Alabama Statewide Airport Pavement Management Program Update

Craig Field (SEM)

Final Report

February 2022

Submitted to

Alabama Aeronautics Bureau

Submitted by

JVIATION

All About Pavements, Inc (API)
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Pavement Management – Evaluation – Testing - Design

ALABAMA STATEWIDE AIRPORT PAVEMENT MANAGEMENT PROGRAM UPDATE

Craig Field, Selma (SEM)

FINAL REPORT

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Executive Summary

The Jviation Inc. team, which included All About Pavements, Inc., (API) was awarded a contract by the Alabama Department of Transportation's Aeronautics Bureau (ALDOT) in 2018 to update the existing Alabama Statewide Airport Pavement Management Program (APMP). The scope of this project includes the airside pavement network at Craig Field (SEM).

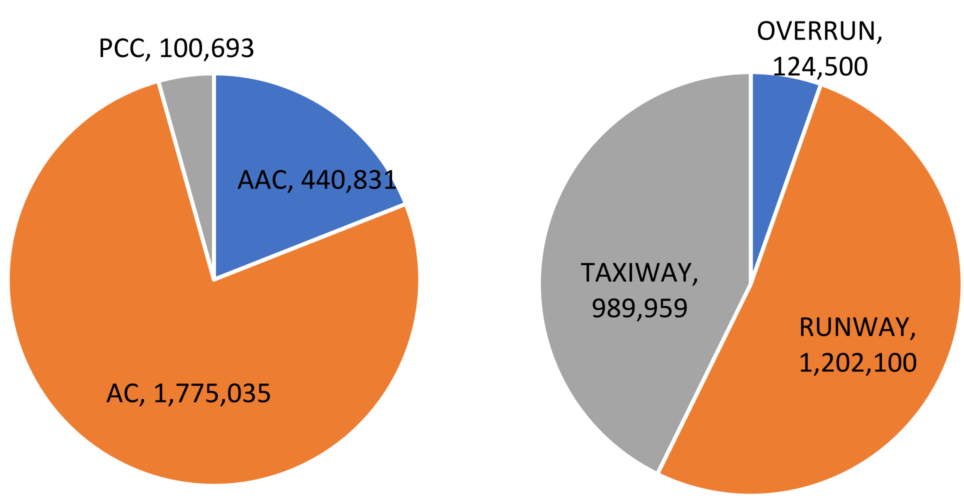
The following APMP tasks were completed to achieve the project objectives at SEM:

- Update the PAVER work history with records review information provided by ALDOT
- Conduct a visual pavement condition survey of the airfield pavements
- Update the PAVER database with inventory and condition data
- Update Maintenance and Rehabilitation (M&R) policies and unit costs
- Develop a 7-Year Pavement Capital Improvement Program (PCIP) with associated cost estimates

ES.1 Pavement Inventory

There are 7 branches and 10 sections within SEM's pavement network with a total surface area of approximately 2.3 million square feet (sf). Figure ES-1 shows the distribution of the pavement network by surface type and branch use.

Figure ES-1: Pavement Area (sf) by Surface Type and Branch Use.



ES.2 Pavement Condition

Visual pavement inspections were conducted in November 2019 using the Pavement Condition Index (PCI) method as specified in ASTM D5340-12 and FAA AC 150/5380-6C. The PCI is a numerical rating scale from 0 to 100 that provides a measure of the pavement's functional surface condition. The overall area-weighted network PCI (AW PCI) for the SEM pavement network is 60, representing a "Fair" condition. The network area-weighted pavement age (AW Age) is 18 years. ALDOT wanted the condition of the overruns to not be included in the overall PCI computations, and they were not considered for the PCIP.

Table ES-1 is a listing of the section PCI values and ratings.

Table ES-1: SEM Section PCI Values and Ratings.

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category
R1533	Runway 15-33	01	AC	1,202,100	61	Fair
TA	Taxiway A	01	AC	425,372	32	Very Poor
TB	Taxiway B	01	AC	23,063	80	Satisfactory
TB	Taxiway B	02	AAC	121,491	77	Satisfactory
TB	Taxiway B	03	AAC	20,641	32	Very Poor
TC	Taxiway C	01	PCC	50,203	92	Good
TC	Taxiway C	02	AAC	298,699	79	Satisfactory
TC01	Taxiway Connector 01	01	PCC	50,490	86	Good

ES.3 Pavement Maintenance and Repair Funding Levels

The PAVER database was updated with 2019 condition data, maintenance and repair (M&R) policies, and unit costs; which were then used to evaluate the effect of multiple funding levels on the overall future pavement condition. Figure ES-2 presents the forecasted SEM network PCI values for each funding level.

ES.4 Pavement Capital Improvement Program (PCIP)

The analysis output from the unlimited funding budget scenario was used as a starting point in developing the PCIP. For this scenario, sections were grouped into projects to allow for a logical construction sequence. Table ES-2 summarizes the 7-year PCIP, which has an estimated total cost of approximately $14.7 million. These recommendations are based on a network-level evaluation. Project-level evaluations should be conducted prior to developing design and bid package documents.

In addition to the major rehabilitation needs that are identified in the PCIP, PAVER was used to develop maintenance activities to repair specific PCI distresses in Year 1. The estimated costs for these maintenance activities are $17,824 as summarized in Table ES-3.

Figure ES-2: M&R Funding Levels.

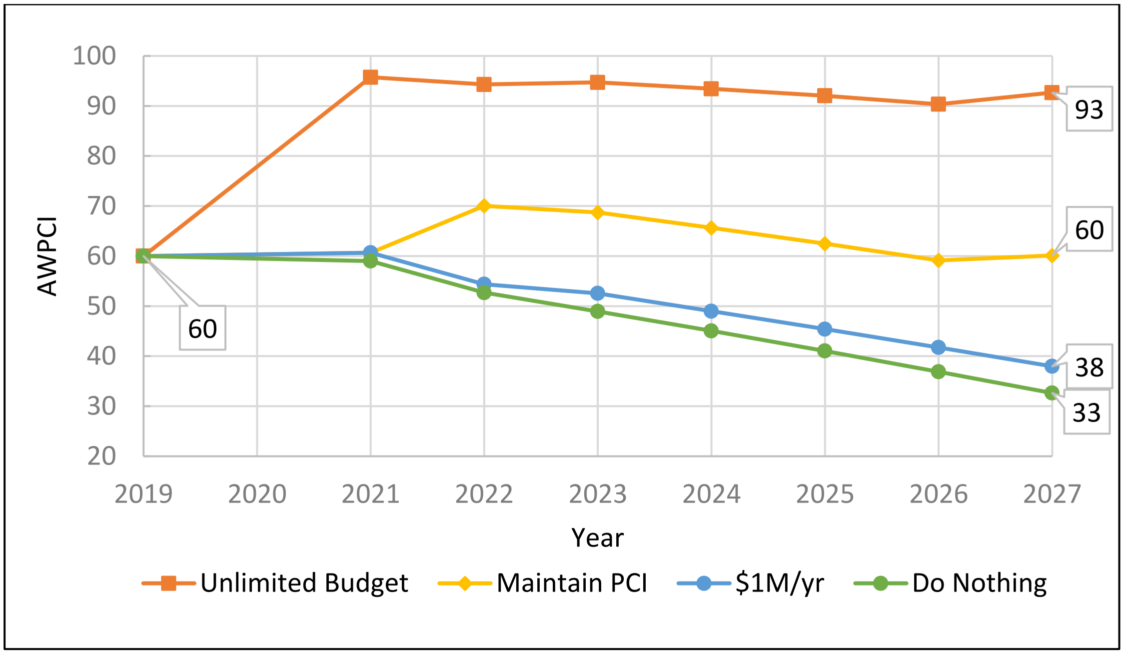


Table ES-2: Summary of Pavement Capital Improvement Program.

Project Year	CIP Project	Total Project Cost	Total Project Area, sf	AWPCI Before	AWPCI After
2021	SEM_21-01_Taxiway A Reconstruction	$4,536,120	446,013	27	100
2024	SEM_24-01_Taxiways B and C Rehabilitation	$2,018,743	420,190	67	100
	SEM_24-02_Taxiway A Surface Treatment	$283,857	446,013	96	99
2025	SEM_25-01_Runway 15-33 Rehabilitation	$7,592,518	1,225,163	44	100
2027	SEM_27-01_Taxiways B and C Surface Treatment	$292,219	420,190	96	99
	Total	**$14,723,457**			

Table ES-3: Summary of Localized Maintenance Plan.

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Patching - AC Full-Depth	233	SqFt	$5,830
	Crack Sealing - AC	3,024	Ft	$11,945
	Patching - AC Partial-Depth	3	SqFt	$49
			Total	**$17,824**

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1 Introduction

1.1. Overview

The Alabama Department of Transportation's Aeronautics Bureau (ALDOT) is responsible for preserving and enhancing Alabama's air transportation system, which consists of 72 airports throughout the State. ALDOT implemented an Airport Pavement Management Program (APMP) in 2008 using the PAVER system. ALDOT awarded a project in 2018 to Jviation Inc. (Jviation) to update the System Plan and conduct an Economic Analysis for the Alabama airports. The scope of work also included an update of the APMP for 59 airports, which was conducted by All About Pavements, Inc., (API), a Jviation team member.

With this update of the APMP, the Alabama airports continue to be eligible for FAA funding for major pavement rehabilitation work under the Airport Improvement Program (AIP) since an APMP meets the pavement maintenance management requirements described in Appendix A of AC 150/5380-6C.

This report discusses the evaluation of the airside pavements at Craig Field (SEM), the current and forecasted pavement condition, and the development of the Pavement Capital Improvement Program (PCIP).

1.2. Work Scope

The goals of the Alabama Statewide Airport Pavement Management Update program are as follows:

- Conduct a visual pavement inspection of the asphalt surfaced pavements for 59 of the 72 public use airports in Alabama.
- Based on the visual inspection analysis results, develop a 7-year PCIP for each airport.

The scope of work is as shown below:

- Conduct a Records Review
- Update Pavement Network Definition
- Conduct Pavement Condition Surveys
- Update and customize existing APMP PAVER database
- Develop PCIP and associated project cost estimates
- Prepare Draft and Final Reports
- Develop a web-based viewer for reporting APMP data

As required in the Scope of Work, a detailed pavement condition survey was not conducted for any Portland Cement Concrete (PCC) aprons and PCC taxiways longer than 2,000 ft. Instead, a condition rating of "Good", "Fair", or "Poor" was assigned based on the overall pavement condition.

The deliverable products include a PAVER 7.0 database, individual airport evaluation reports, a statewide summary report, and the web viewer. The SEM report will be one of the 59 individual airport reports that will be available on ALDOT's website.

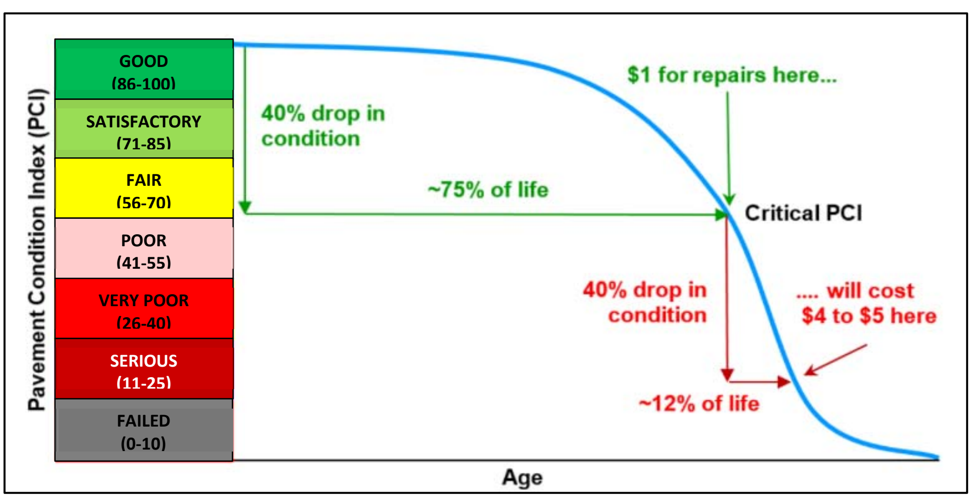
1.3. Pavement Management Concept

An APMP provides an integrated framework for comprehensive evaluation and decision making for managing airfield pavements. The essential components of an effective APMP provide for an objective evaluation of the condition of existing pavements, identification of short-term and long-range major rehabilitation work, necessary improvements in the pavement structural capacity, and the recurring maintenance work that should be completed each year. The APMP will also provide a budget for each of these types of pavement construction.

Historically, most organizations have made maintenance decisions based on past experience, without the benefit of documented data or analysis. This practice does not encourage life cycle cost analysis, nor the evaluation of cost effectiveness of alternate scenarios, and can lead to the inefficient use of funds. With limited allocated funding for Maintenance and Repair (M&R) Program projects, a defined procedure for setting priorities and schedules that will maximize the funds available is more important than ever.

In examining the lifespan of a 20-year pavement, a "Good" to "Fair" condition rating may last only 5 to 15 years. After that point, the rate of deterioration of pavements accelerates sharply as the age of the pavement increases, and within five years, the pavement may deteriorate to the point of failure. In order to extend pavement life, maintenance and repairs need to be scheduled and performed before the pavement surface declines to a "fair" condition. The point at which rehabilitation can be done before the steep decline occurs is called the "critical PCI", and is generally considered to occur when the Pavement Condition Index (PCI) is between 60 and 70 for general aviation airports. If the work is done before deterioration accelerates, the cost of rehabilitation can be reduced as shown in Figure 1.1.

Figure 1.1: Pavement Management Concept.



2 Airfield Pavement Inventory

2.1. Introduction

SEM is a General Aviation (GA) airport located approximately 4 miles south east of Selma. The airport was activated in February 1979 and is owned and operated by the Craig Field Airport and Industrial Authority. Figure 2.1 shows an aerial image of the airport.

Figure 2.1: Craig Field.

(Source: Google Earth)

2.2. Pavement Inventory

SEM consists of one runway, multiple taxiways, and an apron. The total pavement area is approximately 2.3 million square feet. Pavement surfaces at SEM include Asphalt Concrete (AC), Asphalt Overlay on AC (ACC) and Portland Cement Concrete (PCC). A complete listing of the pavement sections is included in Appendix A. Runway 15-33 is 8,014 ft. long and 150 ft. wide.

A records search was undertaken to identify any preservation or rehabilitation work that has occurred at Craig Field Airport since the last APMP update in 2009. The following records that were provided by ALDOT were reviewed, and the PAVER database was updated with work history information:

- Taxiway/Apron Intersection Repair, 2018
- Runway 15-33 Crack Seal and Seal Coat, 2020

2.3. Climatic Conditions

Table 3.1 provides a summary of the climatic data for the geographic region that includes SEM. As the table shows, the pavements at SEM are not exposed to any freeze-thaw cycles. The mean air temperature for January ranges from an average low of 37 degrees °F to an average high of 57 degrees °F. The average annual rainfall at SEM is near 53 inches.

Table 2.1: Average Annual Temperatures and Rainfall for SEM.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp (°F)	57	61	69	76	83	89	92	91	87	78	68	60
Low Temp (°F)	37	40	46	51	60	68	71	70	65	53	44	38
Precip. (in)	5.6	4.9	6.7	4.3	3.7	4.1	4.3	3.7	3.9	2.6	4.3	4.7

Source: www.intellicast.com

2.4. Pavement Network Definition

A key element in developing an APMP system is defining the pavement network, which is the process of dividing an agency's pavements into a hierarchical order that facilitates inspection and M&R planning. The SEM network (e.g. all airside pavements) is then divided into branches, which are a readily identifiable part of the pavement system and have distinct functions. For airports, branches typically consist of individual runways, taxiways and aprons. Figure B1A in Appendix B shows the branches at SEM.

Once branches have been defined, pavement evaluation and analysis techniques require the airfield pavement system to be broken up into discrete sections. A pavement "section" is the smallest management unit that is used when considering the application and selection of maintenance and rehabilitation (M&R) treatments, and is defined in Section 2.1.8 of ASTM D 5340-12 as *"a contiguous pavement area having uniform construction, maintenance, usage history, and condition. A section should also have the same traffic volume and load intensity."* A complete list of the pavement inventory and the corresponding section designations are included in Appendix A. Figure B1B presents the section layout.

To facilitate the visual survey of the airside pavement, each section is further subdivided into conveniently defined sub-section areas, or sample units. Similar sizing is critical as studies have found that maintaining the size of the sample units to within 40 percent of the established norm may reduce the standard error of the average PCI values. To meet that criteria, ASTM recommends that sample units for asphalt pavements be 5,000 square feet (± 2,000).

Table 2.2 was used as a guideline in developing sampling rates that reflect typical rates that are used for other large pavement networks. In general, this sampling rate will not provide a 95% confidence level with a standard error of 5 PCI points. A higher level of sampling is recommended before a project-level rehabilitation design is developed for a pavement section or facility.

Sample units that include a one-time occurrence of a distress (i.e. a large patch) or an unusual severity or quantity of a distress seen elsewhere, were designated as “additional” sample units as described in the ASTM D5340 PCI procedure. This allows the PCI to be calculated without extrapolating the aberrant distress throughout the section as a whole. In Appendix B, Figure B1C shows the sample unit layout for SEM.

Table 2.2: PCI Sampling Rate for AC Surfaces.

Total Samples	Samples to Inspect
1	1
2	2
3 – 6	3
7 – 13	4
14 – 39	5
> 39	15 percent, but less than 12

2.5. Inventory Summary

There are 7 branches (facilities) at SEM that include 10 pavement sections and a total area of approximately 2.3 million square feet of paved surfaces, as shown in Table 2.3.

Table 2.3: SEM Pavement Branches.

Branch ID	Branch Name	Branch Use	Area, sf	Number of Sections
ORR15	Overrun Runway 15 End	OVERRUN	103,500	1
ORR33	Overrun Runway 33 End	OVERRUN	21,000	1
R1533	Runway 15-33	RUNWAY	1,202,100	1
TA	Taxiway A	TAXIWAY	425,372	1
TB	Taxiway B	TAXIWAY	165,195	3
TC	Taxiway C	TAXIWAY	348,902	2
TC01	Taxiway Connector 01	TAXIWAY	50,490	1
		Total	**2,316,559**	**10**

Table 2.4 shows the distribution of airfield pavement by age with the area-weighted age being 18 years for all airside pavements at SEM.

Table 2.4: SEM Pavement Age.

Age (Years)	Number of Sections	Percent of Area	Area, sf
0 – 5	0	0	0
6 – 10	1	5	121,491
11 – 15	3	15	342,403
16 – 20	2	54	1,252,303
> 20	4	26	600,362

Figure 2.2 shows the distribution by surface type. Figure 2.3 presents the distribution by pavement use (e.g. runway, taxiway, and apron).

Figure 2.2: SEM Pavement Area by Surface Type.

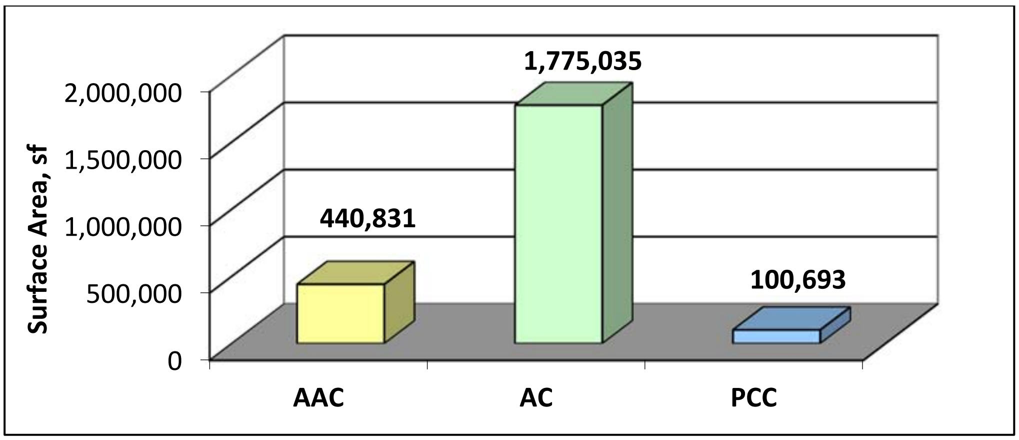
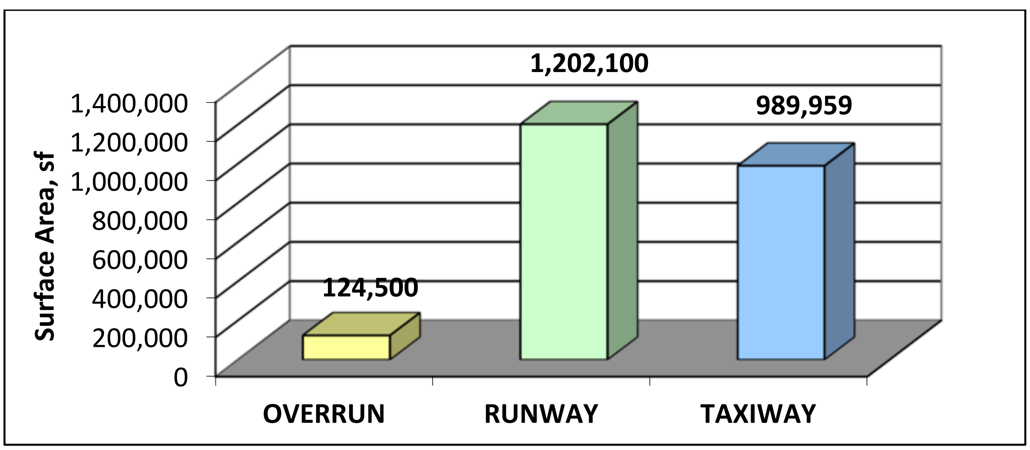


Figure 2.3: SEM Pavement Area by Branch Use.



