



Aeronautics Division
Tennessee Department of Transportation



Tennessee Airport Pavement Management Program Update

2022-2023 Executive Summary



Tennessee Department of Transportation

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Inclusion of a project in the plan is not a commitment for funding. Project requests must be submitted and reviewed by Tennessee Aeronautics Commission and/or Tennessee Department of Transportation (TDOT) Aeronautics Division for approval and grant award. Projects will be analyzed, reviewed, and approved based on various factors, including, but not limited to, the funding available, inclusion on the Airport Layout Plan (ALP), environmental approval, project justification, scope of work, bid tabulations, and work schedule.



Project Overview

The principal objectives of this project were to:

- ◆ **Inventory** the pavement infrastructure and assess the current condition of seventy airports located throughout the state of Tennessee.
- ◆ **Identify** pavement-related needs and develop cost-effective short- and long-term maintenance and rehabilitation (M&R) strategies for addressing those needs.
- ◆ **Expand** the capabilities of the existing Tennessee Airport Pavement Management Program (APMP).
- ◆ **Update** the web-based tool that provides easy access to APMP findings and recommendations.

Key Findings

- ◆ The project included the evaluation of seventy paved airports in Tennessee, one of which is privately owned-public use and not eligible for state funding (Johnson City Airport, A04). Also, it does not include the Lovell Field (CHA), McGhee Tyson (TYS), Memphis International (MEM), Nashville International (BNA), and Tri-Cities (TRI) Airports.
- ◆ The pavement area at the seventy airports is 78.7 million square feet, and the area-weighted age at the time of last inspection in 2022 is 21 years. The overall age of the pavement system is significant because it indicates that many of the pavements may be nearing the end of their design lives.
- ◆ The 2022 pavement condition of the airports when evaluated using the Pavement Condition Index (PCI) methodology was an area-weighted PCI of 73 (on a scale of 100 [showing no visible signs of deterioration] to 0 [failed]), as compared to the PCI of 73 determined during the 2019 inspections. This is evidence that the Tennessee Department of Transportation (TDOT) Aeronautics Division investments in pavement preservation, rehabilitation, and reconstruction projects are successful in maintaining the condition level of the pavement system.
- ◆ Based on the PCI of the airports evaluated during this project, it is estimated that the most cost-effective treatment for 44 percent of the pavement area is rehabilitation (such as an overlay) or reconstruction, and the remaining 56 percent area is in a condition range where maintenance (such as crack sealing and surface treatments) would be beneficial and delay the need for a rehabilitation or reconstruction project.
- ◆ The Aeronautics Division is currently reviewing the use of slurry surfacing as a mechanism to delay the need for pavement rehabilitation and reconstruction projects to reduce overall funding needs, however, additional evaluation is needed.
- ◆ If no funding for pavement M&R is expended on the airports evaluated during this project over the next 5 years, the overall area-weighted PCI is estimated to drop from 73 in 2022 to 65 by 2027.
- ◆ If enough funding is provided to complete all identified M&R projects during the next 5 years at the project airports, it is estimated that a total of \$403.8 million (or approximately \$80.8 million annually if distributed evenly) will be needed during that period. Under this scenario, the overall area-weighted PCI would increase to 83 by 2027.
- ◆ To maintain the current overall area-weighted PCI of 73, the annual budget needed for pavement rehabilitation and reconstruction projects would be approximately \$30.5 million.
- ◆ To achieve a goal of an overall area-weighted PCI of 75, the annual budget needed for pavement rehabilitation and reconstruction projects would be approximately \$41.4 million.
- ◆ To maintain an area-weighted PCI of 78 for only the runways, approximately \$14.7 million annually for pavement rehabilitation and reconstruction projects is needed.



Project Background

Tennessee's airport system plays a vital role in supporting economic development statewide, and its pavements comprise a large capital investment as well as directly impact operational safety. If Tennessee's airport pavements are not maintained at an acceptable condition level, the value of these capital investments will diminish, and safety could be compromised.

Recognizing a need to protect this critical capital investment and to maintain safe operational conditions at the airports, the Aeronautics Division maintains a statewide APMP to monitor the condition of the pavement system and to proactively plan for its cost-effective preservation. The ultimate goal of the APMP is to provide the Aeronautics Division, airport sponsors and their consultants, the Federal Aviation Administration (FAA), and other stakeholders with current pavement data and the analytical tools needed to identify pavement-related needs, prioritize those needs, formulate M&R programs, and evaluate the near- and long-term impacts of pavement-related decisions. The Aeronautics Division's continued update and utilization of the APMP is evidence of its commitment to maintaining its airport infrastructure, which coincides with the priorities of the FAA for continued maintenance of existing pavement.

Applied Pavement Technology, Inc. (APTech), assisted by CHA Consulting, Inc. (CHA), updated the Tennessee APMP in 2022-2023. This Executive Summary provides an overview of the findings and recommendations of the APMP update, during which the pavement conditions at seventy

Tennessee airports were assessed and the APMP database updated with the most current information. The data was analyzed to identify pavement-related needs and to provide recommendations for pavement M&R.

Tennessee's airport system plays a vital role in supporting economic development statewide, and its pavements are a large capital investment within that system.

