STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Worcester BF 0241(57)

VT ROUTE 12, BRIDGE 89 OVER NORTH BROOK

July 31, 2020

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I. Site Information

Bridge 89 is a State-owned bridge located on VT Route 12 in the Town of Worcester approximately 5.3 miles north of the junction with Calais Road. The bridge is at a skew to the roadway and is located on a horizontal curve under an average of 3 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	Major Collector
Bridge Type	Corrugated Galvanized Metal Plate Pipe (CGMPP)
Culvert Span	15 feet
Culvert Length	172 feet
Fill Over Culvert	3 feet
Year Built	1964
Ownership	State of Vermont

Need

Bridge 89 carries VT Route 12 across North Brook. The following is a list of deficiencies of Bridge 89 and VT Route 12 in this location:

1. The culvert is in fair condition. The invert has some holes and undermining has started at the outlet.

2. The existing culvert does not meet the calculated or measured bank full width.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2023 and 2043.

TRAFFIC DATA	2023	2043
AADT	1,100	1,200
DHV	170	180
ADTT	70	110
%T	6.0	8.8
%D	62	62

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 1,200, a DHV of 180, and a design speed of 50 mph for a Major Collector. VT Route 12 is considered a Low Use/Priority bicycle route at this area.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 5.3	11'/4' (30')	11'/3' (28')	
Bridge Lane and Shoulder Widths	VSS Section 5.7	11'/4' (30')	11'/3' (28')[1]	
Clear Zone Distance	VSS Table 5.5	No Issues Noted	16' fill / 10' cut (1:3 slope), 12' cut (1:4 slope)	
Banking	VSS Section 5.13	e = 0.03	8% (max)	
Speed		50 mph (Posted)	50 mph (design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 3,820'	R_{min} = 8,150' @ NC	
Vertical Grade	VSS Table 5.6	7.0% (max)	7% (max) for rolling terrain	
K Values for Vertical Curves	VSS Table 5.1	K_{sag} = 115	110 crest / 90 sag	
Vertical Clearance	VSS Section 5.8	No Issues Noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 5.1	496'	400'	
Bicycle/Pedestrian Criteria	VSS Table 5.8	4' shoulder	3' Shoulder	
Hydraulics	VTrans Hydraulics Section	HW/D (Q_{50}) = 0.58 Clearspan: 15'	HW/D<1.0 Bank Full Width: 42'	Substandard Bankfull Width
Structural Capacity	SM, Ch. 3.4.1	Not Deficient	Design Live Load: HL-93	

Inspection Report Summary

Culvert Rating 5 Fair
Channel Rating 6 Satisfactory

11/23/2016 – The invert has some holes and undermining has started at the outlet. This culvert is large and would be costly to replace when a new invert would give the structure years of service. ~JAS

09/28/2011 – The pipe is in satisfactory condition. with moderate rust scale and a few small holes in the invert at the outlet end. ~DP/JM

07/13/2006 – Culvert is in good condition.

Hydraulics

The existing structure meets the current hydraulic standards of the VTrans hydraulic manual. However, the existing structure constricts the channel width, as it does not meet the 42-foot width

[1]Vermont State Standards specifies a typical section of 10'/2' (24') for safety and service. As per HSDEI 11-004, there shall be a minimum paved width of 28' for winter maintenance.

ANR calculation for bank full width. Hydraulics 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:

Municipal Utilities
- There are no municipal utilities within the project area.

Public Utilities

Underground:
- There are no buried utilities within the project area.

Aerial:
- There are no aerial utilities within the project area.

Right Of Way

The existing Right-of-Way is plotted on the Existing Conditions Layout Sheet. This Right-Of-Way is not centered on the centerline of VT Route 12. There is an adequate amount of Right-of0Way on both the upstream and downstream sides of the road, and as such, it is anticipated that no additional Right-Of-Way will be required 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
There are no wetlands within the review area.

Rare, Threatened, and Endangered Species
In reviewing the NHI digital database, there are no records or occurrences of RTE plant or animal species in or directly adjacent to the study area.

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 ≥ 3 inches in diameter that have holes, crevices, cracks or peeling bark. Several trees that fit this description have been identified in the immediate vicity of the project. As the project moves forward, additional investigation is warranted to avoid impacts to potential roosting habitat.

Wildlife Habitat
Vt. Fish and Wildlife identifies the study area as a Highest Priority wildlife crossing and Highest Priority surface water and riparian area in the Vt. Conservation Design Community and Species Scale Components. The forest surrounding the study area is unfragmented with varying habitat

types and considerable compositional and structural diversity. The roadway cuts tightly through the surrounding forest with some elevation changes between road edge and forest, but no significant barriers to habitat connectivity in the surrounding landscape. In, and directly adjacent to, the stream itself forest cover is dense and provides excellent protected movement opportunities for wildlife. The structure is significantly undersized in relation to the channel width resulting in minimal terrestrial wildlife passage value, especially when combined with a fairly deep outlet pool. In the coldest weather, the pool may partially freeze at the structure outlet, but the narrow culvert likely results in continual flow and open water at its outlet that may make it unappealing as a road crossing alternative for many terrestrial wildlife species. Riparian associated species such as mink, otter and beaver probably pass through the structure in all seasons to avoid climbing the embankment and crossing the road. The concentrated flow through the undersized culvert eliminates development of bed features or sediment retention. This, coupled with the structure outfall elevated off the streambed, functionally reduces this structure for aquatic organism passage. New site and structure design should consider retention and enhancement of the surrounding forest and seek to improve aquatic organism as well as terrestrial wildlife passage potential through the structure.

Agricultural Soils

Primary agricultural soils were not identified in the Project area. The soils are primarily mapped as Stetson loam with Tunbridge-Lymon complex along the northern margin of the study area (NRCS Soil Survey). These soils are considered high erodible.

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 89 is not historic and there are no historic or Section 4(f) resources in the project area.

Archeological:

There are no archaeologically sensitive areas within the project area.

Stormwater:

There are no stormwater concerns for this project.

II. Safety

There have been no recorded crashes within the project area in the last five-year period.

III. Alternatives Discussion

No Action

This alternative is not recommended. While the culvert is in fair condition, holes are beginning to form in the invert and will continue deteriorate if no action is taken. 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 metal plate pipe.

Since the minimum hydraulic opening would be substandard for all options, and any rehabilitation will reduce the waterway area, it is assumed that an improved beveled inlet would be required for each option to optimize hydraulic performance and to funnel the stream into the culvert.

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 Preliminary Hydraulics Report indicates that a new minimum interior pipe dimension of 14' with fish baffles would meet the hydraulic standard but would 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.

Rehabilitation options considered:

a. Invert Repair
   In many cases, invert repair is used to rehabilitate reinforced concrete pipe where the invert has eroded. Invert repair can be utilized on corrugated steel pipe, and typically consists of paving the invert or pouring a concrete invert. Much of the deterioration is located at the invert, making this a suitable repair for the culvert. This option involves removal of the degraded invert and pouring a 2-inch to 3-inch thick section of concrete in its place. Additionally, there may be repair of any holes along the circumference of the pipe. This option would have the least impacts 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 has been no evidence of crushing or squashing, and as such, additional structural capacity is not required.

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 sliplining is generally specified to be at least 4 inches smaller than the inside diameter of the host pipe to allow the grout to be injected into the annular space between the two pipes. A greater reduction would be required at this site since the existing pipe is not symmetrical. The reduced waterway would have a substandard bankfull width, but would still pass the design flood event with no roadway overtopping. A liner option is anticipated to have the longest life expectancy of the rehabilitation alternatives, since the grout provides an increased structural capacity, prevents liner collapse, prevents fatigue failure, stabilizes the pipe, extends the design life from uncertainty to at least 40 years, and resists temperature changes. However, due to the existing shape of the culvert and substandard bankfull width, a pipe liner is not recommended as it would further restrict the waterway opening.

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. Spray-on liners are generally applicable for pipes up to 10-feet in diameter. It would be cost prohibitive to spray-line Bridge 89 due to its size.

Advantages: The rehabilitation alternative would be the most cost-efficient option. It would have minimal impacts to resources and would not interrupt traffic. A repair alternative would address the ongoing deterioration issues with the invert of the existing culvert without affecting traffic flow, and with minimum upfront costs. Additionally, it would have minimal impacts on resources.

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 30 years. The existing culvert does not meet the minimum bank full width standard, and this option would slightly reduce the bank full width. Wildlife connectivity would not be improved with this alternative. This option would not satisfy aquatic organism passage requirements without construction of several weirs downstream as well as weirs throughout the culvert.

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

Replacement

The preliminary hydraulics report suggests several possible configurations for a new structure, including an open bottom precast concrete arch or frame, or a new bridge with vertical face abutments. The replacement options are discussed below:

Structure Replacement with a New Culvert 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 and replacing it with a new precast structure having a waterway opening of at least 275 square feet and a span of 42 feet. Since there is approximately 3 feet of fill above the existing culvert, there would not be a significant amount of excavation, making an open-cut method cost effective. 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.

a. Roadway Width

The current roadway width is 30 feet, which includes 11-foot-wide travel lanes and 4-foot-wide shoulders. This meets the minimum standard of 28 feet. Since a new 75+ year structure is being proposed, the roadway geometry should meet the minimum standards. A 30-foot width roadway will be proposed through the project area to match the corridor.

b. Structure Type

The most common structure types for the recommended hydraulic opening are a 3-sided open bottom concrete structure, or a structural plate arch. A plate arch is not recommended at this site, since it would have a reduced design life compared to a reinforced concrete structure.

A 4-sided concrete box culvert will not be considered as the required span is outside of the preferred limits for a precast box.

The footing for an open-bottom 3-sided structure would need to be placed six feet below the stream bed or to bedrock. Additionally, full depth headwalls are recommended to prevent piping. Exposed bedrock has been observed at both the inlet and outlet ends of the culvert. As such, a precast structure may not be feasible without blasting. Borings should be requested early on in design to verify the in-situ condition and determine the appropriate substructure type.

c. Culvert Size, Length and Skew

The existing culvert has a span of 15 feet and a height of 20 feet. The 15-foot span constricts the natural channel width. If a new structure is chosen Hydraulics has recommended a 3-sided concrete frame with a 42-foot-wide and 7.75-foot-high inside opening. This type of structure would provide a natural bottom for fish passage. This culvert will have no roadway overtopping up to and including the Q_{100} design flow. In order to accommodate a 30-foot-wide roadway, the proposed barrel length will be approximately 150 feet long. The culvert will have a skew of 55 degrees to the roadway to match the existing skew of the channel.

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 provide adequate AOP as well as address on-going issues with debris blockage. This option would have minimal future maintenance costs.

Disadvantages: This option has the highest upfront costs.

Structure Replacement with a New Bridge

This alternative would replace the existing culvert with a new integral abutment bridge at the existing location. The various considerations under this option include: the bridge width and length, skew, superstructure type and substructure type.

a. Bridge Width

The existing lane widths and shoulders on VT Route 12 over the culvert are 11-feet-wide and 4-feet-wide respectively; this exceeds the minimum standard as set forth in the Vermont State Standards. Since a new 75+ year bridge is being proposed, the bridge geometry should meet the minimum standards and match the existing conditions. A 30-foot rail-to-rail distance is proposed over the bridge to match the corridor.

b. Bridge Length and Skew

The existing culvert has a 15-foot span with a 55 degree skew. The required bankfull width is 42 feet and the brook matches the skew of the existing structure with a skew of 55 degrees to the roadway. In order to meet the minimum bankfull width requirements with a 55 degree skew, the bridge would have an approximate 100-foot span.

c. Superstructure Type

If the bridge is closed during construction, a precast structure would be the preferred choice, due to decreased construction time. The possible 100' length bridge types that are most commonly used in Vermont are box beams with a structural overlay, and steel beams with a composite concrete deck (Precast Bridge Units). If VT Route 12 through the project area is to remain open during construction, then a cast-in-place deck on steel beams would be recommended as this type of superstructure is more cost efficient than precast superstructure types. The superstructure depth is not critical for hydraulics; therefore, the beam depth is not a controlling factor in choosing a superstructure type.

d. Substructure Type

There is visible bedrock on both the inlet and outlet ends of the existing culvert. Borings should be taken at the project site, to verify the in-situ conditions. The substructure would likely be reinforced concrete abutments on spread footings. The preliminary geotechnical report can be found in Appendix E for additional information.

e. Maintenance of Traffic:

Either a temporary bridge, phased construction, or an offsite detour could be utilized for traffic control.

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. There are two detours that could be used if the bridge is closed during construction. The two potential State-signed detours are as follows:

1. VT Route 12, to VT Route 100, and US Route 2, back to VT Route 12 (57 miles end-to-end)

2. VT Route 12, to US Route 2, VT Route 14, and VT Route 15, back to VT Route 12 (66 miles end-to-end)

There are no local bypass routes available. Access to driveways and town highways would be maintained. A map of the detour routes can be found in the appendix.

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 have to 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 acceptable to close one lane of traffic, and maintain one lane of traffic, both ways, with a traffic signal. While there is only approximately 3 feet of vertical fill over the existing culvert, the culvert as a rise of 20 feet. This is a high amount of fill to hold back with sheet piles, making this option more costly.

Advantages: Traffic flow would be maintained through the project corridor during construction. Also, this option would have minimal impacts to adjacent properties and environmental resources. Right-of-Way would not be required for this maintenance of traffic option.

Disadvantages: Phased construction generally involves higher costs and complexity of construction. Costs are usually higher and construction duration is longer, since many construction activities have to be performed two times. Additionally, since cars are traveling near construction activity, there is decreased safety. There would be some delays and disruption to traffic, since the road would be reduced to one-way traffic.

Option 3: Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed on either the upstream or downstream side of the structure. A temporary bridge on the downstream side would need to span a large scour hole at the outlet. The culvert is located in a heavily wooded area, and a temporary bridge on either side would require a significant amount of tree clearing. On both the upstream side and downstream side of the culvert, there are bedrock outcrops that may make placement of a temporary bridge more complicated.

Additional costs would be incurred to construct a temporary bridge, including the cost of the temporary bridge itself, fill and sheet piles, installation and removal of the temporary roadway, restoration of the disturbed area, and the time and money associated with any temporary Right-of-Way, if needed.

If a temporary bridge is chosen as the preferred method of traffic control, based on the traffic volumes and site conditions, it should be a one-lane bridge with alternating traffic to minimize impacts to surrounding resources. The bridge is surrounded by wooded areas, and both an upstream and downstream bridge would require a number of trees 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 VT Route 12 corridor.

Disadvantages: This option would have greater impacts to surrounding resources and adjacent properties. 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.

V. Alternatives Summary

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

- Alternative 1a: New Concrete Invert
- Alternative 1b: Culvert Slip Liner
- Alternative 1c: Spray-on Liner
- Alternative 2a: New 3-Sided Structure (open cut) with Traffic Maintained on Offsite Detour
- Alternative 2b: New 3-Sided Structure (open cut) with Traffic Maintained with Phased Construction
- Alternative 2c: New 3-Sided Structure (open cut) with Traffic Maintained on a Temporary Bridge
- Alternative 3a: New bridge with Traffic Maintained on Offsite Detour
- Alternative 3b: New bridge with Traffic Maintained with Phased Construction
- Alternative 3b: New bridge with Traffic Maintained on a Temporary Bridge

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

VI. Cost Matrix[2]

Worcester BF 0241(57)		Do Nothing	Alternative 1			Alternative 2			Alternative 3		
			Culvert Rehabilitation			New 3-Sided Structure			New Bridge		
			a. Concrete Invert	b. Slipliner	c. Spray On Liner	a. Offsite Detour	b. Phased Construction	c. Temporary Bridge	a. Offsite Detour	b. Phased Construction	c. Temporary Bridge
COST	Bridge Cost	$0	191,360	319,318	294,560	1,824,028	2,412,277	2,097,632	1,604,400	1,608,900	1,399,100
	Removal of Structure	$0	258,000	258,000	258,000	258,000	296,700	258,000	258,000	296,700	258,000
	Roadway	$0	87,976	88,014	79,912	273,066	360,952	251,097	234,000	330,000	229,000
	Maintenance of Traffic	$0	35,840	35,840	35,840	199,300	359,100	279,040	174,300	296,600	254,040
	Construction Costs	$0	573,176	701,171	668,312	2,554,394	3,429,029	2,885,769	2,270,700	2,532,200	2,140,140
	Construction Engineering & Contingencies	$0	114,635	245,410	233,909	638,599	685,806	721,442	522,261	759,660	535,035
	Accelerated Premium	$0	0	0	0	102,176	0	0	158,949	0	0
	Total Construction Costs w CEC	$0	687,811	946,581	902,221	3,295,169	4,114,835	3,607,212	2,951,910	3,291,860	2,675,175
	Preliminary Engineering	$0	171,953	210,351	200,494	510,879	685,806	577,154	340,605	506,440	428,028
	Right of Way	$0	0	0	0	0	0	0	0	0	0
	Total Project Costs	$0	859,764	1,156,932	1,102,715	3,806,047	4,800,641	4,184,366	3,292,515	3,798,300	3,103,203
	Annualized Costs	$0	42,988	28,923	27,568	50,747	64,009	55,792	43,900	50,644	41,376
TOWN SHARE			No Local Share								
TOWN %											
SCHEDULEING	Project Development Duration	N/A	2 years	2 years	2 years	2 years	2 years	2 years	2 years	2 years	2 years
	Construction Duration	N/A	4 months	4 months	4 months	6 months	9 months	9 months	6 months	9 months	9 months
	Closure Duration (If Applicable)	N/A	N/A	N/A	N/A	7 days	N/A	N/A	30 days	N/A	N/A
ENGINEERING	Typical Section - Roadway (feet)	30	30	30	30	30	30	30	30	30	30
	Typical Section - Bridge (feet)	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'	4' - 11' - 11' - 4'
	Geometric Design Criteria	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	Meets Minimum Standards	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	Improved	Improved	Improved
	Alignment Change	No Change	No Change	No 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	No Change	No Change	No Change	No Change	No Change	No Change
	Pedestrian Access	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change	No Change
	Hydraulics	Substandard BFW	Substandard BFW	Substandard BFW	Substandard BFW	Meets Minimum Standards	Meets Minimum Standards	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	No Change	No Change	No Change
OTHER	ROW Acquisition	No	No	No	No	No	No	No	No	No	No
	Road Closure	No	No	No	No	Yes	No	No	Yes	No	No
	Design Life	<15 years	20	40	40	75	75	75	75	75	75

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

VII. Conclusion

Alternative 3b or 3c is recommended; to replace the existing culvert with a new bridge while one lane of alternating traffic is maintained during construction.

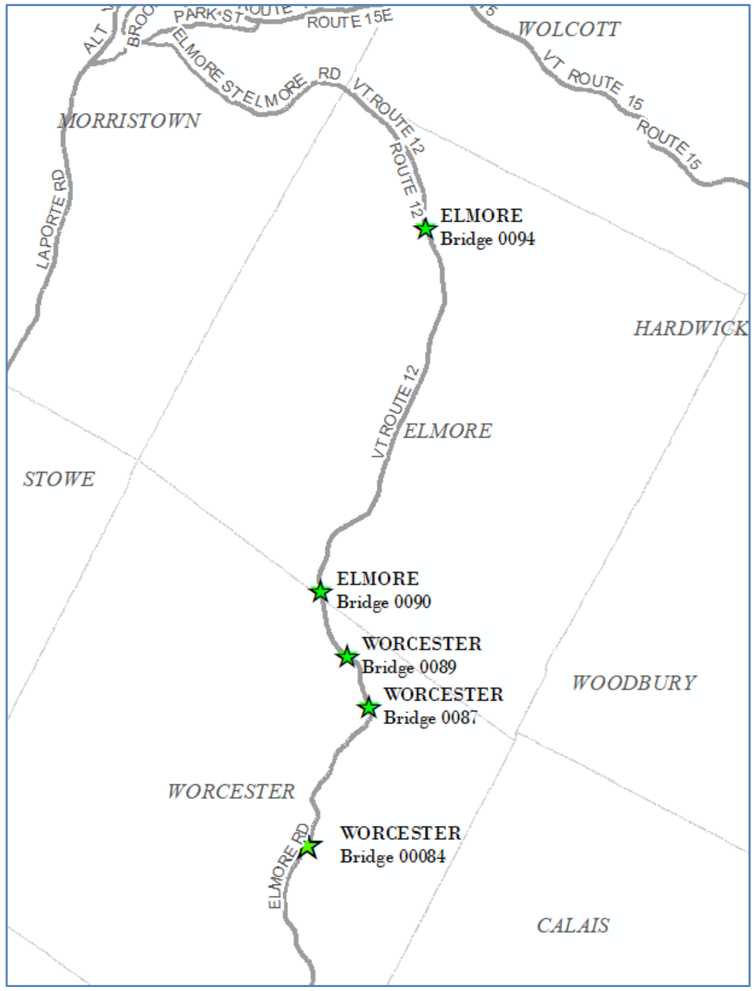
Structure:
While the culvert is in fair condition with no distortion, the invert is deteriorated along approximately half the length of the culvert. An invert repair would extend the life of the culvert approximately 20 more years, however the substandard bankfull width and wildlife crossing potential would not be addressed with an invert repair. The existing culvert is 55 years old and has reached the end of its anticipated design life, and replacement with a hydraulically adequate structure is recommended.

Due to the span and rise of existing culvert along with the required length of a new buried structure, a new bridge is more cost effective than a new buried structure.

The new bridge will have a rail-to-rail width of 30-feet, to match the existing conditions. This exceeds the minimum standards as set forth in the Vermont State Standards. A minimum bridge span of approximately 45-feet is recommended based on the required clear span. If the site is found to be conducive to an integral abutment bridge, then a longer span would be anticipated. The new structure will meet the minimum hydraulics standards and will also satisfy Aquatic Organism Passage (AOP) and wildlife crossing needs.

Traffic Control:
The regional detour routes available have an end-to-end distance of approximately 60 miles, with no local bypass routes available. This distance is considered relatively long for a detour route, and as such, traffic should be maintained through the project area. The recommended method of traffic control is to either construct a temporary bridge to one side of the existing roadway or to construct the new bridge in phases. Phased construction would require the roadway though the project area to be widened slightly during construction. After the new bridge is constructed on the existing alignment, the existing culvert, additional fill, and temporary bridge or widened section will be removed.

Coordination with other projects:
There are several projects in the State Highway Bridge Program within the project area that are currently in the scoping phase of project development. The projects are as follows:



- ELMORE BF 0241(55) 19B212, VT Route 12, Bridge 94 over unnamed brook.
- ELMORE STP CULV(64) 18B003, VT Route 12, Bridge 90 over unnamed brook.
- WORCESTER BF 0241(56) 19B213, VT Route 12, Bridge 87 over Hardwood brook.
- WORCESTER BF 0241(57) 19B214, VT Route 12, Bridge 89 over North brook.
- WORCESTER BF 0241(59) 86E053, VT Route 12, Bridge 84 over the north branch of Winooski river

Consideration should be given to bundling these projects for design and/or construction.

