STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Wardsboro BF 013-1(22)

VT ROUTE 100, BRIDGE 73 OVER UNNAMED BROOK

July 30, 2013

Table of Contents

Table of Contents **2**

I. Site Information **3**

Need 3

Traffic 3

Design Criteria 4

Inspection Report Summary 4

Hydraulics 5

Utilities 5

Right Of Way 5

Resources 5

Biological: 5

Hazardous Materials: 6

Historic: 6

Archeological: 6

Stormwater: 6

II. Maintenance of Traffic **6**

Option 1: Temporary Bridge 7

Option 2: Phased Construction 7

Option 3: Off-Site Detour 8

III. Alternatives Discussion **8**

No Action 8

Rehabilitation 8

New Structure 9

IV. Alternatives Summary **10**

V. Cost Matrix **11**

VI. Conclusion **12**

VII. Appendices **13**

I. Site Information

Bridge 73 is located in a rural area along VT Route 100 approximately 5.6 miles south of the junction with VT 30. The bridge and southern approach are located on a straight segment of VT 100 and the northern approach is located on a curved segment. There is a residence in the Northern quadrant of the project, and a garage located in the Southern quadrant. 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	Rural Minor Arterial (State Highway)
Culvert Type	5'-7"H x 7'-11"W Corrugated Galvanized Metal Plate Pipe Arch
Culvert Length	50 feet long
Year Built	1957
Ownership	State of Vermont

Need

Bridge 73 has a culvert rating of 3, which is considered serious. The following is a list of the deficiencies of Bridge 73 and VT 100 in this location.

1. The culvert has a Steel Culvert Corrosion Indicator of 2, which indicates that there are perforations throughout the culvert that are greater than 2 inches in width.

2. The bottom of the culvert is heavily rusted and rotted out.

3. The culvert constricts the natural channel width for hydraulics. Additionally, the culvert is not hydraulically adequate, as headwater to depth ratios are not within the state standards and water overtops the roadway below the Q_{50} design storm event. Also, there is a scour pool at the outlet of the culvert.

4. The ends of the culvert are mitered, which can lead to structural failure.

5. There is no guardrail at the culvert or approach sections.

6. The shoulders on VT 100 are substandard by two feet throughout 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 2016 and 2036.

TRAFFIC DATA	2016	2036
ADT	1,100	1,200
DHV	150	170
ADTT	130	210
%T	13.7	20.4
%D	55	55

Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997. Minimum standards are based on an AADT of 1,200 and a design speed of 50 mph.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 4.3	11'/2' (26')	11'/4' (30')	Substandard
Bridge Lane and Shoulder Widths	VSS Section 4.7	11'/2' (26')	11'/4' (30')	Substandard
Clear Zone Distance	VSS Table 4.4		16' fill / 10' (1:3) cut 12' (1:4) cut	
Banking		e_{max} = 7.4% (Northern Approach)	8% (max)	
Speed		50 mph	50 mph (Design)	
Horizontal Alignment	AASHTO Green Book Table 3-10b	R = 1,275' (Northern approach), R = ∞ (Bridge and Southern approach)	R_{min} = 1,260' @ e=6.8%	
Vertical Grade	VSS Table 4.5	(-)0.5125%	4% (max) for level terrain	
K Values for Vertical Curves	VSS Table 4.1	Bridge located on crest (K = 143)	110 crest / 90 sag	
Vertical Clearance Issues	VSS Section 4.8	None noted	14'-3" (min)	
Stopping Sight Distance	VSS Table 4.1	870'	400'	
Bicycle/Pedestrian Criteria	VSS Table 4.7	2' Shoulder	4' Shoulder	Substandard
Bridge Railing	Structures Design Manual Section 13	None	TL-3	Substandard
Hydraulics	VTrans Hydraulics Section	Roadway overtopped below the Q_{50} flow	Roadway not overtopped below the Q_{50} flow	Substandard
Structural Capacity	SM, Ch. 3.4.1	Unknown	Design Live Load: HL-93	Substandard

Inspection Report Summary

Channel Rating 7 Good
Culvert Rating 3 Serious

8/28/2012 – Culvert should be evaluated for a concrete invert in the near future. ~FRE/JAS

11/15/2011 – Severe section loss along invert. Pipe needs concrete invert repair installation. Needs guardrail system as well. ~MJ/DK

10/27/2010 – Culvert should be evaluated for a possible concrete invert. Guardrail needs to be installed on both sides. ~FRE/MK

Hydraulics

From preliminary hydraulics report, 6/19/2013:

The roadway is overtopped below the Q_{50} design event flow, which is considered hydraulically inadequate. Additionally, the existing structure constricts the natural channel width. For a replacement structure, the recommendation is a concrete box with a 14' wide by 8' high inside opening, with 12" high bed retention sills (baffles) in the bottom. The box invert should be buried 24", so the top of the sills will be buried 12" and not be visible. That will result in a 14' wide by 6' high waterway opening above streambed, providing 84 sq. ft. of waterway area. Sills should be spaced no more than 8'-0" apart throughout the structure with one sill placed at the inlet and one at the outlet. Sills should be cast in a V shape with a 10:1 lateral slope, to create a low flow channel in the center if the bed material in the structure is washed out. The spaces between sills should be filled with stone graded to match the natural stream bed material. If a new box is installed, it is recommended to have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

Utilities

There are aerial electric and telephone lines which run along the west (upstream) side of VT Route 100 throughout the entire project area; these lines are a substantial distance from the VT Route 100 edge of pavement (75 to 100 feet). These aerial facilities are owned by Green Mountain Power Corporation and FairPoint Communications. There are two aerial crossings of electric and telephone service lines within the project area; these lines cross VT Route 100 approximately 160 feet south of the existing culvert and 60 feet north of the existing culvert. The existing utilities are shown on the Existing Conditions Layout Sheet.

Right Of Way

The existing Right-of-Way is plotted on the Layout Sheet. The inlet of the existing culvert is less than one foot inside the existing Right-of-Way. It is anticipated that additional rights will need to be obtained regardless of the alternate chosen.

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 project area.

An unnamed tributary of Wardsboro Brook flows through the project area. This tributary would support a variety of aquatic organisms including wild brook trout. Efforts to minimize water quality impacts during construction will need to be evaluated as the project design moves forward.

The US Corps of Engineers and the Agency of Natural Resources- Department of Environmental Conservation would regulate all activities below ordinary high water.

Wildlife Habitat

The project corridor ranks as in the range of 4 on the wildlife habitat regional linkage analysis. This indicates that the area is of higher importance to wildlife movement. The culvert replacement is likely to be a larger structure which in turn will support small mammal wildlife movement along the bank lines. Larger wildlife would likely make a crossing across the road at this location due to the low volumes of traffic and the smaller size of the culvert at this location.

The tributary supports a variety of aquatic organisms including wild brook trout. VT Fish and Wildlife fisheries biologists have reviewed this site in the past confirming the presence of aquatic organisms. The new culvert design will need to accommodate aquatic organism passage (AOP) in accordance to the VT Fish and Wildlife AOP guidelines. As the design moves forward it would be beneficial to receive feedback from the fisheries biologist on the various alternatives.

Rare, Threatened and Endangered Species

There are no mapped rare, threatened or endangered species within the project area according to latest GIS information available.

Agricultural

There are no prime agricultural soils within the project area.

Hazardous Materials:

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

Historic:

Bridge 73 is not historic and there are no historic resources within the project area.

Archeological:

There are no areas of archeological sensitivity present in the general area around Bridge 73.

Stormwater:

There are no stormwater concerns for this project.

II. 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 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 precast 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: Temporary Bridge

A temporary bridge could only be placed on the upstream side of the culvert from a constructability standpoint. There is a garage on the downstream side of the culvert, making temporary bridge placement impossible without removal of the garage. There would also be significantly more clearing on the downstream side. An upstream temporary bridge would require temporary Right-of-Way acquisition, and would have impacts to adjacent driveways.

A one-way temporary bridge, with traffic signals, would be appropriate based on the daily traffic volumes and sight distance. See the Temporary Bridge Layout Sheet in the appendix.

Advantages: Traffic flow can be maintained through the project corridor during construction.