Benefits of the APMP

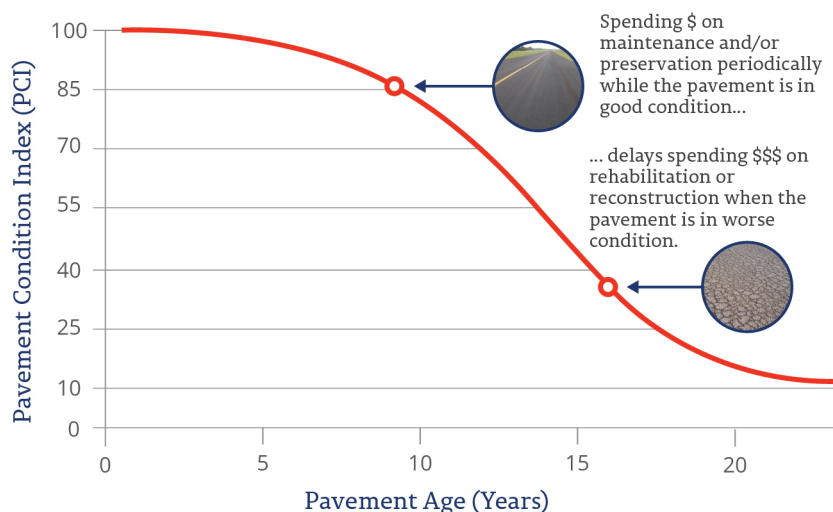
Tennessee's APMP yields many benefits. It provides easy access to information needed to monitor pavement condition as well as the tools needed to make cost-effective decisions about the M&R of the pavement infrastructure while understanding the long-term impacts of the decisions made.

The APMP can also be used to identify when different levels of pavement repair will be most appropriate. The figure below shows that there is a point in a pavement's life cycle when the rate of deterioration increases, and the financial impact of delaying repairs beyond this point can be severe.

Preventive maintenance actions, such as crack sealing and

surface treatments, can cost-effectively extend the life of a pavement in situations where the overall pavement structure is sound and in good condition. Once a pavement deteriorates to the level where preventive maintenance is no longer the appropriate repair, it is critical to program rehabilitation, such as an overlay, as soon as possible. If delayed too long, the pavement structure may become so degraded that the only alternative is reconstruction. Additionally, there is a point when the pavement becomes unsafe for aircraft operations.

The APMP also provides the Aeronautics Division with the ability to fulfill most of the Public Law 103-305 and Grant Assurance 11 requirements for maintaining an effective pavement maintenance management system, which are required for airports that are part of the National Plan of Integrated Airport Systems (NPIAS). The effective utilization of APMP data and results demonstrates Tennessee's commitment to maintain its airport infrastructure in line with the priorities of the FAA for continued maintenance of existing pavement.



Project Scope

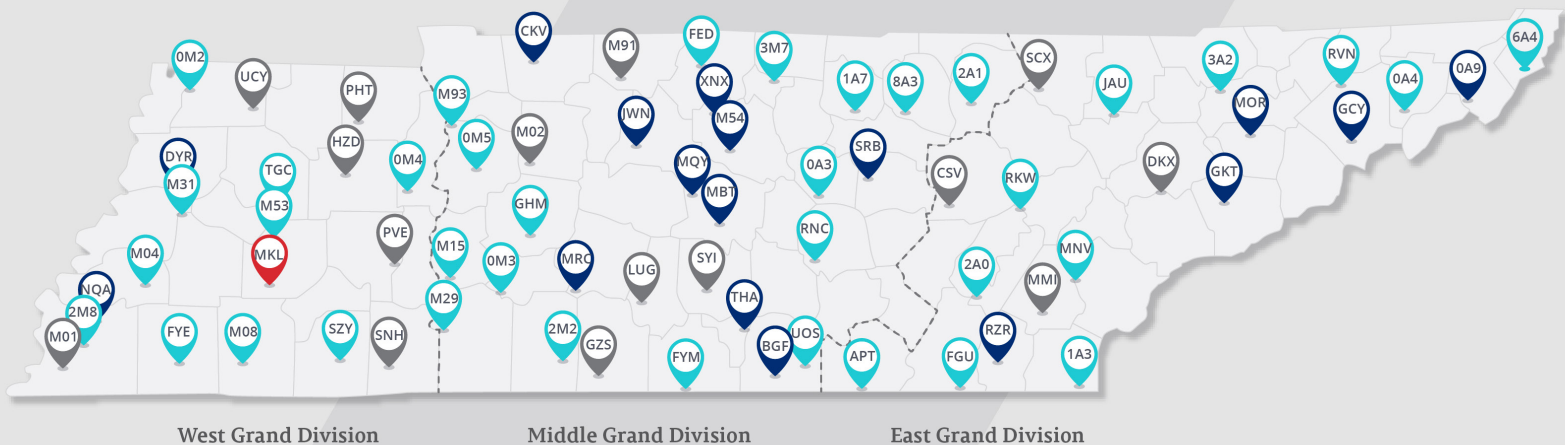
Pavement inspections were conducted at the seventy airports shown in the map below. The map is broken out by the Tennessee Aviation System Plan (TASP) role. Note that one is privately owned-public use and is not eligible for state funding (Johnson City Airport, A04). Lovell Field (CHA), McGhee Tyson (TYS), Memphis International (MEM), Nashville International (BNA), and

Tri-Cities (TRI) Airports operate their own APMPs and were not included in this project.

