CAPTG 2019 Workshop - Chris Olidis, P.Eng.

APPLIED RESEARCH ASSOCIATES, INC.

MANAGING YOUR PAVEMENT ASSETS

AIRPORT PAVEMENT MANAGEMENT

- What is Pavement Management?
  - A systematic methodology for collecting, analyzing, maintaining, and reporting pavement condition data
- What can it do?
  - Assist airport operators with developing cost effective strategies for maintaining pavement in a serviceable condition

AIRPORT PAVEMENT MANAGEMENT

- AC 302-016

  Airport Pavement Management System (APMS)

  - To improve the quality and performance of airside pavement
  - Minimize cost through good management practices
  - To assist with planning and scheduling of maintenance and rehabilitation
  - Document compliance with standards

CAPITAL PLANNING PROGRAM

- A pavement management plan (PMP) will typically consider the following pavement attributes:
  - Condition / integrity
  - Strength
  - Roughness
  - Surface friction
  - Surface drainage

AIRPORT PAVEMENT MANAGEMENT

- AC 302-016

  Airport Pavement Management System (APMS)

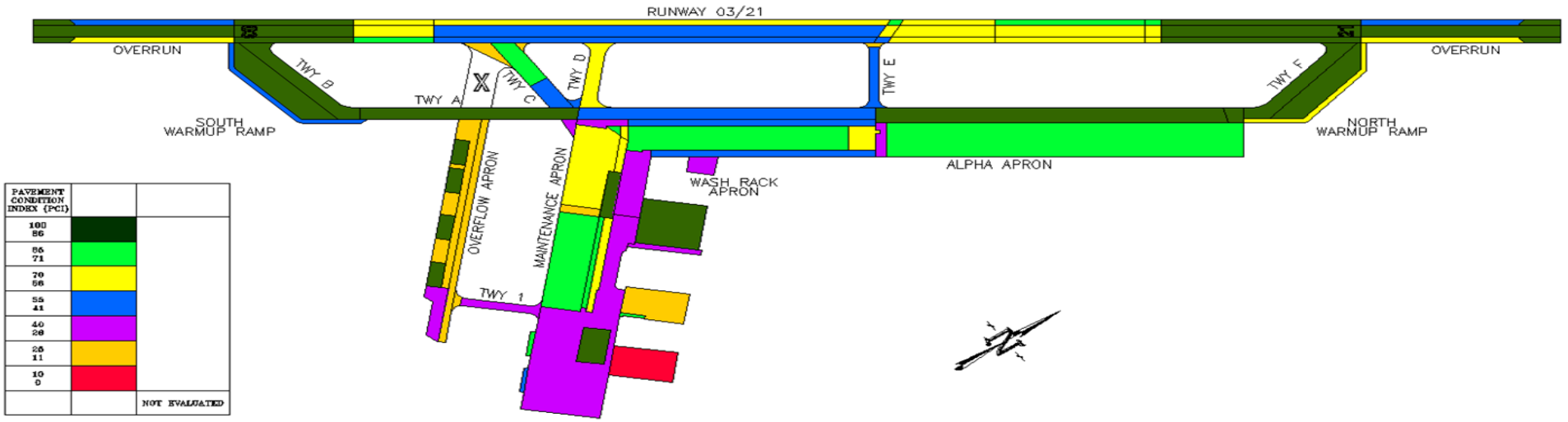
  - A detailed condition survey of airside movement surfaces once a year by trained personnel
  - The frequency of the detailed inspections using the PCI survey method (ASTM D5340) may be extended to three years

WHAT IS A PMP?

- A systematic method for:
  - Assessment of pavement condition and past performance
  - Identification of M&R needs
  - Prediction of future conditions
  - Planning / budgeting of maintenance, rehabilitation and reconstruction.
- APMS software can simplify data management and analysis
- Not a must have - but it certainly makes life easier!

BASIC ELEMENTS OF APMS

- Detailed pavement inventory
  - Age – construction history / last construction date
  - Usage – runway, taxiway, apron, storage, etc
  - Dimensions – pavement area
- Periodic distress surveys to assess condition



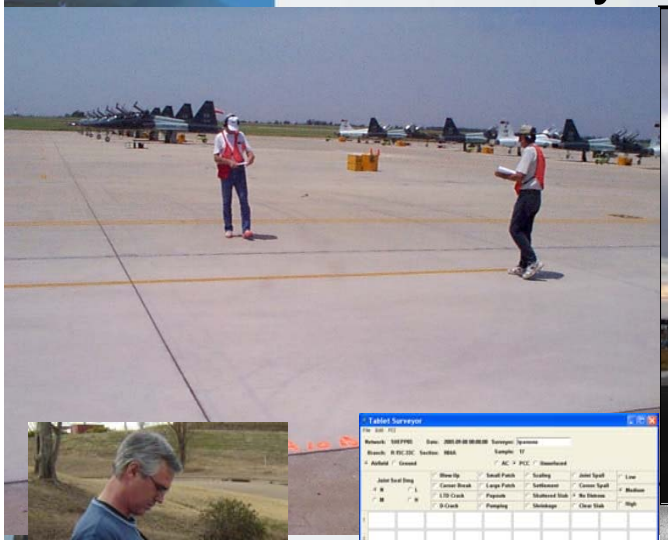
PAVEMENT CONDITION INDEX

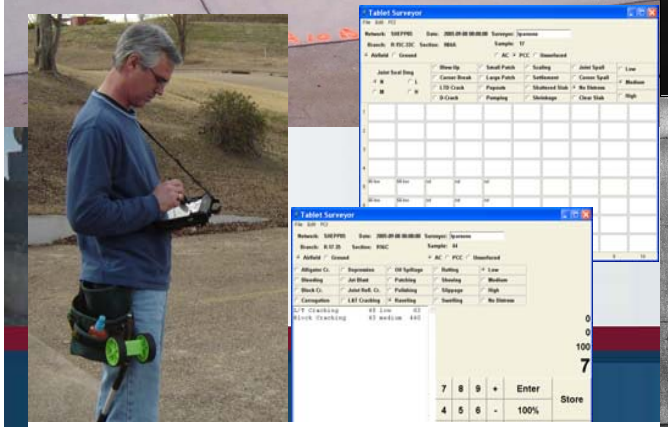
- Provides measure of surface condition
- Considers distress types and impacts on performance
- ASTM D 5340 - Standard Test Method for Airport Pavement Condition Index Surveys

DISTRESS IDENTIFICATION

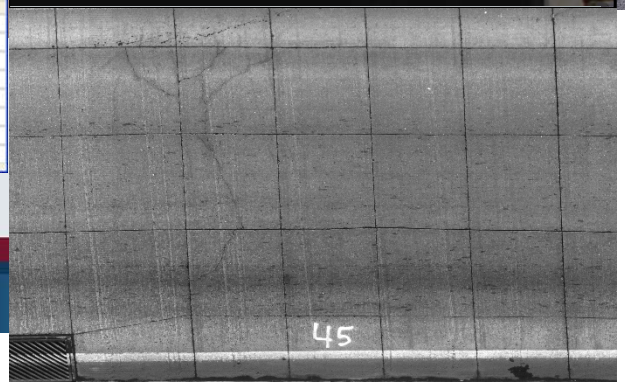
INSPECTION METHODS?