Disadvantages: This option would require some Right-of-Way acquisition, which would lengthen the project development phase. This option would have impacts to adjacent properties. Compared to removing traffic from the construction site, there would be decreased safety to the workers and to vehicular traffic, because of cars driving near the construction site, and construction vehicles entering and exiting the construction site. This traffic control option would be costly and time consuming, in order to set up the temporary bridge.

Option 2: Phased Construction

Phased construction is the maintenance of one way alternating 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. Since there is very little fill above the existing culvert, large amounts of fill retention would not be required for phased construction, making this a good candidate for phased construction.

There is an existing 3 rod Right-of-Way though the project area, and in order to phase traffic, the culvert length can remain essentially unchanged from the existing culvert. However, due to the close proximity of the existing culvert to the Right-of-Way, the project limits will need to be extended past the 3-rods on the upstream end. Based on the traffic volumes, it is reasonable to close one lane of traffic, and maintain one lane of traffic, both ways, with a traffic signal.

The phasing for this site could be done with 2 phases. The layout of this phasing sequence can be found in the appendix. The following is a description of the phases:

- Phase 1: A single lane open to traffic on the upstream side of the road, over the existing culvert. During this phase, three precast culvert sections would be installed on the downstream side of the road.

- Phase 2: A single lane open to traffic on the downstream side of the road, over the new culvert sections that were placed in Phase 1. During this phase, three precast culvert sections would be installed on the upstream side of the road. The channel flow would be established in the new culvert at this time.

Advantages: Traffic flow would be maintained through the project corridor during construction. Also, this option would have minimal impacts to adjacent properties and wooded areas.

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: Off-Site Detour

This option would close the bridge and reroute traffic onto VT RT 9, and VT RT 30 back to VT RT 100. This regional detour has an end-to-end distance of 64.8 miles. This detour adds approximately 19.4 miles to travel distance.

There are several local bypass routes that may see an increase in traffic from local passenger cars. Local bypass routes are not signed detours, but may experience higher traffic volumes if VT 100 is closed during construction. One of the most likely local bypass routes is as follows:

1. VT 100, to South Wardsboro Road (Class 2 – Paved), Cobb and Reed Hill Road (Class 3 – Unpaved), Potter Road (Class 3 – Paved), Podunk Road (Class 3 – Unpaved), Smead Road (Class 3 – unpaved), back to VT 100 (11.7 mi end-to-end)

A map of the detour route and a possible local bypass route, which could see an increase in traffic, can be found in the appendix.

Advantages: This option would eliminate the need for a temporary bridge or phased construction, which would significantly decrease cost and time of construction.

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

III. Alternatives Discussion

No Action

This alternative is not recommended. The culvert was given a culvert rating of "serious". In addition to the structural deficiencies of the culvert, there is no existing guardrail at the project location. Although the culvert does not appear to be in imminent danger of collapse, it will eventually not be able to safely support all associated loads. In the interest of safety to the traveling public, the No Action alternative is not recommended. No cost estimate has been provided for this alternative since there are no immediate costs.

Rehabilitation

This alternative involves the rehabilitation of the existing culvert.

Rehabilitation work for culverts generally involves an invert repair, or a culvert liner. Both of these options are considered to be preventative maintenance, and are used in order to extend the remaining life of the structure.

In this case, an invert repair is not an option because the pipe is not hydraulically adequate, and the headwater depths would reach roadway overtopping under even less flow conditions where it

already occurs. Additionally, aquatic organism passage would be greatly hindered by an invert or lining repair.

There is little remaining life left to this culvert; it is over 50 years old and in serious condition. Neither an invert repair nor a culvert liner would address the diminished structural capacity due to corrosion. Therefore, due to the current hydraulic and structural condition of the culvert, the rehabilitation option will not be considered any further.

New Structure

This option involves removing the existing Corrugated Galvanized Metal Plate Pipe Arch and replacing it with a new precast structure having a waterway opening 14 feet wide and 6 feet high. Since there is only an average of 4 feet of fill above the existing culvert, there would not have to be an extremely large amount of earthwork, making this a good site for a new precast buried structure. Any new structure should have flared wingwalls at the inlet and outlet to make a smooth transition between the channel and the culvert. The various considerations under this option include: the roadway width, structure type, culvert length and skew, and roadway alignment.

a. Roadway Width

The current roadway width is 26 feet. This does not meet the minimum standard of 30 feet. Since a new 80+ 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.

b. Structure Type

The most common structure types for the recommended hydraulic opening are a 4-sided concrete box culvert, a 3-sided open bottom concrete structure, or a structural plate arch. A plate arch is not recommended at this site, since it would not have the recommended cover of 36 inches.

It is preferred that the structure be a precast 4-sided concrete box culvert. This type of structure would provide protection against scour and undermining, and would require less excavation than an open bottomed structure. Additionally, it would have a shorter construction duration compared to an opened bottom structure, since footings would not have to be placed six feet below the stream bed.

c. Culvert Size, Length and Skew

The existing culvert has a span of 8 feet, which constricts the natural channel width. Hydraulics has recommended a box with a 14 feet wide and 8 foot high inside opening, with 12 inch high bed retention sills spaced no more than 8 feet apart. The top of the sills should be buried 12 inches, resulting in a waterway opening with a rise of 6 feet. This culvert will have no roadway overtopping up to the Q_{100} design flow. In order to accommodate a 30 foot wide roadway, the proposed barrel length will be 40 feet long. The culvert will have a skew of 90 degrees to the roadway to match the existing skew of the channel.

d. Roadway Alignment

The existing horizontal and vertical alignments meet current geometric standards, and as such will remain unchanged.

e. 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 be a new structure with an estimated life span of 80 years. The hydraulic capacity of the structure would be improved and the increased road width would meet Vermont State Standards, making the bridge crossing safer for bikes and pedestrians.

Disadvantages: This alternative would require Right-of-Way acquisition and have impacts to adjacent properties.

IV. Alternatives Summary

Based on the existing site conditions, bridge condition, and recommendations from hydraulics, there are three viable alternatives:

Alternative 1: New Precast Box Culvert with Traffic Maintained on Offsite Detour
Alternative 2: New Precast Box Culvert with Traffic Maintained with Phased Construction
Alternative 3: New Precast Box Culvert with Traffic Maintained on a Temporary Bridge

V. Cost Matrix

Wardsboro BF 013-1(22)		Do Nothing	Alt 1 Precast Box Culvert Offsite Detour	Alt 2 Precast Box Culvert Phased	Alt 3 Precast Box Culvert Temporary Bridge
COST[1]	Bridge Cost	$0	$194,000	$194,000	$194,000
	Removal of Structure	$0	$10,000	$15,000	$10,000
	Roadway	$0	$124,000	$135,000	$145,000
	Maintenance of Traffic	$0	$30,000	$110,000	$110,000
	Construction Costs	$0	$358,000	$454,000	$459,000
	Construction Engineering + Contingencies	$0	$108,000	$137,000	$138,000
	Total Construction Costs w CEC	**$0**	**$466,000**	**$591,000**	**$597,000**
	Preliminary Engineering[2]	**$0**	**$117,000**	**$148,000**	**$150,000**
	Right of Way	**$0**	**$26,000**	**$32,000**	**$33,000**
	Total Project Costs	$0	$609,000	$771,000	$780,000
	Annualized Costs	$0	$7,700	$9,700	$9,800
SCHEDULING	Project Development Duration[3]		>4 years	>4 years	>4 years
	Construction Duration		3 months	8 months	8 months
	Closure Duration (If Applicable)		1 week	N/A	N/A
ENGINEERING	Typical Section - Roadway (feet)	26'	30'	30'	30'
	Typical Section - Bridge (feet)	2-11-11-2	4-11-11-4	4-11-11-4	4-11-11-4
	Geometric Design Criteria	No Change	Improved	Improved	Improved
	Traffic Safety	No Change	Improved	Improved	Improved
	Alignment Change	No	No	No	No
	Bicycle Access	No Change	Improved	Improved	Improved
	Hydraulic Performance	No Change	Improved	Improved	Improved
	Pedestrian Access	No Change	Improved	Improved	Improved
	Utility	No Change	No Change	No Change	No Change
OTHER	ROW Acquisition	No	Yes	Yes	Yes
	Road Closure	No	Yes	No	No
	Design Life	<10 years	80 years	80 years	80 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 starting from the end of the Project Definition Phase.