Maps B1D, B1E, and B1F show the pavement type, branch use, and pavement age, respectively.

3 Pavement Condition

3.1. Introduction

A visual PCI survey of the airside pavements at SEM was conducted in order to assist in the development of a realistic PCIP. The PCI survey measures and records pavement distresses that exist within each of the inspected sample units. This survey was conducted in November 2019 by a 2-person team. The survey was performed in accordance with the methods described in ASTM D 5340-12 and FAA AC 150/5380-7B, using the sampling rates from Chapter 2 of this API report.

During the pavement survey, Quality Control (QC) and data verification were performed on both the individual distresses and the calculated section PCI values. QC included the following activities;

- Review of distress quantities to identify data entry errors (100% review at the sample unit level). General guidance was used from ASTM D5340-12, section 13, which addresses the precision of distress quantities that are recorded during PCI surveys.
- Duplicate surveys were performed to ensure consistency between each of the inspectors in a 2-person PCI survey team.

3.2. Pavement Condition Rating Methodology

The PCI is a measure of the pavement's functional surface condition. It provides insight into the causes of each distress, and whether the distress is primarily caused by load, climatic conditions, and other material related deficiencies. The PCI is a numerical rating (on a scale of 0 to 100) that is based on the type, severity and quantity of each distress that is found in an inspected sample unit.

The PCI survey results are displayed using seven categories and ratings in accordance with the ASTM, but can also be presented using a simplified 3-category rating system for use in comparing with other distress related indices, as shown in Table 3.1.

Table 3.1: Pavement Condition Index Rating Scale.

	Simplified PCI Color Legend	ASTM PCI Color Legend	PCI Range	PCI Ratings and Definition
GOOD			86-100	<u>GOOD</u>: Pavement has minor or no distresses and should require only routine maintenance.
			71-85	<u>SATISFACTORY</u>: Pavement has scattered low-severity distresses that should require only routine maintenance.
FAIR			56-70	<u>FAIR</u>: Pavement has a combination of generally low- and medium-severity distresses. Near-term maintenance and repair needs may range from routine to major.
POOR			41-55	<u>POOR</u>: Pavement has low-, medium-, and high-severity distresses that probably cause some operational problems. Near-term M&R needs range from routine to major. requirement for
			26-40	<u>VERY POOR</u>: Pavement has predominantly medium- and high-severity distresses that cause considerable maintenance & operational problems. Near-term M&R needs will be major.
			11-25	<u>SERIOUS</u>: Pavement has mainly high-severity distresses that cause operational restrictions; immediate repairs are needed.
			0-10	<u>FAILED</u>: Pavement deterioration has progressed to the point that safe aircraft operations are no longer possible; complete reconstruction is required.

3.3. Distress Types

The ASTM D5340 standard considers 17 distresses, which tend to fall into one of the following four cause categories:

- <u>Load related</u>: AC distresses include alligator cracking, corrugation, depression, polished aggregate, rutting and slippage cracking; PCC distresses include corner breaks, longitudinal cracking, divided slabs, polished aggregate, pumping and joint spalling.
- <u>Climate and durability related</u>: AC distresses include bleeding, block cracking, joint reflection cracking, longitudinal and transverse (L&T) cracking, swelling, raveling, and weathering; PCC distresses include blow-ups, “D” cracking, longitudinal cracking, pop-outs, pumping, scaling, shrinkage cracks, and joint and corner spalling.
- <u>Moisture & Drainage related</u>: AC distresses include alligator cracking, depressions, potholes and swelling; PCC distresses include corner breaks, divided slabs and pumping.
- <u>Other factors</u>: Oil spillage, jet blast erosion, bleeding, patching and concrete slab joint faulting.

As described above, distress may have more than one cause. For example, depressions may be caused by incorrect compaction during construction, or by subgrade softening due to environmental factors. In addition, a distress may be initiated by one cause but may progress to a distress of higher severity by another cause. Therefore, engineering judgment is critical in analyzing the actual causes of the distress.

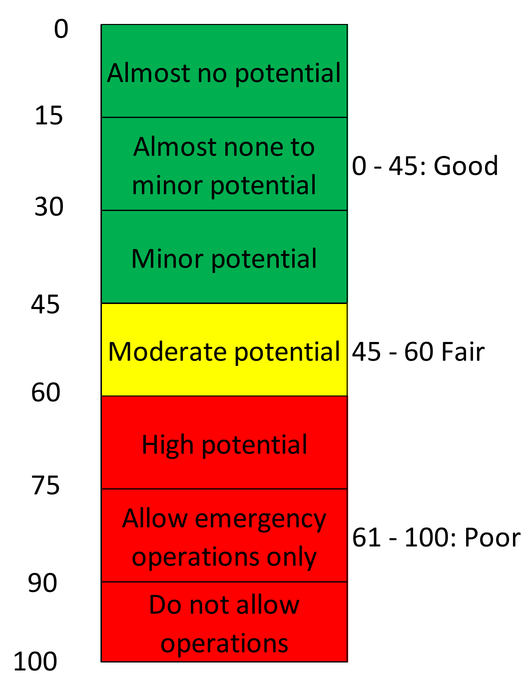
Distress descriptions provided in Appendix C were taken from the "PCI Field Manual," developed by the U.S. Army Construction Engineering Research Lab (CERL), latest edition. Appendix C provides a detailed explanation of each type of AC and PCC surface distress.

3.4. Additional PCI-based Indices

The distress data used to compute PCI can also be used to calculate additional indices that are helpful in understanding the condition of the pavement and developing PCIP recommendations. One additional index that was computed is the Foreign Object Damage (FOD) potential index.

The FOD index was developed by the US Air Force and is described in detail in the US Army Corp of Engineers Engineering Technical Letter (ETL) 04-09, Pavement Engineering Assessment (EA) Standards. Loose objects on an airfield pavement surface resulting from pavement distresses can be detrimental to aircraft engines, specifically engines that are low to the ground. The objects are ingested into the engines causing costly damage and presenting a safety hazard. Not all pavement distresses create a FOD potential. Therefore, an additional index was identified that uses the results of the PCI distress survey. As shown in Figure 3.1, the scale ranges from 0 to 100 with 0 being no FOD potential. Note that the FOD index uses a simplified three color scale.

Figure 3.1: FOD Potential Rating Scale.



3.5. PCI Survey Results

The condition of the overruns was not included in the overall PCI computations and they were not considered for the PCIP. The airside pavements at SEM include 8 sections with 413 sample units. The sample number of sample units that were surveyed in the field is 81, which is 20 percent of the total samples. Data from the inspected sample units were input into the PAVER database and a resultant PCI for each section was computed.

Figure 3.2 presents the area-weighted PCI by use and the overall airside network.

Figure 3.2: Pavement Condition by Branch Use.

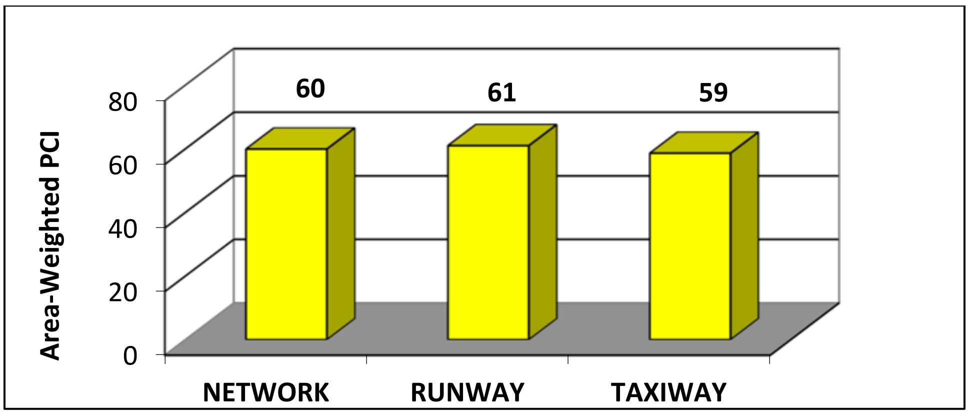


Figure 3.3 shows the distribution of the SEM pavement network by condition. Approximately 20 percent of the network is in "Poor" or worse condition.

Figure 3.3: Pavement Condition by Percent of Area.

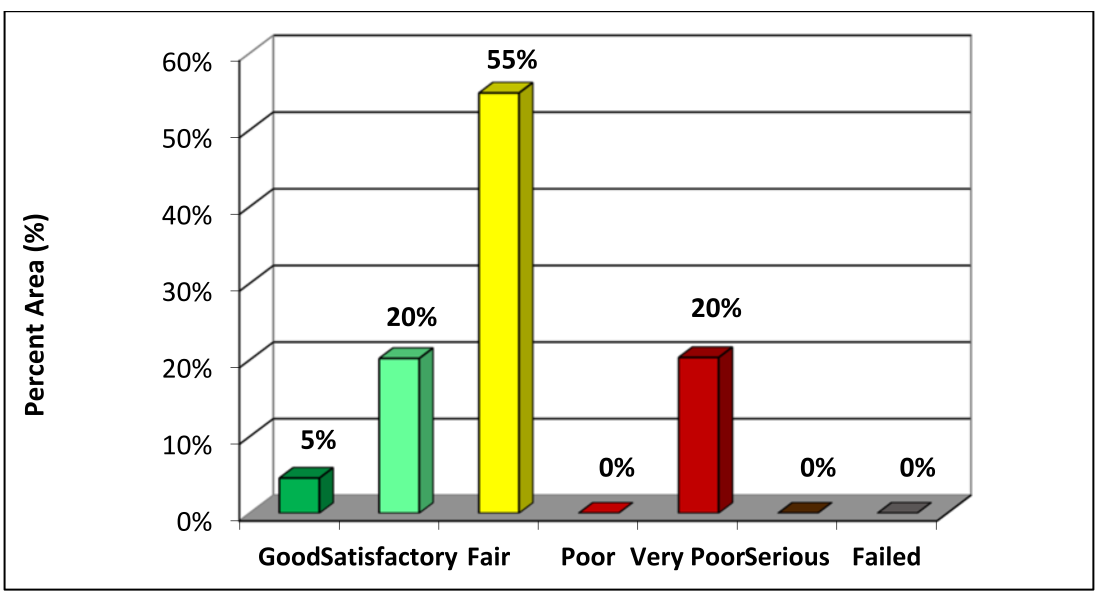


Table 3.2 is a listing of the section PCI.

Table 3.2: Section PCI.

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category	FOD
R1533	Runway 15-33	01	AC	1,202,100	61	Fair	50
TA	Taxiway A	01	AC	425,372	32	Very Poor	80
TB	Taxiway B	01	AC	23,063	80	Satisfactory	32
TB	Taxiway B	02	AAC	121,491	77	Satisfactory	34
TB	Taxiway B	03	AAC	20,641	32	Very Poor	81
TC	Taxiway C	01	PCC	50,203	92	Good	12
TC	Taxiway C	02	AAC	298,699	79	Satisfactory	33
TC01	Taxiway Connector 01	01	PCC	50,490	86	Good	38

Figure B2A and B2B in Appendix B are maps of the section PCI in 7- and 3-scale categories, respectively. Figures B2C is a map of the FOD rating. Appendix D contains a detailed report of the PCI values and distress type, quantity, and severity data for each sample unit that was surveyed in a section. Appendix E is a summary report of the extrapolated distress data at the section level.

Appendix F contains current section and branch PCI data and forecasted section PCI values. FOD values by section and branch are also presented. Figure B2D in Appendix B shows the locations of the photos that were taken during the survey. Photos are included in Appendix J.

3.6. PCC Pavements

As stated earlier, the project scope did not include a detailed pavement condition survey for any Portland Cement Concrete (PCC) aprons. For these pavements, a rating of “Good”, “Fair”, or “Poor” was assigned based on the overall pavement condition. Figure 3.4 shows the condition of the PCC aprons at SEM.

Figure 3.4: PCC Apron Condition Rating.

4 Pavement Capital Improvement Program

4.1. Introduction

PCI data were collected and entered into the PAVER database. In addition, the database customization included the following components, which are described in detail in this chapter.

1. Performance Modeling
2. Maintenance & Repair (M&R) Triggers (Critical PCI)
3. M&R Policies
4. Unit Costs

Once the database was customized, it was used to run budget analysis scenarios and develop a 7-year PCIP.

4.2. Performance Modeling

To determine long-term M&R needs, a APMP must be able to predict future pavement condition. Future pavement condition is predicted using equation models that are generated from current and historical PCI data. Equation models are developed by grouping pavements based on similar performance characteristics such as region, construction history, surface type, traffic, priority and use. Mathematical techniques such as straight-line extrapolation and regression that include boundary and outlier filters are used to develop models that provide the best fit equation for the pavement condition data. PAVER's Prediction Modeling module was used to develop pavement performance models that are commonly referred to as 'Family Curves'.

Prediction models are used at the section level to compute future conditions based on the typical performance of the pavement sections that are included in each model. Future condition is computed by defining its position relative to the prediction model. The section prediction curve, or equation, is drawn through the current PCI-age point for each specific section. Since the shifted curve will run parallel to the computed prediction model, the predicted condition can be computed for any future age. Figure 4.1 is an illustration of this process.

Prediction models provide an effective way to compute future pavement performance based on past and current conditions, and pavement maintenance and rehabilitation practices. As new PCI inspection surveys are conducted, these models should be updated accordingly. In the case of the Alabama statewide airport pavement network, the best fit family curves were developed for each region by grouping pavements according to branch use (e.g. runway, taxiway) and surface type (e.g. AC, AAC, and APC). The family curves for ALDOT were developed based on branch use and are presented in Figure 4.2.

Figure 4.1: PCI Forecasting.

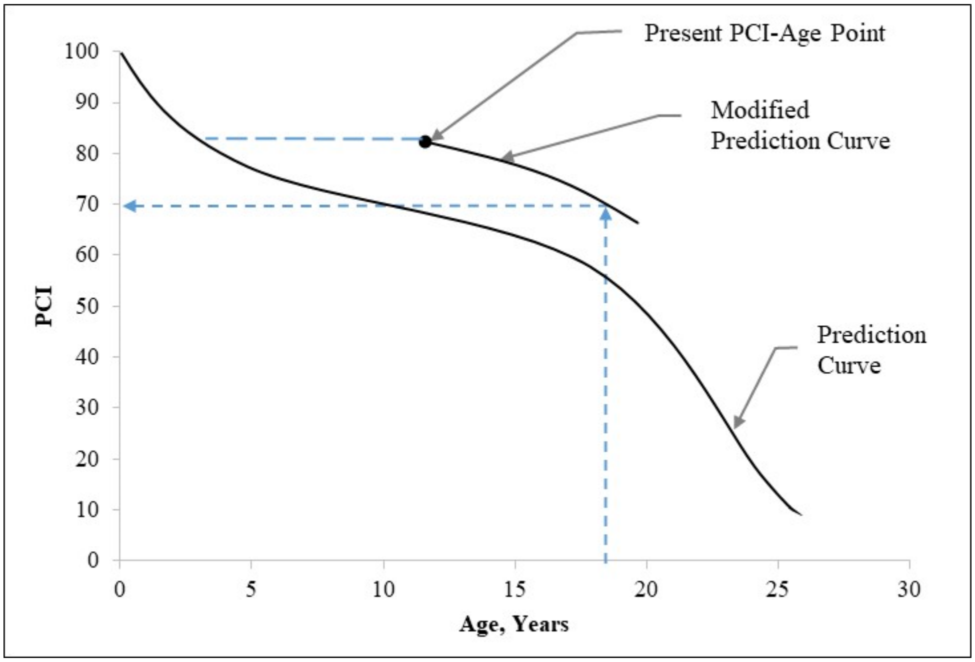
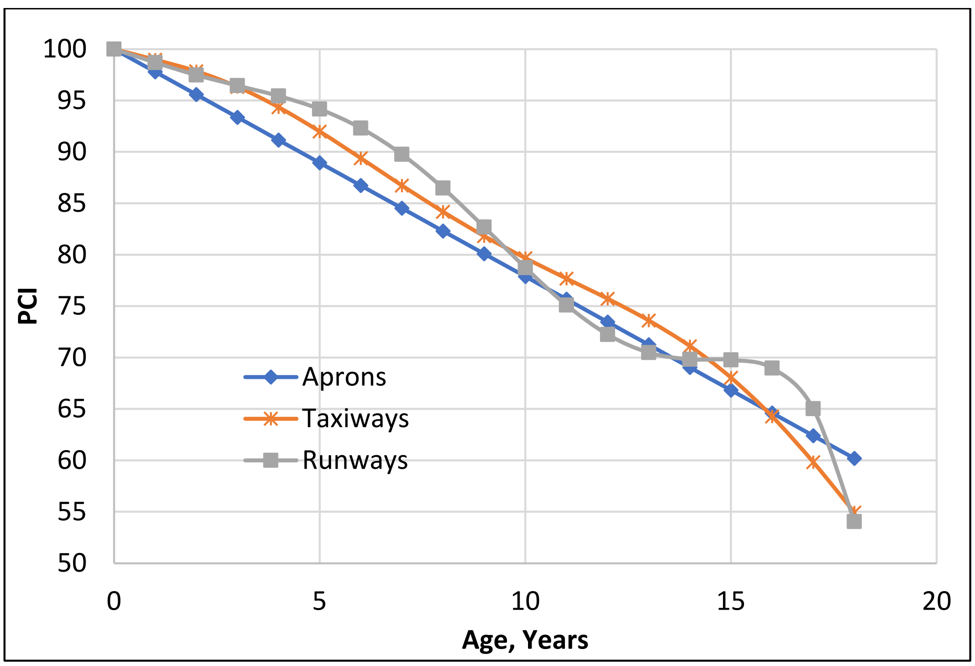


Figure 4.2: Family Curves.



4.3. Critical PCI Values

The Critical PCI value is defined as "*the PCI value at which the rate of PCI loss increases with time, or the cost of applying localized preventive maintenance increases significantly*." This definition is incorporated into PAVER in defining and measuring the critical PCI values. These values, or M&R triggers, are assigned for each prediction model. As such, the critical PCI values are directly related to the branch use.

These critical PCI levels are selected based on several factors including a review of performance models; experience; other airport triggers; and acknowledge that time is required for funding approval and design. Note that preventive maintenance is recommended, and it should generally be performed above the critical PCI (trigger) values and Major M&R is generally performed below them. The critical PCI (CP) values were set at 70 for runways and taxiways, and 65 for other pavements.

4.4. M&R Policies and Unit Costs

M&R policies refer to the activities that are applied at different condition levels to maintain and repair a pavement section.

Maintenance activities are localized activities which are typically assigned in the first year of the M&R plan based on the observed distresses. Safety (stopgap) maintenance addresses distresses that would affect operational safety if left unrepaired and is applied to pavements below the critical PCI. Preventive maintenance activities are aimed at slowing the rate of deterioration through consistent maintenance of existing pavements and are generally applied to pavements above the critical PCI. Appendix G presents the policies for preventive and safety maintenance.

Repair activities are conducted for larger areas, typically at the section level and are assigned based on the critical PCI. Repair activities broadly consist of three categories: preservation, rehabilitation, and reconstruction. Pavement preservation involves activities like surface treatments that are used to extend pavement service life and to delay more expensive rehabilitation work. These are applied when the pavement is in relatively good condition and does not exhibit any structural distress. Rehabilitation activities are used to repair pavements below or around the critical PCI and typically include mill and overlay. Reconstruction is recommended when the pavement has deteriorated to a level where rehabilitation is no longer cost effective.

Table 4.1 lists the pavement activity types, the individual activities within each type, and their associated 2020 unit costs. A more detailed description of the M&R activities and the development of the M&R unit costs is presented in Appendix H.

In accordance with ALDOT's focus on preservation, surface treatment is applied to all resurfaced and reconstructed runways, taxiways, and aprons three years after construction work is complete. Taxilanes and T-Hangar pavements are excluded from this requirement. This policy is applicable for projects in the PCIP between 2021 and 2024. For cost estimating, this surface treatment is assumed to have the same cost as the runway surface treatment.

Table 4.1: M&R Activities and Unit Costs.

Activity Type	PCI	Activity	Cost/sf
Maintenance	Note 1	Seal Cracks – AC ($/lf)	$3.95
		AC Full-Depth Patching	$25.05
		AC Partial-Depth Patching	$16.28
Preservation	75-90	Runway Surface Treatment	$0.57
		Taxiway and Apron Surface Treatment	$0.85
Rehabilitation	> CP	2" AC OL[2]	$3.91
	55 - CP	Mill 2" & 2" AC OL	$4.27
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)	$5.37
Reconstruction	0 - 45	AC Reconstruction	$9.87

[1] Preventive > CP; Safety (Stopgap) < CP
[2] For sections with structural distress and PCI > CP

4.5. Pavement CIP Development

The PAVER database, updated with condition data and customized with condition performance priorities, policies, and costs; was used to evaluate the effect of multiple funding levels on the overall future pavement condition. This output was further used to develop the PCIP. Figure 4.3 illustrates the process that PAVER uses in the funding analysis.

The following M&R funding levels were used for the SEM pavement network to help establish the 7-Year PCIP. Figure 4.4 presents the network area-weighted average PCI for each of the following funding scenarios at the end of the analysis period:

- Unlimited Funding: Unlimited funding is available for all pavement needs. The PCI increases to 93 by 2027.
- Maintain PCI: Maintain existing PCI of 60.
- Constrained Funding: This scenario constrains the funding to $1 million each year (total of $7 million). The PCI decreases to 38 in 2027.
- Do Nothing: Performing no M&R would reduce the network PCI from 60 to 33 by 2027.

Figure 4.3: Budget Analysis Process.

