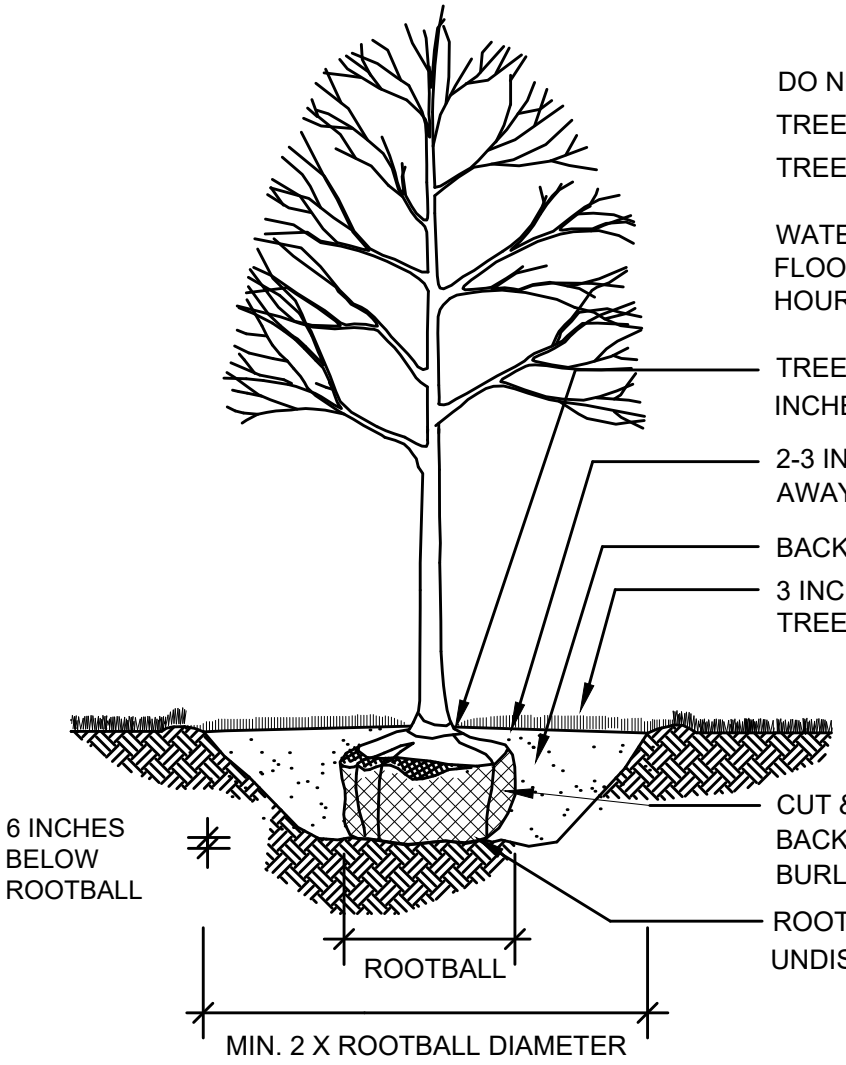
10-18-2023




DO NOT CUT LEADER

TREE WRAP SHALL NOT BE USED

TREE SHALL BE SET PLUMB

WATERING SAUCER SHALL BE FLOODED TWICE DURING THE FIRST 24 HOURS AFTER PLANTING

TREE SHALL BE PLANTED SO THAT CROWN IS 3 INCHES ABOVE FINISHED GRADE AFTER SETTLEMENT

2-3 INCHES AGED PINE BARK MULCH (PULL MULCH AWAY FROM TRUNK OF TREE)

BACKFILL MIX PER SPECIAL PROVISIONS

3 INCH HIGH EARTH WATERING SAUCER AROUND TREE PIT

CUT & ROLL BACK 1/3 OF BURLAP BEFORE BACKFILLING. COMPLETELY REMOVE SYNTHETIC BURLAP & LACING

ROOTBALL SHALL BE PLACED ON UNDISTURBED SUBGRADE

# DECIDUOUS TREE PLANTING

NOT TO SCALE

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Highway Division

| | | |
|---|---|---|
| STURBRIDGE<br>STURBRIDGE ROUTE 20 DRAINAGE REPAIR<br>100% DESIGN SUBMISSION<br><br>CONSTRUCTION DETAILS | SHEET NO. | TOTAL SHEETS |
| | 21 | 21 |
| | PROJECT FILE NO. 612991 | |