VIII. Appendices

- Appendix A: Site Pictures
- Appendix B: Town Map
- Appendix C: Bridge Inspection Report
- Appendix D: Hydraulics Memo
- Appendix E: Preliminary Geotechnical Information
- Appendix F: Resource ID Completion Memo
- Appendix G: Natural Resources Memo
- Appendix H: Archeology Memo
- Appendix I: Historic Memo
- Appendix J: Hazardous Sites Map
- Appendix K: Community Input
- Appendix L: Operations Input
- Appendix M: Crash Data
- Appendix N: Utility Resource Identification
- Appendix O: Detour Routes
- Appendix P: Plans

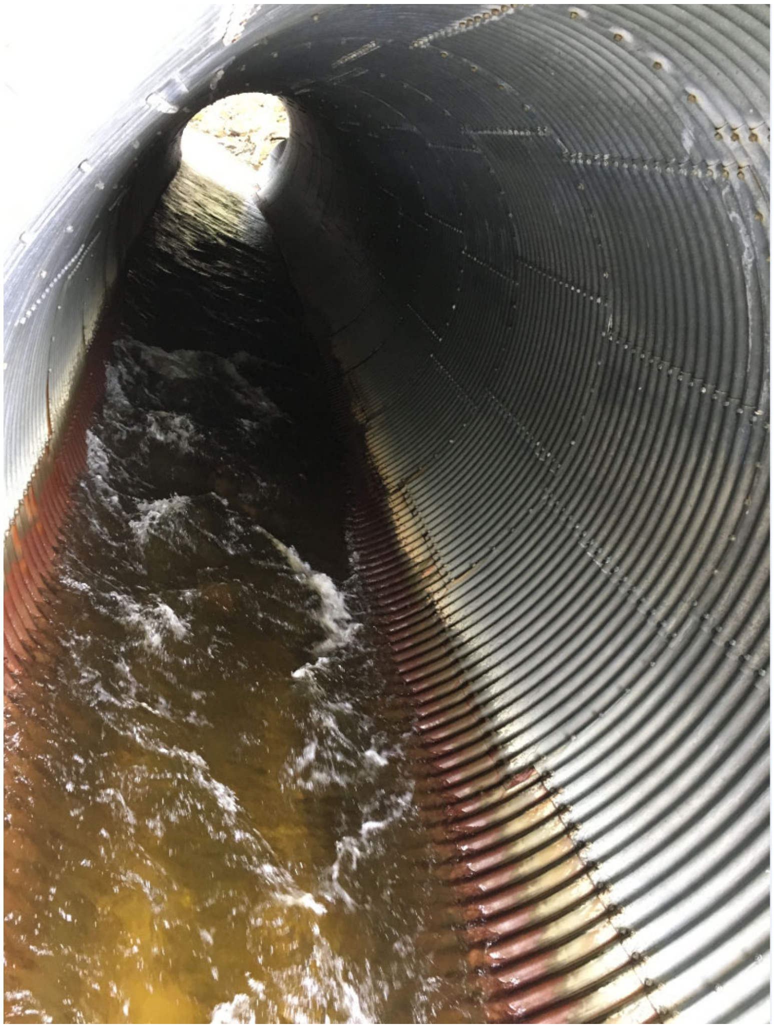
Appendix A: Site Pictures


Picture 1: Looking North on VT Route 12 over Bridge 89


Picture 2: Looking South on VT Route 12 over Bridge 89


Picture 3: Culvert Inlet

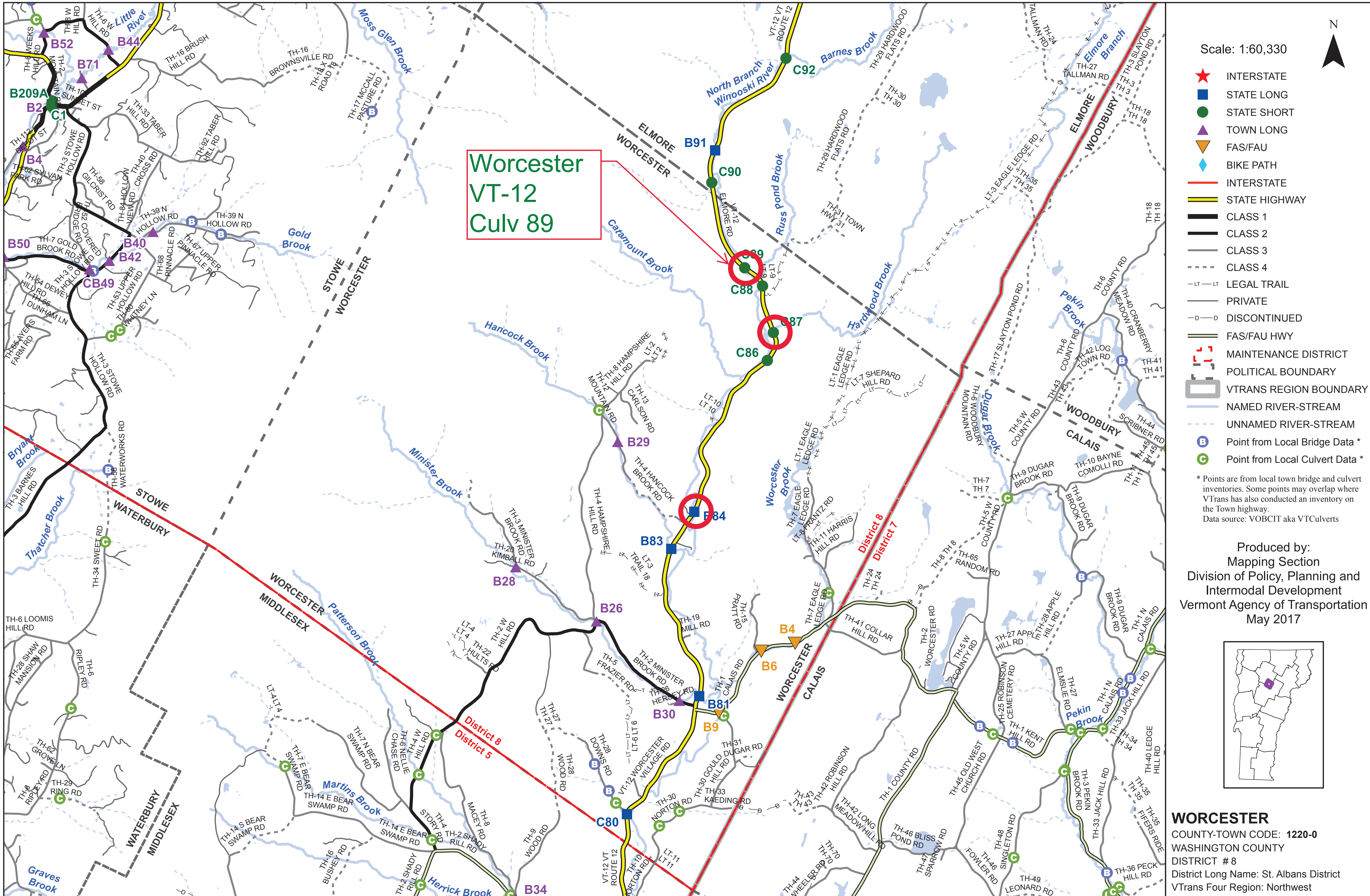

Picture 4: Culvert Outlet


Picture 4: Culvert Barrel


Picture 5: Looking Downstream (Note Scour Pool)


Picture 6: Looking Upstream

Appendix B: Town Map



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 C: Bridge Inspection Report

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation ~ Structures Section ~ Bridge Management and Inspection Unit

Inspection Report for WORCESTER **bridge no.:** 0089 **District:** 8

Located on: VT12 **over** NORTH BROOK **approximately** 5.3MI NORTH SA1 CALA **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 6 SATISFACTORY

Culvert Rating: 5 FAIR

Federal Str. Number: 300241008912201

AGE and SERVICE

Year Built: 1964 **Year Reconstructed:** ____

Type of Service On: 1 HIGHWAY

Type of Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 4

ADT: 1000 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 15

Structure Length (ft): 15

Lt Curb/Sidewalk Width (ft): 0

Rt Curb/Sidewalk Width (ft): 0

Bridge Rdwy Width Curb-to-Curb (ft): 0

Deck Width Out-to-Out (ft): 0

Appr. Roadway Width (ft): 30

Skew: 55

Bridge Median: 0 NO MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 16 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPP

Number of Main Spans: 1

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: N NOT APPLICABLE

Type of Wearing Surface: N NOT APPLICABLE

Type of Membrane: N NOT APPLICABLE

Deck Protection: N NOT APPLICABLE

CULVERT GEOMETRIC DATA and INDICATORS

Culvert Barrel Length (ft): 172

Average Cover Over Culvert (ft): 03

Waterway Area Through Culvert (sq.ft.): 177

Wingwall/Headwall Rating: 6 SATISFACTORY CONDITION

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 112016 **Inspection Frequency (months):** 60

INSPECTION SUMMARY and NEEDS

11/23/2016 - The invert has some holes and undermining has started at the outlet. This culvert is large and would be costly to replace when a new invert would give the structure years of service. JAS

09/28/11 The pipe is in satisfactory condition. with moderate rust scale and a few small holes in the invert at the outlet end. DP & JM

Culvert is in good condition. 07/13/06

Appendix D: Hydraulics Memo

State of Vermont
Structures and Hydraulics Section
One National Life Drive
Montpelier, Vermont 05633-5001
vtrans.vermont.gov

[phone] 802-371-7326
[fax] 802-828-3566
[ttd] 800-253-0191

Agency of Transportation

TO: Laura Stone, Structures, Scoping Engineer

CC: Nick Wark, Hydraulics Engineer

FROM: Jeff DeGraff, Hydraulics Project Engineer

DATE: June 2, 2020

SUBJECT: Worcester BF 0241(57) pin #19B214
Worcester, VT-12 Br89, over North Branch Winooski River
Site location: MM 7.012
Coordinates: 44.440925, -72.540059

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

On 12/11/19 we met with ANR at the site. In an email on 12/12/19 they indicated a minimum span of 42-feet should be used to span bankfull width (BFW).

Design Storm Flow is 2% AEP (Q50).

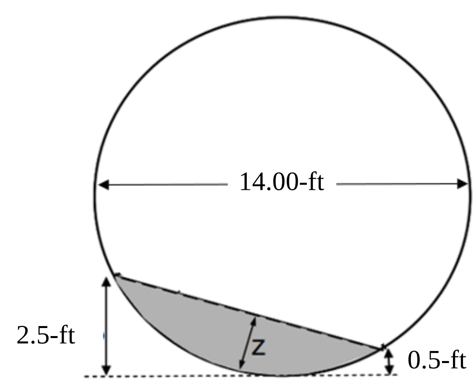
The following options were analyzed:

Existing Conditions: 15-ft span by 20-ft rise vertical elliptical corrugated metal pipe Culvert

- Provides a Headwater to Depth ratio (HW/D) of 0.58 and 0.61 during the design and check storm event, respectively. Headwater depths of 11.64-ft and 12.22-ft were determined during the design and check storm event, respectively.
- The existing culvert meets the current hydraulic standards

Option 1: Rehabbed Existing Culvert (Slip Lined w/ Fish Baffles)

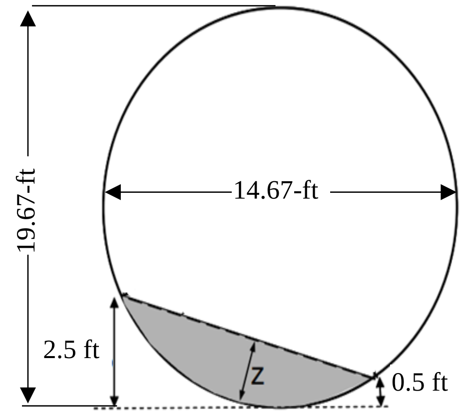
- This analysis assumed that the culvert is to be slip lined with a 14.0-ft CMP.
- Assumes that a rock weir will be required.
- The analysis assumed that fish baffles to be installed at 14.5-ft spacing with minimum and maximum height of 0.5-feet and 2.5-feet, respectively (as seen in Option 1).
- The installation of fish baffles would allow for adequate fish passage for Adult Brook Trout.
- The HW/D ratio would increase to 0.85 and 0.98 during the 2% and 1 % AEP, respectively. Headwater depths of 12.02-ft and 13.69-ft were determined during the design and check storm event, respectively.



Option 1: Typical Section

Option 2: Rehabbed Existing Culvert (Spray Lined w/ Fish Baffles)

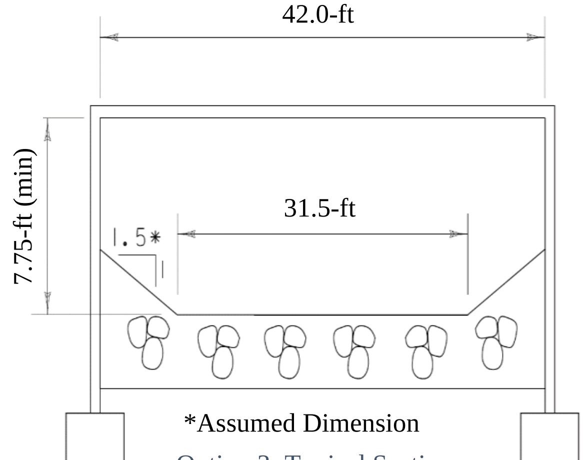
- This analysis assumed that the culvert is to be lined with a 2.0-inch thick liner which would provide a 14.67-ft span by 19.67-ft rise.
- Assumes that a rock weir will be required.
- The analysis assumed that fish baffles to be installed at 7.5-ft spacing with minimum and maximum height of 0.5-feet and 2.5-feet, respectively (as seen in Option 2)
- The installation of fish baffles would allow for adequate fish passage for Adult Brook Trout
- The HW/D ratio would increase to 0.59 and 0.65 during the 2% and 1 % AEP, respectively. Headwater depths of 11.65-ft and 12.87-ft were determined during the design and check storm event, respectively.



Option 2: Typical Section

Option 3: Bridge (3 sided), 42-foot span x 7.75-foot clear height w/sloping fill

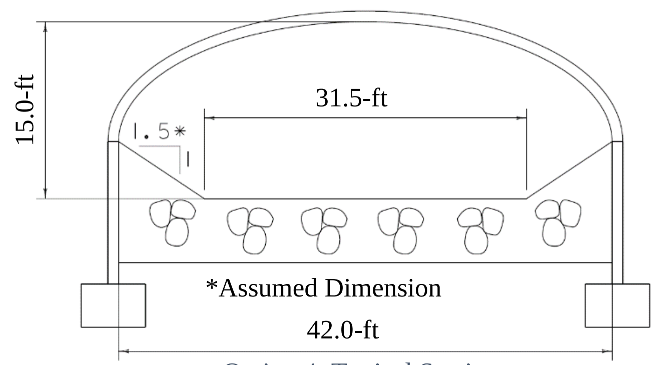
- There is approximately 1.4-feet of freeboard at the design AEP, providing a minimum waterway area of 275.6 sq. ft ±.
- E-Stone, Type IV will need to be used to grade the channel through this structure
- Stone Fill, Type IV shall be used to protect any disturbed channel banks or roadway slopes at the structure’s inlet and outlet
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew



Option 3: Typical Section

Option 4: Arch Bridge, 42-foot span x 15.0-foot clear height w/sloping fill

- There is approximately 8.6-feet of freeboard at the design AEP, providing a minimum waterway area of 450.6 sq. ft ±.
- E-Stone, Type IV will need to be used to grade the channel through this structure
- Stone Fill, Type IV shall be used to protect any disturbed channel banks or roadway slopes at the structure’s inlet and outlet
- Does not increase the 100-year base flood elevations
- Assumes no changes to the existing structure alignment/skew



Option 4: Typical Section

If the Existing crossing were to be slip- or spray lined and retrofitted with baffles (Option 1 and 2), fish passage standards may be met. However, the existing crossing currently prohibits sediment continuity and hinders channel equilibrium. For these reasons, a replacement in-kind option is not recommended. If Option 1 or Option 2 are a preferred option, further environmental coordination is recommended. In addition, if Option 2 is chosen as the preferred alternative, a Computational Fluid Dynamics Model is recommended to be developed to optimize the baffle geometry and spacing.

Options 3 and 4 meet or surpass the current hydraulic standards, as well as minimum bankfull width criteria.

For Option 4, a CON\SPAN Series O-700 type arch bridge was assumed to be used during final design. If an arch type bridge is selected, a 7.75-ft minimum clear height is recommended.

Historical borings and geomorphic assessments are not available for this site. Therefore, a preliminary scour analysis was not performed as part of this study. However, a head cut propagating upstream through the bridge is possible due to the downstream scour pool with a bottom pool elevation of approximately 981.7-ft. The proposed stream invert at the outlet was assumed to be 988.0-ft. If head cut were to occur, there would potentially be 6.3-ft of scour or more. Ledge outcrops are found just upstream of the inlet of the existing culvert which indicates that there is a variable ledge profile.

For preliminary design assume that the bottom of footing elevation is 6.5-ft below the streambed or founded on ledge. With that said, a larger E-Stone may be needed to protect the outlet from scouring during the design and check event to adequately dissipate and/or mitigate excessive outlet velocities. Further analysis and stone sizing and/or energy dissipation design will be required during the final design phase of this project as the proposed crossing slope effects hydraulic characteristics. A final scour analysis will be performed during the final design phase.

This study also analyzed a "natural channel" with a bottom width of 22-ft with side slopes of 2.5:1 (not shown in this memo) to determine if a 42-ft bankfull width was representative for this crossing and how sediment continuity and channel equilibrium may be affected. Based on the natural channel analysis, sediment continuity and channel equilibrium did not appear to be adversely affected. If a shorter span structure would significantly decrease the construction costs, further environmental coordination is strongly recommended.

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 E: Preliminary Geotechnical Information

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Nick Wark, P.E., P.I.I.T. Program Manager

END CEE

From: Eric Denardo, P.E., Geotechnical Engineer, via Callie Ewald, P.E.

Date: December 11, 2019

Subject: Worcester BF 0241(57) - Preliminary Geotechnical Information

1.0 INTRODUCTION

We have completed our preliminary geotechnical investigation for the replacement of Bridge No. 89 on VT Route 12 located approximately 5.3 miles north of the intersection of VT Route 12 and State Aid Road 1 (Calais Road). The subject project consists of replacing or rehabilitating the existing culvert. The existing structure is a corrugated galvanized metal plate pipe arch culvert. The project is currently in the scoping phase. This review included the examination of as-built record plans, historical in-house bridge boring files, water well logs and hazardous site information on-file at the Agency of Natural Resources, published surficial and bedrock geologic maps, and observations made from previous inspections, and site photos.

2.0 SUBSURFACE INFORMATION

2.1 Published Geologic Data

Published data indicates that soils at the site generally consist of Glaciofluvial Lake Gravel (Doll, 1970) underlain by the Pinstriped Granofels and Quartzite member of the Moretown Formation (Ratcliffe, et. al, 2011).

The Agency of Natural Resources (ANR) documents and publishes all water wells that are drilled for residential or commercial purposes. Published online, these logs may provide general characteristics of the soil strata in the area. No water wells were located within an approximate 500-foot (ft) radius of the project.

The Geotechnical Engineering Section maintains a GIS based historical record of subsurface investigations, which contains electronic records for the majority of borings completed in the past 10 years. An exploration of this database revealed no projects within a half mile radius.

2.2 Hazardous Materials and Underground Storage Tanks

The ANR Natural Resource Atlas also maps the location and information of known hazardous waste sites and underground storage tanks. The location of this project is not on the Hazardous Site List and no hazardous sites or underground storage tanks were identified in a 1-mile radius of the culvert.

Record Plans

An investigation into records plans for the construction of the culvert was also a part of this research. Record plans were available from the original construction of the culvert in 1964 however, the plans did not include any borings or subsurface information. The plans detail dowels under the inlet and outlet wingwalls if ledge is encountered.

3.0 FIELD OBSERVATIONS

A site investigation was not conducted by Geotechnical Section staff for this project; however, photos from a site visit done by the Structures Section, bridge inspection photos, and satellite imagery were reviewed to evaluate feasibility of boring operations and assess general site conditions as they relate to the proposed project.

No overhead utilities are present at the site. Based on photos from the site there appears to be exposed bedrock at both the inlet and the outlet of the culvert as shown in Figures 3.1 and 3.2, respectively. It looks as if there is access near the inlet and outlet for a drill rig in order to perform borings outside of the roadway, as shown in Figure 3.3.

Figure 3.1: *Exposed bedrock in the area of the inlet. [Structures photo dated April 2019]*

Figure 3.2: *Bedrock in the area of the outlet. [Google Earth image July 2012]*

Figure 3.3: *Space to perform borings outside of the roadway.*
[Structures photo dated April 2019]

4.0 PRELIMINARY FOUNDATION ALTERNATIVES

Based on the available existing information reviewed during this investigation, if a new structure is proposed, options for a replacement include a new corrugated galvanized metal plate pipe culvert, a reinforced concrete box culvert with new headwalls and wingwalls, or a precast or steel arch with spread footings founded on soil or rock. Depth and condition of the foundation soils and bedrock will need to be identified during the subsurface investigation.

5.0 PROPOSED SUBSURFACE INVESTIGATION

If a full replacement of the culvert is selected, we recommend a minimum of two borings be advanced with one at the inlet and one at the outlet in order to more fully assess the subsurface conditions at the site including, but not limited to, the soil properties, groundwater conditions, and depth to bedrock. Shallow bedrock is anticipated, and additional borings or probes should be advanced in the roadway along the proposed culvert alignment to profile depth to rock. Borings can likely be advanced near the inlet and outlet due to the shallow slopes and additional probes can be performed in the roadway. The use of geophysical methods to better profile the bedrock should be considered and can used to augment the subsurface investigation.

6.0 CLOSING

When a design alternative as well as preliminary alignment has been chosen, the Geotechnical Engineering Section should be contacted to help design a subsurface investigation that efficiently gathers adequate information for the alternative chosen.

If you have any questions or would like to discuss this report, please contact us by phone at (802) 828-2561.

7.0 REFERENCES

Doll, C. G., 1970, Surficial Geologic Map of Vermont, Vermont Geological Survey, Montpelier, VT.

Ratcliffe, N. M., Stanley, R. S., Gale, M. H., Thompson, P. J., Walsh, G. J., 2011, Bedrock Geologic Map of Vermont, Vermont Geological Survey, Montpelier, VT.

Vermont Agency of Natural Resources Department of Environmental Conservation, Natural Resources Atlas, www.anr.vermont.gov/maps/nr-atlas%20, accessed 12/4/2019.

cc: Laura Stone, P.E., PIIT Project Engineer
Electronic Read File
Project File/CEE
END

Appendix F: Resource ID Completion Memo

OFFICE MEMORANDUM

AOT - PDB - ENVIRONMENTAL SECTION

RESOURCE IDENTIFICATION COMPLETION MEMO

TO: Laura Stone, Project Manager
FROM: Jeff Ramsey, Environmental Specialist Supervisor
DATE: November 5, 2019
Project: Worcester BF 0241 (57)

ENVIRONMENTAL RESOURCES:

	Yes	No	
Archaeological Site:		X	See Archaeological Resource ID Memo
Historic/Historic District:		X	See Historic Resource ID Memo
Wetlands:		X	See Natural Resources Assessment Report
Agricultural Land:		X	See Natural Resources Assessment Report
Fish & Wildlife Habitat:	X		See Natural Resources Assessment Report
Wildlife Habitat Connectivity:	X		See Natural Resources Assessment Report
Endangered Species:	X		See Natural Resources Assessment Report
Stormwater:		X	
6(f) Property:		X	
Hazardous Waste/ ANR Urban Background Soils:		X	
USDA-Forest Service Lands:		X	
Scenic Highway/ Byway:		X	
Act 250 Permits:		X	
FEMA Floodplains:	X		
Flood Hazard Area/ River Corridor:	X		A Flood Hazard Area River Corridor permit may be required.
US Coast Guard:		X	
Lakes and Ponds:		X	
303D List/ Class A Water/ Outstanding Resource Water:		X	
Surface and Ground Water (SPA) Source Protection Area:		X	
Groundwater Classification:		X	
Public Water Sources/ Private Wells:		X	
Other:		X	

cc:
Project File

Appendix G: Natural Resources Memo

Natural Resources Assessment Report for Vermont Agency of Transportation Worcester BF 0241 (57)

Worcester, Vermont

Prepared by:
Arrowwood Environmental, LLC

October 18, 2019

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON, VT 05462
(802 434-7276 FAX: (802) 329-2253

Natural Resources Assessment Report for
Vermont Agency of Transportation
Worcester BF 0241 (57)

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Natural Resources Assessment Report for
Vermont Agency of Transportation
Worcester BF 0241 (57)

I. Introduction and Project Description

Arrowwood Environmental, LLC (AE) was retained by the Vermont Agency of Transportation to perform a natural resources assessment for the proposed Culvert 89 project between mile marker 7.1 and mile marker 7 along Route 112 in Worcester, Vermont. The study area for the assessment is shown in Appendix 2 on the Resource Map.

