ALIGNMENT STUDY

FOR

BURKE BHF 0269(13)

VT ROUTE 114, BRIDGE 13 OVER DISH MILL BROOK

Prepared for:

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December 13, 2012 **CLD Ref. No. 12-0121**

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I. EXISTING STRUCTURE

The existing bridge is a single 25-foot span concrete T-beam bridge constructed in 1925. The bridge abutments are skewed approximately 25 degrees to the roadway and appear to consist of a concrete facing on pre-existing stone abutments on spread footings. The bridge has a clear span of approximately 21.5 feet. The clear height of the bridge is approximately 7 feet. The bridge's typical section consists of 10.5-foot travel lanes (including a safety curb on one side). There is also a sidewalk on the north side of the bridge that is 4 feet wide. There is an intersection with TH 52 just west of the bridge.

II. PURPOSE AND NEED STATEMENT

Purpose

The purpose of this project is to provide a safe highway crossing on VT 114 over Dish Mill Brook that is capable of supporting all of the anticipated vehicular loads and provides sufficient hydraulic capacity.

Need

Bridge 13 is considered functionally deficient and has a sufficiency rating of 74.3 (of a possible 100). The deck, superstructure, and substructure are all rated 6 (of a possible 10) by Vermont Agency of Transportation bridge inspectors.

There is ongoing breakdown of the concrete T-beam end areas along both abutments, and deterioration of the deck soffit area, particularly in bays 2 and 3.

The functionally deficient rating is based on the bridge geometry. The curb-to-curb width is only 20.4 feet, resulting in a constriction at the bridge.

The existing structure is not hydraulically adequate. The channel is constricted, and occasional overtopping of the bridge and roadway occurs, resulting in significant traffic delays. In addition, scour along the west abutment resulted in the exposure of 3 feet of the footing. Preliminary scour calculations indicate that there could be close to 9 feet of abutment scour at the site, and the addition of stone fill would increase the base flood elevation.

The existing bridge is on an 1145-foot radius along the road on a 3.6% grade. The existing bridge has little to no superelevation which is consistent with urban design standards. There is an existing sidewalk on the north side of the roadway that currently has little to no curb reveal. Based on the design speed and traffic volumes, the clear zone is 14 feet. The grade of the roadway, narrow shoulders, constricted bridge width, close proximity to adjacent drives and TH 52 are all factors in this location being classified as "geometrically intolerable" in the structure inspection report.

III. SITE INFORMATION

This bridge is located in a village area. There are multiple homes, businesses and historic buildings located in the immediate vicinity. Immediately adjacent to the bridge is a bed and breakfast, a gas station, a general store, and a residence that might be influenced by the construction. Several other businesses and residences might be influenced by construction, particularly during the summer tourist season. VT 114 is considered a major collector route.

The areas along the edges of Dish Mill Brook are primarily woodlands outside the Town center. A utility pole is located less than 10 feet from the existing abutment at the northwest corner of the structure, with utility lines extending across the road and bridge to the southwest and southeast corners of the structure. There is also a drop inlet with a 30-inch drain pipe extending out the existing retaining wall at the northeast corner of the structure.

Hydraulics

The existing channel width is approximately 28 feet wide. The existing structure is centered well on the channel, but has a clear span of only 21.5 feet, resulting in a constriction of the channel. The stream has a slight curve into the bridge, but is straight through the bridge reach. The existing retaining walls running parallel to the channel continue the stream constriction past the bridge structure.

The bridge and roadway experience periodic overtopping, and there are local reports of periodic ice dams. Water is up onto the beams below the Q_{50} Flood. Therefore, the structure does not meet hydraulic standards.

Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2014, 2034, and 2054.

TRAFFIC DATA	2014	2034	2054
ADT	3600	4100	~
DHV	460	530	~
ADTT	240	410	~
%T	5.9	8.6	~
%D	55	55	~
FLEXIBLE ESAL	~	**2014~2034** 2,339,000	**2014~2054** 5,829,000

Utilities

There are overhead utility lines on the north side of VT 114 that extend across the road and bridge to the southeast and southwest corners of the bridge. A dry hydrant is located on the southwest corner of the structure (upstream side).

Right-of-Way

All portions of the existing superstructure and substructure are within the existing right-of-way except for the downstream retaining walls.

Environmental Resources

This project occurs entirely within a historic district, consisting of multiple historic properties. The concrete bridge is considered a contributing structure within the historic district. The southeast corner of the bridge contains the potential for a buried structure foundation and is, therefore, archaeologically sensitive. The northwest corner of the bridge may have contained the remnants of a historic structure, but the area has been completely disturbed through construction of a parking lot and a mound that contains a well head.

The river is considered the only biological resource. There are no agricultural or floodplain soils within the project area either.

Design Criteria

Existing Bridge:

Design Speed = 30 mph
Lane/Shoulder Width = 10'-6"/0'-0"
Sidewalk = 4'-0"

New Bridge:
The design standards for this project are the latest Vermont Agency of Transportation Standards, AASHTO Green Book and the AASHTO Roadside Design Guide.

Design Speed = 30 mph
Lane/Shoulder Width = 11'-0"/3'-0" (Left) and 11'-0"/4'-0" (Right)
Sidewalk = 5'-0" (excluding curb on the left)
Banking = 0.020 max. (Utilizing urban design standards)
Bridge Capacity = HL-93
Hydraulic Requirement = 826' min. average low chord elevation

Per Standards, a 3'-0" shoulder is sufficient for this location. However, the bridge is located near a bicycle rental business. As a result, bicycle traffic during the summer tourist season will likely be extensive. Therefore, CLD attempted to increase both shoulders to 4'-0" to accommodate the additional bicycle traffic. However, due to site constraints, the additional width could only be accommodated on one side of the bridge, resulting in one 3'-0" shoulder and one 4'-0" shoulder.

The *East Burke Transportation Safety and Capacity Study* dated January 2012 provides a "safe pedestrian facility that will connect the residences and businesses along Main Street and will improve the safety and mobility of pedestrians, relieve automobile and pedestrian conflicts and provide for alternative transportation between existing, residential, recreational, and municipal centers". The typical section and roadway and bridge improvements proposed in this report appear to meet the purpose and intent of this study.

See Plan Sheet 1 for Existing and Proposed Bridge Typical Sections and Plan Sheet 2 for Proposed Approach Roadway Typical Sections.

IV. MAINTENANCE OF TRAFFIC

The bridge rail on the northeast corner of the bridge will end without an approach rail due to the presence of a private drive immediately adjacent to the bridge. While this is not ideal, this will be no worse than the existing condition and cannot be remedied without extensive impacts to the property owner.

Due to the revisions to the proposed roadway alignment and profile discussed below, grading will be required along the edges of the road. In the archaeologically sensitive area, additional fill will be required to provide adequate slopes for all of the options.

Option 1: Temporary Bridge Upstream (See Plan Sheets 7 and 7A)

This option involves installing a temporary bridge upstream of the existing structure. Both one-way alternating and two-way detours were reviewed.

For the one-way alternating traffic detour, a 70-foot span temporary bridge would be installed. The bridge width was assumed to be 14’-6” wide, which is the minimum required one-lane bridge width per VTrans Standard Specifications. The roadway approaches to the temporary bridge would vary in width from 11’-6” to 23’-2” with a normal crowned (2%) section. Due to the width and radii of the approach curves, a 15-mph speed should be posted for the temporary bridge, which is reasonable given that temporary traffic signals will be required to alternate one-way traffic. Truck traffic through the detour was designed to accommodate WB-62 sized trucks. WB-67 trucks would need to be detoured around the project using the Regional Detour shown on Plan Sheet 9. A temporary bridge will allow traffic to travel through the project area while allowing for bridge construction on the existing alignment.

For the two-way detour, an 85-foot span temporary bridge would be installed. The bridge width was based on the vehicular needs of a WB-62 truck which requires additional pavement to make the necessary turning movements. Therefore, a 30-foot wide bridge was selected. The roadway approaches to the temporary bridge vary in width with a normal crowned (2%) section. Typical lanes would be striped at 11’ from the centerline with additional pavement for truck tracking. The speed along the detour should be posted at 15 mph; however, WB-62 trucks will likely navigate the detour at slower speeds due to the alignment. The two-way temporary bridge will allow traffic to travel through the project area while allowing for the bridge construction on the existing alignment.

Advantages: The one-way alternating traffic and two-way options would allow vehicular traffic to continue through the area during construction. The two-way traffic option would allow vehicular traffic to move unhindered; thus, minimizing backups and delays through the construction area. It is anticipated that this option would result in traffic disruptions occurring over a period of approximately 6 months; however, the total construction period, including constructing and deconstructing the temporary bridge, would extend through two construction seasons.

Disadvantages: The one-way alternating traffic option would result in traffic queues on the order of 300 feet for the 95th percentile queue at both ends in part due to the temporary traffic signal.

The two-way temporary bridge will require more earthwork impacts than the one-way alternating bridge. Maneuvering through the sharp curves of the two-way roadway approaches for the temporary bridge could be difficult for larger vehicles. Both temporary bridge options will extend the limits of the project beyond that which is required for the bridge construction and approach work.

TH 52 is immediately adjacent to the west end of the bridge. Under the two-way temporary bridge scenario, access to and from TH 52 to VT 114 will be closed as guardrail or barrier will be needed to clearly define the detour route and provide a safe approach to the temporary bridge. The driveway ingress/egress points along VT 114 will need to be coordinated so that traffic flows safely in this area. For the one-way alternating traffic option, TH 52 can remain open; however, the right-hand turn required to access the temporary bridge would be extremely difficult.

The historic and archaeologically sensitive area east of the temporary bridge will be impacted by both temporary bridge options. Therefore, there is the possibility for potential archaeological impacts, although the temporary bridge construction will fill the site with only minimal excavation required to construct the east abutment. Test excavations could be used prior to performing this excavation to ensure no archaeological material is disturbed.

The driveway to the house southeast of the temporary bridge will need to be reconstructed for both the one-way and two-way detour options to provide access to the detour route and comply with VTrans standard details. Coordination with the property owner will be necessary to determine impacts and the ultimate limits of driveway reconstruction.

We anticipate that significant temporary Right-of-Way acquisition will be required. This will delay the project schedule and increase project costs, as Right-of-Way acquisition can be very expensive.

Pedestrian access will be maintained for the entirety of the project. However, the additional width required to provide a sidewalk on the temporary bridge will increase impacts to the property owners adjacent to the bridge.

Recommendation: We considered the concerns related to potential delays and traffic backups with the impacts to the property east of the bridge, and CLD recommends the two-way detour.

Option 2: Phased Construction (See Plan Sheet 8)

This option utilizes the existing structure for traffic while a section of the proposed bridge is built parallel to the existing. A portion of the existing structure would be removed prior to Phase 1 to provide room to construct the proposed bridge. During Phase 1, traffic would be reduced to one lane on the remaining portion of the existing bridge, while a section of the new bridge is built. During Phase 2, traffic would be re-routed onto the newly built section of proposed bridge while the remaining portion of the existing structure is built. Temporary traffic signals would be utilized to alternate one-way traffic across the bridge.

