November 18, 2016

Boyds MD 117 Crossing Feasibility Evaluation

Contents

Appendices

Background

The Montgomery County Planning Department, in coordination with the Maryland State Highway Administration (SHA) and Montgomery County Department of Transportation (DOT), requested a feasibility analysis for a new roadway crossing of MD 117 (Barnesville Road/Clopper Road) over the CSX railroad line in Boyds, MD. The purpose of this analysis is to identify planning level concepts and cost estimates associated with the feasibility of constructing a new grade separated roadway connection over or under the railroad. This report summarizes the findings of the analysis.

Existing Site Conditions

As described in the Maryland Area Regional Commuter (MARC) Rail Communities Plan Scope of Work, Boyds, MD is a small, rural unincorporated town with a population of approximately 2,000 people according to the 2013 American Communities Survey. The community consists primarily of single-family homes on large lots on the eastern edge of the County's Agricultural Reserve. The town is located between two larger communities, Clarksburg to the north and Germantown to the east.

The heart of Boyds is centered on its MARC rail station and small commercial area west of the intersections of Barnesville Road, Clarksburg Road and Clopper Road. Little Seneca Lake, a man-made lake serving as a backup drinking water supply within the Black Hill Regional Park, is a defining feature of the area roughly 450ft northeast of the existing crossing. A well-preserved and cohesive historic district is located on both sides of the MARC station platform and extends down White Ground Road south of the MARC station. The Boyds Local Park is another important feature within the community. The entire area is located outside of the municipal sewer envelope, so it is served by private well and septic

MCDOT is currently evaluating alternatives to provide bus pull-offs in both directions on Clopper Road to connect MARC passengers from the northwestern part of the county to the Boyds station. This would be a new existing condition by the time the crossing moves forward into preliminary design. This could potentially include the addition of sidewalks or other pedestrian connections to the existing MARC station. The bus pull-offs may be considered an interim condition that will be impacted by alternative alignments options for Route 117 or alternative MARC station locations.

Figure 1: Boyds, MD Location Map

Existing Railroad Track & Bridge Structure

The existing rail line consists of two tracks on tangent alignment running east-west through the project area with a single span bridge spanning MD 117. The tracks carry freight, Amtrak passenger, and MARC passenger rail service, and are owned by CSX Transportation. As an active railroad in use daily, any significant impacts to existing rail traffic during construction is undesirable.

The structure consists of a single-span steel superstructure supported on reinforced concrete abutments that are assumed to be founded on spread footings. The bridge is perpendicular to the roadway with no apparent skew. The existing structure provides approximately 13 ft. of vertical clearance for the roadway passing under the railroad (field verification of clearance was not conducted). A bridge inspection or load rating was not included as part of this feasibility analysis.

The population increase in this area has also resulted in the Countywide Transit Corridors Functional Master Plan recommending an additional 25 feet of horizontal clearance allowance be considered between the Frederick County line and Metropolitan Grove to accommodate a future third track north of the two existing tracks. The ability to accommodate three tracks is to be accounted for in the feasibility analysis.

As Clarksburg and Cabin Branch continue to see population increases there will be a growing need to understand the feasibility of road and rail improvements in this area with additional users anticipated on both networks.

Figure 2: MARC Station Platform (looking west)

Approach Roadway

MD 117 is a two lane highway that runs along a generally east-west alignment through Boyds and crosses under the CSX railroad tracks just east of the Boyds MARC rail station. MD 117 is named Barnesville Road on the north side of the CSX railroad tracks and Clopper Road on the south side of the rail tracks. Barnesville Road intersects Clopper Road and White Ground Road at an all-way stop controlled T-intersection on the south side of the rail crossing. An existing driveway along the north side of the tracks accesses the Winderbourne Mansion, a Victorian home within the historic district, and the WSSC for the dam. MD 117 intersects MD 121 (Clarksburg Road) just north of the rail bridge crossing. A 30 mile per hour posted speed limit is provided on MD 117 through the project area. MD 117 is considered a significant commuter route for residents in the Clarksburg area traveling toward central Montgomery County, North Virginia, or other District of Columbia, and the annual average daily traffic (AADT) volume on MD 117 is 7,682 vehicles per day, per information provided by the Maryland SHA count database.

Figure 3: MD 117/ Clarksburg Road Intersection (looking west)

Figure 4: MD 117 Approaching Rail Bridge (looking south)

Operational deficiencies exist on MD 117 from MD 121 south past the CSX railroad tracks to Clopper Road. The Boyds Civic Association has noted traffic delay issues on MD 117 and MD 121 in the vicinity of the railroad bridge during both the weekday morning and evening peak periods. The geometric constraints of the site, including the short distance between the two roadways and the inability to widen MD 117 under the narrow railroad bridge has limited the improvements available in the area. The limited roadway width and proximity of the rail bridge to the Barnesville Road/Clopper Road intersection results in sight distance limitations for vehicles approaching the intersection. The Boyds Historic District would also be impacted if Clopper Road were to be widened with a longer railroad bridge or realigned south of the CSX tracks to accommodate a larger signalized intersection or roundabout to improve traffic control efficiency.

The Maryland SHA has conducted a traffic operations study and identified issues associated with the all-way stop controlled MD 117/MD 121/White Ground Road intersection. The study notes congestion and queuing stemming from the intersection and recommends a traffic signal with vehicle detection at this location to minimize operational issues. In June 2015, the Maryland SHA District 3 Traffic Engineer submitted a Design Request package to signalize the intersection.

Utilities within the Bridge Site

There are aerial utilities along the north and south side of Clopper Road through the project area as well as under the bridge and mounted to the top of the east abutment, just under the concrete slab. No ground surveyor bridge inspection was completed to identify utilities as part of this study, however there is an existing drainage structure located on the south side of the current underpass on the south side of roadway.

