MONTANA
Department of Transportation

DIVISION OF AERONAUTICS STATE AVIATION SYSTEM PLAN

2024 STATEWIDE PCI UPDATE

Contents

Chapter 1 – Program Introduction

1.1 Statewide Aviation System Plan (SASP) Background

The Aeronautics Division (Division) of the Montana Department of Transportation (MDT) has been conducting regular updates to the SASP since 1988. As part of the program, the Division provides an update to the Pavement Condition Index (PCI) values for participating airports every three (3) years. Kimley-Horn was contracted by MDT in coordination with the Federal Aviation Administration (FAA) and Helena Airports District Office to provide the 2024 PCI update.

Airport pavement infrastructure represents a large capital investment in the Montana airports system. Timely and appropriate maintenance and strategic rehabilitation are essential as repair costs increase in proportion to deterioration. Additionally, airport pavement distresses can contribute to the development of loose debris and decreased ride quality, which can be a safety concern for aircraft operations. The PCI methodology analyzes an overall measure of the pavement condition and provides an indication of the degree of maintenance, repair, or rehabilitation efforts that will be required to sustain functional pavement. A statewide PCI survey allows for the systematic and objective review of facilities within the program to assist in the identification of pavement needs. This objective study helps provide the sponsor justification for redevelopment of existing facilities. The program is funded by the State and the FAA to assist airports in remaining compliant with the AIP Handbook requirement of completing an ASTM PCI inspection of airfield pavements every three (3) years.

1.2 Participating Airports

The participating airports list for the 2024 update was communicated by the FAA and MDT staff. Airports previously excluded in the 2021 program, due to significant infrastructure development at the time and various other reasons, were added into the 2024 update. These airports include 5U8, 9U0, 57S, EKS, HRF, RPX, S64, and THM.

Table 1.1 2024 Program Participating Airports

Airport ID	Airport Name
00F	Broadus Airport
00U	Big Horn County (Hardin) Airport
1S3	Tillitt Field
32S	Stevensville Airport
38S	Deer Lodge-City-County Airport
3U3	Bowman Field (Anaconda) Airport
3U7	Benchmark (Augusta) Airport
3U8	Big Sandy Airport
48S	Harlem Airport
4U6	Circle Town County Airport
57S	Troy Airport
5U8	Geraldine Airport
6S0	Big Timber Airport
6S3	Woltermann Memorial (Columbus) Airport
6S8	Laurel Municipal Airport
79S	Fort Benton Airport
7S0	Ronan Airport

Airport ID	Airport Name
7S6	White Sulphur Springs Airport
88M	Eureka Airport
8S0	Starr-Browning Airstrip Airport
8S1	Polson Airport
8U6	Terry Airport
97M	Ekalaka Airport
9S2	Scobey Airport
9S4	Mineral County (Superior) Airport
9U0	Turner Airport
BHK	Baker Municipal Airport
CII	Choteau Airport
CTB	Cut Bank International Airport
EKS	Ennis – Big Sky Airport
GDV	Dawson Community (Glendive) Airport
GGW	Wokal Field/Glasgow-Valley County Airport
HRF	Rivalli County Airport
HVR	Havre City-County Airport
HWQ	Wheatland County Airport At Harlowton
JDN	Jordan Airport
LTY	Liberty County (Chester) Airport
LVM	Mission Field (Livingston) Airport
LWT	Lewistown Municipal Airport
M46	Colstrip Airport
M75	Malta Airport
MLS	Frank Wiley Field
OLF	L M Clayton (Wolf Point) Airport
PO1	Poplar Municipal Airport
PWD	Sher-Wood (Plentywood) Airport
RPX	Roundup Airport
RVF	Ruby Valley Field
S34	Plains Airport
S59	Libby Airport
S64	Stanford/Biggerstaff Field
S69	Lincoln Airport
S71	Edgar G Obie (Chinook) Airport
S85	Big Sky Field (Culbertson) Airport
SBX	Shelby Airport
SDY	Sidney-Richland Regional Airport
THM	Thompson Falls Airport
WYS	Yellowstone Airport

1.3 Project Scope and Objectives

In accordance with FAA AC 150/5380-7B *Airport Pavement Management Program (PMP),* an effective pavement management program consists of a system that achieves specific objectives. The MDT Statewide Aviation System Plan (SASP) PCI study objectives are as follows:

1. Update airport pavement database for tracking maintenance and construction history.
2. Calibrate the database to the ASTM pavement inventory hierarchy.
3. Achieve a systematic means for collecting and storing information regarding the existing pavement structure and condition.
4. Achieve an objective and repeatable system for evaluating pavement condition.
5. Report new pavement conditions in an intuitive manner for improved use during AIP Grant applications.

Kimley-Horn, in association with both MDT and the FAA, developed a scope to meet the project objectives. The MDT SASP PCI scope of services consists of the following:

A. The SASP update will consist of fifty-seven (57) airports. This consists of the 54 participating NPIAS airports and the three (3) participating Non-NPIAS airports.
B. A program-wide response form will be issued to achieve an updated contact list and request record drawings for all completed projects since the last update. Received documents will be incorporated into the PAVER database.
C. Update existing PAVER database to the standard ASTM pavement inventory hierarchy.
D. Update base map drawings for geometry and facility construction updates. Confirm any missing pavement areas via document review and include area if confirmed in the field. Establish pavement inventory for airports with no prior PCI information.
E. Conduct visual ASTM D5340 pavement condition index (PCI) survey for fifty-seven (57) general aviation (GA) airports throughout the state of Montana.
F. Obtain current PCI values using the most recent version of PAVER.
G. Develop pavement performance models to forecast section-level PCI values (5-year).
H. Develop practical maintenance and rehabilitation policies based on pavement performance. This analysis will be conducted with no budget constraints to identify all pavement projects for a 5-year duration. A policy table will program the major rehabilitation work identified at the Section-level based on current and predicted pavement PCI.
I. Produce an appendix of representative photos for each airport.
J. Produce a summary report of the observed distresses from each airport inspection.
K. Summarize the data and findings in a technical report.

Chapter 2 – System Inventory and Network Definition

2.1 Pavement Management System Database

The MDT SASP utilizes PAVER, a pavement management software, to maintain the statewide pavement database. In general, a PAVER database is used to achieve the following objectives:

- Implement a system for managing pavement asset inventories, and
- Store and analyze pavement condition information.

Additionally, this software has the capabilities to create performance models to forecast conditions and develop pavement maintenance, repair, and major rehabilitation recommendations based on funding scenarios and/or constraints.

2.1.1 PAVER Computer Program

PAVER was developed by the U.S. Army Construction Engineering Research Laboratory (USA-CERL) and uses the guidelines contained in FAA Advisory Circular 150/5380-6C *Guidelines and Procedures for Maintenance of Airport Pavements.* PAVER can store information relating to pavements including, but not limited to, pavement type (layer and material property data), dates of construction, pavement condition data, traffic data, construction and maintenance history information, and nondestructive testing data, to name a few. The data stored in the PAVER database provides the user with many capabilities, including evaluating current condition, predicting future condition, determining maintenance and rehabilitation (M&R) needs, scheduling future inspections, and identifying budget needs based on various analysis scenarios. The existing PAVER database was updated to Version 7.0.10 as part of this update and was used to assist in updating the PCI for MDT airports.

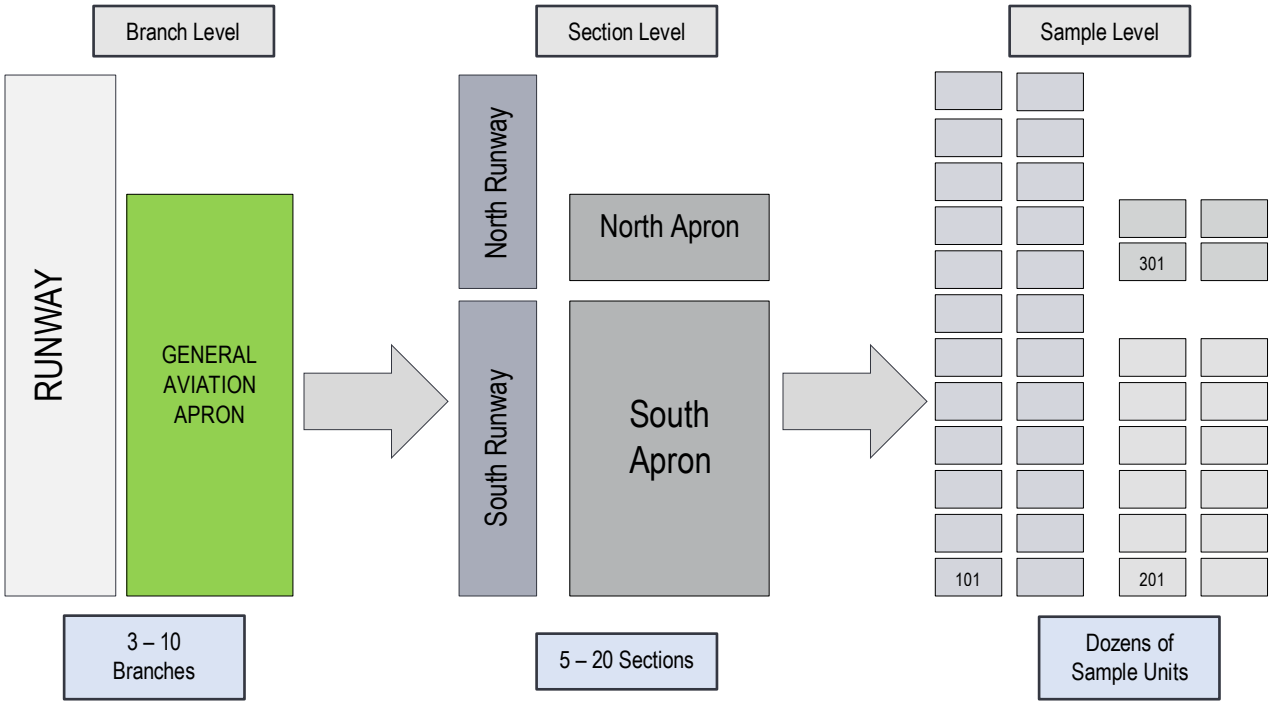
The following steps were completed to update the existing airside PAVER database for MDT:

- Update the existing PAVER database to Version 7.0.10;
- Update PAVER inventory based on recent airfield work since 2021;
- Calibrate the existing PAVER inventory to the ASTM pavement inventory hierarchy (i.e., Network ID, Branch ID, and Section ID)
- Data collection and entry;
- Data integrity and quality control;
- Determination of current PCIs; and
- PAVER report generation and interpretation.

