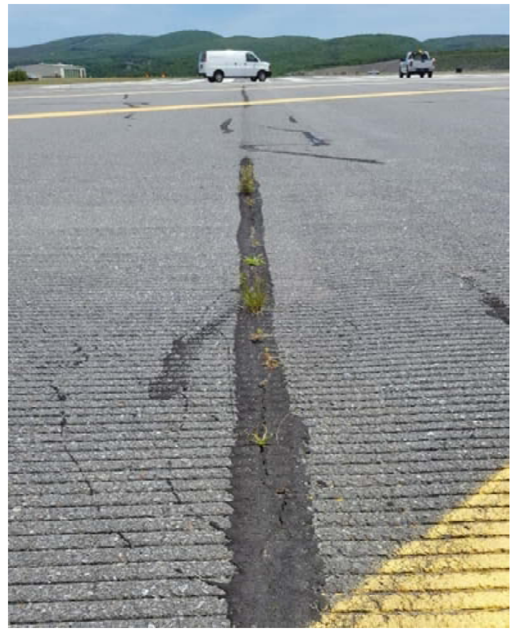
A. Pavement Management Plan



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A. Airfield Pavement Management Study

A.1. INTRODUCTION

A.1.1. Project Description and Scope of Work

McFarland-Johnson, Inc. (Engineer/Consultant) was retained by the Counties of Luzerne and Lackawanna, Pennsylvania, Owner/Sponsor of the Wilkes-Barre/Scranton International Airport (AVP) to provide planning and engineering services to complete a Master Plan Update (MPU) and Airport Layout Plan Update (ALPU).

Integrated into Task 3, Airport Facilities Inventory, of the MPU is the Airfield Pavement Management Study (APMS) for airside pavement at AVP. The APMS will aid the Owner/Sponsor in project planning and securing grants and funding as part of an overall Maintenance and Rehabilitation (M&R) plan for their airfield pavement.

All work performed as part of this APMS has been performed in accordance with:

- *Federal Aviation Administration (FAA) Advisory Circular 150/5380-7B Airport Pavement Management Program*
- *FAA Advisory Circular 150/5380-6C Guidelines and Procedures for Maintenance of Airport Pavements*
- *ATSM D5340-12 Standard Test Method for Airport Pavement Condition Index Surveys Airport Pavement*
- *ASTM D6690 Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*

List of Acronyms			
AVP	Wilkes-Barre/Scranton International Airport	**AIP**	Airport Improvement Program
MPU	Master Plan Update	**ALPU**	Airport Layout Plan Update
APMS	Airfield Pavement Management Study	**PFC**	Passenger Facility Charges
M&R	Maintenance and Rehabilitation	**GPS**	Global Positioning System
FAA	Federal Aviation Administration	**PCC**	Portland Cement Concrete
ASTM	American Society for Testing and Materials	**AC**	Asphalt Concrete
PCI	Pavement Condition Index	**PDF**	Portable Document Format
CIP	Capital Improvement Program	**SF**	Square Feet
PCN	Pavement Classification Number	**MSL**	Minimum Service Level

To complete the APMS, the following services were performed by the Engineer/Consultant:

- Review existing record plans to develop pavement histories
- Defined the pavement network and calculated sample units based on project history and record documents
- Conducted an airfield pavement condition survey to visually assess the condition of all airfield pavement and document pavement distress types, severities, and quantities
- Evaluated the results of the visual assessment and documented distresses to assign a Pavement Condition Index (PCI) value for each section and branch of pavement using PAVER software
- Performed analyses of distress data and deterioration rates to develop a maintenance plan, 5-year near term Capital Improvement Program (CIP), and a 20-year long term CIP including estimated project costs
- Identify basic short and long-term maintenance and rehabilitation (M&R) techniques

A.1.2. Deliverables

The following deliverables are included as part of this contract:

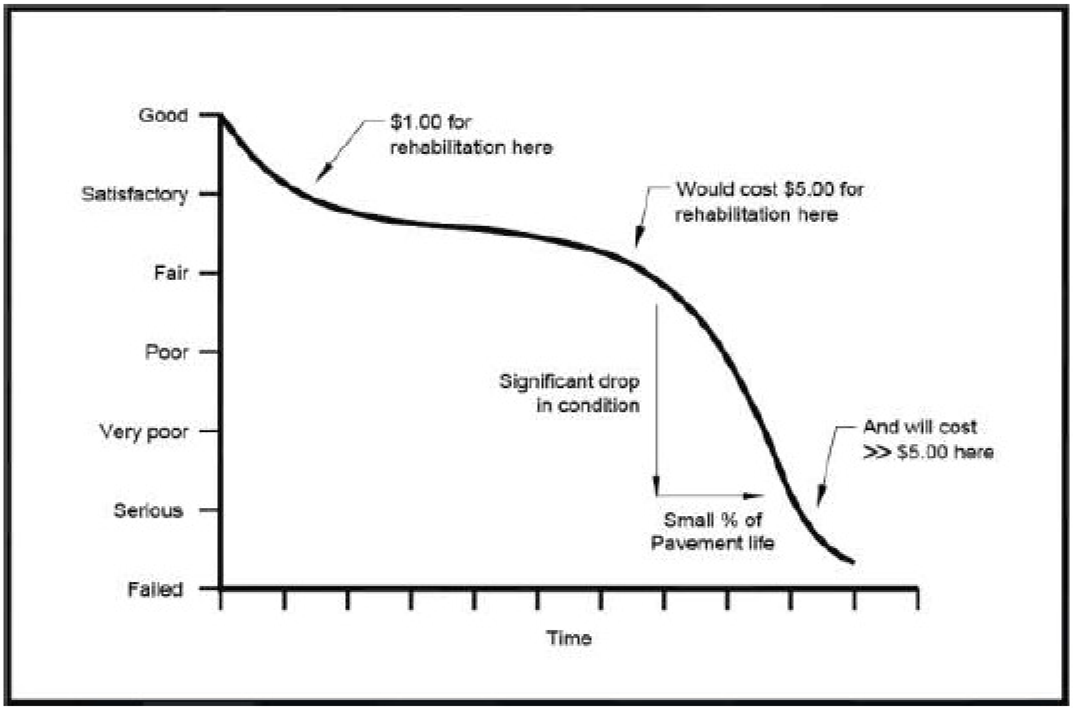
- Color-coded PCI map of all airfield pavement
- Network map of airfield pavement showing branch, section, and sample unit boundaries, including inspected sample units
- APMS which includes a PCI analysis, types of distresses noted for each pavement branch, deterioration rate and its effect on the PCI, and basic M&R techniques.
- 5-year near term CIP
- 20-year long term CIP
- Pavement Classification Numbers (PCNs) for Runway 4-22 and Runway 10-28
- Technical report which summarizes the above data and includes PCI maps along with inspection photographs, descriptions of pavement distresses and definitions of repair methods and strategies