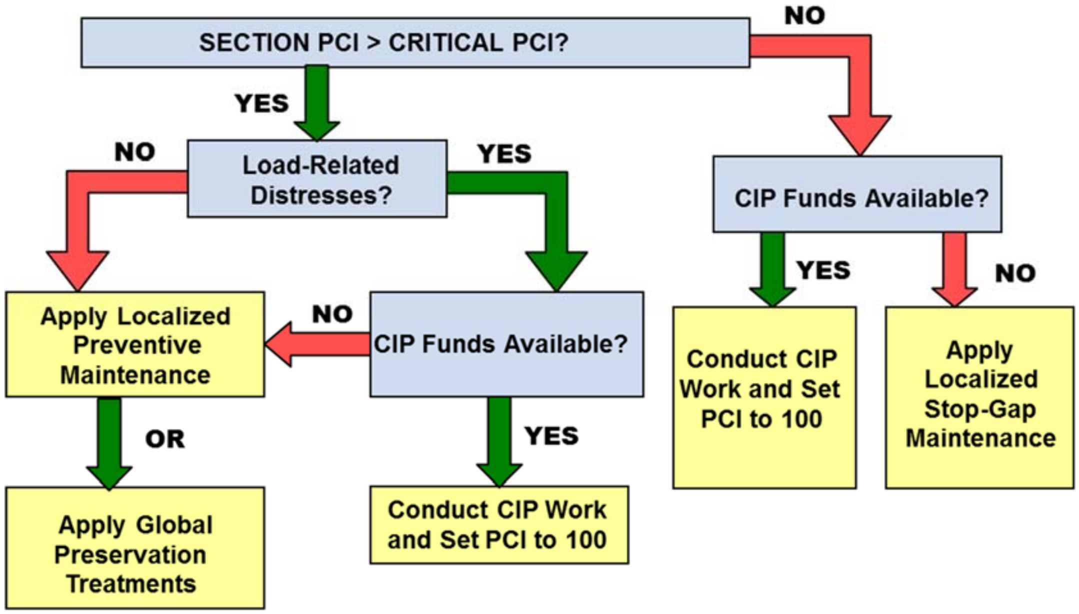


Figure 4.4: M&R Funding Levels.

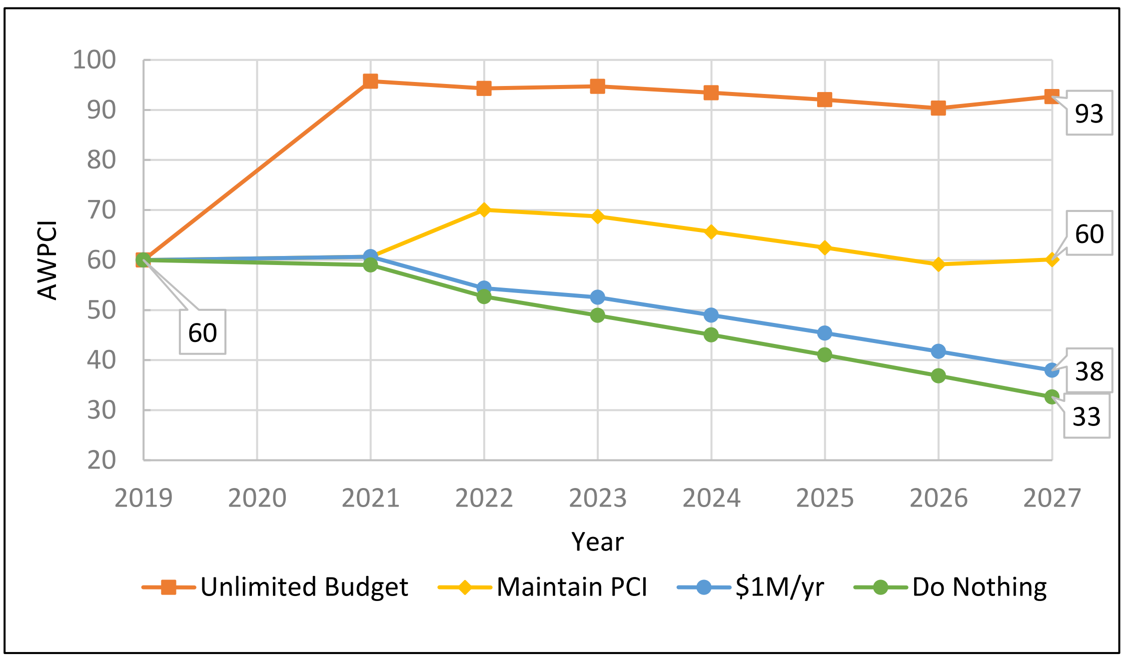


Table 4.2 summarizes the annual funding required for the above analyses. For the unlimited analysis, all pavement needs are funded in the year they are required. Therefore, the unfunded costs are zero. The total funded amount over the 7-year period is approximately $12 million. For the annual funding level of $1 million per year, funding is prioritized based on the prioritization matrix. When the needs exceed the funding for any year, the remaining sections are transferred to the succeeding year and the amount

for these activities are represented as “unfunded”. The “unfunded” repairs in 2027 for this funding level is approximately $22 million.

Table 4.2: Summary of M&R Funding Level Analyses.

Year	Unlimited	Maintain PCI	Constrained $1M/year	Do Nothing
2021	$9,819,000	$602,000	$602,000	$0
2022	$12,000	$4,364,000	$144,000	$0
2023	$562,000	$594,000	$712,000	$0
2024	$15,000	$52,000	$211,000	$0
2025	$19,000	$61,000	$263,000	$0
2026	$24,000	$93,000	$567,000	$0
2027	$1,542,000	$1,714,000	$189,000	$0
Total	**$11,993,000**	**$7,480,000**	**$2,688,000**	**$0**
2027 Backlog	**-**	**$14,167,000**	**$21,959,000**	**$23,525,000**

Map B3A in Appendix B presents the 2027 forecasted PCI by section when the M&R activities recommended in the CIP are not conducted.

4.6. Pavement Capital Improvement Program

The unlimited funding analysis contains rehabilitation activities for sections from the same branch spread out over the seven-year period, which is not always operationally feasible to construct. The analysis output was treated as a starting point in developing the CIP. Sections were often integrated together to account for construction feasibility and other factors, resulting in larger projects which were more realistic. In addition, each project could contain sections whose condition did not trigger rehabilitation but were included to provide a logical plan which would avoid creating “islands” of newer pavement within a particular feature. For example, if the PAVER analysis showed rehabilitation was required for eight out of 10 sections on a runway, the entire runway would be recommended for rehabilitation to provide a continuous new pavement surface.

Table 4.3 shows the projects and the associated costs for the recommended 7-year PCIP. Table 4.4 is a more detailed view of the PCIP. This table lists the individual pavement section, section level M&R work, section repair cost, surface area and the PCI before the M&R is applied. The costs that are presented represent an annual escalation rate of 3% for the unit costs. The total 7-year PCIP cost is approximately $14.7 million. Map B3B shows the recommended repair types, while Map B3C presents the recommended projects and activities in the PCIP. Appendix I1 presents a summary of the recommended activities and cost by year for each section at SEM.

Table 4.3: Summary of 7-Year PCIP by Project.

Project Year	CIP Project	Total Project Cost	Total Project Area, sf	AWPCI Before	AWPCI After
2021	SEM_21-01_Taxiway A Reconstruction	$4,536,120	446,013	27	100
2024	SEM_24-01_Taxiways B and C Rehabilitation	$2,018,743	420,190	67	100
	SEM_24-02_Taxiway A Surface Treatment	$283,857	446,013	96	99
2025	SEM_25-01_Runway 15-33 Rehabilitation	$7,592,518	1,225,163	44	100
2027	SEM_27-01_Taxiways B and C Surface Treatment	$292,219	420,190	96	99
	Total	**$14,723,457**			

Table 4.4: Summary of 7-Year PCIP by Project and Section.

Branch	Section	Area, sf	PCI Before Rehab	Activity	Activity Type	Cost
SEM_21-01_Taxiway A Reconstruction						**$4,536,120**
TA	01	425,372	28	AC Reconstruction	Reconstruction	$4,326,193
TB	03	20,641	28	AC Reconstruction	Reconstruction	$209,927
SEM_24-01_Taxiways B and C Rehabilitation						**$2,018,743**
TB	02	121,491	66	Mill 2" & 2" AC OL	Rehabilitation	$583,686
TC	02	298,699	70	Mill 2" & 2" AC OL	Rehabilitation	$1,435,057
SEM_24-02_Taxiway A Surface Treatment						**$283,857**
TA	01	425,372	-	Surface Treatment	Preservation	$270,720
TB	03	20,641	-	Surface Treatment	Preservation	$13,137
SEM_25-01_Runway 15-33 Rehabilitation						**$7,592,518**
R1533	01	1,202,100	45	Mill 2" & 2" AC OLP	Rehabilitation	$7,478,391
TB	01	23,063	68	Mill 2" & 2" AC OL	Rehabilitation	$114,127
SEM_27-01_Taxiways B and C Surface Treatment						**$292,219**
TB	02	121,491	-	Surface Treatment	Preservation	$84,490
TC	02	298,699	-	Surface Treatment	Preservation	$207,729
					Total	**$14,723,457**

The FAA, under the Airport Improvement Program (AIP) provides approximately 90 percent of eligible costs for planning and development of public-use airports included in the NPIAS as grants. The remaining 10 percent of costs are shared between ALDOT and the airport sponsor. The following is the distribution of the 7-yr PCIP cost of $14.7 million for SEM:

- FAA (90%): $13.3 million
- ALDOT (5%): $0.7 million
- Airport Sponsor (5%): $0.7 million

The recommendations within the PCIP are based on a network-level study and should be used for planning purposes only. A detailed project-level assessment should be conducted for each project to determine the appropriate repair activities and develop more accurate cost estimates.

Table 4.5 summarizes the maintenance activities that are recommended for Year 1 (2021). The estimated cost is approximately $17,824. A complete listing of the maintenance activities by section is presented in Appendix I2. This may be used as a basis for establishing an annual maintenance budget for the SEM pavements.

Table 4.5: Summary of Year-1 Maintenance Plan.

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Patching - AC Full-Depth	233	SqFt	$5,830
	Crack Sealing - AC	3,024	Ft	$11,945
	Patching - AC Partial-Depth	3	SqFt	$49
			Total	**$17,824**

APPENDIX A

INVENTORY

Appendix A
Pavement Inventory Report
Craig Field (SEM)

Branch ID	Name	Branch Use	Section ID	Rank[1]	Length (ft)	Width (ft)	Area (sf)	LCD[2]	Surface[3]
ORR15	Overrun Runway 15 End Selma	OVERRUN	01	S	690	150	103,500	1/20/80	AC
ORR33	Overrun Runway 33 End Selma	OVERRUN	01	S	140	150	21,000	5/21/86	AC
R1533	Runway 15-33 Selma	RUNWAY	01	P	8,014	150	1,202,100	5/15/02	AC
TA	Taxiway A Selma	TAXIWAY	01	P	4,750	75	425,372	4/24/95	AC
TB	Taxiway B Selma	TAXIWAY	01	P	155	170	23,063	12/31/09	AC
TB	Taxiway B Selma	TAXIWAY	02	S	1,600	75	121,491	6/2/10	AAC
TB	Taxiway B Selma	TAXIWAY	03	S	235	75	20,641	10/2/09	AAC
TC	Taxiway C Selma	TAXIWAY	01	P	625	70	50,203	8/13/02	PCC
TC	Taxiway C Selma	TAXIWAY	02	S	3,990	70	298,699	10/2/09	AAC
TC01	Taxiway Connector 01 Selma	TAXIWAY	01	S	570	75	50,490	8/25/95	PCC

[1] P = Primary pavement, S = Secondary pavement, T = Tertiary pavement

[2] LCD = Last construction date. The date of the last major pavement rehabilitation (e.g. AC overlay)

[3] AC = Asphalt Cement Concrete, AAC = Aphalt Overlay AC, PCC = Portland cement Concrete, APC = Asphalt Overlay PCC

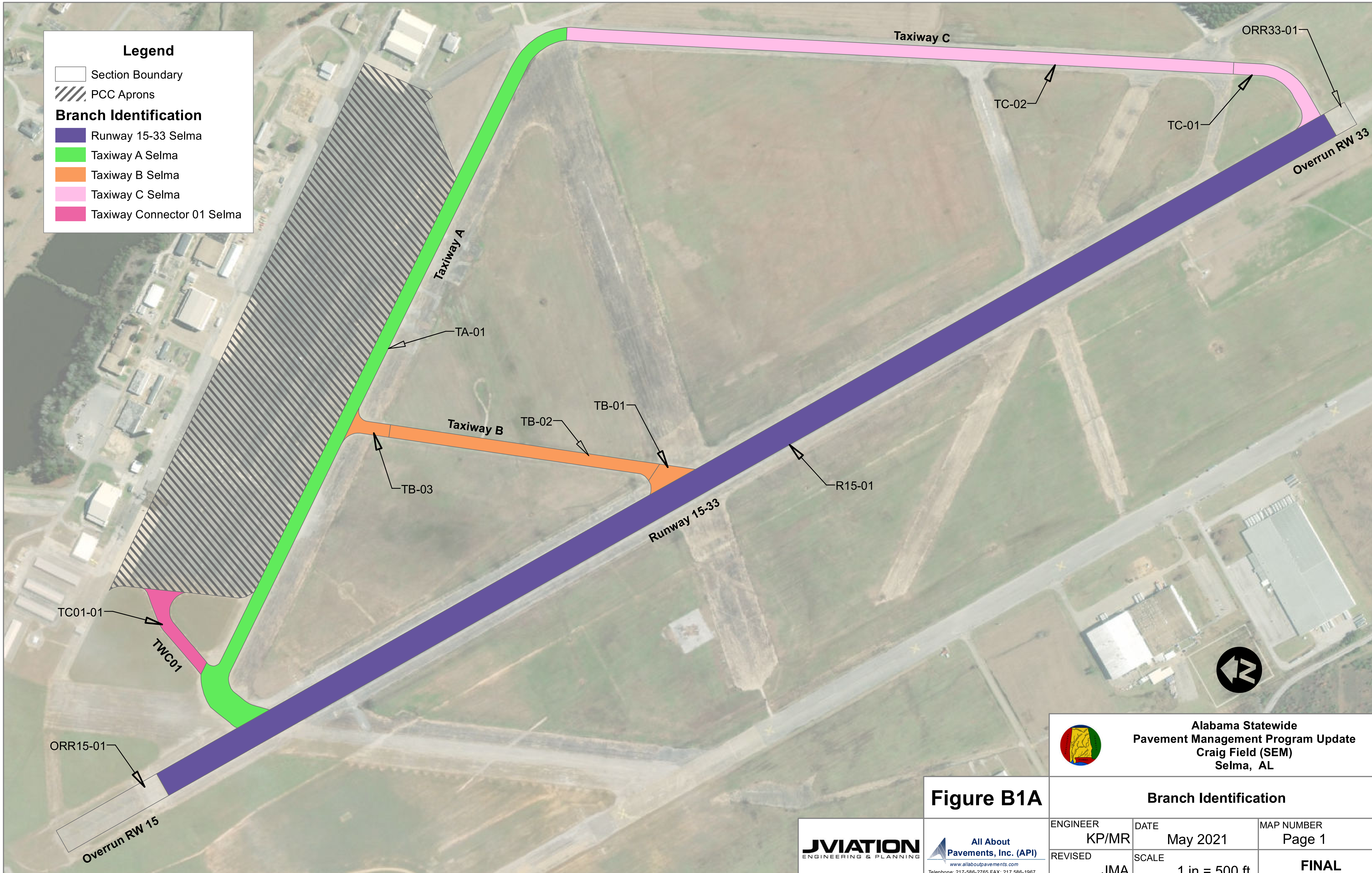
APPENDIX B

PMP Maps

B1: Inventory Maps
- B1A: Branch Identification
- B1B: Section Identification
- B1C: Sample Unit Layout
- B1D: Pavement Type
- B1E: Branch Use
- B1F: Pavement Age

B2: Surface Condition Maps
- B2A: 7-Color PCI
- B2B: 3-Color PCI
- B2C: FOD Rating
- B2D: Survey Photo Locations

B3: Pavement Capital Improvement Plan (PCIP) Maps
- B3A: 2027 Forecasted PCI without PCIP
- B3B: M&R Needs
- B3C: PCIP Recommendations



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Craig Field (SEM)
Selma, AL

Figure B1A

Branch Identification

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ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 1
REVISED	SCALE	
JMA	1 in = 500 ft	FINAL

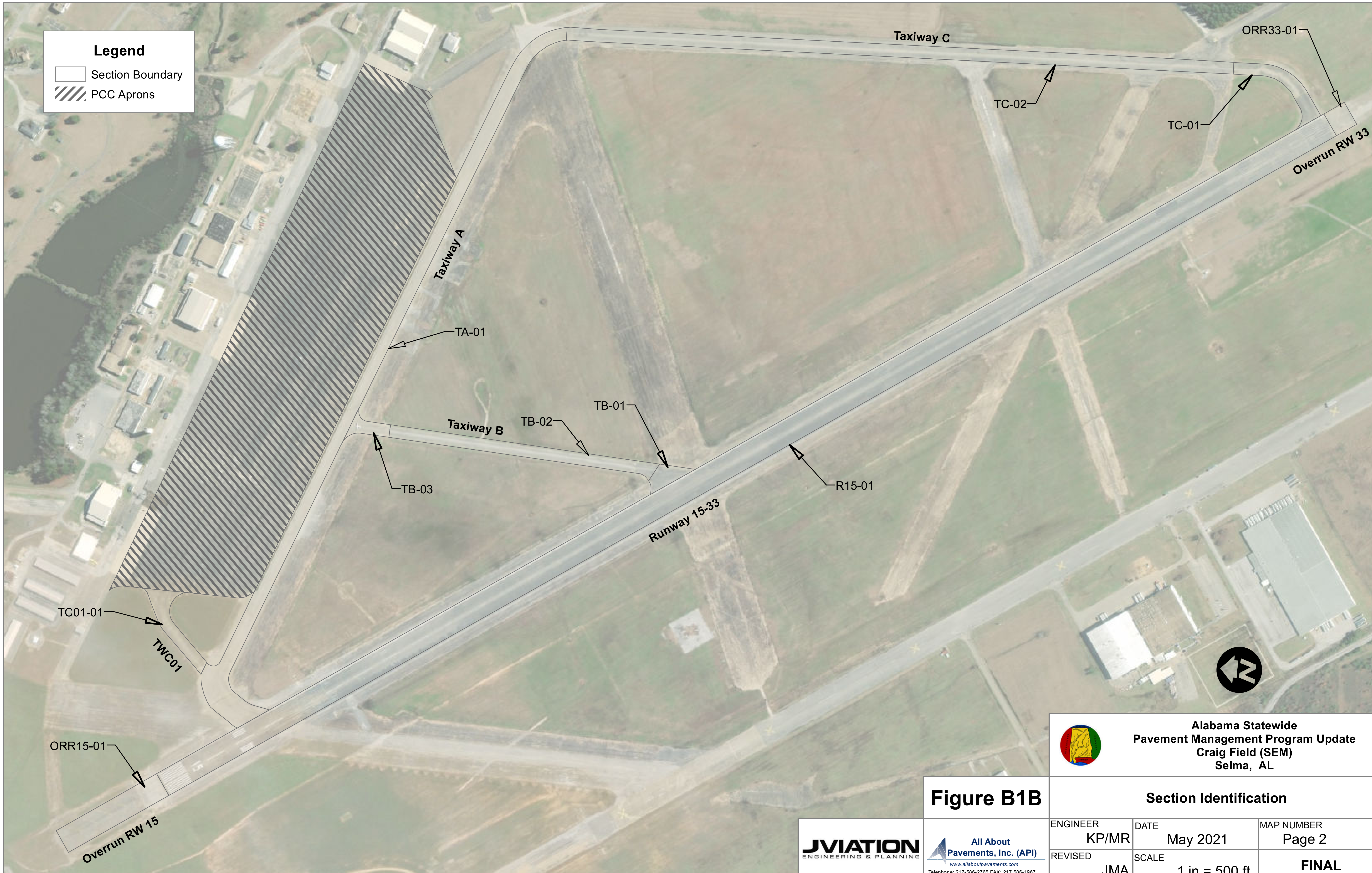

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Figure B1B

Section Identification

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 2
REVISED	SCALE	
JMA	1 in = 500 ft	**FINAL**

