

# Alabama Statewide Airport Pavement Management Program Update



**Roanoke Municipal Airport (7A5)**

**Final Report**

**February 2022**



Submitted to

**Alabama Aeronautics Bureau**

Submitted by



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**Pavement Management – Evaluation – Testing – Design**

**ALABAMA STATEWIDE AIRPORT PAVEMENT MANAGEMENT  
PROGRAM UPDATE**

**Roanoke Municipal Airport, Roanoke (7A5)**

**FINAL REPORT**

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## Executive Summary

The Aviation 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 Roanoke Municipal Airport (7A5).

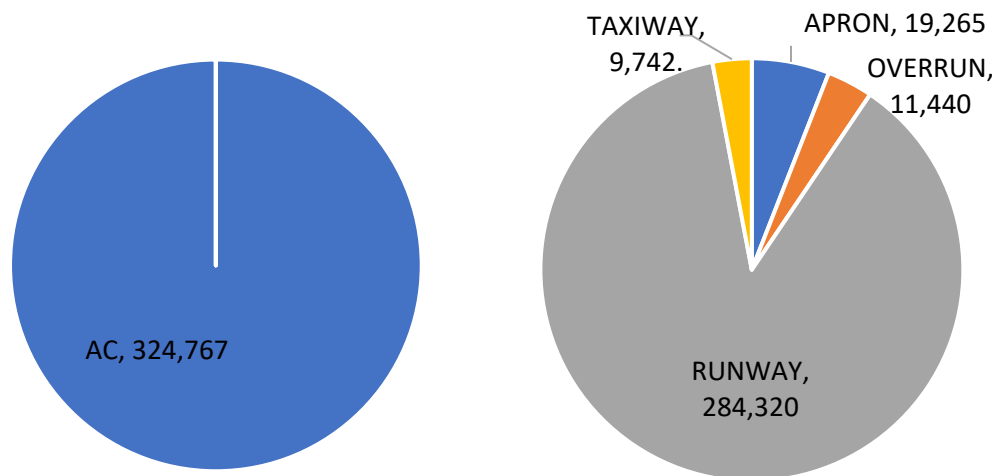
The following APMP tasks were completed to achieve the project objectives at 7A5:

- 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 4 branches and 6 sections within 7A5’s pavement network with a total surface area of approximately 0.32 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 7A5 pavement network is 67, representing a “Fair”



condition. The network area-weighted pavement age (AW Age) is greater than 20 years. ALDOT wanted the condition of the overrun to not be included in the overall PCI computations, and it was also not considered for the PCIP.

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

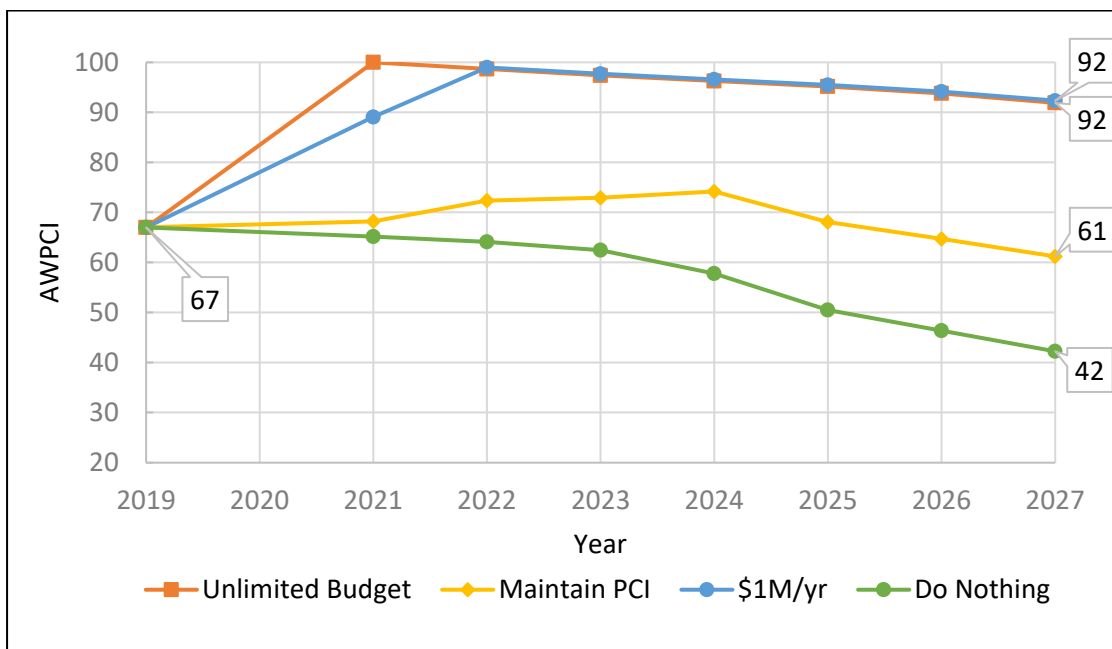
**Table ES-1: 7A5 Section PCI Values and Ratings.**

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category
A01	Apron 01	01	AC	19,265	27	Very Poor
R1129	Runway 11-29	01	AC	31,600	71	Satisfactory
R1129	Runway 11-29	02	AC	216,480	71	Satisfactory
R1129	Runway 11-29	03	AC	36,240	69	Fair
TA	Taxiway A	01	AC	9,742	50	Poor

### 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 7A5 network PCI values for each funding level.

**Figure ES-2: M&R Funding Levels.**



### 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 \$1.5 million. These recommendations are based on a network-level evaluation. Project-level evaluations should be conducted prior to developing design and bid package documents.

**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	7A5_21-01_Runway 11-29 Rehabilitation	\$1,191,766	294,062	68	100
	7A5_21-02_Taxilane Reconstruction	\$151,431	19,265	24	100
2024	7A5_24-01_Runway 11-29 Surface Treatment	\$187,150	294,062	96	99
<b>Total</b>		<b>\$1,530,348</b>			

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 \$19,633 as summarized in Table ES-3.

**Table ES-3: Summary of Localized Maintenance Plan.**

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Crack Sealing - AC	2,786	Ft	\$11,003
Safety	Patching - AC Full-Depth	344	SqFt	\$8,629
<b>Total</b>				<b>\$19,633</b>

TABLE OF CONTENTS

**1 INTRODUCTION ..... 1-1**

1.1. OVERVIEW ..... 1-1

1.2. WORK SCOPE ..... 1-1

1.3. PAVEMENT MANAGEMENT CONCEPT ..... 1-2

**2 AIRFIELD PAVEMENT INVENTORY ..... 2-1**

2.1. INTRODUCTION ..... 2-1

2.2. PAVEMENT INVENTORY ..... 2-1

2.3. CLIMATIC CONDITIONS ..... 2-1

2.4. PAVEMENT NETWORK DEFINITION ..... 2-2

2.5. INVENTORY SUMMARY ..... 2-3

**3 PAVEMENT CONDITION ..... 3-1**

3.1. INTRODUCTION ..... 3-1

3.2. PAVEMENT CONDITION RATING METHODOLOGY ..... 3-1

3.3. DISTRESS TYPES ..... 3-2

3.4. ADDITIONAL PCI-BASED INDICES ..... 3-3

3.5. PCI SURVEY RESULTS ..... 3-4

3.6. PCC PAVEMENTS ..... 3-5

**4 PAVEMENT CAPITAL IMPROVEMENT PROGRAM ..... 4-1**

4.1. INTRODUCTION ..... 4-1

4.2. PERFORMANCE MODELING ..... 4-1

4.3. CRITICAL PCI VALUES ..... 4-3

4.4. M&R POLICIES AND UNIT COSTS ..... 4-3

4.5. PAVEMENT CIP DEVELOPMENT ..... 4-4

4.6. PAVEMENT CAPITAL IMPROVEMENT PROGRAM ..... 4-6



## LIST OF TABLES

Table 2.1: Average Annual Temperatures and Rainfall for 7A5.....	2-2
Table 2.2: PCI Sampling Rate for AC Surfaces.....	2-3
Table 2.3: 7A5 Pavement Branches.....	2-3
Table 2.4: 7A5 Pavement Age.....	2-3
Table 3.1: Pavement Condition Index Rating Scale.....	3-2
Table 3.2: Section PCI.....	3-5
Table 4.1: M&R Activities and Unit Costs.....	4-4
Table 4.2: Summary of M&R Funding Level Analyses.....	4-6
Table 4.3: Summary of 7-Year PCIP by Project.....	4-7
Table 4.4: Summary of 7-Year PCIP by Project and Section.....	4-7
Table 4.5: Summary of Year-1 Maintenance Plan.....	4-8

## LIST OF FIGURES

Figure 1.1: Pavement Management Concept.....	1-2
Figure 2.1: Roanoke Municipal Airport.....	2-1
Figure 2.2: 7A5 Pavement Area by Surface Type.....	2-4
Figure 2.3: 7A5 Pavement Area by Branch Use.....	2-4
Figure 3.1: FOD Potential Rating Scale.....	3-3
Figure 3.2: Pavement Condition by Branch Use.....	3-4
Figure 3.3: Pavement Condition by Percent of Area.....	3-4
Figure 4.1: PCI Forecasting.....	4-2
Figure 4.2: Family Curves.....	4-2
Figure 4.3: Budget Analysis Process.....	4-5
Figure 4.4: M&R Funding Levels.....	4-5



## APPENDICES

- Appendix A:** Pavement Inventory Report
- 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 Program (PCIP) Maps
    - B3A: 2027 Forecasted PCI without PCIP
    - B3B: Repair Type
    - B3C: PCIP Recommendations
- Appendix C:** Overview of Pavement Distresses
- Appendix D:** Detailed Pavement Condition Data (electronic version only)
- Appendix E:** Distress Summary Report
- Appendix F:** Pavement Condition Reports
- F1: Section Forecasted Pavement Condition Rating
  - F2: Branch PCI Rating
  - F3: Branch FOD Rating
- Appendix G:** Safety and Preventive Maintenance Policies
- Appendix H:** M&R Unit Costs
- Appendix I:** Pavement Capital Improvement Program (PCIP)
- I1: CIP Summary
  - I2: Year 1 Maintenance Plan
- Appendix J:** USB Thumb Drive – FINAL ONLY
- Final Report in PDF format
  - Geo-referenced Field Photos

# 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 74 general aviation 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 Aviation Inc. (Aviation) 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 general aviation airports, which was conducted by All About Pavements, Inc., (API), a Aviation 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 Roanoke Municipal Airport (7A5), 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 74 general aviation 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 7A5 report will be one of the 59 individual airport reports that will be available on ALDOT's website.



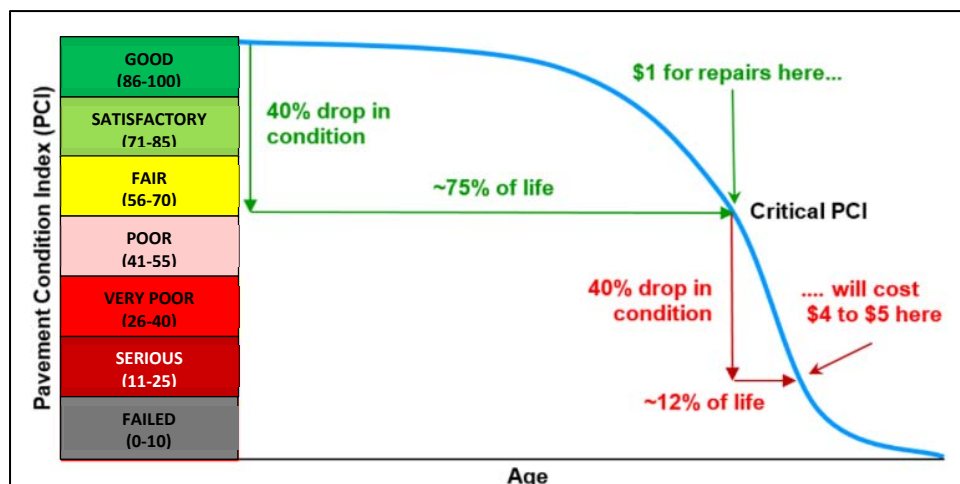
### 1.3. Pavement Management Concept

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

7A5 is a General Aviation (GA) airport located approximately 2 miles south of Roanoke. The airport was activated in October 1961 and is owned and operated by the City of Roanoke. Figure 2.1 shows an aerial image of the airport.

**Figure 2.1: Roanoke Municipal Airport.**



(Source: Google Earth)

### 2.2. Pavement Inventory

7A5 consists of one runway and an apron. The total pavement area is approximately 0.32 million square feet. All pavements at 7A5 are Asphalt Concrete (AC) surfaced. A complete listing of the pavement sections is included in Appendix A. Runway 12-30 is 3,561 ft. long and 80 ft. wide.

A records search was undertaken to identify any preservation or rehabilitation work that has occurred at 7A5 since the last APMP update in 2009. The records for the 2016 crack seal and seal coat that were provided by ALDOT were reviewed, and the PAVER database was updated with work history information.

### 2.3. Climatic Conditions

Table 3.1 provides a summary of the climatic data for the geographic region that includes 7A5. As the table shows, the pavements at 7A5 are exposed to freeze-thaw cycles in January. The mean air temperature for January ranges from an average low of 31 degrees °F to an average high of 54 degrees °F. The average annual rainfall at 7A5 is near 53 inches.



**Table 2.1: Average Annual Temperatures and Rainfall for 7A5.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High Temp (°F)	54	59	68	75	82	88	90	89	84	75	65	56
Low Temp (°F)	31	35	41	47	55	64	67	66	59	48	39	34
Precip. (in)	4.0	5.2	5.2	4.0	3.5	5.5	5.6	3.8	3.8	2.9	4.5	5.1

Source: [www.intellicast.com](http://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 7A5 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 7A5.

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 7A5.



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 4 branches (facilities) at 7A5 that include 6 pavement sections and a total area of approximately 0.32 million square feet of paved surfaces, as shown in Table 2.3.

Table 2.3: 7A5 Pavement Branches.

Branch ID	Branch Name	Branch Use	Area, sf	Number of Sections
A01	Apron 01	APRON	19,265	1
ORR29	Overrun Runway 29	OVERRUN	11,440	1
R1129	Runway 11-29	RUNWAY	284,320	3
TA	Taxiway A	TAXIWAY	9,742	1
<b>Total</b>			<b>324,767</b>	<b>6</b>

Table 2.4 shows the distribution of airfield pavement by age with the area-weighted age being greater than 20 years for all airside pavements at 7A5.

Table 2.4: 7A5 Pavement Age.

Age (Years)	Number of Sections	Percent of Area	Area, sf
0 – 5	0	0	0
6 – 10	0	0	0
11 – 15	0	0	0
16 – 20	0	0	0
> 20	6	100	324,767

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: 7A5 Pavement Area by Surface Type.

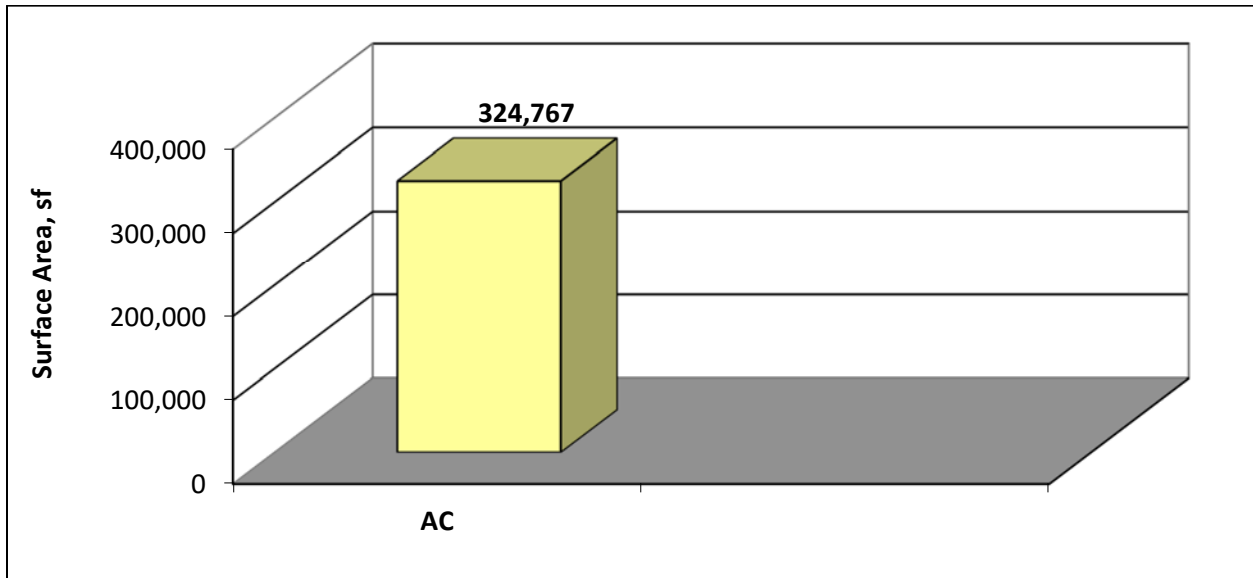
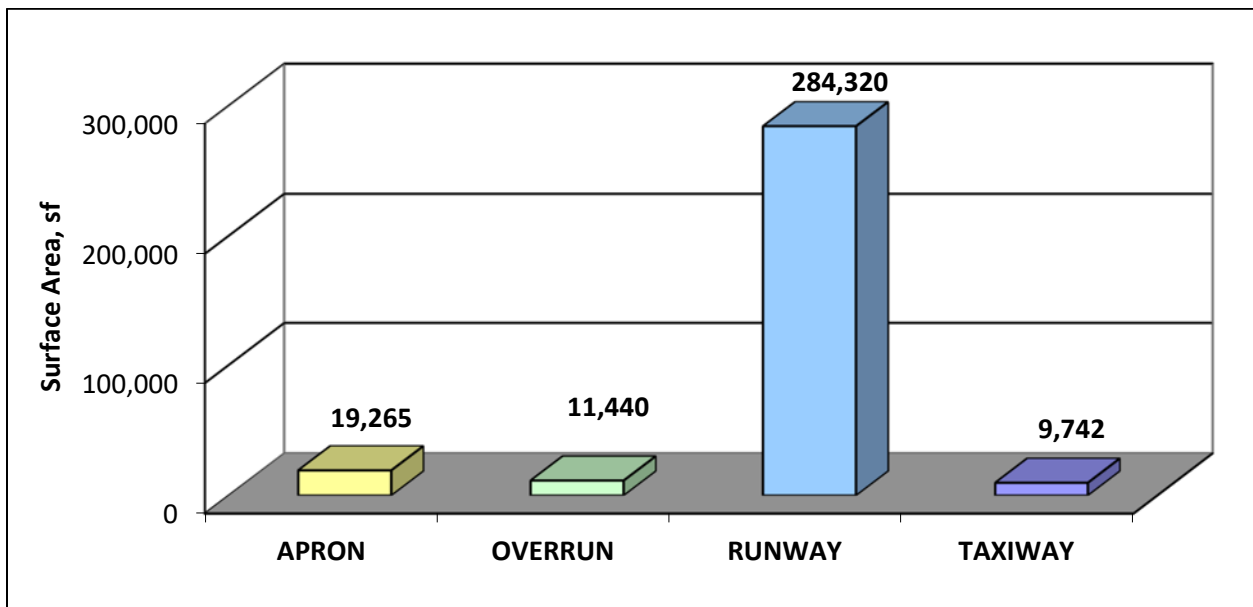


Figure 2.3: 7A5 Pavement Area by Branch Use.



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 7A5 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:

- Load related: 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.
- Climate and durability related: 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.
- Moisture & Drainage related: AC distresses include alligator cracking, depressions, potholes and swelling; PCC distresses include corner breaks, divided slabs and pumping.
- Other factors: 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.

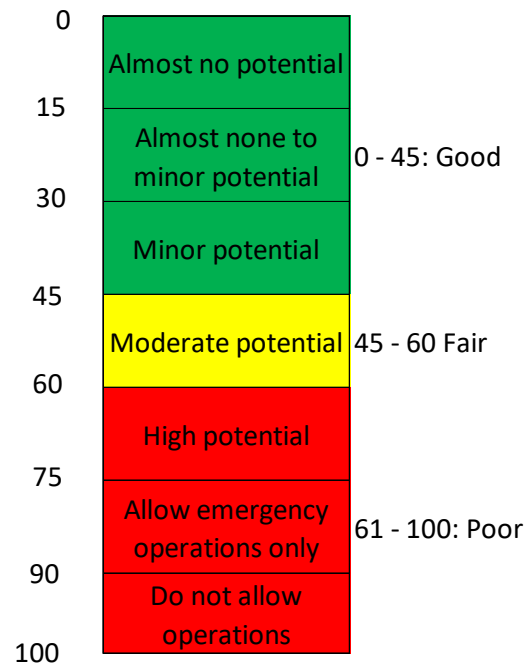
Distress descriptions provided in Appendix C were taken from the “PCI Field Manual,” developed by the U.S. Army Construction Engineering Research Lab (CERL), latest edition. Appendix C provides a detailed explanation of each type of AC and PCC surface distress.