The APMP analytical tools were used to identify pavement-related needs over a 5-year period for the airports evaluated during this project. Pavement M&R plans to address those needs were developed using different funding scenarios and system goals regarding pavement condition.

The final deliverables of this project include this Executive Summary, an APMP Primer, a Statewide APMP Report, an APMP report for each of the seventy project airports, and a web-based tool providing easy access to the results of this project which can be accessed through TDOT's website: <https://www.tn.gov/tdot/aeronautics/engineering-documents---forms.html>.

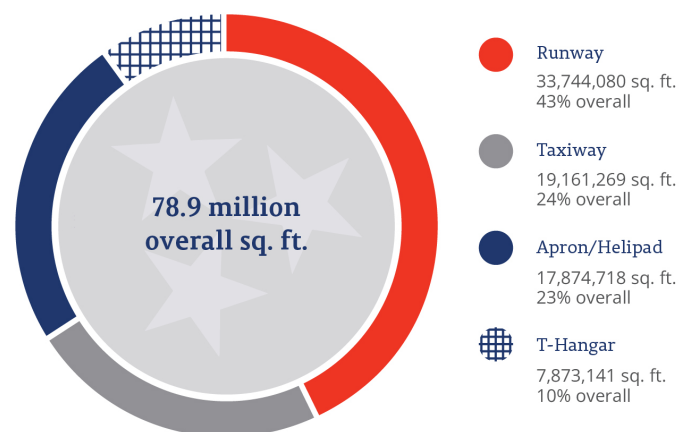
 Commercial Service
  Regional Service
  Community Business
  Community Service



Pavement Inventory

The seventy airports evaluated during this project include approximately 78.7 million square feet of pavement. The total area can be further broken down into 43 percent runway pavement, 33 percent taxiway and T-hangar pavement, and 24 percent apron and helipad pavement. The pavement consists of 86 percent asphalt-surfaced pavement and 14 percent portland cement concrete (PCC) pavement. The area-weighted age of the pavement infrastructure at the time of last inspection in 2022 is 21 years, which is significant

because it indicates that many of the pavements may be nearing the end of their design lives.





Pavement Condition Assessment

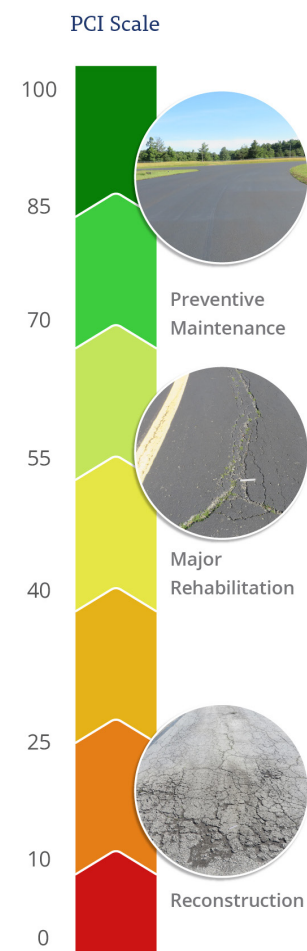
The PCI methodology, as documented in FAA Advisory Circular 150/5380-6C, Guidelines and Procedures for Maintenance of Airport Pavements and ASTM D5340-20, Standard Test Method for Airport Pavement Condition Index Surveys, was used to evaluate the pavement condition at Tennessee airports. This procedure is the standard used by the aviation industry in the United States for visually assessing and monitoring the condition of airport pavements. Established in the early 1980s, it provides a consistent, objective, and repeatable method to evaluate the overall pavement condition.

During a PCI survey, the types, severities, and amounts of distress present on a pavement's surface are quantified. This information is then used to develop a composite index that represents the overall condition of the pavement in numerical terms, ranging from 100 (no

visible signs of deterioration) to 0 (failed).

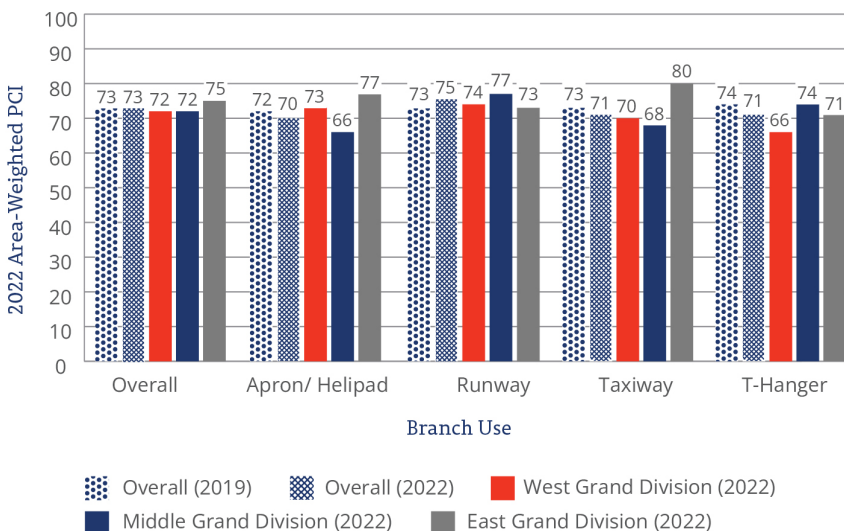
The PCI is a measure of overall condition and is indicative of the level of work that will be required to maintain or repair a pavement. Furthermore, the distress information provides insight into the cause of the pavement deterioration, which is the first step in selecting the appropriate repair action.