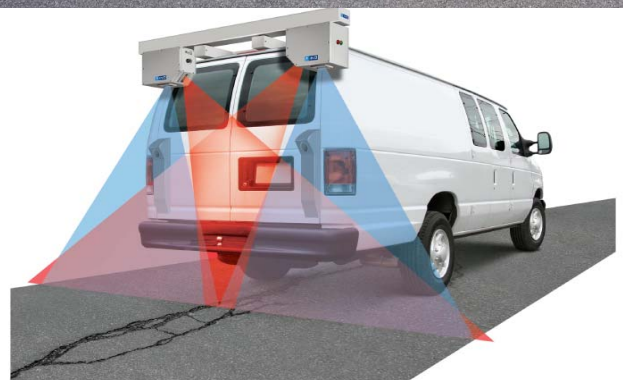
- Manually or semi automated





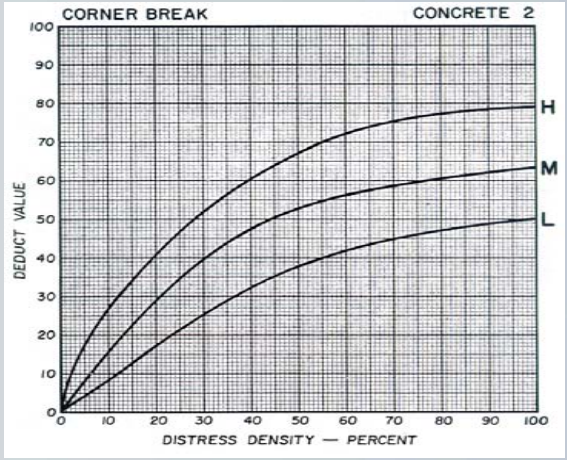
Tablet PC used for field data recording



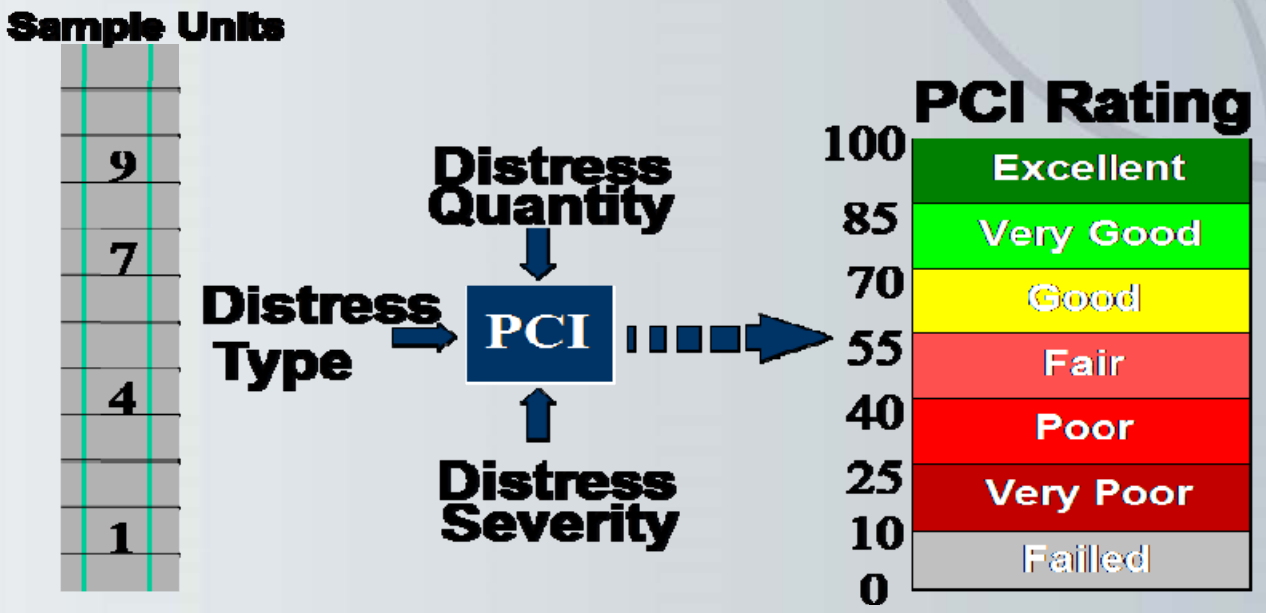


HOW IS PCI DETERMINED?

- PCI is an objective measurement based on:
  - Distress type
  - Distress severity
  - Distress quantity
- Each distress has an associated deduct curve
- Reduced to a single number reflecting serviceability

