National Park Service
U.S. Department of the Interior

PAVEMENT INVESTIGATION AND ANALYSIS REPORT

Kings Mountain National Military Park (KIMO)

NPS Contract No. 140P2022D0002
NPS Task Order No. 140P2025F0167
PMIS 334920

July 28, 2025

AECOM

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1.0 Project Description

National Park System (NPS) retained AECOM Services, Inc. (AECOM) to provide engineering services related to pavement preservation at multiple parks in South Carolina. Preservation is the strategy designed to maintain and restore the overall condition of relatively new pavements that are in good to fair condition (distress severity and extent are low/moderate) by protecting them from water intrusion and limiting oxidation using treatments such as crack seal, slurry seal, chip seal, micro surfacing, and thin overlays. Pavement preservation treatments generally can extend the life of pavement in good or fair condition by 5-7 years and delay more expensive and intrusive rehabilitation activities.

As outlined in the project Scope of Services, the goal is to evaluate selected paved roads and parking areas at Kings Mountain National Military Park (KIMO) and identify suitable pavement preservation or rehabilitation treatments. AECOM conducted pre-design activities, including an on-site scoping site visit and review of available project documents, to perform an initial pavement assessment. The preliminary findings were documented in a Pavement Analysis Report dated February 22, 2025. This report supplements the February 2025 pavement analysis by incorporating findings from additional pavement investigations and analyses conducted by AECOM during the Design Development (DD) phase. It presents the final recommendations for pavement treatment options for the designated roads and parking areas at KIMO, in accordance with Chapter 11 of the *Federal Highway Administration (FHWA) Project Design and Development Manual*.

To ensure continuity and completeness in documenting the pavement evaluation efforts and findings, the activities conducted during the predesign (PD) phase are discussed in Section 2 of this report, while the DD phase activities are documented in Section 3. Section 4 contains the findings and recommendations. The specific roadway and parking lot sections are listed in Table 1, and the project location is provided in Appendix A.

2.0 Scope of Work – Predesign (PD) Phase

AECOM performed the following activities at KIMO during the predesign phase:

2.1 Review of RIP Data

NPS provided AECOM with the FHWA Road Inventory Program (RIP) report for KIMO (Cycle 6 Final Report – Road Inventory and Condition Assessment of Paved Road, November 2021). AECOM reviewed the RIP report to gather the roadway inventory and current condition information for the target road and parking lot sections of KIMO; i.e., sections identified by the RIP report as candidates for pavement preservation, as well as sections adjacent to these candidate sections and/or sections considered to be in similar condition. Table 1 summarizes the relevant RIP data for the candidate and additional sections of KIMO. The added sections (shown in blue text throughout the report) are included in the 70% design plans as “Options”.

Table 1: KIMO Target Road/Parking Lot Sections RIP Data

ROUTE ID	ROAD	AREA (SF)	LENGTH (MILES)	WIDTH (FT)	PAVEMENT TYPE	PCR	RECOMMENDED TREATMENT
KIMO-0010	MAIN PARK DRIVE		2.82	20.5	Asphalt	98	Localized Repair
KIMO-0900	VISITOR CENTER PARKING	46,317			Asphalt	90	Preventative Maintenance
KIMO-0901	MAINTENANCE AREA PARKING	15,648			Asphalt	90	Preventative Maintenance
KIMO-0903	HEADQUARTERS PARKING	7,967			Asphalt	97	Localized Repair

Notes:

1) *PCR = Pavement Condition Rating, L3R = Light Rehabilitation, H3R = Heavy Rehabilitation*
2) *Throughout this report, Added Sections are shown in BLUE.*

2.2 Review of FY19 Pavement Preservation Design Scoping Report for KIMO

NPS provided AECOM with the Design Scoping Report for the previous pavement preservation project for KIMO (NP-SER PMS FY19). A review of this report indicated that all KIMO target sections were also included for pavement preservation treatments as part of the FY19 project. Further discussions with the NPS team and the Park Units, along with a review of other relevant project documents, confirmed that these sections received pavement preservation under the SER PMS FY19 Project. The available project plans listed four proposed preservation treatment options: 1.5-inch overlay, 0.75-inch overlay, chip seal, and micro-surfacing. However, the actual treatment choice for each road or parking lot section was left to the contractors. AECOM's visual observations regarding the most likely past pavement preservation treatments are included in Table 3.

2.3 On-Site Scoping

AECOM performed an on-site scoping field visit on November 26, 2024, along with members of the NPS project team and the KIMO Park Unit team. Per the project scope, the on-site scoping field visit was conducted to evaluate the current site conditions of the park sections listed in Table 1. The project team's on-site scoping field visit activities included the following:

- Conduct tailgate safety briefings with the project team and sign Task Hazard Assessment (THA).
- Discuss the scope and objectives of the on-site field visits with the Park Unit Team.
- Gather site-specific information from the Park Unit Team including:
  - Priorities of roadways to treat,
  - Other ongoing/planned projects that may impact the planned pavement treatment work,
  - Concerns with existing roadway configurations (one-way roads),
  - Any present or anticipated changes in vehicular traffic volume and/or type within the park.
  - Past safety incidents/concerns related to roadway signage reported by park users,
  - Past pavement preservation/rehabilitation work at the park and experiences with those treatments,
  - Any other relevant information such as staging areas, permitting requirements, etc.
- Conducting the site walk of each roadway/parking lot section to:
  - Evaluate the existing pavement condition, including estimating cracks and identifying the preliminary pavement preservation treatment.

- Evaluate the conditions of existing curbs, gutters, wheel stops, drainage inlets, ADA ramps, etc., and note improvement requirements.
- Provide opinion on the condition and adequacy of existing roadway and parking signage, including handicap parking signs.
- Review the existing striping (including the need for scarifying thermoplastic prior to treatments) and the need for striping parking stalls, as well as add/relocate handicap parking spots.

The draft on-site scoping field meeting minutes were submitted to NPS on December 15, 2024, and the final meeting minutes (revised in response to NPS comments) were submitted to NPS on January 17, 2025. The field notes from the on-site scoping field meeting, including geo-referenced photographs taken by the project team, are included in Appendix B.

3.0 Scope of Work – Design Development (DD) Phase

AECOM performed the following activities during the DD phase to finalize the pavement preservation treatment recommendations for the KIMO sections:

3.1 70% Design Site Visit

AECOM conducted a 70% design site walk at the park on May 20, 2025, to supplement the findings from the scoping site walk and perform a more detailed pavement condition survey. This was to finalize pavement recommendations and the 70% design deliverables. The following activities were conducted during the 70% design site walk:

- Establish the project baseline for the 70% design plans.
- Mark the core and test pit locations for the Geotechnical investigation.
- Identify the locations and conditions of existing roadway features, such as structures (bridges and culverts), signage, utility features, traffic loops, and other elements, and note any needs for improvements.
- Identify locations that need localized pavement treatments, such as full or partial depth patching and aggregate/seed mixes for shoulder support.

The findings from the 70% design site walk, along with corresponding recommendations, are incorporated into Section 4 of this report and the 70% design plans.

3.2 Subsurface Sampling and Investigation

On May 30, 2025, AECOM extracted six (6) pavement cores and one (1) test pit to assess the existing pavement structure and conditions, including layer types, thicknesses, and engineering properties of both bound and unbound layers along Main Park Drive (KIMO-0010). Two (2) additional cores were taken from the Headquarters Parking (KIMO-0903). The Geotechnical test results are included in Appendices C1 through C3, and the key findings are discussed below:

- Asphalt thickness along KIMO-0010 varies from 5-8 inches with an average of 6.0 inches.
- Debonding of the asphalt layers was observed at depths varying from 1.25 to 4.0 inches in all but two cores.
- The lone core taken on a crack showed the cracking to have propagated through the entire thickness of the core.

- The soil samples extracted from the core holes indicated the presence of 6 inches of base quality material. A **6-inch-thick aggregate base** is assumed for pavement design purposes.
- Laboratory analysis of the soil samples indicated that the subgrade consists of silty clay with sand (USCS soil type CL-ML, AASHTO soil classification A-4). A **subgrade resilient modulus (M_R) of 10,000 psi** is considered suitable for pavement design for this road.
- Asphalt within KIMO-0903 is 2.5 to 3.25 inches thick and is free of debonding and cracking. The base consists of Silty Sand or Gravel.

3.3 Review of Available Traffic Data

NPS provided AECOM with historical traffic counts on Main Park Drive (KIMO-0010). The most recent traffic counts (from February 2023) reported Average Daily Traffic (ADT) of 271 and Average Daily Truck Traffic (ADTT) of 17. Considering the reported historical traffic volume counts (from 2019 to 2023), a design ADT of 400 is deemed appropriate for this road. This volume information was used along with the reported vehicle classification distributions to determine the 18-kip equivalent single axle load (ESAL) for pavement design. The reviewed traffic data and the ESAL calculations are included in Appendix D. The calculated **20-year design ESAL for KIMO-0010 is 58,819**.

3.4 Construction Summary Estimate

A DD level construction cost estimate, consistent with the Department of the Interior (DOI) Estimate Type B, is being developed based on the pavement preservation treatments proposed for the parking lots and roadway sections of KIMO. This estimate will be submitted as a separate deliverable with the 70% design package. A summary of the estimated construction cost, based on a DOI Estimate Type C for KIMO is included in Appendix F.

3.5 Construction Schedule Summary

A construction schedule was developed based on the pavement preservation treatments proposed for the parking lots and roadway sections of KIMO, and it is included in Appendix G.