Hazardous Materials

Hazardous materials, consistent with those found in the vicinity of former and active railways, are anticipated in the excavated soils near and within the right-of-way and should be treated as such. The most common contaminants are metals, pesticides (such as lead arsenate), petro-chemicals and creosote from existing crossties.

Planned Roadway and Railroad Cross Section

The proposed railroad typical section will follow the existing horizontal alignment with the same cross section as existing along with an additional 25-foot width to the north for a potential future third track.

The proposed MD 117 roadway alignment varies based on the alternatives discussed below for both horizontal alignment and vertical profile. Both alternatives will be required to accommodate the future widening of the roadway.

Montgomery County Planning staff identified the MCDOT roadway design standard for a Rural Minor Arterial Road (MC-2004.33) as an appropriate design reference for MD 117 in the study area. The proposed roadway cross section used for the feasibility evaluation assumes a total width of 44′-0″ including two 12′-0″ travel lanes and two 5′-0″ shoulders, as defined in the Rural Minor Arterial Standard. Additionally, two 5′-0″ sidewalks are shown in the roadway cross-section for the feasibility evaluation and assumed in cost estimating purposes. The sidewalk is intended to support overall pedestrian connectivity across the rail tracks, as could specifically support future rail passenger movements between north and south side station platforms for facilities.

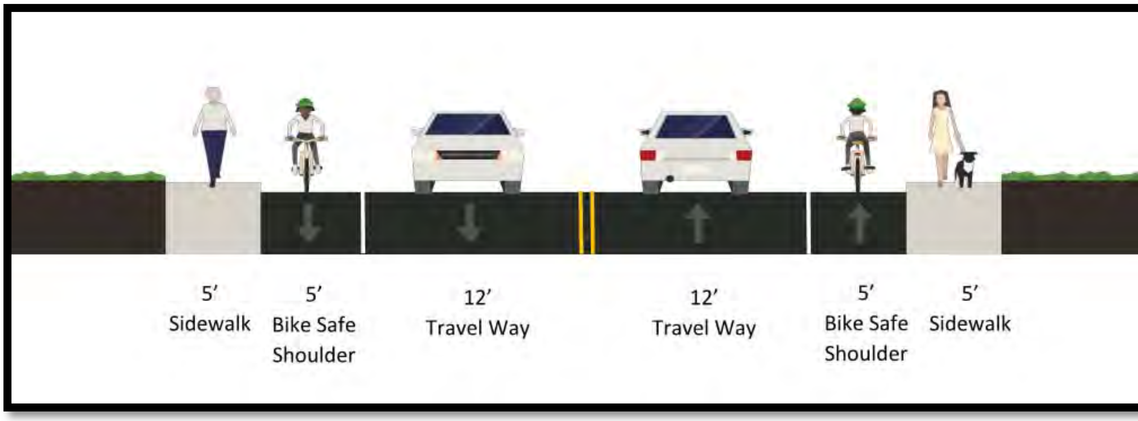


Figure 5: Typical Roadway Section

Alternative Identification

There are two basic alternatives for a new railroad crossing for MD 117 at Boyds:

- Alternative 1 – New Roadway Bridge over Railroad
- Alternative 2 – New Railroad Bridge over Re-aligned MD 117

Each of the above alternatives are discussed further below and each has a number of variations to consider based on the desired alignments, impacts, costs, and constructability, while maintaining a 30MPH speed limit. All recommendations will need to be further investigated during preliminary design, including the bridge type and constructability of the project.

Alternative 1

This alternative retains the existing railroad bridge, re-routes MD 117 along an alignment to the east of MD 121, and constructs a new MD 117 roadway bridge over the railroad. An approximately 500-foot long section of existing Clopper Road, along the northern boundary of the Local Boyds Park, would be converted to a cul-de-sac with driveway to the Local Boyds Park and a private entrance for a private property owner on the south side of the street. This alternative includes a 3-way stop for local traffic at the intersection of MD 121, White Ground Road, and Clopper Road. Traffic volume data provided by the Maryland SHA suggests that all-way Stop control is likely to provide adequate traffic operations at the Barnesville Road (MD 117)/Clarksburg Road (MD 121) intersection. A roundabout is an alternative intersection configuration option, or a traffic signal may be considered for the intersection subsequent to separate evaluation of traffic operations and traffic signal warrants contained in the Manual on Uniform Traffic Control Devices (MUTCD).

The conceptual design for Alternative 1 considered the following primary project constraints:

- Minimize impacts to MD 117 vertical profile

- Provide a vertical clearance sufficient for the requirements of the railroad corridor, including a planned third track
- Maintain two lanes of traffic on MD 117 in each direction
- Maintain freight and passenger railroad traffic
- Accommodate the private/reservoir access road to be realignment beneath the bridge
- Accommodate a skewed bridge alignment for the crossing

A single-span bridge was the only span configuration considered as multiple spans are not practical or required for this length of crossing. This alternative would locate the face of the south abutment a sufficient distance away from the southern track to accommodate a pedestrian walkway from the west side of the new MD 117 roadway to the east side along the face of abutment. This would be a fenced multi-use path providing access from Clopper Road to a potential future MARC station on the east side of MD 117. This span configuration would result in a span length of 250 feet along the 40° skew.

The anticipated bridge structure depth and top of deck elevation that sets the roadway profile will be as required for the HL-93 loading and minimum 23 feet of railroad vertical clearance. This assumes there will be no lowering of the existing track profiles in conjunction with this project. If CSX representative indicate the existing track profiles can be lowered, additional cost savings may be realized by subsequently lowering the bridge and roadway embankments. However, the track work would then be increased significantly to not only lower the grade at the bridge but also to transition a newly depressed profile back to existing grades on the rail approaches. This could also impact the current MARC station platforms to the west.