Programmed into an APMP, PCI data are used to determine current pavement condition, predict future pavement condition, and identify the most cost-effective repair type and timing of that repair. In addition, the collected data are used to calculate pavement deterioration rates and identify major causes of pavement deterioration. Along with the overall PCI, these are important inputs into selecting the most appropriate repair strategy.



Pavement Condition Results

The 2022 area-weighted PCI (average PCI adjusted to account for the relative size of the pavement sections) of the seventy airports evaluated during this project is 73, which is comparable to the PCI of 73 achieved in 2019. This is evidence that the investments in pavement preservation, rehabilitation, and reconstruction projects employed by the Aeronautics Division are successful at maintaining the system average.



Typical Distress Types at Tennessee Airports

Following are the most frequently observed pavement distresses at the evaluated Tennessee airports. This list is limited to asphalt-surfaced pavements because 86% of the Tennessee airport infrastructure consists of this type of pavement.



Alligator Cracking

Alligator cracking is a load-related distress caused by excessive tensile strains at the bottom of the asphalt layer or stabilized asphalt base layer from repeated aircraft loadings. It typically shows up as a series of parallel cracks, which eventually connect to form a pattern resembling alligator skin.



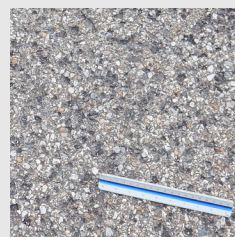
Longitudinal & Transverse (L&T) Cracking

L&T cracking can be caused by any of the following: separation of pavement at paving lane joints, shrinkage of asphalt pavement due to temperature differentials in older or brittle pavements, or reflection cracking from underlying existing cracking in overlaid pavements.



Patching/ Utility Cut

Patching is a localized repair of a distress or a utility cut. A patch is considered a defect, no matter how well it is performing.



Raveling

Raveling occurs as the coarse aggregate begins to dislodge and produce loose pieces of material, posing a safety hazard as it may be ingested by aircraft engines.



Weathering

Weathering is the wearing away of the asphalt binder and/or fine aggregate that occurs as the asphalt pavement ages and hardens.

Pavement Needs Assessment

An M&R program was developed for the seventy Tennessee airports evaluated during this project using the PAVER pavement management software. The analysis was prepared for 5 years, beginning in July 2023. Localized preventive maintenance (such as crack sealing and patching) was considered in 2023 only, whereas surface treatments were considered for 2023 and 2024 with input from the Aeronautics Division. Pavement rehabilitation and reconstruction actions were determined for all analysis years. An inflation rate of 4 percent was applied when calculating the future cost of work.

Level of Repair Needed

For each year of the analysis, the future conditions of the pavements were predicted using Tennessee-specific models, and a determination was made as to whether localized preventive maintenance, rehabilitation, or reconstruction was the best strategy based on whether a pavement was above or below its critical PCI threshold. The critical PCI thresholds were set at 65 for runways and 60 for taxiways, aprons, helipads, and T-hangars.

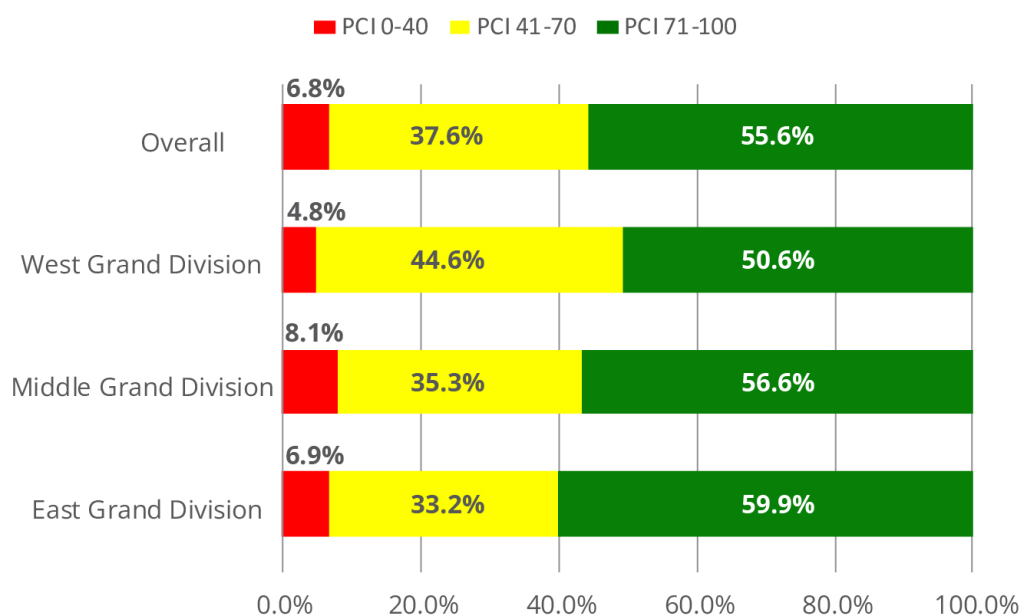
Above its critical PCI, the pavement was considered for localized preventive maintenance, which does not reset the PCI to 100. However, upon