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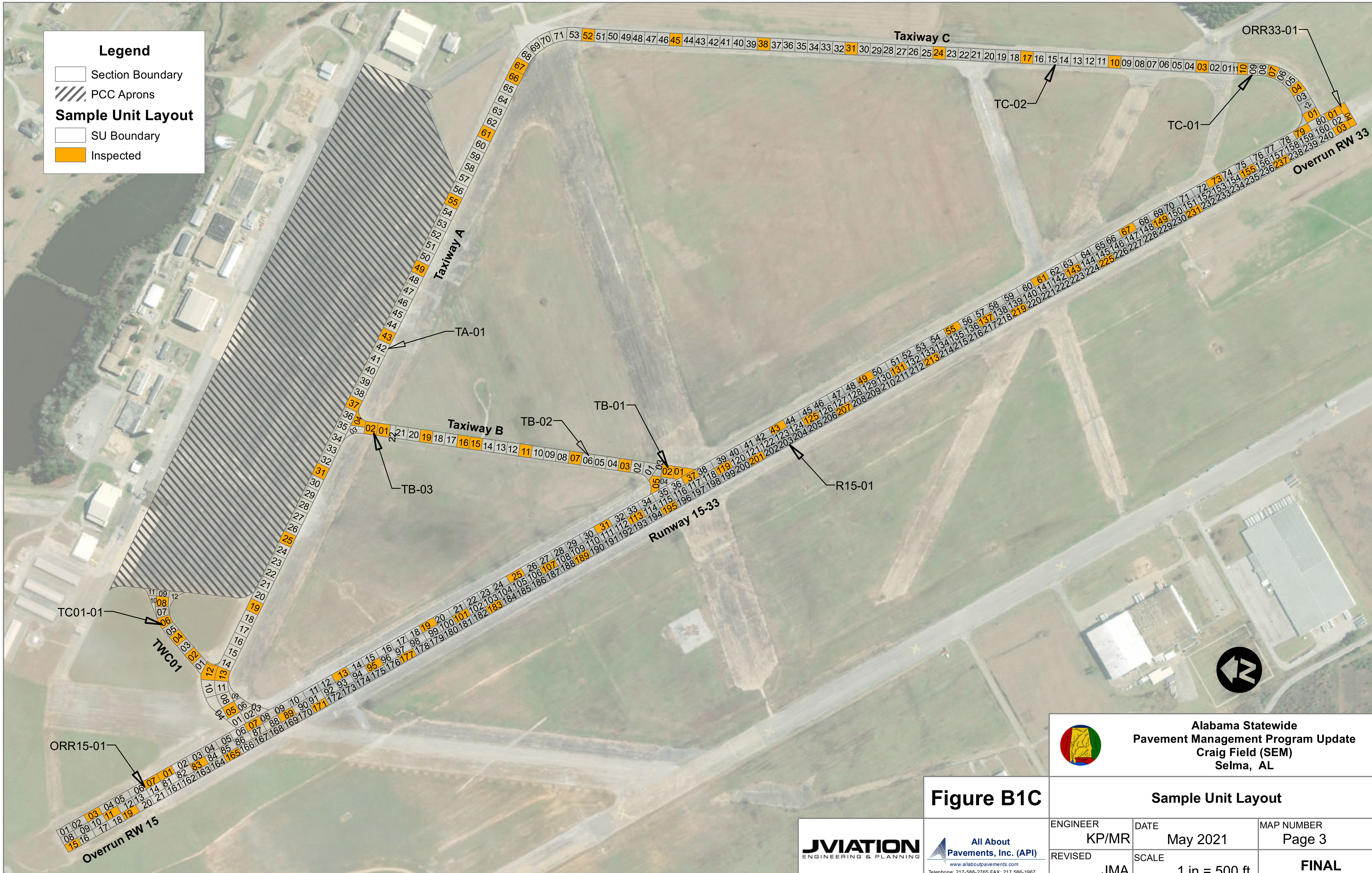

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Craig Field (SEM)
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Figure B1C

Sample Unit Layout

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 3
REVISED	SCALE	
JMA	1 in = 500 ft	FINAL

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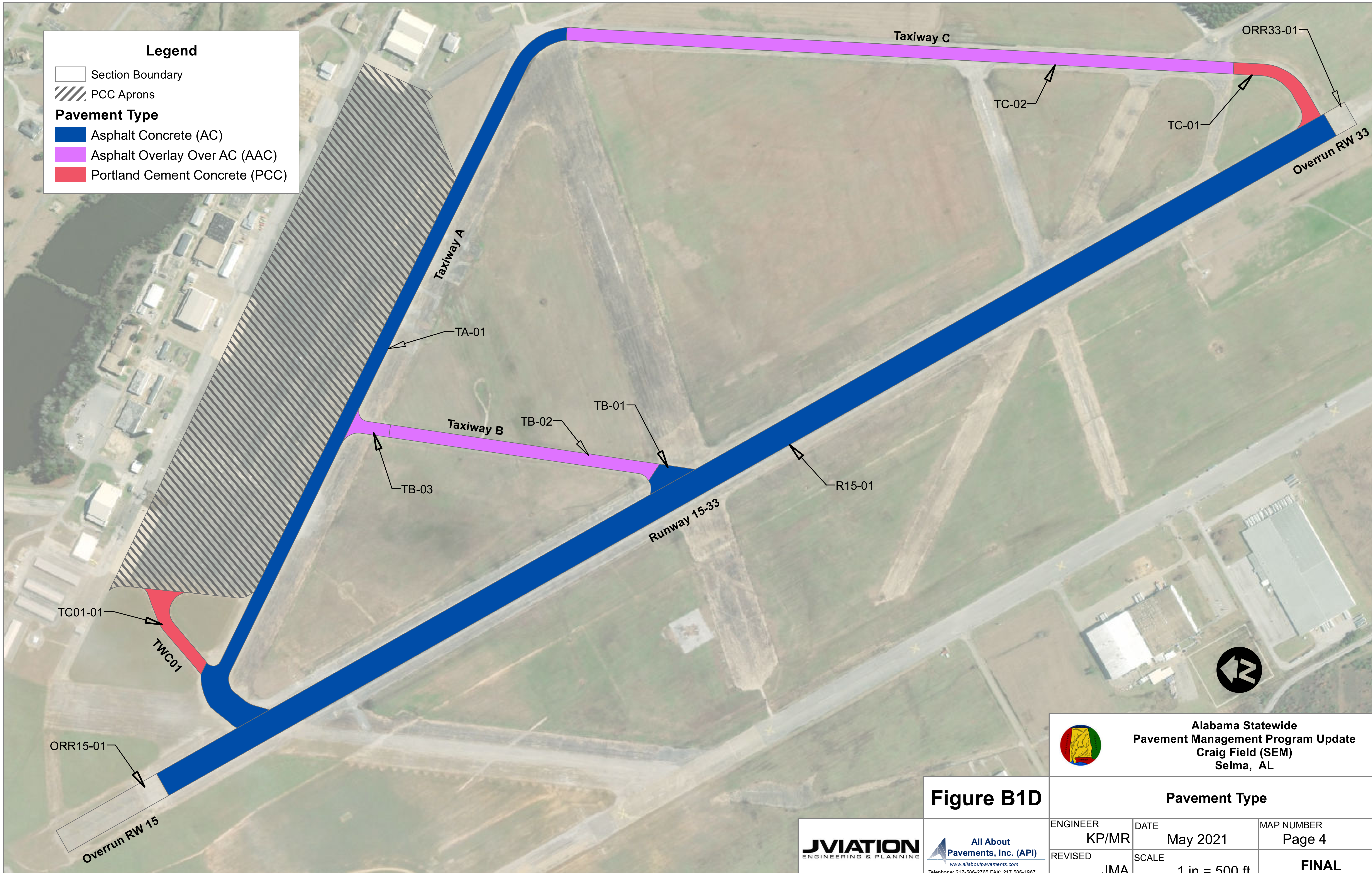
Legend
Section Boundary
PCC Aprons
Pavement Type
Asphalt Concrete (AC)
Asphalt Overlay Over AC (AAC)
Portland Cement Concrete (PCC)
Taxiway C
ORR33-01
TC-02
TC-01
Overrun RW 33
Taxiway A
TA-01
TB-01
TB-02
Taxiway B
TB-03
R15-01
Runway 15-33
TC01-01
TWC01
ORR15-01
Overrun RW 15
Alabama Statewide
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Craig Field (SEM)
Selma, AL
Figure B1D
Pavement Type
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ENGINEER
KP/MR
DATE
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MAP NUMBER
Page 4
REVISED
JMA
SCALE
1 in = 500 ft
FINAL


Legend
Section Boundary
PCC Aprons
Branch Use
RUNWAY
TAXIWAY
Taxiway C
ORR33-01
TC-02
TC-01
Overrun RW 33
Taxiway A
TA-01
Taxiway B
TB-01
TB-02
TB-03
R15-01
Runway 15-33
TC01-01
TWC01
ORR15-01
Overrun RW 15
Alabama Statewide
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Craig Field (SEM)
Selma, AL
Figure B1E
Branch Use
ENGINEER
KP/MR
DATE
May 2021
MAP NUMBER
Page 5
REVISED
JMA
SCALE
1 in = 500 ft
FINAL
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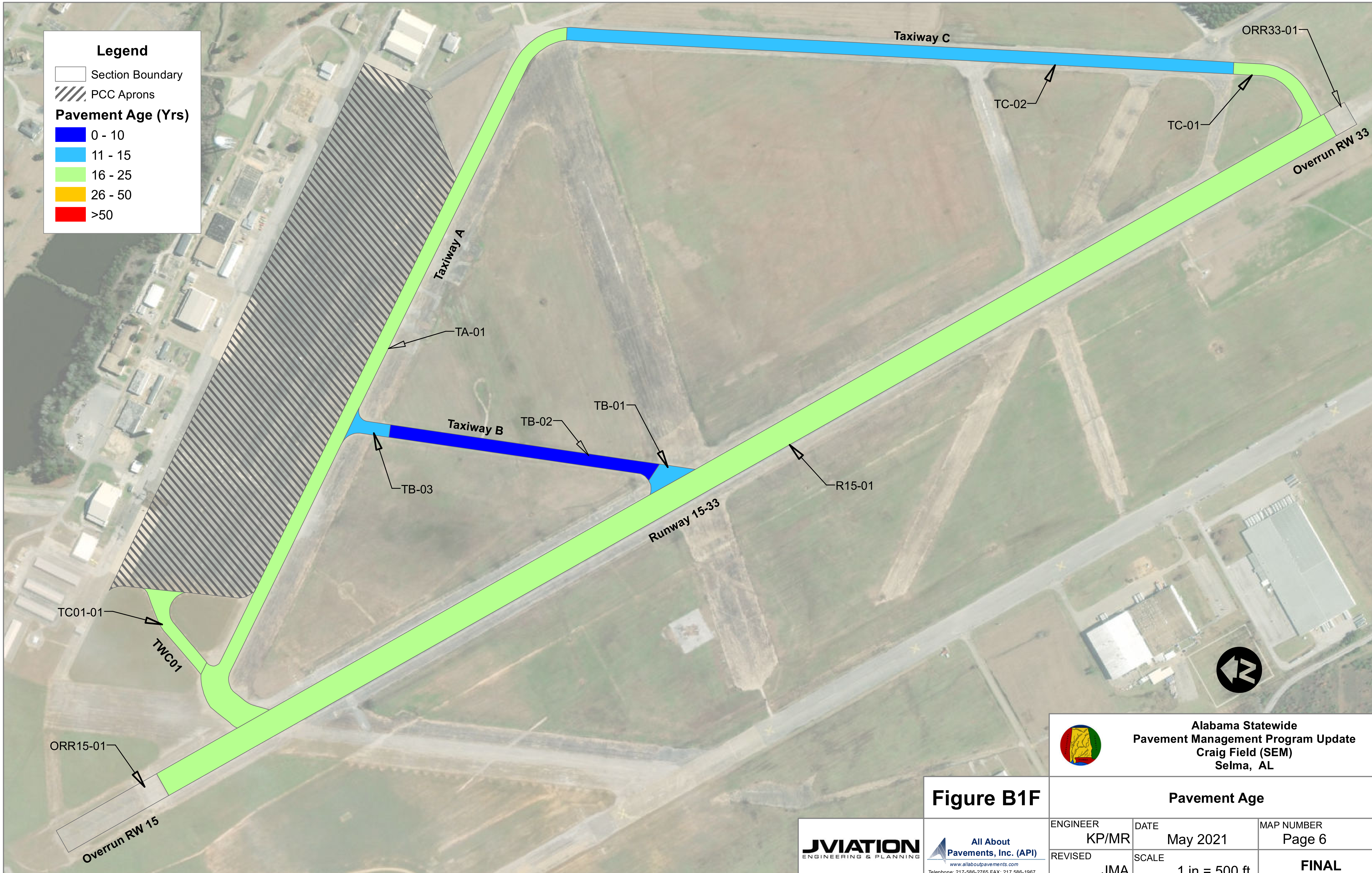

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Figure B1F

Pavement Age

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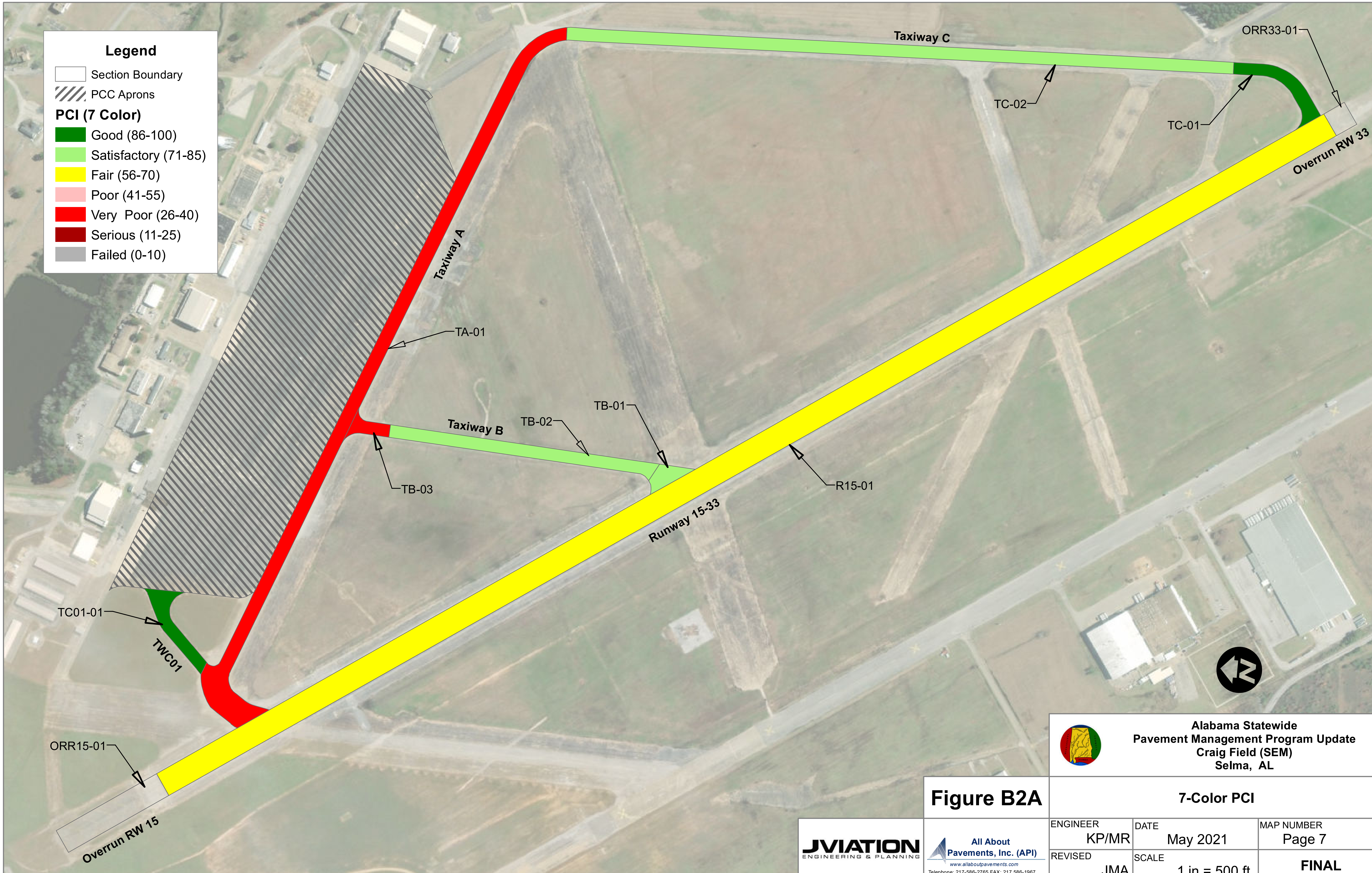
ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 6
REVISED	SCALE	
JMA	1 in = 500 ft	FINAL



Legend
Section Boundary
PCC Aprons
PCI (7 Color)
Good (86-100)
Satisfactory (71-85)
Fair (56-70)
Poor (41-55)
Very Poor (26-40)
Serious (11-25)
Failed (0-10)
Taxiway C
ORR33-01
TC-02
TC-01
Overrun RW 33
Taxiway A
TA-01
TB-01
TB-02
Taxiway B
TB-03
R15-01
Runway 15-33
TC01-01
TWC01
ORR15-01
Overrun RW 15
Alabama Statewide
Pavement Management Program Update
Craig Field (SEM)
Selma, AL
Figure B2A
7-Color PCI
ENGINEER KP/MR
DATE May 2021
MAP NUMBER Page 7
REVISED JMA
SCALE 1 in = 500 ft
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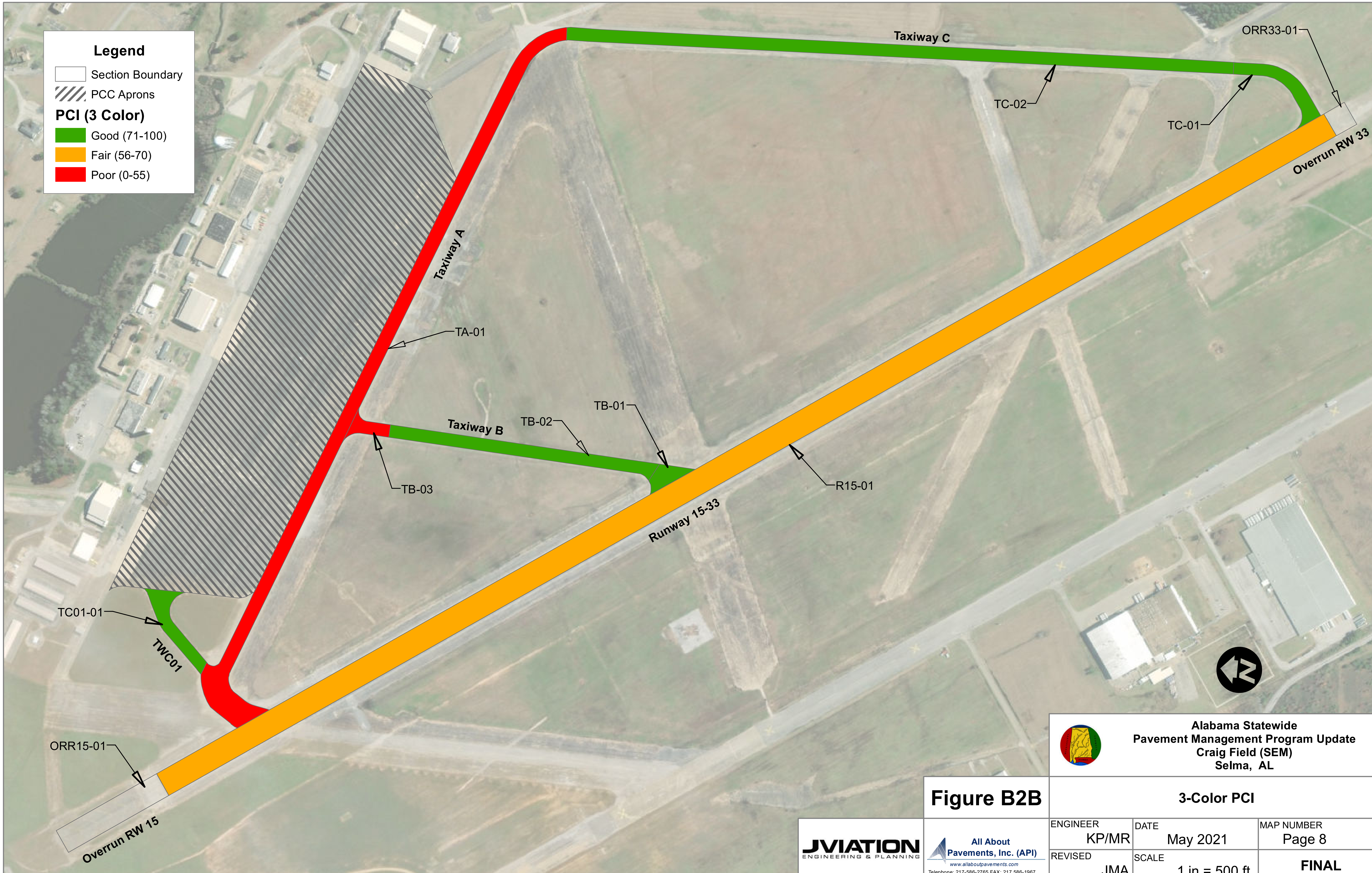

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Figure B2B

3-Color PCI

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 8
REVISED	SCALE	
JMA	1 in = 500 ft	FINAL