The assessment consisted of a remote landscape analysis of the study area as well as a field assessment. The field assessment was conducted on September 10, September 13, and September 16, 2019. This Natural Resource Assessment Report summarizes the results of the remote analysis and field assessment.

II. Site Characterization

Ecologically the site is within the Northern Green Mountains biophysical region of the state (Thompson and Sorenson, 2000). The study area is located at approximately 1000 feet above mean sea level according to U.S. Geologic Survey ("USGS") topographic data. The mapped bedrock that is underlying the site is granofels and quartzite from the Moretown Formation. (Ratcliffe et al. 2011). The soils are primarily mapped as Stetson loam with Tunbridge-Lymon complex along the northern margin of the study area (NRCS Soil Survey). The surrounding landscape is dominated by forest land.

Much of the study area consists of mowed roadside dominated by herbaceous vegetation. The upland forests in the study area consist of Hemlock-Northern Hardwood forests and Northern Hardwood Forests.

III. Wetlands

The wetland assessment involved both a remote review of available maps (including Vermont Significant Wetland Inventory Maps and the NRCS Soil Survey) and a field inventory component conducted on September 10, 2019. The protocols put forth in the USACE's *Corp of Engineers Wetlands Delineation Manual* (2009 Regional Supplement for the Northcentral and Northeast Region) were employed for delineating wetlands as is the standard practice in Vermont. No wetlands were mapped within the study area.

IV. Rare, Threatened and Endangered Species

The RTE species review involved both a remote review of available digital maps for the study area as well as a field survey. AE reviewed digital orthophotography, the NRCS Soil Survey, the 2011 Bedrock Geologic Map of Vermont and the Wildlife Natural Heritage Inventory (NHI) Rare, Threatened and Endangered Species digital database.

In reviewing the NHI digital database, there are no records or occurrences of RTE plant or animal species in or directly adjacent to the study area.

Plant Species

An inventory for RTE and uncommon plant species was undertaken in the study area on September 13, 2019. No RTE or uncommon plant species were identified during the survey of the project area. A list of all plant species documented during the inventory is included in Appendix 3.

Animal Species

The Northern Long Eared Bat (*Myotis septentrionalis*, MYSE) became a federally listed endangered species in May of 2015. The State of Vermont has determined that project clearing greater than 1% of the total forested area within a 1 square mile radius of a project triggers greater review for habitat loss for this endangered species. Although the specific details of the proposed project at this location are unknown, it is located in an extensively forested environment with approximately 1750 acres of forest within a 1 mile radius. The Project would require more than 17.5 acres of clearing before reaching the 1% threshold triggering MYSE related restrictions or further review.

The study area was reviewed for the presence of trees that may provide potential summer roost habitat for MYSE. Eight trees with features that could support MYSE roosting were documented during the field investigation. Although project clearing is unlikely to trigger MYSE related restrictions or further review, the preservation of these potential roost trees would help insure avoidance of any impacts to MYSE.

No other RTE animal species are documented nearby or are expected to be impacted by the proposed project.

V. Non-Native Invasive Species (NNIS)

A non-native invasive plant species is considered to be a species which has become established outside of its native range and grows aggressively enough to threaten native ecological communities. For the purposes of this study, a NNIS plant is any species listed as a Class A or Class B noxious weed by the Vermont Noxious Weed Quarantine Rule or a plant on the Vermont Invasive Exotic Plant Committee Watch List. An inventory for non-native invasive plant species was conducted on September 16, 2019.

Five NNIS species comprising ten discrete populations were identified and mapped in the study area. The following is a summary of those findings.

N-1	*Hesperis matronalis*	dame's rocket	scattered plants on riprap embankment
N-2	*Anthriscus sylvestris*	wild chervil	1 plant
N-3	*Fallopia japonica*	Japanese knotweed	80% cover along road edge
N-4	*Anthriscus sylvestris*	wild chervil	40% cover at culvert basin
N-5	*Phalaris arundinacea*	reed canary grass	10% cover around small culvert basin/ditch
N-6	*Pastinaca sativa*	parsnip	2 plants along roadside
N-7	*Phalaris arundinacea*	reed canary grass	9 plants, small patch on embankment
N-8	*Fallopia japonica*	Japanese knotweed	95% cover, patch on river island
N-9	*Fallopia japonica*	Japanese knotweed	100% cover, west and in channel
N-10	*Phalaris arundinacea*	reed canary grass	10% cover in ditch

VI. Streams

The stream assessment involved both a remote review of the USGS topographic map, Vermont Hydrography Dataset (streams, rivers, and waterbodies), LiDAR derived elevation data, and field investigation on September 10, 2019. The North Branch Winooski River and a small unnamed tributary stream were mapped in the study area and are summarized below. Stream data summaries are provided in Appendix 4.

North Branch Winooski River: The project structure crosses the North Branch Winooski River. In the project area, the North Branch is characterized as a step-pool system with both bedrock and cobble substrate. The estimated bankfull channel width is approximately 30'to 40' (upstream to downstream in the study area). The stream banks have been riprapped upstream of the undersized culvert and there is a scour pool present downstream of the culvert.

Unnamed Tributary Stream: An unnamed tributary stream to the North Branch Winooski River was mapped in the north eastern project area. The small intermittent stream is a step-pool system with cobble and course gravel substrate. The measured bankfull channel width is approximately 2'. The stream originates from the steeply sloped forest to the northeast of the study area and flows into the roadside drainage system.

VII. Wildlife Habitat and Habitat Connectivity

The wildlife habitat assessment involved both a remote review of available digital maps for the study area and a field inventory component. A remote review of available digital databases was conducted to identify potentially necessary wildlife habitat within the study area and within the vicinity of the study area.

There are no mapped Vt. Fish and Wildlife deer winter habitats in the study area and field investigation confirmed the absence of deer wintering areas or significant deer activity within the study area.

Vt. Fish and Wildlife identifies the study area as a Highest Priority wildlife crossing and Highest Priority surface water and riparian area in the Vt. Conservation Design Community and Species Scale Components. The forest surrounding the study area is unfragmented with varying habitat types and considerable compositional and structural diversity. The roadway cuts tightly through the surrounding forest with some elevation changes between road edge and forest, but no significant barriers to habitat connectivity in the surrounding landscape. In, and directly adjacent to, the stream itself forest cover is dense and provides excellent protected movement opportunities for wildlife. The structure is significantly undersized in relation to the channel width resulting in minimal terrestrial wildlife passage value, especially when combined with a fairly deep outlet pool. In the coldest weather, the pool may partially freeze at the structure outlet, but the narrow culvert likely results in continual flow and open water at its outlet that may make it unappealing as a road crossing alternative for many terrestrial wildlife species. Riparian associated species such as mink, otter and beaver probably pass through the structure in all seasons to avoid climbing the embankment and crossing the road. The concentrated flow through the undersized culvert eliminates development of bed features or sediment retention. This, coupled with the structure outfall elevated off the streambed, functionally reduces this structure for aquatic organism passage. New site and structure design should consider retention and enhancement of the surrounding forest and seek to improve aquatic organism as well as terrestrial wildlife passage potential through the structure.

Concentrated amphibian crossing areas occur when different amphibian habitat features are separated from each other by roads. Typical habitat features include wetland/vernal pool breeding habitats and upland habitats, or, in some cases, different wetland feeding habitats. Movement typically occurs on warm rainy nights in the spring and early summer. Depending on surrounding land-use and the position of the different habitat features, this amphibian movement can be concentrated and involve hundreds or thousands of individuals. When this concentrated movement occurs across a busy road, mass mortality of amphibians can occur. While minor amphibian movement can occur scattered across the landscape, this movement rarely results in mass amphibian mortality or traffic difficulties. For this reason, it is the concentrated amphibian crossing areas that are of a concern.

There are no wetlands or vernal pools in the project study area or immediate vicinity, therefore concentrated amphibian crossing areas are not of concern.

Stream salamanders are likely present in the study area along the North Branch. Based on the habitats present, these species likely include spring salamanders (*Gyrinophilus porphyriticus*), northern dusky salamanders (*Desmognathus fuscus*) and northern two-lined salamanders (*Eurycea bislineata*). For these species only limited movement occurs outside of the river corridor and mass migrations do not occur. Since these species rarely cross roads, they do not pose a management concern as concentrated amphibian crossing areas. However, since they do migrate within the stream corridor, management for these species at road crossings is best achieved by adhering to the AOP Guidelines for culvert and bridge construction.

VIII. Agricultural Soils

The agricultural soils assessment involved a remote review of the NRCS County Soil Survey for the Project area. Primary agricultural soils were not identified in the Project area. The soils are primarily mapped as Stetson loam with Tunbridge-Lymon complex along the northern margin of the study area (NRCS Soil Survey). These soils are considered high erodible.

Appendix 1

Photo Log

Structure 89 Inlet
September 10, 2019

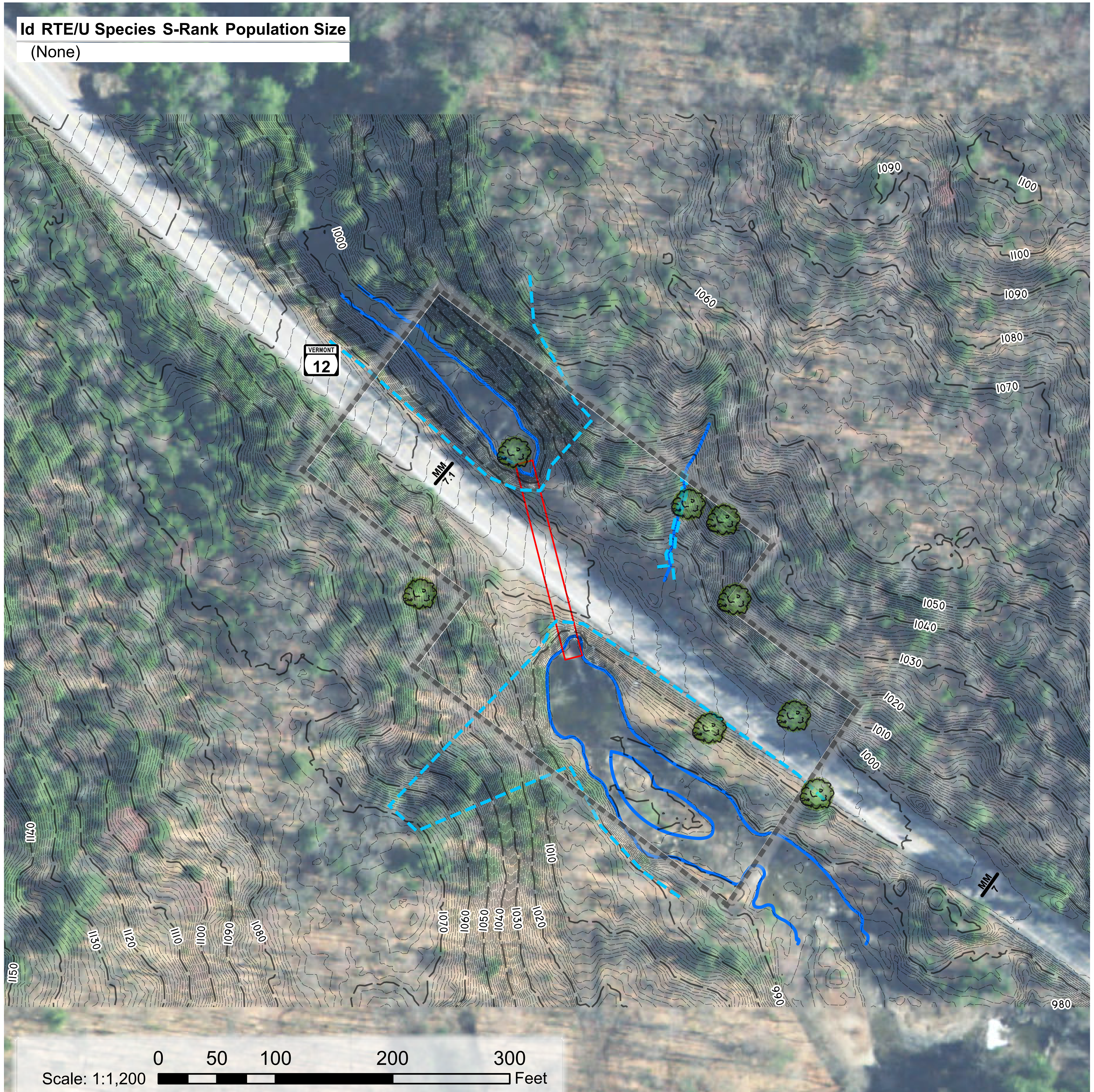
Structure 89 Outlet
September 10, 2019

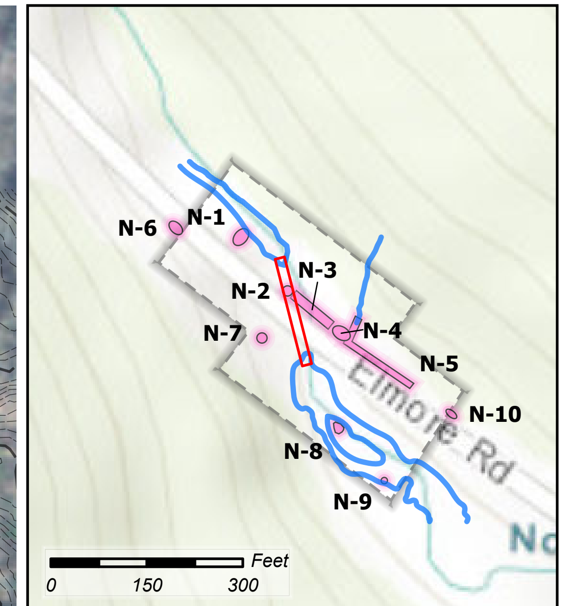
Unnamed Tributary Stream
September 10, 2019

Potential Bat Roost Tree
September 10, 2019

Appendix 2

Resource Map



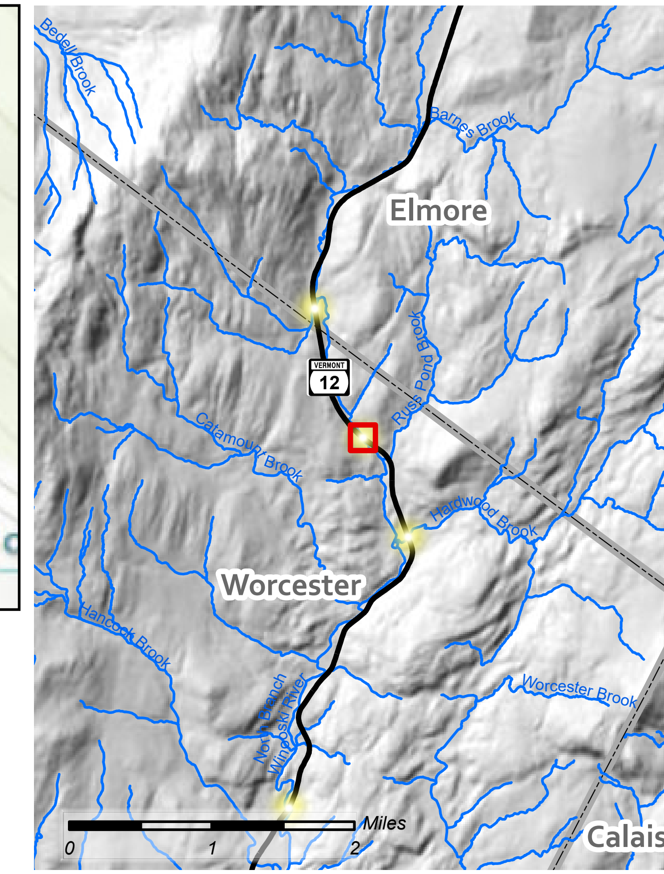


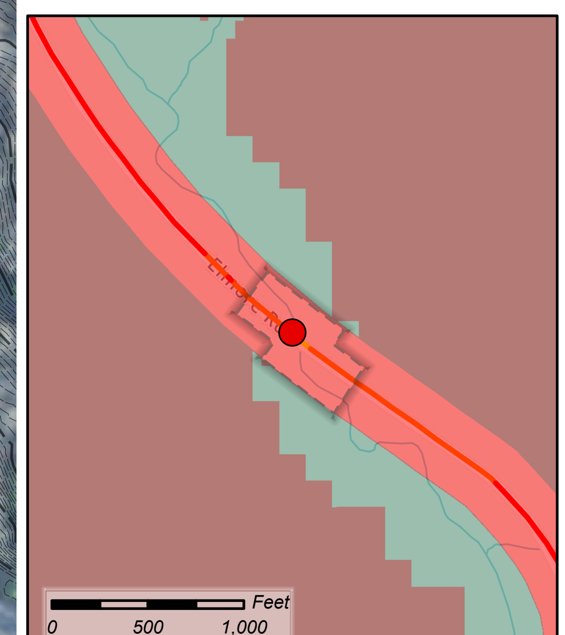
Non-native Invasive Species (NNIS)

Prime Ag Soils: Statewide Ag Soils:

NNIS Populations at this Site

NNIS ID	Species	NNIS ID	Species
N-1	Hesperis matronalis	N-5	Phalaris arundinacea
N-10	Phalaris arundinacea	N-6	Pastinaca sativa
N-2	Anthriscus sylvestris	N-7	Phalaris arundinacea
N-3	Fallopia japonica	N-8	Fallopia japonica
N-4	Anthriscus sylvestris	N-9	Fallopia japonica





Vt. Conservation Design Elements

- Highest Priority Wildlife Crossings
- Highest Priority Surface Water and Riparian Areas
- Highest Priority Interior Forest Blocks

Combined Linkage Ratings

◀not impt. more impt.▶

- Mile Markers (VCGI)
- Study Area
- Structures
- Wetlands
- Stream or Edge of Water
- Stream Top-of-Bank
- RTE Plant: S1
- Uncommon Plant: S3
- Potential Bat Tree

NOTES: INFORMATION PROVIDED BASED ON REMOTE AND FIELD ASSESSMENT BY ARROWWOOD ENVIRONMENTAL, 2019. WETLANDS FIELD DELINEATED, FLAGGED AND FLAGS LOCATED WITH SUB-METER GRADE GPS BY ARROWWOOD ENVIRONMENTAL. STREAMS, TOP-OF BANK, PLANT POPULATIONS, WILDLIFE FEATURES, AND STRUCTURE LOCATIONS FROM SUB-METER GRADE GPS, FIELDNOTES, AND ANALYSIS OF AERIAL IMAGERY AND HIGH-RESOLUTION LIDAR TOPOGRAPHIC DATA.

OTHER DATA FROM VCGI, VT AGENCY OF NATURAL RESOURCES. CONTOUR INTERVAL 1' DERIVED FROM LIDAR-BASED ELEVATION MODELS PROVIDED BY VCGI. MILE MARKERS FROM VCGI LAYER TITLED:"VT_MILE_POINTS__110MILE". BACKGROUND IMAGERY- VCGI 2018.

Vt. Agency of Transportation: Worcester BF 0241(57). Statewide Natural Resource Services 2019

Monday, October 14, 2019 File: VtransNorthStructures Prepared By: A Worthley, Arrowwood Environmental Coordinate System: NAD 1983 StatePlane Vermont FIPS 4400

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON, VT 05462
(802) 434-7276 FAX: (802) 329-2259

Appendix 3

Plant Species List

Matt Peters
Consulting Ecologist & Botanist
Office: 802.456.1051 / Cell: 651.323.8234
1225 Foster Hill Rd – East Calais, VT 05650
peters.matt@yahoo.com

Plant Species List for VTrans Structure Worcester BF 0241 (57), Worcester, VT.