2.2 Network Inventory Definitions

In a PCI study, a pavement network is established and then subdivided into smaller, manageable working units. **Figure 2.1** shows the relationship between branches, sections, and sample units within a pavement network. The following terms describe this network definition hierarchy and will be referred to throughout this report.

Figure 2.1 Pavement Network Definitions



2.2.1 Pavement Network

A pavement network is the starting point for the hierarchy of pavement management organization and is a logical unit for organizing airfield pavements. For example, for MDT and most other statewide systems, the network includes all non-privately maintained pavement facilities at the airport. Thus, the network name is interchangeable with the airport name.

2.2.2 Pavement Branch

A pavement branch, or facility, is a logical unit of generally identifiable pavement within a network with a distinct functional classification. For example, in an airfield environment, runways, taxiways, and aprons are considered separate branches. A branch must consist of at least one section.

2.2.3 Pavement Section

A pavement section is a subdivision of a branch that has consistent characteristics and condition levels throughout its area. These characteristics include structural composition (pavement layer material type and thickness), construction history, age, traffic type and frequency, and pavement condition. A section is the basic management unit of a pavement network and is the level at which condition results are analyzed.

2.2.4 Pavement Sample

A pavement sample (or sample unit) is a part of a pavement section that is evaluated according to the ASTM D5340 methodology. Sample unit areas are typically 5,000 contiguous square feet (± 2,000 square feet) for flexible (asphalt) pavement and 20 contiguous slabs (± 8 slabs) for rigid (concrete) pavement.

2.3 Inventory Updates

As part of the update, Kimley-Horn was tasked with updating the pavement inventory and CAD files with work performed since the last inspection in 2021. In response to a statewide request, MDT, sponsors, and the airport consultants have provided available information regarding recent maintenance or construction. Construction projects that impacted existing pavement sections or geometry were reflected in the PAVER database and associated AutoCAD drawings. Major rehabilitation or construction activities in the twelve months prior to inspection are assumed to restore the PCI to 100 and were omitted from ASTM PCI survey.

There are certain common areas of pavement, however, that have not been included in the airfield pavement network at the airports, including shoulders, blast pads, non-aircraft pavements, areas that are closed or fenced off, and privately owned/maintained areas, such as private hangar aprons. Many of these areas were labeled as “exempt” in previous PCI studies.

2.3.1 Record Documentation

It is encouraged by the FAA that airports maintain records of all airfield construction and maintenance related to the pavement facilities. A history of maintenance and rehabilitation (M&R) performed and the associated costs can provide valuable information on the cost and effectiveness of various treatments. Relevant record documentation includes the following:

- Location and limits of work
- Type of work
- Cost of work
- Supporting documents (contract documents, construction drawings, specifications, bid tabulations, repair product, photograph records, etc.)

2.3.2 Sample Unit Updates

During a visual condition survey, random samples of a pavement network are taken to provide a statistical reliability as outlined in the FAA Advisory Circular 150/5380-7B *Airport Pavement Management Program.* In total, a sampling rate similar to what was used in the 2021 PCI study was used to inspect the airside pavement networks at MDT airports in 2024.

With the exception of areas where major rehabilitation efforts resulted in an update to the network definition since the previous study, sample units in the same representative area as previous inspections were inspected for data consistency. Subsequent network inspections should be completed with this same frequency and sample locations to better predict the future PCI of the pavements.

Pavement sections added to the scope of the PCI study were inspected at a sampling rate that achieved an estimated 95% confidence interval, matching the standard sampling rate of prior studies.

2.4 Pavement Inventory Summary

2.4.1 Pavement Age

Pavement age is defined as the number of years since any major construction activity has occurred. Major construction is defined as any construction activity that substantially improves the pavement, such as a mill and overlay or full-depth reconstruction. It should be noted that surface treatments do not reset a pavement’s age to zero as a reconstruction or rehabilitation project

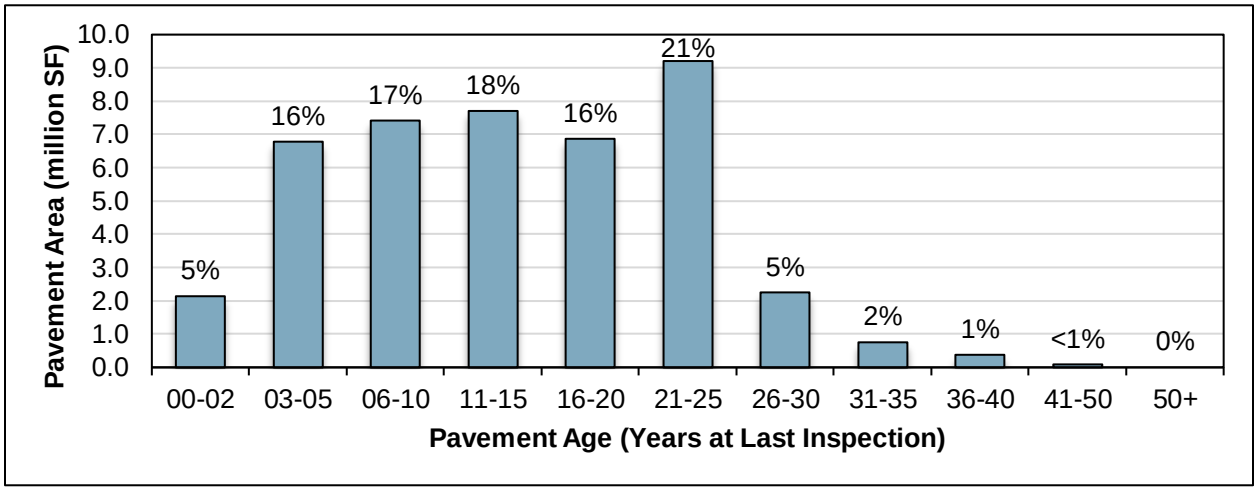
would; they are used as a measure to maintain and improve the current pavement surface and extend the useful life of the pavement without performing major work. Based on the review of the historic pavement construction at the participating airports, **Table 2.1** summarizes the age of the inspected pavement sections at the time of the PCI evaluations.

Table 2.1 Pavement Age at Time of Inspection

Age Category	Pavement Area (SF)	% Area	No. of Sections	% Sections	Area Weighted Avg Age at Inspection
00-02	2,134,964	5%	29	6%	1
03-05	6,769,657	16%	87	19%	4
06-10	7,414,374	17%	75	16%	8
11-15	7,712,760	18%	74	16%	14
16-20	6,855,359	16%	62	14%	18
21-25	9,193,402	21%	79	17%	23
26-30	2,247,560	5%	30	7%	28
31-35	749,334	2%	12	3%	32
36-40	383,367	1%	9	2%	38
41-50	85,000	<1%	2	-	43
50+	-	-	-	-	-
TOTAL	**43,545,777**	**100%**	**418**	**100%**	**15.0**

The pavement ages reported here are intended to be a rough estimate based on interpretation of the data provided by MDT or the record documentation. Presently, nearly 34% of airfield pavements are between 10 to 20 years of age, while approximately 38% of all pavements are less 10 years old. Airfield pavements beyond the standard FAA design life of 20 years represent 28% of all pavement area. **Figure 2.2** summarizes this information graphically.

Figure 2.2 Pavement Age Distribution



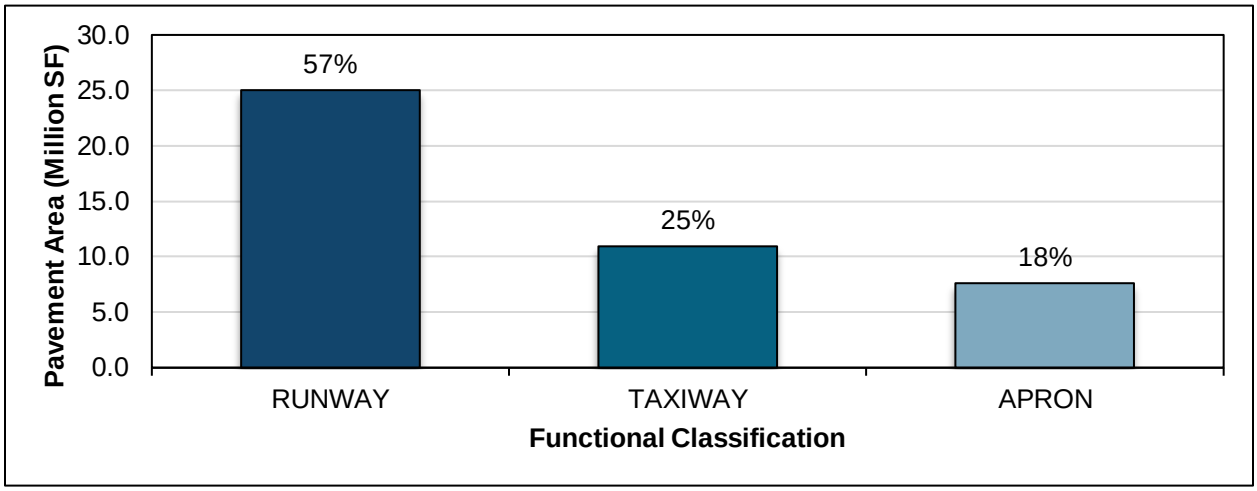
2.4.2 Functional Use Classification

Airfield pavements are subjected to various vehicle loading patterns based on utilization and overall operational use. The functional use categories defined for the Montana statewide program include Runway, Taxiway, and Apron. No shoulder, blast pad, or non-aircraft pavement was evaluated as part of this study. **Table 2.2** provides summary statistics for the various functional classifications and **Figure 2.3** depicts this information graphically.