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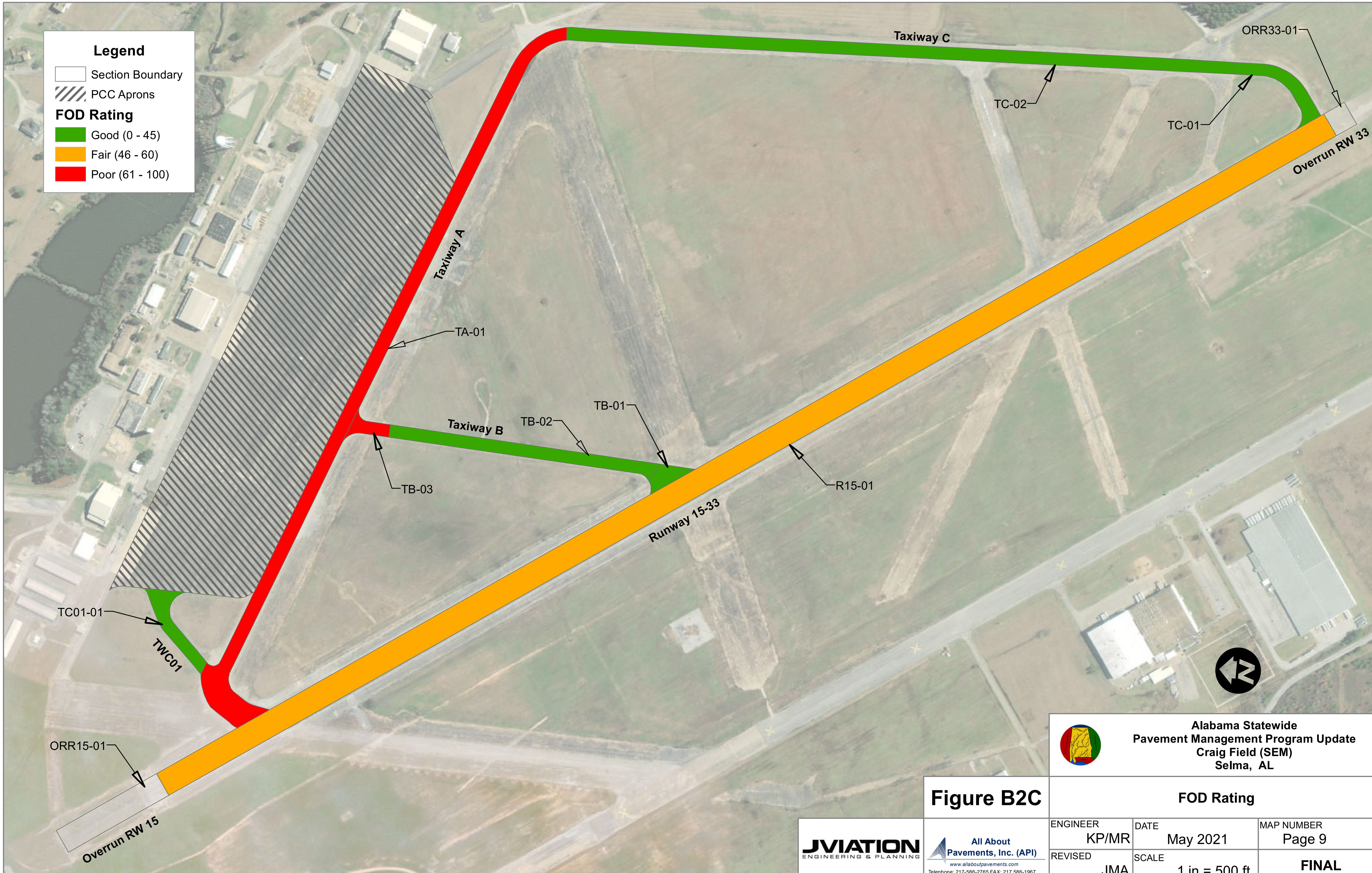
Legend
Section Boundary
PCC Aprons
FOD Rating
Good (0 - 45)
Fair (46 - 60)
Poor (61 - 100)
Taxiway C
ORR33-01
TC-02
TC-01
Overrun RW 33
Taxiway A
TA-01
TB-01
TB-02
Taxiway B
TB-03
R15-01
Runway 15-33
TC01-01
TWC01
ORR15-01
Overrun RW 15
Alabama Statewide
Pavement Management Program Update
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Figure B2C
FOD Rating
ENGINEER KP/MR
DATE May 2021
MAP NUMBER Page 9
REVISED JMA
SCALE 1 in = 500 ft
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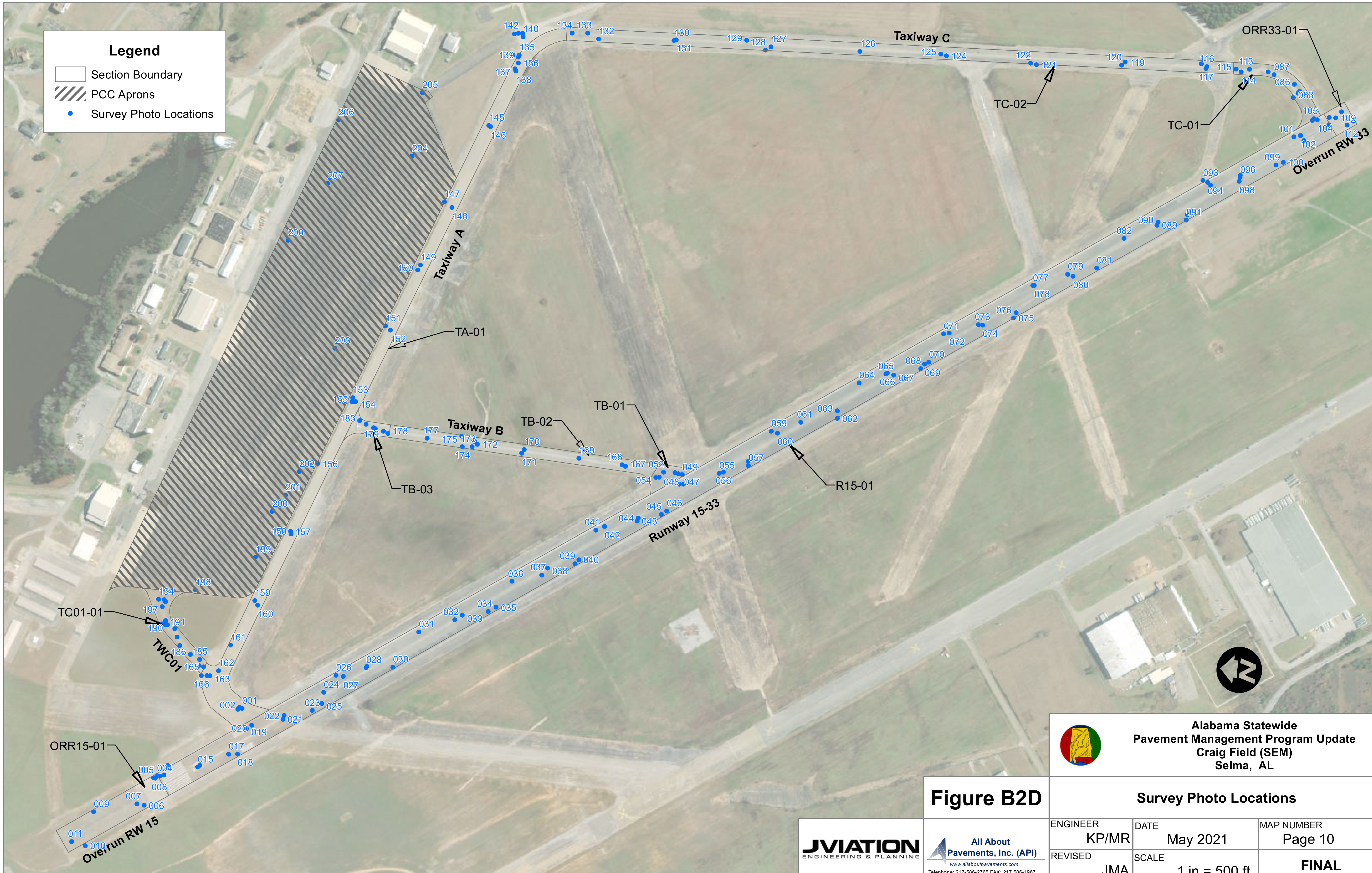

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Craig Field (SEM)
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Figure B2D

Survey Photo Locations

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 10
REVISED	SCALE	
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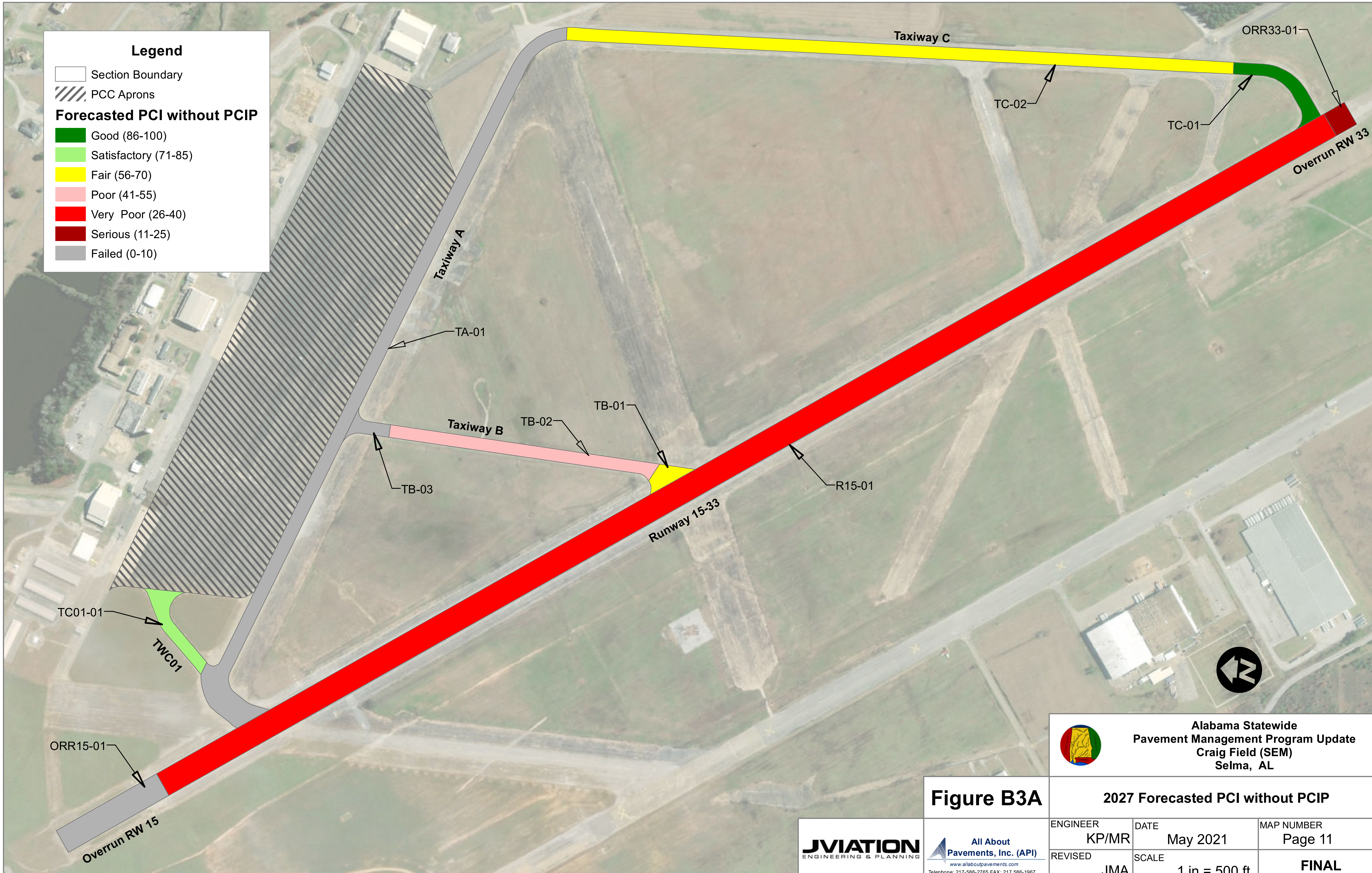

Legend
Section Boundary
PCC Aprons
Forecasted PCI without PCIP
Good (86-100)
Satisfactory (71-85)
Fair (56-70)
Poor (41-55)
Very Poor (26-40)
Serious (11-25)
Failed (0-10)
Taxiway C
ORR33-01
TC-02
TC-01
Overrun RW 33
Taxiway A
TA-01
TB-01
TB-02
Taxiway B
TB-03
R15-01
Runway 15-33
TC01-01
TWC01
ORR15-01
Overrun RW 15
Alabama Statewide
Pavement Management Program Update
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Figure B3A
2027 Forecasted PCI without PCIP
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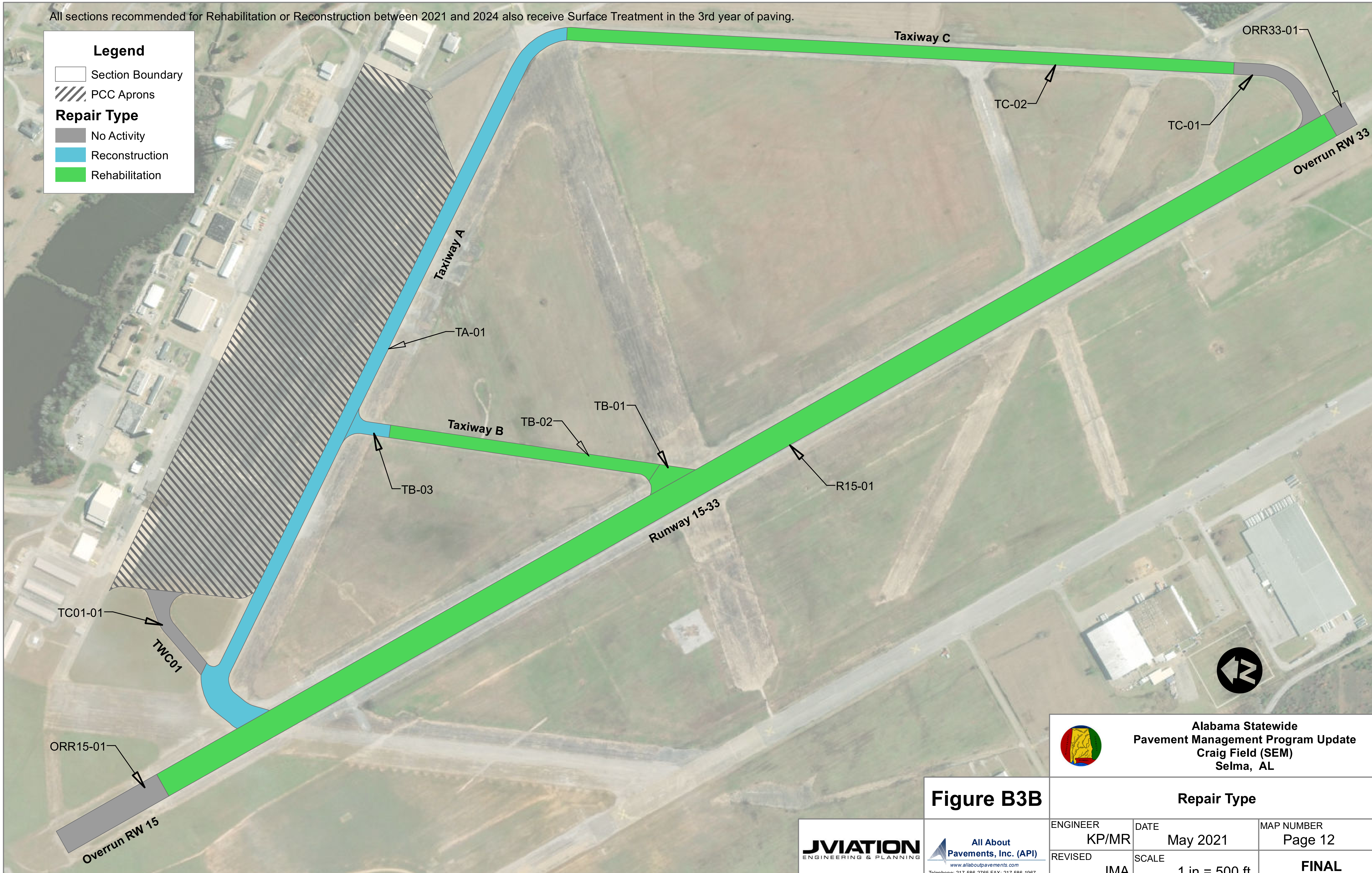
ENGINEER KP/MR
DATE May 2021
MAP NUMBER Page 11
REVISED JMA
SCALE 1 in = 500 ft
FINAL

All sections recommended for Rehabilitation or Reconstruction between 2021 and 2024 also receive Surface Treatment in the 3rd year of paving.



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Craig Field (SEM)
Selma, AL

Figure B3B

Repair Type

ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 12
REVISED	SCALE	
JMA	1 in = 500 ft	FINAL

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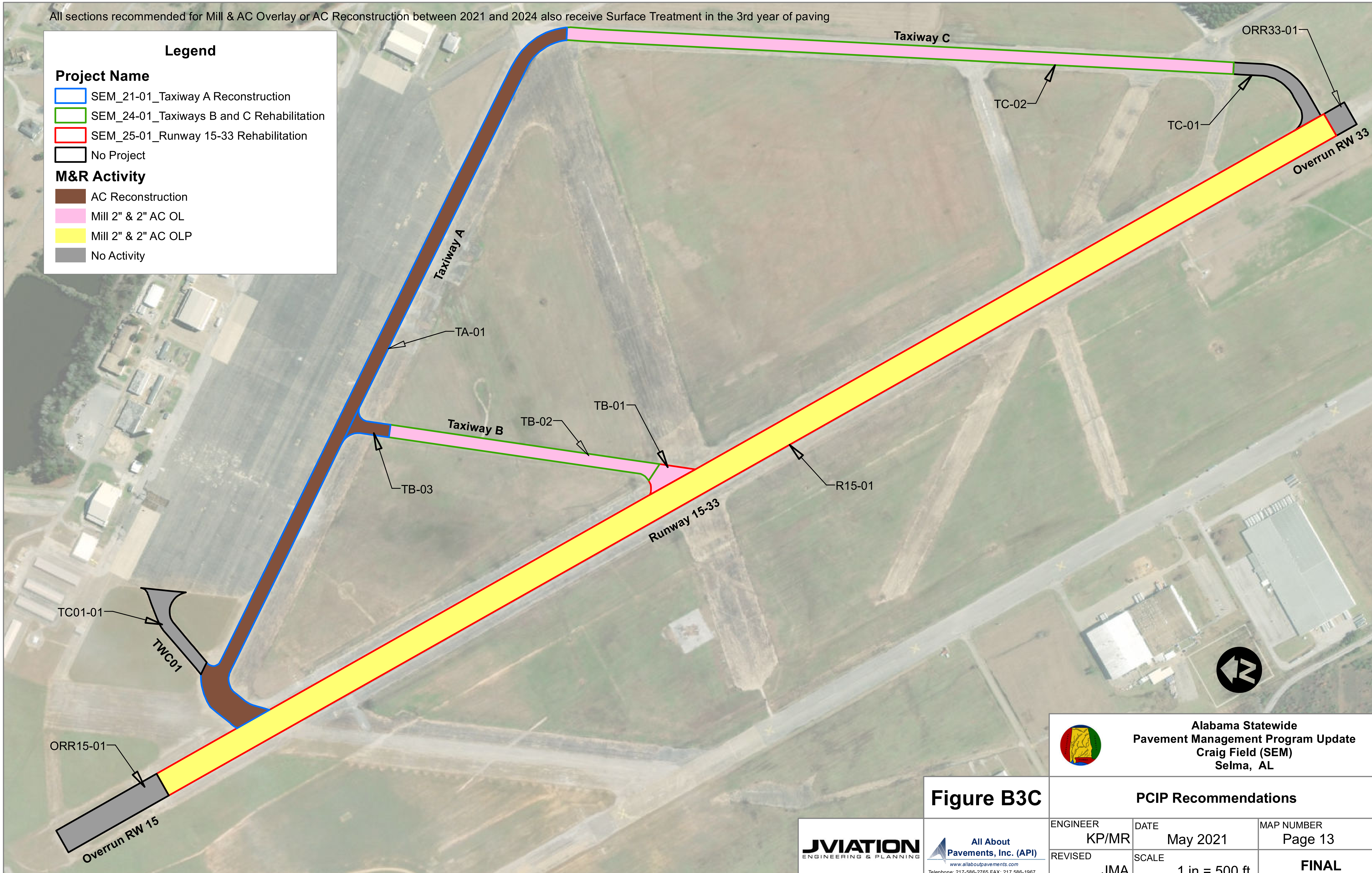
All sections recommended for Mill & AC Overlay or AC Reconstruction between 2021 and 2024 also receive Surface Treatment in the 3rd year of paving



Alabama Statewide Pavement Management Program Update Craig Field (SEM) Selma, AL			
Figure B3C	**PCIP Recommendations**		
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	REVISED JMA	SCALE 1 in = 500 ft	**FINAL**

APPENDIX C

OVERVIEW OF PAVEMENT DISTRESSES

1. Alligator Cracking (AC)

Alligator cracking is a series of interconnecting cracks caused by fatigue failure of the asphalt concrete surface where tensile stress and strain is highest under wheel loads. The cracks propagate to the surface initially as a series of parallel cracks. After repeated traffic loading the cracks connect, forming many sided, sharp angled pieces that develop a pattern resembling chicken wire or the skin of an alligator. The pieces are less than 2 feet long on the longest side. Alligator cracking occurs only in areas that are subjected to repeated traffic loading, such as wheel paths, and is considered a major structural distress.

Severities:

- Low - made up of fine, hair-like cracks running parallel to each other with none or only a few inter-connecting cracks. The cracks are not spalled;
- Medium - Further development of light alligator cracking into a pattern or network of cracks that may be lightly spalled. Medium-severity alligator cracking is defined by a well-defined pattern of interconnecting cracks, where all pieces are securely held in place (good aggregate interlock between pieces);
- High - has progressed so that the pieces are well defined and spalled at the edges. Some of the pieces may rock under traffic and may cause FOD potential.

Repair options:

- Low - No action, surface seal or overlay for low severity distress;
- Medium - partial or full depth patch, overlay or reconstruct;
- High - partial or full depth patch, overlay or reconstruct.

2. Bleeding (AC)

Bleeding is a film of bituminous material on the pavement surface that creates a shiny, glass-like, reflecting surface that usually becomes quite sticky. Bleeding is caused by excessive amounts of asphaltic cement or tars in the mix or low-air void content, or both. It occurs when asphalt fills the voids of the mix during hot weather and then expands out onto the surface of the pavement. Since the bleeding process is not reversible during cold weather, asphalt or tar will accumulate on the surface.

Severities: No degrees of severity are defined. Bleeding should be noted when it is extensive enough to reduce skid resistance.

Repair Policies: Do nothing; sand blot the distressed area by applying heat and roll sand into the areas affected with bleeding, remove the excess material; patch.

3. Block Cracking (AC)

Block cracks are interconnected cracks that divide the pavement into rectangular shaped pieces. The blocks may range in size from 1 by 1 foot to 10 by 10 feet. Block cracking is caused mainly by shrinkage of the asphalt concrete and is not load associated. The occurrence of block cracking usually indicates that the asphalt has hardened significantly. Block cracking normally occurs over a large proportion of the pavement area, but will sometimes occur only in the non-traffic areas.

Severities:

- Low - defined by cracks that are at most lightly spalled, causing no foreign object damage (FOD) potential. Un-filled cracks have 1/4 inch or less mean width, and filled cracks have filler in satisfactory condition;
- Medium - defined by cracks that are moderately spalled (some FOD potential), un-filled cracks that are at most lightly spalled, but have a mean width greater than 1/4 inch or filled cracks that are at most lightly spalled but have filler in unsatisfactory condition;
- High - defined by cracks that are severely spalled, causing a definite FOD potential.

