STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Springfield BF 0134(45)

VT ROUTE 11, BRIDGE 60 over UNNAMED BROOK

October 13, 2017

I. Contents

I. Site Information

Bridge 60 is a culvert located on VT Route 11 adjacent to a commercial driveway approximately 0.6 miles west of the intersection with VT 106. The culvert is located on a straight segment of VT 11 at approximately mile marker 3.44. The depth of cover on top of the culvert is approximately 3'. The existing conditions were gathered from a combination of the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

Roadway Classification	Urban Major Collector
Culvert Type	Corrugated Galvanized Metal Plate Pipe Arch
Culvert Span	14 feet
Culvert Length	152 ft.
Skew	48 degrees
Year Built	1961
Ownership	State of Vermont
County	Windsor
VTrans Maintenance District	2

Need

The following is a list of the deficiencies of Bridge 60 and VT Route 11 in this location.

1. This culvert has a rating of 3 "Serious" and has significant corrosion and section loss, particularly in the invert area. Piping is occurring.

2. The existing culvert does not meet Bank Full Width (BFW) Standards.

3. VT 11 is slightly substandard in banking in the project area.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2017 and 2037.

TRAFFIC DATA	2017	2037
AADT	6,900	7,300
DHV	730	770
ADTT	340	550
%T	4.0	6.2
%D	52	52

Design Criteria

The design standards for this bridge project include:

1. AASHTO. *A Policy on Geometric Design of Highways and Streets.* Association of State Highway and Transportation Officials, Washington, DC, 2011. ("The Green Book").

2. AASHTO. *Roadside Design Guide.* Association of State Highway and Transportation Officials, Washington, DC, 2011.

3. Vermont State Standards, dated October 22, 1997. Minimum standards are based on an ADT > 2000 and a design speed of 40 mph.

Additional information was obtained from the Route Log, survey, and a site visit

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 5.3	12'/8' (45')	11'/3' (28')	45' includes 4' sidewalk
Bridge Lane and Shoulder Widths	VSS Table 5.3	12'8' (45')	11'/3' (28')	45' includes 4' sidewalk
Clear Zone Distance	VSS Table 5.5	Shielded on VT 11	16' fill / 14' cut (1:4), 14' cut (1:3)	
Banking	VSS Section 5.13	Varies from 3.69% to an adverse crown	8% (max), 6% at side roads	Substandard
Speed	VSS Section 5.3	40 mph (Unposted)	40 mph (Design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	Roadway is on a tangent at the bridge, but curve begins approx..140' to the east		
Vertical Grade	VSS Table 5.7	Roadway centerline slopes at 4.49%.	10% (max) for rolling terrain	
K Values for Vertical Curves	VSS Table 5.1	Bridge is on vertical sag – K=81	60 crest / 60 sag	
Vertical Clearance Issues	VSS Section 5.8	None noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 5.1	370 ft.	275'	
Bicycle/Pedestrian Criteria	VSS Table 5.9	8' Shoulder	4'	
Bridge Railing	Structures Manual Section 13	Steel Beam Guardrail	Steel Beam Guardrail	
Hydraulics	VTrans Hydraulics Section	Meets standard with the exception of BFW.	Pass Q_{50} storm event without exceeding 1.2X diameter, and Q_{100} without exceeding 1.5X diameter	
Structural Capacity	SM, Ch. 3.4.1	Unknown	Design Live Load: HL-93	

Inspection Report Summary

Culvert Rating	3 Serious
Channel Rating	6 Satisfactory

From the most recent Inspector's Report:

*"11/08/2016- ** Culvert has severe corrosion of invert, along with piping occurring. Pipe has potential for significant distortion/sink hole formation and needs replacement. ~ MJ/AC*

"12/3/2015 Culvert is in poor condition. Should consider a concrete invert soon. ~ FRE/TJB"

"9/23/2014 – Pipe has high potential for radical deterioration/distortion during high-water events. Culvert needs extensive invert repair or full pipe replacement soon. ~ MJ/JS"

*"12/05/2013 - ** Pipe invert is in poor condition with extensive corrosion and needs replacement or extensive repair now. ~ MJ/JS"*

"10/8/2012 Culvert should be evaluated for a concrete invert in the very near future. ~FRE/JAS"

*"11/28/2011 - ** Pipe is in poor condition due to heavy corrosion and loss along the invert. Pipe arch needs invert repair now before "piping" starts to effect support and shape. ~MJ/DK"*

Hydraulics

A Preliminary Hydraulics Report was done for this site and can be seen in the Appendix. The existing culvert is a Corrugated Galvanized Metal Plate Pipe Arch and has a span of 14'-3", a height of 8'-11" and is 152' long. It meets the hydraulic standard. Due to the extensive development in the area of this project, and the existence of a Flood Insurance Study, an increase in 100-year flood elevations would be prohibited. The pipe is at a skew of 48 degrees with the roadway. There is a small vertical drop at the outlet end of the culvert, possibly inhibiting Aquatic Organism Passage (AOP) at this location. There is ledge visible in some places near the culvert. The Preliminary Hydraulics Report does not discuss Bank Full Width (BFW), but does state that the existing culvert constricts the channel. Subsequent investigation by the Vermont Agency of Natural Resources resulted in a BFW of 18' being found acceptable.

<u>Recommendations</u>

Note that The Preliminary Hydraulics Report states that the culvert does not meet the Hydraulic Standard. Since the report was completed, a new Hydraulics Manual has been adopted. Modelling the culvert with the new manual results in a conclusion that the culvert currently does meet the Hydraulic Standard.

The Preliminary Hydraulics Manual, since it concludes that the standard is not currently met and advises against raising the 100 year flood elevation, contains only recommendations for culvert replacement, none for rehabilitation. The options given are as follows:

1. An open bottom precast concrete arch or similar 3-sided structure with a 24' minimum clear span perpendicular to the channel and a 9' clear height above the average channel bottom. A minimum waterway area of 190 SF is recommended.
2. A bridge with vertical abutments with a minimum span of 24' perpendicular to the channel and a minimum low beam elevation of 489.2. No fill would be allowed between abutments that would reduce the waterway area. A BFW of 18' is acceptable. The allowable vertical height of the culvert will be confirmed during the Final Hydraulics study.

Note that the existing culvert, with an 8'-11" vertical height, has only about 3.5' of cover over the pipe. Alternative dimensional configurations should be investigated to try to get more cover over the new structure.

This project is located in a mapped floodplain, so no rise in water surface elevations should be allowed.

The Preliminary Hydraulics Report can be seen in the Appendix.

Utilities

Underground:

There are existing buried municipal water and sewer lines in the vicinity, including an 8" sewer line which travels down the center of the paved drive to the west of the culvert. These should not be a conflict with the project, but may need to be protected during the work. Nearby water lines will not be a conflict with the project.

Aerial:

There are several overhead utility lines passing over the culvert. They are shown on the Existing Conditions Layout. Aerial utilities will need to be relocated for a replacement project.

Right-of-Way

The existing Right-of-Way is shown on the Layout sheet. At the project site, the Right-of-Way is variable. It is anticipated that additional Right-of-Way will be required for all options considered except the Do-Nothing alternative.

Resources

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

Biological:

"This unnamed watercourse is tributary to the Black River and will require a provision for aquatic organism passage. It is regulated by the US Army Corps of Engineers and the removal of existing vegetation along the stream should be minimized. If there is a need to remove some of this vegetation during construction, the site should be restored by planting native trees and shrubs."

Wetlands

There are no mapped wetlands within the project area.

Rare, Threatened and Endangered Species

There are no mapped rare, threatened or endangered species within the project area, except potentially for the Northern Long Eared Bat.

Agricultural

There are no prime agricultural soils within the project area.

Archaeological:
No Archaeological Resources have been identified at the site.

Historic:
No Historic Resources have been identified at the site.

Hazardous Materials:
According to the Vermont Agency of Natural Resources (ANR) Vermont Hazardous Sites List, there are no known active hazardous sites in the project area.

Stormwater:
There are no stormwater concerns for this project.

II. Safety

The project area is not in a high crash segment, but one begins 0.2 miles east of the project. Banking at the project location is substandard, but the existing conditions within the project area are considered adequate for the purposes of safety.

III. Alternatives Discussion

The existing roadway at the culvert location meets most standards in terms of roadway geometry and safety features, but is substandard in banking. Even if a replacement alternative is selected that involves open cutting, work on the existing roadway alignment is not anticipated since the substandard portions of the roadway are beyond the immediate project area. The alternatives presented here are based on improvement of the condition of the culvert and channel.

The original Preliminary Hydraulics Report recommends only replacement alternatives because it concluded that the culvert does not meet the Hydraulic Standard. However, it has been determined that under the new Hydraulics Manual, the culvert does meet the Standard, but not BFW. It is also recognized that some projects will not get funded for full replacements that meet all standards and resource

requirements. Therefore, rehabilitation alternatives will also be discussed in this report as a measure to extend the life of this culvert to the point where a replacement can be completed. There is a small vertical drop at the culvert outlet, but it is not clear from the Natural Resources ID whether AOP is prohibited by existing conditions or not.

There are two basic approaches to this project; replacement and rehabilitation.

- A replacement project could be designed to resolve all of the deficiencies that exist today at the project site, with the possible exception of roadway banking. Improvements include structural deterioration, BFW, AOP, and maintenance of flood elevations.
- A rehabilitation project would restore some degree of structural integrity to the culvert, but would leave several desirable features unresolved including BFW and full AOP, and would only extend the service life of the structure approximately 30 years. Hydraulic and flood capacity could even be reduced.

No Action

This alternative would involve leaving the culvert in its current condition. There are two ways used to evaluate whether a "No Action" alternative is appropriate. One is to determine whether the existing structure can stay in place without substantial work being required during the next 10 years. The other is to evaluate the ratings of all of the elements of a bridge or culvert, with the goal that all elements rated 4 or less are to be removed or rehabilitated. In this case, the culvert will likely require substantial work within the next 10 years. Also, given the 3 (serious) rating on this culvert, it is not acceptable to leave it as is. Therefore, the No Action alternative is not recommended.

Structure Replacement with an Integral Abutment Bridge

A full replacement with an integral abutment bridge was discussed in the Preliminary Hydraulics Report. This concept was not developed for this project because it is generally more economical to construct a buried structure for short spans where there is adequate cover for the structure. A buried structure in this location will also be more protected from de-icing salts and will require less maintenance. An integral abutment bridge would require a centerline span of approximately 85' to provide a Bank Full Width of 24' and 1:1.5 slopes and a 20-degree skew. It would conflict with an existing commercial driveway in the northwest quadrant.

Structure Replacement Using Trenchless Methods

Trenchless methods, as defined in this scoping report, include jack and bore, pipe ramming, and similar methods of installing a new pipe without open excavation. A replacement of the existing culvert adjacent to the current location using these methods was considered. Although done more frequently in other states, it is unlikely that there is the expertise or equipment available to make these methods of pipe replacement cost competitive for this project, which would require one 16' diameter pipe or two 11' diameter pipes be installed. As this method does not seem economical for pipes that have 3'-5' of cover,

and it would require relocation of the water course, these methods will not be considered further in this report.

Alternative 1: Rehabilitation

Rehabilitation is usually initially considered for any culvert project. Normally on a project with the hydraulic characteristics seen here (constricts the stream and would raise the Q_{100} flood elevations if lined), rehabilitation would be discounted, and a replacement project would be recommended. However, economic considerations are becoming a higher priority on many projects and it may be possible for short term improvements to be made in a manner that prevents raising the flood elevations.

Rehabilitation options considered:

a. Invert Repair
b. Pipe Liner
c. Cured in Place Pipe
d. Spray-On Lining

All rehabilitation options would employ the use of hydro-blasting or hydro-demolition 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. Additional injection of flowable fill would be recommended to stabilize the roadbed above the culvert. Curing in dry conditions would be required in most cases, necessitating a re-routing of the stream flow during the work and for a prescribed curing period (usually 24 hours). A headwall with beveled inlets would be recommended for all rehabilitation alternatives. A service life of approximately 30 years can be expected if the culvert is rehabilitated.

a. Invert Repair

The condition of the galvanized metal above the ordinary water line in the culvert is fairly good. There is some corrosion evident along bolt lines and seams, but it does not appear that the pipe is settling significantly. There are different types of invert repair that can be utilized on corrugated steel pipe. The following were considered:

- Bituminous concrete paving is not recommended for this situation because it is ineffective where structural capacity needs to be replaced.
- Reinforced concrete can also be used to form the new invert. This does restore some of the structural integrity of the culvert and extends the life of the culvert, but it also reduces the waterway area, likely causing higher velocities and water surface elevations during flood conditions.
- VTrans' Construction and Maintenance Bureau (Technical Section) is experimenting with a project which uses phased plate replacement to accomplish the invert repair. Since this project is likely to be bundled with up to 3 other projects on VT 11, this project is probably not a good choice for a pilot project. Plate replacement will not be considered further in this report.

- To provide the maximum possible waterway area, a configuration of the new invert using reinforced concrete that is lower than the existing pipe bottom could be considered. Provision of AOP and avoidance of higher flood elevations should be considerations.

b. Pipe Liner

Adding a pipe liner, also called sliplining, consists of pulling a complete new pipe into the existing culvert, then grouting the space between the two. Sliplining can be done using several different types of pipe material including corrugated steel, aluminum, reinforced concrete, and polyethylene, and can restore the structural integrity of the culvert. There are drawbacks to sliplining: one is that the waterway area is always reduced when sliplining is done; and two, it can be difficult to get the new liner installed, especially if there is distortion of the original host pipe. Another drawback is that it does not enhance AOP. Lastly, actions that raise the water surface elevations in Flood Insurance Zones or flood plains are prohibited without additional modelling of the waterway to show no detrimental effects. Crucial to the success of this method would be surveying the interior of the existing CMP to ensure that a rigid liner can be installed in the pipes. In the case of a pipe arch, it may be possible to procure a slightly smaller pipe arch to use as a liner, but it will be costly and will reduce further the waterway area. Temporary Right-of-Way would likely be needed to provide a staging area at each end to accomplish this alternative. Pipe lining with an interior liner will not be considered further in this report.

c. CIPP (Cured In Place Pipe)

CIPP is another way of providing a new lining to the interior of an existing pipe. A resin-saturated felt or fiber tube is inserted into the pipe in a folded configuration, and is then expanded to be in contact with the entire interior surface of the existing culvert. Curing takes place by heating the resin using hot water, steam, or UV light. This method of culvert repair is not considered further in this report because a literature search on the subject yields no data on CIPP over the size of 8' diameter. Therefore, although it is expected that this method of culvert repair will be used in the future in Vermont, it is not considered to be a feasible solution for this project.

d. Spray-On Liners

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.

It is important to note that this method of lining also has thickness, which has the result of raising the water elevations and adversely affecting AOP.

Advantages: A repair alternative using methods a, b, c, and d would address the structural deficiencies of the existing culvert pipes with minimum upfront costs. Alternative a. would extend the life of the culvert for only a few years. Utility relocation would likely not be required. A repair would have minimal impacts on resources and traffic flow.

Disadvantages: Several of the rehabilitation methods described above have detrimental impacts on flood elevations, AOP, and normal flow characteristics. BFW would not be improved. Rehabilitation offers the shortest service life projection (approximately 30 years would be gained, depending on the alternative chosen). It is assumed that for any rehabilitation alternative, temporary right-of-way will be necessary for the contractor's access.

