STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Sunderland BM20102

US ROUTE 7, BRIDGE 19-5 OVER UNAMED BROOK

August 22, 2023

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I. Site Information

Bridge 19-5 is a State-owned bridge located on US Route 7 in the Town of Sunderland approximately 0.6 miles south of exit 3. The bridge is at a 20-degree skew to the roadway and is located under an average of 13 feet of fill. The existing conditions were gathered from a combination of a Site Visit, the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

Roadway Classification	Principal Arterial, National Highway System
Bridge Type	Corrugated Galvanized Metal Plate Pipe Arch (CGMPPA)
Culvert Span	8 feet
Culvert Length	162 feet
Fill Over Culvert	13 feet
Year Built	1978
Ownership	State of Vermont

Need

Bridge 19-5 carries US Route 7 across an Unnamed Brook. The following is a list of deficiencies of Bridge 19-5 and US Route 7 in this location:

1. The culvert is in poor condition. There are holes throughout the invert ranging in size up to full length across the invert. Piping is present throughout; however, the barrel continues to hold good shape with little distortion.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2027 and 2047.

TRAFFIC DATA	2027	2047
AADT	7,760	8,520
DHV	950	1,050
ADTT	470	615
%T	5.3	6.3
%D	51	51

Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997. Minimum standards are based on an ADT of 8520, a DHV of 1050, and a design speed of 55 mph for a Principal Arterial.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 3.3	12'/8' (40') guardrail not present through project limits	12'/8' (40') w/o guardrail 12'/10' (44') with guardrail	
Bridge Lane and Shoulder Widths	VSS Section 3.7	NA	12'/10' (44')	
Clear Zone Distance	VSS Table 3.4	No Issues Noted	26' fill / 16' cut (1:3 slope), 20' cut (1:4 slope)	
Banking	VSS Section 3.13	Normal Crown	8% (max)	
Speed		55 mph (Posted)	55 mph (design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 11,500'	R_{min} = 9,720' @ NC	
Vertical Grade	VSS Table 3.6	-2.16% (max)	4% (max) for level terrain	
K Values for Vertical Curves	VSS Table 3.1	K_{sag} = 902	150 crest / 100 sag	
Vertical Clearance	VSS Section 3.8	No Issues Noted	16'-3" (min)	
Bicycle/Pedestrian Criteria	VSS Table 3.8	8' shoulder	6' Shoulder	
Hydraulics	VTrans Hydraulics Section	HW/D = 0.45 Clearspan: 8.2'	HW/D < 1.2 Bank Full Width: 8'	
Structural Capacity	SM, Ch. 3.4.1	Poor condition	Design Live Load: HL-93	Substandard

Inspection Report Summary

Culvert Rating 4 Poor
Channel Rating 6 Satisfactory

11/8/2022 – Corrugated galvanized multi plate pipe arch (CGMPPA) is in satisfactory condition however the invert is in poor condition having heavy corrosion present with large perforations throughout causing piping and voiding. Remaining structure invert has heavy pitting and rust scaling throughout. Structure should be sleeved or have concrete invert installed to prevent further piping and deterioration along the invert. No roadway settlement is present at time of inspection however invert and lower portions of barrel walls / invert have voids present due to piping. ~SP

12/2/2020 – Structure has fairly good form however the invert has heavy deterioration present with large perforations throughout with piping present. Invert has heavy pitting and rust scaling throughout. Structure should be sleeved or have concrete invert installed to prevent further piping and deterioration along the invert. ~SMP/MAC

9/25/2019 – Structure is in poor condition and should be considered for a replacement. ~MAC/JW

10/18/2018 – Structure is in poor condition. Invert has perforations throughout the structure w/ some piping occurring. It is recommended that repairs be made to the invert. ~MAC/JW

Hydraulics

While the existing culvert meets the current hydraulic standards and bank full width standard, it does not meet Aquatic Organism Passage standards due to a perch at the outlet. The existing 8.2-foot x 5.8-ft rise Corrugated Metal Plate Pipe Arch Culvert provides a Headwater to Depth ratio (HW/D) of 0.45 during the design storm event. Per the current standards, a culvert with a diameter greater than 60-inches should provide a maximum HW/D of 1.2 during the design storm event. The VTrans Hydraulics Section has made several recommendations for a rehabilitation or replacement structure; these options are outlined in the preliminary hydraulics report in Appendix D. Regardless of the recommendation, Aquatic Organism Passage is required and will need to be incorporated into the design and construction of the project.

Utilities

The existing utilities are shown on the Existing Conditions Layout Sheet, and are as follows:

There are no existing utilities present within the project area.

Right-Of-Way

The existing Right-of-Way is plotted on the Existing Conditions Layout Sheet. There is ample ROW through the project area. It is anticipated that no additional ROW will be needed for construction.

Environmental and Cultural Resources

The environmental resources present at this project are shown on the Existing Conditions Layout Sheet, and are as follows:

Biological:

Wetlands/Floodplains

According to the VANR Natural Resources Atlas, there are class II wetlands surrounding the project area.

Rare, Threatened, and Endangered Species

There are no occurrences of R/T/E species within the project vicinity.

The USFWS IPaC mapping indicates that the project area is within the Northern Long Eared Bat's (NLEB's) habitat range. The NLEB is a federally listed threatened species. Suitable habitats for NLEB's per guidance from USFWS are: trees $\geq$ 3 inches in diameter that have holes, crevices, cracks or peeling bark. During a site visit by the VTrans Environmental Section, trees that fit this description on both sides of the road were identified. As the project moves forward, additional investigation is warranted to avoid impacts to potential roosting habitat.

Wildlife Habitat

Bridge 19-5 was identified as being a "top priority for wildlife passage" categorization for habitat and also as having "prime fish habitat" category under the AOP analysis.

Hazardous Materials:

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there are no hazardous waste sites located in the project area.

Historic:

Bridge 19-5 is not historic and there are no other historic resources in the project area.

Archaeological:

There are no archaeological resources within the project area.

Stormwater:

There are no stormwater concerns for this project.

II. Safety

The project area is not in a high crash area. There have been no recorded crashes within the project area in the last five-year period.

III. Alternatives Discussion

No Action

The culvert is in poor condition. The culvert has heavy rust scaling, pitting and large perforations scattered along the barrel invert throughout the structure. Something will have to be done to improve this culvert in the near future. In the interest of safety to the traveling public, the No Action alternative is not recommended. No cost estimate has been provided for this alternative since there are no immediate costs.

Rehabilitation

This alternative involves the rehabilitation of the existing corrugated galvanized metal plate pipe arch. The culvert is in poor condition, however, there is very little settlement or displacement, and the culvert maintains its shape making rehabilitation feasible at this location. While the existing structure meets the minimum bankfull width requirements, any rehabilitation option that reduces the opening by more than 3-inches will not meet the minimum standard. Additionally, the current structure does not meet minimum Aquatic Organism Passage (AOP) standards due to the drop at the outlet. As such, any rehabilitation option would need to include several downstream weirs to backwater the culvert and baffles placed throughout the structure.

Rehabilitation options considered:

a: Invert Repair
b: Pipe Liner
c: Spray on Liner

All rehabilitation options would employ the use of hydroblasting or hydrodemolition to appropriately clean the existing pipe interior prior to rehabilitation. In addition to cleaning, some

grouting would be needed to plug holes in the pipe and fill all voids on the outside of the pipe. The new interior pipe dimension may have a substandard bankfull width. Curing in dry conditions would be required in most cases, necessitating a re-routing of the stream flow during the work and for a prescribed curing period (usually 24 hours). A headwall with beveled inlets would be recommended for all rehabilitation alternatives.

a. Invert Repair
   This option involves removal of the degraded invert and pouring a 2-inch to 3-inch-thick section of concrete in its place. This option would have the least impact to the hydraulic capacity of the existing culvert. While this option is a good solution to the current degradation of the culvert invert, it adds little structural stability to the current structure. There is evidence that crushing is beginning to occur, and as such, an invert repair would only extend the life an additional 10 to 15 years.

b. Pipe Liner:
   A pipe liner involves inserting a culvert liner into the existing culvert, and grouting between the two. The outside diameter of the pipe used for slip lining is generally specified to be approximately 1-foot smaller than the inside diameter of the host pipe in order to be able to push the liner through and to allow the grout to be injected into the annular space between the two pipes. Since the existing pipe is an arch, a liner would also be an arch in order to maximize the span. A Liner would have an approximate 7.25-foot span and 5.25-foot rise. A liner option is anticipated to have the longest life expectancy of the rehabilitation alternatives, since the grout provides an increased structural capacity, prevents fatigue failure, stabilizes the pipe, and extends the design life by approximately 50 years.

c. Spray-On Liner
   Spray-On liners provide a new rigid interior surface for the pipe and use either cementitious materials (polymer-enhanced cement mortar) or polyurea. These liners are spray applied either by hand or machine, although some users have had better quality control with hand-applied methods. Cementitious liners installed by these methods can provide full structural support, depending on thickness applied. Proper curing is essential to using spray-on liners to avoid bond failures. There could be water quality impacts associated with the application of these liners, their degree of impact related to selection of materials, and adherence to curing requirements. If a spray-on liner is selected, the polymer-enhanced cement mortar is recommended for environmental and safety reasons.

Advantages: The rehabilitation alternatives have the lowest upfront costs. A rehabilitation would have minimal impact to resources and would not interrupt traffic.

Disadvantages: The rehabilitation alternative is only a repair and not a new structure. The life span of the repair work is estimated to be 15 to 50 years. Also, the existing culvert just meets the ANR standard for bank full width, and all rehabilitation options would reduce the hydraulic opening.

Maintenance of Traffic: The rehabilitation alternative has minimal effect on traffic. Traffic will remain open during the duration of the project, except for intermittent lane closures for some construction activities.

Structure Replacement

A preliminary hydraulics site visit found that an 8-foot minimum span would be required at this location. The possible configurations for a new structure this size would be a new precast box or an open bottom precast concrete arch or frame with a 5-foot-high waterway opening and natural bottom.

Structure Replacement Using Open Cut

Culvert replacement using an open cut is considered a more cost-effective solution then trenchless methods when there is a shallow amount of fill over the culvert.

This option involves removing the existing Corrugated Galvanized Metal Plate Pipe Arch and replacing it with a new precast structure having a minimum span of 8-feet. Since there is approximately 13 feet of fill above the existing culvert, there would not be a considerable amount of earthwork. Any new structure should have flared wingwalls at the inlet and outlet to make a smooth transition between the channel and the culvert. The various considerations under this option include: the roadway width, structure type, culvert length and skew, and roadway alignment.

a. Roadway Width

The existing roadway currently has 12-foot-wide lanes and 8-foot-wide shoulders, which meets the minimum standard of 40-feet as set forth in the Vermont State Standards. Since a new 75+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 40-foot width roadway with 12-foot-wide lanes and 8-foot-wide shoulders will be proposed through the project area to meet minimum requirements.

b. Structure Type: Size, Length, and Skew

The most common structure type for the recommended hydraulic opening is a 4-sided concrete box culvert, or a 3-sided open bottom concrete structure.

It is preferred that the structure be a precast 4-sided concrete box culvert. This type of structure would provide protection against scour and undermining and would require less excavation than an open bottomed structure. Additionally, it would have a shorter construction duration compared to an opened bottom structure, since footings would not have to be placed six feet below the stream bed. Hydraulics has recommended a 7-foot rise box with the invert buried 2-feet resulting in an 8-foot x 5-foot minimum waterway opening. Preliminary borings have been drilled to 45-feet below surface with no bedrock encountered. As such, a precast box will be assumed versus a 3-sided structure.

In order to accommodate a 40-foot-wide roadway, the proposed barrel length will be approximately 135 feet long. The culvert will have a skew of 20 degrees to the roadway to match the existing skew of the channel.

c. Roadway Alignment

The existing roadway alignment meets the minimum standards as set forth by the AASHTO Green Book. As such it is recommended that the alignments remain unchanged in order to minimize impacts to surrounding resources.

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d. Maintenance of Traffic

Either an off-site detour, phased construction, or a temporary bridge would be appropriate measures for traffic control at this site.

Advantages: This alternative would address the structural deficiencies of the existing bridge, with a brand-new culvert with a 75-year design life. This option would meet the minimum hydraulic standards and minimum roadway width standards.

Disadvantages: This option has the higher upfront costs compared to the rehabilitation options.

IV. Maintenance of Traffic

The Vermont Agency of Transportation has created an Accelerated Bridge Program, which focuses on faster delivery of construction plans, permitting, and Right of Way, as well as faster construction of projects in the field. One practice that helps in this endeavor is closing bridges for portions of the construction period, rather than providing temporary bridges. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to contractors to complete projects early. The Agency will consider the closure option on most projects where rapid reconstruction or rehabilitation is feasible. The use of prefabricated elements in new bridges will also expedite construction schedules. This can apply to decks, superstructures, and substructures. Accelerated Construction should provide enhanced safety for the workers and the travelling public while maintaining project quality. The following options have been considered:

Option 1: Off-Site Detour

This option would close the bridge and reroute traffic onto an official, signed State detour utilizing VT Route 7A between exits 2 & 3. The potential State-signed detour is as follows:

- US Route 7, to VT Route 313, and VT Route 7A, back to US Route 7 (12.9 miles)

There are no local bypass routes available. However, US Route 7 through the project area is a limited access highway, with no driveways or Town Highways to maintain. Rerouting traffic onto VT Route 7A adds 3.3 miles to travel distance.

A map of the detour route can be found in Appendix M.

Advantages: Utilizing an off-site detour would eliminate the need to use a temporary bridge or phase construction to maintain traffic. This would decrease the cost and amount of time required to construct a project in this location. The impacts and amount of temporary rights required to construct a project in this location would also be reduced for this option. The safety of both construction workers and the travelling public will be improved by removing traffic from the construction site.

Disadvantages: Traffic flow would not be maintained through the project corridor during construction.

Option 2: Phased Construction

Phased construction is the maintenance of traffic on the existing bridge while building one lane at a time of the proposed structure. This allows keeping the road open during construction, while having minimal impacts to adjacent property owners and environmental resources.

While the time required to develop a phased construction project would remain the same, the time required to complete a phased construction project increases because some of the construction tasks must be performed multiple times. In addition to the increased design and construction costs mentioned above, the costs also increase for phased construction because of the inconvenience of working around traffic and the effort involved in coordinating the joints between the phases. Another negative aspect of phased construction is the decreased safety of the workers and vehicular traffic, which is caused by increasing the proximity and extending the duration that workers and moving vehicles are operating in the same confined space. Phased construction is usually considered when the benefits include reduced impacts to resources and decreased costs and development time by not requiring the purchase of additional ROW.

Based on the current traffic volumes, it is not acceptable to close one lane of traffic, and maintain one lane of traffic, both ways, with a traffic signal. However, the road is fairly wide through the project location, and by constructing a wider width through the project area, 2 lanes of traffic could be maintained. There is approximately 13 feet of vertical fill over the existing culvert, making phased construction possible.

Option 3: Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed either upstream or downstream of the existing structure. The culvert is located in a heavily wooded area, and a temporary bridge on either side would require a significant amount of tree clearing. A temporary bridge on the upstream side would require additional ROW to be acquired for placement of the temporary bridge.

Additional costs would be incurred to construct a temporary bridge next to the existing culvert, including the cost of fill and potential need for sheet piles, installation and removal of the temporary roadway/bridge and restoration of the disturbed area.

If a temporary roadway is chosen as the preferred method of traffic control, it should be a two-way bridge to accommodate the traffic volumes along with the long temporary roadway approaches that would be required at this site. The bridge is surrounded by wooded areas, both upstream and downstream. A number of trees would need to be cut down for this temporary condition. See the Temporary Bridge Layout Sheet in the Appendix.

Advantages: Traffic flow can be maintained along the US Route 7 corridor.

Disadvantages: This option would require a significant amount of tree clearing. There would be decreased safety to the workers and to vehicular traffic, because of cars driving near the construction site, and construction vehicles entering and exiting the construction site. This traffic control option would be more costly and time-consuming than an offsite detour. Additionally, a temporary bridge would have impacts on the surrounding wetlands.

V. Alternatives Summary

Based on the existing site conditions, culvert condition, and recommendations from hydraulics and others, the following alternatives are offered:

- Alternative 1: Culvert Rehabilitation with Traffic Maintained on Existing Roadway
    a. Pipe Invert
    b. Pipe Liner
    c. Spray-On Culvert Liner
- Alternative 2a: New Precast Box Culvert with Traffic Maintained on an Offsite Detour
- Alternative 2b: New Precast Box Culvert with Traffic Maintained with Phased Construction
- Alternative 2c: New Precast Box Culvert with Traffic Maintained on a Temporary Roadway

A cost evaluation for each of the alternatives is shown below.

VI. Cost Matrix[1]

Sunderland Bridge 19-5		Do Nothing	Alternative 1			Alternative 2		
			Culvert Rehabilitation			New Precast Box		
			a. Invert Repair	b. Pipe Liner	c. Spray-on	a. Offsite Detour	b. Phased Construction	c. Temporary Roadway
COST	Bridge Cost	$0	$197760	395,983	408,360	650,965	748,609	650,965
	Removal of Structure	$0	$168480	168,480	168,480	168,480	193,752	168,480
	Roadway	$0	$131716	141,697	144,172	326,451	469,273	326,451
	Maintenance of Traffic	$0	$79040	79,040	79,040	112,300	234,100	1,579,040
	Construction Costs	$0	$576996	785,200	800,052	1,258,196	1,645,735	2,724,936
	Construction Engineering & Contingencies	$0	$201949	274,820	280,018	314,549	411,434	681,234
	Accelerated Premium	$0	$0	0	0	50,328	0	0
	Total Construction Costs w CEC	$0	$778945	1,060,019	1,080,070	1,623,073	2,057,169	3,406,170
	Preliminary Engineering	$0	$200000	200,000	200,000	300,000	350,000	400,000
	Right of Way	$0	$0	0	0	0	0	0
	Total Project Costs	$0	$978945	1,260,019	1,280,070	1,923,073	2,407,169	3,806,170
	Annualized Costs	$0	65,263	25,200	64,004	25,641	32,096	50,749
SCHEDULEING	Project Development Duration	N/A	2 Years	2 Years	2 Years	2 Years	2 Years	2 Years
	Construction Duration	N/A	3 Months	3 Months	3 Months	6 Months	9 Months	9 Months
	Closure Duration (If Applicable)	N/A	N/A	N/A	N/A	14 days	N/A	N/A
ENGINEERING	Typical Section - Roadway (Feet)	40	40	40	40	40	40	40
	Typical Section - Bridge (Feet)	NA	NA	NA	NA	NA	NA	NA
	Geometric Design Criteria	No Change	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards
	Traffic Safety	No Change	Improved	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Bicycle Access	No Change	No Change	No Change	No Change	Improved	Improved	Improved
	Pedestrian Access	No Change	No Change	No Change	No Change	Improved	Improved	Improved
	Hydraulics	Meets Minimum Standards	Meets Minimum Standards	Substandard BFW	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards
	Utilities	No Change	No Change	No Change	No Change	No Change	No Change	No Change
OTHER	ROW Acquisition	No	No	No	No	No	No	No
	Road Closure	No	No	No	No	Yes	No	No
	Design Life (Years)	5-10	15	50	20	75	75	75

[1] Costs are estimates only, used for comparison purposes.