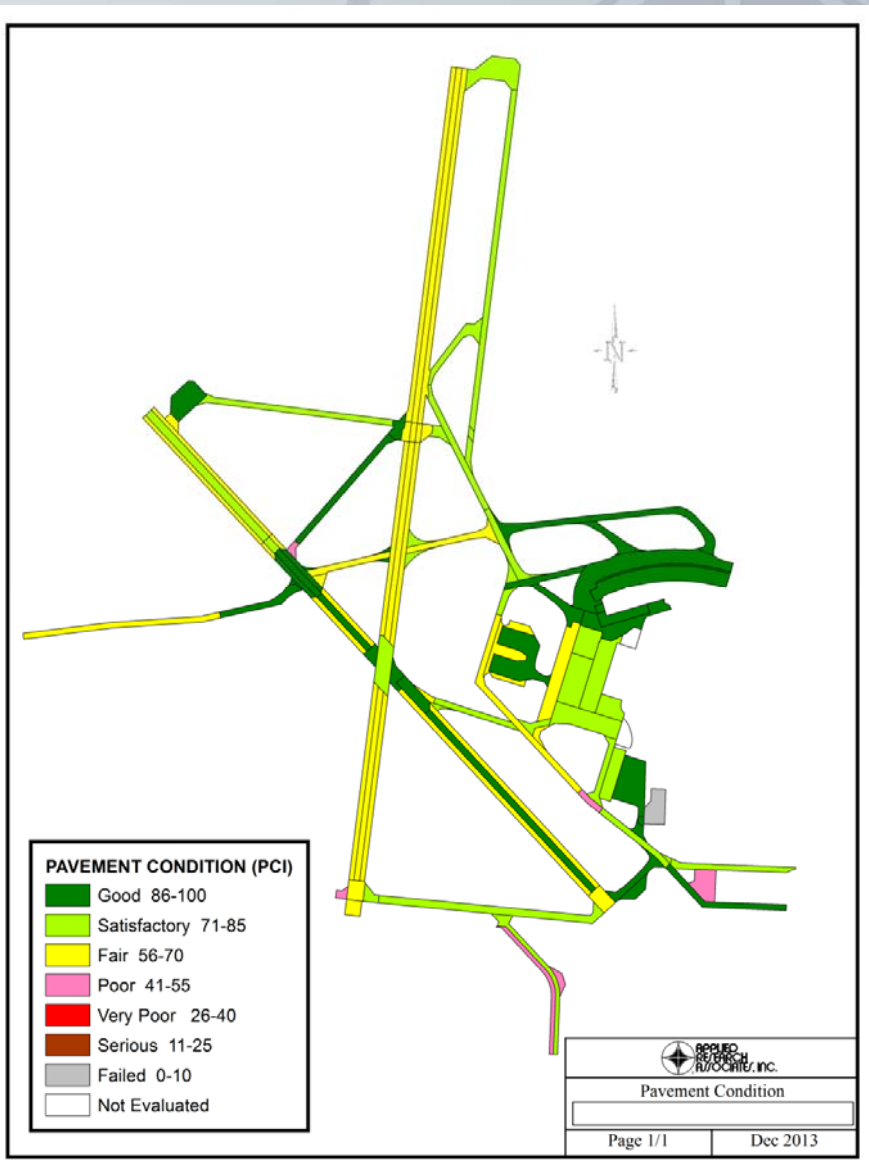


PAVEMENT CONDITION INDEX

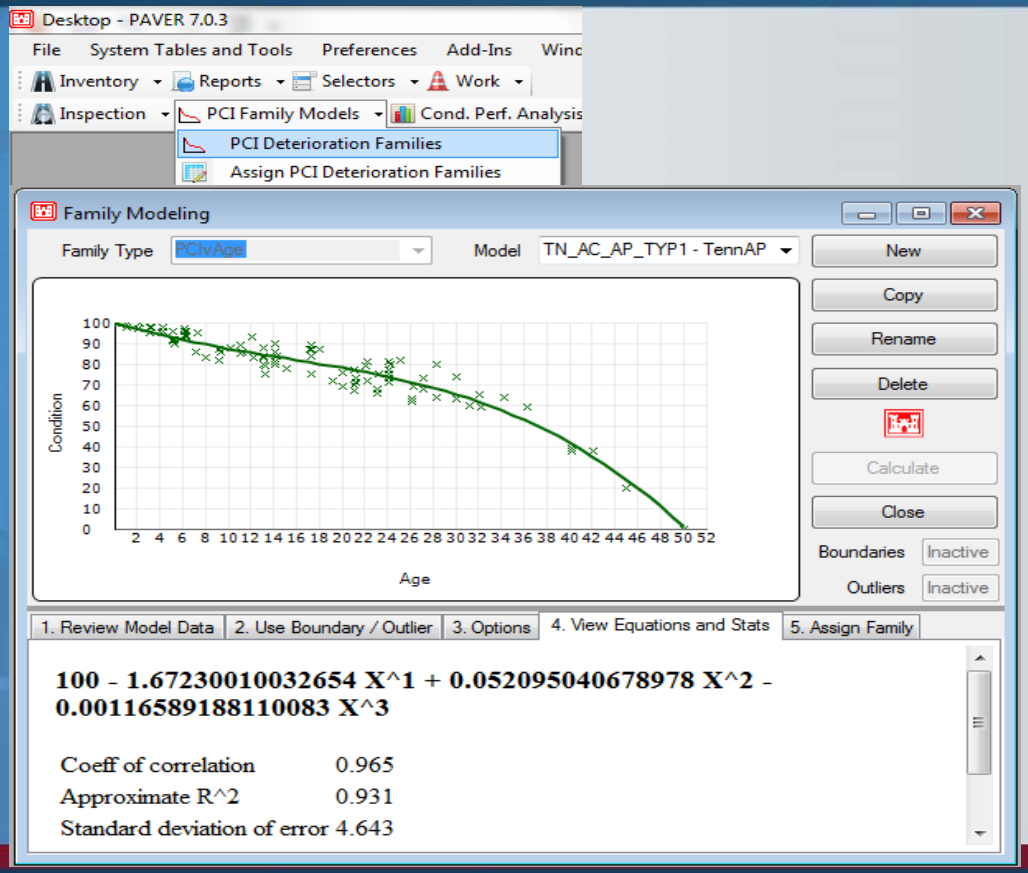


AIRFIELD PCI

- GIS is an ideal method to present PCI results



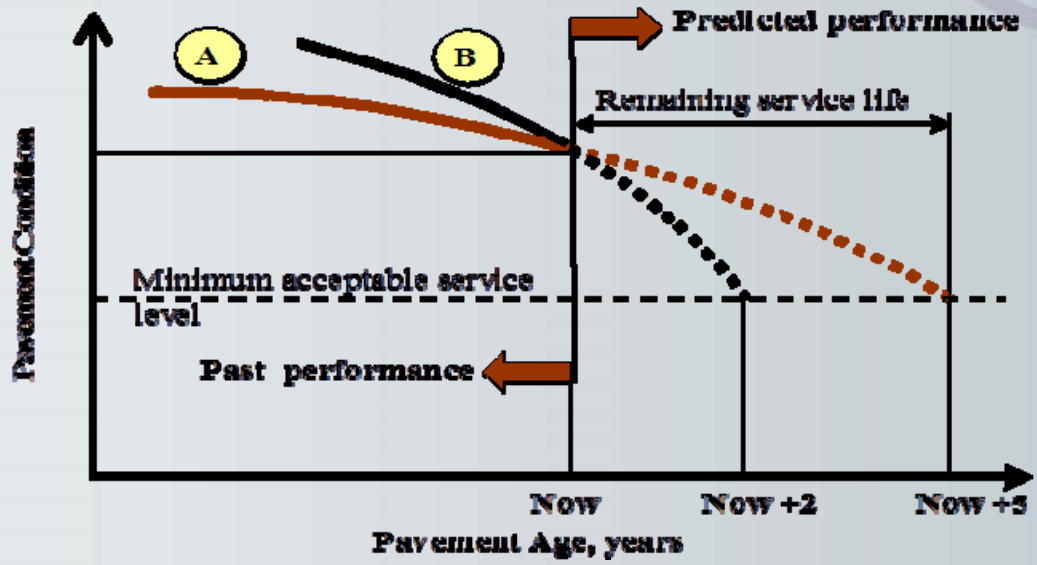
FAMILY/DETERIORATION CURVES



- Considerations
  - Function
  - Pavement type
  - Thickness
  - Traffic

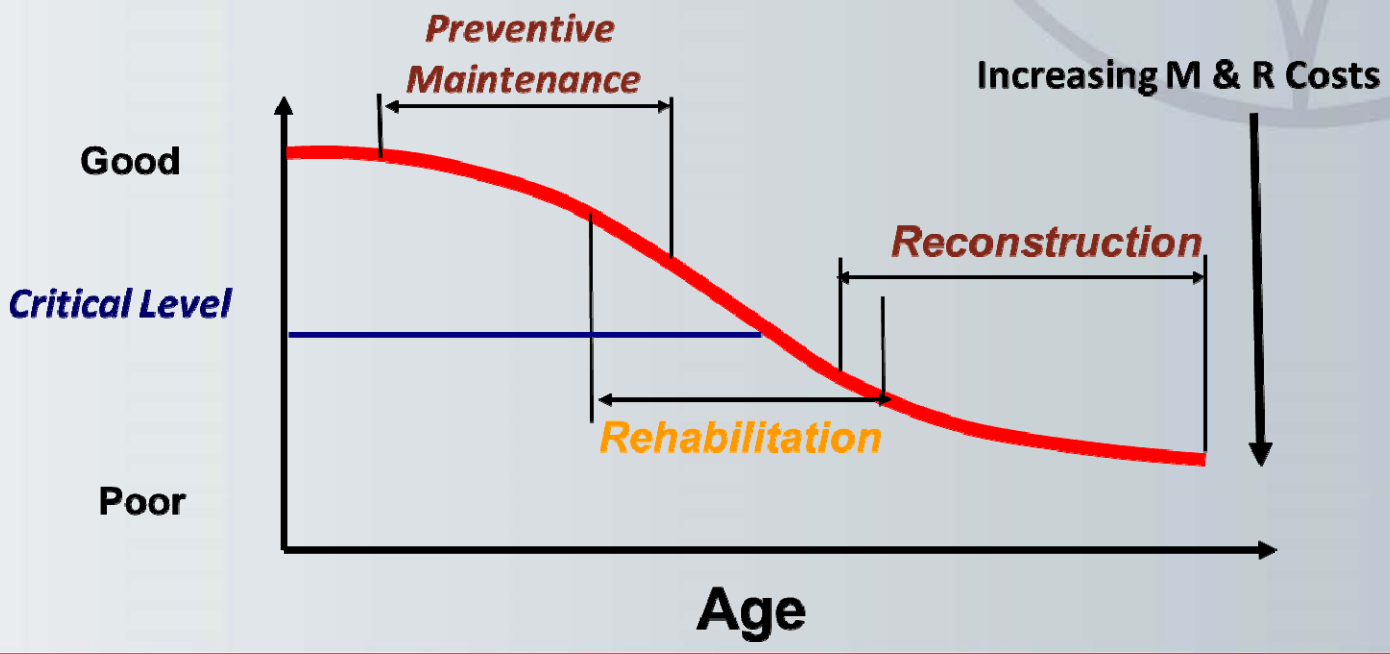
INSTALLATION DEPENDENT

- Rate of deterioration is dependant on a number of factors including, thickness, aircraft loading, maintenance practices, etc.



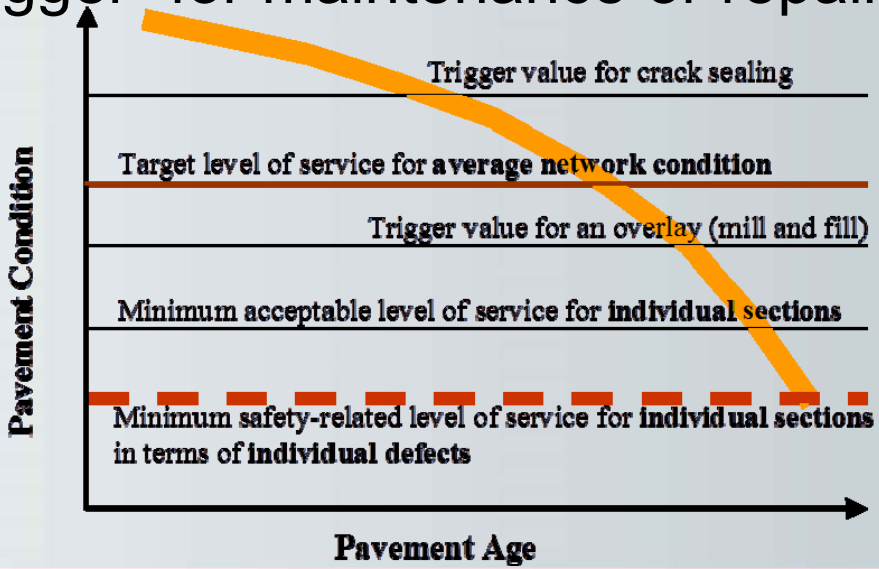
HOW CAN WE USE THIS DATA?