Alternative 2: Structure Replacement with a Buried Structure

Culvert replacement using an open cut was considered. The preliminary hydraulics report suggests several possible configurations for a new structure, including an open bottom precast concrete arch or frame.

The new culvert could be a 18' wide by 9' high (clear interior) precast concrete arch, frame, or any other shape meeting the waterway requirements. The height should be confirmed during final hydraulics. If an arch or frame is used, it should be founded either on sound ledge or 6' minimum below the channel bottom, and full depth headwalls used. Additional right-of-way would be required with this alternative. An open bottom should be considered as a means to provide a natural stream bottom and AOP. Additional Right-of-Way would be required with this alternative. Roadway geometry would not be revised with this method of replacement. Traffic could be maintained with an offsite detour, or using phased construction. A temporary bridge could also be used.

Advantages: A new buried structure would resolve all structural deficiencies at this site and offer a 100-year service life. It would provide the full waterway area required to meet the hydraulic standard and BFW, as well as AOP.

Disadvantages: This alternative would have the largest initial cost of the alternatives considered and would have the largest impact in terms of traffic disruption and excavation. Utility relocation would likely be required.

IV. Maintenance of Traffic

In keeping with a nation-wide trend toward accelerated construction aided and supported by the Federal Highway Administration, 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 will help 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, which detours traffic from the intersection of VT 11 and VT 106 in Springfield north on VT 106 to the intersection of VT 106 and VT 10 in North Springfield. Then the detour heads west on VT 10 to VT 103, south on VT 103 to Chester, and then back onto VT 11.

Thru distance:	7.1 miles	9 minutes
Detour distance:	13 miles	19 minutes
Added distance for Thru Traffic:	5.9 miles	10 minutes
End to end distance:	20.1 miles	28 minutes

The times listed include no delays due to traffic congestion.

An alternate detour exists routing traffic to the south of the project:

Starting at the intersection of VT 106 and VT 11 in Springfield, travel southeast on VT 11 to I-91, then south on I-91 to Exit 6 in Rockingham. From Exit 6, travel northwest on VT 103 to Chester, then back to VT 11.

Thru distance:	7.1 miles	9 minutes
Detour distance:	20 miles	23 minutes
Added distance for Thru Traffic:	12.9 miles	14 minutes
End to end distance:	27.1 miles	22 minutes

Again, no delays for congestion are included in the travel times above.

There are some opportunities for local bypasses, but they are few and not ideal. Fairground Heights (TH-27 in the Town of Springfield and TH-337 in the Urban Compact) travels from VT 11 just west of the project site northeastward to TH-336, Fairground Road. These are narrow Class 3 Town roads with many residential buildings close to the road. These roads would not easily endure an increase of some 7000 cars per day. In a closure, this route would nonetheless become a bypass of choice for many.

The bypass could be used by emergency responders, but would add to response times. The distance required by emergency responders would be increased from approximately 0.5 miles via the through route on VT 11 to approximately 1.0 miles following the bypass through Fairground Heights and Fairground Road.

Another possible bypass starting on the west side of the project site follows TH-78 (Pleasant Valley Road) southward into the Town of Rockingham until it eventually joins VT 103. TH-78 is a Class 3 Town Road and avoids the more developed area of Chester, but is nearly as long as the southern detour route.

Other bypass routes may be available. Access to driveways and town highways would be maintained. A map of the primary detour route 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 plan and 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. Emergency response times would be affected.

Option 2: Phased Construction

Phased construction is the maintenance of one lane of alternating traffic on the existing bridge while building one lane at a time of the proposed structure. Once the first half of the project is completed, traffic is shifted to the new lane, and work proceeds on the second lane. This allows keeping the road open during construction, while having minimal impacts to resources and adjacent property owners.

Existing conditions at this project site; traffic volumes, length of project, and existing roadway width, marginally meet the most recent guidance for closing one lane of traffic and maintaining one lane of traffic, alternating direction, with a traffic signal. However, it is likely that with some temporary widening of the roadway fill embankment, two-way traffic could be maintained on each side in turn to allow the project to be completed in phases without the need for alternating one-way traffic. Delays will still occur as speed will be reduced through the work zone.

The excavation to install a 3-sided frame or arch would be approximately 20'-22' deep to reach the recommended footing scour depth if bedrock is not encountered at that depth. Phasing would require a fairly deep braced excavation immediately adjacent to a live traffic lane while the work is performed. Subsurface borings have been obtained which indicate the presence of bedrock at depths ranging from 13'-31' below ground surface at each boring location. Bedrock could interfere with the installation of a box culvert, but a new buried structure here would most likely be an arch or frame. Bedrock would affect the ability to drive sheet piles for bracing the excavation during phased construction. A modified method of bracing the excavation for each phase will likely be required, similar to that used for Duxbury or Winhall. Note that if a precast structure is used, the design of the joint in the structure between phases will need to be well thought out, since a precast structure will come in sections with square ends.

Advantages: Traffic would be maintained through the work zone.

Disadvantages: Delays would be experienced due to reductions in speed through the work area. Additional ROW would be required and utility relocation would be required. The construction duration would be longer if done in phases.

Option 3: Temporary Bridge

Initial investigations indicate that the configuration of the site is unfavorable for locating a temporary bridge. On the downstream side, a commercial drive would have to be used to access a temporary bridge. Then a vertical embankment would be negotiated to get to and cross TH-338 (Old Chester Road), and then another embankment to get back to VT 11. The grades and private property would be obstacles to a temporary bridge on this side and it would be very difficult to get appropriate geometry and sight distance.

On the upstream side, the terrain goes up sharply and is densely populated with fairly mature trees.

A temporary bridge does not seem feasible and will not be considered further on this project.

V. Alternatives Summary

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

Alternative 1a: Culvert Rehabilitation using Invert Replacement, with Traffic Maintained through the work zone with periodic short term delays.

Alternative 1b: Culvert Rehabilitation using Spray-On Liner with traffic maintained through the work zone with periodic short term delays.

Alternative 2a: New Buried Structure using Open Cut with two-way Traffic Maintained by Phasing

Alternative 2b: New Buried Structure using Open Cut with Traffic Maintained on an Off-Site Detour.

VI. Cost Matrix[1]

Springfield BF 0134(45)		Alt 1a	Alt 1b	Alt 2a	Alt 2b
		Invert Repair	Spray-On Liner	Culvert Replacement using Open Cut	Culvert Replacement using Open Cut
		Minor Traffic Impacts	Minor Traffic Impacts	Off-Site Detour	Phased
	Bridge Cost	$380,000	$228,000	$926,000	$1,020,000
	Removal of Structure	$0	$0	$5,000	$5,000
	Roadway	$125,000	$125,000	$179,000	$305,000
	Maintenance of Traffic	$25,000	$25,000	$45,000	$100,000
	Construction Costs	$530,000	$378,000	$1,155,000	$1,430,000
	Construction Engineering + Contingencies	$180,000	$110,000	$335,000	$415,000
	Total Construction Costs w CEC	$710,000	$488,000	$1,490,000	$1,845,000
	Preliminary Engineering[2]	$159,000	$95,000	$373,000	$356,000
	Right of Way	$17,000	$17,000	$57,000	$108,000
	Total Project Costs	**$886,000**	**$600,000**	**$1,920,000**	**$2,309,000**
	Annualized Cost	**$29,500**	**$20,000**	**$19,200**	**$23,100**
	Project Development Duration[3]	2 years	2 years	3 years	4 years
	Construction Duration	2 months	2 months	3 months	4 months
	Closure Duration (If Applicable)	NA	NA	25 days	NA
	Typical Section - Roadway (feet)	43’ (incl. sidewalk)	43’ (incl. sidewalk)	43’ (incl. sidewalk)	43’ (incl. sidewalk)
	Typical Section - Bridge (feet)	7-12-12-7	7-12-12-7	7-12-12-7	7-12-12-7
	Geometric Design Criteria	No Change	No Change	No Change	No Change
	Traffic Safety	Improved	Improved	Improved	Improved
	Alignment Change	No	No	No	No
	Bicycle Access	No Change	No Change	No Change	No Change
	Hydraulic Performance	Meets Standard	Substandard	Meets Standard	Meets Standard
	Pedestrian Access	No Change	No Change	No Change	No Change
	Utility	No Change	No Change	Relocation	Relocation
	ROW Acquisition	Yes	Yes	Yes	Yes
	Road Closure	No	No	Yes	No
	Design Life	30 years	30 years	100 years	100 years

[1] Costs are estimates only, used for comparison purposes.
[2] Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.
[3] Project Development Durations are staring from the end of the Project Definition Phase.

VII. Conclusion

Alternative 2a is recommended; replace the existing culvert with a new buried structure in phases.

A full replacement was chosen because any liner alternative would reduce waterway area and raise water surface elevations at flood levels, which is not advised. The invert repair alternative is an innovative solution that has not been attempted, and it is believed that it would be a high risk due to the size of this culvert and the consequences to traffic mobility if the attempt met with difficulties.

A full replacement allows the installation of a new structure that meets the hydraulic standard, resolves BFW and AOP deficiencies, meets flood plain regulations, and offers a service life of 100 years if a precast concrete structure is used and installation is detailed for protection against road salts and other factors that accelerate deterioration. If a precast structure is used, special considerations may be required to accommodate how the joint between phases is constructed.

Conventional Design-Bid-Build contracting is recommended for this project.

Maintenance of Traffic:

The recommended method of traffic control is to maintain traffic on VT 11 via an on-site detour with two way traffic. Speed reductions would be used and occasional short and minor delays may be experienced as construction vehicles enter and leave the project site.

There are three other culvert projects on VT 11 in Springfield and Chester that are currently being scoped. Two are rated 3, and one is rated 2, and it makes sense to consider bundling all four of these projects for economic reasons.

Small impacts to adjacent properties are expected and it is conservatively expected that Right-of-Way will be needed.

VIII. Appendices

Appendix A: Site Pictures

Outlet End

Outfall

Pipe Interior

Deteriorated Invert

Appendix B: Town Map

SPRINGFIELD C60
BF 0134(45)

Scale 1:47,965

N

- INTERSTATE
- STATE LONG
- STATE SHORT
- TOWN LONG
- FAS/FAU
- FAS/FAU HWY
- INTERSTATE
- STATE HIGHWAY
- CLASS 1
- CLASS 2
- CLASS 3
- CLASS 4
- LEGAL TRAIL
- PRIVATE
- DISCONTINUED
- DISTRICT
- POLITICAL BOUNDARY
- NAMED RIVERS-STREAMS
- UNNAMED RIVERS-STREAMS

Produced by:
Mapping Unit
Vermont Agency of Transportation
August 2011

SPRINGFIELD
WINDSOR COUNTY
DISTRICT # 2

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 SPRINGFIELD **bridge no.:** 0060 **District:** 2

Located on: VT11 **over** BROOK **approximately** 0.6 MI W JCT VT 106 **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: 3 SERIOUS

Federal Str. Number: 302500006014181

AGE and SERVICE

Year Built: 1961 **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: 5600 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 14

Structure Length (ft): 14

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): 43

Skew: 48

Bridge Median: 0 NO MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 08 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: CGMPPA

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): 152

Average Cover Over Culvert (ft): 03

Waterway Area Through Culvert (sq.ft.): 101

Wingwall/Headwall Rating: 4 POOR CONDITION

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 112016 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

*11/08/2016 - ** Culvert has severe corrosion of invert, along with piping occurring. Pipe has potential for significant distortion/sink hole formation and needs replacement. ~ MJ/AC*

*04/22/2016 - Special inspection to monitor distress .** Extensive invert deterioration with large holes, especially at midlength with a 4' square hole and 16" drop where piping is ocurring. Culvert needs extensive invert repair or full pipe replacement soon. ~ MJ/SP*

12/3/2015 Culvert is in poor condition. Should consider a concrete invert soon. ~FRE/TJB

09/23/2014 - Pipe has high potential for radical deterioration/distortion during high-water events. Culvert needs extensive invert repair or full pipe replacement soon. ~ MJ/JS

*12/05/2013 - ** Pipe invert is in poor condition with extensive corrosion and needs replacement or extensive repair now. ~ MJ/JS*

10/8/2012 Culvert should be evaluated for a concrete invert in the very near future. ~FRE/JAS

*11/28/2011 - ** Pipe is in poor condition due to heavy corrosion and loss along the invert. Pipe arch needs invert repair now before "piping" starts to effect support and shape. ~ MJ/DK*

Appendix D: Preliminary Hydraulics Report

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Chris Williams, Structures Project Manager

FROM: David Willey, Hydraulics Project Supervisor

DATE: October 9, 2014

SUBJECT: Springfield BF 0134(45), VT 11 BR 60 over unnamed stream
Preliminary Hydraulics

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

Existing Conditions

The existing structure is a 14'-3" X 8'-11" X 152' long CGMPPA. It was built in 1961. This pipe is on a 48 degree skew to the road. The pipe is rusted with some holes through the invert. Rocks and debris have accumulated in the culvert. The stream makes a bend coming into the pipe and is straight downstream. Some ledge was observed in the channel upstream, and there is a large ledge outcrop on the east side of the inlet. There is a small drop at the outlet. The downstream channel is confined by a retaining wall with a paved road on top of it on the west side and a steep bank with a parking area and building on top of it on the east side. There is about 3' of cover over the existing pipe.

Our calculations show the existing structure does not meet the current hydraulic standards, as water overtops the roadway below the design 50-year flood. The Q10 is the largest flow that does not submerge the inlet. Q10 headwater elevation is 486.6'. The pipe constricts the channel width.

Recommendations

There is a Flood Insurance Study for this river. That fact, the development in the floodplain and the fact that the existing pipe is undersized all dictate there be no increase in water surface elevations. A complete replacement appears to be the best solution for this site.

This is a somewhat developed area. The channel and floodplain through this area have been affected by a retaining wall, roads, buildings and parking areas. Site conditions affect hydraulics and will limit project options.

In sizing a new structure we attempt to select structures that meet both the current VTrans hydraulic standards, state environmental standards with regard to span length and opening height, and allow for roadway grade and other site constraints. Based on the above considerations and the information available, we recommend any of the following structures as a replacement at this site:

1. An open bottom precast concrete arch, or similar 3 sided structure, with a 24' minimum clear span and 9' minimum clear height above the average channel bottom could be considered, if adequate cover over the structure can be provided. No fill should be placed between the abutments that would reduce the waterway area of the structure. The structure should have at least 190sq. ft. of waterway area. This structure will provide 1' of freeboard at the design Q50 and will have no roadway overtopping below Q100. So it will meet the hydraulic standards.

2. A bridge with a 24’ minimum clear span length, measured perpendicular to the channel, with vertical abutments aligned with the channel. No fill should be placed between the abutments that would reduce the waterway area of the bridge. Assuming the upstream bridge fascia is located near the existing edge of road, the bottom of beams would need to be at least elevation 489.2’ to have 1’ of freeboard at the design Q50. This size bridge will lower upstream water surface elevations by about 1.9’ at Q100. If it is not practical to design a bridge within the confines of the site that will have bottom of beams at elevation 489.2’, lower bottom of beams may be acceptable, but will not meet the standards. The bottom of beams should be kept as high as practical.

A longer bridge will be required if spill-through abutments are used. However, it does not appear this site lends itself to the use of spill-through abutments, due to the site constraints.

