2015 PAVEMENT CONDITION INDEX (PCI) STUDY **EXECUTIVE SUMMARY**

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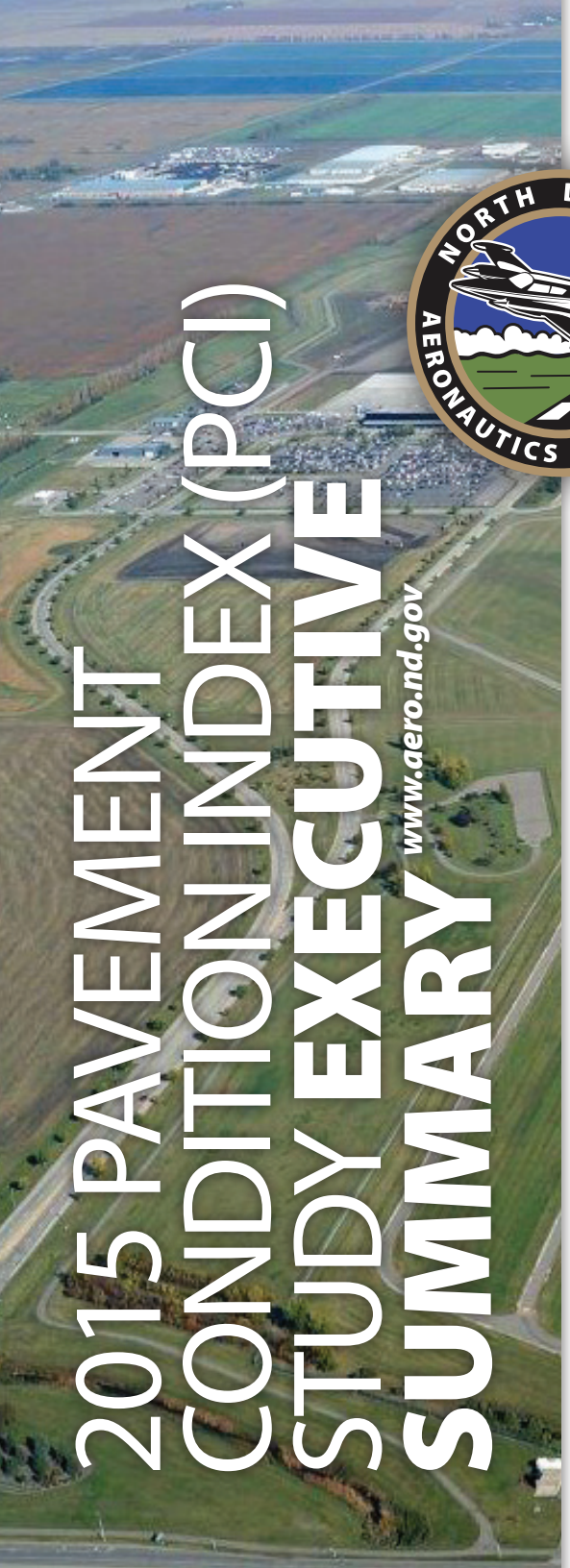
NORTH DAKOTA
AERONAUTICS COMMISSION
A STATEWIDE VOICE FOR AVIATION



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FEDERAL AVIATION ADMINISTRATION
A.I.P. NO. 3-38-0000-013-2015

NORTH DAKOTA
AERONAUTICS COMMISSION
A STATEWIDE VOICE FOR AVIATION

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Overview

The Airport Pavement Management System (APMS) was developed by the Federal Aviation Administration (FAA) and is intended to provide a consistent and systematic approach to identifying pavement that is in need of maintenance or rehabilitation. The North Dakota Aeronautics Commission (NDAC) developed a customized APMS in accordance with FAA requirements.

An APMS evaluates both the current condition of the pavement as well as predicts a future condition based on the Pavement Condition Index (PCI). This in turn allows the individual airports, the NDAC and the FAA to monitor the condition of the airport pavements and budget for required maintenance to avoid excessive deterioration. The timing of this maintenance or rehabilitation is vital as airport pavement conditions play a crucial role in ensuring the safety of all airport users.

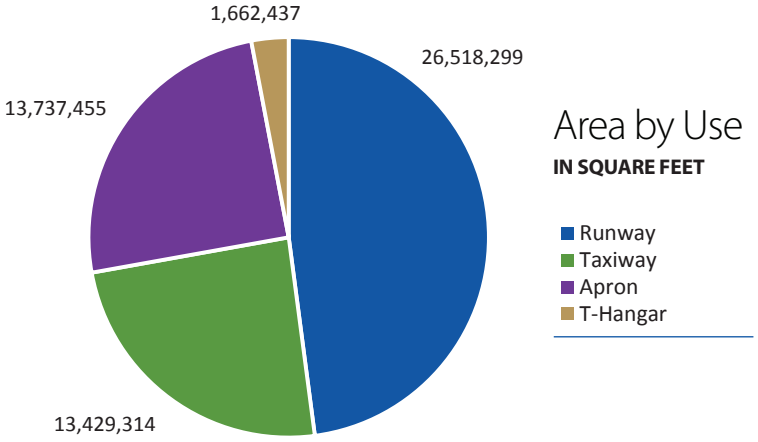
This system is updated every three years to accurately reflect current pavement conditions across the state's airports. In 2012, the APMS was updated to an electronic format to allow the data to be readily available to the airports, the FAA and the NDAC.