Survey Date: Sept. 13, 2019	**Red =invasive species**
Surveyor: Matt Peters	**Blue = RTE (S1, S2, T, or E) species**
Nomenclature follows Gilman. 2015. *New Flora of Vermont*	**Yellow = Uncommon (S3) species**
Scientific Name	**Common Name**
Abies balsamea	balsam fir
Acalypha rhomboidea	common three-seeded mercury
Acer pensylvanicum	striped maple
Acer rubrum	red maple
Acer saccharum	sugar maple
Acer spicatum	mountain maple
Achillea millefolium	yarrow
Agrimonia gryposepala	common agrimony
Agrostis gigantea	red-top
Alnus incana	gray alder
Ambrosia artemisiifolia	common ragweed
Amelanchier laevis	common shadbush
Anaphalis margaritacea	pearly everlasting
Anthoxanthum odoratum	sweet vernal grass
Anthriscus sylvestris	wild chervil
Arctium lappa	great burdock
Athyrium filix-femina	lady fern
Barbarea vulgaris	winter cress
Betula alleghaniensis	yellow birch
Betula papyrifera	paper birch
Betula populifolia	gray birch
Bidens frondosa	common beggar's-ticks
Bromus ciliatus	fringed brome
Bromus inermis	Hungarian brome
Calamagrostis canadensis	Canada bluejoint
Capsella bursa-pastoris	Shepherd's purse

Carex blanda	woodland sedge
Carex debilis	weak sedge
Carex gynandra	gynandrous sedge
Carex lurida	sallow sedge
Carex projecta	beaded broom sedge
Carex torta	twisted sedge
Centaurea jacea	brown knapweed
Cerastium fontanum	common mouse-ear chickweed
Cicuta bulbifera	bulbiferous water-hemlock
Cirsium vulgare	bull thistle
Clematis virginiana	virgin's-bower
Crepis capillaris	hawk's-beard
Cyperus esculentus	yellow nut-sedge
Dactylis glomerata	orchard grass
Danthonia compressa	flat-stemmed oat-grass
Daucus carota	Queen Anne's lace
Dennstaedtia punctilobula	hay-scented fern
Dichanthelium acuminatum	woolly panic grass
Dichanthelium clandestinum	deer-tongue
Diervilla lonicera	dwarf bush-honeysuckle
Digitaria sanguinalis	hairy crabgrass
Doellingeria umbellata	tall white aster
Dryopteris intermedia	intermediate woodfern
Elymus repens	witch grass
Epigaea repens	trailing arbutus
Epilobium ciliatum	ciliate willow-herb
Epipactis helleborine	helleborine
Equisetum arvense	field horsetail
Erigeron canadensis	horseweed

Eupatorium perfoliatum	boneset
Euphorbia maculata	spotted spurge
Euthamia graminifolia	grass-leaved goldenrod
Eutrochium maculatum	common Joe-Pye weed
Fagus grandifolia	American beech
Fallopia japonica	Japanese knotweed
Festuca rubra	red fescue
Fragaria virginiana	wild strawberry
Fraxinus americana	white ash
Galeopsis tetrahit	dead hemp-nettle
Galium mollugo	common bedstraw
Gaultheria hispidula	creeping snowberry
Gnaphalium uliginosum	low cudweed
Hesperis matronalis	dame's-rocket
Hieracium scabrum	rough hawkweed
Hypericum mutilum	dwarf St. John's-wort
Hypericum perforatum	common St. John's-wort
Juncus effusus	soft rush
Lactuca biennis	tall wild lettuce
Lathyrus sylvestris	flat pea
Leucanthemum vulgare	common daisy
Lotus corniculatus	bird's-foot trefoil
Luzula acuminata	hairy wood rush
Lycopus americanus	American water-horehound
Lysimachia borealis	starflower
Lysimachia terrestris	swamp-candles
Maianthemum canadense	Canada mayflower
Melilotus albus	white sweet clover
Muhlenbergia mexicana	wirestem muhly
Nabalus altissimus	tall white lettuce
Oclemena acuminata	whorled wood aster
Oenothera parviflora	small-flowered evening primrose
Onoclea sensibilis	sensitive fern
Osmunda claytoniana	interrupted fern
Osmunda regalis	royal fern
Oxalis montana	wood-sorrel
Oxalis stricta	tall yellow wood-sorrel
Panicum capillare	old witch-grass

Parathelypteris noveboracensis	New York fern
Pastinaca sativa	parsnip
Persicaria maculosa	lady's-thumb
Phalaris arundinacea	reed canary grass
Phegopteris connectilis	long beech fern
Phleum pratense	Herd's grass
Picea rubens	red spruce
Pilosella aurantiaca	orange hawkweed
Pilosella caespitosa	yellow king devil
Pinus resinosa	red pine
Plantago lanceolata	buckhorn plantain
Poa compressa	Canada bluegrass
Poa palustris	fowl meadow grass
Polygonatum pubescens	common Solomon's-seal
Polygonum aviculare	dooryard knotweed
Populus balsamifera	balsam poplar
Potentilla simplex	old-field cinquefoil
Prunella vulgaris	self-heal
Pteridium aquilinum	bracken
Ranunculus acris	common buttercup
Ranunculus hispidus var. caricetorum	swamp buttercup
Ranunculus repens	creeping buttercup
Rhus typhina	staghorn sumac
Rubus allegheniensis	common highbush blackberry
Rubus odoratus	flowering raspberry
Rubus pubescens	dwarf raspberry
Rumex obtusifolius	bitter dock
Salix bebbiana	Bebb's willow
Salix eriocephala	wand willow
Salix sericea	silky willow
Schedonorus arundinaceus	tall fescue
Scirpus atrovirens	dark bulrush
Scorzoneroides autumnalis	fall dandelion
Securigera varia	crown vetch
Setaria sp.	foxtail
Silene vulgaris	common bladder

	campion
Solidago altissima	tall goldenrod
Solidago canadensis	Canada goldenrod
Solidago flexicaulis	zig-zag goldenrod
Solidago gigantea	large goldenrod
Solidago juncea	early goldenrod
Solidago nemoralis	gray goldenrod
Solidago rugosa	rough-leaved goldenrod
Sonchus arvensis	sow thistle
Sorbus americana	American mountain ash
Spiraea alba	meadowsweet
Symphyotrichum lateriflorum	calico aster
Symphyotrichum puniceum	red-stemmed aster
Taraxacum officinale	common dandelion
Thalictrum pubescens	tall meadow-rue
Tiarella cordifolia	foam flower
Trifolium arvense	rabbit's-foot clover
Trifolium aureum	large hop clover
Trifolium pratense	red clover
Tsuga canadensis	eastern hemlock
Tussilago farfara	colt's-foot
Ulmus americana	American elm
Veratrum viride	Indian poke
Verbascum thapsus	common mullein
Verbena hastata	blue vervain
Vicia cracca	cow vetch
Total Species Richness	**154**

Appendix 4

Stream Summary Forms

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON, VT 05462
(802 434-7276 FAX: (802) 329-2259

Streams: Existing Condition Summary

October 18, 2019

Project: Worcester BF 0241 (57)

Stream ID:	North Branch Winooski River
Date(s) Observed:	9/16/19
Survey Type:	Rapid
Field Observations	
Observation Location:	LAT 44.440947 LONG -72.540062
Stream Type (typical):	Cascade☐ Step-Pool☒ Riffle-pool☐ Plane Bed☐ Ripple-dune☐ Braided☐
Dominant Sediment Size:	Bedrock☒ Boulder☐ Cobble☒ C-Gravel☐ F-Gravel☐ Silt/Sand☐
Average Bankfull Width:	Estimated☒ Measured☐ ~30' to 40' (upstream to downstream of culvert)
Flow Conditions:	Flowing☒ Pools☐ Damp☐ Dry☐ Prelim* Perennial☒ Intermittent☐
Slope/Confinement:	Not measured, stream is within a relatively confined valley within the study area
Field Comments:	There is rip rap present on the banks upstream of the undersized culvert and a scour pool present downstream of the culvert.
Other Data	
Watershed Size:	~9 square miles (ANR Atlas)
Approx. Elevation:	~1000ft

**preliminary assessment of flow regime based on field observations and professional judgement*

Photos

Scour pool downstream of culvert

Photo Date: 9/16/19

Upstream looking at culvert inlet

Photo Date:9/16/19

Stream ID:	Unnamed Tributary Stream			
Date(s) Observed:	9/16/19			
Survey Type:	Rapid			
Field Observations				
Observation Location:	LAT	44.440931	LONG	-72.539661
Stream Type (typical):	Cascade☐ Step-Pool☒ Riffle-pool☐ Plane Bed☐ Ripple-dune☐ Braided☐			
Dominant Sediment Size:	Bedrock☐ Boulder☐ Cobble☒ C-Gravel☒ F-Gravel☐ Silt/Sand☐			
Average Bankfull Width:	Estimated☒ Measured☐	~2’		
Flow Conditions:	Flowing☐ Pools☐ Damp☐ Dry☒	Prelim*	Perennial☐	Intermittent☒
Slope/Confinement:	Not measured			
Field Comments:	Small intermittent stream that originates in the steeply sloped forest to the northeast of the study area. Flows into roadside drainage system.			
Other Data				
Watershed Size:	Not measured			
Approx. Elevation:	~1000ft			

**preliminary assessment of flow regime based on field observations and professional judgement*

Photos

Photo Date: 9/16/19

Appendix H: Archeology Memo

VERMONT

Jeannine Russell
VTrans Archaeology Officer
State of Vermont
Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
802-477-3460 phone
Jeannine.russell@vermont.gov

Agency of Transportation

To: Jeff Ramsey, Environmental Specialist Supervisor

From: Jeannine Russell, VTrans Archaeology Officer

Date: August 12, 2019

Subject: Worcester BF 0241(57) – Archaeological Resource ID

VTrans proposes work on a culvert in the town of Worcester located along VT Route 12. The current scope and boundaries of the project are unknown. A circle with the culvert sitting at the center has been used for a stand in project area on the map provided. The VTrans Archaeology Apprentice was able to conduct a field visit on August 6th, 2019.

The project area is located at MM 7.012 along VT Route 12, about a mile south along the road of the Washington/Lamoille county border. The north branch of the Winooski River runs southwestward through the culvert and drains out into a small pond on the western side of the road.

The area on the east side of the road is mostly stream boulders and exposed bedrock. The area on the west side of the culvert is steep undisturbed land. There is a small triange-shapped plateau on the west side of the road that acts as a trail down to the culvert and appears disturbed from road construction and maintenance. No known precontact sites exist near the project area.

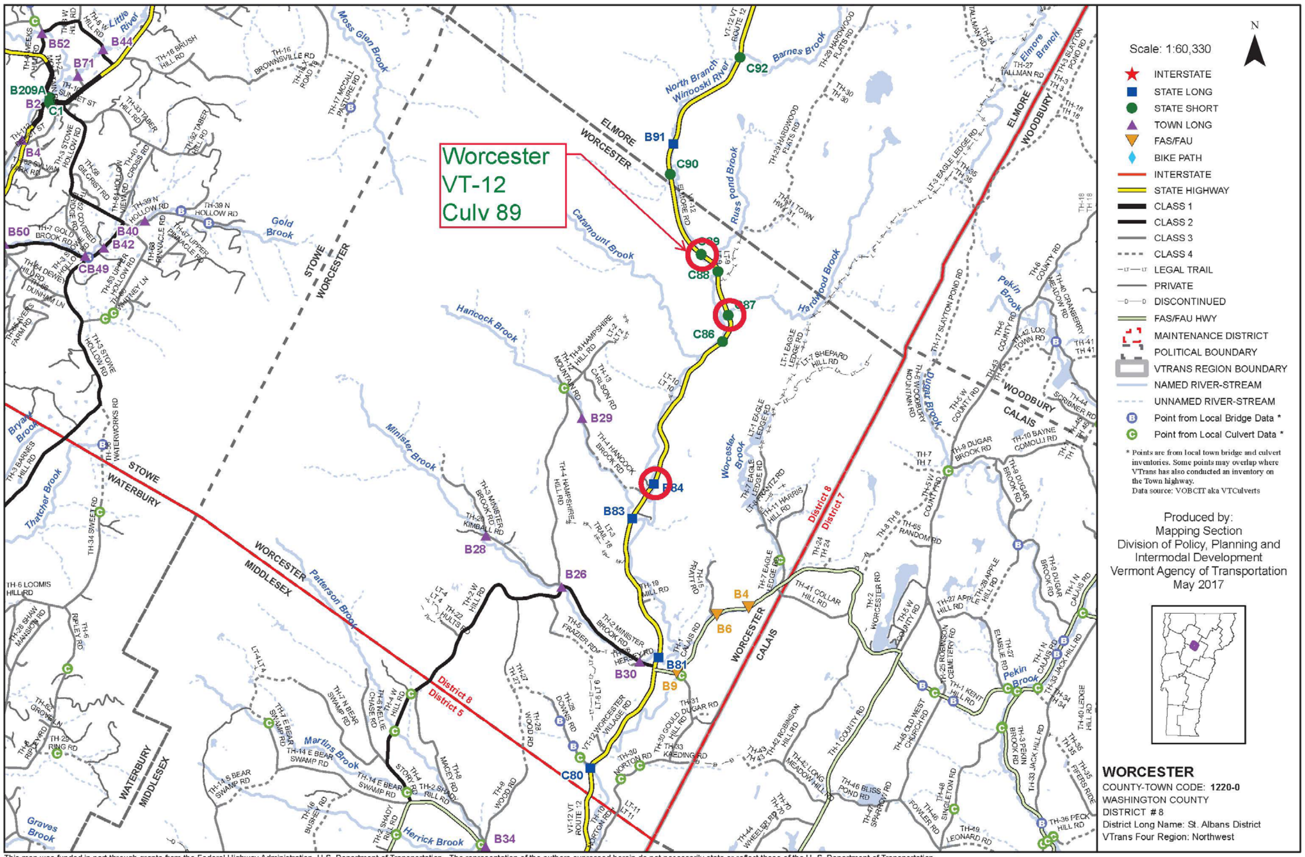
The project is not considered archaeologically sensitive. The score provided by the environmental predictive model for the project is -20, based on the river flowing through the culvert and the excessive sloping in the area. The surrounding area is mostly rocky streams and steep forested slopes with no other indicators of Native American presence.

In conclusion, there are no expected cultural resources within the area surveyed for resource ID. Supporting information including resource mapping and other images that provide context for the area can be found below.

Please let me know if you have any questions.

Thank you,
Jen Russell
VTrans Archaeology Officer

VTrans Working to Get You There
Vermont Agency of Transportation



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.

Project Location

ARA Map made using ArcMap

Photo of culvert from west side of the road

Western half of project area

Eastern half of project area

Eastern inlet of culvert

Appendix I: Historic Memo

VERMONT

State of Vermont *Agency of Transportation*

Gabrielle Fernandez
AOT Technical Apprentice IV
Gabrielle.Fernandez@vermont.gov
(802) 793-3738

Project Delivery Bureau - Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
vtrans.vermont.gov

Historic Resources Identification Memo

To: Jeff Ramsey, AOT Environmental Specialist
CC: Jeannine Russell, AOT Archaeology Officer
Reviewed By: Judith Ehrlich, AOT Historic Preservation Officer

Date: November 1, 2019

Subject: Worcester BF 0241(57) 19B214

I have completed the Resource Identification for Worcester BF 0241(57). At this time, one resource over fifty years of age was identified within the possible project area: culvert 89 in Worcester. In addition, one 4(f) resource was identified: the CC Putnam State Forest, which lies on the northeastern side of VT-12 within the survey area.

This Resource Identification effort is being undertaken to provide information to the VTrans designers working on a proposed improvement project. Toward that end, VTrans Cultural Resources staff have identified potential resources within a broad preliminary Area of Potential Effect to ensure the designers are aware of all cultural resources that could possibly be affected by a project. Once the project is defined at the Conceptual Design phase, Cultural Resources staff will be able to determine a formal Area of Potential Effect for purposes of Section 106 and 22 VSA § 14.

This Resource ID is being undertaken to identify cultural resources within a survey area that could possibly be impacted by a VTrans project on culvert 89 in Worcester (Figure 1). Once the project has been formally developed at the Conceptual Design phase, VTrans Cultural Resources staff will be able to determine a formal Area of Potential Effect for purposes of Section 106 and Section 4(f) responsibilities.

Culvert 89 is a metal culvert over the North Brook on VT 12 in Worcester (Figure 2), adjacent to the 4(f) resource, the CC Putnam State Forest. Built in 1964, this culvert meets the 50-year criteria for eligibility for the National Register. However, because of the condition of the culvert and the fact that it displays common materials, design, and construction, VTrans has determined that is not historic as it does not possess any qualities of significance necessary for inclusion in the National Register of Historic

Places individually or as a contributing resource to an existing or potential historic district under any applicable evaluation criteria. No other buildings, structures, or sites are within the survey area.

Please do not hesitate to contact me should you have any questions.

Attachments:
- Map
- Photos

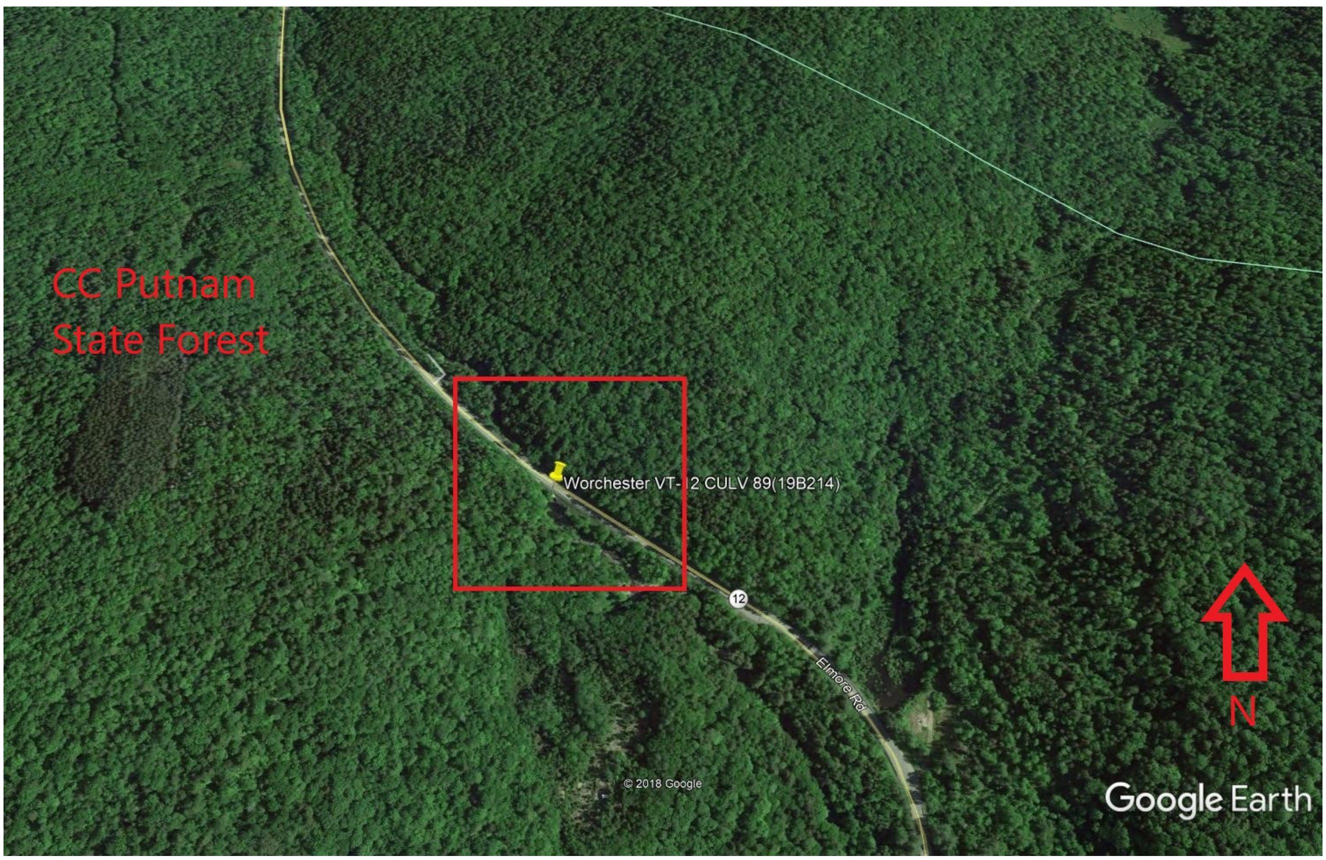


Figure 1: Google Earth view of the approximate survey area for Worcester BF 0241(57).

Figure 2: Culvert 89 in Worcester on VT-12.

Figure 3: Google Maps view of the survey area and culvert 89.

Appendix J: Hazardous Sites Map

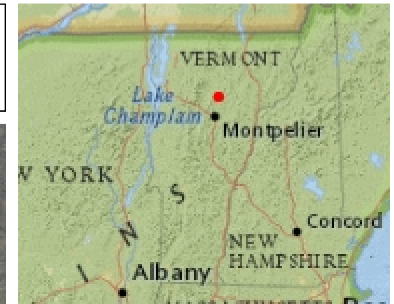
Haz Waste VT LRS

Vermont Agency of Natural Resources

vermont.gov

1: 10,757

August 21, 2019



LEGEND

Landfills
- OPERATING
- CLOSED

Land Use Restrictions
- Class IV GW Reclass
- Class VI GW Reclass
- Deed Restriction
- Easement
- Land Record Notice
- Other

Hazardous Site

Hazardous Waste Generators

Brownfields

Salvage Yard

Aboveground Storage Tank

Underground Storage Tank (w

Dry Cleaner

Urban Soil Background Areas

Roads
- Interstate
- Principal Arterial
- Minor Arterial
- Major Collector
- Minor Collector
- Local
- Not part of function Classification S

Waterbody

546.0 | 0 | 273.00 | 546.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere

1" = 896 Ft. 1cm = 108 Meters

© Vermont Agency of Natural Resources

THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

NOTES

Map created using ANR's Natural Resources Atlas

Appendix K: Community Input

Local & Regional Input Questionnaire

Project Summary

This project, BF 0241(57), focuses on culvert 89 on VT Route 12 in Worcester, Vermont. The culvert is deteriorating and is in need of either a major maintenance action or replacement. Potential options being considered for this project include a liner placed into the existing culvert, or a replacement of the existing structure on the existing alignment. It is possible that VTrans will recommend a road closure and detour traffic away from the project site for the duration of the work. Efforts will be made to limit the detour to State roads.

Community Considerations

1. Are there regularly scheduled public events in the community that will generate increased traffic (e.g. vehicular, bicycles and/or pedestrians), or may be difficult to stage if the culvert is closed during construction? Examples include annual bike races, festivals, parades, cultural events, weekly farmers market, concerts, etc. that could be impacted? If yes, please provide approximate date, location and event organizers' contact info.
   4th of July. Thursday, June thru September- Farmer's Market.

2. Is there a "slow season" or period of time from May through October where traffic is less or no events are scheduled?

   May-August
3. Please describe the location of the Town garage, emergency responders (fire, police, ambulance) and emergency response routes that might be affected by the closure of the culvert, one-way traffic, or lane closures and provide contact information (names, address, email addresses, and phone numbers.

   Brian Powers, brianpowers68@comcast.net 223-6942 11 Maxham Dr. is the highway dept: Will Sutton, wsznbvt@comcast.net 802-557-1037 20 Worcester Village Rd is the location of the fire dept.; Rt 12 is the only access for fire and rescue to reach homes north on Rt12. Highway is responsible to plow side roads only accessible from Rt12.
4. Are there businesses (including agricultural operations and industrial parks) or delivery services (fuel or goods) that would be adversely impacted either by a detour or due to work zone proximity?

   Yes, Rt12 is the only access to many homes.
5. Are there important public buildings (town hall, community center, senior center, library) or community facilities (recreational fields, town green, etc.) close to the project?

   No
6. What other municipal operations could be adversely affected by a road/culvert closure or detour?

   Schools
7. Are there any town highways that might be adversely impacted by traffic bypassing the construction on other local roads? Please indicate which roads may be affected and their

condition (paved/unpaved, narrow, weight-limited culverts, etc), including those that may be or go into other towns.
Calais Rd-paved/gravel

8. Is there a local business association, chamber of commerce, regional development corporation, or other downtown group that we should be working with? If known, please provide name, organization, email, and phone number.
No

9. Are there any public transit services or stops that use the culvert or transit routes in the vicinity that may be affected if they become the detour route?
No

__Schools__

1. Where are the schools in your community and what are their yearly schedules (example: first week in September to third week in June)?

   South of Bridge on Calais Rd – August thru June

2. Is this project on specific routes that school buses or students use to walk to and from school?

   Yes
3. Are there recreational facilities associated with the schools nearby (other than at the school)?

   Yes-Ladd Field

__Pedestrians and Bicyclists__

1. What is the current level of bicycle and pedestrian use on the culvert?

   Heavy Bicycle/pedestrian

2. Are the current lane and shoulder widths adequate for pedestrian and bicycle use?

   No
3. Does the community feel there is a need for a sidewalk or bike lane on the culvert?

   Yes
4. Is pedestrian and bicycle traffic heavy enough that it should be accommodated during construction?

   Yes
5. Does the Town have plans to construct either pedestrian or bicycle facilities leading up to the culvert? Please provide any planning documents demonstrating this (scoping study, master plan, corridor study, town or regional plan).

   No

6. In the vicinity of the culvert, is there a land use pattern, existing generators of pedestrian and/or bicycle traffic, or zoning that will support development that is likely to lead to significant levels of walking and bicycling?

No

Design Considerations

1. Are there any concerns with the alignment of the existing road? For example, if the culvert is located on a curve, has this created any problems that we should be aware of?

   Width is a problem

2. Are there any concerns with the width of the road over the existing culvert?

   Yes-too narrow

3. Are there any special aesthetic considerations we should be aware of?
   No

4. Does the location have a history of flooding? If yes, please explain.

   No
5. Are there any known Hazardous Material Sites near the project site?