## Upland Riverfront Area Mitigation Planting Plan

The entire work area is located in upland with the majority of the work area being located within the 0-100 foot Riverfront Area (RFA) zone and a small portion of the work area adjacent to the roadway, located in the 100-200 foot RFA zone. Vegetation within the work area is dominated by mature trees, which provides a partially open canopy. A total of 6 living trees with a 5-inch diameter at breast height (DBH) were identified within the work area, which includes three Sugar Maple (*Acer saccharum*), two Big-tooth Aspen (*Populus grandidentata*), and one Northern Red Oak (*Quercus* rubra), which are all native species to Massachusetts. It should be noted that there are four dead trees within the work area, which include the three largest diameter trees (24-inch, 28-inch, and 30-inch). The three large dead trees appear to have been Eastern White Pine (*Pinus strobus*) species and the other dead tree appears to be White Ash (*Fraxinus americana*), all of which no longer appear to be present in the immediately surrounding forest. Note that the above noted large diameter dead trees will be retained and tree protection will be installed (as noted on the site plan) to maintain existing wildlife habitat where possible. However, these trees may be removed if any safety concerns arise during construction. Trees to be retained will be marked in the field prior to tree clearing and tree protection ( i.e., orange construction fencing, wood slates around trunk) will be installed. The existing shrub and herbaceous layers consist largely of saplings and seedlings of the above-noted tree species but also included Bitternut Hickory (*Carya cordiformis*).

Mitigation plantings will be installed in accordance with the planting schedule, which includes a 3:1 ratio of replacement of the number of 5-inch or greater DBH trees removed during construction and includes additional plantings to account for saplings. A total of 22 plantings will consist of 2-3 foot specimens of the same species that were removed, in order to recreate the existing natural vegetation, plant only native species, and provide a higher chance of survival, based on existing site conditions. Plantings will be inspected and installed under the supervision of a qualified wetland scientist to ensure that the specimens are healthy, free from pests, and suitable for use within the upland RFA replacement area. Unsuitable specimens will be rejected and replaced with suitable specimens. Any planting substitutions, as needed, will be approved by the wetland scientist. Planting locations within the replacement area will conform to the planting plan sheet or will be completed in accordance with directions provided in the field by the wetland scientist. As shown on the planting plan sheet, plantings will be spaced within the cleared work zone, leaving a 12-foot wide gap in the center of the easement and a space to the north of the headwall to allow for future maintenance access. Following planting of the RFA restoration area, the slope will be seeded with New England Wetland Plants Conservation Seed mixture at a rate of 23 lbs per acre. The wetland seed mixture shall be reviewed and approved by the wetland specialist prior to seeding.

**Table 1 - Upland Riverfront Area Mitigation Planting Schedule**

| Common Name | Scientific Name | Plant Type | Wetland Indicator Status | Planting Location | Number of Plantings | Suggested Size | Suggested Spacing |
|---|---|---|---|---|---|---|---|
| Sugar Maple | *Acer saccharum* | Tree | FACU | Upland RFA (lower slope and upper slope) | 9 | 2-3 feet | 4-6 feet |
| Northern Red Oak | *Quercus rubra* | Tree | FACU | Upland RFA (upper slope) | 3 | 2-3 feet | 4-6 feet |
| Big-tooth Aspen | *Populus grandidentata* | Tree | FACU | Upland RFA (upper slope) | 6 | 2-3 feet | 4-6 feet |
| Bitternut Hickory | *Carya cordiformis* | Tree | FAC | Upland RFA (lower slope and upper slope) | 4 | 2-3 feet | 4-6 feet |
| **Total Plantings** | | | | | **22** | | |
| conservation seed mix | see Note 1 | Herbaceous | N/A | Upland RFA (all disturbed areas along slope) | N/A | N/A | N/A |