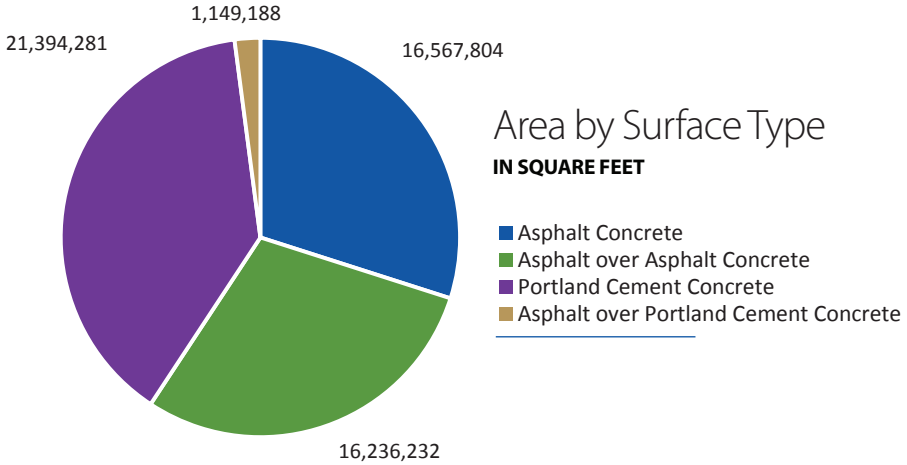
In 2015, Mead & Hunt along with Applied Pavement Technology and EVS conducted the update to the APMS. During the 2015 update, record information collected in the previous three-year cycle has been added to the database. Pavement inspections have been completed, and additional airports have been added that were not part of the previous study. Functionality changes also have been made to the website itself. The findings and recommendations of the APMS update are included in this report. Full results can be found online on the NDAC website, **www.aero.nd.gov**.

Pavement Inventory

In 2015, a total of 71 airports were assessed for the current project. Of these, 52 were part of the National Plan of Integrated Airport Systems (NPIAS) and 19 were non-NPIAS. NPIAS airports qualify for federal funding. Non-NPIAS airports do not qualify for federal funding and must be funded solely by state and local contributions. Therefore, the FAA only provided funding for pavement inspections and reports for the NPIAS airports as part of this study. NPIAS airports inspected included 7 commercial service airports and 45 general aviation airports. Williston was not inspected as part of the 2015 study due to future relocation of the existing airport. However, Williston's 2012 pavement inventory data was used in the 2015 data analysis and is included as part of the 2015 results. Pavement inventory data includes area, age and condition. Projected costs for Williston were excluded from the funding assessment needs. A PCI of 100 was assumed for all newly constructed pavement or pavement programmed to be reconstructed in the next year. The map on page 5 identifies all of the airports in North Dakota that were included as part of the 2015 APMS update.

These airports represent 55.3 million square feet of pavement – 26.5 million square feet of runway pavement, 13.4 million square feet of taxiway pavement, 13.7 million square feet of apron pavement, and 1.7 million square feet of T-hangar pavement, comprised of both concrete and asphalt, as shown in the *Area by Use* and *Area by Surface Type* pie charts below. Pavement at the airports in the state have an average age of 17 years for commercial service airports and 10 years for general aviation airports. Throughout the years, the airports have performed preventive maintenance and carried out a series of rehabilitation/reconstruction projects to sustain and extend the pavement life. The charts shown on the next page, *Pavement Area by Use* and *Area-Weighted Average Age by Use*, summarize the total square footage of pavements found in the state and the average age of those pavements based on use.