Table 2.2 Pavement Functional Use Distribution

Functional Classification	Pavement Area (SF)	% Area	No. of Sections
RUNWAY	25,021,753	57%	88
TAXIWAY	10,942,150	25%	239
APRON	7,581,874	18%	132
TOTAL	43,545,777	100%	459

Figure 2.3 Pavement Functional Classifications by Area



Chapter 3 – Pavement Condition Index Surveys

Visual condition surveys were completed at 57 public-use Montana airports. Visually identifying a specific pavement distress type (i.e., load- or climate-related), determining the severity and quantity of the distress, and computing a PCI value provides valuable information to identify possible causes of the pavement deterioration and help in developing maintenance and rehabilitation (M&R) recommendations.

It should be noted that the PCI method of pavement condition evaluation is strictly a visual and functional evaluation. Further evaluation of the pavement condition may be necessary for design and/or project-level determination of pavement rehabilitation. For example, pavements exhibiting visual indications of load-related distress can be further evaluated by conducting a structural evaluation consisting of non-destructive testing methods prior to project determination and implementation.

3.1 PCI Survey Methodology

Pavement condition assessments on behalf of MDT relied on use of the PCI survey method of inspection to collect pavement distress data. As noted above, the PCI survey is a visual statistical method for recording distress types, quantities, and severity levels. It is the most commonly used method for obtaining and recording airfield pavement distress data.

The method was developed by the United States Army Corps of Engineers (USACE) and later standardized by the ASTM National. The PCI value ranges from 0 to 100, with “0” indicating a failed pavement and “100” indicating a pavement in new condition. Several factors contribute to the PCI score, including the type, severity, and quantity of each distress. Together, these factors help to determine the deduct value, or numerical reduction from 100, that each observed distress contributes to the PCI of the sample unit.

3.2 Pavement Distress Mechanisms

Pavement distress types have varying deduct values that affect the overall PCI of a given sample unit, which is largely due to the underlying factors that cause the distress. Typically, most pavement distresses can be attributed to **loading**, **climate**, or **other** influences.

Load-related distresses typically have the highest PCI deduct values. They exist where the pavement is likely insufficient to accommodate applied wheel loads, and the effects are subsequently visible at the surface of the pavement. Asphalt pavement distresses, such as alligator cracking and rutting, and concrete pavement distresses, such as corner breaks and shattered slabs, are load-related distresses and can be indications of a structural failure of the pavement.

Pavement distresses caused by **climate** are directly related to the process of oxidation and the effects of freeze-thaw cycles. As soon as asphalt pavement is constructed, it is immediately influenced by the effects of oxidation due to exposure to the environment. Over time, the pavement becomes less flexible and more brittle, allowing the effects of climate to gradually deteriorate the pavement. Specifically, the combination of brittle pavement and freeze-thaw action can cause common climate-related distresses such as longitudinal and transverse (L&T) cracking, block cracking, raveling, and weathering in AC pavement, and blow-ups, durability cracking, joint seal damage, and shrinkage cracking in Portland cement concrete (PCC) pavement.

Distresses caused by **other** influences tend to range in criticality. Distresses categorized as "other" can include inconsistent mixes, human error in design and construction, and inadequate pavement materials used during construction. In AC pavement, typical distresses caused from other influences include bleeding, corrugation, depression, and oil spillage, while typical PCC distresses caused from other influences include popouts, pumping, and scaling.

The ASTM distresses can be found in **Table 3.1** with their associated primary mechanism or potential causes. For more information on the distress cause and how they are quantified in the PCI procedure, reference the most recent copy of ASTM D5340.

Table 3.1 Airfield Pavement Distresses

Distress Mechanism	Distress Type
AC Distresses	
Load	Alligator Cracking Rutting
Climate/Durability	Block Cracking Joint Reflection Cracking Longitudinal and Transverse Cracking (LT) Raveling Shoving Weathering
Construction/Material	Bleeding Corrugation Depression Polished Aggregate Slippage Cracking Swelling
Other	Jet Blast Erosion Oil Spillage Patching and Utility Cut Patching

PCC Distresses	
Load	Corner Break Longitudinal, Transverse, and Diagonal Cracking (LTD) Pumping Shattered Slab/Intersecting Cracks
Climate/Durability	Blowup Durability "D" Cracking Joint Seal Damage Popouts
Construction/Material	Alkali Silica Reaction (ASR) Scaling Shrinkage Cracking
Other	Corner Spalling Joint Spalling Large Patching and Utility Cut Settlement or Faulting Small Patching

3.3 Calculating the Pavement Condition Index

Visual condition data collected during the PCI inspections was entered into the PAVER database. PAVER was then used to calculate the current PCI for each sample unit and section. As noted above, the PCI is a number ranging from 0 to 100 that indicates the apparent structural integrity and surface operational condition of the pavement, with “100” indicating a pavement in new condition and “0” indicating a failed pavement section. Pavement Condition Ratings are associated with PCI ranges and these ratings vary from *Failed* to *Good* and assigned a corresponding color scale as noted in **Table 3.2**.

To calculate a PCI for a given sample unit, each distress type observed is assigned a deduct value based on its density (frequency of occurrence) and severity within that sample area. All deducts are summed and subsequently adjusted (or corrected) for the number of different distresses found. This corrected deduct value is subtracted from 100 to arrive at the PCI for that particular sample unit. The PCI for a pavement section is the mean PCI value of all sample units evaluated within that section.

Based on the visual condition data gathered and the likely causes associated with these distresses (i.e., load-, climate/environment-related), the engineer has some understanding of the cause of deterioration over the life of the pavement. Analyzing the potential causes of deterioration exhibited helps the user identify proper maintenance and rehabilitation strategies.

Table 3.2 shows the Pavement Condition Ratings and range of PCI values to which each descriptive rating corresponds.

Table 3.2 Pavement Condition Index – Condition Range Summary

Representative Photo	Pavement Condition Rating	PCI Range	Description
	**Good**	86 - 100	Pavement has minor or no distresses present and may benefit from routine maintenance
	Satisfactory	71 - 85	Pavement has dispersed low-severity distresses that should require only routine maintenance
	**Fair**	56 - 70	Pavement has a combination of generally low- and medium-severity distresses that may require either routine maintenance or rehabilitation, such as a mill and overlay
	Poor	41 - 55	Pavement has a combination of low-, medium, and high-severity distresses that often cause operation issues, often necessitating rehabilitation or reconstruction
	**Very Poor**	26 - 40	Pavement is categorized by a significant amount of medium- and high-severity distresses that cause prominent operational issues, necessitating reconstruction
	Serious	11 - 25	Pavement contains primarily high-severity distresses that cause operational safety concerns, requiring immediate repairs or complete reconstruction
	Failed	0 - 10	Pavement poses significant safety concerns and is no longer operationally usable or safe, requiring complete reconstruction

3.4 Data Integrity and Quality Control

Because the usefulness of the PAVER database outputs is dependent on the accuracy of the data contained within it, it is essential that all data be carefully reviewed by senior pavement engineers for quality control. Once all the information obtained was entered into the PAVER database, spreadsheets were generated and checked for discrepancies against the tablet-stored data collected in the field and corrections were made as needed.

3.5 Critical PCI

An important concept in pavement management is the critical PCI value, a value that prompts major rehabilitation activities. It serves as a condition threshold that helps determine a section's suitability to receive major work. As soon as a section's PCI reaches the critical PCI value, the rate of PCI loss (deterioration) is expected to increase. The critical PCI concept assumes that once a pavement section deteriorates to the critical level, it is more cost-effective to complete a major rehabilitation project rather than continuing to apply preventive maintenance or to defer major work until more costly reconstruction activities are required.

Historically, critical PCI values can vary and are typically based on a pavement's surface type, functional use, and importance, or priority, in daily operations. Based on FAA Order 5100.38D Change 1 Airport Improvement Handbook, issued February 26, 2019, the FAA has established pavement construction based on thresholds that distinguish Rehabilitation and Reconstruction. Pavement sections between PCI Values 55 and 70 will be considered for rehabilitation and sections between PCI Values 0 to 54 will be considered for reconstruction at the planning-level, as shown in **Table 3.3**. It is recommended that participating airports use these PCI thresholds as guidance for future airfield pavement projects to maintain alignment with the FAA AIP eligibility for project planning.