Many variables are in play such as span, low beam, roadway grade and site constraints. There are limitless combinations, all with different impacts. We have done our best to describe the ideal solution above. Please realize the above recommendations are the minimum required to meet the standards and are based on making assumptions for the variables listed. The final design may be different than our assumptions, and therefore may have different results. A slightly short span length with a higher clear height might be acceptable hydraulically, if it fits the site better. You may want to consider making the waterway area larger than recommended, to ensure the proposed design meets the standards. If you are unable to meet these recommendations and/or would like to have us test other options, please let us know.

We recommend early coordination with the Agency of Natural Resources River Management Engineer. They may have other recommendations for this project; including recommending or allowing a different span length.

General Comments

If a new bridge or open bottom structure is installed, the bottom of abutment footings should be at least six feet below the channel bottom, or to ledge, to prevent undermining. Abutments on piles should be designed to be free standing for a scour depth at least 6’ below channel bottom.

It is always desirable for a new structure of this size to have flared wingwalls at the inlet and outlet, to smoothly transition flow through the structure, and to protect the structure and roadway approaches from erosion. The wingwalls should match into the channel banks.

Any new structure should be properly aligned with the channel.

Please contact us if you have any questions or if we may be of further assistance.

DCW

cc: Hydraulics Project File via NJW
Hydraulics Chrono File

Appendix E: Geotechnical Data Report

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Jennifer Fitch, P.E., Structures Project Manager

END

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

CEE

Date: September 26, 2016

Subject: Springfield BF 0134(45) – Subsurface Investigation

1.0 INTRODUCTION

We have completed our geotechnical and geological subsurface investigation for the culvert located on Vermont RT 11 located approximately 0.6 miles west of the intersection of VT RT 11 and VT RT 106 in Springfield, Vermont. The borings were completed to determine the soil strata and depth to bedrock to aid in design for a replacement structure. Contained herein are the results of our field sampling and testing, laboratory analyses of soil and rock samples, as well as boring logs.

2.0 FIELD INVESTIGATION

The field investigation was conducted between July 28 and August 6, 2016. Five standard penetration borings were drilled to determine the existing subsurface strata. A summary of the location of each boring and corresponding ground surface elevation can be found in Table 1 as well as in the attached Boring Location Plan. The values for the Northings and Eastings are based on the Vermont State Plane Grid Coordinate System NAD 83, and were located by a handheld GPS. Elevations for the borings were then taken off a VTrans survey file. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used to determine them.

Table 1: Boring Locations and Elevations

Boring Number	Station	Offset (ft)	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft)	Top of Bedrock Elevation (ft)
B – 101	365+9.0	-52.96	291257.36	1641364.34	485.4	464.5
B – 102*	364+56.0	23.22	291171.15	1641329.99	491.7	Not Encountered
B-102A	364+61.0	23.22	291172.28	1641334.86	491.6	478.6
B-103	365+25.1	-18.50	291227.45	1641387.84	489.5	458.0
B-104	364+25.5	-23.28	291164.18	1641300.31	492.1	475.4

**Encountered culvert at 5.3 feet, moved 5 feet to B-102A*

The borings were performed in general accordance with AASHTO T206, *Standard Method of Test for Penetration Test and Split-Barrel Sampling of Soils.* During boring operations, for boring B-101, split spoon samples and standard penetration tests (SPT) were taken continuously to bedrock. When bedrock was encountered, NX rock cores were taken 15 feet into bedrock to collect five foot core sample runs to confirm the presence of bedrock. Due to low RQD values in the first two core runs, a third core run from 10 to 15 feet in rock was completed. For B-103, split spoon samples and SPTs were taken continuously to 21 feet, then at 5 foot intervals to bedrock. When bedrock was encountered, one five foot core run was completed to confirm the presence of bedrock. For boring B-102, split spoon samples were taken continuously to 5.3 feet where the drill casing encountered the culvert. After hitting the culvert, the drill rig was moved 5 feet parallel to the roadway away from the culvert to where boring operations were

continued as B-102A. In boring B-102A, the boring was advanced to a depth of 7 feet before sampling began. Split spoon samples and SPTs were taken until bedrock was encountered at a depth of 13 feet. When bedrock was encountered, two NX rock cores were taken ten feet into rock to collect five foot core runs to confirm the presence of bedrock. For B-104, split spoon samples and SPTs were taken continuously to bedrock. When bedrock was encountered, one five foot core run was completed to confirm the presence of bedrock.

Soil samples were visually identified in the field and SPT blow counts were recorded on the boring logs when applicable. Soil and rock samples were preserved and returned to the Construction and Materials Bureau Central Laboratory for testing and further evaluation. Upon completion of the laboratory testing, the boring logs were revised to reflect the results of the laboratory classification analysis.

In addition to the borings, four exploratory probes were completed in the roadway in order to better profile the shallow bedrock encountered. The probes were completed to depths between 11.9 and 20.6 feet. It should be noted that cores were not taken to confirm if rock encountered by the probes was boulders or bedrock. A summary of the location and depth of each probe can be found in Table 2 as well as in the attached Boring Location plan. The values for the Northings and Eastings are based on the Vermont State Plane Grid Coordinate System NAD 83, and were located by a handheld GPS.

Table 2: Probe Locations and Depths

Probe Number	Station	Offset (ft)	Northing (ft)	Easting (ft)	Ground Surface Elev. (ft)	Depth Completed (ft)
P-1	365+6.75	-15.78	291220.64	1641370.58	490.0	12.7
P-2	365+70.52	-0.23	291197.29	1641338.81	490.9	20.6
P-3	364+89.62	7.81	291193.78	1641359.24	490.8	11.9
P-4	364+30.34	15.55	291172.81	1641303.26	491.3	13.5

3.0 FIELD AND LABORATORY TESTING

The standard penetration resistance of the in-situ soil is determined by the number of blows required to drive a 2 inch OD split barrel sampler into the soil with a 140 pound hammer dropped from a height of 30 inches, in accordance with procedures specified in AASHTO T206. During the standard penetration test (SPT), the sampler is driven for a total length of 2 feet, while counting the blows for each 6 inch increment. The SPT N-value, which is defined as the sum of the number of blows required to drive the sampler through the second and third increments, is commonly used with established correlations to estimate a number of soil parameters, particularly the shear strength and density of cohesionless soils. The N-values provided on the boring logs are raw values and have not been corrected for energy, borehole diameter, rod length, or overburden pressure. The VT Agency of Transportation has determined a hammer correction value, C_E, to account for the efficiency of the SPT hammer on the drill rig. For all of the borings, a CME 45C Skid Rig was used, with a hammer energy correction factor of 1.42. This value, included on the boring logs, should be used in calculations to determine soil parameters. Laboratory tests were conducted on all samples to evaluate grain size, moisture content, and percent finer than No. 200 sieve. Results from this testing can be found on the attached boring logs.

A detailed description of the rock cores is presented on the boring logs including run length, drill times, recovery, and Rock Quality Designation (RQD). Recovery is defined as the length of core obtained expressed as a percentage of the total length cored. In accordance with ASTM D6032, RQD is the total length of core pieces, 4 inches or greater in length, expressed as a percentage of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams, jointing and bending planes. The Rock Mass Rating (RMR) is also included on the logs. RMR is AASHTO's (LRFD

Bridge Design Specification) recommended method of classifying rock, and is based on five different parameters that all have relative ratings which combine to form the RMR. These parameters include rock strength, RQD, joint spacing, joint condition, and groundwater (AASHTO Section 10.4.6.4).

4.0 RECOMMENDATIONS

The depth of bedrock varies significantly across the footprint of this culvert. Based on the overburden material encountered above bedrock, we believe sheet piles can only be driven to depths between 10 and 20 feet if phased construction is selected. Although some dense materials including broken rock were present in the borings, no large boulders or cobbles were noted by the drillers. As a result, it appears sheet piles can be driven by equipment commonly used by contractors in the region through the soils encountered. These recommendations are based on the information encountered at the boring locations and it should be noted that site conditions can vary across the project site.

In the previous scoping report dated July 10, 2014, a precast arch bridge on spread footings or a reinforced concrete box culvert with new headwalls and wingwalls were possible options for the replacement of the culvert. Based on the findings of this geotechnical investigation, we believe these are still feasible options. Once this project moves further along in the design phase, we would be happy to assist with any foundation design required.

5.0 CONCLUSION

If you have any questions, or you would like to discuss this report, please contact us at (802) 828-2561. The boring logs are attached as available in the *M:Projects\13d336\MaterialsResearch* folder.

Enclosures: Boring Location Plan (1 page)
Boring Logs (5 pages)

cc: Gary Sweeny
Electronic Read File/DJH
Project File/CEE
END

DAVID COLEMAN
PAVED DRIVE
BOUNDRY MARKER
REBAR ONLY
IN PAVEMENT
HVCTRL 100
COMB 58A 35B
B-101
PAVED DRIVE
SEWER MANHOLE
2 MAILBOX #41
ECT
SIGN VD-701 (BR 60 VT 11)
WALL H
B-103
A.C. SEWER FLOW
P1
P2
14'-3"X8' CGMPPA
24" CGMP FLOW
P3
P4
B-104
B-102
B-102A
364+00
365+00
366+00
PC
STA 366+16.19
BOUND APPARENT LOCATION
STRUCTSIGNAL UNDER PAVEMENT
COMB 58A 35A
PAVED DRIVE
HVCTRL 102
HVCTRL 103
SIGN W3-5 (35) MM 0110 1418 0340
STONE FILL
SIGN VD-018 (SPRINGFIELD)
COMB 7 58 36
GUY
STREAM FLOW

BORING CHART

HOLE NO.	SURV. STATION	OFFSET	GROUND ELEV.	ELEV. TLOB
B-101	365+9.0	52.96 LT	485.4	464.5
B-102	364+56.0	23.22 RT	491.7	---
B-102A	364+61.0	23.22 RT	491.6	478.6
B-103	365+25.1	18.50 LT	489.5	458.0
B-104	364+25.5	23.28 LT	492.1	475.4
P-1	365+6.75	15.78 LT	490.0	477.3
P-2	365+70.52	0.23 LT	490.9	470.3
P-3	364+89.62	7.81 RT	490.8	478.9
P-4	364+30.34	15.55 RT	491.3	477.8

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(45)

FILE NAME: 13d336/si3d336border.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: ------
RESOURCE SITE PLAN

PLOT DATE: $$$$DATE$$$
DRAWN BY:
CHECKED BY: ------
SHEET $S"S OF $T"S

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

BORING LOG

Springfield
BF 0134(45)
VT 11 Culv. 60

Boring No.: **B-101**
Page No.: 1 of 1
Pin No.: 13d336
Checked By: END

Boring Crew: Emerson, Judkins, Gomes
Date Started: 7/28/16 Date Finished: 7/29/16
VTSPG NAD83: N 291257.36 ft E 1641364.34 ft
Station: 365+09 Offset: -52.96
Ground Elevation: 485.4 ft

	Casing	Sampler
Type:	WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Auto/AWJ
Rig:	CME 45C SKID	C_E = 1.42

Groundwater Observations

Date	Depth (ft)	Notes
07/29/16	8.6	W.T. before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		A-1-b, GrSa, brn, Moist, Rec. = 0.9 ft				2-4-3-2 (7)	10.6	36.8	45.3	17.9
		A-1-b, SiGrSa, brn, Moist, Rec. = 1.0 ft, Lab Note: Broken rock was within sample				34-27-3-4 (30)	10.6	35.9	42.4	21.7
		Field Note:, NXDC, Cleaned out casing								
5		Field Note:, No Recovery				4-2-2-6 (4)				
		Field Note:, NXDC, Cleaned out casing								
		A-1-b, GrSa, brn, Moist, Rec. = 0.5 ft				4-4-6-3 (10)	13.9	37.7	44.4	17.9
		Field Note:, NXDC, Cleaned out casing								
		A-1-a, SaGr, gry, Moist, Rec. = 0.2 ft, Lab Note: Broken rock was within sample				R@3.5" (R)	9.2	69.6	25.0	5.4
10		Field Note:, NXDC, Cleaned out casing								
		A-2-4, SiSaGr, gry, Moist, Rec. = 1.0 ft				12-21-10-14 (31)	11.6	41.5	29.5	29.0
		Field Note:, NXDC, Cleaned out casing								
		A-4, GrSaSi, gry, Moist, Rec. = 1.4 ft				10-12-22-20 (34)	11.4	25.3	35.0	39.7
15		A-4, SaSi, gry, Moist, Rec. = 13.0 ft				12-16-20-30 (36)	12.7	12.7	40.0	47.3
		Field Note:, NXDC, Cleaned out casing								
		A-4, SaSi, gry, Moist, Rec. = 1.7 ft, Lab Note: A very small amount of clay was within sample. Sample tested non-plastic				10-12-16-26 (28)	11.2	13.8	40.4	45.8
		Field Note:, NXDC, Cleaned out casing								
		A-1-b, SaGr, brn, MTW, Rec. = 1.0 ft				4-9-R@2.5" (R)	11.7	48.1	36.7	15.2
20		Field Note:, NXDC, Cleaned out casing								
		A-2-4, GrSiSa, brn-gry, Moist, Rec. = 0.1 ft, Lab Note: Broken rock was within sample				R@1" (R)	8.8	29.2	36.3	34.5
		20.9 ft - 25.9 ft, Brown and tan, Rusty weathering, biotite-muscovite-quartz-plagioclase schist and Meta-Andesite, with hornblend. Penetrative rust staining and fine sandy silt coating along joints and broken rock. Schist is soft, moderately weathered. Moderately hard, Moderately weathered, Poor rock, NX, RMR=26	1 (70)	44 (0)	4 4 2 2 2	Top of Bedrock @ 20.9 ft				
25										
		25.9 ft - 30.9 ft, Tan to white, Rusty weathering Meta-Andesite, with hornblende. Persistant rust and orange staining along Meta-Andesite. Hard, Slightly weathered, Poor rock, NX, RMR=34	2 (65-70)	56 (0)	1 2 1 2 1					
30										
		30.9 ft - 35.9 ft, White, Gneiss with brown to tan weathering and green/gray SCHIST, Gneiss is moderately hard. Soft, Moderately weathered, Poor rock, NX, RMR=25	3 (60)	14 (14)	1 2 2 2 2					
35										
		Hole stopped @ 35.9 ft								
		Remarks: Hole collapsed at 6.4 feet.								
40										

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

BORING LOG 2 SPRINGFIELD BF 0134(45).GPJ VERMONT AOT.GDT 9/9/16

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BORING LOG

Springfield
BF 0134(45)
VT 11 Culv. 60

Boring No.: **B-102**
Page No.: 1 of 1
Pin No.: 13d336
Checked By: END

Boring Crew: Emerson, Judkins, Gomes
Date Started: 7/28/16 Date Finished: 7/28/16
VTSPG NAD83: N 291171.15 ft E 1641329.99 ft
Station: 364+56 Offset: 23.22
Ground Elevation: 491.7 ft

	Casing	Sampler
Type:	WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:	Auto/AWJ	
Rig:	CME 45C SKID	C_E = 1.42

Groundwater Observations

Date	Depth (ft)	Notes
07/28/16		No W.T. observed

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.45 ft					
		A-1-b, GrSa, brn, Moist, Rec. = 1.3 ft	4-3-3-3 (6)	9.2	40.0	46.8	13.2
2.5		A-2-4, SiGrSa, brn, Moist, Rec. = 1.1 ft	4-6-22-14 (28)	11.0	30.4	46.5	23.1
		Field Note:, Rollercone, Cleaned out casing					
5.0		Field Note:, No Recovery	R@3.5" (R)				
		Hole stopped @ 5.3 ft					
7.5							

Remarks:
Hole collapsed at 2.5 feet.