A.1.3. Purpose

The FAA requires federally obligated airports whose projects are funded through federal grant monies from the Airport Improvement Program (AIP) or with revenue from the Passenger Facility Charges (PFC) Program to implement an APMS. A detailed inspection of airfield pavements at least once a year is also required. If a PCI survey (such as the one included as part of this project) is performed, then the frequency of detailed inspections may be extended to three years.

By implementing an APMS, an airport is able to evaluate the condition of its pavements, prioritize preventative M&R, quickly identify the most economical time to perform M&R, and implement the best M&R practice for a given section of pavement. The importance of this is identified in Figure A-1. Preserving pavements by performing M&R within the first 75 percent of the pavement life can eliminate or delay rehabilitation or reconstruction expenses that may be six to ten times the cost of preventative maintenance measures.

Figure A-1: Typical Pavement Condition Life Cycle



Source: FAA Advisory Circular 150/5380-7B, Airport Pavement Management Program.

A.1.4. Software

PAVER Version 7.1 and PAVER FieldInspector, developed by Colorado State University were used to develop the APMS.

PAVER Version 7.1 and PAVER FieldInspector was developed for the sole purpose of managing pavement and allows the user to inventory pavement, calculate PCI values from field inspections, predict pavement deterioration, and plan and prepare pavement maintenance and repair programs.

PAVER FieldInspector is a tablet-based software application that allows pavement inspectors to record pavement distress data in the field and calculate the PCI in real time. Additionally, the Global Positioning System (GPS) capability in both the tablet and the software allow inspectors to rapidly identify their position on a pavement network map.

A.2. PAVEMENT INVENTORY

A.2.1. Overview

This section of the APMS describes the steps taken to define the pavement network and establish the various pavement branch and section boundaries at the Airport. An accurate pavement network allows for a comprehensive PCI survey to be conducted.

A.2.2. Definitions

To provide an accurate assessment of the PCI, each APMS is divided into a pavement network with branches, sections and sample units within those sections. These terms, common to all APMSs, are used as a baseline for the organization of pavements to be inspected. Found in FAA Advisory Circular 150/5380-7B *Airport Pavement Management Program* and ASTM D5340-12 *Standard Test Method for Airport PCI Surveys*, they are defined as follows:

- Pavement Network: The highest level of an APMS. For example, a network can include all the airfield pavements at a single airport or all the airfield pavements in a state airport system. For this project, the AVP airfield pavements are defined as the pavement network.

- Pavement Branch: A readily identifiable part of the pavement network with a distinct function. For example, pavement branches in an airport setting consist of each individual runway, taxiway or apron and together make up the pavement network.

- Pavement Section: Individual components of a pavement branch. Each branch consists of at least one section, but may consist of more if pavement characteristics vary throughout the branch. Factors that affect the division of branches into sections include, but is not limited to: pavement structure, type, age and condition; traffic composition and frequency (current and future); construction history; pavement function; and drainage facilities and shoulders.

- Pavement Sample Unit: The final level of an APMS. Sample units are 20 contiguous slabs (±8 slabs if the total number of slabs in the section is not evenly divided by 20, or to accommodate specific field condition) for Portland Cement Concrete (PCC) airfield pavement and 5,000 contiguous square feet (SF) (± 2,000 SF if the pavement is not evenly divided by 5,000, or to accommodate specific field conditions) for Asphalt Concrete (AC) airfield pavement and porous friction surfaces. A statistically significant number of sample units are inspected within a pavement section to determine the PCI.

In addition to the above, other terms related to M&R efforts are commonly used throughout APMSs. Some of these include:

- Preventive Maintenance: Cost-effective efforts applied to an existing pavement network that slows future deterioration, preserves the network, and maintains or improves the condition of the system. Preventive maintenance does not significantly increase the structural capacity of pavement section. Examples include slurry seals, crack sealing/filling, or patching for AC pavements and joint or slab repair for PCC pavements.

- Pavement Rehabilitation: Structural improvements to an existing pavement section that increase its load carrying capacity and extend its service life. Examples of pavement rehabilitation include mill and overlay of existing AC pavements as well as reclamation through pulverization and AC or PCC overlay for PCC pavements.

- Pavement Reconstruction: Replacement of the entire pavement section with an equivalent or increased section dependent upon the aircraft fleet mix.