Table 3.3 FAA AIP Handbook M&R PCI Requirements

Pavement Condition Index Requirements for Airfield Pavement Projects	
Airfield Pavement Project Type	**Pavement Condition Index (PCI) Requirement**
Reconstruction	PCI <55 (Poor and below)
Rehabilitation	55 ≤ PCI <70 (Fair)
Maintenance	N/A

Source: AIP Handbook, in reference to Runways, Taxiways, and Aprons as seen in table G -2, H-1, and I -1 respectively

Chapter 4 – Statewide Pavement Condition Results

4.1 Statewide-Level Results

The following **Table 4.1** summarizes the pavement condition analysis at each participating airport based on the most recent PCI Survey inspection results. These PCI values are intended for a high-level summary; further detail for each airport's PCI results can be found in the individual airport report located in **Appendix A**.

Table 4.1 2024 PCI Results by Airport

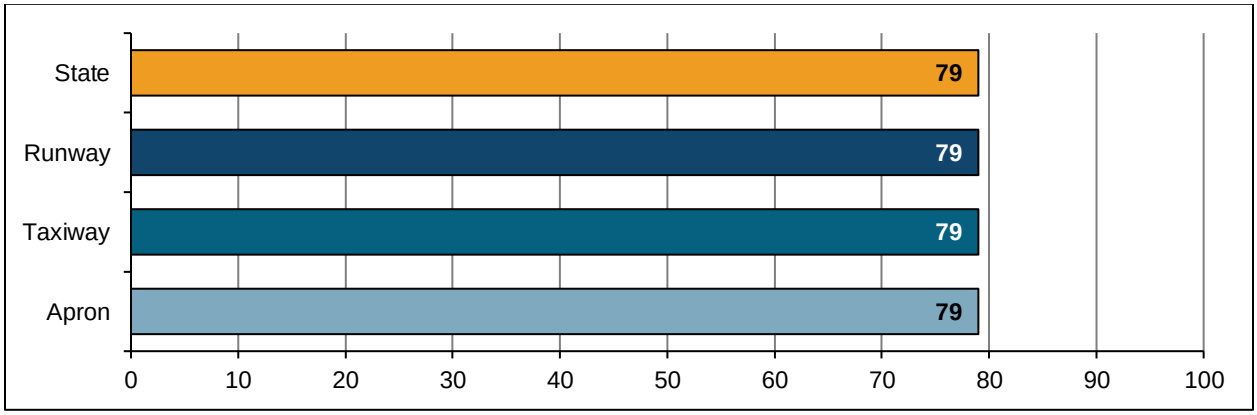
Airport ID	Airport Name	Area-Weighted Pavement Condition Index (PCI)			
		Runway PCI	Taxiway PCI	Apron PCI	Overall PCI
00F	Broadus Airport	79	80	80	79
00U	Big Horn County (Hardin) Airport	79	85	81	80
1S3	Tillitt Field	81	84	84	82
32S	Stevensville Airport	85	72	94	80
38S	Deer Lodge-City-County Airport	78	86	73	77
3U3	Bowman Field (Anaconda) Airport	85	87	99	87
3U7	Benchmark (Augusta) Airport	55	-	46	53
3U8	Big Sandy Airport	75	86	69	76
48S	Harlem Airport	89	90	89	89
4U6	Circle Town County Airport	67	68	65	67
57S	Troy Airport	12	15	-	12
5U8	Geraldine Airport	99	98	98	99
6S0	Big Timber Airport	60	72	100	69
6S3	Woltermann Memorial (Columbus) Airport	85	90	92	88
6S8	Laurel Municipal Airport	85	75	78	80
79S	Fort Benton Airport	87	89	89	88
7S0	Ronan Airport	55	62	65	59
7S6	White Sulphur Springs Airport	78	71	83	77
88M	Eureka Airport	87	80	82	84
8S0	Starr-Browning Airstrip Airport	67	44	45	65
8S1	Polson Airport	100	63	57	76
8U6	Terry Airport	67	77	58	66
97M	Ekalaka Airport	74	72	64	71
9S2	Scobey Airport	94	72	62	87
9S4	Mineral County (Superior) Airport	78	75	75	77
9U0	Turner Airport	93	95	90	93
BHK	Baker Municipal Airport	76	75	67	73
CII	Choteau Airport	82	85	83	82
CTB	Cut Bank International Airport	85	79	87	83
EKS	Ennis – Big Sky Airport	94	90	89	92

Airport ID	Airport Name	Area-Weighted Pavement Condition Index (PCI)			
		Runway PCI	Taxiway PCI	Apron PCI	Overall PCI
GDV	Dawson Community (Glendive) Airport	68	71	73	70
GGW	Wokal Field/Glasgow-Valley County Airport	80	57	65	73
HRF	Rivalli County Airport	94	92	94	93
HVR	Havre City-County Airport	86	82	88	86
HWQ	Wheatland County Airport At Harlowton	81	82	80	81
JDN	Jordan Airport	61	69	67	62
LTY	Liberty County (Chester) Airport	74	72	68	72
LVM	Mission Field (Livingston) Airport	78	88	83	82
LWT	Lewistown Municipal Airport	82	64	78	73
M46	Colstrip Airport	71	67	71	71
M75	Malta Airport	75	75	81	77
MLS	Frank Wiley Field	79	76	76	78
OLF	L M Clayton (Wolf Point) Airport	77	81	80	78
PO1	Poplar Municipal Airport	80	85	87	82
PWD	Sher-Wood (Plentywood) Airport	76	75	76	76
RPX	Roundup Airport	93	87	92	91
RVF	Ruby Valley Field	84	87	90	86
S34	Plains Airport	80	80	71	78
S59	Libby Airport	94	85	77	87
S64	Stanford/Biggerstaff Field	87	93	88	88
S69	Lincoln Airport	75	82	84	78
S71	Edgar G Obie (Chinook) Airport	71	74	82	74
S85	Big Sky Field (Culbertson) Airport	74	82	71	75
SBX	Shelby Airport	69	76	73	72
SDY	Sidney-Richland Regional Airport	81	80	71	79
THM	Thompson Falls Airport	94	88	95	93
WYS	Yellowstone Airport	69	91	92	80

4.2 PCI by Functional Use

The following **Figure 4.1** depicts the Statewide System area-weighted PCI for each pavement functional use – Runway, Taxiway, and Apron.

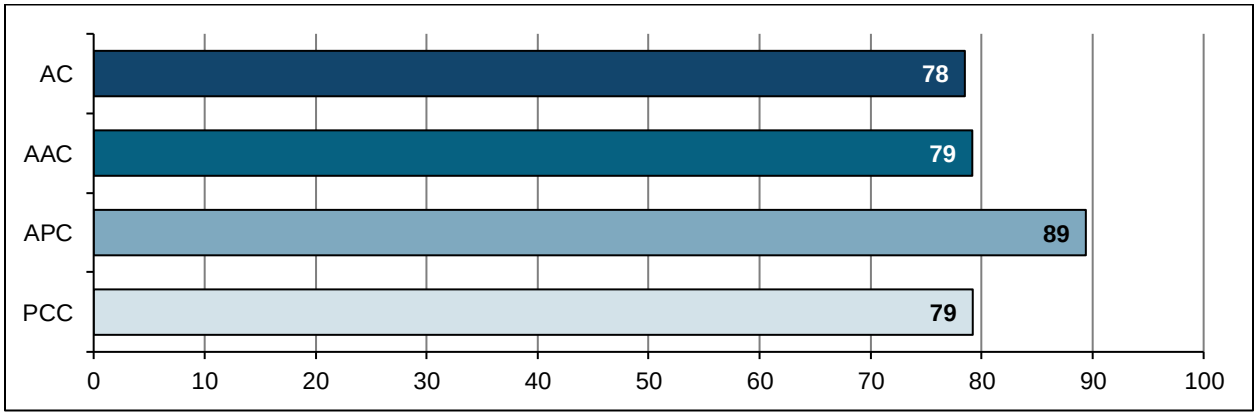
Figure 4.1 2024 PCI by Pavement Functional Use



4.3 PCI by Surface Type

Pavement facility surface types considered for the PCI update consist of the four (4) common types: Portland Cement Concrete (PCC), Asphalt Concrete Overlaid on Portland Cement Concrete Pavement (APC), Asphalt Concrete Pavement (AC), and Asphalt Concrete Overlaid on Asphalt Concrete (AAC). The following **Figure 4.2** summarizes the Statewide System PCI determined based on the various pavement types within the participating airports.

Figure 4.2 2024 PCI by Surface Type



4.4 Statewide PCI Summary

The following **Figure 4.3 (a)** provides the categorical summary of the statewide PCI as a relative area percentage. Furthermore, **Figure 4.3 (b) through (d)** depict the relative area as a percentage based on Functional Use. On a network level, approximately 78% of surveyed pavements are in Good or Satisfactory condition. Presently, roughly 17% of surveyed pavements are in Fair condition and the remaining 5% of surveyed pavements are in Poor or worse condition.

