2013 EXECUTIVE SUMMARY

Washington State Airport Pavement Management System

Washington State Department of Transportation

Key Findings

- The Washington State Department of Transportation (WSDOT) Aviation airport pavement management system (APMS) database includes 100 airports: 95 airports that were evaluated during this project and five primary airports (Boeing Field [BFI], Seattle-Tacoma International Airport [SEA], Spokane International Airport [GEG], Tri-Cities Airport [PSC], and Yakima Air Terminal [YKM]) that have their own APMS and provided data from those systems for use in this study.
- The 100 airports include approximately 150 million square feet of pavement. This represents a very significant capital investment.
- Pavement conditions were visually assessed using a methodology that results in a pavement condition index (PCI), which ranges from 0 (failed) to 100 (perfect).
- The 2012 area-weighted PCI of the 100 airports is 77. The 2012 area-weighted PCIs of the Primary NPIAS, Non-Primary NPIAS, and Non-NPIAS airports are 80, 76, and 66, respectively.
- Since 2005, only the Primary NPIAS airports have shown an improvement in condition; the Non-Primary NPIAS and Non-NPIAS airports showed a significant decrease in condition. If this trend continues, the airport system in Washington will be in jeopardy.
- Approximately 71 percent of the pavement area at the 100 airports is at a condition level where preventive maintenance, such as crack sealing, is a cost-effective approach to maintaining the pavement. Unfortunately, 29 percent of the pavement area has deteriorated to a condition level where more costly major rehabilitation or even reconstruction is needed.
- If no funding for pavement maintenance and rehabilitation (M&R) is provided at the Non-Primary airports, it is projected that the overall area-weighted PCI will deteriorate from 75 to 66 by 2020.
- If all the projects identified as needing pavement M&R at the Non-Primary airports are funded over the next eight years, approximately $217 million will be needed to achieve overall condition goals. This funding level would result in an estimated area-weighted 2020 PCI of 84 and eliminate the backlog of reconstruction and major rehabilitation projects.
- If the level of funding for the Non-Primary airports remains at its current level of $4.5 million annually, the area-weighted PCI at the Non-Primary airports is predicted to fall from 75 to 71 by 2020. The backlog of major rehabilitation and reconstruction work is estimated to increase by 43 percent to $257 million in 2020.

BACKGROUND

Pavements represent one of the largest capital investments in Washington's aviation system, and the condition of these pavements is important both from cost-effectiveness and safety standpoints. Timely airport pavement maintenance and rehabilitation (M&R) are crucial because repairs are much more costly once the condition deteriorates below a certain level. Additionally, airport pavement weaknesses, such as cracks and loose debris, pose significant safety risks to aircraft.

Recognizing a need to protect its critical aviation investment, Washington State Department of Transportation (WSDOT) Aviation established a statewide airport pavement management system (APMS) in 2000. The APMS monitors the condition of Washington's airport infrastructure and proactively plans for its preservation. The ultimate goal of this project is to provide the airports, WSDOT Aviation, and the Federal Aviation Administration (FAA) with the pavement information and analytical tools that will help them identify pavement-related needs, optimize the selection of projects and treatments over a multi-year period, and evaluate the long-term impacts of project priorities.

The WSDOT APMS was updated in 2005 and again as part of this project. During this update, the pavement conditions at 95 Washington airports were assessed, and the collected pavement inventory and condition data were used to update the APMS. The data were analyzed to determine the overall health of the aviation pavement system, to identify pavement-related needs, and to provide recommendations for pavement M&R. This report describes the findings and recommendations of the APMS project.