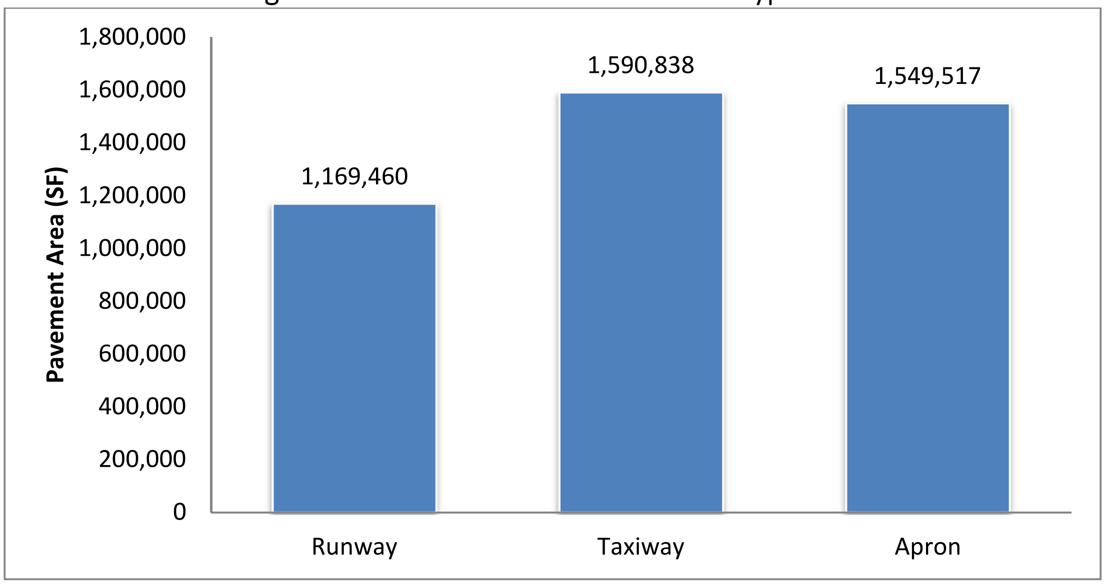
A.2.3. Records Review and Pavement History

The Engineer/Consultant performed a thorough review of past project records at AVP to determine construction history and the pavement structures for the existing airfield pavements. Record plans from recent projects were reviewed, as well as the review of older projects provided by Airport staff as hard copies or in Portable Document Format (PDF). Pavement section data and construction history at AVP is included in Appendix A1.

A.2.4. Pavement Inventory Results

The total existing airfield pavement area at the AVP is 4,309,815 SF. A detailed breakdown of the pavement areas categorized by type (branch use) is shown in Figure A-2. The final pavement inventory is displayed as a Network Map showing the established branches, sections and sample units, is included in Appendix A2.

Figure A-2: Pavement Area and Branch Type



Source: PAVER, McFarland-Johnson Analysis.

A.3. PAVEMENT CONDITION EVALUATION

A.3.1. Field Inspection and Procedure

Pavement conditions for AVP were evaluated using the PCI procedure, as documented in the FAA Advisory Circular 150/5380-6C *Guidelines and Procedures for Maintenance of Airport Pavements* and ASTM D5340-12 *Standard Test Method for Airport PCI Surveys*. The PCI procedure is the aviation industry standard for visually assessing pavement condition. It involves inspecting sample units within a particular section, identifying the type and severity of pavement distresses within that sample unit, and measuring the quantity of distress.

The PCI represents the overall condition of the pavement ranging from 100. A pavement section in excellent condition receives a PCI of 100, with a failed pavement section receiving a PCI score of zero. Figure A-3 shows a visual representation of several PCI values at AVP.

Figure A-3: Visual Representation of PCI Values

Pavement Surface[1]	PCI
	84
	63
	41

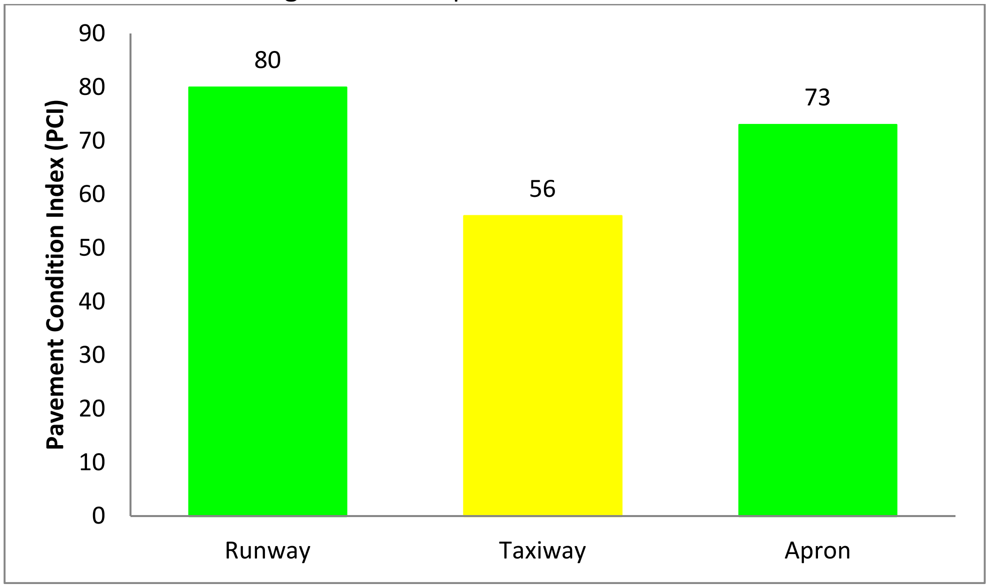
The PCI field inspection of AVP took place over the course of four days – June 21-24, 2016 and was performed by a two-person crew. Measurements and photographs were taken of the various distresses found in the pavement sample units identified in Appendix A3.

A.3.2. Pavement Condition Index (PCI) Results Summary

As documented in the Pavement Inventory portion of this report, the entirety of the Airport's 4,309,815 SF of airside pavement was included in this PCI study. Approximately 1,444,531 SF of the total pavement was surveyed by the inspectors.

Figure A-4 depicts the results of the PCI survey in graph format by branch type.

Figure A-4: Graph of PCI Results



Source: PAVER, McFarland-Johnson Analysis.

Table A-1 provides a general description of the PCI rating categories and the corresponding pavement areas at the Airport which fall under these categories.

Table A-1: Distribution of PCI Ratings for AVP

Simplified PCI Rating	PCI Range	Definition	Pavement Area (SF)	Pavement Area (%)
Good	86-100	GOOD: Pavement has minor or no distresses and requires only routine maintenance	45,519	1%
	71-85	SATISFACTORY: Pavement has scattered low-severity distresses that need only routine maintenance	2,202,458	51%
Fair	56-70	FAIR: Pavement has a combination of generally low and medium-severity distresses. M&R needs are routine to major in the near future	1,460,155	34%
Poor	41-55	POOR: Pavement has low, medium, and high-severity distresses that probably cause some operational problems. Near-term maintenance and repair needs may range from routine up to a requirement for reconstruction	433,484	10%
	26-40	VERY POOR: Pavement has predominantly medium and high-severity distresses that cause considerable maintenance and operational problems. Near-term maintenance and repair needs will be intensive in nature	168,199	4%

	11-25	SERIOUS: Pavement has mainly high-severity distresses that cause operational restrictions; immediate repairs are needed	-	-
	0-10	FAILED: Pavement deterioration has progressed to the point that safe operations are no longer possible; complete reconstruction is required	-	-

Source: PAVER, McFarland-Johnson Analysis.