### 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 overrun was not included in the overall PCI computations and it was not considered for the PCIP. The airside pavements at 7A5 include 5 sections with 54 sample units. The sample number of sample units that were surveyed in the field is 18, which is 33 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.**

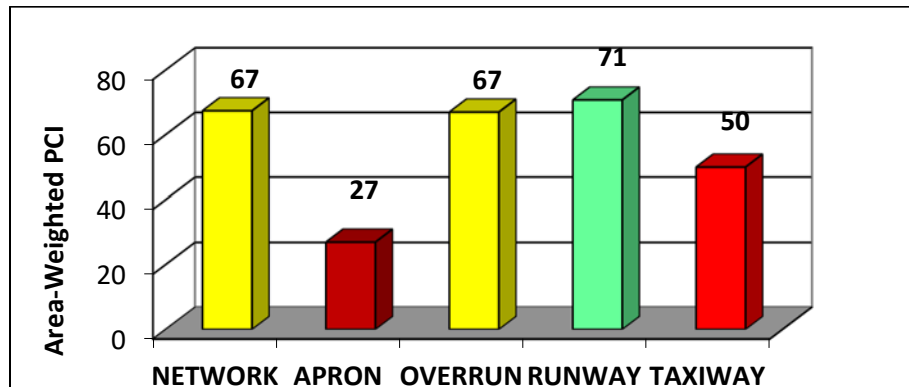


Figure 3.3 shows the distribution of the 7A5 pavement network by condition. Approximately 9 percent of the network is in “Poor” or worse condition.

**Figure 3.3: Pavement Condition by Percent of Area.**

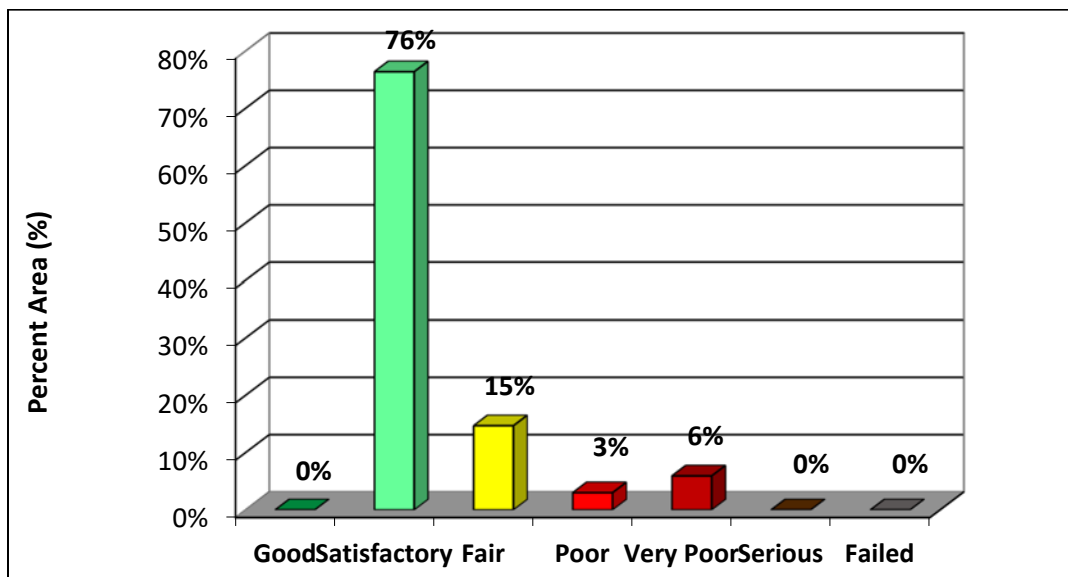


Table 3.2 is a listing of the section PCI.

**Table 3.2: Section PCI.**

Branch ID	Name	Section ID	Surface	Area, sf	PCI	PCI Category	FOD
A01	Apron 01	01	AC	19,265	27	Very Poor	83
R1129	Runway 11-29	01	AC	31,600	71	Satisfactory	42
R1129	Runway 11-29	02	AC	216,480	71	Satisfactory	42
R1129	Runway 11-29	03	AC	36,240	69	Fair	44
TA	Taxiway A	01	AC	9,742	50	Poor	65

Figure B2A and B2B in Appendix B are maps of the section PCI in 7- and 3-scale categories, respectively. Figure 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. There are no PCC aprons at 7A5.

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## 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.

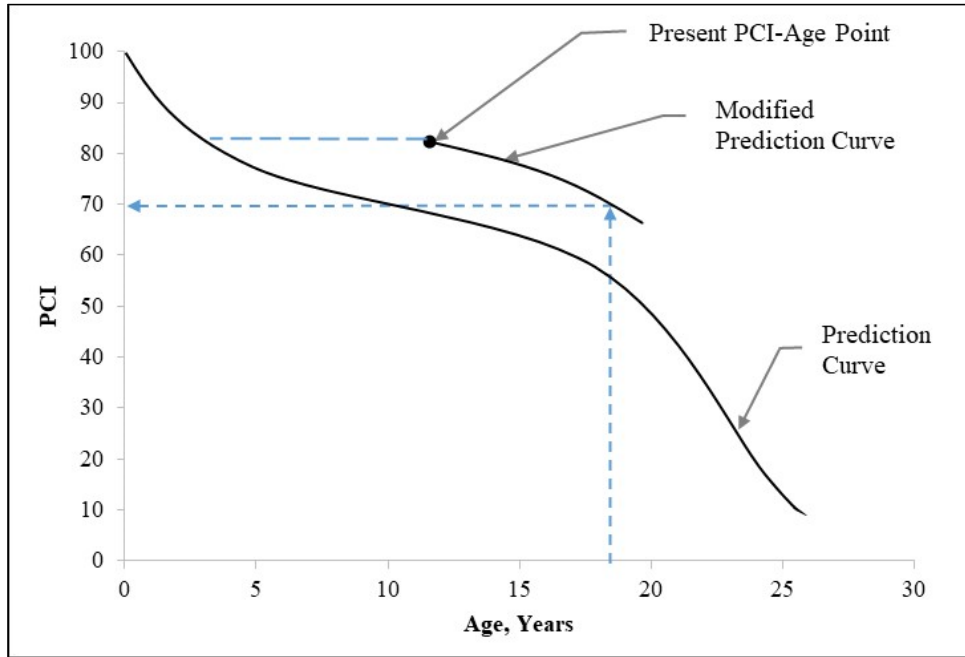
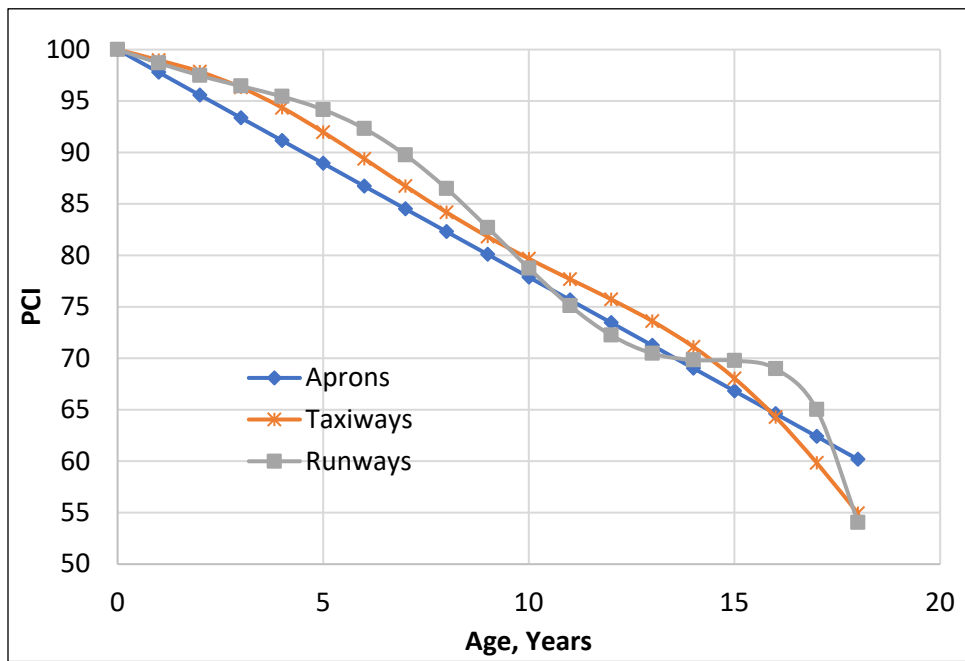


Figure 4.2: Family Curves.



### 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 <sup>2</sup>	\$3.54
	55 - CP	Mill 2" & 2" AC OL	\$3.90
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)	\$4.82
Reconstruction	0 - 45	AC Reconstruction	\$7.63

<sup>1</sup> Preventive > CP; Safety (Stopgap) < CP

<sup>2</sup> 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 7A5 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 92 by 2027.
- Maintain PCI: Maintain existing PCI of 67.
- Constrained Funding: This scenario constrains the funding to \$1 million each year (total of \$7 million). The PCI increases to 92 in 2027.
- Do Nothing: Performing no M&R would reduce the network PCI from 67 to 42 by 2027.

Figure 4.3: Budget Analysis Process.

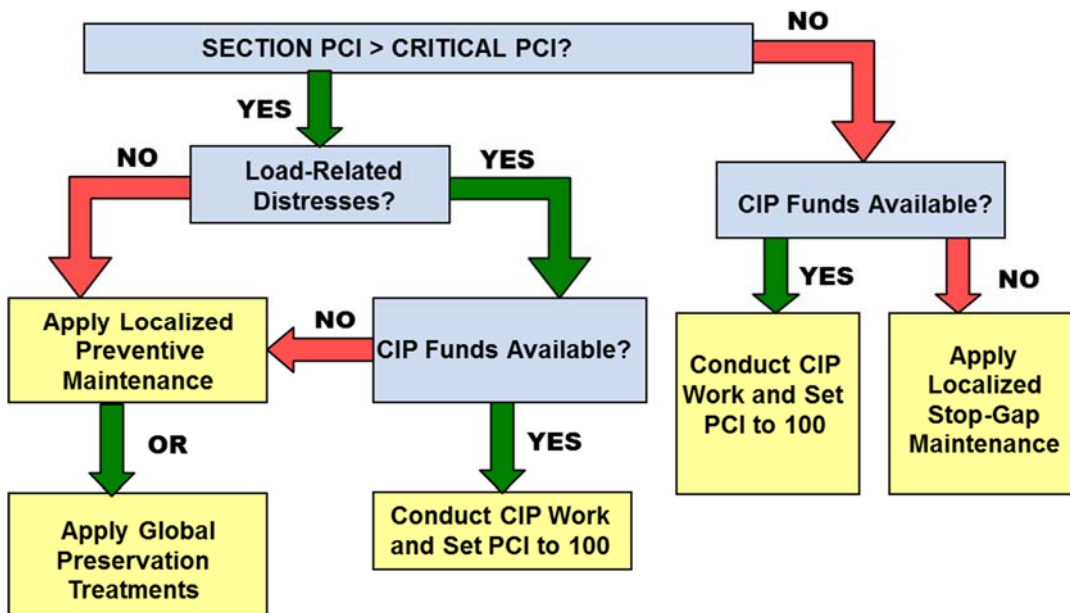


Figure 4.4: M&R Funding Levels.

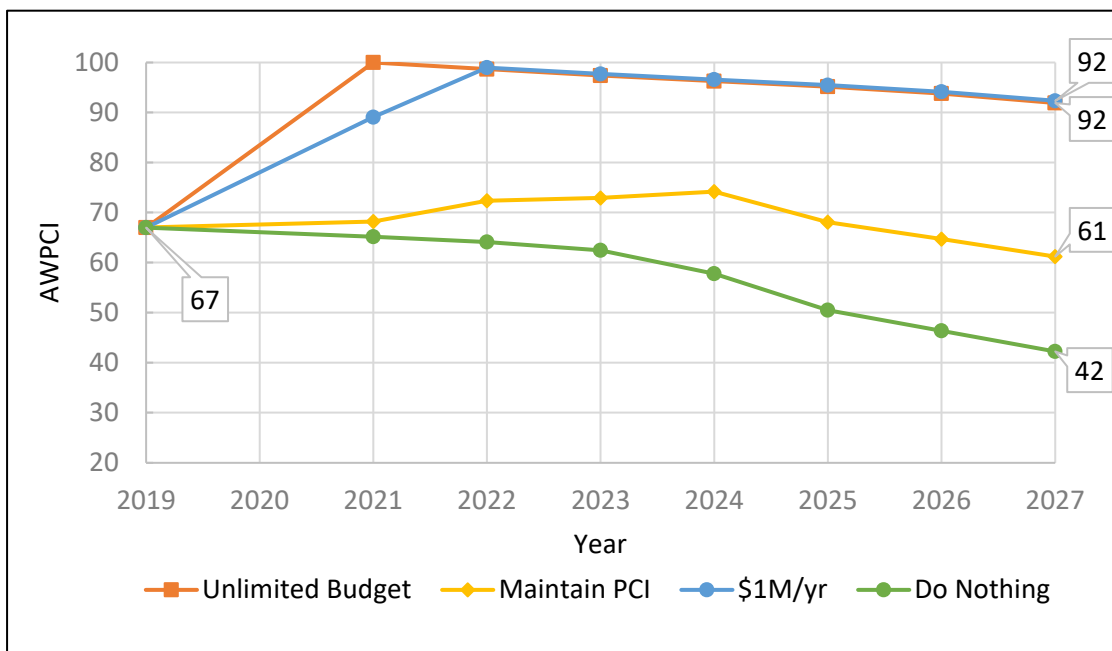


Table 4.2 summarizes the annual funding required for the above analyses. For the unlimited analysis, all pavement needs are funded in the year they are required. Therefore, the unfunded costs are zero. The total funded amount over the 7-year period is approximately \$1.3 million. For the annual funding 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”. There are no “unfunded” repairs in 2027 for this funding level.

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

Year	Unlimited	Maintain PCI	Constrained \$1M/year	Do Nothing
2021	\$1,316,000	\$131,000	\$973,000	\$0
2022	\$,000	\$174,000	\$387,000	\$0
2023	\$1,000	\$87,000	\$1,000	\$0
2024	\$1,000	\$165,000	\$1,000	\$0
2025	\$2,000	\$6,000	\$2,000	\$0
2026	\$2,000	\$8,000	\$2,000	\$0
2027	\$3,000	\$9,000	\$3,000	\$0
<b>Total</b>	<b>\$1,326,000</b>	<b>\$580,000</b>	<b>\$1,369,000</b>	<b>\$0</b>
<b>2027 Backlog</b>	<b>-</b>	<b>\$1,478,000</b>	<b>-</b>	<b>\$2,318,000</b>

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 \$1.5 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 7A5.



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	7A5_21-01_Runway 11-29 Rehabilitation	\$1,191,766	294,062	68	100
	7A5_21-02_Taxilane Reconstruction	\$151,431	19,265	24	100
2024	7A5_24-01_Runway 11-29 Surface Treatment	\$187,150	294,062	96	99
<b>Total</b>		<b>\$1,530,348</b>			

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

Branch	Section	Area, sf	PCI Before Rehab	Activity	Activity Type	Cost
<b>7A5_21-01_Runway 11-29 Rehabilitation</b>						<b>\$1,191,766</b>
R1129	01	31,600	70	Mill 2" & 2" AC OL	Rehabilitation	\$127,080
R1129	02	216,480	70	Mill 2" & 2" AC OL	Rehabilitation	\$870,580
R1129	03	36,240	64	Mill 2" & 2" AC OL	Rehabilitation	\$145,740
TA	01	9,742	46	Mill 2" & 2" AC OLP	Rehabilitation	\$48,366
<b>7A5_21-02_Taxilane Reconstruction</b>						<b>\$151,431</b>
A01	01	19,265	24	AC Reconstruction	Reconstruction	\$151,431
<b>7A5_24-01_Runway 11-29 Surface Treatment</b>						<b>\$187,150</b>
R1129	01	31,600	-	Surface Treatment	Preservation	\$20,111
R1129	02	216,480	-	Surface Treatment	Preservation	\$137,775
R1129	03	36,240	-	Surface Treatment	Preservation	\$23,064
TA	01	9,742	-	Surface Treatment	Preservation	\$6,200
<b>Total</b>						<b>\$1,530,348</b>

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 \$1.5 million for 7A5:

- FAA (90%): \$1.3 million
- ALDOT (5%): \$0.1 million
- Airport Sponsor (5%): \$0.1 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 \$19,633. 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 7A5 pavements.

**Table 4.5: Summary of Year-1 Maintenance Plan.**

Policy	Work Description	Work Quantity	Work Unit	Work Cost
Preventive	Crack Sealing - AC	2,786	Ft	\$11,003
Safety	Patching - AC Full-Depth	344	SqFt	\$8,629
			<b>Total</b>	<b>\$19,633</b>

**APPENDIX A**

**INVENTORY**



**Appendix A**  
**Pavement Inventory Report**  
 Roanoke Municipal Airport (7A5)

Branch ID	Name	Branch Use	Section ID	Rank <sup>1</sup>	Length (ft)	Width (ft)	Area (sf)	LCD <sup>2</sup>	Surface <sup>3</sup>
A01	Apron 01 Roanoke	APRON	01	S	350	45	19,265	1/1/1961	AC
ORR29	Overrun Runway 29 Roanoke	OVERRUN	01	S	143	80	11,440	1/1/1961	AC
R1129	Runway 11-29 Roanoke	RUNWAY	03	P	453	80	36,240	1/1/1961	AC
R1129	Runway 11-29 Roanoke	RUNWAY	01	P	395	80	31,600	1/1/1961	AC
R1129	Runway 11-29 Roanoke	RUNWAY	02	P	2,706	80	216,480	1/1/1961	AC
TA	Taxiway A Roanoke	TAXIWAY	01	S	220	30	9,742	1/1/1961	AC

<sup>1</sup> P = Primary pavement, S = Secondary pavement, T = Tertiary pavement

<sup>2</sup> LCD = Last construction date. The date of the last major pavement rehabilitation (e.g. AC overlay)

<sup>3</sup> AC = Asphalt Cement Concrete, AAC = Asphalt 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