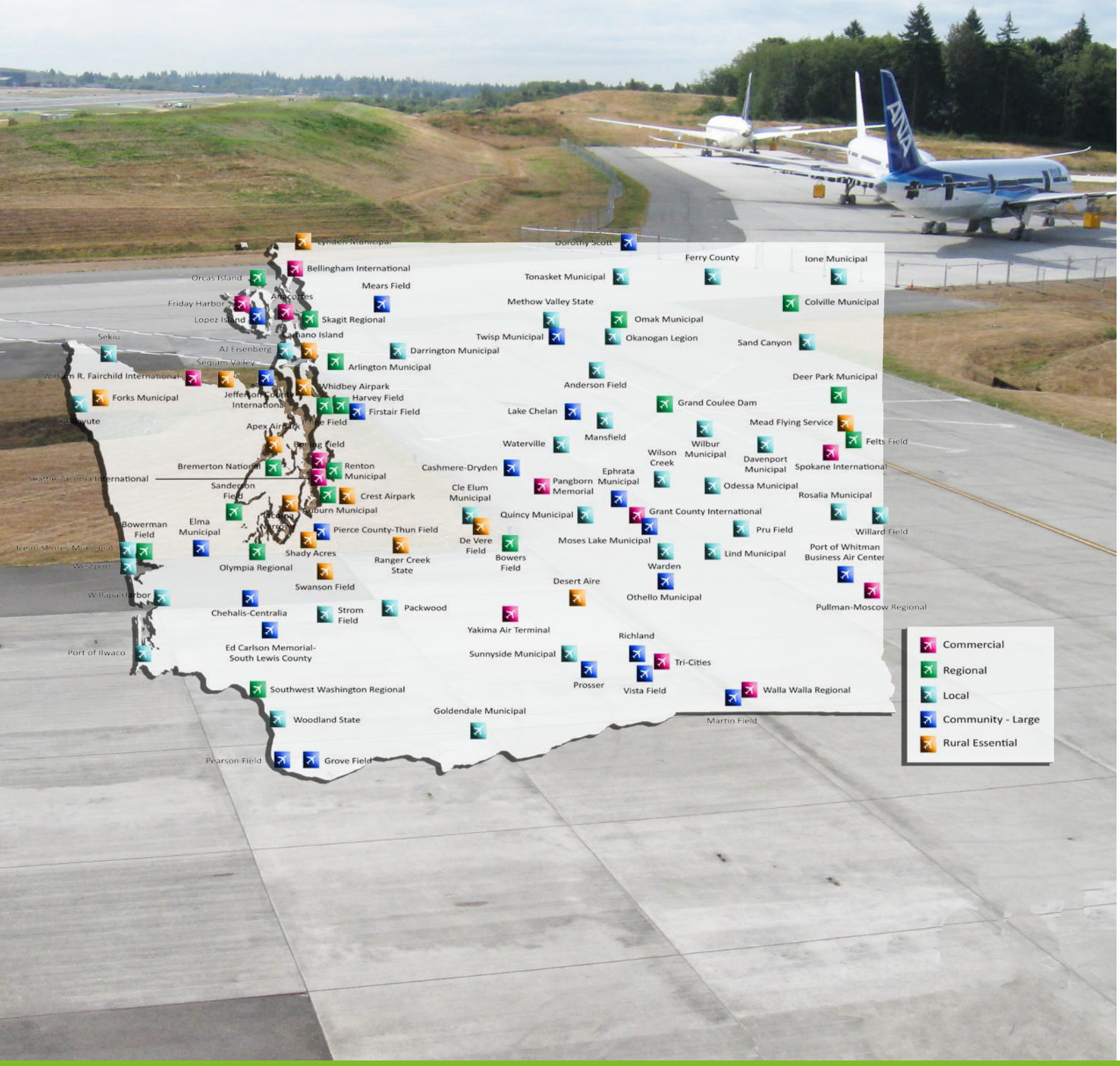
BENEFITS OF THE APMS

The WSDOT APMS yields many benefits. It provides WSDOT Aviation, the individual airports, and the FAA with the information needed to monitor the condition of the pavements to ensure they are able to safely accommodate aircraft operations. The APMS also provides WSDOT Aviation with information necessary to make cost-effective decisions about the M&R of the pavement infrastructure while understanding the long-term impacts of the decisions made. In addition, the APMS fulfills many of the National Plan of Integrated Airports System (NPIAS) airport requirements (Public Law 103-305 and Grant Assurance 11) for maintaining a pavement maintenance management system.

The APMS also identifies when different pavement strategies are most appropriate. The timing of projects is important because preventive maintenance actions, such as crack sealing and surface treatments, can cost-effectively extend the life of a pavement. Once preventive maintenance is no longer the appropriate repair, it is critical to step in with major rehabilitation, such as an overlay, as soon as possible. At some point, the pavement structure may become so degraded that the only viable alternative is reconstruction. The financial impact of delaying repairs until this point is reached can be severe, as reconstruction can cost a significant amount more than an overlay. In addition, there is a point where the pavement becomes unsafe for aircraft operations.