Advantages: The option would maintain traffic within the project area without the property impacts associated with a temporary bridge. Over-widening of the bridge is required to maintain minimal travel lanes for traffic for the duration of the project. This over-widening results in an extra wide shoulder and the possible inclusion of an additional sidewalk on the south side of the bridge. This would be beneficial for the large volume of bike traffic evident in the Town during the summer months. Pedestrian access will be maintained during Phase 1 construction on the existing bridge.

Disadvantages: Phased construction is more expensive than the temporary bridge option due to the additional material and labor costs resulting from the required over-widening of the proposed superstructure and substructure by 8 feet. In addition, the construction costs are increased as a result of the difficulties involved in constructing a bridge in sections. This option, like the temporary bridge options, would also require two full construction seasons to construct, but it would increase the time period that traffic is disrupted from 6 months for the temporary bridge options to approximately 18 months, meaning that one-lane alternating traffic would occur during the winter months.

Another major concern associated with the phased bridge option is the substructure removal. The existing substructures are stone with concrete facing. Removing stone structures in phases is extremely difficult, and could compromise the integrity of the remaining portion of the structure still supporting the existing bridge.

Pedestrian access cannot be maintained during Phase 2 of construction unless a third phase of construction is added.

We anticipate that some permanent Right-of-Way acquisition would be required, as the over-widened portion of the bridge extends outside of the existing Right-of-Way. This will delay the project schedule and increase project costs, as Right-of-Way acquisition can be very expensive.

Option 3: Off-Site Detour (See Plan Sheet 7 (Without Temporary Bridge) and Plan Sheet 9)

This option involves maintaining traffic by the use of an off-site detour.

Advantages: This option would eliminate the need for a temporary bridge or phased construction, which would decrease cost and time of construction. It would also decrease the amount of Right-of-Way acquisitions, which would reduce costs. This option will minimize impacts to property owners as well as reduce environmental impacts. It is anticipated that this option could be constructed in one construction season with traffic disruptions occurring over 4 to 6 weeks, assuming the 21-inch voided slab superstructure without a cast-in-place concrete overlay (discussed in Section VI below) is utilized. During that time, through traffic would utilize a regional detour, and local traffic and tourists staying in the area would likely utilize local roads for a much shorter detour around the project area. The regional detour plan with mileage, along with the local detour routes and mileage, are provided on Plan Sheet 9.

Disadvantages: This option would have the largest impact on local vehicular and pedestrian traffic, as the road would be closed for 4 to 6 weeks. It was assumed that a precast concrete superstructure (21-inch voided slabs) and precast concrete substructures (one integral abutment on piles and one semi-integral stub abutment with tremie seal/subfooting – See Section VII below) would be utilized to minimize construction time; however, removing the existing abutments and retaining walls and installing the new substructures will require extensive cofferdams and water control, which will extend the project schedule. However, on the west side of the bridge, the existing abutment and retaining walls can be utilized as cofferdams, which will save time, and then removed down to ordinary high water (OHW) (assuming VTrans Hydraulics Unit approves) or down to the top of footing. Floating silt booms would be required to remove them below water level. Incentives/disincentives may need to be included in the contract to ensure the contractor completes enough of the construction within the 4- to 6-week closure period to open the road to traffic, as it will likely be imperative to construct both sides of the bridge concurrently.

V. ALTERNATIVES

Alternative A: No Action

The “no action” alternative would involve leaving the bridge as-is, and allowing the State to continue to inspect and repair the structure as needed.

Advantages: This alternative would have no immediate costs.

Disadvantages: This alternative will inevitably result in a reduced load rating of the bridge due to the ongoing deterioration of the concrete T-beam end areas along the abutments. Overtopping of the bridge and roadway by the river will continue to occur, possibly resulting in further deterioration of the bridge.

Maintenance of Traffic: This alternative would require no maintenance of traffic.

This alternative is not recommended since it does not address the purpose and need of the project. No cost estimate has been provided for this alternative since there are no immediate costs.

Alternative B: Superstructure Replacement Only

The T-beam structure could be rehabilitated, but widening the existing superstructure to accommodate the required roadway widths necessary to correct the current roadway constriction at the bridge would not be practical. This alternative would replace the existing superstructure and reuse the existing substructure. Repairs would be needed to the substructure to fix the scour evident along the footing of the west abutment, and calculations would need to be performed to determine if the substructure could accommodate the weight of the new superstructure. In order to widen the structure to meet required roadway widths, both abutments would also need to be widened.

Advantages: This alternative would cost less than a full replacement in both materials and labor. The existing retaining walls could be maintained, and the impact on vehicles and abutters will be significantly decreased.

Disadvantages: While being rated satisfactory by the bridge inspection unit, the condition of the existing substructures is unknown. At least 3 feet of the west abutment footing has been exposed by scour, and the potential of 9 feet of scour exists according to the Preliminary Hydraulics Report. Widening of the abutments could be difficult due to the presence of the existing retaining walls. In addition, the existing structure does not meet hydraulic requirements, and increasing the rise of the bridge is not possible due to the site constraints, or recommended hydraulically due to the possibility of increasing upstream flooding.

Maintenance of Traffic: This alternative would utilize Option 1 or 3 to maintain traffic during construction. Option 2 could be utilized if widening of the substructures was included in this option.

This alternative is not recommended and, therefore, we have not studied this alternative any further or produced a cost estimate.

Alternative C: New Structure on Revised Alignment

Due to the presence of a bed and breakfast immediately adjacent to the northeast corner of the bridge, as well as the intent to leave the northeast retaining wall in place as much as possible, the north fascia of the bridge could not be shifted to the north to accommodate the necessary additional bridge width required to meet standards on the existing alignment. Therefore, a revised alignment with a smaller radius was developed. The additional width provided by decreasing the radius of the existing alignment was sufficient to accommodate the required roadway width and sidewalk. The resulting alignment still meets all design requirements.

Based on the proposed curvature and design speed, AASHTO recommends that a rural roadway be superelevated to 5%. However, this section of VT 114 is located in an urban area which reduces the required superelevation. Due to existing road conditions beyond the limits of the project, the proposed road is limited to a maximum superelevation of 2%. To match the existing superelevation while maintaining the appropriate runoff rate determined the project's begin and end project limits.

TH 52 will be impacted as a result of both the permanent and temporary bridge alternatives. Due to the likelihood of requiring guardrail at the southwest corner of the proposed bridge, the east side of TH 52 should be realigned so adequate guardrail can be installed. In addition to realigning TH 52 due to guardrail impacts, TH 52 in general will require some reconstruction to account for revisions to VT 114. Approximately 100 LF of TH 52 will need to be reconstructed to account for the revisions to the superelevation along VT 114 as well as the realignment of TH 52. The limits of reconstruction were controlled by VTrans Standard B-71 requiring a 20-foot platform at 3% and grading the roadway to meet existing in the shortest distance reasonable. The realignments to TH 52 appear to meet the purpose and intent of the *East Burke Transportation Safety and Capacity Study*.

Advantages: This alternative will allow the bridge to match the width of the approaches and meet design requirements for required roadway widths. In addition, the retaining wall on the northeast corner of the structure will be maintained, significantly decreasing the impacts to the bed and breakfast.

Disadvantages: This alternative would alter the alignment of VT 114 by decreasing the radius.

Along the northeast side of the existing bridge in front of the bed and breakfast, a segment of sidewalk is located off the edge of travelled way. Due to the proposed superelevation, grading impacts behind the proposed sidewalk will be required so as to minimize the chance for ponding of runoff. In addition, the two walkways that exist in the area will need to be coordinated with the grading of the sidewalk and curb. Preliminary review of these areas indicates that in order to avoid adversely impacting the bed and breakfast property, very little curb reveal will be provided.

Maintenance of Traffic: This alternative would utilize any one of the Options discussed previously to maintain traffic during construction.

This alternative would satisfy the project purpose and need in that the new bridge would easily carry the design loads and is a long-term solution to this deteriorating structure. CLD recommends this option.

Alternative D: New Structure on Existing Alignment

Using the existing alignment of the bridge would result in the north bridge fascia extending further north to accommodate the required bridge width, and would cause significant problems with the driveway of the bed and breakfast adjacent to the northeast corner of the structure.

Advantages: This alternative would maintain the existing alignment, requiring little to no slope work or property impacts outside the limits of the structure except for the bed and breakfast driveway on the northeast corner of the structure.

Disadvantages: This alternative would not match in as well with the approaches as Alternative C does, and would result in the replacement of the northeast retaining wall, which will increase material costs as well as construction time and costs. It would also significantly increase property impacts to the adjacent bed and breakfast.

Maintenance of Traffic: This alternative would utilize any one of the Options discussed previously to maintain traffic during construction.

This alternative is not recommended since the bridge would be difficult to construct so close to the bed and breakfast. In addition, the removal and replacement of the northeast wingwall would require sheeting along its length to construct, which would increase costs and would likely cause significant vibrations that could affect the stone foundation of the bed and breakfast. Given that a relatively minor radius change corrected the problems associated with this alternative, we have not studied this alternative any further or produced a cost estimate.

VI. SUPERSTRUCTURE TYPES

The average low chord elevation required to meet hydraulics requirements is 827 feet. As the existing structure depth is only 2 feet, and the site constraints prevented raising the road more than a few inches, the bridge replacement types were limited.

NEXT Beams

The minimum depth of a NEXT beam structure is 28 inches. This depth, combined with additional pavement and cross slope, could not meet the hydraulics requirements of the project. We have, therefore, not examined this structure type further.

Prestressed Voided Slabs

Two voided slab options were examined for this option; a 15-inch voided slab with 5-inch composite cast-in-place concrete overlay and a 21-inch voided slab with 2½" of pavement (no overlay).

Advantages: Voided slabs can be constructed quickly, and can be easily phased if required. The aesthetics of this bridge will also be similar to the existing historic bridge, particularly with the chosen Texas rail that will be used as bridge rail on the structure. The structure depth of the 15-inch voided slab option is shallow enough to meet the hydraulic requirements, whereas the 21-inch voided slab option is 1½" too deep to meet hydraulic requirements and use of these voided slabs will need approval from VTrans' Hydraulic Unit. In addition, the concrete overlay is generally preferred by VTrans as it covers up imperfections between the slabs and thus makes the voided slab placement easier.

Disadvantages: While the 21-inch voided slab option is 1½" too deep to satisfy hydraulic requirements, it does not require a cast-in-place concrete composite overlay like the 15-inch voided slab option does. While the overlay has many benefits, it is time-consuming to construct and will increase the overall construction period.

CLD recommends the voided slab structure type for the replacement bridge as it is less expensive than the steel option discussed below and will provide the best solution to the multiple constraints of this project. Of the two options discussed above, CLD recommends the 21-inch voided slab option for the off-site detour option as it minimizes construction time allowing a road closure to occur (as discussed in Section IV, Option 3), and only exceeds hydraulics requirements by a minimal amount. However, for the temporary bridge and phasing options, CLD recommends the 15-inch voided slab option as it is preferred by VTrans and meets hydraulic requirements.

Prefabricated Bridge Units (PBUs)

PBUs were examined for this project as an accelerated bridge option. PBUs are girder pairs spaced closer together than standard girder spacing, with the concrete deck precast with the girders. Each unit would be placed one at a time with closure pours completed with high strength concrete.