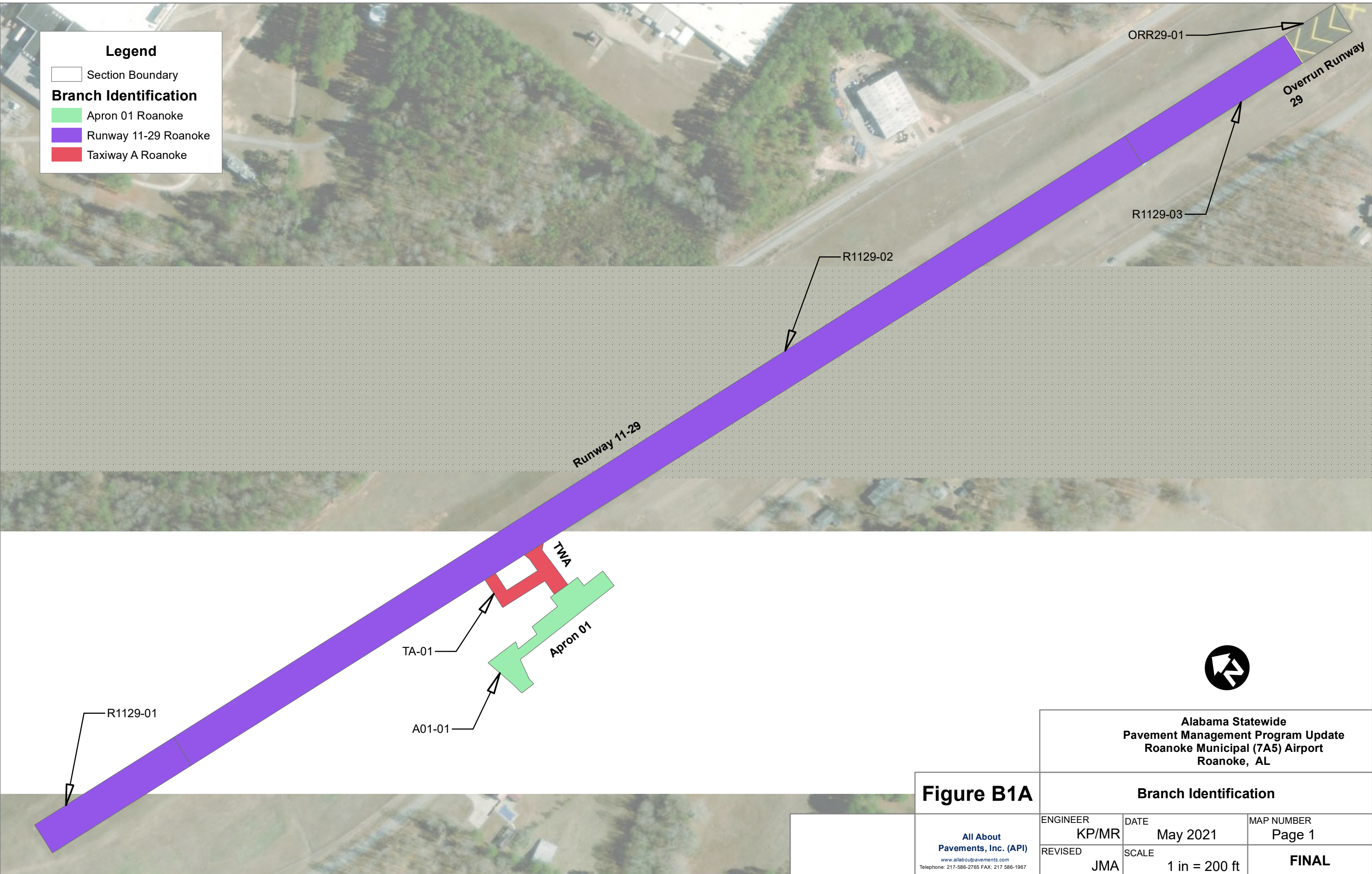


**Legend**

Section Boundary

**Branch Identification**

- Apron 01 Roanoke
- Runway 11-29 Roanoke
- Taxiway A Roanoke



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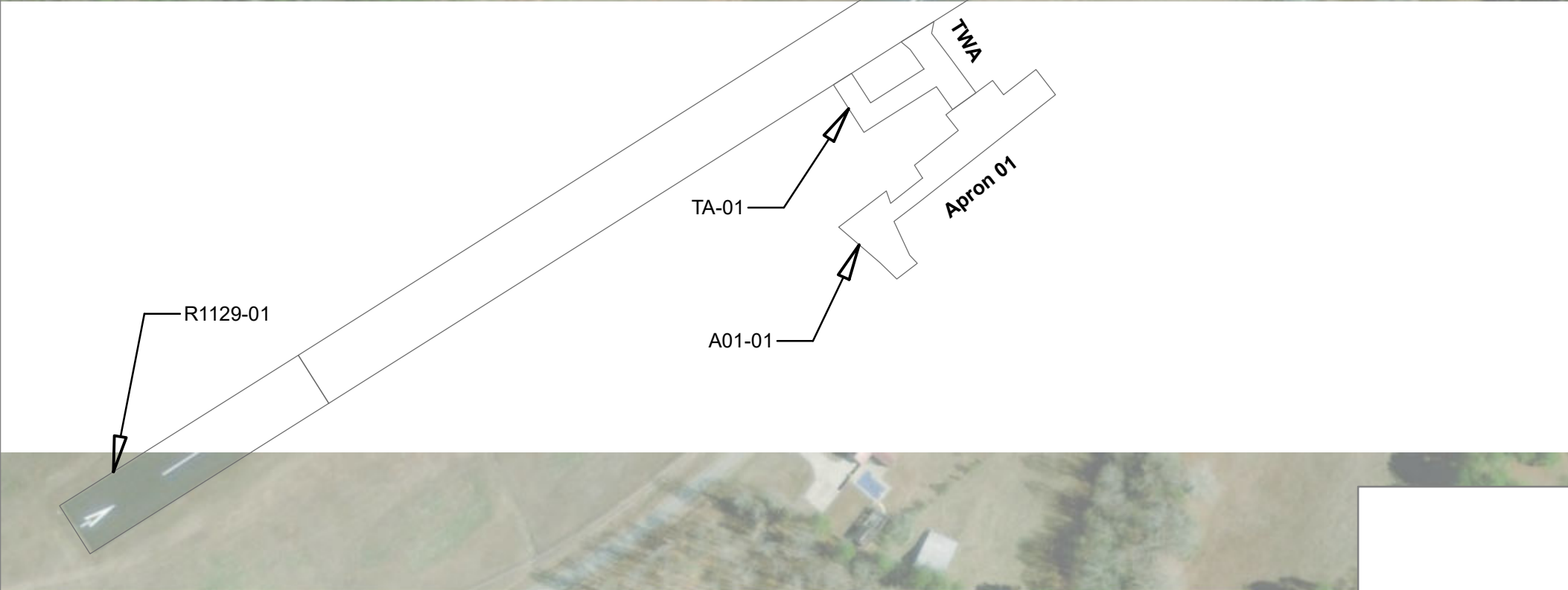
**Figure B1A**

Branch Identification		
ENGINEER KP/MR	DATE May 2021	MAP NUMBER Page 1
REVISED JMA	SCALE 1 in = 200 ft	<b>FINAL</b>

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**Legend**

□ Section Boundary






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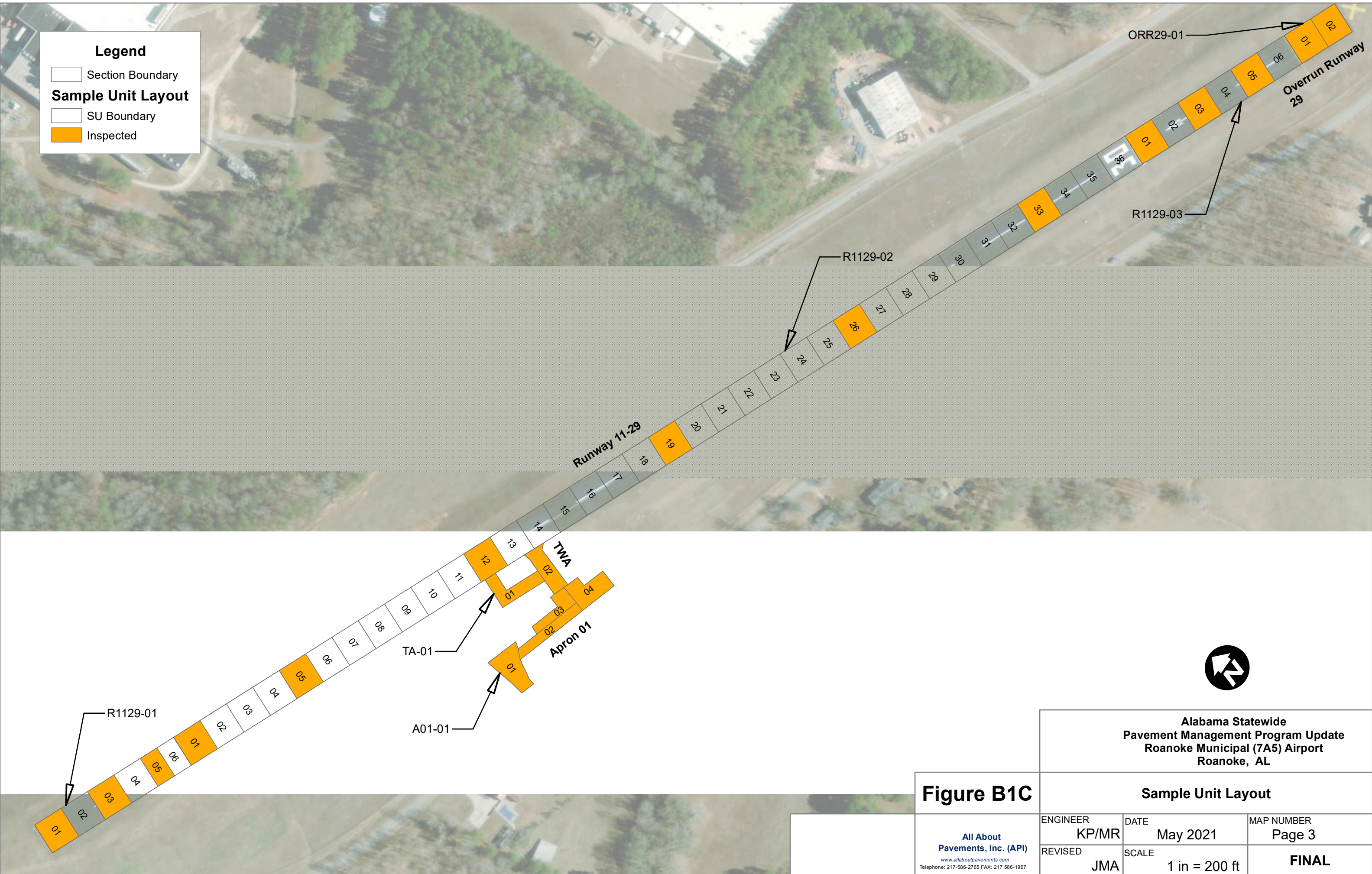
**Figure B1B**

Section Identification		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 2
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

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**Legend**

-  Section Boundary
- Sample Unit Layout**
-  SU Boundary
-  Inspected



**Figure B1C**

<b>Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL</b>		
<b>Sample Unit Layout</b>		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 3
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

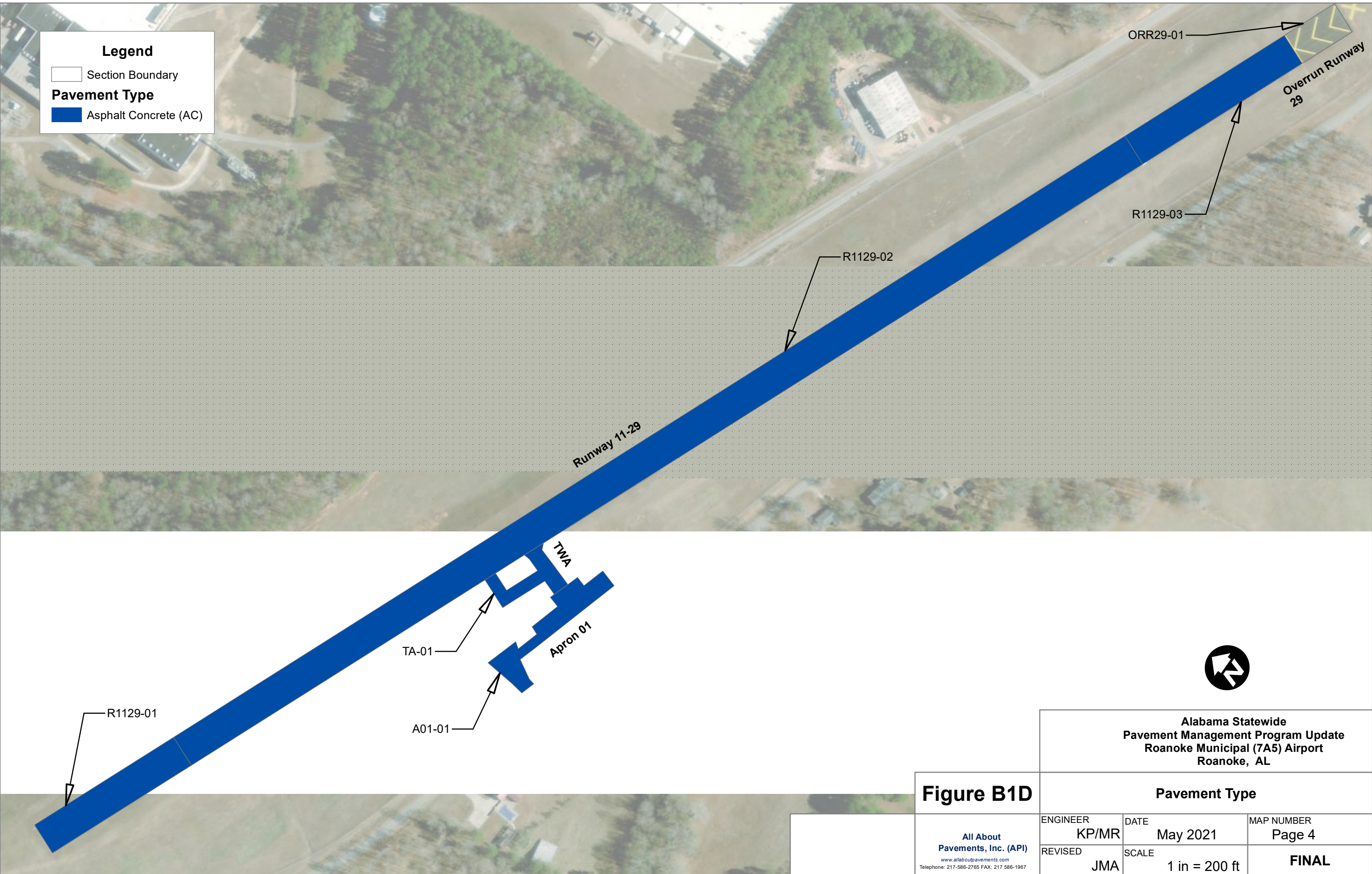
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**Legend**

Section Boundary

**Pavement Type**

Asphalt Concrete (AC)



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**Figure B1D**

Pavement Type		
ENGINEER KP/MR	DATE May 2021	MAP NUMBER Page 4
REVISED JMA	SCALE 1 in = 200 ft	<b>FINAL</b>

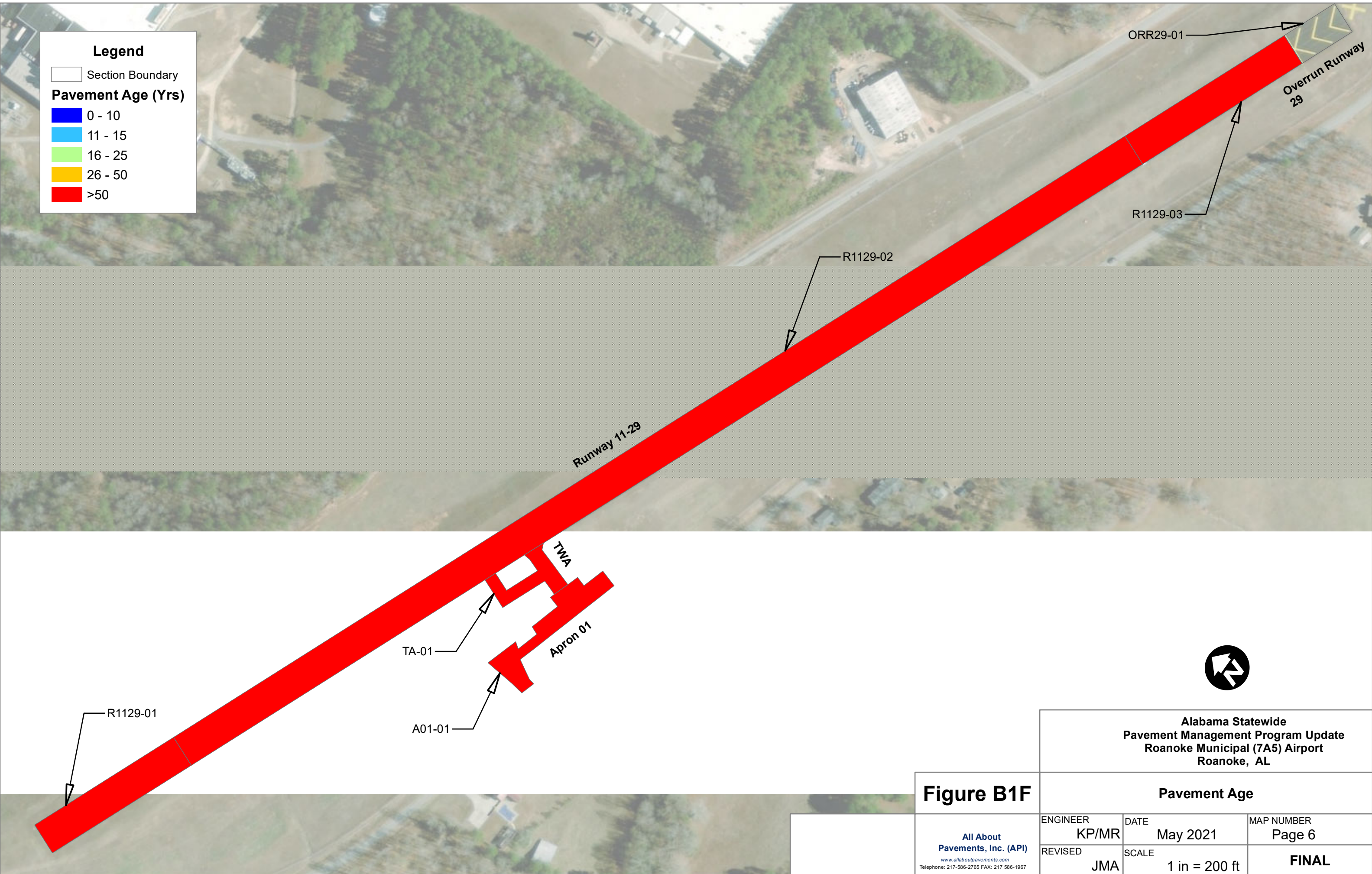
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**Legend**

Section Boundary

**Pavement Age (Yrs)**

- 0 - 10
- 11 - 15
- 16 - 25
- 26 - 50
- >50



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**Figure B1F**

Pavement Age		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 6
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

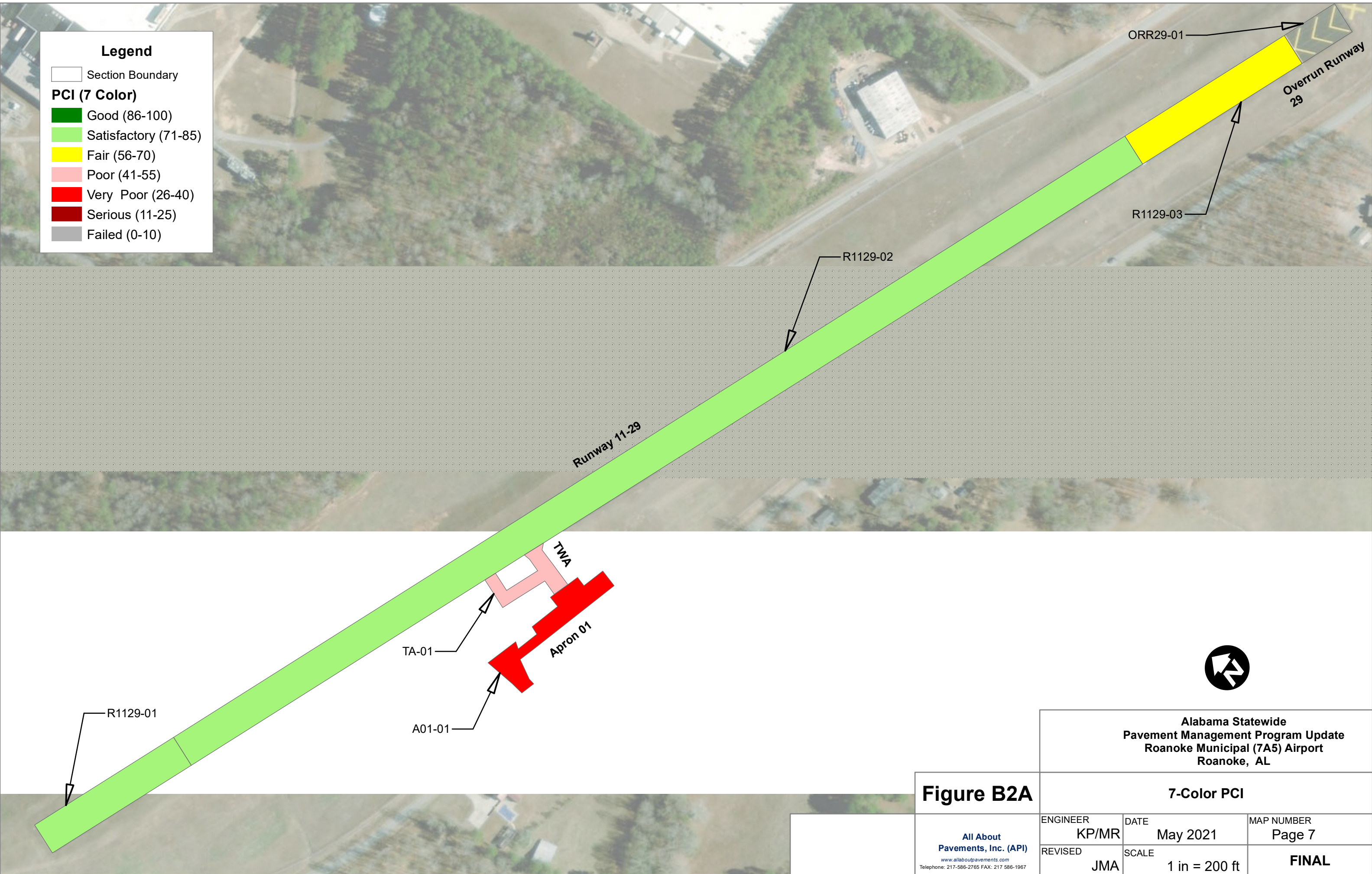
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**Legend**