1.) Hit culvert at 5.3 feet. Aborted drilling operations.

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

BORING LOG 2 SPRINGFIELD BF 0134(45).GPJ VERMONT AOT.GDT 9/9/16

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BORING LOG

Springfield
BF 0134(45)
VT 11 Culv. 60

Boring No.: **B-102A**
Page No.: 1 of 1
Pin No.: 13d336
Checked By: END

Boring Crew: Emerson, Judkins, Gomes
Date Started: 7/28/16 Date Finished: 7/28/16
VTSPG NAD83: N 291172.28 ft E 1641334.86 ft
Station: 364+61 Offset: 23.22
Ground Elevation: 491.6 ft

	Casing	Sampler
Type:	WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:		Auto/AWJ
Rig:	CME 45C SKID	C_E = 1.42

Groundwater Observations

Date	Depth (ft)	Notes
07/28/16	10.4	W.T. during drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.45 ft								
5		Field Note:, NXDC, Cleaned out casing								
		A-1-b, GrSa, brn, Moist, Rec. = 0.9 ft				5-4-6-15 (10)	11.7	37.6	48.7	13.7
10		A-1-b, GrSa, brn, Moist, Rec. = 0.3 ft				5-7-10-10 (17)	12.7	37.5	45.7	16.8
		Field Note:, NXDC, Cleaned out casing								
		A-1-b, GrSa, brn, Moist, Rec. = 0.8 ft				9-18-R@5" (R)	12.6	29.4	57.2	13.4
		Field Note:, NXDC, Cleaned out casing								
15		13.0 ft - 14.3 ft, White, Biotite-muscovite-quartz-plagioclase-hornblend GNEISS, Brown and orange staining along joints. Hard, Slightly weathered, NX 14.3 ft - 18.0 ft, Gray to black, Biotite-muscovite-quartz-plagioclase SCHIST, Rust staining along joints. Moderately hard, Slightly weathered, Fair rock, RMR=43	1 (70)	76 (32)	2 3 4 7 6	Top of Bedrock @ 13.0 ft				
20		18.0 ft - 23.0 ft, Gray, Interlayed biotite-quartz-plagioclase SCHIST, and white, biotite-muscovite-quartz-plagioclase-garnet GNEISS. Slightly vuggy. Light brown, yellow, and orange staining along joints. Gneiss is hard.. Moderately hard, Slightly weathered, Fair rock, NX, RMR=49	2 (70)	100 (64)	3 2 3 3 4					
25		Hole stopped @ 23.0 ft Remarks: Hole collapsed at 8.2 feet.								

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

BORING LOG 2 SPRINGFIELD BF 0134(45).GPJ VERMONT AOT.GDT 9/9/16

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BORING LOG

Springfield
BF 0134(45)
VT 11 Culv. 60

Boring No.: **B-103**
Page No.: 1 of 1
Pin No.: 13d336
Checked By: END

Boring Crew: Gomes, Judkins, Emerson
Date Started: 8/02/16 Date Finished: 8/02/16
VTSPG NAD83: N 291227.45 ft E 1641387.84 ft
Station: 365+25.10 Offset: -18.50
Ground Elevation: 489.5 ft

	Casing	Sampler
Type:	WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:	Auto/AWJ	
Rig:	CME 45C SKID	C_E = 1.42

Groundwater Observations

Date	Depth (ft)	Notes
08/02/16	9.9	W.T. during drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.68 ft								
		A-1-b, SaGr, brn, Moist, Rec. = 0.8 ft, Lab Note: Broken rock was within sample				7-6-7-6 (13)	8.9	46.5	43.8	9.7
		A-1-b, GrSa, brn, Moist, Rec. = 0.6 ft				7-7-8-6 (15)	9.5	35.3	49.9	14.8
5		A-1-b, GrSa, brn, Moist, Rec. = 0.4 ft				9-7-5-7 (12)	13.8	30.0	53.4	16.6
		A-2-4, SiSa, brn, Moist, Rec. = 0.3 ft				7-4-5-3 (9)	13.0	18.8	56.8	24.4
		A-2-4, SiSa, brn, Moist, Rec. = 0.9 ft				3-1-2-1 (3)	17.6	15.8	60.9	23.3
10		Field Note:, Rollercone, cleaned out casing								
		A-1-b, GrSa, gry-brn, Moist, Rec. = 0.2 ft				1-1-W.H.-8 (1)	13.4	41.0	45.9	13.1
		A-1-a, SaGr, gry-brn, Moist, Rec. = 0.9 ft, Lab Note: Pieces of wood and a lot of broken rock was within sample				5-7-28-19 (35)	11.9	68.4	23.3	8.3
15		Field Note:, Rollercone, cleaned out casing								
		A-4, SaSi, gry, Moist, Rec. = 1.2 ft, Lab Note: Some clay was within sample. Sample tested non-plastic				8-2-5-8 (7)	13.3	14.4	35.7	49.9
		Field Note:, No Recovery				22-R@2.5"				
20		A-4, SiSa, gry-brn, Moist, Rec. = 1.5 ft				8-16-27-R@5" (43)	18.5	2.1	51.5	46.4
		Field Note:, NXDC, cleaned out casing								
25		A-4, SiSa, white-brn, Moist, Rec. = 0.1 ft, Lab Note: Sample consisted of weathered rock				R@1"	11.8	1.7	56.4	41.9
30										
		31.5 ft - 36.5 ft, Light green & gray, To white biotite-quartz-plagioclase-pyrite gneiss Meta-Andesite, with hornblende. Slight brown and rust staining along joints. Rare vugs. Hard, Very slightly weathered, Good rock, NX, RMR=69	1 (50)	98 (93)	7 7 6 5 6	Top of Bedrock @ 31.5 ft				
35										
		Hole stopped @ 36.5 ft								
40		Remarks: Hole collapsed at 8.7 feet.								

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

BORING LOG 2 SPRINGFIELD BF 0134(45).GPJ VERMONT AOT.GDT 9/9/16

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

BORING LOG

Springfield
BF 0134(45)
VT 11 Culv. 60

Boring No.: **B-104**
Page No.: 1 of 1
Pin No.: 13d336
Checked By: END

Boring Crew: Gomes, Judkins, Emerson
Date Started: 8/01/16 Date Finished: 8/02/16
VTSPG NAD83: N 291164.18 ft E 1641300.31 ft
Station: 364+25.51 Offset: 23.28
Ground Elevation: 492.1 ft

	Casing	Sampler
Type:	WB	SS
I.D.:	4 in	1.5 in
Hammer Wt:	N.A.	140 lb.
Hammer Fall:	N.A.	30 in.
Hammer/Rod Type:	Auto/AWJ	
Rig:	CME 45C SKID	C_E = 1.42

Groundwater Observations

Date	Depth (ft)	Notes
08/02/16	11.2	W.T. before drilling

Depth (ft)	Strata (1)	CLASSIFICATION OF MATERIALS (Description)	Run (Dip deg.)	Core Rec. % (RQD %)	Drill Rate minutes/ft	Blows/6" (N Value)	Moisture Content %	Gravel %	Sand %	Fines %
		Asphalt Pavement, 0.0 ft - 0.25 ft								
		A-1-b, GrSa, brn, Moist, Rec. = 0.8 ft Field Note:, NXDC, Cleaned out casing				--4-4-3 (8)	11.3	32.6	51.1	16.3
		A-1-b, SaGr, brn, Moist, Rec. = 0.9 ft Field Note:, NXDC, Cleaned out casing				4-5-7-14 (12)	10.2	51.5	34.5	14.0
5		A-1-b, SaGr, brn, Moist, Rec. = 1.2 ft, Lab Note: Broken rock was within sample				16-16-44-15 (60)	10.2	50.0	36.3	13.7
		A-2-4, SiGrSa, gry, Moist, Rec. = 1.0 ft, Lab Note: Broken rock was within sample Field Note:, NXDC, Cleaned out casing				12-11-11-19 (22)	10.3	27.1	47.6	25.3
		Field Note:, No Recovery				R@2.5" (R)				
		Field Note:, NXDC, Cleaned out casing								
10		A-2-4, GrSiSa, gry, Moist, Rec. = 0.7 ft				11-11-11-29 (22)	12.0	21.2	56.4	22.4
		Field Note:, No Recovery				R@5" (R)				
		Field Note:, NXDC, Cleaned out casing								
15		A-4, SiSa, brn, Moist, Rec. = 1.1 ft				21-25-R@5" (R)	15.0	4.1	52.4	43.5
		A-1-b, SaGr, brn, Moist, Rec. = 0.4 ft, Lab Note: Broken rock was within sample				R@5" (R)	10.0	53.1	30.5	16.4
		16.7 ft - 19.7 ft, Gray, Biotite-quartz-plagioclase SCHIST, Brown and rust staining along joints. Vugs forming along plagioclase foliations at 16.9 feet to 17.05 feet. Moderately hard, Very slightly weathered, Fair rock, NX, RMR=46	1 (50)	60 (60)	5 5 3	Top of Bedrock @ 16.7 ft				
20		19.7 ft - 21.7 ft, Gray, Biotite-muscovite-quartz-plagioclase SCHIST, Brown and orange staining along slickensided joints. Slightly vuggy. Moderately hard, Slightly weathered, Fair rock, NX, RMR=41	2 (50)	20 (55)	5 5					
		Hole stopped @ 21.7 ft								
		Remarks: Hole collapsed at 6.4 feet.								
25										

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

BORING LOG 2 SPRINGFIELD BF 0134(45).GPJ VERMONT AOT.GDT 9/9/16

Appendix F: Natural Resources ID Memo

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

TO: Lee Goldstein, Environmental Specialist

FROM: John Lepore, Transportation Biologist

DATE: February 6, 2014

SUBJECT: **Springfield B_F 0134 (45)**
Natural Resources ID
Br. 60 on VT 11

I have completed my review of this project which included both a desk review and a site. Based on my review, I have report the following:

Wetlands
There are no mapped wetlands in the immediate vicinity of this crossing.

Agricultural Soils
There are no prime agricultural soils located in the vicinity of this crossing.

Floodplains
This project is located on a mapped floodplain.

Fisheries
The unnamed watercourse associated with this crossing is tributary of the Black River and will require a provision for aquatic organism passage.

Species of Special Concern
There are no rare, threatened or endangered species or habitats of special concern in the vicinity of this crossing.

Permits & Construction
This watercourse is regulated by the US Army Corps of Engineers, and the existing vegetation along the stream is sparse on the downstream side, but if there is a need to removal some of this vegetation during construction, the site should be restored by planting native trees and shrubs.

Should you have any questions about this, please call me at 828-3963.

Appendix G: Archaeological Memo

VERMONT

Jeannine Russell
VTrans Archaeology Officer
State of Vermont
Environmental Section
One National Life Drive
Montpelier, VT 05633-5001
www.aot.state.vt.us

Agency of Transportation

[phone] 802-828-3981
[fax] 802-828-2334
[ttd] 800-253-0191

To: James Brady, VTrans Environmental Specialist

From: Jeannine Russell, VTrans Archaeology Officer
via Brennan Gauthier, VTrans Archaeologist

Date: 5/9/2014

Subject: Springfield BF 0134(45) – Archaeological Resource ID

Brennan,

A field visit was conducted on May 8th, 2014 by VTrans Archaeology Officer Jen Russell in order to identify archaeological resources in APE of Bridge 60 on VT Route 11 in the town of Springfield, Windsor County, Vermont. A rough boundary radius of 200 feet from the center of the bridge was used as a baseline APE. Based on field observations it has been determined that there are no identifiable areas of archaeological sensitivity in the project area. Please feel free to contact myself of Jen with any questions or concerns that may arise as part of this project.

Sincerely,

Brennan

Brennan Gauthier
VTrans Archaeologist
Vermont Agency of Transportation
Program Development Division
Environmental Section
1 National Life Drive
Montpelier, VT 05633
tel. 802-828-3965
fax. 802-828-2334
Brennan.Gauthier@state.vt.us

VTrans Working to Get You There
Vermont Agency of Transportation

Appendix H: Historic Memo

Sweeny, Gary

From: O'Shea, Kaitlin
Sent: Wednesday, February 12, 2014 1:36 PM
To: Brady, James
Cc: Newman, Scott; Williams, Chris
Subject: Springfield BF 0134(45) Historic Resource ID

Hi James, I have completed the historic resource ID for Springfield BF 0134(45). Bridge 60 carries Route 11 over a brook in Springfield, VT is not historic. There are no historic properties. This project can be processed as a Section 106 NHPA for historic.

Thanks,
Kaitlin

Kaitlin O'Shea
Historic Preservation Specialist
Vermont Agency of Transportation

802-828-3962
Kaitlin.O'Shea@state.vt.us

Appendix I: Local Input

Local & Regional Input Questionnaire

Project Name: Springfield Culverts 57 and 60 on VT-11
Project Number: Springfield BF 0134(43) and Springfield BF 0134(45)

Please note that answers apply to both C57 and C60, unless otherwise noted.

Attachments to give context to answers uploaded at https://drive.google.com/folderview?id=0B2jtfm2nTjt4LUxBR2FYeWU2TUU&usp=sharing :

- Land Use Map
- Context Map (includes sidewalks and some land use)
- Future Land Use Map
- Current Land Use Map
- Base Features Map (includes water and sewer lines)
- Public Transit Route Map
- Regional Transportation Map

Community Considerations

1. Are there any 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 bridge is closed during construction? Examples include: a bike race, festivals, cultural events, farmers market, concerts, etc. that could be impacted? If yes, please provide date, location and event organizers' contact info.
   High School Alumni Day Parade (2nd or 3rd weekend in June)

2. Is there a "slow season" or period of time from May through October where traffic is less?
   No particular slow season. Very high traffic all year round.

3. Please describe the location of emergency responders (fire, police, ambulance) and emergency response routes.
   Springfield Police. 201 Clinton Street, Springfield, VT. Phone: (802)885-2113. Chief Douglas Thompson douglas.johnston@state.vt.us

   Springfield Fire and Ambulance. 77 Hartness Avenue, Springfield, VT. Phone 802-885-4546. Fire Chief Russ Thompson

4. Where are the schools in your community and what are their schedules?
   Elm Hill Primary School (K-2) – 10 Hoover Street, Springfield, Vermont 05156
   Union Street Elementary School (3-5) – 43 Union Street, Springfield, Vermont 05156
   Riverside Middle School – 13 Fairground Road, Springfield, Vermont 05156
   Springfield High School – 303 South St, Springfield, Vermont 05156

   School District summer dates approx 4th week in June through 3rd week of August

5. In the vicinity of the bridge, 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? Please explain.

Residential and commercial land use. Near to Middle School, Hospital and several residential areas. This is a major through road carrying significant truck traffic. Sidewalks already exist (see map).

6. Are there any businesses (including agricultural operations) that would be adversely impacted either by a detour or due to work zone proximity?
   Many local businesses that have truck traffic travelling through the Town would be affected. See map for locations of businesses in town.

7. Are there any important public buildings (town hall or community center) or community facilities (recreational fields or library) in close proximity to the proposed project?
   Riverside Middle School, Springfield Hospital (main campus), Springfield Hospital (Rehabilitation Center).

8. Are there any town highways that might be adversely impacted by traffic bypassing the construction on another local road?
   Several town roads would be affected. No local roads could accommodate volume of traffic diverted.