- Understanding pavement deterioration and it's relationship to M&R costs



ESTABLISHING LEVELS OF SERVICE

- Identify the minimum acceptable level of service based on mission criticality
- Set “trigger” for maintenance or repair



TYPICAL PLANNING LOGIC

- Funds available
- Importance of pavement section
  - Mission critical sections have higher priority
- Current pavement condition
  - Critical PCI level (Minimum Service Level)
- Structural distresses versus other causes
- Maintenance policies
  - Major M&R overrides need for Preventive M&R

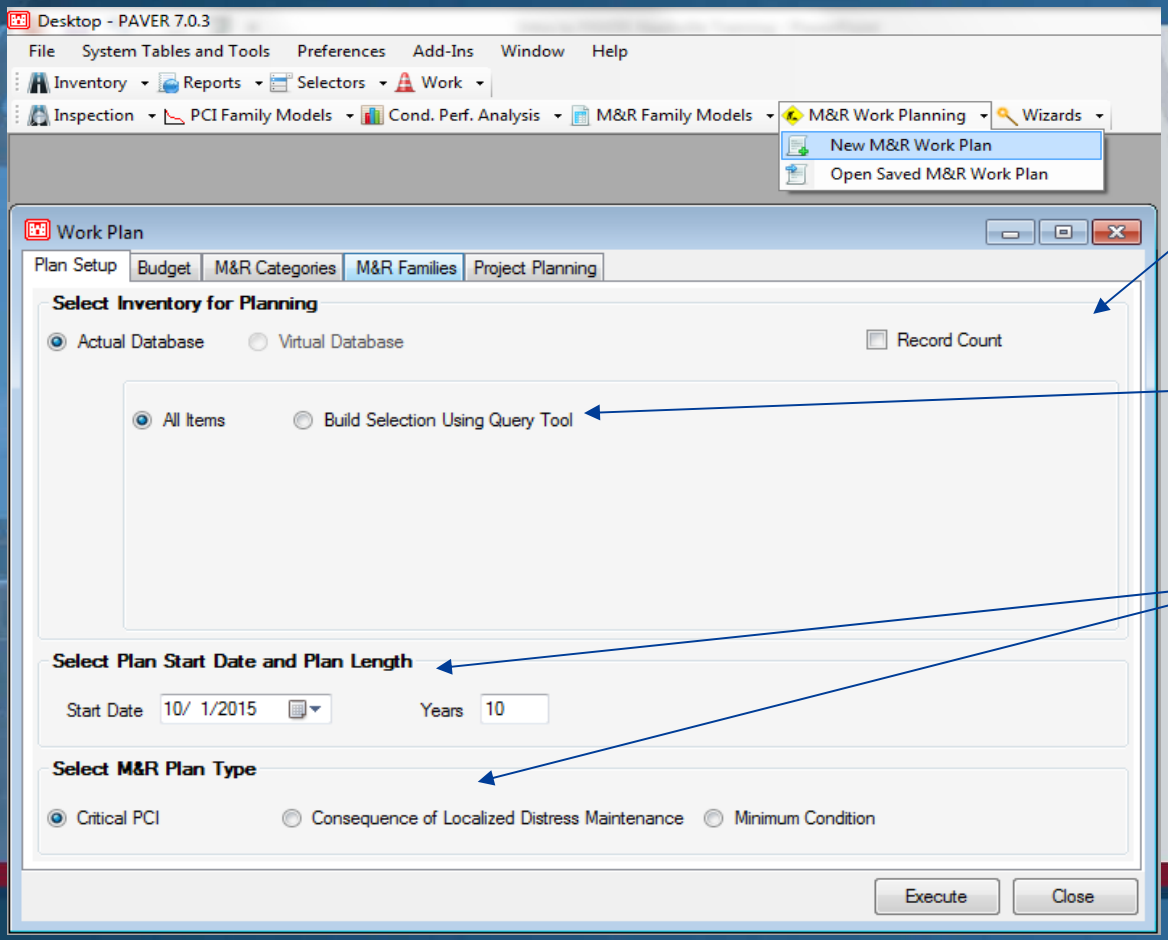
M&R PLANNING DEFINITIONS

- **Critical PCI**: The PCI value that is used to trigger major rehabilitation. Also called the Minimum Service Level (MSL).
- **Preventative**: PCI is above the MSL.
- **Restorative**: PCI is below the MSL, but the identified maintenance actions will restore the PCI to a level above the MSL.
- **Stopgap**: PCI is below the MSL. Maintenance actions will increase PCI, but can't raise it above the MSL.

WORK PLAN DEFINITIONS

- Critical PCI
  - Optimize M&R activity against a specified budget / budget needed to maintain a specified PCI
- Consequence of Local M&R
  - Calculates the cost and resulting condition from Local M&R (1 year plan)
- Major M&R based on Minimum Condition
  - User sets the lowest allowable PCI each year