Using the distress measurements taken by the inspectors, a PCI was determined for each pavement sample unit within a given pavement section. PCI calculations were completed using the PAVER software to determine a PCI value for each section, with a weighted PCI then calculated for each branch. These results may be found in Table A-2 and a visual representation of these results may be found on the PCI Map in Appendix A4.

Table A-2: PCI Results for AVP

Branch Description	Branch	Branch PCI	Surface	Section	Section PCI
ARFF/Old Terminal Building Apron	A	72	AC	A-1	71
			AC	A-2	73
Cargo Apron	CARGO	75	PCC	CARGO	75
Commercial Apron	CTA	69	AC	CTA-1	68
			PCC	CTA-2	74
			PCC	CTA-3	84
General Aviation Apron	GAA	74	AC	GAA-1	74
			PCC	GAA-2	59
			PCC	GAA-3	54
Helipad	Heli	85	PCC	SGAA-2	85
Runway 10 Safety Area	RSA	66	AC	RSA	66
Runway 10-28	RWY10-28	65	AC	RWY10-28-1	66
			AC	RWY10-28-2	41
			AC	RWY10-28-3	81
			AC	RWY10-28-4	87
			AC	RWY10-28-5	43
			AC	RWY10-28-6	64
Runway 4-22	RWY4-22	80	AC	RWY4-22	80
South General Aviation Apron	SGAA	84	AC	SGAA-1	84
Taxiway A	TWYA	63	AC	TWYA-1	84
			AC	TWYA-2	41
			AC	TWYA-3	80
Taxiway B	TWYB	41	AC	TWYB-1	39
			AC	TWYB-2	42

			AC	TWYB-3 B5	41
Taxiway B2	TWYB2	50	AC	TWYB2-1	37
			AC	TWYB2-2	76
Taxiway B3	TWYB3	52	AC	TWYB3-1	41
			AC	TWYB3-2	73
Taxiway B4	TWYB4	59	AC	TWYB4	59
Taxiway C	TWYC	47	AC	TWYC-1	56
			AC	TWYC-2	38
			AC	TWYC-3	73
Taxiway D	TWYD	61	AC	TWYD-1	57
			AC	TWYD-2	41
			AC	TWYD-3	76
			AC	TWYD-4	63
Taxiway E	TWYE	76	AC	TWYE	76

Source: PAVER, McFarland-Johnson Analysis.

Distress Types and Frequency

The types of distresses identified during the pavement inspection help determine the cause of pavement deterioration. PCI distress types are caused by loading, environmental factors, construction deficiencies or a combination thereof. Load related distresses are caused by aircraft or vehicular traffic and may indicate structural deficiency. Environmental related distresses, like weathering, suggest aged or climate-vulnerable pavement. Understanding the source of distress can help determine a maintenance method that would address the cause and correct the distress in the most cost effective manner.

For AC pavements, mostly due to environmental factors such as stresses induced by temperature changes, freeze-thaw cycles. The asphalt concrete mix also becomes increasingly brittle due to oxidation and deterioration of asphalt cement. PCC Joint seal damage is primarily due to temperature and freeze-thaw induced stresses, and age related oxidation and deterioration of the joint seal materials.

The most common distress types found at AVP were longitudinal and transverse cracking, weathering, raveling, and alligator cracking. Each of these distress types observed exhibited all levels of severity at AVP, photographs of these distresses can be found in Appendix A5.

A.3.3. Pavement Classification Number (PCN)

Based on the existing subgrade strength, the existing pavement sections, and the air traffic mix, the PCN's were calculated for the airport pavement sections and are shown in Appendix A9.

A.4. MAINTENANCE AND REHABILITATION (M&R) PROGRAM

A.4.1. Introduction

The results of the PCI survey can be correlated with the appropriate M&R work type. This is illustrated in Table A-3. Pavements with a PCI of 71 or above will benefit from preventative maintenance, such as crack sealing and surface treatments. Pavements with a PCI between 41 and 70 likely will require major or minor rehabilitation. Pavement with a PCI of 40 or below has damage and oftentimes only full reconstruction will correct the problems exhibited. The M&R program for this APMS was developed using the criteria shown in Table A-3.

Table A-3: PCI Compared to Repair Type

PCI		Rating	Repair
86-100		Good	Preventive Maintenance
71-85		Satisfactory	
56-70		Fair	Minor Rehabilitation
41-55		Poor	Major Rehabilitation
26-40		Very Poor	Reconstruction
11-25		Serious	
0-10		Failed	

A.4.2. Inspection Schedule

Airport Owners/Sponsors are required by the FAA to meet certain requirements for their APMS. One of these requirements is the frequency of inspections. Airports must perform a detailed inspection of airfield pavements at least once a year. The only exception is if a PCI survey, such as that included in this project, is performed whereupon the frequency of the detailed inspections may be extended to three years. Airports should also incorporate less detailed daily, weekly, and monthly inspections of their pavements.

A.4.3. Best Practices for Rehabilitation and Repair

Different types and severity levels of distresses require varying degrees and frequency of maintenance in order to be effective. Table A-4 contains recommended localized pavement maintenance based on distress type and severity level for AC and PCC pavement types. Appendix A6 provides further detail of M&R Work Descriptions.