4.0 Pavement Analysis, Findings, and Recommendations

AECOM performed pavement design analysis to determine whether the existing pavement has sufficient structural capacity to support the expected design traffic load for a 20-year service life. Pavement design calculations were performed according to the *AASHTO Guide for Design of Pavement Structures, 1993*, and in line with Chapter 11 of the *FHWA Project Design and Development Manual*. The *AASHTO 1993* design calculations are included in Appendix E, and the findings and recommendations are discussed below:

Main Park Drive (KIMO-0010)

The existing pavement on Main Park Drive exhibits widespread low- to medium-severity alligator and transverse cracking along its entire length. Localized edge cracking and tree root damage were also observed and will require patching. Additionally, edge drop-off was noted at several locations.

Based on *AASHTO 1993* design calculations, the current pavement structure—6 inches of asphalt over 6 inches of aggregate base, with a subgrade resilient modulus (M_R) of 10,000 psi—is

considered structurally adequate and does not necessitate full-depth structural reconstruction. However, a 1.5-inch asphalt overlay is recommended for the following reasons:

- Extensive low-severity alligator cracking is present along the wheel paths throughout most of the roadway. These cracks appear to have reflected through the microsurfacing applied during the previous pavement preservation project (FY19). Although structurally sufficient by design, the pavement would benefit from increased structural capacity to mitigate further deterioration.
- Core sampling revealed debonding at various depths in all but two cores, indicating that the pavement layers are not acting as a cohesive system. This compromises the effective structural capacity and likely contributes to the observed alligator cracking. A properly bonded overlay will restore structural integrity and reduce the likelihood of new or worsening cracking.
- The overlay will serve as a protective layer against moisture infiltration, helping to slow the progression of existing cracks and extend the pavement's service life.

Therefore, a preservation treatment consisting of localized patching and edge repair, followed by a 1.5-inch asphalt overlay, is recommended for Main Park Drive (KIMO-0010).

Visitor Center Parking (KIMO-0900)

The pavement contains low-severity Longitudinal and Transverse Cracking. Pavement preservation with crack sealing followed by seal coating is proposed for this parking lot. The asphalt sidewalks are in poor condition and are scheduled for replacement as part of a separate project in FY2025 (KIMO-240503). Patching was observed as part of the recently installed automated gates (QTY: 3), which include several loops.

Maintenance Parking (KIMO-0901)

This parking lot was not part of the current pavement preservation project scope. However, considering the proximity to KIMO-0010 and the pavement condition being suitable for preservation, this roadway is included in the design plans as an "option." The existing pavement is in Fair to Good condition, with localized repairs needed to address areas of Alligator cracking, Edge Cracking, and damage caused by tree uprooting. Pavement preservation through surface treatment (seal coating) is appropriate for this parking lot.

Headquarters Parking (KIMO-0903)

The pavement shows signs of medium severity longitudinal and transverse cracking, along with block cracking. The cracking pattern indicates that these cracks are "reflective" in nature, with cracks from the underlying pavement propagating through the most recent micro-surfacing layer (1/8-inch). The existing pavement thickness ranges from 2.5 to 3.25 inches, but there is no indication of debonding issues. An asphalt overlay of 1.5 inches is recommended for this parking lot, similar to the adjacent KIMO-0010, to enhance structural capacity and prevent cracks from worsening due to moisture damage. Additionally, an automated sliding gate is planned for this location as part of a separate NPS project.

The following additional design considerations apply to KIMO:

- Isolated areas needing more extensive repairs, such as partial- or full-depth patches due to significant damage like high-severity alligator cracks, edge cracks, or potholes, are identified during AECOM's 70% design site visit and shown in the 70% design plans.
- Aggregate/seed mixes are recommended to fix edge-shoulder drop-off in specific areas along KIMO-0010. The locations and quantities of these mixes are detailed in the 70% design plans.
- Signage improvements are recommended, including new pedestrian crossing signs and pavement markings along KIMO-0010.
- Resizing the left turn lane on KIMO-0010 at the visitor center parking entrance is recommended, and the necessary details are shown on the 70% design plans.
- The Raised Pavement Markings (RPMs) at KIMO-0010 need to be reset as part of the overlay operation.
- Observed adverse drainage conditions, such as water ponding issues and deteriorated drainage structures, were noted during the field visits. Grade corrections, where necessary, will be made through the recommended overlay treatment. The table below shows the drainage condition observations for each KIMO section.

Table 2: Drainage Observations for KIMO Sections

Route ID	Drainage Observation
KIMO-0010	Culverts w/ stone headwalls (need cleaning), historical stone gutters & headwalls
KIMO-0900	Catch basins in fair condition (needs cleaning)
KIMO-0901	Catch basins, RCP pipe culvert (Good), RCP pipe culvert concrete grate (Failed)
KIMO-0903	Catch basin (Good), scupper (Good)

Below is a summary of the findings and recommendations for each park section based on the pavement investigation and analysis results:

Table 3: Findings and Recommendations for Each KIMO Road/Parking Lot Section

Route ID	Previous Preservation Treatment (FY19)[1]	From the RIP Report		From AECOM's Field Site Visits			Comment / Reasons for Variance
		PCR	Recommended Treatment[2]	Overall Pavement Condition	Predominant Distress	Treatment Recommendation	
KIMO-0010	Microsurfacing	98	Localized Repair	Fair	Alligator cracking, transverse cracking edge cracking, edge drop-off	1.5" Asphalt overlay w/ localized patching	Pavement is worse than the RIP-reported condition
KIMO-0900	Microsurfacing	90	Preventative Maintenance	Fair	L&T cracking	Crack seal & seal coat w/ localized patching	Pavement is worse than the RIP-reported condition
KIMO-0901	Microsurfacing	90	Preventative Maintenance	Fair	Pavement damage from uprooted tree edge cracking, alligator cracking	Crack seal & seal coat w/ localized patching	Pavement is worse than the RIP-reported condition
KIMO-0903	Microsurfacing	97	Localized Repair	Fair	L&T / reflective cracking	1.5" Asphalt overlay w/ localized patching	Pavement is worse than the RIP-reported condition

Notes:

1) The most likely previous pavement preservation treatment based on the visual observations during the on-site scoping site visit.
2) Per the RIP Report, below are the descriptions of the recommended treatment categories:
    a. Localized Repair: Pavement in "Excellent" condition (PCR = 95-100). Treatment includes spot repairs.
    b. Preventative Maintenance: Pavement in "Good" condition (PCR = 85-95). Treatments include crack sealing, chip seal, slurry seal, micro-surfacing, thin/ ultrathin overlay, concrete joint sealing, diamond grinding, dowel-bar retrofit, and isolated, partial or full-depth concrete slab repairs.
    c. Light Rehaiblitation: Pavement in "Fair" condition (PCR = 60-85). Treatment includes single-lift overlay up to 2.5" and milling and overlaying.
    d. Heavy Rehabilitation: Pavement in "Poor" condition (PCR < 60). Treatment includes multi-lift overlay > 2.5".
    e. Reconstruction: Pavement in "Poor" condition (PCR < 60). Treatment includes replacing the entire existing pavement structure.

Note that the overall pavement conditions were rated as Good/Fair/Poor based on AECOM's on-site scoping field visit observations. Standard pavement engineering practices were applied to determine such rating, a summary of which is included below for reference:

"Good" pavement condition:

- Pavement has minimal surface defects.
- No significant cracks, potholes, or raveling (loss of aggregate).
- Minimum aging (surface color remains dark, indicating minimal loss of asphalt binder due to oxidation).
- Maintenance treatments, e.g., seal coating, crack sealing, etc. are appropriate for a "Good" condition pavement.

"Fair" pavement condition

- Some visible signs of wear, such as minor cracks (hairline to ¼ inch wide).
- Early signs of aging (fading asphalt color).
- Some surface raveling or minor depressions but no major structural issues.
- Patching or previous repairs are intact.
- Heavier preservation treatments, such as localized repair, micro surfacing, or resurfacing are considered to treat a pavement in "Fair" condition.

"Poor" Condition

- Extensive cracking, including alligator (interconnected) cracks or wide transverse/longitudinal cracks (>¼ inch).
- Potholes, ruts, or significant depressions present, causing uneven surfaces.
- Medium to severe raveling or aggregate loss, leading to rough texture.
- Potential water pooling or drainage issues.
- Previous patches or repairs are deteriorating or failing.
- The pavement may be a candidate for a mill and overlay treatment or full-depth reconstruction.

Depending on the treatment types, pavement preservation activities generally can extend the life of a pavement by 5-10 years. For reference, the table below provides a general guideline on the expected performances of the different preservation treatments *(when applied to a pavement in appropriate condition)*:

