



Executive Summary

Purpose: The Anne Arundel County Department of Public Works (DPW) has prepared a planning study for 3600 feet of Clark Road between Jane Court / Gleneagle Drive and Watts Avenue in the communities of Jessup and Hanover (see map below). The study purpose is to evaluate the feasibility of widening the existing two-lane roadway to improve pedestrian and bicycle travel.

FIGURE 1: VICINITY MAP



Existing Conditions: Clark Road is functionally classified as a Collector with a posted speed of 35 mph. The roadway is within the BWI/Fort Meade Growth Area and the BWI 4-mile District and is located in the communities of Jessup and Hanover, in the western part of the County. The corridor is 1.52 miles, connecting Milestone Parkway on the east to the roundabout at Watts Avenue on the west. Seven-tenths of a mile are within the project limits of Jane Court/Gleneagle Drive to the roundabout at Watts Avenue.



CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

The area immediately surrounding Clark Road is zoned residential with R1, R5, and R33 zoning on the eastbound side of the road. Suffolk Way and Tifton Lane intersect Clark Road at the eastern project limits, providing access to approximately 30 homes. Jane Court and Glen Eagle Drive provide direct access to additional subdivisions and approximately 200 homes. An additional 14 homes are located on the eastbound side of Clark Road, shared driveways result in 12 driveway access points. The westbound side of the roadway is mainly open space owned by Villages at Dorchester community and shopping centers in the Arundel Mills district. There is 1 home with driveway access along westbound Clark Road. There are no community facilities within the project limits. Arundel Mills Boulevard and the Arundel Mills Commercial / Retail and Casino complex are located to the north of Clark Road and Watts Avenue but are not accessed from these local roadways.

Existing Roadway Section: The existing roadway section within the study limits is an open-section, two-lane roadway with shoulders that vary from 0 feet to 6 feet. Eastbound shoulders (approximately 6 feet) exist from Jane Court/Gleneagle Drive to 500 feet west of Suffolk Way and from Suffolk Way to Tifton Lane. No shoulders are provided along the westbound roadway. The corridor has limited clear zones with trees and utility poles frequently located within 10 feet of the roadway.



Existing Roadway Geometry: The existing horizontal geometry and cross slopes of the roadway meet County Standards; however, the vertical geometry has a crest curve with inadequate stopping sight distance for the posted 35 mph speed. A crash history analysis should be performed to determine if a vertical alignment improvement at this location would reduce local crashes and enhance safety east of Jane Court / Gleneagle Drive.

Proposed Alternatives: Three alternatives were developed and evaluated for the study as follows:

Alternative 1 – Eastbound Improvements with Sidewalk and Shoulder: Widen the eastbound roadway to an 18-foot width with an 11-foot travel lane and a 7-foot shoulder; construct a 5-foot wide sidewalk and 4-foot buffer on the eastbound side; no improvements are proposed along the westbound roadway.

Alternative 2 – Eastbound and Westbound Improvements with Sidewalk and Shoulders: Widen both the eastbound and westbound roadways to an 18-foot width with 11-foot travel lanes and 7-foot shoulders; construct sidewalk and buffer along the eastbound roadway per Alternative 1; no sidewalk or buffer will be constructed along the westbound roadway.

Alternative 3 – Eastbound and Westbound Improvements with Shared Use Path and Shoulders: Widen both the eastbound and westbound roadways to a 15-foot width with 11-foot travel lanes and 4-foot shoulders; construct a 10-foot shared use path along the eastbound roadway; no sidewalk or buffer will be constructed along the westbound roadway.



CLARK ROAD IMPROVEMENT STUDY

From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

Vertical Alignment Reconstruction Option: The vertical geometry for approximately 1,100 feet of the roadway is substandard and only meets criteria for a 20-25 mph design speed. This improvement would reconstruct approximately 1,100 feet of the roadway in its entirety to achieve a 40 mph design speed. The option can be completed with any of the three alternatives. A review of the crash history along Clark Road is recommended to help determine if the substandard vertical geometry and substandard sight distance are contributing to local crashes.

Operational Improvements:

Alternative 1 - Eastbound Improvements with Sidewalk and Shoulder: Pedestrian and bicycle mobility and safety will be enhanced by providing a sidewalk and shoulder along the eastbound roadway. The sidewalk will accommodate two-way pedestrian travel while the shoulder will accommodate eastbound bicycle travel. The shoulder will accommodate the confident on-road cyclist but not the more cautious cyclist who prefers to be separated from vehicular traffic. The improvements will not enhance westbound bicycle travel. Pedestrians who reside along the westbound roadway will be required to cross Clark Road in order to access the sidewalk. The sidewalk provides direct access for approximately 14 residences located along the eastbound roadway within the study limits.

Alternative 2 – Eastbound and Westbound Improvements with Sidewalk and Shoulders: Pedestrian and bicycle mobility and safety will be enhanced by providing a sidewalk along the eastbound roadway and shoulders along both the eastbound and westbound roadways. The sidewalk and shoulders will accommodate two-way pedestrian and bicycle travel. The shoulders will accommodate the more confident on-road cyclist but not the more cautious cyclist who prefers to be separated from vehicular traffic. The improvements will not enhance westbound bicycle travel. Pedestrians who reside along the westbound roadway will be required to cross Clark Road in order to access the sidewalk. The sidewalk provides direct access for approximately 14 residences located along the eastbound roadway within the study limits.

Alternative 3 - Eastbound and Westbound Improvements with Shared Use Path and Shoulders: Pedestrian and bicycle mobility and safety will be enhanced by providing a shared use path along the eastbound roadway and shoulders along both the eastbound and westbound roadways. The shared use path will accommodate pedestrians and more cautious off-street cyclists while the shoulders will accommodate more confident on-street cyclists. Pedestrians who reside along the westbound roadway will be required to cross Clark Road in order to access the sidewalk. The sidewalk provides direct access for approximately 14 residences located along the eastbound roadway within the study limits.

Impacts: The three alternatives will impact adjacent properties, natural resources and utilities. The impacts are not substantially different between alternatives. Table 1 summarizes the property impacts expected with each alternative; properties along both eastbound and westbound Clark Road are impacted.



TABLE 1: PROPERTY IMPACTS

	Property Impacts (Acres)	No. of Properties Impacted
Alternative 1		
Without Vertical Alignment Correction	2.06	30
With Vertical Alignment Correction	2.11	
Alternative 2		
Without Vertical Alignment Correction	2.26	31
With Vertical Alignment Correction	2.31	
Alternative 3		
Without Vertical Alignment Correction	2.14	31
With Vertical Alignment Correction	2.19	

None of the alternatives are anticipated to impact Wetlands. However, both Waters of the US and Forest Stands identified within the project limits will be impacted by the proposed alternatives. Natural resource impacts are summarized in Table 2.

TABLE 2: FOREST STAND IMPACTS

	Forest Stand Impacts (Acres)
Alternative 1	
Without Vertical Alignment Correction	2.4
With Vertical Alignment Correction	2.4
Alternative 2	
Without Vertical Alignment Correction	2.5
With Vertical Alignment Correction	2.5
Alternative 3	
Without Vertical Alignment Correction	2.4
With Vertical Alignment Correction	2.4

Potential utility impacts are estimated to include relocation and/or adjustments to both overhead and underground utilities including utility poles, water mains, storm drains, sewers, fire hydrants, gas mains and service lines to adjacent properties

Estimated Costs: A major quantities cost estimate was completed for the proposed improvements using MDOT SHA Project Planning methodologies. The estimates include construction, proposed right-of-way acquisition, engineering, construction administration and a 35% contingency. Costs for each alternative are presented in Table 3. The estimated cost for the vertical alignment reconstruction option is approximately \$1.8 million.



CLARK ROAD IMPROVEMENT STUDY
 From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

TABLE 3: COST COMPARISON

	Construction Cost (\$)	Utility Relocation Cost (\$)	Property Acquisition Cost (\$)	Preliminary Engineering Cost (\$)	Total Cost (\$)
Alternative 1					
Without Vertical Alignment Correction	2.9 million	400,000	2.7 million	435,000	6.4 million
With Vertical Alignment Correction	4.2 million	580,000	2.8 million	630,000	8.2 million
Alternative 2					
Without Vertical Alignment Correction	3.3 million	450,000	3.0 million	495,000	7.3 million
With Vertical Alignment Correction	4.6 million	630,000	3.1 million	690,000	9.1 million
Alternative 3					
Without Vertical Alignment Correction	3.6 million	485,000	2.8 million	535,000	7.4 million
With Vertical Alignment Correction	4.9 million	660,000	2.9 million	735,000	9.2 million

Recommendation: Operationally, Alternative 2 and Alternative 3 are preferred since they improve mobility for both pedestrians and bicyclists in the eastbound and westbound directions. Alternative 3 further enhances bicycle mobility because the shared use path accommodates the less confident cyclists that comprise a majority of cyclists who prefer to be physically separated from vehicular traffic.

While Alternative 1 is approximately 10-20% less than Alternatives 2 and 3 in terms of construction and utility relocation costs, property and environmental impacts are not substantially decreased when compared to Alternatives 2 and 3. Similarly, the estimated costs of Alternative 3 are approximately 10% greater than Alternative 2. Therefore, Alternative 3 is the recommended alternative based on its greater operational and safety improvements and ability to accommodate a larger percentage of cyclists with a modest increase in costs and impacts.

A crash history analysis should be performed to determine if a vertical alignment improvement would reduce local crashes and enhance safety east of Jane Court / Gleneagle Drive.



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I. Introduction

The Anne Arundel County Department of Public Works (DPW) has prepared a planning study for 3600 feet of Clark Road between Jane Court / Gleneagle Drive and Watts Avenue to evaluate the feasibility of widening the exiting two-lane roadway to improve pedestrian and bicycle travel.