VI. Conclusion

We recommend **Alternative 2**; to replace the existing culvert with a Precast Concrete Box Culvert, while maintaining traffic with phased construction.

Structure:
Since the culvert is rated as being in serious condition, it is reasonable to assume that a replacement structure is needed. Additionally, the culvert would become even more hydraulically inadequate if rehabilitated, further warranting a full replacement. By choosing to replace the culvert, the width of the roadway through the project area can be widened by two feet on each side to accommodate bicycle traffic, with 4 foot shoulders as per the Vermont State Standards.

The new culvert will be a 14 foot x 8 foot precast concrete box culvert, as per the VTrans Hydraulic Section's recommendation. The new precast box will have bed retention sills, to allow for a natural channel bottom to form, accommodating aquatic organism passage. Since the precast culvert will have a closed bottom, it will be protected from scour. In order to satisfy the AOP needs, the culvert invert should be buried 24 inches and stone should be placed along the length of the channel bottom through the culvert, resulting in a 6 foot high waterway opening. The new culvert should have headwalls that extend four feet below the channel bottom at the inlet and the outlet to prevent undermining. This structure will have no roadway overtopping below the Q_{100} storm event.

Traffic Control:
The recommended method of traffic control is to maintain traffic in phases. Since there is an average of four feet of fill above the culvert, which is relatively low, it will not be extremely costly to retain the soil between phases, making this site a good candidate for phased construction. A detour for this project location would have an end-to-end distance of 65 miles, and take over an hour and a half to drive. Additionally, the local bypass routes available are not appropriate for the expected volume of traffic. It seems unreasonable to send 1,100 vehicles a day on a detour of that distance, when the option to phase traffic at a slightly higher cost is a viable option.

The cost and construction duration to maintain traffic on a temporary bridge is comparable to maintaining traffic in phases and would be an acceptable method of traffic control as well. However, since the temporary bridge option would have greater impacts to adjacent properties, it is recommended that traffic is maintained in phases.

Additional Considerations:
Due to the similarity of scope and proximity of Culvert 70 and Culvert 73 to each other, it is recommended that the two projects be combined for the Project Development and Construction Phases. Additionally, with proper community input and support, it is possible for these projects to have an accelerated Construction duration using a short term road closure.

VII. Appendices

- Site Pictures
- Town Map
- Bridge Inspection Report
- Hydraulics Memo
- Preliminary Geotechnical Information
- Natural Resources Memo
- Archeology Memo
- Historic Memo
- Detour and Local Bypass Maps
- Plans
    - Existing Conditions
    - Proposed Typical Sections
    - Proposed Layout
    - Proposed Profile
    - Phasing Layouts
    - Temporary Bridge Layout

Looking East over the culvert

Looking West over the culvert

Looking Upstream

Looking Downstream

Culvert Inlet (Note that water is able to seep in around pipe due to lack of a cutoff wall)

Culvert Outlet

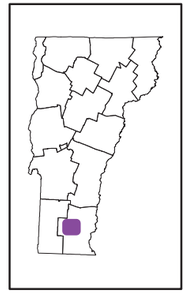
Wardsboro
VT 100,
Bridge 73

Scale 1:36,669

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



WARDSBORO
WINDHAM COUNTY
DISTRICT # 2

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

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

Inspection Report for WARDSBORO **bridge no.:** 0073 **District:** 2

Located on: VT100 **over** BROOK **approximately** 5.6 MI S JCT VT 30 **Maintained By:** STATE

CONDITION

Deck Rating: N NOT APPLICABLE

Superstructure Rating: N NOT APPLICABLE

Substructure Rating: N NOT APPLICABLE

Channel Rating: 7 GOOD

Culvert Rating: 3 SERIOUS

Federal Str. Number: 300013007313191

AGE and SERVICE

Year Built: 1957 **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): 18

ADT: 1300 **Year of ADT:** 1996

GEOMETRIC DATA

Length of Maximum Span (ft): 7

Structure Length (ft): 7

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): 26

Skew: 0

Bridge Median: 0 NO MEDIAN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 05 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): 50

Average Cover Over Culvert (ft): 4

Waterway Area Through Culvert (sq.ft.): 42

Culvert Wing/Header Rating: N NOT APPLICABLE

Steel Culvert Corrosion Indicator: 2 PERFORATIONS > 2" THROUGHOUT, CULVERT

Multi Plate Culvert Bolt Line Crack Indicator: 0 NO BOLT LINE CRACKS PRESENT

APPRAISAL

Appr. Rdwy. Alignment: 8 EQUAL TO DESIRABLE CRITERIA

INSPECTION

Inspection Date: 082012 **Inspection Frequency (months):** 12

INSPECTION SUMMARY and NEEDS

8/28/2012 Culvert should be evaluated for a concrete invert in the near future. ~FRE/JAS

*11/15/2011 - ** Severe section loss along invert. Pipe needs concrete invert repair installation. Needs guard rail system as well.~ MJ/DK*

10/27/2010 Culvert should be evaluated for a possible concrete invert. Guard rail needs to be installed on both sides. ~FRE/MK

09/02/2009 Culvert should be evaluated for a concrete invert. Debris should be removed from pipe. ~FRE~

Culvert is in poor condition due to large perforations throughout. Piping is occurring below the culvert and will continue to progress. Culvert should be evaluated for a concrete invert as there is no deflection or distortion in the culvert. Inspected 10-8-08 ~MK

VT AGENCY OF TRANSPORTATION PROGRAM DEVELOPMENT DIVISION

HYDRAULICS UNIT

TO: Chris Williams, Structures Project Manager

FROM: Leslie Russell, P.E., Hydraulics Project Supervisor

DATE: 19 June 2013

SUBJECT: Wardsboro BF 013-1(22) VT 100 BR 73 over unnamed brook

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

Existing Bridge Information

The original structure was constructed in 1957 based on available information. It is a multiplate pipe arch that is 7' – 11" wide by 5' – 7" tall. It provides 35 sq. ft. of waterway area. The structure has mitered ends and is slightly skewed to the roadway. There is a scour pool at the outlet. The inspection report states that the arch is in poor condition due to many holes in the invert.

The structure is not hydraulically adequate. Headwater to depth ratios are not within state standards and water overtops the roadway below the Q50 flow.

Recommendations

In sizing a new structure we attempt to select structures that meet the hydraulic standards, fit the natural channel width, the roadway grade and other site conditions. We measured a channel width of approximately 8' – 10' during our site visit in 2009. However, the cross sections show a channel width of over 13'. The ANR regression equations calculate a bankfull width of 14' for this size drainage area. Based on our calculations and the information available, we recommend the following structure as a replacement at this site:

1. A concrete box with a 14' wide by 8' high inside opening, with 12" high bed retention sills (baffles) in the bottom. The box invert should be buried 24", so the top of the sills will be buried 12" and not be visible. That will result in a 14' wide by 6' high waterway opening above streambed, providing 84 sq. ft. of waterway area. Sills should be spaced no more than 8'-0" apart throughout the structure with one sill placed at the inlet and one at the outlet. Sills should be cast in a V shape with a 10:1 lateral slope, to create a low flow channel in the center if the bed material in the structure is washed out. The spaces between sills should be filled with stone graded to match the natural stream bed material. This structure will result in a headwater depth at Q50 = 4.0' and at Q100 = 4.6', with no roadway overtopping up to Q100.

2. A 13' – 11" wide by 8' – 7" high structural plate arch with bed retention sills built and buried as described for the box above. This will result in a structure with approximately 70.7 sq. ft. of waterway area and result in approximate headwater depths of 4.8' at Q50 and 5.8' at Q100. This structure will have approximately 29" of cover at the inlet side of the pipe. It will, therefore, not have the recommended cover of 36".

If a new box is installed, we recommend it have full headwalls at the inlet and outlet. The headwalls should extend at least four feet below the channel bottom, or to ledge, to act as cutoff walls and prevent undermining.

If the pipe arch option is installed, concrete headwalls should be constructed at the inlet and outlet. The headwalls may be either half height or full height. The headwalls should extend at least four feet below the channel bottom or to ledge, to prevent undermining of the structure. We recommend a minimum cover of 3' over all pipe structures. Obtaining the minimum cover of 3' might be a problem at this site. Pipe manufactures can provide specific recommendations for minimum and maximum fill heights and required pipe thickness.