9. Are there any other municipal operations that could be adversely impacted if the bridge is closed during construction? If yes, please explain.
   All operations in town would be adversely affected if bridge closed – due to large volume of traffic.

10. Please identify any local communication channels that are available—e.g. weekly or daily newspapers, blogs, radio, public access TV, Front Porch Forum, etc. Also include any unconventional means such as local low-power FM.
    Newspaper of record – Springfield Reporter

    Springfield Reporter – Weekly newspaper
    Eagle Times – Daily newspaper

    News updates emailed from Town Website - http://www.springfieldvt.govoffice2.com/

    Facebook (Town) - https://www.facebook.com/townofspringfieldvermont?fref=ts
    Facebook (Police Dept) - https://www.facebook.com/pages/Springfield-Police-Department-Springfield-VT/133631763326692?fref=ts
    Facebook (Springfield Regional Chamber of Commerce) - https://www.facebook.com/pages/Springfield-Regional-Chamber-of-Commerce/320106738039513?fref=ts
    Facebook (Springfield On The Move) - https://www.facebook.com/pages/Springfield-On-The-Move/168814006467688?ref=stream

11. Is there a local business association, chamber of commerce or other downtown group that we should be working with?
    Springfield Regional Chamber of Commerce – Jen Johnson spfldcoc@vermontel.net

Springfield Regional Development Corporation (SRDC) – Bob Flint
bobf@springfielddevelopment.org

Springfield On The Move (Downtown Organization) – Carol Lighthall som@vermontel.net

Design Considerations

1. Are there any concerns with the alignment of the existing bridge? For example, if the bridge is located on a curve, has this created any problems that we should be aware of?
   No particular concerns

2. Are there any concerns with the width of the existing bridge?
   No particular concerns

3. What is the current level of bicycle and pedestrian use on the bridge?
   Some pedestrians on the sidewalk

4. If a sidewalk or wide shoulder is present on the existing bridge, should the new structure have one? Are there existing bicycle and/or pedestrian facilities on the approaches to the bridge?
   Retain or widen shoulder width and area for sidewalk where possible.

5. Does the Town have plans to construct either bicycle or pedestrian facilities leading up to the bridge? Please provide a copy of the planning document that demonstrates this (e.g. scoping study, master plan, corridor study) Please explain and provide documentation.
   Existing sidewalk shown on map attached. Currently no plans for bike lane.

6. Does the bridge provide an important link in the town or statewide bicycle or pedestrian network such that you feel that bicycle and pedestrian traffic should be accommodated during construction?
   Important connection in sidewalk network from Downtown to residential neighborhoods in southeast part of town.

7. Are there any special aesthetic considerations we should be aware of?
   Not aware of any

8. Are there any traffic, pedestrian or bicycle safety concerns associated with the current bridge? If yes, please explain.
   No particular safety concerns known.

9. Does the location have a history of flooding? If yes, please explain.
   No known history

10. Are you aware of any nearby Hazardous Material Sites?
    None known

11. Are you aware of any historic, archeological and/or other environmental resource issues?
    None known

12. Are there any other comments you feel are important for us to consider that we have not mentioned yet?
    No

Land Use & Public Transit Considerations – to be filled out by the municipality or RPC.

1. Does your municipal land use plan reference the bridge in question? If so please provide a copy of the applicable section or sections of the plan.
   No specific mention of bridges in municipal land use plan

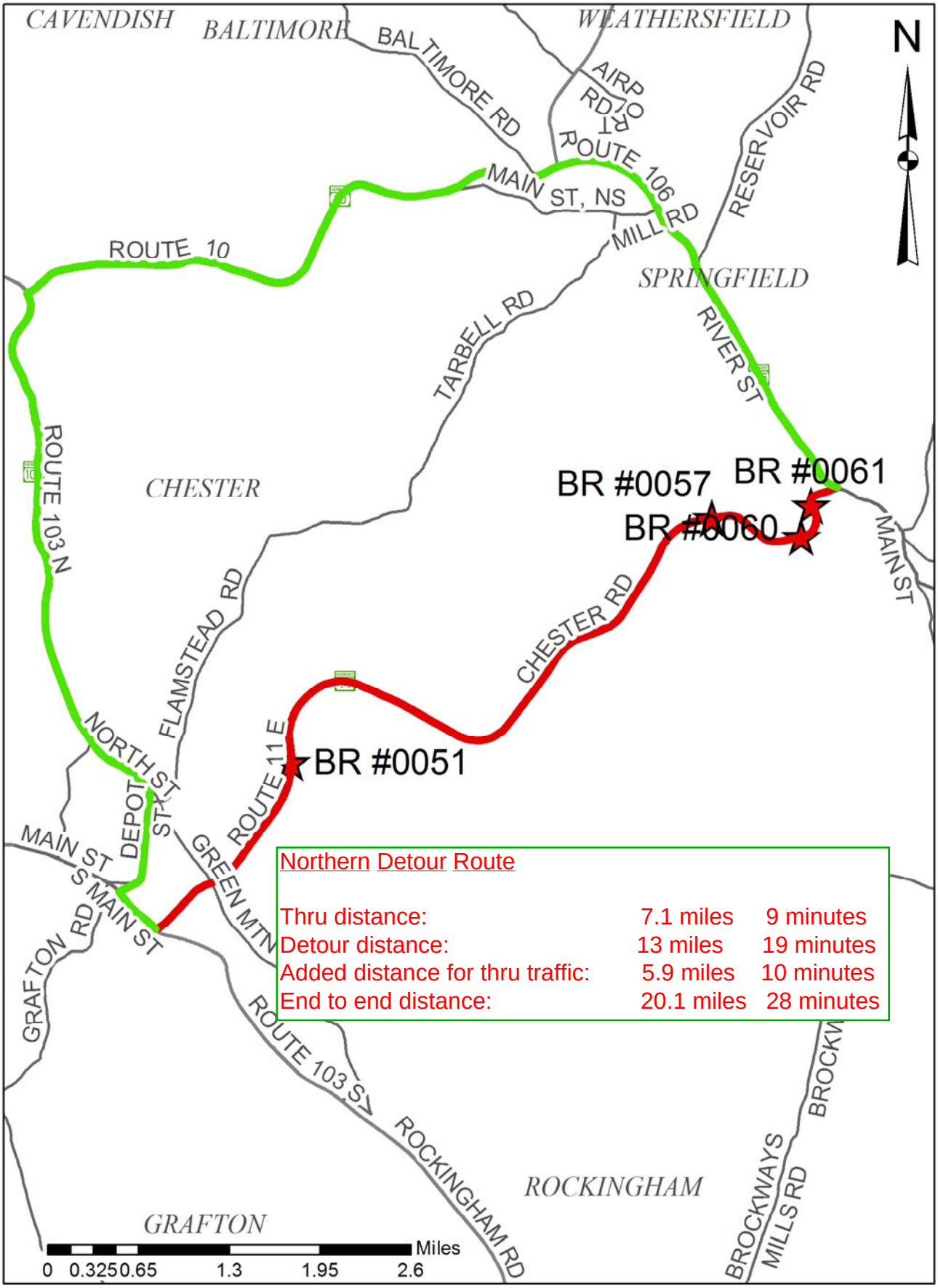
2. Please provide a copy of your existing and future land use map, if applicable.
   Attached

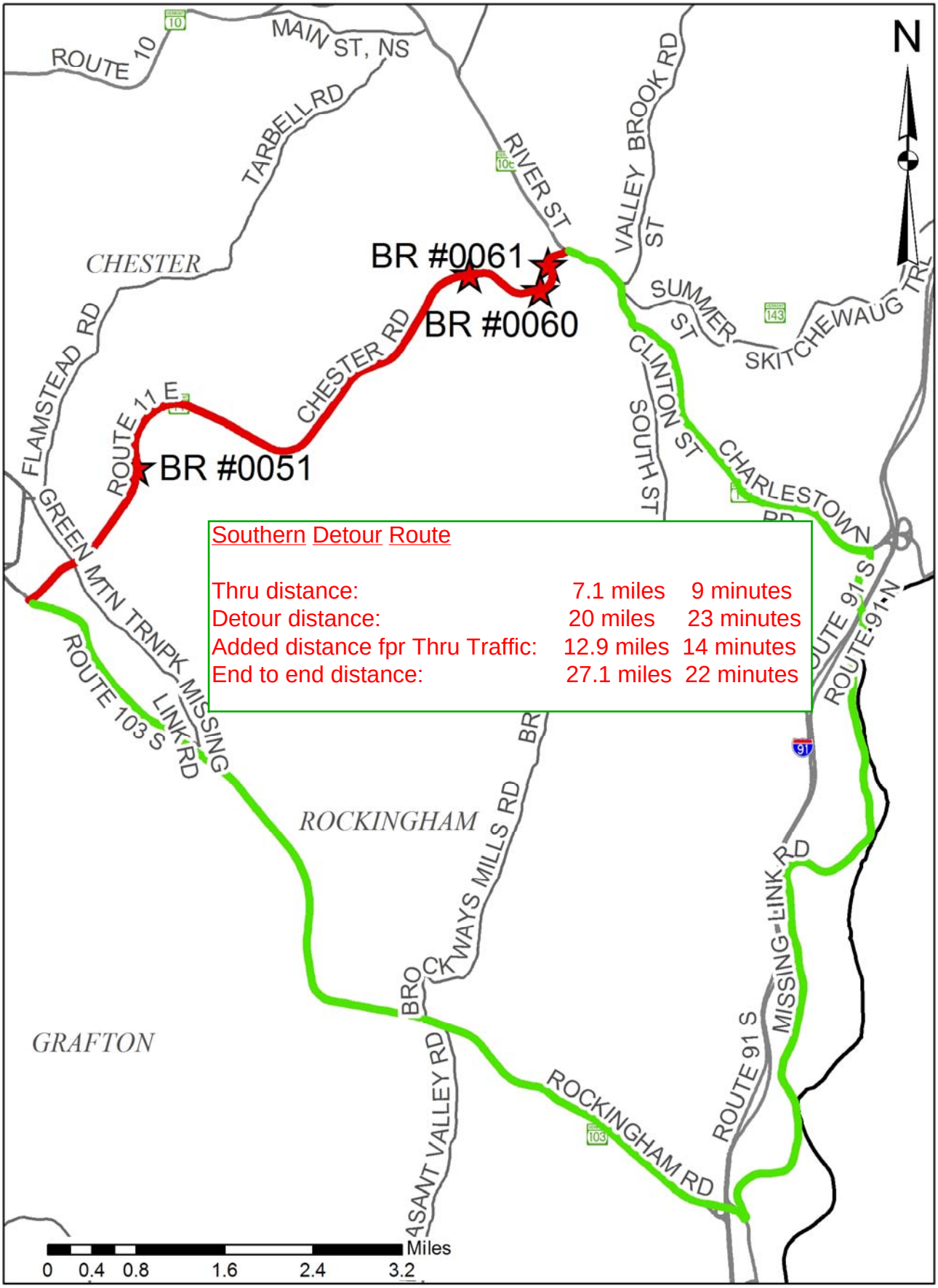
3. Are there any existing, pending or planned development proposal that would impact future transportation patterns near the bridge? If so please explain.
   None. But traffic will increase over time. VT-11 is a route over the Green Mountains which carries significant truck traffic.

4. Is there any planned expansion of public transit service in the project area? If not known please contact your Regional Public Transit Provider.
   None known expansion of public transit route known. Does not affect Fixed Route Transit Service (see map attached) but would affect Dial-A-Ride service – which covers the entire town of Springfield.

   For more information contact Rebecca Gagnon at Connecticut River Transit (The Current) who provides all transit services – rgagnon@crtransit.org

Appendix J: Detour


CAVENDISH
BALTIMORE
BAL TIMORE RD
WEATHERSFIELD
AIRPORT RD
ROUTE 106
MAIN ST, NS
RESERVOIR RD
MILL RD
ROUTE 10
SPRINGFIELD
TARBELL RD
RIVER ST
ROUTE 103 N
CHESTER
BR #0057
BR #0061
BR #0060
MAIN ST
CHESTER RD
FLAMSTEAD RD
NORTH ST
DEPOT ST
ROUTE 11 E
BR #0051
MAIN ST
S MAIN ST
GREEN MTN
GRAFTON RD
ROUTE 103 S
ROCKINGHAM RD
ROCKINGHAM
BROCKWAYS
MILLS RD
GRAFTON
Miles
0 0.325 0.65 1.3 1.95 2.6
N
Northern Detour Route
Thru distance: 7.1 miles 9 minutes
Detour distance: 13 miles 19 minutes
Added distance for thru traffic: 5.9 miles 10 minutes
End to end distance: 20.1 miles 28 minutes



Southern Detour Route

Thru distance:	7.1 miles	9 minutes
Detour distance:	20 miles	23 minutes
Added distance fpr Thru Traffic:	12.9 miles	14 minutes
End to end distance:	27.1 miles	22 minutes

Appendix K: Plans

N

VT STATE PLANE GRID

POB
STA 362+11.27

PC
STA 366+16.19

VT ROUTE 11
TO CHESTER

VT ROUTE 11
TO I-91

TH-338
(OLD CHESTER RD)