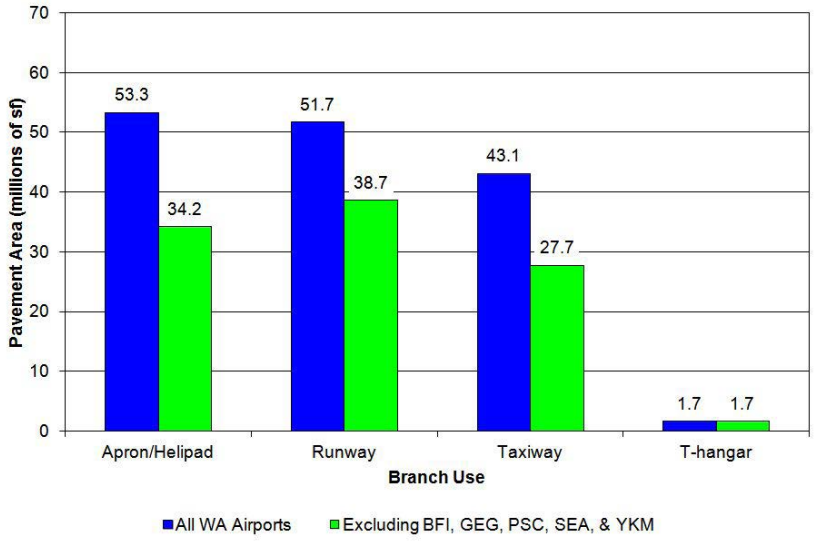
Project Airports

During this project, the pavement conditions at 100 airports, shown in the figure below, were assessed, and the WSDOT APMS database was updated with the information. Applied Pavement Technology, Inc. (APTech) inspected the pavement conditions at 95 airports; five airports (BFI, GEG, PSC, SEA, and YKM) operate their own APMS. The pavement information for these five airports was extracted from the individual APMS and incorporated into the WSDOT APMS database.



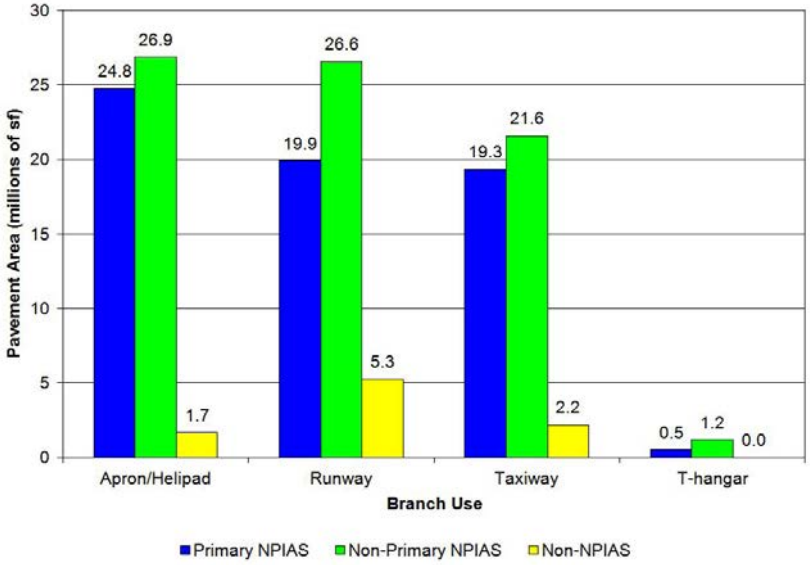
The 100 airports represent approximately 150 million square feet of pavement—the equivalent of a two-lane highway stretching from Seattle, Washington to Albuquerque, New Mexico. This can be further broken down into 51.7 million square feet of runway pavement, 43.1 million square feet of taxiway pavement, 53.3 million square feet of apron/helipad pavement, and 1.7 million square feet of T-hangar pavement. The following figure shows this breakdown for all 100 airports, as well as for the 95 airports evaluated during this project.

Pavement Area by Branch Use



The figure shown below further breaks down the pavement area by branch use and airport classification (Primary NPIAS, Non-Primary NPIAS, and Non-NPIAS) for all 100 airports.

Pavement Area by Branch Use and Airport Classification



PAVEMENT CONDITION INDEX

The pavements were evaluated using the pavement condition index (PCI) procedure, documented in FAA Advisory Circular (AC) 150/5380-6B, *Guidelines and Procedures for Maintenance of Airport Pavements*, and ASTM D5340-11, *Standard Test Method for Airport Pavement Condition Index Surveys*. During a PCI survey, the types, severities, and amounts of distress present on a pavement 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 0 (failed) to 100 (excellent). 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. Further, the distress information provides insight into what is causing the pavement to deteriorate, which is the first step in selecting the appropriate repair action.

Programmed into an APMS, 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. The relationship between a pavement's PCI and the typical type of repair recommended for the pavement is shown in the figure below.

PCI	Representative Pavement Surface	Repair Alternative
85		Pavements with PCIs above 70 often benefit from cost-effective preventive maintenance, such as crack sealing and surface treatments.
57		Pavements with a PCI in the range of 40 to 70 will typically require more expensive rehabilitation, such as an overlay.
30		Pavement allowed to deteriorate below a PCI of 40 could require costly reconstruction to restore it to operational condition.

TYPICAL DISTRESS TYPES AT WASHINGTON AIRPORTS

Following is a description of the most commonly observed pavement distresses at the Washington airports included in the project scope. The description is limited to asphalt-surfaced pavements, because the majority of the 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 (AC) layer or stabilized AC base layer from repeated aircraft loadings. It typically shows up on the surface as a series of parallel cracks, which eventually interconnect to form a pattern resembling alligator skin.