VII. Conclusion

Alternative 2a is recommended; to replace the existing culvert with a new precast concrete box while maintaining traffic on an offsite detour for 14 days.

Structure:
While the structure is less than 50 years old, it is in poor condition and does not meet AOP standards. Additionally, this location was identified as top priority for wildlife passage. As such, it is reasonable to assume that a replacement structure is needed.

The VTrans Hydraulics Section has recommended a new 4-sided box culvert with a minimum 8-foot x 7-foot opening. The culvert invert should be buried 2-feet and provide a minimum waterway opening of 8-foot span x 5-foot clear height and will include bed retention sills in the bottom of the structure per the preliminary hydraulics memo. The new culvert should also have headwalls that extend four feet below the channel bottom at the inlet and the outlet to prevent undermining.

Traffic Control:
The recommendation is to close the road for 14 days while the new culvert is being constructed. US Route 7 through the project area is a limited access highway, with no driveways or Town Highways to maintain. As such, there would be minimal extra travel distance for rerouting traffic onto VT Route 7A, which parallels US Route 7 through the project area. This detour adds 3.3 miles to the traveled distance.

Manchester Village would be affected by the increase in traffic and as such, the closure duration should be kept as short as possible. Additionally, during design, the intersections along the detour route should be evaluated to make sure that the additional traffic can be handled with no modifications.

VTrans will work with the Towns of Sunderland, Manchester, and Arlington to determine the best timing of the closure. Continuous traffic counters along US Route 7 show that traffic volumes along the corridor are the lowest in April and May and are the highest in August and October. The bridge closure should occur when traffic is at its lowest and avoid any possible community events that would have an impact on traffic.

VT Route 313 in Arlington has a low clearance bridge, which is posted for 14-feet. As such, large vehicles and super loads can't come up VT Route 7A through Bennington. These larger vehicles will need to go up through Manchester or utilize US Route 4 through New York.

A temporary bridge is not recommended here due to the high costs and need for a second temporary bridge over TH-16 (South Road) for the adjacent Bridge 19-7 project. Additionally, a temporary bridge would be in place for an entire construction season. There are super loads coming up through Route 7 including mobile homes and these wide loads would have a hard time navigating a temporary bridge.

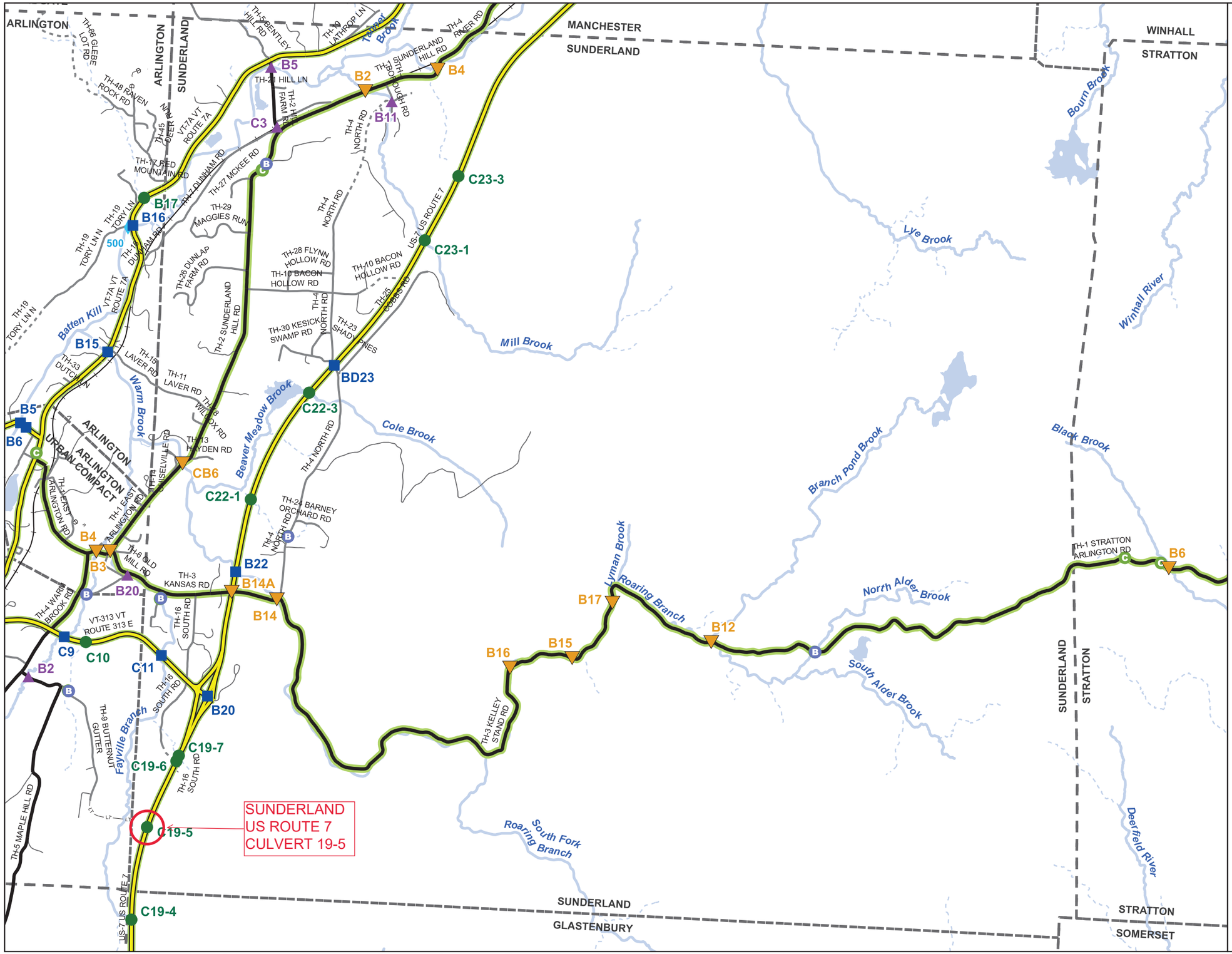
Phased construction is not recommended here as it results in reduced lanes widths of 12-feet for an entire construction season. The super loads coming up through Route 7 would not be accommodated with the reduced lane widths for phased construction.

Other Considerations:
Bridge 19-5 will be bundled with the Bridge 19-7 projects for design and construction.

VIII. Appendices

- Appendix A: Town Map
- Appendix B: Bridge Inspection Report and Site Pictures
- Appendix C: Hydraulics Memo
- Appendix D: Preliminary Geotechnical Information
- Appendix E: Crash Data
- Appendix F: Detour Map
- Appendix G: Plans

Appendix A: Town Map



Scale: 1:44,930

N

- INTERSTATE
- STATE LONG
- STATE SHORT
- TOWN LONG
- FEDERAL AID
- BIKE PATH
- INTERSTATE
- STATE HIGHWAY
- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4
- LEGAL TRAIL
- PRIVATE
- DISCONTINUED
- FEDERAL AID
- MAINTENANCE DISTRICT
- POLITICAL BOUNDARY
- VTRANS REGION BOUNDARY
- NAMED RIVER-STREAM
- UNNAMED RIVER-STREAM
- Point from Local Bridge Data *
- Point from Local Culvert Data *

* Points are from local town bridge and culvert inventories. Some points may overlap where VTrans has also conducted an inventory on the Town highway.
Data source: VOBCIT aka VTCulverts

Produced by:
Mapping Section
Division of Policy, Planning and Intermodal Development
Vermont Agency of Transportation
March 2021

SUNDERLAND

COUNTY-TOWN CODE: **0215-0**
BENNINGTON COUNTY
DISTRICT # 1
District Long Name: Bennington District
VTrans Four Region: Southwest

This map was funded in part through grants from the Federal Highway Administration, U.S. Department of Transportation. The representation of the authors expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

Appendix B: Bridge Inspection Report and Site Pictures

VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
US7 over BROOK
Team Lead: Aaron Campbell **Inspection Date:** December 13, 2021

Town: SUNDERLAND

District 1, BENNINGTON County

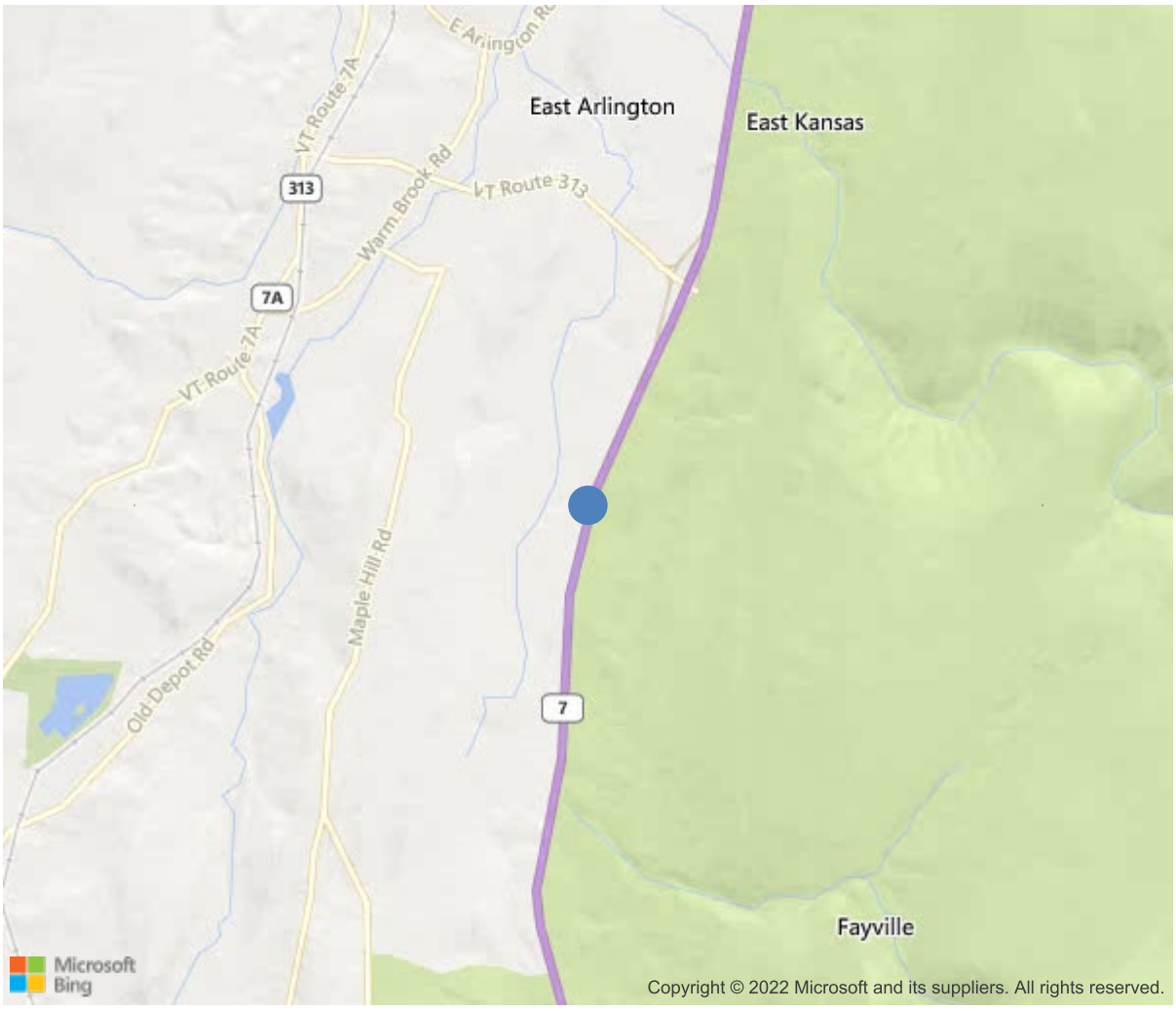
Owner: -

Maintenance Responsibility: 1-State Highway Agency

VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
US7 over BROOK
Team Lead: Aaron Campbell, **Inspection Date:** December 13, 2021

0.6 MI S EXIT 3



43.03275, -73.13794

VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
US7 over BROOK
Team Lead: Aaron Campbell, **Inspection Date:** December 13, 2021

IDENTIFICATION	
(1) State Names	Vermont
(8) Structure Number	30001919-502151
(5) Inventory Route	
(2) Highway Agency District	1
(3) County Code	3-003 - BENNINGTON
(4) Place Code	71425
(6) Features Intersected	BROOK
(7) Facility Carried	US7
(9) Location	0.6 MI S EXIT 3
(11) Mile Point	mi
(12) Base Highway Network	No
(13) LRS Inventory Rte & Subrte	
(16) Latitude	43.03275
(17) Longitude	-73.1379388888889
(98) Border Bridge State Code	
(99) Border Bridge Structure No.	
STRUCTURE TYPE AND MATERIAL	
(43) Main Structure Type	319
Material	3-Steel
Type	19-Culvert
(44) Approach Structure Type	
Material	
Type	
(45) No. of Spans in Main Unit	1
(46) No. of Approach Spans	
(107) Deck Structure Type	N-Not applicable
(108) Wearing Surface/Protective System	
Type of Wearing Surface	N-Not applicable (applies only to structur
Type of Membrane	N-Not applicable (applies only to structur
Type of Deck Protection	N-Not applicable (applies only to structur
AGE AND SERVICE	
(27) Year Built	1978
(106) Year Reconstructed	
(42) Type of Service	15
On	1-Highway
Under	5-Waterway
(28) Lane	
On	2
Under	0
(29) Average Daily Traffic	5700
(30) Year of ADT	1996
(109) Truck ADT	%
(19) Bypass, Detour Length	2 mi
GEOMETRIC DATA	
(48) Length of Maximum Span	8 ft
(49) Structure Length	8 ft
(50) Curb or Sidewalk Width	
Left	0 ft
Right	0 ft
(51) Bridge Roadway Width Curb to Curb	0 ft
(52) Deck Width Out to Out	0 ft
(32) Approach Roadway Width (W/Shoulders)	41 ft
(33) Bridge Median	0-No median
(34) Skew	19 Deg
(35) Structure Flared	
(10) Inventory Route Min Vert Clear	ft
(47) Inventory Route Total Horiz Clear	410 ft
(53) Min Vert Clear Over Bridge Rdwy	ft
(54) Min Vert Underclear	550 ft
Ref:	
(55) Min Lat Underclear RT	ft
Ref:	
(56) Min Lat Underclear LT	ft
NAVIGATION DATA	
(38) Navigation Control	-
(111) Pier Protection	-
(39) Navigation Vertical Clearance	ft
(116) Vert-Lift Bridge Nav Min Vert Clear	ft
(40) Navigation Horizontal Clearance	ft

CLASSIFICATION	
(112) NBIS Bridge Length	
(104) Highway System	
(26) Functional Class	2-Rural Principal Arterial - Oth
(100) Defense Highway	-
(101) Parallel Structure	-
(102) Direction of Traffic	
(103) Temporary Structure	
(105) Federal Lands Highways	-
(110) Designated National Network	-
(20) Toll	-
(21) Maintain	1-State Highway Agency
(22) Owner	-
(37) Historical Significance	-
CONDITION	
(58) Deck	N
(59) Superstructure	N
(60) Substructure	N
(61) Channel & Channel Protection	6
(62) Culverts	4
LOAD RATING AND POSTING	
(31) Design Load	-
(63) Operating Rating Method	
(64) Operating Rating	
Type	-
Rating	
(65) Inventory Rating Method	-
(66) Inventory Rating	
Type	1
Rating	
(70) Bridge Posting	
(41) Structure Open/Posted/Closed	-
APPRAISAL	
(67) Structural Evaluation	
(68) Deck Geometry	
(69) Clearances, Vertical/Horizontal	
(71) Waterway Adequacy	
(72) Approach Roadway Alignment	8
(36A) Bridge Railings	-
(36B) Transitions	-
(36C) Approach Guardrail	-
(36D) Approach Guardrail Ends	-
(113) Scour Critical Bridges	-
PROPOSED IMPROVEMENTS	
(75) Type of Work	
(76) Length of Structure Improvement	ft
(94) Bridge Improvement Cost	$
(95) Roadway Improvement Cost	$
(96) Total Project Cost	$
(97) Year of Improvement Cost Estimate	
(114) Future ADT	
(115) Year of Future ADT	

INSPECTIONS*			
(90) Inspection Date			12/2021
(91) Frequency			12 Months
(92) Critical Feature Inspection	Req.	Freq. (Mon)	Date
A: Fracture Critical Detail	Yes		
B: Underwater Inspection	Yes		
C: Other Special Inspection	Yes		

* The inspection date and frequency information in this box contains the current NBI date and frequency information. Please refer to the report header for the date this inspection was conducted.

VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
US7 over BROOK
Team Lead: Aaron Campbell, **Inspection Date:** December 13, 2021

Culvert

ELEM #	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
240	Steel Culvert	LF	162	0	0	162	0
1000	Corrosion	LF	162	0	0	162	0

APPROACH / DECK

72-Approach Roadway Alighment (8)
58-Deck Condition (N)

CULVERT

(62) Culvert (4)
Comment: Holes throughout invert ranging in size up to full length across invert. Piping is present throughout. Barrel continues to hold good shape with no distortion.

SUBSTRUCTURE

60-Substructure Condition (N)
Retaining/Wingwall(Good)

CHANNEL

61-Channel Condition (6)
Comment: Moderate scour hole downstream. Minor depressions in banks above pipe.