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, and constructed on a grade that matches the channel. A new structure should span the natural channel width.

An invert repair is not an option because the pipe is not hydraulically adequate, as well as, the headwater depths would promote roadway overtopping under even less flow conditions where it already occurs. Also, aquatic organism passage would be greatly hindered by an invert lining repair.

Temporary Bridge

If a temporary bridge is required at this site, we will size it at final hydraulics.

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

LGR

cc: Hydraulics Project File via NJW
Hydraulics Chrono File

AGENCY OF TRANSPORTATION **OFFICE MEMORANDUM**

To: Chris Williams, Project Manager, Structures

From: Callie Ewald, P.E. Geotechnical Engineer, via Christopher C. Benda, P.E., Soils and Foundations Engineer

Date: June 4th, 2013

Subject: Wardsboro BRF 013-1(22) – VT 100, BR 73 Prelim. Geotechnical Information

In an effort to assist the Structures Section with their bridge type study, the Soils and Foundations Unit within the Materials and Research Section has completed a review of available geological data near VT Route 100 crossing over a small unnamed brook in Wardsboro, Vermont. This review included our in-house bridge boring files, record plans, USDA Natural Resources Conservation soil survey records, surficial geology and bedrock maps of the State and the Agency of Natural Resources Well logs.

Figure 1, USDA Soil Survey and ANR Well Data near Bridge 73.
Note: Depth to bedrock in illustrated in red print next to each private well.

The Agency of Natural Resources (ANR) documents and publishes all water wells that are drilled for residential or commercial purposes. Published online, the logs can be used to determine general characteristics of soil strata in the area. The soil description given on the logs is done in the field, by unknown personnel, and as such, should only be used as an

approximation. Based on subsurface information reported by well drilling reports on file at ANR and the USDA web soil survey, the surficial geology in the vicinity of the subject area is expected to consist of a mixture of clay, sand and gravel. Bedrock was encountered in two of the four wells, with 60 feet being the shallowest depth below the ground surface. USDA soil descriptions and four well locations within 1000 feet of the culvert are shown in Figure 1.

The Natural Resources Conservation Service USDA soil descriptions from Figure 1 indicate that the subject area is classified as Colton loamy fine sand. These deposits are usually found along floodplains and are evidenced in the water well records nearby and the 1970 Surficial Geologic Map of Vermont. Bedrock in the area is expected to be Schist according to the new 2011 Bedrock Map of Vermont. No exposed bedrock outcrops were seen near Bridge 73. Cobbles can be seen along the stream bottom from the bridge inspection photos.

Relying on information gathered for this scoping report, we anticipate possible foundation options for a bridge replacement include the following:

- Precast arch supported on spread footings, or
- Reinforced concrete abutments on spread footings, or an
- Integral abutment bridge on steel H-piles

The depth and concentration of any boulders at this site should be confirmed with borings as their presence can have a significant impact on the feasibility of using piles.

Based on the lack of site specific information, we recommend drilling two borings at opposite ends of the proposed culvert in order to more fully assess the subsurface conditions at the site including, but not limited to, the soil properties, ground water conditions and the depth to bedrock. Shallow bedrock is not expected due to the great depth to rock seen in the wells, however if shallow bedrock is encountered, more borings may be necessary to establish a more accurate bedrock profile across the footprint of the proposed culvert or bridge. Access and traffic control should be relatively simple, and overhead wires should not impede drilling.

If you have any questions, please feel free to call us at 828-1235.

c: WEA/Read File
CCB/Project File
CEE

VERMONT

State of Vermont
Program Development Division
One National Life Drive
Montpelier, VT 05633-5001
www.aot.state.vt.us

Agency of Transportation

[phone] 802-828-3979
[fax] 802-828-2334
[ttd] 800-253-0191

To: James Brady, VTrans Environmental Specialist

From: Glenn Gingras, VTrans Environmental Biologist

Date: 4/26/2012

Subject: Wardsboro BF 013-1 (22) - Natural Resource ID

I have completed my natural resource scoping review for the above referenced project. My evaluation has included the following resources: wetlands, wildlife habitat, agricultural soils, and rare, threatened and endangered species. I have reviewed all existing mapped information and performed a site review of the project area.

Wetlands/Watercourses
There are no wetlands within the project area.

An unnamed tributary of Wardsboro Brook flows through the project area. This tributary would support a variety of aquatic organisms including wild brook trout. Efforts to minimize water quality impacts during construction will need to be evaluated as the project design moves forward.

The US Corps of Engineers and the Agency of Natural Resources- Department of Environmental Conservation would regulate all activities below ordinary high water.

Wildlife Habitat
The project corridor ranks as in the range of 4 on the wildlife habitat regional linkage analysis. This indicates that the area is of higher importance to wildlife movement. The culvert replacement is likely to be a larger structure which in turn will support small mammal wildlife movement along the bank lines. Larger wildlife would likely make a crossing across the road at this location due to the low volumes of traffic and the smaller size of the culvert at this location.

The tributary supports a variety of aquatic organisms including wild brook trout. VT Fish and Wildlife fisheries biologists have reviewed this site in the past confirming the presence of aquatic organisms. The new culvert design will need to accommodate aquatic organism passage (AOP) in accordance to the VT Fish and Wildlife AOP guidelines. As the design moves forward it would be beneficial to receive feedback from the fisheries biologist on the various alternatives.

Rare, Threatened and Endangered Species
There are no mapped rare, threatened or endangered species within the project area according to latest GIS information available.

Agricultural Soils
There are no prime agricultural soils within the project area.

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 Assistant Archaeologist

Date: 6/3/2013

Subject: Wardsboro BF 013-1(22) – Archaeological Resource ID

James,

I've completed my review of the Wardsboro VT 100 Bridge 73 resource identification and have concluded that there are no archaeological resources present in the current APE. Bridge 73 is slated for rehab/replacement and the APE took into account all four quadtrants as well as access and dewatering issues. Please feel free to contact me with any questions that may arise.

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

Brady, James

From: O'Shea, Kaitlin
Sent: Monday, April 29, 2013 11:20 AM
To: Brady, James
Cc: Newman, Scott; Williams, Chris
Subject: Wardsboro BF 013-1(22) Historic Resource ID