the application of localized maintenance many of the distress types are reduced to low-severity upon application which may result in an incremental increase to the PCI. Below its critical PCI, the pavement was considered for rehabilitation or reconstruction. For asphalt-surfaced pavements, if the 2022 PCI was below 40 and structural deterioration was visible, the pavement was recommended for reconstruction. If the PCI was between the critical PCI and 40 and no structural deterioration was visible, the asphalt-surfaced pavement was recommended for rehabilitation. In all other cases, rehabilitation/reconstruction was recommended for asphalt-surfaced sections. For PCC sections, rehabilitation/reconstruction was listed. Once a rehabilitation or reconstruction project is completed, the PCI for that section is reset to 100.

For pavements that are experiencing primarily climate-related distresses, a surface treatment was considered if

load-related distresses were not observed and the benefit of applying the appropriate type of surface treatment with a crack seal resulted in a PCI at least 15 points above the critical PCI.

The analysis indicates that 56 percent of Tennessee's airport pavement would benefit from preventive maintenance (such as crack sealing, patching, PCC joint sealing, and surface treatments), 44 percent needs more extensive rehabilitation such as an overlay or reconstruction. Because the pavement system is aging, many of the pavements that will benefit now from preventive maintenance actions will soon deteriorate to a point where more costly rehabilitation will be required. The figure below shows the percentage of pavements in each condition range and further breaks down the percentage in each range by Grand Division.



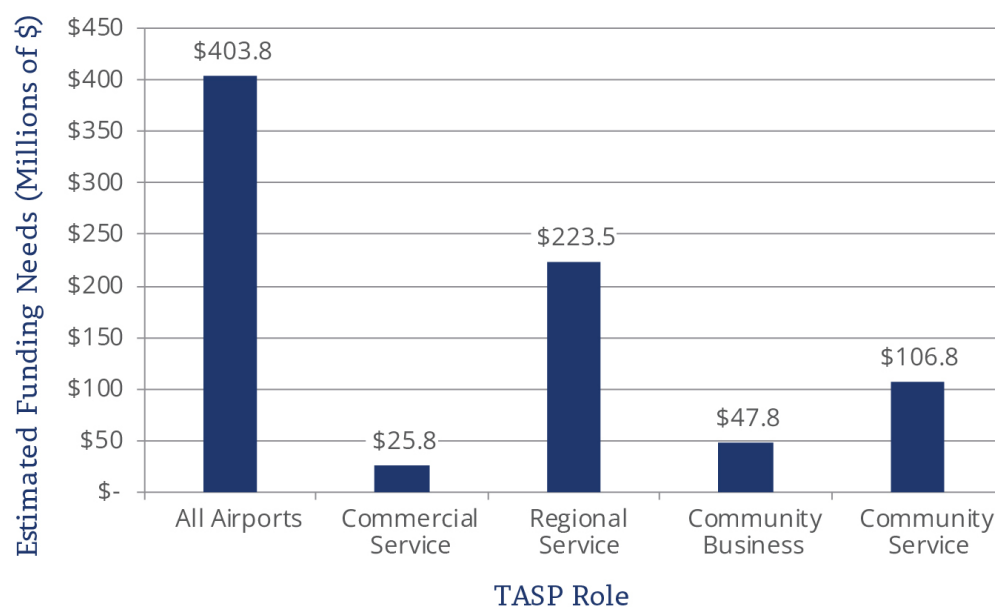
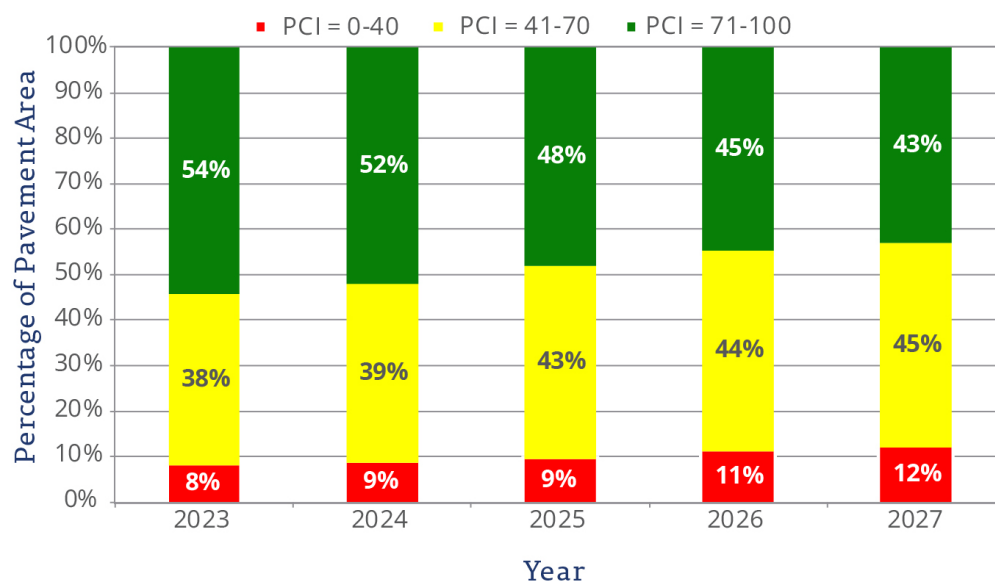
Funding Needed

Several financial scenarios were analyzed for the 5-year analysis period: no funding, unlimited funding, the annual funding amount needed to maintain the current area-weighted PCI of 73, the annual funding amount needed to achieve an area-weighted PCI of 75 for the overall pavement system, and the annual funding amount needed to achieve an area-weighted PCI of 78 for the runway pavement.