DEPRESSION

Depressions are areas with elevations slightly lower than those of the surrounding pavement. They can be caused by settlement of the underlying base layers or soils. Depressions are often found in areas with insufficient drainage capacity and soils are weakened due to water penetration or where underlying layers were not compacted enough during construction.

LONGITUDINAL AND TRANSVERSE (L&T) CRACKING

L&T cracking can be caused by any of the following: 1) separation of pavement at paving lane joints, 2) shrinkage of AC pavement due to temperature differentials in older or brittle pavements, or 3) reflection cracking from underlying existing cracking in overlaid pavements.

PATCH/UTILITY CUT PATCH

Patching is a localized repair of a distress. 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.

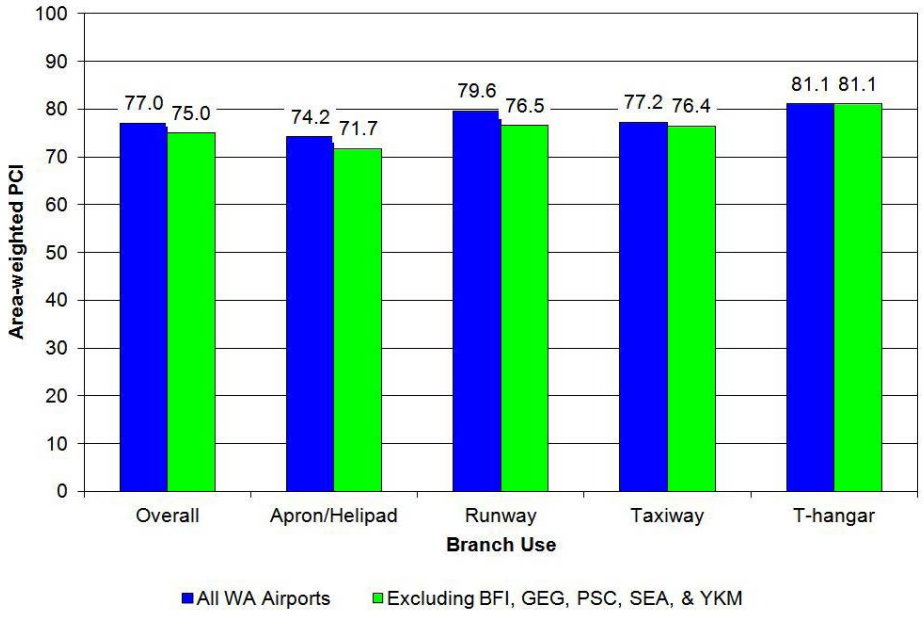
WEATHERING

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

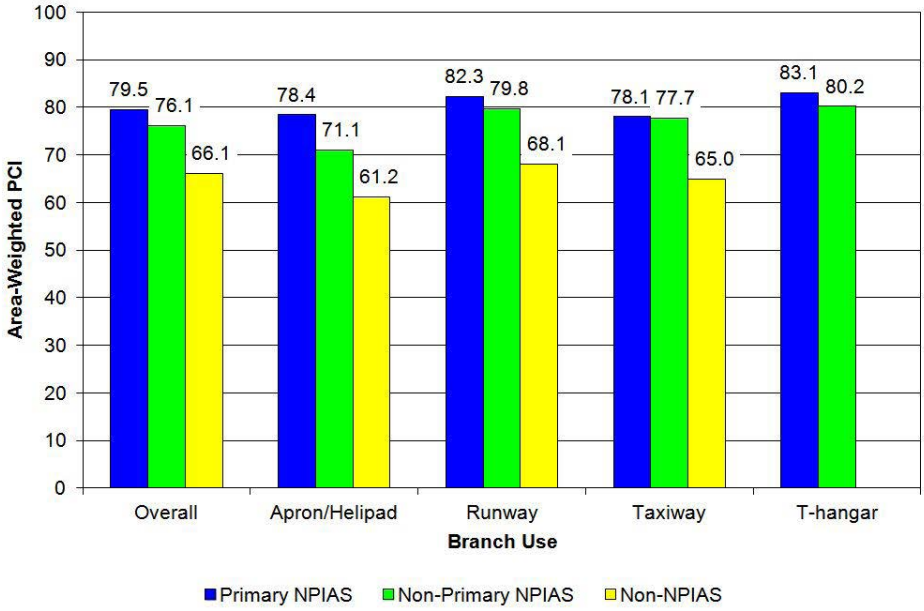
OVERALL PAVEMENT CONDITION

The overall area-weighted PCI (average PCI adjusted to account for the relative size of the pavement sections) of the 100 airports is 77. The overall area-weighted PCI of the 95 airports evaluated during this project (excluding BFI, GEG, PSC, SEA, and YKM) is 75. The figures below show the 2012 condition of the pavement broken out by branch use (apron/helipad, runway, taxiway, and T-hangar), as well as by branch use and the Primary NPIAS, Non-Primary NPIAS, and Non-NPIAS airport classifications for all 100 airports.