362+11
363+00
364+00
365+00
366+00
367+00

52+00
53+00
51+00
50+00

14'-3" X 8'-11"
CGMPPA

BENCHMARK
RAIL ROAD
SPIKE IN POLE
ELEV. = 495.11

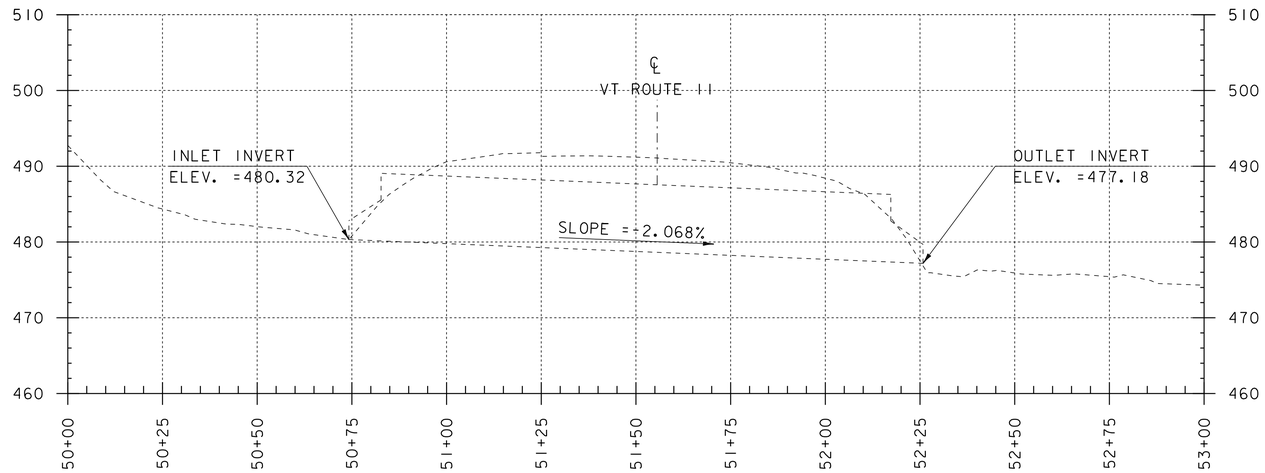
STREAM
FLOW

EXISTING 152' CGMPPA
BUILT 1961
SPAN 14'-3", RISE 8'-11"
AVERAGE COVER 3'
WATERWAY AREA = 101 SF

RESOURCE SITE PLAN

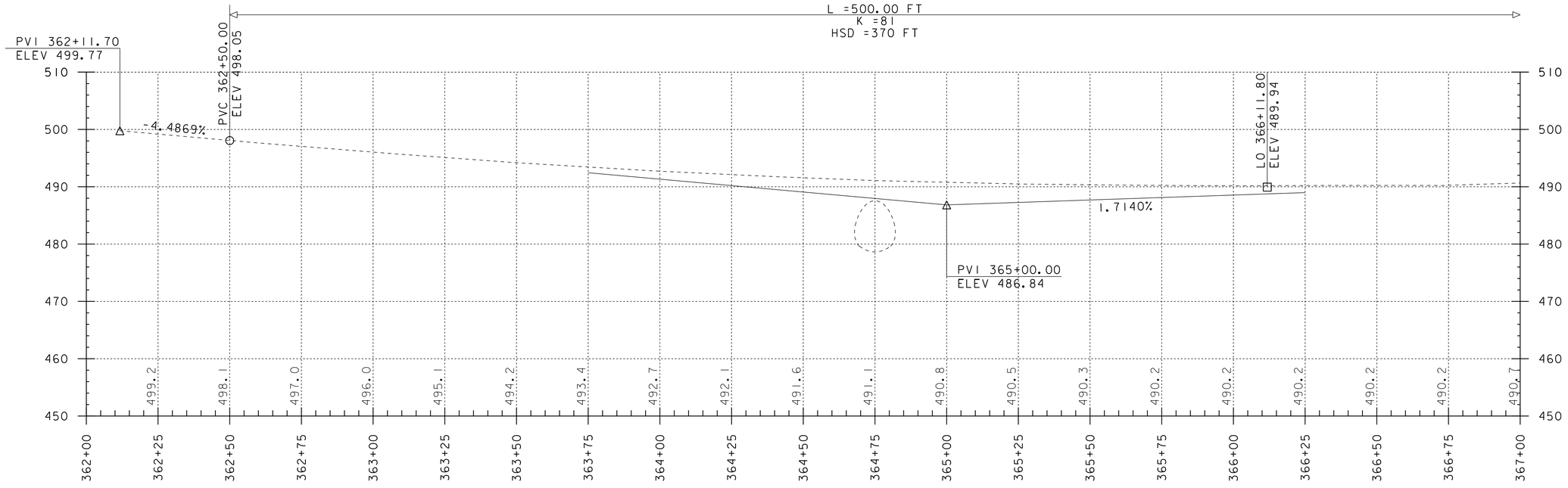
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)
FILE NAME: l3d336/sl3d336border.dgn	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
RESOURCE SITE PLAN	SHEET 1 OF 12



CULVERT 60 EXISTING PROFILE

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

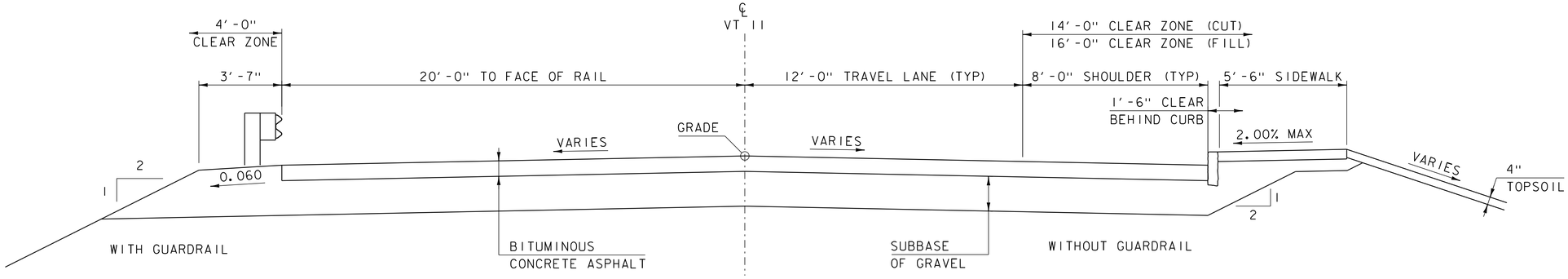


VT ROUTE 11 EXISTING PROFILE

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

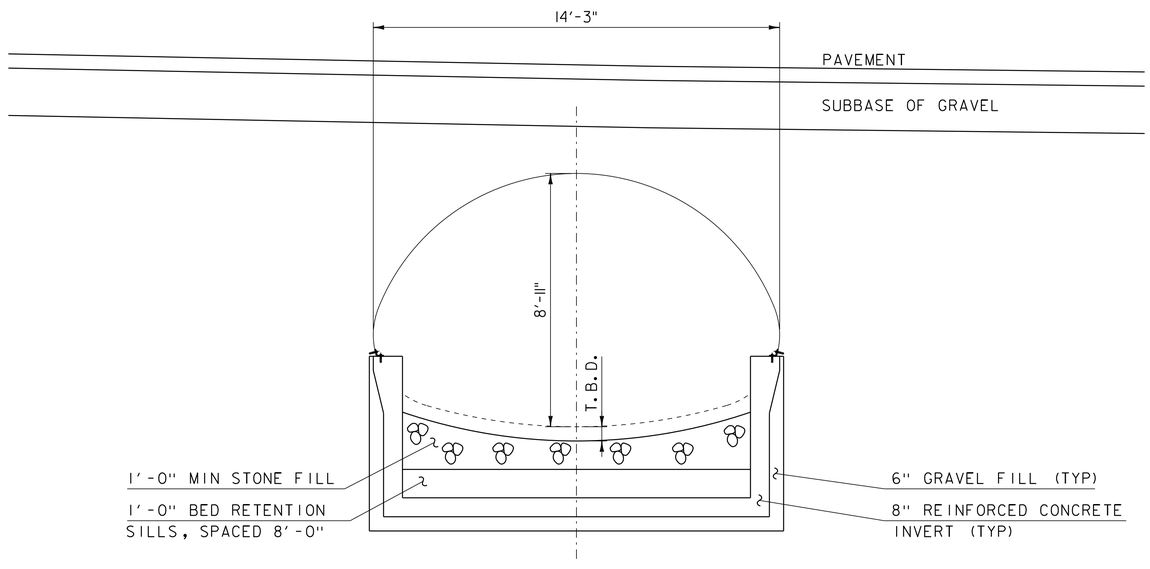
NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄
GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)
FILE NAME: 13d336/sl3d336profile	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
PROFILE SHEET	SHEET 2 OF 12



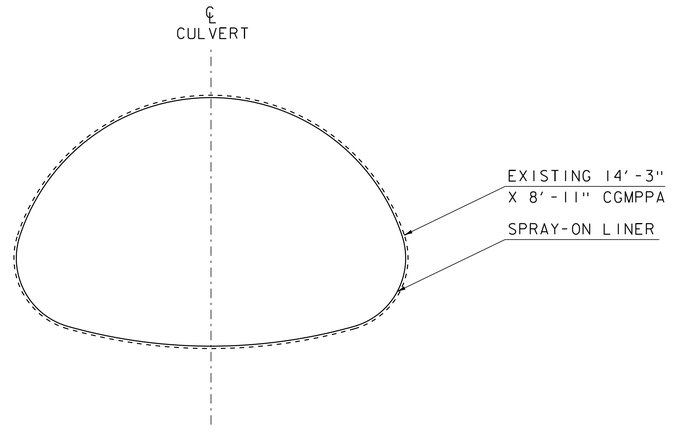
PROPOSED VT 11 ALTERNATIVE 1 TYPICAL SECTION

SCALE 3/8" = 1'-0"



ALTERNATIVE 1A TYPICAL SECTION

SCALE 3/8" = 1'-0"



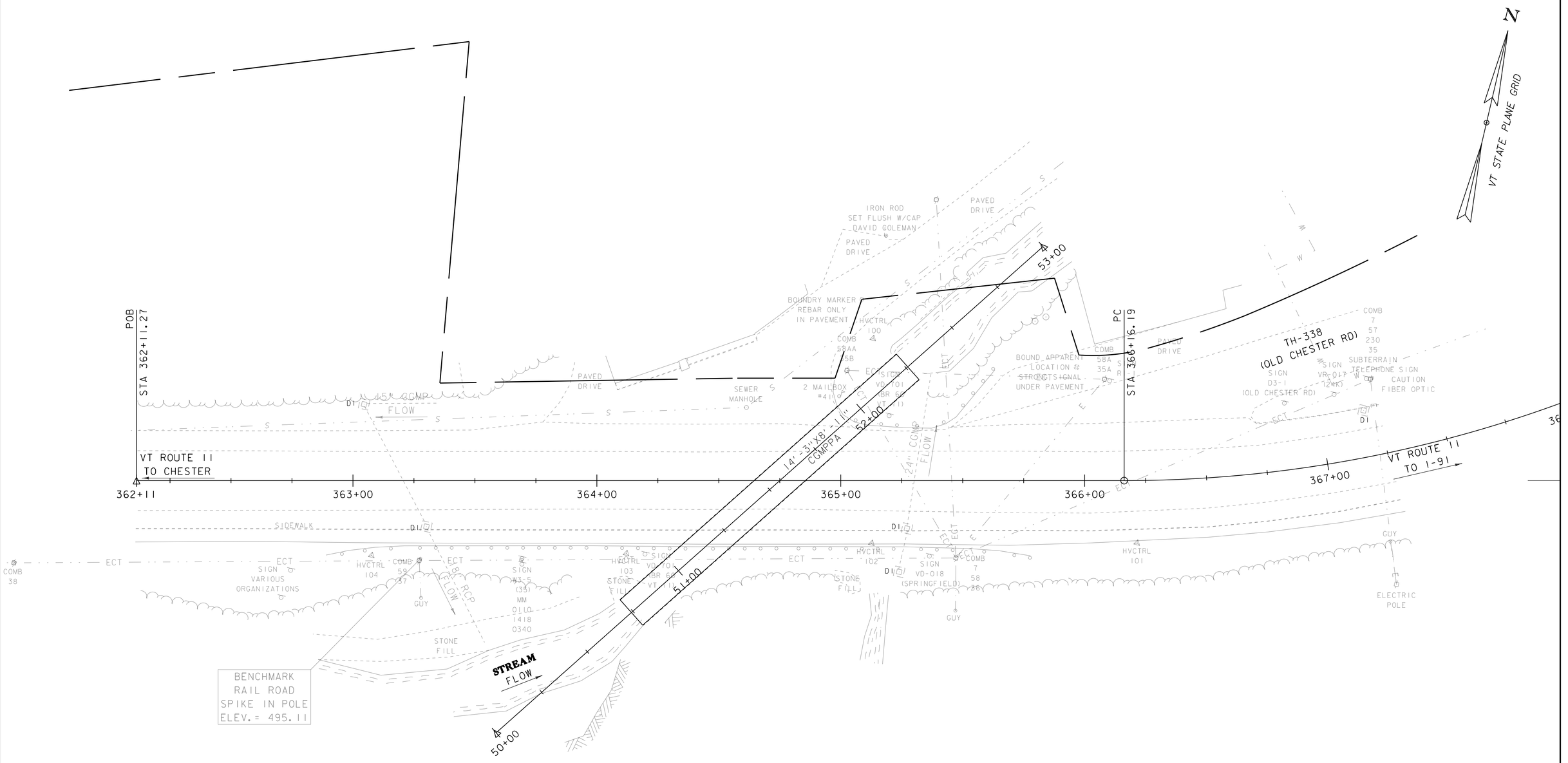
ALTERNATIVE 1B TYPICAL SECTION

SCALE 3/8" = 1'-0"

NOTES:

1) CONCRETE INVERT, RETENTION SILLS, AND OTHER MATERIALS NOT YET DESIGNED.
2) THE INTENT IS TO RETAIN THE SAME OR SLIGHTLY LARGER WATERWAY AREA TO AVOID RISE IN THE 50 & 100 YEAR FLOODS
3) REINFORCED CONCRETE INVERT MAY BE CAST IN PLACE OR PRECAST
4) CONTRACTOR TO DETERMINE THE LENGTH OF CULVERT TO BE REMOVED AT ANY ONE TIME.

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BF 0134(45)	
FILE NAME: 13d336\sl3d336typical.dgn	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
ALTERNATIVE 1 TYPICAL SECTIONS	SHEET 3 OF 12



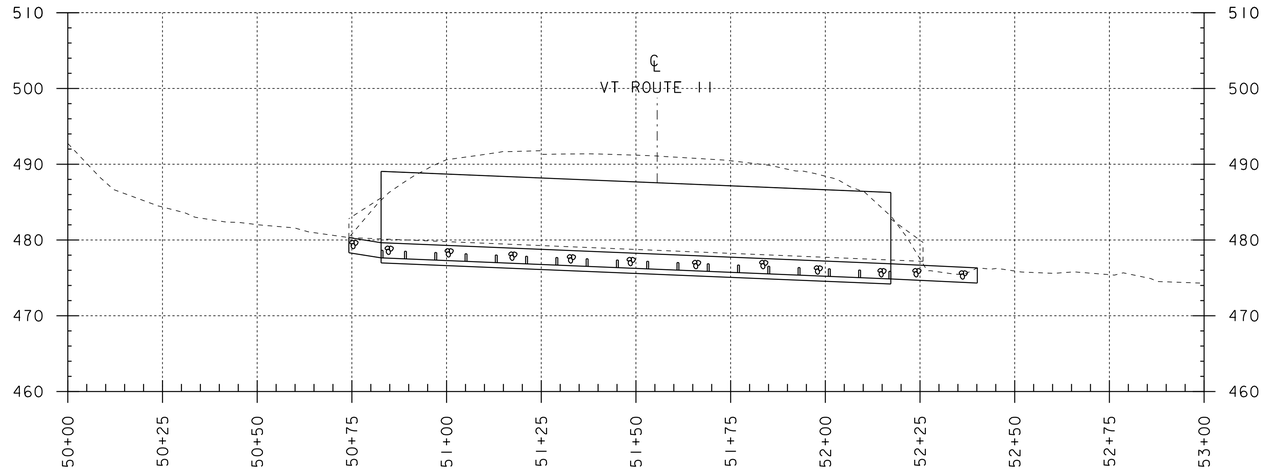
EXISTING 152' CGMPPA
BUILT 1961
SPAN 14'-3", RISE 8'-11"
AVERAGE COVER 3'
WATERWAY AREA = 101 SF