GENERAL OBSERVATION

VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
Location: 0.6 MI S EXIT 3
Inspection Date: December 13, 2021

Upstream Elevation

Upstream Channel

Large Perforations along Southern Side of Culvert Invert

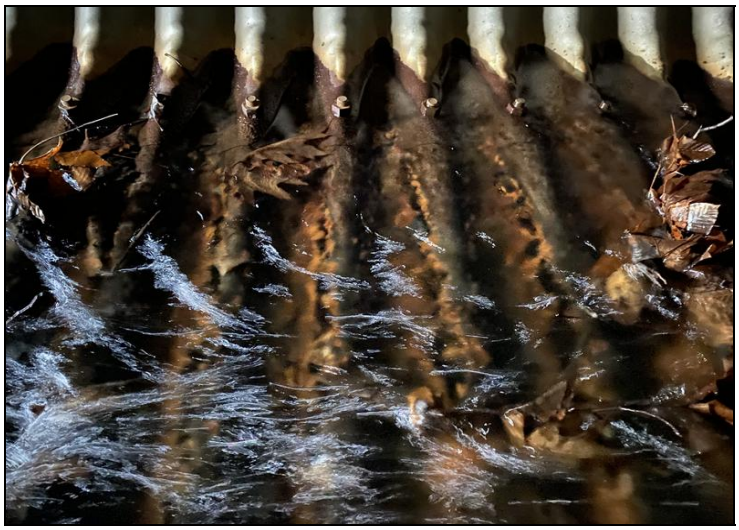
VERMONT
AGENCY OF TRANSPORTATION

Route US7
Bridge #19-5 (Routine)
Location: 0.6 MI S EXIT 3
Inspection Date: December 13, 2021

Large Perforations along Southern Side of Culvert Invert

Culvert looking Downstream

Perforations along Invert below Roadway



Perforations along Invert below Roadway

VERMONT
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Route US7
Bridge #19-5 (Routine)
Location: 0.6 MI S EXIT 3
Inspection Date: December 13, 2021

Perforations along Invert below Roadway

Culvert Looking Downstream from Below Roadway

Culvert Invert at Downstream End

Culvert from Downstream End looking Upstream

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Route US7
Bridge #19-5 (Routine)
Location: 0.6 MI S EXIT 3
Inspection Date: December 13, 2021

Culvert Invert at Downstream End

Downstream Elevation

Downstream Channel

Appendix C: Preliminary Hydraulics Memo

VERMONT

State of Vermont
Structures and Hydraulics Section
219 North Main Street
Barre, VT 05641
vtrans.vermont.gov

Agency of Transportation

TO: Laura Stone, Structures, Scoping Engineer

CC: Patrick Ross, Hydraulics Engineer

FROM: Christian Boisvert, Hydraulics Project Engineer

DATE: June 7, 2022

SUBJECT: Sunderland BM20102 pin#20B155
Sunderland, US-7 Br19-5, over Unnamed Brook
Coordinates: 43.032758, -73.13794

We have completed our hydraulic study for the above referenced site, and offer the following for your use:

In an email on 5/24/2023 ANR indicated that a minimum span of 8-ft to span bankfull width of this perennial stream is recommended for this project site.

Design Storm Flow is 2% AEP (Q50).

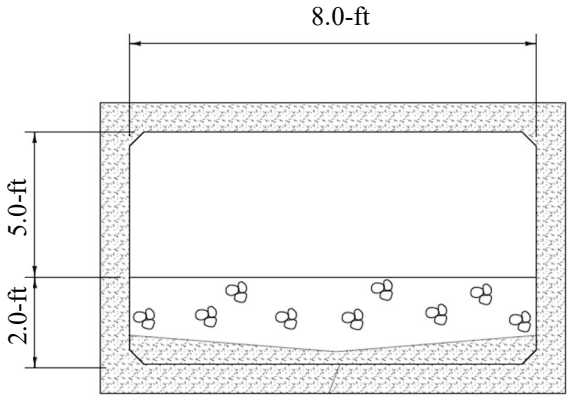
Existing Conditions: 8.2-ft Span x 5.8-ft Rise Corrugated Metal Plate Pipe Arch Culvert

- Provides a Headwater to Depth ratio (HW/D) of 0.45 and 0.50 during the design and check storm event, respectively. Headwater depths of 2.6-ft and 2.9-ft were determined during the design and check storm event, respectively.
- The existing culvert meets the current hydraulic and bankfull width standards but does not meet Aquatic Organism Passage standards.
- Invert deterioration is found throughout the culvert.

The following options were analyzed:

Proposed Replacement Option 1: Four-Sided Concrete Box (closed bottom, embedded 2-ft) 8-foot Span x 7-foot Rise

- Provides a Headwater to Depth ratio (HW/D) of 0.46 and 0.52 during the design and check storm event, respectively. Headwater depths of 2.3-ft and 2.6-ft were determined during the design and check storm event, respectively.
- Structure invert is to be buried 2-feet and provide a minimum waterway opening of 8-foot span x 5-foot clear height.
- Assumes similar skew, alignment, and slope as existing conditions.

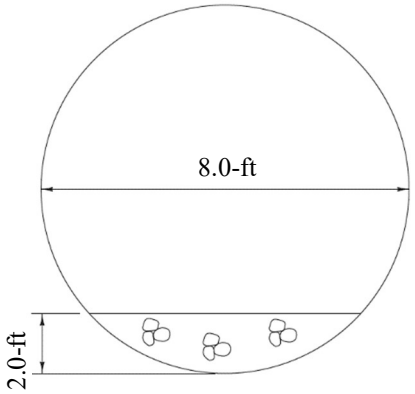


Option 1: Typical Section

VERMONT

Proposed Replacement Option 2: 8-foot Diameter Corrugated Metal Pipe (Embedded 2-feet)

- Provides a Headwater to Depth ratio (HW/D) of 0.40 and 0.46 during the design and check storm event, respectively. Headwater depths of 2.4-ft and 2.7ft were determined during the design and check storm event, respectively.
- Structure invert is to be buried 2-feet and provide a 6-foot clear height.
- Assumes similar skew, alignment, and slope as existing conditions.



Option 2: Typical Section

Proposed Rehabilitation Option 3: Poured Concrete Invert or Spray Line Repair with Fish Baffles

- This analysis assumes the existing structure would include a 6 inch thick concrete pour or spray invert repair which would provide an approximate 8.2-ft span and 5.3-ft clear height at the outlet.
- This analysis assumes installation of contoured fish baffles with a height of 6 inches at a spacing of 5-ft (32 baffles) and a downstream rock weir system will be required.
- Based on preliminary analysis, the installation of fish baffles will allow for adequate fish passage for Adult Brook Trout.
- Increases Headwater to Depth ratios (HW/D) to 0.60 and 0.69 during the design and check storm event, respectively. Headwater depths of 2.9-ft and 3.3-ft were determined during the design and check storm event, respectively.

Proposed Rehabilitation Option 4: Slip Lined with Fish Baffles

- This analysis assumes slip lining the existing culvert with an 87 inch by 63 inch metal pipe arch.
- This analysis assumes installation of contoured fish baffles with a height of 6 inches at a spacing of 5-ft (32 baffles) and a downstream rock weir system will be required.
- Based on preliminary analysis, the installation of fish baffles will allow for adequate fish passage for Adult Brook Trout.
- Provides a Headwater to Depth ratio (HW/D) of 0.61 and 0.70 during the design and check storm event, respectively. Headwater depths of 2.9-ft and 3.3-ft were determined during the design and check storm event, respectively.

Any replacement with a closed bottom should have bed retention sills added to the bottom of the structure. Sills should be V-shaped 12 inches high at the edges and 6 inches tall at the center. Sills should be spaced no more than 8 feet apart throughout the structure with one sill placed at both the inlet and the outlet.

For options 1 and 2, a minimum of E-Stone, Type II will need to be used to grade the channel through the respective structures. Stone Fill, Type II shall be used to protect any disturbed channel banks or roadway slopes at the structure's inlet and outlet.

If a rehabilitation option with AOP retrofit is chosen, hydraulics can provide a detailed analysis on hydraulic conditions to accommodate brook trout passage when a preliminary design is complete.

Other similar sized structures could be considered for this site. If another alternative is considered, coordinate with the Hydraulics Unit to perform additionally analyses.

Please contact us with any questions, or to check substructure configuration scenarios.

Appendix D: Preliminary Geotechnical Information

TECHNICAL MEMORANDUM

TO: Mr. Stephen P. Madden

FROM: Mirsad Alihodzic, EIT, Karen Roth, EIT, and Jay R. Smerekanicz, PG, CPG

SUBJECT: Summary of Geotechnical Investigation and Subsurface Conditions, Vermont Agency of Transportation, Sunderland BM 20102

DATE: June 2, 2023

WSP Project No.: 31405712.002

INTRODUCTION

WSP USA Inc., (WSP), formerly Golder Associates USA Inc. (WSP Golder), is pleased to provide the Vermont Agency of Transportation (VTrans) this Technical Memorandum summarizing our geotechnical investigation for the proposed replacement of the Bridge 19-5 Culvert carrying U.S. Route 7 over an unnamed brook in Sunderland, VT (see Figure 1). This memorandum presents a summary of the geotechnical investigation we performed in April 2023, consisting of soil geotechnical information obtained from field characterization and observations of geotechnical borings conducted at the proposed culvert replacement location, and geotechnical laboratory results of select soil samples, conducted by VTrans' geotechnical laboratory.

This Technical Memorandum constitutes the completion of Task 1 – Subsurface Investigation, Task 2 – Geotechnical Laboratory Analysis and Interpretation, and Task 3 – Technical Memorandum from our proposed scope of work under contract with VTrans.

PROJECT BACKGROUND

The existing culvert was constructed in 1978 as part of original construction of U.S. Route 7, and consists of a steel pipe arch culvert with an eight-foot span.[1] Based on the Preliminary Geotechnical Report[2] completed by VTrans, we understand that VTrans is evaluating replacement options for the existing culvert, including a reinforced concrete box culvert with new headwalls and wingwalls, and a precast or steel arch bridge with spread footings founded on soil or bedrock. To support the scoping phase, VTrans requested WSP to drill two (2) geotechnical borings within the roadway shoulders at cross corners of the existing culvert.[3]

SUBSURFACE INVESTIGATION

WSP drilled the two (2) test borings, designated B-101 and B-102, between April 10, 2023 and April 12, 2023. B-101 lies in the U.S. Route 7 shoulder closest to the southwest corner of the culvert, and B-102 lies in the U.S. Route 7 shoulder closest to the northeast corner of the culvert. The approximate as-drilled locations of the borings are shown on Figure 1. WSP subcontracted Platform Environmental Drilling and Remediation Services LLC (Platform) of Montpelier, Vermont to complete the borings. Platform drilled the borings with a Geoprobe 7822DT track-mounted drill rig. A WSP geologist monitored drilling activities, logged the subsurface conditions encountered, and obtained soil samples for use in visual description and classification. As requested by VTrans, each boring was drilled to a target depth of 45 feet below ground surface (bgs). The WSP geologist used swing-tie measurements from

[1] Vermont Agency of Transportation. December 13, 2021. Inspection Report: Bridge #19-5 (Routine), US7 over Brook.

[2] Vermont Agency of Transportation. January 4, 2023. Office Memorandum: Sunderland BM 20102 Preliminary Geotechnical Information.

[3] Vermont Agency of Transportation. January 26, 2023. Work Order Request (WOR) for Geotechnical Engineering Services, Sunderland BM 20102.

known civil site features to record the approximate as-drilled locations of the borings. The as-drilled boring locations of borings B-101 and B-102 were surveyed by VTrans early in May 2023 and provided to WSP on May 18, 2023.

Boring logs are provided in Appendix A, including details of the sampling methods used, field data obtained, soil conditions encountered during the investigation, geotechnical laboratory data, and borehole backfilling details. An explanation of the boring log symbols and terms used for the soil descriptions precedes the boring logs.

WSP delivered select soil samples to the VTrans Central Laboratory for grain size and moisture content testing on April 25, 2023. The laboratory test results are summarized in Table 1 and on the boring logs in Appendix A. Full laboratory test results are provided in Appendix B.

SUBSURFACE CONDITIONS

Soils encountered during our subsurface investigation include: fill materials placed during construction of U.S. Route 7; sand and silt interpreted as fluvial terrace deposits; and gravel and sand interpreted as glacial till. The borings were drilled to the target depth of 45 feet and did not encounter bedrock. The following descriptions summarize the major stratigraphic units and groundwater conditions encountered.

Pavement: Asphalt pavement thickness of 6 inches was encountered in each boring.

Fill: A two-foot thick nested cobble zone, interpreted as aggregate subbase, was encountered directly below the asphalt in each boring.

Fluvial Terrace Deposits: A layer interpreted as fluvial terrace deposits[4] was encountered beneath the fill in each boring. In boring B-101, this layer generally consists of medium dense to very dense gravelly sand with some silt. In boring B-102, the layer generally consists of medium dense to dense silt with some gravel and some sand; a zone of loose sand was noted near the bottom of the layer. The fluvial terrace deposit thickness ranges from approximately 13 feet in B-101 to approximately 18 feet in B-102.

Glacial Till: A layer interpreted as glacial till[4] was encountered beneath the fluvial terrace deposits in each boring. The layer generally consists of medium dense to very dense gravel with some sand and some silt, and dense to very dense sand with some gravel and some silt. The glacial till thickness ranges from at least 25 feet in B-102 to at least 30 feet in B-101. Both borings terminated within the glacial till layer.

Groundwater: WSP measured groundwater levels in boring B-101 during drilling and in boring B-102 upon completion of the hole. Measurements were made with temporary steel casing in the ground. Groundwater levels were measured as 13.6 feet bgs in B-101 and 10.8 feet bgs in B-102. We note that groundwater levels will vary seasonally from those measured.

CLOSING

WSP prepared this Technical Memorandum for the exclusive use of VTrans for specific application to the replacement of Bridge 19-5 Culvert carrying U.S. Route 7 in Sunderland, Vermont. We performed the geotechnical site investigation and compiled our subsurface interpretations in accordance with generally accepted soil and foundation engineering practices in this geographical area and under similar time and financial constraints. Our interpretations are based, in part, on information obtained from the referenced subsurface explorations completed at the discrete locations described in the memorandum. Variations in the nature and extent of subsurface conditions between explorations should be expected. WSP makes no other warranty, either express or implied.

The professional services provided by WSP for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous activities or

[4] DeSimone, David. 2000. Surficial Geologic Map of the Arlington and Vermont Portion of the Shushan Quadrangles. Vermont Geological Survey Open-File Report VG00-2. Map Scale 1:24,000.

uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this report and have not been investigated or addressed.

WSP appreciates the opportunity to provide our geotechnical services to VTrans for this project. Please contact us if you have any questions.

Sincerely,

WSP USA Inc.

Mirsad Alihodzic
Senior Consultant, Geotechnical Engineer

Jay R. Smerekanicz PG, CPG
Engineering Geologist, Technical Principal, Vice President

Attachments: Table 1: Summary of Soil Index and Classification Laboratory Testing Results
Figure 1: Boring Location Plan
Appendix A: Boring Logs
Appendix B: Laboratory Testing Results

Table

Table 1: Summary of Soil Index and Classification Laboratory Testing Results
Bridge 19-5 Culvert carrying U.S. Route 7 over Unnamed Brook
Sunderland BM 20102

Test Boring Designation[1]	Ground Surface Elevation[2] (feet)	Sample Number	Sample Depth Below Ground Surface (feet)	Approximate Sample Elevation (feet)	Laboratory Testing[3]		Soil Classification	
					Sieve Minus No. 200[4] (%)	Moisture Content[5] (%)	AASHTO	USCS
B-101	944.54	S-2	10.0 - 12.0	934.54 - 932.54	20.2	10.6	A-1-b	SM
		S-4	20.0 - 22.0	924.54 - 922.54	24.9	10.7	A-1-b	SM
		S-6	30.0 - 32.0	914.54 - 912.54	31.2	10.1	A-2-4	SM
		S-7	35.0 - 37.0	909.54 - 907.54	20.5	8.4	A-1-b	GM
		S-8	40.0 - 42.0	904.54 - 902.54	35.1	11.2	A-4	SM
B-102	942.45	S-1	5.0 - 7.0	937.45 - 935.45	36.9	12.6	A-4	SM
		S-3	15.0 - 17.0	927.45 - 925.45	19.0	17.2	A-2-4	SM
		S-5	25.0 - 27.0	917.45 - 915.45	26.1	10.8	A-2-4	SM
		S-7	35.0 - 37.0	907.45 - 905.45	32.3	9.3	A-2-4	GM
		S-8	43.0 - 45.0	899.45 - 897.45	32.6	10.6	A-2-4	SM

Notes:
1. Test boring locations are shown on Figure 1 - Boring Location Plan.
2. As-drilled boring elevations were provided to WSP by VTrans on May 18, 2023.
3. Laboratory testing was performed by the VTrans Central Laboratory in Berlin, VT.
4. Grain size testing was performed in accordance with AASHTO T-88, Standard Method of Test for Particle Size Analysis of Soils.
5. Moisture content testing was performed in accordance with AASHTO T-265, Standard Method of Test for Laboratory Determination of Moisture Content of Soils.

Prepared by: KAR
Checked by: FCT
Reviewed by: JRS

Figure

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

N
VT STATE PLANE GRID

920'
930'
940'

PI 25+06.73

DELINEATOR

HVCTRL #2

BORING 130

US ROUTE 7
TO GLASTONBURY

US ROUTE 7
TO MANCHESTER

0
23+00
24+00
25+00
26+00
27+00
28+00

BORING 125

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH
M. HEMLOCK
HVCTRL #3
M. OAK
M. HEMLOCK

ROW MONUMENT

BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

EXISTING CONDITIONS

SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Existing.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
EXISTING CONDITIONS LAYCUT	SHEET 1 OF 19

Appendix A

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Moisture (dry, damp, moist, wet, saturated)
Density/Consistency (from above right hand side)
Name (sand, silty sand, clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc., if applicable)
Cementation (weak, moderate, or strong, if applicable, ASTM D 2488)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation
Groundwater level

wsp

Key to Soil and Rock Descriptions
Including Boring Log Terms and
Field Identification Information

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Consistency is rated according to standard penetration resistance.