The eastbound roadway would be widened in accordance with the County's P/4 Urban Collector Standard, which consists of a 18-foot wide roadway (measured from centerline to curblineline) with a varying width grass buffer and 4-foot minimum width sidewalk within a 30-foot right-of-way (measured from centerline). The westbound roadway would be widened using a modified version of the County's P/5 Rural Collector Standard, which consists of a 19-foot wide roadway and shoulder (measured from centerline to edge of shoulder) within a minimum 30-foot right-of-way (measured from centerline). The study evaluated three alternatives:

1. **Alternative 1 – Eastbound Improvements with Sidewalk and Shoulder:** Widen the eastbound roadway to an 18-foot width and construct a proposed 5-foot wide sidewalk and 4-foot buffer on the eastbound side; no improvements are proposed along the westbound roadway. Eastbound improvements would be in accordance with the P/4 Urban Collector Standard.
2. **Alternative 2 – Eastbound and Westbound Improvements with Sidewalk and Shoulders:** Widen and construct sidewalk and buffer along the eastbound roadway per Alternative 1 and widen the westbound roadway to an 18-foot width; no sidewalk or buffer will be constructed along the westbound roadway. Eastbound improvements are in accordance with the P/4 Urban Collector Standard. Westbound improvements are a modified P/5 Rural Collector Standard (the total paved width is reduced by 1-foot to be consistent with eastbound improvements).
3. **Alternative 3 – Eastbound and Westbound Improvements with Shared Use Path and Shoulders:** Widen both the eastbound and westbound roadway to a 15-foot width and construct a 10-foot shared use path along the eastbound roadway. This typical section does not follow a County Standard.

a. Existing Conditions

Clark Road is functionally classified as a Collector and the posted speed is 35 mph. The roadway is within the BWI/Fort Meade Growth Area and the BWI 4-mile District and is located in the communities of Jessup and Hanover, in the western part of the County. The corridor is 1.52 miles, connecting Milestone Parkway on the east to the roundabout at Watts Avenue on the west. Seven-tenths of a mile are within the project limits of Jane Court/Gleneagle Drive to the roundabout at Watts Avenue. See Figure 2 for a Vicinity Map.

The area immediately surrounding Clark Road is zoned residential with R1, R5, and R33 zoning on the eastbound side of the road. Suffolk Way and Tifton Lane intersect Clark Road at the eastern project limits, providing access to approximately 30 homes. Jane Court and Glen Eagle Drive provide direct access to additional subdivisions and approximately 200 homes. An additional 14 homes are located on the eastbound side of Clark Road, shared driveways result in 12 driveway access points. The westbound side of the roadway is mainly open space owned by Villages at Dorchester community and shopping centers in the Arundel Mills district. There is 1 home with driveway access along westbound Clark Road. There are no community facilities within the project limits. Arundel Mills Boulevard and the Arundel Mills Commercial / Retail and Casino complex are located to the north of Clark Road and Watts Avenue but are not accessed from these local roadways.



CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

FIGURE 2: VICINITY MAP





i. Typical Section

The existing typical section within the study limits is an open-section, two-lane roadway with shoulders that vary from 0 feet to 6 feet. Eastbound shoulders (approximately 6 feet) exist from Jane Court/Gleneagle Drive to 500 feet west of Suffolk Way and from Suffolk Way to Tifton Lane. No shoulders are provided along the westbound roadway. The corridor has limited clear zones with trees and utility poles frequently located within 10 feet of the roadway.

The roadway west of the project limits maintains the same 2-lane open-section with a 6-foot shoulder along the eastbound roadway from Jane Court to Holiday Mobile Estates, a distance of 2000 feet. From Holiday Mobile Estates to Milestone Parkway, the final 2000 foot segment of the roadway is a narrow 2-lane roadway with no shoulders.



PHOTO 1: EXISTING TYPICAL SECTION

ii. Horizontal and Vertical Alignment

The existing horizontal alignment has a minimum radius curve of 700 feet, which exceeds the county minimum for collector roads in an urban district (603-foot minimum). Existing cross slopes within the corridor vary, and some curves have a reverse crown; however, collector roads within an urban district are not required to have superelevation per the County standards. The existing vertical alignment has a maximum grade of 5.4% which meets the County's standard (10% maximum) for Collector Roads within R-1, R-5 and R-22 zoning districts. There are two existing vertical curves that do not meet AASHTO criteria for a design speed of 35 mph. VC-2 located 500 feet east of Jane Court / Gleneagle Drive (Sta. 114+35) is a sag curve with a design speed of 30 mph based on AASHTO headlight sight distance criteria. However, lighting is provided at this location and the curve exceeds the length necessary to meet the comfort criteria. VC-3 located 675 feet east of Jane Court / Gleneagle Drive (Sta. 116+80) is a crest curve that meets a design speed of 20 mph and has inadequate stopping sight distance for the posted speed.



PHOTO 2: INSUFFICIENT SIGHT DISTANCE AT VC- 3



iii. Drainage

This project is located in the Patapsco River Lower North Branch (02-13-09-06) watershed. The runoff from the project area flows northerly into Piney Run, either directly or via an unnamed tributary. Eastbound, properties are generally at a higher elevation than the roadway between Jane Court/Gleneagle Drive and Suffolk Way, leading to a significant amount of off-site drainage directed towards the road. Ditches are intermittent along these properties, which has led to erosion along the roadway. The pavement is exposed in many areas (see photo) and the shoulder is beginning to deteriorate.



PHOTO 3: EXPOSED PAVEMENT SECTION

There are two existing cross culverts within the project area that convey stormwater runoff from the south side to the north side of Clark Road. A pipe of an unknown diameter at the low point on the west side of the project at Station 114+00 and a large quadruple concrete pipe cross culvert (see photo) under the intersection of Clark Road and Suffolk Way (Station 136+00).



PHOTO 4: LARGE CONCRETE CULVERT AT SUFFOLK WAY

Along westbound Clark Road, runoff sheet flows away from the roadway and into the adjacent forested areas. There does not appear to be any erosion or drainage issues along this side of the roadway.

iv. Natural Resources

A preliminary wetlands and waters field investigation and walkthrough forest stand analysis were conducted on May 31, 2017 to approximate the limits of wetlands, Waters of the U.S., and forest stands within the project study area.

Waters of the US and Wetlands. Two waters of the U.S. and one potential wetland were identified within the study area during the preliminary field investigation.



CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

One perennial relatively permanent waters (RPW) in the vicinity of Suffolk Way was identified as Feature A, flowing southeast to northwest through culverts under Clark Road. The feature has a natural channel shape with moderately stable banks and forest vegetation cover types along both banks. The substrate consists of silts, cobbles, sands, and gravel. Feature A abuts a potential emergent wetland identified as Feature B on the southeast side of Clark Road. The observed hydrologic indicators include standing water and saturation. Prominent hydric vegetation included lurid sedge (*Carex lurida*)



PHOTO 5: FEATURE A

One ephemeral non-RPW located 500 feet east of Gleneagle Drive and identified as Feature C, crosses under Clark Road and flows south to north. Feature C is a drainage feature and originates from a storm grate south of Clark Road. Feature C has a natural channel shape and stable banks in its north end. Substrates consist of silts and sands and has forest vegetation cover types along both banks.

Forest Stands. Three forest stands were identified within the project study area.

Two mid-successional forest stands (FS₂ and FS₃) and one mature forest stand (FS₁) were identified, with size classes of 12 to 20 inches DBH. Dominant canopy species within these stands include white oak (*Quercus alba*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), Virginia pine (*Pinus virginiana*), tulip poplar (*Liriodendron tulipifera*), and sweetgum (*Acer saccharinum*). Dominant understory species within these stands include sweetgum, northern red oak, red maple, white oak, blackgum (*Nyssa sylvatica*), sawtooth oak (*Quercus acutissima*), and sassafras (*Lauraceae sp.*). Herbaceous layer species include sassafras, poison ivy (*Toxicodendron radicans*), oriental bittersweet (*Celastrus orbiculatus*), Virginia creeper (*Parthenocissus quinquefolia*), and common greenbrier (*Smilax rotundifolia*). The herbaceous layer contains heavy oak regeneration. Invasive species cover is low to medium within the forest stands and downed woody debris ranges from low to high. FS₁, FS₂, and FS₃ were in good condition with at least four specimen trees observed between the three stands.



PHOTO 6: FOREST STAND



CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

Rare Threatened and Endangered Species. Letters requesting database review for rare, threatened, and endangered (RTE) species, fisheries, and cultural resources were sent to the following agencies:

- Maryland Department of Natural Resources Wildlife and Heritage Section (MDNR-WH)
- Maryland Department of Natural Resources Project Review Division (MDNR-PRD)
- U.S. Fish and Wildlife Service (USFWS)
- Maryland Historical Trust (MHT)

Requests for information on the presence of RTE species and fisheries resources were sent to MDNR-WH and MDNR-PRD on June 13, 2017, to USFWS on June 20, 2017, and to MHT on June 15, 2017. MDNR-WH responded on June 29, 2017 indicating that there are no official State or Federal listed plant or animal species within the project area. MDNR-PRD responded on August 2, 2017 indicating that the project will impact a Use-I, unnamed tributary to Piney Run (Feature A). As a Use-I stream, instream work is prohibited from March 1 through June 15 of any given year. A USFWS official species list, obtained via the online IPaC tool on June 13, 2017, indicated the presence of swamp pink (*Helonias bullata*) within the vicinity of the project area. A letter requesting further information and guidance on the swamp pink was sent to USFWS on June 20, 2017. USFWS responded on August 1, 2017 indicating that the project will have no effect on swamp pink populations. MHT responded on July 14, 2017 determining the project will affect no historic properties.

v. Utilities

Utilities were inventoried based on GIS data, available record plans provided by the utility owners and field reconnaissance. The following utilities were identified:

- Anne Arundel County Water & Sewer
- BG&E Electric
- BG&E Gas
- Comcast
- Verizon

Properties along eastbound Clark Road have well and septic and are not serviced by County Water and Sewer. County Water and Sewer lines service Suffolk Way and Tifton Lane. A 16-inch County water line is located in the center of Clark Road from 100 feet east of Suffolk Way to the roundabout at Watts Avenue. These homes are also serviced by an 8-inch sanitary sewer line that runs through the Villages of Dorchester community open space and along the westbound edge of roadway.

Both overhead and underground electric lines are present within the project limits, with underground electric lines to the west of Suffolk Way and overhead lines to the east of Suffolk Way. Lighting exists intermittently within the project corridor. Generally, street lighting is present from Suffolk Way east towards the roundabout at Watts Avenue; however, there are also two light poles further west between Sta. 114+50 and Sta. 117+50.

BGE Gas services Suffolk Way and Tifton Lane via a 2-inch underground gas line which runs from Suffolk Way to the roundabout at Watts Avenue along the edge of the eastbound roadway.

Underground Comcast and Verizon telecommunication lines are along the eastbound roadway from Jane Court / Gleneagle Drive to the roundabout at Watts Avenue.



b. Proposed Development

The properties at 7619 Clark Road, 7614 Watts Avenue and Lot 2RR along Watts Avenue are proposed to be redeveloped as Watts Village subdivision with 10 single family homes and 22 condo units. Access to this development will be provided from Watts Avenue. Planned improvements along Clark Road by the developer include curb and gutter, sidewalk, and inlets.