Section Boundary

**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)



**Figure B2A**

<b>Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL</b>		
<b>7-Color PCI</b>		
ENGINEER	DATE	MAP NUMBER
KP/MR	May 2021	Page 7
REVISED	SCALE	
JMA	1 in = 200 ft	<b>FINAL</b>

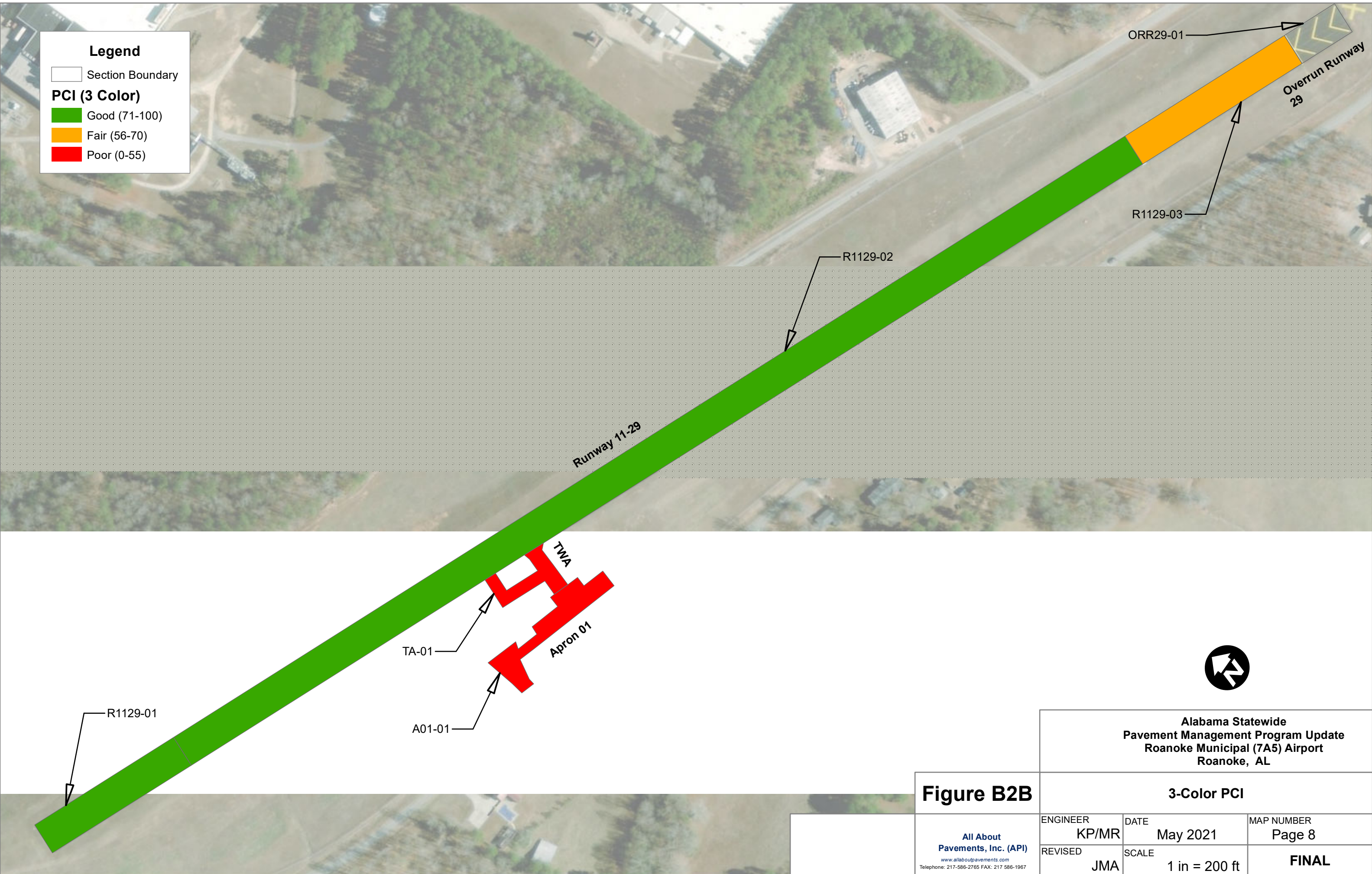
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**Legend**

Section Boundary

**PCI (3 Color)**

- Good (71-100)
- Fair (56-70)
- Poor (0-55)



**Figure B2B**

Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL		
3-Color PCI		
ENGINEER KP/MR	DATE May 2021	MAP NUMBER Page 8
REVISED JMA	SCALE 1 in = 200 ft	<b>FINAL</b>

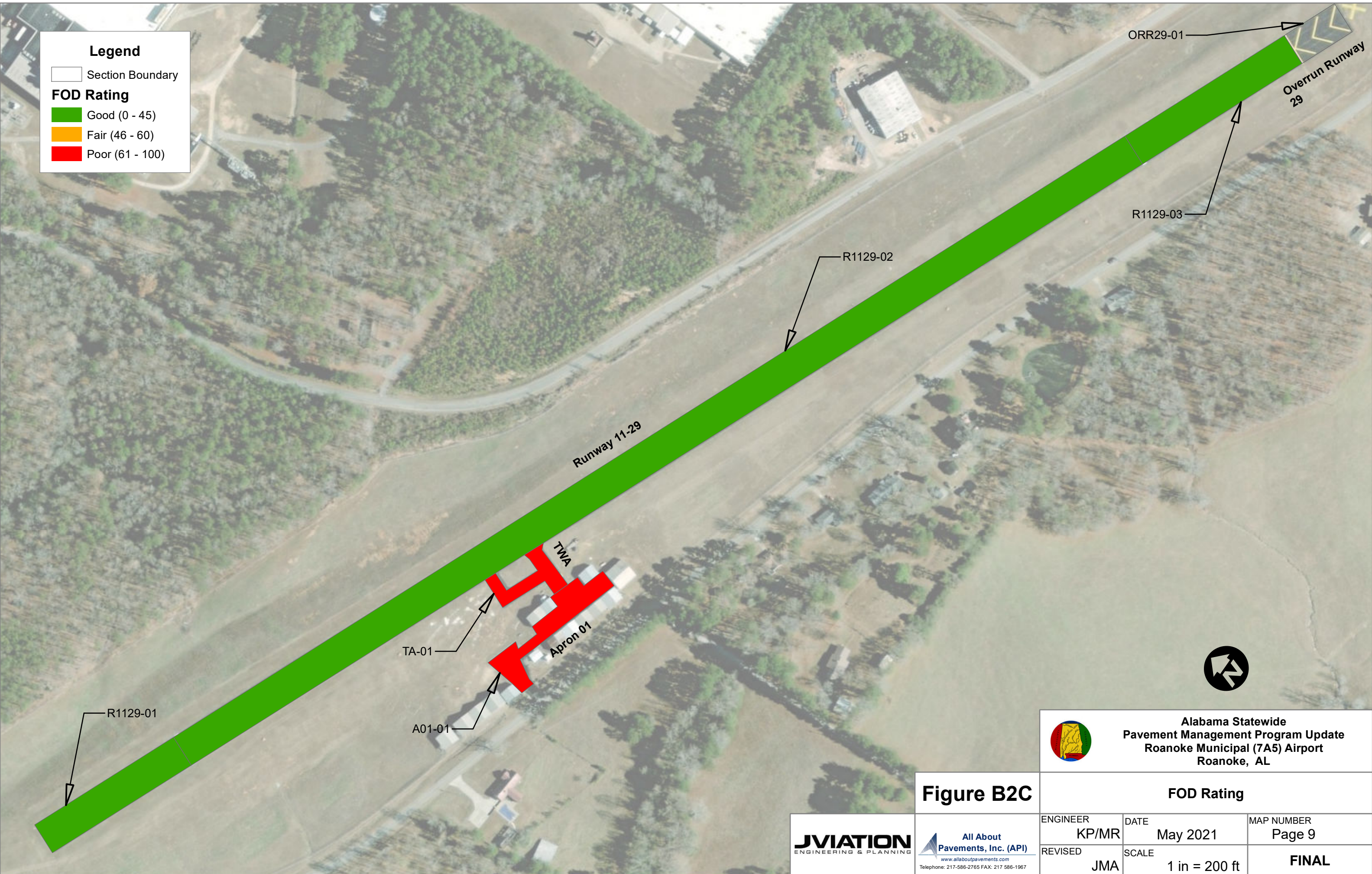
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**Legend**

Section Boundary

**FOD Rating**

- Good (0 - 45)
- Fair (46 - 60)
- Poor (61 - 100)



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**Figure B2C**

FOD Rating		
ENGINEER KP/MR	DATE May 2021	MAP NUMBER Page 9
REVISED JMA	SCALE 1 in = 200 ft	<b>FINAL</b>

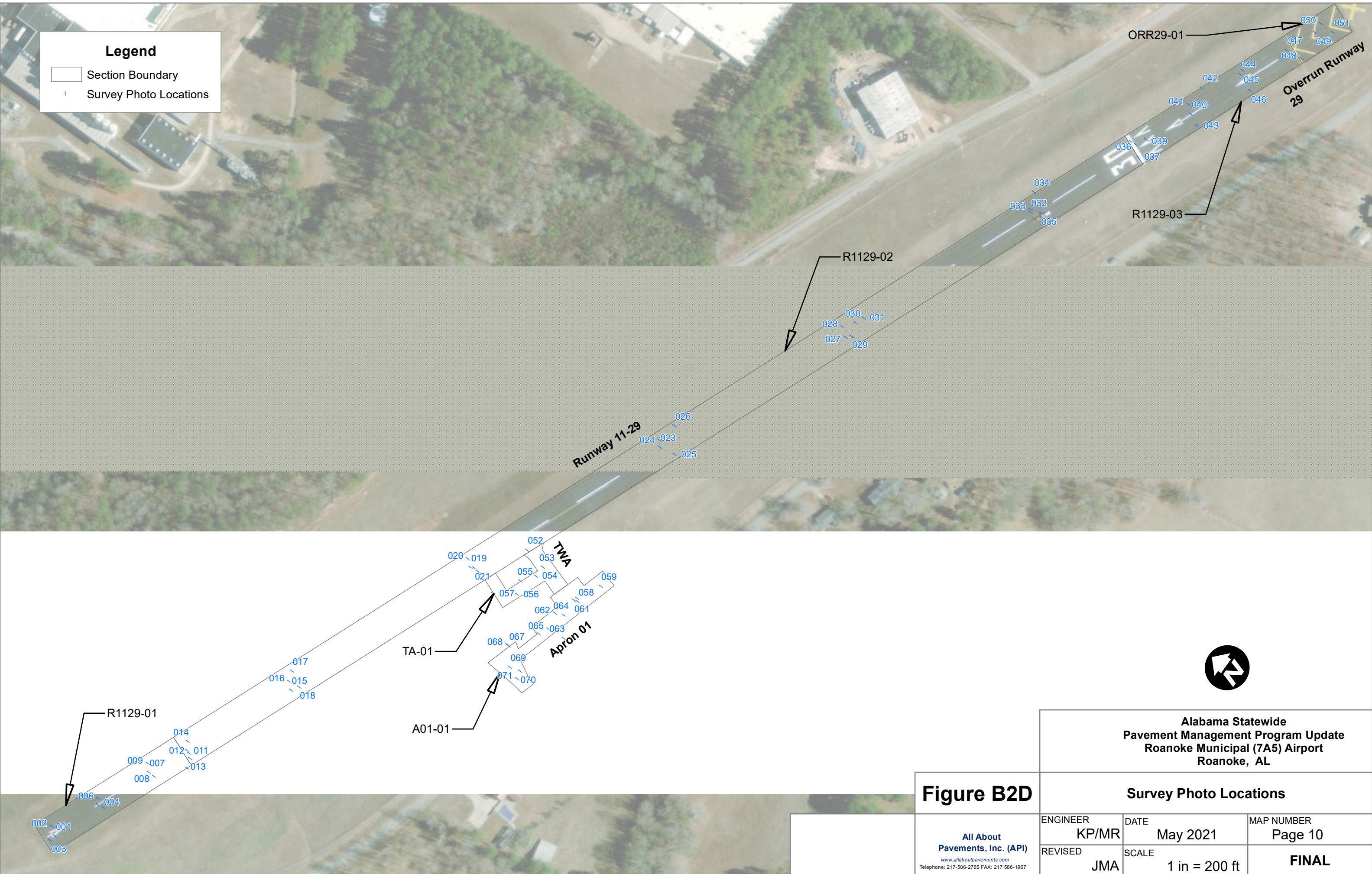
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**Legend**

- Section Boundary
- Survey Photo Locations



**Figure B2D**

<b>Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL</b>		
<b>Survey Photo Locations</b>		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 10
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

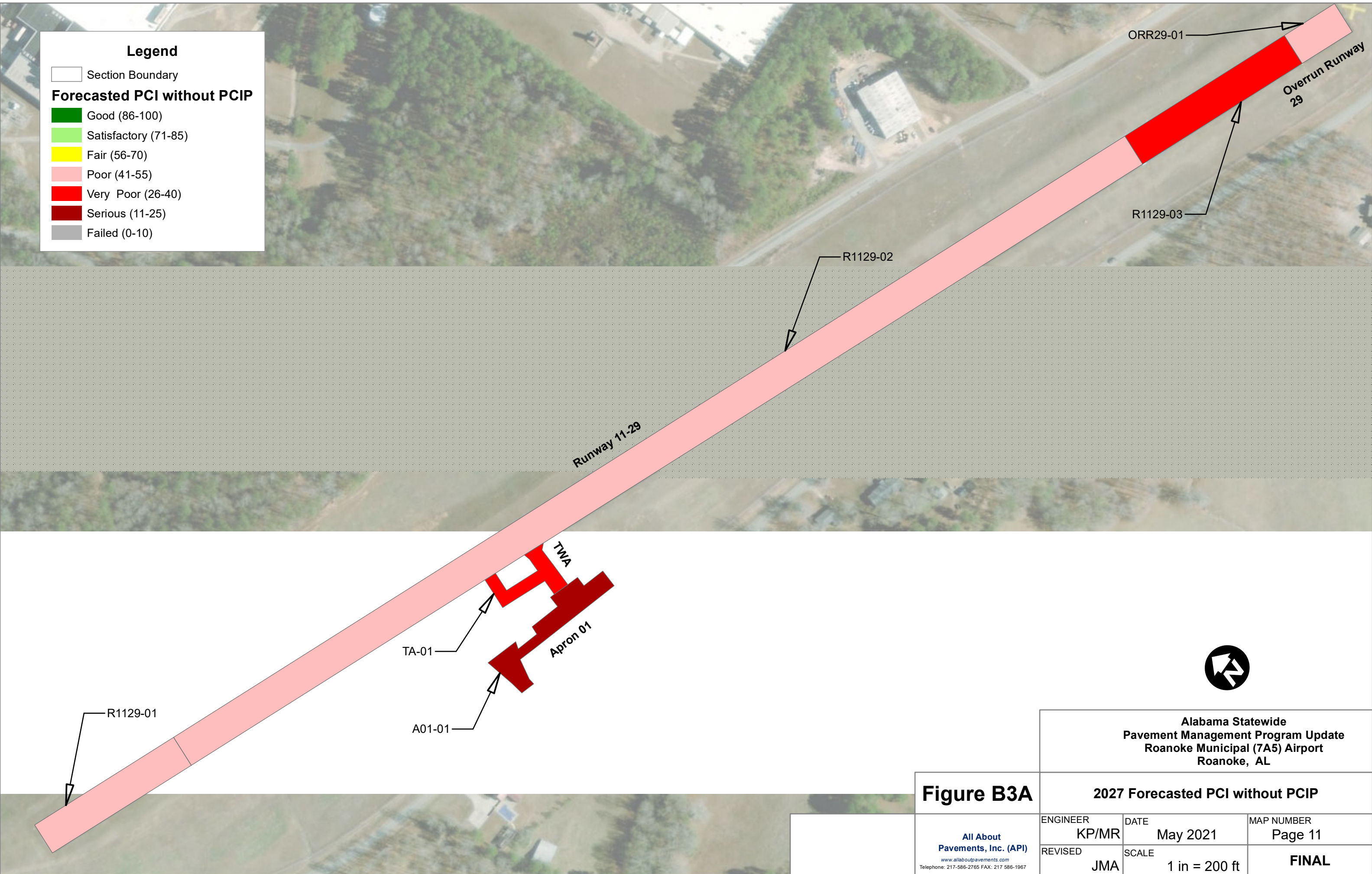
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**Legend**

Section Boundary

**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)



**Figure B3A**

<b>Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL</b>		
<b>2027 Forecasted PCI without PCIP</b>		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 11
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

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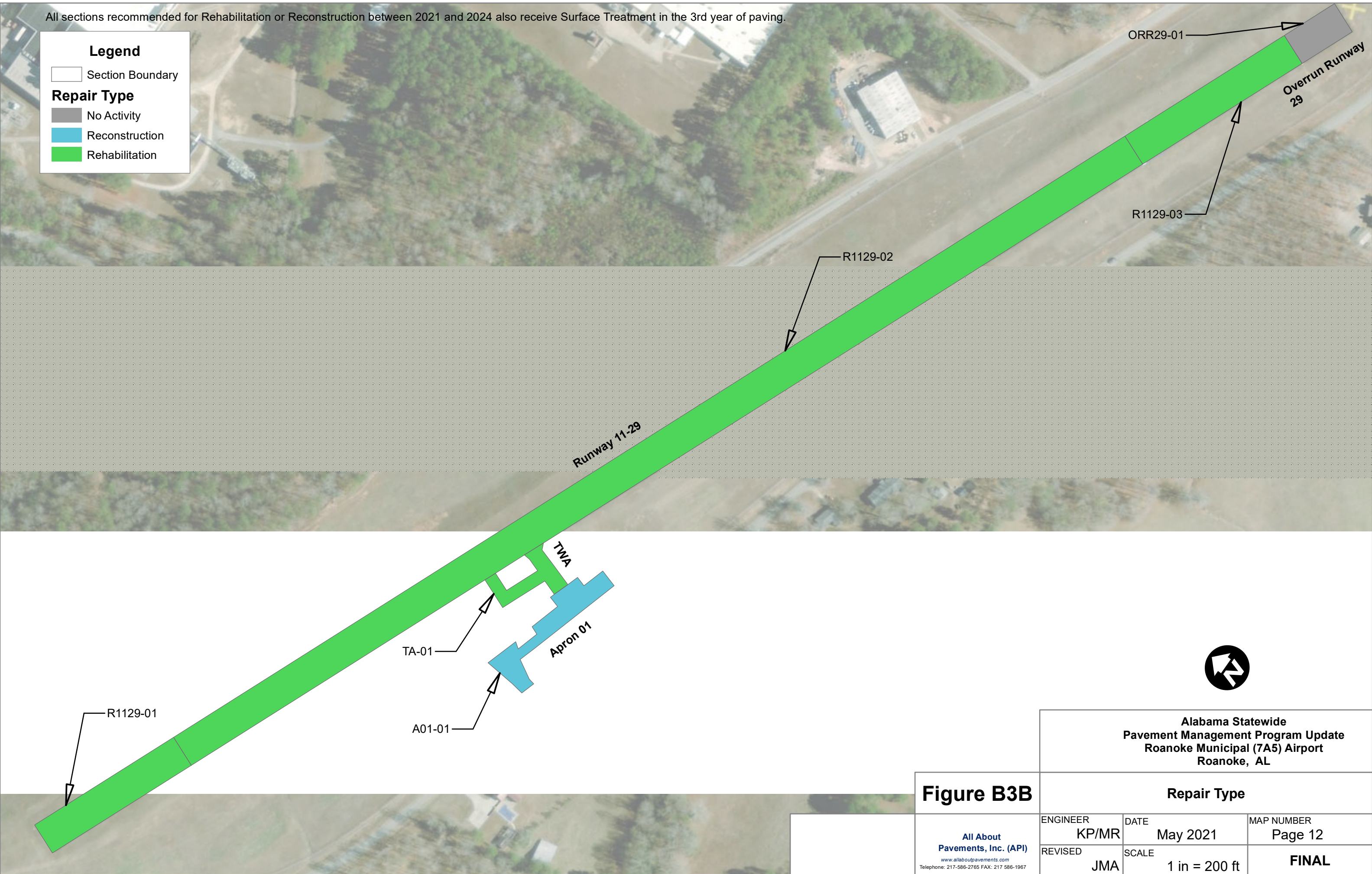
All sections recommended for Rehabilitation or Reconstruction between 2021 and 2024 also receive Surface Treatment in the 3rd year of paving.

