The National Academies of
SCIENCES · ENGINEERING · MEDICINE

TRANSPORTATION RESEARCH BOARD

# Smooth Road Ahead – Applying Pavement Condition Data for Airports

**July 7, 2020**
**2:00-3:30 PM ET**

**@NASEMTRB**
**#TRBWebinar**

## Learning Objectives

At the end of this webinar, you will be able to:

- List available pavement condition data collection methods and their advantages and disadvantages
- Identify how pavement condition data are used within airport organizations
- Apply guidelines for collecting pavement condition data depending on the use
- Describe possible advancements of pavement condition data collection tools

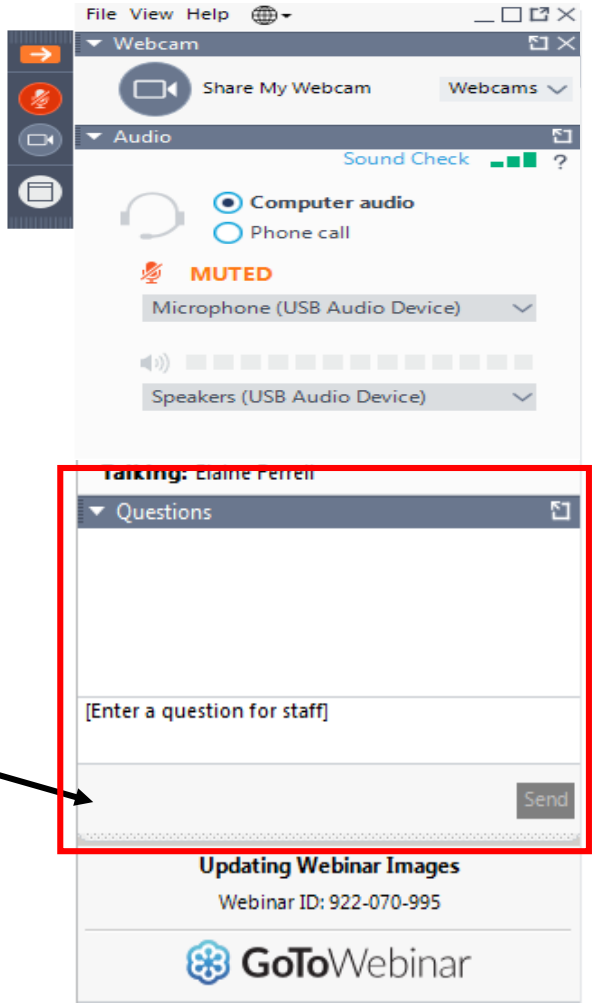
# American Association of Airport Executives (AAAE)

1.0 Continuing Education Units (CEUs) are available to Accredited Airport Executives (A.A.E.)

Report your CEUs: www.aaae.org/ceu

# Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



# Today's Panelists

#TRBWebinar

**Vivek Khanna,** Woolpert

Casey Ries, Gerald R. Ford International Airport

**David Peshkin**, Applied Pavement Technology

**Kyle Wanner**, North Dakota Aeronautics Commission

# Vivek Khanna, Ph.D., P.E.
# Woolpert, Inc.

- Woolpert's Practice Leader - Aviation Design based in Dallas, TX
- Expanding Woolpert's Aviation practice in Texas
- (2002) Oklahoma's Web-based Airport Pavement Management System Development (2003) and Data Collection (2000 – 2014)
- Inaugural ACRP Ambassador (2012 – 2014)
- Regular contributor to ACRP - project panels, Graduate Student Mentorship

# Five Ways to Get Involved!

ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

1. Join the ACRP IdeaHub community
2. Volunteer for a project panel
3. Prepare a research proposal
4. Answer an ACRP survey
5. Apply the research results

**Visit us online:**

**www.trb.org/ACRP**

# Today's Speakers

David Peshkin, Applied Pavement Technology, Inc.

Kyle Wanner, North Dakota Aeronautics Commission

and

Casey Ries, Gerald R. Ford International Airport Authority

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## Presenting

ACRP Report 203: Guidelines for Collecting, Applying, and Maintaining Pavement Condition Data at Airports

# ACRP Report 203

## Smooth Road Ahead – Collecting, Applying, and Maintaining Airport Pavement Condition Data

David Peshkin, Applied Pavement Technology
Kyle Wanner, North Dakota DOT
Casey Ries, Gerald R Ford International Airport

# David Peshkin, P.E.
# Principal Investigator

- Chief Engineer, Applied Pavement Technology, Inc.
- 33 years of experience in pavement evaluation, design, maintenance, preservation, and rehabilitation
- Airfield pavement forensics, training, and research

# Additional Team Members

**Applied Pavement Technology, Inc.**

- Peter-Paul Dzwilewski
- Kyle Potvin
- Katherine Gauthier
- Monty Wade

**Woolpert, Inc.**

- Eric Risner
- Ryan Robinson
- Chris Snyder
- Marianne Cardwell

**PMS Ltd. (Ireland)**

- Kieran Feighan

# ACRP Report 203 Oversight Panel

Casey W. Ries, Gerald R. Ford International Airport, Panel Chairman

Alexander K. Bernier, Stantec

Angela R. Newland, CCI Engineering Services

Owen K. Silbaugh, Jr., Massachusetts DOT

Dianne L. Walker, DW LLC

Kelvin C. P. Wang, Oklahoma State University

Gregory D. Cline, FAA Liaison

Albert Larkin, FAA Liaison

Theresia H. Schatz, ACRP Staff Officer

# The Challenge

- Collecting airfield pavement condition data can be expensive and time-consuming
- Access to collect such data is increasingly challenging
- Little guidance available on need for and uses of many types of condition data
- Standards have not kept pace with new data collection technologies

# Approach to the Solution

- Review literature
- Survey airport practices
- Survey consulting engineering practices
- Develop case studies
- Create *Guidelines*

# Types of Pavement Condition Data

- Distress
- Surface characteristics
- Structural condition

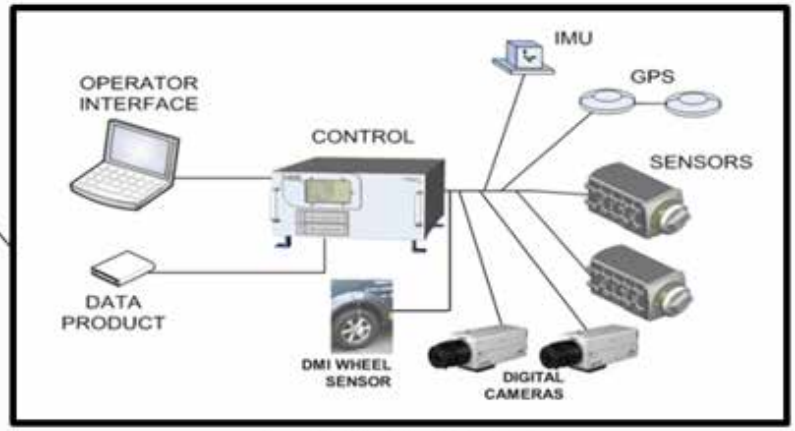
# Distress Data Collection

- Visual (manual) condition survey
- Light Detection and Ranging (LiDAR)
- Two- and three-dimensional (2D and 3D) laser imaging
- Vehicle-mounted camera survey
- Unmanned-mounted camera survey (small unmanned aircraft system or unmanned aerial vehicle [sUAS/UAV])