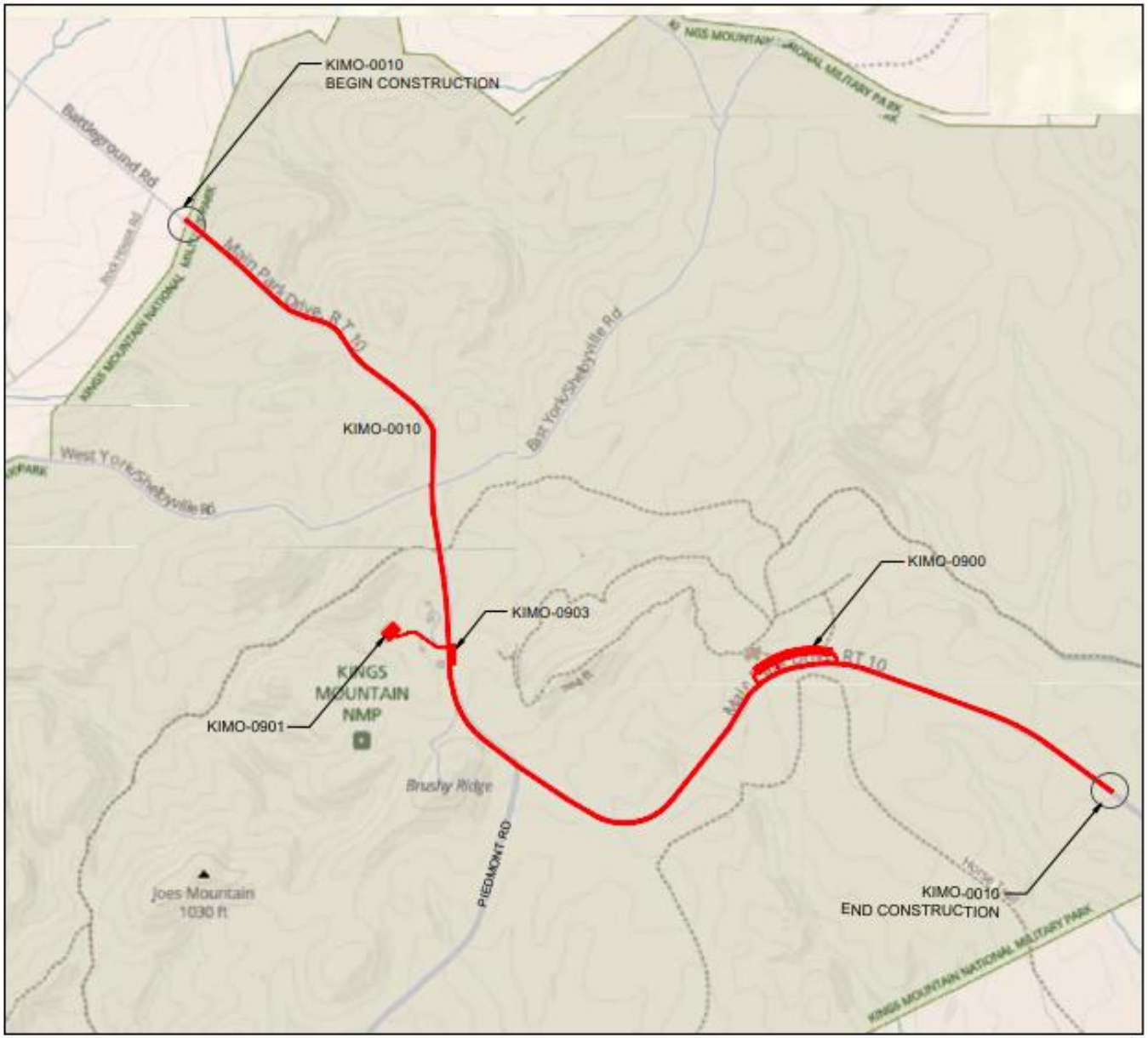
Table 4: "Expected" Performance Period of Typical Pavement Preservation Treatments

Treatment	Expected Performance (Years)
Crack Sealing + Seal Coating (Slurry Seal)	5-7
Microsurfacing	6-8
Thin Overlay	8-10
Non-structural Mill and Overlay	10+

Appendix A – Project Location

KIMO

Antioch Road
Battleground Drive
Road
Apple Road
Pole Branch
Historic Trace of Overmountain Victory
Park Road
Road
House Road
Rock
Yorkville-Shelbyville
Long
Creek
Kings
Stonehouse
Branch
Visitor Center
National Historic Trail
Branch
National Park Administration Office
Battlefield Trail
Bellingham
Branch
KINGS MOUNTAIN NATIONAL MILITARY PARK
Browns Mountain
1045ft
319m
Branch
Lookout Tower Road
Piedmont Road
KINGS MOUNTAIN STATE
Long


KIMO-0010
BEGIN CONSTRUCTION
Battleground Rd
Main Park Drive, R T 10
KIMO-0010
East York/Shelbyville Rd
West York/Shelbyville Rd
KIMO-0900
KIMO-0903
KINGS MOUNTAIN NMP
KIMO-0901
RT 10
Brushy Ridge
PIEDMONT RD
Joes Mountain
1030 ft
KIMO-0010
END CONSTRUCTION
KINGS MOUNTAIN NATIONAL MILITARY PARK

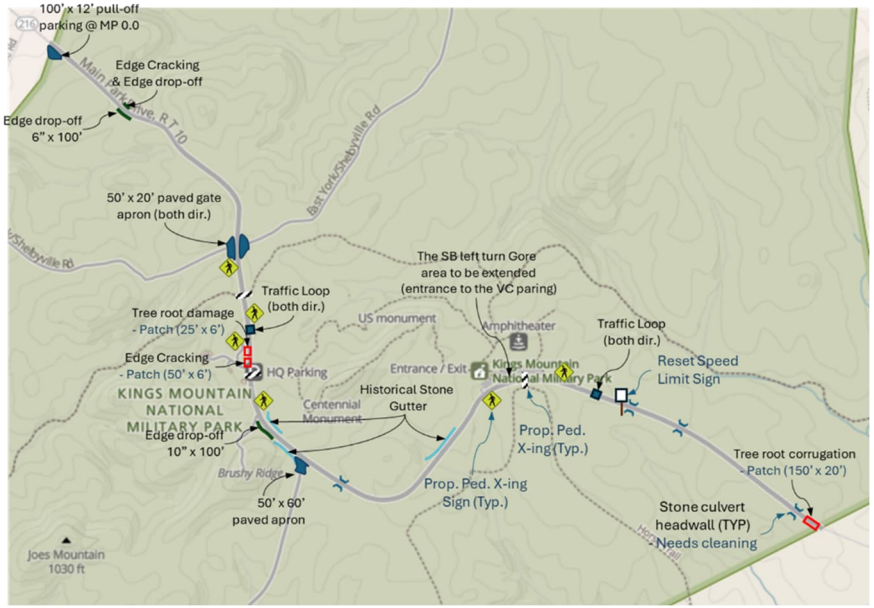
Appendix B – Scoping Site Visit Field Notes and Photos

KIMO-0010: Main Park Drive

Section Length/Area	2.82 Miles	**Other Observations**	Raised Pavement Markers (RPM) - metal (Good)[2]
Pavement Type	Asphalt	**Curb**	Concrete curb & gutter @ MP 0.0 pull off (Good) Granite curb @ HQ pull off (Good)
RIP Data (PCR)	98	**Sidewalk**	None
Overall Pavement Condition	Fair	**Drainage Structure**	Culverts w/ stone headwalls[1] (needs cleaning) Historical stone gutters & headwalls (protect)[1]
Predominant Distress	Alligator cracking, Transverse cracking Edge cracking and edge drop off	**Road Signs**	One "Speed Limit" sign needs to be reset[1] Proposed "Ped X-ing" signs @ HQ & VC X-walks
Recommended Treatment	Asphalt patching with 1.5" AC overlay, Edge/shoulder support	**Handicap Parking**	None
Geotechnical Testing	6 Cores & 1 test pit	**Existing Striping**	Thermoplastic paint (Good/Fair)

Notes:

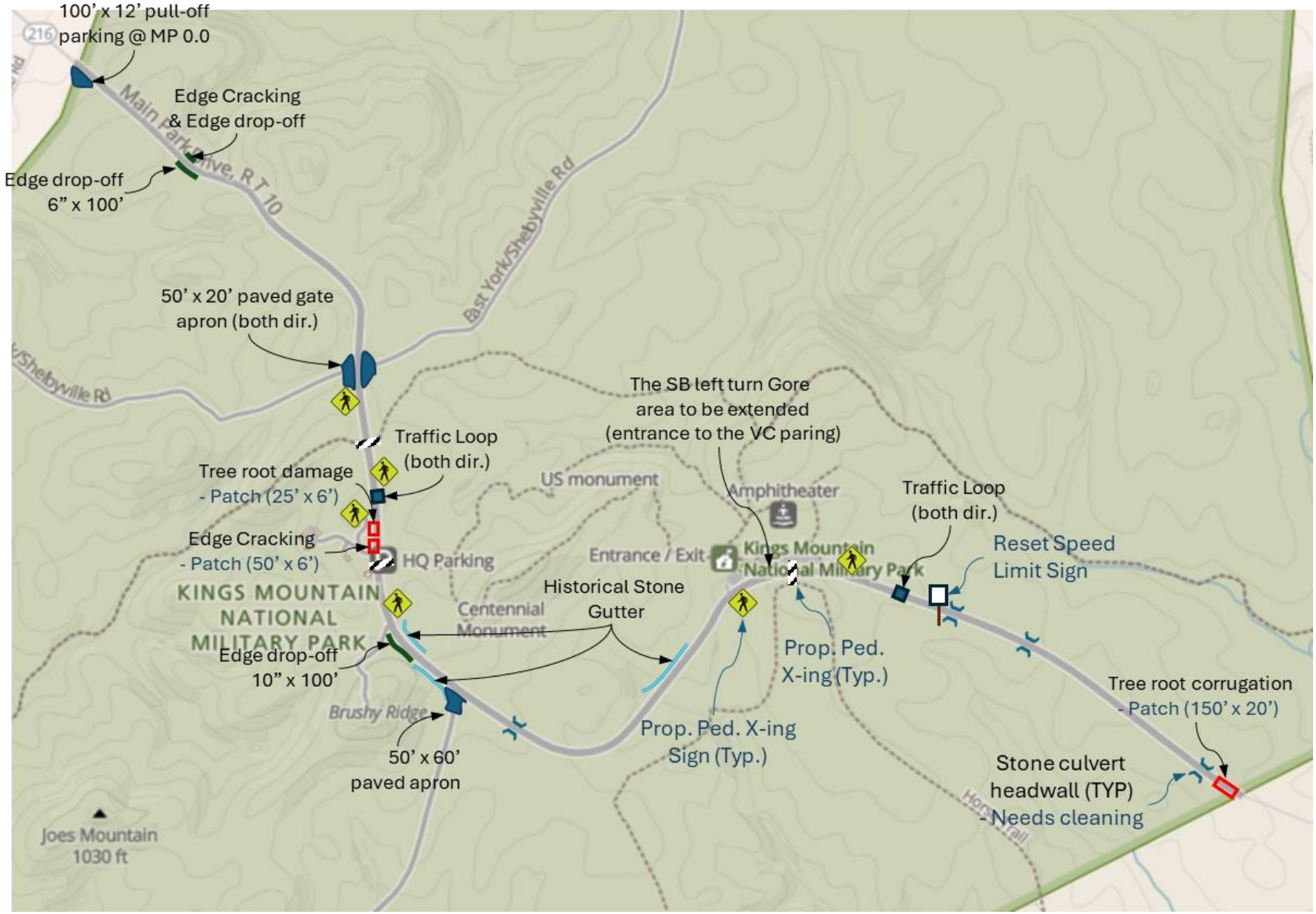
1. *Locations on marked plan.*
2. *Metal Raised Pavement Markings (RPM) throughout @ ~100' spacing (the RPM spacing reduces to ~25' near the VC parking) - removed and reset as part of the SER-PMS-FY19 Project.*