2012 Area-Weighted PCI by Branch Use



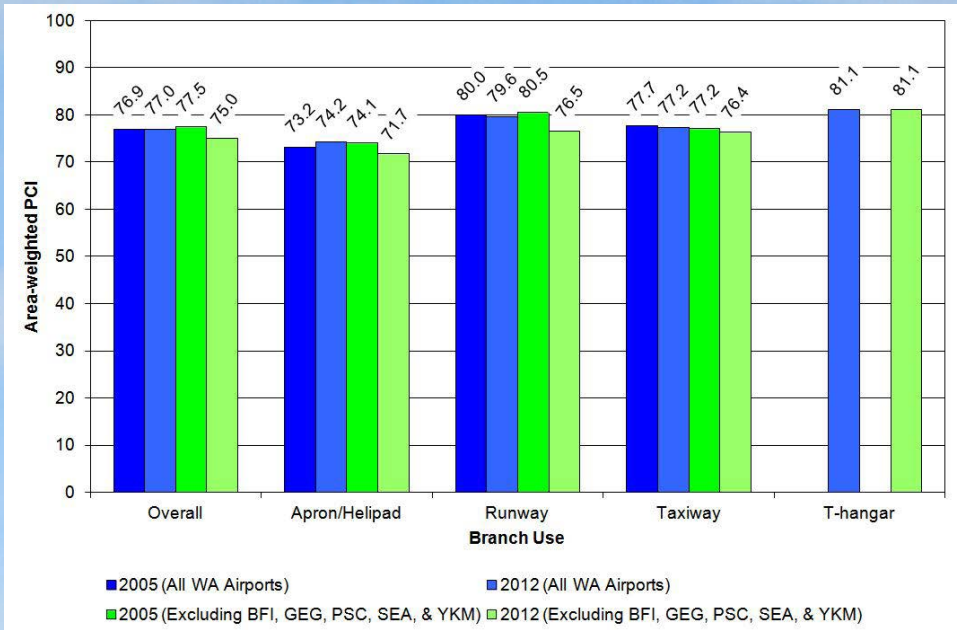
2012 Area-Weighted PCI by Branch Use and Airport Classification



HISTORICAL OVERALL PAVEMENT CONDITION

A comparison of the 2012 project results to the past conditions in 2005 is provided below. It is important to note that the values below are for the entire system of airports included during each update, therefore a few of the airports may vary between the two years. The intent of the graph is to show how the system as a whole is performing. Please also note that the T-hangar branch use was separated out from the taxiway branch use during the 2012 update.