Source: VHB, 2023

1 Conservation seed mix: "New England Conservation/Wildlife Mix from New England Wetland Plants, Inc. or similar. Typical species: Virginia Wild Rye (Elymus virginicus), Little Bluestem (Schizachyrium scoparium), Big Bluestem (Andropogon gerardii), Red Fescue (Festuca rubra), Switch Grass (Panicum virgatum), Partridge Pea (Chamaecrista fasciculata), Panicledleaf Tick Trefoil (Desmodium paniculatum), Indian Grass (Sorghastrum nutans), Blue Vervain (Verbena hastata), Butterfly Milkweed (Asclepias tuberosa), Black Eyed Susan (Rudbeckia hirta), Common Sneezeweed (Helenium autunale), Heath Aster (Asterpilosus/Symphyotrichum pilosum), Early Goldenrod (Solidago juncea), Upland Bentgrass (Agrostis perennans)

# Sturbridge Rt. 20 Drainage Repair Project

## Stormwater Memorandum

PREPARED FOR

Massachusetts Department of Transportation, Highway Division
499 Plantation Parkway
Worcester, Massachusetts 01605

PREPARED BY

101 Walnut Street
PO Box 9151
Watertown, MA 02471
617.924.1770

August 2023
Revised October 2023

Memorandum

To: Sturbridge Conservation Commission
308 Main St
Sturbridge, MA 01566

Date: October 18, 2023

Project #: 14961.06

From: Luke Boucher, PE

Re: Stormwater Management Memorandum **(Rev 2023-10-18)**
Sturbridge Route 20 Drainage Improvements

---

This Stormwater Management Memorandum has been prepared to show compliance with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00).

## Project Description

The project is located along the eastbound side of Route 20, just east of the intersection of Route 20 and Route 148 and west of Church Street in Sturbridge, Massachusetts (the Site). The existing drainage on the Site consists of inlet structures at the entrance to 9 Holland Street, across from School Street. The conveyance pipes are deteriorated corrugated metal pipes and some of the drainage structures do not have frame or covers. This system, which is owned by MassDOT, discharges through the 595 Main Street Property down to Quinebaug River. Additionally, catch basins to the north of the Site, which are owned by the Town of Sturbridge (the Town), tie into to the MassDOT owned system and discharge through the same outfall. Substantial erosion exists on the steep slope between the existing uncontrolled discharge location to the river, a distance of approximately 50 feet, on the 595 Main Street property. The Applicant, MassDOT, is proposing to remediate the existing erosion by filling in the scoured channel. The project also aims to prevent future erosion by installing a stilling basin and stone slope protection at the discharge location. In addition, to conform with MassDOT regulations, the project will separate the town and state drainage. New drainage components will be installed, including the addition of a new headwall with two outfalls: one discharging the state drainage system and one discharging the town's drainage system. Both outfalls would discharge into the aforementioned stilling basin, which overflows via a level spreader down a stone stabilized slope into the Quinebaug River. The system will require an easement along the shared property line between 9 Holland Road and 595 Main Street.

## Site Description

The Site is generally bounded on the west by Route 148 and Holland Road, to the east by Church Street, to south by the Quinebaug River, and to the north by the westbound lane of Route 20. There are three existing catch basins on the site that discharge south to the Quinebaug river down a steep, wooded slope. A fourth catch basin is located on the Site south of Route 20, but is not operational.

The Site is located within the Quinebaug River watershed. The section of the river to which the project discharges has the following impairments: non-native aquatic plants, ambient bioassays - chronic aquatic toxicity, fish bioassessments, lack of A coldwater assemblage, temperature, and mercury in fish tissue. The site is above the 100-



101 Walnut Street
Watertown, MA 02472
P 617.924.1770

year floodplain with the minimum elevation within the proposed work envelope being 603 feet and the floodplain elevation being between 597 and 598 feet (See Attachment 3).