Figure 4.3 (a) Statewide PCI Summary

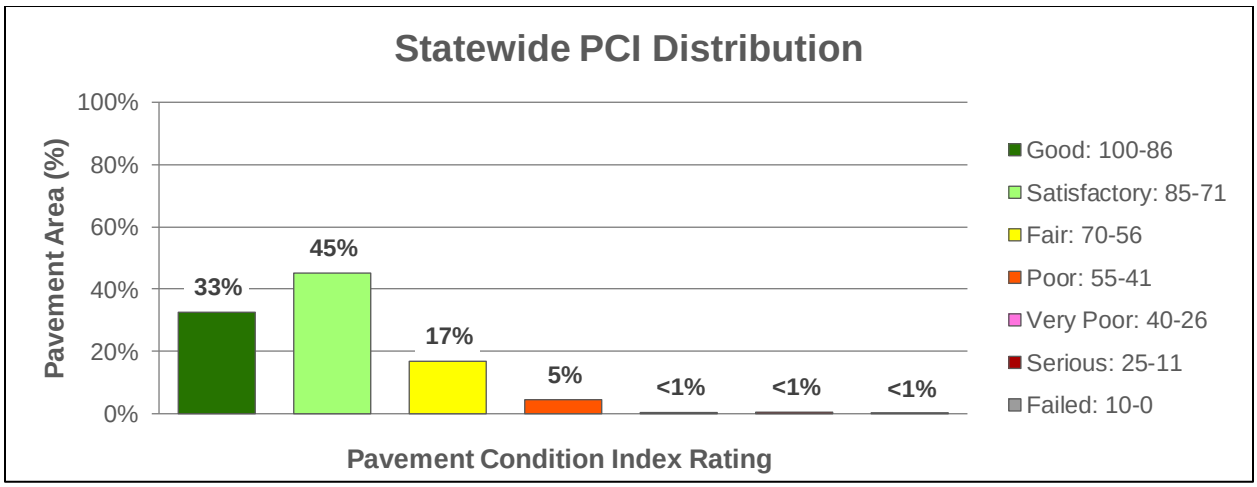


Figure 4.3 (b) Statewide PCI Summary – Runways

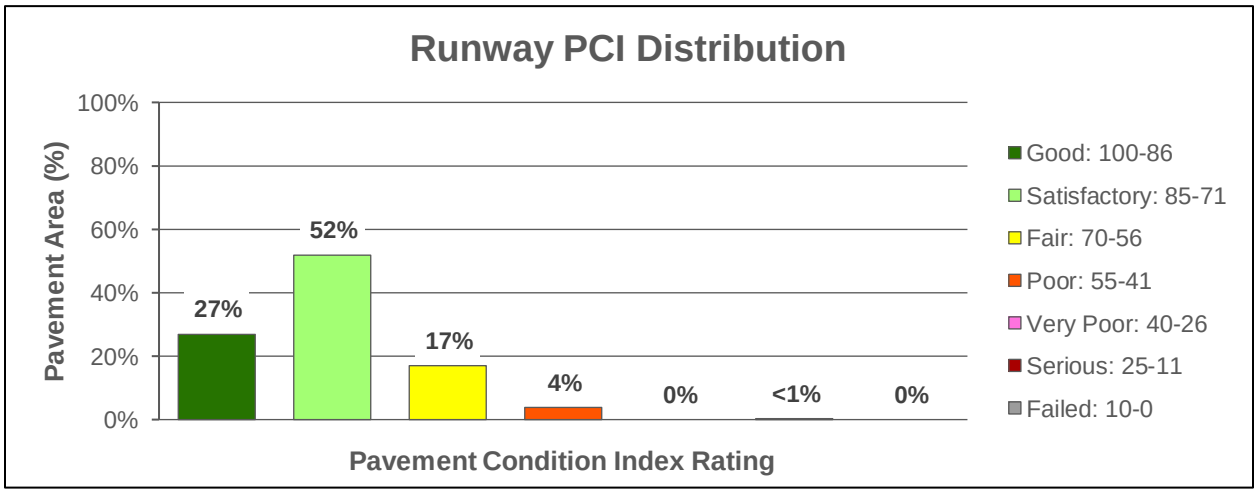


Figure 4.3 (c) Statewide PCI Summary – Taxiways

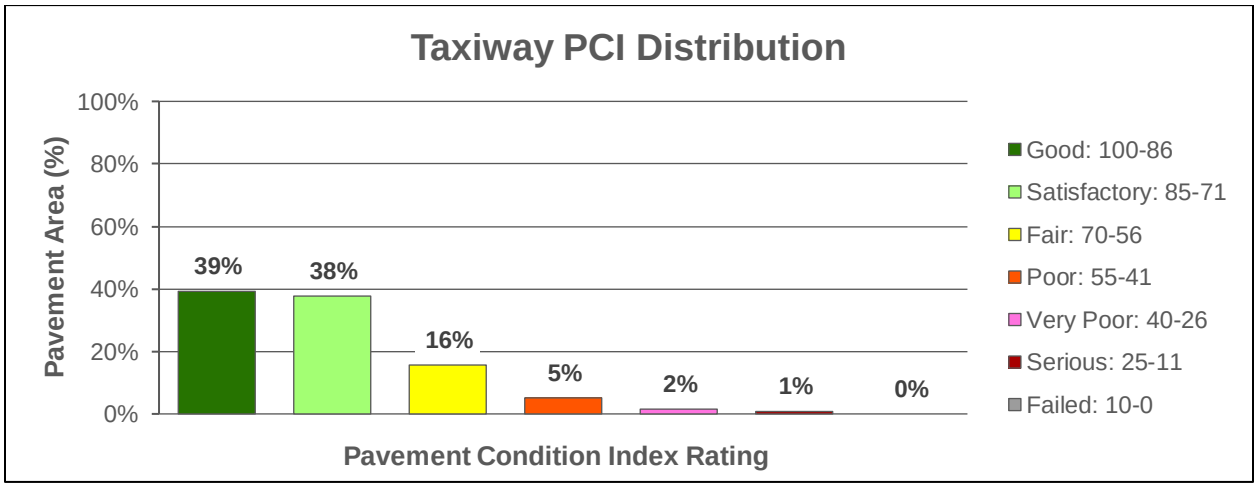
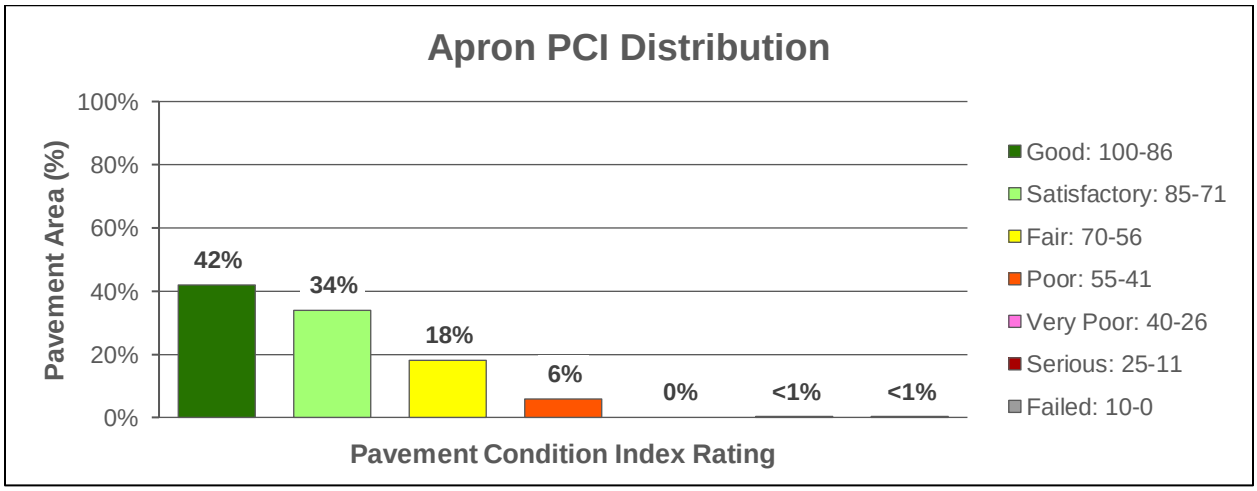


Figure 4.3 (d) Statewide PCI Summary – Aprons



4.5 Predicted Pavement Condition

The key to any pavement management system is accurately estimating the future condition of each individual pavement section using the data collected. PAVER is used to develop performance models and determine typical deterioration rates that are then used to forecast a future PCI value. This value will assist decision makers in determining at what point in time certain pavement sections will require rehabilitation. Data collected during this study was used in the development of performance models and predicting future pavement condition.

To develop these curves, all airside pavements for each airport included in this study were first divided into “groups” or “families” with similar pavement type, traffic, use, and performance. For example, all asphalt-surfaced taxiway pavements were grouped together to constitute a family. PAVER then establishes a best-fit curve through the visual condition data collected during the study to determine the PCI versus time for each family group. Research has demonstrated that there is a high probability that the behavior of one section will be similar to the behavior of other sections in the same family when following this approach. These curves were used to determine

when a pavement section would reach the critical PCI value and to determine the proper timing of maintenance and rehabilitation (M&R) activities.

Multiple prediction curves were developed and evaluated for the airfield pavements within the Montana system; ultimately, seven (7) prediction curves were used for the functional analysis. The seven (7) curves are listed below:

- MDT – AP AC: Asphalt Apron Pavements
- MDT – AP AAC: Asphalt Overlaid on Asphalt Apron Pavements
- MDT – RW AC AAC: Asphalt and Asphalt Overlaid on Asphalt Runway Pavements
- MDT – TW AC: Asphalt-Surfaced Taxiway Pavements
- MDT – TW AAC: Asphalt Concrete Overlaid on Asphalt Taxiway Pavements
- MDT – All PCC: All Portland Cement Concrete Pavements
- MDT – All APC: All Asphalt Overlaid on Portland Cement Concrete Pavements

An example of a family curve generated is shown in **Figure 4.4**, which shows the actual data points used to generate the prediction model. The remaining prediction curves are summarized in **Appendix B**. These curves will need to be further defined and developed as more inspection data is gathered during subsequent PCI program updates in future years.