Section	Distress		Treatment
1	L/M L/M	Alligator Cracking 10-15% of length Edge Cracking 400' Edge Drop-Off	Asphalt patching with 1.5" AC overlay

Legend:

L, M – Low or Medium severity cracks


100' x 12' pull-off parking @ MP 0.0
Edge Cracking & Edge drop-off
Edge drop-off 6" x 100'
Main Park Drive, RT 10
East York/Shelbyville Rd
50' x 20' paved gate apron (both dir.)
Traffic Loop (both dir.)
Tree root damage - Patch (25' x 6')
Edge Cracking - Patch (50' x 6')
HQ Parking
KINGS MOUNTAIN NATIONAL MILITARY PARK
Centennial Monument
Edge drop-off 10" x 100'
Brushy Ridge
50' x 60' paved apron
Joes Mountain 1030 ft
The SB left turn Gore area to be extended (entrance to the VC paring)
US monument
Amphitheater
Entrance / Exit
Kings Mountain National Military Park
Historical Stone Gutter
Prop. Ped. X-ing (Typ.)
Prop. Ped. X-ing Sign (Typ.)
Traffic Loop (both dir.)
Reset Speed Limit Sign
Tree root corrugation - Patch (150' x 20')
Stone culvert headwall (TYP) - Needs cleaning

KIMO-0010: Main Park Drive

❶ **Lat/Long:** 35.15105,-81.393128
Medium Alligator Cracking

❷ **Lat/Long:** 35.140336,-81.386894
Medium Edge Cracking

❸ **Lat/Long:** 35.136756,-81.381311
Low Alligator Cracking

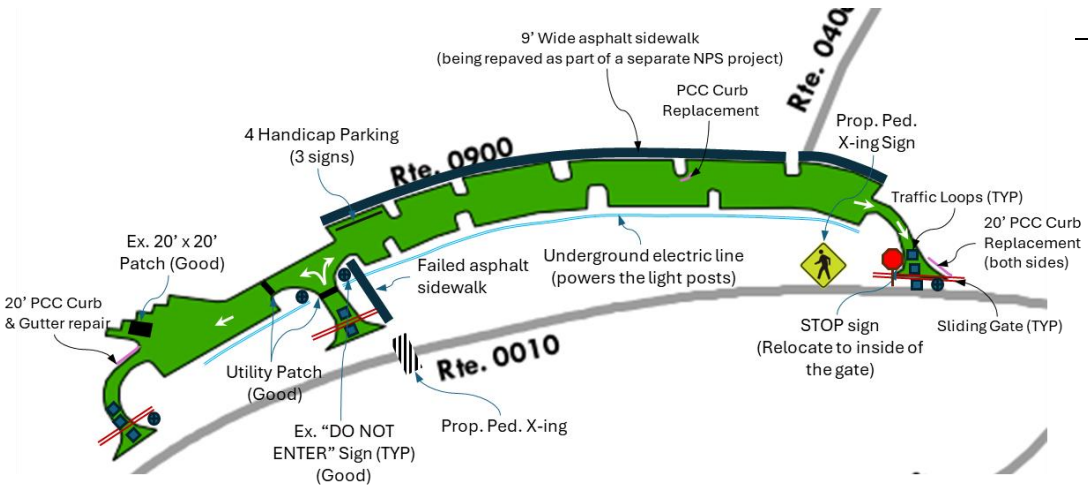
❹ **Lat/Long:** 35.135942,-81.362786
Tree root damage (proposed patch)

KIMO-0900: Visitor Center Parking

Section Length/Area	46,317 SF	**Other Observations**	Prv. Overlays exceed curb & gutter height
Pavement Type	Asphalt	**Curb**	PCC curb & gutter (6" reveal) (Fair)[1]
RIP Data (PCR)	90	**Sidewalk**	Asphalt (Poor)[1]
Overall Pavement Condition	Fair	**Drainage Structure**	Catch basins
Predominant Distress	L&T cracking	**Road Signs**	Okay
Recommended Treatment	Crack seal & Seal coat	**Handicap Parking**	4 (3 signs)[1] – possible non-conforming ramps
Geotechnical Testing	None	**Existing Striping**	Regular paint (Fair)

Notes:

1. *Locations on marked plan.*



Section	Distress	Treatment Options[2]
1	L L&T 3,000' M Alligator Cracking 300 SF	Crack seal & Seal coat

Legend:

L&T – Longitudinal & Transverse cracking
L, M – Low or Medium severity cracks

KIMO-0900: Visitor Center Parking

❶ **Lat/Long:** 35.141303,-81.375617
Low severity L&T Cracking.

❷ **Lat/Long:** 35.140881,-81.376922
Low-severity asphalt patch.

❸ **Lat/Long:** 35.140747,-81.377061
Medium-severity Alligator Cracking.

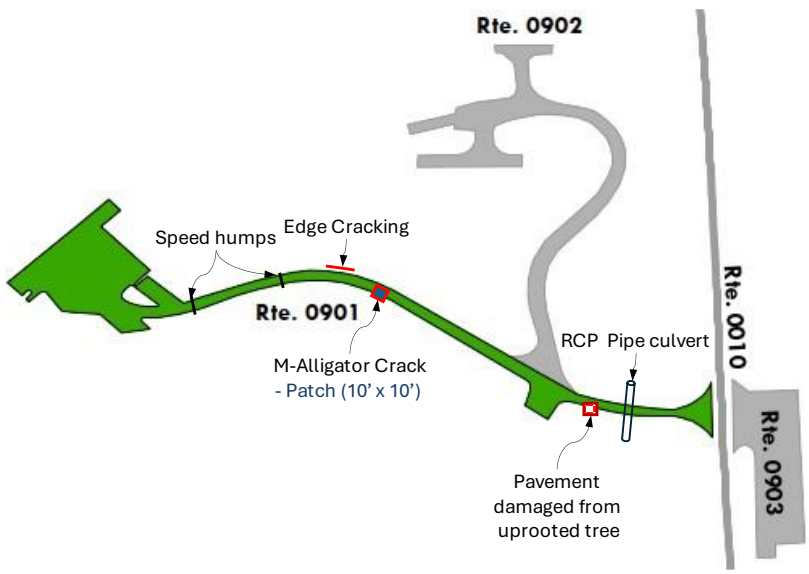
❹ **Lat/Long:** 35.141453,-81.375189
Asphalt sidewalk in poor condition (being repaired as part of a separate project.

KIMO-0901: Maintenance Area Parking (added)

Section Length/Area	15,648 SF	**Other Observations**	Swing gate (needs resetting)
Pavement Type	Asphalt	**Curb**	None
RIP Data (PCR)	90	**Sidewalk**	None
Overall Pavement Condition	Fair	**Drainage Structure**	Catch basins, RCP pipe culvert[1] (Good) RCP Pipe Culvert Concrete Grate (Failed)
Predominant Distress	Pavement damage from uprooted tree[1] Edge cracking[1], Alligator Cracking[1]	**Road Signs**	Okay
Recommended Treatment	AC Patch with Seal Coat	**Handicap Parking**	None
Geotechnical Testing	None	**Existing Striping**	None

Notes:

1. *Locations on marked plan.*



Section	Distress	Treatment Options[2]
1	L Alligator Cracking 100 SF L Edge Cracking 20'	AC Patch with Seal Coat

Legend:

L&T – Longitudinal & Transverse cracking
L, M – Low or Medium severity cracks

KIMO-0901: Maintenance Area Parking (added)

❶ **Lat/Long:** 35.14144,-81.387405
Pavement damage from uprooted tree

❷ **Lat/Long:** 35.141676,-81.38797
Alligator cracking

❸ **Lat/Long:** 35.141929,-81.388143
Edge cracking & swing gate

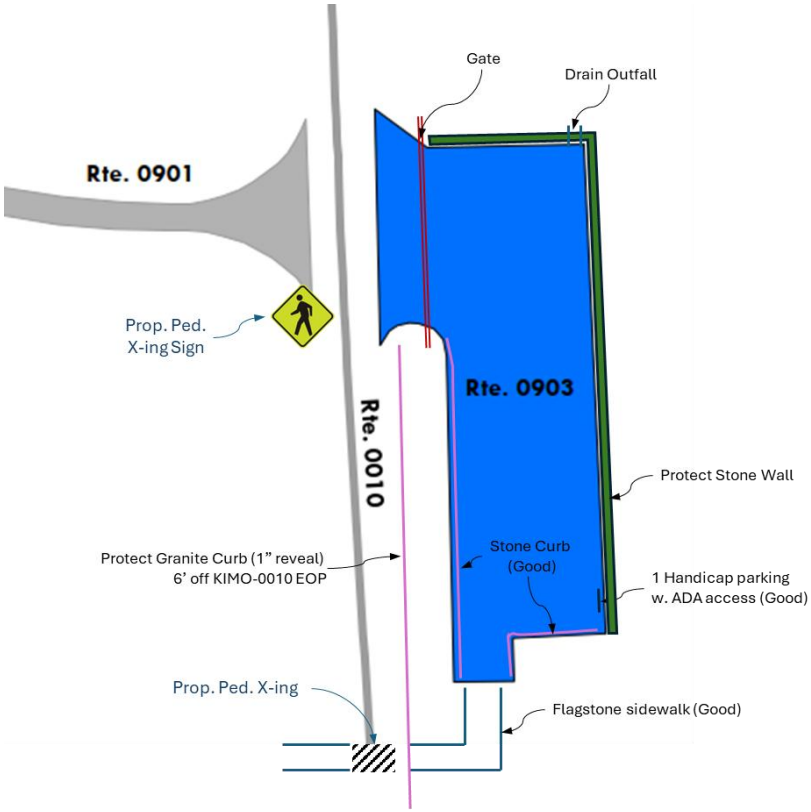
❹ **Lat/Long:** 35.141924,-81.38813
Edge cracking & speed humps

