

SOILS AND FOUNDATIONS

REPORT NO. 05-05

PROJECT PRA-FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1)

FREDERICKSBURG AND SPOTSYLVANIA NATIONAL MILITARY PARK

PAVEMENT REHABILITATION

SPOTSYLVANIA AND ORANGE COUNTIES, VIRGINIA

FEBRUARY 2006

PMIS # 98889



U.S. Department of Transportation  
Federal Highway Administration  
*Eastern Federal Lands Highway Division*  
*21400 Ridgetop Circle*  
*Sterling, VA 20166*

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**Note: Design changes made subsequent to distribution of this report and prior to project advertisement will be documented by a memo inserted after the title page**

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**PROJECT PRA-FRSP 11(1), 19(1), 20(1), 22(1), 23(1), 900(1), 912(1), 914(1), 916(1)  
FREDERICKSBURG AND SPOTSYLVANIA NATIONAL MILITARY PARK  
SPOTSYLVANIA AND ORANGE COUNTIES, VIRGINIA  
ROADWAY AND PARKING AREA REHABILITATION**

## **INTRODUCTION**

### **General**

This report presents the results of the geotechnical investigation, analyses, design, and recommendations for Project PRA-FRSP 11(1), 19(1), 20(1), 22(1), 23(1), 900(1), 912(1), 914(1), 916(1) located in the Fredericksburg and Spotsylvania National Military Park (NMP) in Spotsylvania and Orange Counties, Virginia. The Fredericksburg and Spotsylvania (FRSP) NMP is an approximately 8374-acre park located in northeastern Virginia, approximately 50 miles southwest of Washington, DC and 60 miles northeast of Richmond, VA.

This project consists of rehabilitating five asphalt concrete (AC) paved roads and four AC paved parking areas, and the paving/construction of existing and new pull-offs/parking areas in four separate units of the FRSP NMP. The five roadways, one parking area, and three pull-offs/parking areas are located within the Spotsylvania Battlefield Unit. The Fredericksburg Battlefield Unit, the Chancellorsville Battlefield Unit, and the Wilderness Battlefield Unit each have one parking area that will be rehabilitated. Refer to Figures 1 through 4 in Appendix A for project and location maps.

### **Project Description**

#### Spotsylvania Battlefield Unit

**Grant Drive** – Grant Drive is designated National Park Service (NPS) Route 11. The road begins at Virginia State Route 613 and terminates at Anderson Drive. Grant Drive is 1.05-miles long, approximately 20-ft wide two-lane two-way AC paved road with grass shoulders. A new AC paved pull-off will be constructed in between the Spotsylvania Exhibit Parking Area and the Upton site, approximate station 24+00 (Site 2), and the existing aggregate surfaced pull-off at the Upton site, approximate station 54+00 (Site 3), will be paved with AC. The Bloody Angle parking area located at the intersection of Grant Drive and Anderson Drive (Site 4) will also be rehabilitated.

**Anderson Drive** – Anderson Drive is designated as NPS Route 19. The road begins at the end of Grant Drive and terminates at the bus parking area, NPS Route 913, just south of the western edge of Gordon Drive. Anderson Drive is 0.73-miles long, approximately 20-ft wide

two-lane two-way, AC paved road with grass shoulders. The currently aggregate surfaced pull-off at station 72+00 (Site 5) is scheduled to be paved with AC. A new AC paved pull-off (Site 6) will also be constructed along the western side of the horizontal curve connecting Anderson Drive and Gordon Drive. Lastly, the bus parking area (Site 7), NPS Route 913, near the end of Anderson Drive will be widened.

***Gordon Drive*** – Gordon Drive is designated NPS Route 20. The road begins at MP 0.45 on Anderson Drive, and terminates at the intersection of Bloody Angle Drive East and Burnside Drive. Gordon Drive is 0.71-miles long, approximately 20-ft wide two-lane two-way road with grass shoulders.

***Burnside Drive*** – Burnside Drive is designated NPS Route 22. The road begins at the intersection of Gordon Drive and Bloody Angle Drive East and terminates at Virginia State Route 208. Burnside Drive is 1.40-miles long, approximately 20-ft wide one-lane one-way AC paved road with grass shoulders. Burnside Drive will be narrowed to approximately 10-ft wide and will be rehabilitated.

***Bloody Angle Drive East*** – Bloody Angle Drive East is designated NPS Route 23. The road begins at the intersection of Gordon Drive and Burnside Drive and terminates at the East Angle Battlefield site. Bloody Angle Drive East is 0.35-miles long, approximately 20-ft wide two-lane two-way AC paved road with grass shoulders. This roadway will have the AC pavement removed and replaced with a natural aggregate surfaced footpath. There will be a new AC paved parking area (Site 8) constructed at the current intersection of Bloody Angle Drive East, Gordon Drive, and Burnside Drive to provide access to the new footpath.

***Spotsylvania Exhibit Shelter Parking*** – The Spotsylvania Exhibit Shelter Parking area (Site 1) is designated NPS Route 912. The parking area is located along Grant Drive, near the intersection of Grant Drive and Brock Road. The Spotsylvania Exhibit Shelter Parking Area is an approximately 7535 square foot AC paved parking area with concrete curb and asphalt sidewalk.

#### Fredericksburg Battlefield Unit

***Fredericksburg Visitor Center Parking*** – The Fredericksburg Visitor Center Parking area is designated NPS Route 900 and is located adjacent to Virginia State Business Route 1, across from the National Cemetery. The Fredericksburg Visitor Center Parking area is an approximately 23,142 square foot AC paved area that has a main parking lot, roundabout, and semi-circular entrance/exit driveway onto Lafayette Blvd. This parking area has both concrete curb with brick sidewalks as well as adjacent concrete walking paths and sidewalks. The FRSP NMP prefers to keep the current curb reveal and pavement elevation. At the time of this report, the FRSP NMP expressed a desire for a rehabilitation that consists of the AC removal and replacement of the AC pavement.

#### Chancellorsville Battlefield Unit

***Chancellorsville Visitor Center Parking*** – The Chancellorsville Visitor Center Parking area is designated NPS Route 914 and is located adjacent to the intersection of Virginia State Route 3 and Bullock Road. This parking area has concrete curb and sidewalks that will be

removed and replaced. The Chancellorsville Visitor Center Parking Area is an approximately 32,292 square foot AC paved parking area.

#### Wilderness Battlefield Unit

**Wilderness Exhibit Shelter Parking** – The Wilderness Exhibit Shelter Parking area is designated NPS Route 916. The parking area is located off of Virginia State Route 20, approximately 6 miles west of the Chancellorsville Battlefield Visitor Center (NPS Route 914). This parking area has concrete curb and sidewalks that will be removed and replaced. The Wilderness Exhibit Shelter Parking Area is an approximately 10,764 square foot AC paved lot.

### **Regional Geology**

The “Geologic Map of Virginia, 1993” produced by the Commonwealth of Virginia Department of Mines, Minerals, and Energy indicates that this project lies on the border of the coastal plain and the eastern piedmont. A geologic map of the project location is provided as Figure 5 Appendix A.

#### Spotsylvania Battlefield Unit

The “Geologic Map of Virginia, 1993” produced by the Commonwealth of Virginia Department of Mines, Minerals, and Energy indicates that the TA River Metamorphic Suite, the Miocene Sand and Gravel, and the Quantico Formation underlie this site. The TA River Metamorphic Suite consists primarily of amphibolite gneiss. Sandy gravel, sand, silt, and clay represent the Miocene Sand and Gravel Formation. The Quantico Formation consists of slate and porphyroblastic schist. A geologic map of the project location is provided as Figure 5 in Appendix A.

The “Soil Survey of Spotsylvania County, Virginia, 1978” produced by the United States Department of Agriculture (USDA) indicates that the near surface soils at the Spotsylvania Battlefield Unit are comprised of the Appling-Wedowee-Emporia Association and the Appling-Louisburg-Wedowee Association. These soil associations are described as well-drained soils that have mostly clayey or loamy subsoil. These soils are generally located on the Piedmont and Coastal Plain Uplands. The soil survey map for this location is provided in Figure 6 in Appendix A.

#### Fredericksburg Battlefield Unit

The soil survey and geologic information regarding this area is not available because the visitor center is located on a historical site with a historical cemetery.

#### Chancellorsville Battlefield Unit

The “Geologic Map of Virginia, 1993” produced by the Commonwealth of Virginia Department of Mines, Minerals, and Energy indicates that Miocene Sand and Gravel underlie this site. This formation consists of sandy gravel, sand, silt, and clay. A geologic map of the project location is provided as Figure 5 in Appendix A.

The “Soil Survey of Spotsylvania County, Virginia”, 1978, produced by the USDA indicates that the near surface soils at the Chancellorsville Battlefield Unit are comprised of the Nason-Tatum-Catharpin Association. This association is described as well-drained soils that have dominantly clayey or loamy subsoil and are generally located on Piedmont Uplands. The Chancellorsville Visitor Center Parking Area is located just west of the Fall Line, which separates the Piedmont and Coastal Plain Physiographic Provinces. The soil survey map for this location is provided in Figure 6 in Appendix A.

#### Wilderness Battlefield Unit

The “Geologic Map of Virginia, 1993” produced by the Commonwealth of Virginia Department of Mines, Minerals, and Energy indicates that Mine Run Complex Formation, specifically the Melange Zone III, underlies this site. A geologic map of the project location is provided as Figure 5 Appendix A.

The “Soil Survey for Orange County, Virginia, 1971” produced by the USDA indicates that the near surface soils at the Wilderness Battlefield Unit are comprised of the Nason-Tatum-Manteo Association. This association is described as deep or shallow, well to extreme-drained soils that slope gently, to steep soils on dissected uplands. Further, this soil association is principally comprised of silt loam and silty clay loam. The soil survey map for this location is provided in Figure 7 in Appendix A.

## **PROCEDURES AND RESULTS**

### **Field Investigation**

The Eastern Federal Lands Highway Division (EFLHD) geotechnical personnel and subsurface exploration team conducted the field and subsurface investigation in July 2004. The field and subsurface investigation consisted of a visual pavement condition survey, non-destructive pavement testing using a Dynatest Falling Weight Deflectometer (FWD), pavement coring using a trailer-mounted core drill with a 4-inch diameter core bit, disturbed sampling utilizing a hand auger, and dynamic cone penetration (DCP) testing. In addition, bulk samples were collected at three (3) locations. The boring location plans are provided in Appendix B and the boring logs are provided in Appendix C.

The visual pavement condition survey was conducted in accordance with the “Distress Identification Manual for the Long-Term Pavement Performance Project (SHRP-P-338)”. The purpose of the pavement condition survey was to make a preliminary determination of the types and limits of the different repair/rehabilitation techniques that would be required based on the type, severity, and extent of pavement distress.

Field-testing was completed at thirty (30) locations within the park. All borings were surveyed in the field using Trimble Global Positioning System (GPS) hand-held equipment. The boring location plan and the boring GPS coordinates are provided in Appendix B. The boring logs are presented in Appendix C.

The FWD testing was completed in accordance with ASTM D4694-96 and D4695-96. Three drops were completed at each boring location using a target load of 9000-lbs and a 5.9-inch radius plate. Seven sensors were used and were located as follows: at the loading plate (i.e. 0), 8, 12, 18, 24, 36, and 48 inches behind the loading plate. Pavement temperature measurements were made at each testing location by inserting a temperature probe down to approximately mid-depth of the AC in a ½-inch diameter drilled hole filled with mineral oil. The FWD testing results are presented in Appendix E.

The pavement coring was conducted using a 4-inch core drill mounted on a haul trailer. The thickness of each pavement core obtained was measured in the field for total thickness and constructed lift thickness. A determination was made whether the constructed lift was either a surface course or base course aggregate size. Hand augers were subsequently advanced at all boring locations with the exception of borings B-14, B-15, B-21, B-23, B-24, and B-25. Hand augers were typically advanced to a depth where one complete hand auger sample was achieved within the soil subgrade. DCP testing was occasionally performed in the base material layer and typically performed in the subgrade layer. A field description by color and texture was made for each recovered soil sample. All pavement core holes were backfilled and compacted with auger cutting materials and sealed with cold patch AC. Representative portions of the disturbed samples were retained in plastic bags and delivered to the EFLHD Materials Laboratory in Sevierville, Tennessee for testing.

### **Data Summary**

Measured FWD data was collected in the field through the Dynatest data acquisition computer system. This measured deflection response data was then transferred to the DARWin Pavement Design System (Version 3.0) computer program for back-calculation of the effective pavement modulus of the AC pavement as well as the subgrade resilient modulus of the soil subgrade. The deflection data represents deflection response at selected locations and deflection discrepancies are expected between test locations due to changes in the layer thickness, material properties, moisture and temperature conditions, subgrade support, and contact pressure under the loading plate. In addition, the measured deflection response data is representative of the pavement structure during the field investigation time, and therefore, deflection variations are expected due to seasonal and climatic variations.

The results of field tests and measurements were recorded on hand auger boring logs and appropriate data sheets in the field. These logs and data sheets contain information concerning the field investigation methods, samples attempted and recovered, indications of the presence of various materials such as gravel, pebbles, organic matter, etc., and observations of groundwater. They also contain interpretations by the geotechnical personnel based on the performance of the equipment and cuttings brought to the surface by the field tools at that particular time. Therefore, the field data represents both factual and interpretive information.

The boring logs in Appendix C of this report represent a compilation of field and laboratory data and descriptions of the soil samples by a geotechnical engineer. These records

occasionally do not include all data recorded on the boring logs and field data sheets, but do include all information considered relevant to design and construction of this project.

## Laboratory Testing

At the conclusion of the fieldwork, laboratory testing was conducted on representative soil samples. Laboratory tests included natural moisture content (AASHTO T-265), mechanical gradation (AASHTO T-27), Atterberg Limits (AASHTO T-89 & T90), AASHTO soil classification (AASHTO T-317), Standard Proctor Compaction (AASHTO T-99) and California Bearing Ratio (CBR) (AASHTO T-193-99). All tests were conducted in accordance with applicable ASTM/AASHTO standard test methods. The results of the laboratory tests are summarized below in Table 1 and presented in Appendix D.

**Table 1: Soil Testing Results Summary**

Boring No.	Sample Depth (ft)	Soil Classification	Fines (%)	Liquid Limit (%)	Plastic Limit (%)	Water Content (%)	CBR Results	
<b>Spotsylvania Battelfield Unit</b>								
<b>Spotsylvania Exhibit Shelter Parking Area</b>								
B-2	.583-2	A-7-5(31)	73.7	76.0	38.0	22.6		
<b>Grant Drive</b>								
B-5	.125-.750	A-1-a	6.6	NA	NA	4.9		
B-5	1.5-2.083	A-6(1)	37.1	28.0	16.0	10.3		
B-7	1.167-1.830	A-1-b	19.7	NA	NA	7.8		
CBR-1 (Site 4)	0-2.0	A-2-4(0)	34.4	29.0	19.0	NA	CBR = 102; Max. Density = 130.6 pcf at 8.6%	
<b>Anderson Drive</b>								
B-9	1.167-1.830	A-4(0)	48.6	NA	NA	8.7		
CBR-2 (Site 5)	0-2.0	A-2-4(0)	33.8	36.0	NA	NA		CBR = 62; Max. Density = 114.2 pcf at 13.2%
<b>Gordon Drive</b>								
B-12	.917-1.5	A-4(0)	40.7	NA	NA	7.7		
CBR-3 (Site 6)	0-2.0	A-2-4(0)	28.2	21.0	NA	NA		CBR = 70; Max. Density = 115.5 pcf at 11.6%
<b>Burnside Drive</b>								
B-16	.917-1.67	A-5(1)	45.9	67.0	NA	22.0		
B-19	1.33-1.833	A-6(4)	49	39.0	24.0	11.8		
<b>Fredericksburg Battlefield Unit</b>								
<b>Fredericksburg Visitors Center Parking Area</b>								
B-22	1.542-2.0	A-6(4)	43.2	36.0	16.0	14.0		
<b>Wilderness Battlefield Unit</b>								
<b>Wilderness Exhibit Shelter Parking Area</b>								
B-26	.854-2.0	A-7-6(14)	74.7	42.0	22.0	16.2		
<b>Chancellorsville Battlefield Unit</b>								
<b>Chancellorsville Visitors Center Parking Area</b>								
B-28	.958-1.67	A-7-6(15)	74.7	37.0	20.0	21.0		

**Notes:**

N.A. = Not Available

**Findings**

The subsurface investigation findings for each site are summarized in Table 2 and discussed further in the paragraphs below. Refer to the boring logs in Appendix C and the laboratory data in Appendix D for more detailed information. The FWD data reduction results are presented in Appendix E.

**Table 2: Summary of Subsurface Investigation Results**

Boring No.	AC thickness (in)	Aggregate Base thickness (in)	Subgrade Classification	Notes
<b>Spotsylvania Battelfield Unit</b>				
<b>Spotsylvania Exhibit Shelter Parking Area</b>				
B-1	3	5		
B-2	3	4	A-7-5(31)	
<b>Grant Drive</b>				
B-3	1.5	12.5		
B-5	1.5	6.5	A-6(1)	
B-7	1.5	12.5	A-1-b	
B-4 (Site 2)	NA	NA	NA	
B-6 (Site 3)	NA	NA	NA	
CBR-1 (Site 4)			A-2-4(0)	CBR = 102, Maximum density = 130.6 pcf at 8.6%
<b>Anderson Drive</b>				
B-8	2.25	12.75	NA	
B-9	2.5	11.5	A-4(0)	
B-10 (Site 7)	3.5	10.5	NA	
CBR-2 (Site 5)			A-2-4(0)	CBR = 62, Maximum density = 114.2 pcf at 13.2%
<b>Gordon Drive</b>				
B-11	1.5	10.5	NA	
B-12	1	9	A-4(0)	
B-13	1.5	9.5	NA	
CBR-3 (Site 6)	NA	NA	A-2-4(0)	CBR = 70, Maximum density = 115.5 pcf at 11.6%
<b>Bloody Angle Drive East</b>				
B-14	4	NA	NA	
B-15	2.5	NA	NA	
<b>Burnside Drive</b>				
B-16	3	8	A-5(1)	
B-17	2.25	22	NA	
B-18	2.5	10	NA	
B-19	2.5	13.5	A-6(4)	

**Notes:**

N.A. = Not Available

**Table 2 Continued -**

Boring No.	AC thickness (in)	Aggregate Base thickness (in)	Subgrade Classification	Notes
<b>Fredericksburg Battlefield Unit</b>				
<b>Fredericksburg Visitors Center Parking Area</b>				
B-20	3.75	7.5	NA	Base material was reinforced concrete pavement.
B-21	3	8	NA	Base material was reinforced concrete pavement.
B-22	5.25	13.5	A-6(4)	Base material was gravel.
B-23	2.75	NA	NA	Base material was reinforced concrete pavement.
B-24	3.5	NA	NA	Base material was reinforced concrete pavement.
B-25	2.5	NA	NA	Base material was reinforced concrete pavement.
<b>Wilderness Battlefield Unit</b>				
<b>Wilderness Exhibit Shelter Parking Area</b>				
B-26	3	7.25	A-7-6(14)	
B-27	2.5	10.5	NA	
<b>Chancellorsville Battlefield Unit</b>				
<b>Chancellorsville Visitors Center Parking Area</b>				
B-28	2.5	9	A-7-6(15)	
B-29	3	10	NA	
B-30	2.5	8	NA	

**Notes:**

N.A. = Not Available

Spotsylvania Battlefield Unit

**Grant Drive** – Based on the pavement condition survey, the AC pavement along Grant Drive was in poor to fair condition. The pavement distress included low to high severity edge cracking, low to moderate severity transverse cracking, low to high severity longitudinal cracking generally in the wheel path and occasionally at the centerline, occasional low severity fatigue cracking, and occasional low severity block cracking. AC surface raveling was observed at some locations. Shoulders built-up and lane-to-shoulder drop off was also observed along the pavement edges.

Boring’s B-3, B-5, and B-7 were performed along the mainline of Grant Drive. The AC pavement thickness measured was 1.5-inches at each location and was noted to be constructed in two lifts. The AC was underlain by aggregate base material ranging in thickness between 8 and 13 inches. Aggregate base was comprised of sand and gravel with a trace of silt. Laboratory testing results on an aggregate base sample from boring B-5 indicates an AASHTO classification of A-1-a. The DCP blow count per increment within the base material in boring B-5 was 15.

The subgrade soils principally consisted of tan and gray silty sand and tan clayey sand. Laboratory test results on a subgrade sample from boring B-5 indicates an AASHTO classification of A-6(1) and a natural moisture content of 10.3%. Atterberg limits laboratory

testing results indicate a liquid limit of 28, a plastic limit of 16, and a plasticity index of 12. Laboratory testing results on a subgrade sample from boring B-7 indicate an AASHTO classification of A-1-b and a natural moisture content of 7.8%. The DCP blow count per increment within the subgrade material ranged from 13 to 29 with an average blow count of approximately 19.

Boring B-4 (site 2) and B-6 (site 3) were performed in the areas where AC paved pull-offs will be constructed. The soil in boring B-4 consisted of 3-inches of grass and topsoil over approximately 2-ft of tan silt and clay. This silt and clay layer had DCP blow counts per increment between 9 and 22 with an average of 13. Boring B-6 consisted of 1.5-inches of gravel and topsoil over tan silty sand. The DCP blow count per increment was 36.

A bulk sample, CBR-1 (site 4), was taken at the aggregate surfaced Bloody Angle parking area at the intersection of Grant Drive and Anderson Drive. Laboratory test results indicate that this material was clayey sand with gravel and classified as an A-2-4(0). This bulk sample had a CBR value of 102 at a maximum dry density of 130.6 pcf at optimum moisture content of 8.6%.

***Anderson Drive*** - Based on the pavement condition survey, the AC pavement along the mainline of Anderson Drive is in fair condition. The observed pavement distress included occasional low to medium severity transverse cracking both full-lane width and ½-lane width, occasional low to medium severity longitudinal cracking along the wheel path, non-wheel path and at the centerline. Some areas of the shoulder had lane-to-shoulder drop-off of up to 10 inches at some locations. The AC pavement within the bus parking area was in good condition.

Boring B-8 and B-9 were performed along the mainline of Anderson Drive and boring B-10 was performed in the bus parking area. The AC pavement thickness measured along the mainline was approximately 2.25 to 2.5 inches and was constructed in two or three lifts. The AC pavement thickness in the bus parking area was 3.5 inches. The AC was underlain by aggregate base material ranging in thickness between 11 and 12 inches. Aggregate base was comprised of sand and gravel with a trace of silt.

The subgrade soils principally consisted of reddish tan and tan silty sand and clayey sand. Laboratory testing results on a subgrade sample from boring B-9 indicates an AASHTO classification of A-4(0) and a natural moisture content of 8.7%. Atterberg limits laboratory test results indicate that the subgrade sample is nonplastic. The DCP blow count per increment within the subgrade material ranged from 8 to 32 with an average of approximately 17.

A bulk sample, CBR-2 (site 5), was taken at an existing aggregate surfaced pull-off location along Anderson Drive. Laboratory test results indicate that this material was silty sand and classified as an A-2-4(0). This bulk sample had a CBR value of 62 at a maximum dry density of 114.2 pcf at optimum moisture content of 13.2%.

***Gordon Drive*** - Based on the pavement condition survey, the AC pavement along

Gordon Drive is in fair condition. The observed pavement distresses included occasional low severity longitudinal cracking, frequent minor raveling, low severity transverse cracking, and occasional low severity edge cracking. Frequent lane-to-shoulder drop offs and over built-up shoulders were also observed.

Boring's B-11, B-12, and B-13 were performed along the mainline of Gordon Drive. The AC pavement thickness was approximately 1.5 to 1.625 inches and was observed to consist of two lifts. The AC was underlain by aggregate base material ranging in thickness between 9 and 11 inches. Aggregate base was comprised of sand and gravel with a trace of silt. Two DCP tests performed within the aggregate base layer in boring B-13 indicate a blow count per increment of 19 and 24.

The subgrade soils consisted of red and tan silty sand with a trace of gravel. Laboratory test results on a subgrade sample from boring B-12 indicates an AASHTO classification of A-4(0) and a natural moisture content of 7.7%. Atterberg limits laboratory testing results indicate that the subgrade sample is nonplastic. The DCP blow count per increment within the subgrade soils ranged from 8 to 46 with an average of 24.

A bulk sample, CBR-3 (site 6), was collected from a hole performed in the grass shoulder at the western side of the horizontal curve connecting Anderson Drive and Gordon Drive. Laboratory test results indicate that this material was silty sand and classified as an A-2-4(0). This bulk sample had a CBR value of 70 at a maximum dry density of 115.5 pcf at optimum moisture content of 11.6%.

***Bloody Angle Drive East*** - Bloody Angle Drive East is planned to have the AC pavement removed and replaced with a natural aggregate surface footpath, therefore, a pavement condition survey was not necessary. Borings B-14 and B-15 were performed along the mainline of Bloody Angle Drive East to assist with calculating pavement removal quantities. The AC pavement thickness was approximately 2.5 to 4.0 inches and was observed to consist of 3 lifts.