Modified Burmister System

Descriptive Term	Portion of Total
trace	0% - 10%
little	11% - 20%
some	21% - 35%
adjective (e.g. sandy, clayey)	36% - 50%

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value blows per foot	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily Penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* > 100 mm}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Correlation of RQD to Rock Mass Quality

Rock Mass Quality	RQD
Very Poor	<25%
Poor	26% - 50%
Fair	51% - 75%
Good	76% - 90%
Excellent	91% - 100%

Desired Rock Observations: (in this order)

Color (Geological Society of America Rock Color Chart)
Texture (aphanitic, fine-grained, etc.)
Strength (ISRM Classification per Table A-2)
Lithology (igneous, sedimentary, metamorphic, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -tightness (tight, open or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock mass quality (very poor, poor, etc.)
ref: AASHTO Standard Specification for Highway Bridges 17th Ed. Table 4.4.8.1.2A
Recovery

Sample Container Labeling Requirements:

Project Name / Town	Blow Counts
Boring Number	Sample Recovery
Sample Number	Date
Sample Depth	Personnel Initials

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

Sunderland
BM 20102
Bridge 19-5 Culvert US Route 7

Boring No.: **B-101**
Page No.: 1 of 2
Pin No.: 20b155
Checked By: MA

Boring Crew: Michael Jordan (Platform), Kaitlin Berube (WSP)
Date Started: 4/10/23 Date Finished: 4/11/23
VTSPG NAD83: N 194749.34 ft E 1469816.28 ft
Station: 25+20 Offset: 17.5 ft L
Ground Elevation: 944.54 ft

	Casing	Sampler
Type:	HSA & WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	140 lb.	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Auto/NWJ	
Rig:	Geoprobe 7822DT	C_E = 1.68

Groundwater Observations

Date	Depth (ft)	Notes
04/11/23	13.6	8:45 AM (AD 16hrs)

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 2.5 ft, Nested cobble zone					
5		5.0 ft - 7.0 ft, A-1-b, SM, reddish-brown, dry, medium dense gravelly fine to coarse SAND, some silt, well-graded., Rec. = 1.1 ft	1-7-8-6 (15)				
10		10.0 ft - 12.0 ft, A-1-b, SM, reddish-brown, dry, very dense gravelly fine to coarse SAND, some silt, well-graded., Rec. = 1.0 ft	70-44-30-20 (74)	10.6	38.8	41.0	20.2
15		15.0 ft - 17.0 ft, A-1-b, SM, reddish-brown, moist, dense gravelly fine to coarse SAND, some silt, well-graded., Rec. = 0.5 ft	8-11-35-39 (46)				
20		20.0 ft - 22.0 ft, A-1-b, SM, reddish-brown, moist, medium dense GRAVEL, some sand, some silt, well-graded., Rec. = 0.8 ft	17-13-9-7 (22)	10.7	41.3	33.8	24.9
25		25.0 ft - 27.0 ft, A-1-b, SM, reddish-brown, moist, medium dense GRAVEL, some sand, some silt, well-graded., Rec. = 0.8 ft	15-11-10-10 (21)				
		27.0 ft - 28.0 ft, During boring advancement driller used a roller bit to advance through a boulder from approximately 27 feet to 28 feet bgs.					
30		30.0 ft - 32.0 ft, A-2-4, SM, reddish-brown, moist to wet, medium dense GRAVEL, some sand, some silt., Rec. = 0.85 ft	16-10-17-28 (27)	10.1	38.4	30.4	31.2

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

BORING LOG 31405712.002 VTRANS SUNDERLAND (1).GPJ VERMONT AOT.GDT 6/2/23

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

Sunderland
BM 20102
Bridge 19-5 Culvert US Route 7

Boring No.: **B-101**
Page No.: 2 of 2
Pin No.: 20b155
Checked By: MA

Boring Crew: Michael Jordan (Platform), Kaitlin Berube (WSP)
Date Started: 4/10/23 Date Finished: 4/11/23
VTSPG NAD83: N 194749.34 ft E 1469816.28 ft
Station: 25+20 Offset: 17.5 ft L
Ground Elevation: 944.54 ft

	Casing	Sampler
Type:	HSA & WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	140 lb.	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Auto/NWJ	
Rig:	Geoprobe 7822DT	C_E = 1.68

Groundwater Observations

Date	Depth (ft)	Notes
04/11/23	13.6	8:45 AM (AD 16hrs)

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
35		35.0 ft - 37.0 ft, A-1-b, GM, reddish-brown, moist to wet, very dense, GRAVEL, some sand, some silt., Rec. = 0.55 ft	46-47-43-44 (90)	8.4	51.8	27.7	20.5
40		40.0 ft - 41.75 ft, A-4, SM, reddish-brown, dry, very dense, GRAVEL, some sand, some silt., Rec. = 0.8 ft	114-48-76-50/3" (124)	11.2	37.1	27.8	35.1
		42.0 ft - 45.0 ft, Roller bit and casing refusal at 42 ft bgs. Advanced core barrel through cobbles and boulders 42 to 45 ft bgs.					
45		Hole stopped @ 45.0 ft Boring backfilled with drill cuttings.					
50							
55							
60							

Remarks:
- Groundwater level recorded 16 hours after drilling (AD), at the time the groundwater level was recorded the steel casing was advanced 25 feet below the ground surface (bgs).
- AASHTO and USCS classifications are based on visual description of sample recovery at depths where lab testing not performed.
- Boring was backfilled with drill cuttings and capped with cold-patch asphalt to the existing ground surface by Platform.
- Boring coordinates and elevation were provided to WSP by VTrans on 5/18/2023.

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
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CENTRAL LABORATORY

BORING LOG

Sunderland
BM 20102
Bridge 19-5 Culvert US Route 7

Boring No.: **B-102**
Page No.: 1 of 2
Pin No.: 20b155
Checked By: MA

Boring Crew: Michael Jordan (Platform), Kaitlin Berube (WSP)
Date Started: 4/12/23 Date Finished: 4/12/23
VTSPG NAD83: N 194771.67 ft E 1469865.12 ft
Station: 25+30 Offset: 20 ft R
Ground Elevation: 942.45 ft

	Casing	Sampler
Type:	HSA & WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	140 lb.	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Auto/NWJ	
Rig:	Geoprobe 7822DT	C_E = 1.68

Groundwater Observations

Date	Depth (ft)	Notes
04/12/23	10.8	4:40 PM (ATD 3 min)

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		0.0 ft - 0.5 ft, Asphalt					
		0.5 ft - 2.5 ft, Nested cobble zone					
5		5.0 ft - 7.0 ft, A-4, SM, reddish-brown, moist, medium dense, SILT, some gravel, some sand, Rec. = 1.0 ft	5-8-7-10 (15)	12.6	30.9	32.2	36.9
10		10.0 ft - 12.0 ft, A-4, SM, reddish-brown, dry to moist, dense, SILT, some gravel, some sand, Rec. = 1.5 ft	39-15-18-25 (33)				
		14.0 ft, Driller switched from hollow stem augers to drive and wash.					
15		15.0 ft - 17.0 ft, A-2-4, SM, brownish-grey, moist, loose, SAND, little silt, trace gravel, Rec. = 0.3 ft	5-3-2-5 (5)	17.2	8.9	72.1	19.0
20		20.0 ft - 22.0 ft, A-2-4, GP-GM, reddish-brown, moist, very dense,SAND, some gravel, some silt, Rec. = 0.45 ft	19-34-29-18 (63)				
25		25.0 ft - 27.0 ft, A-2-4, SM, reddish-brown, moist, dense, SAND, some gravel, some silt, Rec. = 0.65 ft	36-16-15-13 (31)	10.8	34.4	39.5	26.1
		29.0 ft, During boring advancement driller noted gravel in the wash water from approximately 29 feet to 30 feet below ground surface (bgs).					
30		30.0 ft - 31.25 ft, A-2-4, GP-GM, reddish-brown, wet, very dense, GRAVEL, trace sand, trace silt, trace quartzite pieces, Rec. = 0.5 ft	30-45-50/3" (R)				

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

STATE OF VERMONT
AGENCY OF TRANSPORTATION
CONSTRUCTION AND
MATERIALS BUREAU
CENTRAL LABORATORY

BORING LOG

Sunderland
BM 20102
Bridge 19-5 Culvert US Route 7

Boring No.: **B-102**
Page No.: 2 of 2
Pin No.: 20b155
Checked By: MA

Boring Crew: Michael Jordan (Platform), Kaitlin Berube (WSP)
Date Started: 4/12/23 Date Finished: 4/12/23
VTSPG NAD83: N 194771.67 ft E 1469865.12 ft
Station: 25+30 Offset: 20 ft R
Ground Elevation: 942.45 ft

	Casing	Sampler
Type:	HSA & WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	140 lb.	140 lb.
Hammer Fall:	30 in.	30 in.
Hammer/Rod Type:	Auto/NWJ	
Rig:	Geoprobe 7822DT	C_E = 1.68

Groundwater Observations

Date	Depth (ft)	Notes
04/12/23	10.8	4:40 PM (ATD 3 min)

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
35		35.0 ft - 37.0 ft, A-2-4, GM, reddish-brown, moist, very dense, GRAVEL, some sand, some silt, well-graded, Rec. = 0.9 ft	21-64-49-20 (113)	9.3	39.8	27.9	32.3
		38.0 ft - 40.0 ft, During boring advancement driller used a roller bit to advance through a cobble zone from approximately 38 feet to 40 feet bgs.					
40							
		43.0 ft - 45.0 ft, A-2-4, SM, reddish-brown, dry, very dense, GRAVEL, some sand, some silt, well-graded, Rec. = 1.0 ft	12-86-42-37 (128)	10.6	35.1	32.3	32.6
45		Hole stopped @ 45.0 ft Boring backfilled with drill cuttings.					
50							
55							
60							

Remarks:
- Groundwater level recorded 3 minutes after drilling (AD), at the time the groundwater level was recorded the steel casing was advanced 43 feet below the ground surface (bgs).
- AASHTO and USCS classifications are based on visual description of sample recovery at depths where lab testing not performed.
- Boring was backfilled with drill cuttings and capped with cold-patch asphalt to the existing ground surface by Platform.
- Boring coordinates and elevation were provided to WSP by VTrans on 5/18/2023.

Notes:
1. Stratification lines represent approximate boundary between material types. Transition may be gradual.
2. N Values have not been corrected for hammer energy. C_E is the hammer energy correction factor.
3. Water level readings have been made at times and under conditions stated. Fluctuations may occur due to other factors than those present at the time measurements were made.

Appendix B

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 133 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-101 **Depth:** 10 ft **to:** 12 ft **Examined For:** Class

Field Description: Silty Sand trace Gr, Moist, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		684.1		
75mm	**3in**	0.0	684.1	100.0
37.5mm	**1.5in**	0.0	684.1	100.0
19mm	**3/4in**	0.0	684.1	100.0
9.5mm	**3/8in**	75.4	608.7	89.0
4.75mm	**No.4**	82.5	526.2	76.9
Reduced	**4.75mm**	213.9		
2.00mm	**No.10**	43.6	170.3	61.2
850um	**No.20**	25.7	144.6	52.0
425um	**No.40**	17.7	126.9	45.6
250um	**No.60**	13.7	113.2	40.7
150um	**No.100**	15.0	98.2	35.3
75um	**No.200**	42.1	56.1	20.2
<75um	**<No.200**			

T-265 Moisture Content

Mass of can and WET SOIL: 1030.17 g
Mass of can and DRY SOIL: 957.35 g
Mass of can: 273.27 g
Moisture content: 10.6 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 38.8 %
Sa: 41.1 %
Si: 20.2 %
100.0 %

M145: AASHTO Class: A-1-b
D2487: Soil Description: SiGrSa

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 134 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-101 **Depth:** 20 ft **to:** 22 ft **Examined For:** Class

Field Description: Silty Gr well graded, Moist, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		503.3		
75mm	3in	0.0	503.3	100.0
37.5mm	1.5in	0.0	503.3	100.0
19mm	3/4in	66.5	436.8	86.8
9.5mm	3/8in	29.3	407.5	81.0
4.75mm	No.4	82.9	324.6	64.5
Reduced	4.75mm	261.3		
2.00mm	No.10	23.6	237.7	58.7
850um	No.20	24.1	213.6	52.7
425um	No.40	22.2	191.4	47.2
250um	No.60	18.0	173.4	42.8
150um	No.100	21.8	151.6	37.4
75um	No.200	50.8	100.8	24.9
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL:	826.70	g
Mass of can and DRY SOIL:	772.61	g
Mass of can:	269.33	g
Moisture content:	10.7	%

T-90 PL = **PI =** 0

T-89 LL =

Gr: 41.3 %

Sa: 33.8 %

Si: 24.9 %

100.0 %

M145: AASHTO Class: A-1-b

D2487: Soil Description: SiSaGr

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 135 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-101 **Depth:** 30 ft **to:** 32 ft **Examined For:** Class

Field Description: Silty Sand trace Gr, MTW, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		649.7		
75mm	3in	0.0	649.7	100.0
37.5mm	1.5in	0.0	649.7	100.0
19mm	3/4in	39.5	610.2	93.9
9.5mm	3/8in	70.1	540.1	83.1
4.75mm	No.4	95.1	445.0	68.5
Reduced	4.75mm	257.3		
2.00mm	No.10	25.8	231.5	61.6
850um	No.20	26.0	205.5	54.7
425um	No.40	18.0	187.5	49.9
250um	No.60	13.0	174.5	46.5
150um	No.100	14.0	160.5	42.7
75um	No.200	43.4	117.1	31.2
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL:	986.11	g
Mass of can and DRY SOIL:	920.17	g
Mass of can:	270.44	g
Moisture content:	10.1	%

T-90 PL = **PI =** 0

T-89 LL =

Gr: 38.4 %

Sa: 30.5 %

Si: 31.2 %

100.0 %

M145: AASHTO Class: A-2-4

D2487: Soil Description: SaSiGr

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 136 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-101 **Depth:** 35 ft **to:** 37 ft **Examined For:** Class

Field Description: Sandy Gr trace Silt, MTW, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		404.6		
75mm	3in	0.0	404.6	100.0
37.5mm	1.5in	0.0	404.6	100.0
19mm	3/4in	37.1	367.5	90.8
9.5mm	3/8in	51.8	315.7	78.0
4.75mm	No.4	88.8	226.9	56.1
Reduced	4.75mm	225.8		
2.00mm	No.10	31.8	194.0	48.2
850um	No.20	21.9	172.1	42.7
425um	No.40	16.7	155.4	38.6
250um	No.60	14.1	141.3	35.1
150um	No.100	17.0	124.3	30.9
75um	No.200	41.6	82.7	20.5
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL: 710.15 g
Mass of can and DRY SOIL: 676.33 g
Mass of can: 271.74 g
Moisture content: 8.4 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 51.8 %
Sa: 27.6 %
Si: 20.5 %
100.0 %

M145: AASHTO Class: A-1-b
D2487: Soil Description: SiSaGr

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 137 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-101 **Depth:** 40 ft **to:** 42 ft **Examined For:** Class

Field Description: Silty Sand trace Gr, Dry, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		697.5		
75mm	3in	0.0	697.5	100.0
37.5mm	1.5in	0.0	697.5	100.0
19mm	3/4in	67.2	630.3	90.4
9.5mm	3/8in	57.5	572.8	82.1
4.75mm	No.4	99.6	473.2	67.8
Reduced	4.75mm	313.0		
2.00mm	No.10	22.6	290.4	62.9
850um	No.20	21.0	269.4	58.4
425um	No.40	18.3	251.1	54.4
250um	No.60	14.9	236.2	51.2
150um	No.100	17.2	219.0	47.5
75um	No.200	57.2	161.8	35.1
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL: 1047.08 g
Mass of can and DRY SOIL: 968.66 g
Mass of can: 271.17 g
Moisture content: 11.2 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 37.1 %
Sa: 27.9 %
Si: 35.1 %
100.0 %

M145: AASHTO Class: A-4
D2487: Soil Description: SaGrSi

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 138 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-102 **Depth:** 5 ft **to:** 7 ft **Examined For:** Class

Field Description: Silty Sand trace Gr, Moist, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		640.6		
75mm	**3in**	0.0	640.6	100.0
37.5mm	**1.5in**	0.0	640.6	100.0
19mm	**3/4in**	107.2	533.4	83.3
9.5mm	**3/8in**	18.2	515.2	80.4
4.75mm	**No.4**	53.4	461.8	72.1
Reduced	**4.75mm**	213.8		
2.00mm	**No.10**	8.8	205.0	69.1
850um	**No.20**	9.1	195.9	66.1
425um	**No.40**	11.2	184.7	62.3
250um	**No.60**	11.1	173.6	58.5
150um	**No.100**	15.4	158.2	53.3
75um	**No.200**	48.7	109.5	36.9
<75um	**<No.200**			

T-265 Moisture Content

Mass of can and WET SOIL: 992.88 g
Mass of can and DRY SOIL: 912.23 g
Mass of can: 271.62 g
Moisture content: 12.6 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 30.9 %
Sa: 32.2 %
Si: 36.9 %
100.0 %

M145: AASHTO Class: A-4
D2487: Soil Description: GrSaSi

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 139 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-102 **Depth:** 15 ft **to:** 17 ft **Examined For:** Class

Field Description: Sand poorly graded, Moist, gry/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		106.6		
75mm	3in	0.0	106.6	100.0
37.5mm	1.5in	0.0	106.6	100.0
19mm	3/4in	0.0	106.6	100.0
9.5mm	3/8in	0.0	106.6	100.0
4.75mm	No.4	2.9	103.7	97.3
Reduced	4.75mm	103.3		
2.00mm	No.10	6.6	96.7	91.1
850um	No.20	9.5	87.2	82.1
425um	No.40	13.1	74.1	69.8
250um	No.60	13.0	61.1	57.5
150um	No.100	13.8	47.3	44.5
75um	No.200	27.1	20.2	19.0
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL: 394.33 g
Mass of can and DRY SOIL: 375.95 g
Mass of can: 269.32 g
Moisture content: 17.2 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 8.9 %
Sa: 72.0 %
Si: 19.0 %
100.0 %

M145: AASHTO Class: A-2-4
D2487: Soil Description: Sa

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 140 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-102 **Depth:** 25 ft **to:** 27 ft **Examined For:** Class

Field Description: Silty Sand trace Gr, Moist, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		412.7		
75mm	**3in**	0.0	412.7	100.0
37.5mm	**1.5in**	0.0	412.7	100.0
19mm	**3/4in**	46.8	365.9	88.7
9.5mm	**3/8in**	31.7	334.2	81.0
4.75mm	**No.4**	38.9	295.3	71.6
Reduced	**4.75mm**	294.4		
2.00mm	**No.10**	24.6	269.8	65.6
850um	**No.20**	25.8	244.0	59.3
425um	**No.40**	23.7	220.3	53.5
250um	**No.60**	20.5	199.8	48.6
150um	**No.100**	28.5	171.3	41.6
75um	**No.200**	63.9	107.4	26.1
<75um	**<No.200**			

T-265 Moisture Content

Mass of can and WET SOIL: 730.60 g
Mass of can and DRY SOIL: 686.06 g
Mass of can: 273.33 g
Moisture content: 10.8 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 34.4 %
Sa: 39.5 %
Si: 26.1 %
100.0 %

M145: AASHTO Class: A-2-4
D2487: Soil Description: SiGrSa

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 141 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-102 **Depth:** 33 ft **to:** 37 ft **Examined For:** Class

Field Description: Sandy Gr well graded, Moist, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		385.8		
75mm	3in	0.0	385.8	100.0
37.5mm	1.5in	0.0	385.8	100.0
19mm	3/4in	38.1	347.7	90.1
9.5mm	3/8in	20.3	327.4	84.9
4.75mm	No.4	74.3	253.1	65.6
Reduced	4.75mm	251.9		
2.00mm	No.10	20.8	231.1	60.2
850um	No.20	21.2	209.9	54.7
425um	No.40	17.1	192.8	50.2
250um	No.60	12.4	180.4	47.0
150um	No.100	12.8	167.6	43.7
75um	No.200	43.5	124.1	32.3
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL: 532.06 g
Mass of can and DRY SOIL: 496.23 g
Mass of can: 110.41 g
Moisture content: 9.3 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 39.8 %
Sa: 27.9 %
Si: 32.3 %
100.0 %