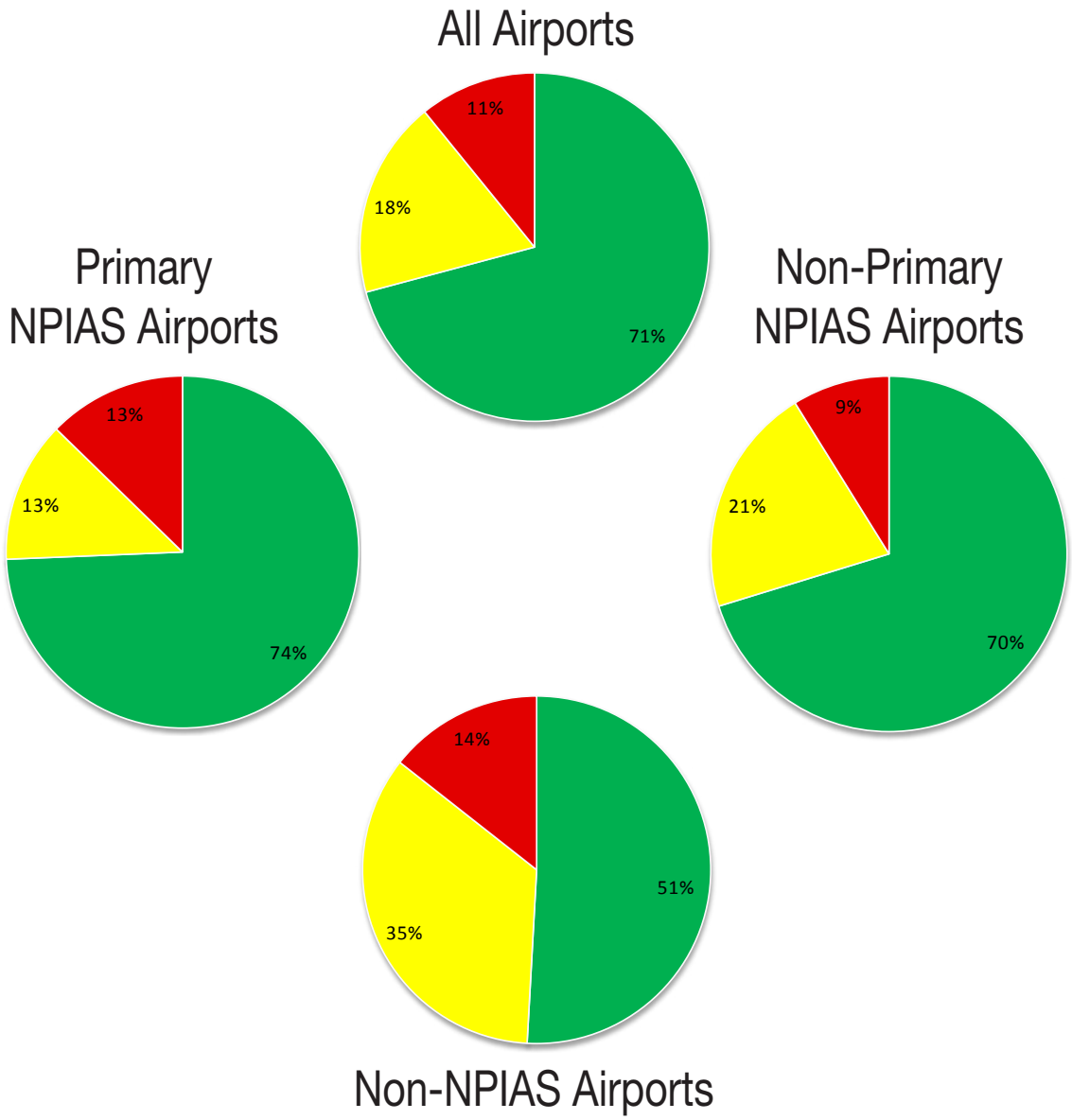
2005/2012 Area-Weighted PCI Comparison by Branch Use



PAVEMENT CONDITION DISTRIBUTION

The following figure shows, in general, the level of work that is needed depending on pavement condition. Approximately 71 percent of the 100 airports included in the WSDOT APMS are at the condition level where they will benefit from preventive maintenance actions, such as crack sealing, joint sealing, patching, and surface treatments. Approximately 18 percent of the pavement infrastructure is in need of more extensive rehabilitation, while approximately 11 percent is in need of reconstruction to restore the pavement.

- Preventive Maintenance
- Major Rehabilitation
- Reconstruction



An M&R program was developed for the 95 Washington airports evaluated during this project (excluding BFI, GEG, PSC, SEA, and YKM) using the PAVER™ pavement management software. The analysis was prepared for eight years (2013 through 2020). Preventive maintenance was considered in 2013 only, and major rehabilitation actions were determined during 2014 through 2020. An inflation rate of 2.5 percent was applied when calculating the future cost of work.

CRITICAL PCIs

For each year of the analysis, the future conditions of the pavements were estimated, and a determination was made as to whether preventive maintenance or major rehabilitation/reconstruction was the appropriate and most cost-effective strategy. The pavement was recommended for preventive maintenance if the forecasted condition was projected to be above the critical PCI thresholds shown in the table below. Below these critical PCI thresholds, major rehabilitation/reconstruction was recommended.

Surface Type	Load Classification	Runway	Taxiway	Apron, Helipad, and T-hangar
AC	< 60,000#	65	60	60
	≥ 60,000#	70	65	60
PCC	< 60,000#	55	50	50
	≥ 60,000#	60	55	50

FUNDING LEVELS FOR NON-PRIMARY AIRPORTS

Three funding levels for pavement M&R were investigated during this project: no funding, unlimited funding, and $4.5 million annually. The funding analysis was run for the years 2014 through 2020 and only addresses the needs of pavements eligible for funding at Non-Primary airports.