***Burnside Drive*** - Based on the pavement condition survey, the AC pavement along Burnside Drive is in good condition. The observed pavement distress included occasional low severity transverse cracking, occasional low severity edge cracking, and occasional low severity longitudinal cracking in the non-wheel path. Burnside Drive had occasional over built-up shoulders, frequent lane-to-shoulder drop offs, and raveling throughout the entire length of the road.

Boring's B-16, B-17, B-18 and B-19 were performed along the mainline of Burnside Drive. The AC pavement thickness was approximately 2 to 3 inches and was constructed in two to three lifts. The AC was underlain by aggregate base material ranging in thickness between 7 and 22 inches with an average of 13 inches. Aggregate base was comprised of sand and gravel with a trace of silt. Two DCP tests performed within the base material layer in boring B-16 indicate a blow count per increment of 11 and 17.

The subgrade soils consisted of red, tan, and gray silty sand and brown sand with some silt and clay. Laboratory test results on a subgrade sample from boring B-16 indicates an AASHTO classification of A-5(1) and a natural moisture content of 22.0%. Atterberg limits laboratory testing results indicate that the subgrade sample is nonplastic. Laboratory test results on a subgrade sample from boring B-19 indicates an AASHTO classification of A-6(4) and a natural moisture content of 11.8%. Atterberg limits laboratory testing results indicate that the liquid limit is 39, the plastic limit is 24, and plasticity index is 15. The DCP blow count per increment within the subgrade soils ranged from 8 to 27 with an average of 17.

***Spotsylvania Exhibit Shelter Parking*** - Based on the pavement condition survey, the AC pavement within the Spotsylvania Exhibit Shelter Parking Area is in poor condition. It appears that a chipseal surface treatment was placed in the past. The chipseal was observed to be deteriorated and removed in several locations exposing the underlying AC. The observed pavement distress includes medium to high severity transverse cracking, low to high severity longitudinal cracking, potholes and settled areas at the entrance/exit locations, and fatigue cracking. Mature vegetation growth is prevalent throughout the cracking. It did not appear that surface water was adequately draining off of the pavement surface and vegetation growth around the curb areas was predominant.

Boring's B-1 and B-2 were performed within the Spotsylvania Exhibit Shelter Parking area. The AC pavement thickness measured approximately 3 inches at each location and was observed to be constructed in two lifts. The AC was underlain by aggregate base material ranging in thickness between 4 and 5 inches. Aggregate base was comprised of tan sand and gravel with a trace of silt.

The subgrade soils consisted of sandy clay. Laboratory test results on a subgrade sample from boring B-2 indicates an AASHTO classification of A-7-5(31) and a natural moisture content of 22.6%. Atterberg limits laboratory testing results indicate that the subgrade sample has a liquid limit of 76, a plastic limit of 38, and a plasticity index of 38. The DCP blow count per increment within the subgrade soils ranged from 6 to 8.

#### Fredericksburg Battlefield Unit

***Fredericksburg Visitor Center Parking*** - Based on the pavement condition survey, the AC pavement within the Fredericksburg Visitor Center Parking area (i.e. main parking area, semi-circle, and roundabout) is in fair to poor condition. Low to moderate severity, frequently spaced transverse cracking and longitudinal cracking, most of which was full-width, was prevalent throughout. The cracking was highly uniform in both length and spacing. Crack sealant was applied in the past however this sealant is no longer functional. No FWD testing was completed within the Fredericksburg Visitor Center Parking area. Photographs of the pavement condition are provided in Photos 1, 2, 3, and 4 in Appendix F.

Construction as-built plans from the original construction in 1936 and from an expansion project in 1972 were provided from the NMP to EFLHD Highway Design and EFLHD Geotechnical. The 1936 as-built plans show that the original pavement structure consisted of 2 inches of cold asphalt concrete pavement constructed in two lifts overlying 7 inches of

reinforced concrete with the reinforcement located 2 inches below the concrete surface. The 1972 as-built plans show that portions of the Visitor Center parking area and roadways were expanded and/or reconstructed in the following areas: northeast corner of the parking area, the southeast corner of the parking area, the entire western edge of the parking area, portions of the entrance/exit spur onto Sunken Road, and a portion of the northern section of the roundabout. The plans indicate removal of the existing reinforced concrete in the locations previously mentioned and replacement with 6 inches of aggregate base course, and replacement of all the existing AC with a 2-inch thick bituminous surface. Based on the observed cracking and the as-built plans, the moderate to high severity, uniform longitudinal and transverse cracking is most likely reflective cracking occurring at the joint locations of the underlying reinforced concrete.

Boring's B-20 to B-22 were performed within the main parking area, boring B-25 was taken in the roundabout, and boring's B-23 and B-24 were performed in the semi-circular entrance/exit spur onto Lafayette Road. Boring's B-20 through B-22 had an AC pavement thickness of 3 to 5.25 inches and were observed to be constructed in three lifts. The AC pavement thickness in the roundabout was 2.5 inches and was observed to be constructed in two lifts. Boring's B-23 and B-24 reveal an AC pavement thickness of 2.75 and 3.5 inches, respectively, and was observed to be constructed in two lifts. The AC was underlain by concrete in all borings except boring B-22 and the concrete was approximately 7 to 8 inches in thickness. Boring B-22 had aggregate base material underlying the existing AC pavement that was approximately 13 inches in thickness. Aggregate base was comprised of gravel with a trace of sand and silt. Two DCP tests performed within the base material layer in boring B-22 indicate a blow count per increment of 19 and 22.

The subgrade soils consisted of yellow and gray silty clay with a trace of sand and tan and gray silty sand with a trace of clay and a trace of gravel. Laboratory testing results on a subgrade sample from boring B-22 indicates an AASHTO classification of A-6(4) and a natural moisture content of 14.0%. Atterberg limit laboratory testing results indicate that the subgrade sample has a liquid limit of 36, a plastic limit of 16, and a plasticity index of 20. The DCP blow count per increment within the subgrade soils ranged from 22 to 36. No FWD testing was performed within the Fredericksburg Visitor Center Parking area.

#### Chancellorsville Battlefield Unit

***Chancellorsville Visitor Center Parking*** - Based on the pavement condition survey, the AC pavement within the Chancellorsville Visitor Center Parking area is in fair condition. The pavement cracking observed included low to moderate severity longitudinal cracking and low to moderate severity transverse cracking. Photographs of the pavement condition are provided in Photos 6 and 7 in Appendix F.

Boring's B-28, B-29, and B-30 were performed within the Chancellorsville Visitor Center Parking area. The AC pavement thickness was approximately 2.5 to 3 inches of AC that was constructed in two lifts. The AC was underlain by aggregate base material ranging in thickness between 7 and 11 inches. Aggregate base was comprised of tan sand and gravel with a trace of silt. The DCP blow count per increment within the base material ranged from 6 to 50 with an average of 22.

The subgrade soils consisted of red sandy clay with a trace of gravel and gray and red silty sand with a trace of gravel. Laboratory test results on a subgrade sample from boring B-28 indicates an AASHTO classification of A-7-6(15) and a natural moisture content of 21.0%. Atterberg limits laboratory testing results indicate that the subgrade sample has a liquid limit of 37, a plastic limit of 20, and a plasticity index of 17.

#### Wilderness Battlefield Unit

***Wilderness Exhibit Shelter Parking*** - Based on the pavement condition survey, the AC pavement within the Wilderness Exhibit Shelter Parking area is in fair to poor condition. There is a mauve colored chipseal with lost AC and exposures in several places, lots of loose aggregate, potholes, and poor drainage with settled areas and standing water. It did not appear that surface water was adequately draining off of the pavement surface and vegetation growth along the perimeter of the parking area was evident. A photograph of the typical pavement condition is provided as Photo 8 in Appendix F.

Boring's B-26 and B-27 were performed within the Wilderness Exhibit Shelter Parking area. The AC pavement thickness was approximately 2.5 to 3 inches of AC that was constructed in two lifts. The AC was underlain by aggregate base material ranging in thickness between 7 and 11 inches. Aggregate base was comprised of tan sand and gravel with a trace of silt. The DCP blow count per increment within the base material layer ranged from 6 to 15 with an average of 11.

The subgrade soils consisted of tan and gray silty clay. Laboratory test results on a subgrade sample from boring B-26 indicates an AASHTO classification of A-7-6(14) and a natural moisture content of 16.2%. Atterberg limits laboratory testing results indicate that the subgrade sample has a liquid limit of 42, a plastic limit of 22, and a plasticity index of 20.

## **ANALYSIS AND CONCLUSIONS**

### **Pavement Design**

A flexible pavement design analysis was performed in accordance with the "AASHTO Guide for Design of Pavement Structures, 1993". The computer program DARWin Pavement Design and Analysis System, Version 3.0, was utilized to perform the design calculations. A 20-year design life was specified. The DARWin computer program was also used to back-calculate the subgrade resilient modulus and the effective pavement modulus using the deflection data obtained during the FWD testing.

Average daily traffic (ADT) estimates along with the estimated vehicle classifications were taken from the "Fredericksburg and Spotsylvania National Military Park Engineering Study for Roads and Bridges, February 1999" prepared by EFLHD Planning and Programming. The 18-kips Equivalent Single Axle Load (ESAL) for the site was determined using the Future Rigorous ESAL Calculation in DARWin and was based upon the estimated ADT and estimated vehicle classifications. Initial average daily traffic values between 80 and 130 were used with an annual growth rate of 2 percent. The estimated ADT vehicle

classifications for each roadway and parking area is comprised of 95% passenger vehicles and 5% light trucks. The average initial truck factors corresponding to these vehicle classifications were taken from the Federal Lands Highway Project Development and Design Manual, September 2003 Minute Memo insert.

Subgrade resilient modulus values for the pavement design analyses were chosen based upon the FWD testing results. FWD tests were performed at each boring location on AC paved surfaces except for Bloody Angle Drive East and the Fredericksburg Visitor Center Parking Area. Based on the scope of work at these locations, AC pavement designs were not required. The back-calculated values for Grant Drive are not included due to a computer error that resulted in the loss of the data. During back-calculation analyses, the effective pavement modulus was approximately 60,000 psi and the subgrade resilient modulus was approximately 4000 psi. The subgrade resilient modulus and the effective pavement modulus for each testing location are tabulated in Appendix E.

The subgrade resilient modulus values back-calculated per drop were averaged for each testing location. This average subgrade resilient modulus for each testing location was averaged with the other testing locations within the individual roadway/parking area. The subgrade resilient modulus values used in the flexible pavement design ranged between 1992 psi and 6548 psi. The effective pavement modulus values ranged from 23,052 psi and 80,695 psi.

The calculated cumulative 18-kip ESAL's for the 20-year design period ranged between 9036 and 5561. The required design structural number for future traffic ranged between 1.40 inches and 2.39 inches. The specified layer design structural numbers ranged between 1.85 inches and 2.56 inches. The flexible pavement design input parameters and results are available in Appendix E.

No pavement design was performed for the Fredericksburg Visitors Center Parking Area as the FRSP NMP has requested that a full design for this area not be undertaken. The FRSP NMP would like to remove and replace the AC throughout the Visitors Center parking area and retain the existing pavement elevation. However, based upon the composite pavement structure at this location, the subgrade soils, and the traffic volume, this composite pavement will have adequate strength to support a 20-year design life.

## **RECOMMENDATIONS**

### **Pavements**

The following pavement recommendations are based on the visual pavement condition survey, the results of the subsurface investigation, laboratory testing results, and the design analyses for conditions as they existed at the time of the field inspection in July 2004. The recommendations included here reference the FP-03, "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects".

### Spotsylvania Battlefield Unit

**Grant Drive** - It is recommended to mill the existing 1.5-inches of AC along Grant Drive and replace with new Superpave Asphalt Concrete Pavement (SACP). Following milling operations, the aggregate base should be reconditioned according to Section 303. The new SACP pavement section should consist of 1.5-inches of SACP surface course, 3/8-inch nominal maximum size aggregate (NMSA), <0.3 million ESAL's, type II pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's.

The pull-off areas and the Bloody Angle parking area located along Grant Drive, Sites 2, 3, and 4 respectively, should have the upper 12-inches of existing material removed. The upper 4-inches should be wasted and the bottom 8-inches may be used as base material. The newly exposed subgrade should be conditioned according to Section 303 before placing the reused material and AC pavement. The base material layer should be placed in accordance to Section 204. The new SACP should consist of 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's.

**Anderson Drive** - It is recommended to overlay Anderson Drive with 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type II pavement smoothness. The bus parking area, Site 7, located near the end of Anderson Drive should have the widened pavement section consisting of 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's. The existing surficial material within the widened section should be removed to a 4-inch depth and wasted, and the newly exposed subgrade should be prepared according to Sections 204 and 303.

The pull-off area along Anderson Drive, Site 5, is recommended to be subexcavated to a depth of 12-inches. The upper 4-inches should be wasted and the bottom 8-inches may be used as base material. The newly exposed subgrade should be conditioned according to Section 303 before placing the reused material and AC pavement. The base material layer should be placed in accordance to Section 204. The new SACP should consist of 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's.

**Gordon Drive** - It is recommended to overlay Gordon Drive with 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type II pavement smoothness. The pull-off area along Gordon Drive, Site 6, is recommended to be subexcavated to a depth of 12-inches. The upper 4-inches should be wasted and the bottom 8-inches may be used as base material. The newly exposed subgrade should be conditioned according to Section 303 before placing the reused material and AC pavement. The base material layer should be placed in accordance to Section 204. The new SACP should consist of 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's.

**Burnside Drive** - It is recommended to overlay Burnside Drive with 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type II pavement smoothness.

***Spotsylvania Exhibit Shelter Parking Area*** - It is recommended to remove and replace the existing AC within the Spotsylvania Exhibit Shelter Parking Area and add 4-inches of aggregate base. The newly exposed base should be reconditioned according to Section 303 before placing additional aggregate base. The new aggregate base should be Grading C or D in accordance with Section 703. The new AC pavement should consist of 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, 3/4-inch NMSA, <0.3 million ESAL's.

Fredericksburg Battlefield Unit

***Fredericksburg Visitor Center Parking*** - Based on the pavement condition survey and the parks desire to retain the existing pavement elevation, it is recommended to remove the existing AC within the Fredericksburg Visitors Center parking area full-depth, seal the joints of the underlying Portland cement concrete (PCC) rigid pavement, and repave with new AC pavement. Before milling, the location of the uniform longitudinal and transverse cracks corresponding to the underlying PCC joints should be identified and recorded in the field since the as-builts do not provide information on joint location or joint width. Joint sealing of the PCC should be completed in accordance with Section 414. A Backer rod in accordance with subsection 712.01(g) should be placed in the existing PCC joint. The joint widths cannot be determined until after milling is complete and they must be measured in the field in order to properly determine the necessary Backer rod size. After the Backer rod is placed, a hot-poured joint sealant for rigid and asphalt pavement in accordance with subsection 712.01(a)-(2) should be applied at the existing joints. The width-to-depth ratio for the joint sealant material should be 1:1.

The new AC surface should consist of two 1.5-inch thick lifts of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness. Because the thickness of the existing AC is not uniform throughout this site, wedge and level SACP should be used to reestablish the existing pavement elevation. Wedge and level SACP should be SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's. After the new SACP surface has been placed, a 1-inch deep, 1/4" wide sawcut should be completed and filled with 712.01(a)-(2) material overtop the location of the joints in the underlying PCC pavement. These sawcuts and crack sealing should be within 1/2-inch horizontally of the joints. Sawcutting and sealing should be completed in accordance with Section 414.

Chancellorsville Battlefield Unit

***Chancellorsville Visitor Center Parking Area*** - It is recommended to overlay the Chancellorsville Visitors Center Parking area with 1.5-inches of SACP surface course, 3/8-inch NMSA, <0.3 million ESAL's, type V pavement smoothness.

Wilderness Battlefield Unit

***Wilderness Exhibit Shelter Parking Area*** - It is recommended to remove and replace the existing AC within the Wilderness Exhibit Shelter Parking Area. The newly exposed base should be reconditioned according to Section 303 before placing the new AC pavement. The new AC pavement should consist of 1.5-inches of SACP surface course, 3/8-inch NMSA,

<0.3 million ESAL's, type V pavement smoothness, over 2.5-inches of SACP base course, ¾-inch NMSA, <0.3 million ESAL's.

## **General**

Drainage provisions should be evaluated for the Spotsylvania Exhibit Shelter Parking area, the Chancellorsville Visitor Center Parking area, and the Wilderness Exhibit Shelter Parking area.

Upon removing the existing AC pavement, if unsuitable subgrade materials are encountered in isolated areas, sub-excavation of the unsuitable materials is recommended. Unsuitable materials should be removed to a minimum depth of 1-ft and to a maximum depth of 2-ft. Geotextile Type II-A should be placed on sub-excavated areas, then backfilled with aggregate base, grading C or D as per Section 703. Compaction should be in accordance with Section 301. Based on the field investigation, 10 cubic yards of sub-excavation and backfill and 40 square yards of geotextile should be included in the project quantity. Areas requiring sub-excavation will be selected by the CO.

If additional fill material is required to achieve the plan grade, Aggregate Base material, Grading C or D, in accordance with Section 703, may be used.

It is recommended to provide adequate drainage at the edge of the roadways by blading down the over built-up shoulders. In these locations, existing shoulder material comprising grass, organic debris, etc. should be bladed to slope away from the roadway surface. These locations should be as directed by the CO.

Where lane to shoulder drop-off is occurring, shoulders should be built up to the elevation of the edge of the roadway with aggregate-topsoil mix, in accordance with Section 703, and sloped away from the roadway surface. These locations should be as directed by the CO.

**DISCLAIMER/LIMITATIONS CLAUSE**

The subsurface explorations and tests described in the section on Procedures and Results have been conducted in accordance with standard practices and procedures (except as specifically noted). The results of these explorations and tests represent conditions at the specific locations indicated. Subsurface conditions between these locations may vary. The Analysis and Conclusions section and the Recommendations section in this report include interpretations and recommendations developed by the Government in the process of preparing the design. These interpretations are not intended as a substitute for the personal investigation, independent interpretation, and judgment of the Contractor.



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Student Engineering Co-op

**APPENDIX A - Figures**

**Figure 1: Location Map**

**Figure 2: Project Map – Spotsylvania Unit**

**Figure 3: Project Map – Fredericksburg Unit**

**Figure 4: Project Map – Chancellorsville and Wilderness Unit**

**Figure 5: Geologic Map**

**Figure 6: Soils Map – Spotsylvania County**

**Figure 7: Soils Map – Orange County**



REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), Etc.	B-1	



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FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK

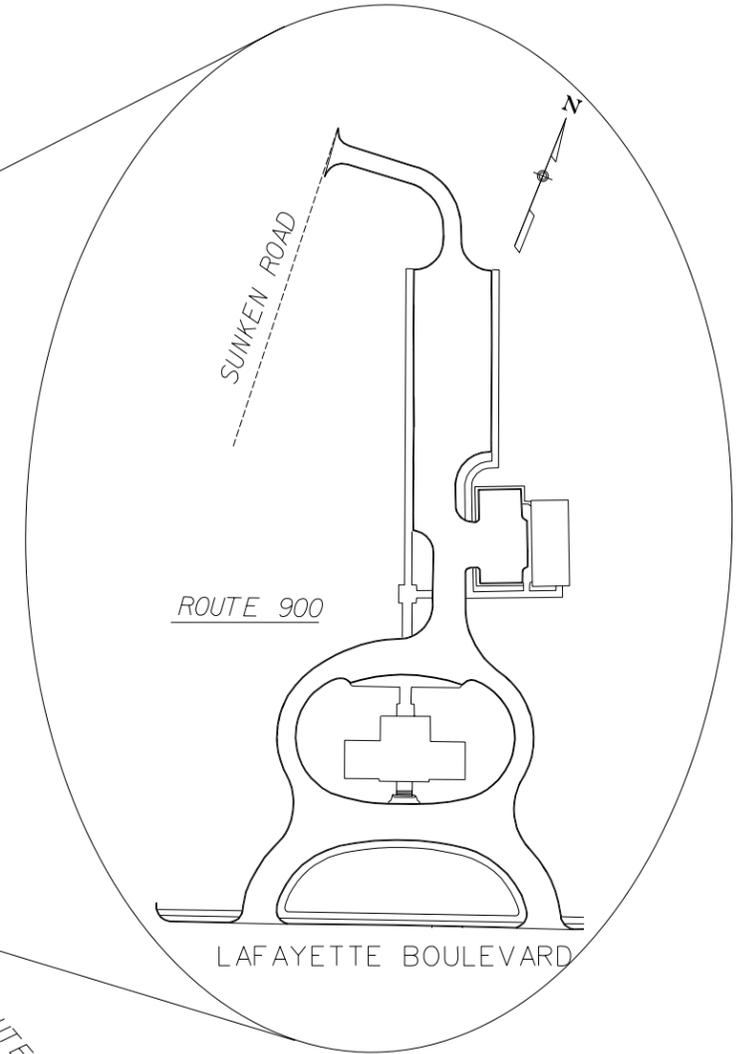
FIGURE 2: PROJECT MAP  
 SPOTSYLVANIA UNIT

SHEET 1 OF 3

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REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), Etc.	B-2	

# FREDERICKSBURG VISITORS CENTER



U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA

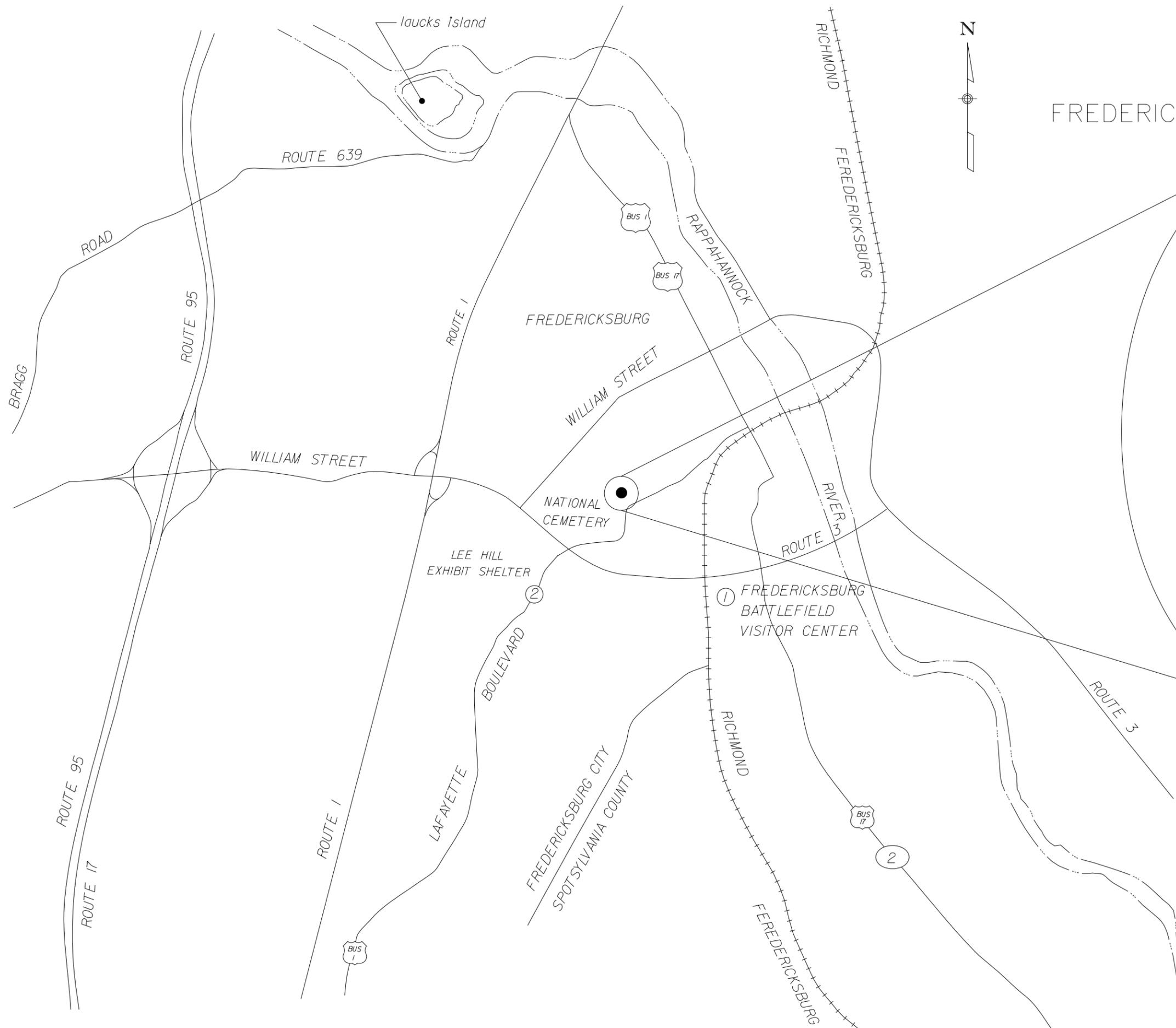
FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK

FIGURE 3: PROJECT MAP

FREDERICKSBURG UNIT

SHEET 2 OF 3

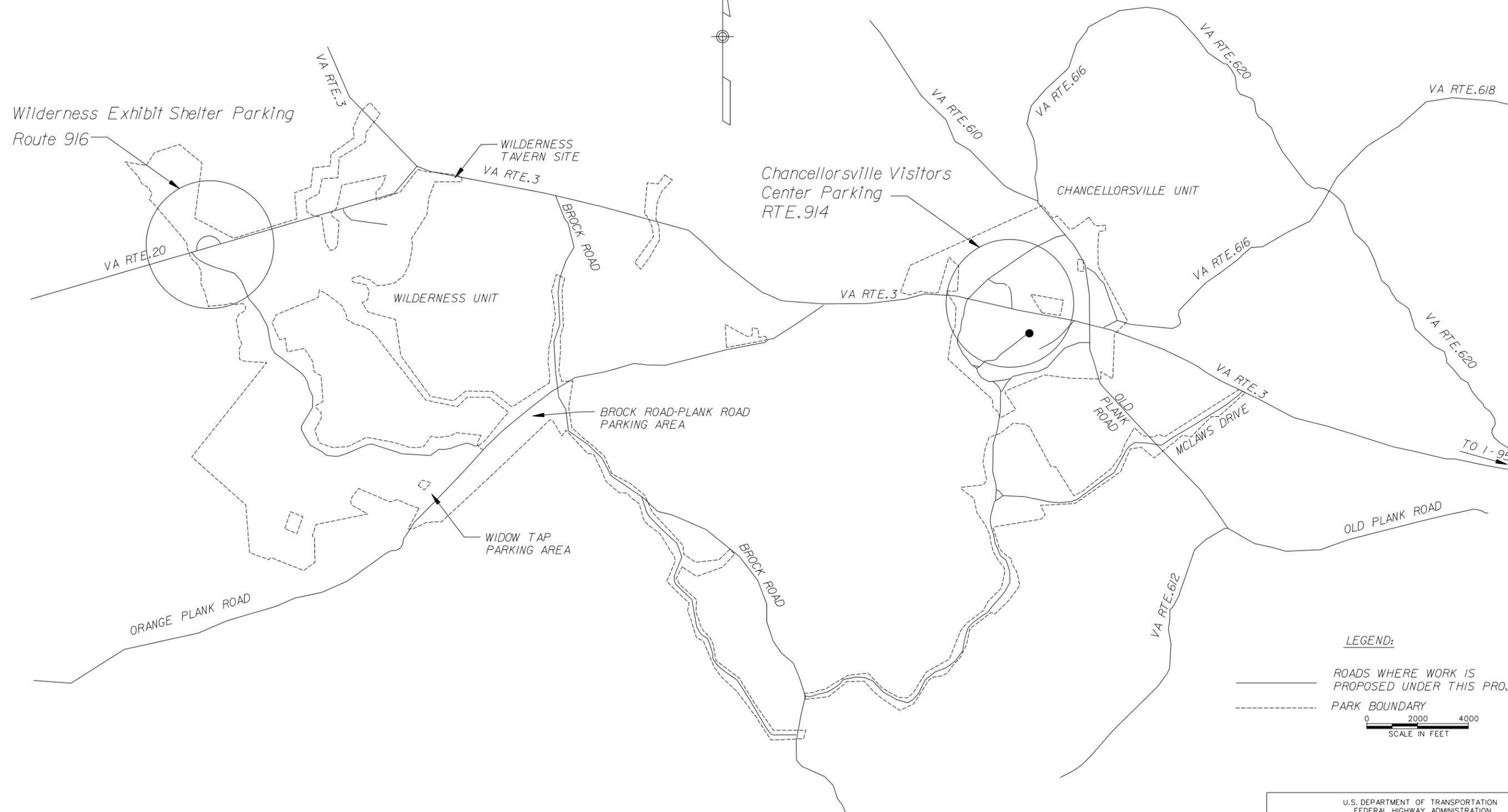
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REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), Etc.	B-3	

# WILDERNESS UNIT

# CHANCELLORSVILLE UNIT



**LEGEND:**

- ROADS WHERE WORK IS PROPOSED UNDER THIS PROJECT
  - - - PARK BOUNDARY
- 0 2000 4000  
SCALE IN FEET

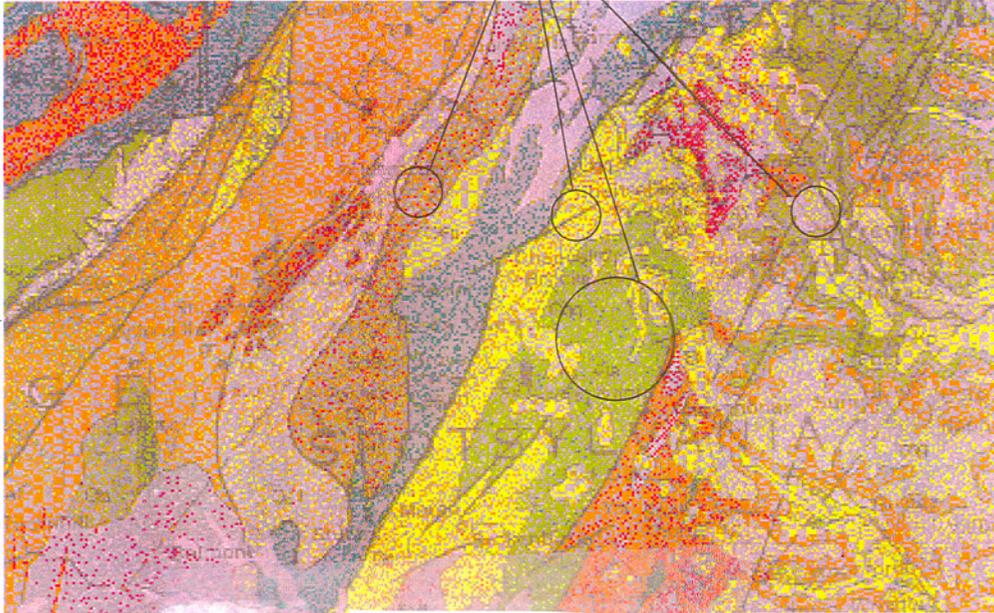
U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA

FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK

FIGURE 4: PROJECT MAP  
 WILDERNESS UNIT AND CHANCELLORSVILLE UNIT

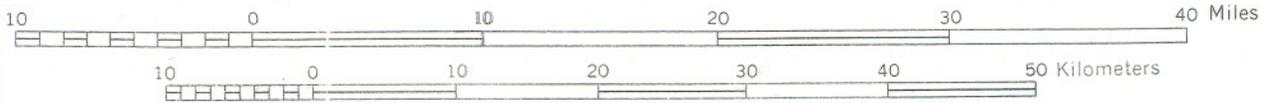
Sheet 3 of 3

Project PRA FRSP 11(1), 12(1), 19(1),  
20(1), 23(1), 900(1), 912(1), 914(1), 916(1)



Scale 1:500,000

1 inch equals approximately 8 miles



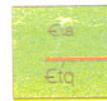
**QUANTICO FORMATION**  
Oq: slate and porphyroblastic schist. Oqq: micaceous quartzite.



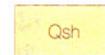
**MIOCENE SAND AND GRAVEL**  
Sandy gravel, sand, silt, and clay



**MINE RUN COMPLEX**  
OZI : Melange Zone I. OZII: Melange Zone II. OZIII: Melange Zone III.



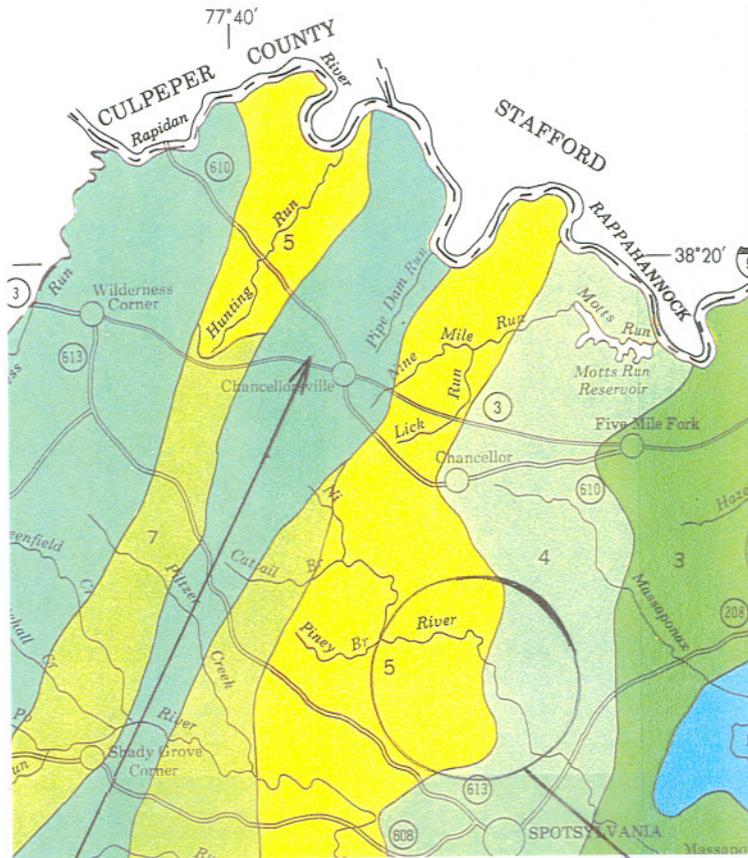
**TA RIVER METAMORPHIC SUITE**  
Eta: amphibolite gneiss. Etaq: ferruginous quartzite.



**SHIRLEY FORMATION**  
Interbedded gravel, sand, silt, clay, and peat; at altitudes to 35-45 ft.

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), etc.	1	1

# Chancellorsville and Spotsylvania Units

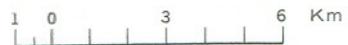


Chancellorsville Unit

Spotsylvania Unit

## SPOTSYLVANIA COUNTY, VIRGINIA

Scale 1:190,080



- 4** Appling-Wedowee-Emporia association: Deep, well drained soils that have a dominantly clayey or loamy subsoil; on Piedmont and Coastal Plain uplands
- 5** Appling-Louisburg-Wedowee association: Deep and moderately deep, well drained soils that have a dominantly clayey or loamy subsoil; on Piedmont uplands
- 6** Nason-Tatum-Catharpin association: Deep, well drained soils that have dominantly clayey subsoil; on Piedmont uplands

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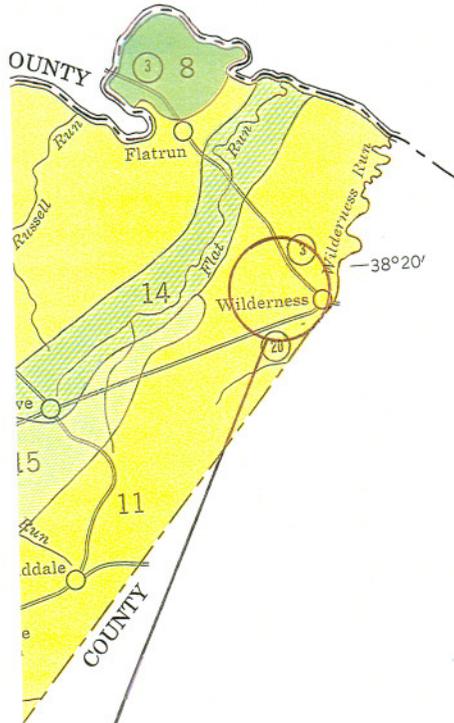
12/8/2005

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 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA

FIGURE 6: SOILS MAP

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 1K(I), etc.	1	1

# Wilderness Unit



Wilderness Unit

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE  
VIRGINIA AGRICULTURAL EXPERIMENT STATION

## GENERAL SOIL MAP ORANGE COUNTY, VIRGINIA



**11** Nason-Tatum-Manteo association: Deep or shallow, well-drained or excessively drained, gently sloping to steep soils on dissected uplands

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12/8/2005

U.S. DEPARTMENT OF TRANSPORTATION  
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EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

### FIGURE 7: SOILS MAP

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP III(I), etc.	1	1

**APPENDIX B – Boring Location Plan and GPS Coordinates**

**GEOGRAPHIC LOCATION OF BORING SUBSURFACE INVESTIGATIONS**

**Equipment** Trimble Handheld GPS, GeoXP

**Software** Pathfinder Office, Version 3.0

**Differential Correction:** CORS, Corbin, VA

**Date Corrected:** 07/08/2004

**Uncorrected File Name:** FRSP 11(1)A.ssf: B-1 through B-4

FRSP 11(1)B.ssf: B-5; Frsp.ssf: B-6 through B-30

**Corrected File Name:** FRSP 11(1)A.cor; FRSP 11(1)B.cor; Frsp.cor

**File Location:** H:\SOILS\GPS Project Files\NPS\Fredericksburg and Spotsylvania NMP

**Coordinate System:** US State Plane 1983

**Zone:** Ohio South 3402

**Datum:** NAD 1983 (Conus)

**Coordinate Units:** US Survey Feet, Northing and Easting (XYZ)

**Altitude Reference:** MSL

**GEOid Model:** Defined Geoid (Geoid99(Conus))

**Current Field Investigation**

Boring	Northing (ft)	Easting (ft)	Elevation		Ground Survey Baseline	Comments
			Altitude (ft)	Survey (ft)		
B-1	117742.836	3371735.673	333.699	329	VA State Plane North	Pavement Core and Hand Auger
B-2	117792.117	3371750.439	328.313	328	VA State Plane North	Pavement Core and Hand Auger
B-3	117711.961	3371796.652	326.297			Pavement Core and Hand Auger
B-4	119360.989	3372492.557	266.758	279	VA State Plane North	Hand Auger
B-5	119611.569	3373004.017	301.688			Pavement Core and Hand Auger
B-6	119567.231	3373874.613	328.098	320	VA State Plane North	Hand Auger
B-7	119649.371	3374970.344	329.322			Pavement Core and Hand Auger
B-8	117941.574	3374844.875	337.881			Pavement Core and Hand Auger
B-9	116754.193	3374154.263	347.018			Pavement Core and Hand Auger
B-10	116198.046	3373661.306	347.866			Pavement Core and Hand Auger
B-11	117564.628	3375332.291	321.215			Pavement Core and Hand Auger
B-12	117612.445	3376421.345	309.607			Pavement Core and Hand Auger
B-13	118253.088	3377565.524	291.833			Pavement Core and Hand Auger
B-14	119095.335	3377097.659	300.734			Pavement Core
B-15	119707.046	3376623.689	323.717			Pavement Core
B-16	118575.062	3378128.963	305.679			Pavement Core and Hand Auger
B-17	117239.016	3378261.563	279.908			Pavement Core and Hand Auger
B-18	116486.705	3380868.319	244.266			Pavement Core and Hand Auger
B-19	115422.966	3382533.434	294.075			Pavement Core and Hand Auger
B-20	147495.276	3412214.168	96.146			Pavement Core and Hand Auger
B-21	147387.849	3412311.634	80.532			Pavement Core
B-22	147355.106	3412259.478	78.003			Pavement Core and Hand Auger
B-23	147234.899	3412404.461	88.195			Pavement Core
B-24	147142.717	3412304.292	85.087			Pavement Core
B-25	147276.638	3412271.605	86.824			Pavement Core
B-26	151367.335	3328999.752	380.704	363	VA State Plane North	Pavement Core and Hand Auger

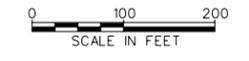
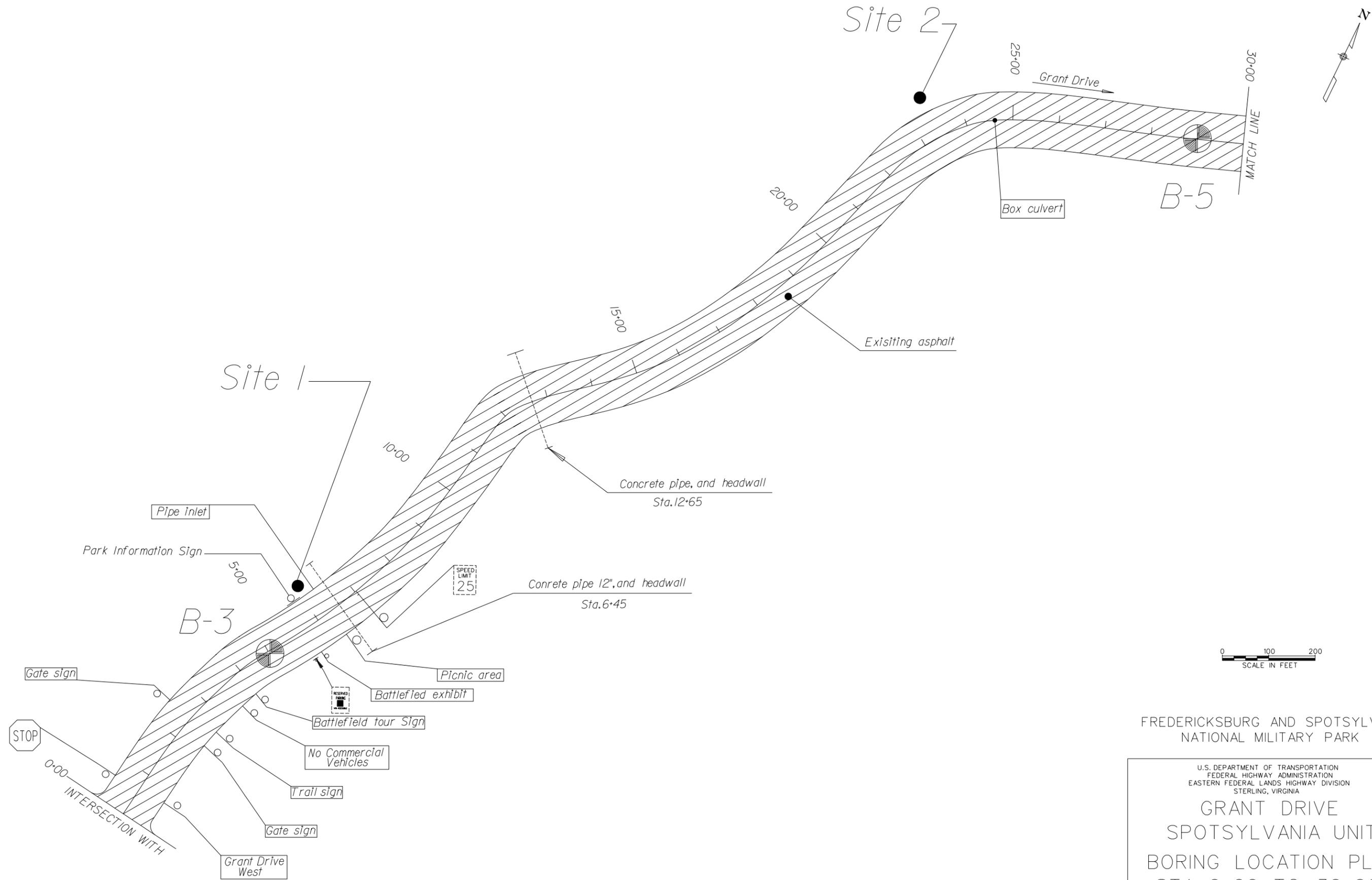
**Current Field Investigation - Continued**

Boring	Northing (ft)	Easting (ft)	Elevation			Comments
			Altitude (ft)	Survey (ft)	Ground Survey Baseline	
B-27	151324.588	3328922.377	359.578	362	VA State Plane North	Pavement Core and Hand Auger
B-28	150823.178	3359761.210	344.383			Pavement Core and Hand Auger
B-29	150862.817	3359928.756	342.368			Pavement Core and Hand Auger
B-30	150812.685	3360031.684	352.995			Pavement Core and Hand Auger
CBR-1	119474.130	3375387.456	324.000	328	VA State Plane North	Bag Sample
CBR-2	118148.955	3374861.037	348.979	347	VA State Plane North	Bag Sample
CBR-3	117400.793	3374819.281	334.882	330	VA State Plane North	Bag Sample

**Notes:**

- 1) No Control Points Surveyed with GPS.
- 2) Only select locations were ground surveyed.
- 3) Ground Survey Information: VA North State Plane, Zone 4501, NAD83.

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), ETC.		



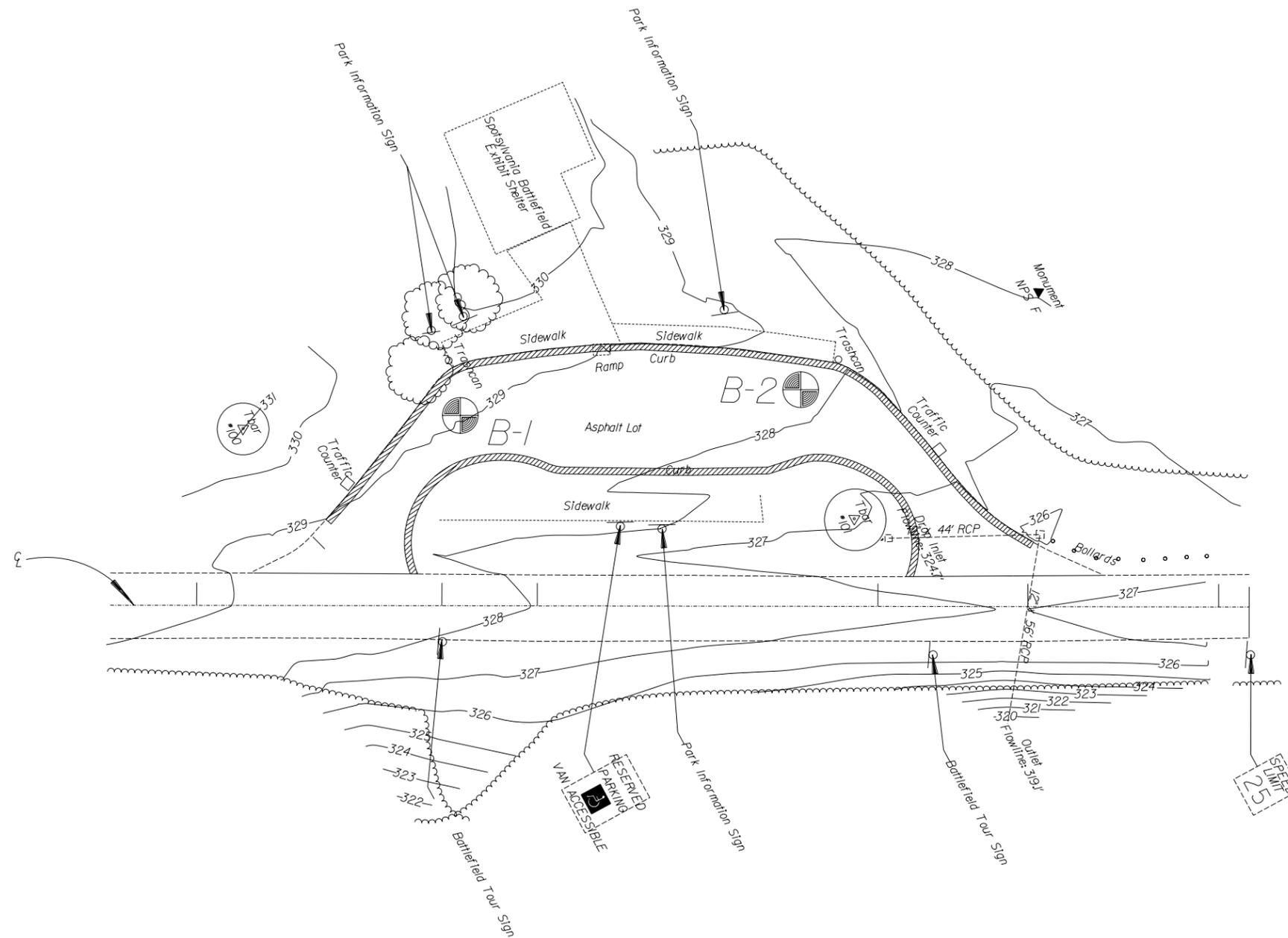
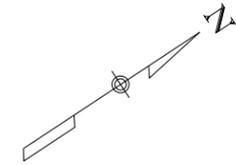
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

GRANT DRIVE  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
STA. 0+00 TO 30+00