M145: AASHTO Class: A-2-4
D2487: Soil Description: SaSiGr

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

State of Vermont
Agency of Transportation
Construction and Materials Bureau
Central Laboratory

Report on Soil Sample

Lab Number: E21 142 **Report Date:** 4/25/2023

Project: Sunderland BM 20102 **Site:** **Tested By:** B. Fletcher

Date Sampled: 4 / 10 / 23 **Date Received:** 4 / 17 / 23 **Date Tested:** 4 / 19 / 23

Station: 0 + 0 **Offset:** 0 **Hole:** B-102 **Depth:** 43 ft **to:** 45 ft **Examined For:** Class

Field Description: Sandy Gr well graded, Dry, red/brn **Submitted By:** KMB **Sample Type:** SS

Test Results

T-88 Sieve Analysis

	TOTAL:	Wt Retained	Wt Passing	% Passing
		637.3		
75mm	3in	0.0	637.3	100.0
37.5mm	1.5in	0.0	637.3	100.0
19mm	3/4in	21.2	616.1	96.7
9.5mm	3/8in	35.8	580.3	91.1
4.75mm	No.4	107.6	472.7	74.2
Reduced	4.75mm	235.5		
2.00mm	No.10	29.3	206.2	64.9
850um	No.20	23.6	182.6	57.5
425um	No.40	18.2	164.4	51.8
250um	No.60	13.1	151.3	47.7
150um	No.100	14.7	136.6	43.0
75um	No.200	33.1	103.5	32.6
<75um	<No.200			

T-265 Moisture Content

Mass of can and WET SOIL: 814.00 g
Mass of can and DRY SOIL: 746.31 g
Mass of can: 109.05 g
Moisture content: 10.6 %

T-90 PL = **PI =** 0
T-89 LL =

Gr: 35.1 %
Sa: 32.3 %
Si: 32.6 %
100.0 %

M145: AASHTO Class: A-2-4
D2487: Soil Description: SaSiGr

Comments: 0

Reviewed By: Stephen Madden, Geotechnical Engineer

Appendix E: Crash Data

Vermont Agency of Transportation

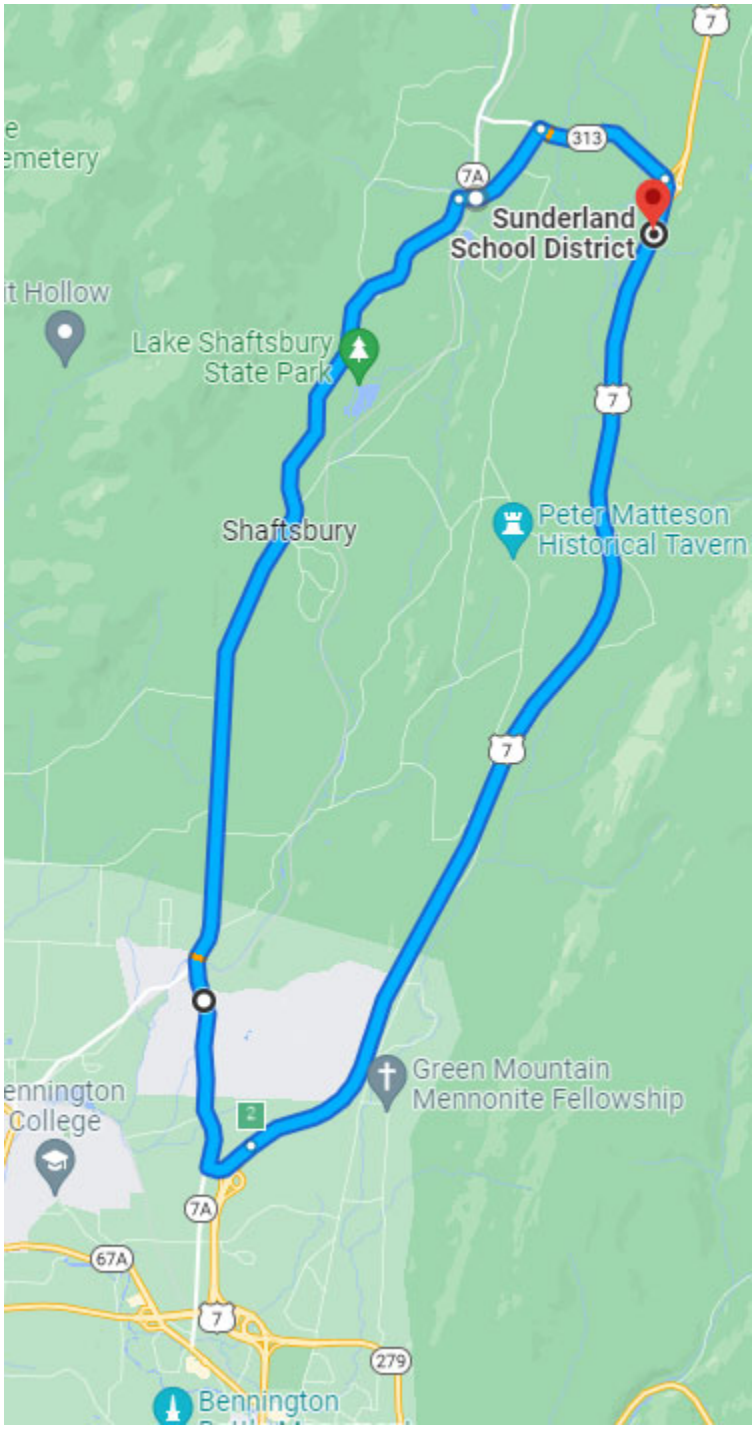
General Yearly Summaries - Crash Listing: State Highways and All Federal Aid Highway Systems

From 01/01/11 To 12/31/15 General Yearly Summaries Information

*	Reporting Agency/ Number	Town	Mile Marker	Date MM/DD/YY	Time	Weather	Contributing Circumstances	Direction Of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Direction	Road Group
Route: US-7 Continued ...													
	VTVSP0900/12C30 1984	Shaftsbury	1.25	07/10/2012	09:56	Clear	Failure to keep in proper lane, Under the influence of medication/drugs/alcohol	Other - Explain in Narrative	1	0	0		SH
	VTVSP0900/11C30 2440	Shaftsbury	1.3	10/27/2011	22:59	Snow	Driving too fast for conditions	Single Vehicle Crash	0	0	0	N	SH
	VTVSP0900/15C30 2589	Shaftsbury	1.71	08/18/2015	12:21	Clear	Operating defective equipment, No improper driving	Other - Explain in Narrative	0	0	0	N	SH
	VTVSP0900/15C30 0788	Shaftsbury	2.52	03/14/2015	16:00	Rain	Inattention, Failure to keep in proper lane, No improper driving	Opp Direction Sideswipe	1	0	0	N	SH
	VTVSP0900/15C30 3216	Shaftsbury	2.65	10/11/2015	20:03				0	0	0		SH
	VTVSP0900/15C30 3813	Shaftsbury	2.79	12/07/2015	18:50	Clear	No improper driving	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/11C30 3091	Shaftsbury	4.51	12/28/2011	06:59	Rain	Other improper action	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/12C30 3765	Glastenbury	0.77	12/16/2012	06:27	Cloudy	Failure to keep in proper lane, Fatigued, asleep	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/11C30 1495	Glastenbury	0.8	07/06/2011	10:00	Clear	Failure to keep in proper lane	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/12C30 1152	Glastenbury	0.96	04/30/2012	08:18	Clear	No improper driving, Failure to keep in proper lane	Same Direction Sideswipe	3	0	0	S	SH
	VTVSP0900/11C30 1967	Sunderland	0.29	08/27/2011	11:04	Cloudy	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	1	0	0		Ramp/Spur
	VTVSP0900/15C30 1552	Sunderland	0.7	05/27/2015	16:03				0	0	0		SH
	VTVSP0900/12C30 2917	Sunderland	0.74	09/22/2012	08:03	Clear	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	1	0	0	N	SH
	VTVSP0900/15C30 3472	Sunderland	1.06	11/04/2015	17:13	Clear	No improper driving	Single Vehicle Crash	0	0	0		SH
	VTVSP0900/14C30 2751	Sunderland	1.16	08/15/2014	23:46				0	0	0		SH
	VTVSP0900/15C30 3418	Sunderland	1.56	10/30/2015	09:50				0	0	0		SH
	VTVSP0900/15C30 0932	Sunderland	1.58	03/30/2015	06:05	Snow	No improper driving, Wrong side or wrong way	Opp Direction Sideswipe	0	0	0	N	SH
	VTVSP0900/11C30 0525	Sunderland	1.63	03/09/2011	04:20	Clear	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	0	0	0	N	SH
	VTVSP0900/13C30 3226	Sunderland	1.93	10/31/2013	06:34	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/12C30 1270	Sunderland	2.14	05/11/2012	22:40	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/11C30 0371	Sunderland	2.16	02/18/2011	21:52	Clear	No improper driving, Under the influence of medication/drugs/alcohol, Failure to keep in proper lane	Head On	2	0	0		SH
	VTVSP0900/11C30 2035	Sunderland	2.2	09/04/2011	14:40	Clear	No improper driving, Failed to yield right of way	Same Direction Sideswipe	0	0	0	N	SH
	VTVSP0900/14C30 2549	Sunderland	2.39	07/31/2014	09:54	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	S	SH
	VTVSP0900/14C30 0605	Sunderland	3.06	02/21/2014	22:47				0	0	0		SH
	VTVSP0900/15C30 0509	Sunderland	3.36	02/15/2015	12:39				0	0	0		SH
	VTVSP0900/13C30 3421	Sunderland	3.62	11/15/2013	17:30	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	N	SH
	VTVSP0900/14C30 2650	Sunderland	3.62	08/07/2014	15:47				0	0	0		SH
	VTVSP0900/13C30 0053	Sunderland	4.67	01/07/2013	06:26				0	0	0		SH

**Crash occurred prior to the last Highway Improvement Project. This data should not be used in a crash analysis. UNK indicates the Mile Marker is Unknown.*

Appendix F: Detour Map



Regional Detour Route: US Route 7, to VT Route 313, and VT Route 7A, back to US Route 7

Through Route: 9.6 miles
Detour Route: 12.9 miles
Added Distance: 3.3 miles
End-to-End Distance: 22.5 miles

Appendix G: Plans

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

N
VT STATE PLANE GRID

920'
930'
940'

PI 25+06.73

DELINEATOR

HVCTRL #2

BORING 130

US ROUTE 7
TO GLASTONBURY

US ROUTE 7
TO MANCHESTER

0
23+00
24+00
25+00
26+00
27+00
28+00

BORING 125

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH
M. HEMLOCK
HVCTRL #3
M. OAK
M. HEMLOCK

ROW MONUMENT

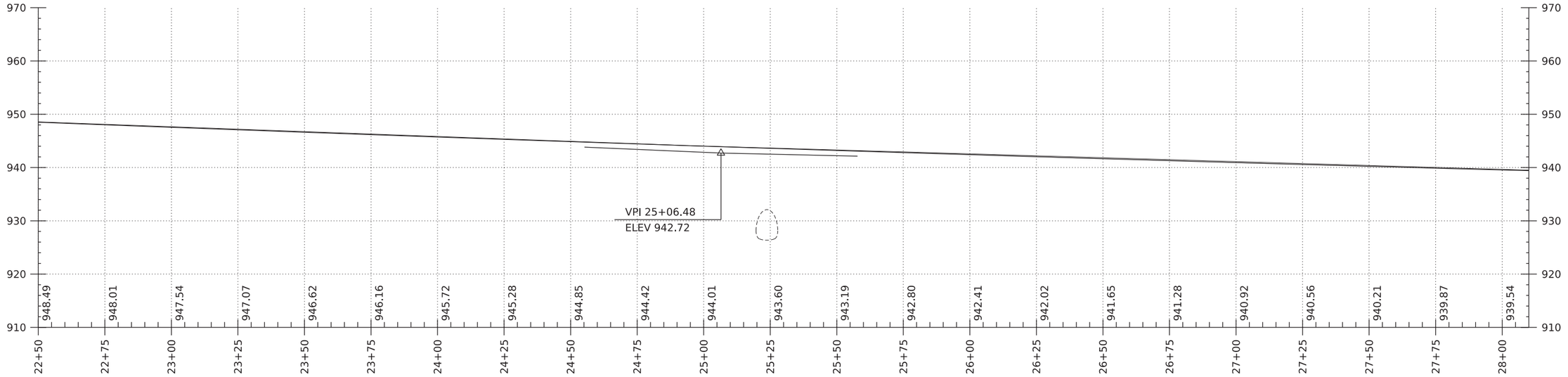
BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

EXISTING CONDITIONS

SCALE 1" = 20'-0"
20 0 20

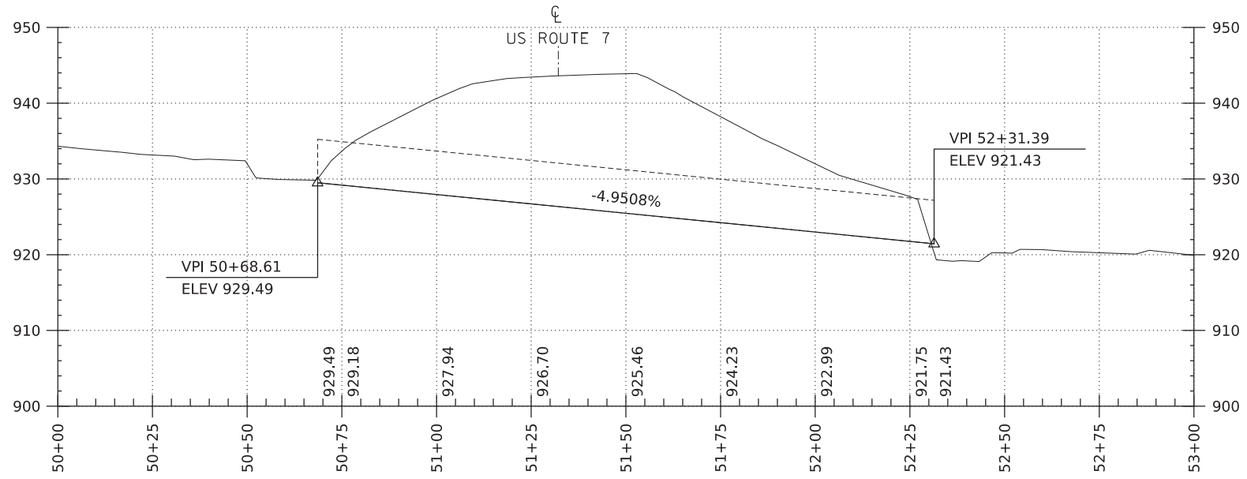
PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Existing.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
EXISTING CONDITIONS LAYCUT	SHEET 1 OF 19

L = 922.20 FT
K = 902
HSSD = INF FT
G1 = -2.1594% ; G2 = -1.1373%



US ROUTE 7 EXISTING PROFILE

SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"



EXISTING CHANNEL PROFILE

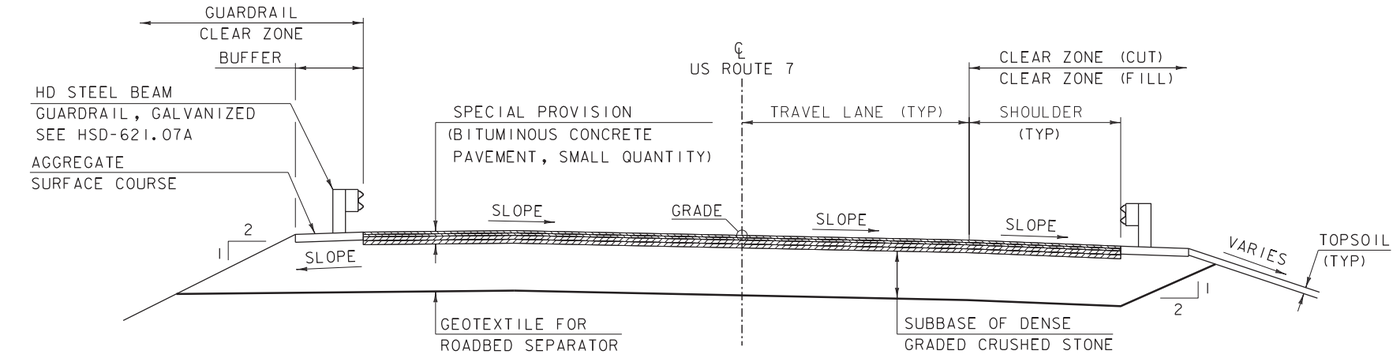
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

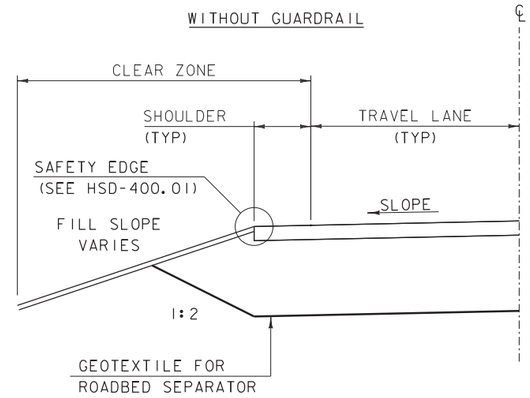
FILE NAME: s20bl55profile.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
EXISTING PROFILE SHEET

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------



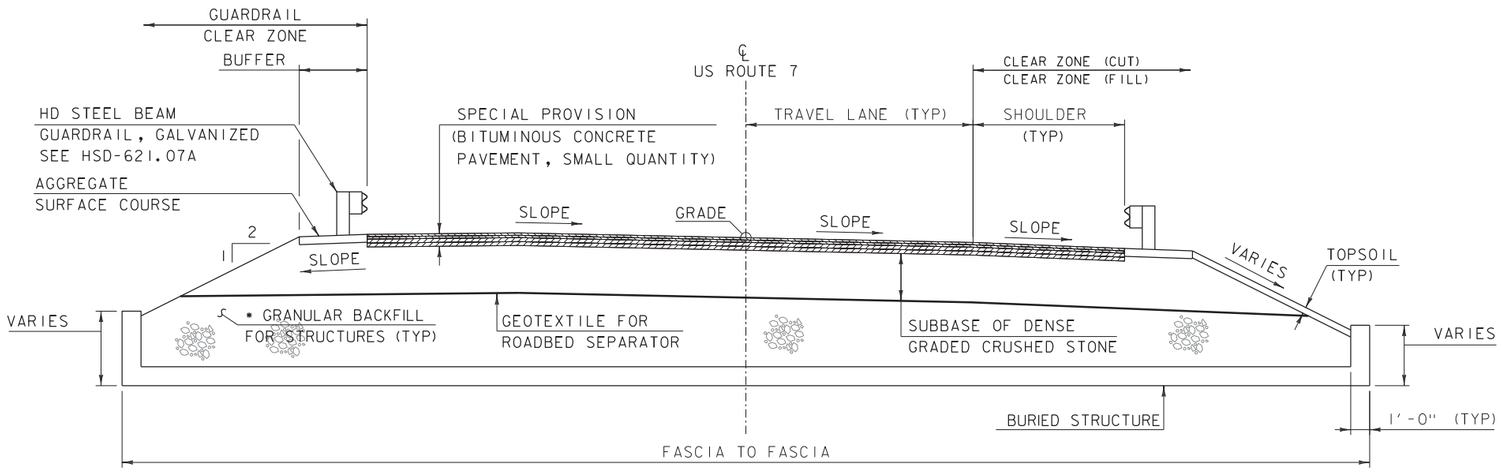
US ROUTE 7 TYPICAL SECTION

SCALE: 1/4" = 1'-0"



ROADWAY TYPICAL SECTION

NOT TO SCALE



US ROUTE 7 BURIED STRUCTURE TYPICAL SECTION

SCALE: 1/4" = 1'-0"

ROAD TYPICAL INFORMATION

	LEFT		RIGHT	
	WIDTH	SLOPE	WIDTH	SLOPE
TRAVEL LANE	12'-0"	VARIES	12'-0"	VARIES
SHOULDER	10'-0"	VARIES	10'-0"	VARIES
BUFFER	3'-7"	-0.060	3'-7"	-0.060
FILL SLOPE	---	VARIES	---	VARIES
CLEAR ZONE (CUT)	20'-0"	---	20'-0"	---
CLEAR ZONE (FILL)	26'-0"	---	26'-0"	---
CLEAR ZONE (GUARDRAIL)	4'-9"	---	4'-9"	---

MATERIAL INFORMATION

	THICKNESS	TYPE
WEARING COURSE	1½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BINDER COURSE	1½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IVS)
BASE COURSE #2	2½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BASE COURSE #1	2½"	SPECIAL PROVISION (BITUMINOUS CONCRETE PAVEMENT, SMALL QUANTITY) (TYPE IIS)
BUFFER	8"	AGGREGATE SURFACE COURSE
SUBBASE	XX"	SUBBASE OF DENSE GRADED CRUSHED STONE
TOPSOIL	4"	TOPSOIL

TACK COAT: EMULSIFIED ASPHALT IS TO BE APPLIED AT A RATE OF 0.025 GAL/SY BETWEEN SUCCESSIVE COURSES OF PAVEMENT AND 0.080 GAL/SY ON COLD PLANED SURFACES AS DIRECTED BY THE ENGINEER.