Proposed Superstructure

The superstructure alternatives investigated were based on a single-span bridge configuration as noted above. Minimizing the superstructure depth will be critical to minimize the MD 117 profile raises on each approach. The following superstructure types were considered:

The proposed bridge will be designed using Load and Resistance Factor Design (LRFD) in accordance with AASHTO LRFD Bridge Design Specifications and AREMA guidelines for an HL-93 roadway vehicle.

Prestressed Concrete Box Beams – The single-span length and configuration is suited for adjacent box beams. The deck thickness would need to vary to accommodate the profile and the roadway cross-slope, increasing the overall structure depth.

Steel Girders – Steel plate girders or rolled beams are suitable for the single-span length and can easily accommodate the skew. The girders can be cambered to follow the road profile, maximizing the clearance under the bridge. Future maintenance costs will need to be taken into consideration.

Concrete Beams – concrete beams are suitable for the single-span length, however the skew exceeds the maximum recommended and the depth of girders far exceeded the steel option, therefore this option was not considered further.

Based on the span and available superstructure types considered, a single span steel girder bridge is the recommended superstructure type. A depth of structure value of four feet is assumed for conceptual planning purposes.

Proposed Substructure

Based on the assumption that the existing structure is founded on spread foundations, the proposed structure north of the rail tracks will also be supported on shallow spread foundations. This assumption will require further validation based on the subsurface exploration program as discussed above and is compatible with the superstructure types discussed above. The substructure will consist of full-height reinforced concrete abutments to minimize span length and superstructure depths. Stormwater management and drainage systems will be necessary and are included in cost estimate assumptions. It should also be noted that SHA will not allow precast substructure units if they design or own the proposed structure.

The roadway section south of the rail tracks will be constructed on retaining walls to minimize the footprint of the substructure. This design will eliminate potential impacts on private property along the south side of Clopper Road (MD 117) and maximize available land for parking between the rail tracks and Clopper Road, where the MARC station may be relocated.

To limit the construction duration and minimize impacts to the railroad operations, precast substructure elements should be considered during final design. In addition, accelerated bridge construction methods should also be considered including a short duration accelerated bridge construction closure over a weekend or a few days (i.e. self-propelled modular transporter (SPMT), heavy lift, slides, etc.).

Proposed Retaining Walls

The proposed retaining walls are assumed to be Mechanically Stabilized Earth (MSE) systems as listed on the Maryland State Highway Administration list of Approved Proprietary Retaining Walls. This assumption will require further evaluation after a subsurface exploration program is completed during the preliminary design phase. New methods and technologies for these walls as well as other slope retention continue to be developed for locations of restricted Right-of-Way, marginal subsurface conditions, and other environmental or property impact constraints and the Maryland SHA continues to update the proprietary wall list to keep abreast of these technologies.

Figure 6: MSE Retaining Wall Example

The application of MSE walls for this project appears to be well suited based on constructability and cost and the precast concrete wall panels can easily accommodate aesthetic architectural treatments such as various stone patters, colors, and textures. These flexible wall systems also are an inexpensive option for curved alignments and can easily be incorporated into the abutments at each end of the bridge. Those charged with the final planning, design, and implementation of these improvements will need to evaluate a host of options that come with these wall types and the latest technologies after the subsurface soil borings are provided and a geotechnical engineering evaluation is complete.

Accessibility

The Alternative 1 concept includes a pedestrian path passing under the planned roadway bridge, along the south side of the rail tracks, to provide a direct connection for residents in the town to the potential MARC station site. The concept also includes sidewalks along the planned MD 117 roadway alignment that will provide a connection between the potential MARC station site and the MD 121/MD 117 intersection. The sidewalks will follow the prevailing grade of the road alignment, which is addressed in ADA requirements for highway design. Additional review by county or state ADA coordinators may be desirable to evaluate the need or desirability for alternative accessible routes.

Alternative Renderings

A rendered model was created for Alternative 1 to illustrate the proposed roadway overpass in a way that is visually appealing to the client and public. The following images depict different views of the model. Slope lines shown in the renderings are conceptual and avoid known wetland boundaries, but will require further evaluation in preliminary design to minimize or eliminate potential impacts to the Little Seneca Lake wetland boundaries.

Figure 7: Alternative 1 Overview (Looking North)

Figure 8: Alternative 1 Overpass (Looking East)

Figure 9: Alternative 1 Overpass from Boyds Historic District (near 19925 White Ground Road)

Alternative 2

This alternative re-aligns MD 117 along a curved alignment and includes construction of a new railroad bridge over MD 117 east of the existing crossing. The MD 117 (Barnesville Road)/ MD 121 (Clarksburg Road) intersection will remain in the current location and continue to function as a three-leg unsignalized intersection. A roundabout could be considered an alternative configuration for this intersection. The White Ground Road/MD 117 (Clopper Road) intersection will be relocated along the planned curvature of the MD 117 alignment and the intersection will be located near the western rail bridge abutment.

Alternative 2 considers similar constraints as Alternative 1. These considerations include minimizing impacts to MD 117 vertical profile, providing sufficient roadway vertical clearance under the bridge, maintaining two lanes of traffic on MD 117 in each direction, maintaining freight and passenger railroad traffic, providing an additional railroad track width, and accommodating a moderate skew for the crossing. The roadway alignment and vertical profile comply with Montgomery County and Maryland SHA roadway standards. The proposed rail bridge abutment design will provide a significant setback from the western roadway edge to provide optimal driver sight distance for drivers turning from White Ground Road onto Route 117 at the unsignalized intersection.