II. Proposed Clark Road Design

The objective of the proposed improvements is to provide shoulders, sidewalk and drainage facilities to widen clear zones and provide facilities for improved pedestrian and bicycle travel. Two alternatives were evaluated as follows:

1. **Alternative 1 – Eastbound Improvements with Sidewalk and Shoulder:** Widen the eastbound roadway to an 18-foot width and construct a proposed 5-foot wide sidewalk and 4-foot buffer on the eastbound side; no improvements are proposed along the westbound roadway. Eastbound improvements would be in accordance with the P/4 Urban Collector Standard.
2. **Alternative 2 – Eastbound and Westbound Improvements with Sidewalk and Shoulders:** Widen and construct sidewalk and buffer along the eastbound roadway per Alternative 1 and widen the westbound roadway to an 18-foot width; no sidewalk or buffer will be constructed along the westbound roadway. Eastbound improvements are in accordance with the P/4 Urban Collector Standard. Westbound improvements are a modified P/5 Rural Collector Standard (the total paved width is reduced by 1-foot to be consistent with eastbound improvements).
3. **Alternative 3 – Eastbound and Westbound Improvements with Shared Use Path and Shoulders:** Widen both the eastbound and westbound roadway to a 15-foot width and construct a 10-foot shared use path along the eastbound roadway. This typical section does not follow a County Standard.

The proposed improvements, approximate grading limits and potential impacts to existing environmental resources, utilities and properties are presented on the Concept Plans included in **Appendix A**.

a. Alternative 1 – Eastbound Improvements with Sidewalk and Shoulder

Alternative 1 includes widening the eastbound roadway to meet the County's P/4 Urban Collector Standard and adding a five-foot sidewalk.

i. Roadway

Within the project limits, the majority of the existing eastbound roadway is 18 feet wide (striped as a +/- 12-foot lane and a +/- 6-foot shoulder). From Sta. 131+00 to Sta. 136+00 and from Sta. 141+00 to Sta. 144+00, the roadway will be widened to meet the standard. The entire length of the project will have curb and gutter and sidewalk installed along the eastbound roadway. A four-foot grass buffer is proposed between the curb and the sidewalk. No roadway widening is proposed along the westbound roadway; however, grass swales and bioretention facilities are proposed to address stormwater management requirements. See Figure 3 below for the Alternative 1 typical section.

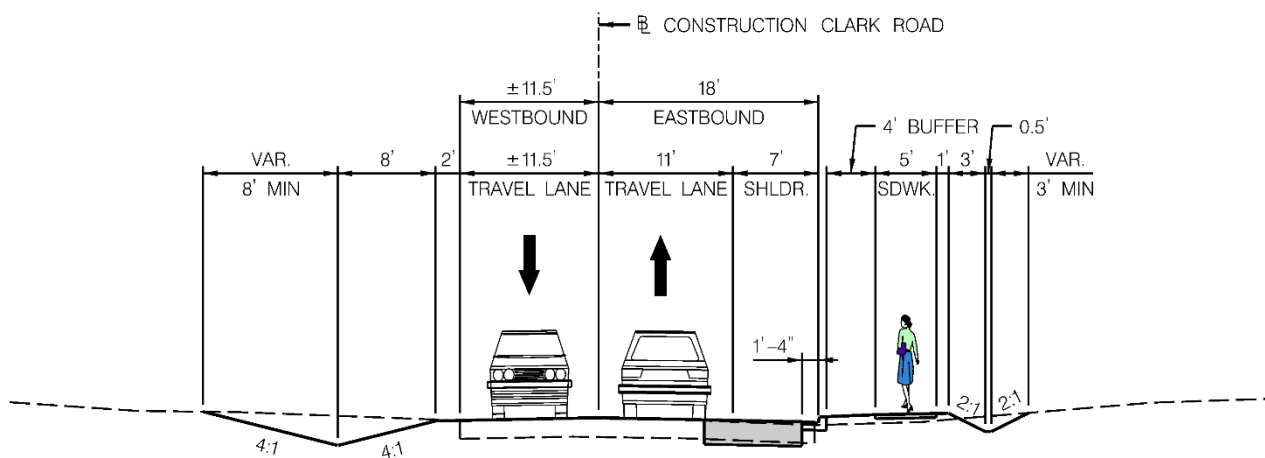


CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

Alternative 1 improves pedestrian travel and safety by providing a sidewalk along the eastbound roadway which can be directly accessed by the adjacent residential properties. The sidewalk will connect to existing sidewalks located along Jane Court, Gleneagle Drive, Suffolk Way and Arundel Mills Drive at the Watts Avenue roundabout, providing a direct connection between the residential communities and the Arundel Mills complex.

Bicycle travel will be improved in the eastbound direction with construction of the widened roadway that can be striped as a shoulder and/or bike lane. However, bicycle travel will not be improved in the westbound direction.

FIGURE 3: ALTERNATIVE 1 TYPICAL SECTION



The proposed widening and grading along both the eastbound and westbound roadways will widen the clear zones to approximately 16 feet which meets the AASHTO recommended clear zone for a 40 mph design speed. To provide this width in the westbound direction, the front and back slopes of the ditch are graded using traversable slopes.

ii. Drainage

The proposed curb and gutter along eastbound Clark Road necessitates the addition of a storm drain system to collect runoff from the roadway and offsite. The proposed storm drain system is composed of multiple WR Combination Inlets in series along the eastbound roadway. The WR Inlets along the eastbound lane have been spaced at roughly 220 feet apart to meet spread criteria. This inlet type was chosen because it is relatively shallow, which will allow the system more opportunity to outfall across Clark Road, despite the relatively shallow grade drop between the north and south sides of the roadway. A ditch is proposed behind the new sidewalk from Sta. 109+00 to Sta. 136+00 RT to convey the large offsite area that drains to the south side of the road; this drainage will be collected in several K Inlets and then connected to the new storm drain system, ultimately outfalling on the north side of Clark Road. The proposed ditch is not required from Sta. 136+00 to Sta. 144+50 RT, as the area behind the sidewalk in this area sheet flows away from the roadway.



CLARK ROAD IMPROVEMENT STUDY From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

The storm drain design results in the creation of 3 new outfalls along Westbound Clark Road: ES-1 (Sta. 114+00 LT), ES-2 (Sta. 124+50 LT) and ES-3 (Sta. 130+25 LT). The storm drain system from Sta. 132+50 to Sta. 135+50 RT is proposed to connect into the large existing culvert at Sta. 136+00, in lieu of creating a new outfall. A pipe already appears to connect with the culvert at the proposed location; analysis will be needed as the design progresses to determine whether this pipe has adequate capacity to carry the new storm drain discharge. Similarly, I-17 (Sta. 138+90 RT) and I-18 (STA 141+25 RT) are set to tie into the existing storm drain system which drains the adjacent residential area. An open back inlet (I-19) is proposed at STA 137+05 RT to drain the roadway area that bypasses I-17 and its drainage system. This open back inlet will outfall into the area directly upstream of the cross culvert. All proposed drainage systems are approximate and will be refined during final design.

iii. Storm Water Management

The proposed work results in an increase in impervious area project wide; thus, the project will require storm water management (SWM), which will include implementation of Environmental Site Design (ESD) to the maximum extent practicable (MEP). Storm water management requirements have been developed based on the *Maryland Stormwater Design Manual, Volumes I & II (Effective October 2000, Revised May 2009)*. This manual requires that the site be separated into Points of Interest (POIs), which are shown on the Concept Plans.

The SWM requirements have been met using 6 micro-bioretenion facilities along westbound Clark Road. Although no widening occurs along westbound Clark Road in this alternative, SWM facilities were located on this side of the road to reduce the property impacts on the eastbound side of the road and because there is more County owned ROW available on the westbound side of the road. Refer to **Appendix C** for more detailed SWM calculations.

b. Alternative 2 – Eastbound & Westbound Improvements with Sidewalk and Shoulders

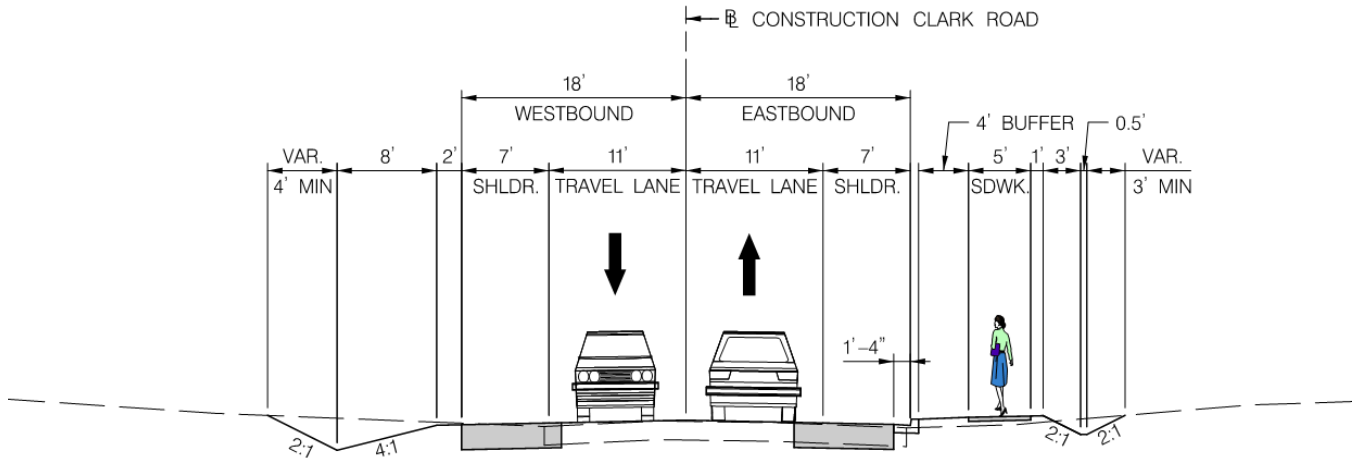
Alternative 2 includes widening to meet the County's P/4 Urban Collector Standard in the eastbound direction and adding a five-foot sidewalk as shown in Alternative 1 and also widening to meet the P/4 Urban Collector Standard in the westbound direction.

i. Roadway

All of the work associated with Alternative 1 will also be built in Alternative 2. In addition, the pavement along the westbound roadway will be widened from approximately 12 feet to 18 feet to provide a shoulder. See Figure 4 below for the Alternative 2 typical section.



FIGURE 4: ALTERNATIVE 2 TYPICAL SECTION



Like Alternative 1, Alternative 2 improves pedestrian travel and safety by providing a sidewalk along the eastbound roadway which can be directly accessed by the adjacent residential properties. The sidewalk will connect to existing sidewalks located along Jane Court, Gleneagle Drive, Suffolk Way and Arundel Mills Drive at the Watts Avenue roundabout, providing a direct connection between the residential communities and the Arundel Mills complex.

Bicycle travel under Alternative 2 will be improved in both the eastbound and westbound directions since both the eastbound and westbound roadways will be widened to provide a shoulder / bike lane. This is an improvement over Alternative 1 which only provides for bicycle travel in the eastbound direction, however it doesn't accommodate the less confident bicyclist who may not feel comfortable using unprotected on-street bicycle lanes.