**Legend**

Section Boundary

**Repair Type**

- No Activity
- Reconstruction
- Rehabilitation



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**Figure B3B**

Repair Type		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 12
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

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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

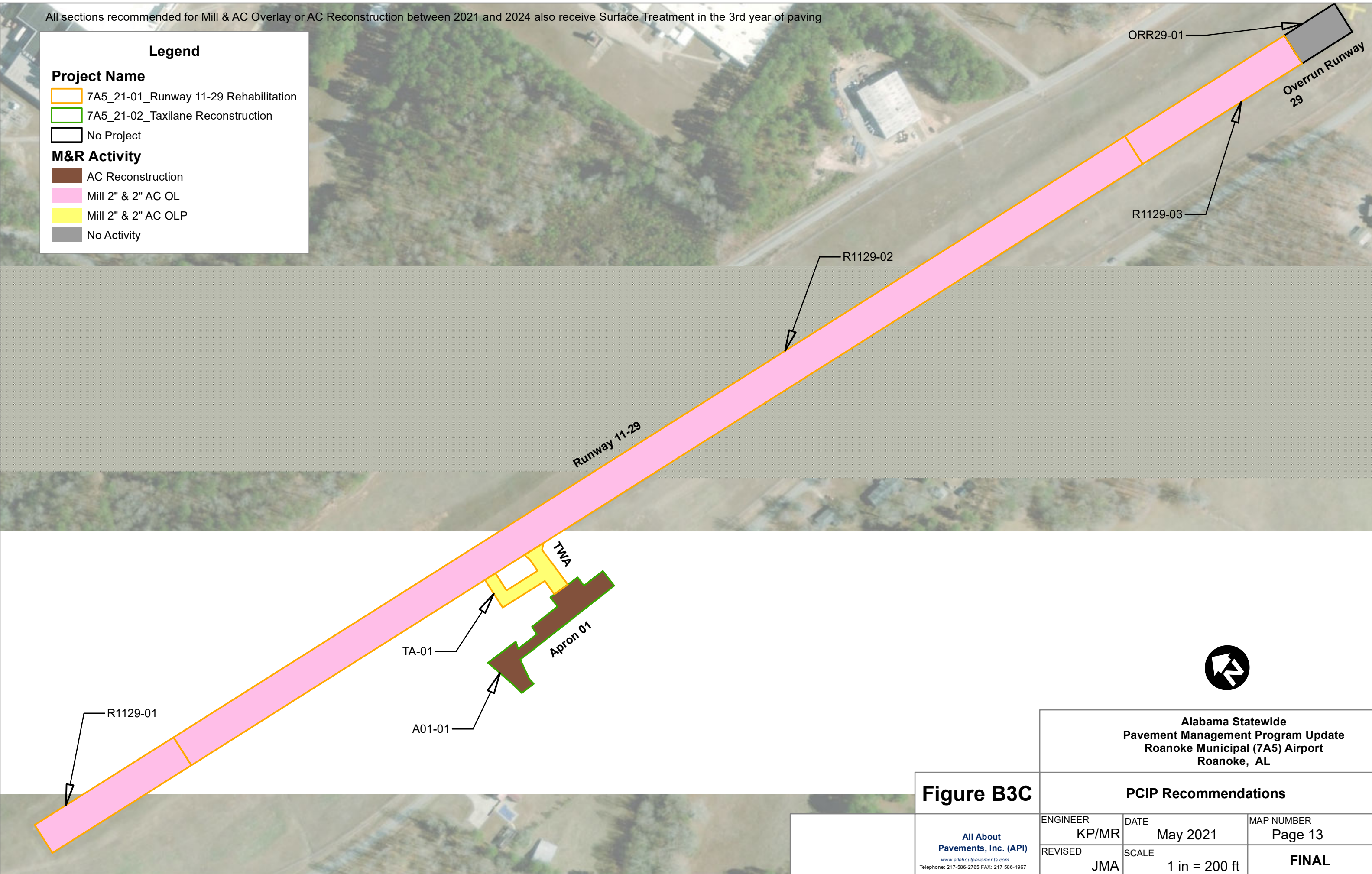
**Legend**

**Project Name**

- 7A5\_21-01\_Runway 11-29 Rehabilitation
- 7A5\_21-02\_Taxilane Reconstruction
- No Project

**M&R Activity**

- AC Reconstruction
- Mill 2" & 2" AC OL
- Mill 2" & 2" AC OLP
- No Activity



<b>Alabama Statewide Pavement Management Program Update Roanoke Municipal (7A5) Airport Roanoke, AL</b>		
<b>PCIP Recommendations</b>		
ENGINEER <b>KP/MR</b>	DATE May 2021	MAP NUMBER Page 13
REVISED <b>JMA</b>	SCALE 1 in = 200 ft	<b>FINAL</b>

**Figure B3C**

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## **APPENDIX C**

### **OVERVIEW OF PAVEMENT DISTRESSES**



% 5~|| Ucf7fUWb| f57L

5~|| UcfVUWb| lgUg|YgcZ|HfVbBb| VUWgUgXVnZ|| iYZ|ifYcZHY  
Ug|UHfUWYg|fZWk\YfYhg|Yg|YgUxg|U|g|\| \Ygi bWk\Y~cUg'HY  
VUWgdcd|U|Ylc|hYg|fZW|b|U|n|g|Ug|Ygc|Z|f|U|Y|VUWg'5ZfYUW  
H|Z|W|c|U|h| hYVUWgVbWZ|fa| |'a|U|ng|X|X|g|U|f|U| |'X|d|W|g|h|U|W|Y|c|d|  
U|d|U|b|n|g|a|V| |W|W|b|k| |Y|c|f|h|Y|g| |b|c|Z|U| || Ucf" HYd|Wg|U|Y|Y|g|h|U|&  
Z|Y|h| |'c|h|Y|c|h| Y|g|X" 5~|| UcfVUWb| 'c|W|g|c|b|n| |b|U|f|g|h|U|f|Y|g| V|U|X|c|'  
f|Y|U|W|X|H|Z|W|c|U|h| |z|g| W|g|k| \Y' |d|h|g|Z|U|X|g|W|g|X|Y|X|U|a| U|c|f|g| |V|U|X|g|Y|g|'

Gj Y|n|g

- ◆ @k! aUWi dcZ|bz\Uf' | YUWg|i|b| |'d|f|U|Y|c| X|W|c|h|Y|k| |h| b|b|Y  
c|f|c|b|n|U|Z|k| |H|f|V|b|B|b| |VUWg' H|Y|V|U|W|g|U|f|Y|c|g|U|Y|X'
- ◆ A Y|a !: i|f|h|Y|X|Y|Y|c|d|a| Y|h|Z| | \H|U| |UcfVUWb| | |b|c| U|d|U|b|n|b|c|f  
b|k|c|f| 'c|Z|U|W|g|h|U|a|U|h|Y| | \h|g|U|Y|X|A| Y|a|! |g|j|Y| |n|U| |UcfVUWb| '  
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- ◆ < | \! \Ug|d| |f|g|X|g| h|U|h|Y|d|W|g|U|f|Y|k|Y| X|b|X|U|X|g|U|Y|X|U|h|Y|X|Y|g|'  
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FYU|f|c|d|c|g

- ◆ @k! Bc U|b|c|g|f|W|g|U|c|f|g|Y|U|h|Z|f~ck'g|j|Y| |n|g|Y|g|/
- ◆ A Y|a ! d|f|U|c|Z| ~X|h|'d|U|W|g|Y|U|h|c|f|Y|W|g| |U|
- ◆ < | \! d|f|U|c|Z| ~X|h|'d|U|W|g|Y|U|h|c|f|Y|W|g| |U|



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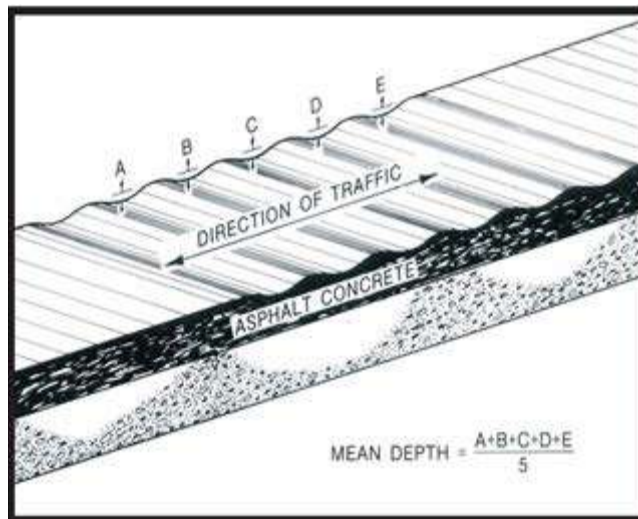
## Corrugation

### 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

- @** 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.
- A** 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.
- <** 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.



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GjYfHg

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- ◆ A Wj a ! GU'ckzdUf]U'cfZ'`Xch'dUW'
- ◆ < || \ ! GU'ckzdUf]U'cfZ'`Xch'dUW'



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h|Y|g|V|W|g|'

GjYf|h|@jYg

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- ◆ A Yia ! gUWg/
- ◆ <||\! gUWgcfmZfa UZ'Xh'dW'



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**FYUFD' MNg**

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- ◆ DffU'cf Z' Xh' dUW'



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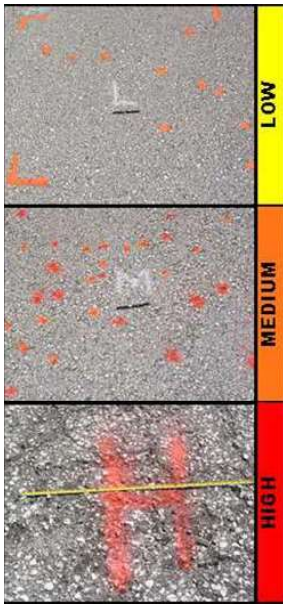
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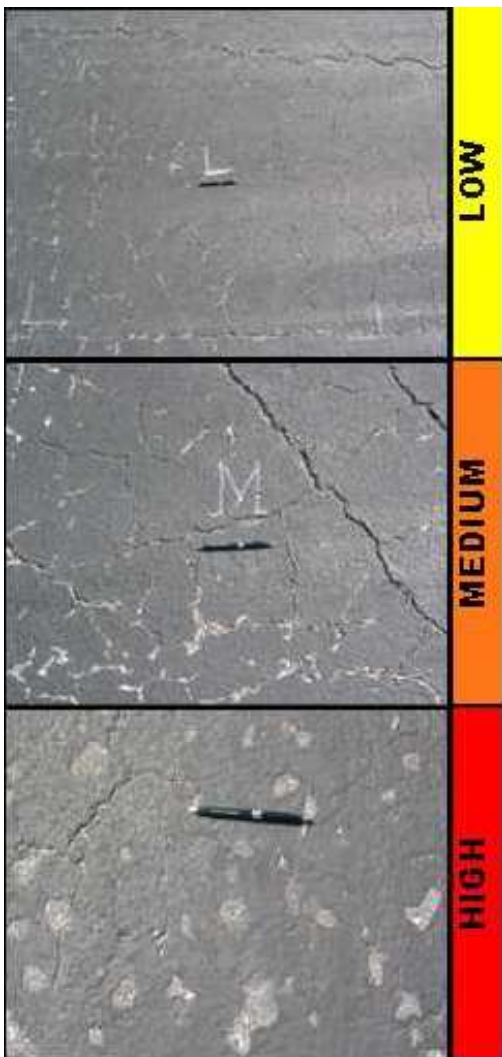
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Gi ffr#7cUHfCjY8YgYAl GYfJh@Yg



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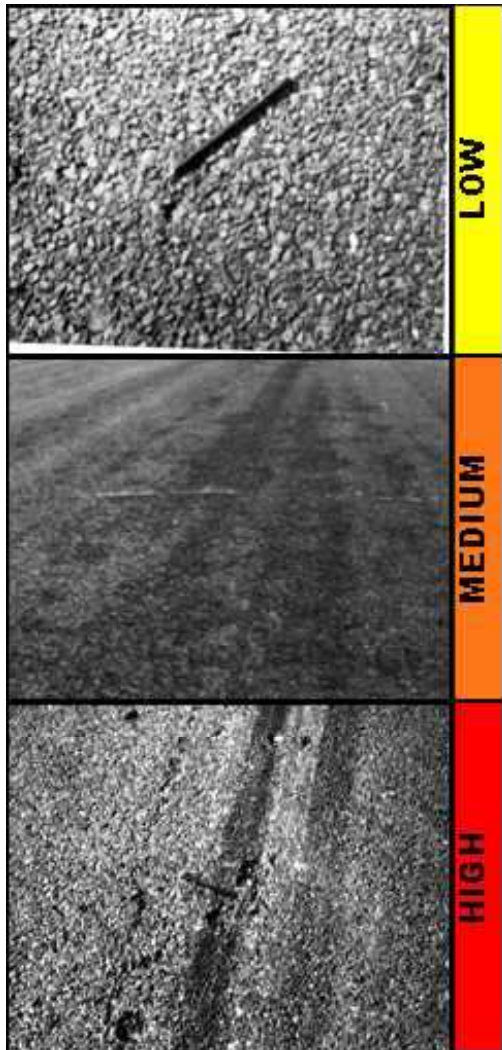
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U[fYUYWg]fYg]fYUfhub%ai hXgchN VwX& dVWicZhYUfU

**<** =bU%gi UYZdfl#Sgi UYa VffYfYgHUIj YgadYhYbi aWfcZ  
U[fYUYd]Wga]ggh'lgjYf(SUX#cfhYbi aWfcZa]ggh' U[fYUYWg]fYg  
]fYUfhub& dVWicZhYUfU



%" Fi Hh 157L

5 fi hg Ug fZWXfYgcb]bhYk\Y'dh^\ckYVZ]ba Un]gUBWgfi lgUY  
bc]MUYcbnUfUUbUzk\YbhYk\Y'dhgUYZ`Yk]h kUM" Dj Ya Yh  
id]ZiaUicWfUch] hYgXgcZhYfiHFiHh] g]hagZca Uda UbhXZfaU]cb  
]bUicZhYdj Ya YhUmfcfg V[ fUXZig UnWgXVhWgc`XU]cbcf`UMU'  
agj Ya YhcZhYa Uf]UgX Yc hZ]WdUg`Q] hZ]Wfih] Wb`YXle'a Ucf  
gi VffUZ]i fycZhYdj Ya Yh

Gj YfngUgXcbfi hXchL

- ◆ @ck! YghUb' ]bW]bXch/
- ◆ A Y]a! VlkYb' Ux%]bW]bXch/
- ◆ <]]\! YVWg%]bW]bXch"

FYUfcdhcg

- ◆ @ck! BcU]cb/
- ◆ A Y]a! dWU]bfcj YUm
- ◆ <]]\! dWU]bfcj YUm



: ]ifY7!. "57Fi Hh"

**% "G|dd|Y7fUW|b| B57L**

**G|dd|Y7fUW|b|** from the direction of traffic. They are produced when braking or turning wheels cause the **dj Ya Yhg fAWc:g|XUXXZfa "H|g|g|U|ncW|fg| \Yb|Y|g|U|ck|g|N|h' g|f|W|a|| 'cf|dc|f|V|b|X|W|k|Y|b|Y|g|f|W|U|X|b|h|U|f|c|Z|dj Ya Yhg|f|W|f|Y'**

**G|Y|f|N|g** No degrees of severity are defined. It is sufficient to indicate that a slippage **W|W|Y|g|g'**

**FYUFD:MG**

- ◆ **Scbch|b|/'**
- ◆ **Dff|U|cf|Z|~|X|h|d|U|W'**



**:||ifY7% G|dd|Y7fUW|b|"**

%"GkY]h] f57L

8Yg]d]b

5'gkY'lgWfUW]h]XVn]bi dkUfXV' [Y]bhYdj Ya YH]g]fZW'5'gkY'aUn  
cWf]g]f]dn]ej YUgaU' fU]cf]g]U]d]h] YZ]f]U]X]U]k]j]Y'9]h]Y]h]n]c]z]g]k]Y' WbWY  
UW]a]d]h]Y]X]V]n]g]f]Z]W]W]U]h]'5'gkY'lg]g]U]m]W]g]X]V]n]c]g]U]W]b]h]Y  
g]V]f]U]X]c]f]V]n]g]k]Y]h]'g]c]Z]V]h]U]g]a]U'g]k]Y' WbU]g]c]W]f]c]b]h]Y]g]f]Z]W]c]Z]b]g]d]U]h]  
c]j]Y]U]h]h]j]Y]D]7]H]g]U]F]g] h]c]Z]U]V]c]k]! i]d]h]b]h]Y]D]7]g]U'

GjY]h]n]@]j]Y]g

GkY'lgWfYnj]lgVYU]X]U]g]U]a]h]c]f]Z]W]c]b]h]Y]d]j]Ya]Y]H]g]f]X]e]i]U]h]m]g]  
X]h]f]a]h]X]U]h]Y]b]c]f]a]U]U]Q]W]Z]g]h]X]Z]f]h]Y]d]j]Ya]Y]h]g]W]b]i]b]X]f'  
@ W]h]g]X]U]h]b]'f]d]k]!g]j]Y]h]n]g]k]Y'g]a]U]h]c]h]U]k]U]g]V]c]V]g]j]U]V]Z]V]h]Y]f'  
Y]lg]b]W]W]b]V]W]b]f]a]X]V]n]g]j]h]U]j]X]W]c]j]Y]h]Y]g]W]b]U]h]Y]b]c]f]a]U'  
U]Q]W]Z]g]h]X]Z]f]h]Y]d]j]c]k]j]c]W]f]Z]h]Y]g]k]Y'lg]d]f]g]h]!

GkY'WbV]c]V]g]j]Y]k]h]c]i]h]Z]V]W]h]U]X]U]g]U]g]l]h]Z]W]h]Z]W]c]b]h]Y'  
A d]j]Ya]Y]H]g]f]X]e]i]U]h]m]g]X]h]f]a]h]X]U]h]Y]b]c]f]a]U]U]Q]W]Z]g]h]X]Z]f]h]Y]d]j]Ya]Y]h]i]  
g]W]b]i]b]X]f]W]h]g]X]U]h]b]'

GkY'WbV]f]D]f]n]c]V]g]j]Y]X]U]X]g]j]Y]Y]m]Z]Z]U]g]h]Y]d]j]Ya]Y]H]g]f]X]e]i]U]h]m]h]Y'  
< h]c]f]a]U]U]Q]W]Z]g]h]X]Z]f]h]Y]d]j]Ya]Y]h]g]W]b]i]b]X]f]W]h]g]X]U]h]b]'



%"KXhY[h] 157L

8Yg[d]db

H YkY[h] UkUicZhYUgUHMpXfUXZBYU[f]UYaUqI Zca hYdjYaYh  
gfAW

GjY[h]e@jYg

5gUhg fAWW[h]bb[ le'g'ck'g[hgcZU[h] k\jWaUuYUWYUUXVn  
VUaUfWbY[h]dg' @cg[hYZBYU[f]UYaUqI lgc[MVYUXXaUuY  
@ UWad[h]XVnZ[h] cZhYUgUHWc" 9N YgcZhYUgYU[f]UYgUY  
V[h]bb[ leVYdcgXfngU\$) bWgcf%aaE' DjYaYhaUuY  
fYUj Ynbk f[h]bk Ug\* 'adhg'X!