The planned rail bridge will maintain the rail track elevation and Alternative 2 includes no raised structural elements above the existing railroad tracks. This concept represents a minimal potential visual impact alternative. Because the MD 117 roadway alignment is located below the existing ground elevation, the new roadway connection will not be visible from nearby residences and traffic noise may be somewhat reduced relative to Alternative 1.

A single-span bridge was again the only span configuration considered as multiple spans are not practical for this roadway configuration below the bridge. The proposed railroad bridge will be designed in accordance with AASHTO Bridge Design Specifications and AREMA guidelines for a Cooper E-80 railroad design vehicle.

The anticipated bridge structure depth and top of deck and rail elevations would be set based on maintaining existing railroad profiles and supporting a Cooper E-80 loading while establishing roadway vertical clearance. This span configuration would result in a span length of 90 feet along the railroad.

Proposed Superstructure

Minimizing the superstructure depth will again be critical to minimize the MD 117 profile sag curve under the bridge on each approach. Steel plate girders or rolled beams are most suitable for the single-span length to accommodate railroad loading and can easily accommodate the skew. The girders can be closely spaced to maximize the clearance under the bridge. Based on the span and railroad loading, a single span steel girder bridge is the recommended superstructure type.

Proposed Substructure

Based on a similar assumption from Alternative 1 that the existing structure is founded on spread foundations wherever possible, the proposed structure will also be supported on shallow spread foundations. This assumption will require validation based on the subsurface exploration program by a geotechnical engineer. The substructure will consist of full-height reinforced concrete abutments to minimize span length and superstructure depths.

Drainage structures would be added under the bridge with a lowering of the existing road surface elevations. A full drainage analysis would need to be completed during preliminary design to determine whether downstream catch basins will require modifications of if a pumping system would need to be considered. Costs for adding drainage structures and piping are included in the order-of-magnitude cost estimate that follows.

Similar to the Alternative 1 roadway bridge, an option to limit the construction duration and minimize impacts to the railroad operations would be to use as much precast substructure elements as possible. In addition, similar accelerated bridge construction methods should also be considered to incorporate a short duration accelerated bridge construction closure over a weekend or a few days. Alternatively, the railroad bridge could be constructed in two phases with one track at a time using sheet piling or soldier pile walls between phases to support excavation for the new substructures. It is not possible to construct Alternative 2 without some impacts to rail operations and detouring of traffic on a temporary basis, whether that be to push all traffic to one track and construct the bridge in phases or have a short term shutdown of all traffic and construct the bridge using accelerated bridge construction methods.

Accessibility

The Alternative 2 concept provides the opportunity for at-grade pedestrian connections between Boyds and a relocated MARC station. The concept accounts for rail bridge abutment locations that would also allow adequate right-of-way for a trail connection along the west side of Route 117 under the rail bridge. The trail would provide a potential connection between the Local Boyds Park and pedestrian/bicycle facilities north of the rail tracks.

Alternative Renderings

A rendered model was produced for the Alternative 2 concept. The following image shows and aerial level view of the Alternative 2 rail bridge and roadway realignment concept.

Figure 10: Alternative 2 Overview (Looking North)

The following set of figures provide a side-by-side comparison of the relative visual character and impacts of both alternatives. Photographs taken in the study area are provided for context regarding the locations of the visualizations.

Figure 11: View from near 15004 Clopper Road. Left: Site photo looking east at rail bridge and Clopper Road. Middle: Alternative 1 highway bridge. Right: Alternative 2 rail bridge.

Figure 12: View from near 15020 Clopper Road. Left: Site photo looking east along White Ground Road to Clopper Road. Middle: Alternative 1 highway bridge. Right: Alternative 2 rail bridge.

Figure 13: View from near 14920 Clopper Road. Left: Site photo looking west. Middle: Alternative 1 highway bridge, looking north. Right: Alternative 2 rail bridge, looking west.

Figure 14: View from Clopper Road, near gravel industrial lot, looking west toward Boyds and rail bridge. Left: Site photo looking west. Middle: Alternative 1 highway bridge, looking west. Right: Alternative 2, looking west.

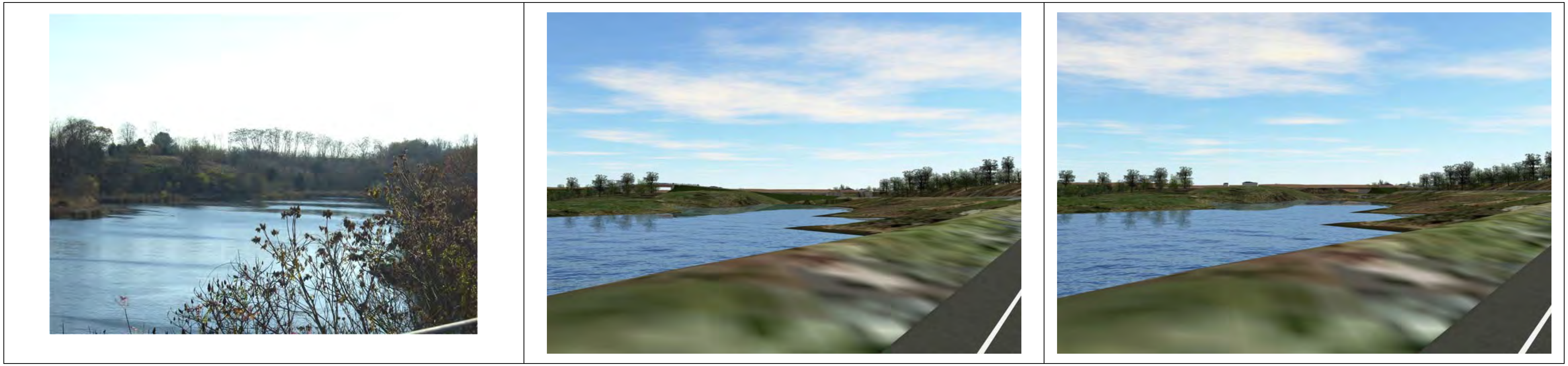


Figure 15: View from Clarksburg Road (MD 121), looking south across reservoir. Left: Site photo looking south. Middle: Alternative 1 highway bridge, looking south. Right: Alternative 2, looking south.