The proposed widening and grading along both the eastbound and westbound roadways will expand the clear zones to a minimum of 16 feet which meets the AASHTO recommended clear zone for a 40 mph design speed. To provide this width in the westbound direction, the front slope of the ditch is graded using traversable slopes, however due to the 7-foot shoulder, the backslope of the ditch can be steepened to 2:1 to reduce impacts.

ii. Drainage

The drainage design for Alternative 2 will be very similar to Alternative 1. Please refer to Alternative 1 Drainage (Section II.a.ii) for a description of the proposed drainage design.

iii. Storm Water Management

Alternative 2 proposes additional new pavement and redeveloped pavement beyond Alternative 1, due to the addition of the paved shoulder along westbound Clark Road. Because of this added shoulder, one additional POI and two additional LOIs were considered in existing conditions. These POIs are shown on the Concept Plans.



The SWM requirements have been met using 8 micro-bioretenention facilities along westbound Clark Road and 1 micro-bioretenention facility along eastbound Clark Road. However, a variance may be required for POI 3 because there is no space within the POI to provide treatment. Stormwater calculations are provided in Appendix C.

c. Alternative 3 – Eastbound & Westbound Improvements with Shared Use Path and Shoulders

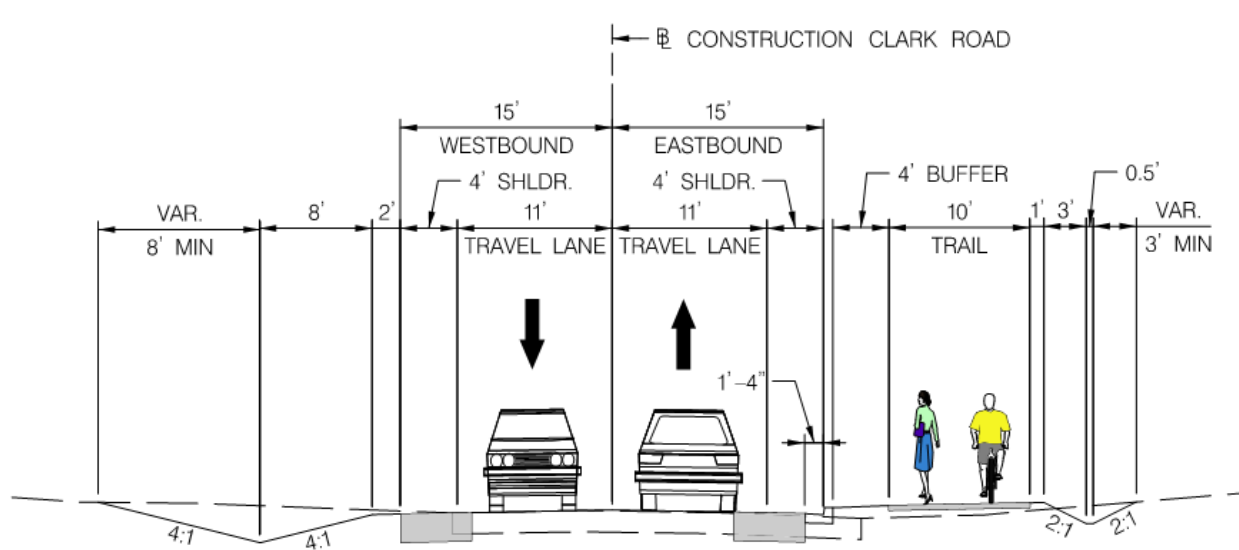
Alternative 3 includes widening to provide 4-foot shoulders in both the eastbound and westbound directions and constructing a 10-foot shared use path along the eastbound roadway.

i. Roadway

Within the project limits, the majority of the existing eastbound roadway is 18 feet wide (striped as a +/- 12-foot lane and a +/- 6-foot shoulder). From Sta. 131+00 to Sta. 136+00 and from Sta. 141+00 to Sta. 144+00, the existing eastbound roadway is 12 feet wide, within these limits the pavement will be widened to 15 feet. In areas where the roadway is already 18 feet wide, three feet of pavement will be removed. The entire length of the project will have curb and gutter, and a 10-foot wide asphalt shared use path will be installed along the eastbound roadway. A four-foot grass buffer is proposed between the curb and the path. In addition, the pavement along the westbound roadway will be widened from approximately 12 feet to 15 feet to provide a shoulder. See Figure 5 below for the Alternative 4 typical section.

Alternative 3 improves pedestrian and bicycle travel and safety by providing a shared use path along the eastbound roadway which can be directly accessed by the adjacent residential properties. The path will connect to existing sidewalks located along Jane Court, Gleneagle Drive, Suffolk Way and Arundel Mills Drive at the Watts Avenue roundabout, providing a direct connection between the residential communities and the Arundel Mills complex. This alternative improves upon the bicycle accommodations provided under Alternative 2 because it provides a dedicated space for bicyclists that is separated from vehicular traffic who may not be comfortable riding in an unprotected on-street bicycle lane.

FIGURE 5: ALTERNATIVE 3 TYPICAL SECTION





The proposed widening and grading along both the eastbound and westbound roadways will expand the clear zones to a minimum of 16 feet which meets the AASHTO recommended clear zone for a 40 mph design speed. To provide this width in the westbound direction, the front and back slopes of the ditch are graded using traversable slopes.

ii. Drainage

The drainage design for Alternative 3 will be very similar to Alternative 1, with one major difference. In order to provide greater treatment in one of the SWM facilities proposed along the WB shoulder, an additional cross culvert is proposed between I-5 and new end section ES-4. This cross culvert will convey drainage from a portion of the proposed shared use path and part of EB Clark Road to be treated in a proposed microbioretention facility. For a description of the remainder of the proposed drainage features for this alternative, please refer to Alternative 1 Drainage (Section II.a.ii). All drainage features will remain in roughly the same locations as Alternative 1, with slight alterations in inlet placing made to account for the additional width of the proposed pathway.

iii. Storm Water Management

Alternative 3 maintains the same POIs/LOIs detailed in Alternative 2, as well as maintaining all the same proposed facilities for this alternative with some alterations. Due to the proposed narrowing of the shoulder widening along westbound Clark Road from that shown in Alternative 2, less impervious area reaches the proposed facilities along the westbound shoulder than in the second alternative. This results in the need for further treatment in POI 1 and POI2/LOI2.

To provide the additional treatment needed in POI 1, an additional microbioretention has been added at the intersection of Clark Road and Gleneagle Drive. It should be noted that this microbioretention is located in what appears to be a residential side yard with several nearby utilities; utility locations will be verified at a later stage in order to determine the feasibility of this facility.

To provide the required additional SWM needed in POI2/LOI2, drainage from the eastbound roadway and proposed shared use path will be diverted to one of the microbioretentions proposed along the westbound shoulder. This will be accomplished using the additional cross culvert discussed in section II.c.ii of this report.

The SWM requirements have been met using 8 micro-bioretention facilities along westbound Clark Road and 2 micro-bioretention facilities along eastbound Clark Road. However, a variance may be required for POI 3 because there is no space within the POI to provide treatment. Stormwater calculations are provided in **Appendix C**.

d. Vertical Alignment Correction

As noted in Section I.a.ii, the vertical geometry at Station 117+00 is substandard and only meets criteria for a 20 mph design speed. Revising the profile to improve the crest vertical curve would require profile adjustments from Sta. 112+25 to Sta. 123+50, which would also correct the substandard sag vertical curve, VC-2. The improvements would require reconstruction of approximately 1,100 feet of the roadway. This improvement can be done with any of the alternatives that were evaluated.



A review of the crash history along Clark Road is recommended to help determine if the substandard vertical geometry and substandard sight distance are contributing to local crashes.

III. Impacts Assessment

a. Property Impacts

The existing right-of-way (ROW) and property boundaries shown on the attached plans are based on County plat and deed records. The exiting roadway generally lies within a ROW ranging from 42 to 60 feet. The existing ROW line is located approximately 10 feet from the edge of the existing roadway in the eastbound direction and approximately 20 feet from the edge of existing roadway in the westbound direction.

The addition of sidewalk along the eastbound direction in both Alternative 1 and Alternative 2 results in property impacts to several residences along the eastbound roadway. In addition, grading related to proposed drainage and SWM facilities along the westbound roadway will result in property impacts along the westbound roadway. Correcting the vertical alignment at Station 117+00 will result in additional impacts to adjacent properties. Table 1 below summarizes the property impacts of each alternative and the reconstruction of the roadway to correct the substandard vertical geometry at Station 117+00.

TABLE 1: PROPERTY IMPACTS

	Property Impacts (Acres)	No. of Properties Impacted
Alternative 1		
Without Vertical Alignment Correction	2.06	30
With Vertical Alignment Correction	2.11	
Alternative 2		
Without Vertical Alignment Correction	2.26	31
With Vertical Alignment Correction	2.31	
Alternative 3		
Without Vertical Alignment Correction	2.14	31
With Vertical Alignment Correction	2.19	

b. Natural Resources Impacts

None of the alternatives are anticipated to impact Wetlands. However, both Waters of the US and Forest Stands identified within the project limits will be impacted by the proposed alternatives.

The culvert carrying Feature A under Clark Road is large and the widening associated with Alternative 1 is not expected to require an extension of the culvert. The westbound widening associated with Alternative 2 may impact the headwall on the north side of the culvert. Potential options include extending the culvert and replacing the headwall, modifying the headwall, or reducing the shoulder width at this location. These options should be further evaluated during the design phase of the project.

Approximately 30 linear feet of Feature C, will be impacted by both Alternative 1 and 2. The existing culvert will be replaced and proposed Inlets I-1 through I-4 will outfall at ES-1.



Forest stands along both the eastbound and westbound roadways will be impacted by the proposed improvements. Table 2 summarizes the estimated impacts of each alternative and the reconstruction of the roadway to correct the substandard vertical geometry at Station 117+00.

TABLE 2: FOREST STAND IMPACTS

	Forest Stand Impacts (Acres)
Alternative 1	
Without Vertical Alignment Correction	2.4
With Vertical Alignment Correction	2.4
Alternative 2	
Without Vertical Alignment Correction	2.5
With Vertical Alignment Correction	2.5
Alternative 3	
Without Vertical Alignment Correction	2.4
With Vertical Alignment Correction	2.4

A Joint Permit Application will need to be completed for the proposed impacts to jurisdictional wetlands and waters. Forest Conservation Plans will need to be prepared in accordance with the Anne Arundel County Forest Conservation Program for impacts to the Forest Stands.

c. Utilities

Potential utility impacts are estimated to include relocation and/or adjustments to both overhead and underground utilities including utility poles, water mains, storm drains, sewers, fire hydrants, gas mains and service lines to adjacent properties. Utilities will need to be designated/located and impacts further evaluated in the final design phase.