   No

6. Are there any known historic, archeological and/or other environmental resource issues near the project site?
   Unknown

7. Are there any utilities (water, sewer, communications, power) buried with the existing culvert? Please provide any available documentation.
   Unknown

8. Are there any existing, pending, or planned municipal utility projects (communications, lighting, drainage, water, wastewater, etc.) near the project that should be considered?
   No

9. Are there any other issues that are important for us to understand and consider?
   Houses close to bridge

Land Use & Zoning

1. Please provide a copy of your existing and future land use map or zoning map, if applicable.
   N/A

2. Are there any existing, pending or planned development proposal that would impact future transportation patterns near the culvert? If so, please explain.
   Unknown
3. Is there any planned expansion of public transit or intercity transit service in the project area? Please provide the name and contact information for the relevant public transit provider.
   No

Communications

1. Please identify any local communication outlets that are available for us to use in communicating with the local population. Include weekly or daily newspapers, blogs, radio, public access TV, Facebook, Front Page Forum, etc. Also include any unconventional means such as local low-power FM.
   FPF, Times Argus, Washington World, Town website, Facebook, WDVE, WGER

2. Other than people/organizations already referenced in this questionnaire, are there any others who should be kept in the loop as the project moves forward?**Unknown**

Appendix L: Operations Input

Culvert Scoping Project BF 0241(57)
Operations Input Questionnaire

The Structures Section has begun the scoping process for BF 0241(57), VT Route 12, Culvert 89, over the North Brook in Worcester. This is a CGMPP culvert constructed in 1964. The Structure Inspection, Inventory, and Appraisal Sheet (attached) rates the culvert as 5 (fair). We are interested in hearing your thoughts regarding the items listed below. Leave it blank if you don't wish to comment on a particular item.

1. What are your thoughts on the general condition of this culvert and the general maintenance effort required to keep it in service?

Good overall but the invert from the middle to the outlet is gone and there's a large hole in the bottom of the outlet end along with some smaller ones I agree with the 2016 inspection report

2. What are your comments on the current geometry and alignment of the roadway over the culvert (curve, sag, banking, sight distance)?

Good low maintenance area for us

3. Do you feel that the posted speed limit is appropriate?

Yes

4. Is the current roadway width adequate for winter maintenance including snow plowing?

Yes

5. Are the railings constantly in need of repair or replacement? What type of railing works best for your district? (We are recommending more and more box beam guardrail on our culverts because of crash-worthiness and compatibility with accelerated projects).

Only due to vehicles hitting it as it is located at the bottom of troublesome hill. The W beam that is currently in place works and is fairly new and is still in decent shape

6. Are you aware of any unpermitted driveways within close proximity to the culvert? We frequently encounter driveways that prevent us from meeting railing and safety standards.

No

7. Are you aware of abutting property owners that are likely to need special attention during the planning and construction phases? These could be people with disabilities, elderly, or simply folks who feel they have been unfairly treated in the past.

No

8. Do you find that extra effort is required to keep the slopes and river banks around the culvert in a stable condition? Is there frequent flood damage that requires repair?

I have heard stories of it washing out in 1985 but that was before my time I do know that in the last ten years I have only known it to over flow once resulting in minor damage to the road way on the south end

9. Does this culvert seem to catch an unusual amount of debris from the waterway?

No

10. Are you familiar with traffic volumes in the area of this project?

Low

11. Do you think a closure with off-site detour and accelerated construction would be appropriate? Do you have any opinion about a possible detour route, assuming that we use State route for State projects and any route for Town projects? Are there locations on a potential detour that are already congested that we should consider avoiding?

No I believe there is room to maintain one way traffic during repairs or replacement, detour would be lengthy starting in Morrisville and Montpellier

12. Please describe any larger projects that you have completed that may not be reflected on the attached Appraisal sheet, such as deck patches, paving patches, railing replacement with new type, steel coating, etc.

None

13. Are there any drainage issues that we should address on this project?

No

14. Are you aware of any complaints that the public has about issues that we can address on this project?

No

15. Is there anything else we should be aware of?

It is a large structure that handles a lot of water in the spring I agree with the 2016 inspection comment of a new invert or maybe lining it

Appendix M: Crash Data

Vermont Agency of Transportation

10/09/2017

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

WHERE Year of Crash >= 2012 AND Year of Crash <= 2016

*	Reporting Agency/ Incident No.	City/Town	Mile Marker	Crash Date	Time	Weather	Contributing Circumstances	Direction of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Direction	Road Group
													Owned
	VTVSP1200/13A303188	Worcester	2.39	08/04/2013	12:43	Clear	Failed to yield right of way, No improper driving	Left Turn and Thru, Angle Broadside -->v--	1	0	0	N, S	SH
	VTVSP1200/16A304476	Worcester	2.68	10/18/2016	10:20	Clear	Driving too fast for conditions	Single Vehicle Crash	1	0	0	S	SH State Owned
	VTVSP1200/15A305585	Worcester	2.87	11/19/2015	14:17	Rain	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	0	0	0	S	SH
	VTVSP1200/15A301256	Worcester	2.99	03/15/2015	11:45	[No Weather]		[No Direction of Collision]	0	0	0		SH
	VTVSP1200/13A304653	Worcester	3.16	11/05/2013	07:19	Cloudy	Failure to keep in proper lane, Inattention	Single Vehicle Crash	0	0	0	S	SH
	VTVSP1200/15A305109	Worcester	3.87	10/18/2015	20:07	[No Weather]		[No Direction of Collision]	0	0	0		SH
	VTVSP1200/16A305468	Worcester	6.20	12/16/2016	06:30	Clear	Driving too fast for conditions, Under the influence of medication/drugs/alcohol, No improper driving	Head On	2	0	0	S, N	SH State Owned
	VTVSP1200/16A305156	Worcester	6.23	11/29/2016	07:36	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
	VTVSP1200/12A302163	Worcester	6.73	05/25/2012	18:00	Clear	Failure to keep in proper lane	Single Vehicle Crash	1	0	0	N	SH
	VTVSP1200/12A301994	Worcester	UNK	05/14/2012	07:25	Rain	Other improper action	Rear End	2	0	0	N	SH
	VTVSP1200/13A300873	Worcester	UNK	02/27/2013	21:00	[No Weather]		[No Direction of Collision]	0	0	0		SH
	VTVSP1200/13A301934	Worcester	UNK	05/16/2013	20:50	Cloudy	No improper driving	Single Vehicle Crash	2	0	0	S	SH
	VTVSP1200/14A301410	Worcester	UNK	03/30/2014	01:00	Sleet, Hail (Freezing Rain or Drizzle)	Fatigued, asleep, Failure to keep in proper lane	Single Vehicle Crash	1	0	0	N	SH
	VTVSP0100/16A101604	Elmore	1.79	04/02/2016	21:51	Cloudy	Under the influence of medication/drugs/alcohol, Exceeded authorized speed limit	Single Vehicle Crash	1	0	0	S	SH State Owned
	VTVSP0100/12A103503	Elmore	3.52	09/08/2012	19:12	Rain	Under the influence of medication/drugs/alcohol	Single Vehicle Crash	1	0	0	N	SH
	VTVSP0100/14A105918	Elmore	4.65	12/26/2014	14:38	Clear	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway etc, No improper driving	Same Direction Sideswipe	0	0	0	N	SH
	VTVSP0100/15A100413	Elmore	4.66	01/25/2015	07:06	[No Weather]		[No Direction of Collision]	0	0	0		SH
	VTVSP0100/16A106536	Elmore	4.66	12/22/2016	21:50	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
	VTVSP0100/16A103497	Elmore	4.90	07/14/2016	13:26	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
	VTVSP0100/16A106388	Elmore	4.96	12/15/2016	17:39	[No Weather]		[No Direction of Collision]	0	0	0		SH State Owned
	VTVSP0100/15A100804	Elmore	5.07	02/11/2015	10:27	[No Weather]		[No Direction of Collision]	0	0	0		SH
	VTVSP0100/15A105765	Elmore	5.11	11/10/2015	17:40	Cloudy	No improper driving	Single Vehicle Crash	0	0	0	N	SH

THIS DOCUMENT IS EXEMPT FROM DISCOVERY OR ADMISSION UNDER 23 U.S.C. 409

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

Appendix N: Utility Resource Identification

From Utilities:

There are no utilities within the limits of the subject project.

Shaun Corbett | Utility Coordination Supervisor

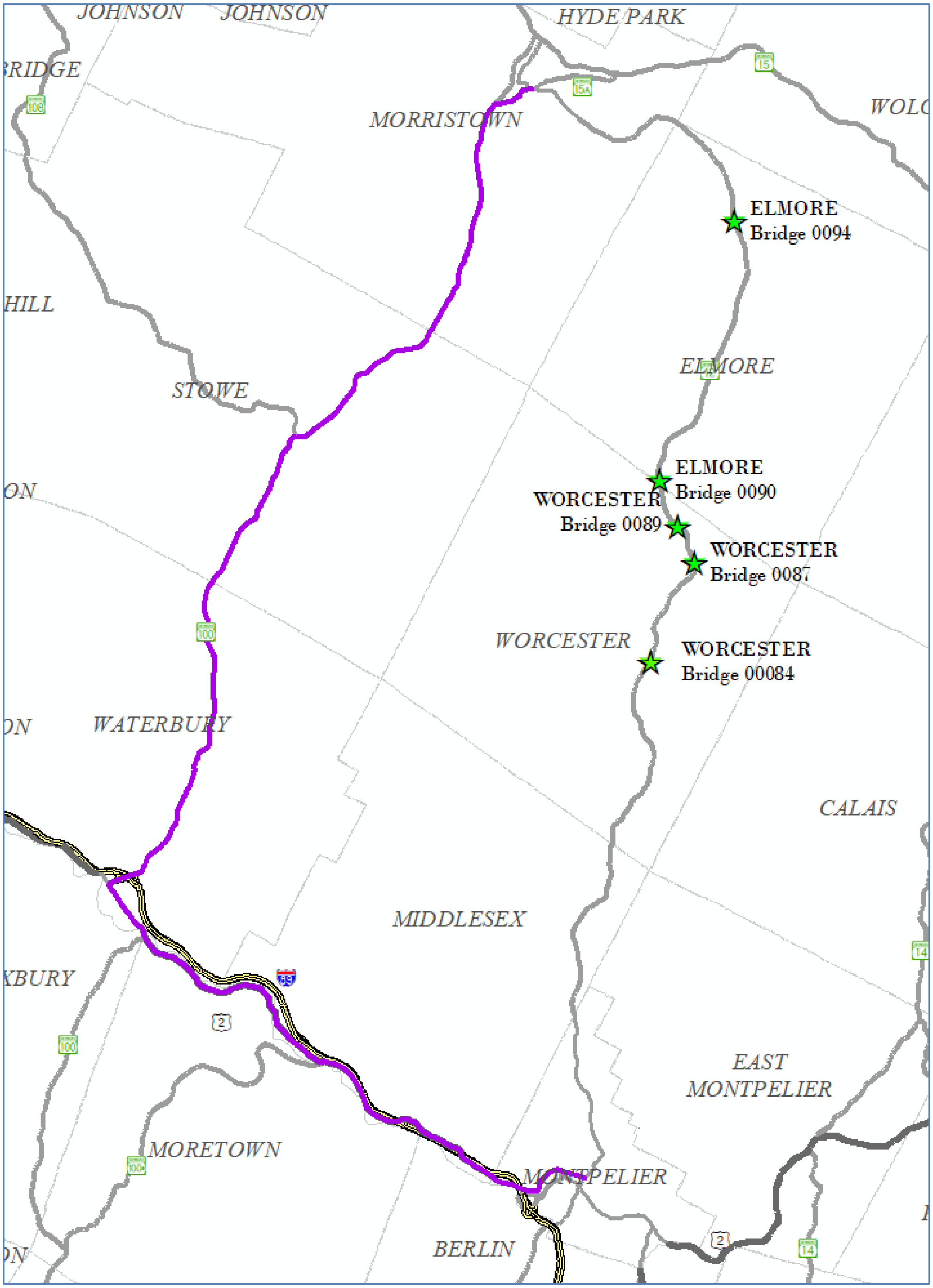
Vermont Agency of Transportation

One National Life Drive | Montpelier, VT 05633-5001

802-371-7943 cell

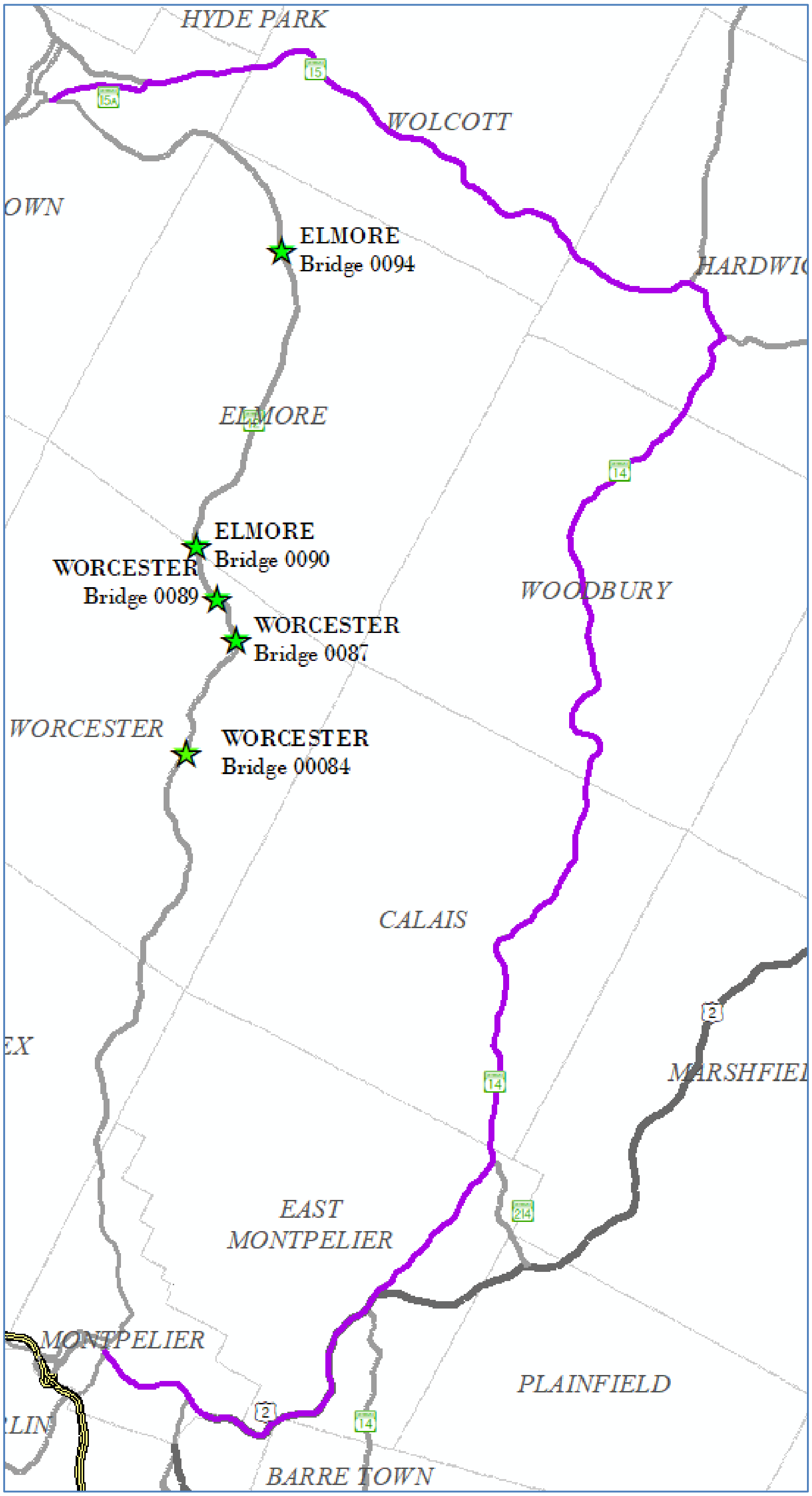
shaun.corbett@vermont.gov

Appendix O: Detour Routes



Regional Detour Route 1: VT Route 12, to VT Route 100, and US Route 2, back to VT Route 12

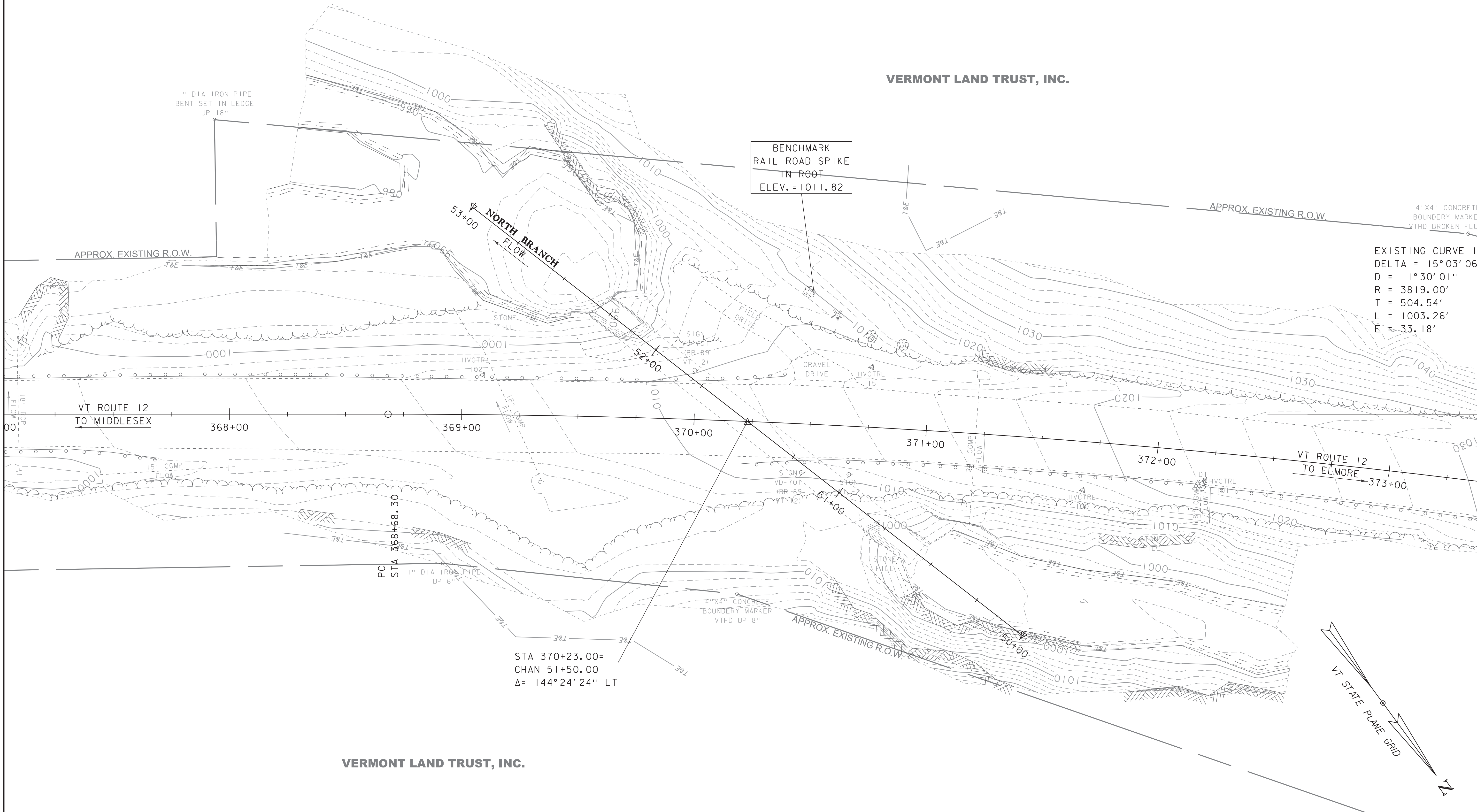
Through Route: 26.2 miles
Detour Route: 30.9 miles
Added Distance: 4.7 miles
End-to-End Distance: 57.1 miles



Regional Detour Route 2: VT Route 12, to US Route 2, VT Route 14, and VT Route 15, back to VT Route 12

Through Route: 26.4 miles
Detour Route: 40.0 miles
Added Distance: 13.6 miles
End-to-End Distance: 66.4 miles

Appendix P: Plans



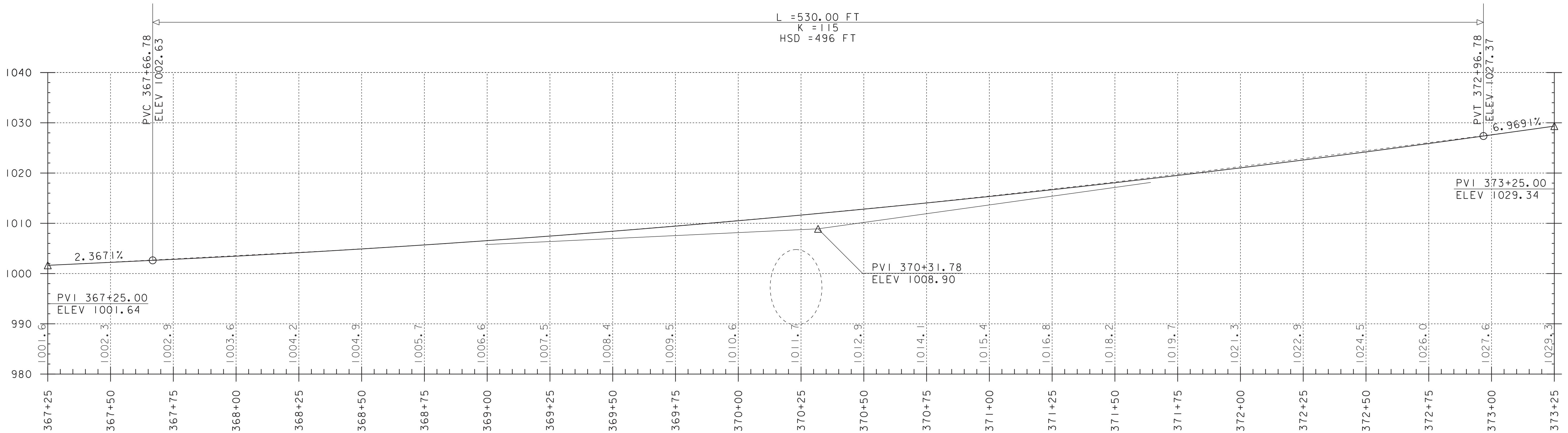
EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

EXISTING CONDITIONS

SCALE 1" = 20'-0"