Table A-4: Recommended Maintenance Method - AC

Distress Type	Probable Cause of Distress	Recommended Maintenance Method
Alligator Cracking	Fatigue failure of the AC surface under repeated traffic loading.	If localized, partial- or full-depth asphalt patch. If extensive, major rehabilitation needed.
Block Cracking	Shrinkage of the AC and daily temperature cycling; it is not load associated.	At low severity levels, crack seal and/or surface treatment. At higher severities, consider overlay.
Bleeding	Excessive amounts of asphalt cement or tars in the mix and/or low air void content.	Spread heated sand, roll, and sweep. Another option is to plane excess asphalt. Or, remove and replace.
Corrugation	Traffic action combines with and unstable pavement layer.	If localized, mill. If extensive, remove and replace.
Depression	Settlement of the foundation soil.	Patch.
Jet Blast	Bituminous binder has been burned or carbonized.	Patch.
Joint Reflection	Movement of the concrete slab beneath the asphalt the AC surface due to thermal and moisture changes.	At low- and medium-severities, crack seal. At higher severities, especially if extensive, consider overlay.
Longitudinal and Transverse Cracking	Cracks may be caused by 1) poorly constructed paving lane joint, 2) shrinkage of the AC surface due to low temperatures or hardening of the asphalt, or 3) reflective crack caused by cracks in an underlying AC layer.	At low- and medium-severity levels, crack seal. At higher severities, especially if extensive, consider overlay options.
Oil Spillage	Deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents.	Patch.
Patching	N/A	Replace patch if deteriorated.
Polished Aggregate	Repeated traffic applications.	Aggregate seal coat is one option. Could also groove or mill. Overlay is another option.
Rutting	Usually caused by consolidation or lateral movement of the materials due to traffic loads.	Patch medium- and high-severity levels if localized. If extensive, consider major rehabilitation.
Shoving	Where PCC pavements adjoin flexible pavements, PCC “growth” may shove the asphalt pavement.	Mill and patch as needed.
Slippage Cracking	Low strength surface mix or poor bond between the surface and next layer of pavement structure.	Partial- or full-depth patch.
Swelling	Usually caused by frost action or by swelling soil.	Patch if localized. Major rehabilitation if extensive.
Raveling	Asphalt binder may have hardened significantly, causing coarse aggregate pieces to dislodge.	Patch if isolated. At higher severity levels, consider major rehabilitation if extensive.
Weathering	Asphalt binder and/or fine aggregate may wear away as the pavement ages and hardens.	Patch if isolated. Consider a surface treatment if extensive.

Recommended Maintenance Method – PCC

Distress Type	Probable Cause of Distress	Recommended Maintenance Method
Alkali Silica Reaction (ASR)	Chemical reaction of alkalis in the Portland cement with certain reactive silica minerals. ASR may be accelerated by the use of chemical pavement deicers.	At medium- and high-severity levels, slab replacement is recommended.
Blow-Up	Incompressibles in joints.	Partial- or full-depth patch. Slab replacement.
Corner Break	Load repetition combined with loss of support and curling stresses.	Seal cracks at low-severity. Full-depth patch.
Cracks	Combination of load repetition, curling stresses, and shrinkage stresses.	Seal cracks. At high-severity, may need full-depth patch or slab replacement.
Durability Cracking	Concrete's inability to withstand environmental factors such as freezethaw cycles.	Full-depth patch if present on small amount of slab. At higher severity levels, once it has appeared on most of slab, slab replacement.
Joint Seal Damage Cracking	Stripping of joint sealant, extrusion of joint sealant, weed growth, hardening of the filler (oxidation), loss of bond to the slab edges, or absence of sealant in joint.	Replace joint seal.
Patching (Small and Large)	N/A	Replace patches if deteriorated.
Popouts	Freeze-thaw action in combination with expansive aggregates.	Monitor.
Pumping	Poor drainage, poor joint sealant.	Seal cracks and joints. Underseal is an option if voids have developed. Establish good drainage.
Scaling	Overfinishing of concrete, deicing salts, improper construction, freezethaw cycles, and poor aggregate.	At low-severity levels, do nothing. At medium- and high-severity levels, partial-depth patches or slab replacement.
Settlement	Upheaval or consolidation.	At higher severity levels, leveling patch or grind to restore smooth ride.
Shattered Slab	Load repetition.	Replace slab.
Shrinkage	Setting and curing of the concrete.	Monitor.
Spalling (Joint and Corner)	Excessive stresses at the joint caused by infiltration of incompressible materials or traffic loads; weak concrete at joint combined with traffic loads.	Partial-depth patch.

A.4.4. Pavement Repair Materials

Pavement repair materials are frequently improved and new products are being introduced to the market on a regular basis. The following materials listed in this section are the recommended materials available to Airport maintenance staff.

Joint and Crack Sealer

Hot-poured, pressure-injected, polymeric rubberized asphalt sealant meeting the requirements of ASTM D6690 *Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements* is the FAA required standard for joint and crack sealant material. The advantage to this material is its low cost, durability, and the fact that it is suitable for both flexible (AC) and rigid (PCC) pavements.

Flexible Pavement Patch

Long-term patches should be made with high-quality plant mixed hot asphalt having a ¾-inch maximum aggregate size and meeting FAA P-401 specifications. P-401 is a specialty asphalt mix and as such is not always available from local suppliers especially in the small quantities required for asphalt patching. Should this be the case, high quality state highway asphalt mixes may be used in lieu of P-401. For short-term repairs, high performance plant mixed cold patching products may be used. Low-quality asphalt patch materials available at local hardware stores should be avoided.

Rigid Pavement Patch

Permanent patches in rigid pavement should be made with air-entrained concrete that has a 1-inch maximum coarse aggregate size. Consideration should be given to whether the area being repaired needs to be opened to traffic quickly. If that is the case, consideration should be given to adding an accelerator admixture to the concrete or using Type III cement. The concrete patch material should either have low slump or zero slump. As with flexible pavement patches, low-quality packaged materials should be avoided.

A.4.5. Pavement Repair Equipment

As with pavement repair materials, the equipment used in pavement repairs is regularly being upgraded and refined. Specialty equipment is available to speed up the process, and produce long lasting pavement repairs. The following are the most commonly used and effective pieces of equipment in pavement repair operations.