IV. Cost Estimate

A major quantities cost estimate was completed for the proposed improvements using MDOT SHA Project Planning methodologies. Construction quantities for major items of work including earthwork, paving, and shoulder improvements were computed based on the concept plans and cross sections. Other items of work including MOT, Drainage, Landscaping, Traffic and Utilities were estimated using percentages established by SHA based on historical project data. The estimate also includes proposed right-of-way acquisition, engineering, construction administration and a 35% contingency. Table 3 summarizes the costs for each alternative, detailed estimates are included in Appendix B. The cost associated with correcting the vertical alignment is approximately \$1.8 million and can be added to either alternative if that option is selected.



TABLE 3: COST COMPARISON

	Construction Cost (\$)	Utility Relocation Cost (\$)	Property Acquisition Cost (\$)	Preliminary Engineering Cost (\$)	Total Cost (\$)
Alternative 1					
Without Vertical Alignment Correction	2.9 million	400,000	2.7 million	435,000	6.4 million
With Vertical Alignment Correction	4.2 million	580,000	2.8 million	630,000	8.2 million
Alternative 2					
Without Vertical Alignment Correction	3.3 million	450,000	3.0 million	495,000	7.3 million
With Vertical Alignment Correction	4.6 million	630,000	3.1 million	690,000	9.1 million
Alternative 3					
Without Vertical Alignment Correction	3.6 million	485,000	2.8 million	535,000	7.4 million
With Vertical Alignment Correction	4.9 million	660,000	2.9 million	735,000	9.2 million

V. Recommendations

Operationally, Alternative 2 and Alternative 3 are preferred since they improve mobility for both pedestrians and bicyclists in the eastbound and westbound directions. Alternative 3 further enhances bicycle mobility because the shared use path accommodates the less confident cyclists that comprise a majority of cyclists who prefer to be physically separated from vehicular traffic.

While Alternative 1 is approximately 10-20% less than Alternatives 2 and 3 in terms of construction and utility relocation costs, property and environmental impacts are not substantially decreased when compared to Alternatives 2 and 3. Similarly, the estimated costs of Alternative 3 are approximately 10% greater than Alternative 2. Therefore, Alternative 3 is the recommended alternative based on its greater operational and safety improvements and ability to accommodate a larger percentage of cyclists with a modest increase in costs and impacts.

A crash history analysis should be performed to determine if a vertical alignment improvement would reduce local crashes and enhance safety east of Jane Court / Gleneagle Drive.



APPENDIX A

CONCEPT PLANS



CLARK ROAD IMPROVEMENT STUDY
From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

APPENDIX B

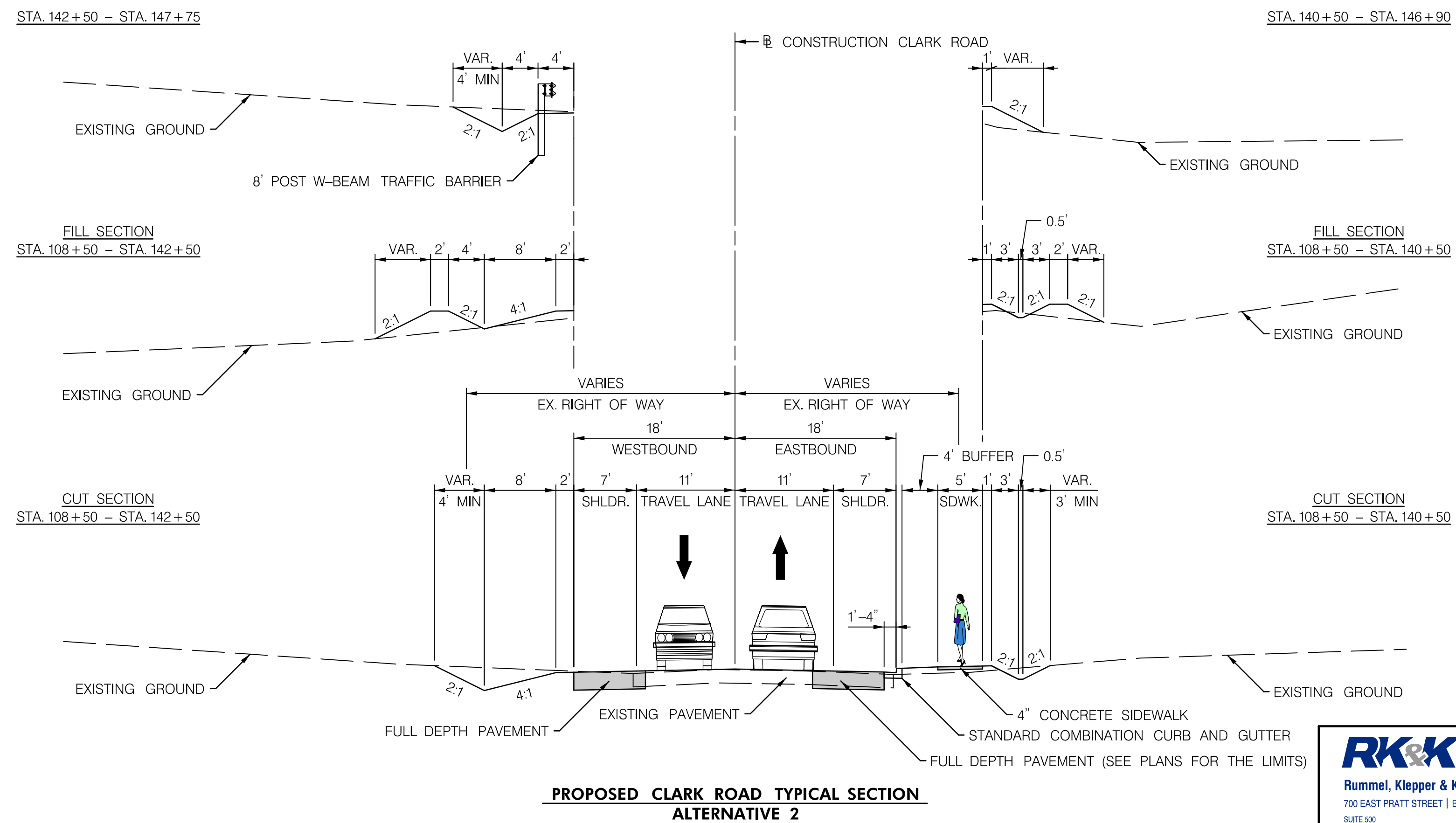
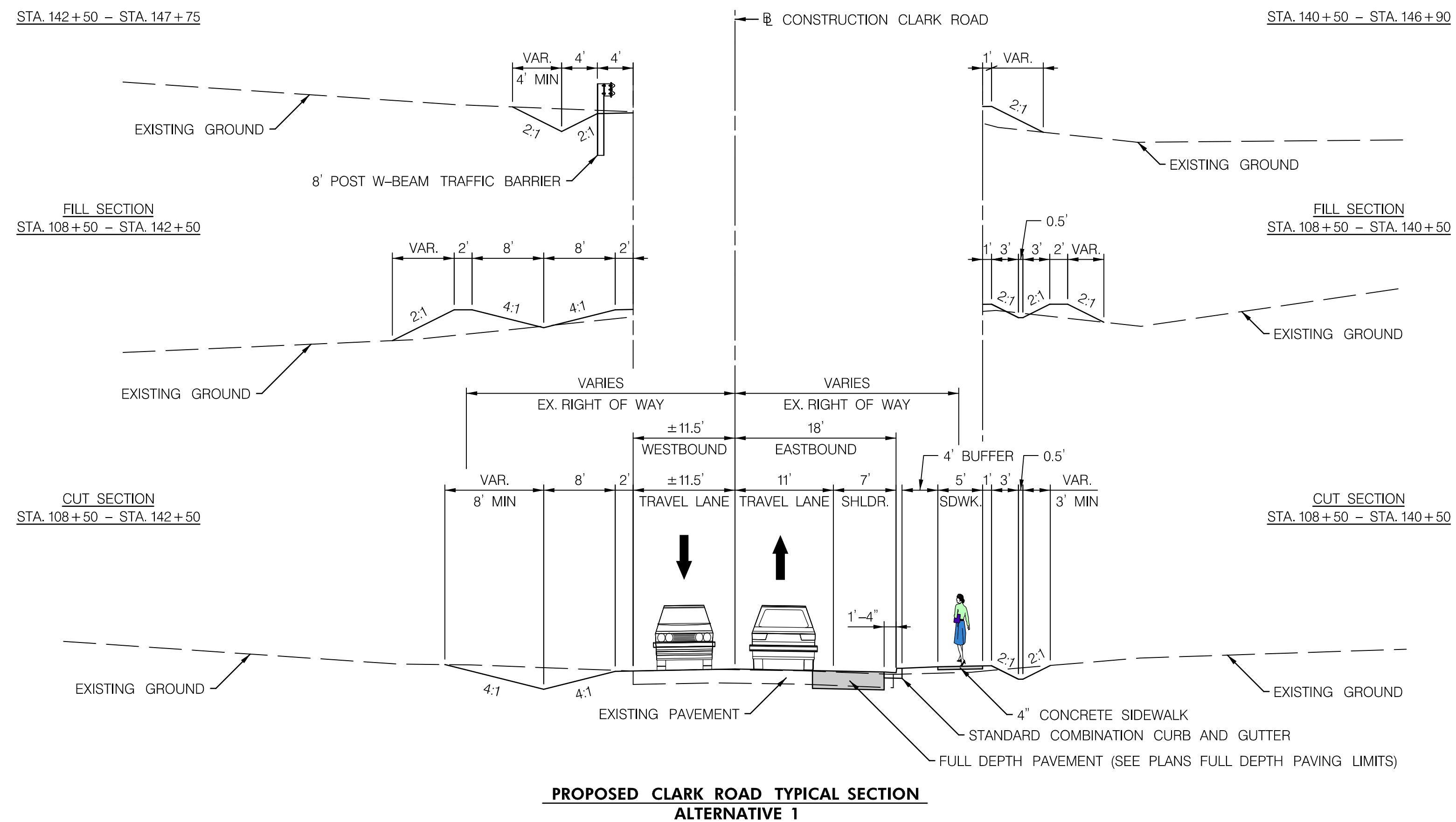
COST ESTIMATE



CLARK ROAD IMPROVEMENT STUDY
From Jane Court/Gleneagle Drive to the Roundabout at Watts Avenue