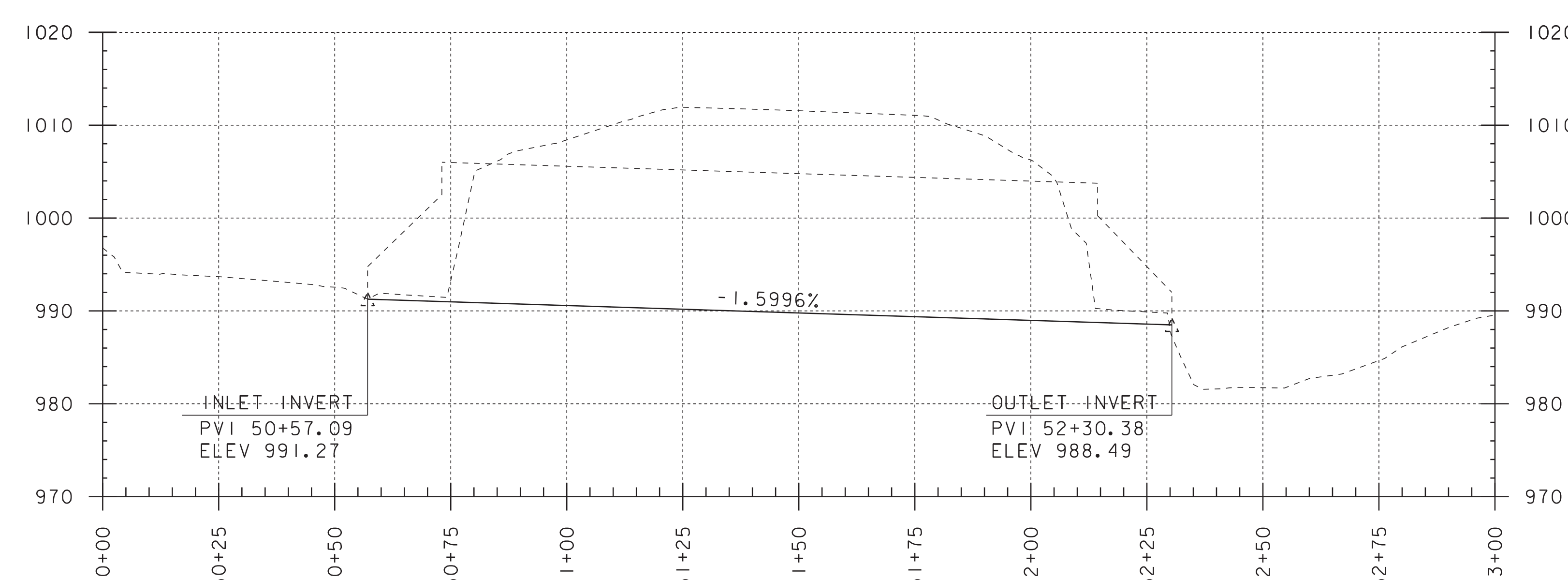
20 0 20

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214border.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
EXISTING CONDITIONS LAYOUT SHEET	SHEET 1 OF 16



VT ROUTE 12 PROFILE

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

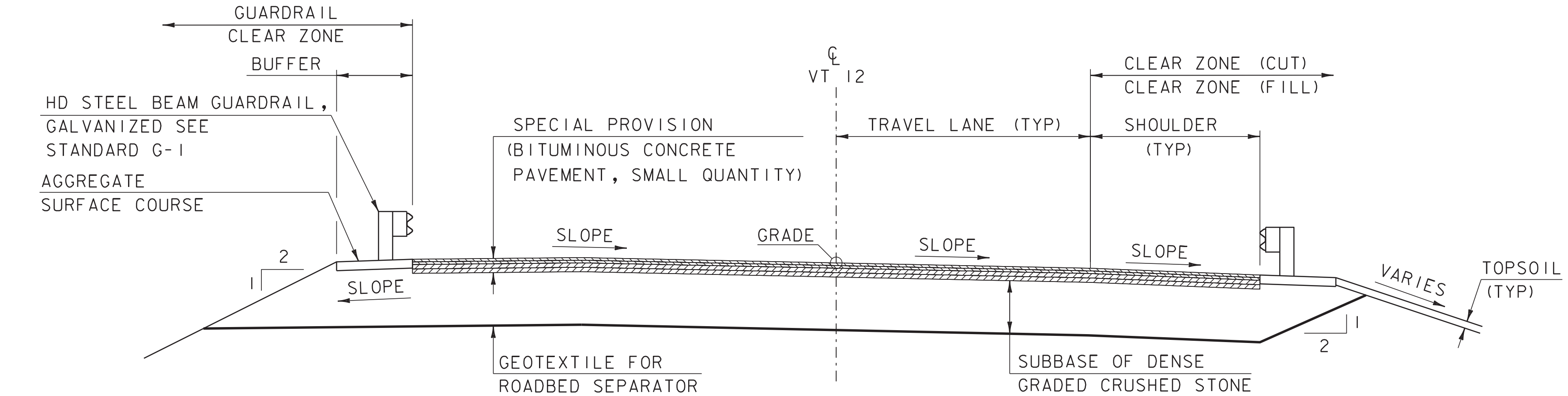


VT ROUTE 12 CULVERT 89 PROFILE

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

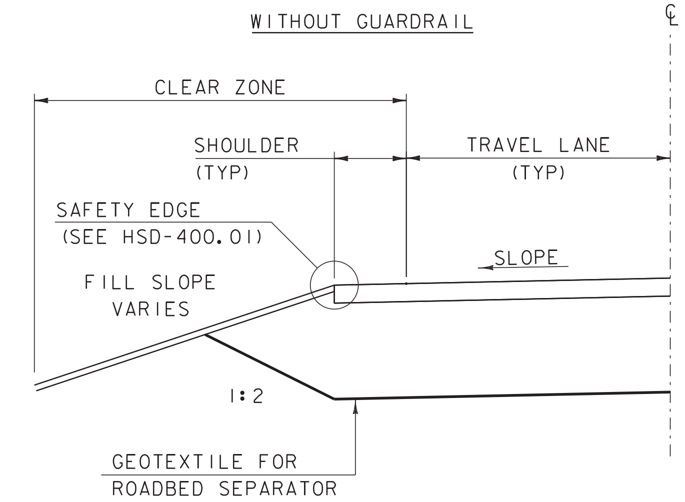
NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214profile.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PROFILE SHEET	SHEET 2 OF 16



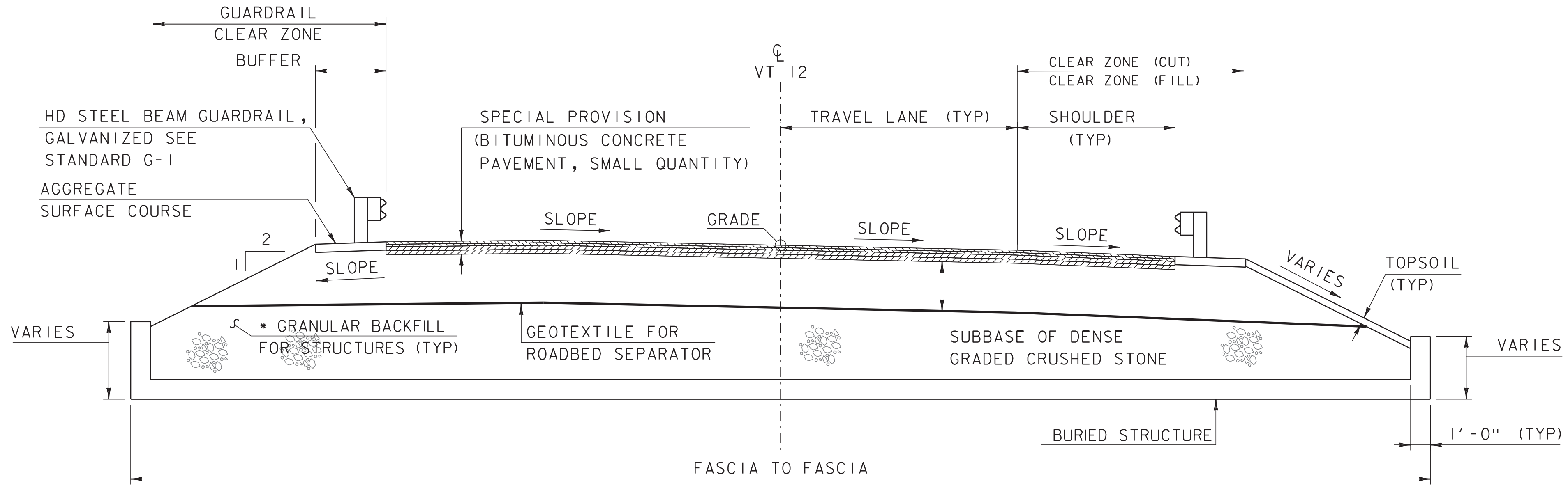
VT ROUTE 12 TYPICAL SECTION

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



ROADWAY TYPICAL SECTION

NOT TO SCALE



VT 12 BURIED STRUCTURE TYPICAL SECTION

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

ROAD TYPICAL INFORMATION

	LEFT		RIGHT	
	WIDTH	SLOPE	WIDTH	SLOPE
TRAVEL LANE	11'-0"	VARIES	11'-0"	VARIES
SHOULDER	4'-0"	VARIES	4'-0"	VARIES
BUFFER	3'-7"	-0.060	3'-7"	-0.060
FILL SLOPE	---	VARIES	---	VARIES
CLEAR ZONE (CUT)	12'-0"	1:3	12'-0"	1:3
CLEAR ZONE (FILL)	16'-0"	---	16'-0"	---
CLEAR ZONE (GUARDRAIL)	4'-0"	---	4'-0"	---

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	24"	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

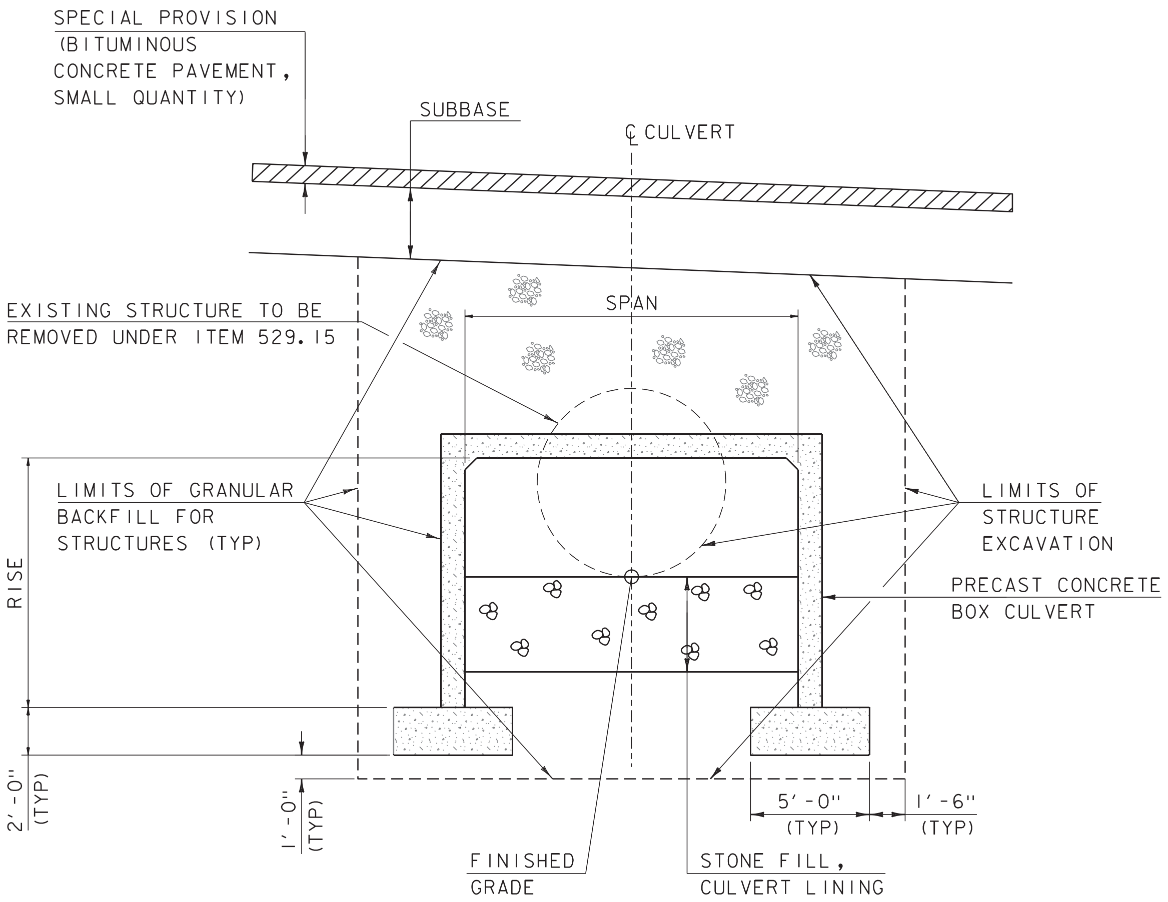
(IF USED ON PROJECT)

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

PROJECT NAME: WORCESTER
PROJECT NUMBER: BF 0241(57)

FILE NAME: 19b214/s19b214typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
CULVERT TYPICAL SECTION SHEET 1

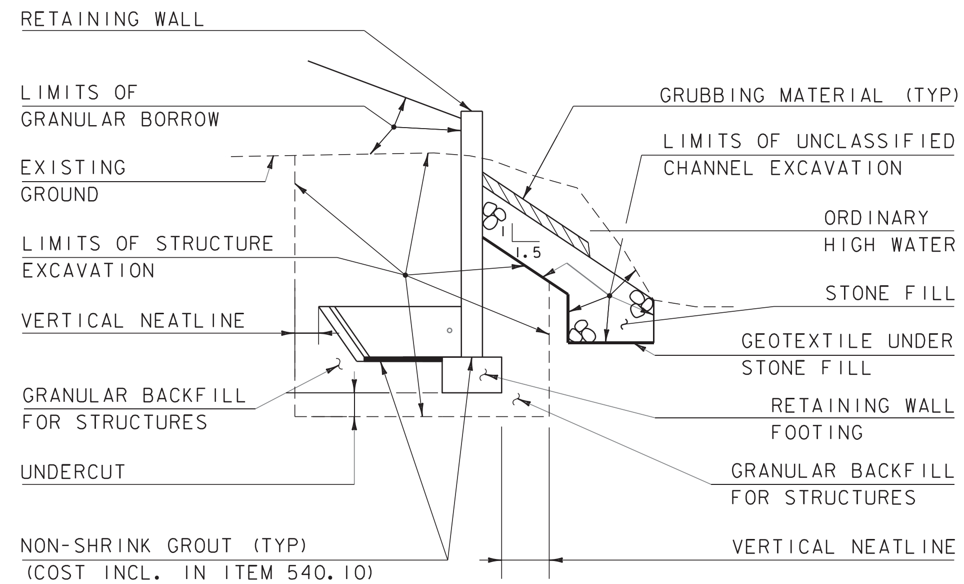
PLOT DATE: 20-APR-2020
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 3 OF 16



SPAN	24'-0"
RISE	16'-0"
LENGTH	170'-0"

NEW CULVERT TYPICAL SECTION

NOT TO SCALE



RETAINING WALL EARTHWORK TYPICAL SECTION

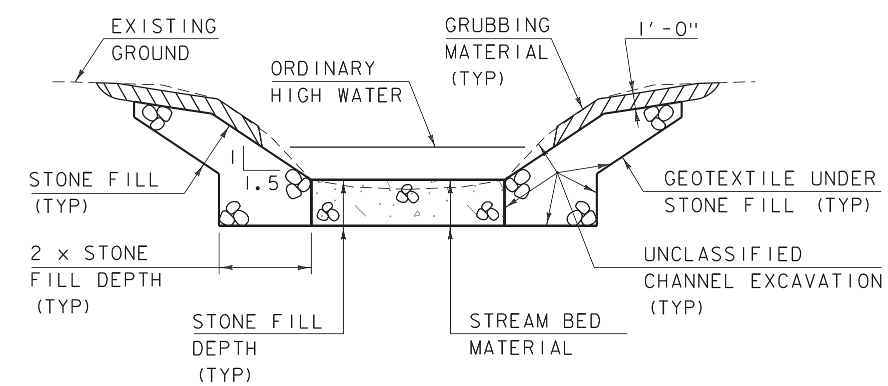
NOT TO SCALE

NOTE:

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

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"



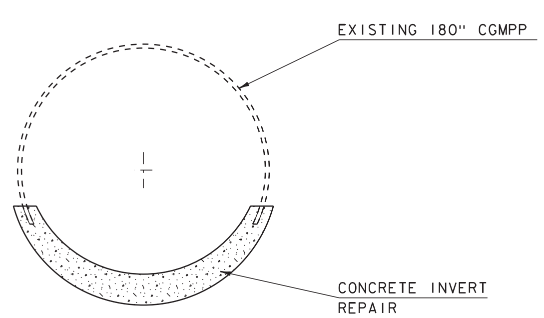
TYPICAL CHANNEL SECTION

(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.



INVERT REPAIR TYPICAL SECTION

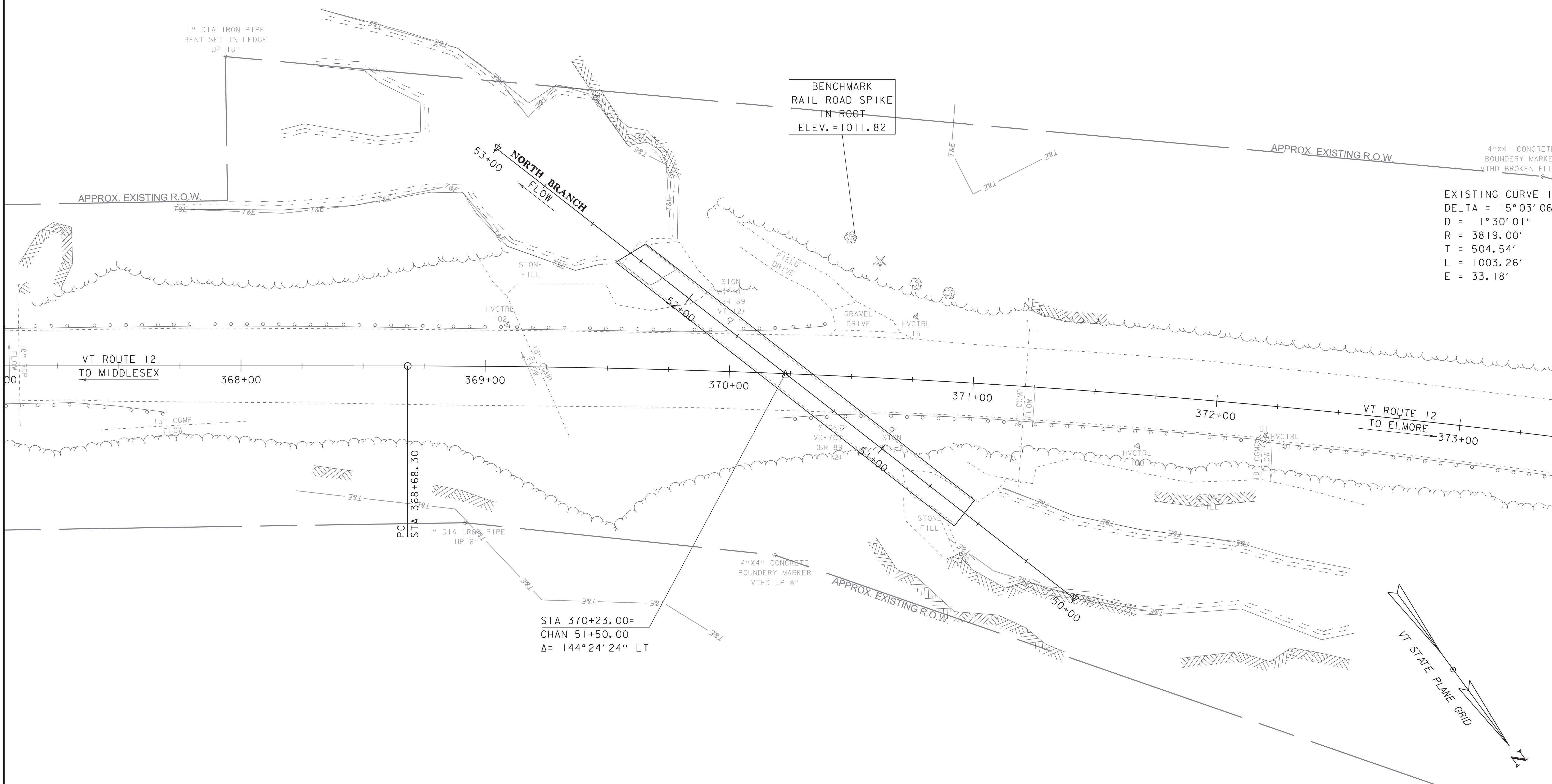
MATERIAL INFORMATION

	THICKNESS	TYPE
STONE FILL	3'-0"	TYPE III
STONE FILL, CULVERT LINING	3'-0"	E-STONE TYPE III
STONE FILL, STREAM BED MATERIAL	3'-0"	E-STONE TYPE III

PROJECT NAME: WORCESTER
PROJECT NUMBER: BF 0241(57)

FILE NAME: 19b214/s19b214typ.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
CULVERT TYPICAL SECTION SHEET 2

PLOT DATE: 20-APR-2020
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 4 OF 16



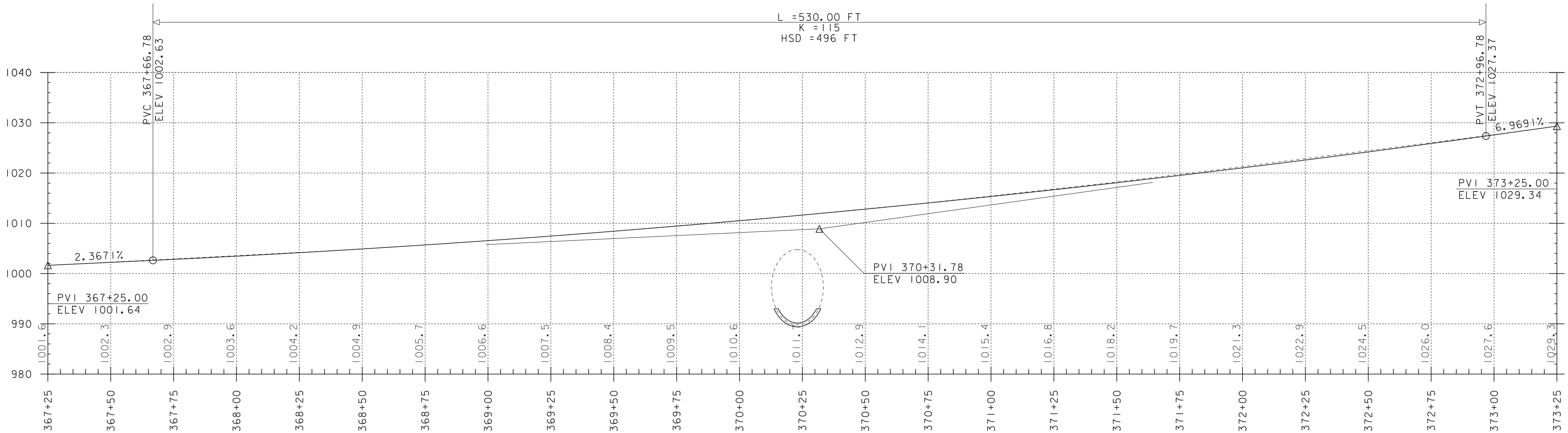
EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