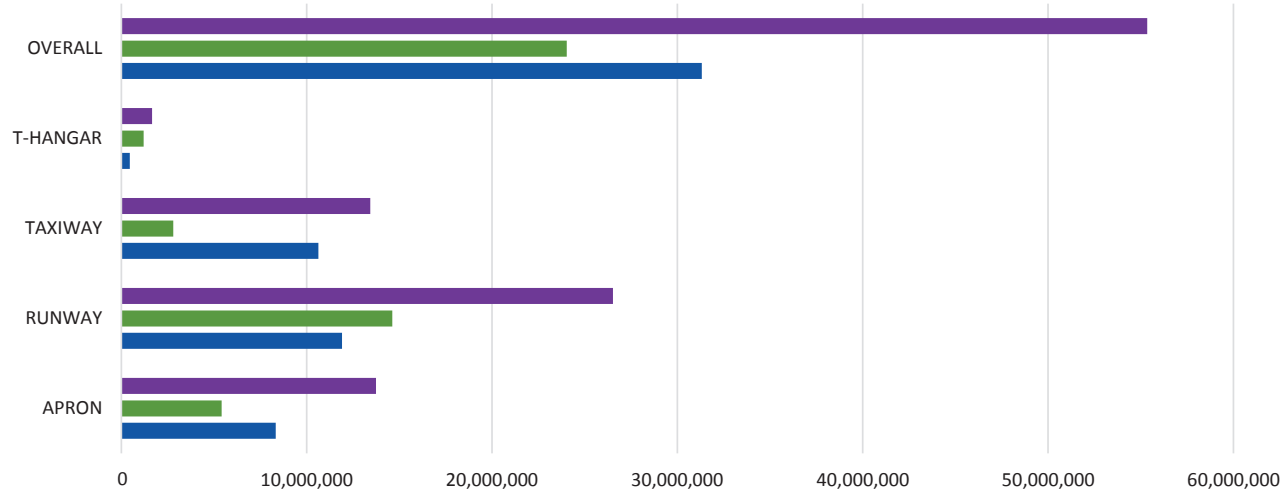




Pavement Area by Use

IN SQUARE FEET

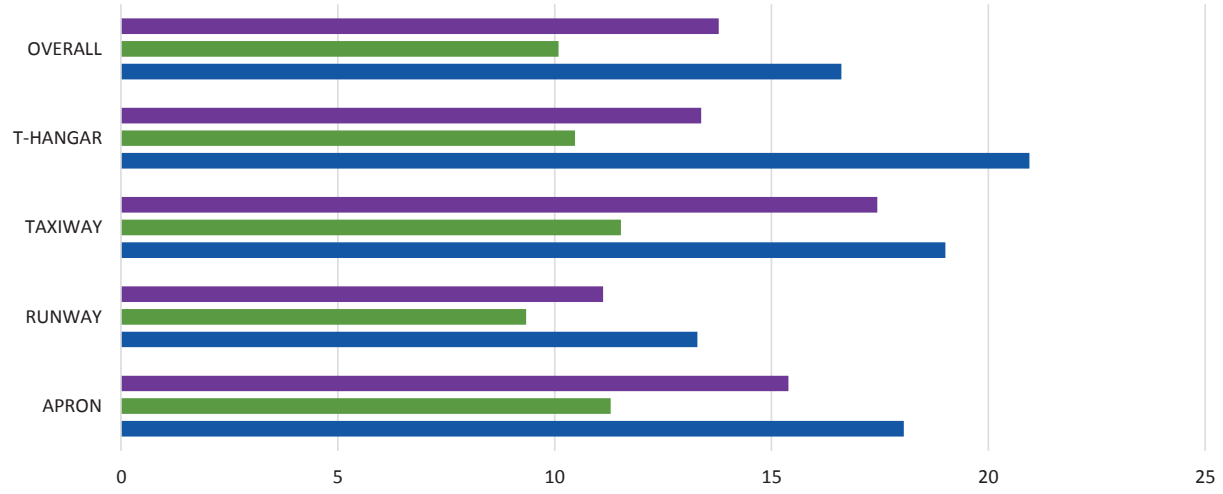
- Overall State System
- General Aviation
- Commercial Service



Area-Weighted Average Age by Use

IN YEARS

- Overall State System
- General Aviation
- Commercial Service



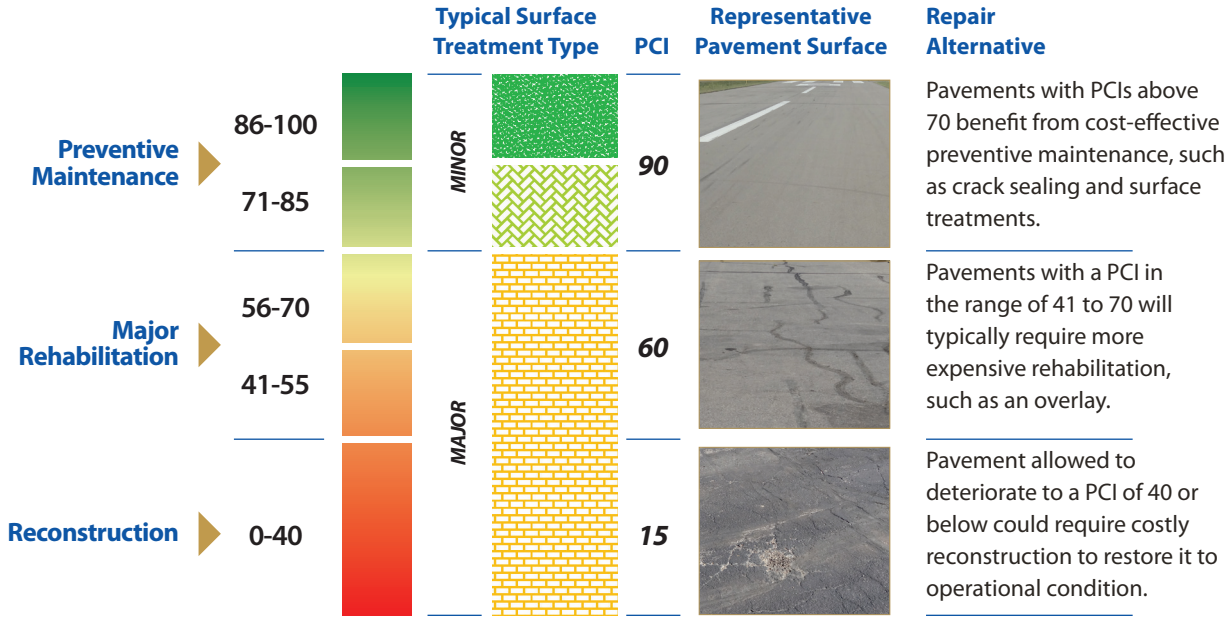
Pavement Evaluation

Pavement Evaluation Procedure

A PCI survey was conducted in accordance with the procedures outlined in American Society for Testing and Materials (ASTM) Standard D5340, *Standard Test Method for Airport Pavement Condition Index Surveys* and the FAA's Advisory Circular 150/5380-6B, *Guidelines and Procedures for Maintenance of Airport Pavements*. A PCI survey consists of dividing pavement into a series of sections, selecting random sections for sampling, and inspecting a given portion of each sample section to determine overall pavement deterioration. Pavement deterioration is based on the quantification of the different types, the severity and the number of distresses present in the sample section. This information is then used to formulate a composite index numerical value that represents the overall pavement condition. This value will range from 0 (failed) to 100 (excellent).

As part of the APMS, the PCI will be used to determine current pavement conditions, predict future conditions, develop a maintenance program and identify the most cost-effective time frame to perform major rehabilitation.

The PCI will also aid in tracking and determining causes of deterioration on a pavement. The correlation between a PCI number and a recommended repair is shown in the illustration to the right. Preventive maintenance consists of patching, crack sealing and joint sealing. Pavement rehabilitation includes surface treatments and thin overlays. Pavement reconstruction refers to full-depth reconstruction and thick overlays. Minor surface treatments are used to address weathering and low-severity raveling. Major surface treatments are used to address medium- and high-severity raveling.