Air Compressor

Air compressors are used to remove non-compressible sand, debris, and other detritus from cracks and joints. A sustained capacity of 120 cubic feet per minute with a nozzle velocity of 100 pounds per square inch is the most effective unit. An air compressor meeting these requirements is typically a towed unit or trailer-mounted.

Concrete Saw

Concrete saws must have the ability to make a minimum 3-inch deep cut in both asphalt and concrete pavements. To perform this type of work, gasoline-powered, 5- to 20-horsepower walk-behind saws are typically used.

Router

Routing pavement cracks before sealant is installed will extend pavement life significantly. Adequate depth is provided after routing to allow the sealant to handle the seasonal expansion and contraction. Typical crack routers have a 25-horsepower motor and are available from a variety of manufacturers.

Heating Kettle

The heating kettle is a critical item in a successful and productive sealing program. A heating kettle with minimum material capacity of 100 gallons and a melt rate of at least 1,000 pounds per hour is recommended for large sealing operations. These variables dictate the rate at which a crew progresses. Heating kettles should also contain a double boiler tank with continuous recirculation. Sealant material has the potential to be overheated by the heating kettle and temperatures should be monitored as sealing operations are ongoing. “Burning” the sealant will age harden the material and reduce its effectiveness.

Vibratory Roller or Plate Compactor

Both pieces of equipment are required to compact plant mixed hot-mix asphalt material. Vibratory rollers are typically used for larger patches and plate compactors are used for smaller patches.

Milling Machine or Cold Planer

These machines use a large rotating drum to remove and grind the pavement surface. They should be used to ensure an adequate area and depth of pavement is removed prior to patching and/or repairing joints.

Other Equipment

General use equipment such as dump trucks, water trucks, power sweeping units, and front end loaders are commonly used in pavement repair operations and can be helpful in a maintenance program.

A.4.6. Pavement Deterioration

Included in the APMS is an analysis of the airfield pavement deterioration rates at AVP. Table A-5 shows the results of PAVER’s Condition Performance Analysis. The analysis shows projected deterioration of the various pavement branches at the Airport over a 5-year period. Colors shown equate to the previously described PCI rating scale. It should be noted that this deterioration rate table does not account for any preventive maintenance implemented at AVP, nor any rehabilitation or reconstruction projects that may take place over this 5-year period.

Table A-5: Projected Pavement Deterioration at AVP

Branch ID	2016	2017	2018	2019	2020	2021
All	70	67	64	62	60	59
A	72	71	69	66	63	59
CARGO	75	75	73	72	69	66
CTA	69	68	65	62	58	55
GAA	74	73	71	69	66	62
Heli	85	82	78	76	76	76
RSA	66	64	61	57	54	50
RWY10-28	65	63	60	57	54	51
RWY4-22	80	78	76	76	76	75
SGAA	84	81	78	76	76	76
TWYA	63	61	59	58	57	57
TWYB	41	40	38	37	36	36
TWYB2	50	50	49	49	49	49
TWYB3	52	51	49	47	45	44
TWYB4	59	53	50	46	43	41
TWYC	47	47	46	45	43	42
TWYD	61	59	56	53	50	47
TWYE	76	76	76	75	75	75

Source: PAVER Condition Performance Analysis (Area Weighted Average), McFarland-Johnson Analysis.

Load-Related Deterioration

A pavement distress such as alligator cracking is indicative of repeated traffic loading and structural deficiency. Asphalt pavements are designed to bend and gradually spread loads over wide areas. As a pavement section ages, distresses develop and allow water to seep in, diminishing the ability for the pavement to withstand and resist loading. Wheel loads from aircraft or snow-removal equipment may exacerbate the severity of cracking in these pavement sections. Sealing these joints and cracks and maintaining pavement integrity will help prevent this load-related deterioration.

Materials-Related Deterioration

Choosing the correct materials that meet FAA specifications and correct installation of those materials is imperative to preventing materials-related pavement deterioration. Aggregates are the biggest component of a pavement section and the contact between these particles is what transfers the loading and provides strength. The shape and durability of aggregate are the most important factors affecting pavement performance. Durability is the ability of the aggregate to resist deterioration and perform satisfactorily over time. Sharp, well-angled aggregates that interlock, compact densely, and resist movement are the most desirable.

Air voids are also a crucial part of any hot mix asphalt job mix. When a pavement section is subjected to aircraft or vehicle loading, a small amount of secondary consolidation will occur. Air voids allow for the movement of the asphalt binder within the mix during this time. Without sufficient air voids, the asphalt binder will migrate to the surfaces. This is known as “bleeding” and will cause the pavement section to not only lose skid resistance but become more susceptible to rutting.

However, if air voids are too high in a mix, water can penetrate the pavement surface and increase its susceptibility to the freeze-thaw cycle encountered in this region of the United States. Air voids should be kept low enough to prevent water penetration but high enough to allow safe movement of the asphalt binder within the mix.

From previously mentioned record research, it was determined that the T-hangar pavement at AVP was constructed using state highway asphalt concrete mixes. It is unknown if asphalt materials testing results are available for this pavement section. The use of state highway asphalt concrete mixes may have played a role in accelerated deterioration of this pavement.

Environmental/Age-Related Deterioration

The seasonal and daily temperature changes encountered in the Northeast region of the United States causes significant expansion and contraction of pavement sections. Shear stresses resulting from this expansion and contraction can cause transverse cracking in flexible pavements as well as opening and closing of pavement joints.

Subsurface water can have the greatest impact on pavement deterioration. A saturated subgrade reduces the ability of the pavement section to handle aircraft and vehicle loading and typically results in alligator cracking and rutting. Water within a pavement section expands when it freezes and causes the pavement to heave. Repeated freeze-thaw cycles will ultimately cause the pavement to fail. Because of this susceptibility, pavement sections in this region are often constructed with a subsurface drainage system, designed to remove as much moisture from the pavement structure as possible.

Subsurface water is also thought to cause a phenomenon known as asphalt stripping. Asphalt stripping occurs when the bond between aggregates and asphalt binder is lost. Typically, this takes place at the bottom of the asphalt layer and manifests itself as other forms of distress such as rutting or alligator cracking on the surface. Because of this, prevention and recognition are difficult. A pavement core is usually necessary to identify asphalt stripping as the cause of the distress.