M&R WORK PLANNING – PLAN SETUP



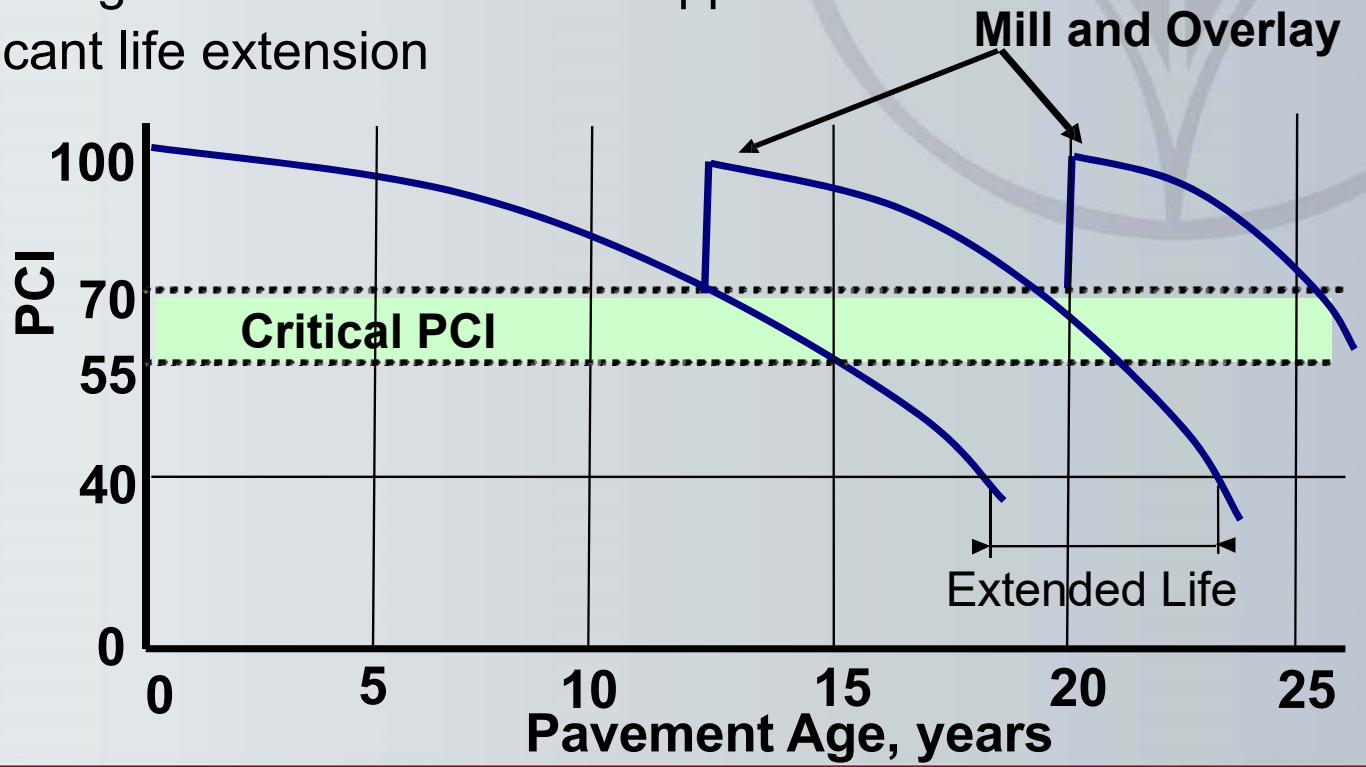
M&R Plan Setup

Query Wizard Tool

M&R plan parameters

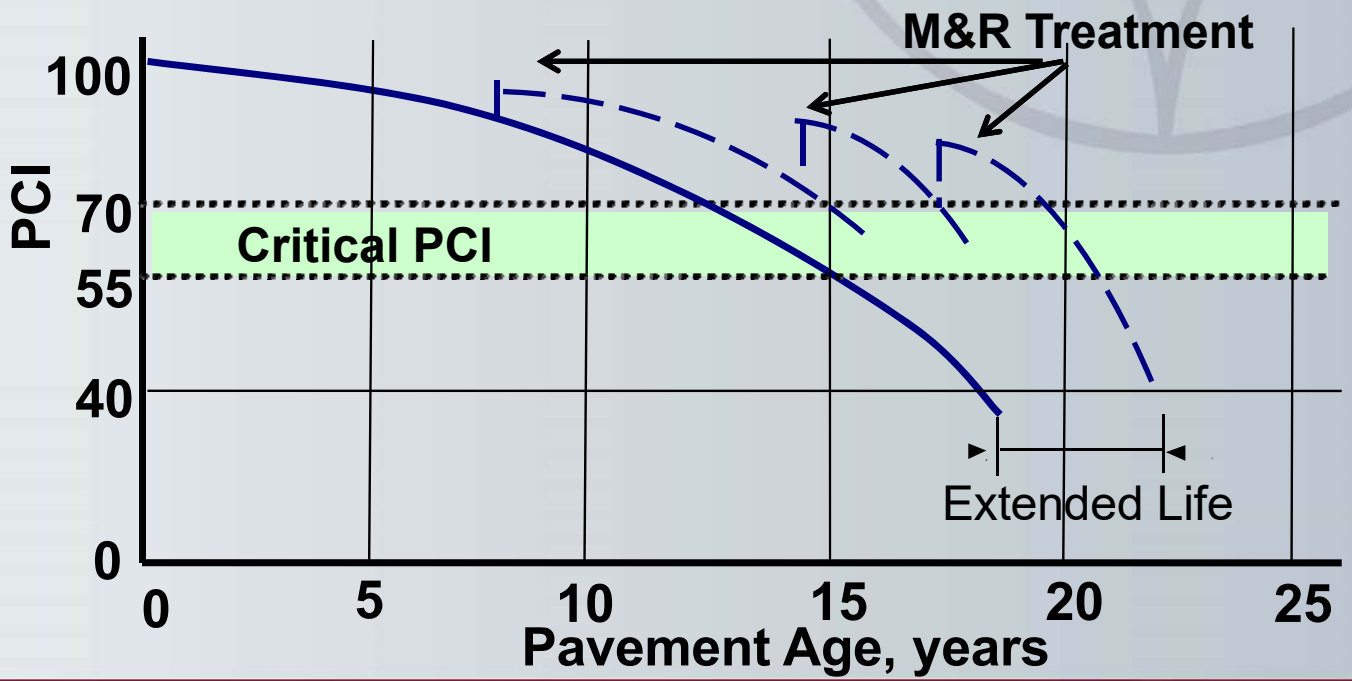
REHABILITATION STRATEGY

- Condition goes back to 100 each application
- Significant life extension

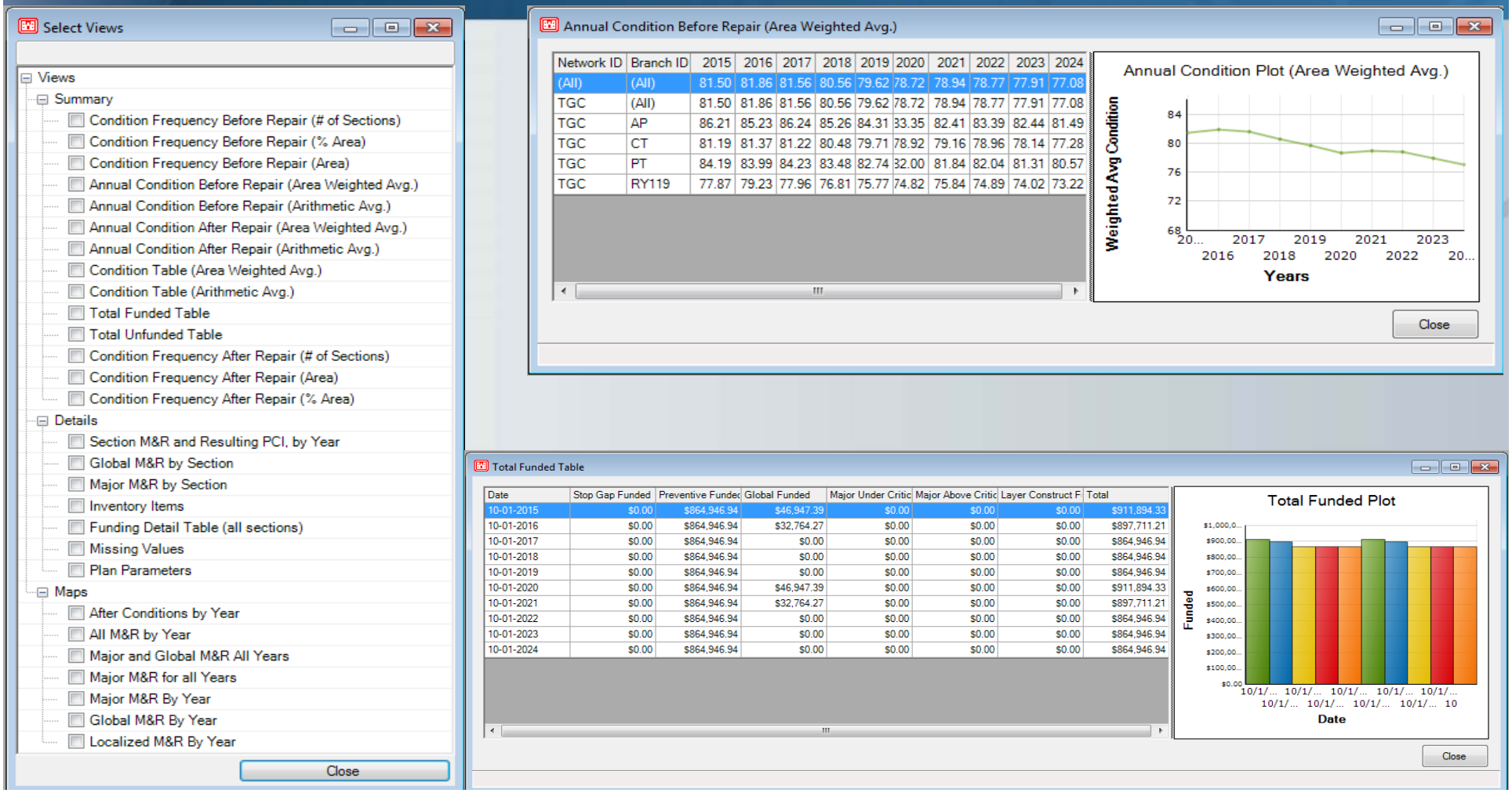


PREVENTATIVE MAINTENANCE

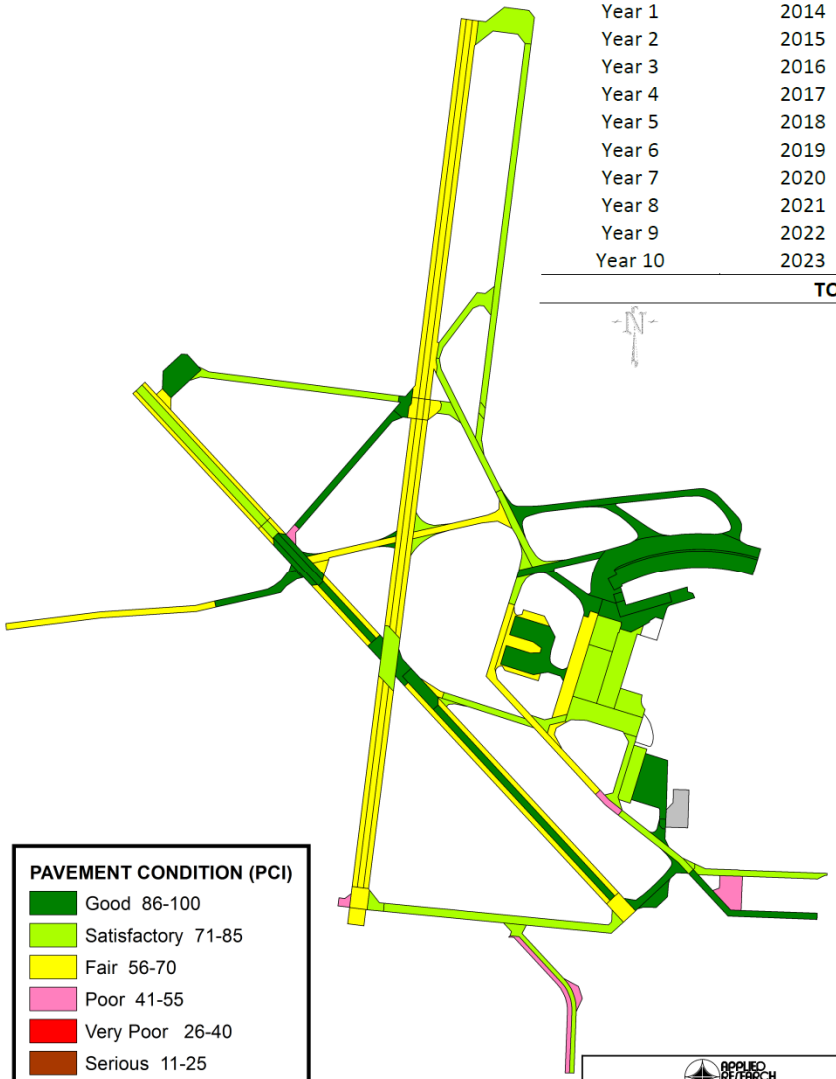
- Condition does not go back to 100 each application
- Incremental life extension



M&R REPORTS


Select Views
Views
Summary
Condition Frequency Before Repair (# of Sections)
Condition Frequency Before Repair (% Area)
Condition Frequency Before Repair (Area)
Annual Condition Before Repair (Area Weighted Avg.)
Annual Condition Before Repair (Arithmetic Avg.)
Annual Condition After Repair (Area Weighted Avg.)
Annual Condition After Repair (Arithmetic Avg.)
Condition Table (Area Weighted Avg.)
Condition Table (Arithmetic Avg.)
Total Funded Table
Total Unfunded Table
Condition Frequency After Repair (# of Sections)
Condition Frequency After Repair (Area)
Condition Frequency After Repair (% Area)
Details
Section M&R and Resulting PCI, by Year
Global M&R by Section
Major M&R by Section
Inventory Items
Funding Detail Table (all sections)
Missing Values
Plan Parameters
Maps
After Conditions by Year
All M&R by Year
Major and Global M&R All Years
Major M&R for all Years
Major M&R By Year
Global M&R By Year
Localized M&R By Year
Close
Annual Condition Before Repair (Area Weighted Avg.)
Network ID | Branch ID | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024
(All) | (All) | 81.50 | 81.86 | 81.56 | 80.56 | 79.62 | 78.72 | 78.94 | 78.77 | 77.91 | 77.08
TGC | (All) | 81.50 | 81.86 | 81.56 | 80.56 | 79.62 | 78.72 | 78.94 | 78.77 | 77.91 | 77.08
TGC | AP | 86.21 | 85.23 | 86.24 | 85.26 | 84.31 | 83.35 | 82.41 | 83.39 | 82.44 | 81.49
TGC | CT | 81.19 | 81.37 | 81.22 | 80.48 | 79.71 | 78.92 | 79.16 | 78.96 | 78.14 | 77.28