# LiDAR Data Collection

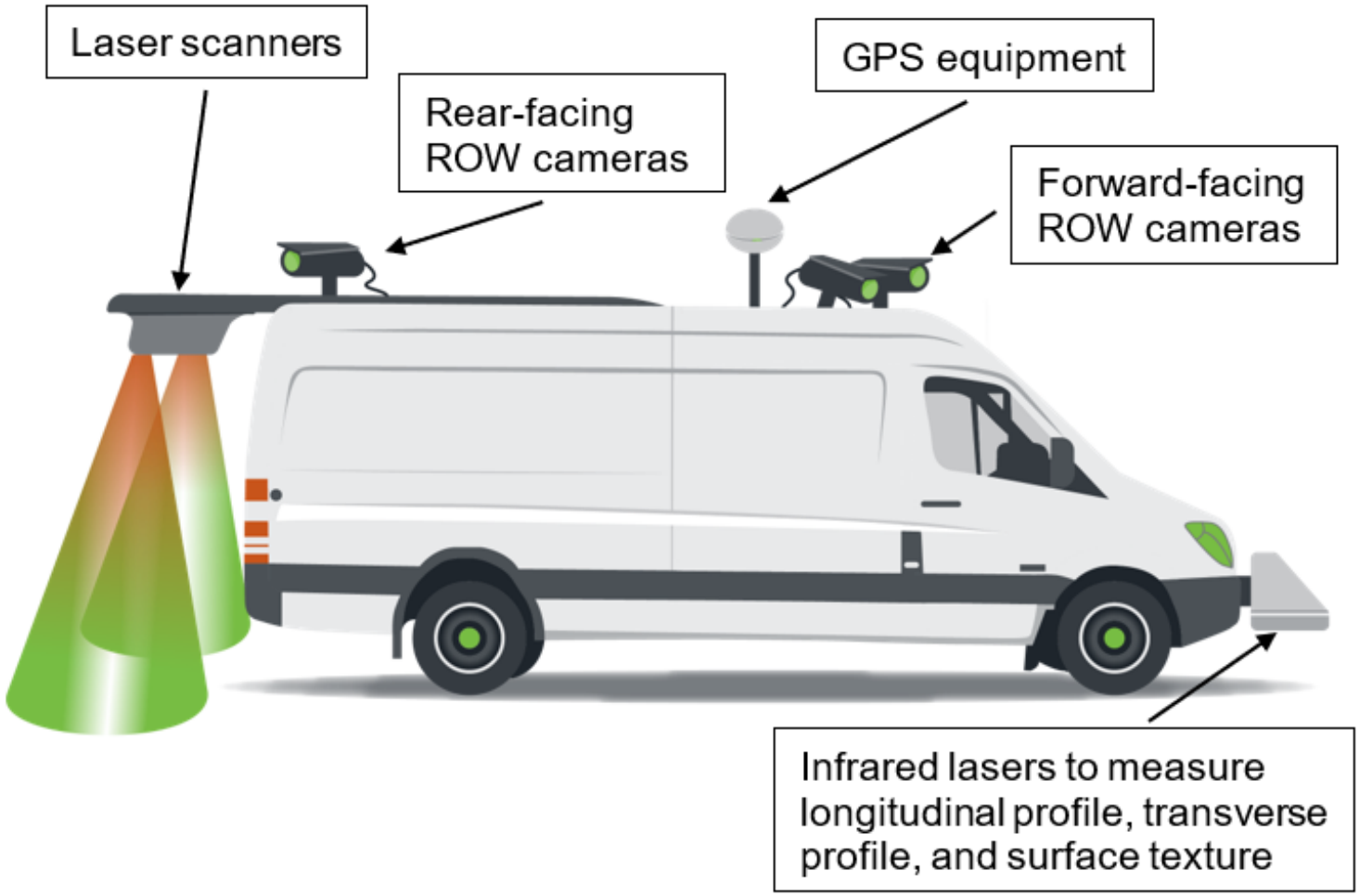
MMS VEHICLE

LiDAR SENSORS AND CAMERAS

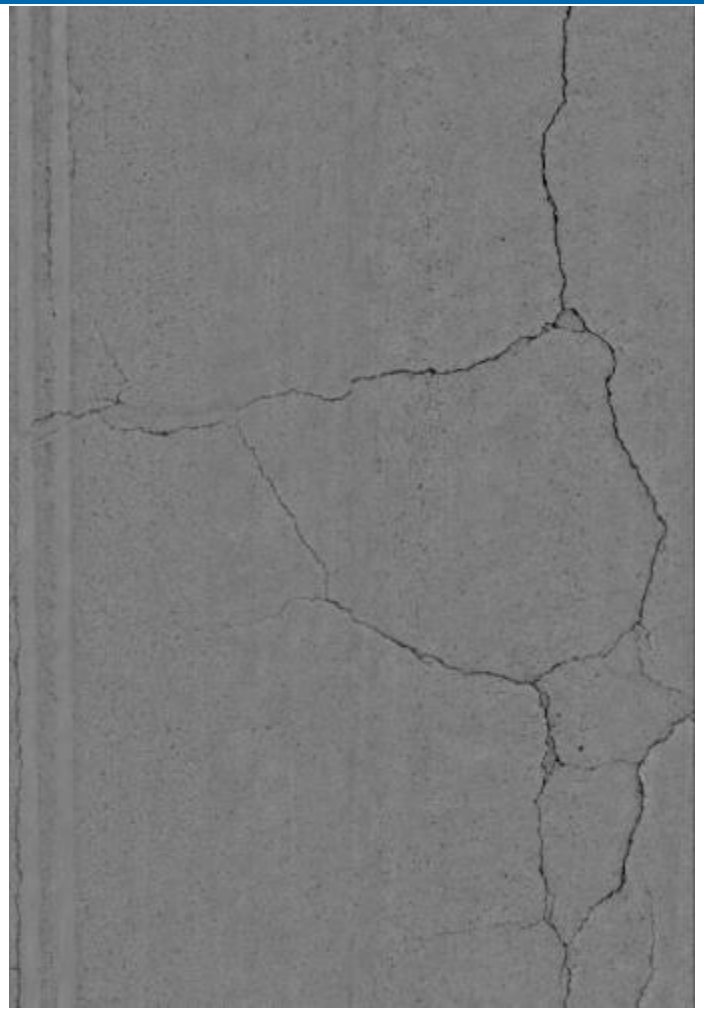


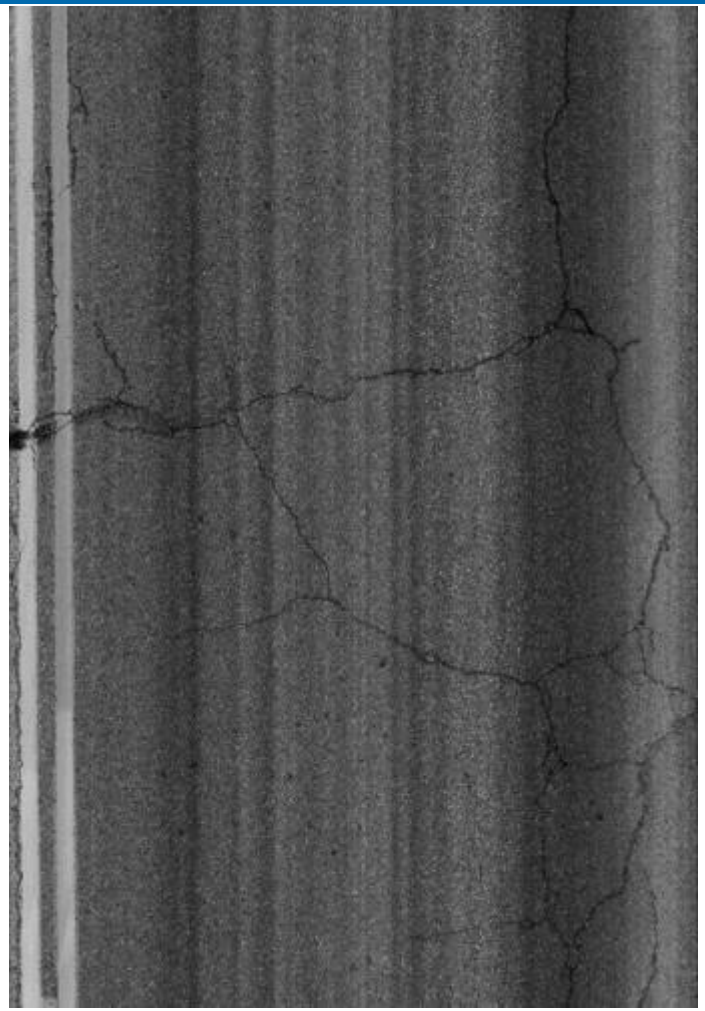

EQUIPMENT

# Laser Imaging Data Collection

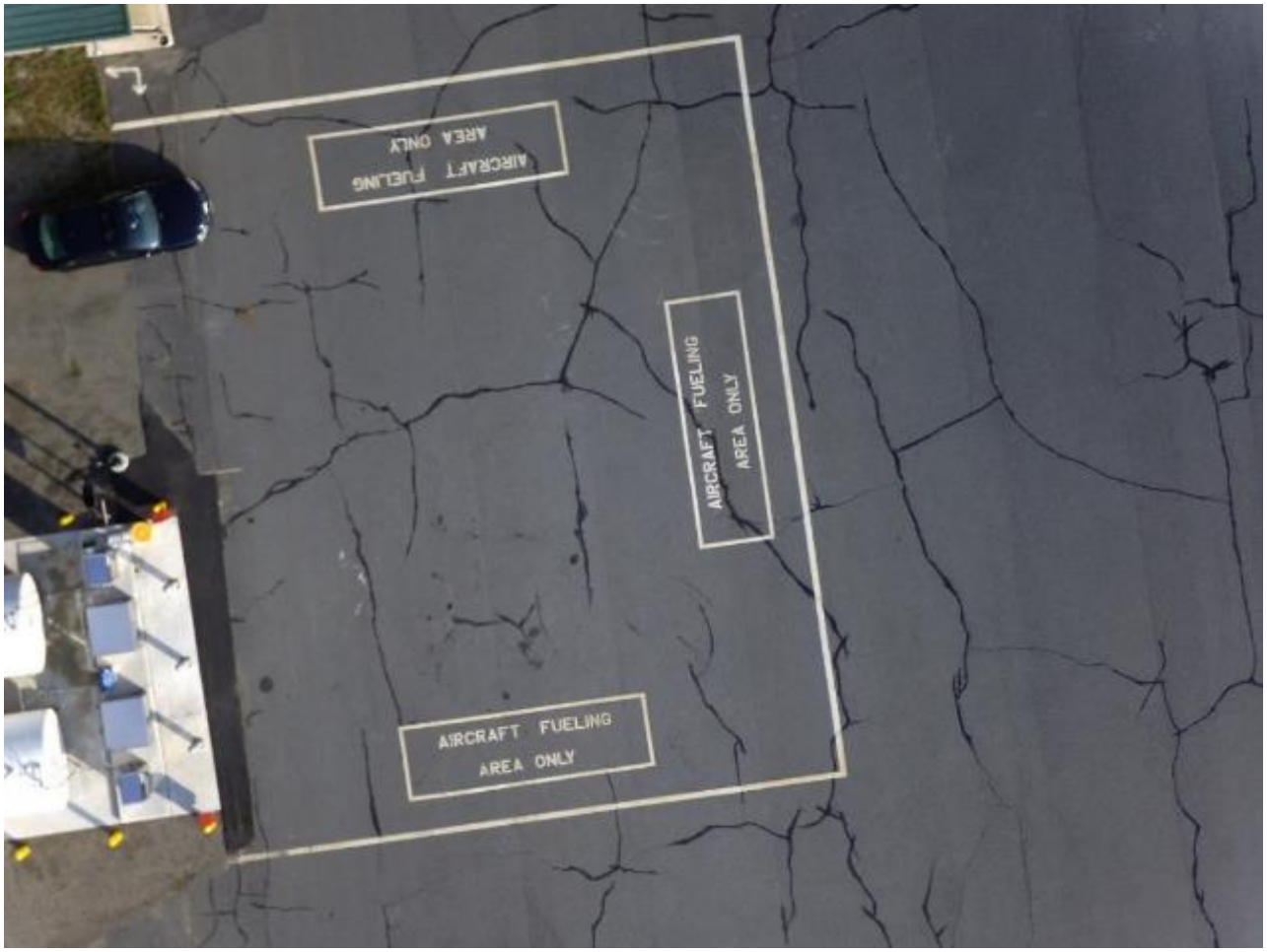


# Laser Imaging Data Example





# sUAS/UAV Data Example



# Longitudinal Profile Data Collection

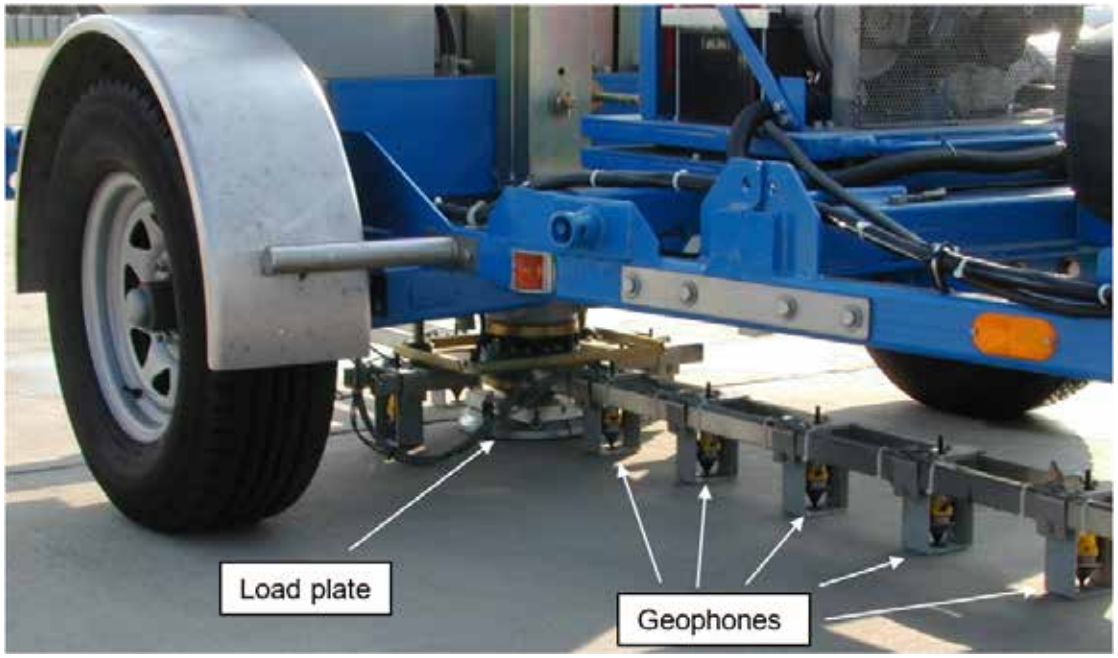
- Rolling surface profilers
- Rod and level
- Autorod and level
- Inertial profiler (ASTM E950 Class 1)
- Accelerometer (smartphone application)

# Surface Characteristics (Friction and Grooves)

- Continuous Friction Measurement Equipment (CFME)
- Circular Track Texture (CT) Meter
- British Pendulum
- Sand patch
- Manual or automated measure of groove spacing / depth

# Structural Condition Data Collection

- Falling Weight Deflectometer (FWD)
- Rolling Weight Deflectometer (RWD) and Traffic Speed Deflectometer (TSD)



# Casey Ries, P.E., LEED AP
# Panel Chair, Contributor

- Gerald R. Ford International Airport
- Engineering & Planning Director
- Former airport consultant and civil engineer
- ACRP panel member, project 09-17 chair

# GRR – Who We Are

## Gerald R. Ford International Airport Authority

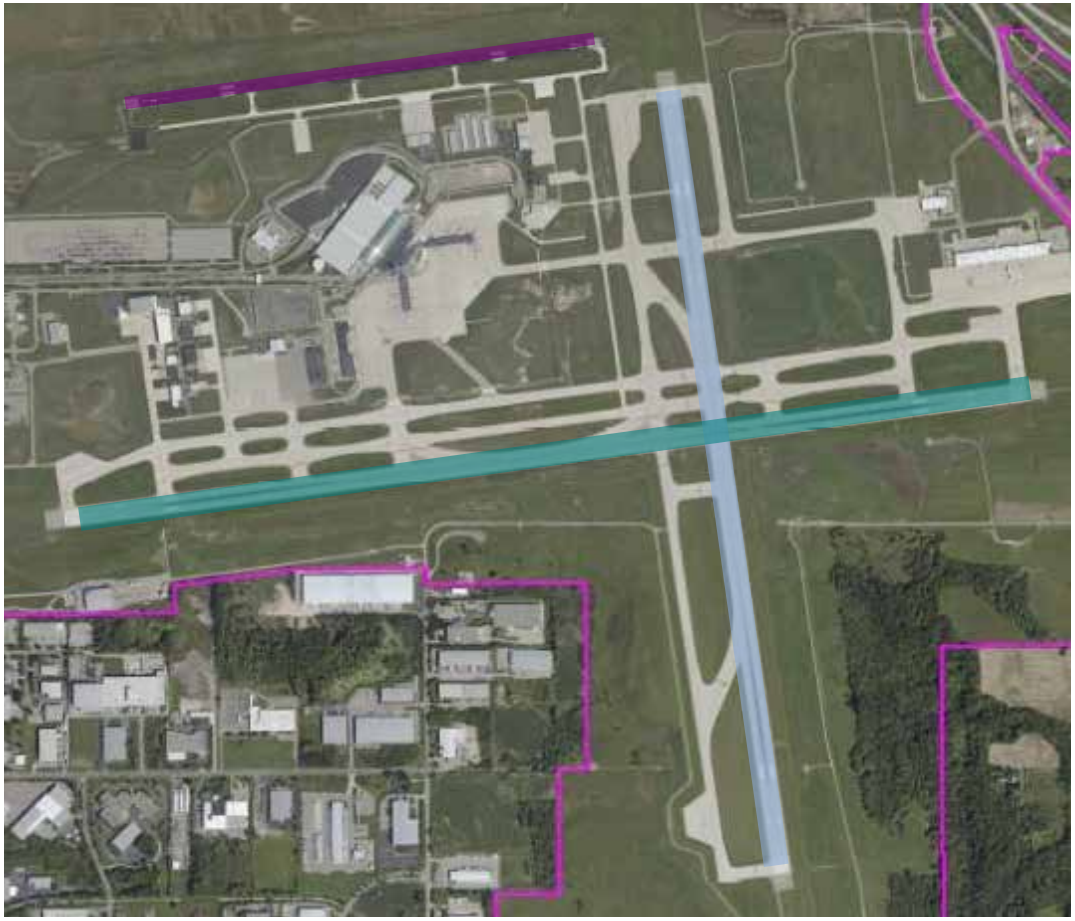
- 2nd Busiest Airport in Michigan
- 3.58 Million passengers in 2019
- Over 3,200 Acres
- Over $3.2 Billion in Economic Output to West Michigan