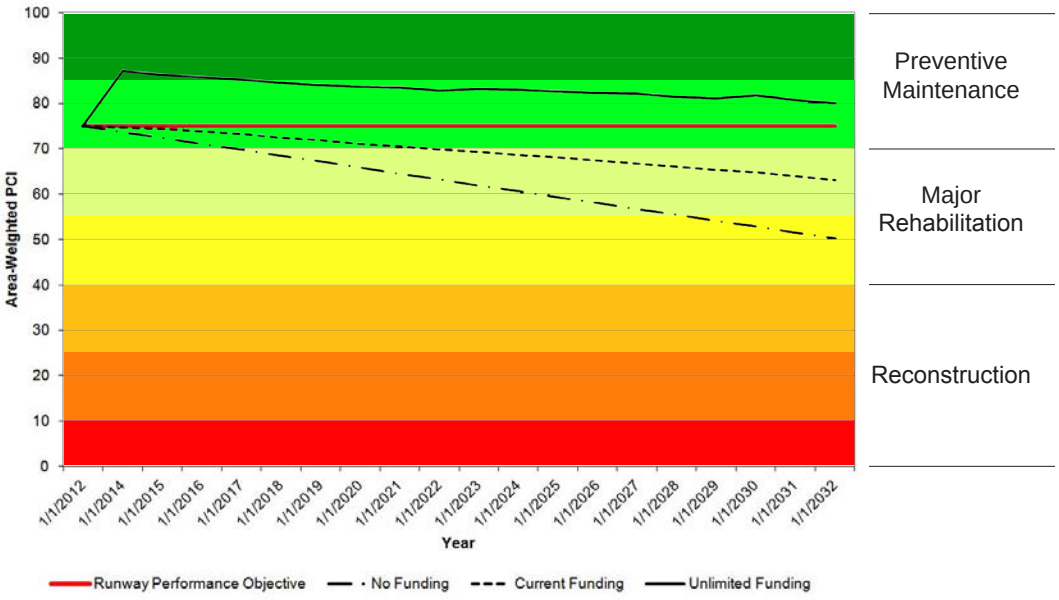
At one extreme end of the scale where no funding is provided for pavement M&R, the condition of the system of Non-Primary airports is anticipated to decrease from 75 to 66 by 2020. This lack of investment in the pavement infrastructure would result in an increased need for pavement rehabilitation and reconstruction, which in turn would substantially increase the costs to keep the pavement system in safe and serviceable condition. In fact, by the end of 2020 under this scenario, the backlog for pavement rehabilitation and reconstruction will increase by approximately 68 percent to $301 million.

At the other end of the scale, if all pavement M&R projects were funded under an unlimited budget scenario, the condition of the Non-Primary airport system is projected to increase from 75 to 84 by 2020. In addition, the backlog of pavement rehabilitation and reconstruction projects would be eliminated. However, it would come at an estimated cost of $217 million for Non-Primary airports.

A third analysis looked at the ramifications of continuing to use the existing funding level for Non-Primary airports of $4.5 million annually. Under this analysis, the pavement system deteriorates but at a slower pace than under the no funding scenario with the condition decreasing from 75 to 71 by 2020. The backlog of the pavement rehabilitation and reconstruction projects by 2020 would increase by approximately 43 percent to $257 million.

To determine the long-term impacts of the different levels of funding, a fourth analysis was run that looked only at the major rehabilitation/reconstruction needs through 2032 for the Non-Primary airport pavements. As shown in the figure below, it is estimated that the area-weighted 2032 PCIs for the Non-Primary airports are projected to be 50, 63, and 80 under the no funding, current funding, and unlimited funding scenarios, respectively. Under current funding levels, it is estimated that the backlog of major rehabilitation/reconstruction needs will grow to $606 million by 2032 from the current 2014 backlog of $179 millon.

20 Year Projected PCI Comparison by Funding Level



Pavement Funding Needs through 2020

The funding needs through 2020 under an unlimited budget for each of the 95 airports inspected during this project are summarized in the following table.

State Classification	Associated City	Airport Name	2012 Area-Weighted PCI	Estimated Funding Needs
Commercial	Anacortes	Anacortes	88	$5,674
	Bellingham	Bellingham International	94	$1,002,068
	Friday Harbor	Friday Harbor	87	$194,391
	Moses Lake	Grant County International	73	$60,621,552
	Port Angeles	William R. Fairchild International	77	$6,176,566
	Pullman	Pullman-Moscow Regional	90	$1,220,676
	Walla Walla	Walla Walla Regional	56	$90,875,869
	Wenatchee	Pangborn Memorial	72	$8,072,022
			Commercial Total:	**$168,168,819**
Community	Camas	Grove Field	90	$16,161
	Cashmere	Cashmere-Dryden	72	$351,051
	Chehalis	Chehalis-Centralia	79	$3,416,853
	Chelan	Lake Chelan	65	$1,104,252
	Colfax	Port Of Whitman Business Air Center	75	$256,567
	College Place	Martin Field	41	$3,795,379
	Concrete	Mears Field (Concrete)	81	$226,208
	Elma	Elma Municipal	65	$329,302
	Ephrata	Ephrata Municipal	69	$8,318,406
	Kennewick	Vista Field	76	$1,508,448
	Lopez	Lopez Island	99	$0
	Monroe	Firstair Field	34	$946,612
	Moses Lake	Moses Lake Municipal	66	$397,827
	Oroville	Dorothy Scott	57	$1,314,477
	Othello	Othello Municipal	64	$1,361,480
	Port Townsend	Jefferson County International	86	$363,637
	Prosser	Prosser	86	$36,466
	Puyallup	Pierce County -Thun Field	75	$375,654
	Richland	Richland	90	$307,919
	Toledo	Ed Carlson Memorial-South Lewis County	79	$2,470,437
	Twisp	Twisp Municipal	78	$635,406
	Vancouver	Pearson Field	73	$848,015
			Community Total:	**$28,380,557**