Advantages: The PBUs meet the hydraulic requirements of the project and can be constructed quickly, without requiring a cast-in-place concrete deck like the voided slab option.

Disadvantages: The new structure will look significantly different than the existing structure, which could be a concern given the historic nature of the bridge and overall district. In addition, in order to meet hydraulic requirements, the steel beams are only slightly deeper than they are wide, which results in beams that do not meet AASHTO recommended flange width-to-depth ratios. The beams also exceed recommended AASHTO span to depth ratios. This option could be phased, but would require 11 feet of over-widening and would result in two additional PBU sections. This significantly increases cost and Right-of-Way impacts.

CLD does not recommend this structure type. The beams cost $150,000 more than the voided slabs, and exceeding the recommended AASHTO ratios is not ideal. In addition, given the relatively small size of the project, it may be difficult to find large fabricator companies familiar with PBUs willing to bid on the project, however, smaller companies are capable of doing the work.

VII. SUBSTRUCTURE TYPES

Two substructure types were examined for this project: integral abutments on piles and conventional abutments on spread footings. Both substructure types were assumed to be precast to minimize construction time; however, the precast option increases substructure costs.

It was assumed for both options that the existing west abutment and retaining walls would be utilized as cofferdams and then removed down to either OHW (with VTrans Hydraulics Unit approval) or to the top of the existing footing. Floating silt booms would be required to remove them below water level. The east abutment and retaining walls will be removed completely, as the new abutments will be placed in the same location as existing, so cofferdams will be required. Placement of the cofferdams and removal of the north portion of the existing east substructure will be extremely difficult due to the proximity of the bed and breakfast at the northeast corner of the project.

Precast Concrete Integral Abutments

Integral abutments are the preferred abutment type for VTrans. It provides a jointless bridge to prevent water from leaking onto the substructure.

Advantages: This substructure provides a jointless bridge requiring fewer maintenance costs. It also requires less concrete and a shallower excavation depth than the conventional abutment option discussed below because it is on piles, which provide greater scour protection.

Disadvantages: An integral abutment is generally designed to be further back from the river channel up the channel slope, resulting in a short stub abutment. The existing east abutment is a full-height abutment with no slope in front of it. Due to site constraints, the required hydraulic opening was obtained by widening the bridge to the west only, leaving the face of the east abutment in its current location. As a result, the proposed east abutment becomes very tall (14'-6" assuming the bottom of the integral is set at 6 feet below finished grade immediately in front of the abutment, or 4 feet below the streambed) with very little slope in front of it. Therefore, the resulting integral abutment does not meet the height requirement for the Simplified Design Method for the VTrans' "Integral Abutment Bridge Design Guidelines." The height of the integral may make it difficult to construct given the large active soil loads resulting from the additional height behind the wall. The west abutment is shorter and falls within the height requirements for the Simplified Design; however, it is not ideal to construct two integral abutments with dissimilar heights.

In addition to the height problem for the east abutment, the skew of the bridge is 28 degrees, which is 8 degrees more than the recommended skew for the Simplified Design.

CLD does not recommend using an integral abutment type for Abutment B (east abutment) due to its excessive height. However, an integral abutment for Abutment A (west abutment) is still a valid option for this project despite the skew. As the impacts for the integral abutment type are less than the conventional abutment type, CLD recommends it over the conventional abutment type for the west abutment. The integral abutment can be used in combination with a different substructure type, such as a semi-integral or conventional abutment, as discussed later in this section.

If integral abutments are chosen for this project, a more detailed design will be performed to account for the additional skew. A semi-integral could be used for the west abutment as well. The costs for a semi-integral abutment on piles, as compared to the integral abutment, are similar so a final determination can be made in the next phase of design.

The conventional abutment options are discussed below.

Precast Concrete Conventional Abutments

Full-height abutments on footings are also a relevant option for this project.

Advantages: This option does not typically require pile driving unless poor soils are encountered. A geotechnical report will be required to analyze the soil properties and determine whether piles will be required.

Disadvantages: These abutments are much larger than the integral abutments and, while they may not require pile driving, they will require additional concrete and reinforcing steel due to the large footing required. In addition, due to the depth of the excavation required to place the footing 6 feet below the stream bed, additional sheeting will be required as compared to the integral abutment on piles resulting in more impacts to the bed and breakfast property for a longer period of time. Extensive dewatering will also be required. Possible scour may also be a concern with this option. Given the existing structure is experiencing extensive scour, additional scour calculations may need to be required to verify that the standard VTrans requirement that the bottom of footing be placed 6 feet below the bottom of the streambed is sufficient for the safety and integrity of the structure.

The precast conventional abutment option is similar in cost to the integral abutment cost, as the savings in pile costs is made up in additional concrete, backfill, excavation, and cofferdams. Therefore, CLD does not recommend this option for the west abutment due to the additional impacts caused by these larger abutments and deeper excavation. For the east abutment where the integral abutment is not recommended due to the required height, CLD recommends using the conventional abutment. However, to obtain the "jointless" bridge that the integral abutment provides and VTrans prefers, CLD recommends a semi-integral/conventional abutment combination. This abutment would have the benefits of a semi-integral abutment at the superstructure level, but would utilize a precast concrete footing similar to a conventional abutment.

One possibility to decrease the size of the footing for this option due to its tall height is to construct a 6-foot tremie seal from the riverbed elevation to 6 feet below riverbed to reach the required scour depth recommended by VTrans. A precast concrete footing would then sit on top of the seal and would have a much smaller heel, saving concrete, reinforcement, and labor costs. The seal would still have similar cofferdams limits as compared to the full-height abutment, but will be significantly easier to construct as dewatering below the riverbed elevation would not be required. However, the contractor will need to ensure that the top surface of the seal has a suitable surface to place the precast footing. The resulting abutment would essentially be a stub abutment with semi-integral top on a tremie seal.

CLD recommends a combination of the two substructure types discussed above: an integral abutment on piles for Abutment A and a semi-integral stub abutment on a 6-foot-deep tremie seal for Abutment B. This combination provides a balance between limiting property impacts and geometry constraints.

VIII. COST ESTIMATES

The following cost estimates are preliminary and were prepared using applicable reference material and CLD's best engineering judgment. The estimates will be subject to change as more information becomes available such as subsurface borings and/or Right-of-Way requirements, and as the design is updated and refined. They are considered reliable for the purposes of planning and decision-making.

Cost estimates have been calculated for six combinations, as shown below.

1. Do Nothing – $0

2. 21-inch Voided Slabs with one Integral Abutment and one Semi-Integral Stub Abutment on a Revised Alignment with Off-Site Detour – $1,637,860

3. 15-inch Voided Slabs with one Integral Abutment and one Semi-Integral Stub Abutment on a Revised Alignment with One-Lane Temporary Bridge – $1,961,409

4. 15-inch Voided Slabs with one Integral Abutment and one Semi-Integral Stub Abutment on a Revised Alignment with Two-Lane Temporary Bridge – $2,001,449

5. 15-inch Voided Slabs with one Integral Abutment and one Semi-Integral Stub Abutment on a Revised Alignment with Phased Construction – $2,199,430

6. 15-inch Voided Slabs with one Integral Abutment and one Semi-Integral Stub Abutment on a Revised Alignment with Phased Construction (with 2 sidewalks) – $2,205,938

A breakdown of the costs for each alternative is given on the evaluation matrix on Page 16. The breakdown includes roadway, structure, temporary structure, traffic and safety, mobilization/demobilization costs, and Right-of-Way acquisition costs. The items included in each of these sections are defined below.

Roadway covers the cost of rebuilding the existing road, signs, drainage, and new approach rail within the project limits.

Structure includes the costs of the complete removal and replacement of the existing superstructure and substructure.

Temporary Structure includes all costs associated with installing and removing the temporary bridge, including the roadway approaches, guardrail, temporary barriers, etc.

Traffic and Safety includes the cost of traffic control items such as signage, barrier, changeable portable message signs, officers, flaggers, and temporary traffic signal systems.

Mobilization/Demobilization includes the costs of preparatory work and operations for the project, for the establishment and removal of the contractor's field offices, buildings, etc., and any other costs incurred prior to beginning work and upon completion of the Contract items. It also includes project cleanup, establishment of vegetation, and the completion of all work not associated with a specific pay item.

Right-of-Way Acquisition includes the cost associated with acquiring the necessary land and/or rights for construction of the project. These costs are extremely variable and will be unknown until the acquisition process commences. However, CLD approximated some numbers based on the amount of temporary and/or permanent acquisition for each option in attempt to obtain reasonable comparisons between them.

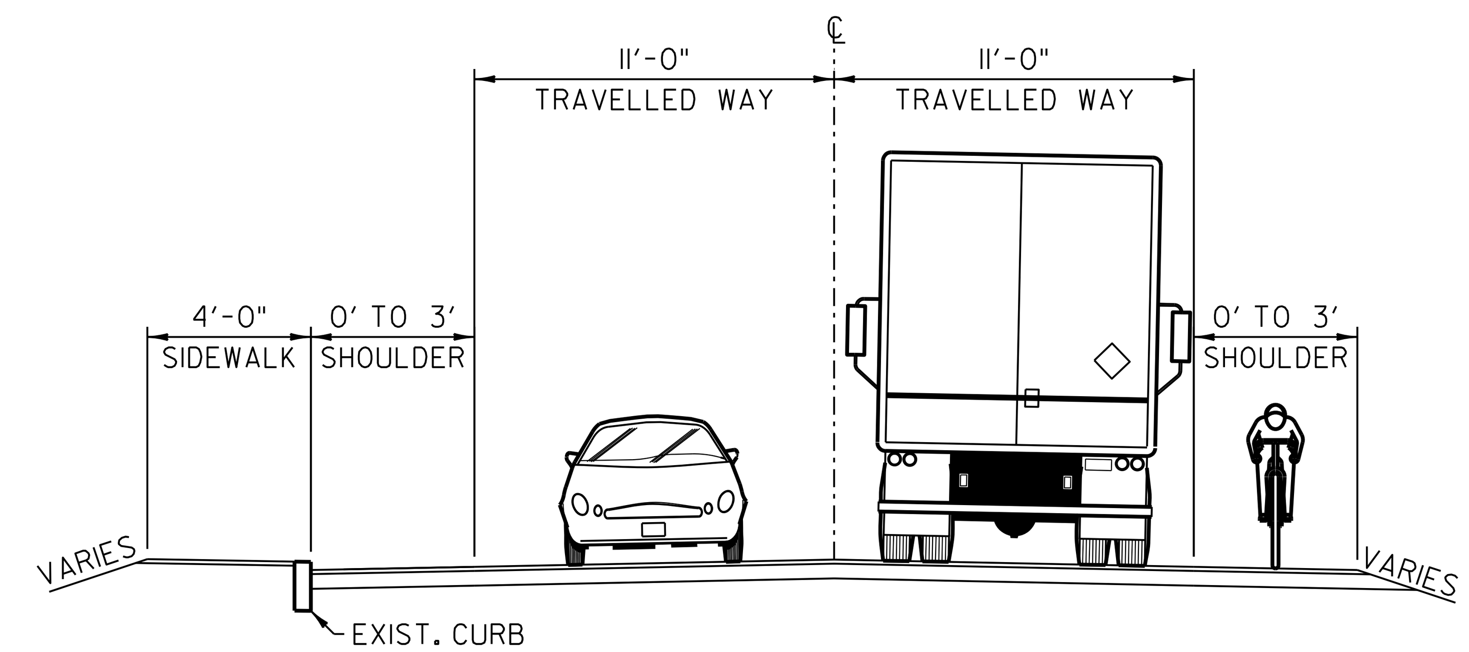
Evaluation Matrix - Bridge No. 13, VT Route 114 over Dish Mill Brook

The following evaluation matrix contains a list of all potential issues and concerns with all possibly affected parties who may have a concern with a proposed alternative. A "No" in a space indicates that there are no concerns, impacts, or permits required. A "Yes" indicates that there is a concern associated with the alternative or a permit is required.