MATERIAL TOLERANCES

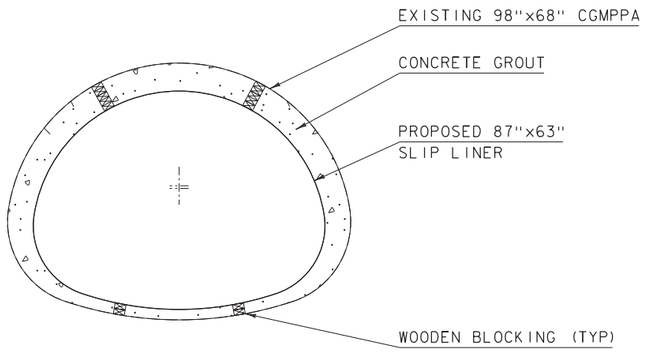
(IF USED ON PROJECT)

SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- 1/4"
- AGGREGATE SURFACE COURSE	+/- 1/2"
SUBBASE	+/- 1"
SAND BORROW	+/- 1"

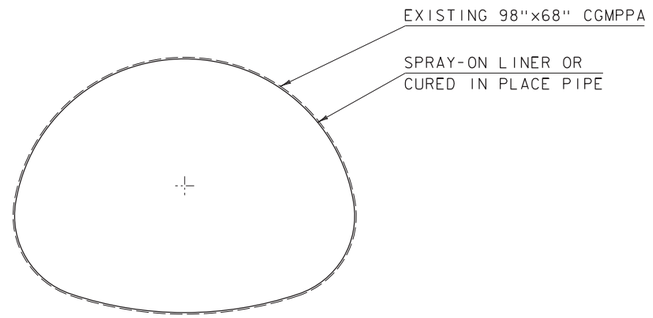
PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: 20b155/s20b155typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
ROADWAY TYPICAL SECTION SHEET

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------

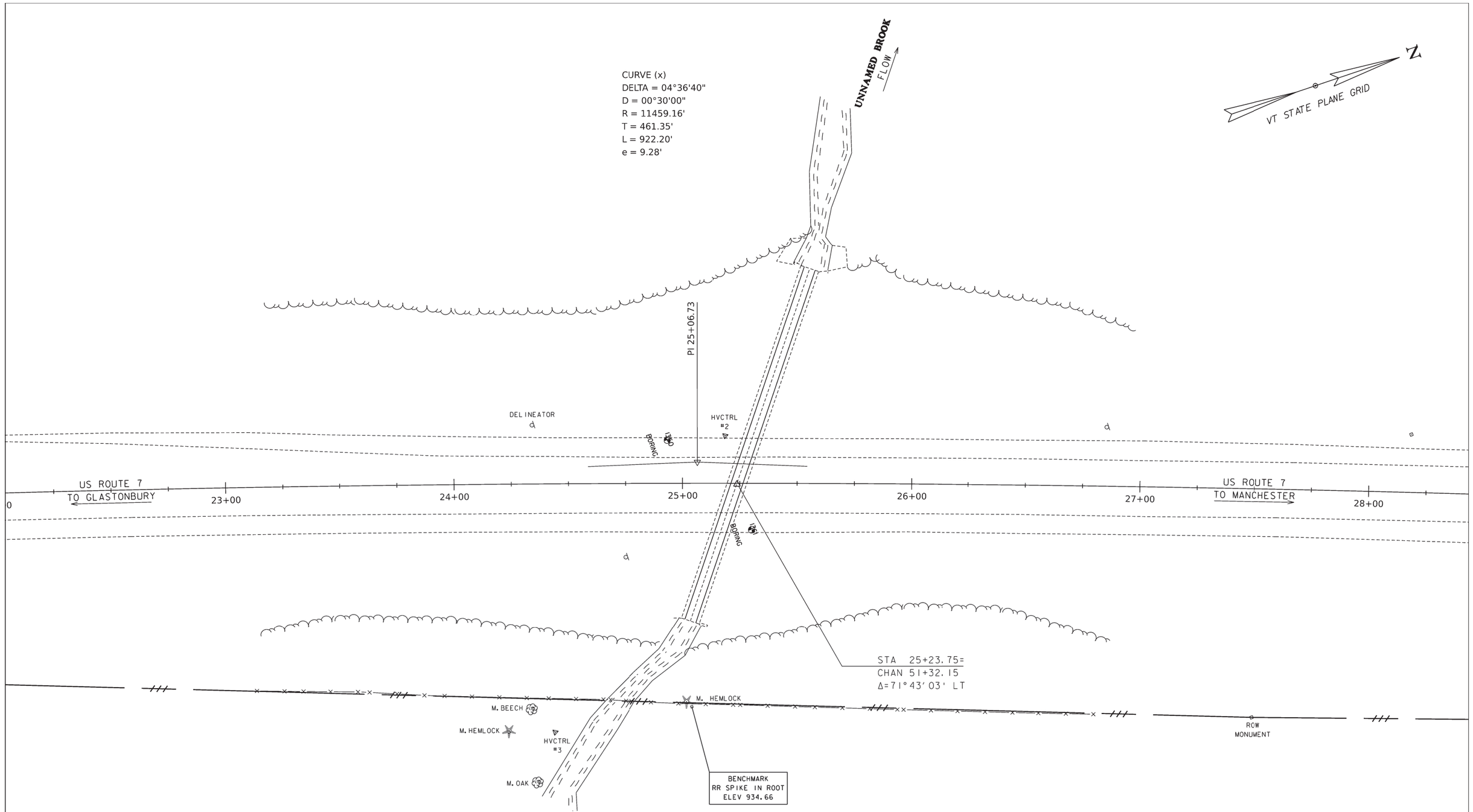


SLIP LINER TYPICAL SECTION



SPRAY LINER TYPICAL SECTION

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: 20b155/s20b155typ.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ----------	CHECKED BY: ----------
REHABILITATION TYPICAL SECTIONS	SHEET 4 OF 19



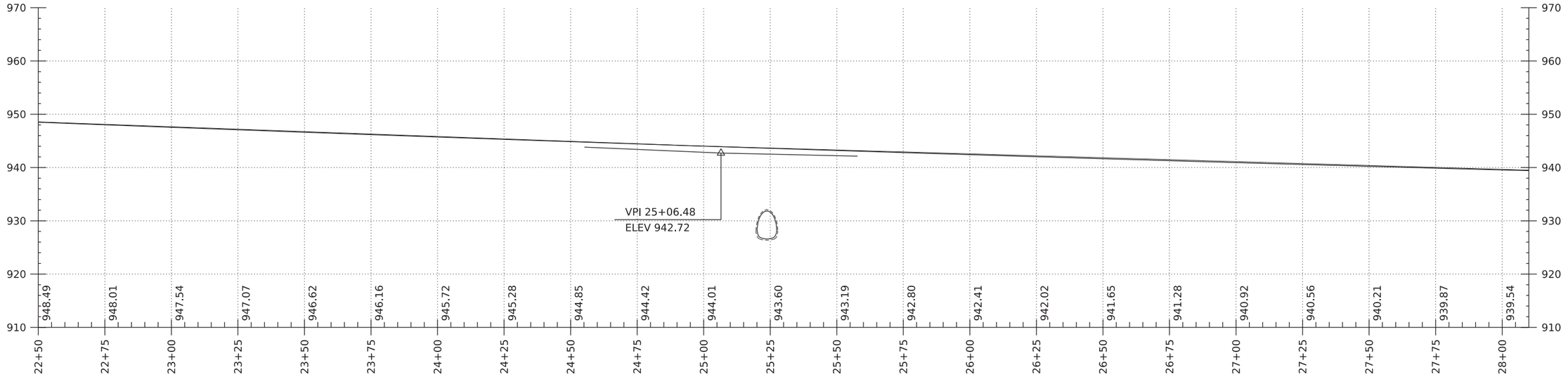
SLIP LINER REHABILITATION

SCALE 1" = 20'-0"

20 0 20

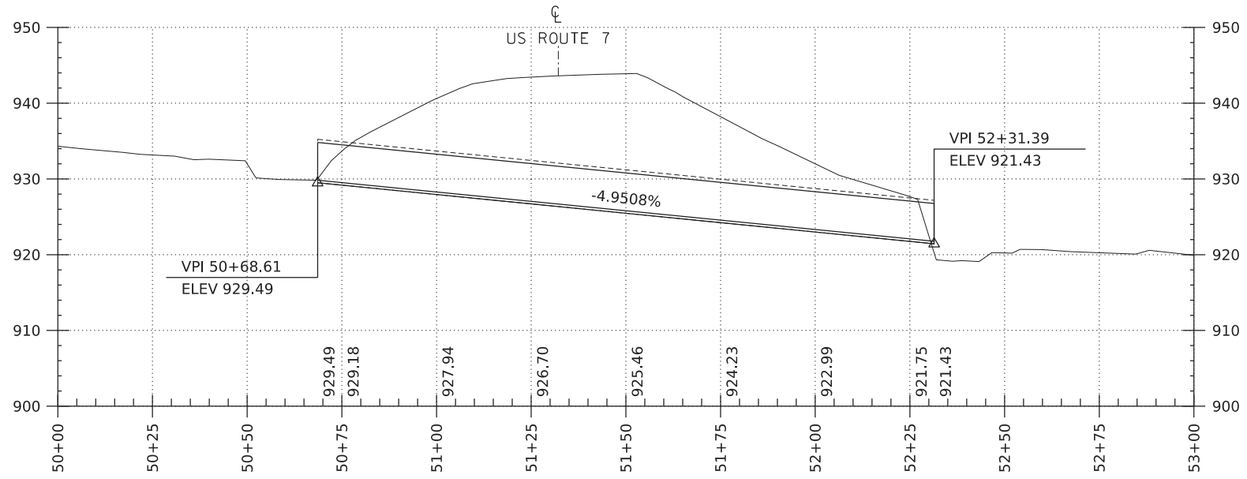
PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Rehabilitation.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
REHABILITATION LAYOUT	SHEET 5 OF 19

L = 922.20 FT
K = 902
HSSD = INF FT
G1 = -2.1594% ; G2 = -1.1373%



US ROUTE 7 SLIP LINER PROFILE

SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"



SLIP LINER CHANNEL PROFILE

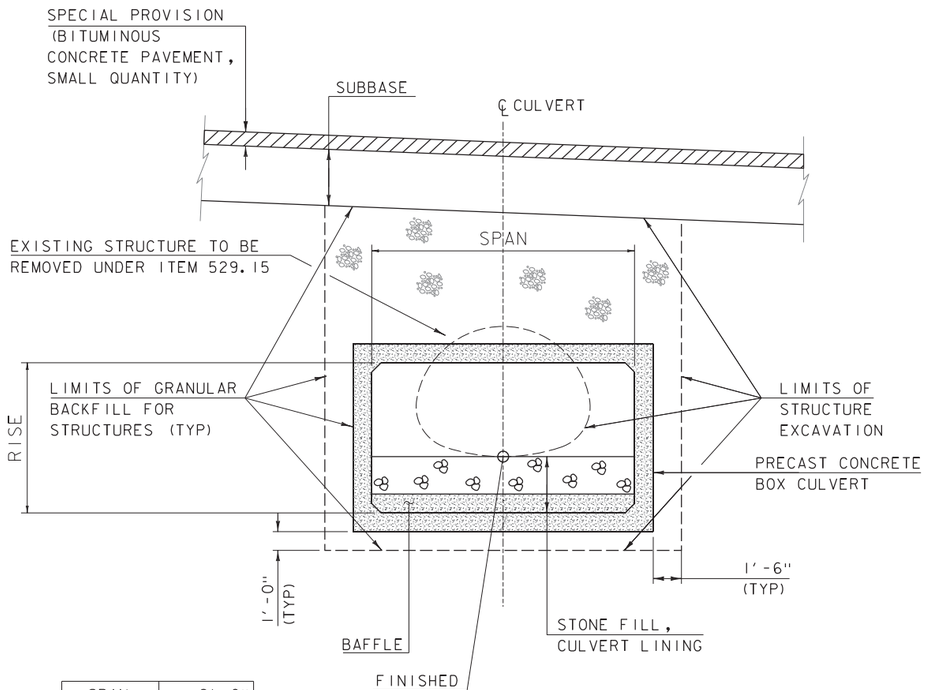
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: s20bl55profile.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
SLIP LINER PROFILE SHEET

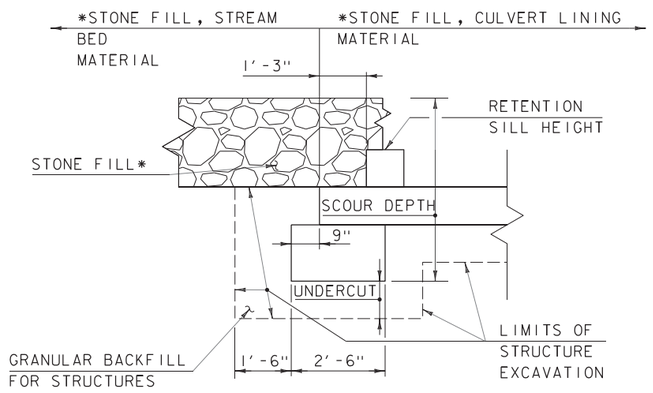
PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 6 OF 19



SPAN	8'-0"
RISE	7'-0"
LENGTH	130'-0"

CULVERT TYPICAL SECTION

NOT TO SCALE



CUTOFF WALL TYPICAL SECTION

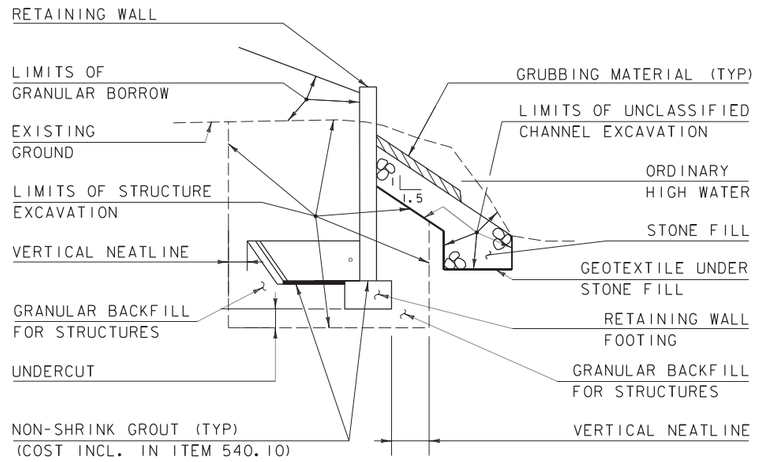
NOTE:

NOT TO SCALE

THE CUTOFF WALL MAY BE OMITTED IF THE DEPTH OF CULVERT LINING MATERIAL PLUS THE THICKNESS TO THE BOTTOM OF THE BOX MEETS OR EXCEEDS THE LISTED SCOUR DEPTH.

CUTOFF WALL - CRITICAL DIMENSIONS

	DIMENSION
SCOUR DEPTH	4'-0"
RETENTION SILL HEIGHT	1'-0"
UNDERCUT	1'-0"

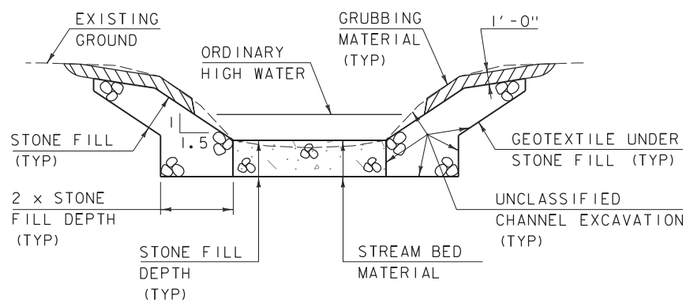


RETAINING WALL EARTHWORK TYPICAL SECTION

NOT TO SCALE

NOTE:

TOP OF RETAINING WALL FOOTING SHALL BE AT OR BELOW BOTTOM OF BOX CULVERT.



TYPICAL CHANNEL SECTION

(NOT TO SCALE)

1) WHENEVER CHANNEL SLOPE INTERSECTS ROADWAY SUBBASE, GRUBBING MATERIAL SHALL BEGIN AT THE BOTTOM OF SUBBASE.

2) THE CONTRACTOR SHALL CREATE A LOW FLOW CHANNEL IN THE STREAM BED MATERIAL AS DIRECTED BY THE ENGINEER.