As flexible pavement ages, it oxidizes causing it to become brittle. Surface treatments and seal coats (commonly found on aircraft aprons and also used to protect against fuel spills) are installed to provide a protective barrier and slow the rate of oxidation.

A.4.7. Recommended Maintenance Actions

The airfield pavements at the Airport most in need of M&R is the network of taxiways which includes Taxiway A, Taxiway B, Taxiway B2, Taxiway B3, Taxiway B4, Taxiway C, Taxiway D, and Taxiway E. The majority of these pavements fall in the major rehabilitation category or will fall into this category within the next few years. There is a project scheduled for 2017 that will correct all of the above taxiways, with the exception of Taxiway D South.

Using the results of the PCI survey, the most common distress types encountered, and the deterioration rate shown on Table A-5, it is recommended that the Airport implement a comprehensive crack sealing program on AC surfaces and joint seal replacement on PCC surfaces. All of the pavements at the Airport would benefit and see increased longevity from these maintenance actions. Localized AC pavement patching is recommended in areas where longitudinal and transverse cracking widths have increased to the point where sealant is no longer effective. Partial-depth patching of PCC pavement is recommended where spalling has become excessive. It should be noted that PCI surveys are conservative estimates as to the current condition of the pavements. Detailed engineering analysis conducted during the design phase of a project may result in a different conclusion as to the extent of repair required. Technically, AIP funding can be used for routine maintenance which includes, cleaning, filling and/or sealing of longitudinal and transverse cracks, grading pavement edges, and pavement patching, however due to funding constraints the FAA has been reluctant to fund these types of projects, therefore, State, PFC and/or Owner/Sponsor funds would be needed to fund preventive maintenance activities at the airport.

A.5. CAPITAL IMPROVEMENT PROGRAM (CIP)

A.5.1. Objective

One of the primary objectives of the AVP APMS is to identify and determine the airfield pavement M&R needs of the Airport by comparing the PCI values to a standardized benchmark called the Minimum Service Level (MSL). The MSL is defined as the minimum pavement condition acceptable for airside operations at the Airport. MSL values were determined based on collaboration with AVP engineering staff and these values are listed in Table A-6 below. Once the MSLs are established, the MSLs are the basis of the Capital Improvement Program (CIP).

Table A-6: Minimum Service Levels

Branch Use	MSL Value
Runway	65
Taxiway	60
Apron	60

A.5.2. Analysis Approach

By establishing benchmark MSLs, a CIP can be developed using project data inputs into the PAVER software to develop projects and costs. It should be noted that the CIP is based on 1) visual evaluation of pavements to establish a condition baseline; 2) applying recommended deterioration rates for pavements to predict when a particular pavement section attains the

MSL; and 3) utilizing historic unit cost data based on type of pavement and PCI to estimate project costs of maintaining, rehabilitating or replacing pavements. Since more rigorous engineering analysis would be necessary to establish overall project costs, the pavement CIP should only be used as a guide in developing the costs associated with only pavement work in any project funding requests. It is advisable to employ a more detailed analysis to identify and estimate overall project scopes and costs that are intended to be used in any grant funding requests.

This section of the report defines and identifies future pavement CIP projects, along with their respective estimated costs based on acceptable PCI service levels, project type, and year of proposed construction. The M&R plan and pavement CIP development utilized analysis of existing record plan information, the visual inspection of the pavement surfaces, and in accordance with the methods described in FAA AC 150/5380-7B and ASTM D5340-12. Based on discussions with the AVP staff the following funding scenario was utilized in development of the pavement CIP's:

- Stopgap/Preventive Maintenance – Set Budget of $37,000: Based on discussion with AVP staff, the airport budget for airfield wide crack sealing is about $12,000/year and for pavement repairs/patching is about $25,000/year.
- Major Rehabilitation – Unlimited Budget with the first 5 years based on the AVP's current airport wide Capital Improvement Plan.

Before presenting the analysis results, it is important to explain how the PAVER software develops such a program. Within the PAVER software, pavement repair is categorized as follows:

- Major Rehabilitation such as an overlay, mill and pave, or reconstruction
- Localized Stopgap/Preventive Maintenance is a maintenance action that is applied only to a distressed area, such as crack sealing or patching. It is called Stopgap Maintenance when the PCI is less than the MSL and called Preventive Maintenance when the PCI is greater than the MSL.

For each year of the analysis, the PAVER software applies the performance models and estimates the future condition of the pavement sections. If a section falls below the MSL's shown in Table A-6, major rehabilitation is recommended during that year. Stopgap maintenance is used if a major rehabilitation project can not be completed in the year the PCI falls below the MSL. If the section is above the critical PCI, localized preventive maintenance may be recommended for that year. After the treatment is selected for the pavement section based on its predicted PCI value and the criteria listed above, its cost is calculated using the unit cost figures stored in PAVER.

A.5.3. 5-Year Near Term CIP

A 5-Year Near-Term CIP was developed to provide the Owner with a list of short-term pavement capital projects for the 2018 through 2022 timeframe, the full 5-Year Pavement Capital Improvement Plan showing treatment and PCI for each Branch/Section of airport pavement is shown in Appendix A7, with the costs shown below in Table A-7.

Table A-7: 5-Year Pavement Capital Improvement Plan Costs

Year	Stopgap/Preventive	Major Rehabilitation
2018	$37,000	$3,534,000
2019	$37,000	$0
2020	$37,000	$2,562,000
2021	$37,000	$0
2022	$37,000	$1,187,000

A.5.4. 20-Year Long Term CIP

A 20-Year Long-Term CIP was developed to provide the Owner with a list of long-term pavement capital projects for the 2018 through 2037 timeframe. The 20-Year Long-Term CIP is an extension of the 5-Year Plan and was developed in the same manner. The full 20-Year Pavement Capital Improvement Plan showing treatment and PCI for each Branch/Section of airport pavement is shown in Appendix A8, with the costs shown below in Table A-8.