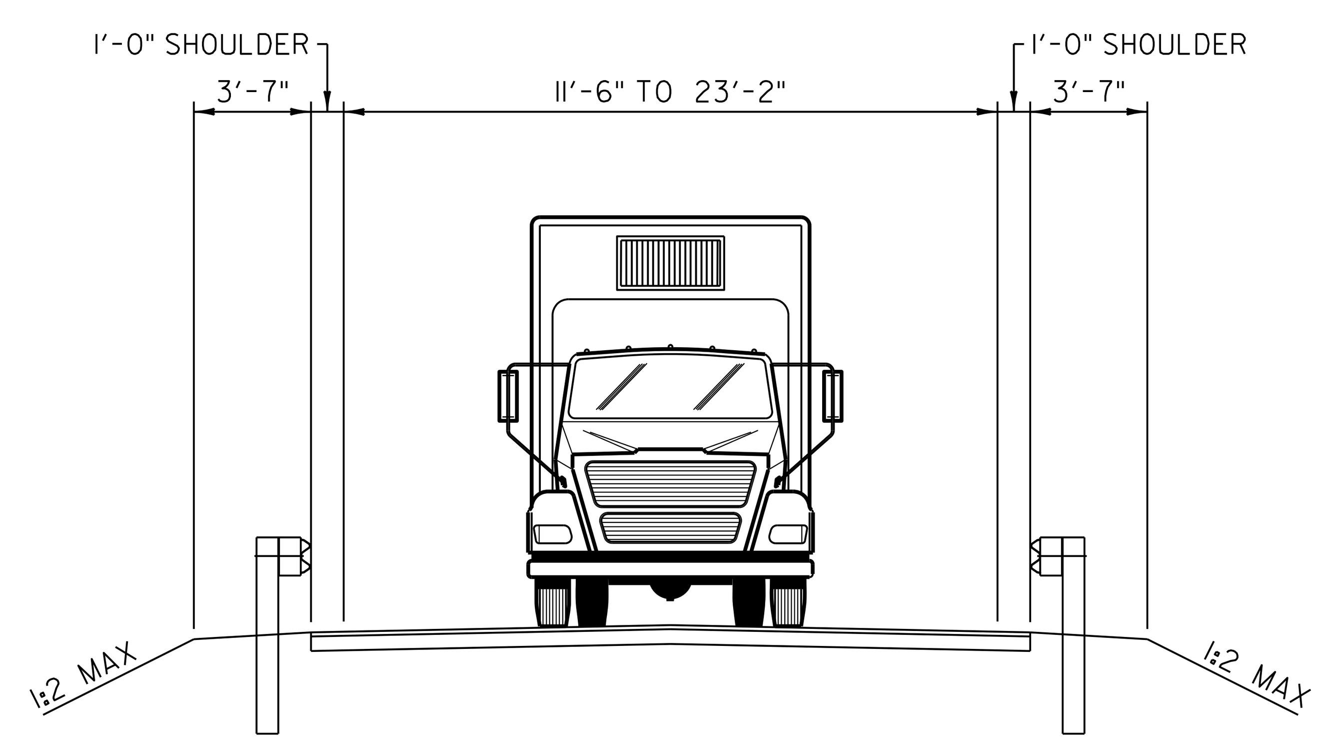
BURKE BHF 0269(13)		COMBINATION 1	COMBINATION 2	COMBINATION 3	COMBINATION 4	COMBINATION 5	COMBINATION 6
		Do Nothing	Voided Slabs on Revised Alignment with Off Site Detour (1 Integral & 1 Semi-Integral Stub Abutment)	Voided Slabs on Revised Alignment with 1-Lane Temporary Bridge (1 Integral & 1 Semi-Integral Stub Abutment)	Voided Slabs on Revised Alignment with 2-Lane Temporary Bridge (1 Integral & 1 Semi-Integral Stub Abutment)	Voided Slabs on Revised Alignment with Phased Construction (1 Integral & 1 Semi-Integral Stub Abutment)	Voided Slabs on Revised Alignment with Phased Construction (2 Sidewalks) (1 Integral & 1 Semi-Integral Stub Abutment)
COST	Roadway	$ -	$ 60,276	$ 58,990	$ 58,990	$ 84,042	$ 84,042
	Structure	$ -	$ 1,030,204	$ 1,029,327	$ 1,029,327	$ 1,335,688	$ 1,340,239
	Temporary Structure	$ -	$ -	$ 130,000	$ 170,000	$ -	$ -
	Traffic and Safety	$ -	$ 19,912	$ 48,402	$ 36,402	$ 48,402	$ 48,402
	Mobilization/Demobilization (10%)	$ -	$ 111,039	$ 126,672	$ 129,472	$ 146,813	$ 147,268
	Construction Cost	$ -	$ 1,221,431	$ 1,393,391	$ 1,424,191	$ 1,614,946	$ 1,619,952
	Design Engineering (15%)	$ -	$ 183,215	$ 209,009	$ 213,629	$ 242,242	$ 242,993
	Right-of-Way Acquisition	$ -	$ 50,000	$ 150,000	$ 150,000	$ 100,000	$ 100,000
	C.E. and permits (5%)	$ -	$ 61,072	$ 69,670	$ 71,210	$ 80,747	$ 80,998
	Contingencies (10%)	$ -	$ 122,143	$ 139,339	$ 142,419	$ 161,495	$ 161,995
	PROJECT TOTAL	$ -	$ 1,637,860	$ 1,961,409	$ 2,001,449	$ 2,199,430	$ 2,205,938
ENGINEERING	Typical Section (feet)	10.5 - 9.92	3 - 11 - 11 - 4	3 - 11 - 11 - 4	3 - 11 - 11 - 4	3 - 11 - 11 - 12.2	3 - 11 - 11 - 6.7
	Traffic Safety	No Change	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No	Yes	Yes	Yes	Yes	Yes
	Bicycle Access	No	Yes	Yes	Yes	Yes	Yes
	Hydraulic Performance	No Change	Improved	Improved	Improved	Improved	Improved
	Utility	No Change	Relocation	Relocation	Relocation	Relocation	Relocation
IMPACTS	Traffic Disruption Duration	None	4 - 6 weeks	6 months	6 months	18 months	18 months
	Agricultural	No	No	No	No	No	No
	Archaeological	No	No	Possible	Possible	Possible	Possible
	Archaeological	No	No	Possible	Possible	Possible	Possible
	Historic Structures, Sites, & Districts	No	Yes	Yes	Yes	Yes	Yes
	Hazardous Materials	No	No	No	No	No	No
	Floodplain/Floodway	No	No	No	No	No	No
	Fish & Wildlife	No	No	No	No	No	No
	Rare, Threatened & Endangered Species	No	No	No	No	No	No
	Public Lands - 4(f) Resources	No	No	Yes	Yes	Yes	Yes
	LWCF - Section 6(f)	No	No	No	No	No	No
	Noise	No	No	No	No	No	No
	Wetlands	No	No	No	No	No	No
LOCAL & REGIONAL	Addresses Concerns	Not Yet Available	Not Yet Available	Not Yet Available	Not Yet Available	Not Yet Available	Not Yet Available
	Community Character	No	No	No	No	No	No
	Economic Impacts	No	No	No	No	No	No
	Conformance to Regional Impact Plan	No	No	Yes	Yes	Yes	Yes
	Satisfies Purpose & Need Statements	No	No	Yes	Yes	Yes	Yes
PERMITS	Act 250	No	No	No	No	No	No
	401 Water Quality Certification	No	Yes	Yes	Yes	Yes	Yes
	404 US Army COE Permit	No	Yes	Yes	Yes	Yes	Yes
	Stream Alteration	No	Yes	Yes	Yes	Yes	Yes
	Conditional Use Determination	No	No	No	No	No	No
	Stormwater Discharge	No	No	No	No	No	No
	Lakes & Ponds	No	No	No	No	No	No
	T & E Species	No	No	No	No	No	No
	SHPO	No	Yes	Yes	Yes	Yes	Yes
	NEPA Categorical Exclusion	No	Yes	Yes	Yes	Yes	Yes
OTHER	ROW Acquisition	No	Yes	Yes	Yes	Yes	Yes
	Road Closure	No	Yes	No	No	No	No

IX. CONCLUSION

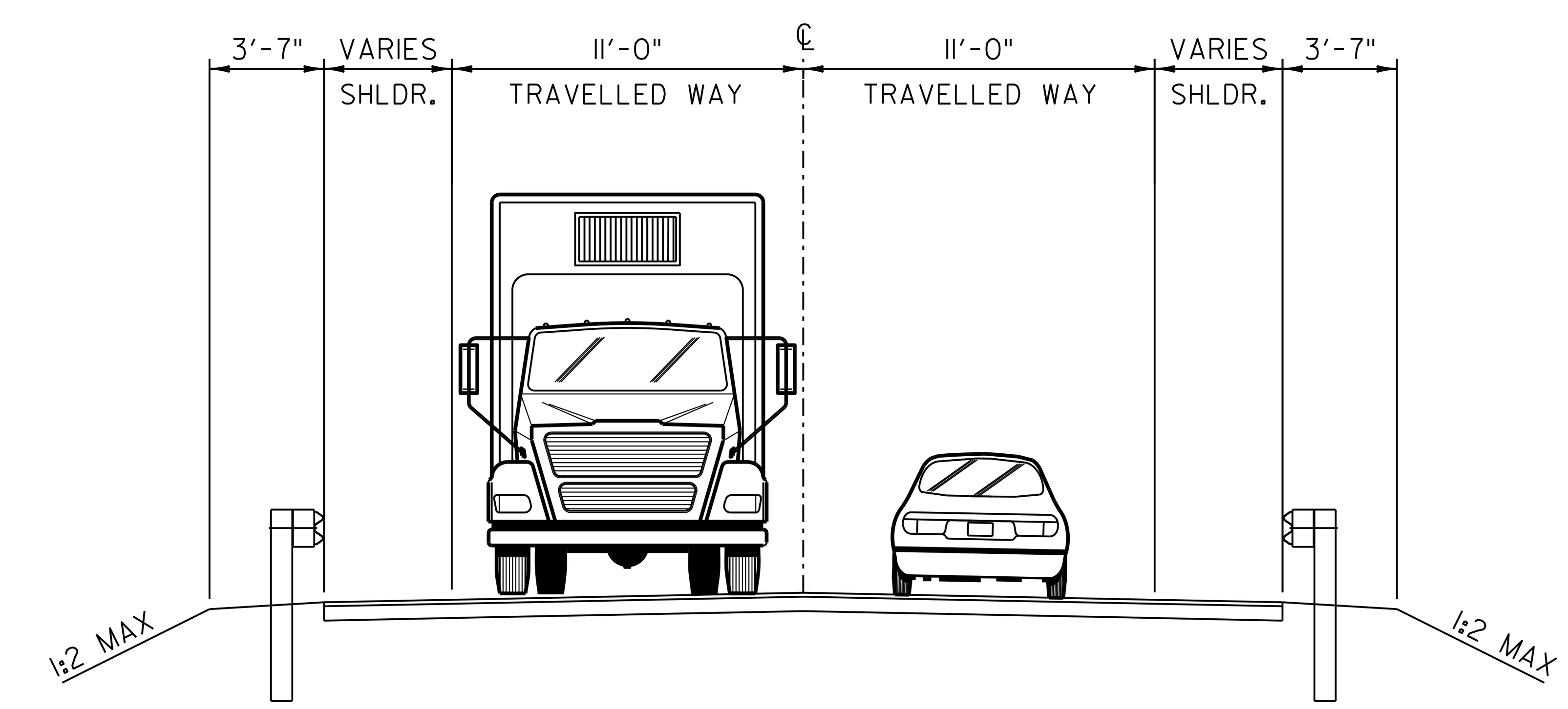
Upon reviewing the proposed alternatives and options with respect to the purpose and need, cost-effectiveness, and all impacts, CLD recommends constructing the 15-inch voided slab structure with 5-inch composite cast-in-place overlay on one integral abutment for the west abutment and one semi-integral stub abutment for the east abutment on the revised alignment utilizing a two-way temporary bridge with pedestrian sidewalk. This option would require two full construction seasons to construct, including the construction and deconstruction of the temporary bridge, with traffic disruptions occurring over a 6-month period.