# GRR – Airfield Facilities

## 8R/26L
- Originally built in 1962
- Reconstructed in 2001
- 10,000’ long x 150’ wide

## 17/35
- Originally built in 1963 as a GA runway
- Reconstructed in 1998
- 8,500’ long x 150’ wide

## 8L/26R
- Originally built in 1973
- Reconstructed in 2015
- 5,000’ long x 100’ wide



# Runway = Essential

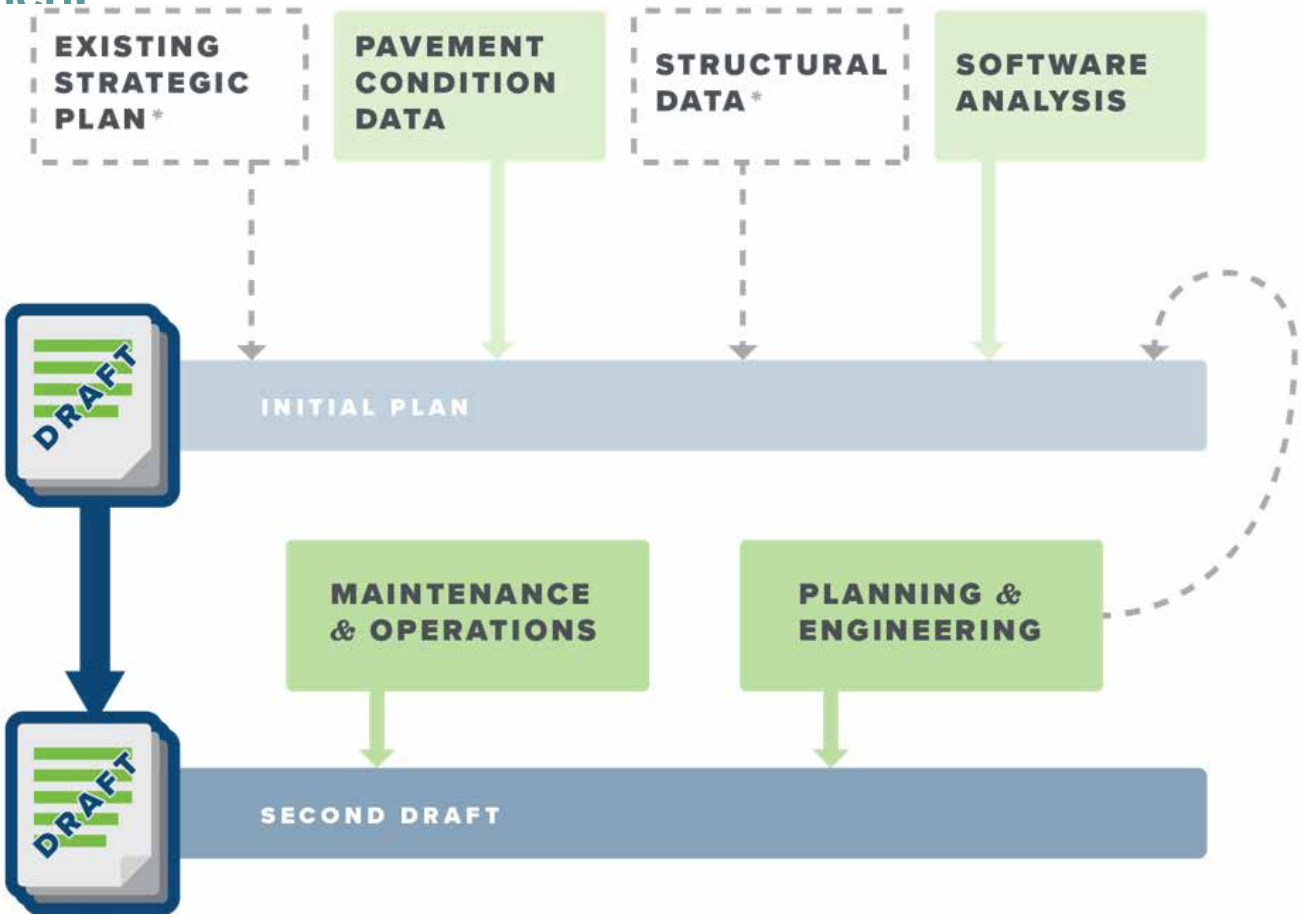
## Value in staff engagement

- Q Operations
- Q Maintenance
- Q Engineering

## Value in data

- Q Collect
- Q Apply

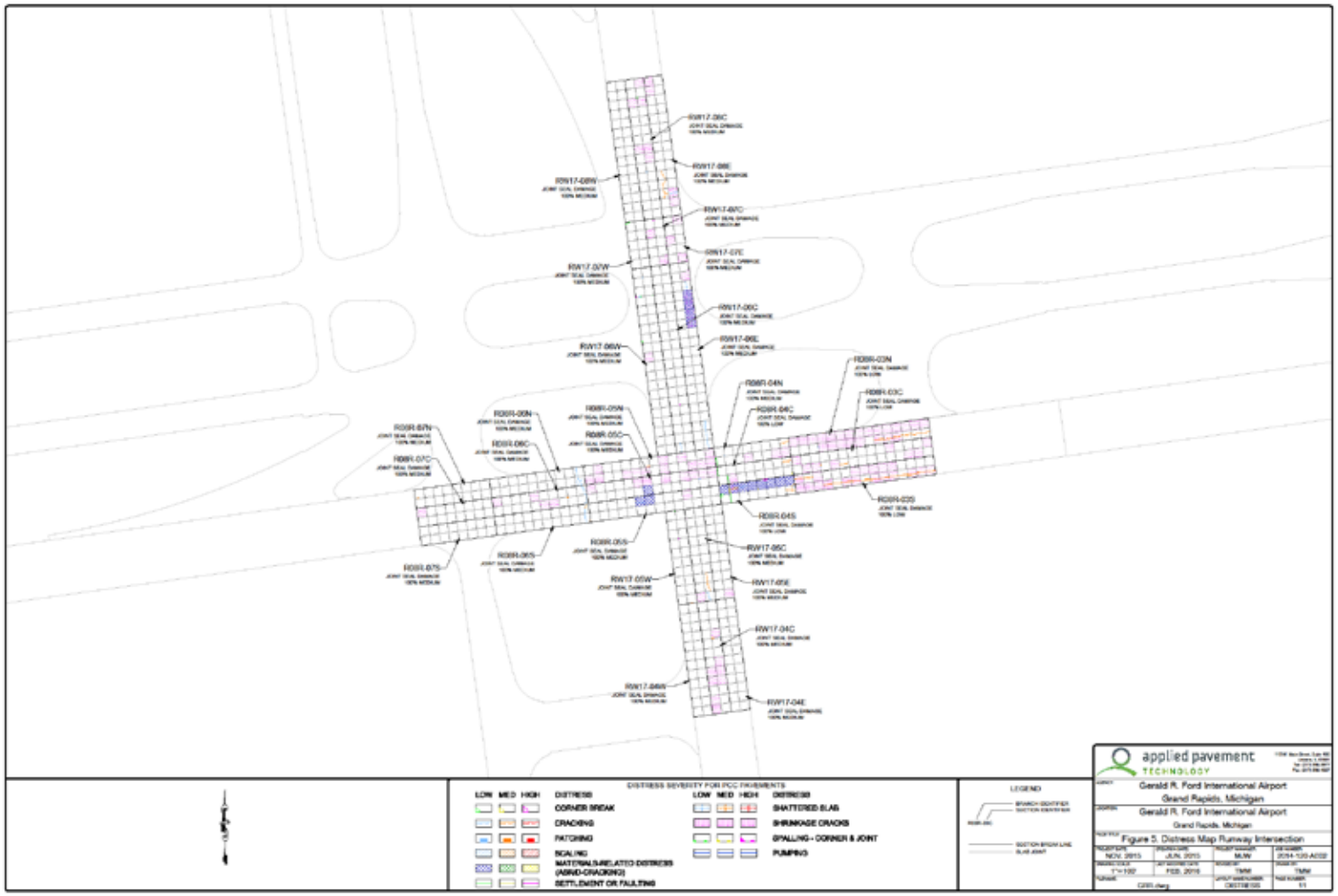
Figure 24 (top)



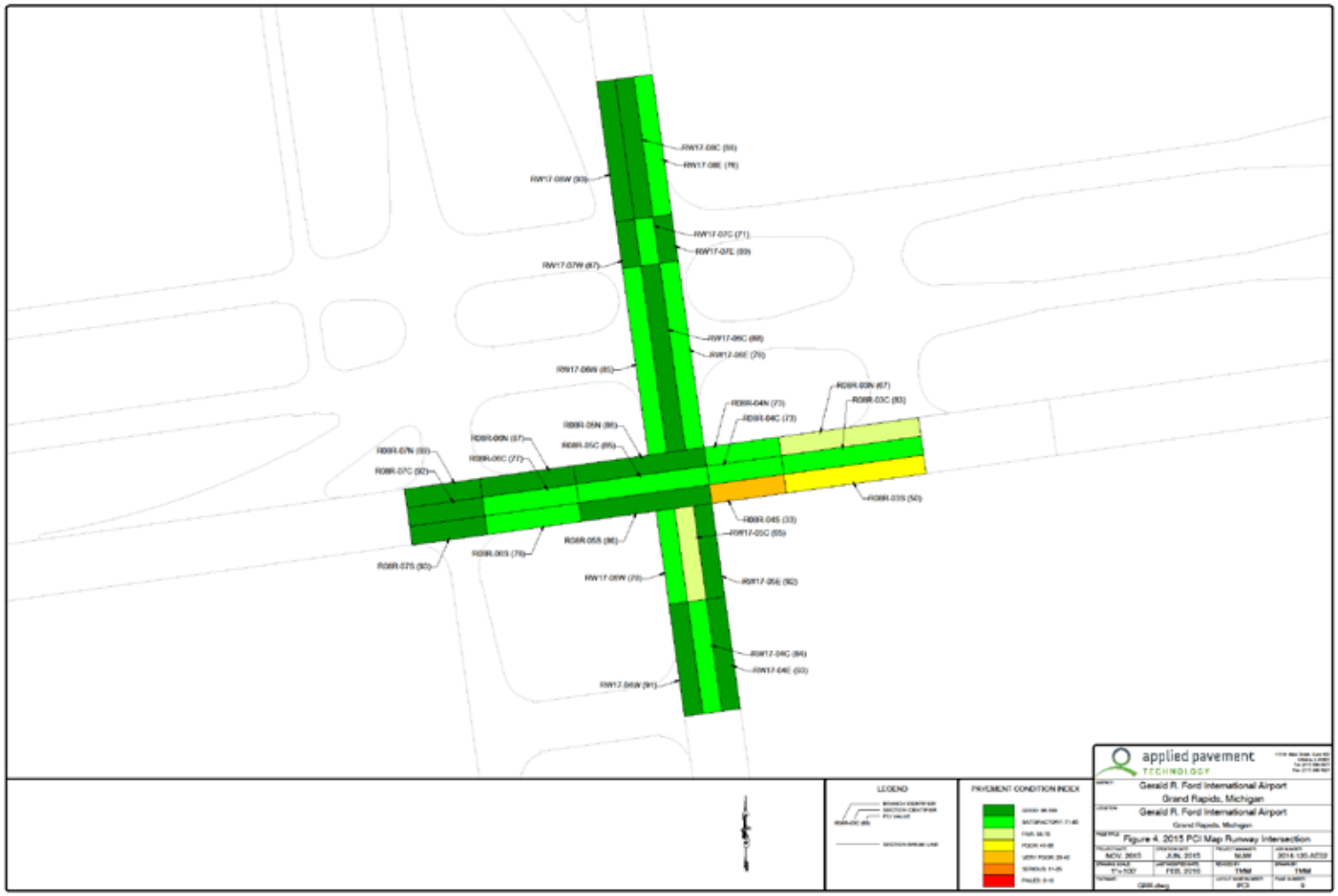
# Runway/Runway Intersection Observations