3) GRUBBING MATERIAL SHALL BE PLACED UNDERNEATH STRUCTURES WHERE THERE IS MORE THAN 6 FEET VERTICALLY FROM ORDINARY HIGH WATER (OHW) TO THE BOTTOM OF SUPERSTRUCTURE AND MORE THAN 6 FEET HORIZONTALLY FROM OHW LINE TO FRONT FACE OF ABUTMENT. THIS MATERIAL SHALL START JUST ABOVE THE OHW ELEVATION AND TERMINATE 3 FEET HORIZONTALLY FROM THE FRONT FACE OF THE ABUTMENT. THIS MATERIAL SHALL NOT BE PLACED UNDERNEATH DOWNSPOUTS. SEE THE CHANNEL SECTIONS FOR ADDITIONAL DETAILING.

MATERIAL INFORMATION

	THICKNESS	TYPE
STONE FILL	2'-0"	TYPE II
STONE FILL, CULVERT LINING	2'-0"	E-STONE TYPE II
STONE FILL, STREAM BED MATERIAL	2'-0"	E-STONE TYPE II

RETAINING WALL - ASSUMED DIMENSIONS

LEVELING PAD	
	DIMENSION
WIDTH	2'-6"
TOE	0'-9"
HEEL	0'-9"
THICKNESS	1'-0"
UNDERCUT	1'-0"
WALL	
THICKNESS	1'-0"
HEIGHT	VARIES
EXCAVATION LIMITS	
VERTICAL NEATLINE	1'-6"
UNDERCUT	1'-0"

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: 20bl55/s20bl55typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
PRECAST BOX TYPICAL SECTION SHEET

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 7 OF 19

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

VT STATE PLANE GRID

PI 25+06.73

DELINEATOR

HVCTRL #2

BORING #2

US ROUTE 7
TO GLASTONBURY

0

23+00

24+00

25+00

26+00

27+00

US ROUTE 7
TO MANCHESTER

28+00

BORING #1

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH

M. HEMLOCK

M. HEMLOCK

HVCTRL #3

M. OAK

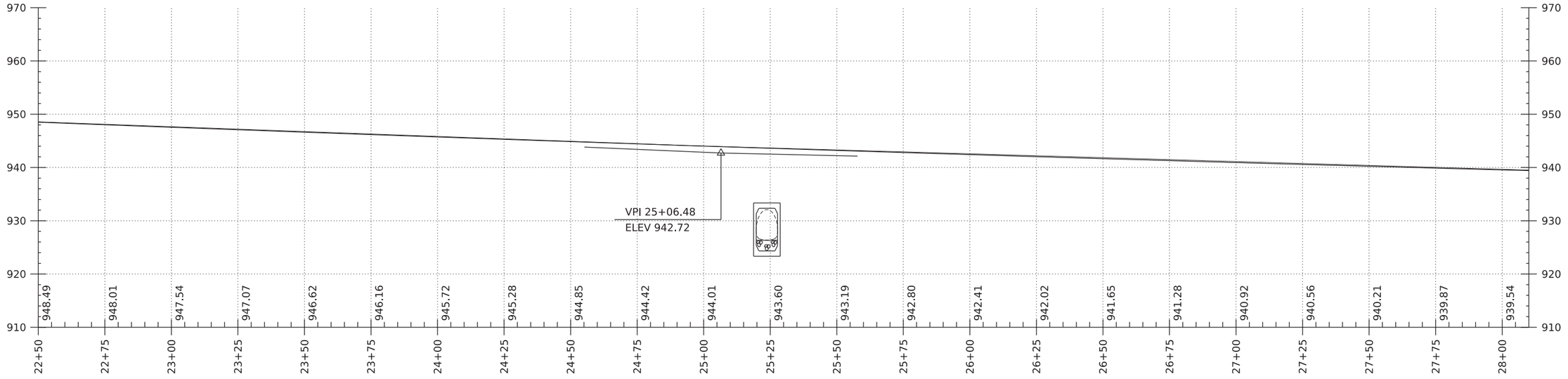
ROW MONUMENT

BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

NEW BOX CULVERT

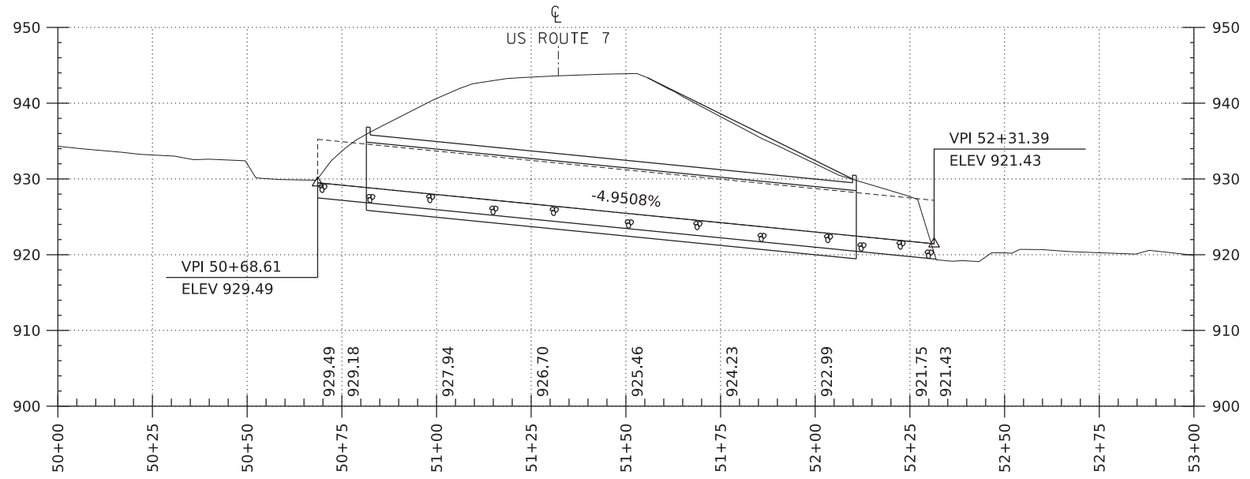
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_New Box Culvert.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW BOX CULVERT LAYOUT	SHEET 8 OF 19



US ROUTE 7 PRECAST BOX PROFILE

SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"



PRECAST BOX CHANNEL PROFILE

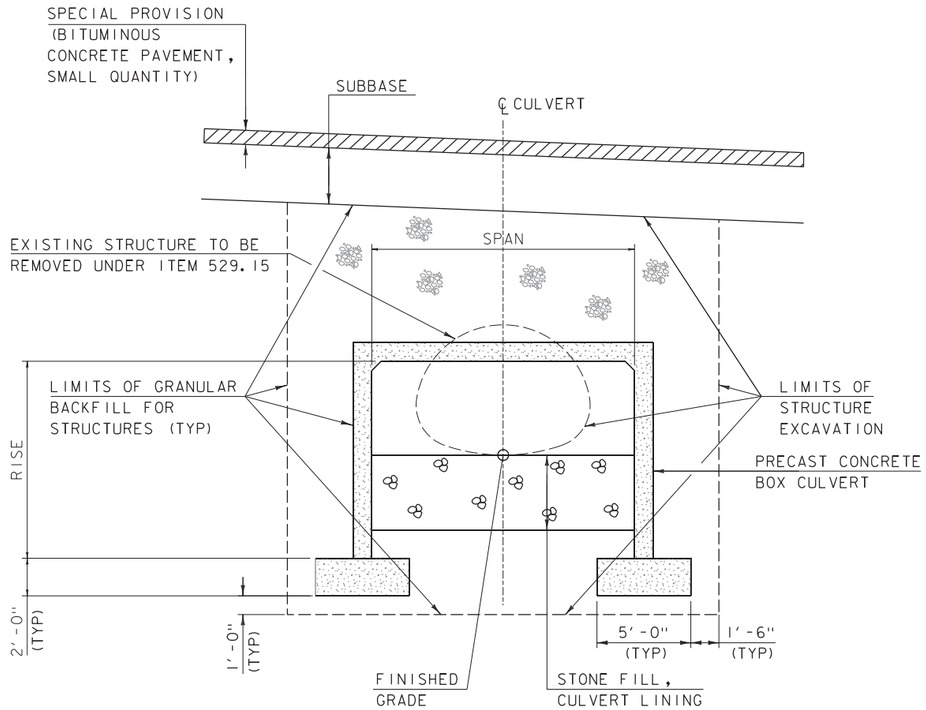
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: s20bl55profile.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
PRECAST BOX PROFILE SHEET

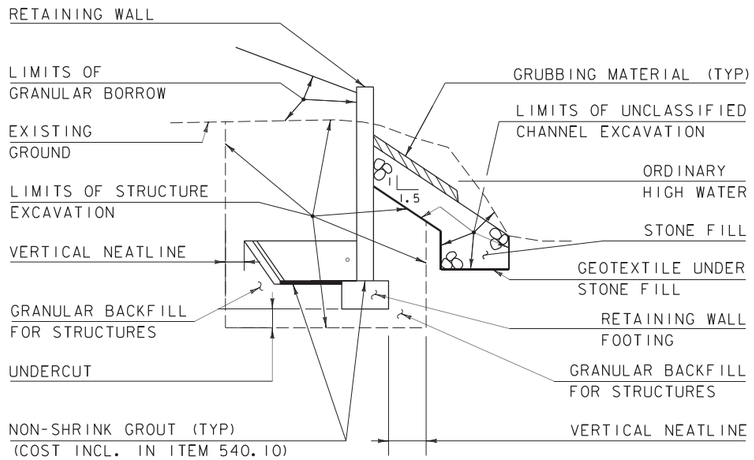
PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 9 OF 19



SPAN	8'-0"
RISE	11'-0"
LENGTH	130'-0"

CULVERT TYPICAL SECTION

NOT TO SCALE

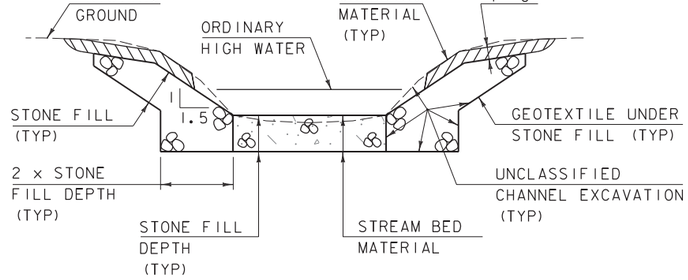


RETAINING WALL EARTHWORK TYPICAL SECTION

NOT TO SCALE

NOTE:

TOP OF RETAINING WALL FOOTING SHALL BE AT OR BELOW BOTTOM OF BOX CULVERT.



TYPICAL CHANNEL SECTION

(NOT TO SCALE)

1) WHENEVER CHANNEL SLOPE INTERSECTS ROADWAY SUBBASE, GRUBBING MATERIAL SHALL BEGIN AT THE BOTTOM OF SUBBASE.

2) THE CONTRACTOR SHALL CREATE A LOW FLOW CHANNEL IN THE STREAM BED MATERIAL AS DIRECTED BY THE ENGINEER.

3) GRUBBING MATERIAL SHALL BE PLACED UNDERNEATH STRUCTURES WHERE THERE IS MORE THAN 6 FEET VERTICALLY FROM ORDINARY HIGH WATER (OHW) TO THE BOTTOM OF SUPERSTRUCTURE AND MORE THAN 6 FEET HORIZONTALLY FROM OHW LINE TO FRONT FACE OF ABUTMENT. THIS MATERIAL SHALL START JUST ABOVE THE OHW ELEVATION AND TERMINATE 3 FEET HORIZONTALLY FROM THE FRONT FACE OF THE ABUTMENT. THIS MATERIAL SHALL NOT BE PLACED UNDERNEATH DOWNSPOUTS. SEE THE CHANNEL SECTIONS FOR ADDITIONAL DETAILING.

MATERIAL INFORMATION

	THICKNESS	TYPE
STONE FILL	2'-0"	TYPE II
STONE FILL, CULVERT LINING	2'-0"	E-STONE TYPE II
STONE FILL, STREAM BED MATERIAL	2'-0"	E-STONE TYPE II

RETAINING WALL - ASSUMED DIMENSIONS

LEVELING PAD	
	DIMENSION
WIDTH	2'-6"
TOE	0'-9"
HEEL	0'-9"
THICKNESS	1'-0"
UNDERCUT	1'-0"
WALL	
THICKNESS	1'-0"
HEIGHT	VARIES
EXCAVATION LIMITS	
VERTICAL NEATLINE	1'-6"
UNDERCUT	1'-0"

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: 20b155/s20b155typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
3-SIDED FRAME TYPICAL SECTION SHEET

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 10 OF 19

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

N
VT STATE PLANE GRID

PI 25+06.73

DELINEATOR

HVCTRL
#2

BORING
#2

BORING
#1

US ROUTE 7
TO GLASTONBURY

US ROUTE 7
TO MANCHESTER

0
23+00
24+00
25+00
26+00
27+00
28+00

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH
M. HEMLOCK
M. OAK
HVCTRL
#3
M. HEMLOCK
ROW
MONUMENT

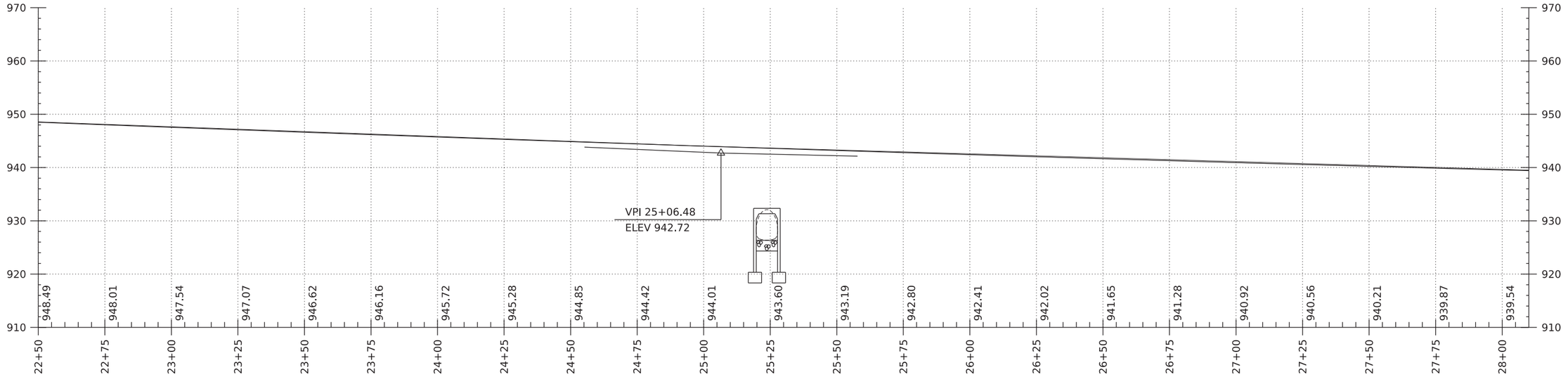
BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

NEW 3-SIDED FRAME

SCALE 1" = 20'-0"
20 0 20

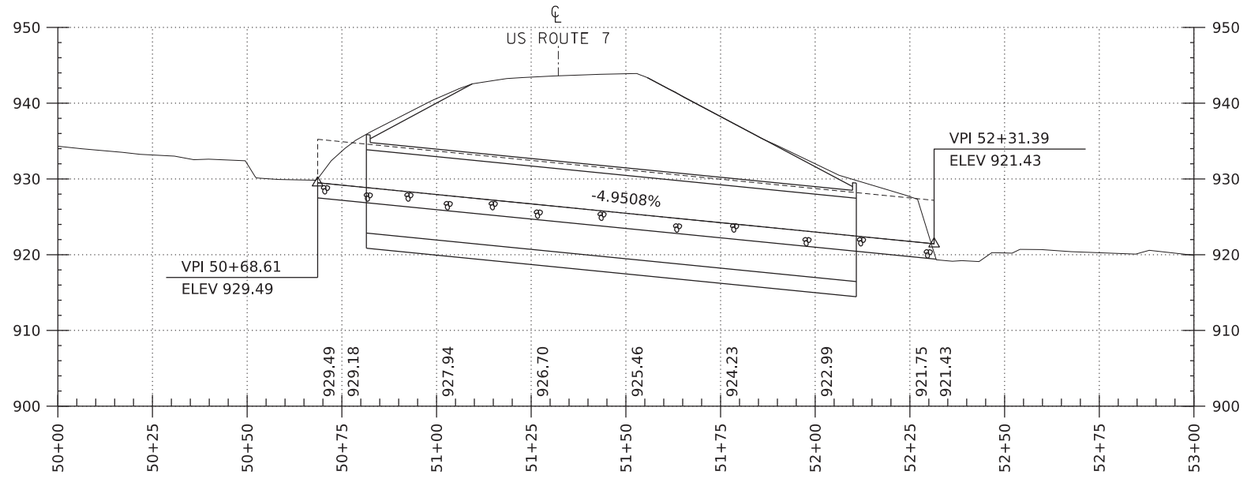
PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_New 3-Sided Frame.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW 3-SIDED FRAME LAYOUT	SHEET 11 OF 19

L = 922.20 FT
K = 902
HSSD = INF FT
G1 = -2.1594% ; G2 = -1.1373%



US ROUTE 7 3-SIDED FRAME PROFILE

SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"



3-SIDED FRAME CHANNEL PROFILE

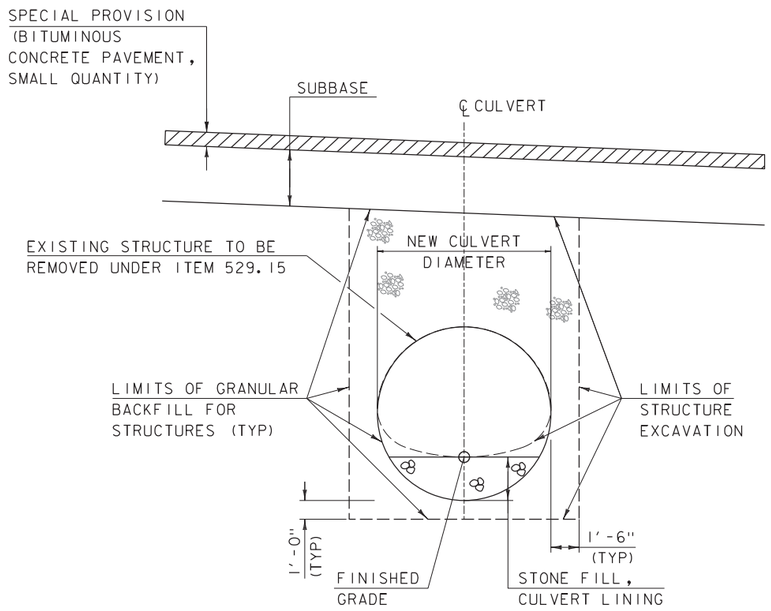
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: s20bl55profile.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
3-SIDED FRAME PROFILE SHEET

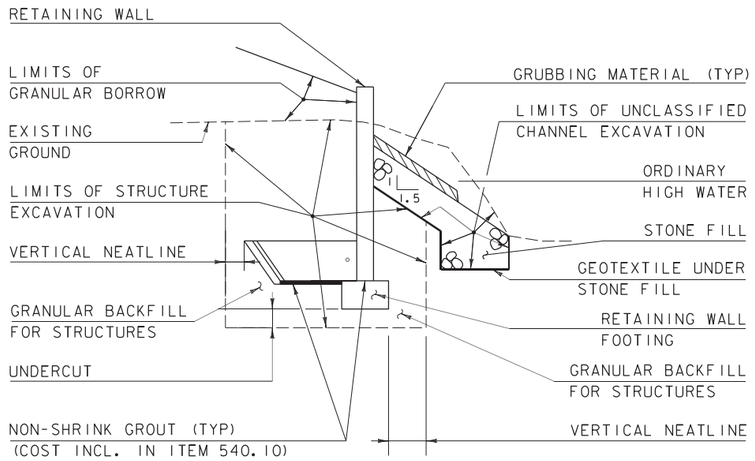
PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 12 OF 19



CULVERT TYPICAL SECTION

NOT TO SCALE

DIAMETER	8'-0"
LENGTH	164'-0"



RETAINING WALL EARTHWORK TYPICAL SECTION

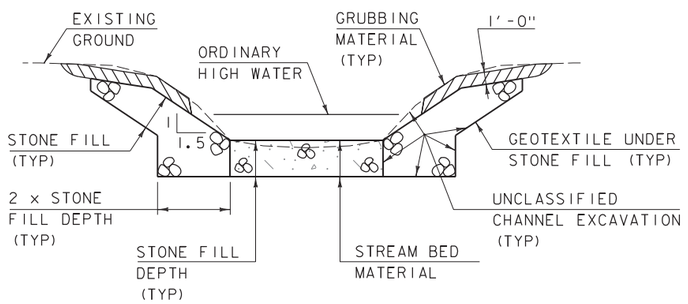
NOT TO SCALE

NOTE:

TOP OF RETAINING WALL FOOTING SHALL BE AT OR BELOW BOTTOM OF BOX CULVERT.