APPENDIX C

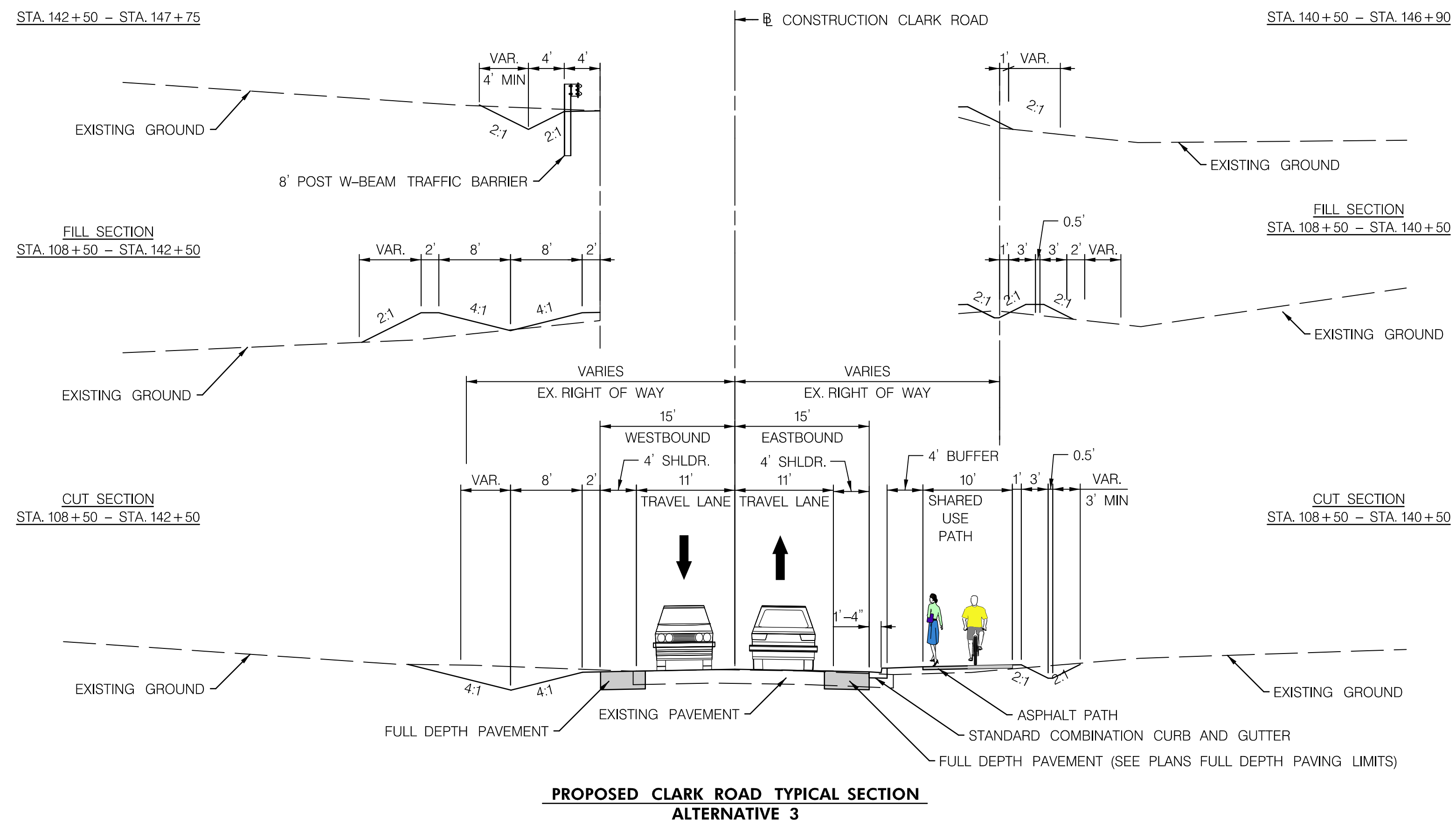
STORMWATER MANAGEMENT NARRATIVE



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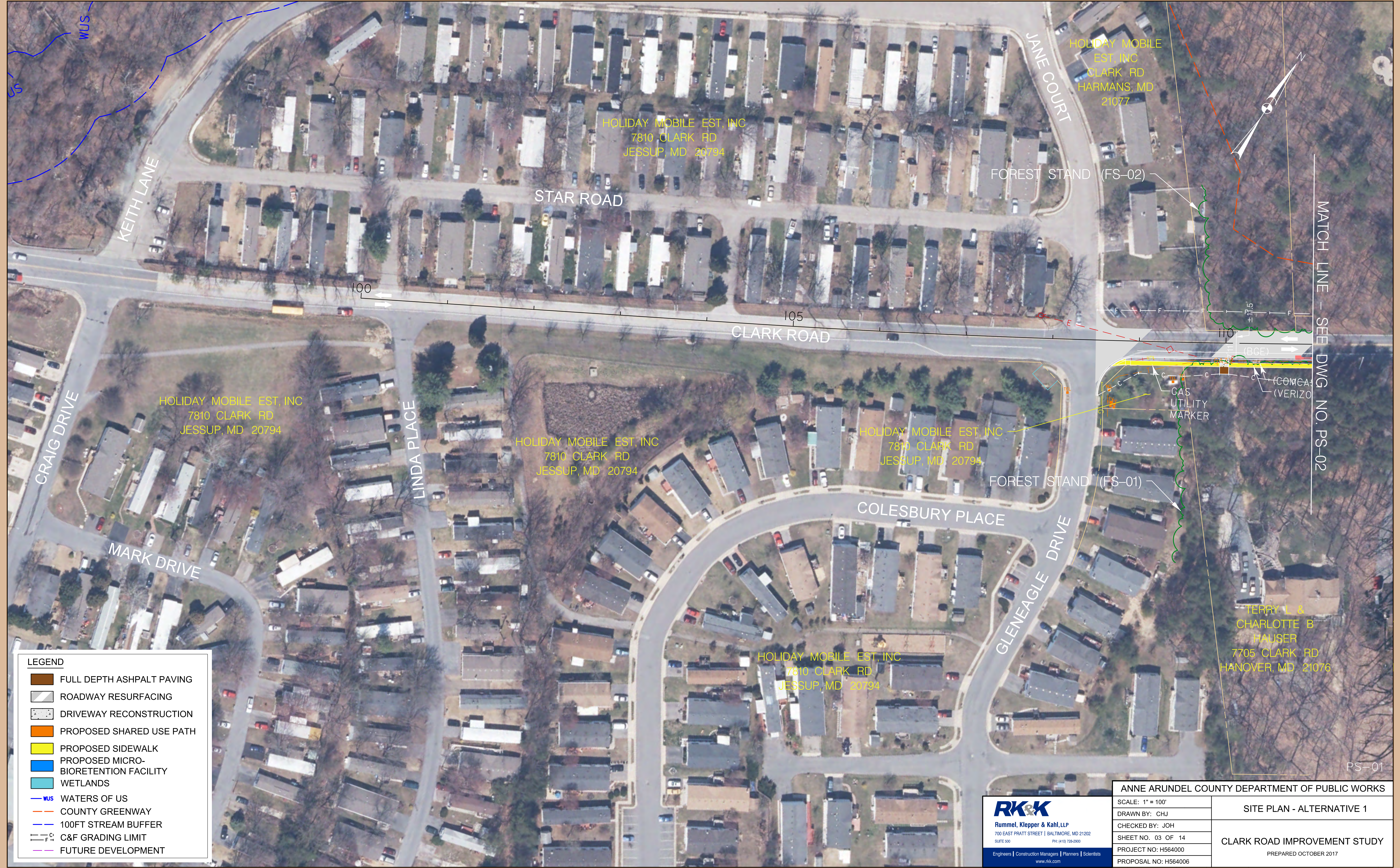