ALTERNATIVE 1 LAYOUT

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

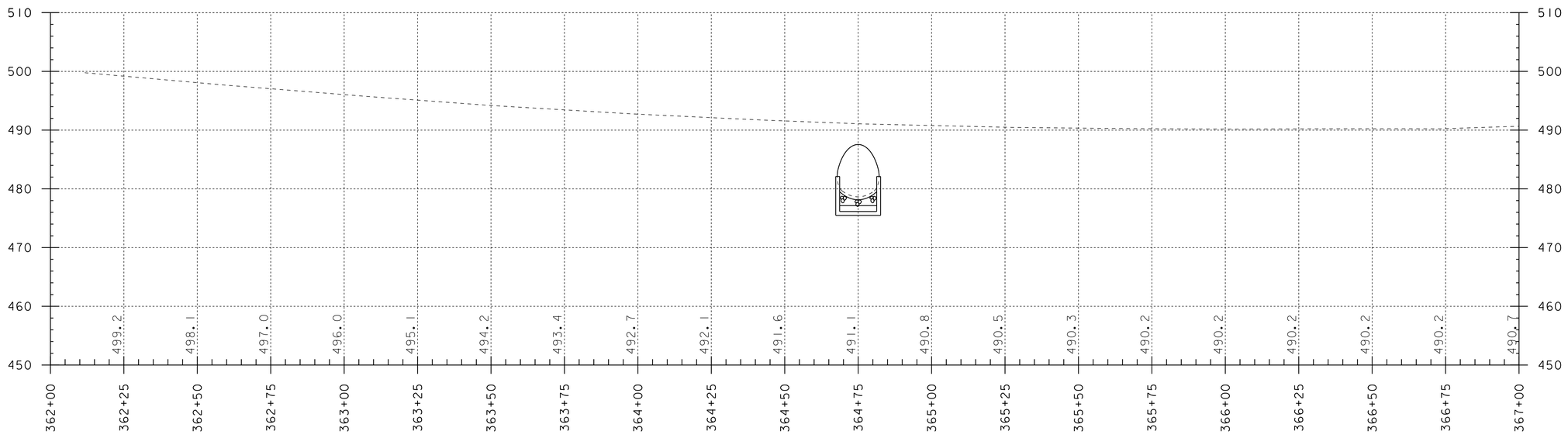
PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)

FILE NAME: 13d336/sl3d336border.dgn	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
ALTERNATIVE 1 LAYOUT SHEET	SHEET 4 OF 12



CULVERT 60 ALTERNATIVE 1 PROFILE

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



VT ROUTE 11 ALTERNATIVE 1A PROFILE

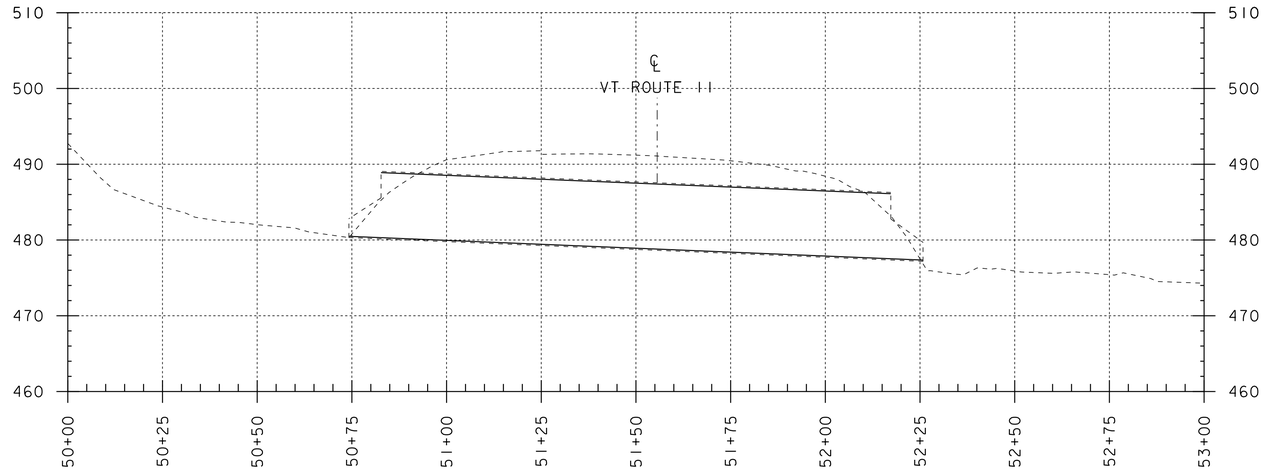
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(45)

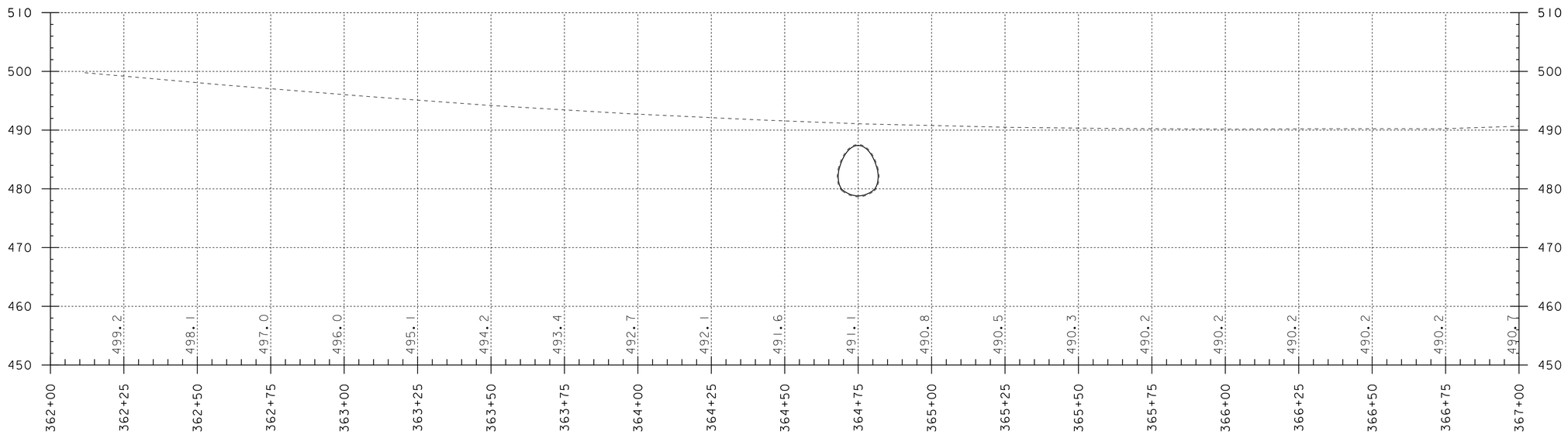
FILE NAME: 13d336/sl3d336profile
PROJECT LEADER: ------
DESIGNED BY: G.SWEENY
ALTERNATIVE 1A PROFILE SHEET

PLOT DATE: 23-MAR-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 5 OF 12



CULVERT 60 ALTERNATIVE 1 PROFILE

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



VT ROUTE 11 ALTERNATIVE IB PROFILE

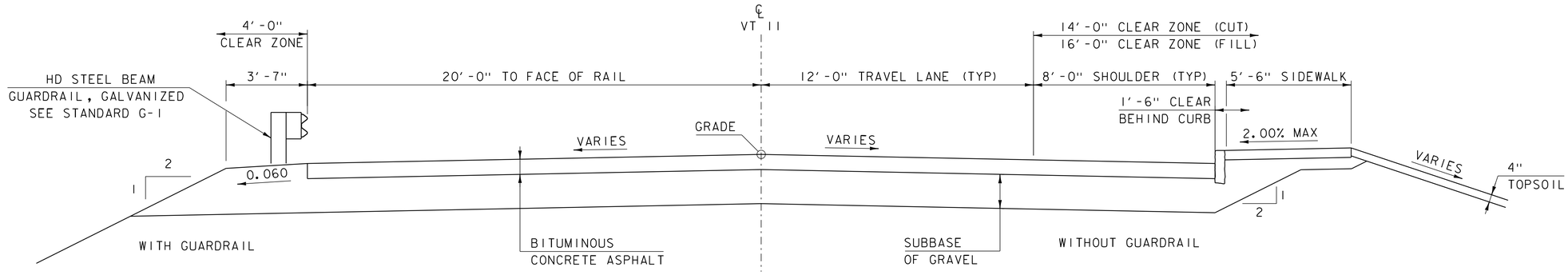
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(45)

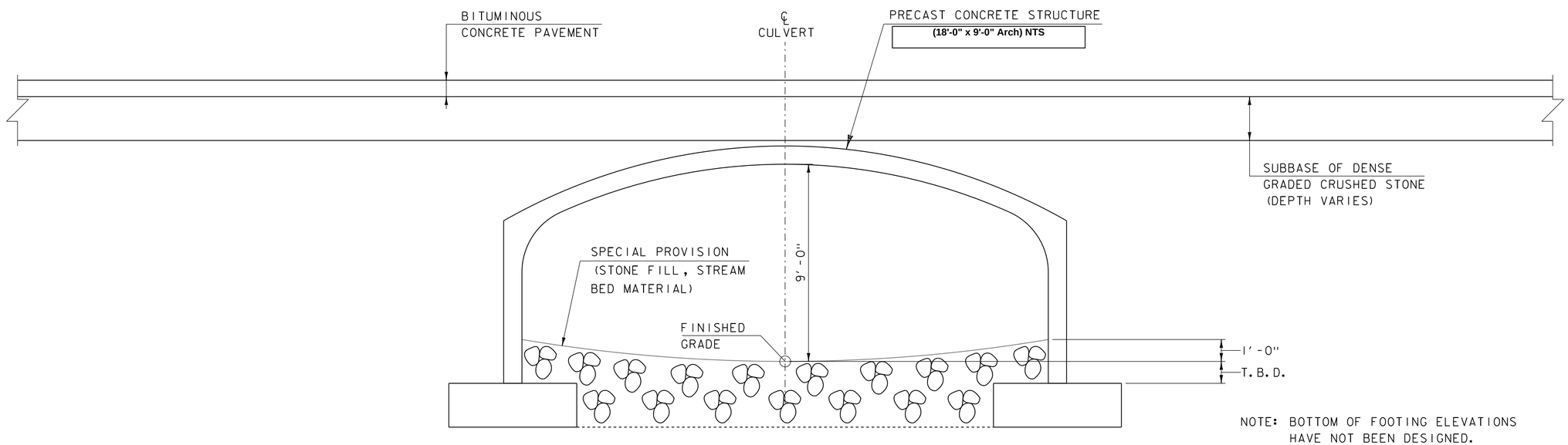
FILE NAME: 13d336/sl3d336profile
PROJECT LEADER: ------
DESIGNED BY: G.SWEENY
ALTERNATIVE IB PROFILE SHEET

PLOT DATE: 23-MAR-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 6 OF 12



PROPOSED VT 11 ALTERNATIVE 2 TYPICAL SECTION

SCALE 3/8" = 1'-0"



NOTE: BOTTOM OF FOOTING ELEVATIONS HAVE NOT BEEN DESIGNED.

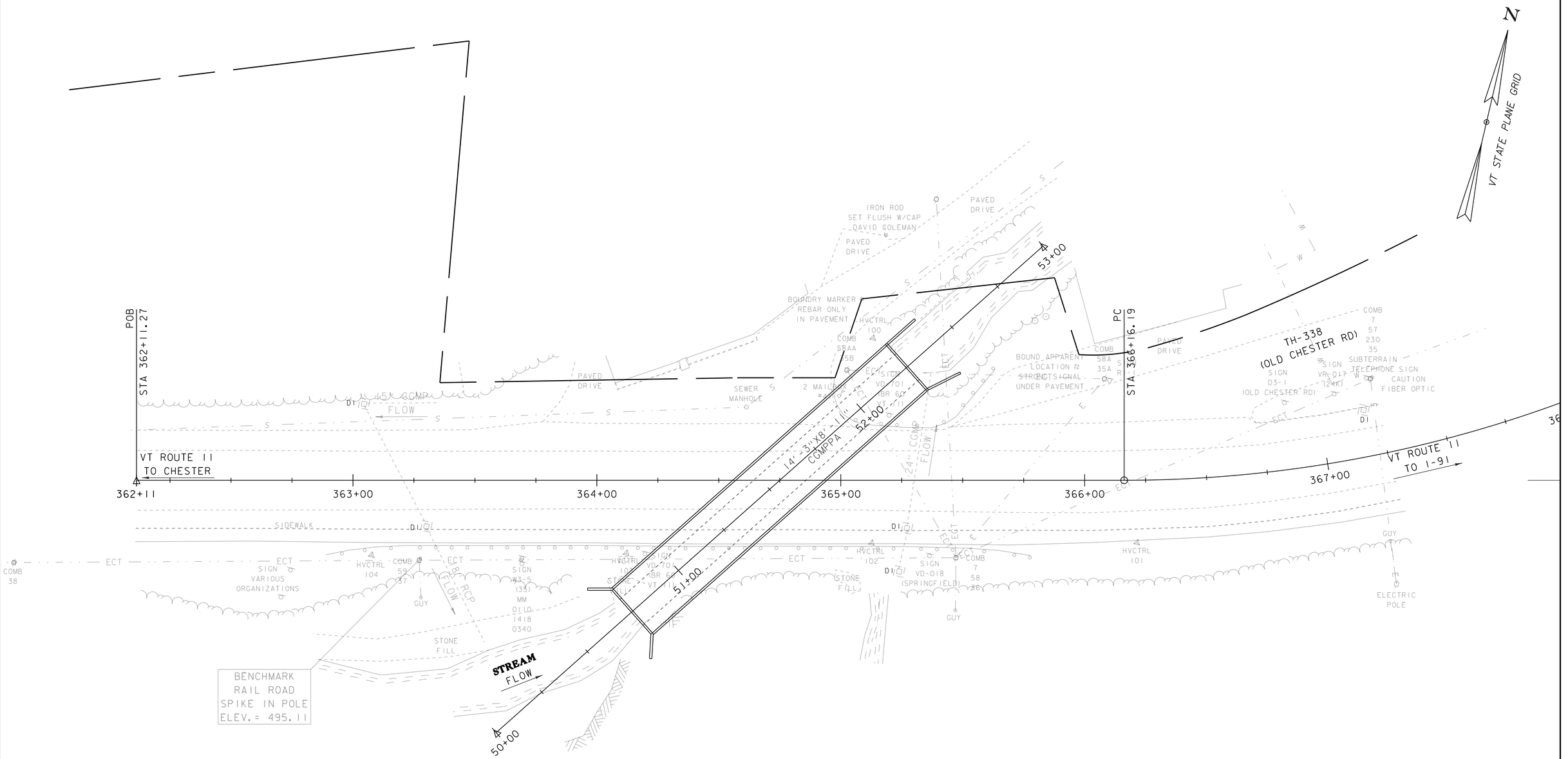
ALTERNATIVE 2 TYPICAL SECTION

SCALE 3/8" = 1'-0"

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(45)