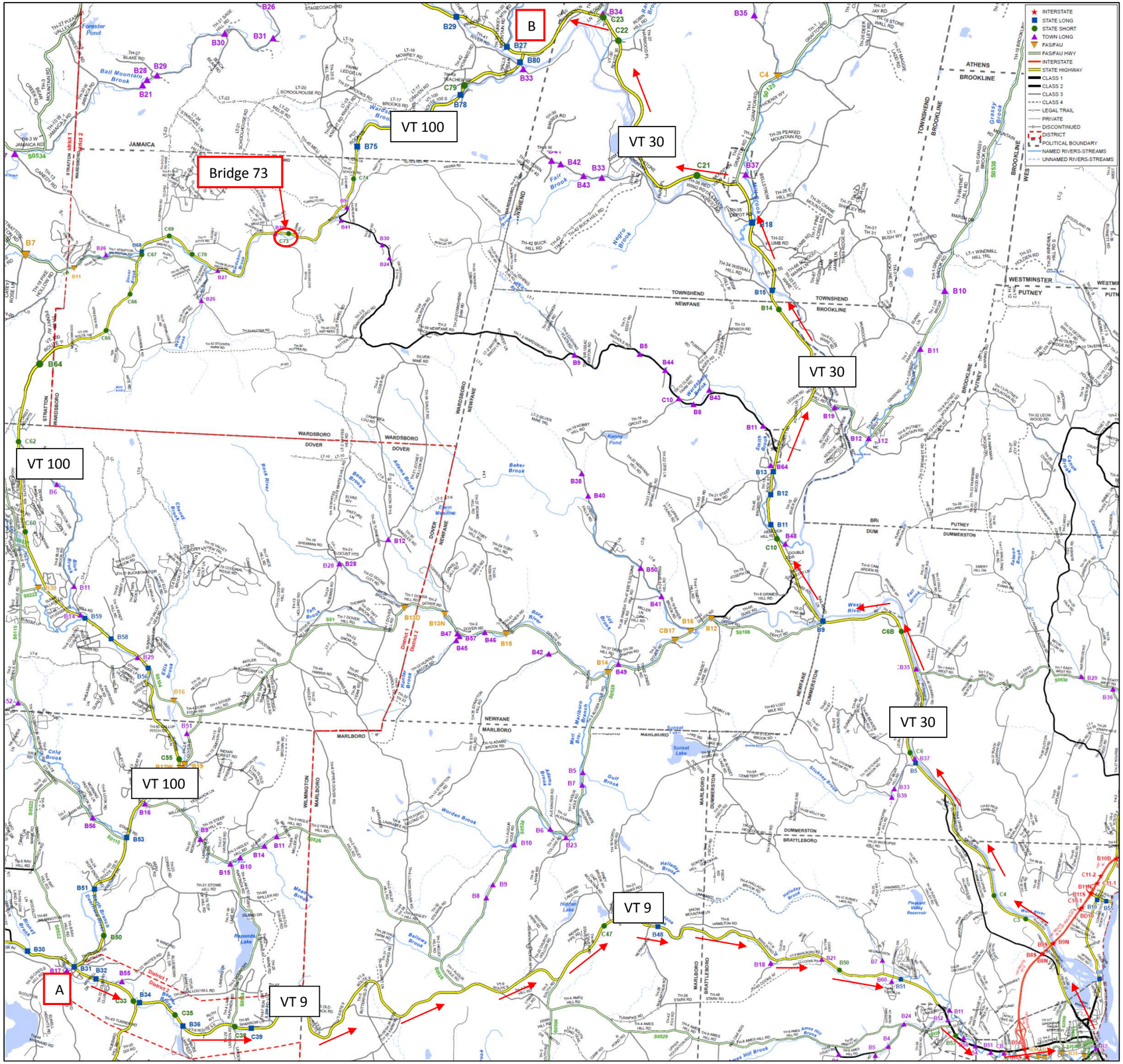
Hi James,

I have completed the historic resource ID for Wardsboro BF 013-1(22). Bridge 73 is not historic and there are no adjacent historic properties.

Thanks,
Kaitlin

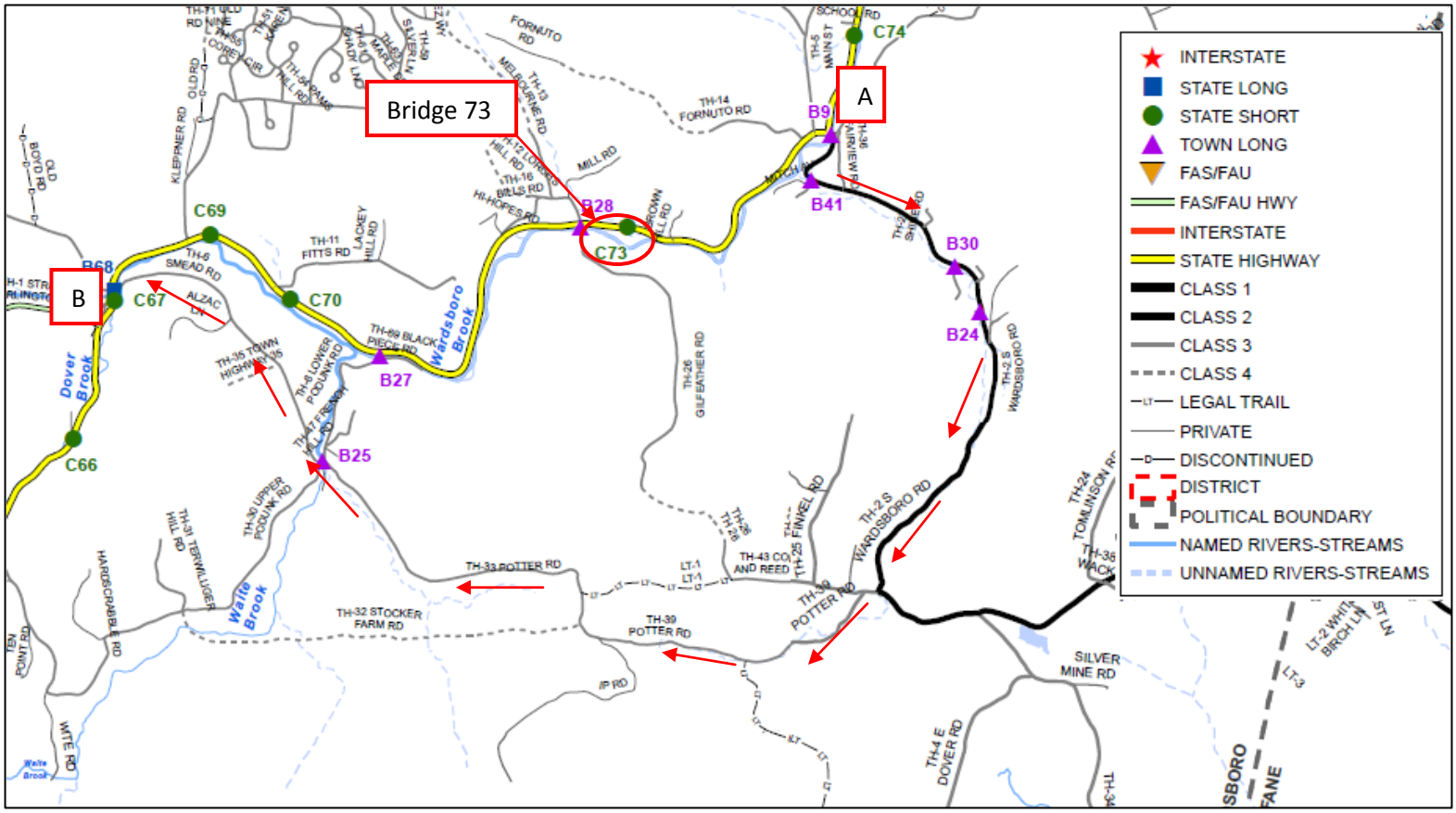
Kaitlin O'Shea
Historic Preservation Specialist
Vermont Agency of Transportation

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



Detour Route
VT Route 100, to VT Route 9, and VT Route 30 back to VT Route 100

A to B on Through Route: 22.7 Miles
A to B on Detour Route: 42.1 Miles
Added Miles: 19.4 Miles
End to End Distance: 64.8 Miles



Local Bypass Route 1

VT Route 100, to South Wardsboro Road, Cobb and Reed Hill Road, Potter Road, Podunk Road, Smead Road, back to VT Route 100

A to B on Through Route: 4.3 Miles
A to B on Detour Route: 7.4 Miles
Added Miles: 3.1 Miles
End to End Distance: 11.7 Miles

N

VT STATE PLANE GRID

CURVE (1)
DELTA = 11°55'46"
D = 4°29'38"
R = 1275.00'
T = 133.22'
L = 265.47'
E = 6.94'

DEWEY, PEARL G.

POB STA 1+00.00

8+00

PI STA 5+30.90

POE STA 6+73.33

WOODS

FIELD DRIVE

MAILBOX M. ELM

PAVED DRIVE

M. MAPLE (STUMP)

2-M. MAPLE

M. MAPLE MAILBOX

FIELD DRIVE

HVCTRL 236

BENCH MARK 38
RRSIR
M. ASH
ELEV = 1086.58

M. MAPLE
TIE M. ASH
DIST = 98.57

VT 100
TO STRATTON

1+00 2+00 3+00 4+00 5+00 6+00

VT 100
TO JAMAICA

6+73

72" CGMP FLOW

HVCTRL 235

M. PINE
M. PINE
M. PINE
M. HEMLOCK
M. PINE
M. PINE
M. PINE

GRAVEL DRIVE

WOODS

IRON ROD
½" DIA
6" AGS CAP LS 681

M. ASH

3-M. ELM
S. MAPLE
M. MAPLE

M. ELM
M. CHERRY
M. MAPLE
M. ASH

PAVED DRIVE

M. MAPLE

9+00 — 9+20

BROOK FLOW

PC STA 3+97.69

TIE M. ASH
DIST = 76.79

WOODS

PT STA 6+63.16

CE R. III

EXISTING R.O.W. BASED ON 1964 RESURVEY OF WARDSBORO VT100.

YOUNG, JR., RAYMOND P. & NANCY L.

DEWEY, PEARL G.