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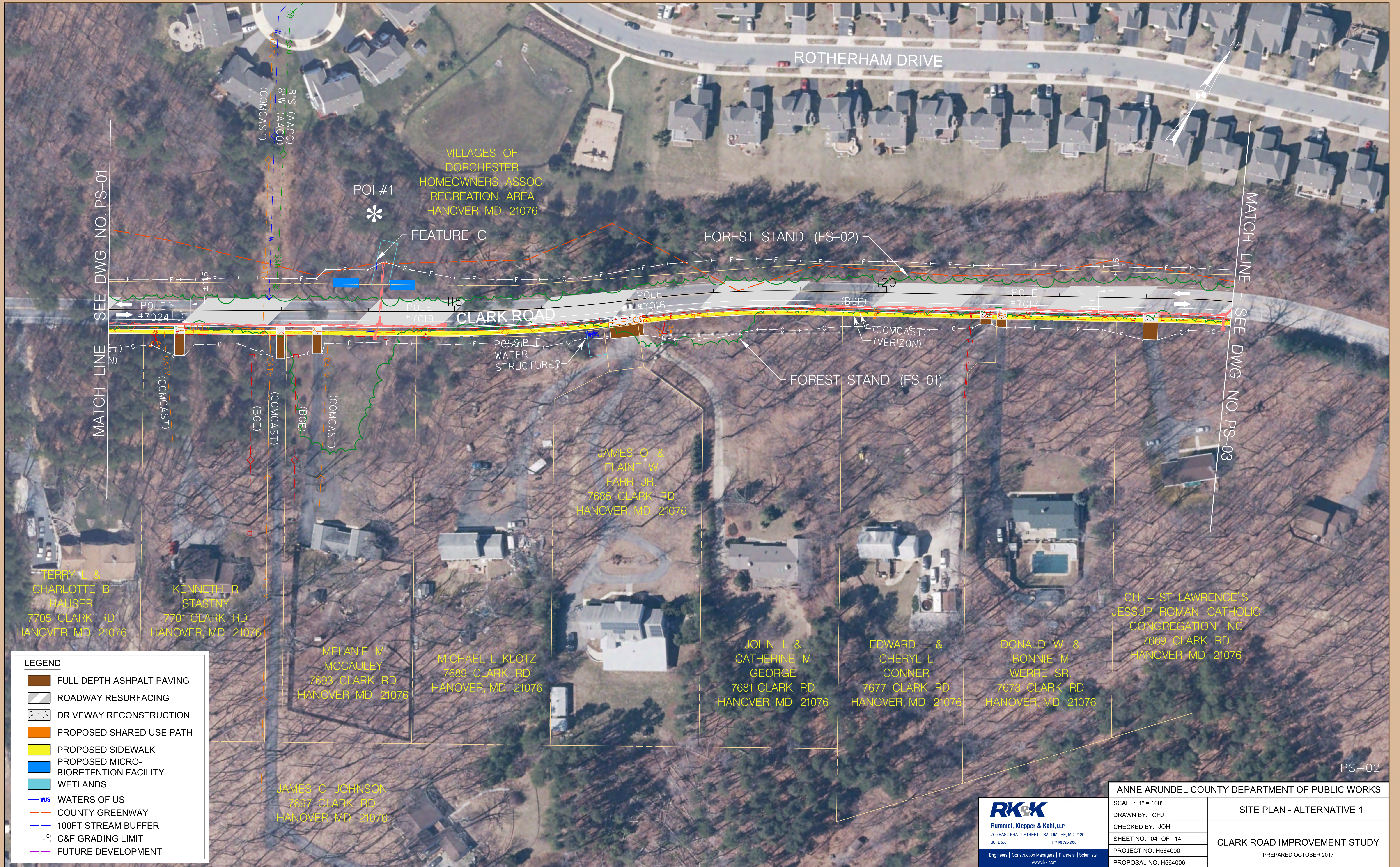
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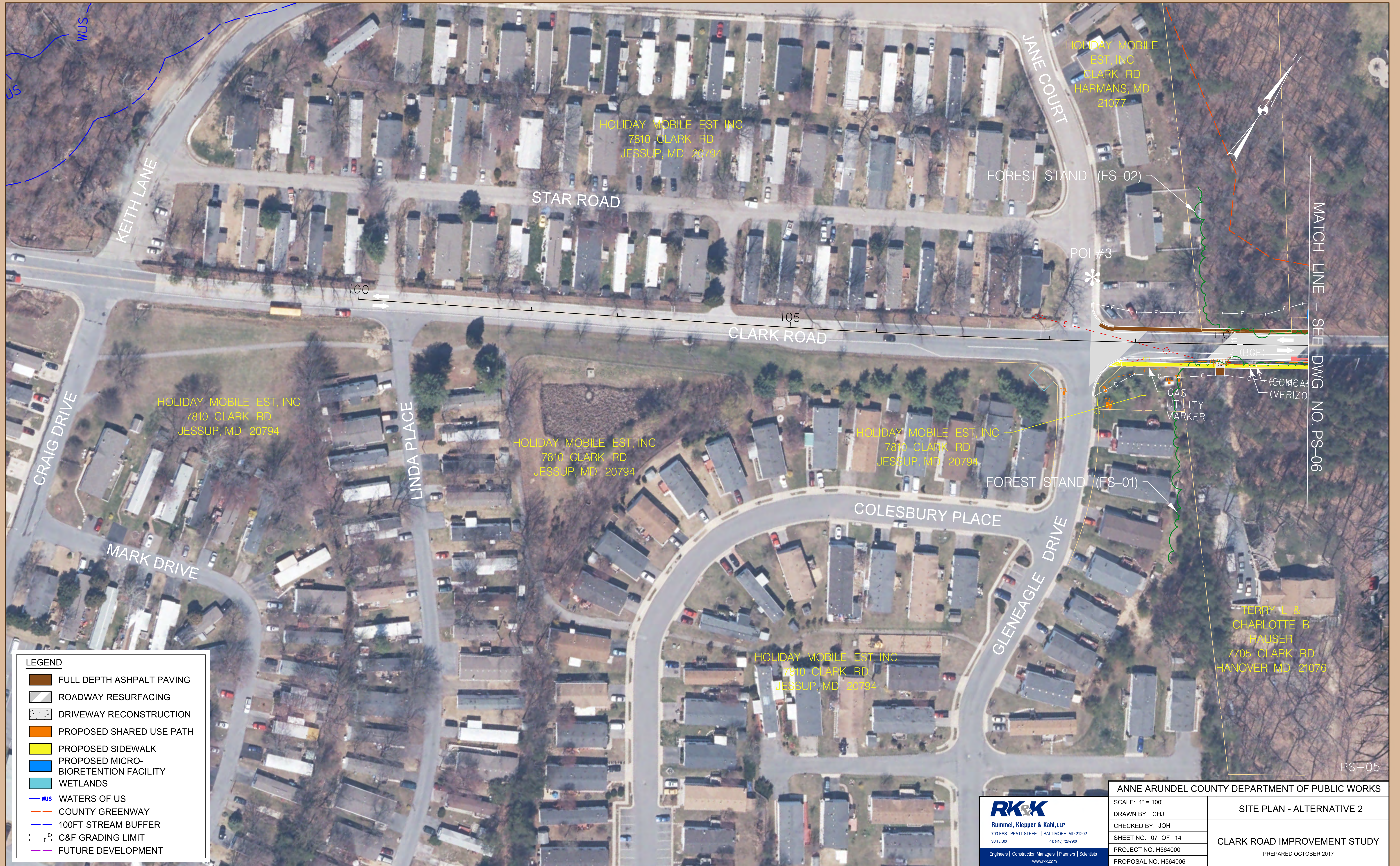
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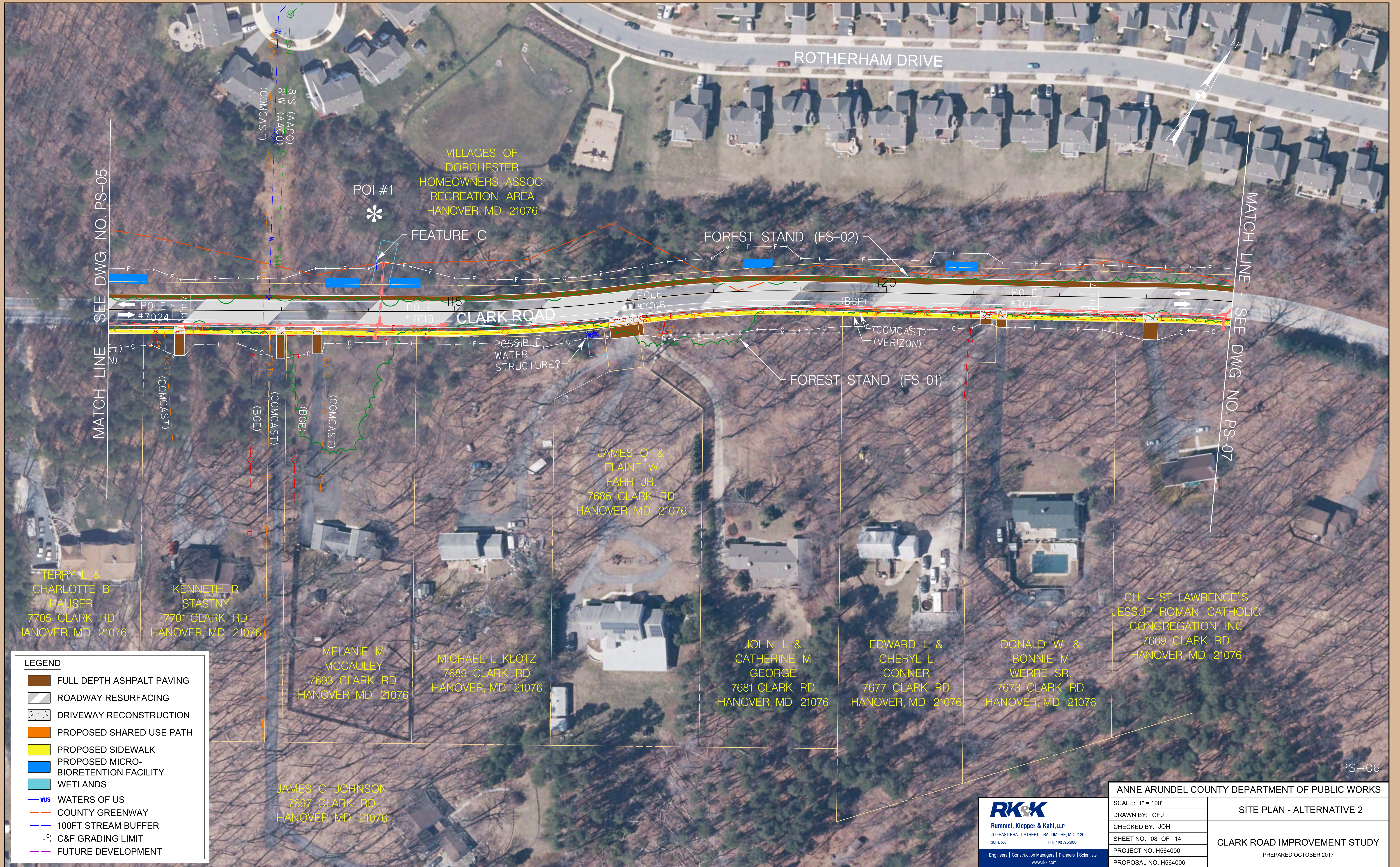
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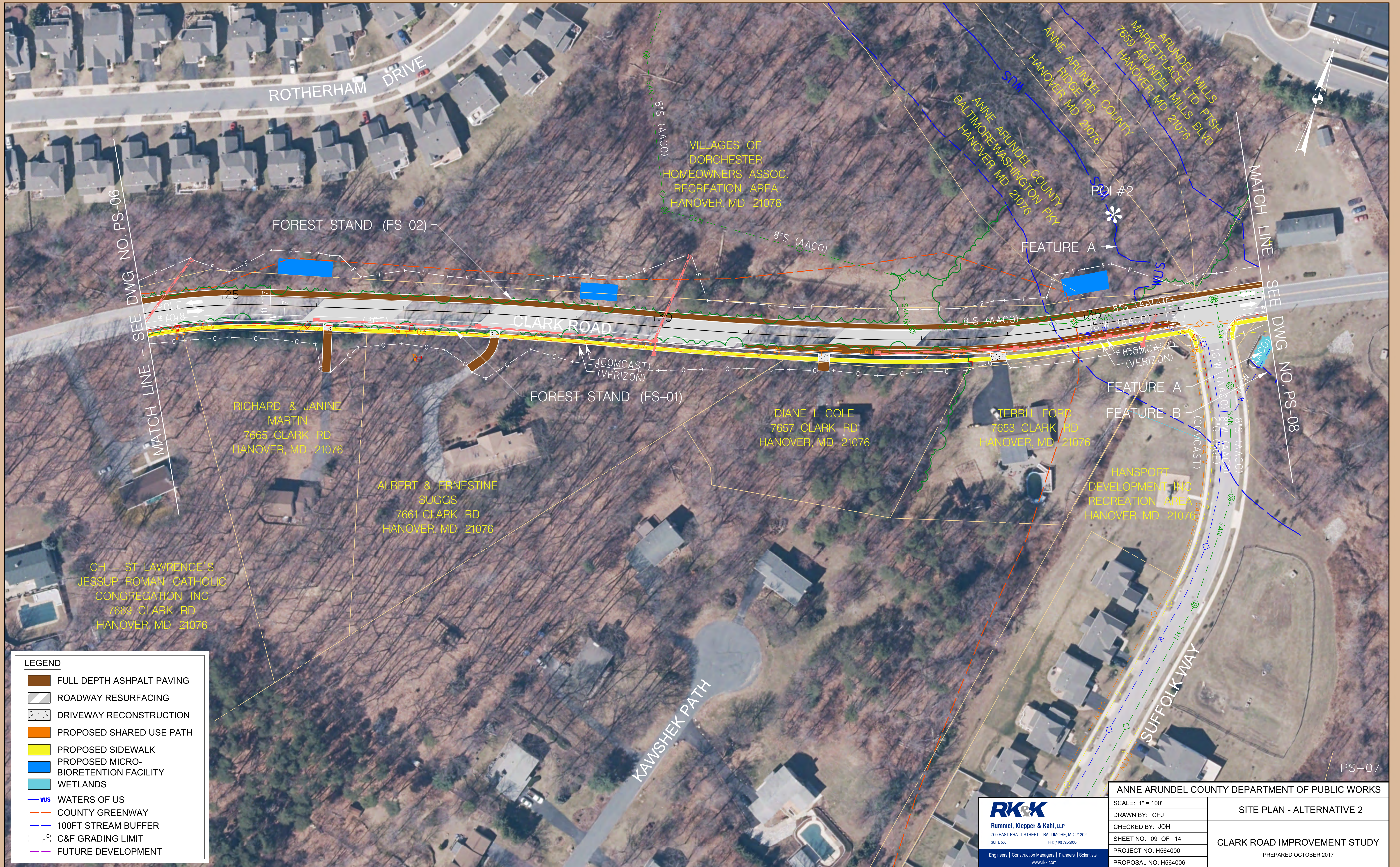
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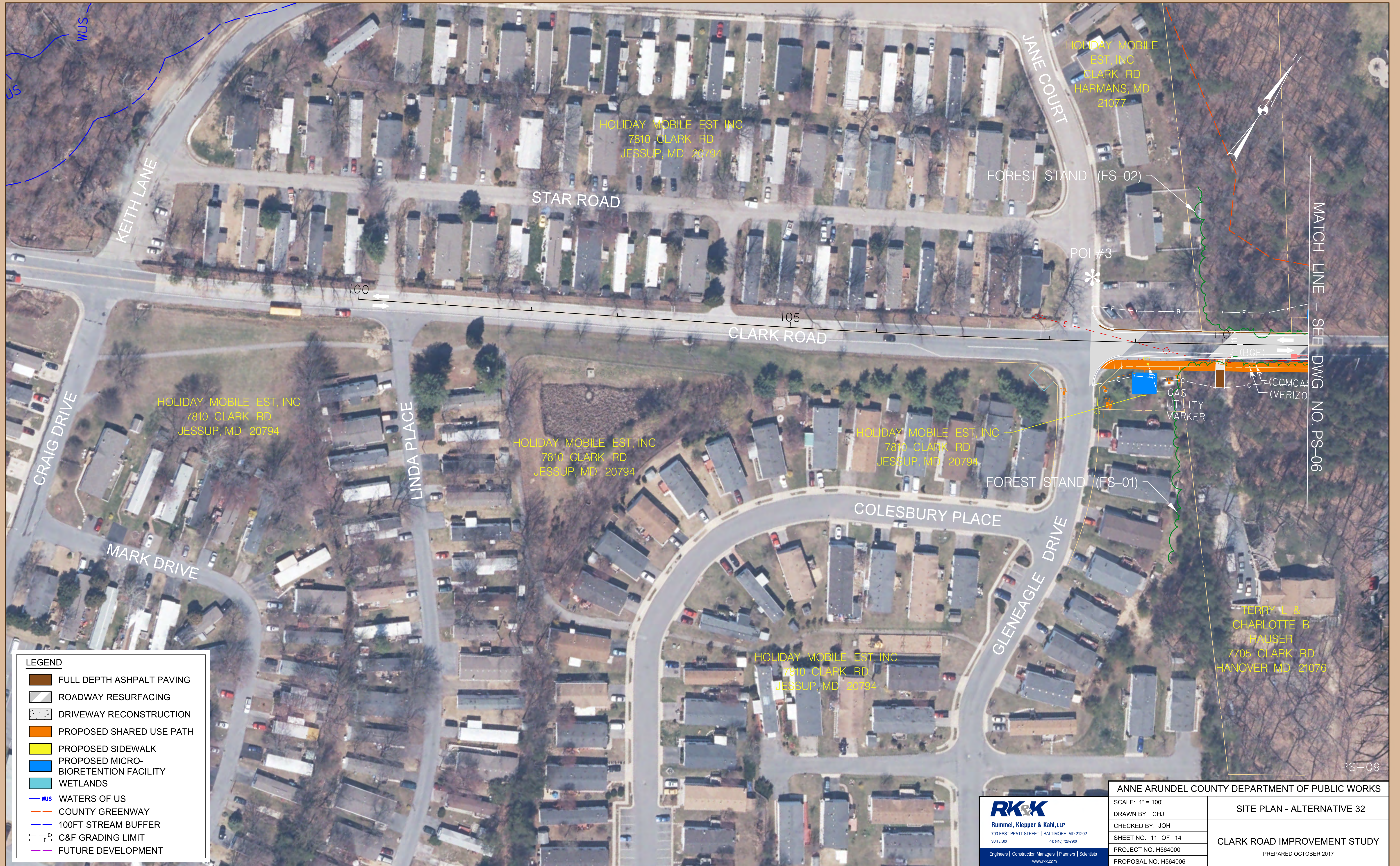
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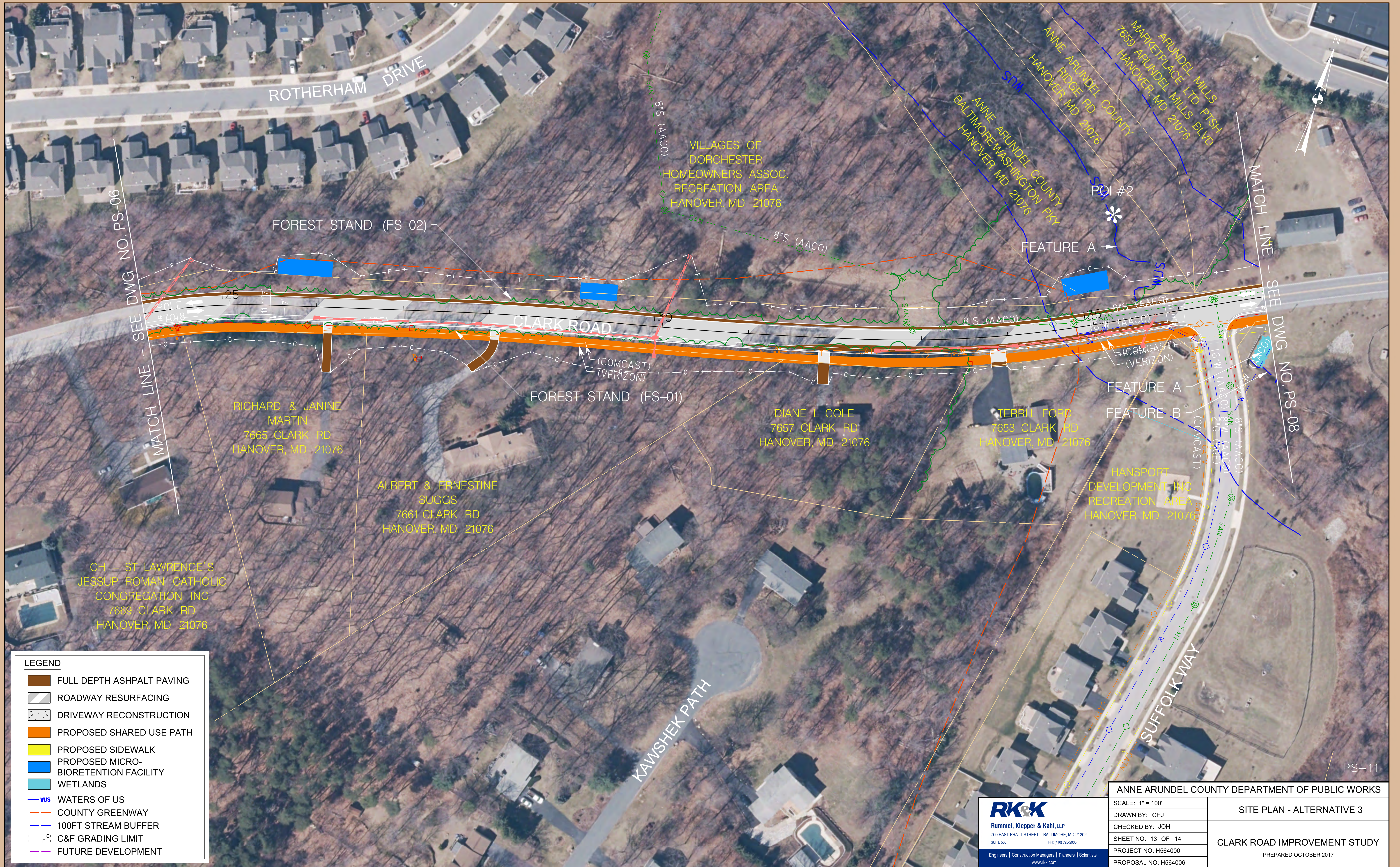
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PS-10