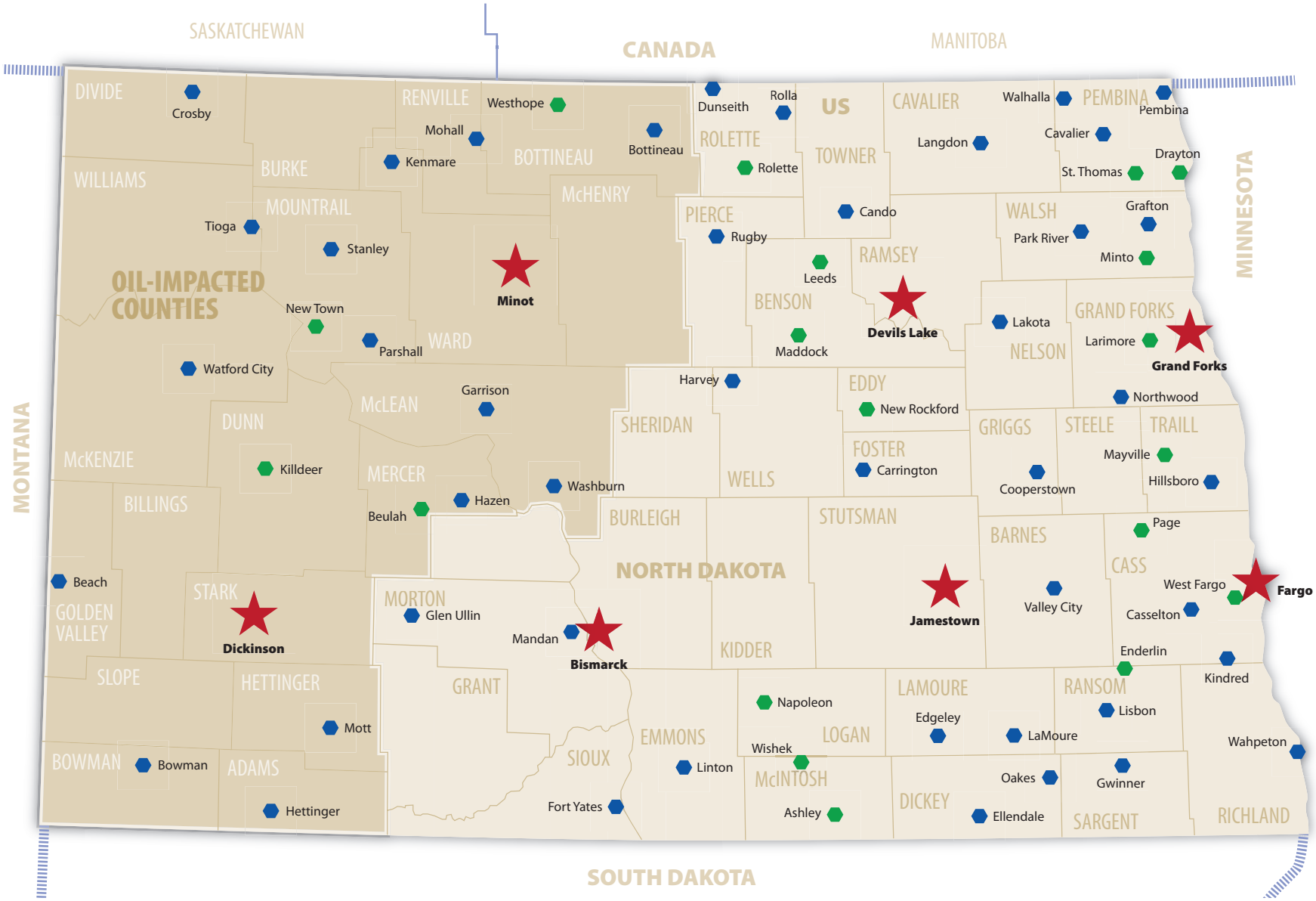


North Dakota Airports included in the 2015 Airport Pavement Management System Update

Commercial Service (Federal Funding)

General Aviation NPIAS (Federal Funding)

General Aviation Non-NPIAS (State & Local Funding)



Typical Distress Types

The FAA Advisory Circular provides a list of specific distresses to be analyzed and recorded when inspecting pavement. Airports in North Dakota are a combination of asphalt concrete (AC) pavement and Portland cement concrete (PCC) pavement with there being slightly more AC pavement than PCC pavement. These two pavement types have unique pavement distresses and repairs. The following is a brief description of commonly observed pavement distresses at North Dakota airports.

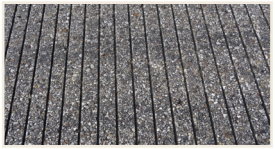
ALLIGATOR (FATIGUE) CRACKING. Alligator (fatigue) cracking is a load-related distress. Alligator cracking is caused by excessive tensile strains at the bottom of the AC layer or stabilized asphalt base layer from repeated aircraft loadings. Alligator cracking typically shows up on the surface as a series of parallel cracks, which eventually interconnect to form a pattern resembling the skin of an alligator.

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

LONGITUDINAL AND TRANSVERSE CRACKING. The predominant distress type found on asphalt pavements at North Dakota airports is longitudinal and transverse (L&T) cracking. This distress 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 faults in supportive layers of pavement or subgrade. Cracking is also a common distress type for PCC pavement. This distress is caused by a combination of load repetition, curling stresses, and shrinkage stresses.

RAVELING. As pavements age and are exposed to oxidation and other environmental stresses, they may experience a loss in the material making up the pavement matrix. Raveling is the dislodging and loss of coarse aggregate in the surface of a pavement. The pavement may be showing signs of aging and hardening and may result in the production of FOD.

SPALLING. Spalling, in PCC pavement, is the breakdown of the slab edges in close proximity to the slab joint. Spalling is identified as occurring in the corner or along the joint of a PCC slab. Spalling is typically caused by the introduction of incompressible material in the joint, weaker pavement at the joint caused by overworking of the pavement during construction, traffic loading or a combination of these.