Figure 16: View from Barnesville Road (MD 117), looking east. Left: Site photo looking east. Middle: Alternative 1 highway bridge, looking east. Right: Alternative 2, looking east.

Roadway and Railroad Traffic Management

The viability of any modified MD 117 rail crossing must provide for construction sequencing that allows existing freight and passenger rail operations to be maintained throughout the majority of construction. Any short-term temporary railroad closures or the establishment of available work windows between train schedules will require close coordination and prior approval of the railroad. One of the primary constraints is to maintain rail traffic during construction although a determination of whether rail traffic can be maintained on one of the two tracks (instead of two in full time use) should be considered as this could significantly impact construction costs. The first alternative evaluated show impacts to the rail operations but not to the degree as the second, which will have a significant advantage when considering constructability and the railroad requirements.

Construction of a new bridge will not require phased construction as the limits of disturbance for each alternative maintain adequate separation from existing traffic crossing the rail lines. During construction, the current two lanes of roadway travel will be maintained in both directions at all times, albeit with reduced lane and shoulder widths likely at times and short-term lane closures with flaggers.

The following anticipated sequence of construction is assumed for the feasibility evaluation:

- Phase One: Relocate MD 117 traffic and rail traffic to any temporary alignments or combined track usage respectively. Construction of the bridge will take place in the work area outside of the existing roadway alignments as much as possible. Depending on the Railroad Agreement and selected alternative, there may or may not be a shift in rail traffic to a single track to reduce construction costs through providing a contractor with additional work space.
- Phase Two: Roadway traffic will have a series of temporary alignment shifts as the roadway approaches to the new bridge are constructed. Once these approaches are in place, one or both lanes of traffic can be moved onto the newly constructed roadway and remaining approach work completed. Similar to Phase 1 and also dependent on the selected alternative, there may be multiple switching of tracks for freight and passenger rail traffic to facilitate construction.
- Phase Three: Final grading, existing roadway and bridge removal, and any railroad temporary impacts will be restored to original conditions.

Clearances

The horizontal and vertical clearances for the proposed bridge structure will be in accordance with MARC and AREMA requirements, as applicable. A minimum 23'0" vertical railroad clearance from the top of rail for the proposed track profile to low beam elevation was used for the bridge over railroad alternative (Alternative 1). A minimum vertical clearance of 14’-6” was used for the roadway under the railroad bridge alternative (Alternative 2) based on minor arterial roadway standards.

Geotechnical Data

Geotechnical data has not been obtained for this study and a subsurface exploration program consisting of half dozen soil borings along the new roadway embankment locations and at the proposed bridge abutments is recommended. Additionally, depending on the selected alternative and the management of rail traffic during construction, a temporary retaining wall between tracks may need to be constructed which would require additional borings along the railroad to provide required design criteria. The foundations for the bridge are assumed to be cast-in-place concrete abutments supported on shallow spread footings for the purposes of cost estimating in this feasibility analysis. If the subsurface investigation results in a recommendation from a geotechnical engineer to use deep foundations such as caissons or piling so, this could increase construction costs estimates.

Constraints Imposed by Approach Roadway Features

The proposed roadway cross-section is based on planned future widening of MD 117 and the proposed bridge width has been shown to accommodate the future build out. If either alternative proceeds into detailed design, further analysis is appropriate to evaluate whether right-turns should be channelized. Sidewalks do not currently exist on the MD 117 approaches in this area. The feasibility evaluation conservatively assumes sidewalks will be constructed along MD 117 in the study area, though it is possible to only construct a sidewalk on the bridge initially.

Traffic control during construction will be a major constraint for construction and will require multiple lane shifts and temporary alignments throughout construction. It is assumed that peak hour traffic volumes will always be accommodated with two open lanes while off-peak times will allow short-term flagger-controlled lane closures when needed for specific operations.

Constraints Imposed by Feature Crossed

For the bridge over the railroad alternative (Alternative 1), daily freight and passenger rail service on the line that must be maintained during bridge construction. This will be a primary constraint on all aspects of design, construction, and cost estimating and an early coordination meeting with railroad owners and operators is highly recommended prior to selecting an alternative. Depending on the allowable rail traffic management requirements, the potential exists for increasing the construction duration and order-of-magnitude costs by a factor of two.

Constraints Imposed by Utilities

There are known aerial utilities within the immediate bridge site that would require relocation and these utility relocations have been accounted for in the feasibility evaluation cost estimates. The proposed roadway and bridge corridor will easily accommodate underground utilities via conduit within the roadway embankment and mounted on the bridge if desired. The final number and size of the conduits can be determined in preliminary design.

Constraints Imposed by Cultural Resources & Environmental Sensitive Areas

There are multiple cultural resources and environmentally sensitive areas within the vicinity of the project. An in-depth environmental analysis was not completed as part of this initial feasibility analysis, however, the alternatives presented generally minimize impacts to resources to the greatest extent possible while balancing other factors including cost, constructability and providing sufficient vertical clearance and acceptable roadway grades.

Hazardous Material Disposition

There is a potential for hazardous materials being encountered in any excavated soils within the railroad Right-of-Way. On-site testing will be required to identify the limits and level of any contamination and any encountered hazardous materials will be disposed of in accordance with applicable regulations. Depending on the anticipated volume of soils that may be impacted within the rail corridor, a pre-characterization program can be completed by obtaining test samples to the anticipated excavation elevations during the geotechnical subsurface exploration.