At one extreme end of the scale, if no funding is provided for pavement projects, the condition of the system of seventy airports is anticipated to experience a decline from 73 in 2022 to 65 by 2027, which is represented in the figure to the right. This lack of investment in the pavement infrastructure

would result in an increased need for pavement rehabilitation and reconstruction, which in turn would substantially increase the costs to keep the pavement system in safe and serviceable condition.

At the other end of the scale, if all identified pavement M&R projects were funded under an unlimited budget scenario, the condition of the seventy



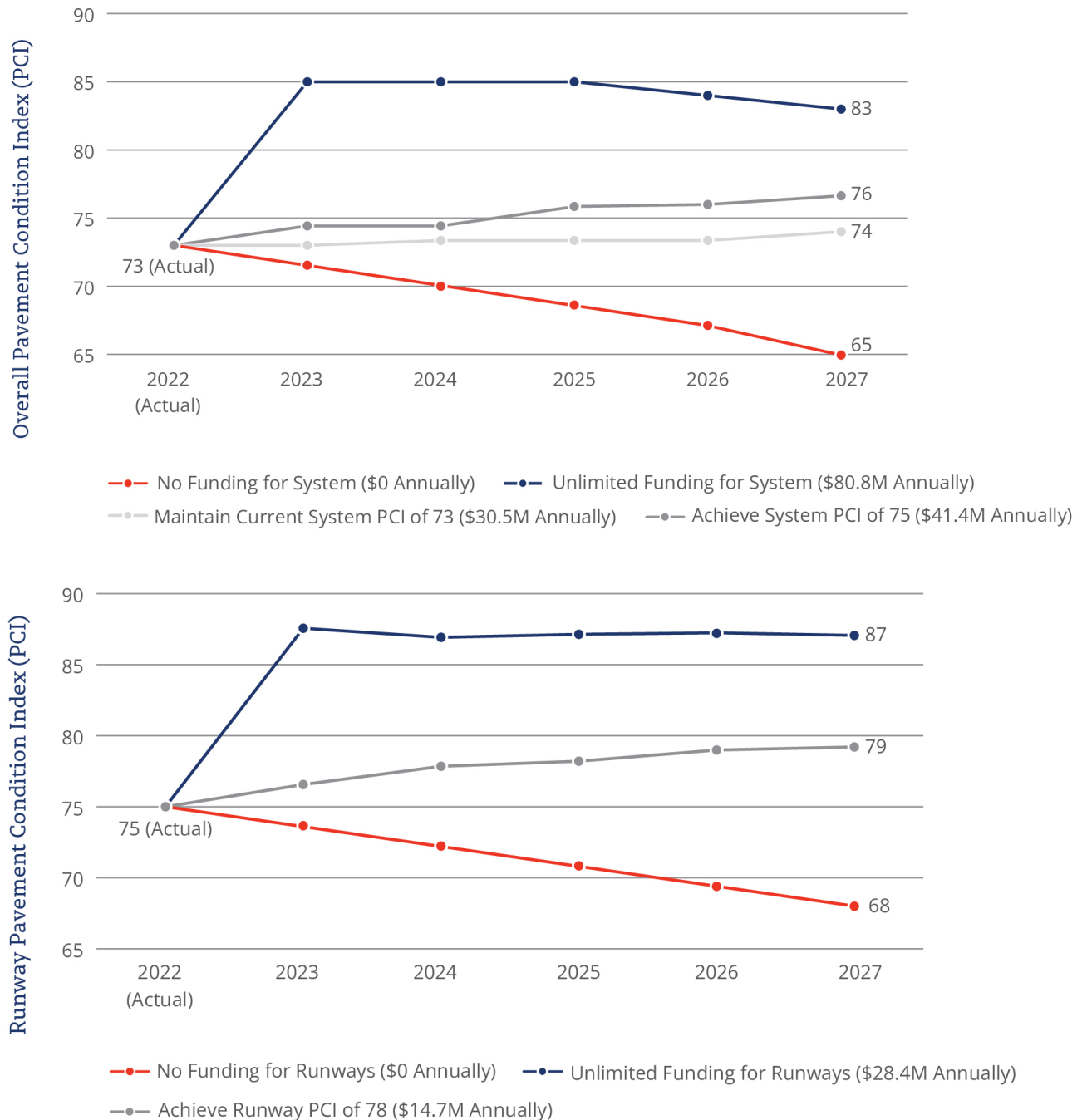
airports is projected to increase from 73 in 2022 to 83 by 2027. In this scenario, the backlog of pavement rehabilitation and reconstruction projects would be eliminated. However, it would come at an estimated cost of \$403.8 million (or approximately \$80.8 million per year, if allocated evenly), which can be further broken down into \$367.8 million for pavement rehabilitation and

reconstruction projects and \$36.0 million for surface treatments and localized preventive maintenance. The table at the end of this report provides a total estimated cost per airport for the projects recommended under the unlimited budget scenario. The figure above shows the estimated funding needs under the unlimited budget scenario by TASP role.