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LEGEND

- FULL DEPTH ASPHALT PAVING
- ROADWAY RESURFACING
- DRIVEWAY RECONSTRUCTION
- PROPOSED SHARED USE PATH
- PROPOSED SIDEWALK
- PROPOSED MICRO-BIORETENTION FACILITY
- WETLANDS
- WUS
- COUNTY GREENWAY
- 100FT STREAM BUFFER
- C&F GRADING LIMIT
- FUTURE DEVELOPMENT

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ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	
SCALE: 1" = 100'	SITE PLAN - ALTERNATIVE 3 CLARK ROAD IMPROVEMENT STUDY PREPARED OCTOBER 2017
DRAWN BY: CHJ	
CHECKED BY: JOH	
SHEET NO. 13 OF 14	
PROJECT NO: H564000	PROPOSAL NO: H564006

PS-11

Friday, October 20, 2017 AT 06:56 AM
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LEGEND

	FULL DEPTH ASPHALT PAVING
	ROADWAY RESURFACING
	DRIVEWAY RECONSTRUCTION
	PROPOSED SHARED USE PATH
	PROPOSED SIDEWALK
	PROPOSED MICRO-BIORETENTION FACILITY
	WETLANDS
	WATERS OF US
	COUNTY GREENWAY
	100FT STREAM BUFFER
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ANNE ARUNDEL COUNTY DEPARTMENT OF PUBLIC WORKS	
SCALE: 1" = 100'	SITE PLAN - ALTERNATIVE 3
DRAWN BY: CHJ	
CHECKED BY: JOH	CLARK ROAD IMPROVEMENT STUDY
SHEET NO. 14 OF 14	
PROJECT NO: H564000	
PROPOSAL NO: H564006	PREPARED OCTOBER 2017

FS-12