Figure 10. Transverse crack adjacent to structure on Runway 8R/26L

# Runway/Runway Intersection Data



# Runway/Runway Intersection Data



# Runway/Runway Intersection Cores

- Surface crack sealed by field maintenance
- No vertical movement evident
- Reflective crack associated with CTB construction joint
- FWD = structural condition good

# 2020 Airfield Pavement Maintenance

# Terminal Apron = Important

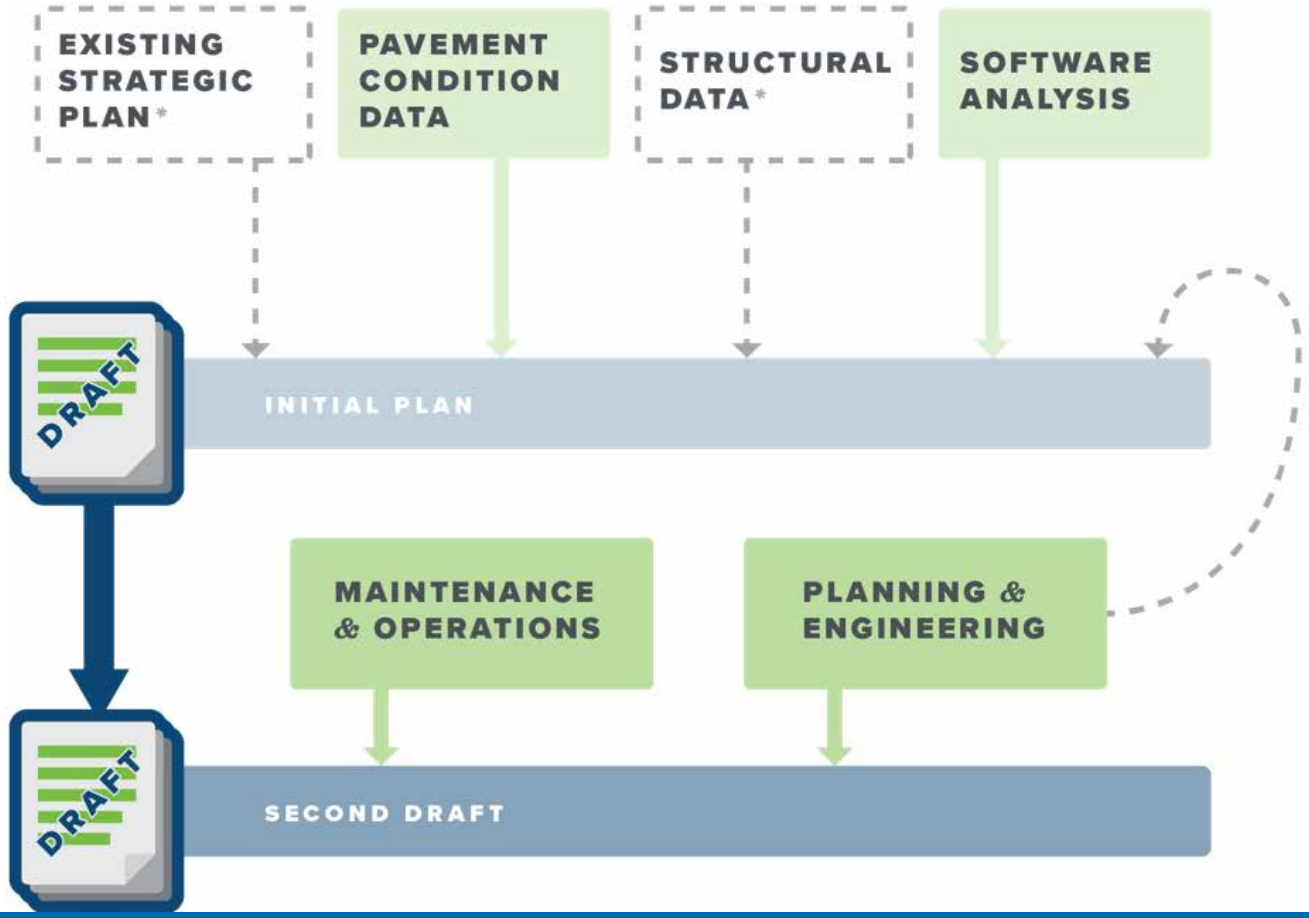
## Value in staff engagement

- Q Operations
- Q Maintenance
- Q Engineering

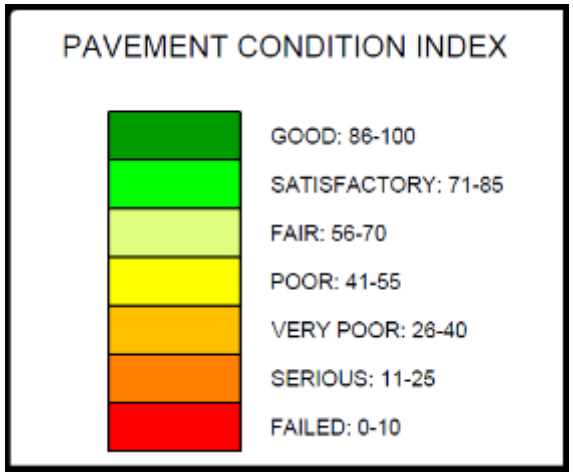
## Value in data

- Q Collect
- Q Apply

Figure 24 (top)



# Data Example – Terminal Apron

# Terminal Apron = Important

## Value in Financial Planning

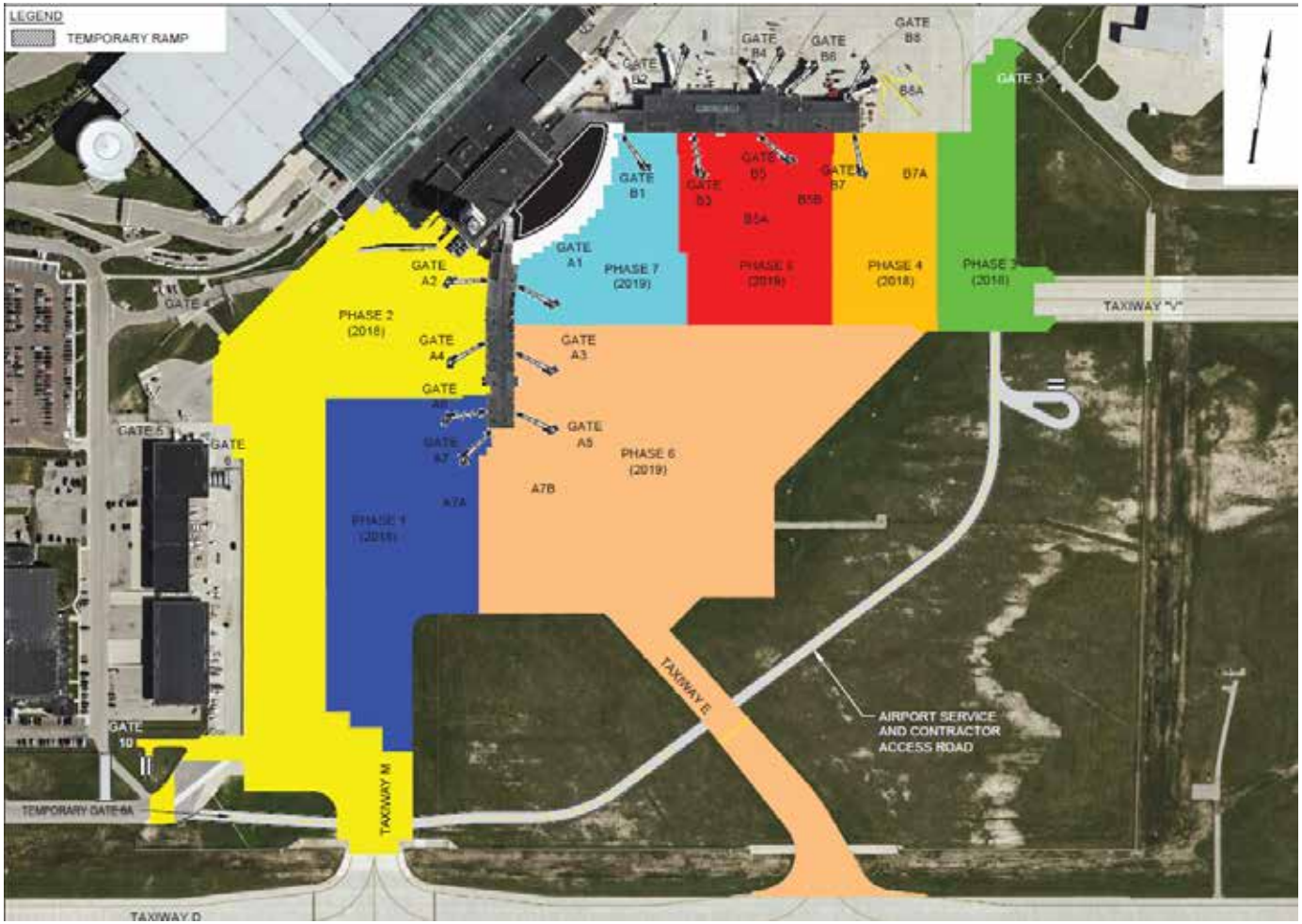
- Q Multi-year construction
- Q Project commitment

## Value in Stakeholder Engagement

- Q Priorities aligned
- Q Grant commitments

Figure 24 (bottom)

# Data Example – Terminal Apron



# Success – Terminal Apron Reconstruction

# USES OF PAVEMENT CONDITION DATA

- Compliance with FAA regulations
- Network-level management
- Strategic-level management
- Project-level assessment
- Maintenance and repair plans
- Troubleshooting and forensics
- Communication to stakeholders

# Compliance with FAA Regulations

- FAA AC 150/5200-18: daily, weekly, monthly, and quarterly to identify safety hazards
- FAA AC 150/5380-7B: annual condition survey or triennial PCI survey
- FAA AC 150/5320-12C or 12D (draft): friction measurements depending on operations
- FAA AC 150/5335-5C: Pavement Classification Number (PCN) reporting

# Network-Level Management

- High-level monitoring of overall conditions
- Based on sampling rather than 100% inspection
- Uses:
  - Document pavement performance
  - Set priorities
  - Predict future conditions and needs

# Strategic-Level Management

- Augments network-level management
- Often iterative process
- Components:
  - Budget scenarios
  - Long-term planning
- Stakeholder input considered

# Maintenance and Repair

## Maintenance

- Determine needs
- Condition data used to match distress types and repair quantities

## Repair

- Design based on distress and structural capacity

# Kyle Wanner, Executive Director
# North Dakota Aeronautics Commission

- University of North Dakota Aerospace & Business School Graduate
- Private Pilot License
- Airport Planning Experience
- Airport Inspection Experience
- State Director for 6 years
- Experience leading 3 statewide PCI Study update efforts

# North Dakota Aeronautics Commission

- Airport Infrastructure Grant Funding
- Airport Planning Support
- Aviation Education Promotion and Funding
- Update Aviation Publications and Planning Documents
- Regulatory Functions to include:
- Aircraft Registrations
- Aerial Applicator Licensing
- Aircraft Dealers
- Aircraft Excise and Fuel Tax
- Represent ND in aeronautical matters before other state and federal agencies
- Update State Aviation Publications, Planning Documents, and **Statewide Studies**