EXISTING BRIDGE DATA
6.0H X 7.0W CGMPPA
CULVERT BUILT IN 1957
CULVERT BARREL LENGTH = 40 FT.
WATERWAY AREA = xx SF

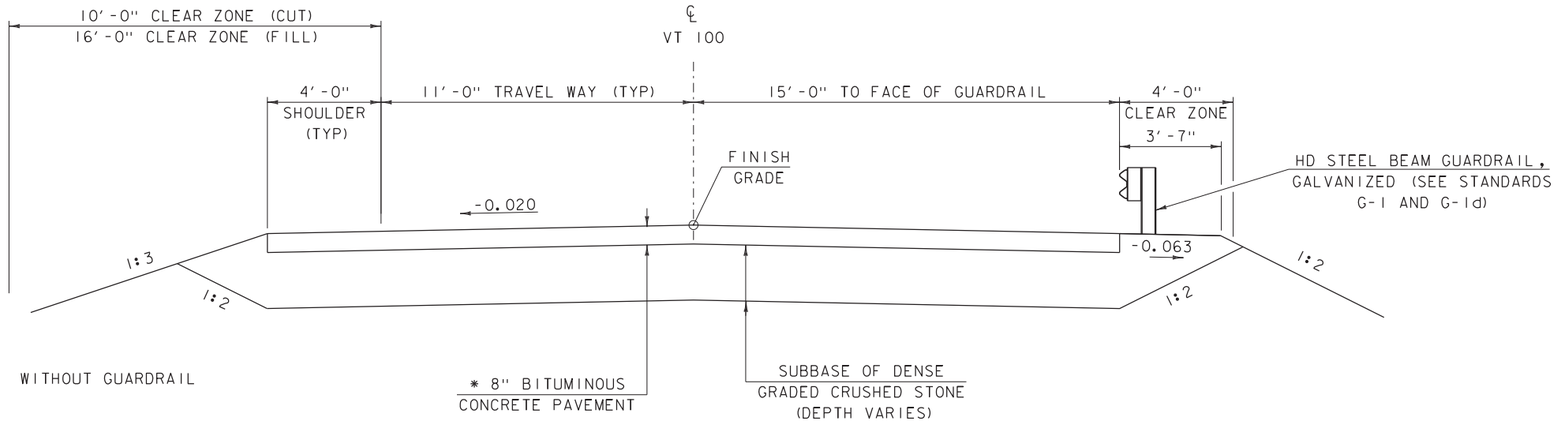
EXISTING CONDITIONS

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

PROJECT NAME: WARDSBORO
PROJECT NUMBER: BF 013-1(22)

FILE NAME: Structures/sl3b074bdr.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: L.J.STONE
EXISTING CONDITIONS

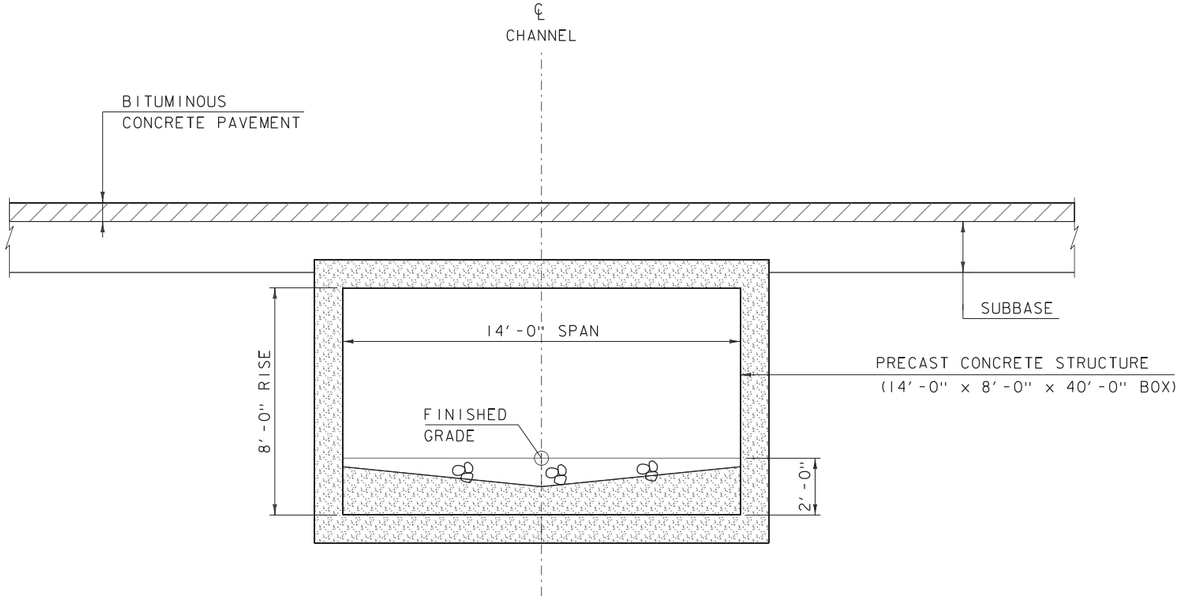
PLOT DATE: 18-JUL-2013
DRAWN BY: L.J.STONE
CHECKED BY: ------
SHEET 1 OF 7



* 1½" TYPE IVS OVER
1½" TYPE IVS OVER
2½" TYPE IIS OVER
2½" TYPE IIS

VT ROUTE 100 ROADWAY TYPICAL SECTION

SCALE: ⅜" = 1'-0"



TYPICAL PRECAST BOX CULVERT SECTION

SCALE ⅜" = 1'-0"

MATERIAL TOLERANCES

(IF USED ON PROJECT)

SURFACE	
- PAVEMENT (TOTAL THICKNESS)	+/- ¼"
- AGGREGATE SURFACE COURSE	+/- ½"
SUBBASE	+/- 1"
SAND BORROW	+/- 1"

PROJECT NAME: WARDSBORO
PROJECT NUMBER: BF 013-1(22)

FILE NAME: Structures/sl3b074typ.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: L.J.STONE
TYPICAL SECTIONS

PLOT DATE: 18-JUL-2013
DRAWN BY: L.J.STONE
CHECKED BY: ------

N

VT STATE PLANE GRID

CURVE (1)
DELTA = 11°55'46"
D = 4°29'38"
R = 1275.00'
T = 133.22'
L = 265.47'
E = 6.94'

MAINLINE STATION 3+65.00
=CHANNEL STATION 8+60.00
Δ = 90° 0" 0' RT

BEGIN APPROACH
STA 2+25.00
MATCH EXISTING

POB
STA 1+00.00

LIMITS OF
POTENTIAL IMPACTS

BEGIN BRIDGE
STA 3+57.00

8+00

END BRIDGE
STA 3+73.00

PI
STA 5+30.90

POE
STA 6+73.33

BENCH MARK 38
RRSIR
M. ASH
ELEV = 1086.58

DEWEY, PEARL G.

WOODS

FIELD DRIVE

MAILBOX M. ELM

M. MAPLE (STUMP)

PAVED DRIVE

2-M. MAPLE

M. MAPLE
MAILBOX

FIELD DRIVE

HYDTRL 236

M. MAPLE

TIE M. ASH
DIST = 98.57

VT 100
TO STRATTON

1+00

2+00

3+00

4+00

5+00

6+00

6+73

VT 100
TO JAMAICA

M. PINE
M. PINE
M. PINE
M. HEMLOCK
M. PINE
M. PINE
M. PINE

GRAVEL DRIVE

WOODS

IRON ROD
½" DIA
6" AGS CAP LS 68

M. ASH

HYDTRL 235

M. ELM
M. CHERRY
PAVED DRIVE
3-M. ELM
S. MAPLE
M. MAPLE
M. MAPLE
M. ASH
M. MAPLE

9+00

9+20

BROOK FLOW

PC
STA 3+97.69

END PROJECT
STA 4+50.00

TIE M. ASH
DIST = 76.79

END APPROACH
STA 5+00.00
MATCH EXISTING

PT
STA 6+63.16

WOODS

EXISTING R.O.W. BASED
ON 1964 RESURVEY OF
WARDSBORO VT100.

CE R. III

BEGIN PROJECT
STA 2+75.00

**YOUNG, JR., RAYMOND P.
& NANCY L.**

DEWEY, PEARL G.