WEATHERING. As pavements age and are exposed to oxidation and other environmental stresses, they may experience a loss in the material making up the pavement matrix. Weathering is the loss of asphalt binder and fine aggregate in the surface of the pavement. The loss of fine matrix material in the surface may eventually lead to the exposure and dislodging of coarse aggregate, leading to raveling and FOD.

Pavement Classification Number (PCN)

A PCN is a value that indicates the strength of a pavement as it relates to aircraft classification numbers, which are assigned to each type of aircraft. Aircraft traffic information as well as subgrade and pavement strengths are critical inputs in determining this value. Pavements at the commercial service airports were analyzed in 2012 to provide a PCN value as detailed in FAA Advisory Circular 150/5335-5B, *Standardized Methods of Reporting Airport Pavement Strength – PCN*. The PCN is expressed as a five-part code. The first part of the PCN is a numerical value indicating the load-carrying capacity of the pavement. This numerical value is followed by four codes representing the following categories:

- **PAVEMENT TYPE**
  - **R = Rigid**
  - **F = Flexible**
- **SUBGRADE STRENGTH**
  - **A = High** (k-value ≥ 442 psi/in or CBR ≥ 13)
  - **B = Medium** (221 psi/in < k-value < 442 psi/in or 8 < CBR < 13)
  - **C = Low** (92 psi/in < k-value ≤ 221 psi/in or 4 < CBR ≤ 8)
  - **D = Ultra Low** (k-value ≤ 92 psi/in or CBR ≤ 4)
- **MAXIMUM ALLOWABLE TIRE PRESSURE**
  - **W = High** (no pressure limit)
  - **X = Medium** (146 to 218 psi)
  - **Y = Low** (74 to 145 psi)
  - **Z = Ultra Low** (pressure limited to 73 psi)
- **PAVEMENT EVALUATION METHOD**
  - **T = Technical Evaluation**
  - **U = Using Aircraft Evaluation**

PCN results were not calculated as part of the 2015 study. The 2012 PCN results for the state are listed in the table below. A detailed PCN report for each airport can be found online on the NDAC website, www.aero.nd.gov.

2012 PCN Results

AIRPORT	BRANCH ID	PCN
Bismarck Municipal	Runway 13-31	42 F/A/W/T
	Runway 3-21	26 F/A/W/T
Devils Lake Regional	Runway 13-31	27 F/D/W/T
	Runway 3-21	26 F/D/W/T
Dickinson Theodore Roosevelt Regional	Runway 14-32	20 F/D/W/T
	Runway 7-25	6 F/D/W/T
Fargo - Hector International	Runway 18-36	95 R/C/W/T
	Runway 9-27	25 R/C/W/T
	Runway 13-31	17 R/D/W/T
Grand Forks International	Runway 17L-35R	9 R/C/W/T
	Runway 17R-35L	35 R/C/W/T
	Runway 9L-27R	24 R/B/W/T
	Runway 9R-27L	10 R/C/W/T
Jamestown Regional	Runway 13-31	79 F/C/W/T
	Runway 4-22	25 F/D/W/T
Minot International	Runway 13-31	43 R/C/W/T
	Runway 8-26	34 F/D/W/T

Analysis of Results

Critical PCI Values

For each year of the analysis, the future condition of each of the pavements was estimated and a determination was made as to whether preventive maintenance or major rehabilitation/reconstruction was the appropriate and most cost-effective method of maintaining pavement life. If a pavement was projected to be above the critical PCI values listed below, the pavement was recommended for preventive maintenance. Major rehabilitation/reconstruction was recommended for any PCI value below the PCI critical thresholds. Surface treatments were identified for viable candidates that exhibited weathering and/or raveling. These were identified separate from the critical value analysis.

- **60 for general aviation taxiways and aprons**
- **65 for commercial service taxiways and aprons**
- **70 for general aviation runways**
- **75 for commercial service runways**

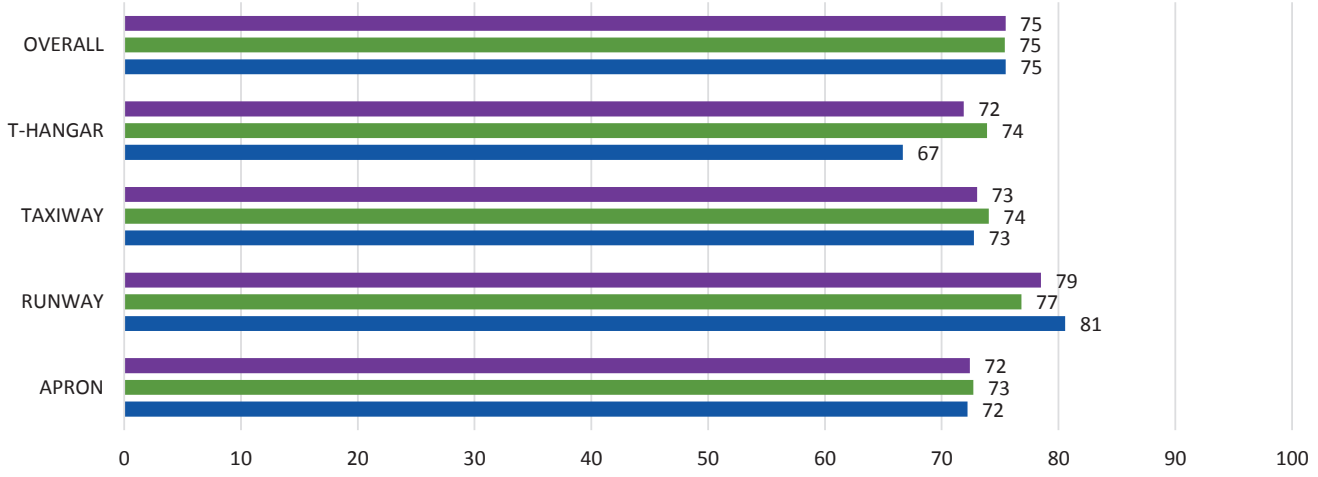
Interested in a Particular Airport's Pavement Condition & History?