KIMO-0903: Headquarters Parking

Section Length/Area	7,967 SF	**Other Observations**	
Pavement Type	Asphalt	**Curb**	PCC wheel stops at parking stalls (Good) Stone curbs (Good)[1]
RIP Data (PCR)	97	**Sidewalk**	Flagstone sidewalk (Good)
Overall Pavement Condition	Fair	**Drainage Structure**	Catch basin (Good), Scupper (Good)
Predominant Distress	L&T/Block/Reflective Cracking	**Road Signs**	Okay
Recommended Treatment	1.5” AC overlay	**Handicap Parking**	1 with ADA access
Geotechnical Testing	2 cores	**Existing Striping**	Regular paint (Fair)

Notes:

1. *Locations on marked plan.*
2. *Final treatment determination to be made considering the overall program budget.*



Section	Distress		Treatment Options[2]
1	L	Reflective Block Cracking 550’	1.5” AC overlay

Legend:

L, M – Low or Medium severity cracks

KIMO-0903: Headquarters Parking

❶ **Lat/Long:** 35.141126, -81.386832
PCC wheel stops, stone wall.

❷ **Lat/Long:** 35.141350, -81.386953
Low severity Reflective Block Crack

❸ **Lat/Long:** 35.14143,-81.386922
Low severity Reflective Block Crack

❹ **Lat/Long:** 35.14114,-81.386904
Handicap parking with ADA accessibility and signage.

Appendix C1 – Subsurface Sampling and Geotechnical Testing Data

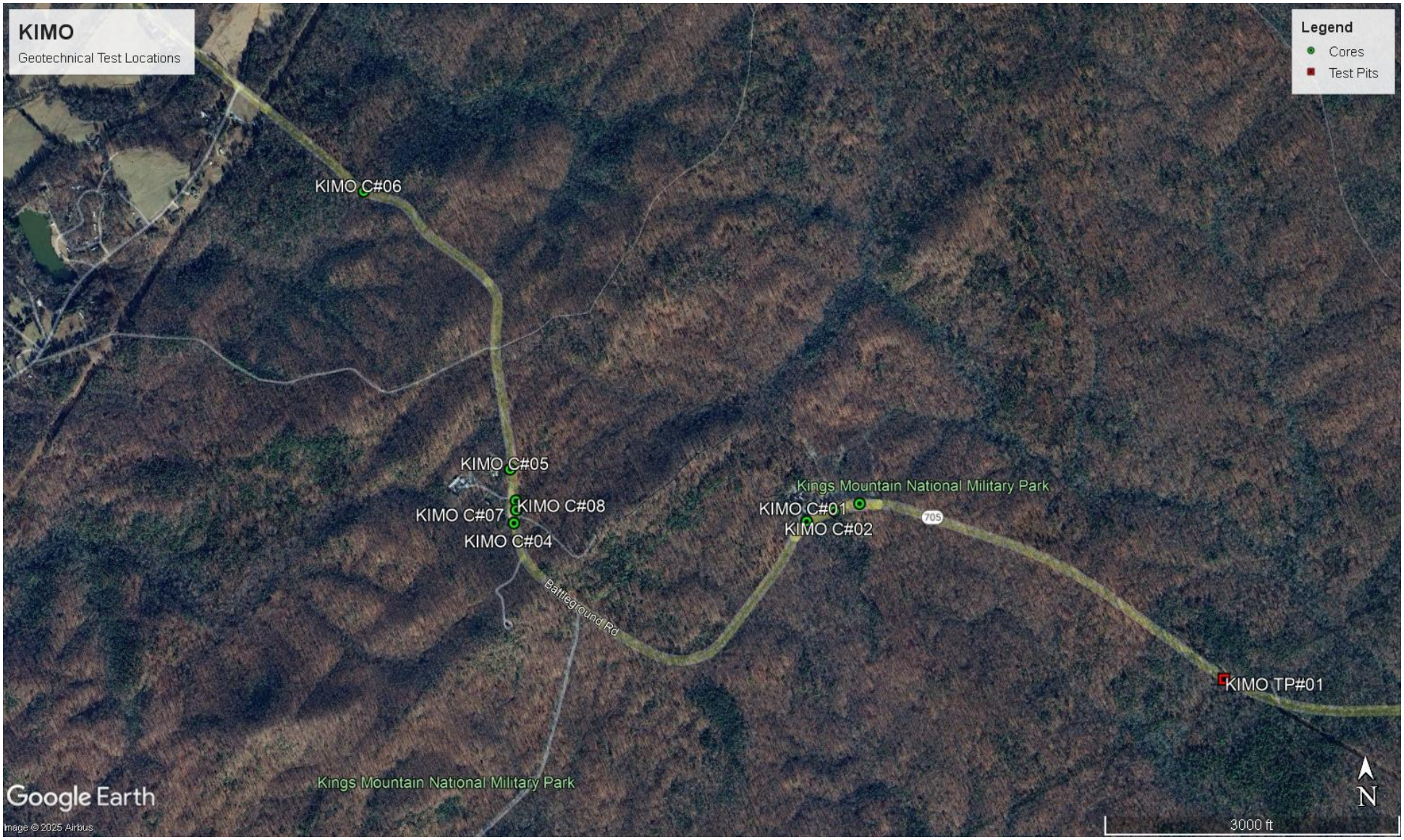
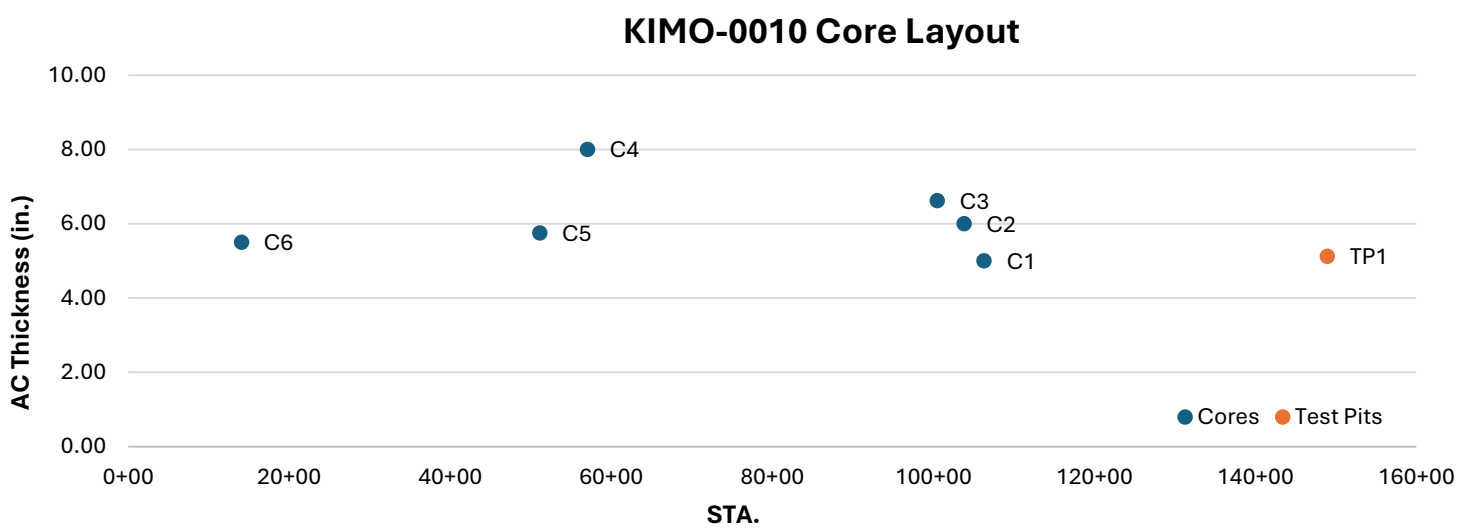

KIMO
Geotechnical Test Locations
Legend
Cores
Test Pits
KIMO C#06
KIMO C#05
KIMO C#07
KIMO C#08
KIMO C#04
Kings Mountain National Military Park
KIMO C#01
KIMO C#02
705
Battleground Rd
KIMO TP#01
Kings Mountain National Military Park
Google Earth
Image © 2025 Airbus
N
3000 ft

Table: Core Data Summary KIMO

Core/ TP #	Route ID	Direction	Sta.	AC			Unbound Layers		
				Thickness (in)	Cracking (in.)	Debonding (in.)	Base	Sub Base	Subgrade
C1	KIMO-0010	NB	106+29	5.00	--	--	Crushed Gravel	--	--
C2	KIMO-0010	SB	103+80	6.00	0.00-6.00	3.25	Crushed Gravel	--	--
C3	KIMO-0010	NB	100+48	6.63	--	4.00	Crushed Gravel	--	--
C4	KIMO-0010	NB	57+02	8.00	--	--	Gravel	--	--
C5	KIMO-0010	SB	51+10	5.75	--	2.88	Crushed Gravel	--	--
C6	KIMO-0010	SB	14+05	5.50	--	3.00	Silty Sand w/ Gravel	--	--
C7	KIMO-0903	--		3.25	--	--	Silty Sand	--	--
C8	KIMO-0903	--		2.50	--	--	Gravel	--	--
TP1	KIMO-0010	SB	148+94	5.13	--	1.25	1.625" of A-1-a	4.75" of A-1-a	A-4