Repair Policies:

- Low - No action;
- Medium - seal cracks, apply rejuvenator, recycle surface or heat scarify and overlay;
- High - recycle surface or heat scarify and overlay.

4. Corrugation (AC)

Description

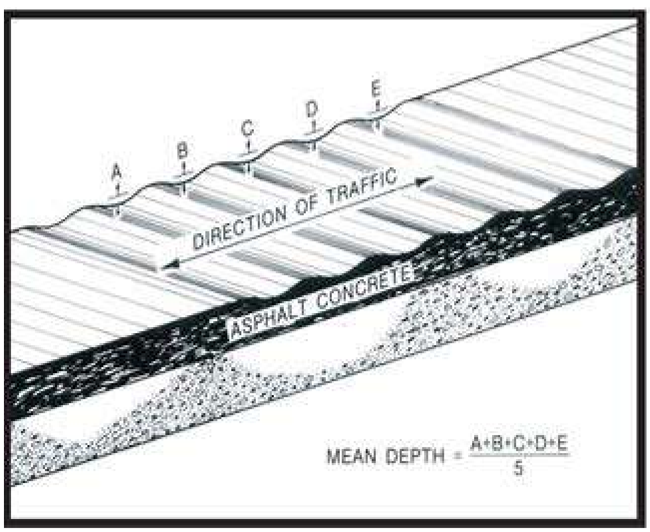
Corrugation is a series of closely spaced ridges and valleys (ripples) occurring at fairly regular intervals, usually less than 5 feet (1.5 meters) along the pavement. The ridges are perpendicular to the traffic direction. Traffic action combined with an unstable pavement surface or base usually causes this type of distress.

Severity Levels

L Corrugations are minor and do not significantly affect ride quality (see measurement criteria below).

M Corrugations are noticeable and significantly affect ride quality (see measurement criteria below).

H Corrugations are easily noticed and severely affect ride quality (see measurement criteria below).



5. Depression (AC)

Depressions are localized pavement surface areas having elevations slightly lower than those of the surrounding pavement. In many instances, light depressions are not noticeable until after a rain, when ponding water creates "birdbath" areas; but the depressions can also be located without rain because of stains created by ponding of water. Depressions can be caused by settlement of the foundation soil or can be built during construction. Depressions cause roughness and, when filled with water of sufficient depth, could cause hydroplaning of aircraft.

Severities:

- Low - Depression can be observed or located by stained areas, only slightly affects pavement riding quality, and may cause hydroplaning potential on runways. Maximum depth 1/8 to 1/2 inch for runways, 1/2 to 1 inch for taxiways and aprons;
- Medium - The depression can be observed, moderately affects pavement riding quality, and causes hydroplaning potential on runways. Maximum depth 1/2 to 1 inch for runways, 1 to 2 inches for taxiways and aprons;
- High - The depression can be readily observed, severely affects pavement riding quality, and causes definite hydroplaning potential; Depth greater than 1 inch for runways, greater than 2 inches for taxiways and aprons;.

Repair Policies:

- Low - No action;
- Medium - Shallow, partial or full depth patch;
- High - Shallow, partial or full depth patch.

6. Jet Blast (AC)

Description

Jet blast erosion causes darkened areas on the pavement surface when bituminous binder has been burned or carbonized; localized burned areas may vary in depth up to approximately 1/2 inch (13 millimeters).

Severity Levels

No degrees of severity are defined. It is sufficient to indicate that jet blast erosion exists.

7. Joint Reflection Cracking (AC)

Description

This distress occurs only on pavements having an asphalt or tar surface over a PCC slab. This category does not include reflection cracking from any other type of base (i. e., cement stabilized, lime stabilized); such cracks are listed as longitudinal and transverse cracks. Joint-reflection cracking is caused mainly by movement of the PCC slab beneath the AC surface because of thermal and moisture changes; it is not load related. However, traffic loading may cause a breakdown of the AC near the crack, resulting in spalling and FOD potential. If the pavement is fragmented along a crack, the crack is said to be spalled. A knowledge of slab dimensions beneath the AC surface will help to identify these cracks.

Severity Levels

L Cracks have only light spalling (little or no FOD potential) or no spalling and can be filled or non-filled. If non-filled, the cracks have a mean width of 1/4 inch (6 millimeters) or less. Filled cracks are of any width, but their filler material is in satisfactory condition.

M One of the following conditions exists: (1) cracks are moderately spalled (some FOD potential) and can be either filled or non-filled of any width; (2) filled cracks are not spalled or are only lightly spalled, but the filler is in unsatisfactory condition; (3) non-filled cracks are not spalled or are only lightly spalled, but the mean crack width is greater than 1/4 inch (6 millimeters); or (4) light random cracking exists near the crack or at the corner of intersecting cracks.

H Cracks are severely spalled (definite FOD potential) and can be either filled or non-filled of any width.

8. Longitudinal and Transverse Cracking (AC)

Longitudinal and transverse (L&T) cracks are parallel to the pavement's centerline or laydown direction. They may be caused by: 1) a poorly constructed paving lane joint, 2) shrinkage of the AC surface due to hardening of the asphalt, or 3) a reflective crack caused by cracks beneath the surface course. Transverse cracks extend across the pavement perpendicularly to the pavement centerline or laydown direction, and may be caused by items 2) or 3) as stated above. These types of cracks are not usually load related.

<u>Severities</u>:

- Low - have either minor spalling or no spalling. The cracks can be filled or un-filled. Un-filled cracks have a mean width of 1/4 inch or less. Filled cracks are any width but their filler is in satisfactory condition;
- Medium - one of the following conditions exists: 1) cracks are moderately spalled and can be either filled or un-filled of any width; 2) filled cracks are not spalled or only lightly spalled, but the filler is in unsatisfactory condition; 3) un-filled cracks are not spalled or only lightly spalled, but the crack width exceeds 1/4 inch; or 4) light random cracking exists near the crack or at the corner of the intersecting cracks;
- High - severely spalled with a definite FOC potential. They can be either filled or un-filled.

<u>Repair Policies</u>:

- Low - No action;
- Medium - seal cracks;
- High - seal cracks or perform a full depth patch.

9. Oil Spillage (AC)

Oil spillage is the deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents.

<u>Severities</u>: No degrees of severity are defined. It is sufficient to indicate that oil spillage exists.

<u>Repair Policies</u>:

- Do nothing;
- Partial or full depth patch.

10. Patching

Repair patching and utility cut patching is considered a defect, regardless of how well it performs or was constructed.

Severities:

- Low - in good condition and is performing satisfactorily;
- Medium - is somewhat deteriorated and affects riding quality to some extent;
- High - is badly deteriorated and affects riding quality significantly or has high FOD potential.

Repair options:

- Low - No action;
- Medium - seal cracks, repair the distresses in the patch or replace the patch;
- High - replace the patch.

Figure C.7: Asphalt Patching.

11. Polished Aggregate (AC)

Description

Aggregate polishing is caused by repeated traffic applications. Polished aggregate is present when close examination of a pavement reveals that the portion of aggregate extending above the asphalt is either very small or there are no rough or angular aggregate particles to provide good skid resistance. Existence of this type of distress is also indicated when the number on a skid resistance rating test is low or has dropped significantly from previous ratings.

Severity Levels

No degrees of severity are defined. However, the degree of polishing should be significant before it is included in the condition survey and rated as a defect.

12. Raveling (AC)

Definition

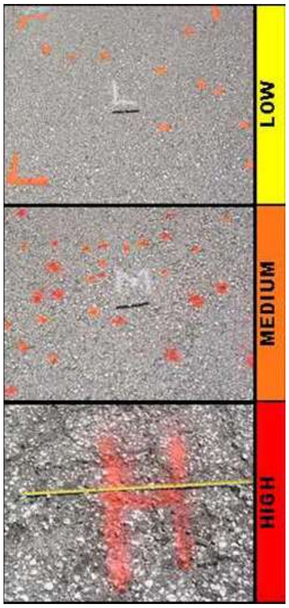
Raveling is the dislodging of coarse aggregate particles from the pavement surface .

Dense Mix Severity Levels.

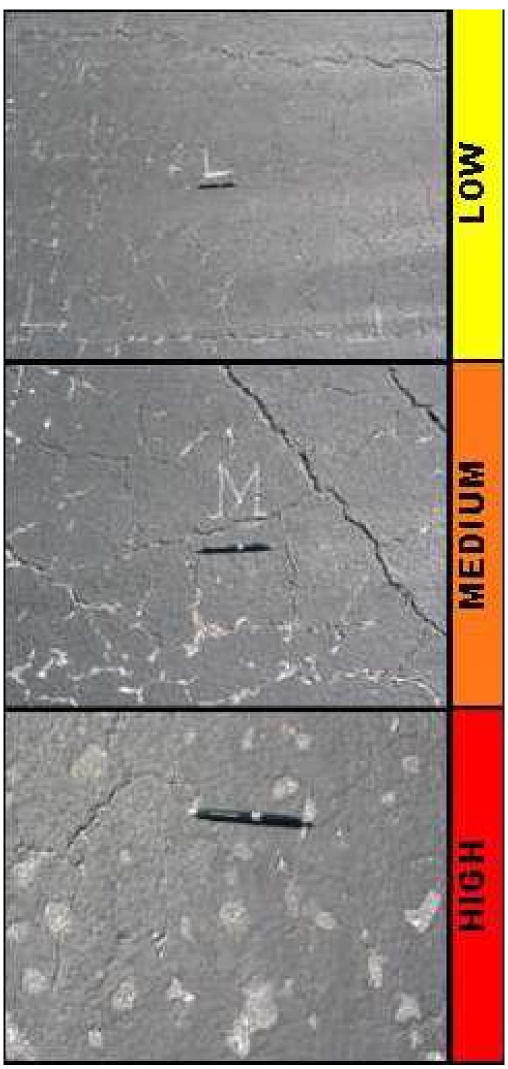
As used herein, coarse aggregate refers to predominant coarse aggregate sizes of the asphalt mix. Aggregate clusters refer to when more than one adjoining coarse aggregate piece is missing. If in doubt about a severity level, three representative areas of 1 square yard (1 square meter) each should be examined and the number of missing coarse aggregate particles counted.

L	Low severity occurs if any one of these conditions exist: (1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 5 and 20. (2) Missing aggregate clusters is less than 2 percent of the examined square yard (square meter) area. In low severity raveling, there is little or no FOD potential.
M	Medium severity occurs if any one of these conditions exist: (1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is between 21 and 40. (2) Missing aggregate clusters is between 2 and 10 percent of the examined square yard (square meter) area. In medium severity raveling, there is some FOD potential.
H	High severity occurs if any one of these conditions exist: (1) In a square yard (square meter) representative area, the number of coarse aggregate particles missing is over 40. (2) Missing aggregate clusters is more than 10 percent of the examined square yard (square meter) area. In high severity raveling, there is significant FOD potential.

Note- this is a new distress since the 2007 survey



Slurry Seal/ Coal Tar Over Dense Mix Severity Levels



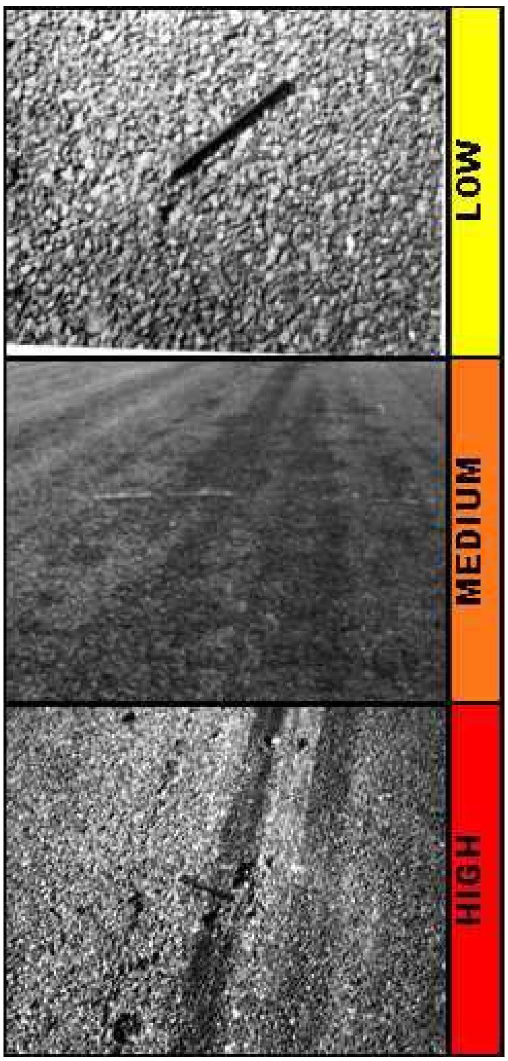
L (1) The scaled area is less than 1 percent. (2) In the case of coal tar where pattern cracking has developed, the surface cracks are less than 1/4 inch (6 mm) wide.

M (1) The scaled area is between 1 and 10 percent. (2) In the case of coal tar where pattern cracking has developed, the cracks are 1/4 inch (6 mm) wide or greater.

H (1) The scaled area is over 10 percent. (2) In the case of coal tar the surface is peeling off.

Porous Friction Course Severity Levels

L	In a 1 square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is between 5 and 20 and/ or the number of missing aggregate clusters does not exceed 1.
M	In a 1 square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is between 21 and 40 and/ or the number of missing aggregate clusters is greater than 1 but does not exceed 25 percent of the area.
H	In a 1 square foot (1/10 square meter) representative sample, the number of aggregate pieces missing is over 40 and/ or the number of missing aggregate clusters is greater than 25 percent of the area.



13. Rutting (AC)

A rut is a surface depression in the wheel path; however, in many instances ruts are noticeable only after a rainfall, when the wheel paths are filled with water. Pavement uplift may occur along the sides of the rut. Rutting stems from a permanent deformation in any of the pavement layers or sub-grade, usually caused by consolidation or lateral movement of the materials due to traffic loads. Significant rutting can lead to major structural failure of the pavement.

Severities (based on rut depth):

- Low - less than ½ inch in depth;
- Medium - between ½ and 1 inch in depth;
- High - exceeds 1 inch in depth.

Repair options:

- Low - No action;
- Medium - patch and/or overlay;
- High - patch and/or overlay.

Figure C.9: AC Rutting.

14. Slippage Cracking (AC)

Slippage cracks are crescent- or half-moon shaped cracks having two ends pointed away from the direction of traffic. They are produced when braking or turning wheels cause the pavement surface to slide and deform. This usually occurs when there is a low-strength surface mix or poor bond between the surface and next layer of pavement structure.

Severities: No degrees of severity are defined. It is sufficient to indicate that a slippage crack exists.

Repair Policies:

- Do nothing;
- Partial or full depth patch.

Figure C.10: Slippage Cracking.

15. Swelling (AC)

Description

A swell is characterized by an upward bulge in the pavement's surface. A swell may occur sharply over a small area or as a longer, gradual wave. Either type of swell can be accompanied by surface cracking. A swell is usually caused by frost action in the subgrade or by swelling soil, but a small swell can also occur on the surface of an asphalt overlay (over PCC) as a result of a blow- up in the PCC slab.

Severity Levels

L	Swell is barely visible and has a minor effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration. (Low-severity swells may not always be observable, but their existence can be confirmed by driving a vehicle over the section at the normal aircraft speed. An upward acceleration will occur if the swell is present).
M	Swell can be observed without difficulty and has a significant effect on the pavement's ride quality as determined at the normal aircraft speed for the pavement section under consideration.
H	Swell can be readily observed and severely affects the pavement's ride quality at the normal aircraft speed for the pavement section under consideration.

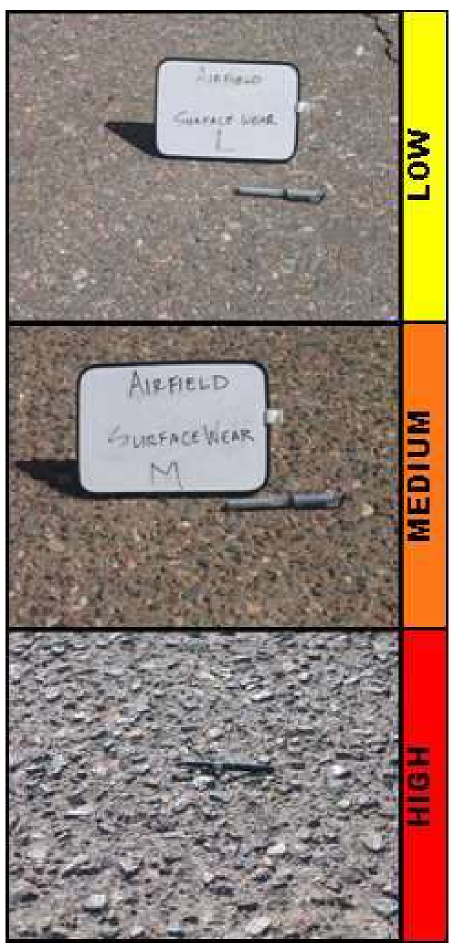
16. Weathering (AC)

Description

The wearing away of the asphalt binder and fine aggregate matrix from the pavement surface.

Severity Levels

L	Asphalt surface beginning to show signs of aging which may be accelerated by climatic conditions. Loss is the fine aggregate matrix is noticeable and may be accompanied by fading of the asphalt color. Edges of the coarse aggregates are beginning to be exposed (less than 0.05 inches or 1 mm). Pavement may be relatively new (as new as 6 months old).
M	Loss of fine aggregate matrix is noticeable and edges of coarse aggregate have been exposed up to 1/4 width (of the longest side) of the coarse aggregate due to the loss of fine aggregate matrix.
H	Edges of coarse aggregate have been exposed greater than 1/4 width (of the longest side) of the coarse aggregate. There is considerable loss of fine aggregate matrix leading to potential or some loss of coarse aggregate.



17. Blow-Up (PCC)

Description

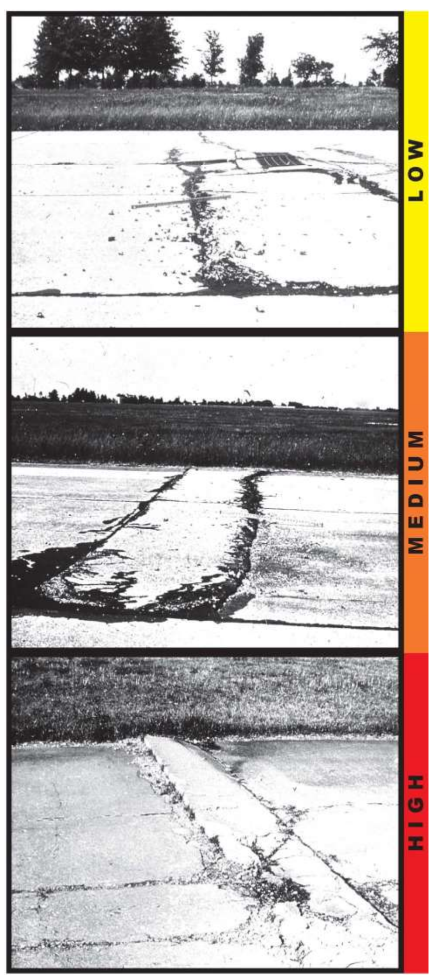
Blowups occur in hot weather, usually at a transverse crack or joint that is not wide enough to permit expansion by the concrete slabs. The insufficient width is usually caused by infiltration of incompressible materials into the joint space. When expansion cannot relieve enough pressure, a localized upward movement of the slab edges (buckling) or shattering will occur in the vicinity of the joint. Blowups can also occur at utility cuts and drainage inlets. This type of distress is almost always repaired immediately because of severe damage potential to aircraft. Blowups are included for reference when closed sections are being evaluated for reopening.

Severity Levels

L Buckling or shattering has not rendered the pavement inoperative, and only a slight amount of roughness exists.

M Buckling or shattering has not rendered the pavement inoperative, but a significant amount of roughness exists.

H Buckling or shattering has rendered the pavement inoperative.



18. Corner Breaks (PCC)

A corner break is a crack that intersects the joints at a distance less than or equal to one-half the slab length on both sides, measured from the corner of the slab. For example, a slab with dimensions of 25 by 25 feet that has a crack intersecting the joint 5 feet from the corner on one side and 17 feet on the other side is not considered a corner break; it is a diagonal crack. However, a crack that intersects 7 feet on one side and 10 feet on the other is considered a corner break. A corner break differs from a corner spall in that the crack extends vertically through the entire slab thickness, while a corner spall intersects the joint at an angle. Load repetition combined with loss of support and curling stresses usually causes corner breaks.

Severities:

- Low - Crack has either no spalling or minor spalling (no foreign object damage (FOD) potential). If non-filled, it has a mean width less than approximately 1/8 inch (3 millimeters); a filled crack can be of any width, but the filler material must be in satisfactory condition. The area between the corner break and the joints is not cracked;
- Medium - One of the following conditions exists: (1) filled or non-filled crack is moderately spalled (some FOD potential); (2) a non-filled crack has a mean width between 1/8 inch (3 millimeters) and 1 inch (25 millimeters); (3) a filled crack is not spalled or only lightly spalled, but the filler is in unsatisfactory condition; (4) the area between the corner break and the joints is lightly cracked with loose or missing particles;
- High - One of the following conditions exists: (1) filled or non-filled crack is severely spalled, causing definite FOD potential; (2) a non-filled crack has a mean width greater than approximately 1 inch (35 millimeters), creating a tire damage potential; or (3) the area between the corner break and the joints is severely cracked.

Repair options:

- Low - No action or seal cracks;
- Medium - seal cracks;
- High - seal cracks, apply a full depth patch or replace the slab.

Figure C.11: PCC Corner Break.