For information on pavement distresses for a specific airport, visit the Interactive Data Exchange Application (IDEA) website by going to www.aero.nd.gov and navigating to "Studies" then "Pavement Condition Index" then "Click Here." Once there, you can view a list of the distresses that were identified as well as a maintenance and rehabilitation plan for each airport. The IDEA site also contains photos of each airport along with an interactive version of the airport's PCI map.

Overall Pavement Condition

Each airport was inspected and an overall area-weighted pavement condition is assigned to each. The information collected at each airport is used to provide greater detail on the uses of pavements and the correlating PCI value associated with each use. The overall area-weighted PCI of all the airports included in this study is 75. The chart below, *Area-Weighted Average PCI Value by Use*, shows the 2015 condition of the pavement broken out by use and airport classification. The *Overall Area-Weighted PCI* table on the next page provides the overall area-weighted PCI for each airport.

Area-Weighted Average PCI Value by Use



Overall Area-Weighted PCI

AIRPORT NAME	AREA-WEIGHTED PCI
Ashley Municipal	59
Beach	79
Beulah Municipal	84
Bismarck Municipal	69
Bottineau Municipal	82
Bowman Regional	100
Cando Municipal	63
Carrington Municipal	72
Casselton Robert Miller Regional	70
Cavalier Municipal	81
Cooperstown Municipal	53
Crosby Municipal	78
Devils Lake Regional	76
Dickinson Theodore Roosevelt Regional	72
Drayton Municipal	67
Dunseith - International Peace Garden	79
Edgeley Municipal	43
Ellendale Municipal	91
Enderlin - Sky Haven	80
Fargo - Hector International	77
Fort Yates - Standing Rock	82
Garrison Municipal	71
Glen Ullin Regional	80
Grafton - Hutson Field	76
Grand Forks International	80
Gwinner - Roger Melroe Field	96
Harvey Municipal	79

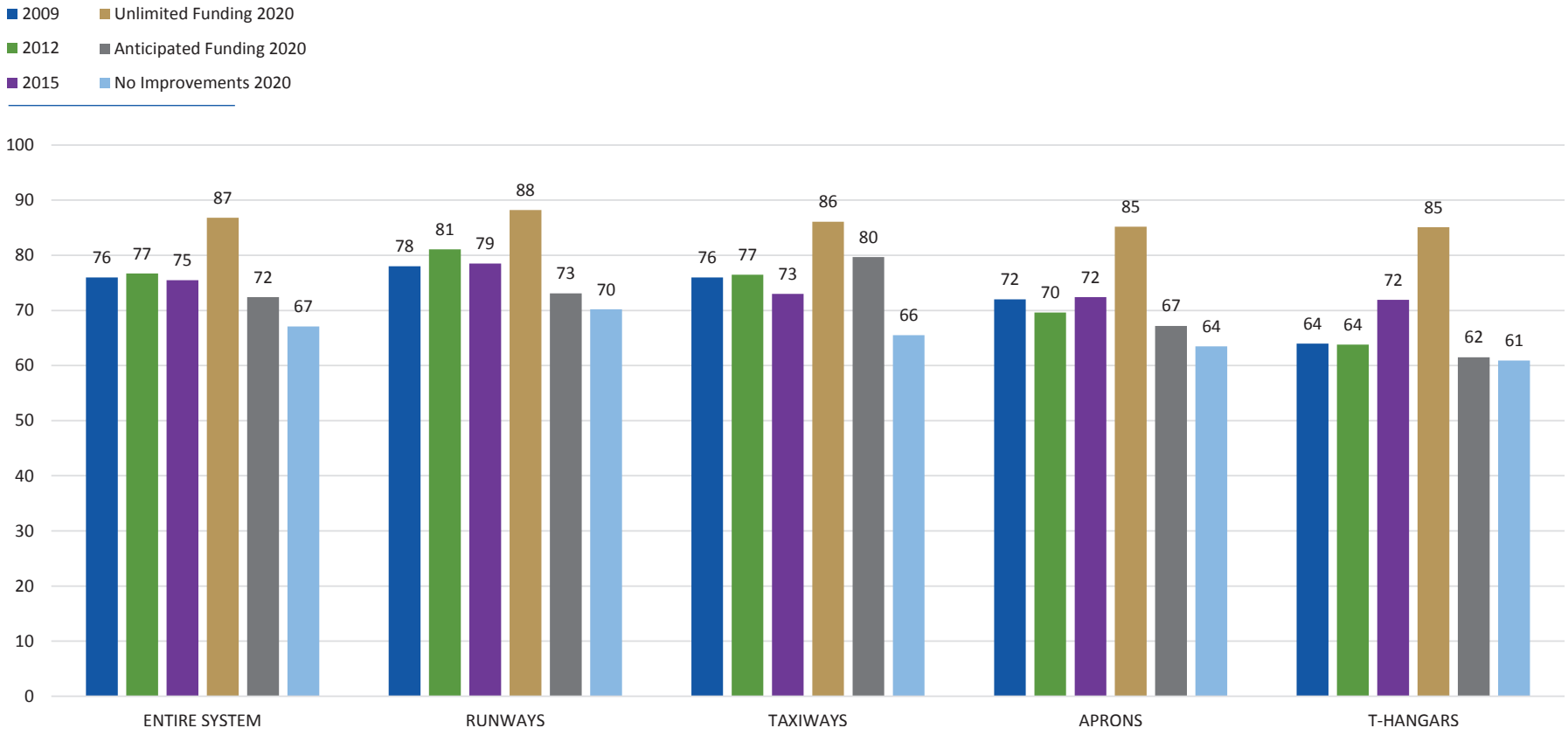
AIRPORT NAME	AREA-WEIGHTED PCI
Hazen - Mercer County Regional	77
Hettinger Municipal	58
Hillsboro Regional	55
Jamestown Regional	62
Kenmare Municipal	93
Killdeer - Dunn County	93
Kindred - Robert Odegaard Field	71
Lakota Municipal	71
LaMoure Rott Municipal	29
Langdon - Robertson Field	46
Larimore Municipal	77
Leeds Municipal	44
Linton Municipal	41
Lisbon Municipal	47
Maddock Municipal	100
Mandan Municipal	85
Mayville Municipal	91
Minot International	82
Minto Municipal	71
Mohall Municipal	85
Mott Municipal	71
Napoleon Municipal	69
New Rockford - Tomlinson Field	63
New Town Municipal	100
Northwood Municipal - Vince Field	43
Oakes Municipal	91
Page Regional	18