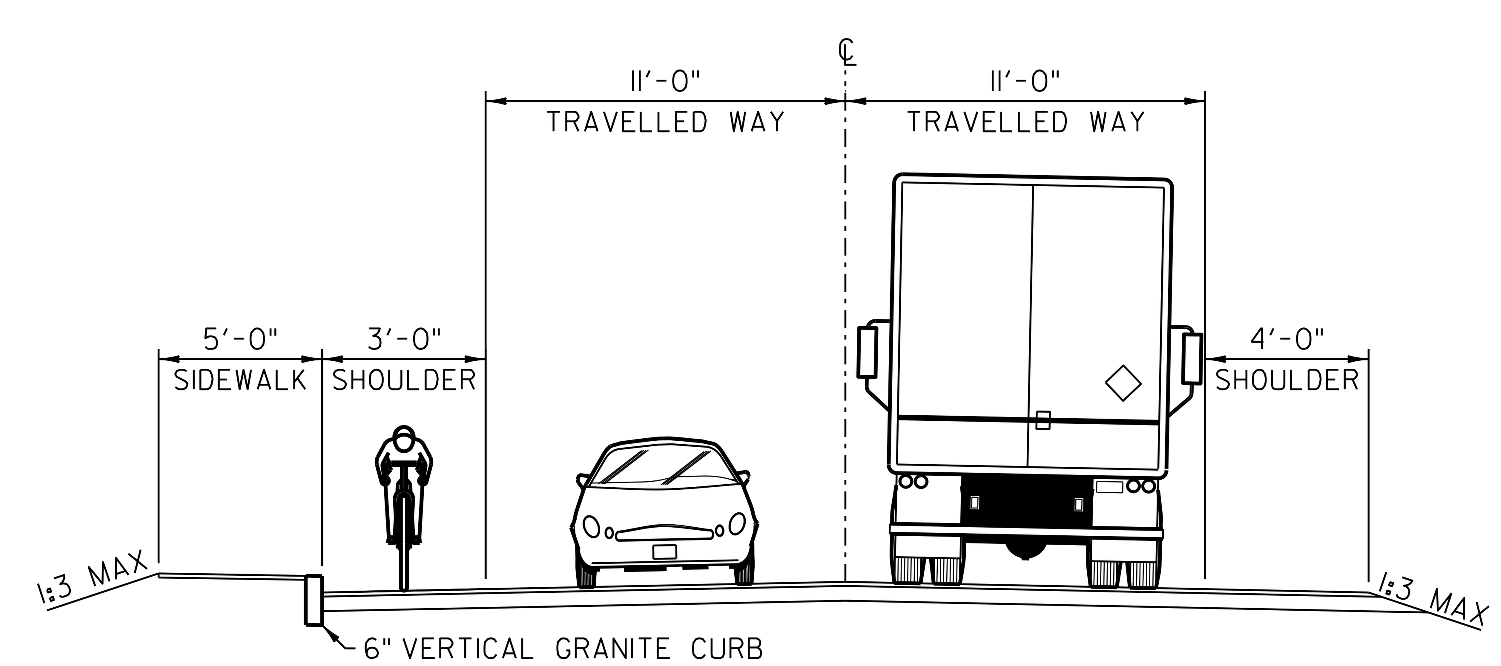
VT ROUTE 114
EXISTING TYPICAL APPROACH ROADWAY SECTION



TYPICAL DETOUR ROADWAY SECTION
ALTERNATING ONE-WAY TRAFFIC



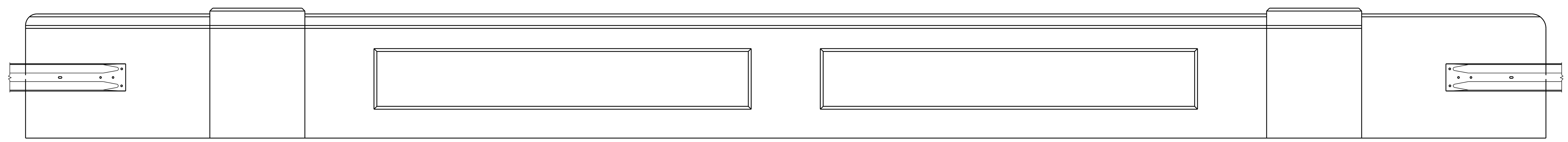
TYPICAL DETOUR ROADWAY SECTION
TWO-WAY ROAD



VT ROUTE 114
PROPOSED TYPICAL APPROACH ROADWAY SECTION

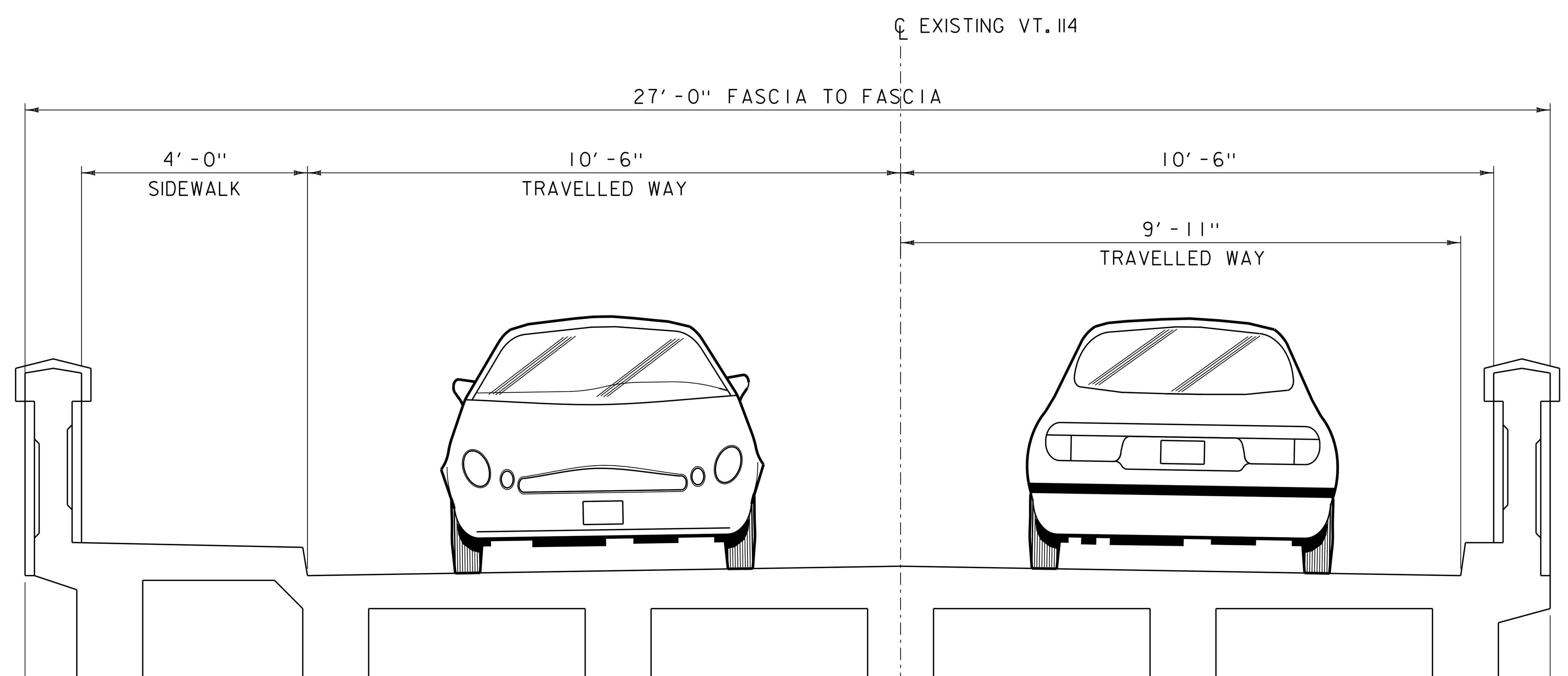
PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_typ.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: SNG
DESIGNED BY: MFH	CHECKED BY: PTS
ROADWAY TYPICAL SECTIONS	SHEET 1 OF 9