TGC | PT | 84.19 | 83.99 | 84.23 | 83.48 | 82.74 | 82.00 | 81.84 | 82.04 | 81.31 | 80.57
TGC | RY119 | 77.87 | 79.23 | 77.96 | 76.81 | 75.77 | 74.82 | 75.84 | 74.89 | 74.02 | 73.22
Annual Condition Plot (Area Weighted Avg.)
Weighted Avg Condition
84
80
76
72
68
20...
2016
2017
2018
2019
2020
2021
2022
2023
20...
Years
Close
Total Funded Table
Date | Stop Gap Funded | Preventive Funded | Global Funded | Major Under Critic | Major Above Critic | Layer Construct F | Total
10-01-2015 | $0.00 | $864,946.94 | $46,947.39 | $0.00 | $0.00 | $0.00 | $911,894.33
10-01-2016 | $0.00 | $864,946.94 | $32,764.27 | $0.00 | $0.00 | $0.00 | $897,711.21
10-01-2017 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
10-01-2018 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
10-01-2019 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
10-01-2020 | $0.00 | $864,946.94 | $46,947.39 | $0.00 | $0.00 | $0.00 | $911,894.33
10-01-2021 | $0.00 | $864,946.94 | $32,764.27 | $0.00 | $0.00 | $0.00 | $897,711.21
10-01-2022 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
10-01-2023 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
10-01-2024 | $0.00 | $864,946.94 | $0.00 | $0.00 | $0.00 | $0.00 | $864,946.94
Total Funded Plot
Funded
$1,000,0...
$900,00...
$800,00...
$700,00...
$600,00...
$500,00...
$400,00...
$300,00...
$200,00...
$100,00...
$0.00
10/1/...
Date
Close

Project Year	Calendar Year	Amount	PCI Before	PCI After
Year 1	2014	$25,988,818	78	92
Year 2	2015	$554,812	92	91
Year 3	2016	$208,317	91	89
Year 4	2017	$1,488,001	89	88
Year 5	2018	$482,353	88	86
Year 6	2019	$2,363,850	86	86
Year 7	2020	$2,232,666	86	86
Year 8	2021	$2,151,761	86	84
Year 9	2022	$425,491	84	82
Year 10	2023	-	82	81
	TOTAL	**$35,896,069**		



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Pavement Condition

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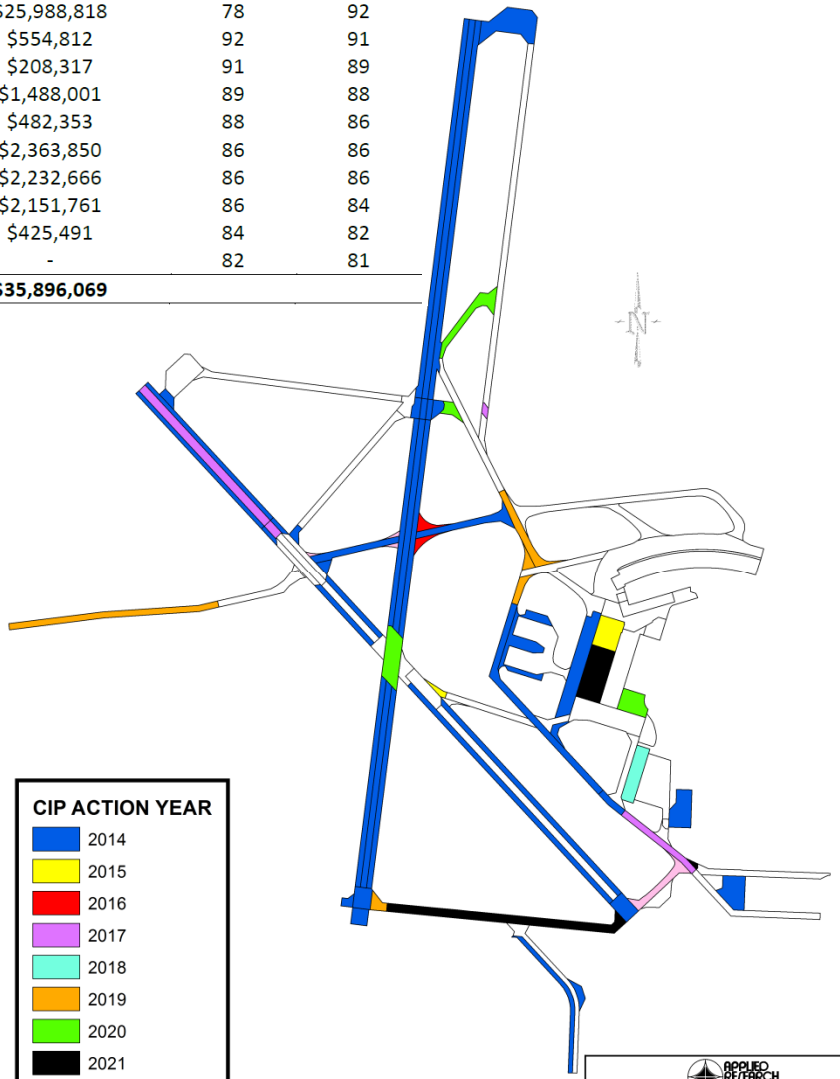