AIRPORT NAME	AREA-WEIGHTED PCI
Park River - W C Skjerven Field	83
Parshall-Hankins	93
Pembina Municipal - Thomas Nord Field	65
Rolette	82
Rolla Municipal	93
Rugby Municipal	76
St. Thomas Municipal	69
Stanley Municipal	80
Tioga Municipal	71
Valley City - Barnes County Municipal	91
Wahpeton - Harry Stern	81
Walhalla Municipal	88
Washburn Municipal	99
Watford City Municipal	77
West Fargo Municipal	83
Westhope Municipal	78
Wishek Municipal	40

Historic Pavement Condition

The APMS is updated every three years and it is important to show how the system as a whole is performing from update to update. The *Area-Weighted Average PCI by Use* chart below provides a summary of the 2009 and 2012 historic PCI values; current 2015 PCI values; projected PCI values in 2020 if unlimited funding were available; projected PCI values in 2020 if only the anticipated state budget funding were available; and the projected PCI values in 2020 if no improvements were completed on the existing system.

Area-Weighted Average PCI by Use

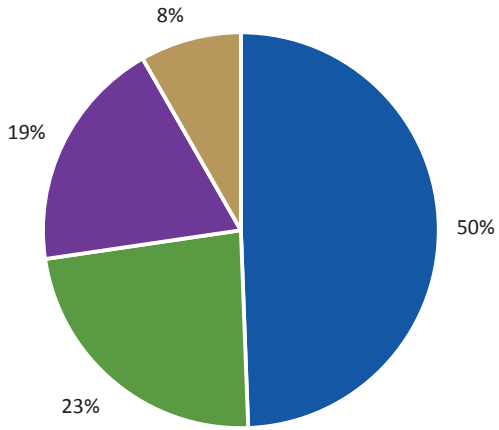


Pavement Condition Distribution

Approximately 50 percent of the airports included in the 2015 APMS are at the condition level where they will benefit from preventive maintenance actions, such as crack sealing, joint sealing, and patching. Roughly 23 percent would benefit from applying a surface treatment. Approximately 19 percent of the pavement infrastructure is in need of more extensive rehabilitation, while 8 percent is in need of reconstruction to restore the pavement. The following pie charts show the level of work that is needed in the system.

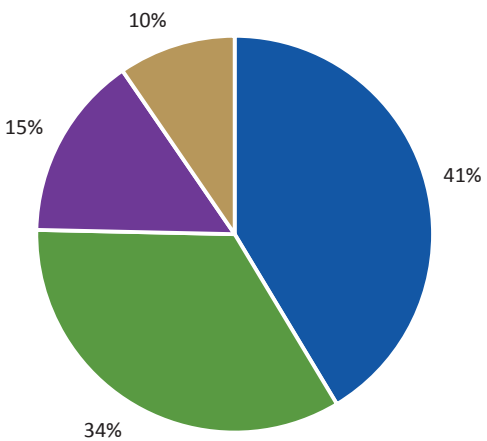
Overall State

- Preventative Maintenance
- Surface Treatments
- Major Rehabilitation
- Major Reconstruction



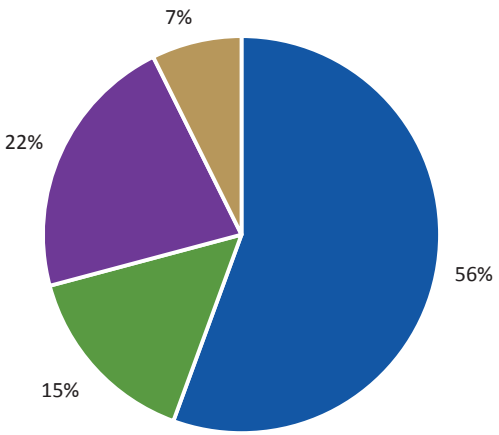
General Aviation

- Preventative Maintenance
- Surface Treatments
- Major Rehabilitation
- Major Reconstruction



Commercial Service

- Preventative Maintenance
- Surface Treatments
- Major Rehabilitation
- Major Reconstruction



Pavement Funding Assessment

Funding for aviation projects within the state is crucial in order to maintain a steady pavement condition and ensure safety of all aviation users. If no funding is provided for pavement maintenance and repair, North Dakota's pavement system will experience a slow and steady decline in condition. This decline would result in a need for more major rehabilitation or reconstruction projects, which in turn significantly increases future cost.

Using the information collected during the pavement inspection, a rehabilitation program for 2016 through 2020 was developed for every airport in the state. A five-year program was prepared with the goal of maintaining the pavement above the established critical PCI values listed earlier in this report. This program generates a major rehabilitation recommendation for pavement in the year they drop below their critical PCI.