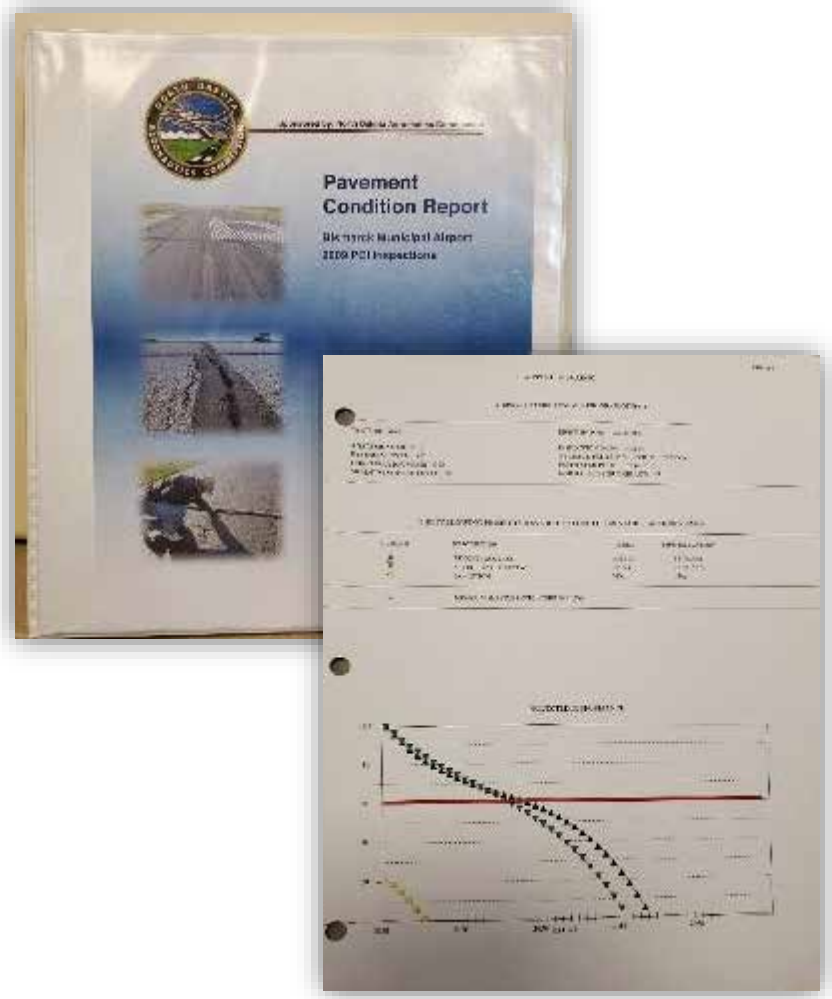
# North Dakota's Airport System

- 89 Public-Use Airports in North Dakota
- 54 NPIAS paved Airports
- 19 Non-NPIAS paved Airports
- 72 paved primary runways
- 9 paved crosswind runways
  - 65 miles of paved runway surfaces


- 57 million $ft^2$ of total pavement to maintain

# North Dakota Pavement Data Collection History

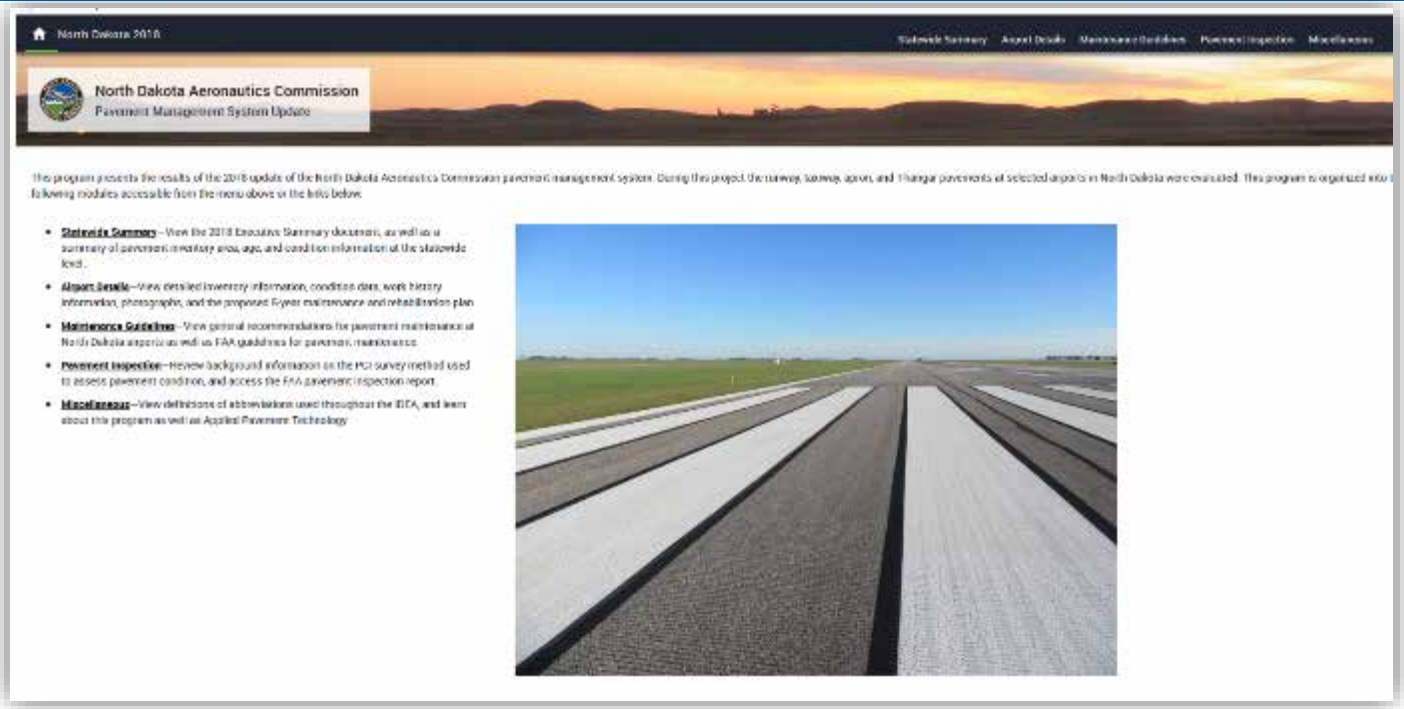
- North Dakota saw value in collecting pavement condition data in the 1980s
- Began on a 3-year rotation which continues today
- Paper reports provided to airports until 2012
- Innovation & Technology led to pavement information transforming into an online interactive data portal



# Project Management

- Request for qualifications
- Identify selection team
- Scope development
- Contract negotiations
- FAA Grant Application
- Determine inspection schedule & trips
  - 7 trips planned for 72 airport inspections
- Coordinate with Airports

# North Dakota's Pavement Management System

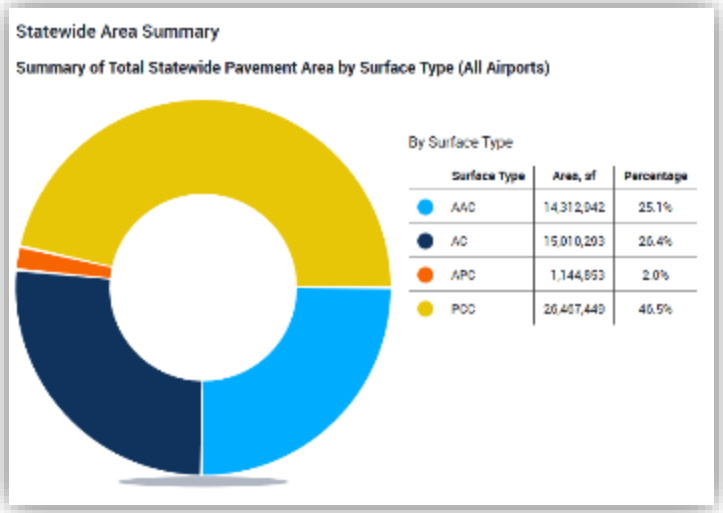


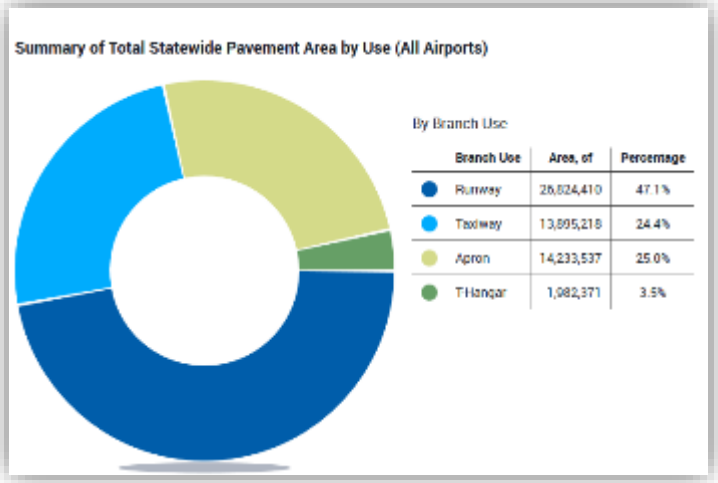

## Benefits of online pavement management system:

- Interactive
- Portable
- Transparent
- Clearer Picture
- Time Savings
- System Management

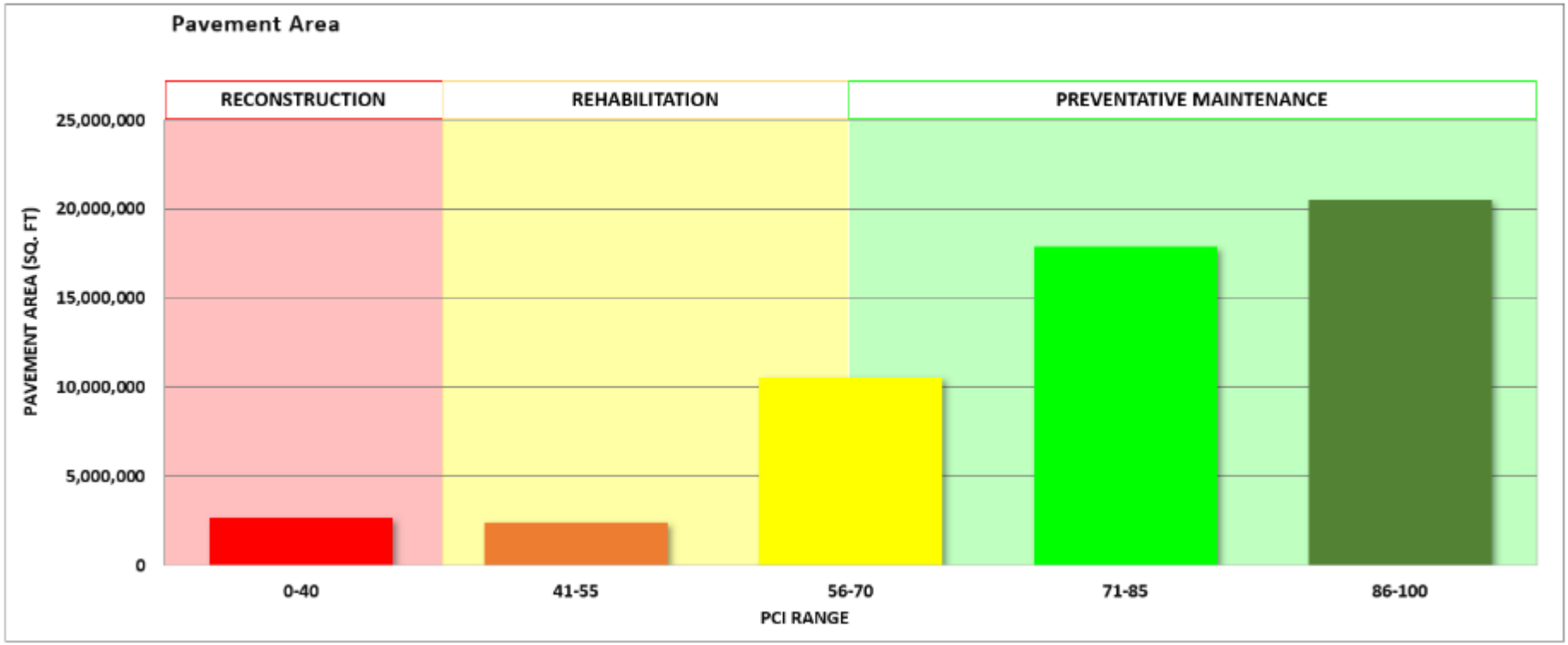
# Statewide & Individual Airport Summary Information