19. Cracks: Longitudinal, Transverse and Diagonal (PCC)

These cracks divide the slab into two or three pieces, and are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses. Low severity cracks are not considered major structural distresses. Medium or high severity cracks are usually working cracks and are considered major structural distresses.

Severities:

- Low - 1) unfilled cracks 1/4 inch to 1/2 inch wide with no faulting or spalling; 2) cracks less than 1/2 inch wide with low severity spalling; or 3) filled cracks of any width, with filter performing in a satisfactory manner and no faulting or spalling;
- Medium - 1) un-filled cracks between 1/2 to 1 inch wide with no faulting or spalling or 2) filled cracks of any width faulting less than 1/8 inch or medium severity spalling;
- High - 1) un-filled cracks with a width greater than 1 inch; 2) un-filled cracks of any width with faulting greater than 1/2 inch or medium severity faulting; or 3) filled cracks of any width faulting greater than 1/2 inch or high severity faulting.

Repair options:

- Low - No action or seal cracks;
- Medium - seal cracks;
- High - seal cracks, apply a full depth patch or replace the slab.

Figure C.12: PCC Transverse Cracks.

20. Durability Cracks (PCC)

Description

Durability cracking is caused by the inability of the concrete to withstand environmental factors such as freeze-thaw cycles. It usually appears as a pattern of cracks running parallel to a joint or linear crack. A dark coloring can usually be seen around the fine durability cracks. This type of cracking may eventually lead to disintegration of the concrete within 1 to 2 feet (300 to 600 millimeters) of the joint or crack.

Severity Levels

L "D" cracking is defined by hairline cracks occurring in a limited area of the slab, such as one or two corners or along one joint. Little or no disintegration has occurred. No FOD potential.

M (1) "D" cracking has developed over a considerable amount of slab area with little or no disintegration or FOD potential; or (2) "D" cracking has occurred in a limited area of the slab, such as in one or two corners or along one joint, but pieces are missing and disintegration has occurred. Some FOD potential.

H "D" cracking has developed over a considerable amount of slab area with disintegration of FOD potential.

21. Joint Seal Damage (PCC)

Joint seal damage is any condition, which enables soil or rocks to accumulate in the joints or allow significant infiltration of water. Accumulation of incompressible materials in the joint prevents the slab from expanding and may result in buckling, shattering, or spalling. Pliable joint filler bonded to the edges of the slabs protects joints from the accumulation of materials and also prevents water from seeping down and softening the foundation supporting the slab. Typical types of joint seal damage are: 1) stripping the joint sealant; 2) extrusion of joint sealant; 3) weed growth; 4) hardening of the filler; 5) loss of bond to the slab edges; and 6) lack or absence of sealant in the joint.

Severities:

- Low - in generally good condition throughout the section. Sealant is performing well with only a minor amount of any of the above types of damage present;
- Medium - in generally fair condition throughout the section, with one or more of any of the above types of damage present occurring to a moderate degree. Sealant needs immediate replacement within 2 years;
- High - in generally poor condition throughout the section, with one or more of any of the above types of damages present, occurring to a severe degree. Sealant needs immediate replacement.

Repair options:

- Low - No action;
- Medium - seal joints;
- High - seal joints.

Figure C.13: PCC Joint Seal Damage.

22. Small Patch (PCC)

A patch is an area where the original pavement has been removed and replaced by a filler material. For condition evaluation, patching is divided into two types: small (less than 5 square feet) and large (over 5 square feet). Large patches are described in the next section.

<u>Severities</u>:

- Low - Patch is functioning well, with little or no deterioration;
- Medium - Patch has deteriorated, and/or moderate spalling can be seen around the edges. Patch material can be dislodged, with considerable effort (minor FOD potential);
- High - Patch has deteriorated, either by spalling around the patch or cracking within the patch, to a state which warrants replacement.

<u>Repair options</u>:

- Low – Do Nothing;
- Medium - Replace patch or replace the slab;
- High – Replace patch or replace the slab.

Figure C.14: PCC Small Patch.

23. Large Patch (PCC)

Patching is the same as defined for a small patch; however, the area of the patch is more than 5 square feet. A utility cut is a patch that has replaced the original pavement because of placement of underground utilities. The severity levels of a utility cut are the same as those for regular patching..

Figure C.15: PCC Large Patch.

Severities:

- Low - Patch is functioning well, with little or no deterioration;
- Medium - Patch has deteriorated, and/or moderate spalling can be seen around the edges. Patch material can be dislodged, with considerable effort (minor FOD potential);
- High - Patch has deteriorated, either by spalling around the patch or cracking within the patch, to a state which warrants replacement.

Repair options:

- Low – Do Nothing;
- Medium - Replace patch or replace the slab;
- High – Replace patch or replace the slab.

24. Popouts (PCC)

A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action in combination with expansive aggregates. Popouts usually range from approximately 1 inch to 4 inches in diameter and from 1/2 inch to 2 inches deep..

<u>Severities</u>:

No degrees of severity are defined for popouts. However, popouts must be extensive before they are counted as a distress; i.e., average popout density must exceed approximately three popouts per square yard over the entire slab area.

Figure C.16: Popouts.

25. Pumping (PCC)

Description

Pumping is the ejection of material by water through joints or cracks caused by deflection of the slab under passing loads. As the water is ejected, it carries particles of gravel, sand, clay, or silt and results in a progressive loss of pavement support. Surface staining and base or subgrade material on the pavement close to joints or cracks are evidence of pumping. Pumping near joints indicates poor joint sealer and loss of support which will lead to cracking under repeated loads.

Severity Levels

No degrees of severity are defined. It is sufficient to indicate that pumping exists.

26. Scaling (PCC)

Map cracking or crazing refers to a network of shallow, fine, or hairline cracks that extend only through the upper surface of the concrete. The cracks tend to intersect at angles of 120 degrees. Map cracking or crazing is usually caused by over finishing the concrete and may lead to scaling of the surface, which is the breakdown of the slab surface to a depth of approximately 1⁄4 to 1⁄2 inch. Scaling may also be caused by improper construction and poor aggregate. Another recognized source of distress is the reaction between the alkalis (Na_2O and K_2O) in some cements and certain minerals in some aggregates. Products formed by the reaction between the alkalis and aggregate result in expansions that cause a breakdown in the concrete.

<u>Severities</u>:

- Low - Crazing or map cracking exists over significant slab area. The surface is in good condition with no scaling. The crack pattern must be well defined and easily recognized;
- Medium - Slab is scaled over approximately 5% or less of the surface with some FOD potential;
- High - Slab is severely scaled causing a high FOD potential. Usually, more than 5% of the surface is affected.

27. Faulting (PCC)

Settlement or faulting is a difference of elevation at a joint or crack caused by upheaval or consolidation.

Severities:

Severity levels are defined by the difference in elevation across the fault and the associated decrease in ride quality and safety as severity increases.

	Runways/Taxiways	Aprons
L	< 1/4 inch	1/8 – 1/2 inch
M	1/4 – 1/2 inch	1/2 - 1 inch
H	> 1/2 inch	> 1 inch

Repair Options:

- Low - No action;
- Medium – Grinding along the joint;
- High – Grinding or joint load transfer restoration.

28. Shattered Slab (PCC)

Intersecting cracks are cracks that break into four or more pieces because of overloading and/or inadequate support. The high-severity level of this distress type, as defined below, is referred to as a shattered slab. If all pieces or cracks are contained within a corner break, the distress is categorized as a severe corner break.

Severities:

- Low - Slab is broken into four or five pieces with the vast majority of the cracks (over 85 percent) of low-severity;
- Medium - (1) Slab is broken into four or five pieces with over 15 percent of the cracks of medium severity (no high-severity cracks); or (2) slab is broken into six or more pieces with over 85 percent of the cracks of low-;
- High - At this level of severity, the slab is called shattered: (1) slab is broken into four or five pieces with some or all of the cracks of high severity; (2) slab is broken into six or more pieces with over 15 percent of the cracks of medium- or high-severity.

Repair options:

- Low – Seal Cracks;
- Medium - Full depth patch or replace the slab;
- High - Full depth patch or replace the slab.

29. Shrinkage Crack (PCC)

Shrinkage cracks are hairline cracks that are usually only a few feet long and do not extend across the entire slab. They are formed during the setting and curing of the concrete and usually do not extend through the depth of the slab.

Severities:

No degrees of severity are defined. It is sufficient to indicate that shrinkage cracks exist.

Repair options:

- Do Nothing

.

30. Joint Spalls (PCC)

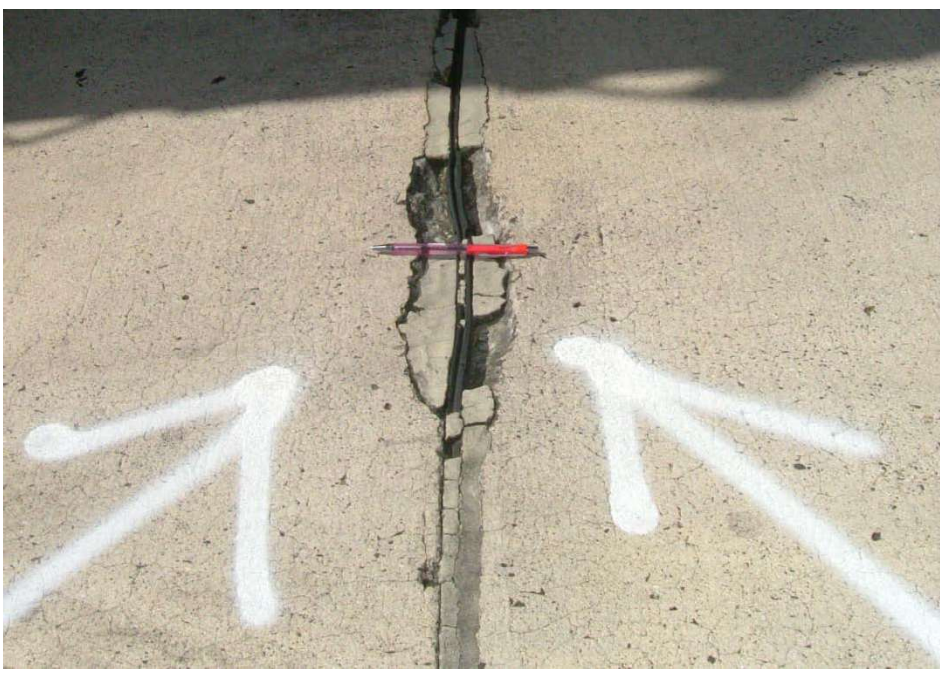
Joint spalling is the disintegration of the slab edges within 2 feet of the side of the joint. A joint spall usually does not extend vertically through the slab, but intersects the joint at an angle. Spalling results from excessive stresses at the joint crack caused by infiltration of incompressible materials or traffic loads. Weak concrete at the joint (caused by overworking) combined with traffic loads is another cause of spalling.

Severities:

- Low - over 2 feet long and is broken into no more than three pieces defined by low or medium severity cracks, with little or no FOD potential, or is 2) less than 2 feet long and is broken into more than three pieces, with little FOD or tire damage potential;
- Medium - over 2 feet long and is broken into more than 3 pieces defined by light or medium cracks or some FOD potential existing, or is 2) less than 2 feet long and is broken into pieces or fragmented, with some of the pieces loose or absent, causing considerable FOD or tire damage potential;
- High - over 2 feet long and is broken into more than three pieces defined by one or more high severity cracks with high FOD potential.

Repair Options:

- Low - No action;
- Medium - perform a partial depth patch;
- High - perform a partial depth patch.



31. Corner Spalls (PCC)

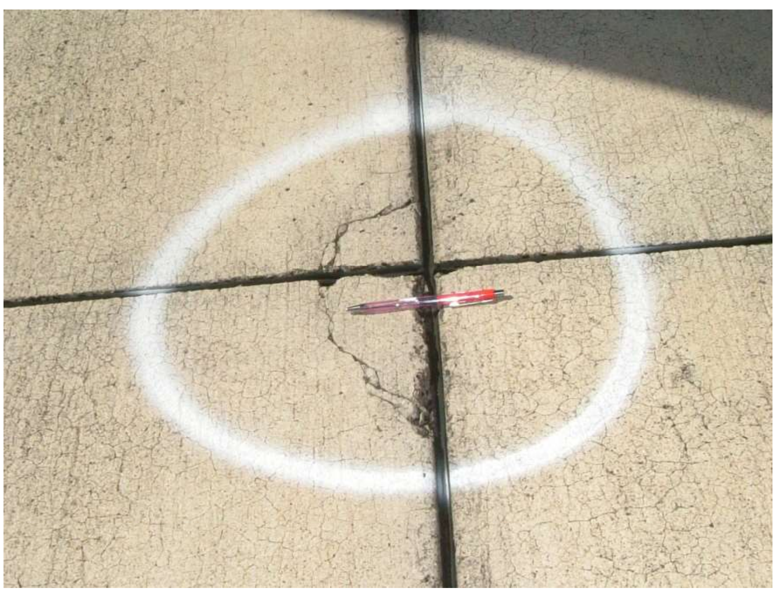
Corner spalling is the raveling or breakdown of the slab within approximately 2 feet of the corner. A corner spall differs from a corner break in that the spall angles downward to intersect the joint while the break extends vertically through the slab.

Severities:

- Low - either 1) the spall is broken into one or two pieces defined by low severity cracks with little or no FOD potential; or 2) the spall is defined by one medium severity crack with little or no FOD potential;
- Medium – 1) the spall is broken into two or more pieces defined by medium severity cracks, and a few small fragments may be absent or loose; 2) the spall is defined by one severe, fragmented crack that may be accompanied by a few hairline cracks or 3) the spall has deteriorated to the point where loose material is causing FOD potential;
- High – 1) the spall has broken into two or more pieces defined by high severity fragmented cracks, with loose or absent fragments; 2) pieces of the spall have been displaced to the extent that tire damage hazard exists, or 3) the spall has deteriorated to the point where loose material is causing high FOD potential.

Repair Options:

- Low - No action;
- Medium - partial depth patch;
- High - partial depth patch.



32. ASR (PCC)

ASR is caused by chemical reaction between alkalis and certain reactive silica minerals which form a gel. The gel absorbs water, causing expansion which may damage the concrete and adjacent structures. Alkalis are most often introduced by the portland cement within the pavement. ASR cracking may be accelerated by chemical pavement deicers.

Visual indicators that ASR may be present include:

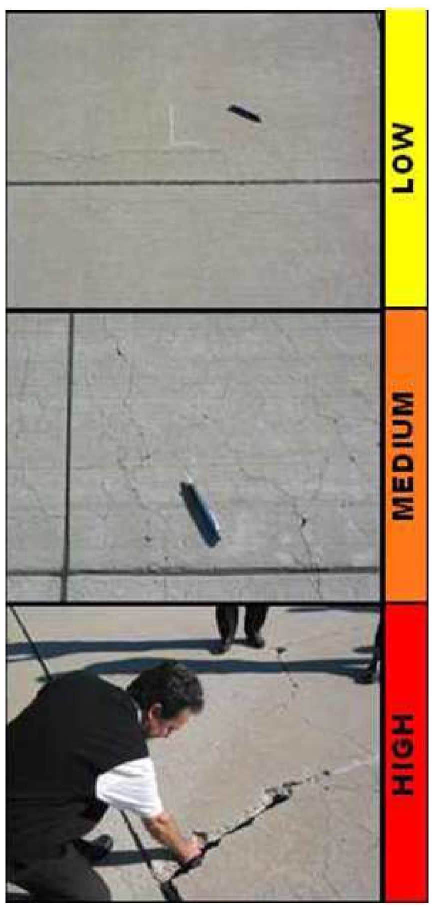
1. Cracking of the concrete pavement (often in a map pattern)
2. White, brown, gray or other colored gel or staining may be present at the crack surface
3. Aggregate popouts
4. Increase in concrete volume (expansion) that may result in distortion of adjacent or integral structures or physical elements. Examples of expansion include shoving of asphalt pavements, light can tilting, slab faulting, joint misalignment, and extrusion of joint seals or expansion joint fillers.

Because ASR is material-dependent, ASR is generally present throughout the pavement section. Coring and concrete petrographic analysis is the only definitive method to confirm the presence of ASR. The following should be kept in mind when identifying the presence of ASR through visual inspection:

1. Generally ASR distresses are not observed in the first few years after construction. In contrast, plastic shrinkage cracking can occur the day of construction and is apparent within the first year.
2. ASR is differentiated from D-Cracking by the presence of cracking perpendicular to the joint face. D-Cracking predominantly develops as a series of parallel cracks to joint faces and linear cracking within the slab.
3. ASR is differentiated from Map Cracking/ Scaling by the presence of visual signs of expansion.

Severity Levels

L	Minimal to no Foreign Object Damage (FOD) potential from cracks, joints or ASR related popouts; cracks at the surface are tight (predominantly 1 mm or less). Little to no evidence of movement in pavement or surrounding structures or elements.
M	Some FOD potential; increased sweeping or other FOD removal methods may be required. May be evidence of slab movement and/ or some damage to adjacent structures or elements. Medium ASR distress is differentiated from low by having one or more of the following: increased FOD potential, increased cracking of the slab, some fragments along cracks or at crack intersections present, surface popouts of concrete may occur, pattern of wider cracks (predominantly 1 mm or wider) that may be subdivided by tighter cracks.
H	One or both of the following exist: 1) Loose or missing concrete fragments which pose high FOD potential, 2) Slab surface integrity and function significantly degraded and pavement requires immediate repair; may also require repairs to adjacent structures or elements.



APPENDIX D

DETAILED PAVEMENT CONDITION DATA

Re-Inspection Report

APPENDIX E

DISTRESS SUMMARY REPORT

Appendix E
Distress Summary Report
Craig Field (SEM)

Branch ID	Section ID	Surface[1]	Area (sf)	Distress Number	Description	Distress Mechanism	Severity	Quantity	Quantity Units	Distress Density
R1533	01	AC	1,202,100	42	BLEEDING	Other	N/A	15,026	SqFt	1.3%
R1533	01	AC	1,202,100	43	BLOCK CRACKING	Climate/Durability	Low	367,242	SqFt	30.6%
R1533	01	AC	1,202,100	43	BLOCK CRACKING	Climate/Durability	Medium	54,095	SqFt	4.5%
R1533	01	AC	1,202,100	47	JOINT REFLECTION CRACKING	Climate/Durability	Low	11,720	Ft	1.0%
R1533	01	AC	1,202,100	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	86,311	Ft	7.2%
R1533	01	AC	1,202,100	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	14,798	Ft	1.2%
TA	01	AC	425,372	43	BLOCK CRACKING	Climate/Durability	Low	94,907	SqFt	22.3%
TA	01	AC	425,372	43	BLOCK CRACKING	Climate/Durability	Medium	91,308	SqFt	21.5%
TA	01	AC	425,372	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	6,426	Ft	1.5%
TA	01	AC	425,372	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	23,642	Ft	5.6%
TA	01	AC	425,372	50	PATCHING	Climate/Durability	Low	23,511	SqFt	5.5%
TA	01	AC	425,372	56	SWELLING	Other	Medium	84	SqFt	0.0%
TA	01	AC	425,372	57	WEATHERING	Climate/Durability	High	212,156	SqFt	49.9%
TA	01	AC	425,372	57	WEATHERING	Climate/Durability	Medium	180,494	SqFt	42.4%
TB	01	AC	23,063	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	537	Ft	2.3%
TB	01	AC	23,063	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	173	Ft	0.8%
TB	01	AC	23,063	57	WEATHERING	Climate/Durability	Low	21,280	SqFt	92.3%
TB	01	AC	23,063	57	WEATHERING	Climate/Durability	Medium	1,783	SqFt	7.7%
TB	02	AAC	121,491	45	DEPRESSION	Other	Low	91	SqFt	0.1%
TB	02	AAC	121,491	45	DEPRESSION	Other	Medium	64	SqFt	0.1%
TB	02	AAC	121,491	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	3,165	Ft	2.6%
TB	02	AAC	121,491	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	1,242	Ft	1.0%
TB	02	AAC	121,491	52	RAVELING	Climate/Durability	High	3	SqFt	0.0%
TB	02	AAC	121,491	57	WEATHERING	Climate/Durability	Low	121,488	SqFt	100.0%

Appendix E
Distress Summary Report
Craig Field (SEM)

Branch ID	Section ID	Surface[1]	Area (sf)	Distress Number	Description	Distress Mechanism	Severity	Quantity	Quantity Units	Distress Density
TB	03	AAC	20,641	43	BLOCK CRACKING	Climate/Durability	Medium	13,336	SqFt	64.6%
TB	03	AAC	20,641	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	877	Ft	4.2%
TB	03	AAC	20,641	57	WEATHERING	Climate/Durability	High	13,973	SqFt	67.7%
TB	03	AAC	20,641	57	WEATHERING	Climate/Durability	Medium	6,668	SqFt	32.3%
TC	01	PCC	50,203	65	JOINT SEAL DAMAGE	Climate/Durability	Low	251	Slabs	100.0%
TC	01	PCC	50,203	67	LARGE PATCH/UTILITY	Other	Low	16	Slabs	6.5%
TC	01	PCC	50,203	70	SCALING	Other	Low	55	Slabs	21.7%
TC	01	PCC	50,203	74	JOINT SPALLING	Other	Low	3	Slabs	1.1%
TC	01	PCC	50,203	75	CORNER SPALLING	Other	Low	3	Slabs	1.1%
TC	02	AAC	298,699	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Low	12,433	Ft	4.2%
TC	02	AAC	298,699	48	LONGITUDINAL/TRANSVERSE CRACKING	Climate/Durability	Medium	1,609	Ft	0.5%
TC	02	AAC	298,699	57	WEATHERING	Climate/Durability	Low	297,968	SqFt	99.8%
TC01	01	PCC	50,490	63	LINEAR CRACKING	Load	Low	2	Slabs	1.0%
TC01	01	PCC	50,490	63	LINEAR CRACKING	Load	Medium	2	Slabs	1.0%
TC01	01	PCC	50,490	65	JOINT SEAL DAMAGE	Climate/Durability	High	47	Slabs	25.0%
TC01	01	PCC	50,490	65	JOINT SEAL DAMAGE	Climate/Durability	Low	47	Slabs	25.0%
TC01	01	PCC	50,490	65	JOINT SEAL DAMAGE	Climate/Durability	Medium	94	Slabs	50.0%
TC01	01	PCC	50,490	66	SMALL PATCH	Other	Low	10	Slabs	5.2%
TC01	01	PCC	50,490	66	SMALL PATCH	Other	Medium	4	Slabs	2.1%
TC01	01	PCC	50,490	67	LARGE PATCH/UTILITY	Other	Low	4	Slabs	2.1%