Pavement Funding Needs through 2020

State Classification	Associated City	Airport Name	2012 Area-Weighted PCI	Estimated Funding Needs
Local	Brewster	Anderson Field	93	$177,832
	Chewelah	Sand Canyon	52	$1,634,989
	Cle Elum	Cle Elum Municipal	94	$0
	Darrington	Darrington Municipal	84	$202,715
	Davenport	Davenport Municipal	71	$228,551
	Goldendale	Goldendale Municipal	74	$498,140
	Ilwaco	Port of Ilwaco	99	$0
	Ione	Ione Municipal	87	$203,780
	Lind	Lind Municipal	86	$232,559
	Mansfield	Mansfield	72	$166,599
	Morton	Strom Field	35	$707,302
	Oak Harbor	AJ Eisenberg	22	$954,964
	Ocean Shores	Ocean Shores Municipal	85	$290,130
	Odessa	Odessa Municipal	62	$1,028,684
	Okanogan	Okanogan Legion	54	$1,065,468
	Packwood	Packwood	50	$305,810
	Quillayute	Quillayute	70	$1,334,045
	Quincy	Quincy Municipal	77	$392,242
	Republic	Ferry County	48	$1,063,815
	Ritzville	Pru Field	69	$376,676
	Rosalia	Rosalia Municipal	100	$0
	Sekiu	Sekiu	27	$1,639,166
	South Bend	Willapa Harbor	100	$0
	Sunnyside	Sunnyside Municipal	66	$758,078
	Tekoa	Willard Field	67	$351,926
	Tonasket	Tonasket Municipal	55	$1,237,944
	Warden	Warden	66	$367,779
	Waterville	Waterville	69	$600,335
	Westport	Westport	66	$280,641
	Wilbur	Wilbur Municipal	96	$117,685
	Wilson Creek	Wilson Creek	55	$559,945
	Winthrop	Methow Valley State	67	$1,489,202
	Woodland	Woodland State	96	$18,697
			Local Total:	**$18,285,701**

Pavement Funding Needs through 2020

State Classification	Associated City	Airport Name	2012 Area-Weighted PCI	Estimated Funding Needs
Regional	Arlington	Arlington Municipal	84	$5,008,415
	Auburn	Auburn Municipal	66	$3,069,125
	Bremerton	Bremerton National	83	$3,624,684
	Burlington	Skagit Regional	81	$8,088,649
	Colville	Colville Municipal	69	$944,641
	Deer Park	Deer Park Municipal	84	$2,852,653
	Eastsound	Orcas Island	81	$434,708
	Electric City	Grand Coulee Dam	86	$3,570
	Ellensburg	Bowers Field	62	$22,947,557
	Everett	Snohomish County (Paine Field)	77	$27,229,313
	Hoquiam	Bowerman Field	78	$2,499,477
	Kelso	Southwest Washington Regional	83	$505,428
	Olympia	Olympia Regional	80	$14,232,738
	Omak	Omak Municipal	67	$7,936,058
	Renton	Renton Municipal	85	$2,903,704
	Shelton	Sanderson Field	77	$927,553
	Snohomish	Harvey Field	56	$1,117,708
	Spokane	Felts Field	64	$10,490,379
	Tacoma	Tacoma Narrows	73	$2,855,292
			Regional Total:	**$117,671,652**
Rural Essential	Cle Elum	DeVere Field	57	$138,580
	Eatonville	Swanson Field	96	$22,610
	Forks	Forks Municipal	48	$1,590,934
	Greenwater	Ranger Creek State	41	$614,963
	Kent	Crest Airpark	61	$1,055,819
	Langley	Whidbey Airpark	97	$23,975
	Lynden	Lynden Municipal	84	$272,380
	Mattawa	Desert Aire	86	$509,637
	Sequim	Sequim Valley	58	$1,113,604
	Silverdale	APEX	82	$165,449
	Spanaway	Shady Acres	94	$7,338
	Spokane	Mead Flying Service	66	$108,331
	Stanwood	Camano Island	50	$147,963
			Rural Essential Total:	**$5,771,583**

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