Bridge Aesthetics

Over the past ten years, increasing interest has been shown in the aesthetic aspects of bridges and structures. This interest has come from a broad spectrum of people, including owners and the public at large. Some of the focus has been centered on "landmark" signature bridges which add significant cost to projects; however, bridge designers have also been increasing its efforts to improve the aesthetic design of all bridges.

Early application of the concepts of adding aesthetically pleasing features can make a significant improvement in the appearance of the bridge and each of the bridge alternatives presented here can incorporate a host of bridge aesthetic features to be further evaluated in preliminary design. Some common features include patterns to exposed concrete surfaces in ashlar stone or a host of other patterns available through the use of form liners. Bridge railing elements or pilasters are often considered along with lighting and colored concrete. Other considerations are to match elements of the environment or other bridges locally.

There's a fundamental approach to aesthetic design for bridges to provide visual elements that meet the objectives or the viewer and user as well as the long term functionality and durability of the structure. Early communication and coordination of these options during preliminary design is key to ensuring objectives are met within available funding goals before design decisions are made that impact options. An additional contingency is included in the estimate to account for aesthetics features.

Figure 17: Ashlar Stone Abutment Example

Order-of-Magnitude Cost Estimate

The following estimates include costs for construction of new abutments, superstructure, removal of the existing structure (as applicable), roadway approach work, and contingencies. Costs for track work are included in the track portion of the overall project cost estimate. Costs for modifying the rail profile in any way has not been included as we assume it would not be allowed. The estimate also excludes the relocation of utilities and disposal of hazardous materials. A more detailed breakdown the cost estimates for each alternative can be found in the appendixes to this report.

Preliminary Bridge Cost Estimate

Alternative	Estimated Cost
Alternative 1	$10,000,000
Alternative 2	$7,500,000

Structural Type Recommendation

Considerations for structure selection include railroad impacts, constructability, structure life expectancy, environmental impacts, and estimated cost. Alternative 1 costs more than Alternative 2; however Alternative 2 requires significantly more railroad coordination and impacts which are unknown costs at this time. The advantages of Alternative 2 are a more desirable roadway geometry, less sightline impacts in historic district without a bridge elevated over the railroad, minimized maintenance costs without approach roadway walls and taller bridge abutments, and minimized construction duration. The disadvantages of Alternative 2 are that there will be greater impacts along the rail line compared to Alternative 1. Ownership of the railroad bridge would need to be established and evaluated since the maintenance of the highway bridge vs. the railroad bridge would potentially be different entities.

Prior to further evaluating alternatives or selecting a preferred alternative that involves significant railroad bridge reconstruction, it is recommended that M-NCPPC staff conduct a meeting with railroad ownership and operators to discuss options for impacts and maintenance of rail traffic requirements.

Other Alternatives Considered

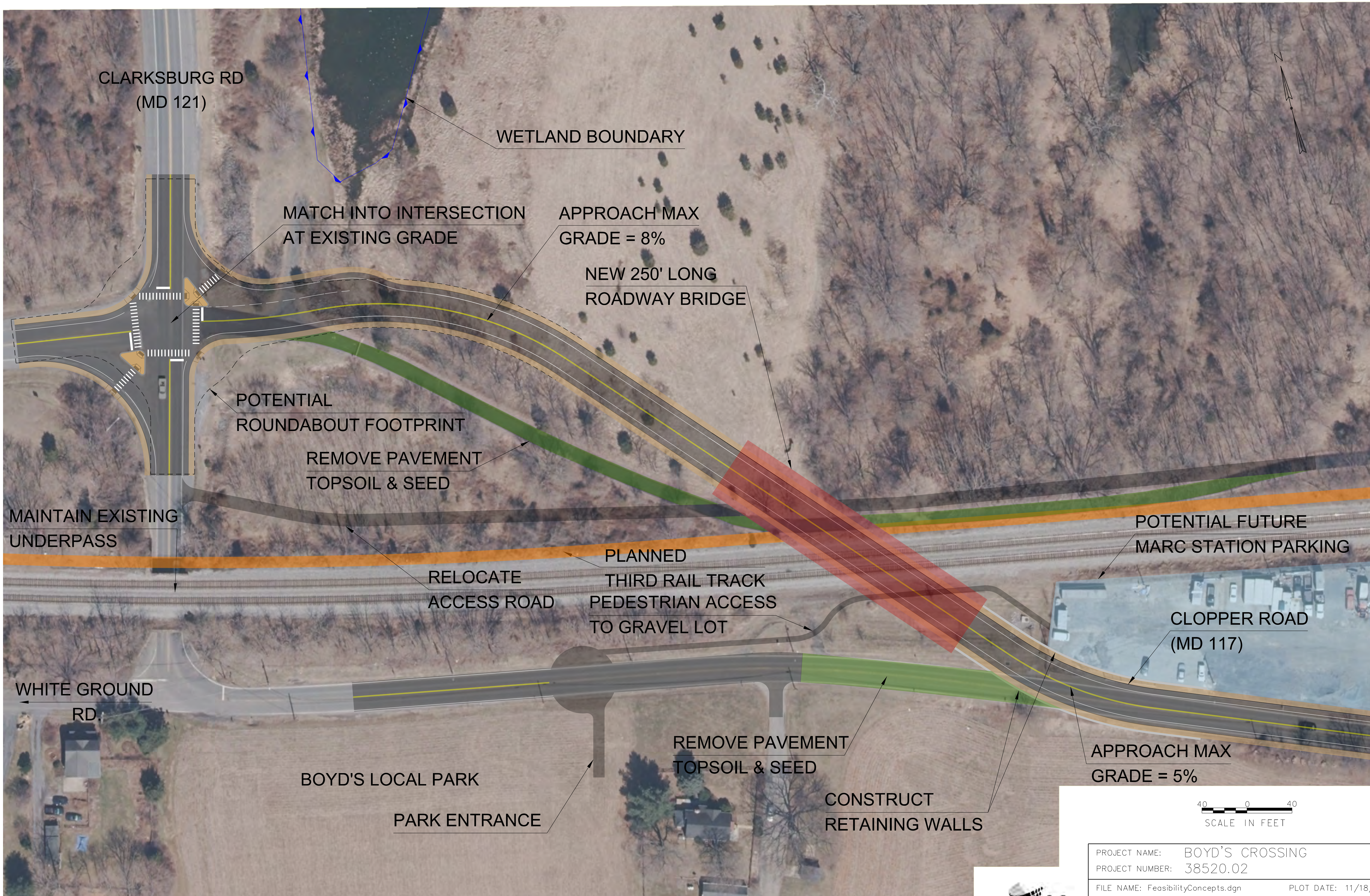
VHB developed other preliminary alternatives for the Route 117 crossing feasibility evaluation; however, these alternatives contain significant constraints that limited their feasibility and were generally considered inferior options. Specifically, tunneling options were initially considered but eliminated from further feasibility evaluation.