A @cg'cZBYU[f]UYaUqI lgc[MVYUXX YgcZUgYU[f]UY YVWb'  
YdcgXi dlc%# k]X hZhYch YgigXcZhYUgYU[f]UYX Yc hYcg'  
cZBYU[f]UYaUqI "

< 9N YgcZUgYU[f]UY YVWb YdcgX fUf hU\$# k]X hZhYch Ygi  
gXcZhYUgYU[f]UY H YUgWgXU VYcg'cZBYU[f]UYaUqI  
YU[h] le'cd[h]U'cf ga Ycg'cZUgYU[f]UY





%!"6dk!I d!D77L

### 8YgAd]b

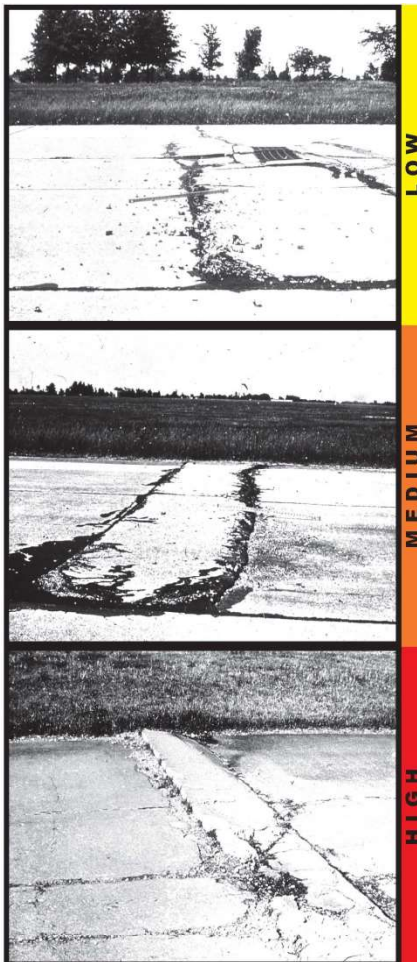
6'dki dg'cWf]b\dkYhYzi gUmHUmhg YgVWcf'c]HhUhgbdk]Y  
Yci [\ lc'dfa]h]d]hgdbVihYWBWYgUG'H Y]hgZ]W]hk]Xh'lgigUm  
W]gXV]h]Z]H]bc]Z]W]adYg]VYaUm]Ug]bc'hY'c]hg]W]K\Y]d]hgdb'  
W]bdfY]Y]Yci [\ dYg]fZU'cW]n]Xi dk]fX]ag Ya Y]h]Z]hYgU]V]Yg'  
fi W]h]f'c]g'UM]h] k]'cWf]b]hY]M]h]icZ]hY'c]h]6'dki dg'W]Ug'cWf]U  
i]h]m]W]g]U]X]U]b]Y]b]Yg'H]g]h]d]c]Z]g]f]g]g]U]a]c]g]U]k]U]g]f]U]f]X  
]a]a]Y]U]Y]m]W]U]g]c]Z]g]Y]Y]X]a]U]Y]d]h]U]l]c]U]M]Z]H]6'dki dg'U]Y]b]W]X]Z]f  
f]Z]f]W]k\Y]b]W]g]X]g]U]h]g]f]Y]V]h] Y]U]U]X]Z]f]f]X]d]h]h]"

### GjY]h]e]jYg

@ 6i W]h] 'cf'g'UM]h] \Ug]b]f]b]W]X]h]Y]d]j Ya Y]h]b]c]d]M]U]j Y]Z]U]X]d]b]n]U]g]l \h  
l]a]c]i]h]c]Z]i [\b]g]Y]g]g'

A 6i W]h] 'cf'g'UM]h] \Ug]b]f]b]W]X]h]Y]d]j Ya Y]h]b]c]d]M]U]j Y]Z]i]H]U]g]l]b]Z]W]h  
l]a]c]i]h]c]Z]i [\b]g]Y]g]g'

< 6i W]h] 'cf'g'UM]h] \Ug]b]f]b]W]X]h]Y]d]j Ya Y]h]b]c]d]M]U]j Y'



%" 7cbf6fU\_gfD77L

5 WbfVU\_lgUWWhUfhgNghY'chgUUXgUWYghUbcfYiUlc'cbY  
\UzhYgUVY[h'cbVch'gXgaYgjfXZca hYWbf'chYgU': cfYUadYZU  
gUkjh Xa YgdcgZ& Vri& ZfhUhgUWWhUfhgNgh hY'ch) Zfhca`  
hYWbf'cbYgYUX% ZYicbhYchYgW'gchUhgXUXUWbfVU/Thg  
UXU'cbUW' <ckY YZUWWhUfhgNgh+ ZYicbhYgYUX%SZYicbhY  
chY'gW'gXUXUWbfVU" 5 WbfVU XZgZca UWbf'gU'bhUHY  
WYhNgj VU'nfci [\ hYhYgUVh]W'gk\]YUWbf'gU'fhgNgh  
hY'chUhbU' Y'@UXYh]cbWa VbXkjh`cggZg'cbfUW'f] g'ggg  
igUmU'gWbfVU\_g'

**GjYhNg**

- ◆ @ck! 7UW\lgYhY'bc'gU'h] 'cfa]bcfgU'h] fbcZfY]bcVWNaU'Y  
f]CSf'df]U'Z'cb filled, it has a mean width less than approximately 1 #'  
inch (3 millimeters); a filled crack can be of any width, but the filler material  
aigWY]bg]gUW'f]W'f]cb'HYU'UWkYb'hYWbfVU' U'XhY'  
^'cb]g]g'cb]W'X
- ◆ A'Wia! One of the following conditions exists: (1) filled or non!filled c'fUW]g'  
acXU'YngU'X]gaY: CS'df]U'f]U'cb] 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  
W'f]cb'f]hYU'UWkYb'hYWbfVU' U'XhY'cb]g]g'[\h'W'X  
k]h`ccY'cfa]gg]d'cf]W'g
- ◆ <]]\! One of the following conditions exists: (1) filled or non!filled crack is  
severely spalled, causing definite FOD potential; (2) a non!filled crack ha'gU  
a'Ubk]h [f]U'YhU'U'hd]aU'Ym'f]W'f] 'a]'a'Y'gZ'W'f] U'f]Y  
XaU'Y'd'f]U'c'f]hYU'UWkYb'hYWbfVU' U'XhY'cb]g]g'  
g]Y'Ym'W'X

**FYU'fcd]cbg**

- ◆ @ck! BcU'f]cb'cf]gU'W'g
- ◆ A'Wia! gU'W'g
- ◆ <]]\! gU'W'gU'f]h'U'~  
cf]YU'WhY'gU'



X'h'dW

: ]]ifY7%&'D77 7cbf6fU''

%" 7fUWg"@cb|liXpUZHFUbg YgYUbxS|U|cbU'D77L

H YgYUWgXj|XhYgU|bc|kc'cfhfYd|WgZUxifYigUmMgXVhU  
WáVhU|bcZcdXfYh|cbZf|h'gYgZUxgfb\_UYgYgYg"@ck'gYf|h  
WUgYfYbdhWgXfXaUcfgiVifUXgYgYg'A Yfi a'cf\\|gYf|hWUgYfY  
igUnkcf|h|WUgYfYbdhWgXfXaUcfgiVifUXgYgYg'

**GjYf|ng**

- ◆ @ck!%i hZ`YXUWg%#`bWlc%&|bWk|Xk|h bcZi |h|'cf gU|h|/E  
WUgYgYhU%&|bWk|Xk|h`ck'gYf|ngU|h|/cf'EZ`YXUWgZ  
Unk|Xk|h ZfYf dZfa|h|`bUgYf|ngUfinaUbfUx|bcZi |h|'cf  
gU|h|/
- ◆ A Yfi a !%i hZ`YXUWgVhYb%&|c%|bWk|Xk|h bcZi |h|'cf  
gU|h|'cf&Z`YXUWgZUnk|h Zi |h|`YgYhU%#`bWcf a Yfi a'  
gYf|ngU|h|/
- ◆ <|\\!%i hZ`YXUWgk|h Uk|h|f|fYhU%|bW&e i hZ`YXUWgZ  
Unk|h k|h Zi |h| |f|fYhU%&|bWcf a Yfi a'gYf|ngZi |h|/cf'E  
Z`YXUWgZUnk|h Zi |h| |f|fYhU%&|bWcf|\\|gYf|ngZi |h|"

**FYUfcd|cbg**

- ◆ @ck! BcU|fbcf gUWUWg/
- ◆ A Yfi a ! gUWUWg/
- ◆ <|\\! gUWUWgUf|nUz`Xh'dUWcfYfUWYgU'



: ||ifY7%&'D77HUbg YgY7fUWg'

§' Si fUj]m7fUWgID77L

8YgAdjb

Si fUj]m7fUWg]gWgXVnhYbUj]m7cZhYWBWYk]hgUXXj]fdaYbU' ZWfggWgZYYhukVWg'-fi gUnldNfgUdUMB'cZMwgi bhd' parallel to a joint or linear crack. A dark coloring can usually be seen around the fine XfUj]m7fUWg'H]ghdYcZMwgd' aUnjYbU'mXkXghN]fulbcZhY WBWYk]h]b%c'SZYfSSle\*SSa]`jaYgicZhY^chidVW'

GjY]h@jYg

@ ÍSÍ VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU'

A ÍSÍ VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU' cfÍSI VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU'

< ÍSÍ VWVh] \gWjYodXgY fUWg]MVYUaci hZgUVfUk]h`]hYcf bcXghN]fulbcf: CS'dhHjU'



8% >chhGU'SUa U YID77L

>chhGU'SUa U YgUmWbNjdbzk\|WYbUVgg|'cfcVgkUWai 'UYbhY^chh  
cfUck'g|b|ZUH|b|f|U|bcZkUf''5Wai 'U|bcZ|WadYgVYaUfUg|b'  
hY'chhdy YghYgUVZca YdbNj| UxAtinfj hbVW|d'zgUmf|zcf  
gU|d|"D|UVY'chh' YVbXX|chYYX'YgZhYgUgdchWg^chhZca hY  
UWai 'U|bcZaUfUgUxUg'cfY YhgkUfZca gX|d' XkbUxgZb|d' hY  
Zi bX|dbj dbf|d' hYgV' Hd|W|hdngZ'chhGU'SUa U YUfY'%g|dd|d' hY  
'chhGU'SUa U YgUmWbNjdbzk\|WYbUVgg|'cfcVgkUWai 'UYbhY^chh  
'cgicZcbX|chYgUVX'YgUx\*EUWcfUg|bWczgUUh|bhY'chh

Gj Yfng

- ◆ @ck ! |b| YbU n|ccXWbNjdbhfc| [\ci hYgUmWbNjdbzk\|WYbUVgg|'cfcVgkUWai 'UYbhY^chh
- ◆ A W|a ! |b| YbU n|fVbNjdbhfc| [\ci hYgUmWbNjdbzk\|WYbUVgg|'cfcVgkUWai 'UYbhY^chh
- ◆ <||\ ! |b| YbU n|bcfVbNjdbhfc| [\ci hYgUmWbNjdbzk\|WYbUVgg|'cfcVgkUWai 'UYbhY^chh

FYUfcdhcg

- ◆ @ck ! BcU|cb/
- ◆ A W|a ! gU^chh
- ◆ <||\ ! gU^chh



: ||ifY7% 'D7 >chhGU'SUa U Y'

**8& GaU DUWID77L**

5' dUWlgUBfUk\ YfhYcfll jBU'dj Ya Yh  
has been removed and replaced by a filler

aUfjU': cfWbXjcbY U UjcbzdUWj lg'  
Xj jXXjhc lkc lndg' gaU fngghU) 'gi UfY  
ZNUXUf Yfj Y) 'gi UfYZNL'@uf YdUWg'  
UfYXgUfVXjbhYbl hgXjcb'

**Gj Yfng:**

- ◆ @k ! DUWlgZbUjcbj kY'zkjh'  
'jhycfbcXfjcfUjcb/
- ◆ A Yjia ! DUW\UgXfjcfUfXZbXf  
acXfUfYgdU'j WbVYgXbUfcbXhY  
YfYg'DUWaUfjUWbVYg'cX'Yz  
kjh WbgXfUfYfZfifh jcf: C8'  
dNfjUf/
- ◆ <ll\ ! DUW\UgXfjcfUfXZbXhYfVn  
gdU'j UfcbXhYdUWcfWUWj'  
kjhjbhYdUWZc UgUfYk\ jWkUfUhg  
fYUWa Yh

**FYUfcdjcbg**

- ◆ @k ÈScBchj/
- ◆ A Yjia ! FYUWdUWcfFYUWY  
gU'
- ◆ <ll\ ÈFYUWdUWcfFYUWYgU'



**: llif7% 'D77 GaU DUW'**

**&" @Uf YDUWID77L**

Patching is the same as defined **ZfUgaU`dUW`  
`ckYVzhYufUcZhYdUWlgacfyhUb) 'gi UfY  
ZNF5 i f]hMhGudUWhUgfydUWkhY  
cf] ]bU'dj Ya YHMMgycZdUWa YhcZ  
i bXf]ci bXi f] ]ng'HYgj Yf]mY YgcZLi f] ]m  
WfYhYga YghcgYZffYi 'Uf dUW]d."**

**Gj Yf]ng**

- ◆ @ck ? DUW]gZb] ]cb] kY`zk]h `]hYcf  
bcXNFcfU]cb/
- ◆ A Y]i a ! DUW`UgXNFcfUWZbXf  
acXfUYgdU]d] WbVYgYbUfci bXhY  
Y] Yg'DUWa Uf]U WbVYg`cX Y`zk]h`  
WbgXfUYWZf]f] ]cf: CS'dh] ]U/
- ◆ < ] \ ! DUW`UgXNFcfUWZ]hYfVn  
gdU]d] Ufci bXhYdUWcfWUW]d] k]h]b'  
hYdUWZc UgU]k` ]WkUffU]g  
fyUWa Yh

**FYUfcd]cbg**

- ◆ @ck `E8cBch]d] /
- ◆ A Y]i a ! FYUWdUWcfFYUWWhYgU'
- ◆ < ] \ `E'FYUWdUWcfFYUWWhYgU'



**: ] ]i fy7% `D77 @Uf YDUW'**

**&" Dddi lgiD77L**

5' dddi HgUga U' dJWcZdj Ya YHhUMFU\_g' cogYZca hYg fZWX Yc ZYH  
hUk UWcbJbWa VbUcbkjh Y ddbj YU [fY UHg' Dddi lgi g UnfUj YZca '  
Uddid ja UYnfbWlc( JbWYgbXLa YfUkZca %&JbWlc' &JbWgXsd"

**Gj YHNg**

No degrees of severity are defined for popouts. < ckY Yzddi lgaig HYYHNgj Y  
VZfYh YnfYw HXUg UXg JYg' YZj YU Yddi hXghiaig H VWX  
Uddid ja UYnfbYddi lgidf gi UYnfbXg YhYHjYg UVfU



**: ||ifY7%. 'Dddi lgi'**



**&"D adq id77L**

**8YAdhb**

**D adq lghYYMbcZaUhfUvkUfhci [\ `c hgc VWgWigXVhWZMcb:  
cZhYgWibXfdlgh `cXg'5ghYkUf'lgYMWZ]hUfYgdUfWgcZ] fj YzgWZ  
WncfgHbXyj lgbUdcfygj YcgicZdj Ya Yhg ddbfG fAWgUhh Ux  
VgYcfj V fUYaUhfU'cbhYdj Ya YhVgYc `c hgc VWgUfyj XbWcZ  
d adq "D adq bnf `c hgc bXWgdcf `c hgc UY Ux cgcZg ddbfk \JWk]`  
`YXlc VWWh i bnfYbUXcXg'**

**GjYfm@jYg**

**BcX]fygcZgj YfmfYXWbX-Hgg ZVbhc ]bXUyhUd adq Ylgg'**



**&" GUVh ID77L**

**AUVWVh 'cfVUth fYZfgUbkcf 'czgUdczZbZcf\UFjBYVWghU  
YfXcbnhfi [\ hYiddf g fZWCZhYWBWYHYVWgN6Xc ]bMgNth  
Uj 'YgZ/8\$X|fyg'AUVWVh 'cfVUth |gigUmWgXVnj YZhg |hY  
WBWYUxaUmXk:cGUh 'czhYgfZWK\|W|ghYVU\_XkbcZhYgU  
g fZWC UXd of approximately 1/4 to 1/2 in W'GUh 'aUthg VVWgXVn  
|adcfWgh VcbUXdcfU|f|UY'5bchYfW|bhXgi fWcZgdYgghY  
fU|bVWkYbhYU\_U|gBUcUx? &E|bga YW YlgUXWUba |bUglb  
ga YU|f|Ug'UcXVZfa YVnhYVU|bVWkYbhYU\_U|gUXU|f|UY  
fg |bYd|gcbghUWgYUVU\_Xkb|bhYWBWY'**

**GjYHNg**

- ◆ @k! 7Uth 'cfAUVWVh Ylggj Yg|bZVWgUVfUHYg fZVW|b  
|ccXWV|cbk|h bc'GUh 'HYVWdUmbaig|WkY X|bXUx  
Yg|n|W|bhX
- ◆ AYia ! GUVggVXkj YUdd |aUym)1 'cfYgczhYgfZWK|h'gaY  
: CS'dh|U/
- ◆ <||\! GUVggj YYngVYXWgh U||\ : CS'dh|U'1 gUmācfYhU  
)1 'czhYgfZVWgUZX



**&": U 'Hb| 1D77L**

**GHVa Yhcf Zi 'Hh |g UXZZfWwCZYj U|cbUfU'c|b|cf VUWUg gXVnd YjU' cfVhg' |U|cb'**

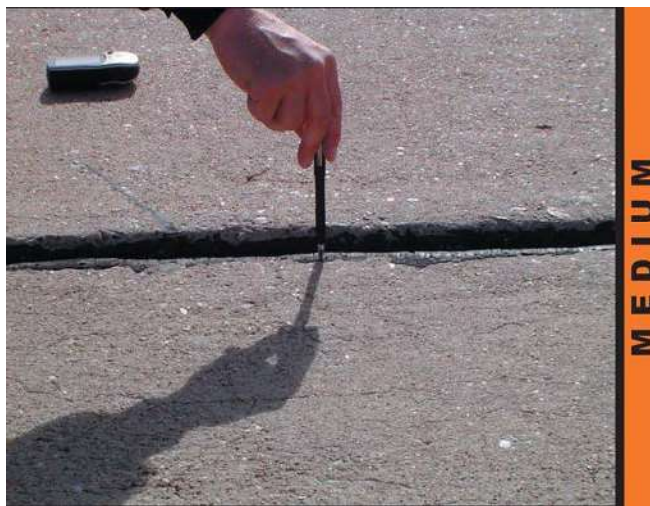
**Gj YfHg**

Severity levels are defined by the difference in elevation across the fault and the

	<b>Fi bkUng#U  kUng</b>	<b>5dfcbg</b>
@	<b>0%# jW</b>	<b>%# E%#jW</b>
A	<b>%# E%#jW</b>	<b>%#2 %jW</b>
<	<b>2%#jW</b>	<b>2%jW</b>

**FYUfCd|cbg**

- ◆ **@k! BcU|cb'**
- ◆ **A Y|a E; f|N|H Uch hY'c|h**
- ◆ **<||\ E; f|N|H 'cf'c|b|cU|UgZfYg'fU|cb'**



**&" G UMFYXGUVFD77L**

**=hfgNMh VUWgUYVUWghUMFU ]hcZifcfacydWgVWU gczj YcUjh' UxwfhDSgiUYgdhffHY\| \!severity level of this distress type, as defined below, lghZffXlc UgUg UMFYXgU'ZU`dWgcfVUWgUYWUjbxkjh bUWbf VUZhYXgUgUgUWU]cfhXUgUgY YWbfVU"**

**Gj Yfhg**

- ◆ **@k! Slab is broken into four or five pieces with the vast majority of the cracks fj Y, ) dMWhcZck!gj Yfh**
- ◆ **AWja !(1) Slab is broken into four or five pieces with over 15 percent of the VUWgZaWja gj Yfhilc \|\!gj YfhVUWg/cffgU]gVc\_Y]hc'gl' cfacydWgkjh'gj Y, ) dMWhcZhYVUWgZck! /**
- ◆ **<|\! 5hlg^Y Y'Zgj YfhYgU]gWYXg UMFYXgU]gVc\_Y]hc' four or five pieces with some or all of the cracks of high severity; (2) slab is Vc\_Y]hc'gl' cfacydWgkjh'gj Y%) dMWhcZhYVUWgZaWja! cf \|\!gj Yfh**

**FYUfcdhbg**

- ◆ **@k EGU'7UWg/**
- ◆ **AWja !: i`Xdh dUWcffYUWhYgU'**
- ◆ **<|\!: i`Xdh dUWcffYUWhYgU'**



**&" Gfb\_ qY7fQWfD77L**

**Gfb\_ qY7fQWfD77L**  
**Yf]bYf]WghUf]YigUnibnUZkZf]hd| UbXXcbdi**  
**Yf]bYf]WghUf]YigUnibnUZkZf]hd| UbXXcbdi**  
**WbNYUXigUnibnUZkZf]hd| \ hYXdh'zhYgU'**

**GjYfDg**

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

**FYUfcdhbg**

- ◆ **8cBch|d**



"