[1] AC = Asphalt Cement Concrete, AAC = Aphalt Overlay AC, PCC = Portland Cement Concrete, APC = Asphalt Overlay PCC

[2] LCD = Last construction date. The date of the last major pavement rehabilitation (e.g. AC overlay)

APPENDIX F

INVENTORY

F1: Section Forecasted Pavement Condition Rating
F2: Branch PCI Rating
F3: Branch FOD Rating

Appendix F1
Forecasted Section PCI
Craig Field (SEM)

Branch ID	Section ID	Forecasted PCI						
		2021	2022	2023	2024	2025	2026	2027
R1533	01	67	59	53	49	45	41	36
TA	01	28	24	21	17	14	10	7
TB	01	78	76	74	71	68	64	60
TB	02	75	72	70	66	62	57	52
TB	03	28	24	21	17	14	10	7
TC	01	91	90	89	88	88	87	86
TC	02	77	75	72	70	66	62	57
TC01	01	85	84	83	82	82	81	80

Branch Condition Report

Pavement Database: ALDOT_Combined_201201

Branch ID	Number of Sections	Sum Section Length (Ft)	Avg Section Width (Ft)	True Area (SqFt)	Use	Average PCI	Standard Deviation PCI	Weighted Average PCI
R1533	1	8,014.00	150.00	1,202,100.00	RUNWAY	61.00	0.00	61.00
TA	1	4,750.00	75.00	425,372.00	TAXIWAY	32.00	0.00	32.00
TB	3	1,990.00	106.67	165,195.00	TAXIWAY	63.00	21.95	71.80
TC	2	4,615.00	70.00	348,902.00	TAXIWAY	85.50	6.50	80.87
TC01	1	570.00	75.00	50,490.00	TAXIWAY	86.00	0.00	86.00

Branch Condition Report

Pavement Database: ALDOT_Combined_201201

Use Category	Number of Sections	Total Area (SqFt)	Arithmetic Average PCI	Average STD PCI	Weighted Average PCI
RUNWAY	1	1,202,100.00	61.00	0.00	61.00
TAXIWAY	7	989,959.00	68.29	23.41	58.62
ALL	8	2,192,059.00	67.38	22.03	59.92

Branch Condition Report

Pavement Database: ALDOT_210811

R1533	1	8,014.00	150.00	1,202,100.00	RUNWAY	50.00	0.00	50.00
TA	1	4,750.00	75.00	425,372.00	TAXIWAY	80.00	0.00	80.00
TB	3	1,990.00	106.67	165,195.00	TAXIWAY	49.00	22.64	39.59
TC	2	4,615.00	70.00	348,902.00	TAXIWAY	22.50	10.50	29.98
TC01	1	570.00	75.00	50,490.00	TAXIWAY	38.00	0.00	38.00

APPENDIX G

SAFETY AND PREVENTIVE MAINTENANCE POLICIES

Appendix G1
Localized Safety (Stopgap) Repair Policy

Distress	Distress Severity	Description	Code	Work Type	Work Unit
41	High	ALLIGATOR CR	PA-FD	Patching - AC Full-Depth	SqFt
43	High	BLOCK CR	CS-AC	Crack Sealing - AC	Ft
45	High	DEPRESSION	PA-FD	Patching - AC Full-Depth	SqFt
47	High	JT REF. CR	CS-AC	Crack Sealing - AC	Ft
48	High	L & T CR	CS-AC	Crack Sealing - AC	Ft
50	High	PATCHING	PA-FD	Patching - AC Full-Depth	SqFt
53	High	RUTTING	PA-FD	Patching - AC Full-Depth	SqFt
54	High	SHOVING	PA-PD	Patching - AC Partial-Depth	SqFt
55	NA	SLIPPAGE CR	PA-PD	Patching - AC Partial-Depth	SqFt
56	High	SWELLING	PA-FD	Patching - AC Full-Depth	SqFt
61	High	BLOW-UP	SL-PC	Slab Replacement - PCC	SqFt
61	Medium	BLOW-UP	PA-PF	Patching - PCC Full Depth	SqFt
62	High	CORNER BREAK	PA-PF	Patching - PCC Full Depth	SqFt
63	High	LINEAR CR	PA-PF	Patching - PCC Full Depth	SqFt
63	Medium	LINEAR CR	CS-PC	Crack Sealing - PCC	Ft
64	High	DURABIL. CR	SL-PC	Slab Replacement - PCC	SqFt
64	Medium	DURABIL. CR	PA-PF	Patching - PCC Full Depth	SqFt
66	High	SMALL PATCH	PA-PP	Patching - PCC Partial Depth	SqFt
67	High	LARGE PATCH	PA-PF	Patching - PCC Full Depth	SqFt
70	High	SCALING	SL-PC	Slab Replacement - PCC	SqFt
71	High	FAULTING	GR-PP	Grinding (Localized)	Ft
72	High	SHAT. SLAB	SL-PC	Slab Replacement - PCC	SqFt
74	High	JOINT SPALL	PA-PP	Patching - PCC Partial Depth	SqFt
75	High	CORNER SPALL	PA-PP	Patching - PCC Partial Depth	SqFt
76	High	ASR	SL-PC	Slab Replacement - PCC	SqFt

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APPENDIX H

M&R UNIT COSTS

Maintenance and Repair (M&R) Unit Costs

The M&R costs developed for the ALDOT PMP include costs for maintenance, preservation, and repair activities and are described below.

Unit Costs Source Data

The source for the M&R costs data is RSMeans, which has data for 14 locations throughout Alabama, as identified by the yellow highlighted boxes in Figure 1. The cost data is presented in terms of individual line items like asphalt wearing course, aggregate base etc., which were consolidated to develop the activity costs described below.

The cost data show a distinct difference in costs between locations north and south of Birmingham, especially for the higher value items like the asphalt layers. Therefore, the unit costs were developed accordingly for the airports north and south of Birmingham, as identified in Figure 1. Appendix H2 presents the component costs used in developing the M&R costs.

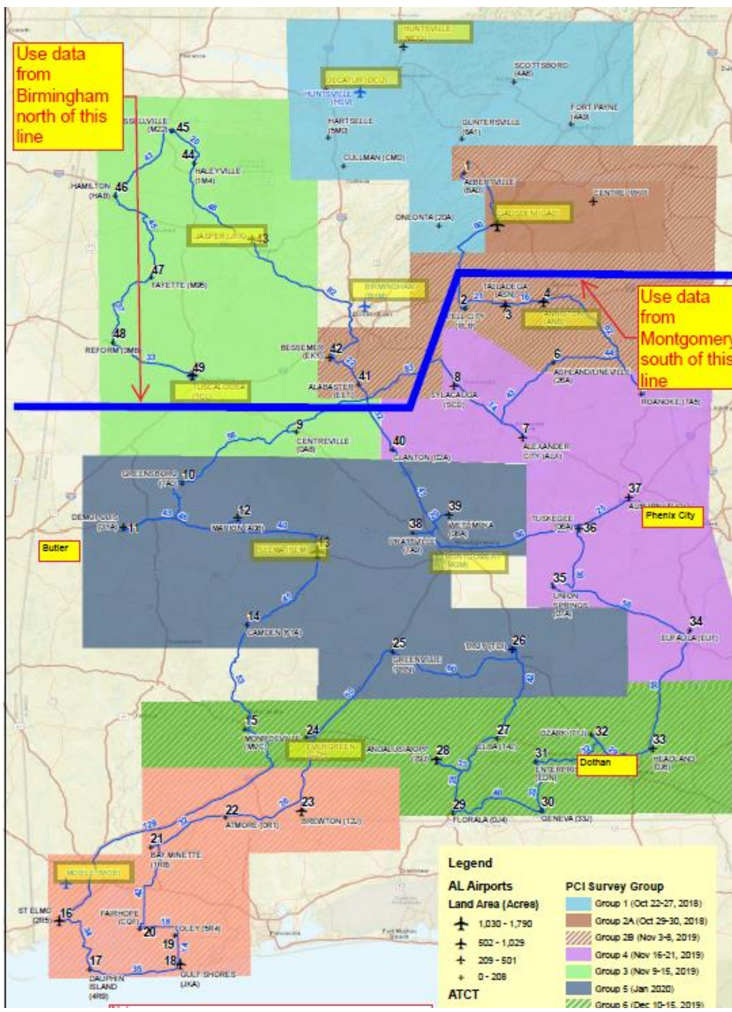

Figure 1: RSMeans Unit Costs Locations.

Maintenance & Repair (M&R) Activities

Maintenance activities are localized activities which are typically assigned in the first year of the M&R plan based on the observed distresses.

Repair activities are further subdivided into preservation, rehabilitation, and reconstruction. Repair activities are conducted for larger areas, typically at the section level and are assigned based on the /ƞƛƭƛŎŀƭ tŀǾŜ¥Ŝȳƭ /ƨȳŘƛƭƛƨȳ LȳŘŜȆ ŘŜȳƨƭŜŘ ŀǎ /t ƛȳ¢ŀōƭŜ мΦ ¢KŜ /t ƛǎ ōŀǎŜŘ ƨȳ ƭKŜ ǎŜŎƭƛƨȳΩǎ ƛŀȳƪ ƨƛ importance within the overall network and typically ranges from 55 to 70. The CP was set at 70 for the ALDOT runway pavements and 65 for the other pavements.

Table 1: Repair Activities.

Activity Type	PCI	Activity
Preservation	> CP	Runway Surface Treatment
		Taxiway and Apron Surface Treatment
Rehabilitation	> CP	2" AC OL[1]
	55 - CP	Mill 2" & 2" AC OL
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)
Reconstruction	0 - 45	Reconstruct with AC

[1]For Sections with Structural Distress and PCI greater than Critical PCI

The depths for the milling and overlay (AC OL) in Table 1 were established by creating a balance between removal of surficial distress and providing additional pavement structural capacity. All overlay options include full-depth patching to repair localized distresses.

From the FAA 5010 records, the Alabama airport network includes a wide range of allowable aircraft loads. The airports were divided into three categories of allowable aircraft loads based on requirements for minimum pavement thickness and the use of a P-401 surface layer. The categories are based on the aircraft maximum gross takeoff weight (MGTOW) and include: less than 12,500 lbs, 12,500 to 30,000 lbs, and 30,000 to 100,000 lbs. Appendix H3 presents the category for each airport.

For any sections requiring reconstruction, the pavement sections were established primarily in accordance with the requirements iȳ¢ŀōƭŜ о ƨƧ ƭKŜ C!! !ŘǾƛǎƨƞȅ /ƛŎƽƭŀƞ 150/5320-6F. The pavement sections used for developing the cost estimates are:

- Ж м2,500 lbs 4ɛ t-403 (State HMA Mix) + 6ɛ P-209 Base
- 12,500 ς 30,000 lbs пɛ t-403 (State HMA Mix) + 8ɛ t-209 Base
- 30,000 ς 100,000 lbs рɛ t-401 + 10ɛ t-209 Base

It is important to note that while the FAA requires a stabilized base for those pavements that support aircraft operations with MGTOWs that are greater than 100,000 lbs, the number of such operations is minimal for those airports shown in Appendix H3. As a result, the cost of a stabilized base is excluded in ƭKŜ ŘŜǾŜƪƨǇ¥Ŝȳƭ ƨƧ ƭKŜ ƽȳƛƭ Ŏƨǎƭǎ Ƨƨƞ !L5h¢Ωǎ t a t ƽƸŘƛŀƭŜΦ Iƨǿ ŜǾŜƞΣ ōŀǎŜŘ ƨȳ ƭKŜ 9ȳƎƛƴŜŜƞΩǎ ƧƽƭƽƞŜ design and aircraft fleet mix development, project-level construction work could include the use of a stabilized base at that time.

M&R Unit Costs

Paving projects typically include additional project costs like mobilization, design, construction administration and inspections, and drainage improvements. A summary of non-direct pavement construction line items has been included in the unit costs in Tables 5 and 6 as described below. These non-direct items are expressed as a percentage of the total component costs for each activity.

These non-[illegible] APMP project cost estimation. These percentages may vary for Alabama airport construction projects; however, since the direct pavement scope of work is estimated in a network-level evaluation, these conservative estimates serve as a good starting point for the development of realistic total project costs and annual APMP budgets for ALDOT. For repair activities such as Mill & Overlay, which typically do not include significant drainage work, the corresponding multiplier was reduced by 50 percent. The non-direct cost factors are presented in Table 2.

Table 2: Cost Factors.

Factor	Function of	Estimate		
		Preservation	Rehabilitation	Reconstruction
Mobilization	All costs, less design	10%	10%	10%
Drainage Improvements	Paving costs	-	4%	8%
Contingency	All costs, less mobilization and design	10%	20%	20%
Design & CM	All costs, less mobilization and design	15%	20%	20%

The M&R unit costs for maintenance, preservation, and repair activities were developed from the RSMeans cost data and are presented in the following section.

Maintenance

The maintenance activities include crack seal, and full and partial-depth patching. The unit costs are presented in Table 3.

Table 3: Unit Costs for Maintenance.

Activity	Unit Cost	Unit
Seal Cracks - AC	$3.95	lf
AC Full-Depth Patching	$25.05	sf
AC Partial-Dept Patching	$16.28	sf
Seal Cracks ς PCC	$8.35	lf
PCC Full-Depth Patching	$48.70	sf
PCC Partial-Depth Patching	$243.51	sf
Jt. Seal	$11.13	lf
Slab Replacement	$27.83	sf
Grinding	$6.96	lf

Preservation

The unit costs for the surface treatments are presented in Table 4. They include sealing of cracks and application of pavement markings.

Table 4: Unit Costs for Preservation Activities.

Activity	Unit Cost	Unit
Runway Surface Treatment	$0.57	sf
Taxiway and Apron Surface Treatment	$0.88	sf

Rehabilitation and Reconstruction

As discussed previously, repair activities are also divided into rehabilitation and reconstruction. The unit costs for airport repair for the Northern Region (Birmingham Area) and Southern Region (Montgomery Area) are shown in Tables 5 and 6, respectively.

Table 5: Unit Costs for Repair Activities, Northern Region.

Activity Type	Activity	MGTOW, thousand lbs		
		Җ м2.5	12.5-30	30-100
Rehabilitation	2" AC OL	$3.78		$4.19
	Mill 2" & 2" AC OL	$4.15		$4.56
	Mill 2" & 2" AC OLP	$5.18		$5.79
Reconstruction	AC Reconstruction	$8.40	$9.10	$10.91

Table 6: Unit Costs for Repair Activities, Southern Region.

Activity Type	Activity	MGTOW, thousand lbs		
		Җ м2.5	12.5-30	30-100
Rehabilitation	2" AC OL	$3.54		$3.91
	Mill 2" & 2" AC OL	$3.90		$4.27
	Mill 2" & 2" AC OLP	$4.82		$5.37
Reconstruction	AC Reconstruction	$7.63	$8.25	$9.87

Appendix H2
Component Costs for Repair

Activity Type	Unit	Birmingham (Northern)	Montgomery (Southern)	Comments
Milling 1" to 3"	SY	$2.08	$2.01	
Pavement Demolition	SY	$6.34	$6.12	
Haulage - For Demolition & AC	CY	$6.08	$5.87	
Haulage for 12" Thick Demolition	SY	$2.03	$1.96	
Haulage for 2" Thick AC Paving	SY	$0.34	$0.33	
Haulage for 3" Thick AC Paving	SY	$0.51	$0.49	
Haulage for 4" Thick AC Paving	SY	$0.68	$0.65	
AC Wearing Course	Ton	$97.42	$86.90	
AC Binder Course	Ton	$87.80	$78.17	
P401 - For airports with >60 kip aircraft	Ton	$116.90	$104.28	Assumed P401 cost to be 20% greater than AC Wearing Course
6" Aggregate Base (P208)	SY	$10.17	$9.12	
8" Aggregate Base (P208)	SY	$13.29	$11.89	
6" P209 Aggregate Base	SY	$12.20	$10.94	Assumed P209 cost to be 20% greater than P208
8" P209 Aggregate Base	SY	$15.95	$14.27	Assumed P209 cost to be 20% greater than P208
10" P209 Aggregate Base	SY	$19.94	$17.84	Direct multiplier for 10" from 8"
4" P154 Aggregate Base	SY	$5.42	$4.86	Assumed P154 cost to be 20% lower than P208
6" P154 Aggregate Base	SY	$8.14	$7.30	Assumed P154 cost to be 20% lower than P208
Pavement Markings	sf	$1.48	$1.39	

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APPENDIX I

PAVEMENT CAPITAL IMPROVEMENT PROGRAM

I1: PCIP Summary
I2: Year 1 Maintenance Plan

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Appendix I2
Localized Maintenance Plan
Craig Field (SEM)

Branch ID	Section ID	Policy	Distress Code	Description	Severity	Distress Qty	Distress Unit	Percent Distress	Work Description	Work Qty	Work Unit	Unit Cost	Work Cost
R1533	01	Safety	48	L & T CR	Medium	14,798	Ft	1.23	No Localized M & R	0		$0.00	$0
R1533	01	Safety	43	BLOCK CR	Low	367,242	SqFt	30.55	No Localized M & R	0		$0.00	$0
R1533	01	Safety	43	BLOCK CR	Medium	54,094	SqFt	4.5	No Localized M & R	0		$0.00	$0
R1533	01	Safety	42	BLEEDING	N/A	15,026	SqFt	1.25	No Localized M & R	0		$0.00	$0
R1533	01	Safety	47	JT REF. CR	Low	11,720	Ft	0.98	No Localized M & R	0		$0.00	$0
R1533	01	Safety	48	L & T CR	Low	86,311	Ft	7.18	No Localized M & R	0		$0.00	$0
TA	01	Safety	56	SWELLING	Medium	84	SqFt	0.02	No Localized M & R	0		$0.00	$0
TA	01	Safety	50	PATCHING	Low	23,511	SqFt	5.53	No Localized M & R	0		$0.00	$0
TA	01	Safety	43	BLOCK CR	Medium	91,308	SqFt	21.47	No Localized M & R	0		$0.00	$0
TA	01	Safety	43	BLOCK CR	Low	94,907	SqFt	22.31	No Localized M & R	0		$0.00	$0
TA	01	Safety	48	L & T CR	Low	6,426	Ft	1.51	No Localized M & R	0		$0.00	$0
TA	01	Safety	48	L & T CR	Medium	23,642	Ft	5.56	No Localized M & R	0		$0.00	$0
TA	01	Safety	57	WEATHERING	Medium	180,494	SqFt	42.43	No Localized M & R	0		$0.00	$0
TA	01	Safety	57	WEATHERING	High	212,156	SqFt	49.88	No Localized M & R	0		$0.00	$0
TB	01	Preventive	48	L & T CR	Low	537	Ft	2.33	No Localized M & R	0		$0.00	$0
TB	01	Preventive	57	WEATHERING	Medium	1,783	SqFt	7.73	No Localized M & R	0		$0.00	$0
TB	01	Preventive	48	L & T CR	Medium	173	Ft	0.75	Crack Sealing - AC	173	Ft	$3.95	$685
TB	01	Preventive	57	WEATHERING	Low	21,280	SqFt	92.27	No Localized M & R	0		$0.00	$0
TB	02	Preventive	45	DEPRESSION	Low	91	SqFt	0.07	Patching - AC Full-Depth	133	SqFt	$25.05	$3,330
TB	02	Preventive	48	L & T CR	Low	3,165	Ft	2.6	No Localized M & R	0		$0.00	$0
TB	02	Preventive	45	DEPRESSION	Medium	64	SqFt	0.05	Patching - AC Full-Depth	100	SqFt	$25.05	$2,500
TB	02	Preventive	48	L & T CR	Medium	1,242	Ft	1.02	Crack Sealing - AC	1,242	Ft	$3.95	$4,905
TB	02	Preventive	57	WEATHERING	Low	121,488	SqFt	100	No Localized M & R	0		$0.00	$0
TB	02	Preventive	52	RAVELING	High	3	SqFt	0	Patching - AC Partial-Dep	3	SqFt	$16.28	$49
TB	03	Safety	48	L & T CR	Medium	877	Ft	4.25	No Localized M & R	0		$0.00	$0
TB	03	Safety	43	BLOCK CR	Medium	13,336	SqFt	64.61	No Localized M & R	0		$0.00	$0
TB	03	Safety	57	WEATHERING	Medium	6,668	SqFt	32.31	No Localized M & R	0		$0.00	$0
TB	03	Safety	57	WEATHERING	High	13,973	SqFt	67.69	No Localized M & R	0		$0.00	$0
TC	02	Preventive	48	L & T CR	Medium	1,609	Ft	0.54	Crack Sealing - AC	1,609	Ft	$3.95	$6,356

Appendix I2
Localized Maintenance Plan
Craig Field (SEM)

Branch ID	Section ID	Policy	Distress Code	Description	Severity	Distress Qty	Distress Unit	Percent Distress	Work Description	Work Qty	Work Unit	Unit Cost	Work Cost
TC	02	Preventive	48	L & T CR	Low	12,433	Ft	4.16	No Localized M & R	0		$0.00	$0
TC	02	Preventive	57	WEATHERING	Low	297,968	SqFt	99.76	No Localized M & R	0		$0.00	$0