Appendix C2 – Material Sampling Photo Documentation Log

AECOM

Appendix C2: MATERIAL SAMPLING PHOTO DOCUMENTATION LOG

Date 7/23/2025 Site Code: KIMO Sampled By JSG/NJ

Legend: G = Good F = Fair P = Poor

Sample Number: C1 Dia.: 6"

Location: KIMO-0010 NB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	1.125	HMA	G		
	Binder	2.125	HMA	F		
	Base	1.75	HMA			
	--	--	--			
	--	--	--			
	Total Depth	5	inches			

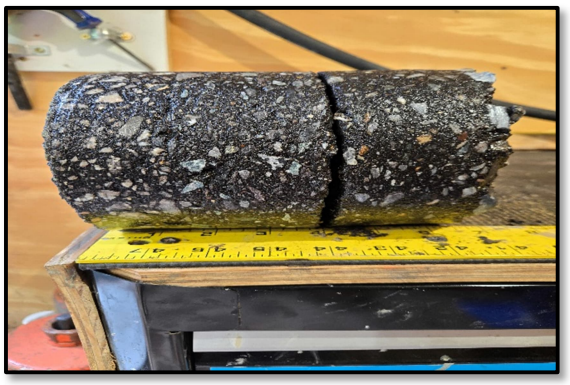
Core Notes: Subbase Course Visual Identification = Gray Crushed Aggregate (3/4" NMAS)

Sample Number: C2 Dia.: 6"

Location: KIMO-0010 SB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	3.25	HMA	P		
	Base	2.75	HMA			
	--	--	--			
	--	--	--			
	--	--	--			
	--	--	--			
	Total Depth	6	inches			

Core Notes: Subbase Course Visual Identification = Gray Crushed Agg Base
Full Depth Cracking



Sample Number: C3 Dia.: 6"

Location: KIMO-0010 NB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	2	HMA	G		
	Binder	2	HMA	P		
	Base	2.625	HMA			
	--	--	--			
	--	--	--			
	--	--	--			
	Total Depth	6.625	inches			

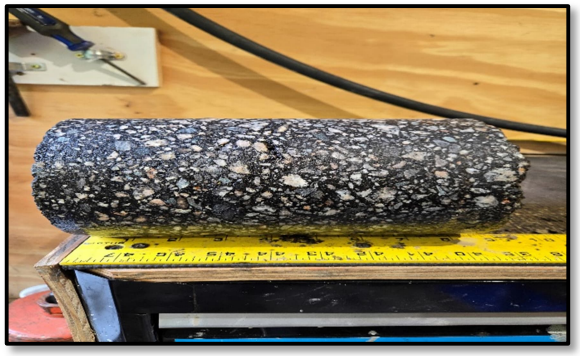
Core Notes: Subbase Course Visual Identification = Gray Crushed Aggregate

AECOM

Appendix C2: MATERIAL SAMPLING PHOTO DOCUMENTATION LOG

Date 7/23/2025 Site Code: KIMO Sampled By JSG/NJ

Legend: G = Good F = Fair P = Poor



Sample Number: C4 Dia.: 6"

Location: KIMO-0010 NB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	1.5	HMA	G		
	Binder	2.5	HMA	G		
	Base	4	HMA			
	--	--	--			
	--	--	--			
	Total Depth	8	inches			

Core Notes: Subbase Course Visual Identification = Brown Gravel

Sample Number: C5 Dia.: 6"

Location: KIMO-0010 SB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	1.375	HMA	G		
	Sand Mix	1.5	HMA	P		
	Sand Mix	1.125	HMA	G		
	Binder Course	1	HMA	G		
	Base	0.75	HMA			
	Total Depth	5.75	inches			

Core Notes: Subbase Course Visual Identification = Gray Crushed Gravel

Sample Number: C6 Dia.: 6"

Location: KIMO-0010 SB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	1.5	HMA	G		
	Binder	1.5	HMA	P		
	Wearing Course	0.25	HMA	G		
	Surface Course	1.25	HMA	G		
	Base Course	1	HMA			
	Total Depth	5.5	inches			

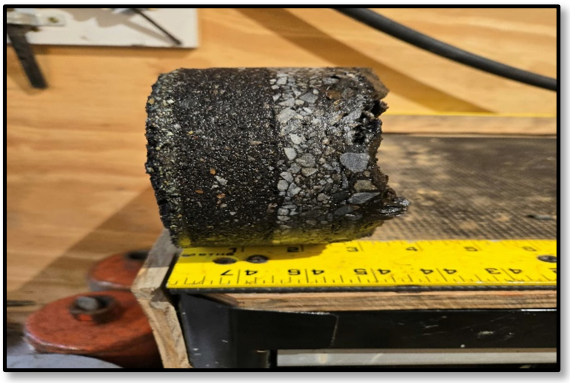
Core Notes: Subbase Course Visual Identification = Silty Sand with Gravel

AECOM

Appendix C2: MATERIAL SAMPLING PHOTO DOCUMENTATION LOG

Date 7/23/2025 Site Code: KIMO Sampled By JSG/NJ

Legend: G = Good F = Fair P = Poor



Sample Number: C7 Dia.: 6"

Location: KIMO-0903

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Wearing Course	0.25	HMA	G		
	Sand Mix	1.25	HMA	G		
	Base Course	1.75	HMA			
	--	--	--			
	--	--	--			
	--	--	--			
	Total Depth	3.25	inches			

Core Notes: Subbase Course Visual Identification = Hard Packed Silty Sand

Sample Number: C8 Dia.: 6"

Location: KIMO-0903

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Wearing Course	0.25	HMA	G		
	Sand Mix	1.125	HMA	G		
	Base Course	1.125	HMA			
	--	--	--			
	--	--	--			
	--	--	--			
	Total Depth	2.5	inches			

Core Notes: Subbase Course Visual Identification = Well Graded Gravel

AECOM

Appendix C2: MATERIAL SAMPLING PHOTO DOCUMENTATION LOG

Date 7/23/2025 Site Code: KIMO Sampled By JSG/NJ

Legend: G = Good F = Fair P = Poor

Sample Number: TP1 Dia.: 6"

Location: KIMO-0010 SB

	Layer Type	Thickness	Description	Bond Quality	Stripping	Deterioration
HMA	Surface	1	HMA	G		
	Binder	1.125	HMA	G		
	Sand Mix	0.75	HMA	G		
	Wearing	0.25	HMA	G		
	Binder	0.875	HMA	G		
	Base	1.125	HMA			
UNBOUND	Agg Base	1.625	Crushed Aggregate (A-1-a)			
	Subbase	4.75	Gravel w. Silt & Sand (GP-GM / A-1-a)			
	Subgrade	8.5	Silty Clay w. Sand (CL-ML / A-4)			
	Total Depth	20	inches			