---

**Existing Drainage Conditions**

According to existing drainage plans (VHB Survey December 2020), stormwater runoff from Route 20 is collected via three catch basins on its eastbound side. A fourth existing catch basin is located on the slope south of Route 20 but does not appear to be operational. All four catch basins within the Site along Route 20 are owned by MassDOT. North of the Site, the Town's stormwater system collects runoff via catch basins on School Street; this system currently connects into the furthest downstream MassDOT catch basin on Route 20 within the Site. The stormwater from both the MassDOT and Town owned systems is conveyed down a steep wooded slope via the same 12-inch corrugated metal pipe, where it discharges uncontrolled into Quinebaug river. Substantial erosion exists on the steep slope between the existing discharge location and the river. Additionally, the 12-inch corrugated metal outlet pipe is deteriorated and some of the MassDOT-owned drainage structures do not have frames or covers. Based on VHB field delineation, the total contributing MassDOT and Town drainage areas to existing outfall are 0.18 acres and 0.34 acres, respectively.

---

**Proposed Drainage Conditions**

The proposed work includes removing the corrugated metal outlet pipe and three catch basins and their connecting pipes on the eastbound side of Route 20. Two new catch basins are proposed to be installed on the eastbound side of Route 20 to collect runoff from the roadway. Three new drainage manholes are also proposed; two of the manholes serve to connect the proposed MassDOT-owned closed drainage on Route 20 to a proposed 12-inch corrugated plastic outlet pipe, which will run down the steep slope south of Route 20 and discharge approximately 14 feet uphill of the existing outfall. The third manhole will be installed at the same location as the furthest downstream catch basin of the existing system and will connect the existing Town owned closed drainage on School Street to a separate proposed 12-inch corrugated plastic outlet pipe. This pipe will run immediately east of the proposed MassDOT outlet pipe down the steep slope and discharge at the same location as the proposed MassDOT outfall. This design will eliminate the drainage interconnection between MassDOT and the Town and discharge their respective runoff via separate outfalls. No new impervious area will be added as part of the proposed work and the contributing drainage areas for MassDOT and the Town will not be altered under proposed conditions. The Town outfall and the MassDOT outfall will both discharge into a riprap stilling basin via a double-barreled headwall. The proposed stilling basin has been sized to dissipate the energy of the flow from both the MassDOT and Town outfalls and will measure approximately 1 foot deep by 12 feet wide by 6 feet long in the direction of flow. The runoff will flow out of the stilling basin over a level spreader and down a stone protected slope into the Quinebaug river. The stone protected slope will be stabilized with 24-inch vertical granite curbing anchored in a concrete footing at the toe of the slope to prevent the stone from sliding down the embankment into the river. The energy dissipation provided by the stilling basin in conjunction with the erosion control provided by the stone stabilized slope will alleviate the existing erosion issue and prevent future sediment discharge from the site into the Quinebaug River.



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Memorandum

## Massachusetts Department of Environmental Protection (MassDEP) – Stormwater Management Standards

The project will result in no increase in impervious cover and thus fully complies with the MassDEP Stormwater Management Standards as a redevelopment project.

**Standard 1: No New Untreated Discharges**

The Project has been designed to fully comply with Standard 1. No new untreated discharges are proposed as part of the Project.

**Standard 2: Peak Rate Attenuation**

The Project has been designed to fully comply with Standard 2. The proposed work does not increase in impervious area and does not increase peak rates coming from the project site.

**Standard 3: Stormwater Recharge**

The Project has been designed to fully comply with Standard 3. No increase in impervious area is proposed as part of the Project.

**Standard 4: Water Quality**

The Project has been designed to fully comply with Standard 4. One of the goals of this project is to increase the water quality of the stormwater discharging from the site by installing a stilling basin and stone stabilized slope at the proposed outfall to reduce erosion and subsequent sediment discharge to the Quinebaug River.

**Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)**

The Project use is not considered a land use with higher potential pollutant loads and therefore fully complies with Standard 5.

**Standard 6: Critical Areas**

The project does not discharge to an Outstanding Resource Water (ORW), Coldwater Fisheries or an Area of Critical Environmental Concern (ACEC). The project does discharge within a Zone II Wellhead Protection Area; however, this is a drainage repair project that does not propose any new BMPs. In addition, the proposed drainage system discharges at the same location as existing drainage system and does not change watershed size or include the installation of new impervious area. Therefore, it fully complies with Standard 6.



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**Standard 7: Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable**

Although the Project is a retrofit project and therefore classified as a redevelopment, the Project has been designed to fully comply with Standard 7 and all other Standards.