REHABILITATION LAYOUT

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

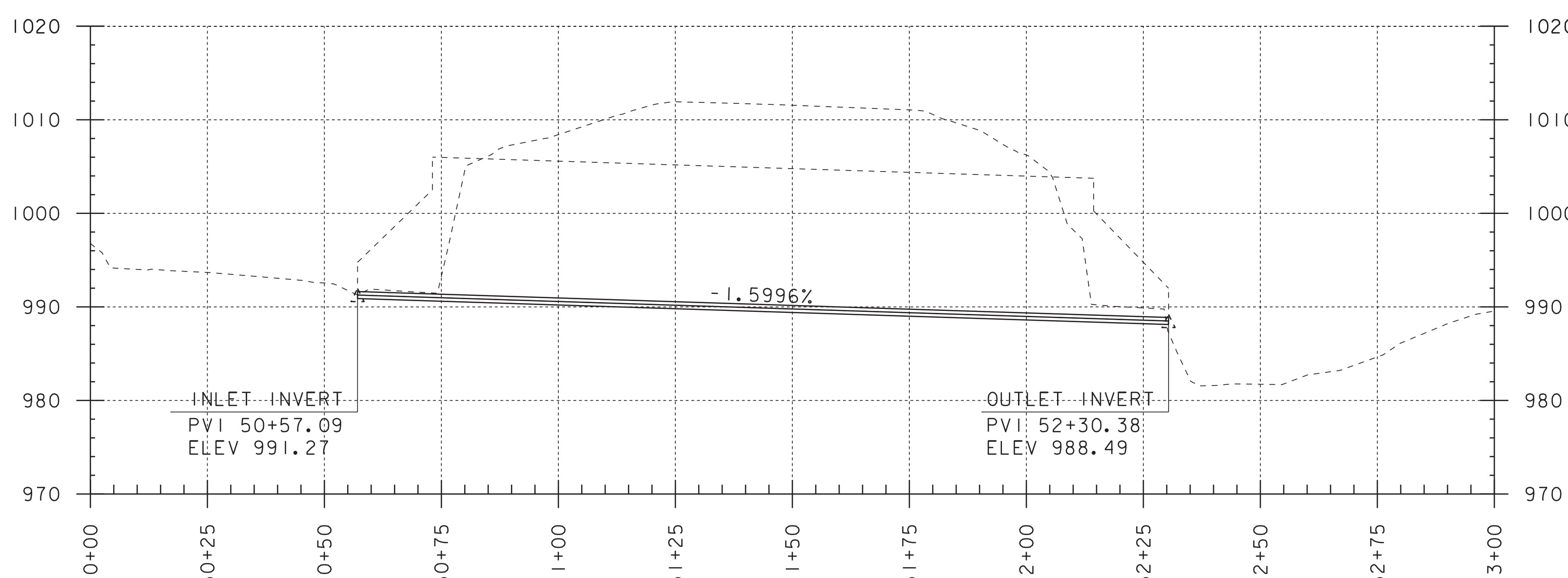
PROJECT NAME: WORCESTER
PROJECT NUMBER: BF 0241(57)

FILE NAME: 19b214/s19b214border.dgn
PROJECT LEADER: L.J.STONE
DESIGNED BY: ------
REHABILITATION LAYOUT SHEET
PLOT DATE: 20-APR-2020
DRAWN BY: D.D.BEARD
CHECKED BY: ------
SHEET 5 OF 16



VT ROUTE 12 PROFILE

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

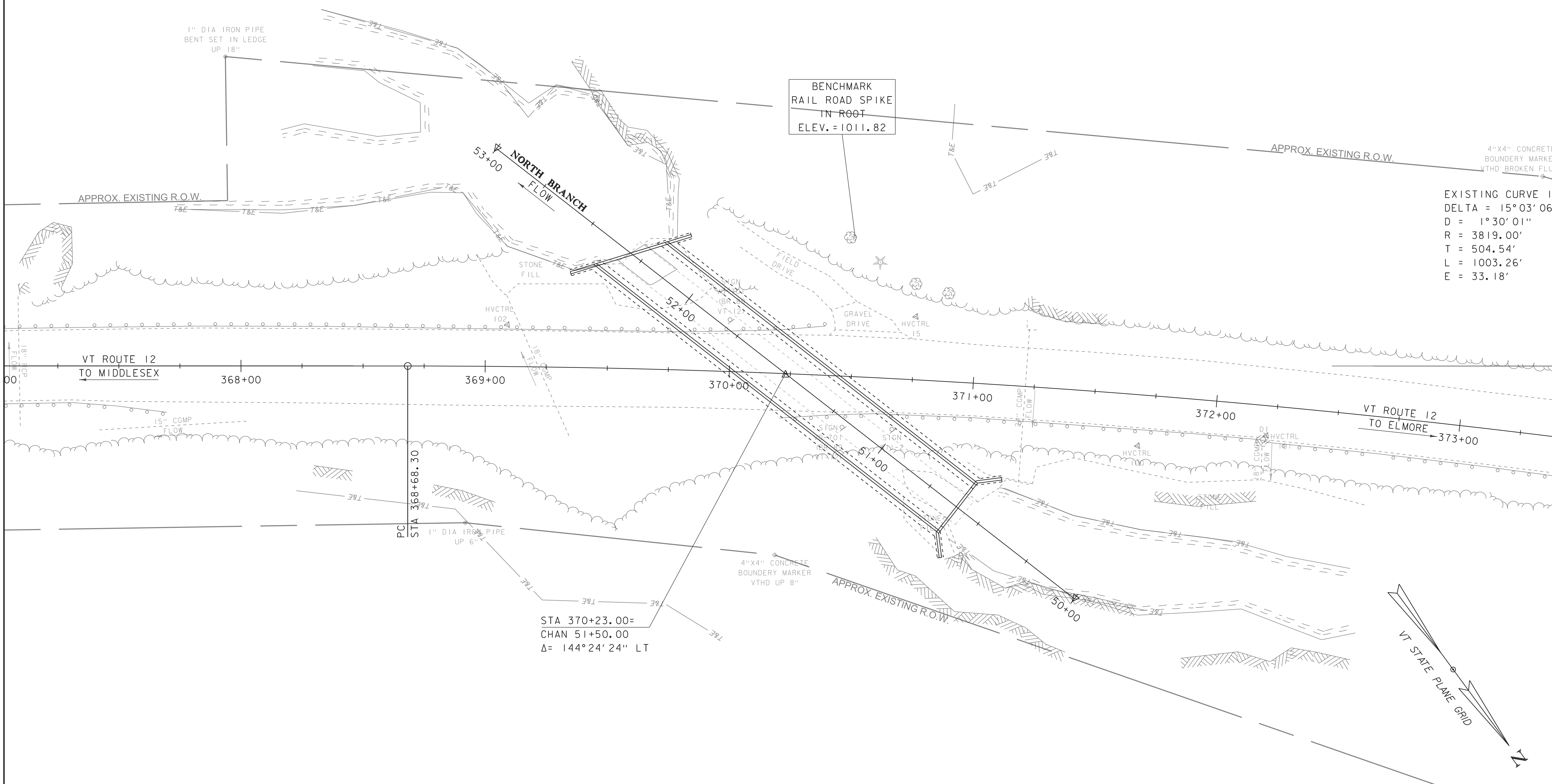


VT ROUTE 12 CULVERT 89 REHABILITATION PROFILE

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: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214profile.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
REHABILITATION PROFILE SHEET	SHEET 6 OF 16

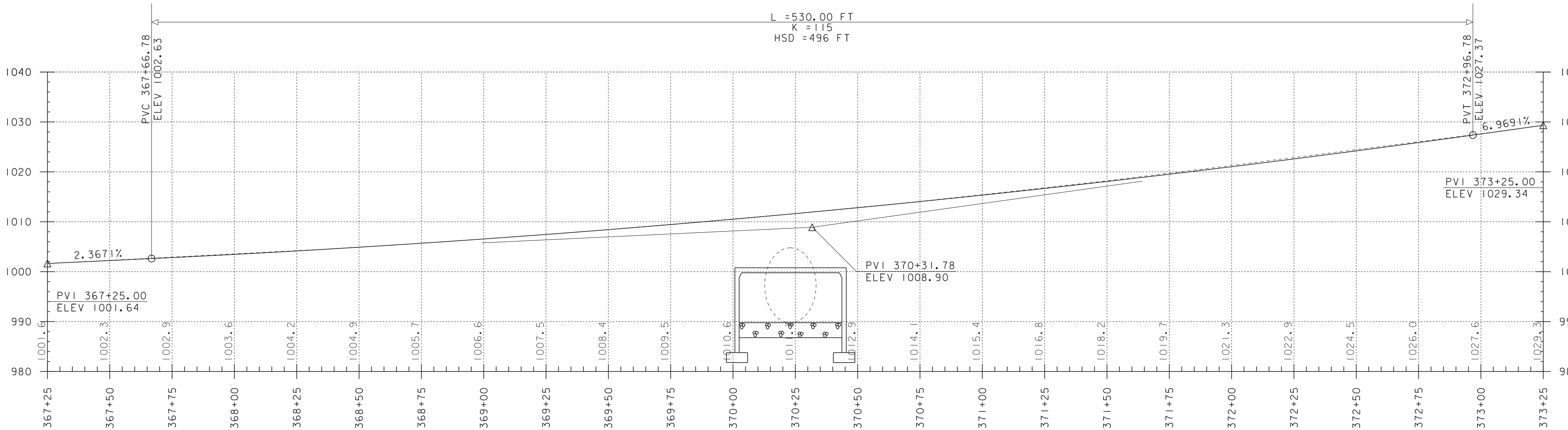


EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

NEW CULVERT LAYOUT

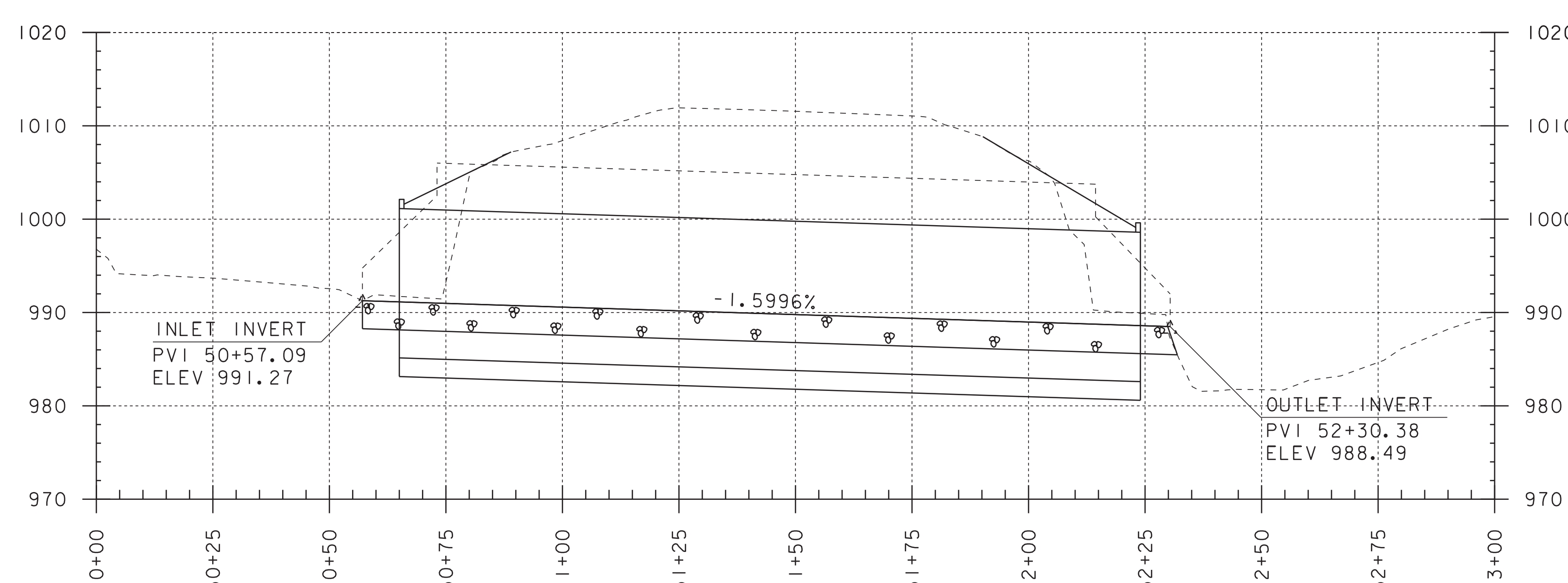
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214border.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW CULVERT LAYOUT SHEET	SHEET 7 OF 16



VT ROUTE 12 PROFILE

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

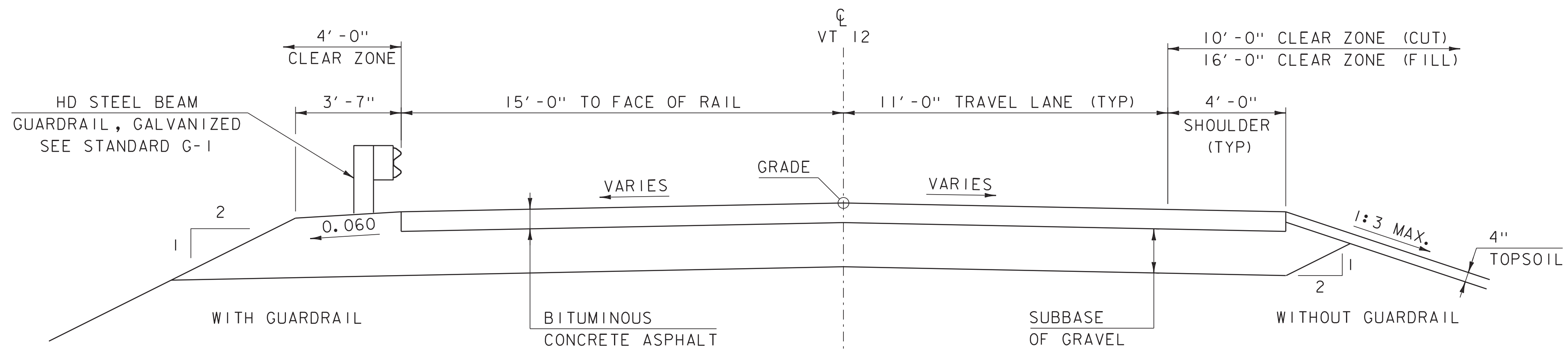


VT ROUTE 12 CULVERT 89 NEW CULVERT PROFILE

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

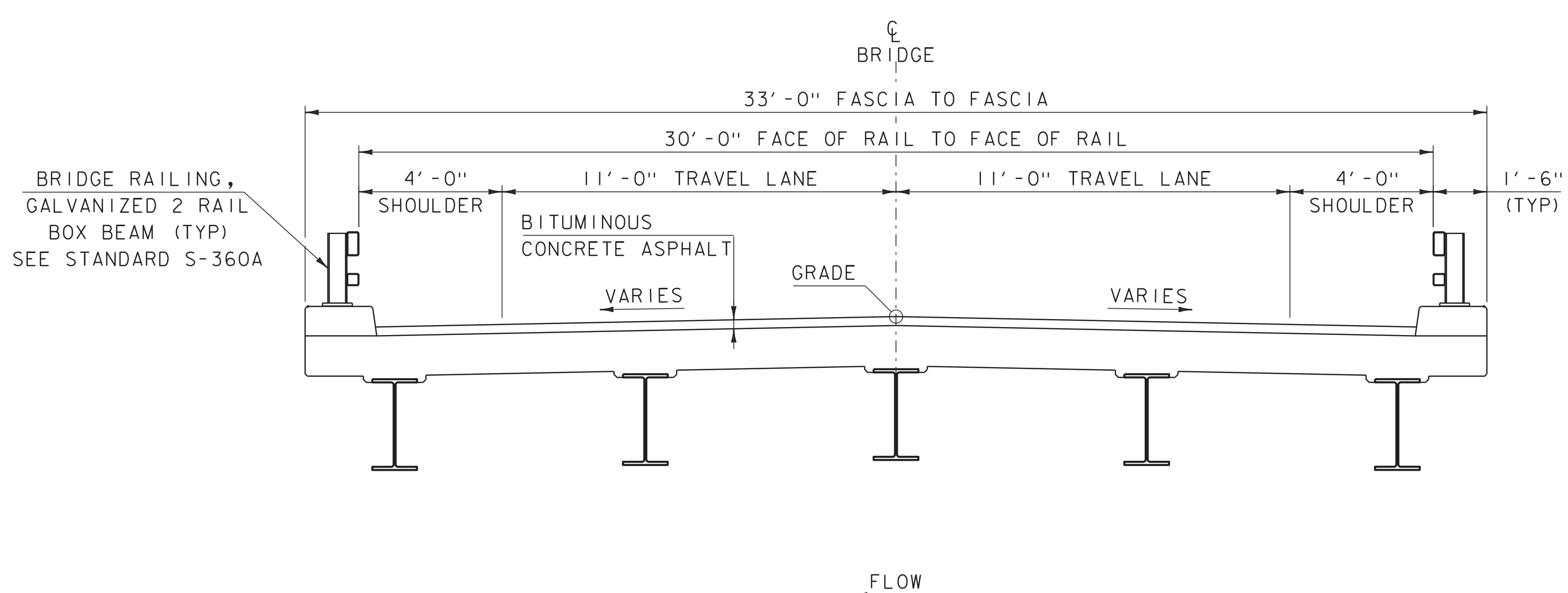
NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214profile.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW CULVERT PROFILE SHEET	SHEET 8 OF 16



PROPOSED VT ROUTE 12 TYPICAL SECTION

SCALE 3/8" = 1'-0"



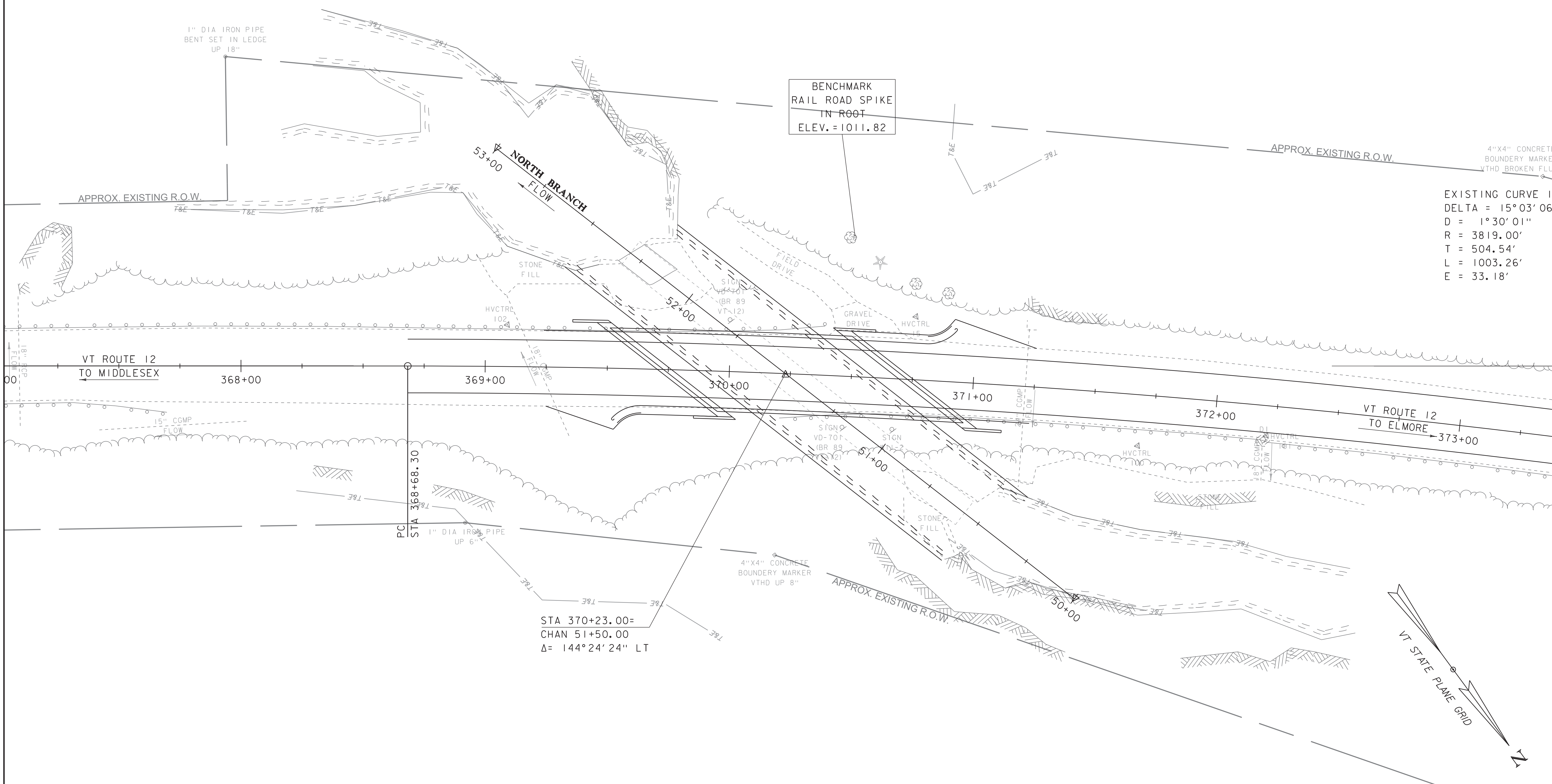
BRIDGE 90 PROPOSED TYPICAL SECTION

SCALE 3/8" = 1'-0"

MATERIAL TOLERANCES
(IF USED ON PROJECT)

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

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214typ.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW BRIDGE TYPICAL SECTION	SHEET 9 OF 16

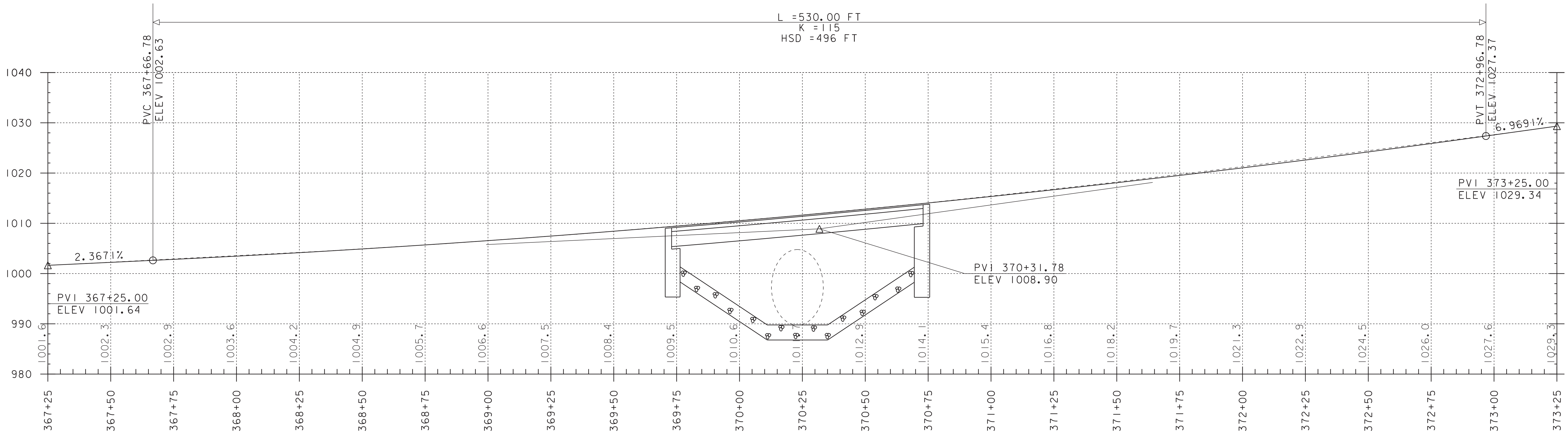


EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

NEW BRIDGE LAYOUT

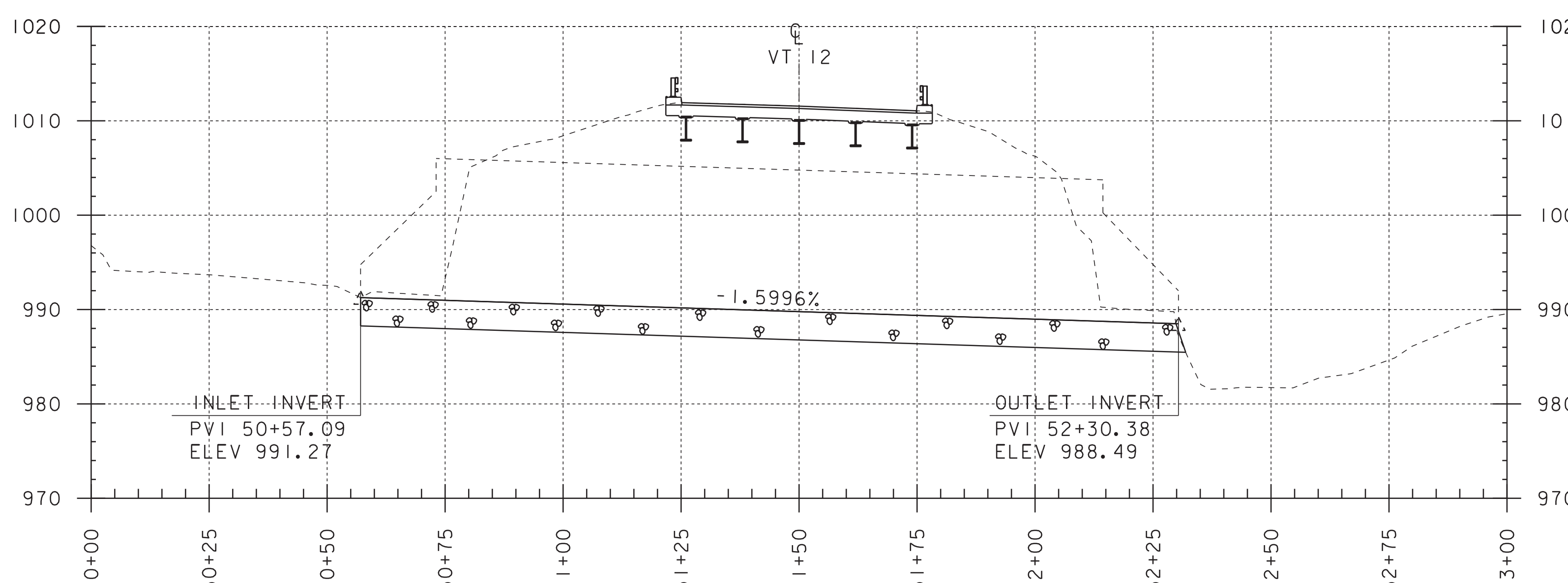
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214border.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW BRIDGE LAYOUT SHEET	SHEET 10 OF 16