Core Notes: --

Appendix C3 – Laboratory Test Results of Unbound Materials

Project: NPS SC - KIMO
Project No.: 60748151

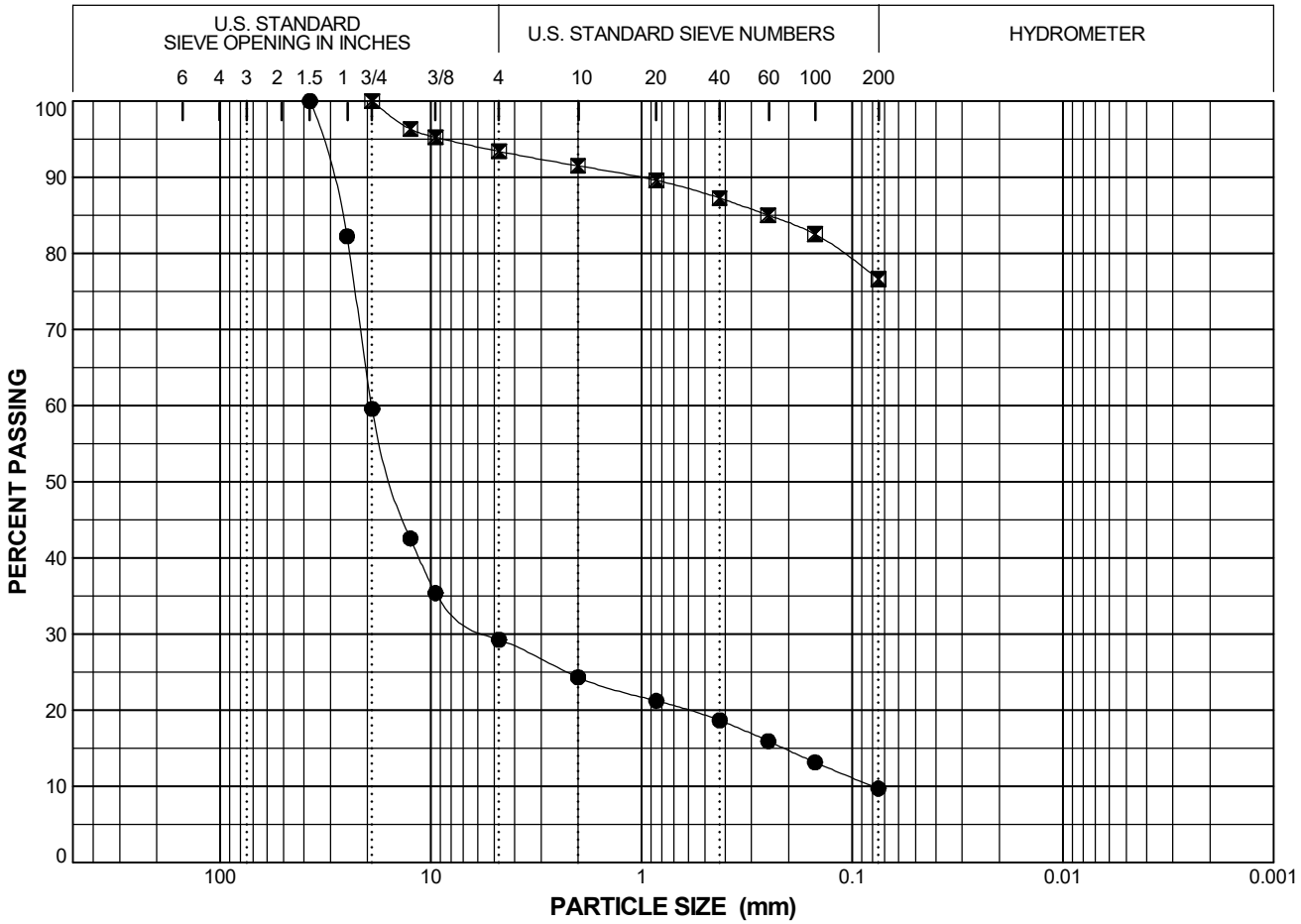
AECOM

SUMMARY OF LABORATORY TEST RESULTS

Boring and Sample Numbers	Depth (ft)	Classification	USCS and AASHTO Symbols	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits		Specific Gravity	Organic Content (%)	Grain Size		Compaction	Consolidation	Unconfined Compression		Triaxial Compression		Permeability (cm/sec)	Special Tests
						Liquid Limit	Plastic Limit			<#200 (%)	<2μ (%)			Strength (psi)	Strain (%)	UU	CIU		
TP1 Subbase 1	6.75-11.5	Gray POORLY GRADED GRAVEL with SILT and SAND	GP-GM A-1-a(0)	3.8						10									
TP1 Subgrade	11.5-20.0	Gray SILTY CLAY with SAND	CL-ML A-4(2)	14.6		23	18			77									

Note: The soil classification is based partially on visual classification unless both grain size and Atterberg limits are performed.

* Refer to Laboratory Test Curves



SYMBOL	●	⊠
Boring	TP1	TP1
Sample	Subbase 1	Subgrade
Spec		
Depth (ft)	6.75-11.5	11.5-20.0
% +3"	0.0	0.0
% Gravel	70.7	6.6
% Sand	19.5	16.8
% Fines	9.7	76.6
% -2μ		
Cc	17.59	
Cu	240.22	
LL		23
PL		18
PI		5
AASHTO	A-1-a(0)	A-4(2)
USCS	GP-GM	CL-ML
w (%)	3.8	14.6

Particle Size (Sieve #)	PERCENT FINER ●	PERCENT FINER ⊠
2"		
1 1/2"	100.0	
1"	82.2	
3/4"	59.6	100.0
1/2"	42.6	96.3
3/8"	35.4	95.2
4	29.3	93.4
10	24.3	91.5
20	21.2	89.6
40	18.7	87.3
60	15.9	85.0
100	13.2	82.5
200	9.7	76.6

SYMBOL	DESCRIPTION AND REMARKS
●	Gray POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
⊠	Gray SILTY CLAY with SAND (CL-ML)

PARTICLE SIZE DISTRIBUTION

NPS SC - KIMO

Project Number	July 2025	Figure 1
60748151		

AECOM

SIEVE_BLUEBELL_AASHTO 60748151_2025-06-16_NPS SC - KIMO.GPJ URS_BLUE.GDT 7/11/25

Laboratory Assignment Sheet

Assignment No.: 2025-06-16

Project Name: NPS East SC 192 Pavement DDs - King's Mountain National Military Park (KIMO)
Project Manager: ST Reviewed By: JSG
Project Number: 60748151 - 00030

Date Received: 6/13/25
Date Completed By:

			Water Content, %	Atterberg Limits ASTM D 4318		Specific Gravity		Grain-Size		Compaction Test		CBR Test	Permeability Test		Consol. Test	CRS Test	Trlaxial Test			Direct Shear	pH	Organic Content, %	Other/ Remarks/ Confining Pressures
								Sieve	Hydro								Uc	UU	CIU				
Boring No.	Sample No.	Depth in.	ASTM D 2216	Air Dried	Oven Dried	ASTM D 854	ASTM D 127	ASTM D 422		ASTM D 698	ASTM D 1557	ASTM D 1883	ASTM D 2434	ASTM D 5084	ASTM D 2435	ASTM 4186	ASTM D 2166	ASTM D 2850	ASTM D 4767	ASTM D 3080	AASHTO T289	ASTM D 2974	
TP1	Subbase 1	6.75" - 11.5"	Y-no bill					X															
TP1	Subgrade	11.5" - 20"	Y-no bill	X				X															
		" - "																					
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		" - "																					
TOTAL =	**2**																						
Base =	0																						
Subbase 1 =	1																						
Subbase 2 =	0																						
Subgrade =	0																						

Notes: Moisture Contents (provide - no bill internal), AASHTO/ASTM Classifications to be provided.
We will decide on the need for and which samples to run Atterbergs on once we know the moisture contents and need for ASTM classification.

Appendix D – Traffic Data for Pavement Design (Provided by the NPS)

000000460821 - 46-0821

- L-705 : County Line - CHEROKEE TO SC 161 (HIGHWAY 161 N)
County: YORK
LRS section: 46090070500N
Functional class: 5R - Major Collector (Rural)
Coordinates: 35.14612694, -81.33863836

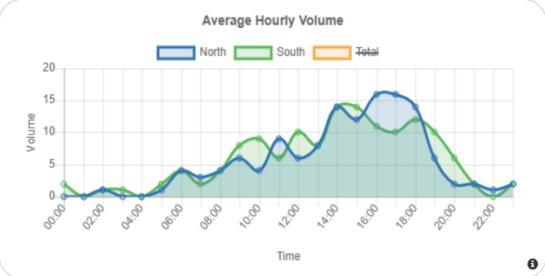
Site Data

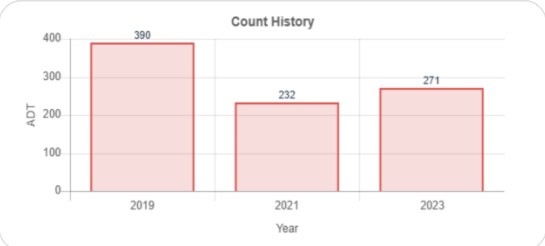
Count History

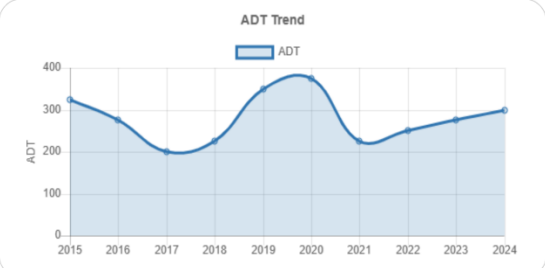
Year	Month	Count type	Duration	Count	ADT
2023	February	Class	48 hours	542	271
2021	February	Class	48 hours	463	232
2019	April	Class	48 hours	781	390

Annual Statistics

Data Item	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
AADT	325	275	200	225	350	375	225	250	275	**300**
SU AADT	-	-	-	-	11	12	9	10	8	**9**
CU AADT	-	-	-	-	2	2	-	-	1	**1**
K-Factor	-	-	-	-	0.130	0.130	0.130	0.130	0.110	**0.110**
D-Factor	-	-	-	-	0.520	0.520	0.550	0.550	0.550	**0.550**







Vehicle Classification 2023

1. Motorcycles 2 axles, 2 or 3 wheels.	4.24%
2. Passenger cars 2 axles. Can have 1- or 2-axle trailers.	60.15%
3. Pickups, panels, vans 2-axle, 4-tire single units. Can have 1- or 2-axle trailers.	32.29%
4. Buses 2- or 3-axle, full length.	0%
5. Single-unit trucks 2-axle, 6-tire, (dual rear tires), single-unit trucks.	2.77%
6. Single-unit trucks 3-axle, single-unit trucks.	0.18%
7. Single-unit trucks 4 or more axle, single-unit trucks.	0%
8. Single-trailer trucks 3- or 4-axle, single-trailer trucks.	0%
9. Single-trailer trucks 5-axle, single-trailer trucks.	0.37%
10. Single-trailer trucks 6 or more axle, single-trailer trucks.	0%
11. Multi-trailer trucks 5 or less axle, multi-trailer trucks.	0%
12. Multi-trailer trucks 6-axle, multi-trailer trucks.	0%
13. Multi-trailer trucks 7 or more axle, multi-trailer trucks.	0%

Table: ESAL Calculation Table for KIMO-0010

Class	Design AADT	Vehicle Distribution (%)	Truck Factor	ESAL
Class 1		4.24%	0.0061	755
Class 2		60.15%	0.0061	10,714
Class 3		32.29%	0.0061	5,751
Class 4		0.00%	0.6806	0
Class 5		2.77%	0.189	15,287
Class 6		0.18%	0.1303	685
Class 7	400	0.00%	0.1303	0
Class 8		0.00%	0.8646	0
Class 9		0.37%	2.3719	25,626
Class 10		0.00%	2.3719	0
Class 11		0.00%	2.3187	0
Class 12		0.00%	2.3187	0
Class 13		0.00%	2.3187	0
			20-Year Design ESAL	**58,819**

Appendix E – *AASHTO 1993* Pavement Design Calculations

AASHTO 1993 Pavement Design Calculations

Project SC192 Pavement Preservation, Multiple Parks in South Carolina
Section ID KIMO-0010
Design for Structural Adequacy of Existing Pavement