Table A-8: 20-Year Pavement Capital Improvement Plan Costs

Year	Stopgap/Preventive	Major Rehabilitation
2018	$37,000	$3,534,000
2019	$37,000	$0
2020	$37,000	$2,562,000
2021	$37,000	$0
2022	$37,000	$1,187,000
2023	$37,000	$3,326,500
2024	$37,000	$112,000
2025	$37,000	$0
2026	$37,000	$3,879,000
2027	$37,000	$0
2028	$37,000	$0
2029	$37,000	$0
2030	$37,000	$2,740,000
2031	$37,000	$0
2032	$37,000	$0
2033	$37,000	$0
2034	$37,000	$733,000
2035	$37,000	$1,810,000
2036	$37,000	$1,292,000
2037	$37,000	$1,878,500

It should also be noted that in using the developed pavement CIP to plan future funding requirements, the airport owner/sponsor may determine that it is necessary to adjust the timing of CIP projects due to fiscal and operational constraints. For example, a runway pavement may be divided into multiple sections that each reach the MSL during different years. However, in an operational sense, it may be deemed not to be feasible to stage the rehabilitation of the runway over the course of multiple years. Instead, the rehabilitation may actually be programmed to minimize the runway closure time, while simultaneously maximizing the remaining service life. Conversely, it also may become necessary to break a large CIP project into multiple phases due to constraints based on available funding.

Appendix A1: AVP Pavement Sections and Construction History

Network	Name	Branch	Section	Section Area (ft²)	Last Major Construction Date	Surface Type[1]	Surface Course[1]		Base Course[1]
AVP Airport	Old Terminal Apron	A	A-1	58,986	6/1/2010	AC	10" AC	-	17" CABC
		A	A-2	88,220	6/1/2010	AAC	1.5" AAC	8.5" AC	17" CABC
	Cargo Apron	CARGO	CARGO	115,200	6/1/1998	PCC	18" PCC	-	9" CTBC, 8" CABC
	Terminal Apron	CTA	CTA-1	598,346	9/1/2005	AC	14" AC	-	30" CABC
		CTA	CTA-2	143,420	8/3/2005	PCC	17" PCC	-	11" CTBC, 7" CABC
		CTA	CTA-3	3,422	6/1/2013	PCC	17" PCC	5" PABC	CABC (VARIES)
	General Aviation Apron	GAA	GAA-1	379,977	6/1/2010	AAC	1.5" AAC	AC VARIES	CABC (VARIES)
		GAA	GAA-2	1,060	*unknown*	PCC	*unknown*	*unknown*	*unknown*
		GAA	GAA-3	8,366	6/1/2010	PCC	8" PCC	-	6" CABC
	Helipad	Heli	SGAA-2	3,906	6/1/2012	PCC	6" PCC	-	21" CABC
	South General Aviation Apron	SGAA	SGAA-1	147,405	6/1/2012	AC	6" AC	-	21" CABC
	Runway 10 Safety Area	RSA	RSA	31,950	4/1/2005	AC	3" AAC	14" AC	5" CABC
	Runway 10-28	RWY10-28	RWY10-28-1	255,210	9/1/1999	AAC	3" AAC	14" AC	5" CABC
		RWY10-28	RWY10-28-2	38,895	3/29/1996	AAC	4" AAC	9" AC	9" DBM
		RWY10-28	RWY10-28-3	36,330	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
		RWY10-28	RWY10-28-4	31,950	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
		RWY10-28	RWY10-28-5	10,425	3/29/1996	AAC	4" AAC	9" AC	9" DBM
		RWY10-28	RWY10-28-6	244,500	9/1/1999	AAC	3" AAC	14" AC	5" CABC
	Runway 4-22	RWY4-22	RWY4-22	1,125,150	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
	Taxiway A	TWYA	TWYA-1	5,358	6/1/2012	AC	11" AC	-	18" CABC
		TWYA	TWYA-2	10,800	6/30/1980	AC	9" AC	9" DBM	5" CABC
		TWYA	TWYA-3	7,340	6/1/2012	AC	11" AC	-	18" CABC
	Taxiway B	TWYB	TWYB-1	96,262	6/30/1980	AC	9" AC	9" DBM	5" CABC
		TWYB	TWYB-2	211,553	9/1/1995	AC	12" AC	9" DBM	5" CABC
		TWYB5	TWYB-3 B5	117,800	9/1/1995	AC	12" AC	9" DBM	5" CABC
	Taxiway B2	TWYB2	TWYB2-1	27,628	6/30/1980	AC	9" AC	9" DBM	5" CABC
		TWYB2	TWYB2-2	14,364	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
	Taxiway B3	TWYB3	TWYB3-1	25,272	9/1/1995	AC	12" AC	9" DBM	5" CABC
		TWYB3	TWYB3-2	12,956	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
	Taxiway B4	TWYB4	TWYB4	33,948	9/1/1995	AC	12" AC	9" DBM	5" CABC
	Taxiway C	TWYC	TWYC-1	19,890	9/1/1995	AC	12" AC	9" DBM	5" CABC
		TWYC	TWYC-2	44,310	9/1/1995	AC	12" AC	9" DBM	5" CABC
		TWYC	TWYC-3	14,863	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
	Taxiway D	TWYD	TWYD-1	162,674	7/1/1996	AC	17" AC	-	22" CABC
		TWYD	TWYD-2	10,373	9/1/1995	AC	12" AC	9" DBM	5" CABC
		TWYD	TWYD-3	32,271	7/1/2007	AAC	2.25" AAC	10.75" AC	14" CABC
		TWYD	TWYD-4	112,577	9/1/1999	AAC	3" AAC	14" AC	5" CABC
	Taxiway E	TWYE	TWYE	13,290	10/27/2005	AC	14" AC	-	30" CABC

[1] AC = Asphalt Concrete, AAC = Asphalt Overlay on AC, PCC = Portland Cement Concrete, CABC = Crushed Aggregate Base Course, CTBC = Cement Treated Base Course, DBM = Dry Bound Macadam, PABC = PennDOT Superpave Binder Course