Figure 4.4 MDT Prediction Curve (AC- and AAC-Surfaced Runway Pavements)

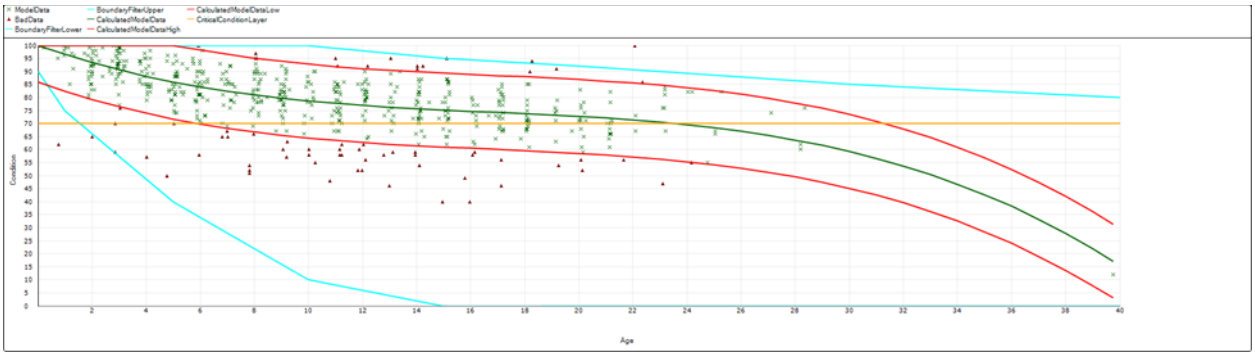


Table 4.2 depicts the network-level current PCI and the 5-year forecasted PCI for the 57 participating airports as if no major rehabilitation (zero budget) is completed on the airfield pavements during that period.

Table 4.2 Network-Level Forecasted PCI by Airport

Airport ID	Airport Name	2024 (Current)	2025	2026	2027	2028	2029 (5-Year)
00F	Broadus Airport	79	79	78	77	76	75
00U	Big Horn County (Hardin) Airport	80	80	79	78	77	76
1S3	Tillitt Field	82	82	81	79	78	77
32S	Stevensville Airport	80	80	78	75	73	72
38S	Deer Lodge-City-County Airport	77	77	76	75	74	73
3U3	Bowman Field (Anaconda) Airport	87	87	85	83	82	80
3U7	Benchmark (Augusta) Airport	53	52	49	46	42	38
3U8	Big Sandy Airport	76	76	75	74	73	73
48S	Harlem Airport	89	88	86	84	83	81
4U6	Circle Town County Airport	67	67	65	63	61	59
57S	Troy Airport	12	11	5	0	0	0
5U8	Geraldine Airport	99	98	95	92	89	87
6S0	Big Timber Airport	69	67	65	62	59	56
6S3	Woltermann Memorial (Columbus) Airport	88	87	85	83	81	80
6S8	Laurel Municipal Airport	80	80	78	76	74	73
79S	Fort Benton Airport	88	87	85	83	81	80
7S0	Ronan Airport	59	59	57	54	52	48
7S6	White Sulphur Springs Airport	77	77	76	75	74	73
88M	Eureka Airport	84	83	82	80	79	78
8S0	Starr-Browning Airstrip Airport	65	65	62	60	58	56
8S1	Polson Airport	76	76	74	71	68	66
8U6	Terry Airport	66	66	64	63	61	59
97M	Ekalaka Airport	71	71	70	69	68	67
9S2	Scobey Airport	87	86	84	82	80	78
9S4	Mineral County (Superior) Airport	77	77	76	75	75	74
9U0	Turner Airport	93	92	90	87	85	83
BHK	Baker Municipal Airport	73	73	71	70	69	68
CII	Choteau Airport	82	82	80	79	78	77
CTB	Cut Bank International Airport	83	82	81	79	78	77
EKS	Ennis – Big Sky Airport	92	91	89	86	84	83
GDV	Dawson Community (Glendive) Airport	70	69	67	66	64	62
GGW	Wokal Field/Glasgow-Valley County Airport	73	72	70	69	68	66
HRF	Rivalli County Airport	93	92	90	87	85	83
HVR	Havre City-County Airport	86	85	83	81	80	78
HWQ	Wheatland County Airport At Harlowton	81	81	79	78	78	76
JDN	Jordan Airport	62	62	60	57	55	51
LTY	Liberty County (Chester) Airport	72	72	71	71	70	70
LVM	Mission Field (Livingston) Airport	82	81	79	78	77	76
LWT	Lewistown Municipal Airport	73	73	71	69	67	65
M46	Colstrip Airport	71	71	69	68	66	64
M75	Malta Airport	77	76	75	74	73	73
MLS	Frank Wiley Field	78	78	76	75	74	72

Airport ID	Airport Name	2024 (Current)	2025	2026	2027	2028	2029 (5-Year)
OLF	L M Clayton (Wolf Point) Airport	78	78	76	76	75	75
PO1	Poplar Municipal Airport	82	82	80	79	78	77
PWD	Sher-Wood (Plentywood) Airport	76	76	75	74	73	73
RPX	Roundup Airport	91	90	88	85	83	82
RVF	Ruby Valley Field	86	86	84	82	80	79
S34	Plains Airport	78	81	79	78	76	76
S59	Libby Airport	87	86	84	82	80	79
S64	Stanford/Biggerstaff Field	88	80	78	76	75	74
S69	Lincoln Airport	78	78	76	76	75	74
S71	Edgar G Obie (Chinook) Airport	74	74	73	72	70	69
S85	Big Sky Field (Culbertson) Airport	75	75	73	73	72	71
SBX	Shelby Airport	72	72	71	69	68	66
SDY	Sidney-Richland Regional Airport	79	79	77	75	73	71
THM	Thompson Falls Airport	93	92	90	87	85	83
WYS	Yellowstone Airport	80	80	78	76	74	72

Chapter 5 – M&R Recommendations

The overall goal of this pavement management system is to provide government agencies with fiscally conscious, timely, and appropriate maintenance and rehabilitation (M&R) recommendations. The pavement management system, paired with continued planning efforts, should enable responsible parties to do the following:

- Maintain existing airport infrastructure at an acceptable condition
- Make timely decisions to appropriately allocate funding
- Apply global maintenance and major M&R activities in a timely manner to maintain an acceptable operational condition of a pavement network

General M&R methods are characterized under two (2) broad categories: global maintenance treatments and major rehabilitation.

- **Global Maintenance Treatments** include surface treatments such as slurry seals and fog seals for flexible pavements.
- **Major Rehabilitation** includes mill and overlays and reconstruction.

This chapter will discuss the planning approach taken for each of these categories, the factors that go into decision making, and the results of each analysis.

5.1 Global Maintenance

Global maintenance activities include treatments that are applied over the entire pavement section and are intended to extend the life of the pavement section. Global maintenance treatments, such as slurry seals and fog seals, are used frequently on airports throughout Montana.

This analysis uses a generalized global maintenance treatment referred to as “Surface Treatment.” It is recommended that a crack seal is completed prior to applying the recommended global treatment. Additionally, it is the responsibility of the airport engineer(s) to determine the appropriate type of surface treatment to be applied based on an evaluation during project-level design in addition to the functional condition identified in this report.

5.1.1 Global Maintenance Policy

In order to be effective, it is important to apply global maintenance treatments at the right time and to pavements that are above the critical PCI and exhibiting only age- or climate-related distresses (e.g., L&T cracking, weathering, and raveling). These types of treatments are often applied as a temporary corrective measure for deteriorated pavement sections when present-day funding is limited.

Due to the inability to anticipate specific distress manifestations over time, global maintenance can be planned based on time, or pavement age, with regard to the last date of construction or prior surface treatment on a section of pavement. This approach is based on assumptions of typical asphalt pavement deterioration rates of one (1) to three (3) points per year and a 2-year increase in life with each application. Thus, global maintenance is recommended at an interval of **five (5) years** following new construction, a mill and overlay, or the last surface treatment application.

5.2 Major Rehabilitation

Major rehabilitation is recommended to correct or improve structural deficiencies and/or functional deterioration for pavement sections within a network. Observation of any load-related distress potentially indicates that the section may be structurally deficient or that the aircraft loads being applied to the pavement section are different than that for which the pavement section was designed. Major rehabilitation is also recommended when a pavement section has deteriorated below the critical PCI value, a point at which localized maintenance and repair activities may not be a cost-effective solution.

5.2.1 Major Rehabilitation Policies

Major rehabilitation for asphalt pavements is defined as pavement construction that removes and replaces the pavement surface, resetting the PCI value to 100. The two (2) types of major rehabilitation are as follows:

- **Mill and Overlay**: removal of all or a portion of the asphalt surface through milling and replacing the milled depth with an overlay of asphalt. This rehabilitation activity is typically applied to pavement that does not require a structural improvement and does not display an extensive amount of load-related distresses. This work type occurs on pavement sections with a PCI value between 55 and 70. As a general rule of thumb, mill and overlay activities have a shorter pavement life compared to a full-depth reconstruction, but a mill and overlay will still reset the pavement to a PCI of 100.
- **Reconstruction**: removal and replacement of the existing pavement section down to the subgrade. This technique is utilized when the pavement is badly deteriorated, or a structural improvement is required. Reconstruction is used when the pavements are structurally deficient, and an overlay is not possible due to adjacent pavement grades.

For this program, major rehabilitation activities are recommended based on the AIP handbook PCI thresholds defined in **Section 3.5 (Critical PCI)**. The thresholds are as follows: pavement sections between PCI Values 55 and 70 will be considered for rehabilitation and sections between PCI Values 0 to 54 will be considered for reconstruction.

5.3 Maintenance and Rehabilitation Needs

It is important for MDT and the individual airports to understand the global maintenance and major rehabilitation policies when determining the proper type and timing of M&R needs. For example, it would not be cost effective to apply a surface treatment on a pavement section that is approaching its critical PCI and is exhibiting load-related distress. However, if a pavement section is only showing signs of aging or climate-related distresses, the application of a surface treatment at the appropriate time could be a cost-effective solution to extend the life of the pavement.