MODEL: Default
z10c412s_typ.dgn
CLD 12-0121



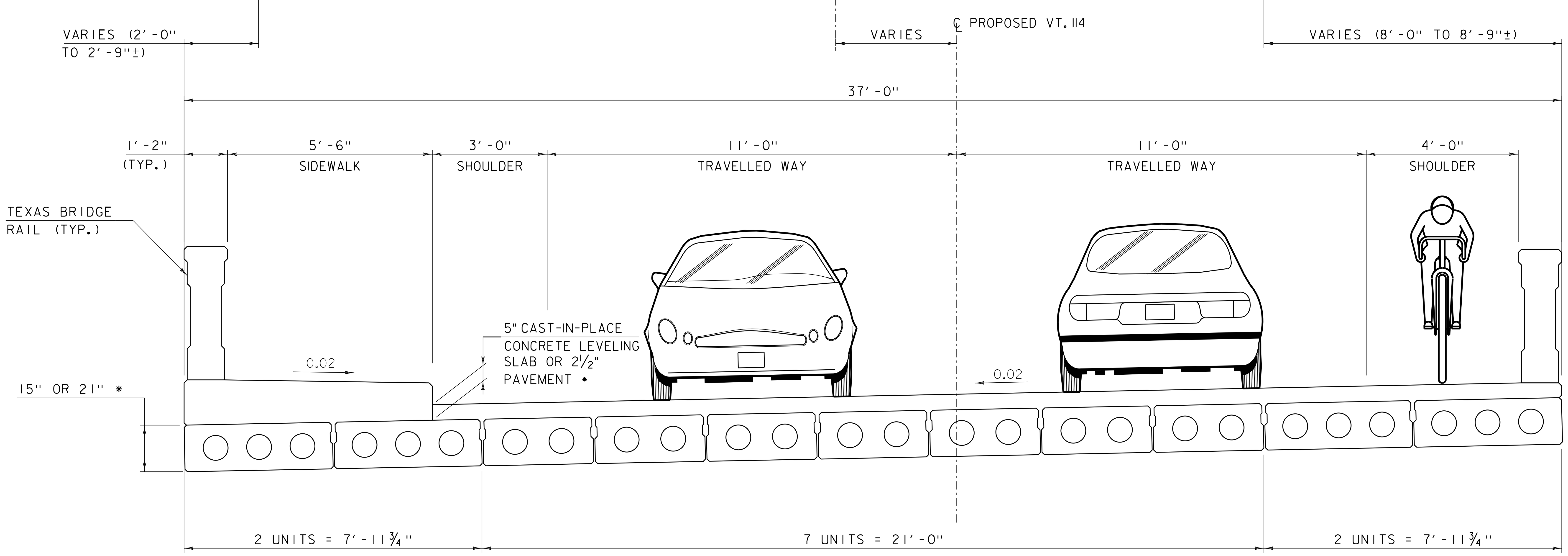
ROADWAY ELEVATION OF TEXAS BRIDGE RAIL

SCALE: 1/2" = 1'-0"



TYPICAL EXISTING BRIDGE SECTION

SCALE: 1/2" = 1'-0"



PROPOSED BRIDGE SECTION

SCALE: 1/2" = 1'-0"

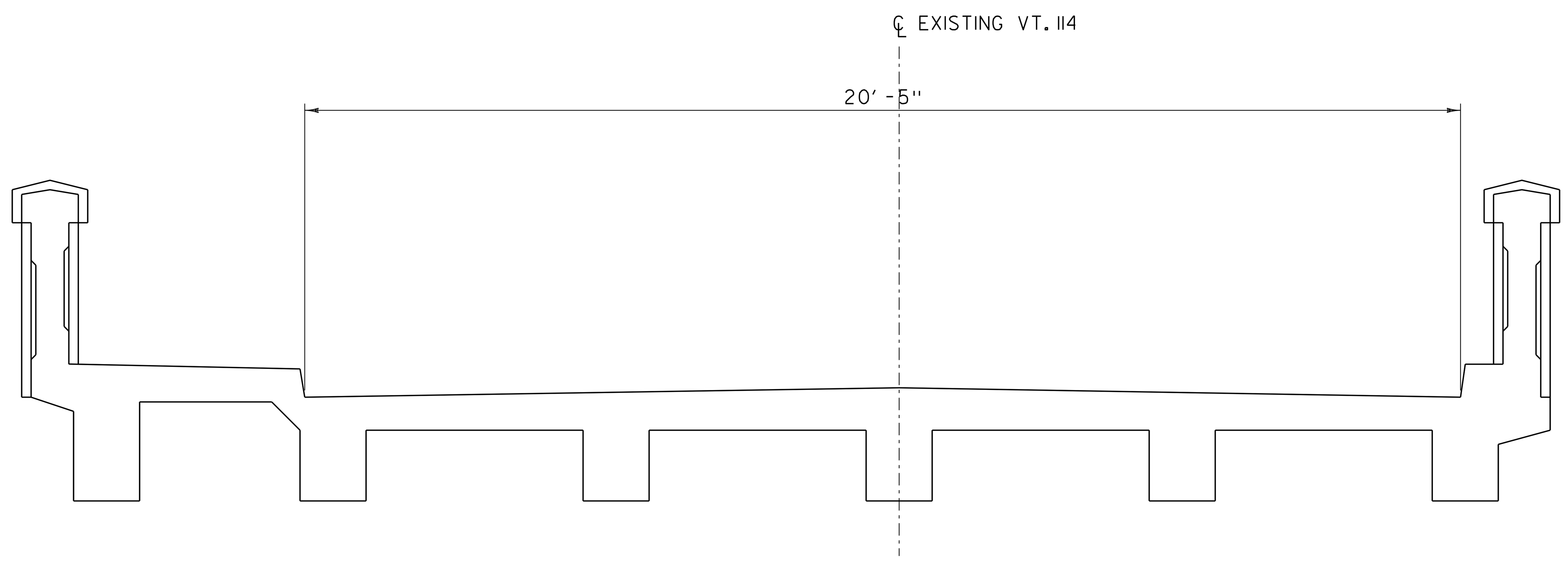
* ALL OPTIONS EXCEPT OFF-SITE DETOUR ASSUME 15" VOIDED SLABS W/ 5" C.I.P LEVELING SLAB.
OFF-SITE DETOUR OPTION ASSUMES 21" VOIDED SLABS WITH 2½" PAVEMENT.

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_sup.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: MWS
DESIGNED BY: SRB	CHECKED BY: JPB
BRIDGE TYPICAL SECTIONS	SHEET 2 OF 9

MODEL: IDeck Section - Detoured

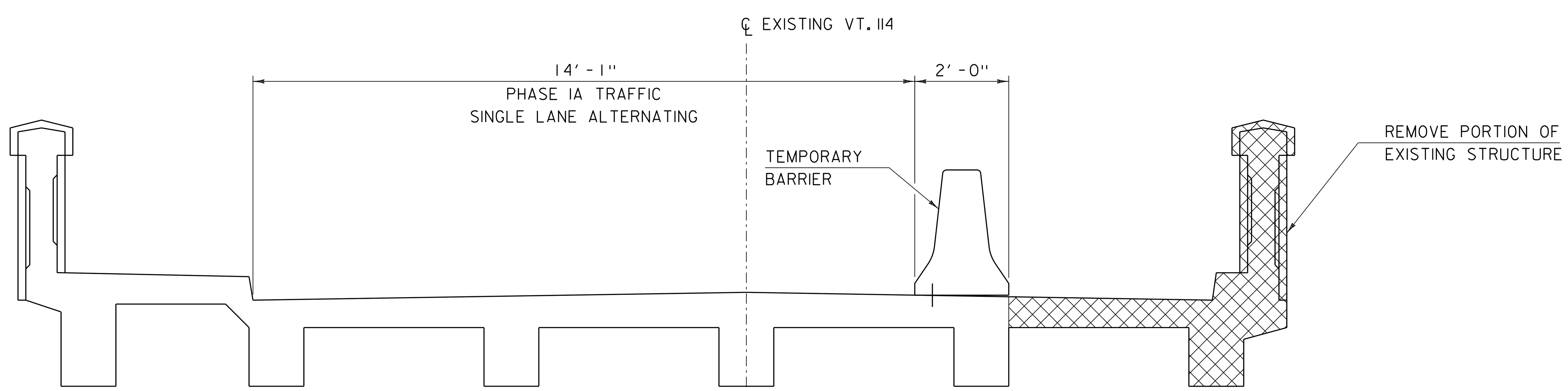
z10c412s_sup.dgn

CLD 12-0121



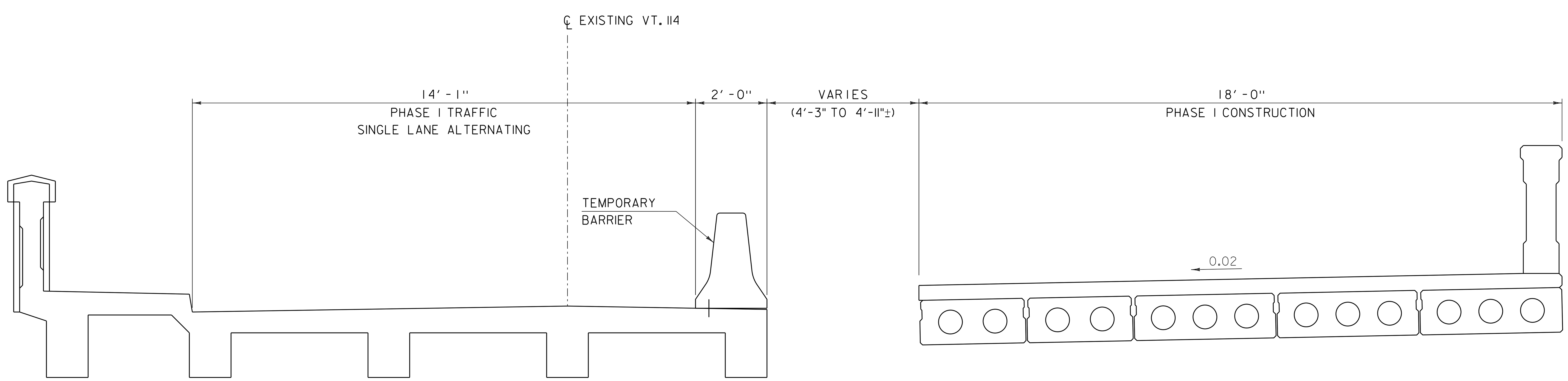
TYPICAL EXISTING BRIDGE SECTION

SCALE: ½" = 1'-0"



PHASE 1A

SCALE: ½" = 1'-0"



PHASE 1

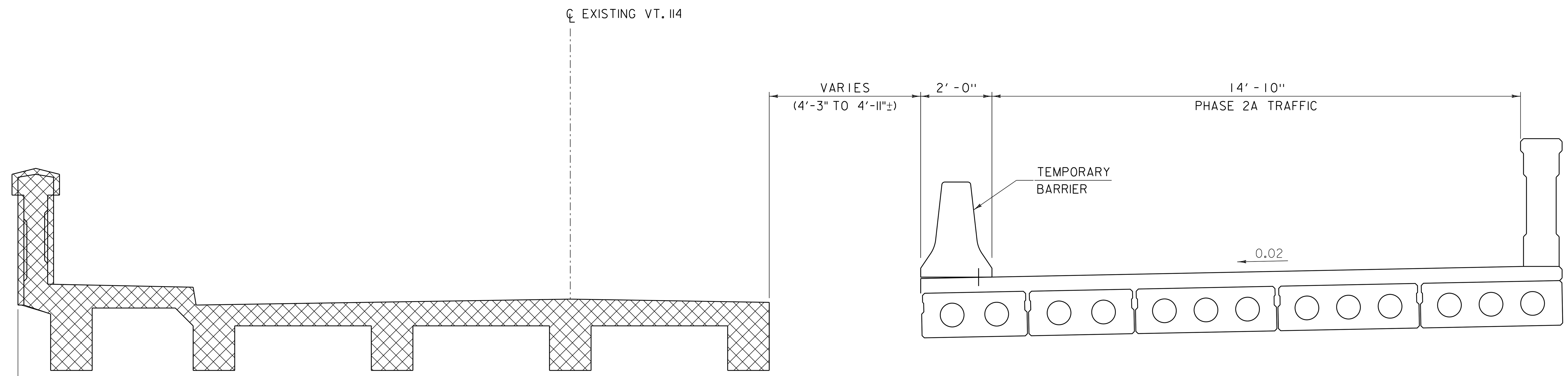
SCALE: ½" = 1'-0"