END PROJECT
STA 4+50.00

EXISTING BRIDGE DATA
6.OH X 7.OW CGMPPA
CULVERT BUILT IN 1957
CULVERT BARREL LENGTH = 40 FT.
WATERWAY AREA = xx SF

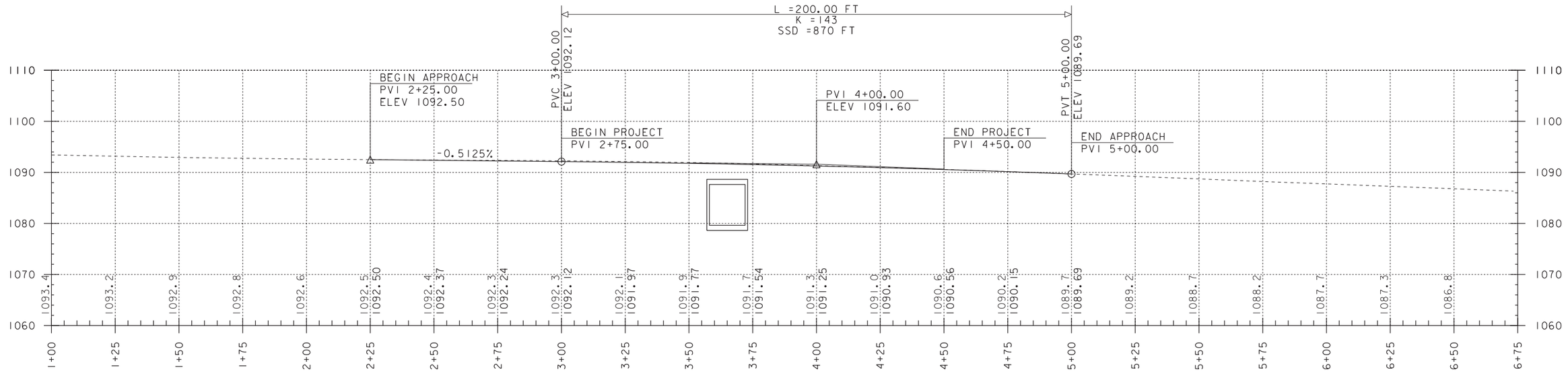
LAYOUT

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

PROJECT NAME: WARDSBORO
PROJECT NUMBER: BF 013-1(22)

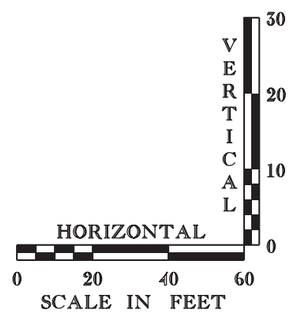
FILE NAME: Structures/sl3b074bdr.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: L.J.STONE
LAYOUT SHEET

PLOT DATE: 18-JUL-2013
DRAWN BY: L.J.STONE
CHECKED BY: ------
SHEET 3 OF 7



VT 100 PROFILE

LINE	SURFACE	OFFSET
--------	x13b074og	0.00
Scaled	2.0000	Times Ver.
Scaled	1.0000	Times Hor.



NOTE:

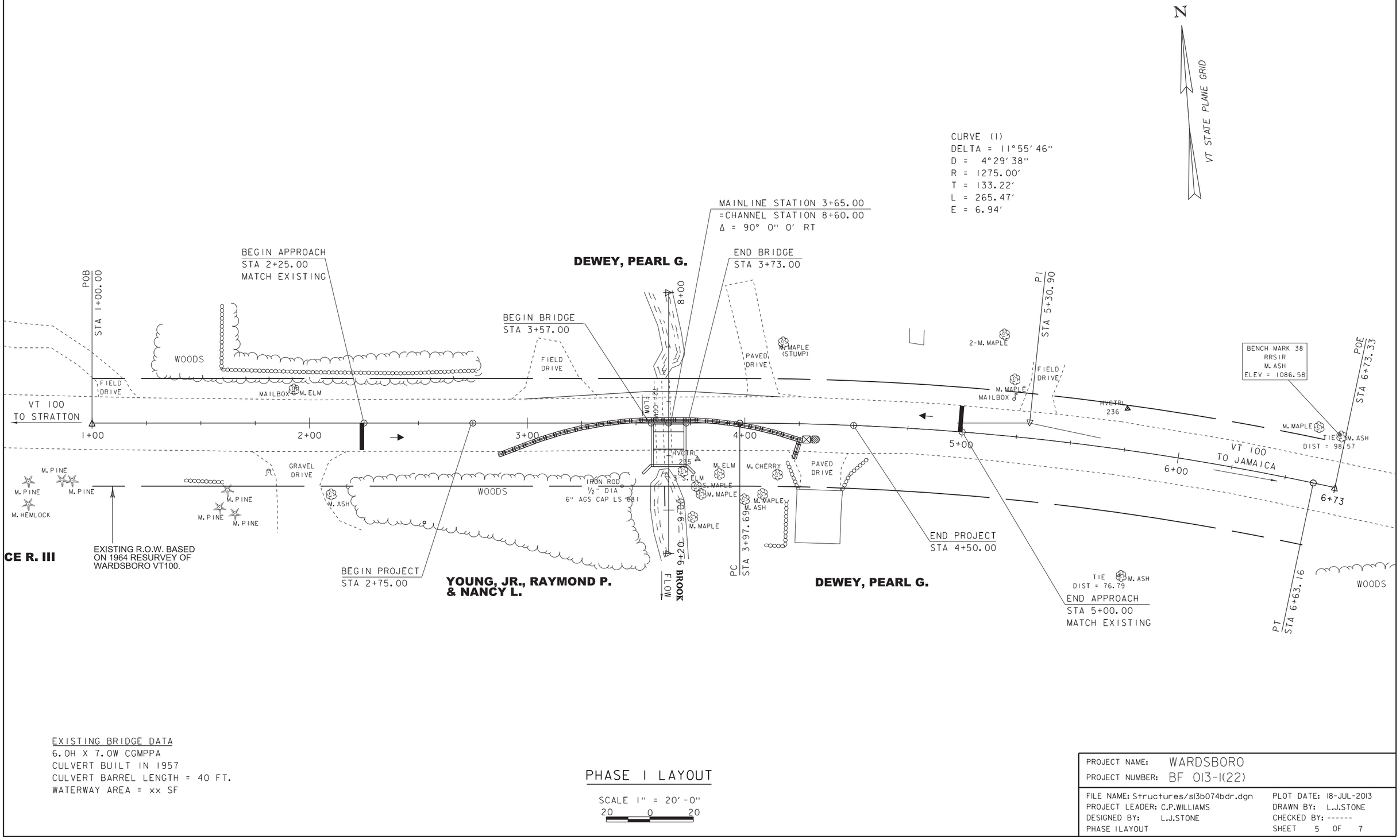
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄

GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISH GRADE ALONG ℄

PROJECT NAME: WARDSBORO
PROJECT NUMBER: BF 013-1(22)

FILE NAME: Structures/sl3b074pro.dgn
PROJECT LEADER: C.P.WILLIAMS
DESIGNED BY: L.J.STONE
PROFILE