RETAINING WALL - ASSUMED DIMENSIONS

LEVELING PAD	
	DIMENSION
WIDTH	2'-6"
TOE	0'-9"
HEEL	0'-9"
THICKNESS	1'-0"
UNDERCUT	1'-0"
WALL	
THICKNESS	1'-0"
HEIGHT	VARIES
EXCAVATION LIMITS	
VERTICAL NEATLINE	1'-6"
UNDERCUT	1'-0"



TYPICAL CHANNEL SECTION

(NOT TO SCALE)

1) WHENEVER CHANNEL SLOPE INTERSECTS ROADWAY SUBBASE, GRUBBING MATERIAL SHALL BEGIN AT THE BOTTOM OF SUBBASE.

2) THE CONTRACTOR SHALL CREATE A LOW FLOW CHANNEL IN THE STREAM BED MATERIAL AS DIRECTED BY THE ENGINEER.

3) GRUBBING MATERIAL SHALL BE PLACED UNDERNEATH STRUCTURES WHERE THERE IS MORE THAN 6 FEET VERTICALLY FROM ORDINARY HIGH WATER (OHW) TO THE BOTTOM OF SUPERSTRUCTURE AND MORE THAN 6 FEET HORIZONTALLY FROM OHW LINE TO FRONT FACE OF ABUTMENT. THIS MATERIAL SHALL START JUST ABOVE THE OHW ELEVATION AND TERMINATE 3 FEET HORIZONTALLY FROM THE FRONT FACE OF THE ABUTMENT. THIS MATERIAL SHALL NOT BE PLACED UNDERNEATH DOWNSPOUTS. SEE THE CHANNEL SECTIONS FOR ADDITIONAL DETAILING.

MATERIAL INFORMATION

	THICKNESS	TYPE
STONE FILL	2'-0"	TYPE II
STONE FILL, CULVERT LINING	2'-0"	E-STONE TYPE II
STONE FILL, STREAM BED MATERIAL	2'-0"	E-STONE TYPE II

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: 20bl55/s20bl55typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
PIPE REPLACEMENT TYPICAL SECTION SHEET

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

N
VT STATE PLANE GRID

PI 25+06.73

DELINEATOR

HVCTRL
#2

US ROUTE 7
TO GLASTONBURY

0
23+00
24+00
25+00
26+00
27+00
28+00

US ROUTE 7
TO MANCHESTER

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH
M. HEMLOCK
M. HEMLOCK
HVCTRL
#3
M. OAK

BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

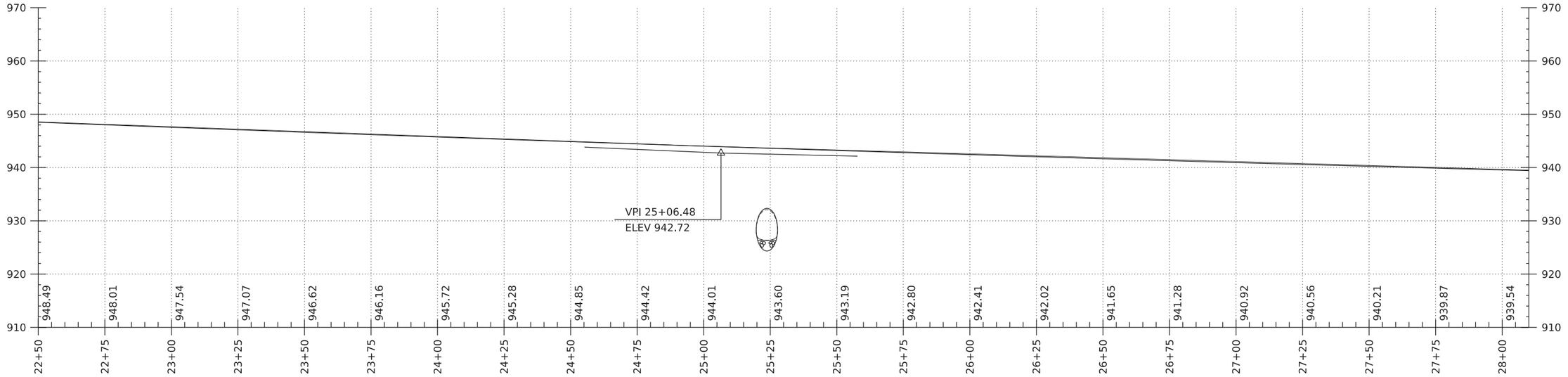
ROW
MONUMENT

NEW PIPE CULVERT

SCALE 1" = 20'-0"
20 0 20

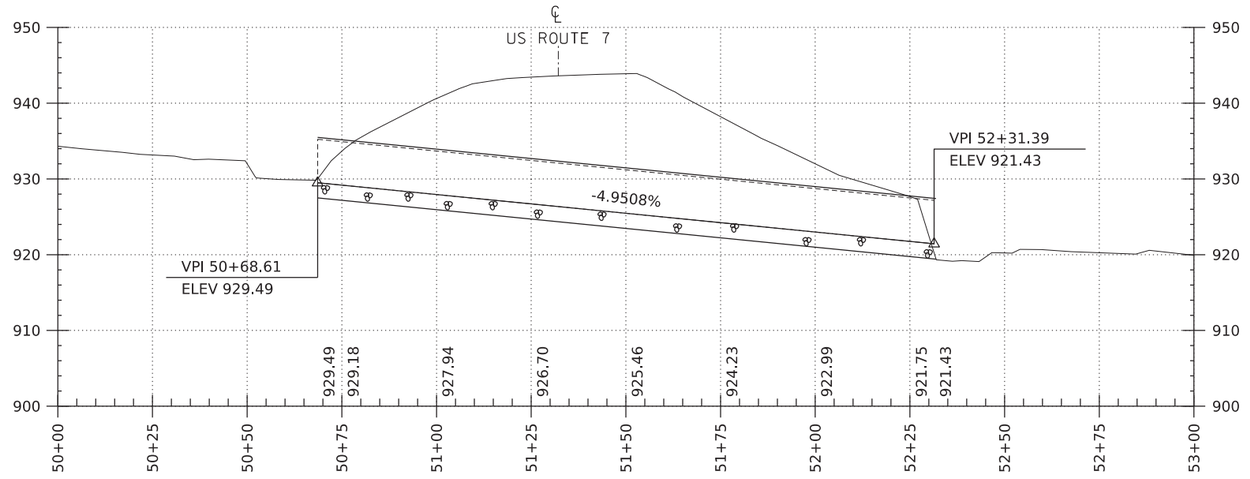
PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_New Pipe Culvert.dg	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW PIPE CULVERT LAYOLT	SHEET 14 OF 19

L = 922.20 FT
K = 902
HSSD = INF FT
G1 = -2.1594% ; G2 = -1.1373%



US ROUTE 7 NEW PIPE PROFILE

SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"



NEW PIPE CHANNEL PROFILE

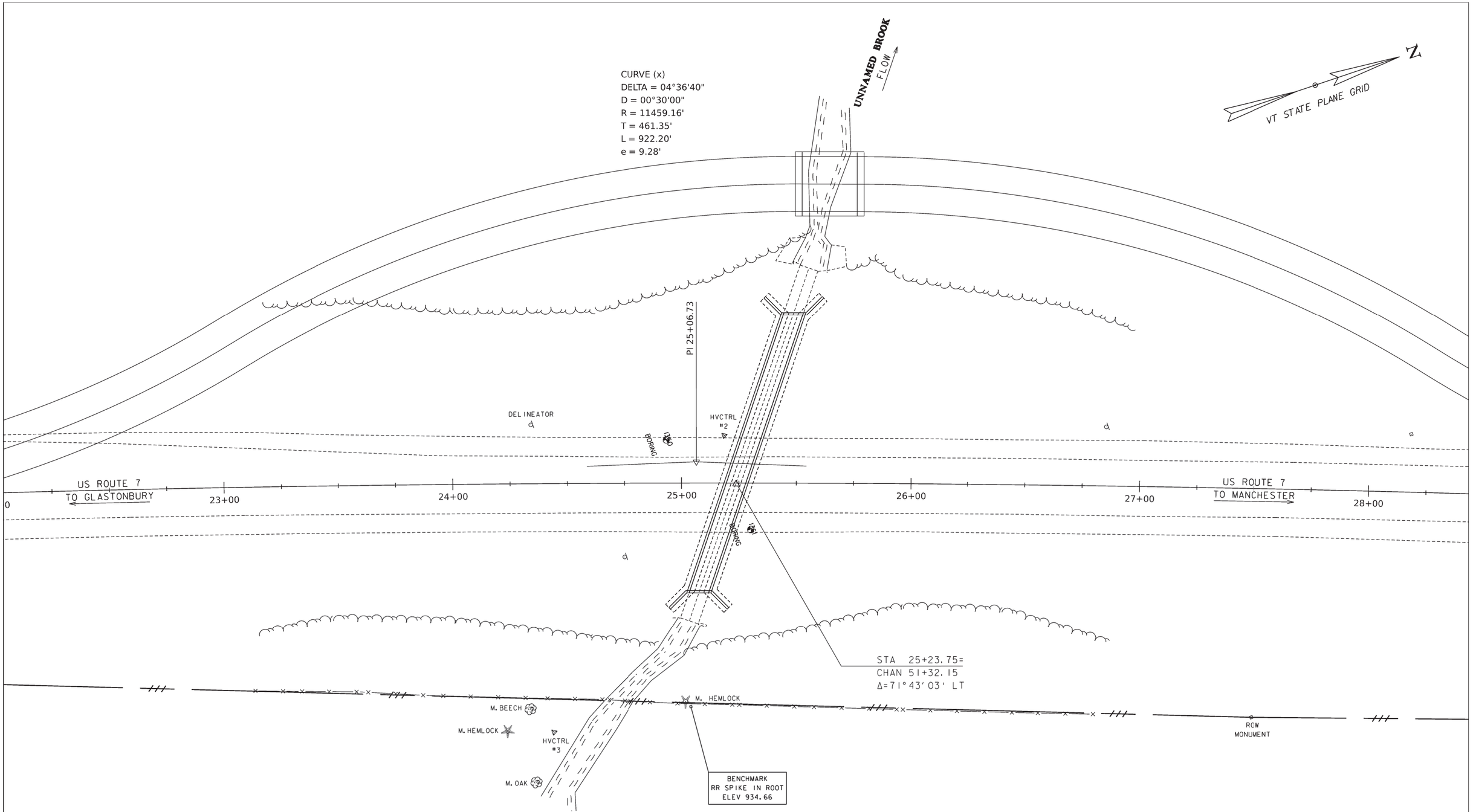
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: s20bl55profile.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
NEW PIPE PROFILE SHEET

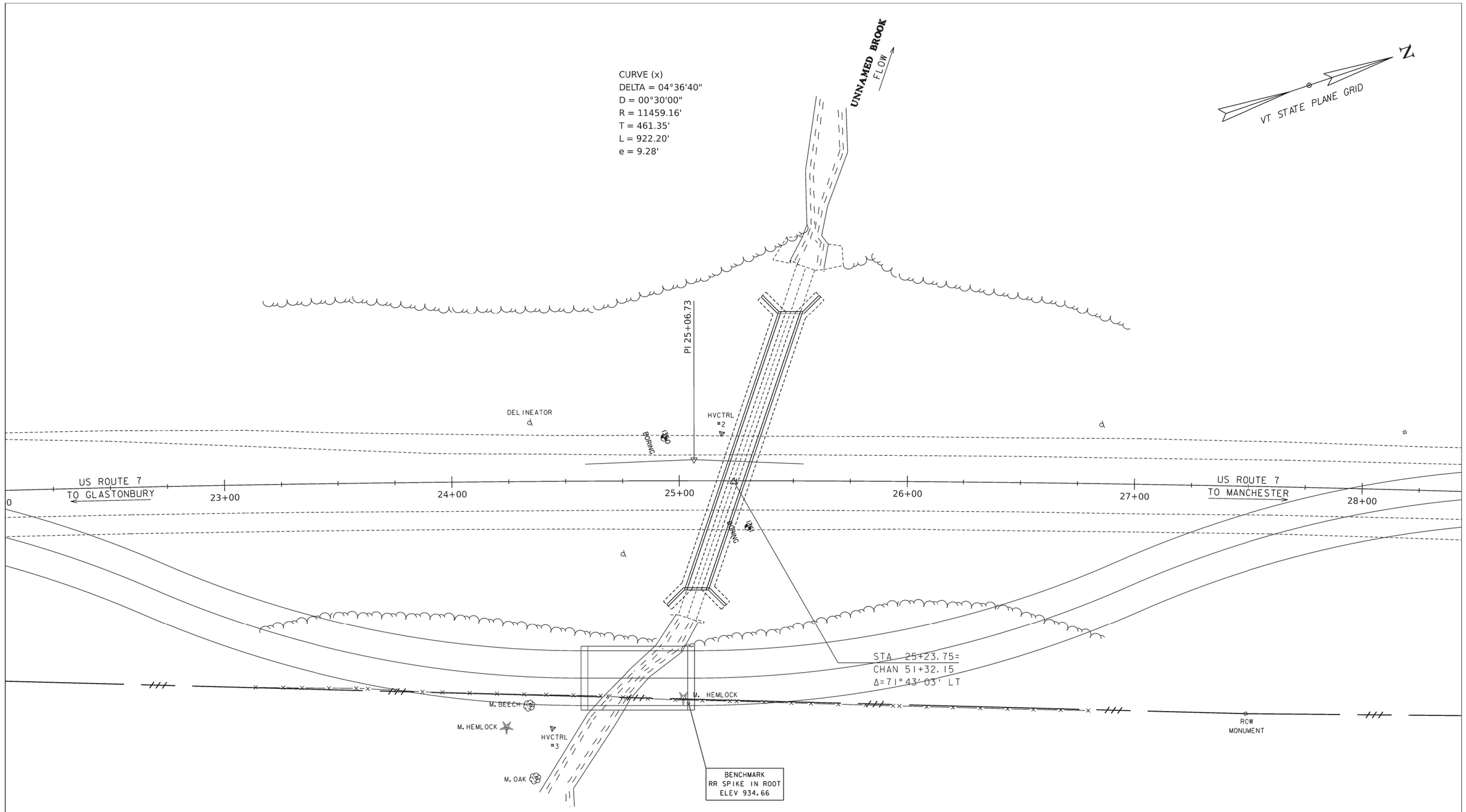
PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 15 OF 19



DOWNSTREAM TEMPORARY BRIDGE

SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Downstream Temp BPLOT DATE:	13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
DOWNSTREAM TEMPORARY BRIDGE LAYOUT	SHEET 16 OF 19



UPSTREAM TEMPORARY BRIDGE

SCALE 1" = 20'-0"

20 0 20

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Upstream Temp Bridge.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
UPSTREAM TEMPORARY BRIDGE LAYOUT	SHEET 17 OF 19

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

POE 53+00.00

UNNAMED BROOK
FLOW

53+00

VT STATE PLANE GRID

PI 25+06.73

52+44.30 03" W

52+00

DELINEATOR

HVCTRL #2

US ROUTE 7
TO GLASTONBURY

US ROUTE 7
TO MANCHESTER

0
23+00
24+00
25+00
26+00
27+00
28+00

51+00

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH

M. HEMLOCK

M. HEMLOCK

ROB 50+00.00

HVCTRL #3

M. OAK

50+00

ROW MONUMENT

BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

PHASE I

SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SUNDERLAND
PROJECT NUMBER:	BM 20102
FILE NAME: s20bl55BDR_Phase I.dgn	PLOT DATE: 13-JUN-2023
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PHASE I LAYOUT	SHEET 18 OF 19

CURVE (x)
DELTA = 04°36'40"
D = 00°30'00"
R = 11459.16'
T = 461.35'
L = 922.20'
e = 9.28'

UNNAMED BROOK
FLOW

N
VT STATE PLANE GRID

PI 25+06.73

DELINEATOR

HVCTRL
#2

BORING

US ROUTE 7
TO GLASTONBURY

0
23+00
24+00
25+00
26+00
27+00
28+00

US ROUTE 7
TO MANCHESTER

STA 25+23.75=
CHAN 51+32.15
Δ=71°43'03" LT

M. BEECH
M. HEMLOCK
HVCTRL
#3
M. OAK
M. HEMLOCK

ROW
MONUMENT

BENCHMARK
RR SPIKE IN ROOT
ELEV 934.66

PHASE 2

SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: SUNDERLAND
PROJECT NUMBER: BM 20102

FILE NAME: s20bl55BDR_Phase 2.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
PHASE 2 LAYOUT

PLOT DATE: 13-JUN-2023
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 19 OF 19