MODEL: 2 Phasing Sheet 1

z10c412s_sup.dgn

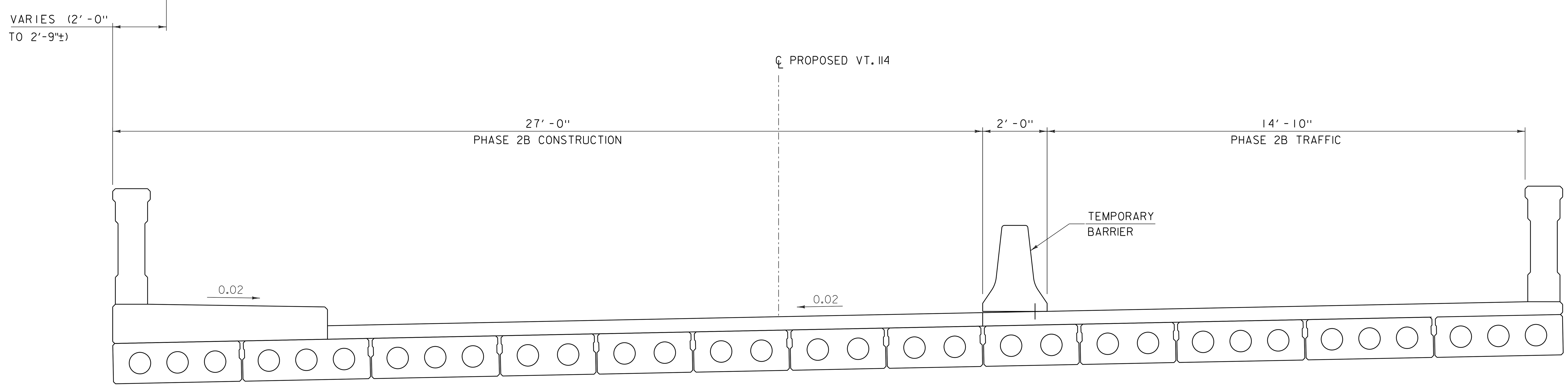
CLD 12-0121

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_sup.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: MWS
DESIGNED BY: SRB	CHECKED BY: JPB
PHASING SECTIONS (1 OF 2)	SHEET 3 OF 9



PHASE 2A

SCALE: 1/2" = 1'-0"



PHASE 2B

SCALE: 1/2" = 1'-0"

MODEL: 3 Phasing Sheet 2

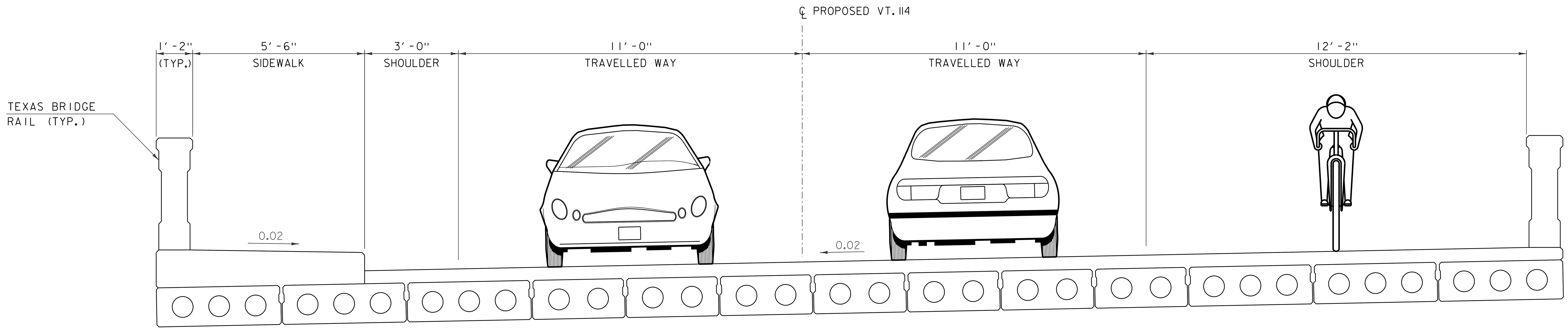
z10c412s_sup.dgn

CLD 12-0121

PROJECT NAME: BURKE

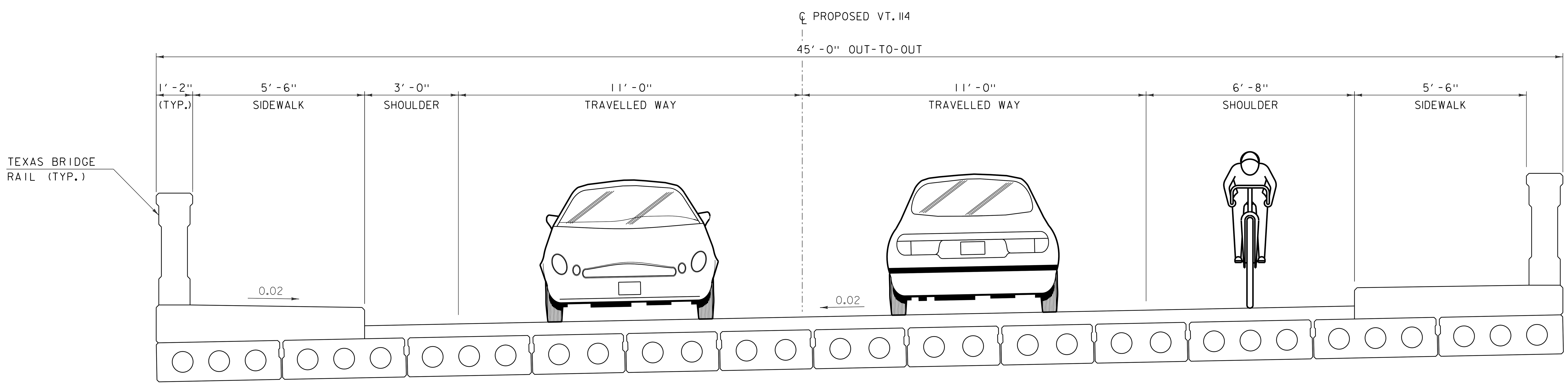
PROJECT NUMBER: BHF 0269(13)

FILE NAME: z10c412s_sup.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: MWS
DESIGNED BY: SRB	CHECKED BY: JPB
PHASING SECTIONS (2 OF 2)	SHEET 4 OF 9



PROPOSED STRUCTURE - OPTION 1

SCALE: $\frac{1}{2}$" = 1'-0"



PROPOSED STRUCTURE - OPTION 2 (WITH SIDEWALK)

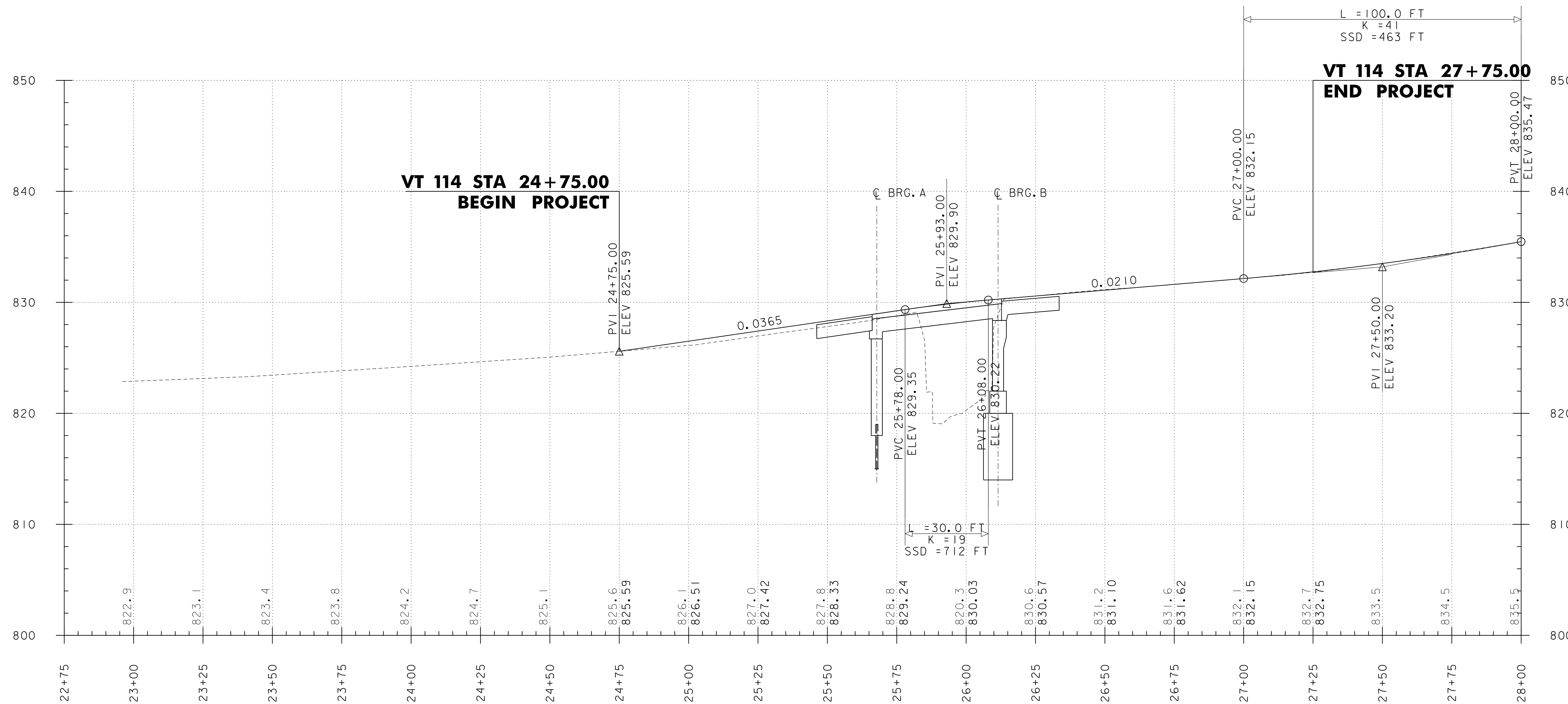
SCALE: $\frac{1}{2}$" = 1'-0"

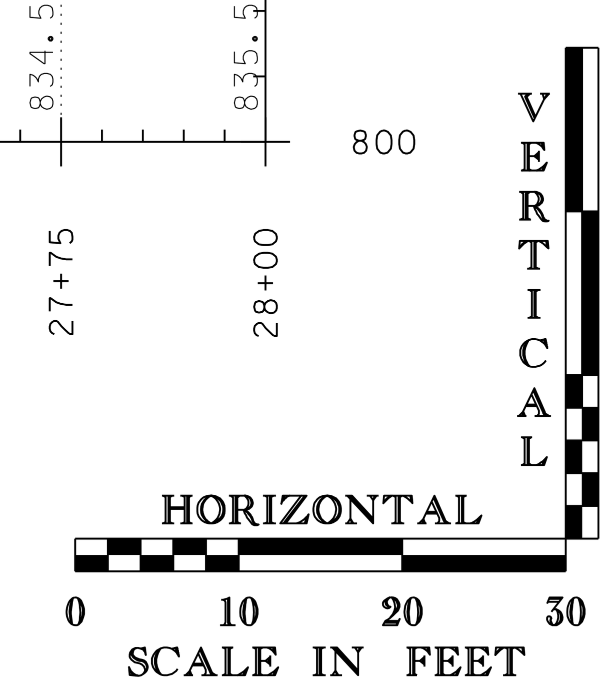
MODEL: 4 Deck Section - Phased

z10c412s_sup.dgn

CLD 12-0121

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_sup.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: MWS
DESIGNED BY: SRB	CHECKED BY: JPB
PHASED BRIDGE TYPICAL SECTIONS	SHEET 5 OF 9





VT 114 PROPOSED PROFILE

NOTE:
GRADES SHOWN TO THE NEAREST TENTH ARE EXISTING GROUND ALONG ℄.