Tunneling Option

Tunneling under the railroad along the Alternative 1 alignment was considered as a possible alternative to constructing a bridge over the railroad. This option results in significantly greater cost for construction. Additionally, this option involves greater potential for issues with groundwater and stormwater issues within the tunnel. A tunnel would likely require a significant permanent pumping system, which would increase both initial construction costs and long-term maintenance costs.

Appendix A

Alternative Plan 1



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PROJECT NUMBER: 38520.02

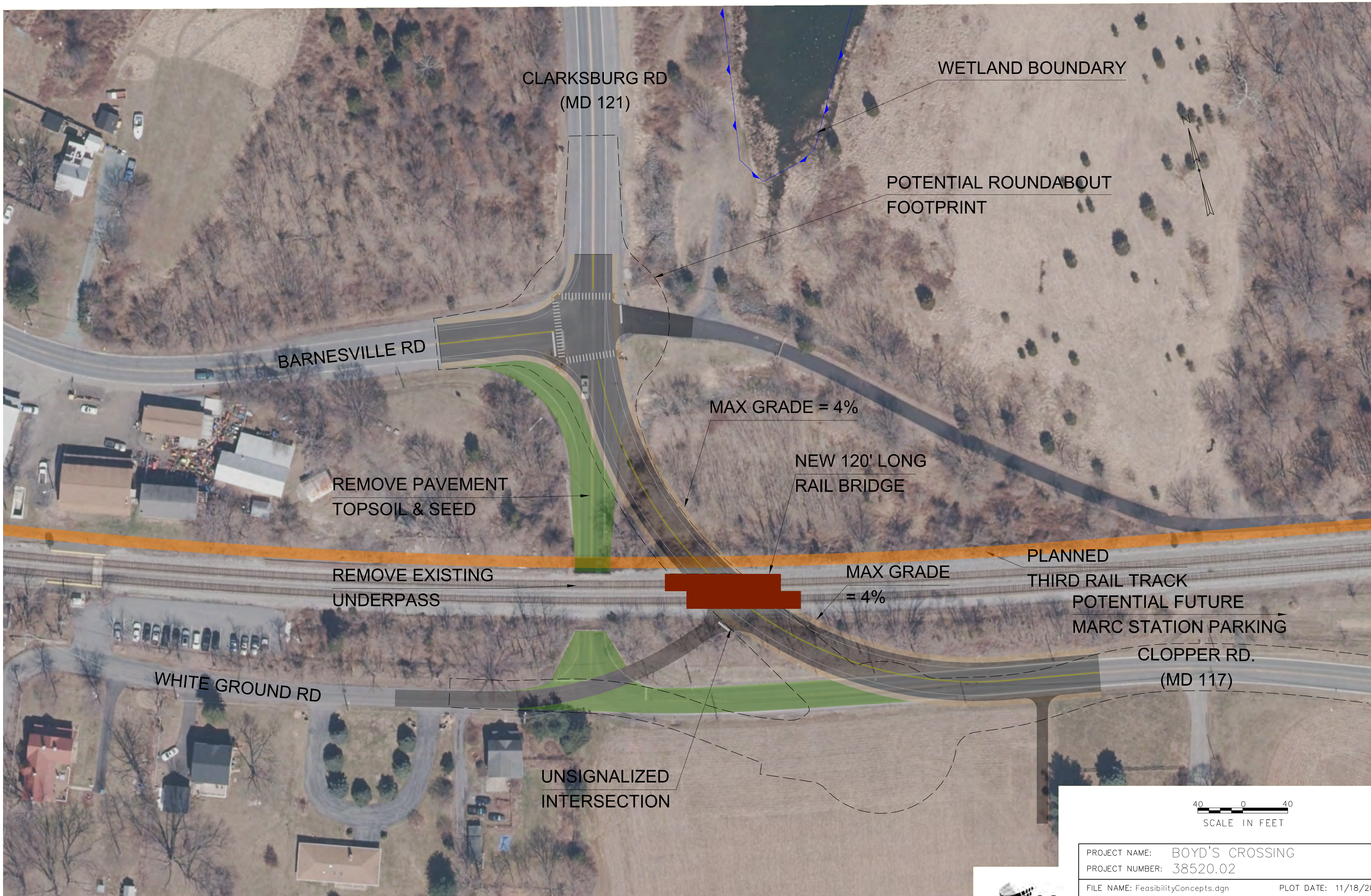
vhb

FILE NAME: FeasibilityConcepts.dgn
PROJECT LEADER: M. COLGAN
DESIGNED BY: O.DARISSE
ALTERNATIVE 1 INTERSECTION OPTION