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		

# EXHIBIT SHELTER PARKING AREA SPOTSYLVANIA UNIT



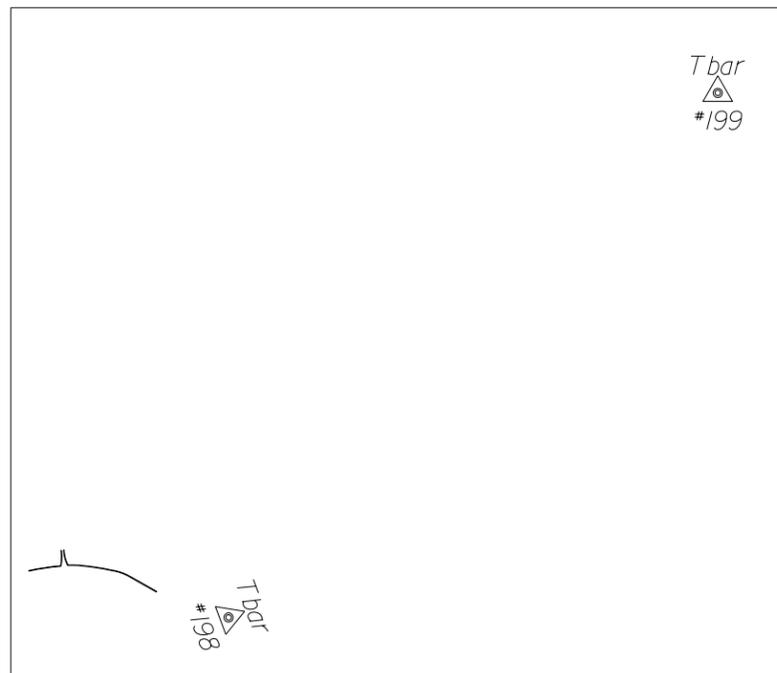
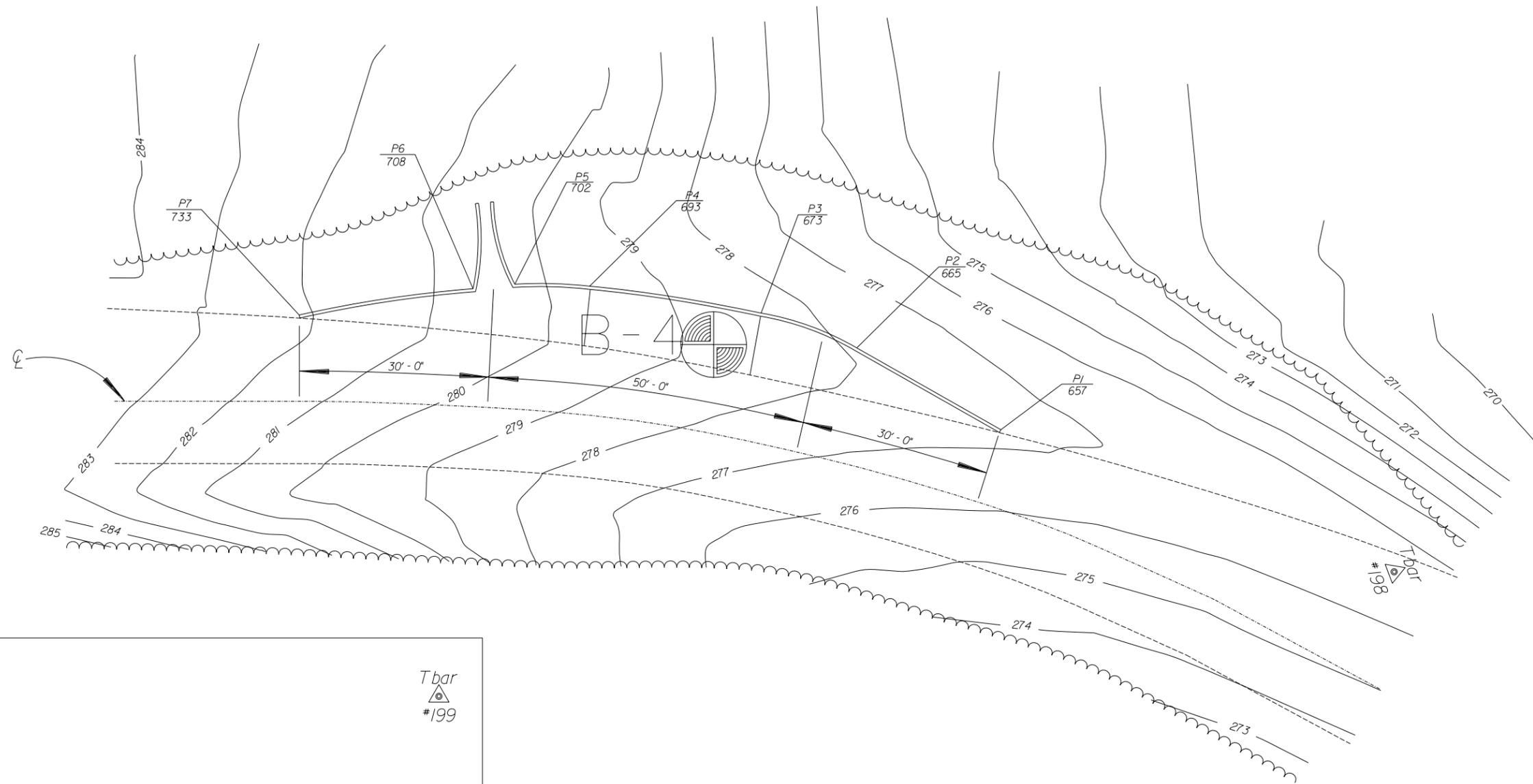
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

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FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

EXHIBIT SHELTER PARKING AREA  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
GRANT DRIVE

SITE 1

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		



FROM TBAR	TO TBAR	LEFT ANGLE	DISTANCE	POINT
198	199	5.7	612	P1
198	199	8.0	622	P2
198	199	9.2	630	P3
198	199	11.0	650	P4
198	199	11.6	660	P5
198	199	11.9	665	P6
198	199	12.9	670	P7



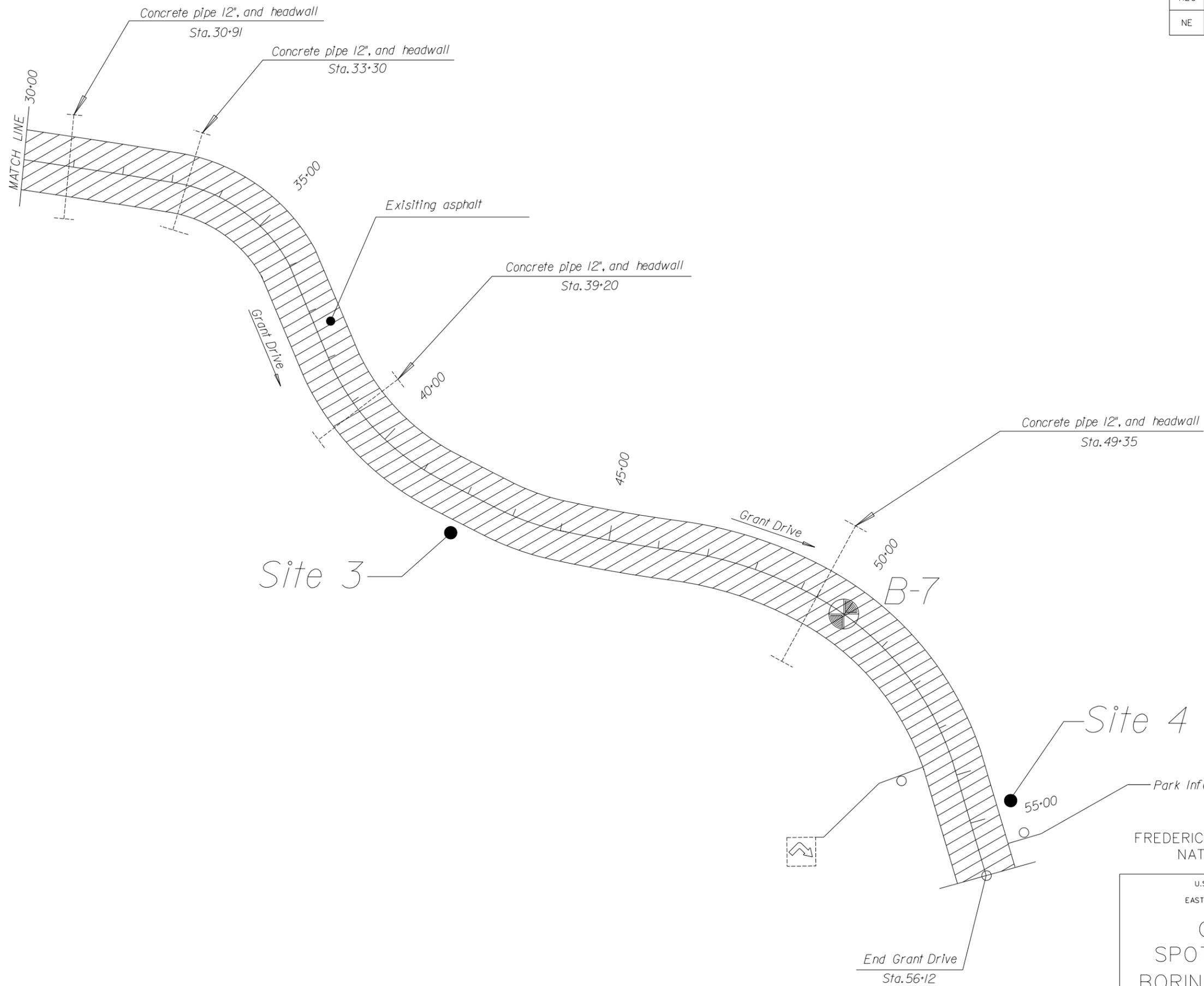
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

NEW PULL-OFF  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
GRANT DRIVE

SITE 2

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), ETC.		

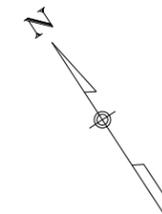
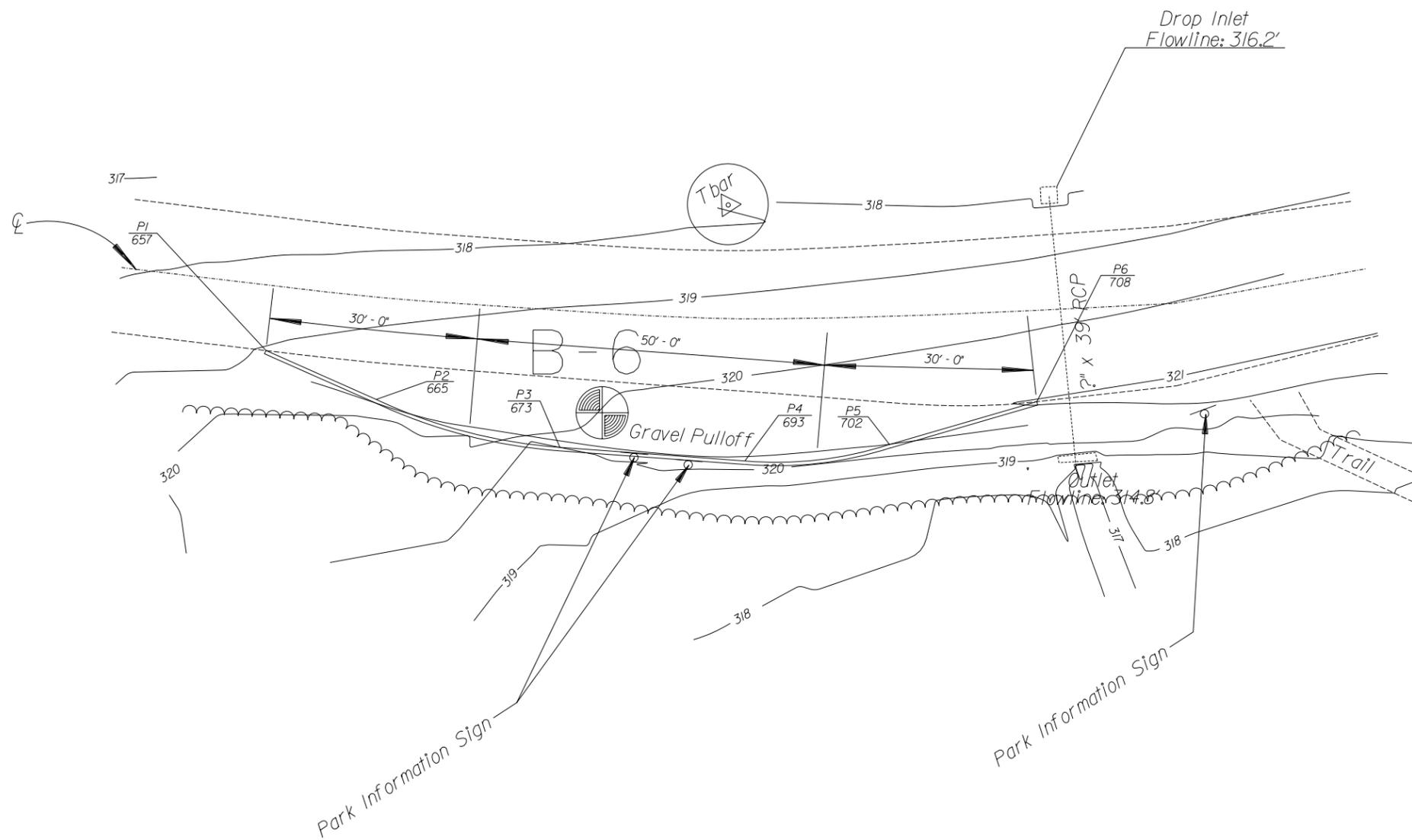


FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

GRANT DRIVE  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
STA. 30+00 TO 56+12

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		



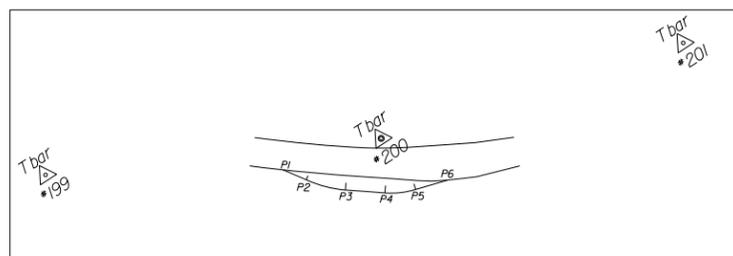
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

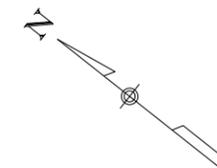
UPTON SITE PULL-OFF  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
GRANT DRIVE

SITE 3

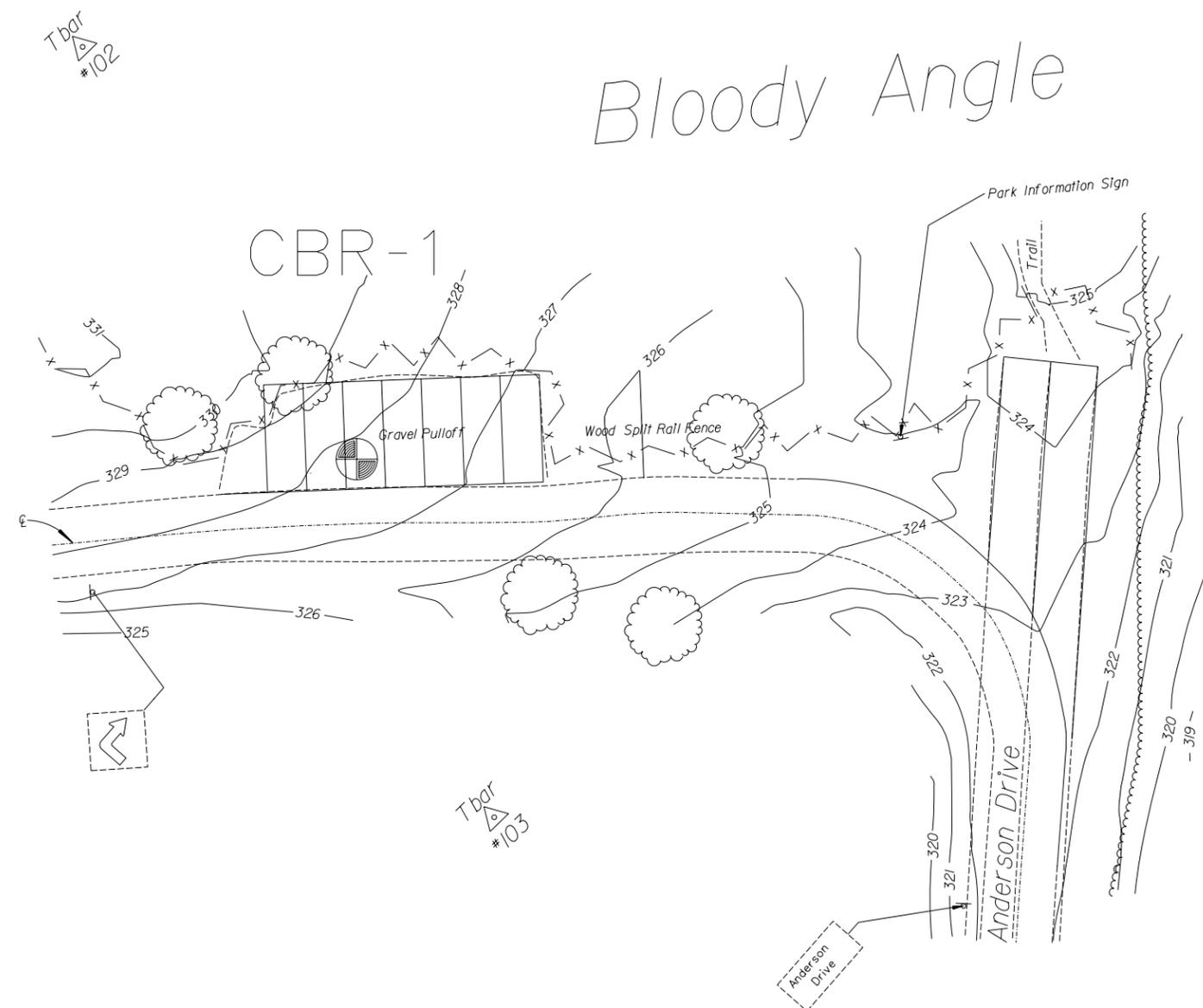
FROM TBAR	TO TBAR	RIGHT ANGLE	DISTANCE	POINT
199	200	2.85	390	P1
199	200	3.7	404	P2
199	200	4.5	430	P3
199	200	4.6	458	P4
199	200	4.2	478	P5
199	200	4.2	156	P6



REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP, 11(1), 19(1), ETC.		



# Bloody Angle



FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

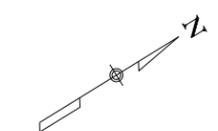
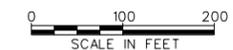
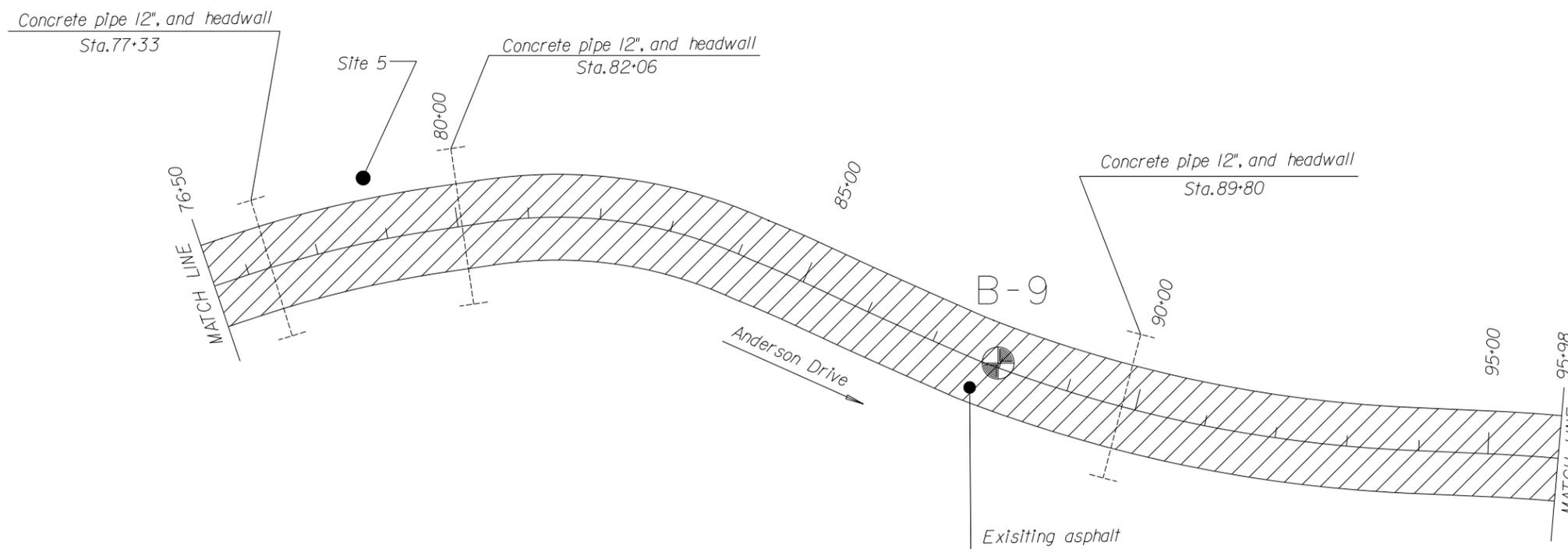
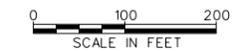
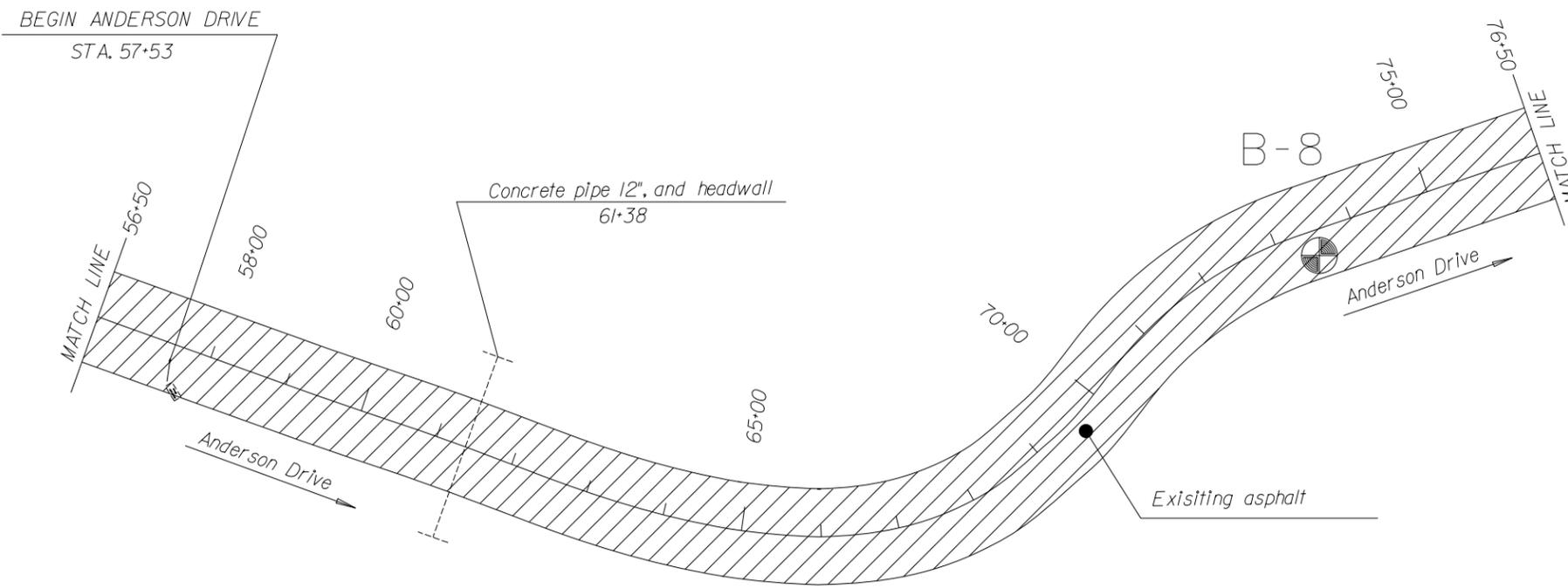
U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

BLOODY ANGLE PARKING AREA  
SPOTSYLVANIA UNIT

BORING LOCATION PLAN  
GRANT DRIVE

SITE 4

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		

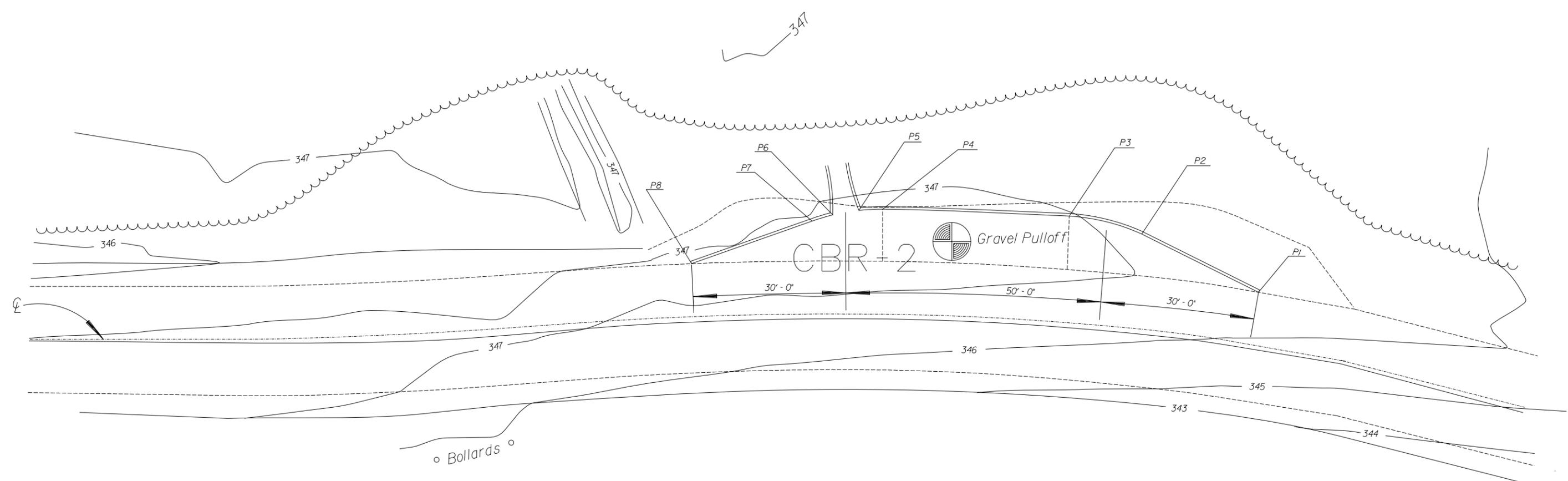
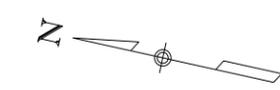


FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

ANDERSON DRIVE  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
STA. 56+50 TO 95+98

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		



FROM BAR	TO TBAR	LEFT ANGLE	DISTANCE	POINT
104	105	22.30	170	P1
104	105	30	160	P2
104	105	34.0	150	P3
104	105	45.0	125	P4
104	105	47.50	122	P5
104	105	49.0	118	P6
104	105	50.0	115	P7
104	105	60.0	97	P8

o Bollards o



FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

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FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

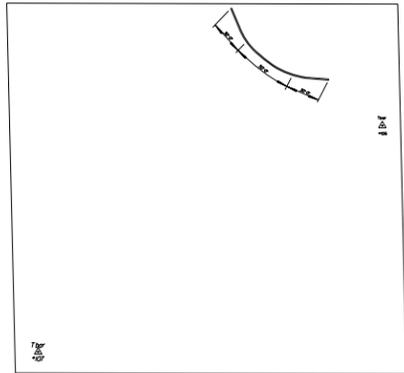
NEW PULL-OFF  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
ANDERSON DRIVE

SITE 5



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REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		



FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

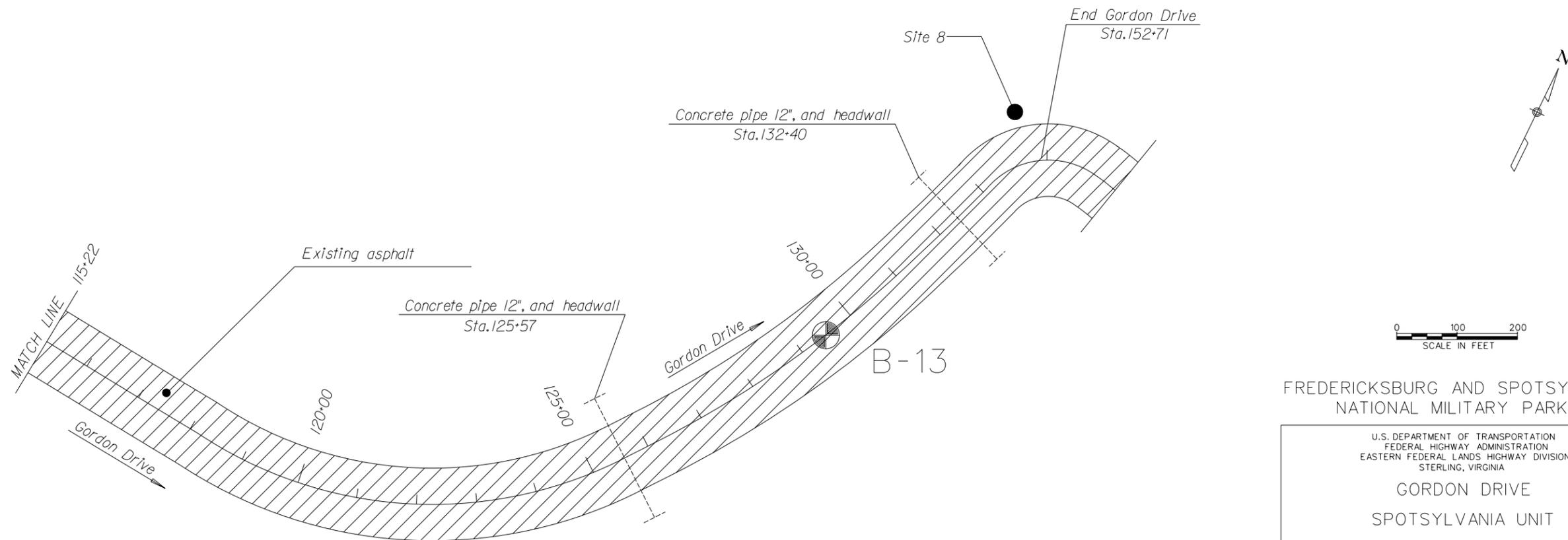
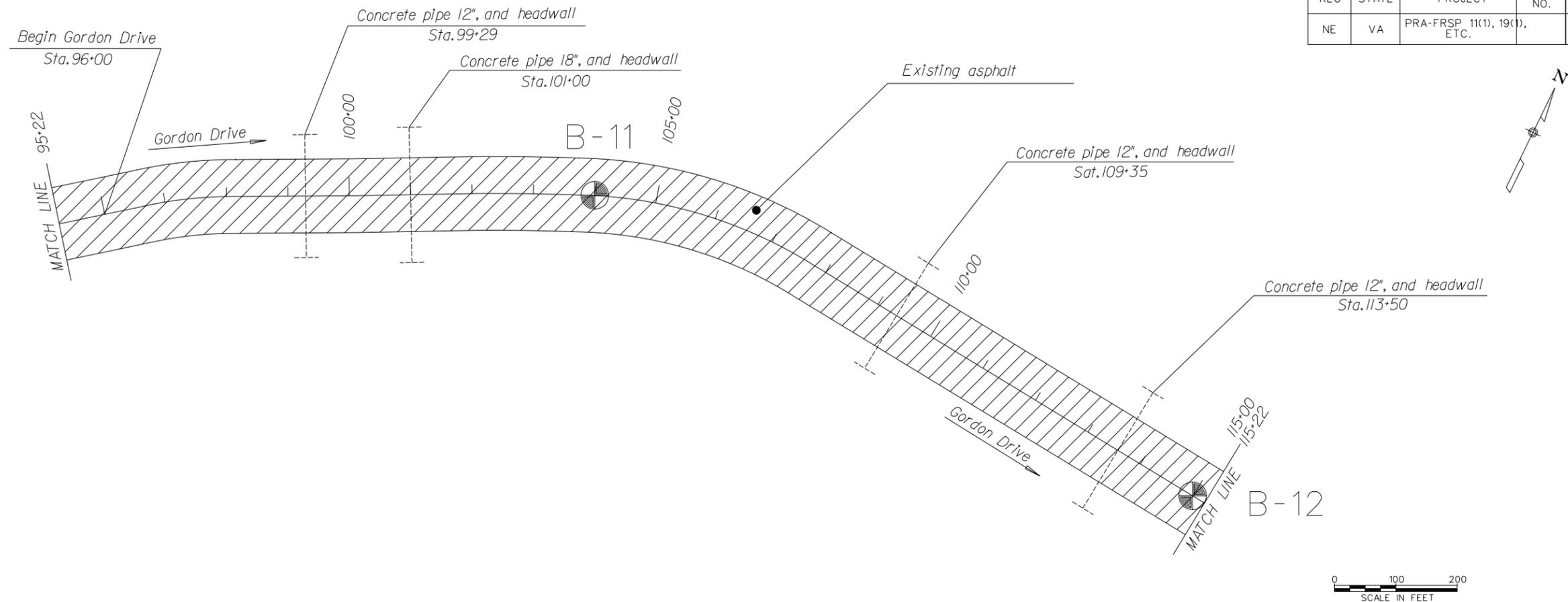
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FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

NEW PULL-OFF  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
ANDERSON - GORDON INTERSECTION

SITE 6



REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), ETC.		



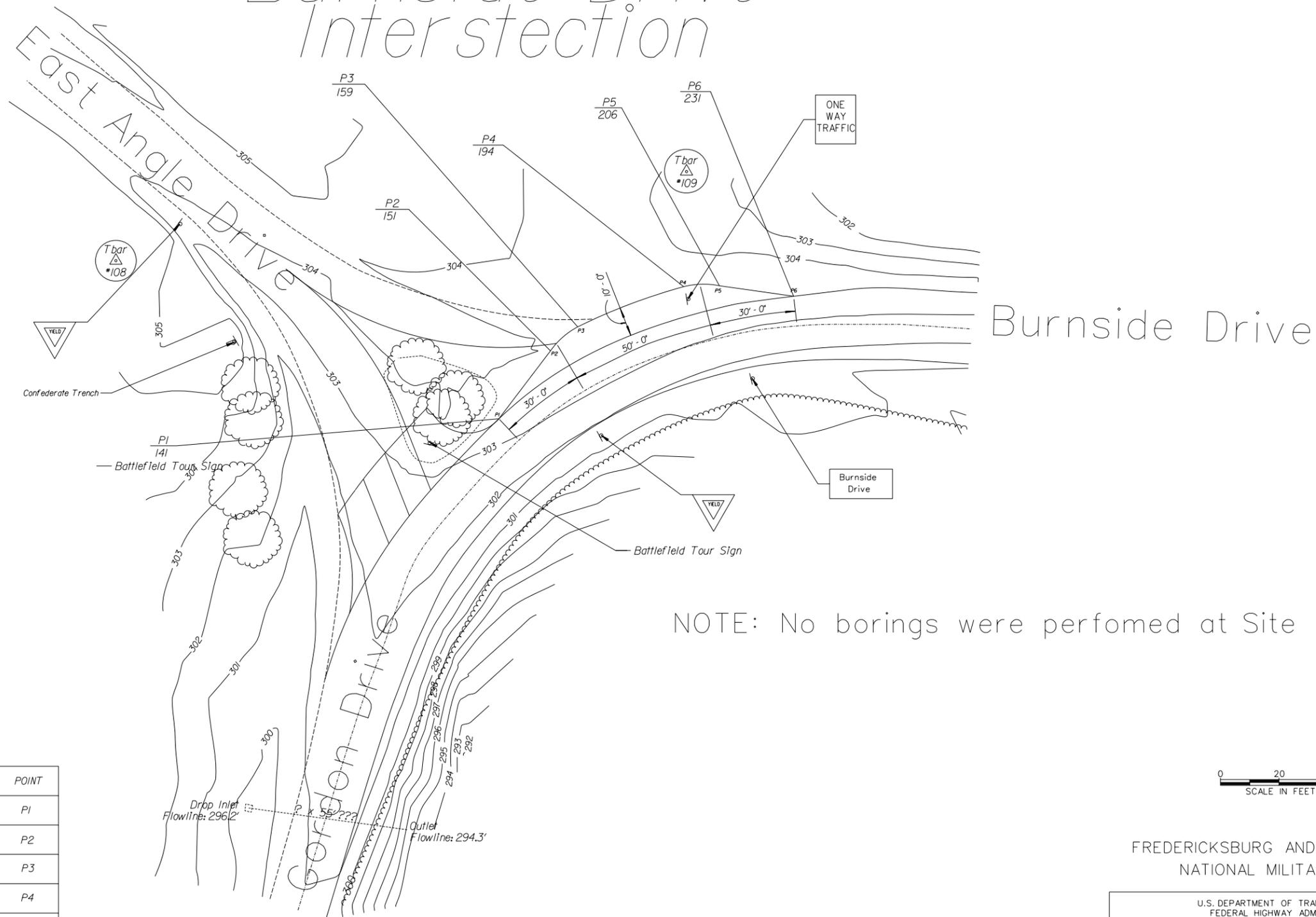
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

GORDON DRIVE  
SPOTSYLVANIA UNIT  
BORING LOCATION PLAN  
STA. 95+22 TO 152+71

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA - FRSP 11(1), 19(1), ETC.		

# Bloody Angle East - Gordon Drive - Burnside Drive Interstection



NOTE: No borings were performed at Site 8.

FROM BAR	TO TBAR	ANGLE\R	DISTANCE	POINT
108	09	31	140	P1
108	109	20	50	P2
108	109	17	160	P3
108	109	12	194	P4
108	109	11	206	P5
108	109	11	230	P6



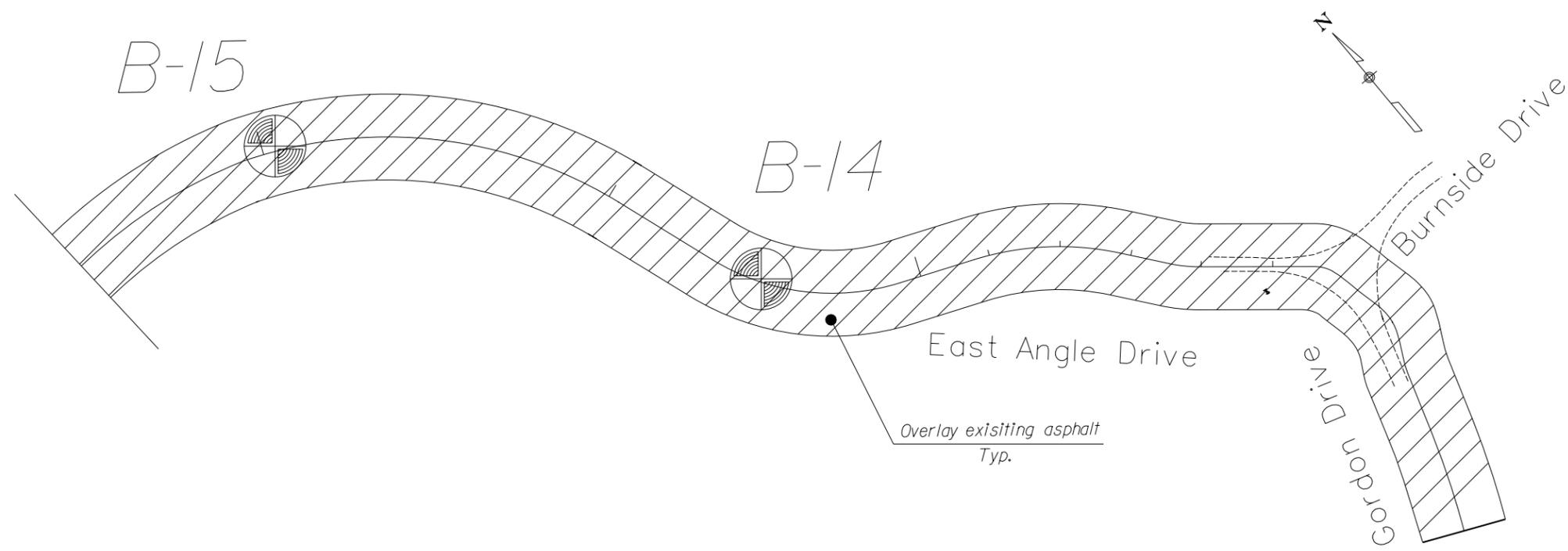
FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

NEW PULL-OFF  
GORDON DRIVE - BURNSIDE DRIVE  
BLOODY ANGLE EAST DRIVE INTERSECTION

SITE 8

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), etc.		



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BLOODY ANGLE DRIVE  
(BLOODY ANGLE EAST)  
SPOTSYLVANIA UNIT

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

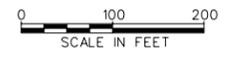
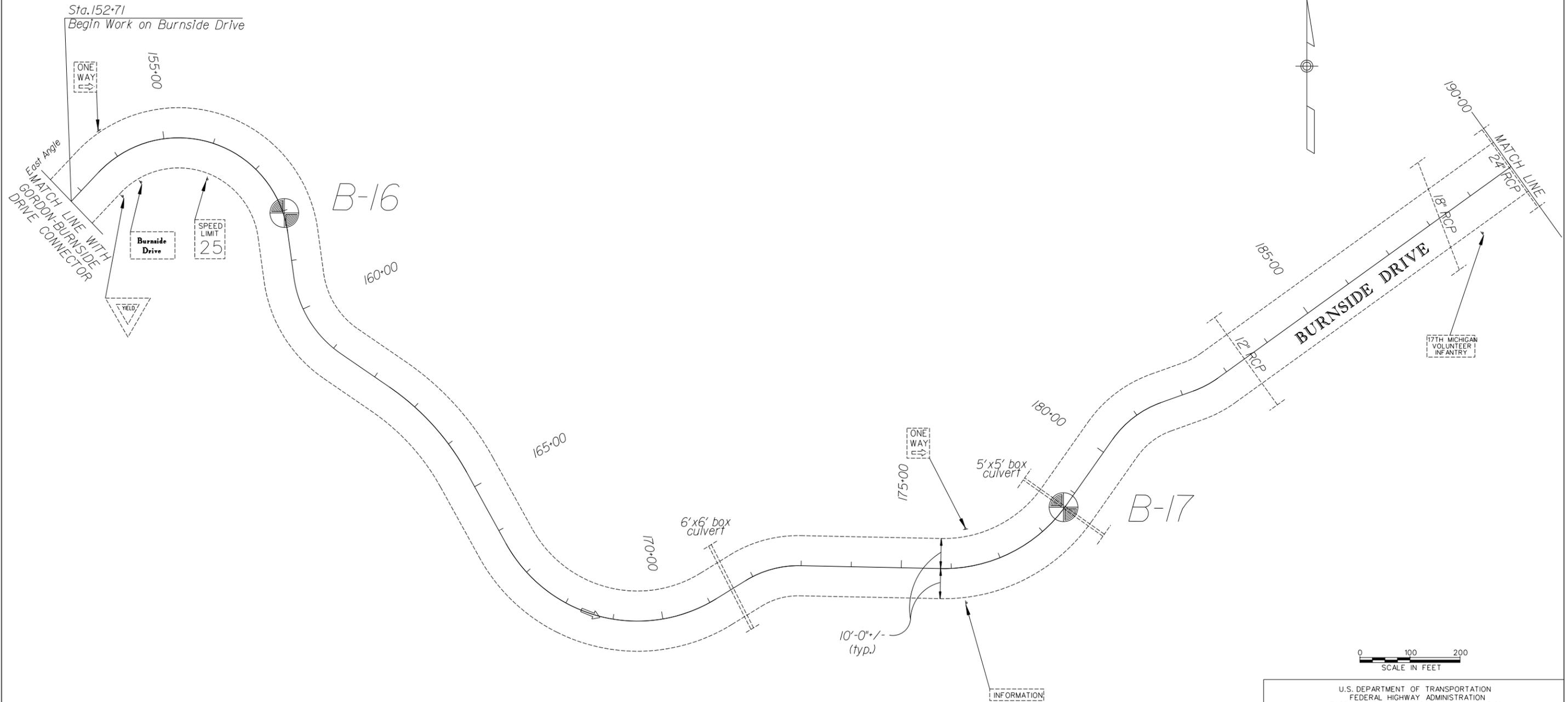
ROUTE 23(1)

BORING LOCATION PLAN

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), etc.		

NOTES:

1. See Parking Area plans for more information.
2. Construct pavement transitions at all tie-ins on the project according to DET.E401-I.



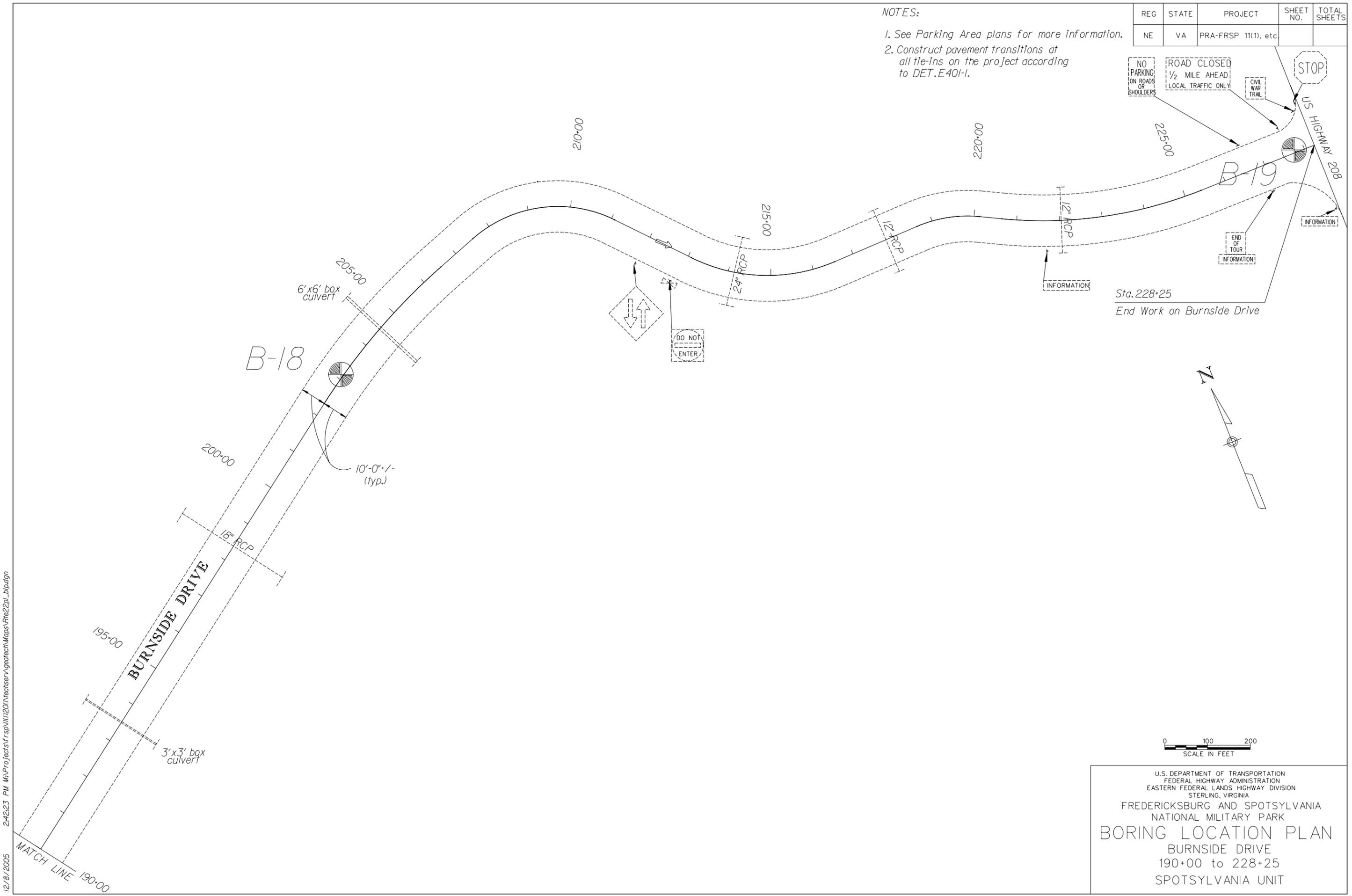
U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA

FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK

**BORING LOCATION PLAN**  
 BURNSIDE DRIVE  
 152+71 TO 190+00  
 SPOTSYLVANIA UNIT

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), etc.		

NOTES:  
 1. See Parking Area plans for more information.  
 2. Construct pavement transitions at all tie-ins on the project according to DET.E401-1.