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Controls**

The stormwater portion of the project will disturb less than 1 acre of land and is therefore not required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit.

**Standard 9: Operation and Maintenance Plan**

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the Project. The O&M Plan is attached. Appropriate erosion and sedimentation controls will be installed during construction.

**Standard 10: Prohibition of Illicit Discharges**

During construction, the Project contractor will be required to verify there are no illicit connections to the drainage system. If an illicit connection is discovered, the applicable entity (MassDOT or Sturbridge Department of Public Works and Board of Health) will be notified to take appropriate action.

No statement is made regarding portions of existing drainage systems not included in the project area.

An illicit discharge statement has been included in Attachment 2.

Attachments: Stormwater Checklist
Operation and Maintenance Plan and Long-Term Pollution Prevention Plan
FEMA FIRMette



101 Walnut Street
Watertown, MA 02472
P 617.924.1770

Memorandum

# Attachment 1

# Stormwater Checklist



101 Walnut Street
Watertown, MA 02472
P 617.924.1770

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.


A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

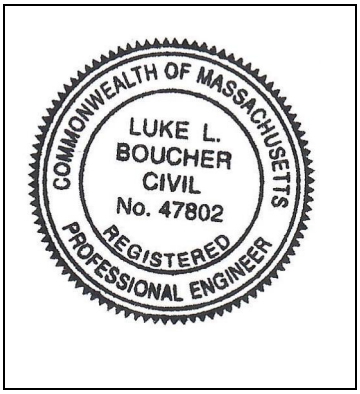
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

## Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the ~~soil evaluation~~, ~~computations~~, Long-term Pollution Prevention Plan, ~~the Construction Period Erosion and Sedimentation Control Plan (if included)~~, the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature




10-18-2023

Signature and Date

## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Installation of energy dissipation and erosion control structures to reduce sediment discharge

**Standard 1: No New Untreated Discharges**

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 2: Peak Rate Attenuation – N.A. No Increase in Impervious area & No Change to existing drainage area**

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☐ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

**Standard 3: Recharge – N.A. No Increase in Impervious Area**

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 3: Recharge** (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

**Standard 4: Water Quality**

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 4: Water Quality** (continued)

☐ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

**Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs) – N.A, project is not located within a LUHPPL**

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

**Standard 6: Critical Areas – N.A.**

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable**

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☒ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☒ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control**

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control** (continued)

☒ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

**Standard 9: Operation and Maintenance Plan**

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

**Standard 10: Prohibition of Illicit Discharges**

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Memorandum

# Attachment 2

# Operation and Maintenance/Long Term Pollution Prevention Plan



101 Walnut Street
Watertown, MA 02472
P 617.924.1770

# Route 20 Drainage Improvements
# Sturbridge, MA

# Operation and Maintenance Plan (O&M)
# and
# Long Term Pollution Prevention Plan (LTPPP)

## October 2023

This Stormwater Management System Operation and Maintenance Plan provides for the inspection and maintenance of two proposed catch basins, two proposed manholes, and a proposed double barrel headwall and stilling basin to alleviate erosion and sediment discharge to the Quinebaug River in Sturbridge, MA

This document has been prepared in accordance with the requirements of the Stormwater Regulations included in the Massachusetts Wetlands Protection Act Regulations (310 CMR 10).

**Responsible Party**

The Massachusetts Department of Transportation (MassDOT) will be responsible for the maintenance of the roadway facilities and associated stormwater management features, in accordance with their own standards.

Questions or concerns regarding maintenance activities may also be addressed to MassDOT:

MassDOT District 3 Headquarters
499 Plantation Street
Worcester, MA 01605
(857) 368-3000

**Maintenance Measures**

The stormwater management system covered by this Operation and Maintenance Plan consists of the following component:

- Two Catch Basins
- Two Manholes
- Double Barrel Headwall Outfall
- Stilling Basin
- Stone Protected Slope

Maintenance of this component will be conducted in accordance with MassDOT standard maintenance practices.

If inspection indicates the need for major repairs, the inspector should contact the MassDOT District 3 maintenance supervisor to initiate procedures to effect repairs in accordance with MassDOT's standard construction practices.