Finally, three analyses were run with the purpose of achieving specified goals for the pavement system. One goal was achieving an area-weighted PCI of 75 for the overall pavement system, which was estimated to require an annual funding level of \$41.4 million for pavement

rehabilitation and reconstruction projects. Another was maintaining the current overall PCI of 73, which was estimated to require an annual funding level of \$30.5 million for pavement rehabilitation and reconstruction projects. The other goal was achieving an area-weighted PCI of

78 for only the runway pavement system, which was estimated to require annual funding of \$14.7 million for runway pavement rehabilitation and reconstruction projects. The projected PCIs for each of these funding scenarios are provided below.



5-year Pavement Funding Needs Under an Unlimited Budget Scenario.

TASP Role	Associated City	Airport Name	FAA Designator	Grand Division	PCI (Area-Weighted)	Area (sf)	Estimated Funding Needs (with Soft Costs)
Commercial Service	Jackson	McKellar-Sipes Regional Airport	MKL	West	60	3,079,044	\$25,767,959
Estimated Commercial Service Total:							\$25,767,959
Regional Service	Clarksville	Outlaw Field	CKV	Middle	71	2,257,714	\$19,011,390
Regional Service	Cleveland	Cleveland Regional Jetport	RZR	East	96	1,484,514	\$359,771
Regional Service	Columbia	Maury County Regional Airport	MRC	Middle	93	1,165,122	\$1,144,072
Regional Service	Dyersburg	Dyersburg Regional Airport	DYR	West	73	1,229,578	\$4,219,630
Regional Service	Elizabethton	Elizabethton Municipal Airport	0A9	East	81	1,059,391	\$1,227,160
Regional Service	Gallatin	Music City Executive Airport	XNX	Middle	84	1,606,410	\$1,587,854
Regional Service	Greeneville	Greeneville Municipal Airport	GCY	East	87	1,615,576	\$4,248,936
Regional Service	Lebanon	Lebanon Municipal Airport	M54	Middle	62	1,378,413	\$8,553,670
Regional Service	Millington	Millington/ Memphis Airport	NQA	West	84	4,297,918	\$6,938,060
Regional Service	Morristown	Moore-Murrell Airport	MOR	East	73	1,558,683	\$3,443,878
Regional Service	Murfreesboro	Murfreesboro Municipal Airport	MBT	Middle	71	1,594,352	\$8,489,759
Regional Service	Nashville	John C. Tune Airport	JWN	Middle	81	2,608,068	\$8,007,284
Regional Service	Sevierville	Gatlinburg-Pigeon Forge Airport	GKT	East	73	1,430,637	\$7,141,961
Regional Service	Smyrna	Smyrna Airport	MQY	Middle	53	6,521,858	\$97,097,507
Regional Service	Sparta	Upper Cumberland Regional Airport	SRB	Middle	75	1,751,084	\$2,687,898
Regional Service	Tullahoma	Tullahoma Regional Airport/William Northern Field	THA	Middle	60	2,853,953	\$48,513,534
Regional Service	Winchester	Winchester Municipal Airport	BGF	Middle	89	936,461	\$797,964

5-year Pavement Funding Needs Under an Unlimited Budget Scenario cont.

TASP Role	Associated City	Airport Name	FAA Designator	Grand Division	PCI (Area-Weighted)	Area (sf)	Estimated Funding Needs (with Soft Costs)
Estimated Regional Service Total:							\$223,470,328
Community Business	Athens	McMinn County Airport	MMI	East	61	1,344,558	\$10,688,950
Community Business	Crossville	Crossville Memorial Airport-Whitson Field	CSV	East	74	1,270,885	\$1,654,350
Community Business	Dickson	Dickson Municipal Airport	M02	Middle	72	997,868	\$3,497,880
Community Business	Huntingdon	Carroll County Airport	HZD	West	78	918,797	\$675,975
Community Business	Knoxville	Knoxville Downtown Island Airport	DKX	East	77	1,245,950	\$4,409,994
Community Business	Lewisburg	Ellington Airport	LUG	Middle	72	1,123,813	\$5,282,510
Community Business	Lexington/Parsons	Beech River Regional Airport	PVE	West	96	1,210,199	\$523,122
Community Business	Memphis	General Dewitt Spain Airport	M01	West	72	973,476	\$2,952,467
Community Business	Oneida	Scott Municipal Airport	SCX	East	95	822,933	\$287,754
Community Business	Paris	Henry County Airport	PHT	West	74	1,148,271	\$1,901,650
Community Business	Pulaski	Abernathy Field	GZS	Middle	73	545,667	\$671,374
Community Business	Savannah	Savannah-Hardin County Airport	SNH	West	93	1,006,815	\$1,998,293
Community Business	Shelbyville	Bomar Field/ Shelbyville Municipal Airport	SYI	Middle	83	1,329,988	\$2,892,409

5-year Pavement Funding Needs Under an Unlimited Budget Scenario cont.