VT ROUTE 12 PROFILE

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

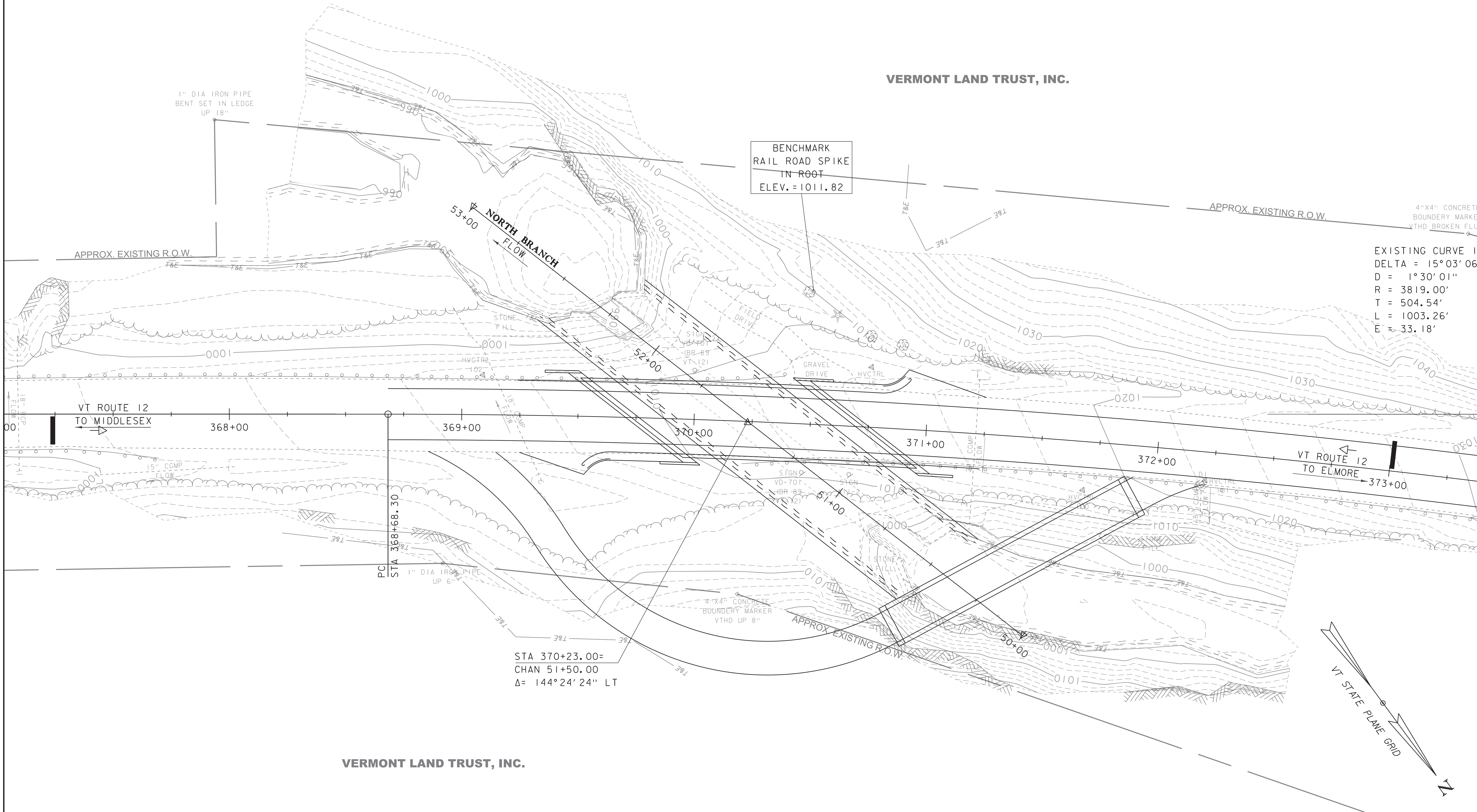


VT ROUTE 12 CULVERT 89 NEW BRIDGE PROFILE

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: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214profile.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
NEW BRIDGE PROFILE SHEET	SHEET 11 OF 16



EXISTING CURVE 1
DELTA = 15°03'06"
D = 1°30'01"
R = 3819.00'
T = 504.54'
L = 1003.26'
E = 33.18'

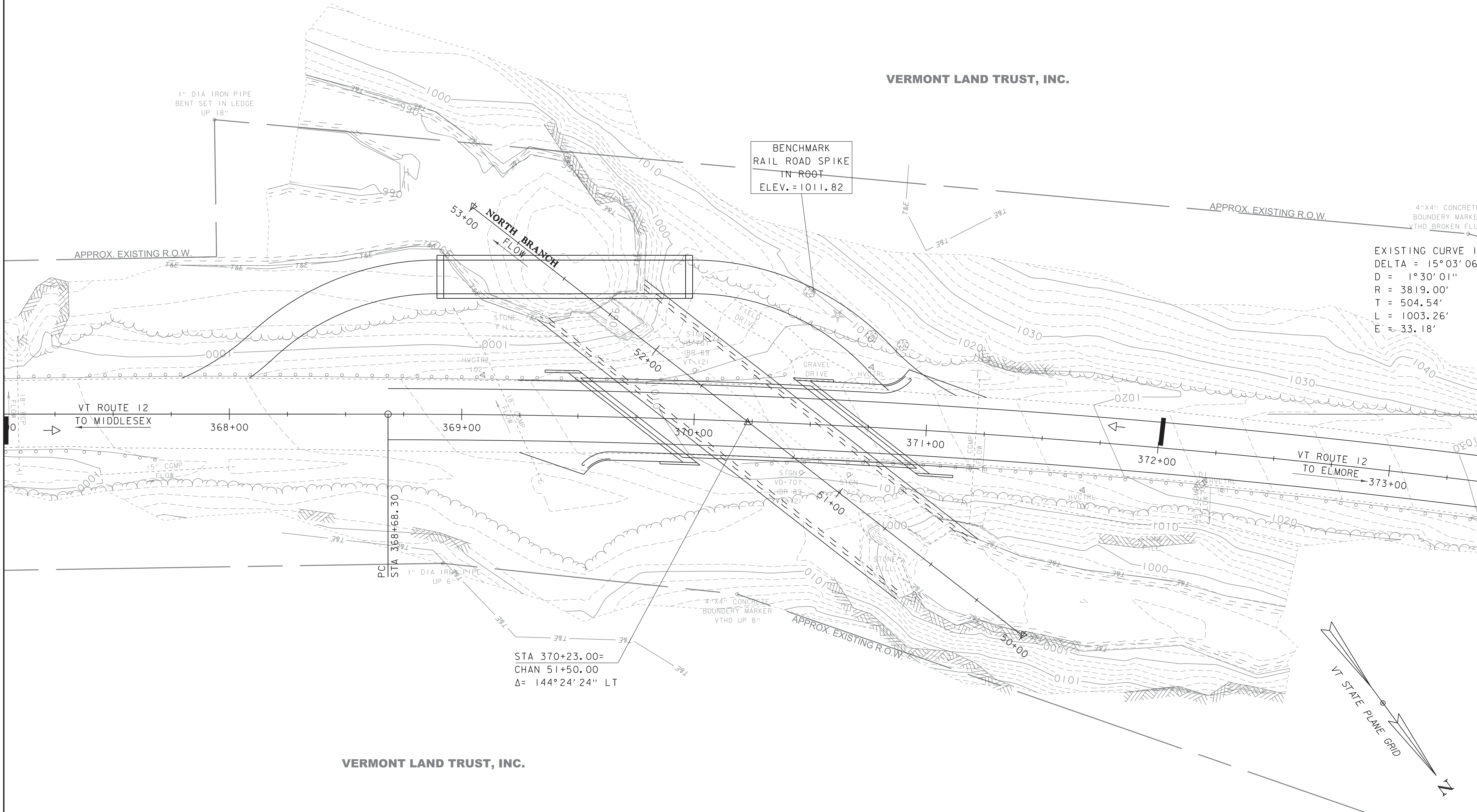
EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

UPSTREAM TEMPORARY BRIDGE

SCALE 1" = 20'-0"

20 0 20

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214TCborder.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
UPSTREAM TEMP BRIDGE LAYOUT SHEET	SHEET 12 OF 16

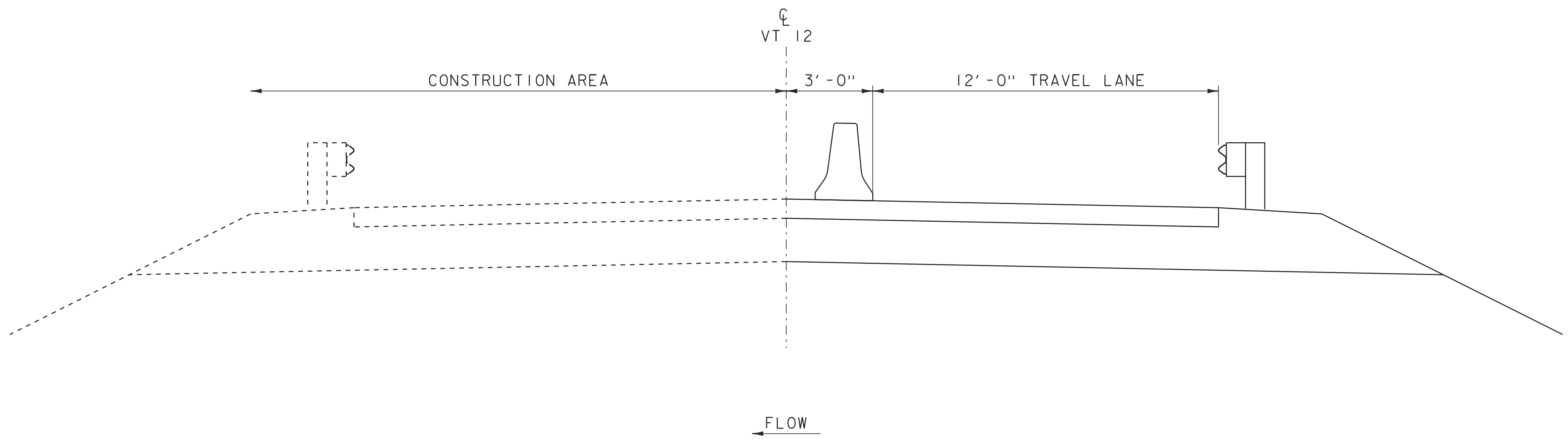


EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

DOWNSTREAM TEMPORARY BRIDGE

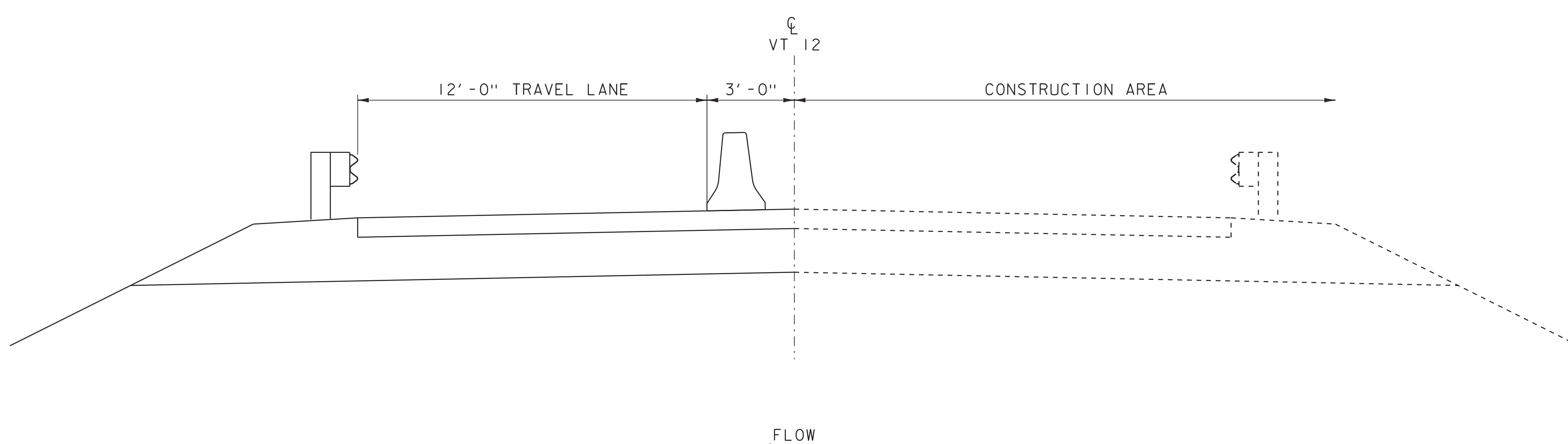
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214TCborder.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
DOWNSTREAM TEMP BRIDGE LAYOUT SHEET	SHEET 13 OF 16



PHASE 1 TYPICAL SECTION

SCALE ⅜" = 1'-0"



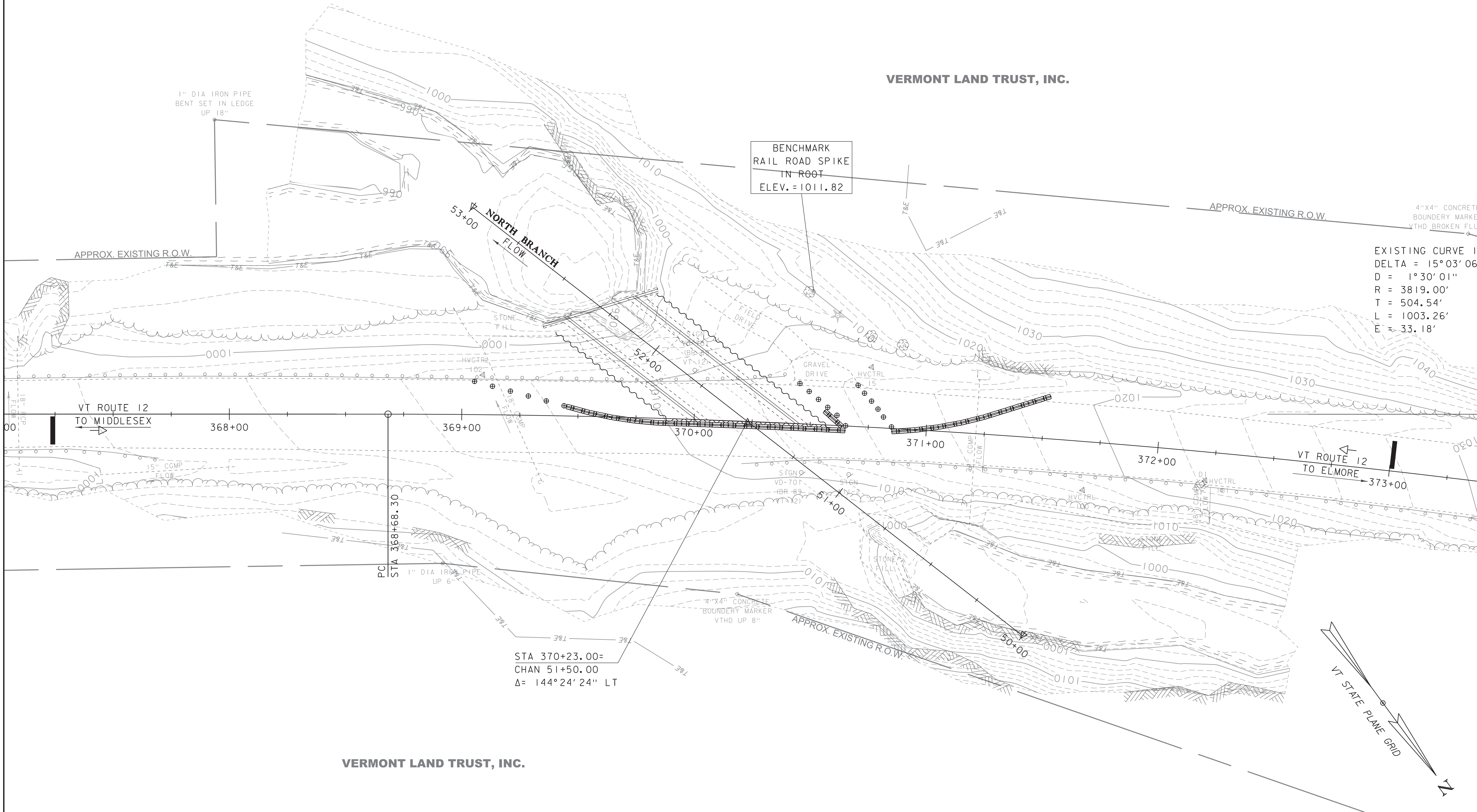
PHASE 2 TYPICAL SECTION

SCALE ⅜" = 1'-0"

PROJECT NAME: WORCESTER

PROJECT NUMBER: BF 0241(57)

FILE NAME: 19b214/s19b214traffic.dgn | PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE | DRAWN BY: D.D.BEARD
DESIGNED BY: ------ | CHECKED BY: ------
PHASING TYPICAL SECTIONS | SHEET 14 OF 16

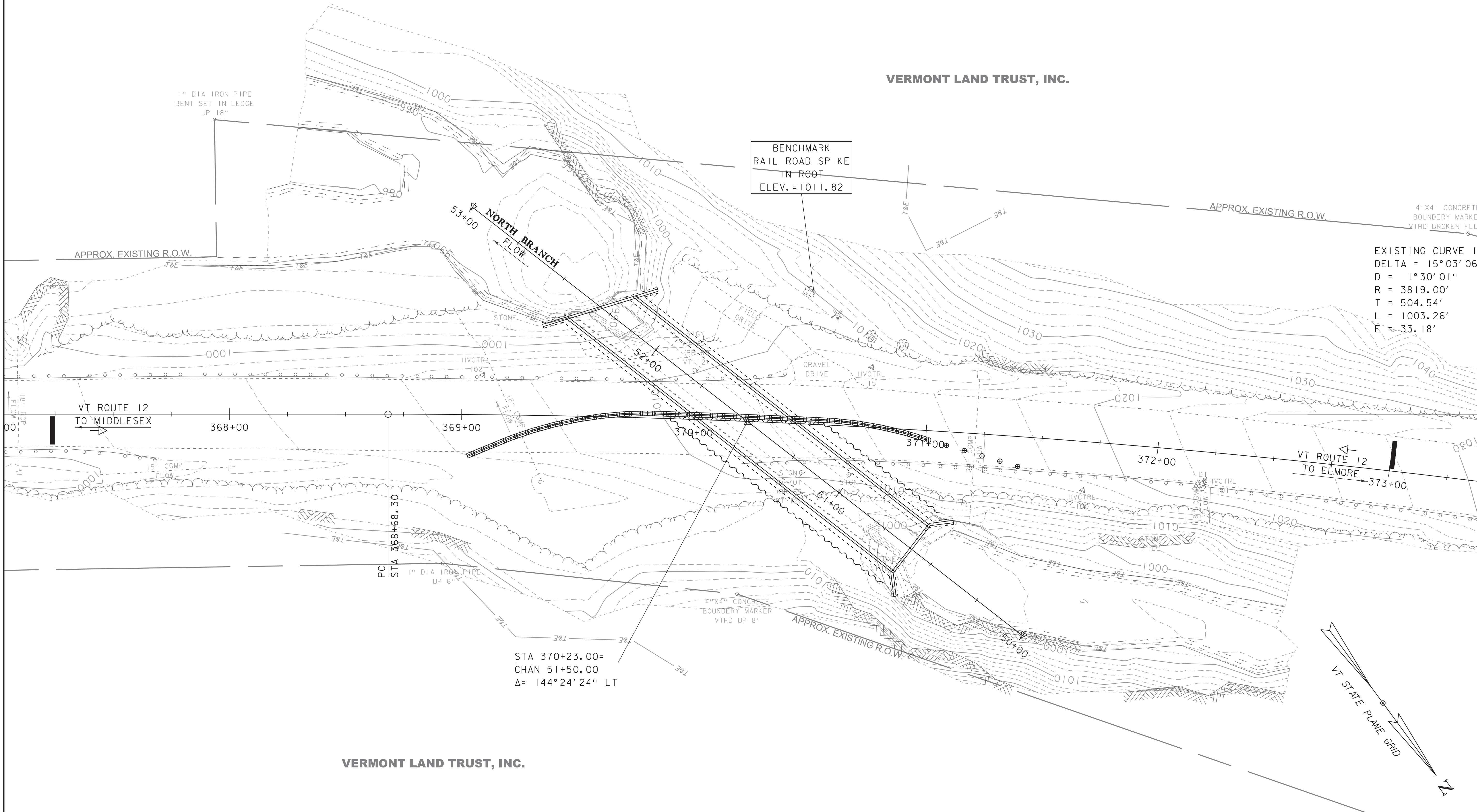


EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

PHASE 1 LAYOUT

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

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214TCborder.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PHASE 1 LAYOUT SHEET	SHEET 15 OF 16



EXISTING BRIDGE INFORMATION
180" CGMPP, BUILT 1964
172' LONG,
3' AVERAGE COVER,
177 SQFT WATERWAY AREA

PHASE 2 LAYOUT

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

PROJECT NAME: WORCESTER	
PROJECT NUMBER: BF 0241(57)	
FILE NAME: 19b214/s19b214TCborder.dgn	PLOT DATE: 20-APR-2020
PROJECT LEADER: L.J.STONE	DRAWN BY: D.D.BEARD
DESIGNED BY: ------	CHECKED BY: ------
PHASE 2 LAYOUT SHEET	SHEET 16 OF 16