- Q Inventory Area
- Q Inventory Age
- Q Condition Summary
- Q Needs Analysis
- Q Executive Summary

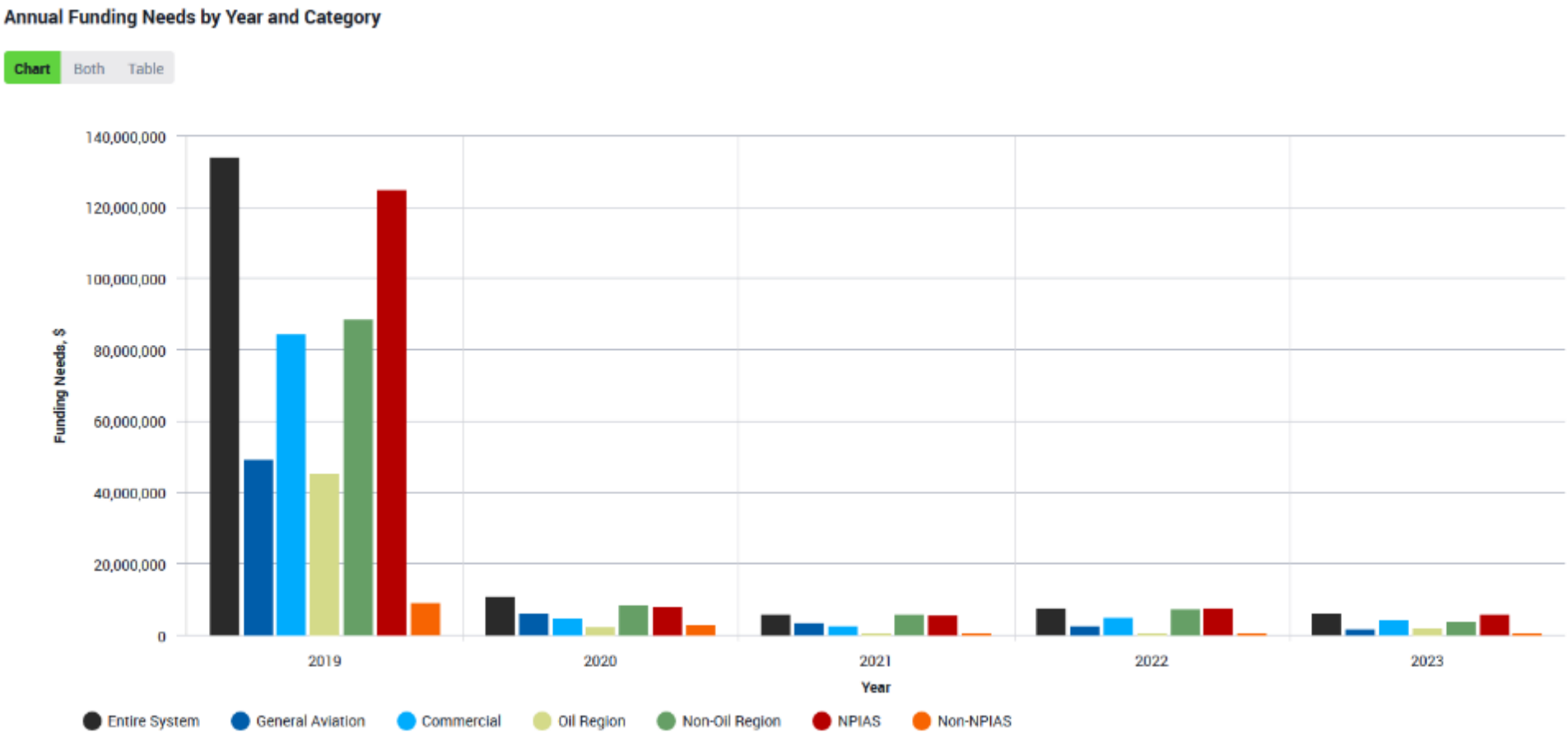


# Statewide Summary Information



# Statewide Needs Analysis



# Airport Individual Details

North Dakota 2018

Statewide Summary | Airport Details | Maintenance Guidelines | Pavement Inspection | Miscellaneous

DATA VIEW

Network | Branch | Section

OBJECT SELECTION

Network: bismarck

Branch

Section

BISMARCK MUNICIPAL AIRPORT

DISPLAY VIEW: Map | Split | Data

MAP TYPE: PCI

TIMELINE: 2018

Inspected Data (2018)

TIMELINE

INSPECTED: 2009, 2017, 2015, 2018

PREDICTED: 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028

Map Labels | Aerial Imagery | Photos

LEGEND: 100 - 86 | 85 - 71 | 70 - 56 | 55 - 41 | 40 - 0

Network / Branch / Section

Inventory | Inspection | Photos | Condition | Recommended Work | Documents | Summary Charts

PCN Information

Distress Data | Inspection Comments

## Distress Data

Export to print

| Branch ID | Section ID | Inspection Date | Distress (Severity) | Extrapolated Quantity | Units |
|---|---|---|---|---|---|
| AGA-BK | 10 | 10/21/2018 | No distresses found | | |
| AGA-BK | 20 | 10/21/2018 | Longitudinal and Transverse Cracking (Low) | 6 | ft |
| AGA-BK | 30 | 10/21/2018 | Weathering (Low) | 3,040 | sf |
| AGA-BK | 35 | 10/21/2018 | Corner Break (Low) | 8 | slabs |
| AGA-BK | 35 | 10/21/2018 | Corner Spalling (Medium) | 8 | slabs |
| AGA-BK | 35 | 10/21/2018 | Joint Sealant Damage (Low) | 1,251 | slabs |
| AGA-BK | 35 | 10/21/2018 | LTD Cracking (Low) | 8 | slabs |
| AGA-BK | 40 | 10/21/2018 | Corner Break (Low) | 6 | slabs |
| AGA-BK | 40 | 10/21/2018 | Corner Break (Medium) | 2 | slabs |
| AGA-BK | 40 | 10/21/2018 | Joint Sealant Damage (Low) | 256 | slabs |
| AGA-BK | 40 | 10/21/2018 | Joint Spalling (Low) | 4 | slabs |
| AGA-BK | 40 | 10/21/2018 | Joint Spalling (Medium) | 2 | slabs |
| AGA-BK | 40 | 10/21/2018 | LTD Cracking (Low) | 24 | slabs |
| AGA-BK | 40 | 10/21/2018 | Popouts (N/A) | 55 | slabs |
| AGA-BK | 50 | 10/21/2018 | Joint Sealant Damage (Low) | 164 | slabs |
| AGA-BK | 50 | 10/21/2018 | LTD Cracking (Low) | 3 | slabs |
| AGA-BK | 50 | 10/21/2018 | Popouts (N/A) | 8 | slabs |

# Pavement History Reporting

**AIRPORT PAVEMENT HISTORY UPDATE**
NORTH DAKOTA AERONAUTICS COMMISSION
STN 60260 (12-2012)

Number

INSTRUCTIONS: Please complete and submit this document for all completed pavement maintenance and construction projects that occurred at a North Dakota public airport.

| Airport Name | Engineering Firm |
|---|---|
| Contact Person | Telephone Number |

**Complete this section for History of Pavement Maintenance**

Provide the following information for all new pavement maintenance:

| Project Name | Date Construction Completed |
|---|---|

Briefly Describe the Maintenance Performed

Location (check all that apply): ☐ Runway ☐ Taxiway ☐ Apron

Pavement Type: ☐ Asphalt ☐ Portland Cement Concrete

Type of Maintenance: ☐ Crack/Joint Repair ☐ Patching ☐ Mill and Overlay ☐ Surface Treatment

**Complete this section for History of New Pavement Construction**

Provide the following information for any new pavement construction, removals, extensions, overlays, or reconstruction

| Project Name | Date Construction Completed |
|---|---|

Briefly Describe Changes in Pavement Structures

Drainage System Installed: ☐ No ☐ Yes - Specify which system: ☐ Edge Drain ☐ Under Drain System

**Provide AutoCAD drawing files of the following (See attached pages for CAD Drawing examples):**

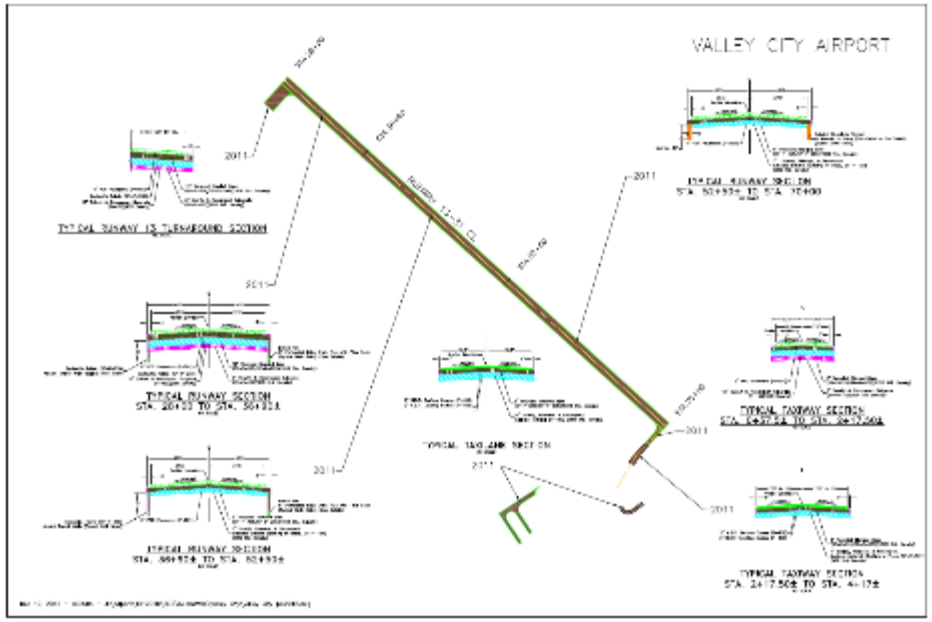
For new pavements:

- ☐ Centerline of each runway must be shown and labeled on the CAD File
- ☐ Pavement layout(s)
- ☐ Pavement section detail(s) with each layer thickness identified
- ☐ Joint Layout Information on all PCC Pavements
- ☐ Any other pertinent details for new pavements

For pavement maintenance

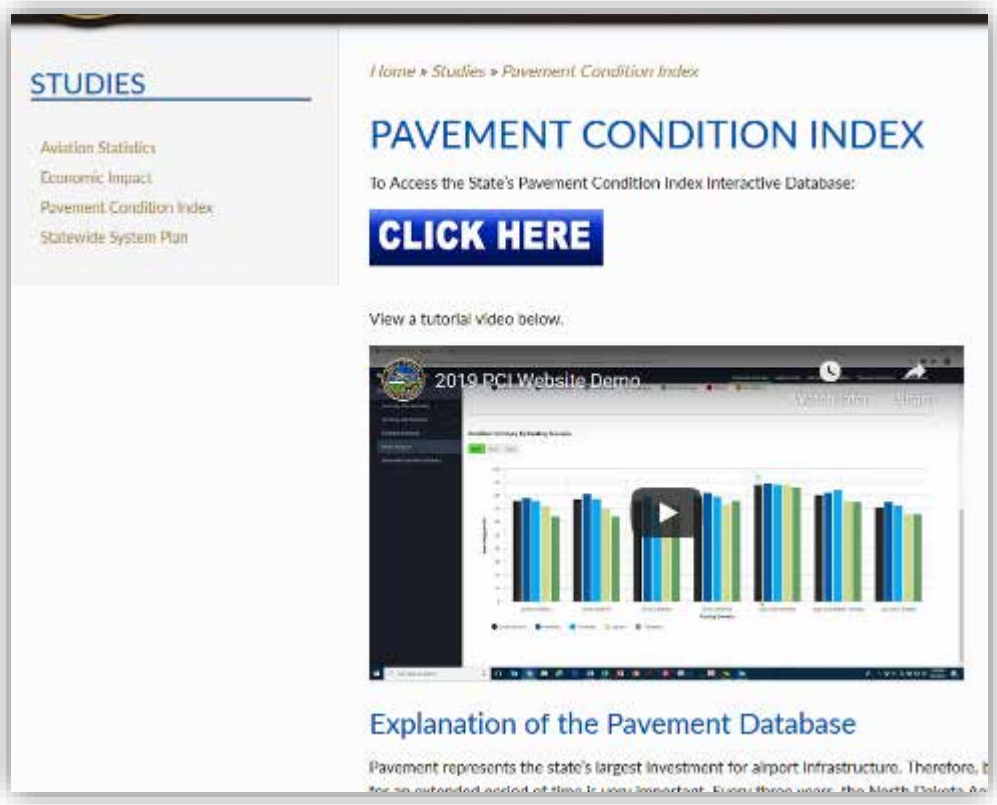
- ☐ Areas maintained with description of what type of maintenance was performed
- ☐ Details of work performed
- ☐ Patching

| Signature of Airport Authorized Representative or Airport's Designated Engineer | Date |
|---|---|