**Practices for Long Term Pollution Prevention**

In general, long term pollution prevention and related maintenance activities will be conducted consistent with MassDOT Management Plans. Further information can be requested via email: hung.pham@state.ma.us.

For the facilities covered by this Operation and Maintenance Plan, long term pollution prevention includes the following measures:

<u>Litter Pick-up</u>
MassDOT will conduct litter pick-up from the stormwater management facilities in conjunction with routine maintenance activities.

<u>Routine Inspection and Maintenance</u>
MassDOT will conduct inspection and maintenance of the stormwater management practices in accordance with the guidelines discussed above.

Spill Prevention and Response

MassDOT will implement response procedures for releases of significant materials such as fuels, oils, or chemical materials onto the ground or other areas that could reasonably be expected to discharge to surface or groundwater.

- Reportable quantities will immediately be reported to the applicable Federal, State, and local agencies as required by law.
- Applicable containment and cleanup procedures will be performed immediately. Impacted material collected during the response must be removed promptly and disposed of in accordance with Federal, State, and local requirements. A licensed emergency response contractor may be required to assist in cleanup of releases depending on the amount of the release and the ability of the responsible party to perform the required response.
- Reportable quantities of chemical, fuels, or oils are established under the Clean Water Act and enforced through DEP.

Snow and Ice Management

Snow and Ice Management shall be conducted according to standard MassDOT practices.

Prohibition of Illicit Discharges

The DEP Stormwater Management Standards prohibit illicit discharges to the stormwater management system. Illicit discharges are discharges that do not entirely consist of stormwater, except for certain specified non-stormwater discharges.

There are no known or proposed illicit connections associated with this project. If a potential illicit discharge to the facilities covered by this plan is detected (e.g., dry weather flows at any pipe outlet, evidence of contamination of surface water discharge by non-stormwater sources), the applicable parties shall be notified for assistance in determining the nature and source of the illicit discharge.

# Illicit Discharge Statement

Sanitary sewer and storm drainage structures remaining from previous development which are part of the redevelopment area will be removed or will be incorporated into updated sanitary sewer and separate stormwater sewer systems. The design plans submitted with this report have been designed so that the components included therein are in full compliance with current standards. No statement is made with regard to the drainage system in portions of the site not included in the redevelopment project area.