If all projects identified in the PCI study were funded, an approximate total of $181 million would be needed during the next five years – $105.1 million for commercial service airports and $75.9 million for general aviation airports. The unlimited budget funding for individual airport needs through 2020 are summarized in the table shown to the right, *Five-Year Funding Plan*. This analysis is for 2016 through 2020 with an inflation factor of four percent when calculating future cost of work. The unit costs used to estimate overall project costs are based on averages of recent projects completed throughout the state. These costs are averages and are not intended to be used for specific project planning purposes. Money identified in an unlimited budget scenario is to maintain or rehabilitate existing infrastructure and does not include any additional needs or improvements made.

Five-Year Funding Plan

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
Commercial Service	Bismarck Municipal	$20,141,319
	Devils Lake Regional	$5,168,798
	Dickinson Theodore Roosevelt Regional	$8,443,856
	Fargo - Hector International	$26,825,163
	Grand Forks International	$16,429,217
	Jamestown Regional	$13,353,434
	Minot International	$14,764,949
Five-Year Commercial Service Funding Total		**$105,126,736**
General Aviation *(NPIAS)*	Beach	$833,072
	Bottineau Municipal	$384,900
	Bowman Regional*	$0
	Cando Municipal	$1,866,699
	Carrington Municipal	$1,741,238
	Casselton Robert Miller Regional	$4,275,086
	Cavalier Municipal	$1,114,929
	Cooperstown Municipal	$1,933,878
	Crosby Municipal	$1,320,059
	Dunseith - International Peace Garden	$95,764
	Edgeley Municipal	$2,599,711
	Ellendale Municipal	$350,709
	Fort Yates - Standing Rock	$232,100
	Garrison Municipal	$1,643,969
	Glen Ullin Regional	$1,361,368
	Grafton - Hutson Field	$1,153,065
	Gwinner - Roger Melroe Field	$127,003
	Harvey Municipal	$383,986
	Hazen - Mercer County Regional	$2,085,064

* *No or minimal five-year funding needed because airport was recently constructed or reconstructed.*

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
General Aviation *(NPIAS)*	Hettinger Municipal	$4,236,058
	Hillsboro Regional	$2,900,094
	Kenmare Municipal	$187,004
	Kindred - Robert Odegaard Field	$2,548,473
	Lakota Municipal	$1,755,477
	LaMoure Rott Municipal	$2,495,926
	Langdon - Robertson Field	$2,780,281
	Linton Municipal	$2,788,554
	Lisbon Municipal	$2,362,470
	Mandan Municipal	$1,692,069
	Mohall Municipal	$372,430
	Mott Municipal	$284,808
	Northwood Municipal - Vince Field	$2,831,781
	Oakes Municipal	$327,941
	Park River - W C Skjerven Field	$234,257
	Parshall-Hankins	$203,261
	Pembina Municipal - Thomas Nord Field	$1,943,878
	Rolla Municipal	$404,465
	Rugby Municipal	$461,607
	Stanley Municipal	$1,080,600
	Tioga Municipal	$2,033,820
	Valley City - Barnes County Municipal	$196,511
	Wahpeton - Harry Stern	$1,921,626
	Walhalla Municipal	$288,251
	Washburn Municipal	$10,096
	Watford City Municipal	$1,517,867
Five-Year General Aviation NPIAS Funding Total		**$61,362,205**

CLASSIFICATION	AIRPORT NAME	5-YEAR TOTAL FUNDING NEEDS
General Aviation *(Non-NPIAS)*	Ashley Municipal	$2,403,220
	Beulah Municipal	$297,012
	Drayton Municipal	$459,907
	Enderlin - Sky Haven	$379,776
	Killdeer - Dunn County*	$35
	Larimore Municipal	$594,863
	Leeds Municipal	$1,872,596
	Maddock Municipal*	$0
	Mayville Municipal	$574,093
	Minto Municipal	$327,389
	Napoleon Municipal	$231,099
	New Rockford - Tomlinson Field	$1,685,344
	New Town Municipal*	$0
	Page Regional	$1,097,942
	Rolette	$412,820
	St. Thomas Municipal	$862,280
	West Fargo Municipal	$725,030
	Westhope Municipal	$77,601
	Wishek Municipal	$2,534,289
Five-Year General Aviation Non-NPIAS Funding Total		**$14,535,296**
Five-Year Statewide Funding Total		**$181,024,237**

* *No or minimal five-year funding needed because airport was recently constructed or reconstructed.*

Summary

This report summarizes the results of the pavement evaluation conducted in North Dakota as part of the state APMS database update for airports. This includes **7* NPIAS commercial service airports**, **45 NPIAS general aviation airports** and **19 non-NPIAS general aviation airports**. The system currently has 55.3 million square feet of pavement – 31.3 million square feet at commercial service airports and 24 million square feet at general aviation airports. In 2012, the PCI value for the state was 77. During a visual inspection of the pavements in 2015, it was found that the current weighted PCI of the pavement network is 75. If no funding is provided, this PCI value will steadily fall to 67 by the end of 2020. If the state budget anticipated funding is provided, the 2020 overall PCI value of the system is anticipated to be 72. If all work identified were to be completed, the 2020 overall PCI of the system is anticipated to increase to a value of 87.

Approximately $181 million in funding would be needed over the next five years to complete all work that has been identified in the unlimited budget scenario. This includes approximately $105.1 million for commercial service airports and $75.9 million for general aviation airports. **Additional information can be found by visiting the NDAC website, www.aero.nd.gov.**

**** Williston was not inspected as part of the 2015 study. The 2012 Williston pavement inventory data used as part of the analysis includes area, age and condition but does not include the cost.***

FOR ADDITIONAL INFORMATION, PLEASE VISIT

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