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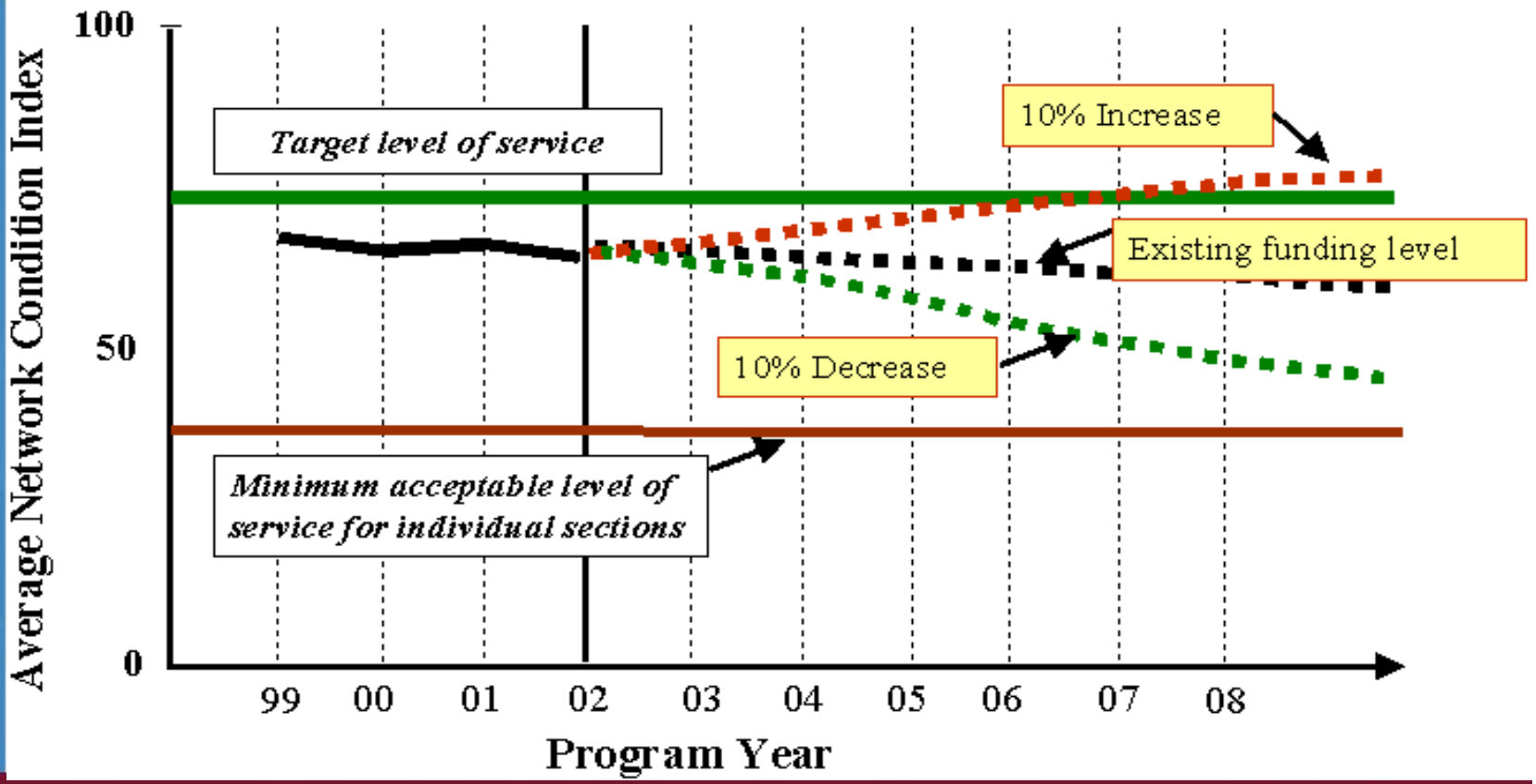
FUNDING SCENARIOS



COS SOFTWARE

- Commercial of the shelf software includes:
  - PAVER (US Army Corps of Engineers)
  - PAVEAIR (FAA – web based)
- Numerous proprietary pavement management systems applicable to airports

HISTORY OF FAA PAVEAIR

PAVER PMS

In 1968, CERL begins development of a mainframe PMS for the DOD. The first version is completed in 1972.

Public Law 103-305

Requires an airport agency to show that it has an effective PMS in place to be eligible for federal funding.

FAA PAVEAIR

February 2011, FAA releases a beta of FAA PAVEAIR, a public web-based APMS

FAA PAVEAIR

May 2016, FAA releases FAA PAVEAIR 2.6.

FAA PAVEAIR

September 2018, FAA releases FAA PAVEAIR 3.1.

1968 | 1985 | 1995 | 2004 | 2011 | 2012 | 2016 | 2017 | 2018

MicroPAVER

In 1985, the FAA funds CERL to develop a microcomputer version of PAVER, named MicroPAVER. The first version is released in 1987.

APMS Systems in Use

By 2004, 84% of state aviation agencies in the US use an APMS.

FAA PAVEAIR

June 2012, FAA releases FAA PAVEAIR 2.0.

FAA PAVEAIR

October 2017, FAA releases FAA PAVEAIR 3.0.

** CERL (U.S. Army Construction Engineering Research Laboratory)*

PAVER vs PAVEAIR

- PAVEAIR is web based and hosted by FAA
- PAVEAIR can read PAVER files
- PAVEAIR has a mobile web page for data entry

- PAVER has been around since the late 1980's
- Current version PAVER 7
- PAVER work planning is more robust
- Software license – US$999

APMS SUMMARY

- An APMS is a decision making tool, not a solution
- Consider meaningful sections with like attributes
- Use trained inspection personnel
- Re-evaluate the deterioration models after each inspection
- Update construction history after each work program
- Select the right treatment, for the right pavement, at the right time

PROGRAM IMPLEMENTATION

- APMS will provide long term network level planning estimates based on condition.
- Implementing a work program must include detailed design and budget refinement.
- Other pavement performance attributes to consider would include:
  - Pavement strength
  - Roughness
  - Surface drainage
  - Surface friction

EVALUATE CAUSE(S)

- A detailed design Investigation is a must
- Determine the cause of the distress and the rehabilitation needs
- Right Treatment / Right Pavement / Right Time

PAVEMENT STRENGTH

- Can the paved surface support aircraft operations and the critical aircraft?

PAVEMENT STRENGTH

- Certified airports must determine and report the bearing strength of all airside pavement operational surfaces.
- With TP 312 5th edition, the historical Canadian ALR/PLR strength reporting system will be replaced with the ICAO ACN-PCN method
- As a minimum, the bearing strength of a pavement should be reviewed, re-affirmed or re-determined as appropriate at least once every 10 years (AC302-011)

WHY IS ROUGHNESS IMPORTANT?