PLOT DATE: 11/18/2016
DRAWN BY: O.DARISSE
CHECKED BY: D.M. PECK
SHEET 1 OF 4

Appendix B

Alternative Plan 2



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PROJECT NUMBER:	38520.02

FILE NAME: FeasibilityConcepts.dgn	PLOT DATE: 11/18/2016
PROJECT LEADER: M. COLGAN	DRAWN BY: O.DARISSE
DESIGNED BY: O.DARISSE	CHECKED BY: D.M. PECK
ALTERNATIVE 2 INTERSECTION OPTION	SHEET 3 OF 4

Appendix C

Detailed Order-of-Magnitude Cost Estimate

Program Level Order-of-Magnitude Project Cost Estimate - Alternative 1

	Feasability Assessment of MD 117 Grade Separation, Boyds MD			**CALCULATED BY:**	**J.D. KEENER**
	CONSTRUCTION COST ESTIMATE			**DATE:**	**11/18/2016**
	VHB PROJECT NUMBER: 38520.02			**CHECKED BY:**	**M.A. COLGAN**
	ITEM DESCRIPTION	**QUANTITY**	**UNITS**	**UNIT COST**	**COST**
	CONSTRUCTION COSTS				
1	Roadway Excavation	7000	CY	$15.00	$ 105,000.00
2	Bridge Superstructure and Substructure	1	LS	$2,250,000.00	$ 2,250,000.00
3	Structure Excavation	200	CY	$20.00	$ 4,000.00
4	Embankment and Subgrade	60000	CY	$40.00	$ 2,400,000.00
5	Hot Mix Asphalt (HMA)	4500	TON	$125.00	$ 563,000.00
6	Metal Railing	750	LF	$30.00	$ 23,000.00
7	End Treatments	4	LS	$5,000.00	$ 20,000.00
8	Retaining Walls	2	LS	$250,000.00	$ 500,000.00
9	Maintenance of Roadway Traffic	1	LS	$35,000.00	$ 35,000.00
10	Maintenance of Rail Traffic and Flaggers	1	LS	$75,000.00	$ 75,000.00
11	Drainage / Stormwater Infrastructure (assume 5% above items)				$ 299,000.00
12	Water Pollution Control (assume 2% above items)				$ 125,000.00
13	Treatment and Disposal of Contaminated Soils (assume 2% above items)				$ 128,000.00
14	Miscellaneous Construction Items (assume 15% above items)				$ 979,000.00
	Sub-Total Construction Items				$ 5,975,000.00
15	Construction Mobilization (Assume 9% construction items)				$ 538,000.00
16	Design Engineering (Assume 12% construction items)				$ 717,000.00
17	Roadway/Bridge Construction Engineering (Assume 7% construction items)				$ 418,000.00
18	Staging/Maintenance of Traffic (Assume 8% construction items)				$ 478,000.00
19	Contingency for Level of Cost Estimating (30% construction items)				$ 1,793,000.00
20	Right-of-Way Allowance	1	LS	$ 100,000.00	$ 100,000.00
				GRAND TOTAL =	**$10,000,000.00**

Program Level Order-of-Magnitude Project Cost Estimate - Alternative 2

	Feasability Assessment of MD 117 Grade Separation, Boyds MD			**CALCULATED BY:**	**Megan Suffel**
	CONSTRUCTION COST ESTIMATE			**DATE:**	**11/18/2016**
	VHB PROJECT NUMBER: 38520.02			**CHECKED BY:**	**Mark Colgan**

	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT COST	COST
	CONSTRUCTION COSTS				
1	Roadway Excavation	6500	CY	$15.00	$ 98,000.00
2	Bridge Superstructure and Substructure	1	LS	$1,500,000.00	$ 1,500,000.00
3	Structure Excavation	5000	CY	$20.00	$ 100,000.00
4	Rock Excavation	2000	CY	$35.00	$ 70,000.00
5	Embankment and Subgrade	11000	CY	$30.00	$ 330,000.00
6	Hot Mix Asphalt (HMA)	3800	TON	$125.00	$ 475,000.00
7	Metal Railing	400	LF	$30.00	$ 12,000.00
8	End Treatments	4	LS	$5,000.00	$ 20,000.00
9	Retaining Walls	4	LS	$150,000.00	$ 600,000.00
10	Removal of Existing Underpass	1	LS	$150,000.00	$ 150,000.00
11	Maintenance of Roadway Traffic	1	LS	$50,000.00	$ 50,000.00
12	Maintenance of Rail Traffic and Flaggers	1	LS	$125,000.00	$ 125,000.00
13	Drainage / Stormwater Infrastructure (assume 5% above items)				$ 177,000.00
14	Water Pollution Control (assume 2% above items)				$ 74,000.00
15	Treatment and Disposal of Contaminated Soils (assume 3% above items)				$ 113,000.00
16	Miscellaneous Construction Items (assume 15% above items)				$ 584,000.00
	Sub-Total Construction Items				$ 4,380,000.00
17	Construction Mobilization (Assume 9% construction items)				$ 394,000.00
18	Design Engineering (Assume 12% construction items)				$ 526,000.00
19	Roadway/Bridge Construction Engineering (Assume 7% construction items)				$ 307,000.00
20	Staging/Maintenance of Traffic (Assume 12% construction items)				$ 526,000.00
21	Contingency for Level of Cost Estimating (30% construction items)				$ 1,314,000.00
22	Right-of-Way Allowance	1	LS	$ 100,000.00	$ 100,000.00
				GRAND TOTAL =	**$7,500,000.00**