GRADES SHOWN TO THE NEAREST HUNDREDTH ARE FINISHED GRADE ALONG ℄.

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: zl0c412s_pro.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: MWS
DESIGNED BY: PTS	CHECKED BY: JPB
PROFILE	SHEET 6 OF 9

MODEL: Default

zl0c412s_pro.dgn

CLD 12-0121

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

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_tempoption.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: SNG
DESIGNED BY: MFH	CHECKED BY: PTS
PROPOSED & TEMPORARY ONE-WAY BRIDGE	SHEET 7 OF 9

MODEL: Default
z10c412s_tempoption.dgn
CLD 12-0121

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

PROJECT NAME: BURKE	
PROJECT NUMBER: BHF 0269(13)	
FILE NAME: z10c412s_2lanedetour.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: SNG
DESIGNED BY: MFH	CHECKED BY: PTS
TEMPORARY TWO-WAY BRIDGE LAYOUT	SHEET 7A OF 9

MODEL: WB62-FINAL
z10c412s_2lanedetour.dgn
CLD 12-0121

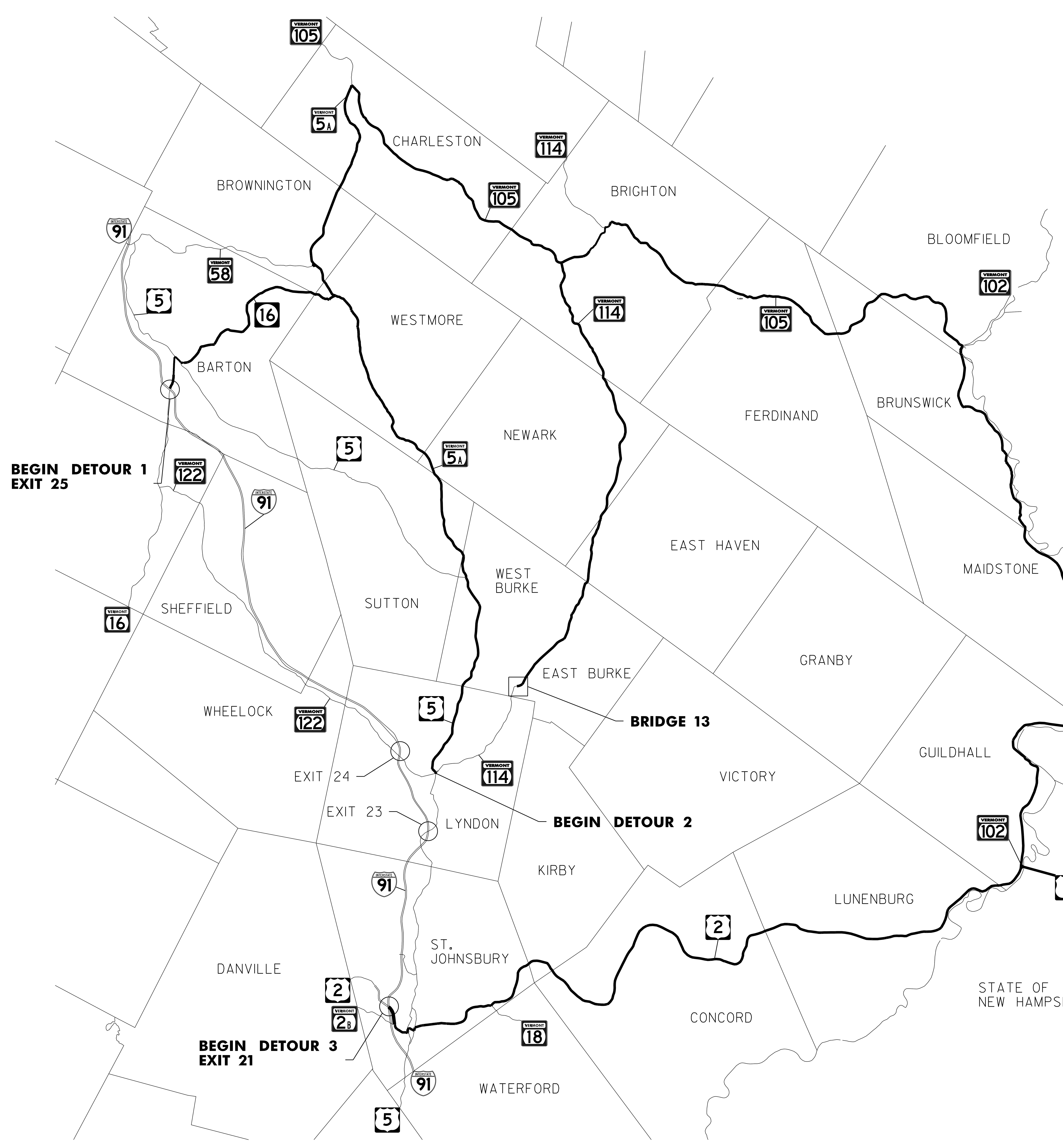
PROJECT NAME: BURKE

PROJECT NUMBER: BHF 0269(13)

FILE NAME: z10c412s_phasedoption.dgn
PROJECT LEADER: R.S. YOUNG
DESIGNED BY: MFH
PHASED BRIDGE LAYOUT

PLOT DATE: 11/30/2012
DRAWN BY: SNG
CHECKED BY: PTS
SHEET 8 OF 9

MODEL: Default
z10c412s_phasedoption.dgn
CLD 12-0121



DISTANCES

DETOUR 1

EXIT 25 TO JUNCTION OF US 5 & VT 16:	1.2 MI
JUNCTION OF US 5 & VT 16 TO JUNCTION OF VT 5A & VT 16:	7.1 MI
JUNCTION OF VT 5A & VT 16 TO JUNCTION OF VT 5A & VT 105:	8.1 MI
JUNCTION OF VT 5A & VT 105 TO JUNCTION OF VT 105 & VT 114:	10.1 MI
VT 114 TO BRIDGE 13:	16.3 MI
EXIT 25 TO BRIDGE 13 VIA VT 16:	42.8 MI
EXIT 25 TO BRIDGE 13 WITH NO DETOUR:	22.5 MI
EXTRA MILEAGE REQUIRED BY DETOUR:	20.3 MI

DETOUR 2

JUNCTION OF US 5, VT 114 & VT 122 TO JUNCTION OF US 5 & VT 5A:	7.3 MI
JUNCTION OF US 5 & VT 5A TO JUNCTION OF VT 5A & VT 105:	19.4 MI
JUNCTION OF VT 5A & VT 105 TO JUNCTION OF VT 105 & VT 114:	10.1 MI
VT 114 TO BRIDGE 13:	16.3 MI
JCT. US 5, VT 114 & VT 122 TO BRIDGE 13 VIA VT 5A:	53.1 MI
JCT. US 5, VT 114 & VT 122 TO BRIDGE 13 WITH NO DETOUR:	4.6 MI
EXTRA MILEAGE REQUIRED BY DETOUR:	48.5 MI

DETOUR 3

EXIT 21 TO VT 102 VIA US 2:	28.6 MI
VT 102 TO JUNCTION OF VT 102 & VT 105:	22.9 MI
JUNCTION OF VT 102 & VT 105 TO JUNCTION OF VT 105 & VT 114:	18.2 MI
VT 114 TO BRIDGE 13:	16.3 MI
EXIT 21 TO BRIDGE 13 VIA US 2:	86.0 MI
EXIT 21 TO BRIDGE 13 WITH NO DETOUR:	13.3 MI
EXTRA MILEAGE REQUIRED BY DETOUR:	72.7 MI

LOCAL DETOUR 1

JCT. OF VT 114 & BELDEN HILL RD TO JCT. OF BELDEN HILL RD & MAPLE LN:	0.20 MI
JCT. OF BELDEN HILL RD & MAPLE LN TO JCT. OF MAPLE LN & KIRBY RD:	0.20 MI
JCT. OF MAPLE LN & KIRBY RD TO JCT. OF KIRBY RD & MOUNTAIN RD:	0.04 MI
JCT. OF KIRBY RD & MOUNTAIN RD TO JCT. OF MOUNTAIN RD & VT 114:	0.08 MI
JCT. VT 114 & BELDEN HILL RD TO JCT. VT 114 & MOUNTAIN RD VIA DETOUR:	0.52 MI
JCT. VT 114 & BELDEN HILL RD TO JCT. VT 114 & MOUNTAIN RD WITH NO DETOUR:	0.20 MI
EXTRA MILEAGE REQUIRED BY DETOUR:	0.32 MI

LOCAL DETOUR 2

JCT. OF VT 114 & EAST DARLING HILL RD TO JCT. OF EAST DARLING HILL RD & BURKE HOLLOW RD:	0.07 MI
JCT. OF EAST DARLING HILL RD & BURKE HOLLOW RD TO JCT. OF BURKE HOLLOW RD & BURKE GREEN RD:	2.00 MI
JCT. OF BURKE HOLLOW RD & BURKE GREEN RD TO JCT. OF BURKE GREEN RD & WHITE SCHOOL RD:	0.40 MI
JCT. OF BURKE GREEN RD & WHITE SCHOOL RD TO JCT. OF WHITE SCHOOL RD & VT 114:	1.40 MI
JCT. VT 114 & EAST DARLING HILL RD TO JCT. WHITE SCHOOL RD & VT 114 VIA DETOUR:	3.87 MI
JCT. VT 114 & EAST DARLING HILL RD TO JCT. WHITE SCHOOL RD & VT 114 WITH NO DETOUR:	2.20 MI
EXTRA MILEAGE REQUIRED BY DETOUR:	1.67 MI

PROJECT NAME: BURKE
PROJECT NUMBER: BHF 0269(13)

FILE NAME: zl0c4l2s_detour.dgn	PLOT DATE: 11/30/2012
PROJECT LEADER: R.S. YOUNG	DRAWN BY: SNG
DESIGNED BY: MFH	CHECKED BY: PTS
REGIONAL DETOUR ROUTE	SHEET 9 OF 9

MODEL: Default
zl0c4l2s_detour.dgn
CLD 12-0121