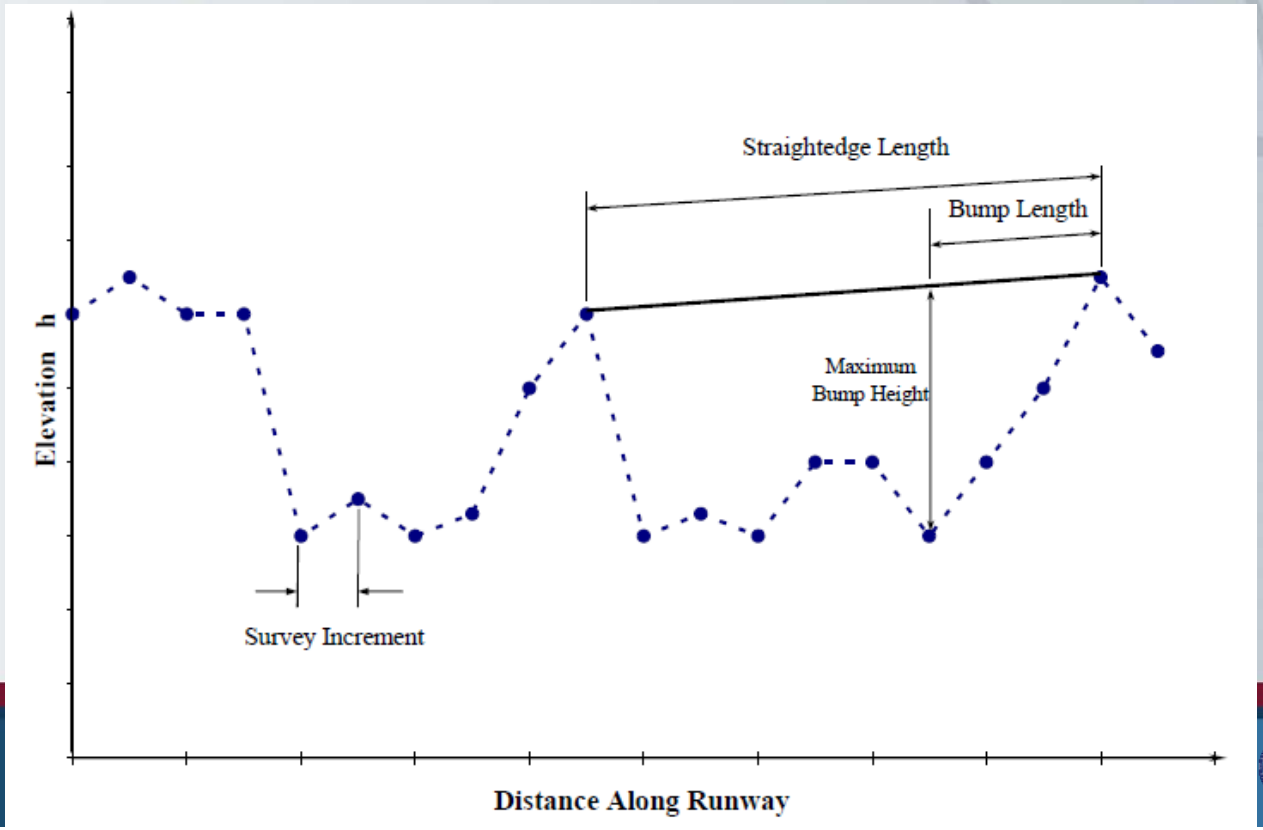
- Affects aircraft performance during take off and landing
- Dynamic forces from rough pavement can accelerate fatigue damage to aircraft components
- Dynamic loading reduces pavement life
- To a lesser extent, user complaints from pilots
  - Pilot complaints – indicator to consider measurement

BOEING BUMP METHOD

- D6-81746 *Runway Roughness Measurement, Quantification and Application – The Boeing Method*
- FAA AC 150/5380-9 *Guidelines and Procedures for Measuring Airfield Pavement Roughness*
- The method is user friendly
- Does not consider detailed analysis of aircraft response

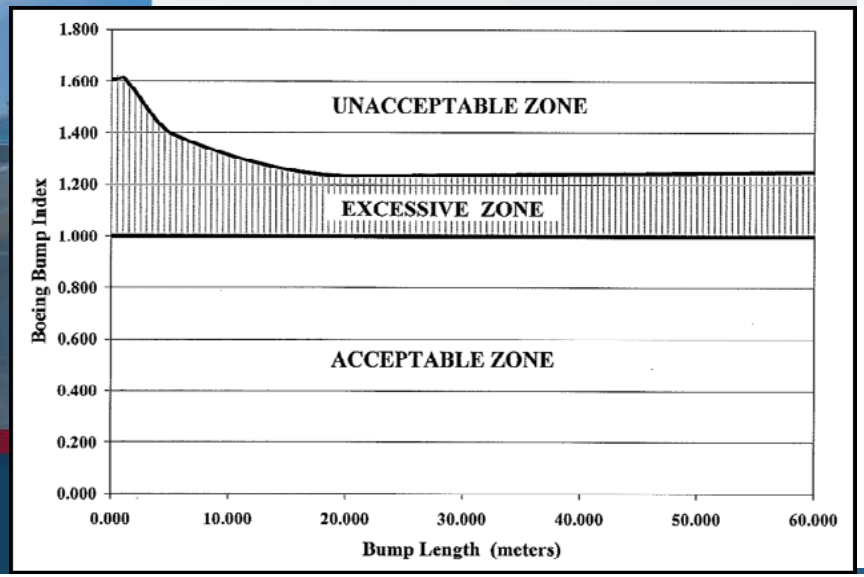
BOEING BUMP INDEX

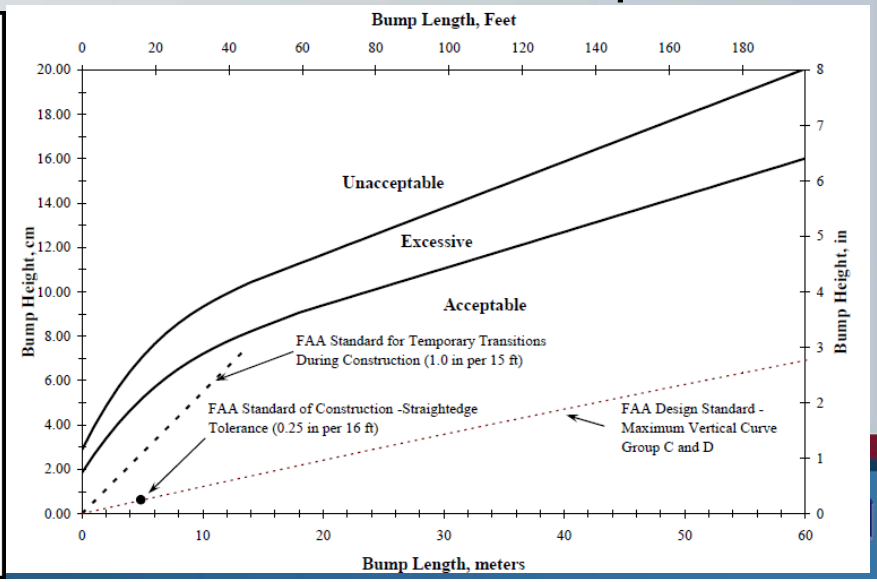
- Considers a virtual straight edge bump length from 0.5 m to 120 m



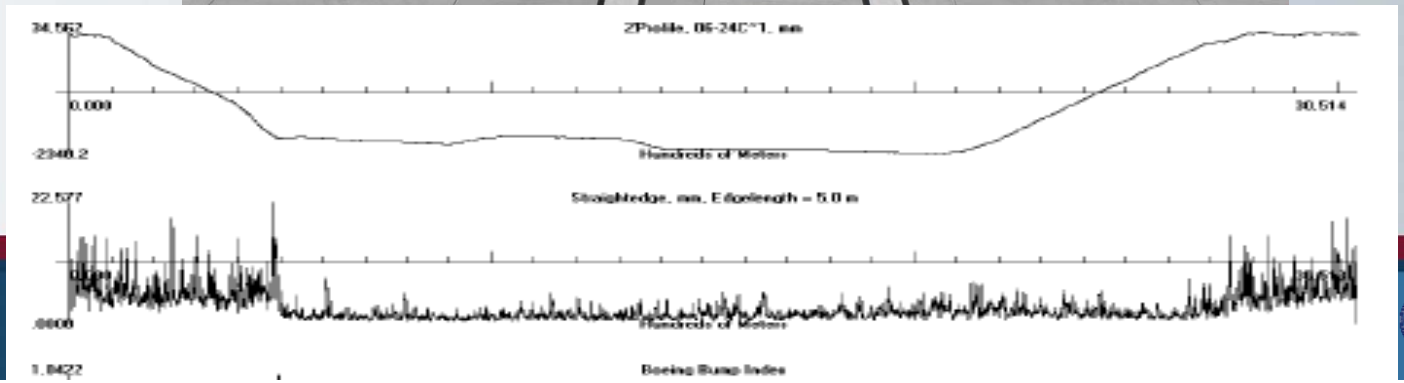
BOEING BUMP INDEX

- Boeing Bump Index (BBI) is the ratio of the measured bump height to the limit of acceptable bump height, for each straight edge length
  - BBI < 1 is considered acceptable
  - BBI > 1 is considered excessive or unacceptable





COMMON CAUSES OF ROUGHNESS



COMMON CAUSES OF ROUGHNESS

SURFACE FRICTION / DRAINAGE

QUESTIONS?