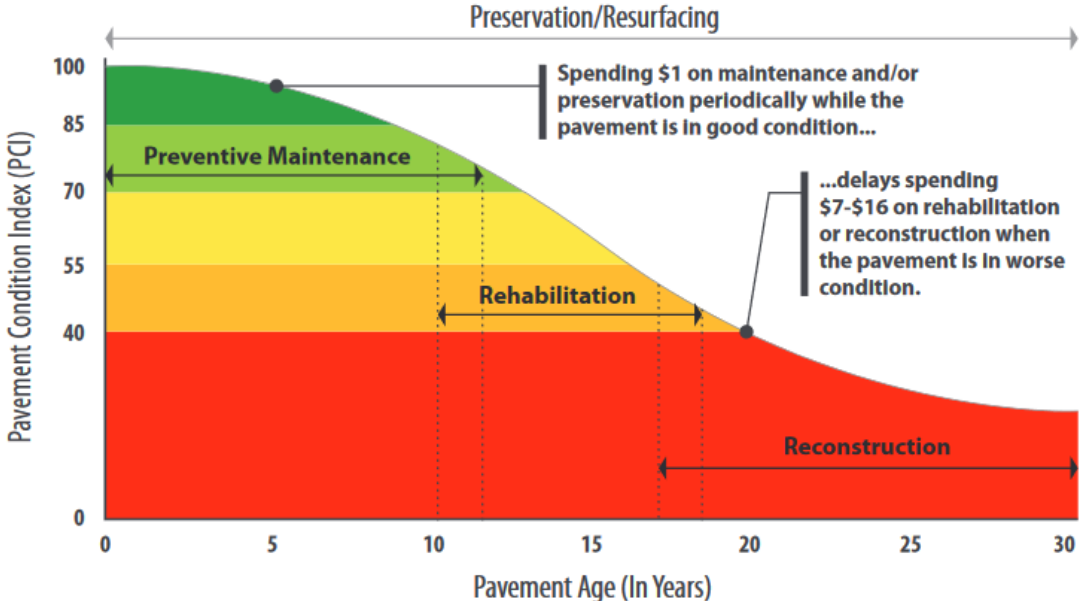


# Training

- Face-to-Face during initial roll-out
- Online training materials available for each update
  - Distress information
  - Causes of distress
  - Maintenance recommendations for distress types



# North Dakota Prioritizes Preventive Maintenance




- Q Preventive Maintenance receives high funding priority for state funds
- Q Airports are trained and encouraged to maintain a good pavement maintenance programs

# Benefits of Pavement Management System

- Prioritize Projects
  - Statewide and individual airport CIP
- Justify Funding Requests
  - Federal, State, and Local
- Complement to other Statewide Studies
- Historical Data
- Future Projections
- Cost Savings
- Enhances Safety
- Enhances Value & Meaning of PCI value

Citation Jet collapsing on overloaded pavement

# Improving the North Dakota Airport System

| Funding Scenario | Area-Weighted PCI | | | | |
|---|---|---|---|---|---|
| | Entire System | Runways | Taxiways | Aprons | T-Hangars |
| 2009 Condition | 76 | 78 | 76 | 72 | 64 |
| 2012 Condition | 77 | 81 | 77 | 70 | 64 |
| 2015 Condition | 76 | 79 | 73 | 72 | 72 |
| 2018 Condition | 79 | 82 | 79 | 73 | 76 |
| 2023 Overall Needs | 88 | 89 | 88 | 88 | 86 |
| 2023 Anticipated Funding | 80 | 82 | 84 | 76 | 75 |
| 2023 No Funding | 71 | 75 | 72 | 66 | 66 |

# Troubleshooting and Forensics

- Addresses specific problem(s)
- Considers several aspects of observed distresses
- Used to link distresses and their causes to propose solutions
- May be most detailed evaluation

# Communication with Stakeholders

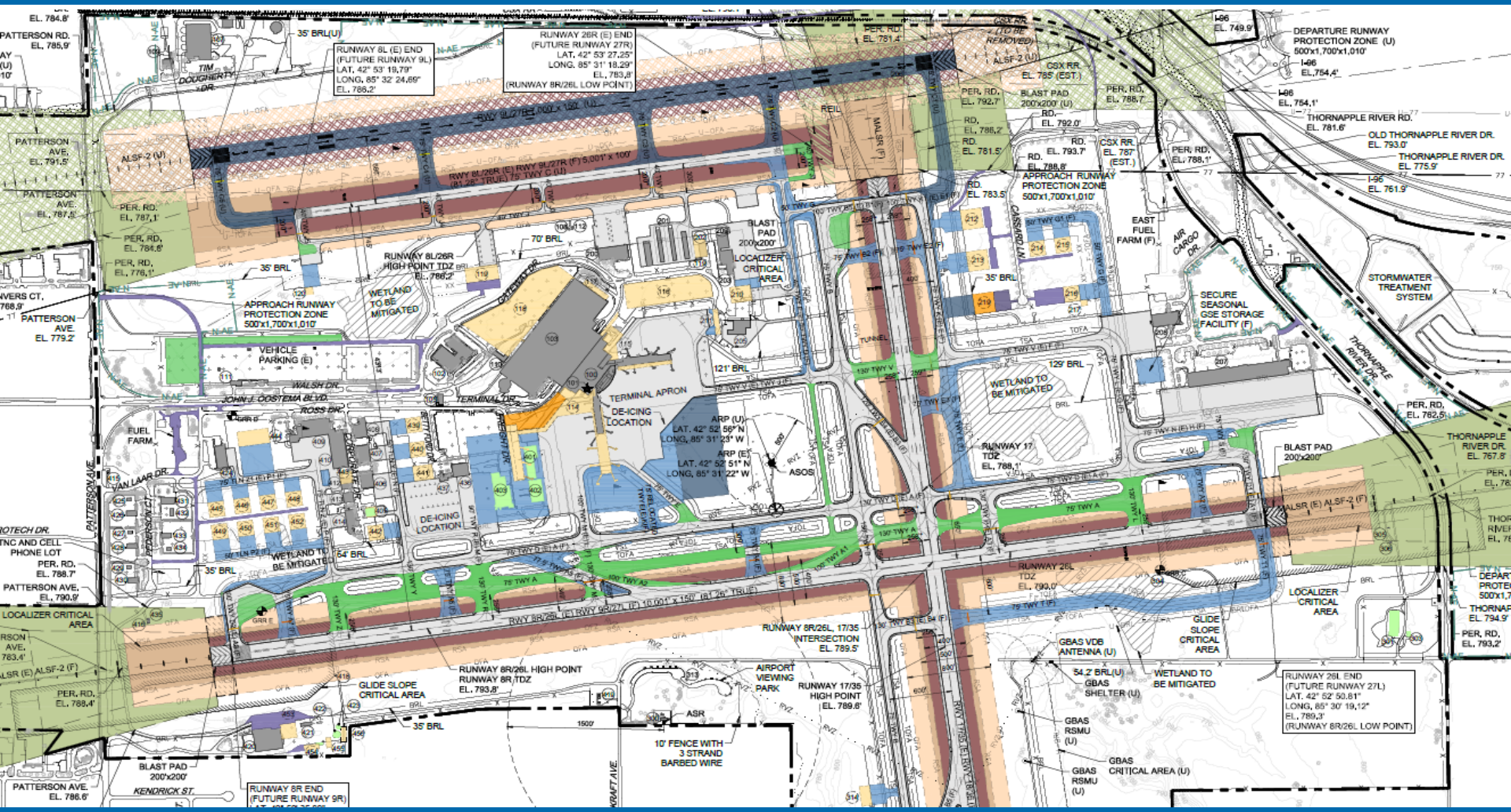
- Explain current conditions
- Support project or funding requests
- Impact of actions or inaction

# Communication with Stakeholders

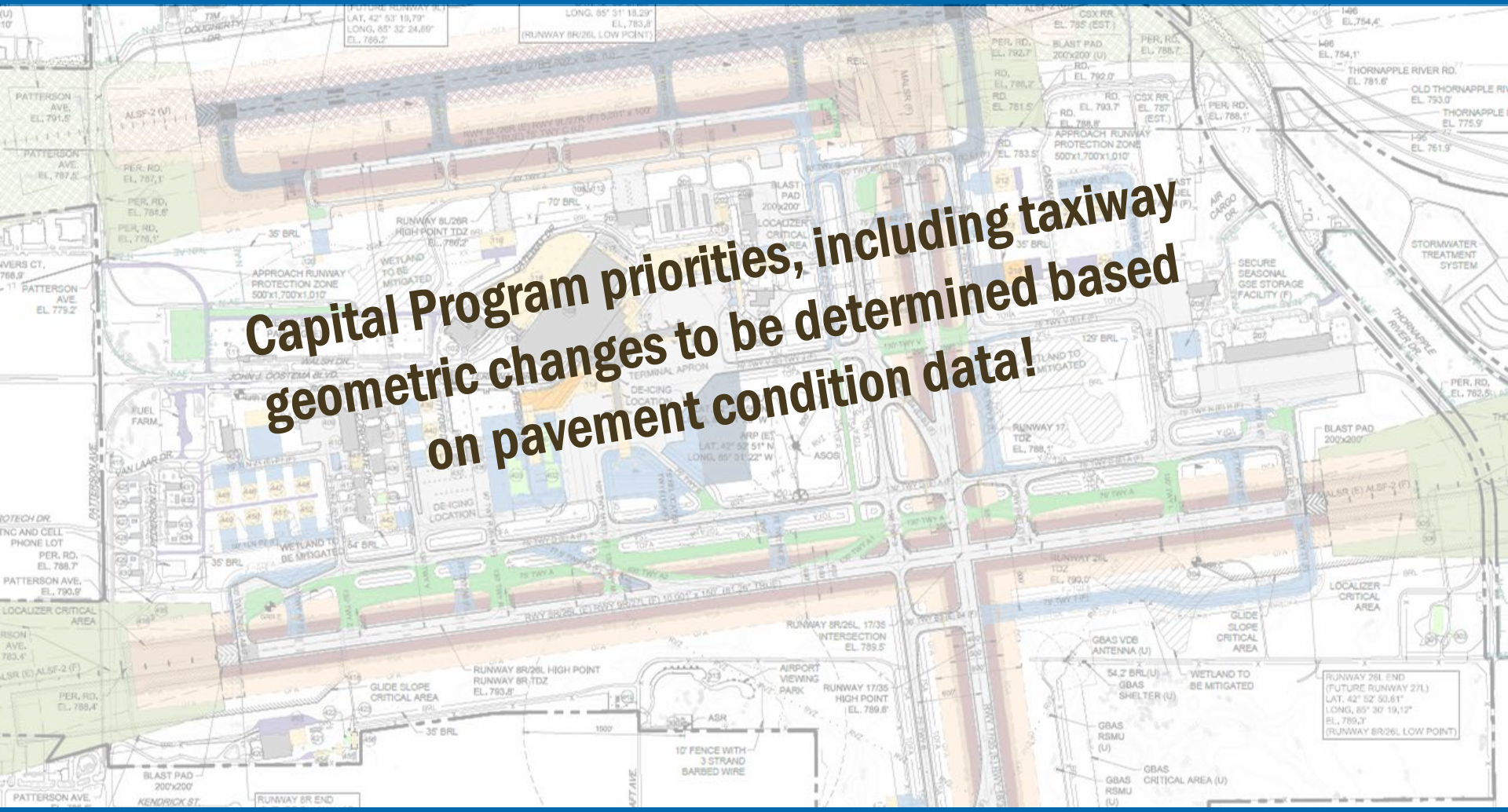
## Pavement Capital Planning

- Q Airport Operations
- Q Airport Maintenance
- Q Airport Engineering
- Q Airport Leadership
- Q Airport Board
- Q State Aeronautics Partners
- Q FAA ADO

# GRR Example – Current Geometric Design



# GRR Example – Current Geometric Design



# Value in Stakeholder Communication

- Continued Engagement
  - Success in tenant and departmental engagement
  - Discussions and input early and often
- Airlines
  - Data collection and maintenance / capital impacts
  - Staff changes – maintain cohesive management group
- Airport
  - Multiple projects
  - Maintenance paired with capital projects