10-12-2023

| Luke Boucher, PE | Date | Massachusetts 47802 |
|---|---|---|

Memorandum

# Attachment 3

# FEMA FIRMette

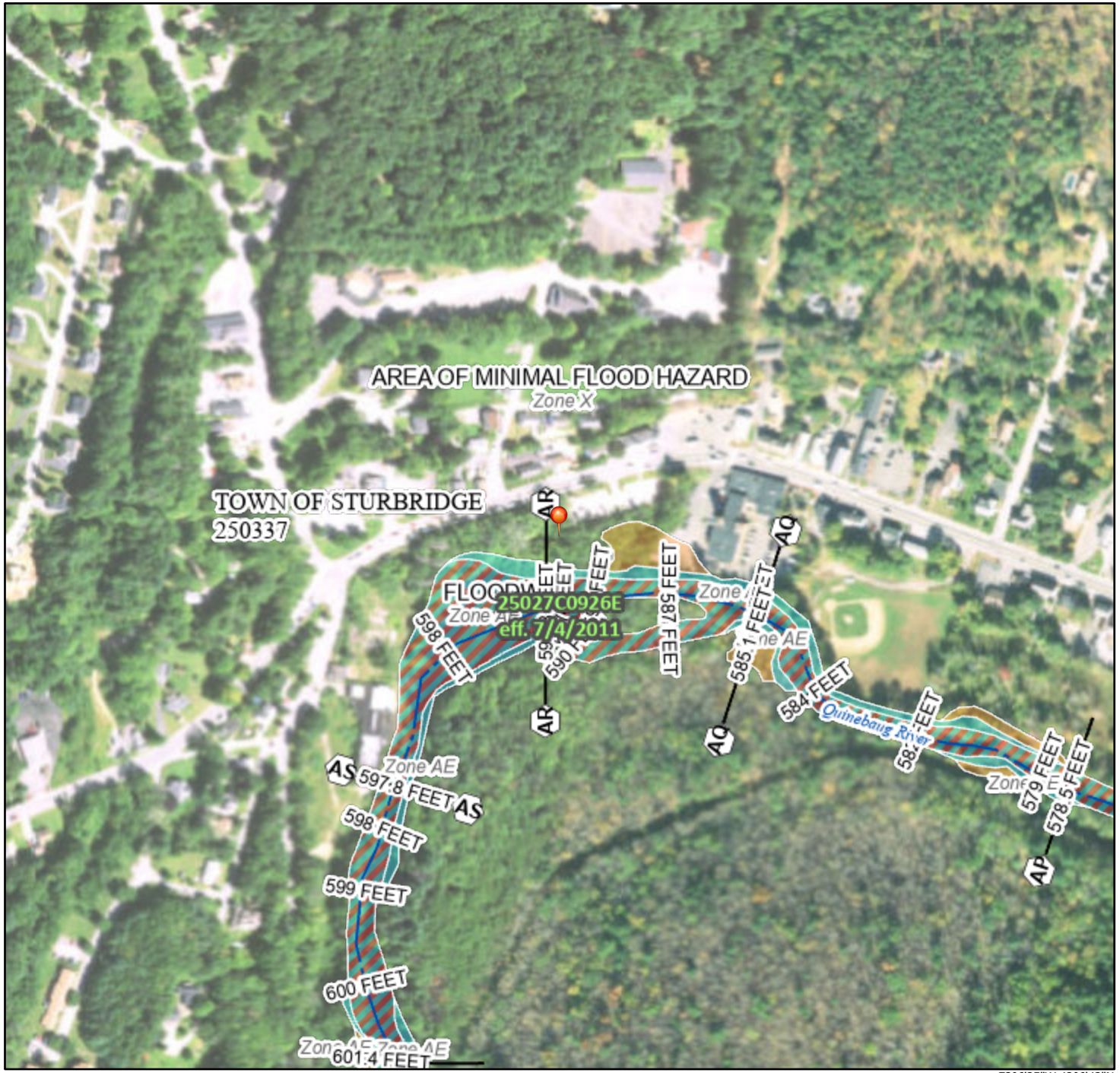


101 Walnut Street
Watertown, MA 02472
P 617.924.1770

# National Flood Hazard Layer FIRMette

FEMA

72°7'12"W 42°7'10"N




72°6'35"W 42°6'43"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

*Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020*

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

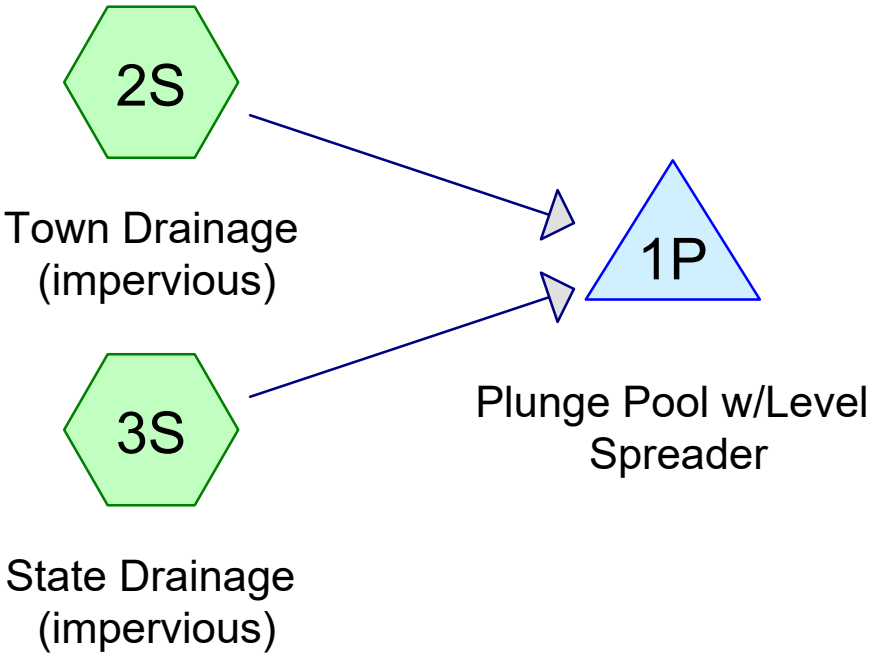
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/22/2022 at 12:45 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