' \$' >chhGUgfD77L

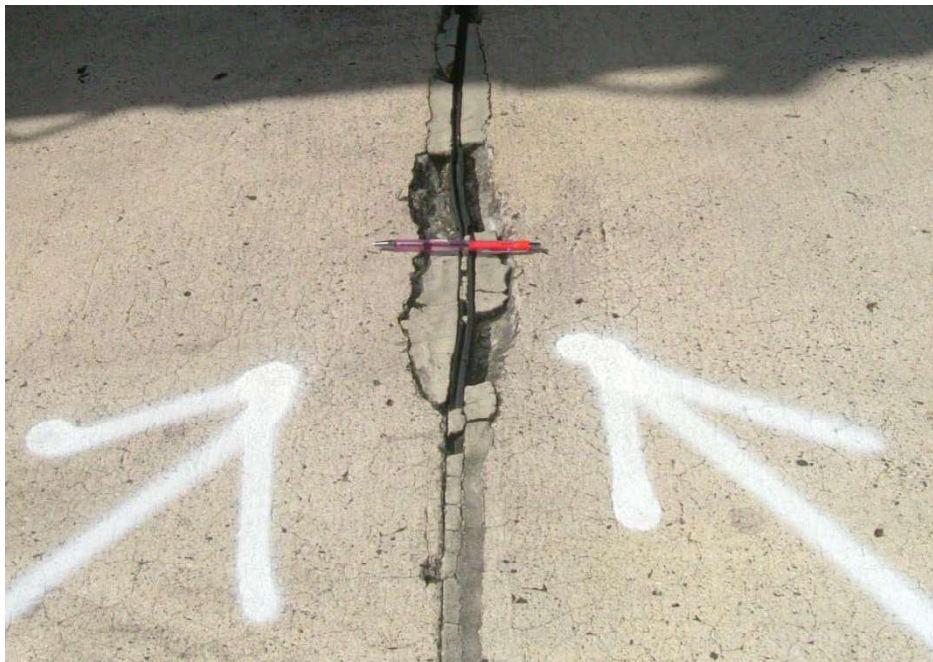
>chhGUh lghYXghN fUbcZhYgUVX Ygkjh b&ZYhZhYgXZHY'chH'  
5'chhGU i gUmXyghN hXj YhU mhfci [ \ hYgUZA hHhGhY'chHh  
UbU 'Y'GUh' h'g l'Zca YWgjj YgYgghY'chHhWU gXVh'f'f'f'f'  
cZbMadYgVYaUhfUgcfhZfWcUg' K'U WbXhYhY'chHh gXVh  
cj Ykcf\_h [EWa VbXkjh hZfWcUgUgUchYVh g'ZgU'h''

**Gj YhNg**

- ◆ @k! gj Y&ZYhch UxlgVc\_Y]hc'acfhUbfYd]WgXVhXVh  
'ck'cfa Y]a 'gj YhMhWgkjh ^]hYcfbc: CS'dhH]Uzcf'g&YghU'  
&ZYhch UxlgVc\_Y]hc'acfhUbfYd]Wgkjh ^]hY: CS'cf]Y  
XaU]YdhhU/
- ◆ A Y]a ! gj Y&ZYhch UxlgVc\_Y]hc'acfhU' 'd]WgXVhXVh] \h  
cfa Y]a Wgcf'ga Y: CS'dhH]U]Y ]h]zcf'g&YghU'&ZYhch '  
UxlgVc\_Y]hc'd]WgcfZU]a YhXkjh'ga YcZhYd]Wg'cg'cfUghz  
Wgh WghXVY: CS'cf]YXaU]YdhhU/
- ◆ <]]! gj Y&ZYhch UxlgVc\_Y]hc'acfhUbfYd]WgXVhXVh  
cfacY]] \ 'gj YhMhWgkjh \]] : CS'dhH]U'

**FYUfCd]bg**

- ◆ @k! BcU]cb/
- ◆ A Y]a ! dhZfa UdhU]Xh'dUW
- ◆ <]]! dhZfa UdhU]Xh'dUW'



'% 7cbfGdUgD77L

7cbfGdUgD77L 'cfVNUXkbcZhYgUkjhBUdIdJaUYn&ZncZ  
hYwbf"5 WbfGdU XZGZca UWbfVNU JbhUhYgUUh 'YgXdkkUX  
lcJhGwY'chk\]YhVNU YHxgjYfU nhci [\ hYgU'

**GjYfng**

- ◆ @ck! YhY%hYgU'lgMc\_Yb]bc'dYcfkcd]WgXbXVnck'gjYfhn  
VWgkjh`JhYcfbc: CS'ddHJU/cf&hYgU'lgXbXVnchYaYfja'  
gjYfhnVWgkjh`JhYcfbc: CS'ddHJU/
- ◆ AYfja È%hYgU'lgMc\_Yb]bc'kcd'afYd]WgXbXVnchYaYfja'  
gjYfhnVWgkjh`JhYcfbc: CS'ddHJU/cf&hYgU'lgXbXVnchYaYfja'  
gjYfhnVWgkjh`JhYcfbc: CS'ddHJU/
- ◆ <||\ È%hYgU'lgMc\_Yb]bc'kcd'afYd]WgXbXVnchYaYfja'  
gjYfhnVWgkjh`JhYcfbc: CS'ddHJU/cf&hYgU'lgXbXVnchYaYfja'  
gjYfhnVWgkjh`JhYcfbc: CS'ddHJU/

**FYUfCdHbg**

- ◆ @ck! BcUfcb/
- ◆ AYfja! dffUXh'dUW
- ◆ <||\! dffUXh'dUW



' & 5G fD77L

5G 'lgW gXVnWw JW fDUkbVWkYbU\_UlgUkXWUbfDUUj Yg JWa JbMUG  
k\JWZfa U|Y' HY|YUgfvGkUfZUgh 'Y dHgdbk\JWa UnA UYhY  
WbWYUkXUWUhg VifY' 5` UlgfYacgicZb JfcXVWVnhYcbfUk  
Ww YHkjh|bhYdj Ya YH' 5G 'WUWj 'a UnYUWYUfXVnWw JW'dj Ya YH  
XjWg'

Jlg U|bXWUfghU5G'a UnYdYgHjBWXY'

% 7UWj 'cZhYWbWYdj Ya YHfZb|bUaUfdUMbL

& K\JZVckbz fufcfhYWcfX|Y'cfgh|j 'a UnYdYgHjUfYUW  
gfWY

" 5|[fYUyddi|g

(" bWUg|bWbWYj'c|a YU dHgdbUha UnYg 'HbXgdf|bcZUXWUf  
JH|fU'g VifYgfd'ngJUYa Ylg'9|UadYgcZU dHgdb|WXYg'cj| 'cZ  
UgdUhdj Ya Ylg'|\HWb|j|z'gUzi |j|z'c|ha|gU||ba YHbXU|f|g|bcz  
'c|hgUgcfY dHgdb'c|Hj'Yg'

6WU g'5G 'ga Uf|U'XVnWw5G 'gl YbU ncfYgHhfc| |\c|H Ydj Ya YH  
gW|b' 7cf| UxWbWYcNfc|fU|WUngg'ghYcbnW|j|j Ya YhcXc'  
WbZfa hYdYgWcZ5G' HYZ`ck|j| g'c'XY\_Yh|ba|bXk\Y|Xb|j|j|'  
hYdYgWcZ5G hfc| |\j|g U|bgW|b

%; YbUn5G XgYggYfYbdcVg|YX|bhYz|g|zk' nUgUZYWg|V|b' b  
Wb|g|d|g|g|f|b UYUWU| W'cWfYXh'cZUg|V|bUk|g|d|f|Yh  
k|j|bhYz|g|n|f'

& 5G 'lgXVnWwJWZfa 8!7UWj VnhYdYgWcZUWj 'dMnXWUf|c'  
hY'c|HAW 8!7UWj 'dYXa|b|HmXjYcdgUgUg|YgZdfUYUWg|c'  
'c|HAWUk|b|fWUW| k|j|bhYgU'

" 5G 'lgXVnWwJWZfa 'AUf7UWj #GU|j VnhYdYgWcZj|g U'g|bgcZ  
YdHgdb'



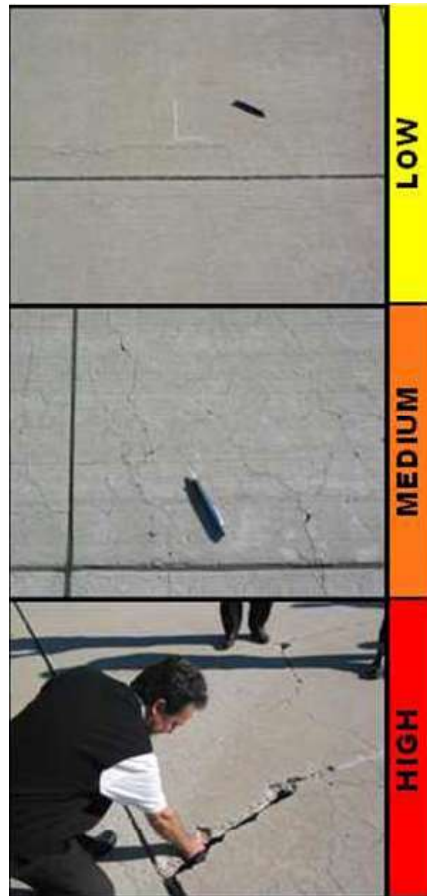
**GjYfhi@jYg**

**@** A|jaUlebc: cf||bCVVNSUaUyECSE'ddnh|UZca V|Wg'cl|gcf5Gf' fYUXXddi|g V|WgU|hYg fZWUfYH| \HfYXca|b|hn?aa'cf~Yg|@|h|Y lebcY|N|WcZagY|Yh|bdjY|Yh|cf|f|di|b|h| |g| V|fYgcfY|Y|Y|g'

**GcaY: CS'ddnh|U| |b|N|g|X|g|Y|h| |'cf|ch|Y: CS'fYag|U'a|Y|c|X|g|a|U|h|Y f|e| |f|X| A|U|h|Y| |N|W|c|Z|g|U|V|a|g|Y|Y|h|U|X|c|f|g|a|Y|X|a|U|Y|c|U|X|W|h| |g| V|fYgcfY|Y|Y|g'**

**A** A|Y|a'5Gf'X|g|N|g|g|N|Z|f|h|U|X|Z|ca'~ckV|h|U|h| |'cb|Y|c|f|a|c|f|c|Z|h|Y Z'~ck|h|. |b|N|g|X: CS'ddnh|U|Z| |b|N|g|X|W|W|h| |'c|Z|h|Y|g|U|Z|g|a|Y|Z|U|a|Y|g| U|d|h| V|W|g|c|f|U|W|W|h|f|g|N|d|g|d|f|Y|g|h|g| fZWddi|g|c|Z|W|N|Y|a|U|h| c|W|Z|d|U|h|b|c|Z|k|X|V|W|g|f|Y|X|a| |b|h|h|?aa'cf|k|X|f|h|U|a|U|h|Y g|V|j| |X|X|h|h| | \HfV|W|g'

**<** Cb|Y|c|f|h|c|Z|h|Y|Z'~ck|h| |Y|g|h| %|@|c|g|Y|c|f|a|g|g|h| W|N|Y|Z|U|a|Y|g|k| \W|d|g| \|| \: CS'ddnh|U|Z| &EGU|g| fZW|h|H| |f|h|U|X|Z|b|h|c|b|g|h|Z|W|h|h| X|f|U|X|U|X|d|j|Y|Y|h|e|i| |f|g|a|a|Y|U|h|f|U|f'|a|U|h|U|c|f|e|i| |f|Y|Y|U|g|e| U|X|W|h|g|h| V|fYgcfY|Y|Y|g'



**APPENDIX D**

**DETAILED PAVEMENT CONDITION DATA**



5@SCH526%  
; YdMUPASUY

)#488%

DjY%Z'

BVkc_f.	+5)	BuáY	FcÜc_YAibjVjU5]fcbfh
GfUBW	58%	BuáY	5dÜb\$%FcÜc_Y
GWjcb	%	cZ %	: fca. HJkÜü5
GfZUW	57	: Üa]m	5@SCH5dÜdg NcbY
5fYU	%Z) Gc h	@Y[h.	'): \$: h KPh.
GUÜg		GUV@Y[h.	: h GUVKPh.
Gcd Xf.		GfYHhdY	; fUX \$
GWjcb7caaYhg			

Kcf_8UY	%44%*	Kcf_HndY	Bk7dÜgÜcb!hJU	7cXY	BI!B	gAUcfA/ F. HfY
Kcf_8UY	%8488	Kcf_HndY	GfZUWGU!FYjYUjH	7cXY	GGF9	gAUcfA/ F. :ÜgY
Kcf_8UY	%8488	Kcf_HndY	7UWGUjH!57	7cXY	7G57	gAUcfA/ F. :ÜgY
Kcf_8UY	%8488	Kcf_HndY	7UWGUjH!57	7cXY	7G57	gAUcfA/ F. :ÜgY
Kcf_8UY	%8488	Kcf_HndY	GfZUWGU!FYjYUjH	7cXY	GGF9	gAUcfA/ F. :ÜgY

@Üghg!8UY %4488% HÜÜÜÜdYg ( GfjYKX (

7cbÜjdg D7= &

-hgNjcb7caaYhg

GädYBiaVf.	%	HndY	F	5fYU	)- \$'SSGc h	D7= &
GädY7caaYhg						
(, @/ H7F		@		)+\$SS : h		
(, @/ H7F		A		%SSSS : h		
)\$ D5H<-B;		@		%SSSS Gc h		
)& F5J9@B;		A		), \$'SS Gc h		

GädYBiaVf.	%&	HndY	F	5fYU	(')+SSGc h	D7= %
GädY7caaYhg						
(% 5@; 5HCF7F		<		%SSS Gc h		
(, @/ H7F		@		&SSS : h		
(, @/ H7F		A		SSSS : h		
)\$ D5H<-B;		@		%SSSS Gc h		
)\$ D5H<-B;		<		(')SS Gc h		
)& F5J9@B;		A		(%SSS Gc h		

GädYBiaVf.	\$	HndY	F	5fYU	'*! \$SSGc h	D7= &
GädY7caaYhg						
(, @/ H7F		@		(')'SS : h		
(, @/ H7F		A		%SSSS : h		
)& F5J9@B;		A		)' \$SS Gc h		
)& F5J9@B;		<		%SSSS Gc h		

GädYBiaVf.	\$(	HndY	F	5fYU	)+'SSGc h	D7= ''
GädY7caaYhg						
(, @/ H7F		@		(+\$SS : h		
(, @/ H7F		A		+\$SS : h		
)& F5J9@B;		A		)+'SS Gc h		

BYkcf. +5) BLaY FdUc\_YAihjVU5]kbfh

GfUW CFF& BLaY CjVfibFibkUin& FdUc\_Y IgX CJ9FFIB 5fU %Z(\$Gc h

GWfch \$% cZ % : fca. FibkUin& 9bX H. 9(YcZDjYaYh @Gj7chjH %%%\*%

GfZAW 57 : Ua]m 5@SCH5dldg NdbY 7UH[cfm FUb. G

5fU %Z(\$Gc h @V[h. % : h K]Ph. , \$: h

GUg GUV@V[h. : h GUVK]Ph. : h >ch@V[h. : h

Gci Xf. GfYVHdY ; fUX \$ @Ug \$

GWfcb7caaYlg

Kcf\_8UY %%%\*% Kcf\_HdY Bk7chjVcb!h]U 7cX BI!B =gAUcfA/ F. HiY

Kcf\_8UY %%%\$% Kcf\_HdY GfZAWGU!FYjYUjH 7cX GGF9 =gAUcfA/ F. :Ug

Kcf\_8UY %%%\$% Kcf\_HdY 7fUWGUjH!57 7cX 7G57 =gAUcfA/ F. :Ug

Kcf\_8UY %%%\$% Kcf\_HdY 7fUWGUjH!D77 7cX 7GD7 =gAUcfA/ F. :Ug

Kcf\_8UY %%%\$% Kcf\_HdY GfZAWGU!FYjYUjH 7cX GGF9 =gAUcfA/ F. :Ug

@Gj7chjH 8UY %%%\$% HRUcladyg & GfjYnX &

7chjVchj D7= \*+

=gAUcfA/ F. :Ug

GladYBiaVf. \$% HdY F 5fU \*\$\$\$Gc h D7= \*)

GladY7caaYlg

(, @/ H7F @ \*\$'\$\$ : h

(, @/ H7F A -)'\$\$ : h

) + K95H 9F-B; A +)'\$\$ Gc h

GladYBiaVf. \$% HdY F 5fU )(( '\$\$Gc h D7= \*,

GladY7caaYlg

(, @/ H7F @ \*% '\$\$ : h

(, @/ H7F A ) '\$\$ : h

) + K95H 9F-B; @ ) \* '\$\$ Gc h

BYkcf_ +5)	BláY	Fclbc_YAihjVU5]kbfh
GfUW F%&	BláY	FibkÚn%& Fclbc_Y
GWfch \$	cZ ' : fca.	FibkÚn& 9bX
GfZAW 57	: Úa]m 5@SCHFKg	NbY
5fU	'*Z\$Geh @Y[h.	O' :h K]Ph.
GUg	GU@Y[h.	:h GUVK]Ph.
Gci Xf.	GfYWHdY	; fUX \$
GWfcb7caaYhg		
Kcf_8UY %%%%	Kcf_HdY Bk7cbjg Vcb! :h]U	7cX BI !-B
Kcf_8UY %%%SS	Kcf_HdY GfZAWGU! FYj YU]H	7cX GGF9
Kcf_8UY %%%+SS	Kcf_HdY 7fUWGU]H !'57	7cX 7G57
Kcf_8UY %%%SS%	Kcf_HdY 7fUWGU]H !'57	7cX 7G57
Kcf_8UY %SS%	Kcf_HdY GfZAWGU! FYj YU]H	7cX GGF9
@Gfjhg]8UY %%%+SS%	HRUcládyg *	GfjYnX '
7cb]jhg D7= *-		
-hg]Vcb7caaYhg		
GládYBiaVf. \$%	HdY F	5fU *SS\$Geh D7= ,
GládY7caaYhg		
(, @/ H7F	@	*) '\$\$ :h
(, @/ H7F	A	%'\$\$ :h
)+ K95H 9F-B;	@	*\$\$Geh
GládYBiaVf. \$	HdY F	5fU *SS\$Geh D7= +%
GládY7caaYhg		
(, @/ H7F	@	*) (\$\$ :h
(, @/ H7F	A	%'\$\$ :h
)+ K95H 9F-B;	@	*\$\$Geh
GládYBiaVf. \$	HdY F	5fU *SS\$Geh D7= *-
GládY7caaYhg		
(, @/ H7F	@	*) '\$\$ :h
(, @/ H7F	A	%'\$\$ :h
)+ K95H 9F-B;	@	*\$\$Geh

BYkcf_ +5)		BláY	Fclbc_YAihjVWU5]fcbh				
GfUW F%&		BláY	FihkUm%& Fclbc_Y	I gY	FIEK5M	5fU	&(žSSGé h
GMfch \$%	cZ ' : fca.	9NYcZDjYh	H. FihkUm%&BX				@gh7cbgH %%%*%
GfZW 57	: Ua]m 5@SCHFKg	NbY	7UH]cfm				Fb. D
5fU	'%SSGé h @Y[h.	'-) : h	K]Ph.			, \$: h	
GUg	GU@Y[h.	: h	GUVK]Ph.		: h	>ch@Y[h.	: h
Gci Xf.	GfYWHdY		; fUX \$			@bYg \$	
GMfcb7caaYhg							
Kcf_8UY %%%*%	Kcf_HdY Bk7cbgH Vcb! :h]U			7cX BI !-B			=gAUcfA/ F. HfY
Kcf_8UY %%%SS	Kcf_HdY GfZWGU! FYj YUH			7cX GGF9			=gAUcfA/ F. : UgY
Kcf_8UY %%%SS	Kcf_HdY 7fUWGUH] !'57			7cX 7G57			=gAUcfA/ F. : UgY
Kcf_8UY %%%SS	Kcf_HdY 7fUWGUH] !'57			7cX 7G57			=gAUcfA/ F. : UgY
Kcf_8UY %%%SS	Kcf_HdY GfZWGU! FYj YUH			7cX GGF9			=gAUcfA/ F. : UgY
@gh7cbgH 8UY %%%SS	HRUcládYg *			Gfj YhX '			
7cbY]cbg D7= +%							
=gh7cbgH 7caaYhg							
GládYBiaVf. \$%	HdY F	5fU	*SSSSGé h			D7= +\$	
GládY7caaYhg							
(, @/ H7F	@	(+) '\$\$ : h					
(, @/ H7F	A	\$\$ : h					
) + K95H 9F-B;	@	*SSSS Gé h					
GládYBiaVf. \$	HdY F	5fU	*SSSSGé h			D7= +%	
GládY7caaYhg							
(, @/ H7F	@	() \$\$\$ : h					
(, @/ H7F	A	) '\$\$ : h					
) + K95H 9F-B;	@	*SSSS Gé h					
GládYBiaVf. \$	HdY F	5fU	', \$\$\$Gé h			D7= +'	
GládY7caaYhg							
(, @/ H7F	@	%\$\$\$ : h					
(, @/ H7F	A	- \$\$\$ : h					
) + K95H 9F-B;	@	', \$\$\$ Gé h					

BYkcf. +5) BLaY FdUc\_YAihjVWU5]kbfh

GfUW F%& BLaY FilkUn%& FdUc\_Y I gY FIEK5M 5fU &(Z\$Gh

GWfch \$& cZ ' : fca. FilkUn%&BX H. FilkUn%& 9IX @gh7chj' %%%\*%

GfZAW 57 : Ua]m 5@SCHFKg NdbY 7UH]cfm FUb. D

5fU \$&Z, \$Gh @V]h. &\$ : h K]Ph. , \$: h

GUg GUV@V]h. : h GUVK]Ph. : h >ch@V]h. : h

Gci Xf. GfYVHdY ; fUX \$ @Ug \$

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**APPENDIX E**  
**DISTRESS SUMMARY REPORT**