# DATA STORAGE, MAINTENANCE, AND ACCESS

- Data types
- Staff level and experience
- Ability to access and use data
- Airport size

# Typical File Sizes of Different Data Types[1]

| File Type | Description | Typical File Size |
|---|---|---|
| PAVER | Pavement management data, including PCI condition data, historical data, models, treatments | 10 MB |
| FWD Deflection Data Network Project | Pavement response to impulse loading, providing measure of pavement structural integrity | 45 MB |
| LiDAR | Point cloud of data | 128 GB |
| Profile | Transverse (rutting) and longitudinal (roughness) profile data | 12 MB |
| 3-dimensional laser image | Laser imaging of pavement surface | 37 GB |
| Video | Video images of pavement and right-of-way | 45 GB |

[1] 4,000,000 square feet of pavement used to determine typical file size

# Matching Condition Data Types And Use(s)

- Goal is to collect appropriate data that will be used effectively by airports
- Date use controls which collection methods are implemented
- Decision trees provide guidance to match condition data types and use(s)

# Decision Tree Categories

- Organized by purpose (use), airport size, and user
- Data use categories:
  - FAA compliance
  - Airport or agency management
  - Engineering or other technical departments
  - Other data uses

# Decision Tree Steps (1 of 2)

- Decide how the data will be used
- Based on the decision trees, select the possible data collection methods
- Record the total occurrences for each data collection method

# Decision Trees Steps (2 of 2)

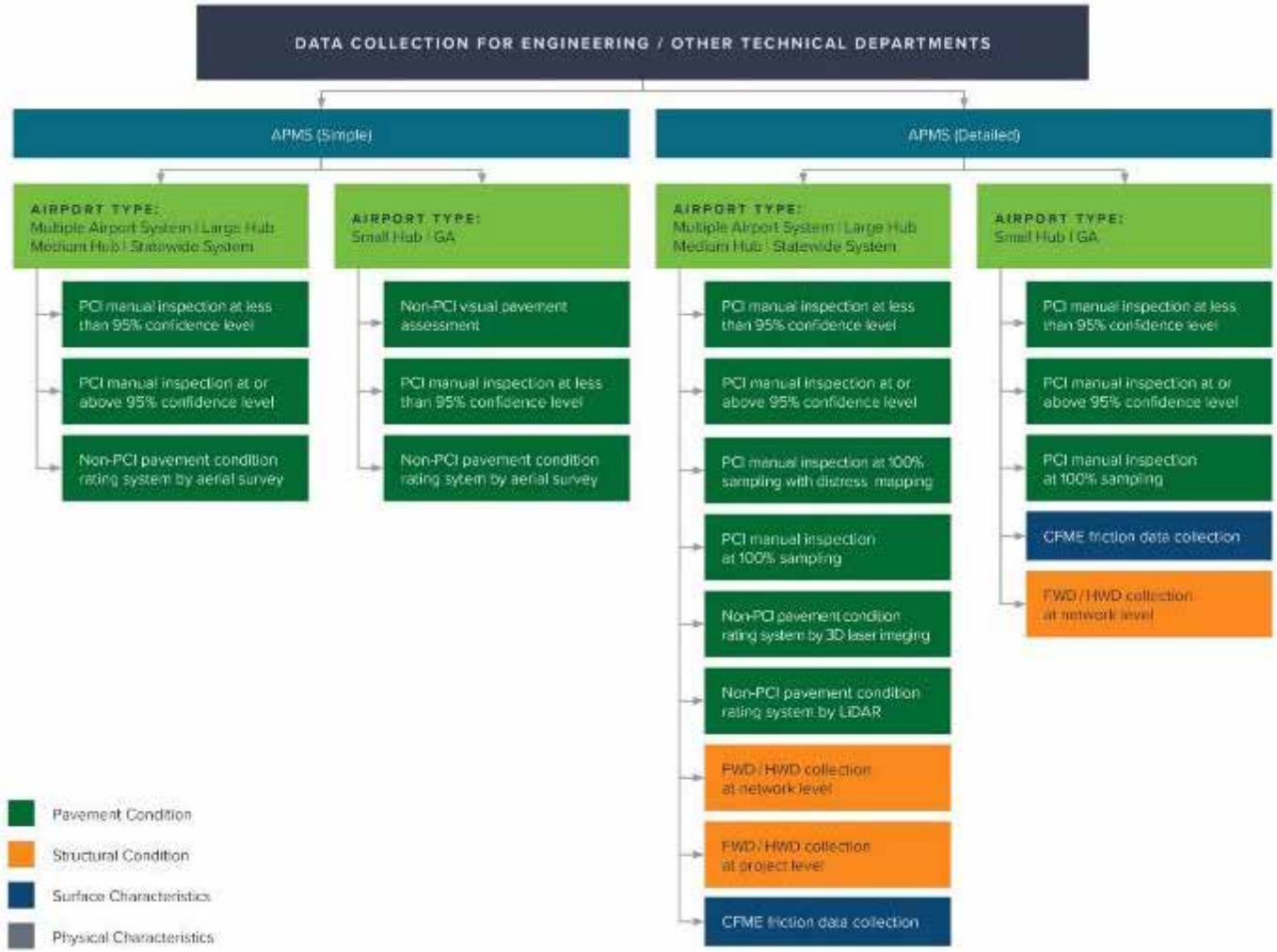
Evaluate the most common available data collection methods

- Q Will most common data collection methods meet all the specific uses?
- Q Will combination of data collection methods be required?
- Q Identify other factors impacting data collection and use
- Q Estimate the cost for data collection and value of associated condition data

# Decision Tree – FAA Compliance

# Decision Tree – Management

# Decision Tree – Engineering (APMS)



# MOVING FORWARD

- Practices associated with airfield pavement condition data collection and use have been relatively stable for years
- Today the situation is fluid, with the need for changes driven by airports and supported by developing technology
- Change is coming

# FOR ADDITIONAL INFORMATION



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## Kyle Wanner

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## NDAC PCI Website:

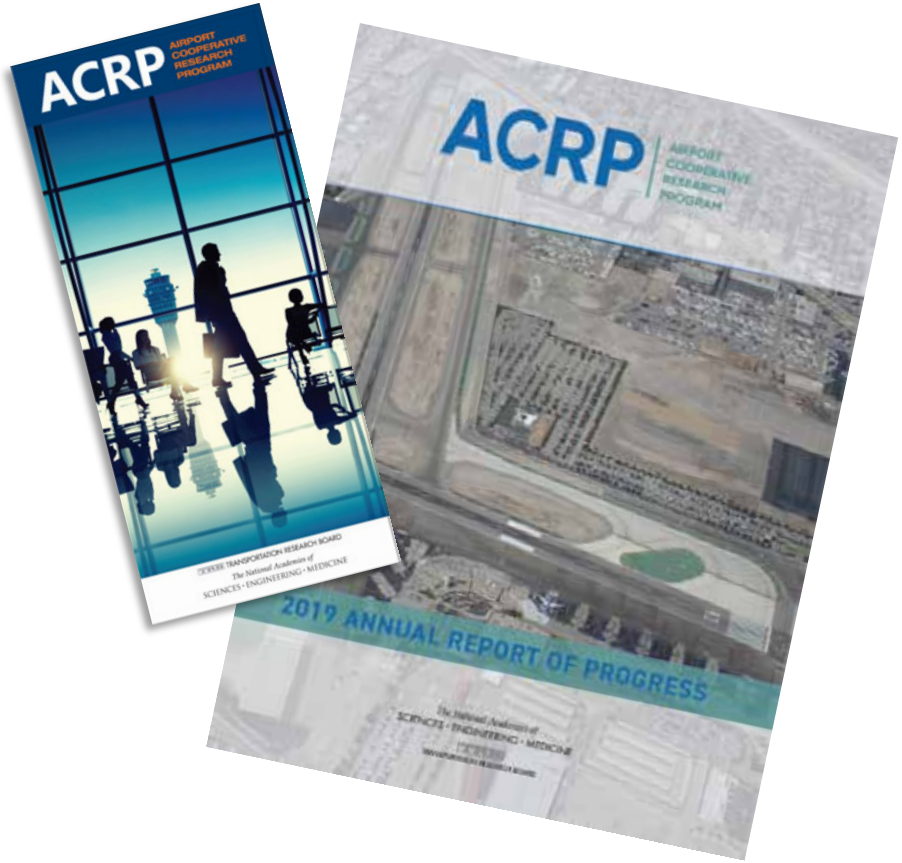
aero.nd.gov/app/pavement/index.html

## ACRP Report 203:

http://www.trb.org/Publications/Blurbs/179612.aspx

# ACRP is an Industry–Driven Program

- Managed by TRB and sponsored by the Federal Aviation Administration (FAA).
- Seeks out the latest issues facing the airport industry.
- Conducts research to find solutions.
- Publishes and disseminates research results through free publications and webinars.



# Other Ways to Participate

ACRP AMBASSADOR

Become an Ambassador. Ambassadors represent ACRP at events and conferences across the country!

ACRP CHAMPION

Sponsor or become an ACRP Champion. The champion program is designed to help early- to mid-career, young professionals grow and excel within the airport industry.

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Report 202: ***Developing Innovative Strategies for Aviation Education and Participation***

Report 214: ***Building Information Management (BIM) Beyond Design Guidebook***

Synthesis 108: ***Characteristics of the FBO Industry 2018-2019***

Web-Only Document 46: ***Recovering International Recyclables from In-Flight Service***

Web-Only Document 47: ***Commercial Space Operations Noise and Sonic Boom Measurements***

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# Upcoming ACRP Webinars

## August 6
## Reach for the Sky – Attracting the NextGen of Aviation Career Professionals

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**#TRBwebinar**

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@NASEMTRB
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*Getting involved is free!*

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– Networking opportunities
– May provide a path to Standing Committee membership

**Join a Standing Committee** bit.ly/TRBstandingcommittee

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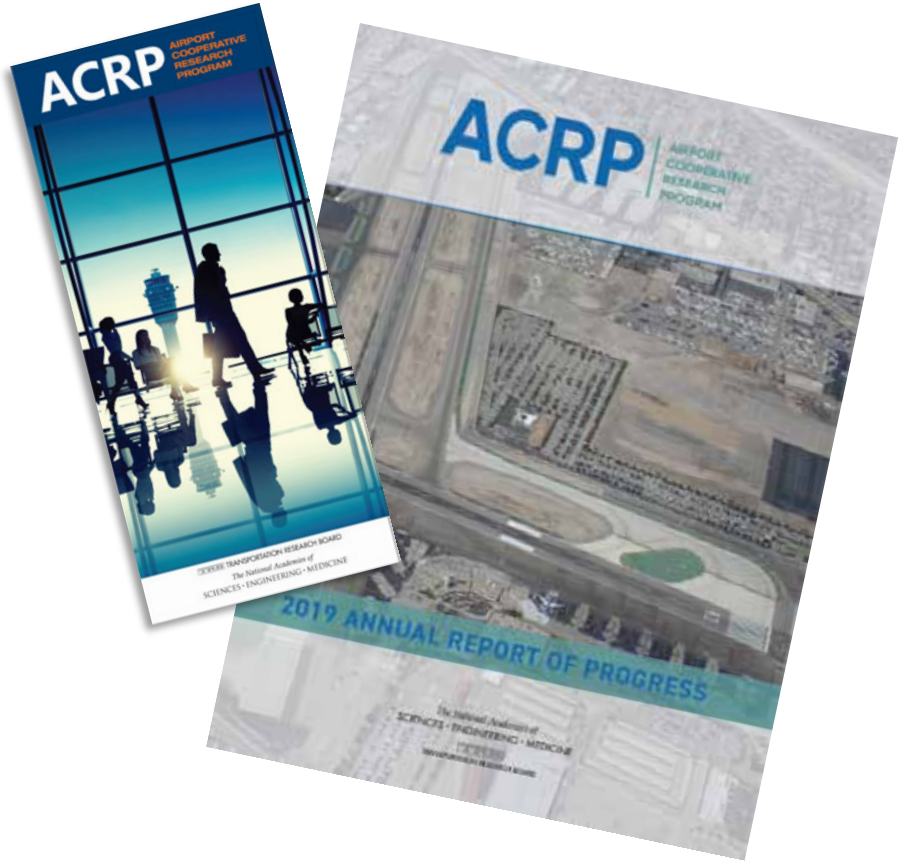

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