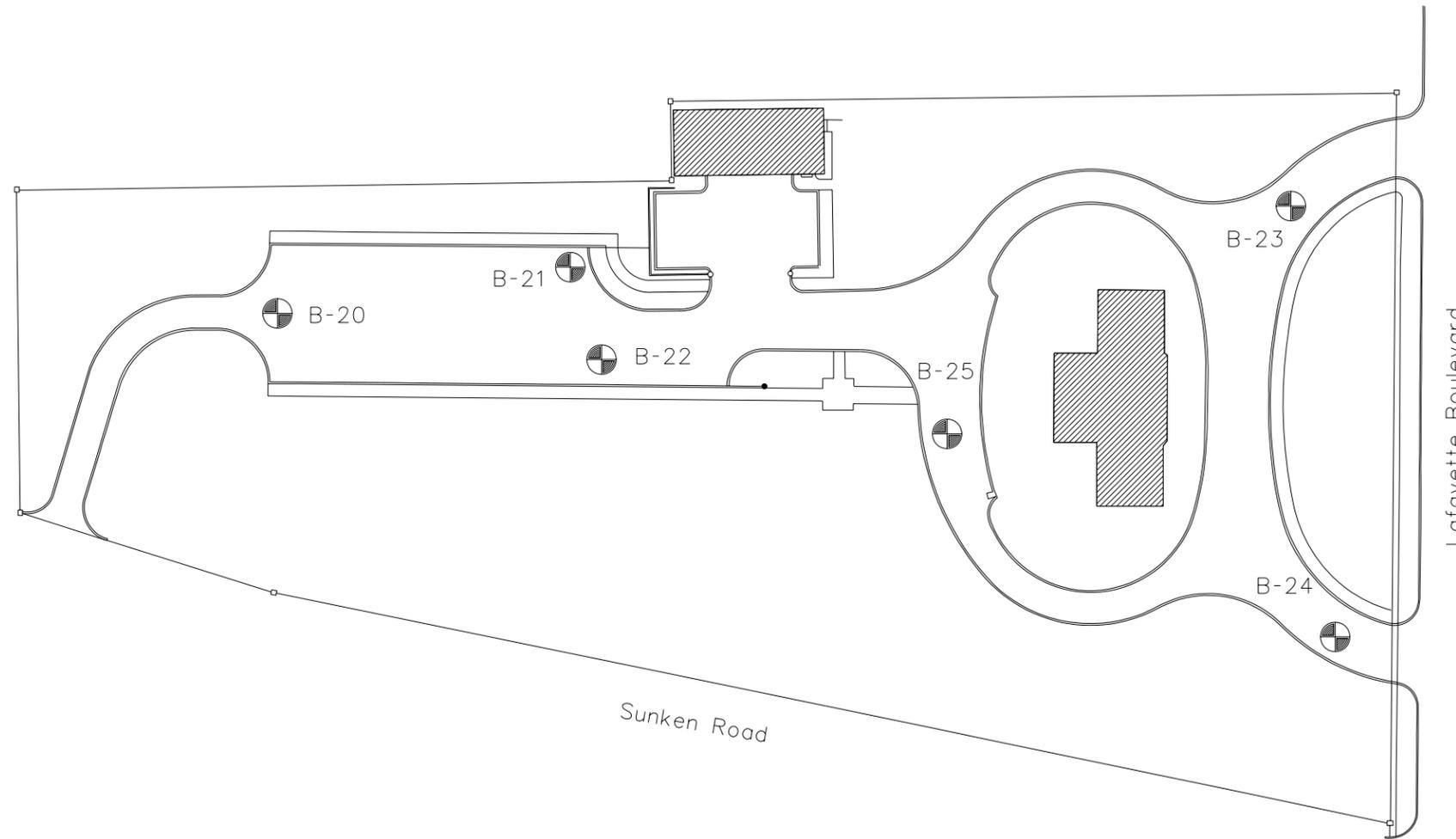
Sta. 228+25  
 End Work on Burnside Drive



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 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA  
 FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK  
**BORING LOCATION PLAN**  
 BURNSIDE DRIVE  
 190+00 TO 228+25  
 SPOTSYLVANIA UNIT

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REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), 19(1), ETC.		



FREDERICKSBURG AND SPOTSYLVANIA  
NATIONAL MILITARY PARK

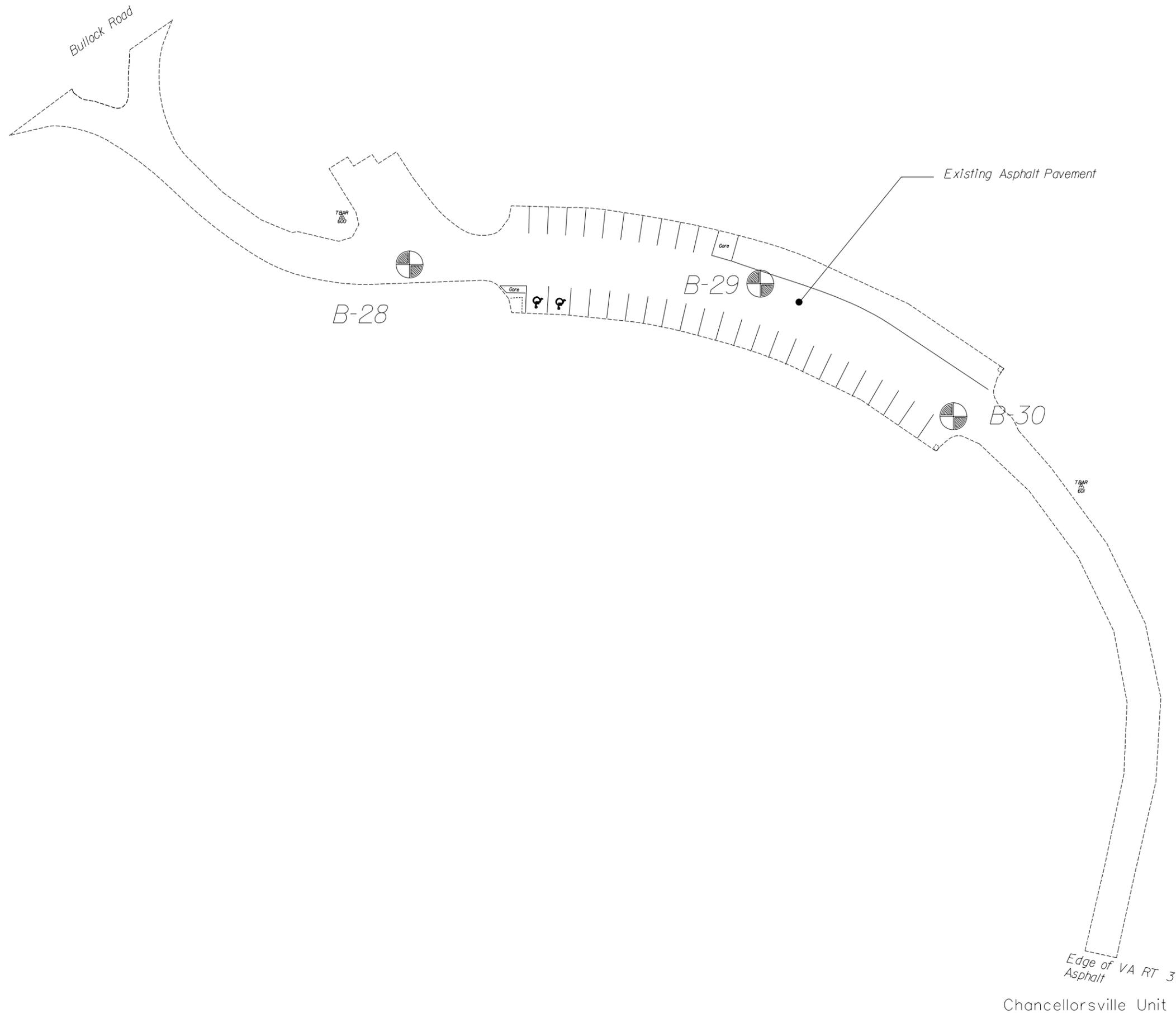
U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION  
STERLING, VIRGINIA

FREDERICKSBURG VISITOR CENTER  
PARKING AREA

FREDERICKSBURG UNIT

BORING LOCATION PLAN

REG	STATE	PROJECT	SHEET NO.	TOTAL SHEETS
NE	VA	PRA-FRSP 11(1), etc.		



U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION  
 STERLING, VIRGINIA  
 FREDERICKSBURG AND SPOTSYLVANIA  
 NATIONAL MILITARY PARK  
 CHANCELLORSVILLE VISITOR  
 CENTER PARKING AREA  
 (ROUTE 94)  
 BORING LOCATION PLAN



**APPENDIX C – Boring Logs**





# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-1 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 912 Spotsylvania Exhibit Shelter Parking, Spotsylvania Unit

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 334.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
333.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3." AC pavement consisted of a 0.25-inch chipseal over 2.75-inches of surface course AC.												
333.3		0.7	<b>BASE MATERIAL:</b> tan coarse sand with some gravel												
			<b>CLAY</b> , some sand (Moist)												
332.0		2.0	Borehole terminated at 2-ft.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-2 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 912 Spotsylvania Exhibit Shelter Parking, Spotsylvania Unit

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 328.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
327.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3." AC pavement consisted of a 0.25-inch chipseal over 2.75-inches of surface course AC.												
327.4		0.6	<b>BASE MATERIAL:</b> coarse sand, some gravel (Moist)												
326.0		2.0	<b>CLAY</b> , some sand, moist  <b>AASHTO Classification: A-7-5(31)</b> %Gravel = 0.1 %Sand = 26.2 %Fines = 73.7		S-1		7-8								
			Borehole terminated at 2-ft												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-3 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., in front of Spotsylvania Exhibit Shelter, Spotsylvania Unit

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 322.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
321.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1.5." AC pavement consisted of 1-inch of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> coarse sand and gravel (moist)												
320.8		1.2	<b>SAND</b> , some silt (moist)		S-1		13-14								
320.0		2.0	Borehole terminated at 2-ft.												

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-4 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., Spotsylvania Unit at sta 23+25 on left

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 267.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_ Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde

At Completion: \_\_\_\_\_ Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_ Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
266.8		0.3	Grassy <b>TOPSOIL</b> , thickness is 3"												
266.0		1.0	Tan <b>SILT AND CLAY</b> (moist)				9-13								
264.8		2.2	Tan <b>SILT AND CLAY</b> (dry)				12-22								
						S-1	9-15								
			Borehole terminated at 26-inches.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:  
1. No water was encountered.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-5 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., Spotsylvania Unit at sta 29+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 302.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit  -----  Liquid Limit						
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
301.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1.5"												
			<b>BASE MATERIAL:</b> tan medium sand and gravel (moist) <b>AASHTO Classification:</b> A-1-a		S-1		15-15		▼						
301.3		0.8	Tan medium <b>SAND</b> , some clay, trace of silt, moist  <b>AASHTO Classification: A-6(1)</b> <b>PI = 12</b> <b>%Gravel = 0.7</b> <b>%Sand = 62.2</b> <b>%Fines = 37.1</b>												
					S-2		15-21		▼	-----					
299.9		2.1	Borehole terminated at 25-inches.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-6 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., Spotsylvania Unit at sta 38+50  
(gravel pulloff)

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 328.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
327.9		0.1	Tan, coarse <b>GRAVEL</b> and organic matter, thickness is 1.5"												
327.7		0.3	Tan <b>SAND AND SILT</b> (dry) Borehole terminated at 3.5-inches.				36								
				5											

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:  
1. No water was encountered.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-7 Sheet: 1 of 1  
 Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., Spotsylvania Unit at sta 50+00 on right side of road  
 Groundwater Depth: \_\_\_\_\_ Surface Elevation: 329.0 ft Boring Began: 6/30/04 Completed: 6/30/04  
 Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: H. Rohde  
 At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson  
 After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit  -----  Liquid Limit ● Standard Penetration Test Data (Blows / ft)									
					Type	No.	Rec.	Blows per 6 in.	10	20	40	60	80					
328.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1.5." AC pavement consisted of 1-inch of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> dark tan gravel and medium sand (moist)															
327.8		1.2	Tan and gray <b>SAND</b> , trace of silt, moist  <b>AASHTO Classification: A-1-b</b> <b>%Gravel = 4.2</b> <b>%Sand = 76.1</b> <b>%Fines = 19.7</b>		S-1		21-29	▼										
327.2		1.8	Borehole terminated at 22-inches.															

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:  
 1. No water was encountered.  
 2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-8 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 19 Anderson Dr., Spotsylvania Unit at sta 73+50 on right side of road

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 338.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
										● Standard Penetration Test Data (Blows / ft)				
										10	20	40	60	80
337.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.25" AC pavement consisted of 1-inch of surface course AC over a second 1-inch of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> reddish-tan, gravel and medium sand											
336.9		1.1	Reddish medium <b>SAND</b> with some clay (moist)		S-1		9-8							
336.3		1.7	Borehole terminated at 20-inches.											
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-9 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 19 Anderson Dr., Spotsylvania Unit at sta 88+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 347.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit  -----  Liquid Limit					
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)					
										10	20	40	60	80
346.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> thickness is 2.5". AC pavement consisted of 1.25-inches of surface course AC over a second 1.25-inches of surface course AC <b>BASE MATERIAL:</b> gravel and medium sand (moist)											
345.8		1.2	Light tan <b>SAND</b> , some silt, dry to moist											
345.2		1.8	<b>AASHTO Classification: A-4(0)</b> %Gravel = 2.3 %Sand = 49.1 %Fines = 48.6		S-1		20-32							
			Borehole terminated at 22-inches.											
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-10 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 19 Anderson Dr., Spotsylvania Unit at end of road (bus turn around)

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 348.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
347.7		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3.5"												
346.8		1.2	<b>BASE MATERIAL:</b> medium sand and gravel (moist)												
			Borehole terminated at 14-inches.												
				5											

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-11 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 20 Gordon Dr., Spotsylvania Unit at sta 104+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 321.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
320.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1.5". AC pavement consisted of 1-in of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> gravel and medium sand (moist)												
320.0		1.0	Reddish <b>SAND</b> , some silt, trace of gravel, moist												
					S-1			15-21							
								8-12							
318.5		2.5	Borehole terminated at 29.5"												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-12 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 20 Gordon Dr., Spotsylvania Unit at sta 115+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 310.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit  -----  Liquid Limit					
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)					
										10	20	40	60	80
309.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1". AC pavement consisted of 1.125-inches of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> gravel and medium sand (moist)											
309.1		0.9	Tan, medium <b>SAND</b> , some silt, dry  <b>AASHTO Classification: A-4(0)</b> <b>%Gravel = 3.9</b> <b>%Sand = 55.4</b> <b>%Fines = 40.7</b>			S-1	16-46							
308.3		1.7	Borehole terminated at 20-inches.											
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:  
1. No water was encountered.  
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-13 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 20 Gordon Dr., Spotsylvania Unit at sta 129+50

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 292.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit  -----  Liquid Limit				
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)				
									10	20	40	60	80
291.9		0.1	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 1.5". AC pavement consisted of 1.125-inches of surface course AC over 0.5-inches of base course AC. <b>BASE MATERIAL:</b> reddish gravel and sand (moist)				19-24						
291.1		0.9	Tan <b>SAND AND SILT</b> (dry)										
290.8		1.3	Borehole refusal at 15-inches.										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-14 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 23 Bloody Angle Dr. East, Spotsylvania Unit at sta 141+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 301.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION  Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %									
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit							
300.7		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 4". AC pavement consisted of 1-in of surface course AC over 1.125-inches of surface course AC over 2-inches of base course AC.  Borehole terminated at 4-inches.	5														

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-15 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 23 Bloody Angle Dr. East, Spotsylvania Unit at sta 149+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 324.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
323.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of 1-in of surface course AC over 0.75-inches of surface course AC over 0.75-inches of base course AC. Borehole terminated at 2.5-inches.	5											

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-16 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 22 Burnside Dr., Spotsylvania Unit at sta 158+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 306.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
305.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3". AC pavement consisted of 1-in of surface course AC over 1-in of surface course AC over 0.75-inches of base course AC. <b>BASE MATERIAL:</b> gravel												
305.1		0.9	<b>SAND</b> , some silt, moist  <b>AASHTO Classification:A-5(1)</b> <b>%Gravel = 0.4</b> <b>%Sand = 53.7</b> <b>%Fines = 45.9</b>												
304.5		1.5	Borehole terminated at 18-inches.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-17 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 22 Burnside Dr., Spotsylvania Unit at sta 172+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 280.0 ft Boring Began: 7/2/04 Completed: 7/2/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %											
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit									
					● Standard Penetration Test Data (Blows / ft)															
					10	20	40	60	80											
279.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.25". AC pavement consisted of 1-in of surface course AC over 1-in of surface course AC over 0.25-inches of base course AC. <b>Base Material:</b> sand and gravel with trace of silt <moist>																	
278.0		2.0	Gray <b>SAND AND SILT</b> (moist)		S-1		10-8													
277.3		2.7	Borehole terminated at 32-inches.																	
				5																

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.





# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-19 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 22 Burnside Dr., Spotsylvania Unit at sta 228+00

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 294.0 ft Boring Began: 7/2/04 Completed: 7/2/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
293.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of 0.75-inches of surface course AC over 1-inch of surface course AC over 0.75-inches of base course AC. <b>BASE MATERIAL:</b> brown sand and gravel (moist)												
292.7		1.3	Brown <b>SAND</b> , some silt, trace of gravel, moist												
292.2		1.8	<b>AASHTO Classification: A-6(4)</b> %Gravel = 1.0 %Sand = 50.0 %Fines = 49.0 Borehole terminated at 22-inches.		S-1		27-24								
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-20 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center in Fredericksburg Unit, back center of lot

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 96.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %											
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit									
					● Standard Penetration Test Data (Blows / ft)															
					10	20	40	60	80											
95.7		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3.75". AC pavement consisted of 1.5-inches of surface course AC over 0.5-inches of surface course AC over 1.75-inches of base course AC.																	
95.0		1.0	<b>CONCRETE</b>																	
93.8		2.2	Yellow and gray <b>CLAY</b> , some silt, trace of fine sand, moist																	
93.2		2.8	<b>SAND</b> , some silt, trace of clay, moist																	
			Borehole terminated at 33.5-inches.																	
				5																

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-21 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center,

Fredericksburg Unit, in front of bookstore

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 80.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
79.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3". AC pavement consisted of 1-inches surface course AC over 2-inches of surface course AC.												
79.1		0.9	<b>CONCRETE</b>		S-1										
			Borehole refusal at 11-inches.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-22 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center, Fredericksburg Unit

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 78.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit ———— Liquid Limit					
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)					
										10	20	40	60	80
77.6		0.4	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 5.25". AC pavement consisted of 1.75-inches of surface course AC over 2-inches of surface course AC over 1.5-inches of base course AC.											
76.5		1.5	<b>BASE MATERIAL:</b> gravel				19-22							
76.0		2.0	Light tan and gray <b>SAND</b> , some silt, trace of medium gravel, moist  <b>AASHTO Classification: A-6(4)</b> <b>PI = 20</b> <b>%Gravel = 3.4</b> <b>%Sand = 53.4</b> <b>%Fines = 43.2</b> Borehole terminated at 2-ft.					S-1						
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-23 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center, Fredericksburg Unit, rt 901 entrance

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 88.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
					● Standard Penetration Test Data (Blows / ft)									
										10	20	40	60	80
87.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.75". AC pavement consisted of 0.75-inches of surface course AC over 2-inches of base course AC. Borehole terminated at 2.75-inches.	5										

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.
3. Concrete was encountered below the AC. Coring was subsequently terminated.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-24 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center,

Fredericksburg Unit, entrance closest to cemetery

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 85.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
										● Standard Penetration Test Data (Blows / ft)				
										10	20	40	60	80
84.7		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3.5". AC pavement consisted of 1-inch of surface course AC over 2.5-inches of base course AC. Borehole terminate at 3.5-inches.	5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.
3. Concrete was encountered below the AC. Coring was subsequently terminated.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-25 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 900 Fredericksburg Visitor Center, Fredericksburg Unit, in one way circle

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 87.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Raining

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %									
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit							
86.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of 1-inch of surface course AC over 1.5-inches of base course AC.															
86.6		0.4	<b>CONCRETE</b>															
			Borehole terminated at 5-inches.															
				5														

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.
3. Concrete was encountered below the AC. Coring was subsequently terminated.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-26 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 916 Wilderness Exhibit Shelter Parking, Wilderness Unit, handicapped parking near

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 381.0 ft Boring Began: 5/11/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit ———— Liquid Limit				
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)				
									10	20	40	60	80
380.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3". AC pavement consisted of a 0.125-inch mauve-colored chipseal over 2.75-inches of surface course AC. <b>BASE MATERIAL:</b> medium sand and gravel, moist				11-6						
380.1		0.9	Tan <b>CLAY</b> , some silt, trace of dark gray silty layer, moist  <b>AASHTO Classification: A-7-6(14)</b> <b>PI = 20</b> <b>%Gravel = 1.5</b> <b>%Sand = 23.8</b> <b>%Fines = 74.7</b>			S-1							
379.3		1.7	Borehole terminated at 20-20-inches.										
				5									

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-27 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 916 Wilderness Exhibit Shelter Parking in the Wilderness Unit - closer to bus parking area

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 360.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %						
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit				
					● Standard Penetration Test Data (Blows / ft)					10	20	40	60	80	
359.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of a 0.125-inch mauve-colored chipseal over 2-inches of surface course AC. <b>BASE MATERIAL:</b> medium tan sand and gravel (moist)					15-10							
358.9		1.1	Dark gray and tan <b>CLAY</b> , some silt, moist												
358.4		1.6	Borehole terminated at 19-inches.												
				5											

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-28 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 914 Chancellorsville Exhibit Parking, Chancellorsville Unit, across from bus/RV parking

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 344.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Raining

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit ———— Liquid Limit					
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)					
										10	20	40	60	80
343.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of 0.75-inches of surface course AC over 1.75-inches of surface course AC. <b>BASE MATERIAL:</b> sand and gravel with some silt (moist)				8-6							
343.1		0.9	Red <b>CLAY</b> , some sand, trace of gravel, moist  <b>AASHTO Classification: A-7-6(15)</b> <b>PI = 17</b> <b>%Gravel = 1.5</b> <b>%Sand = 23.8</b> <b>%Fines = 74.7</b>			S-1								
342.3		1.7	Borehole terminated at 20-inches.											
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-29 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 914 Chancellorsville Exhibit Parking,  
Chancellorsville Unit, base of History Loop Trail

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 342.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Raining

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content % Plastic Limit ———— Liquid Limit				
					Type	No.	Rec.	Blows per 6 in.	● Standard Penetration Test Data (Blows / ft)				
									10	20	40	60	80
341.8		0.3	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 3". AC pavement consisted of 1-inch of surface course AC over 2-inches of base course AC.										
			<b>BASE MATERIAL:</b> gray sand and gravel (moist)				17-30						
340.9		1.1	Gray and reddish <b>SAND</b> , some silt, trace of gravel, moist			S-1							
340.5		1.5	Borehole terminated at 18-inches.										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: B-30 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 914 Chancellorsville Exhibit Parking,  
Chancellorsville Unit end of major PA

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 353.0 ft Boring Began: 7/7/04 Completed: 7/7/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: HAND AUGER Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: 15 lbs/DCP Hole Diameter: 4" Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: 20 in. Rock Core Diam: N/A Weather: Raining

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
					● Standard Penetration Test Data (Blows / ft)									
										10	20	40	60	80
352.8		0.2	<b>ASPHALT CONCRETE (AC) PAVEMENT</b> , thickness is 2.5". AC pavement consisted of 0.75-inches of surface course AC over 1.75-inches of surface course AC.											
			<b>BASE MATERIAL</b> : gray sand and gravel (moist)				19-50							
352.0		1.0	Borehole refusal at 12-inches.											
				5										

Sample Types:  
 Auger Cuttings  
 Vane Shear  
 SPT

UD  
 Penetrometer  
 Rock Core

Remarks:

1. No water was encountered.
2. Boring was backfilled with auger cuttings and sealed with cold patch AC.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: CBR-1 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 11 Grant Dr., Spotsylvania Unit at sta 54+50 (gravel pulloff)

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 324.0 ft Boring Began: 6/30/04 Completed: 6/30/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: SHOVEL Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: \_\_\_\_\_ Hole Diameter: 1' Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: \_\_\_\_\_ Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
										● Standard Penetration Test Data (Blows / ft)				
										10	20	40	60	80
			<b>Clayey Sand with Gravel</b> <b>A-2-4(0)</b> <b>PI = 10</b> <b>%Gravel = 18.9</b> <b>%Sand = 46.7</b> <b>%Fines = 34.4</b>  <b>Maximum Dry Density = 130.6 pcf</b> <b>Optimum Moisture Content = 8.6%</b> <b>CBR = 102</b>	5	CBR-1									

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:  
1. No water was encountered.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: CBR-2 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 19 Anderson Dr. in Spotsylvania Unit at sta 71+50

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 349.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: SHOVEL Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: \_\_\_\_\_ Hole Diameter: 1' Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: \_\_\_\_\_ Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
										● Standard Penetration Test Data (Blows / ft)				
										10	20	40	60	80
			<b>Silty Sand</b> <b>A-2-4(0)</b> <b>Nonplastic</b> <b>%Gravel = 13.0</b> <b>%Sand = 53.2</b> <b>%Fines = 33.8</b>  <b>Maximum Dry Density = 114.4 pcf</b> <b>Optimum moisture content = 13.7%</b> <b>CBR = 62</b>	5	CBR-2									

Sample Types:

- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:  
1. No water was encountered.