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## **APPENDIX F**

### **INVENTORY**

F1: Section Forecasted Pavement Condition Rating

F2: Branch PCI Rating

F3: Branch FOD Rating

**Appendix F1**  
**Forecasted Section PCI**  
 Roanoke Municipal Airport (7A5)

Branch ID	Section ID	Forecasted PCI						
		2021	2022	2023	2024	2025	2026	2027
A01	01	24	22	20	18	16	13	11
R1129	01	70	70	69	66	57	53	49
R1129	02	70	70	69	66	57	53	49
R1129	03	64	56	51	47	43	38	34
TA	01	46	44	40	37	33	30	26

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**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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<b>Dstress</b>	<b>Dstress Severity</b>	<b>Description</b>	<b>Code</b>	<b>WorkType</b>	<b>Work Unit</b>
41	Medun	ALLGATORCF	PAAC	Patching- ACFull Depth	Sqft
41	Hgh	ALLGATORCF	PAAC	Patching- ACFull Depth	Sqft
42	NA	BIBBING	PAAS	Patching- ACPartial Depth	Sqft
42	Hgh	BLOCKCR	PAAC	Patching- ACFull Depth	Sqft
42	Medun	BLOCKCR	CSAC	GackSealing- AC	R
44	Low	CORRUATION	PAAS	Patching- ACPartial Depth	Sqft
44	Hgh	CORRUATION	PAAS	Patching- ACPartial Depth	Sqft
44	Medun	CORRUATION	PAAS	Patching- ACPartial Depth	Sqft
45	Medun	DEPRESSION	PAAC	Patching- ACFull Depth	Sqft
45	Low	DEPRESSION	PAAC	Patching- ACFull Depth	Sqft
45	Hgh	DEPRESSION	PAAC	Patching- ACFull Depth	Sqft
45	Hgh	JIRE CR	CSAC	GackSealing- AC	R
45	Medun	JIRE CR	CSAC	GackSealing- AC	R
45	Hgh	L&TCR	CSAC	GackSealing- AC	R
45	Medun	L&TCR	CSAC	GackSealing- AC	R
45	NA	OILSPILLAGE	PAAC	Patching- ACFull Depth	Sqft
51	Hgh	PAKING	PAAC	Patching- ACFull Depth	Sqft
51	Medun	PAKING	PAAC	Patching- ACFull Depth	Sqft
52	Hgh	RAVING	PAAS	Patching- ACPartial Depth	Sqft
52	Hgh	RUIDING	PAAC	Patching- ACFull Depth	Sqft
52	Low	RUIDING	PAAC	Patching- ACFull Depth	Sqft
52	Medun	RUIDING	PAAC	Patching- ACFull Depth	Sqft
52	NA	SURFACECR	PAAC	Patching- ACFull Depth	Sqft
52	Low	SWELLING	PAAC	Patching- ACFull Depth	Sqft
52	Medun	SWELLING	PAAC	Patching- ACFull Depth	Sqft
61	Low	BLOWUP	PAH	Patching- FCCFull Depth	Sqft
61	Medun	BLOWUP	PAH	Patching- FCCFull Depth	Sqft
61	Hgh	BLOWUP	PAH	Patching- FCCFull Depth	Sqft
62	Medun	CORNERBREAK	PAH	Patching- FCCFull Depth	Sqft
62	Hgh	CORNERBREAK	PAH	Patching- FCCFull Depth	Sqft
62	Low	CORNERBREAK	CSFC	GackSealing- FCC	R
62	Medun	LINEARCR	CSFC	GackSealing- FCC	R
62	Hgh	LINEARCR	PAH	Patching- FCCPartial Depth	Sqft
64	Medun	DURABL CR	PAH	Patching- FCCFull Depth	Sqft
64	Hgh	DURABL CR	SLFC	SkbReplacement- FCC	Sqft
65	Hgh	JISEALDMG	JSIC	Jirt Seal (Localized)	R
65	Medun	JISEALDMG	JSIC	Jirt Seal (Localized)	R
65	Hgh	SMALLPATCH	PAH	Patching- FCCPartial Depth	Sqft
65	Medun	SMALLPATCH	PAH	Patching- FCCPartial Depth	Sqft
65	Medun	LARGEPATCH	PAH	Patching- FCCFull Depth	Sqft

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<b>Dstress</b>	<b>Dstress Severity</b>	<b>Description</b>	<b>Code</b>	<b>WorkType</b>	<b>Work Unit</b>
<b>6</b>	<b>Hgh</b>	<b>LARGEPAICH</b>	<b>PAH</b>	<b>Patching- FCCFull Depth</b>	<b>SqFt</b>
<b>6E</b>	<b>N/A</b>	<b>PUMING</b>	<b>JSIC</b>	<b>JointSeal(Localized)</b>	<b>R</b>
<b>7</b>	<b>Medun</b>	<b>SCALING</b>	<b>PAH</b>	<b>Patching- FCCPartial Depth</b>	<b>SqFt</b>
<b>7</b>	<b>Hgh</b>	<b>SCALING</b>	<b>SLR</b>	<b>SlabReplacement- FCC</b>	<b>SqFt</b>
<b>7I</b>	<b>Hgh</b>	<b>FAILING</b>	<b>GRH</b>	<b>Girding(Localized)</b>	<b>R</b>
<b>7I</b>	<b>Medun</b>	<b>FAILING</b>	<b>GRH</b>	<b>Girding(Localized)</b>	<b>R</b>
<b>7Z</b>	<b>Medun</b>	<b>SHR SLAB</b>	<b>SLR</b>	<b>SlabReplacement- FCC</b>	<b>SqFt</b>
<b>7Z</b>	<b>Hgh</b>	<b>SHR SLAB</b>	<b>SLR</b>	<b>SlabReplacement- FCC</b>	<b>SqFt</b>
<b>7J</b>	<b>Hgh</b>	<b>JONISPAII</b>	<b>PAH</b>	<b>Patching- FCCPartial Depth</b>	<b>SqFt</b>
<b>7J</b>	<b>Medun</b>	<b>JONISPAII</b>	<b>PAH</b>	<b>Patching- FCCPartial Depth</b>	<b>SqFt</b>
<b>7C</b>	<b>Medun</b>	<b>CORNERSPAII</b>	<b>PAH</b>	<b>Patching- FCCPartial Depth</b>	<b>SqFt</b>
<b>7C</b>	<b>Hgh</b>	<b>CORNERSPAII</b>	<b>PAH</b>	<b>Patching- FCCPartial Depth</b>	<b>SqFt</b>
<b>7E</b>	<b>Medun</b>	<b>ASR</b>	<b>SLR</b>	<b>SlabReplacement- FCC</b>	<b>SqFt</b>
<b>7E</b>	<b>Hgh</b>	<b>ASR</b>	<b>SLR</b>	<b>SlabReplacement- FCC</b>	<b>SqFt</b>

## **APPENDIX H**

### **M&R UNIT COSTS**

H1: M&R Unit Costs

H2: Component Costs for Repair

H3: Airport Category

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## 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 RSMMeans, 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.

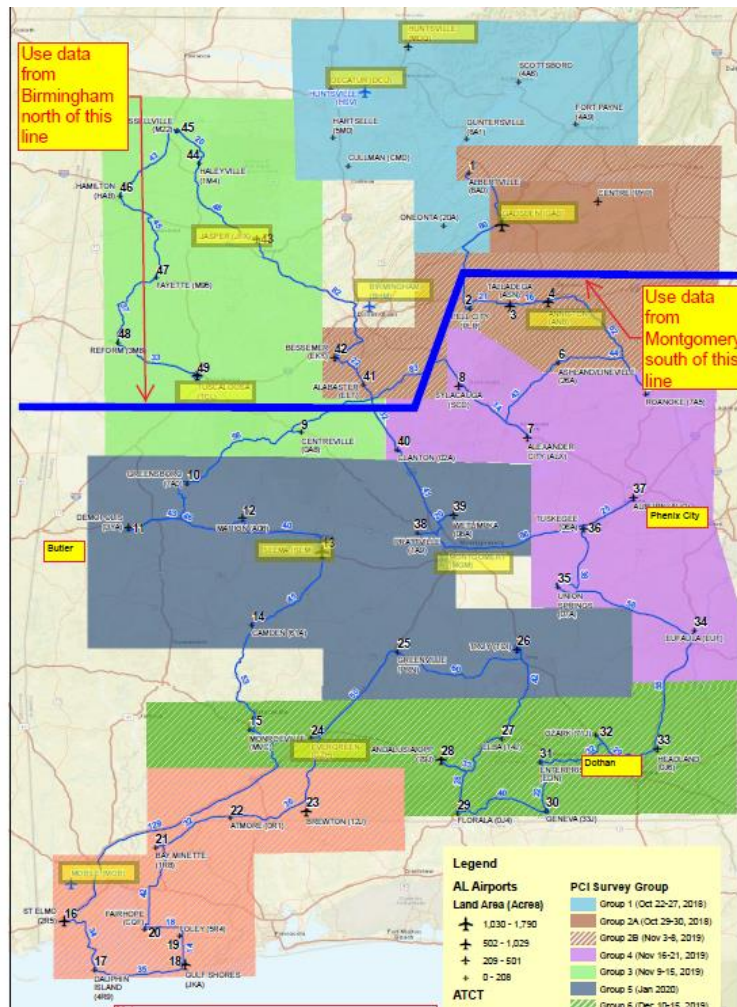


Figure 1: RSMMeans Unit Costs Locations.

**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 Critical Pavement Condition Index, denoted as CP in Table 1. The CP is based on the section’s rank or 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 <sup>1</sup>
	55 - CP	Mill 2" & 2" AC OL
	45 - 55	Mill 2" & 2" AC OLP (With Pre-Overlay Repairs)
Reconstruction	0 - 45	Reconstruct with AC

<sup>1</sup>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 in Table 3 of the FAA’s Advisory Circular 150/5320-6F. The pavement sections used for developing the cost estimates are:

- ≤ 12,500 lbs                    4" P-403 (State HMA Mix) + 6" P-209 Base
- 12,500 – 30,000 lbs        4" P-403 (State HMA Mix) + 8" P-209 Base
- 30,000 – 100,000 lbs      5" P-401 + 10" P-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 the development of the unit costs for ALDOT’s PMP update. However, based on the Engineer’s future 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-direct pavement construction items were developed from API’s extensive experience with 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 RSMMeans 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 – 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		
		≤ 12.5	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		
		≤ 12.5	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	

**Appendix H3  
Airport Category**

Region	City	FAA ID	Max Gross Weight (Thousand lbs)			Max GW	Category
			S	D	2D		
Birmingham	Reform	3M8	12.5	-	-	12.5	<= 12,500
	Fayette	M95	15.0	-	-	15.0	12,500-30,000
	Hamilton	HAB	15.0	-	-	15.0	12,500-30,000
	Scottsboro	4A6	15.0	-	-	15.0	12,500-30,000
	Alabaster	EET	16.0	-	-	16.0	12,500-30,000
	Centre-Piedmont	PYP	16.0	-	-	16.0	12,500-30,000
	Fort Payne	4A9	16.0	-	-	16.0	12,500-30,000
	Haleyville	1M4	20.0	-	-	20.0	12,500-30,000
	Hartselle	5M0	20.0	-	-	20.0	12,500-30,000
	Guntersville	8A1	24.0	-	-	24.0	12,500-30,000
	Cullman	CMD	30.0	-	-	30.0	12,500-30,000
	Russellville	M22	30.0	-	-	30.0	12,500-30,000
	Jasper	JFX	50.0	-	-	50.0	> 30,000
	Oneonta	20A	20.0	35.0	55.0	55.0	> 30,000
	Bessemer	EKY	60.0	60.0	-	60.0	> 30,000
	Albertville	8A0	60.0	90.0	130.0	130.0	> 30,000
	Madison	MDQ	60.0	75.0	140.0	140.0	> 30,000
	Decatur	DCU	75.0	125.0	150.0	150.0	> 30,000
	Tuscaloosa	TCL	61.0	87.0	168.0	168.0	> 30,000
	Gadsden	GAD	90.0	115.0	195.0	195.0	> 30,000
Montgomery	Florala	0J4	-	-	-	-	<= 12,500
	Elba	14J	4.0	-	-	4.0	<= 12,500
	Headland	0J6	12.0	-	-	12.0	<= 12,500
	Roanoke	7A5	12.0	-	-	12.0	<= 12,500
	Greenville	PRN	15.0	-	-	15.0	12,500-30,000
	Union Springs	07A	15.0	-	-	15.0	12,500-30,000
	Wetumpka	08A	15.0	-	-	15.0	12,500-30,000
	Atmore	0R1	16.0	-	-	16.0	12,500-30,000
	Clanton	02A	16.0	-	-	16.0	12,500-30,000
	Eufaula	EUF	16.0	-	-	16.0	12,500-30,000
	Geneva	33J	16.0	-	-	16.0	12,500-30,000
	Greensboro	7A0	16.0	-	-	16.0	12,500-30,000
	Centreville	0A8	18.0	-	-	18.0	12,500-30,000
	Ashland-Lineville	26A	20.0	-	-	20.0	12,500-30,000
	Sylacauga	SCD	20.0	-	-	20.0	12,500-30,000
	St. Elmo	2R5	23.0	-	-	23.0	12,500-30,000
	Ozark	71J	-	25.0	-	25.0	12,500-30,000
	Camden	61A	27.0	-	-	27.0	12,500-30,000
	Bay Minette	1R8	28.0	-	-	28.0	12,500-30,000
	Foley	5R4	28.0	-	-	28.0	12,500-30,000
Tuskegee	06A	28.5	-	-	28.5	12,500-30,000	

**Appendix H3  
Airport Category**

Region	City	FAA ID	Max Gross Weight (Thousand lbs)			Max GW	Category
			S	D	2D		
Montgomery	Alexander City	ALX	30.0	-	-	30.0	12,500-30,000
	Dauphin Island	4R9	30.0	-	-	30.0	12,500-30,000
	Pell City	PLR	30.0	-	-	30.0	12,500-30,000
	Prattville	1A9	30.0	-	-	30.0	12,500-30,000
	Enterprise	EDN	-	-	-	-	> 30,000
	Evergreen	GZH	30.0	50.0	-	50.0	> 30,000
	Marion	A08	30.0	50.0	-	50.0	> 30,000
	Selma	SEM	33.0	54.0	-	54.0	> 30,000
	Fairhope	CQF	36.0	58.0	-	58.0	> 30,000
	Brewton	12J	40.0	60.0	-	60.0	> 30,000
	Demopolis	DYA	30.0	38.0	60.0	60.0	> 30,000
	Monroeville	MVC	70.0	-	-	70.0	> 30,000
	Auburn-Opelika	AUO	45.0	75.0	-	75.0	> 30,000
	Talladega	ASN	30.0	65.0	95.0	95.0	> 30,000
	Gulf Shores	JKA	80.0	100.0	-	100.0	> 30,000
	Troy	TOI	24.0	80.0	140.0	140.0	> 30,000
	Anniston	ANB	28.0	43.5	260.0	260.0	> 30,000
Andalusia-OPP	79J	98.0	160.0	275.0	275.0	> 30,000	

## **APPENDIX I**

### **PAVEMENT CAPITAL IMPROVEMENT PROGRAM**

I1: PCIP Summary

I2: Year 1 Maintenance Plan



**Appendix I1**  
**PCIP Summary**  
Roanoke Municipal Airport (7A5)

Branch & Section	2021	2022	2023	2024	2025	2026	2027
A01-01	Required Project Major Below Critical \$151422.9 Before:23.65 After:100	Preventive \$44.8 Before:97.79 After:97.79	Preventive \$92.28 Before:95.58 After:95.58	Preventive \$142.77 Before:93.36 After:93.36	Preventive \$196 Before:91.15 After:91.15	Preventive \$252.51 Before:88.94 After:88.94	Preventive \$312.01 Before:86.73 After:86.73
R1129-01	Required Project Major Below Critical \$127032 Before:69.81 After:100	Preventive \$43.24 Before:98.7 After:98.7	Preventive \$86.27 Before:97.48 After:97.48	Preventive + Required Project Global MR \$20349.11 Before:96.45 After:98.7	Preventive \$91.53 Before:97.48 After:97.48	Preventive \$132.73 Before:96.45 After:96.45	Preventive \$175.27 Before:95.45 After:95.45
R1129-02	Required Project Major Below Critical \$870249.6 Before:69.81 After:100	Preventive \$296.22 Before:98.7 After:98.7	Preventive \$591.02 Before:97.48 After:97.48	Preventive + Required Project Global MR \$139404.29 Before:96.45 After:98.7	Preventive \$627.01 Before:97.48 After:97.48	Preventive \$909.28 Before:96.45 After:96.45	Preventive \$1200.72 Before:95.45 After:95.45
R1129-03	Required Project Major Below Critical \$145684.8 Before:60.68 After:100	Preventive \$49.59 Before:98.7 After:98.7	Preventive \$98.94 Before:97.48 After:97.48	Preventive + Required Project Global MR \$23337.08 Before:96.45 After:98.7	Preventive \$104.97 Before:97.48 After:97.48	Preventive \$152.22 Before:96.45 After:96.45	Preventive \$201.01 Before:95.45 After:95.45

**Appendix I1**  
**PCIP Summary**  
 Roanoke Municipal Airport (7A5)

Branch & Section	2021	2022	2023	2024	2025	2026	2027
TA-01	Required Project Major Below Critical \$48320.32 Before:45.27 After:100	Preventive \$10.44 Before:98.98 After:98.98	Preventive \$22.76 Before:97.85 After:97.85	Preventive + Required Project Global MR \$6274.83 Before:96.33 After:98.98	Preventive \$24.14 Before:97.85 After:97.85	Preventive \$42.39 Before:96.33 After:96.33	Preventive \$67 Before:94.36 After:94.36



**Appendix I2**  
**Localized Maintenance Plan**  
Roanoke Municipal Airport (7A5)

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
A01	01	Safety	41	ALLIGATOR CR	High	170	SqFt	0.88	Patching - AC Full-Depth	226	SqFt	\$25.05	\$5,673
A01	01	Safety	48	L & T CR	Low	1,665	Ft	8.64	No Localized M & R	0		\$0.00	\$0
A01	01	Safety	48	L & T CR	Medium	330	Ft	1.71	No Localized M & R	0		\$0.00	\$0
A01	01	Safety	50	PATCHING	Low	240	SqFt	1.25	No Localized M & R	0		\$0.00	\$0
A01	01	Safety	50	PATCHING	High	45	SqFt	0.23	Patching - AC Full-Depth	76	SqFt	\$25.05	\$1,904
A01	01	Safety	52	RAVELING	High	100	SqFt	0.52	No Localized M & R	0		\$0.00	\$0
A01	01	Safety	52	RAVELING	Medium	18,880	SqFt	98	No Localized M & R	0		\$0.00	\$0
R1129	01	Preventive	48	L & T CR	Medium	230	Ft	0.73	Crack Sealing - AC	230	Ft	\$3.95	\$909
R1129	01	Preventive	48	L & T CR	Low	2,190	Ft	6.93	No Localized M & R	0		\$0.00	\$0
R1129	01	Preventive	57	WEATHERING	Low	31,600	SqFt	100	No Localized M & R	0		\$0.00	\$0
R1129	02	Preventive	48	L & T CR	Low	17,559	Ft	8.11	No Localized M & R	0		\$0.00	\$0
R1129	02	Preventive	48	L & T CR	Medium	2,556	Ft	1.18	Crack Sealing - AC	2,556	Ft	\$3.95	\$10,095
R1129	02	Preventive	50	PATCHING	Low	2,646	SqFt	1.22	No Localized M & R	0		\$0.00	\$0
R1129	02	Preventive	57	WEATHERING	Low	116,418	SqFt	53.78	No Localized M & R	0		\$0.00	\$0
R1129	03	Safety	48	L & T CR	Low	3,795	Ft	10.47	No Localized M & R	0		\$0.00	\$0
R1129	03	Safety	48	L & T CR	Medium	715	Ft	1.97	No Localized M & R	0		\$0.00	\$0
R1129	03	Safety	57	WEATHERING	Low	3,624	SqFt	10	No Localized M & R	0		\$0.00	\$0
TA	01	Safety	48	L & T CR	Low	700	Ft	7.19	No Localized M & R	0		\$0.00	\$0
TA	01	Safety	48	L & T CR	Medium	315	Ft	3.23	No Localized M & R	0		\$0.00	\$0
TA	01	Safety	50	PATCHING	High	20	SqFt	0.21	Patching - AC Full-Depth	42	SqFt	\$25.05	\$1,052
TA	01	Safety	52	RAVELING	Medium	4,678	SqFt	48.02	No Localized M & R	0		\$0.00	\$0