FILE NAME: l3d336\sl3d336typical.dgn
PROJECT LEADER: ------
DESIGNED BY: G.SWEENY
ALTERNATIVE 2 TYPICAL SECTIONS

PLOT DATE: 23-MAR-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 7 OF 12

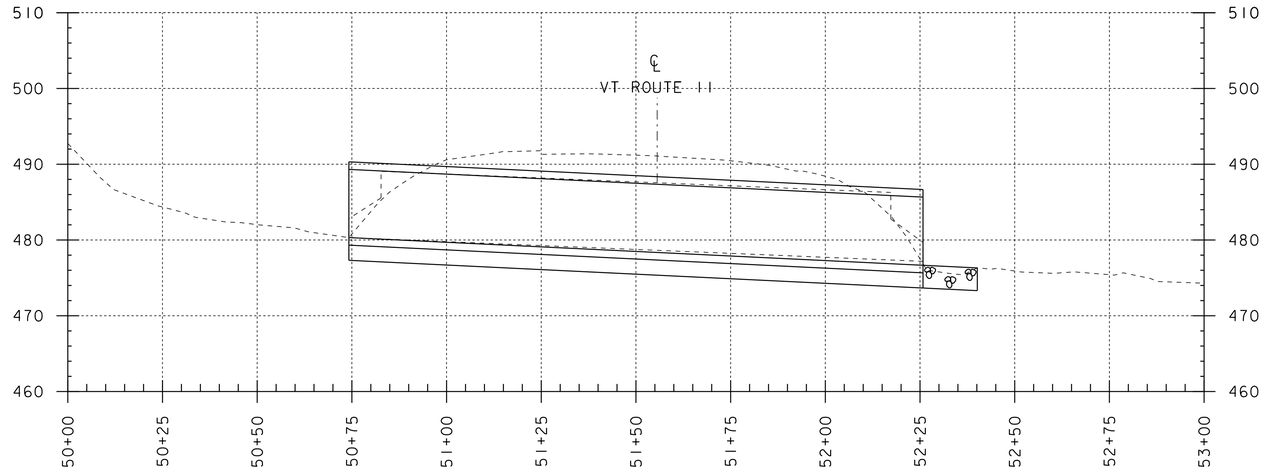


EXISTING 152' CGMPPA
BUILT 1961
SPAN 14'-3", RISE 8'-11"
AVERAGE COVER 3'
WATERWAY AREA = 101 SF

ALTERNATIVE 2 LAYOUT

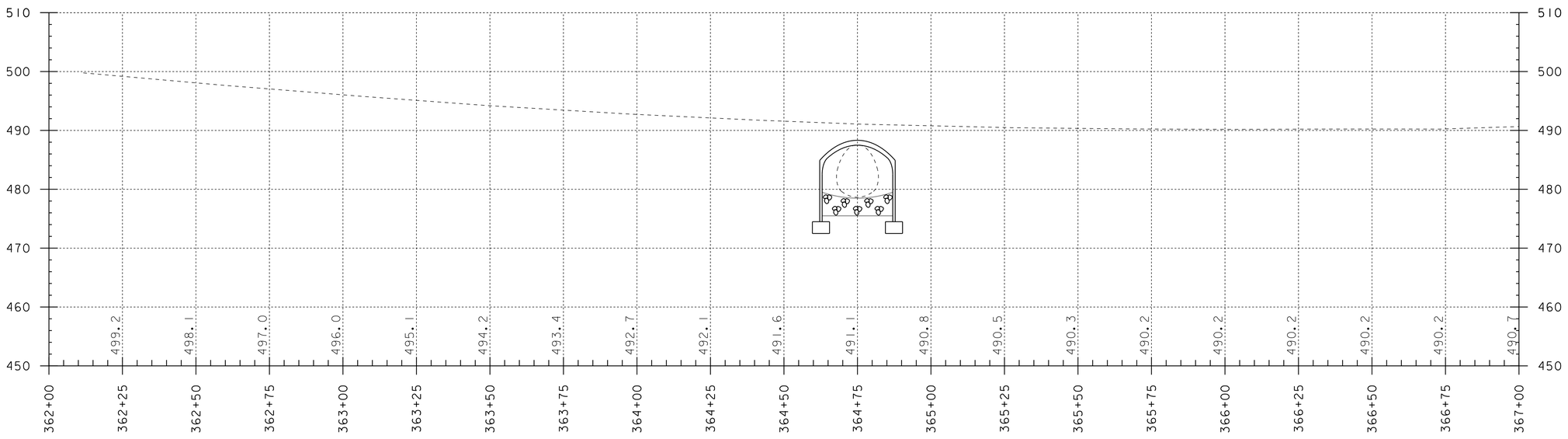
SCALE 1" = 20'-0"
20 0 20

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)
FILE NAME: 13d336/sl3d336border.dgn	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
ALTERNATIVE 2 LAYOUT SHEET	SHEET 8 OF 12



CULVERT 60 ALTERNATIVE 2 PROFILE

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



VT ROUTE 11 ALTERNATIVE 2 PROFILE

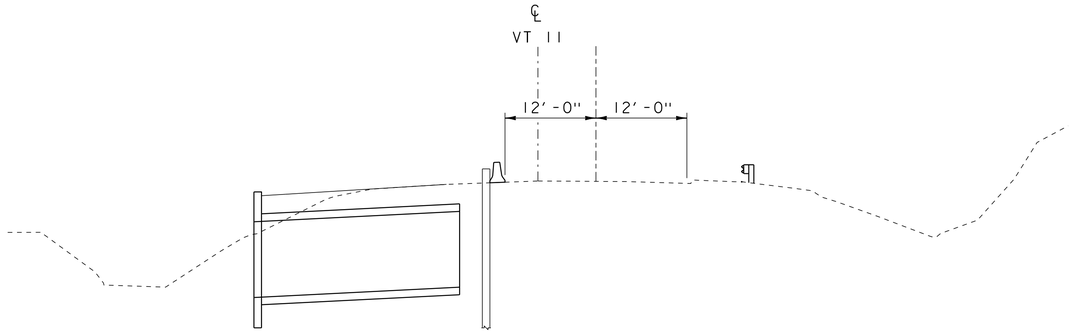
SCALE: HORIZONTAL 1"=20'-0"
VERTICAL 1"=10'-0"

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

PROJECT NAME: SPRINGFIELD
PROJECT NUMBER: BF 0134(45)

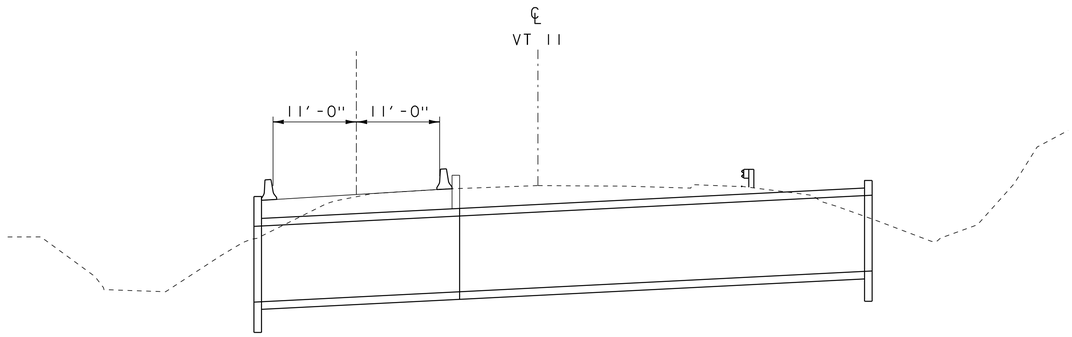
FILE NAME: 13d336/sl3d336profile
PROJECT LEADER: ------
DESIGNED BY: G.SWEENY
ALTERNATIVE 2 PROFILE SHEET

PLOT DATE: 23-MAR-2017
DRAWN BY: D.D.BEARD
CHECKED BY: G.SWEENY
SHEET 9 OF 12



PHASE 1 TYPICAL SECTION

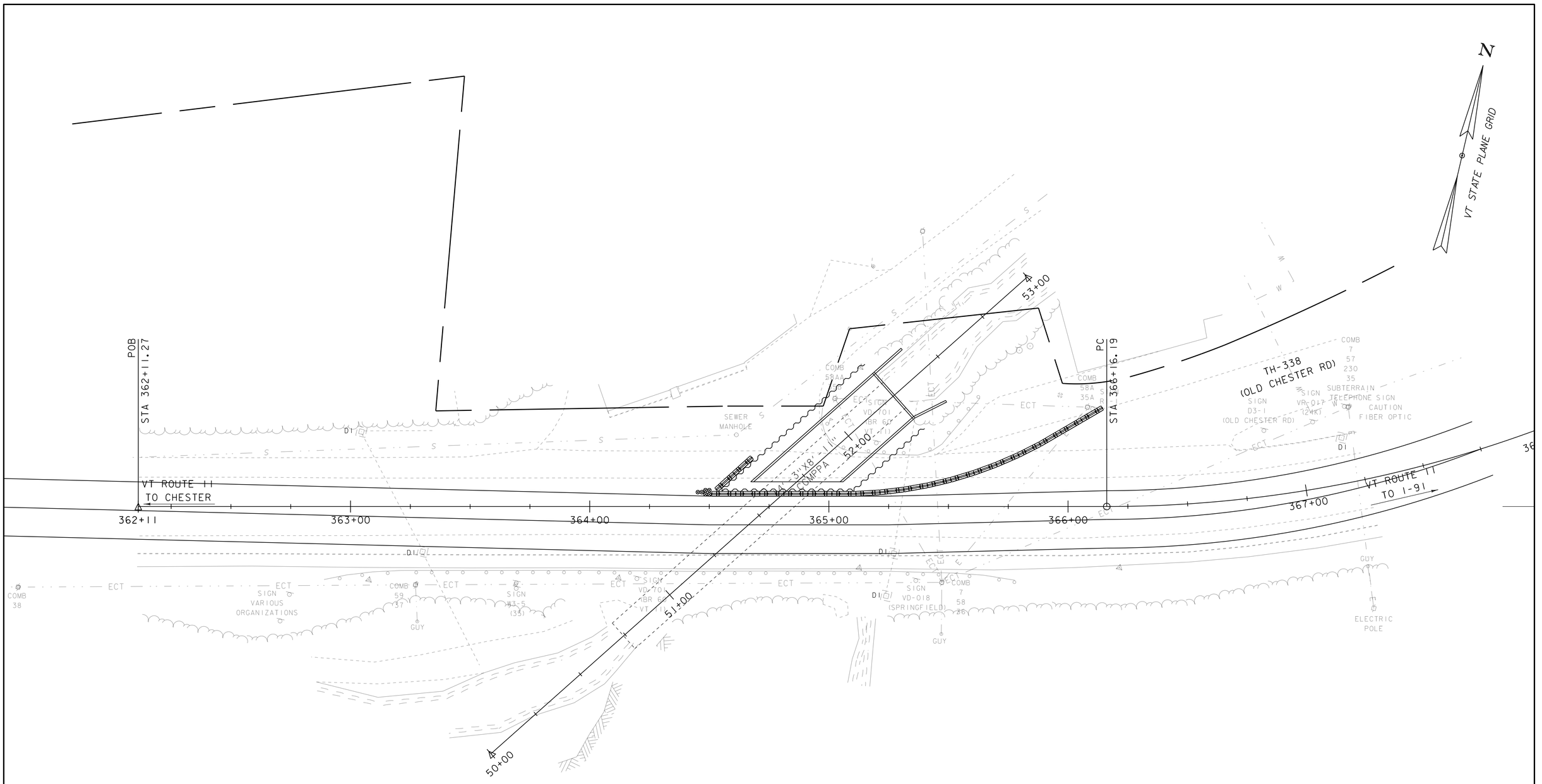
SCALE 1″ = 10′-0″
10 0 10



PHASE 2 TYPICAL SECTION

SCALE 1″ = 10′-0″
10 0 10

PROJECT NAME: SPRINGFIELD	
PROJECT NUMBER: BF 0134(45)	
FILE NAME: l3d336/sl3d336phasing	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
PHASING TYPICAL SHEET	SHEET 10 OF 12

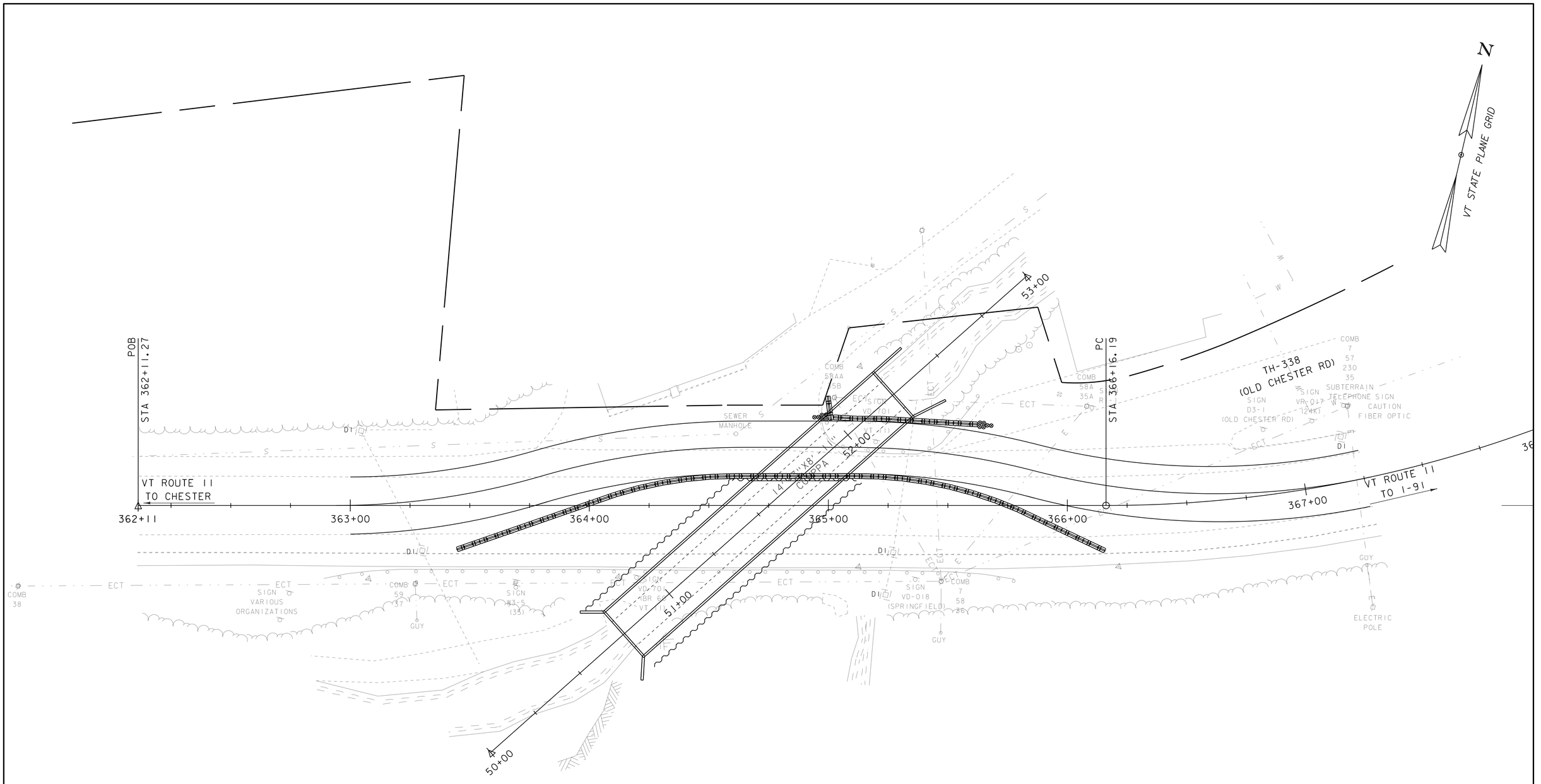


PHASE I LAYOUT

SCALE 1" = 20'-0"

20 0 20

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)
FILE NAME:	13d336/sl3d336border.dgn
PROJECT LEADER:	------
DESIGNED BY:	G.SWEENY
PHASE I LAYOUT SHEET	
PLOT DATE:	23-MAR-2017
DRAWN BY:	D.D.BEARD
CHECKED BY:	G.SWEENY
SHEET	11 OF 12



PHASE 2 LAYOUT

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

PROJECT NAME:	SPRINGFIELD
PROJECT NUMBER:	BF 0134(45)
FILE NAME: 13d336/sl3d336border.dgn	PLOT DATE: 23-MAR-2017
PROJECT LEADER: ------	DRAWN BY: D.D.BEARD
DESIGNED BY: G.SWEENY	CHECKED BY: G.SWEENY
PHASE 2 LAYOUT SHEET	SHEET 12 OF 12