For this program, M&R needs were identified by analyzing the Airports' pavement age and condition in relationship to the policies set forth herein. Given the uncertainty in the availability of funding, an unlimited budget analysis was completed to evaluate the worst-case scenario and identify all pavement-related needs. A 5-year planning period was utilized for the analysis of the participating airports. While this is financially impractical, it does yield the unbiased pavement needs over the 5-year timeframe given current and forecasted pavement conditions and age.

MDT recognizes that airports are constrained by budgets and does not intend to convey an unrealistic approach of addressing pavement rehabilitation. Each airport has a unique set of

challenges and MDT's goals are to provide each with the data needed to formulate a practical Capital Improvement Program. This includes:

- An estimation of current and predicted pavement condition;
- Global pavement maintenance needs based on age and last treatment; and
- Major pavement rehabilitation needs based on condition and policies.

The major rehabilitation analysis is run in combination with global maintenance in the PAVER software since they are both applied at the section-level over the full duration of the 5-year planning period. Both work types are eligible for federal funding based on the requirements in the FAA Airport Improvement Program (AIP) Handbook. The analysis was performed strictly to identify the needs and timing of M&R needs for each pavement section. This program update did not include project cost development for the provided recommendations.

The results of the PAVER analysis are summarized at the network-level in **Table 5.2** for the 57 participating airports over the 5-year planning period as percentage of the airports' total airfield pavement area. The results are intended for a high-level network summary; further detail for each airport's section-level results can be found in the individual airport report located in **Appendix A**.

Table 5.2 – Network-Level 5-Year M&R Needs Summary

		% of Airfield Pavement Area Recommended for Maintenance or Major Rehabilitation by Year						Recommended Work Types	
Airport ID	Airport Name	2025	2026	2027	2028	2029	5 Year Total	Global Treatment	Major Rehabilitation
00F	Broadus Airport	100%	-	-	-	-	100%	✓	-
00U	Big Horn County (Hardin) Airport	3%	97%	-	-	-	100%	✓	-
1S3	Tillitt Field	100%	-	-	-	-	100%	✓	-
32S	Stevensville Airport	67%	33%	-	-	-	100%	✓	-
38S	Deer Lodge-City-County Airport	100%	-	-	-	-	100%	✓	✓
3U3	Bowman Field (Anaconda) Airport	-	-	-	-	100%	100%	✓	-
3U7	Benchmark (Augusta) Airport	100%	-	-	-	-	100%	-	✓
3U8	Big Sandy Airport	2%	98%	-	-	-	100%	✓	✓
48S	Harlem Airport	-	-	100%	-	-	100%	✓	-
4U6	Circle Town County Airport	100%	-	-	-	-	100%	-	✓
57S	Troy Airport	100%	-	-	-	-	100%	-	✓
5U8	Geraldine Airport	-	100%	-	-	-	100%	✓	-
6S0	Big Timber Airport	86%	-	-	14%	-	100%	✓	✓
6S3	Woltermann Memorial (Columbus) Airport	-	91%	-	-	9%	100%	✓	-
6S8	Laurel Municipal Airport	12%	-	-	-	88%	100%	✓	-
79S	Fort Benton Airport	100%	-	-	-	-	100%	✓	-
7S0	Ronan Airport	100%	-	-	-	-	100%	✓	✓
7S6	White Sulphur Springs Airport	9%	91%	-	-	-	100%	✓	-
88M	Eureka Airport	-	100%	-	-	-	100%	✓	-
8S0	Starr-Browning Airstrip Airport	100%	-	-	-	-	100%	-	✓
8S1	Polson Airport	57%	-	3%	-	-	60%	✓	-
8U6	Terry Airport	100%	-	-	-	-	100%	✓	✓
97M	Ekalaka Airport	98%	-	-	-	-	98%	✓	✓
9S2	Scobey Airport	20%	-	-	80%	-	100%	✓	✓
9S4	Mineral County (Superior) Airport	100%	-	-	-	-	100%	✓	-
9U0	Turner Airport	-	-	-	-	99%	99%	✓	-
BHK	Baker Municipal Airport	96%	-	-	-	-	96%	✓	✓
CII	Choteau Airport	-	-	-	-	100%	100%	✓	-
CTB	Cut Bank International Airport	24%	-	-	76%	-	100%	✓	-

		% of Airfield Pavement Area Recommended for Maintenance or Major Rehabilitation by Year						Recommended Work Types	
Airport ID	Airport Name	2025	2026	2027	2028	2029	5 Year Total	Global Treatment	Major Rehabilitation
EKS	Ennis – Big Sky Airport	89%	-	11%	-	-	100%	✓	-
GDV	Dawson Community (Glendive) Airport	100%	-	-	-	-	100%	✓	-
GGW	Wokal Field/Glasgow-Valley County Airport	24%	-	53%	22%	-	99%	✓	✓
HRF	Rivalli County Airport	3%	97%	-	-	-	100%	✓	✓
HVR	Havre City-County Airport	33%	67%	-	-	-	100%	✓	-
HWQ	Wheatland County Airport At Harlowton	-	100%	-	-	-	100%	✓	-
JDN	Jordan Airport	100%	-	-	-	-	100%	✓	✓
LTY	Liberty County (Chester) Airport	100%	-	-	-	-	100%	✓	✓
LVM	Mission Field (Livingston) Airport	-	90%	-	10%	-	100%	✓	-
LWT	Lewistown Municipal Airport	93%	-	-	-	7%	100%	✓	-
M46	Colstrip Airport	100%	-	-	-	-	100%	✓	✓
M75	Malta Airport	97%	-	-	-	-	97%	✓	-
MLS	Frank Wiley Field	44%	21%	7%	28%	-	100%	✓	✓
OLF	L M Clayton (Wolf Point) Airport	-	-	-	100%	-	100%	✓	-
PO1	Poplar Municipal Airport	-	100%	-	-	-	100%	✓	-
PWD	Sher-Wood (Plentywood) Airport	14%	86%	-	-	-	100%	✓	-
RPX	Roundup Airport	13%	87%	-	-	-	100%	✓	-
RVF	Ruby Valley Field	-	-	-	-	100%	100%	✓	-
S34	Plains Airport	-	100%	-	-	-	100%	✓	✓
S59	Libby Airport	41%	58%	-	-	-	99%	✓	-
S64	Stanford/Biggerstaff Field	-	93%	-	-	-	93%	✓	-
S69	Lincoln Airport	100%	-	-	-	-	100%	✓	-
S71	Edgar G Obie (Chinook) Airport	7%	93%	-	-	-	100%	✓	✓
S85	Big Sky Field (Culbertson) Airport	100%	-	-	-	-	100%	✓	-
SBX	Shelby Airport	26%	71%	-	-	-	98%	✓	-
SDY	Sidney-Richland Regional Airport	66%	-	5%	23%	-	94%	✓	✓
THM	Thompson Falls Airport	-	-	100%	-	-	100%	✓	-
WYS	Yellowstone Airport	100%	-	-	-	-	100%	✓	-

The identification of rehabilitation needs has been determined at the planning level. Design-level investigation is recommended prior to developing construction-level design documents and budgets.

Chapter 6 – Conclusion

6.1 Re-Inspection of Pavements

A high priority should be given for continuous maintenance and re-inspection of pavements to ensure continued safe aircraft operations. While deterioration of the pavements due to usage and exposure to the environment cannot be completely prevented, applying timely and effective maintenance strategies can slow the anticipated rate of deterioration. Lack of adequate and timely maintenance is large contributor to pavement deterioration.

A series of scheduled periodic inspections must be carried out for an effective maintenance program. Re-inspection of pavements should be scheduled to ensure that all areas, particularly those that may not come under day-to-day observation, are thoroughly evaluated and reported. Thorough inspections of all paved areas should be scheduled accordingly. It is recommended that a PCI survey be performed, and the PAVER database be updated on a 3-year basis for each pavement section of the network.

6.2 Project Level Rehabilitation Projects (Design Level)

Prior to implementing major rehabilitation projects, it is recommended that each airport and their consultant perform a full project-level evaluation of the specific section(s) of pavements during the design process. Specific pavement rehabilitation alternatives can then be developed based on specific conditions at the time of rehabilitation and a recommended alternative can be selected after a life-cycle cost analysis is performed.