TASP Role	Associated City	Airport Name	FAA Designator	Grand Division	PCI (Area-Weighted)	Area (sf)	Estimated Funding Needs (with Soft Costs)
Community Business	Springfield	Springfield Robertson County Airport	M91	Middle	75	1,266,178	\$3,641,833
Community Business	Union City	Everett-Stewart Regional Airport	UCY	West	72	1,565,385	\$6,704,281
Estimated Community Business Total:							\$47,782,842
Community Service	Bolivar	William L. Whitehurst Field	M08	West	58	803,455	\$5,206,847
Community Service	Camden	Benton County Airport	0M4	West	75	771,939	\$3,364,063
Community Service	Centerville	Centerville Municipal Airport	GHM	Middle	70	543,408	\$2,639,518
Community Service	Clifton	Hassell-Carroll Field	M29	Middle	73	399,337	\$2,745,382
Community Service	Collegedale	Collegedale Municipal Airport	FGU	East	62	705,038	\$3,972,932
Community Service	Copperhill	Martin Campbell Field	1A3	East	62	390,905	\$2,349,640
Community Service	Covington	Covington Municipal Airport	M04	West	67	1,072,326	\$5,692,465
Community Service	Dayton	Mark Anton Airport	2A0	East	79	983,745	\$633,921
Community Service	Fayetteville	Fayetteville Municipal Airport	FYM	Middle	80	1,147,239	\$1,995,066
Community Service	Gainesboro	Jackson County Airport	1A7	Middle	79	399,303	\$163,748
Community Service	Halls	Arnold Field	M31	West	34	474,055	\$7,642,494
Community Service	Hohenwald	Paul Bridges Field	0M3	Middle	95	395,578	\$305,903

5-year Pavement Funding Needs Under an Unlimited Budget Scenario cont.

TASP Role	Associated City	Airport Name	FAA Designator	Grand Division	PCI (Area-Weighted)	Area (sf)	Estimated Funding Needs (with Soft Costs)
Community Service	Humboldt	Humboldt Municipal Airport	M53	West	53	638,355	\$5,770,703
Community Service	Jacksboro	Colonel Tommy C Stiner Airfield	JAU	East	68	489,185	\$2,939,731
Community Service	Jamestown	Jamestown Municipal Airport	2A1	Middle	96	442,309	\$87,619
Community Service	Jasper	Marion County Airport-Brown Field	APT	East	41	527,925	\$6,485,306
Community Service	Johnson City	Johnson City Airport	0A4	East	25	216,856	\$3,929,651
Community Service	Lafayette	Lafayette Municipal Airport	3M7	Middle	94	573,824	\$69,169
Community Service	Lawrenceburg	Lawrenceburg-Lawrence County Airport	2M2	Middle	75	977,468	\$2,337,221
Community Service	Linden	James Tucker Airport	M15	Middle	66	358,440	\$2,548,864
Community Service	Livingston	Livingston Municipal Airport	8A3	Middle	83	631,364	\$899,091
Community Service	Madisonville	Monroe County Airport	MNV	East	85	643,658	\$2,412,038
Community Service	McKinnon	Houston County Airport	M93	Middle	75	282,089	\$458,857
Community Service	McMinnville	Warren County Memorial Airport	RNC	Middle	55	1,075,898	\$6,904,583
Community Service	Millington	Charles W. Baker Airport	2M8	West	61	1,091,924	\$7,436,422
Community Service	Mountain City	Johnson County Airport	6A4	East	76	486,641	\$329,639
Community Service	Portland	Douglas Hunter Field	FED	Middle	89	839,271	\$1,305,156

5-year Pavement Funding Needs Under an Unlimited Budget Scenario cont.

TASP Role	Associated City	Airport Name	FAA Designator	Grand Division	PCI (Area-Weighted)	Area (sf)	Estimated Funding Needs (with Soft Costs)
Community Service	Rockwood	Rockwood Municipal Airport	RKW	East	68	915,059	\$3,445,019
Community Service	Rogersville	Hawkins County Airport	RVN	East	78	409,070	\$2,208,240
Community Service	Selmer	Robert Sibley Airport	SZY	West	70	732,434	\$4,526,938
Community Service	Sewanee	Franklin County Airport	UOS	Middle	61	297,195	\$1,640,487
Community Service	Smithville	Smithville Municipal Airport	0A3	Middle	88	527,323	\$103,056
Community Service	Somerville	Fayette County Airport	FYE	West	72	842,312	\$3,002,064
Community Service	Tazewell	New Tazewell Municipal Airport	3A2	East	58	676,605	\$3,691,128
Community Service	Tiptonville	Reelfoot Lake Airport	0M2	West	54	383,548	\$2,491,424
Community Service	Trenton	Gibson County Airport	TGC	West	68	797,701	\$4,757,936
Community Service	Waverly	Humphreys County Airport	0M5	Middle	80	510,867	\$306,171
Estimated Community Service Total:							\$106,798,492
Estimated Statewide Total:							\$403,819,621



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