# BORING LOG

U. S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION  
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Project Name: FRSP 11(1),19(1),20(1),22(1),23(1),900(1),912(1),914(1),916(1) Boring No.: CBR-3 Sheet: 1 of 1

Project Location: Fredericksburg and Spotsylvania National Military Park Boring Location: Rte 19 Anderson Dr. in Spotsylvania Unit at sta 229+50

Groundwater Depth: \_\_\_\_\_ Surface Elevation: 335.0 ft Boring Began: 7/1/04 Completed: 7/1/04

Encountered at: \_\_\_\_\_  Caved at: \_\_\_\_\_ Boring Method: SHOVEL Inspector: A. Warrick

At Completion: \_\_\_\_\_  Hammer Wt. & Type: \_\_\_\_\_ Hole Diameter: 1' Operator: A. Richardson

After \_\_\_\_\_ hrs \_\_\_\_\_  Hammer Drop: \_\_\_\_\_ Rock Core Diam: N/A Weather: Partly Cloudy

Elevation (feet)	Graphic Log	Layer Depth (ft)	MATERIAL DESCRIPTION Density, Color, Plasticity, Size, Proportions, Moisture	Depth Scale (ft)	SAMPLE				▼ Water Content %					
					Type	No.	Rec.	Blows per 6 in.	Plastic Limit		Liquid Limit			
										● Standard Penetration Test Data (Blows / ft)				
										10	20	40	60	80
			<b>Silty Sand</b> <b>A-2-4(0)</b> <b>Nonplastic</b> %Gravel = 9.1 %Sand = 62.7 %Fines = 28.2  Maximum Dry Density = 115.9 pcf Optimum moisture content = 11.6% CBR = 70	5	CBR-3									

Sample Types:

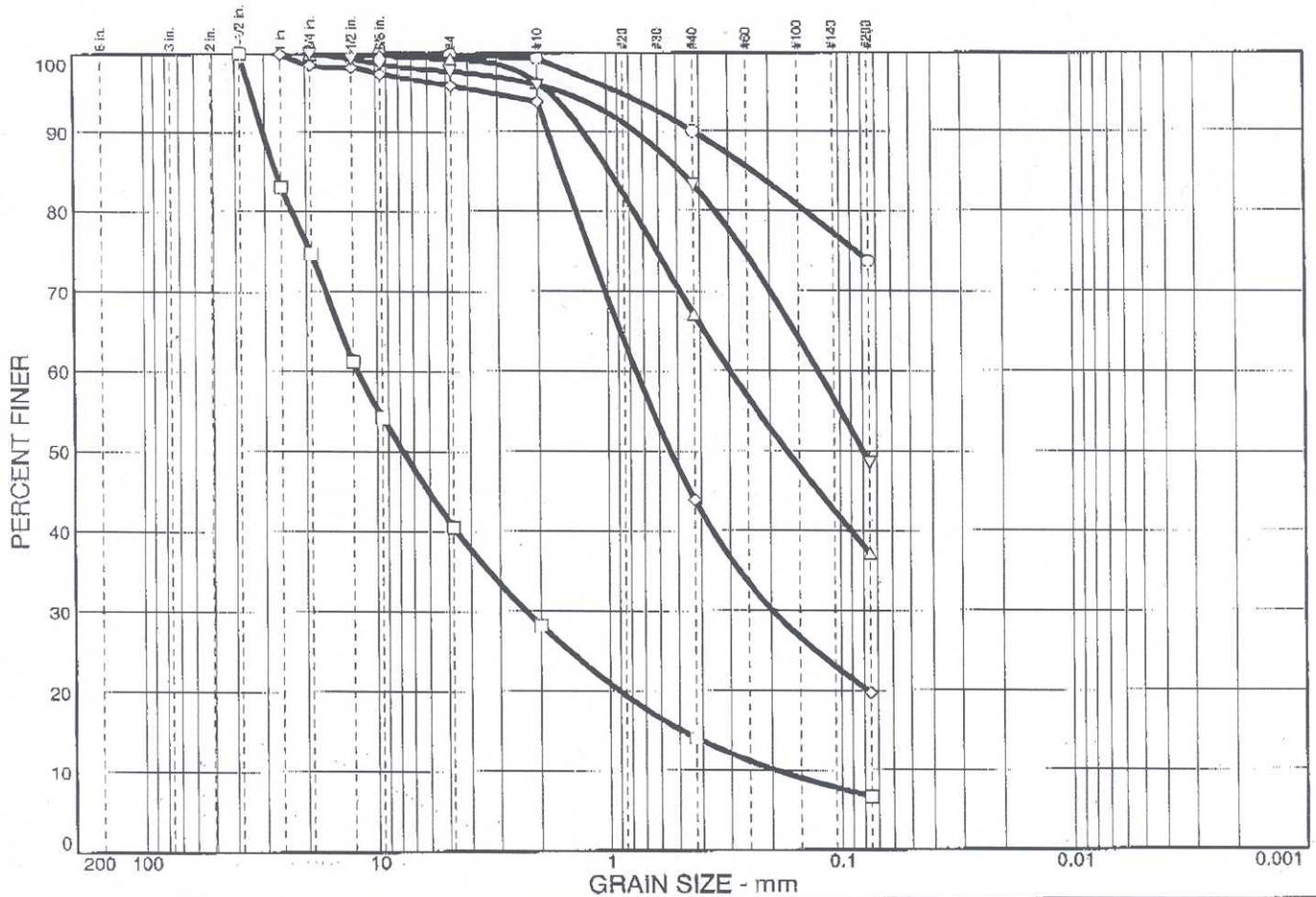
- Auger Cuttings
- Vane Shear
- SPT

- UD
- Penetrometer
- Rock Core

Remarks:  
1. No water was encountered.

**APPENDIX D – Laboratory Testing Results**

# Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	0.1	26.2	73.7	
□	0.0	59.5	33.9	6.6	
△	0.0	0.7	62.2	37.1	
◇	0.0	4.2	76.1	19.7	
▽	0.0	2.3	49.1	48.6	

## SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	AASHTO
○		B-2/S-1	.583-2.0	Elastic silt with sand	A-7-5(31)
□		B-5/S-1	.125-.750	Well-graded gravel with silt and sand	A-1-a
△		B-5/S-2	1.5-2.083	Clayey sand	A-6(1)
◇		B-7/S-1	1.167-1.830	Silty sand	A-1-b
▽		B-9/S-1	1.167-1.830	Silty sand	A-4(0)

Particle Size Distribution Report  
FEDERAL HIGHWAY ADMINISTRATION

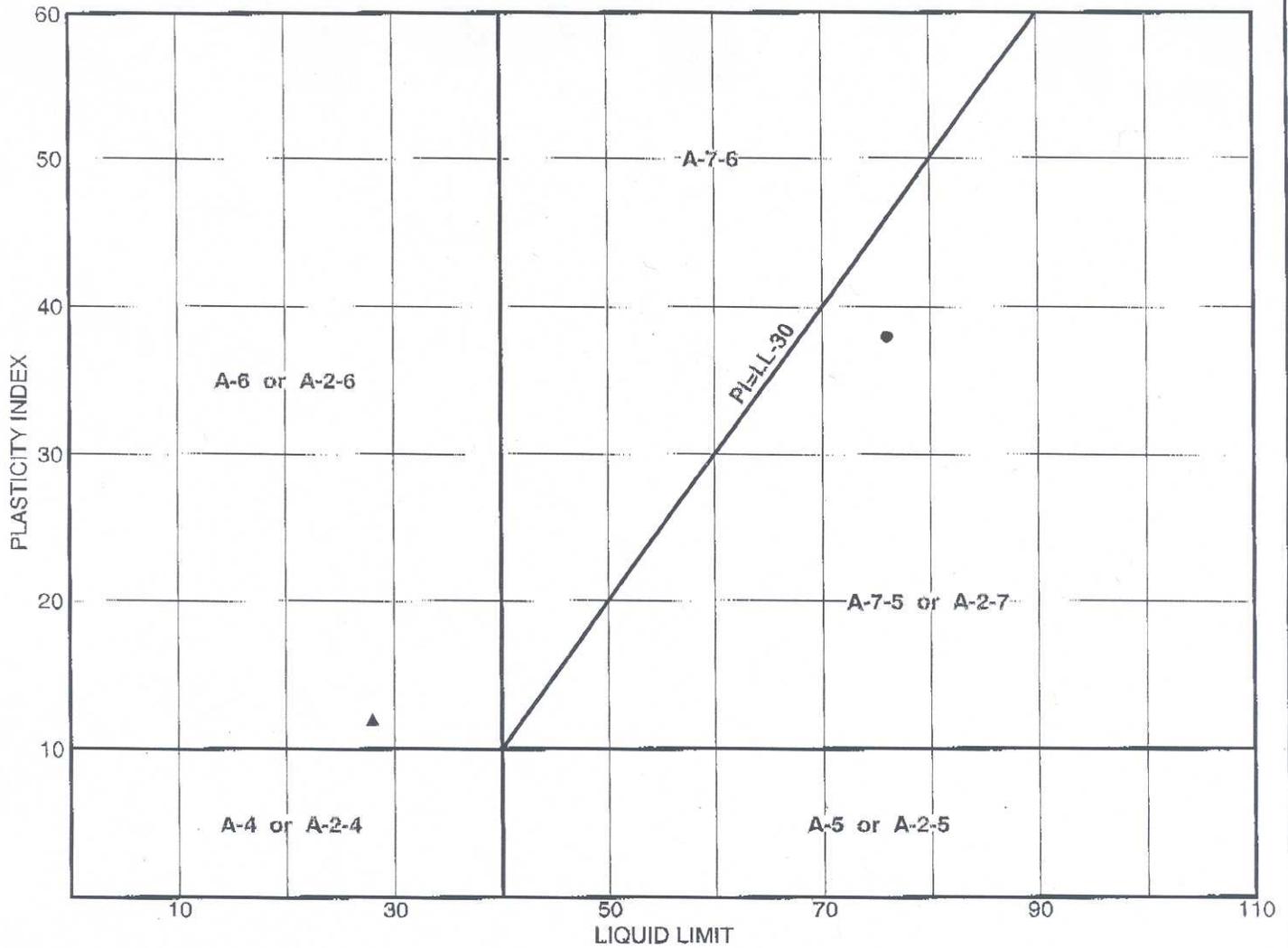
EASTERN FEDERAL LANDS HIGHWAY DIVISION

Client: FHWA/EFLHD  
Project: Fredricksburg and Spotsylvania NMP

Project No.: FRSP-

Figure

# LIQUID AND PLASTIC LIMITS TEST REPORT



## SOIL DATA

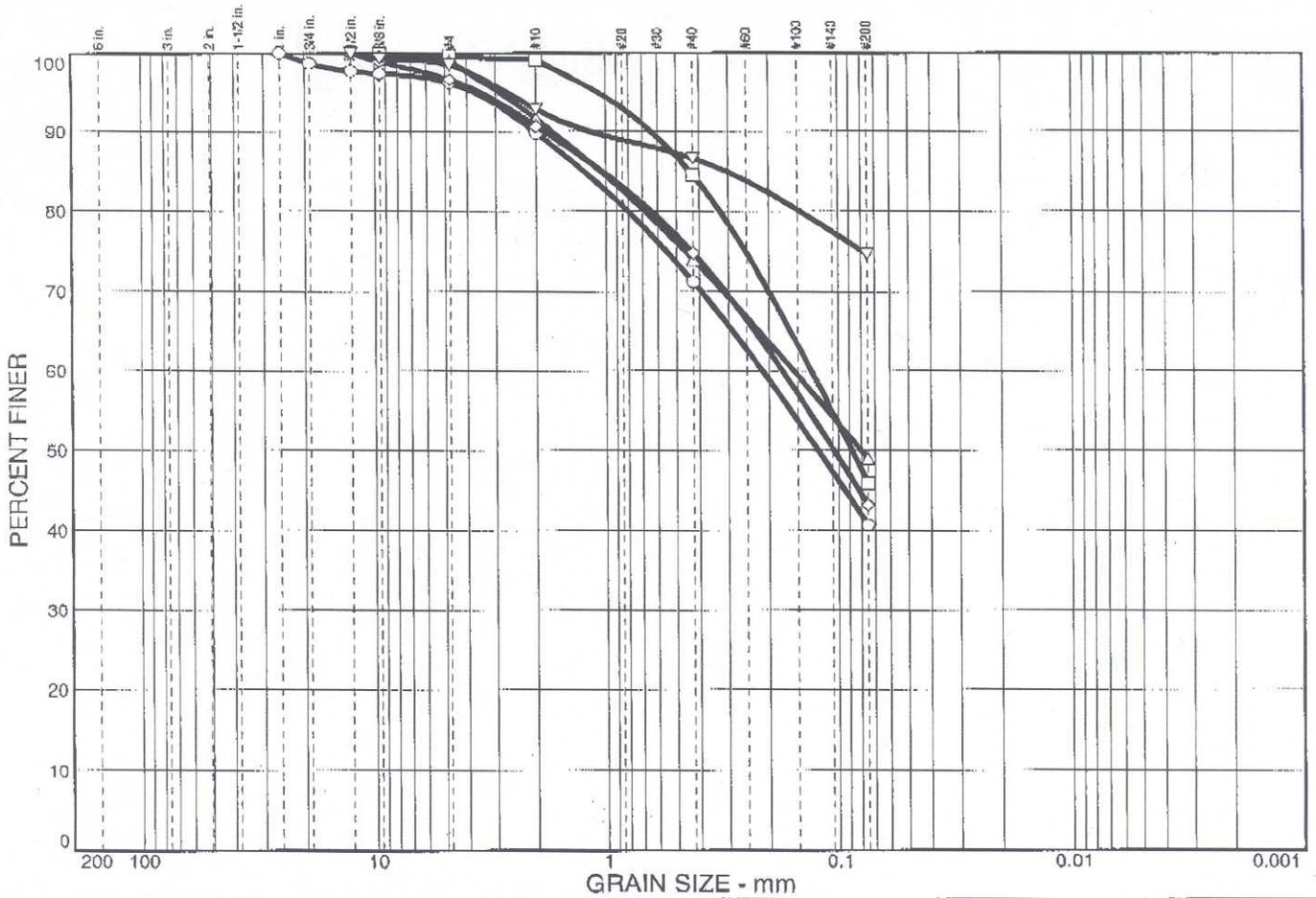
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	AASHTO
●		B-2/S-1	.583-2.0	22.6	38	76	38	A-7-5(31)
■		B-5/S-1	.125-.750	4.9	NP	NV	NP	A-1-a
▲		B-5/S-2	1.5-2.083	10.3	16	28	12	A-6(1)
◆		B-7/S-1	1.167-1.830	7.8	NP	NV	NP	A-1-b
▼		B-9/S-1	1.167-1.830	8.7	NP	NV	NP	A-4(0)

LIQUID AND PLASTIC LIMITS TEST REPORT  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION

Client: FHWA/EFLHD  
 Project: Fredricksburg and Spotsylvania NMP  
 Project No.: FRSP-

Figure

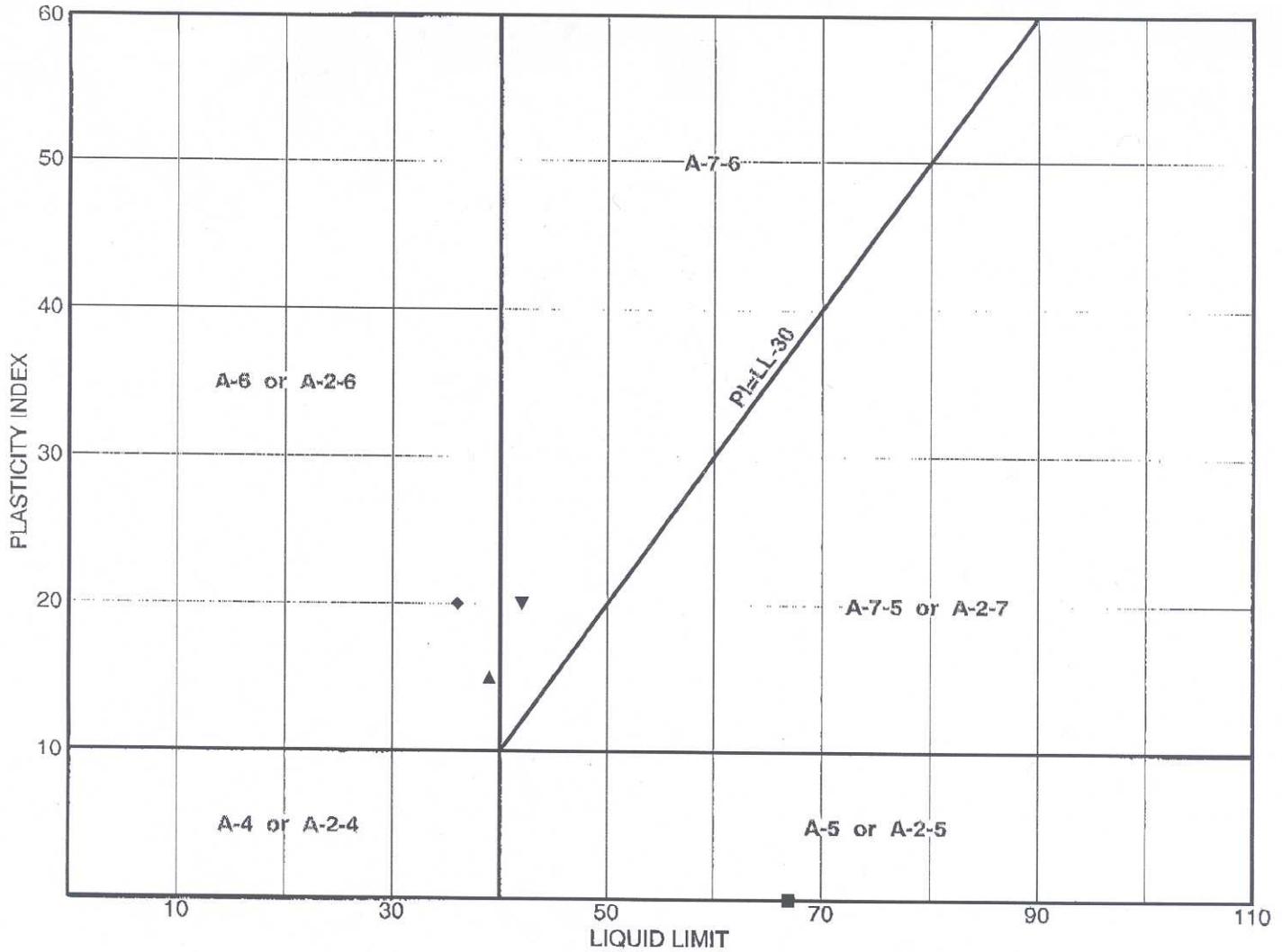
# Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	3.9	55.4	40.7	
□	0.0	0.4	53.7	45.9	
△	0.0	1.0	50.0	49.0	
◇	0.0	3.4	53.4	43.2	
▽	0.0	1.5	23.8	74.7	

SOIL DATA					
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	AASHTO
○		B-12/S-1	.917-1.50	Silty sand	A-4(0)
□		B-16/S-1	.917-1.67	Silty sand	A-5(1)
△		B-19/S-1	1.33-1.833	Clayey sand	A-6(4)
◇		B-22/S-1	1.542-2.00	Clayey sand	A-6(4)
▽		B-26/S-1	.854-1.67	Lean clay with sand	A-7-6(14)

# LIQUID AND PLASTIC LIMITS TEST REPORT



## SOIL DATA

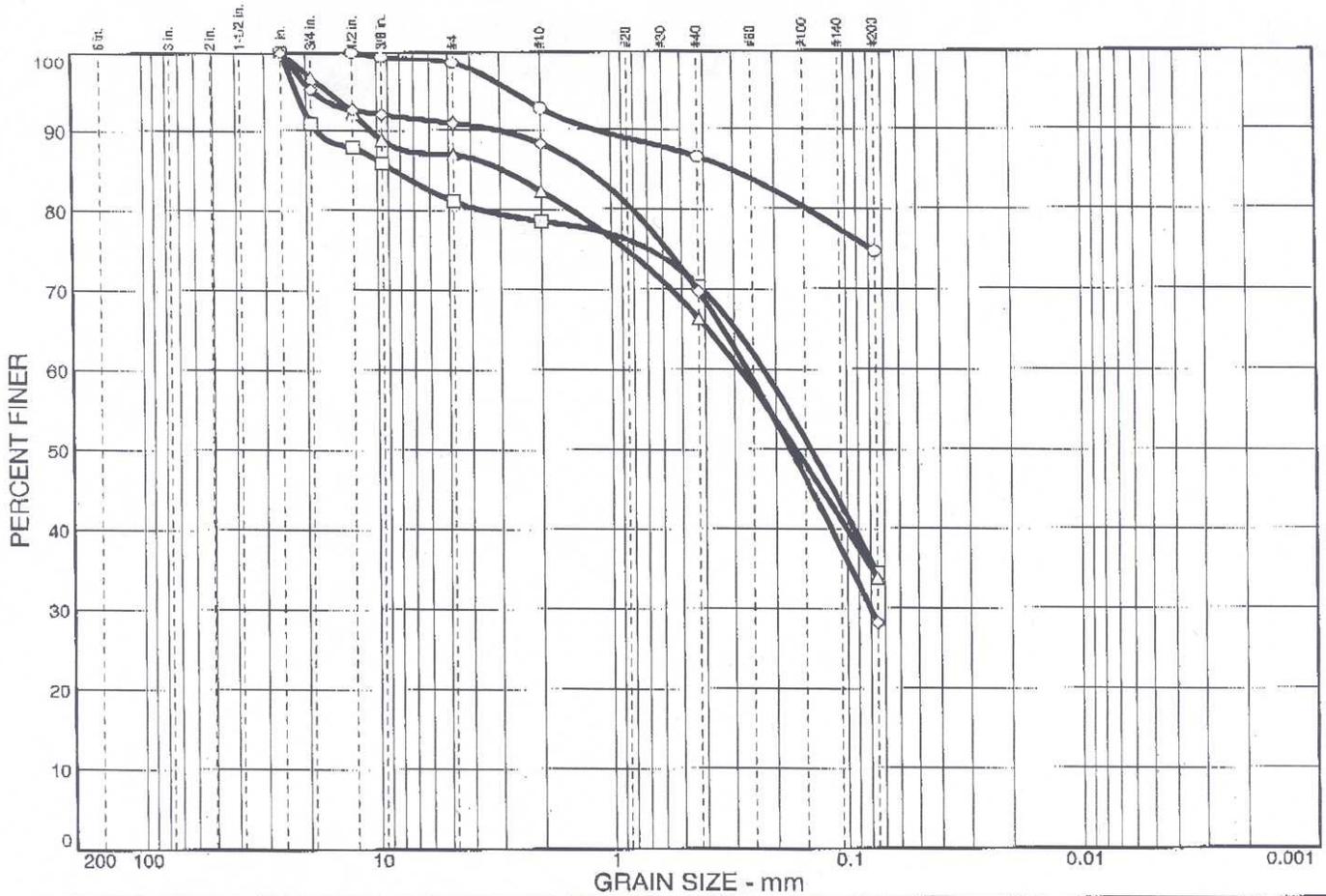
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	AASHTO
●		B-12/S-1	.917-1.50	7.7	NP	NV	NP	A-4(0)
■		B-16/S-1	.917-1.67	22.0	NP	67	NP	A-5(1)
▲		B-19/S-1	1.33-1.833	11.8	24	39	15	A-6(4)
◆		B-22/S-1	1.542-2.00	14.0	16	36	20	A-6(4)
▼		B-26/S-1	.854-1.67	16.2	22	42	20	A-7-6(14)

LIQUID AND PLASTIC LIMITS TEST REPORT  
 FEDERAL HIGHWAY ADMINISTRATION  
 EASTERN FEDERAL LANDS HIGHWAY DIVISION

Client: FHWA/EFLHD  
 Project: Fredricksburg and Spotsylvania NMP  
 Project No.: FRSP-

Figure

# Particle Size Distribution Report

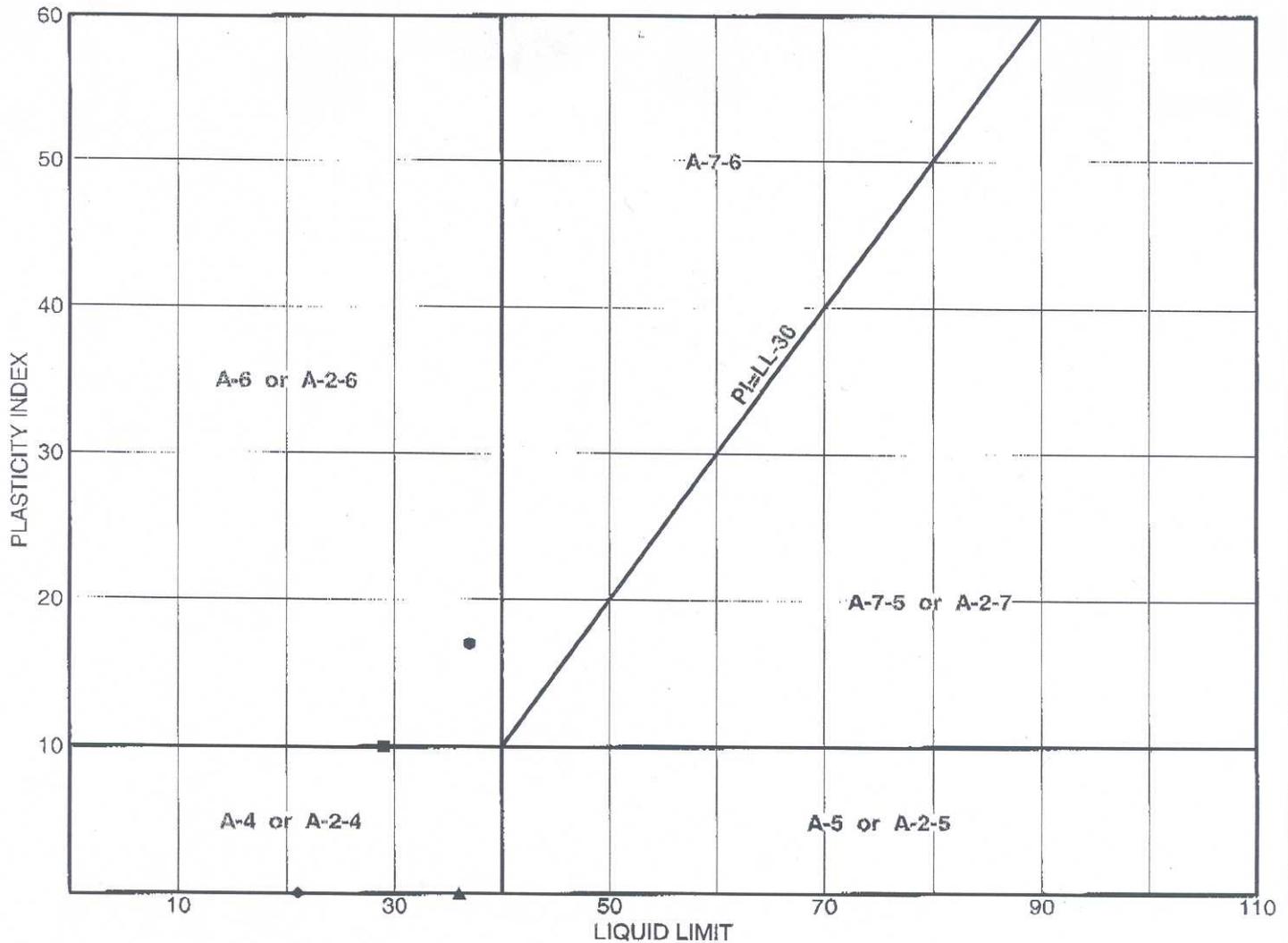


	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
○	0.0	1.5	23.8	74.7	
□	0.0	18.9	46.7	34.4	
△	0.0	13.0	53.2	33.8	
◇	0.0	9.1	62.7	28.2	

### SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	DESCRIPTION	AASHTO
○		B-28/S-1	.9583-1.67	Clayey sand	A-7-6(15)
□		CBR-1/1	0.0-2.0	Clayey sand with gravel	A-2-4(0)
△		CBR-2/1	0.0-2.0	Silty sand	A-2-4(0)
◇		CBR-3/1	0.0-2.0	Silty sand	A-2-4(0)

# LIQUID AND PLASTIC LIMITS TEST REPORT



## SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	AASHTO
●		B-28/S-1	.9583-1.67	21.0	20	37	17	A-7-6(15)
■		CBR-1/1	0.0-2.0	NA	19	29	10	A-2-4(0)
▲		CBR-2/1	0.0-2.0	NA	NP	36	NP	A-2-4(0)
◆		CBR-3/1	0.0-2.0	NA	NP	21	NP	A-2-4(0)

LIQUID AND PLASTIC LIMITS TEST REPORT

FEDERAL HIGHWAY ADMINISTRATION

EASTERN FEDERAL LANDS HIGHWAY DIVISION

Client: FHWA/EPLAD

Project: Fredricksburg and Spotsylvania NMP

Project No.: FRSP-

Figure



**U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION**



**JAR SAMPLES**

Project Number:  
Date Sampled:  
Submitted By:

FRSP-11(1)19(1)20(1)22(1)900(1)912(1)
Corey Bobba

Project Location:  
Sample From:  
Reported By:  
Date:

Fredericksburg & Spotsylvania NMP
Chris Johnson
8/9/2004

IDENTIFICATION			
Laboratory Number	E-04-0466	E-04-0467	E-04-0468
Field Number:	CBR-1/ 1	CBR-2/ 1	CBR-3/ 1
Station Location:			
Depth:	0-2"	0-2"	0-2"

CLASSIFICATION TEST RESULTS (SIEVE ANALYSIS (% Passing))			
2" sieve (50mm)			
1 1/2" sieve (37.5mm)			
1" sieve (25mm)			
3/4" sieve (19mm)			
1/2" sieve (12.5mm)			
3/8" sieve (9.5mm)			
No. 4 sieve (4.75mm)			
No. 10 sieve (2.0mm)			
No. 40 sieve (0.425mm)			
No. 200 sieve (0.075µm)			

Particle Size By Hydrometer (T 88)			
0.050mm			
0.020 mm			
0.005mm			
0.002mm			
0.001mm			

Proctor (T 99)			
Maximum Density	130.6	114.2	115.5
Optimum Moisture	8.6	13.2	11.6

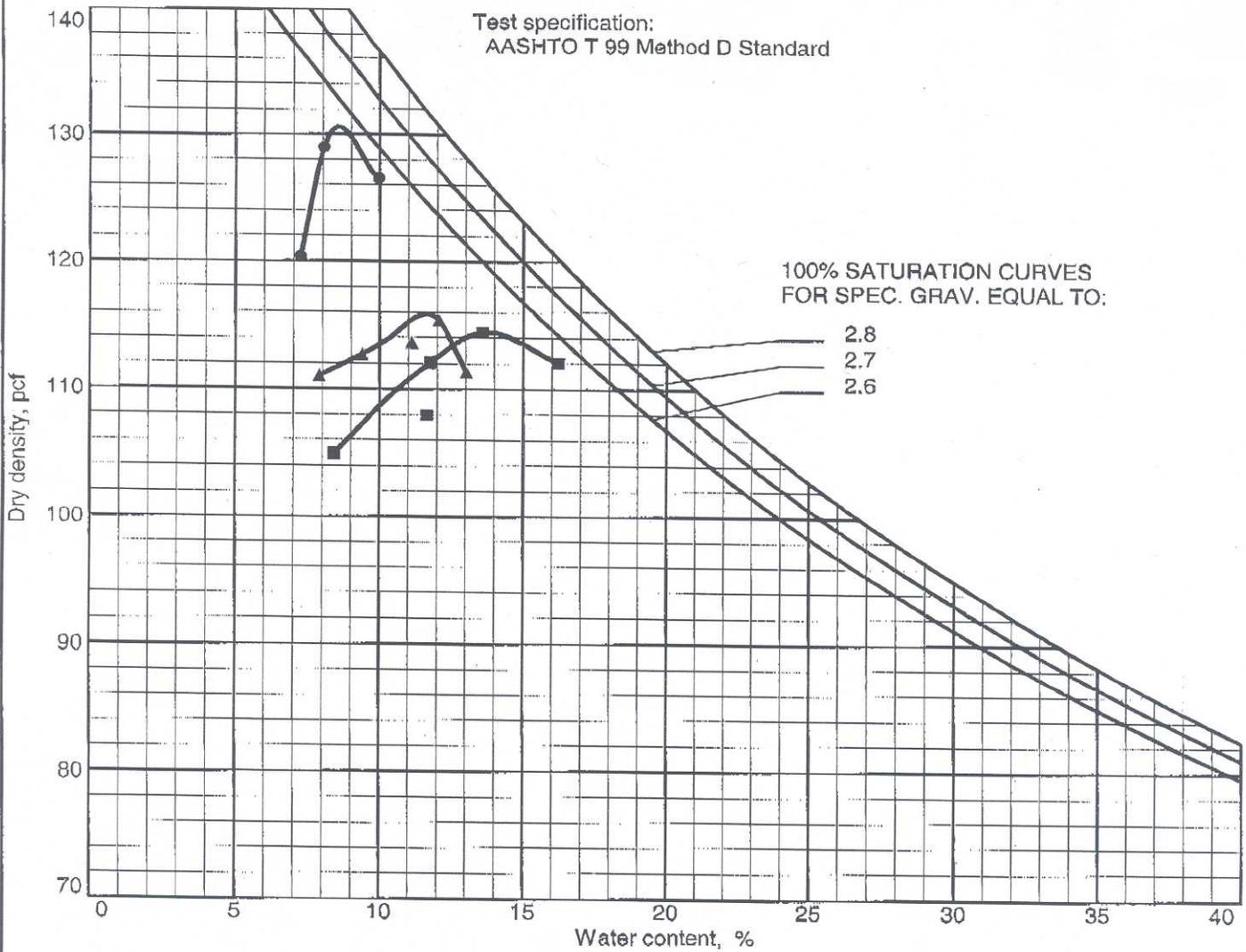
California Bearing Ratio (T 193)			
	102	62	70
% Moisture Content of Sample as Received			

Atterberg Limits			
Total Sample Wt. (g)			
Liquid Limit (T 89)			
Plastic Limit (T 90)			
Plasticity Index			
Classification (M 145)			

Remarks:

# COMPACTION TEST REPORT

Test specification:  
AASHTO T 99 Method D Standard



## SOIL DATA

	SOURCE	SAMPLE NO.	ELEV./ DEPTH (ft.)	USCS	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	MAXIMUM DRY DENSITY pcf	OPTIMUM MOISTURE CONTENT (%)
●		CBR-1/1	0.0-2.0	SC	NA	19	29	130.6	8.6
■		CBR-2/1	0.0-2.0	SM	NA	NP	36	114.4	13.7
▲		CBR-3/1	0.0-2.0	SM	NA	NP	21	115.9	11.6

FEDERAL HIGHWAY ADMINISTRATION

EASTERN FEDERAL LANDS HIGHWAY DIVISION

Client: FHWA/EFLHD

Project: Fredricksburg and Spotsylvania NMP

Project No.: FRSP-

Figure

**APPENDIX E – Pavement Design Analyses and FWD Results**

**Anderson Drive, Rt. 19**

Spotsylvania Battlefield Unit

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-8</b>		
Drop 1	7458	59,215
Drop 2	7470	60,440
Drop 3	7557	61,146
Average	7495	60,267
<b>Boring B-9</b>		
Drop 1	8817	80,158
Drop 2	8853	80,751
Drop 3	8874	81,209
Average	8848	80,706
<b>Boring B-10</b>		
Drop 1	3306	40,273
Drop 2	3294	41,022
Drop 3	3302	41,525
Average	3301	40,940

**Cumulative Averages**

Resilient Modulus: 6548 psi

Effective Pavement Modulus: 60,638 psi

**Gordon Drive, Rt. 20**

Spotsylvania Battlefield Unit

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-11</b>		
Drop 1	5204	50,150
Drop 2	5201	51,854
Drop 3	5234	52,971
Average	5213	51,658
<b>Boring B-12</b>		
Drop 1	No FWD Testing Performed	
Drop 2	No FWD Testing Performed	
Drop 3	No FWD Testing Performed	
Average		
<b>Boring B-13</b>		
Drop 1	5825	99,018
Drop 2	6083	102,853
Drop 3	6071	104,673
Average	5993	102,181

**Cumulative Averages**

Resilient Modulus: 5603 psi

Effective Pavement Modulus: 76,920 psi

**Burnside Drive, Rt. 22**

Spotsylvania Battlefield Unit

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-16</b>		
Drop 1	5595	59,215
Drop 2	5640	60,440
Drop 3	5660	61,146
Average	5632	60,267
<b>Boring B-17</b>		
Drop 1	3037	80,158
Drop 2	3062	80,751
Drop 3	3067	81,209
Average	3055	80,706
<b>Boring B-18</b>		
Drop 1	No FWD Testing Performed	
Drop 2	No FWD Testing Performed	
Drop 3	No FWD Testing Performed	
Average		
<b>Boring B-19</b>		
Drop 1	6494	98768
Drop 2	6574	101195
Drop 3	6611	103372
Average	6560	101,112

**Cumulative Averages**

Resilient Modulus: 5082 psi

Effective Pavement Modulus: 80,695 psi

**Spotsylvania Exhibit Shelter, Rt. 912**

Spotsylvania Battlefield Unit

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-1</b>		
Drop 1	2312	77,196
Drop 2	2336	78,374
Drop 3	2349	78,803
Average	2332	78,124
<b>Boring B-2</b>		
Drop 1	1650	54,357
Drop 2	1649	56,367
Drop 3	1657	56,451
Average	1652	55,725

**Cumulative Averages**

Resilient Modulus: 1992 psi

Effective Pavement Modulus: 66,925 psi

**Chancellorsville Visitors Center Parking Area, Rt. 914**

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-29</b>		
Drop 1	4517	39,692
Drop 2	4580	40,522
Drop 3	4611	41,080
Average	4569	40,431
<b>Boring B-30</b>		
Drop 1	3971	37,667
Drop 2	3994	38,369
Drop 3	4014	38,805
Average	3993	38,280

**Cumulative Averages**

Resilient Modulus: 4281 psi

Effective Pavement Modulus: 39,356 psi

**Wilderness Exhibit Shelter Parking , Rt. 916**

	Resilient Modulus, psi	Effective Pavement Modulus, psi
<b>Boring B-26</b>		
Drop 1	1760	22,192
Drop 2	1755	23,022
Drop 3	1751	23,346
Average	1755	22,853
<b>Boring B-27</b>		
Drop 1	3094	22,781
Drop 2	3102	23,314
Drop 3	3110	23,655
Average	3102	23,250

**Cumulative Averages**

Resilient Modulus: 2429 psi

Effective Pavement Modulus: 23,052 psi

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

### A Proprietary AASHTOWare Computer Software Product

### Overlay Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Spotsylvania Unit  
Grant Drive, Rt. 11

### AC Overlay of AC Pavement

Structural Number for Future Traffic

1.82 in

<u>Design Method</u>	<u>Effective Existing Structural Number (in)</u>	<u>Overlay Structural Number (in)</u>
Component Analysis	0.6	1.22
Remaining Life	-	-
Non-Destructive Testing	-	-

### Structural Number for Future Traffic

Future 18-kip ESALs Over Design Period	7,646
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Subgrade Resilient Modulus	4,000 psi
Calculated Structural Number for Future Traffic	1.82 in

### Effective Pavement Thickness - Component Analysis Method

<u>Layer</u>	<u>Material Description</u>	<u>Structural Coefficient</u>	<u>Drainage Coefficient</u>	<u>Thickness (in)</u>
1	Existing AC Pavement	0.2	1	1.5
2	Existing Aggregate Base	0.1	0.75	8
Milling Thickness		1.5 in		
Calculated Results				
Calculated Pavement Structural Number Before Milling		0.90 in		
Calculated Effective Pavement Structural Number		0.60 in		

### Future Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	110
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %

Percent Trucks in Design Direction

50 %

<u>Vehicle Class</u>	<u>Percent of ADT</u>	<u>Annual % Growth</u>	<u>Average Initial Truck Factor (ESALs/Truck)</u>	<u>Annual % Growth in Truck Factor</u>	<u>Accumulated 18-kip ESALs over Performance Period</u>
1	95	2	0.0007	0	325
2	5	2	0.3	0	7,322
Total	100	-	-	-	7,646

Growth Compound

Total Calculated Cumulative ESALs 7,646

### Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	<u>Struct Coef. (Ai)</u>	<u>Drain Coef. (Mi)</u>	<u>Thickness (Di)(in)</u>	<u>Width (ft)</u>	<u>Calculated SN (in)</u>
1	SACP Surface Course	0.44	1	1.5	10	0.66
2	SACP Base Course	0.4	1	2.5	10	1.00
Total	-	-	-	4.00	-	1.66

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

### A Proprietary AASHTOWare Computer Software Product

### Overlay Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Spotsylvania Unit  
Anderson Drive, Rt. 19

### AC Overlay of AC Pavement

Structural Number for Future Traffic

1.4 in

<u>Design Method</u>	<u>Effective Existing Structural Number (in)</u>	<u>Overlay Structural Number (in)</u>
Component Analysis	1.69	0.00
Remaining Life	-	-
Non-Destructive Testing	-	-

### Structural Number for Future Traffic

Future 18-kip ESALs Over Design Period	5,561
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Subgrade Resilient Modulus	6,548 psi

Calculated Structural Number for Future Traffic 1.40 in

### Effective Pavement Thickness - Component Analysis Method

<u>Layer</u>	<u>Material Description</u>	<u>Structural Coefficient</u>	<u>Drainage Coefficient</u>	<u>Thickness (in)</u>
1	Existing AC Pavement	0.2	1	2.25
2	Existing Aggregate Base	0.15	0.75	11

Milling Thickness 0 in

#### Calculated Results

Calculated Pavement Structural Number Before Milling 1.69 in  
Calculated Effective Pavement Structural Number 1.69 in

### Future Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	80
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %

Percent Trucks in Design Direction

50 %

<u>Vehicle Class</u>	<u>Percent of ADT</u>	<u>Annual % Growth</u>	<u>Average Initial Truck Factor (ESALs/Truck)</u>	<u>Annual % Growth in Truck Factor</u>	<u>Accumulated 18-kip ESALs over Performance Period</u>
1	95	2	0.0007	0	236
2	5	2	0.3	0	5,325
Total	100	-	-	-	5,561

Growth Compound

Total Calculated Cumulative ESALs 5,561

### Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	<u>Struct Coef. (Ai)</u>	<u>Drain Coef. (Mi)</u>	<u>Thickness (Di)(in)</u>	<u>Width (ft)</u>	<u>Calculated SN (in)</u>
1	SACP Surface Course	0.44	1	1.5	10	0.66
Total	-	-	-	1.50	-	0.66

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

### A Proprietary AASHTOWare Computer Software Product

#### Overlay Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Spotsylvania Unit  
Gordon Drive, Rt. 20

#### AC Overlay of AC Pavement

Structural Number for Future Traffic

1.5 in

<u>Design Method</u>	<u>Effective Existing Structural Number (in)</u>	<u>Overlay Structural Number (in)</u>
Component Analysis	1.31	0.19
Remaining Life	-	-
Non-Destructive Testing	-	-

#### Structural Number for Future Traffic

Future 18-kip ESALs Over Design Period	5,561
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Subgrade Resilient Modulus	5,603 psi

Calculated Structural Number for Future Traffic 1.50 in

#### Effective Pavement Thickness - Component Analysis Method

<u>Layer</u>	<u>Material Description</u>	<u>Structural Coefficient</u>	<u>Drainage Coefficient</u>	<u>Thickness (in)</u>
1	Existing AC Pavement	0.2	1	1.5
2	Existing Aggregate Base	0.15	0.75	9

Milling Thickness 0 in

#### Calculated Results

Calculated Pavement Structural Number Before Milling 1.31 in  
Calculated Effective Pavement Structural Number 1.31 in

#### Future Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	80
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %

Percent Trucks in Design Direction

50 %

<u>Vehicle Class</u>	<u>Percent of ADT</u>	<u>Annual % Growth</u>	<u>Average Initial Truck Factor (ESALs/Truck)</u>	<u>Annual % Growth in Truck Factor</u>	<u>Accumulated 18-kip ESALs over Performance Period</u>
1	95	2	0.0007	0	236
2	5	2	0.3	0	5,325
Total	100	-	-	-	5,561

Growth Compound

Total Calculated Cumulative ESALs 5,561

### Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	<u>Struct Coef. (Ai)</u>	<u>Drain Coef. (Mi)</u>	<u>Thickness (Di)(in)</u>	<u>Width (ft)</u>	<u>Calculated SN (in)</u>
1	SACP Surface Course	0.44	1	1.5	10	0.66
Total	-	-	-	1.50	-	0.66

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

### A Proprietary AASHTOWare Computer Software Product

#### Overlay Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Spotsylvania Unit  
Burnside Drive, Rt. 22

#### AC Overlay of AC Pavement

Structural Number for Future Traffic

1.65 in

<u>Design Method</u>	<u>Effective Existing Structural Number (in)</u>	<u>Overlay Structural Number (in)</u>
Component Analysis	1.19	0.46
Remaining Life	-	-
Non-Destructive Testing	-	-

#### Structural Number for Future Traffic

Future 18-kip ESALs Over Design Period	7,646
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Subgrade Resilient Modulus	5,082 psi
Calculated Structural Number for Future Traffic	1.65 in

#### Effective Pavement Thickness - Component Analysis Method

<u>Layer</u>	<u>Material Description</u>	<u>Structural Coefficient</u>	<u>Drainage Coefficient</u>	<u>Thickness (in)</u>
1	Existing AC Pavement	0.2	1	2
2	Existing Aggregate Base	0.15	0.75	7

Milling Thickness 0 in

#### Calculated Results

Calculated Pavement Structural Number Before Milling	1.19 in
Calculated Effective Pavement Structural Number	1.19 in

#### Future Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	110
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %

Percent Trucks in Design Direction

50 %

<u>Vehicle Class</u>	<u>Percent of ADT</u>	<u>Annual % Growth</u>	<u>Average Initial Truck Factor (ESALs/Truck)</u>	<u>Annual % Growth in Truck Factor</u>	<u>Accumulated 18-kip ESALs over Performance Period</u>
1	95	2	0.0007	0	325
2	5	2	0.3	0	7,322
Total	100	-	-	-	7,646

Growth

Compound

Total Calculated Cumulative ESALs

7,646

### Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	<u>Struct Coef. (Ai)</u>	<u>Drain Coef. (Mi)</u>	<u>Thickness (Di)(in)</u>	<u>Width (ft)</u>	<u>Calculated SN (in)</u>
1	SACP Surface Course	0.44	1	1.5	10	0.66
Total	-	-	-	1.50	-	0.66

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare  
Computer Software Product

### Flexible Structural Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Spotsylvania Unit  
Spotsylvania Exhibit Shelter Parking Area, Rt. 912

### Flexible Structural Design

18-kip ESALs Over Initial Performance Period	7,646
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	1,992 psi
Stage Construction	1
Calculated Design Structural Number	2.39 in

### Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	110
Number of Lanes in Design Direction	5
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	95	2	0.0007	0	325
2	5	2	0.3	0	7,322
Total	100	-	-	-	7,646
Growth			Compound		
Total Calculated Cumulative ESALs			7,646		

### Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	SACP Surface Course	0.44	1	1.5	10	0.66
2	SACP Base Course	0.4	1	2.5	10	1.00
3	Base Material	0.15	0.75	8	10	0.90
Total	-	-	-	12.00	-	2.56

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

### A Proprietary AASHTOWare Computer Software Product

### Overlay Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Chancellorsville Unit  
Chancellorsville Visitor Center Parking, Rt. 914

### AC Overlay of AC Pavement

Structural Number for Future Traffic

1.74 in

<u>Design Method</u>	<u>Effective Existing Structural Number (in)</u>	<u>Overlay Structural Number (in)</u>
Component Analysis	1.29	0.45
Remaining Life	-	-
Non-Destructive Testing	-	-

### Structural Number for Future Traffic

Future 18-kip ESALs Over Design Period	6,951
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Subgrade Resilient Modulus	4,281 psi

Calculated Structural Number for Future Traffic 1.74 in

### Effective Pavement Thickness - Component Analysis Method

<u>Layer</u>	<u>Material Description</u>	<u>Structural Coefficient</u>	<u>Drainage Coefficient</u>	<u>Thickness (in)</u>
1	AC Pavement	0.2	1	2.5
2	Aggregate Base	0.15	0.75	7

Milling Thickness 0 in

#### Calculated Results

Calculated Pavement Structural Number Before Milling 1.29 in  
Calculated Effective Pavement Structural Number 1.29 in

### Future Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	100
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %

Percent Trucks in Design Direction

50 %

<u>Vehicle Class</u>	<u>Percent of ADT</u>	<u>Annual % Growth</u>	<u>Average Initial Truck Factor (ESALs/Truck)</u>	<u>Annual % Growth in Truck Factor</u>	<u>Accumulated 18-kip ESALs over Performance Period</u>
1	95	2	0.0007	0	295
2	5	2	0.3	0	6,656
Total	100	-	-	-	6,951

Growth Compound

Total Calculated Cumulative ESALs 6,951

### Specified Layer Design

<u>Layer</u>	<u>Material Description</u>	<u>Struct Coef. (Ai)</u>	<u>Drain Coef. (Mi)</u>	<u>Thickness (Di)(in)</u>	<u>Width (ft)</u>	<u>Calculated SN (in)</u>
1	SACP Surface Course	0.44	1	1.5	10	0.66
Total	-	-	-	1.50	-	0.66

# 1993 AASHTO Pavement Design

## DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare  
Computer Software Product

### Flexible Structural Design Module

PRA-FRSP Fredericksburg and Spotsylvania NMP  
Wilderness Unit  
Wilderness Exhibit Shelter Parking, Rt. 916

### Flexible Structural Design

18-kip ESALs Over Initial Performance Period	9,036
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	80 %
Overall Standard Deviation	0.45
Roadbed Soil Resilient Modulus	2,429 psi
Stage Construction	1
Calculated Design Structural Number	2.28 in

### Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	130
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	100 %
Percent Trucks in Design Direction	50 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	95	2	0.0007	0	384
2	5	2	0.3	0	8,653
Total	100	-	-	-	9,036
Growth			Compound		
Total Calculated Cumulative ESALs			9,036		

### Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	SACP Surface Course	0.44	1	1.5	10	0.66
2	SACP Base Course	0.4	1	2.5	10	1.00
3	Aggregate Base	0.15	0.75	7	10	0.79
Total	-	-	-	11.00	-	2.45

**APPENDIX F – Photographs**



**Photo 1: Fredericksburg Visitors Center Parking Area, Main Lot**



**Photo 2: Fredericksburg Visitors Center Parking Area, Semi-Circle Entrance**



**Photo 3: Fredericksburg Visitors Center Parking Area, Roundabout**



**Photo 4: Fredericksburg Visitors Center Parking Area, Roundabout**



**Photo 5: Spotsylvania Exhibit Shelter Parking Area**



**Photo 6: Chancellorsville Visitors Center Parking Area**



**Photo 7: Chancellorsville Visitors Center Parking Area**



**Photo 8: Wilderness Exhibit Shelter Parking Area**