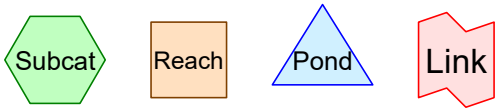



Per MassDEP
Stormwater Handbook,
Vol. 2, Ch. 2

1.6 acres of impervious →

| Drainage Area | Minimum Spreader Length |
|---|---|
| 1 acre | 10 feet |
| 2 acres | 10 feet |
| 3 acres | 15 feet |
| 4 acres | 18 feet |
| 5 acres | 20 feet |

← Proposed 12 ft length




**Routing Diagram for 1496106 Level Spreader**
Prepared by VHB, Inc, Printed 10/6/2023

## Rainfall Events Listing (selected events)

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 10-Year | Type III 24-hr | | Default | 24.00 | 1 | 4.83 | 2 |

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment2S: Town Drainage** Runoff Area=1.300 ac 100.00% Impervious Runoff Depth=4.59"
Tc=6.0 min CN=98 Runoff=6.00 cfs 0.498 af

**Subcatchment3S: State Drainage** Runoff Area=0.300 ac 100.00% Impervious Runoff Depth=4.59"
Tc=6.0 min CN=98 Runoff=1.38 cfs 0.115 af

**Pond 1P: Plunge Pool w/Level Spreader** Peak Elev=618.33' Storage=79 cf Inflow=7.38 cfs 0.612 af
Outflow=7.38 cfs 0.611 af

**Total Runoff Area = 1.600 ac Runoff Volume = 0.612 af Average Runoff Depth = 4.59"**
**0.00% Pervious = 0.000 ac 100.00% Impervious = 1.600 ac**

## Summary for Subcatchment 2S: Town Drainage (impervious)

Runoff = 6.00 cfs @ 12.09 hrs, Volume= 0.498 af, Depth= 4.59"
Routed to Pond 1P : Plunge Pool w/Level Spreader

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

| Area (ac) | CN | Description |
|---|---|---|
| 1.300 | 98 | Paved roads w/curbs & sewers, HSG B |
| 1.300 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, NRCS Minimum** |

## Summary for Subcatchment 3S: State Drainage (impervious)

Runoff = 1.38 cfs @ 12.09 hrs, Volume= 0.115 af, Depth= 4.59"
Routed to Pond 1P : Plunge Pool w/Level Spreader

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

| Area (ac) | CN | Description |
|---|---|---|
| 0.300 | 98 | Paved roads w/curbs & sewers, HSG B |
| 0.300 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 6.0 | | | | | **Direct Entry, NRCS Minimum** |

## Summary for Pond 1P: Plunge Pool w/Level Spreader

Inflow Area = 1.600 ac,100.00% Impervious, Inflow Depth = 4.59" for 10-Year event
Inflow = 7.38 cfs @ 12.09 hrs, Volume= 0.612 af
Outflow = 7.38 cfs @ 12.09 hrs, Volume= 0.611 af, Atten= 0%, Lag= 0.0 min
Primary = 7.38 cfs @ 12.09 hrs, Volume= 0.611 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 618.33' @ 12.09 hrs Surf.Area= 75 sf Storage= 79 cf

Plug-Flow detention time= 2.9 min calculated for 0.611 af (100% of inflow)
Center-of-Mass det. time= 1.5 min ( 750.1 - 748.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 617.00' | 134 cf | **Plunge Pool (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 617.00 | 43 | 0 | 0 |
| 618.00 | 67 | 55 | 55 |
| 619.00 | 91 | 79 | 134 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 618.00' | **Level Spreader, Cv= 2.62 (C= 3.28)**<br>Head (feet) 0.00 1.00<br>Width (feet) 11.20 15.20 |

**Primary OutFlow** Max=7.19 cfs @ 12.09 hrs HW=618.33' (Free Discharge)
↑—**1=Level Spreader** (Weir Controls 7.19 cfs @ 1.85 fps)