Design Inputs

Subgrade M_r (psi) =	10,000
Acceptable terminal servicibility P_t =	2.5
Initial servicibility P_0 =	4.2
Servicibility loss (ΔPSI) =	1.7
ADT =	400
% Trucks =	3.3%
Daily Truck Volume =	13
Design Life (Year) =	20.00
Design ESAL =	58,819
Reliability, R =	90
Z_R =	-1.282
Standard Deviation S_0 =	0.45
W_{18} =	58,819
Required SN =	**1.94**

Existing Structure

Layer	Thickness (in)	Layer Coeff.
HMA	1.5	0.34
HMA	2.5	0.34
HMA	2.0	0.34
Agg. Base	6.0	0.14
Subbase	0.0	0.11
Total Pavement Thickness		**12**
Provided SN		**2.88**

Pass
[Provided SN > Required SN]

AASHTO 1993 Design Input References

Functional Classification	Urban	Rural
Interstate and other freew ays	85-99.9	80-99.9
Principle arterials	80-99	75-95
Collectors	80-95	75-95
Local	50-80	50-80

Page II-9

S_0=0.40-0.50 for flexible pavement (or overlay) design (I-62&III-82)
S_0=0.30-0.40 for AC overlay (III-121)

R	Z_R
50	0
60	-0.253
70	-0.524
80	-0.841
85	-1.037
90	-1.282
91	-1.34
92	-1.405
93	-1.476
94	-1.555
95	-1.645
96	-1.751
97	-1.881
98	-2.054
99	-2.327
100	-3.75

AASHTO 1993 Pavement Design Calculations

Project SC192 Pavement Preservation, Multiple Parks in South Carolina
Section ID KIMO-0010
Design for Proposed Treatment: 1.5" Overlay

Design Inputs

Subgrade M_r (psi) =	10,000
Acceptable terminal servicibility P_t =	2.5
Initial servicibility P_0 =	4.2
Servicibility loss (ΔPSI) =	1.7
ADT =	400
% Trucks =	3.3%
Daily Truck Volume =	13
Design Life (Year) =	20.00
Design ESAL =	58,819
Reliability, R =	90
Z_R =	-1.282
Standard Deviation S_0 =	0.45
W_{18} =	58,819
Required SN =	**1.94**

Proposed Structure

Layer	Thickness (in)	Layer Coeff.
HMA	3.0	0.34
HMA	2.5	0.34
HMA	2.0	0.34
Agg. Base	6.0	0.14
Subbase	0.0	0.11
Total Pavement Thickness		**14**
Provided SN		**3.39**

Pass
[Provided SN > Required SN]

AASHTO 1993 Design Input References

Functional Classification	Urban	Rural
Interstate and other freew ays	85-99.9	80-99.9
Principle arterials	80-99	75-95
Collectors	80-95	75-95
Local	50-80	50-80

Page II-9

S_0=0.40-0.50 for flexible pavement (or overlay) design (I-62&III-82)
S_0=0.30-0.40 for AC overlay (III-121)

R	Z_R
50	0
60	-0.253
70	-0.524
80	-0.841
85	-1.037
90	-1.282
91	-1.34
92	-1.405
93	-1.476
94	-1.555
95	-1.645
96	-1.751
97	-1.881
98	-2.054
99	-2.327
100	-3.75

Appendix F – Construction Cost Estimate Summary
(Class B Estimate will be submitted separately)

Class C Summary Estimate for all South Carolina Parks

Park	PMIS #	PMIS Estimated Budget	Base Bid			Options			Total W. Options		
			Direct Construction	Markups	Total	Direct Constructio	Markups	Total	Direct Construction	Markups	Total
COWP	334929	$1,869,762	$346,791	$332,795	$679,586	$10,209	$9,797	$20,005	$357,000	$342,591	$699,591
CONG	334914	$615,000	$403,196	$403,613	$806,809	$16,801	$16,819	$33,620	$419,997	$420,432	$840,429
KIMO	**334920**	**$1,155,041**	**$987,432**	**$1,081,349**	**$2,068,780**	**$9,669**	**$10,589**	**$20,257**	**$997,101**	**$1,091,937**	**$2,089,038**
NISI	334915	$121,000	$14,000	$16,030	$30,030	$9,608	$11,001	$20,610	$23,608	$27,031	$50,639
	Total	**$3,760,803**	**$1,751,419**	**$1,833,786**	**$3,585,205**	**$46,287**	**$48,205**	**$94,492**	**$1,797,706**	**$1,881,991**	**$3,679,697**

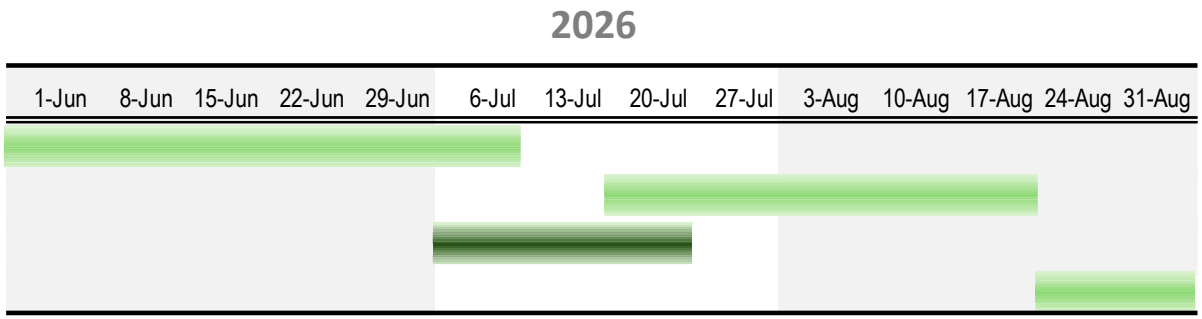
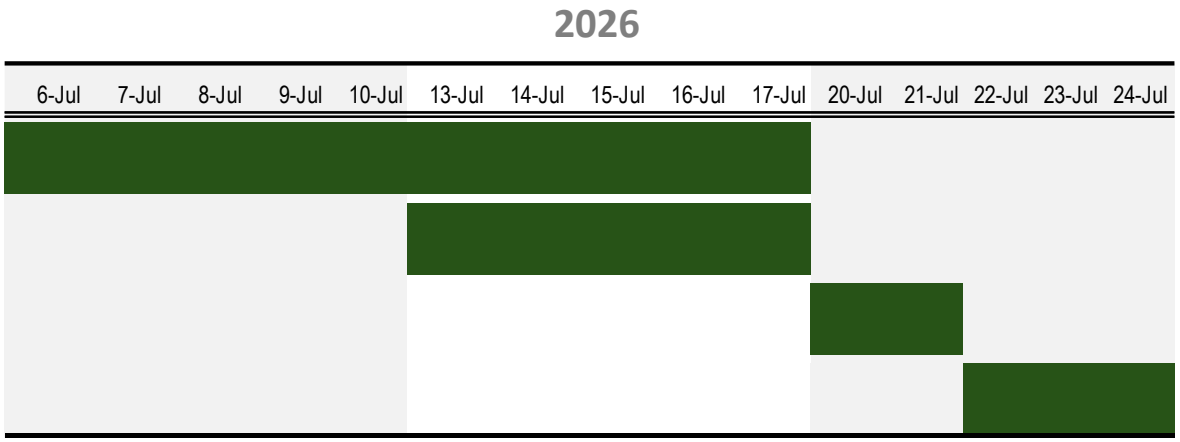
Class C Summary Estimate for the KIMO Sections

ROUTE ID	ROAD	FMSS#	PAVEMENT TYPE	PROPOSED TREATMENT	COST W/O MARKUPS	TOTAL MARKUP	COST W/ MARKUPS	PMIS ESTIMATED BUDGET
KIMO-0010	MAIN PARK DRIVE	42951	Asphalt	ASPHALT OVERLAY w/ LOCALIZED PATCHING	$ 937,644	$ 1,026,826	$ 1,964,470	$ 979,474
KIMO-0900	VISITOR CENTER PARKING	52487	Asphalt	CRACK SEAL & SEAL COAT w/ LOCALIZED PATCHING	$ 44,337	$ 48,554	$ 92,891	$ 150,155
KIMO-0901	MAINTENACE AREA PARKING	54288	Asphalt	CRACK SEAL & SEAL COAT w/ LOCALIZED PATCHING	$ 9,669	$ 10,589	$ 20,257	$ -
KIMO-0903	HEADQUARTERS PARKING	54290	Asphalt	CRACK SEAL & SEAL COAT	$ 5,450	$ 5,969	$ 11,419	$ 25,411
				Total Base Bid	**$ 987,432**	**$ 1,081,349**	**$ 2,068,780**	**$ 1,155,041**
				Total Options	**$ 9,669**	**$ 10,589**	**$ 20,257**	**$ -**
				Total	**$ 997,101**	**$ 1,091,937**	**$ 2,089,038**	**$ 1,155,041**

Note: The added section (KIMO-0901) will be included as a "Bid Option" in the Class C Construct Cost Estimate and the 15% Design Plans.

Appendix G – Construction Schedule Summary

PARK ID	PMIS #	Duration (days)
COWP	334929	41
CONG	334914	34
KIMO	**334920**	**20**
NISI	334,915	13



ROUTE ID	ROAD	PROPOSED TREATMENT
KIMO-0010	MAIN PARK DRIVE	ASPHALT OVERLAY w/ LOCALIZED PATCHING
KIMO-0900	VISITOR CENTER PARKING	CRACK SEAL & SEAL COAT w/ LOCALIZED PATCHING
KIMO-0901	MAINTENACE AREA PARKING	CRACK SEAL & SEAL COAT w/ LOCALIZED PATCHING
KIMO-0903	HEADQUARTERS PARKING	CRACK SEAL & SEAL COAT