PLOT DATE: 18-JUL-2013
DRAWN BY: L.J.STONE
CHECKED BY: ------
SHEET 4 OF 7



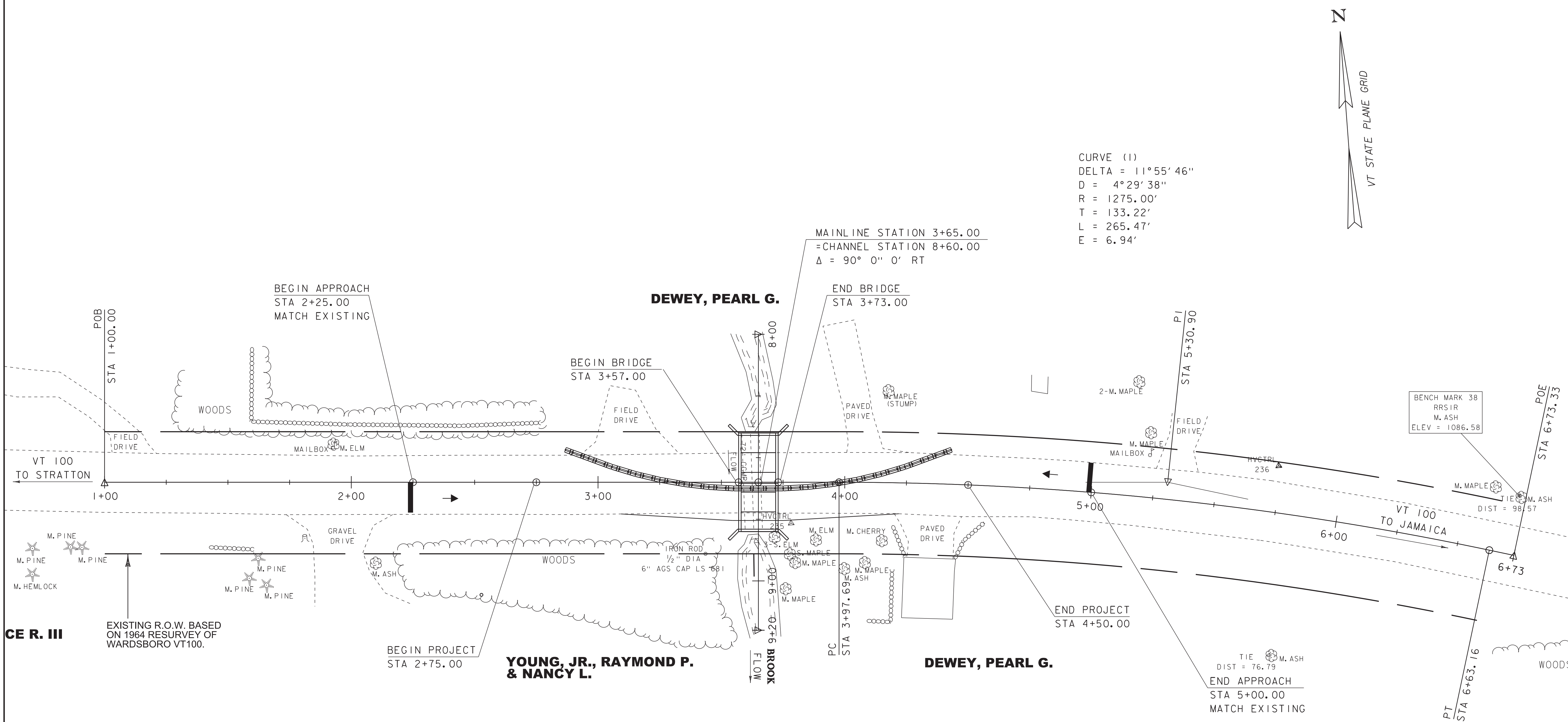
EXISTING BRIDGE DATA
6.OH X 7.OW CGMPPA
CULVERT BUILT IN 1957
CULVERT BARREL LENGTH = 40 FT.
WATERWAY AREA = xx SF

PHASE I LAYOUT

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

PROJECT NAME:	WARDSBORO
PROJECT NUMBER:	BF 013-1(22)

FILE NAME: Structures/sl3b074bdr.dgn	PLOT DATE: 18-JUL-2013
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: L.J.STONE
DESIGNED BY: L.J.STONE	CHECKED BY: ------
PHASE ILAYOUT	SHEET 5 OF 7

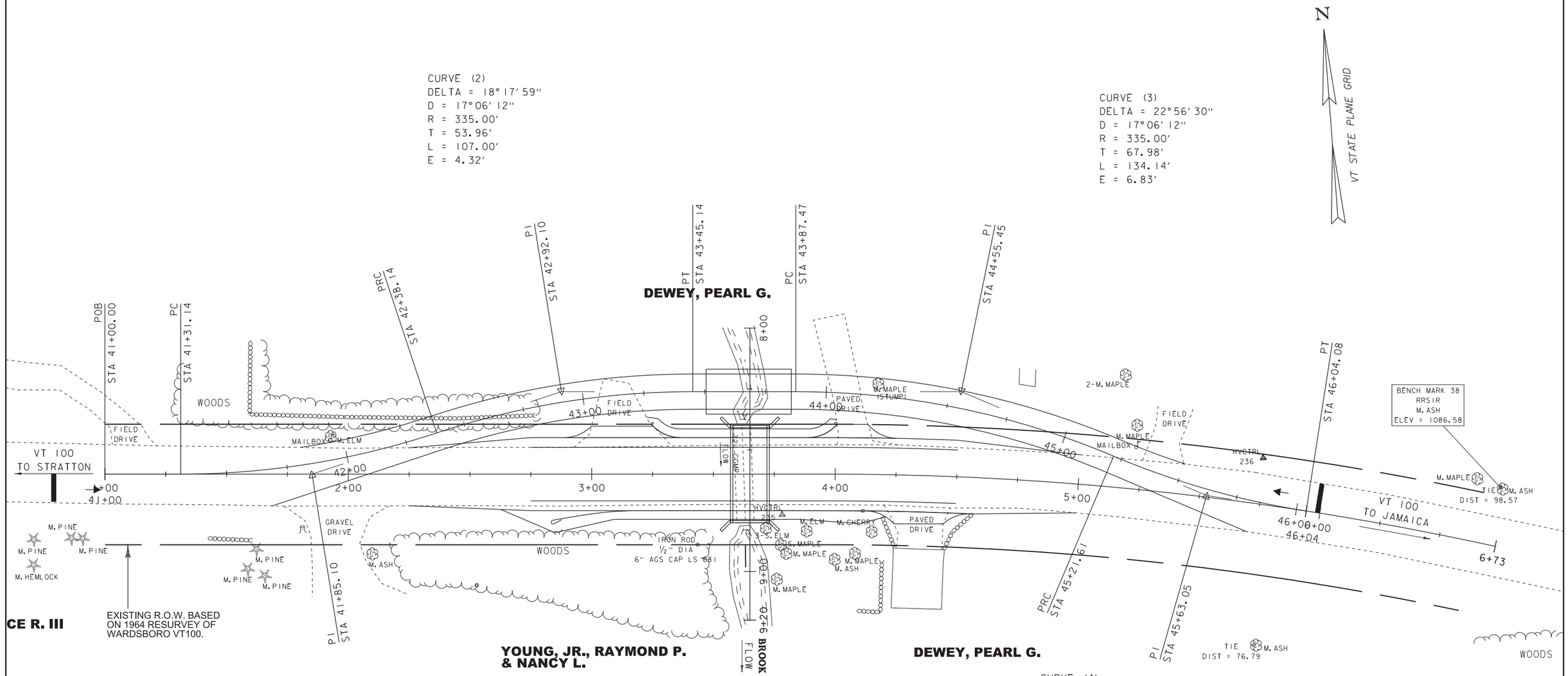


EXISTING BRIDGE DATA
6.0H X 7.0W CGMPPA
CULVERT BUILT IN 1957
CULVERT BARREL LENGTH = 40 FT.
WATERWAY AREA = xx SF

PHASE 2 LAYOUT

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

PROJECT NAME: WARDSBORO	
PROJECT NUMBER: BF 013-1(22)	
FILE NAME: Structures/sl3b074bdr.dgn	PLOT DATE: 18-JUL-2013
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: L.J.STONE
DESIGNED BY: L.J.STONE	CHECKED BY: ------
PHASE 2 LAYOUT	SHEET 6 OF 7



CURVE (1)
DELTA = 18°17'59"
D = 17°06'12"
R = 335.00'
T = 53.96'
L = 107.00'
E = 4.32'

CURVE (4)
DELTA = 14°06'17"
D = 17°06'12"
R = 335.00'
T = 41.44'
L = 82.47'
E = 2.55'

NOTE: TEMPORARY BRIDGE IS DESIGNED PER STD E-107 WITH A DESIGN SPEED OF 30 MPH, AND A SUPERELEVATION OF 2%

EXISTING BRIDGE DATA
6.0H X 7.0W CGMPPA
CULVERT BUILT IN 1957
CULVERT BARREL LENGTH = 40 FT.
WATERWAY AREA = xx SF

TEMPORARY BRIDGE

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

PROJECT NAME:	WARDSBORO
PROJECT NUMBER:	BF 013-1(22)
FILE NAME: Structures/sl3b074bdr.dgn	PLOT DATE: 18-JUL-2013
PROJECT LEADER: C.P.WILLIAMS	DRAWN BY: L.J.STONE
DESIGNED BY: L.J.STONE	CHECKED BY: ------
TEMPORARY BRIDGE	SHEET 7 OF 7