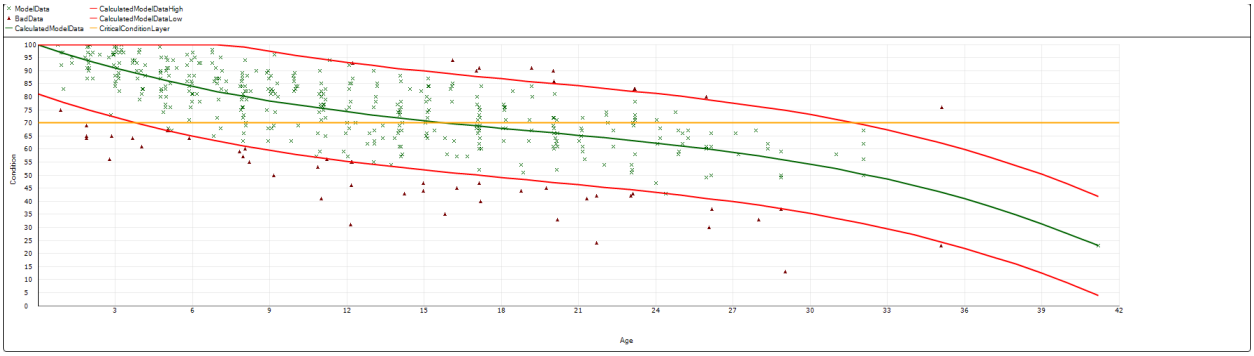
6.3 Pavement Management System Recommendations

The following recommendations are made to fully implement a pavement management program for each MDT airport:

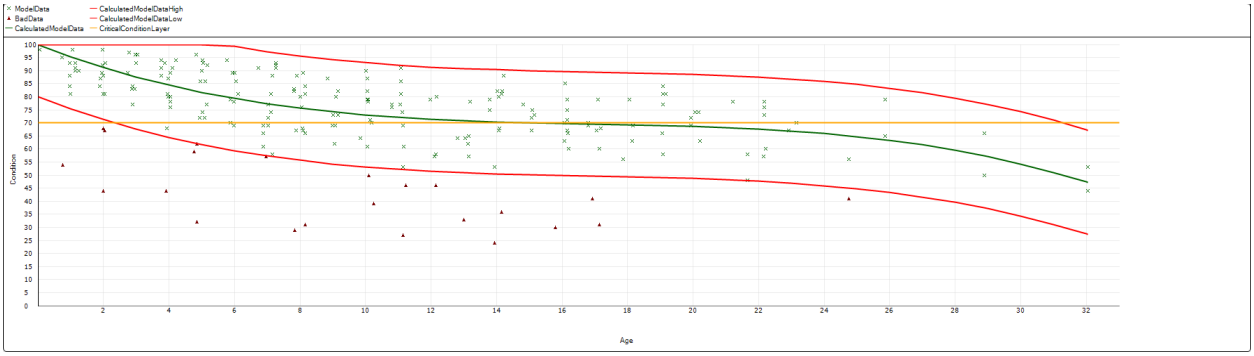
- Develop a detailed preventative maintenance program.
- Further refine and implement the updated recommended rehabilitation program.
- Maintain the PAVER program either through a consultant or trained in-house staff.
- Routinely update PAVER with new construction and maintenance cost data.
- Update the PCI on a 3-year cycle to see the greatest benefit.
- Develop a Statewide Pavement Design Criteria Report with design guidelines for each subsequent design project(s) that will take into consideration the recommendations of this report.

Appendix A – PAVER Prediction Models

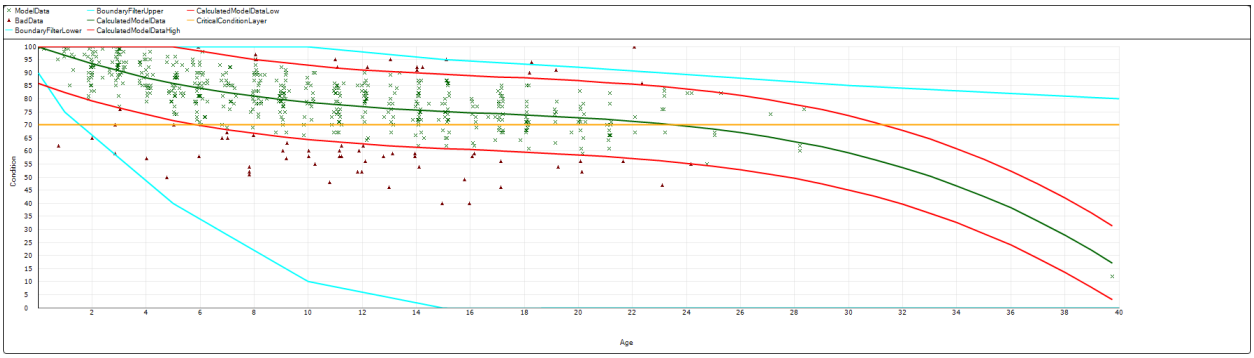
MDT – AP AC



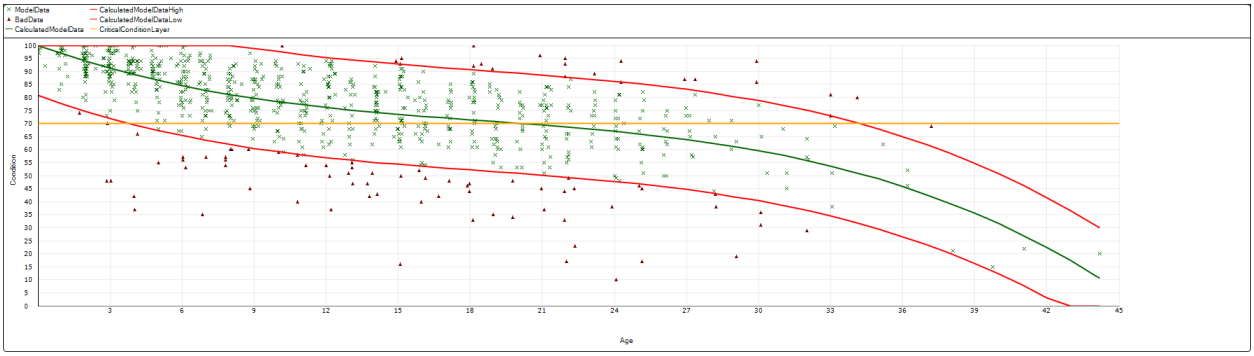
MDT – AP AAC



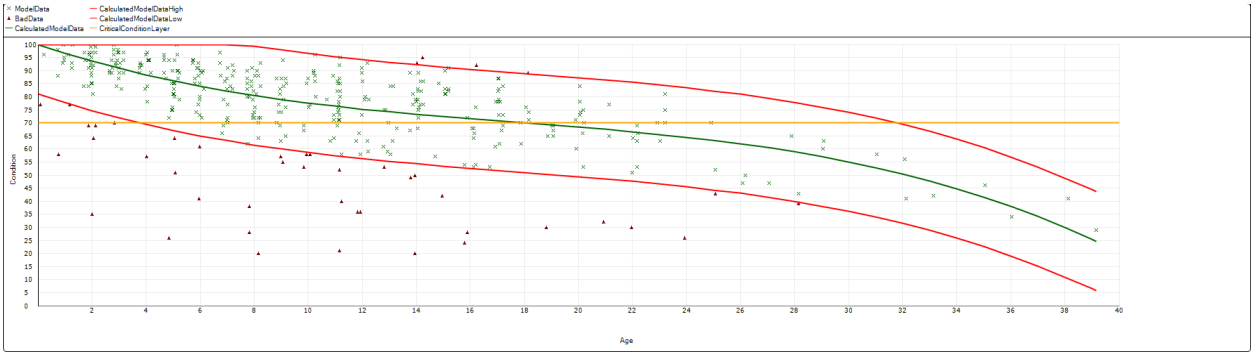
MDT – RW AC AAC



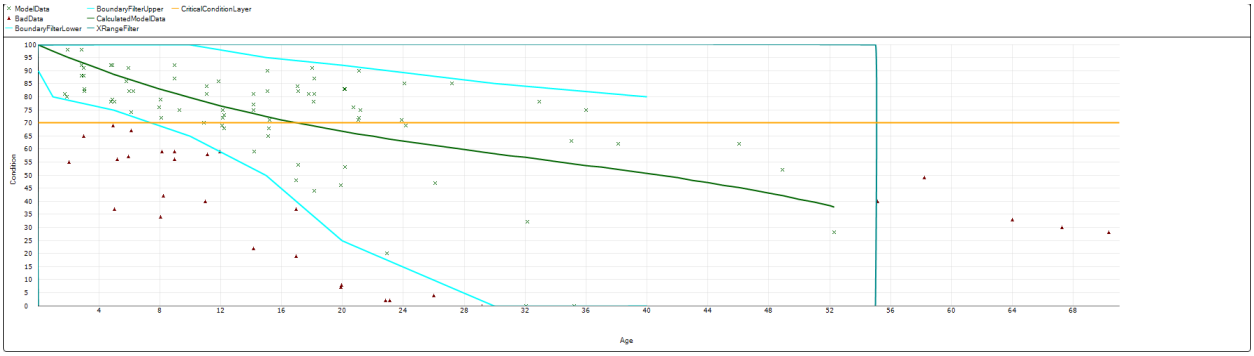
MDT – TW AC



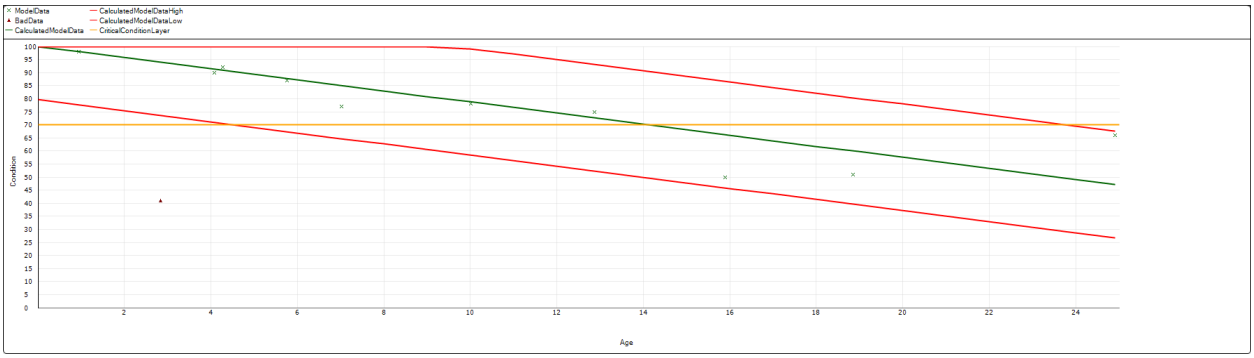
MDT – TW AAC



MDT – All PCC



MDT – All APC



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