Stantec

REGIONAL AIRPORT INFRASTRUCTURE AUDIT

SWIFT

VANCOUVER SEPT 17–19 2024

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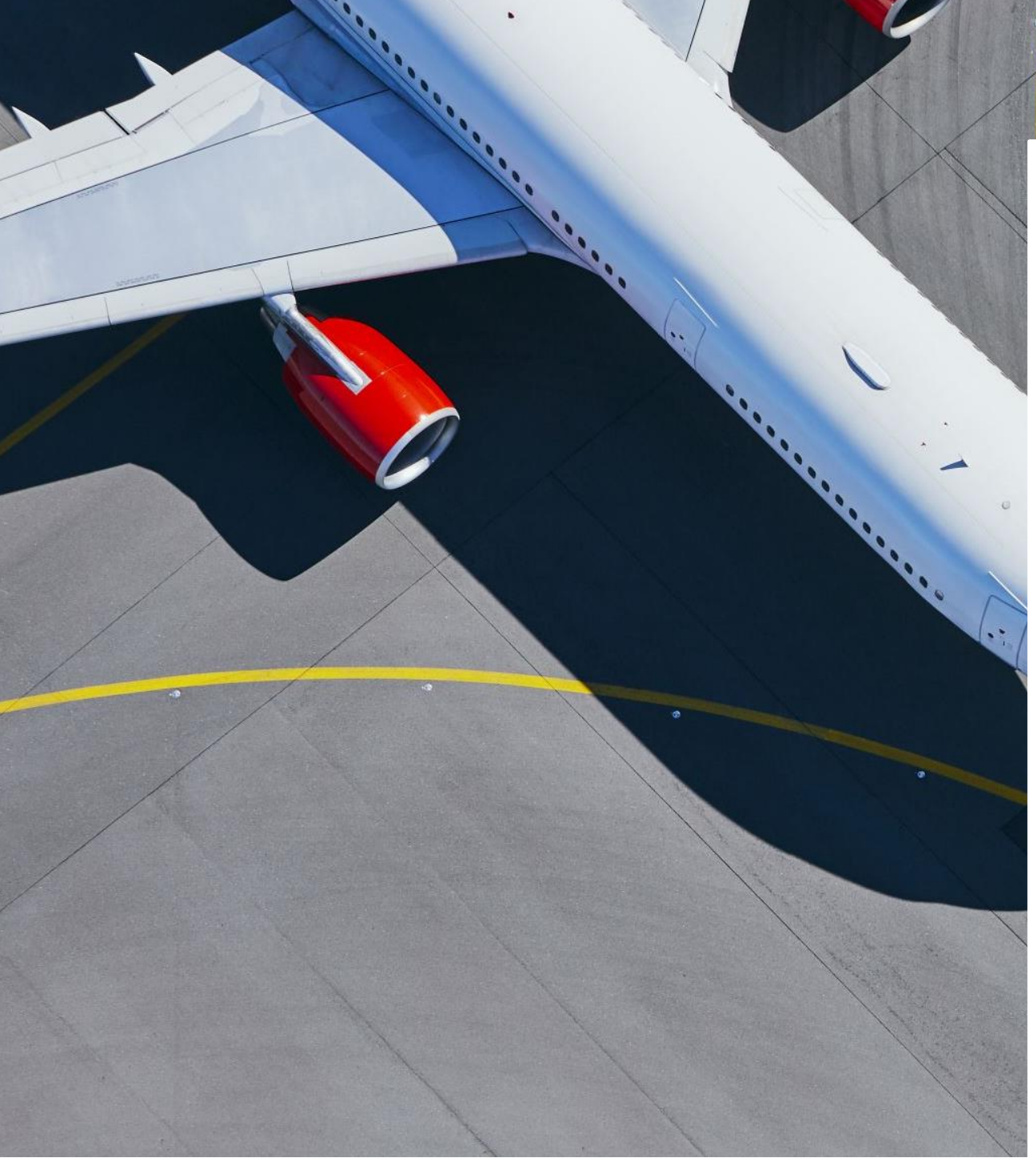
Purpose

The purpose of the presentation is to demonstrate the asset audit **process** at small regional airports and the **benefits** it can bring regardless of the **size** of commercial operations.

We will start by outlining the **entirety** of the scope of an asset audit, and later focus on the **pavement** asset.



Agenda

1. Asset Audit Scope
   - State of good repair
   - Types of recommendations
   - Opinions of Cost and Planning

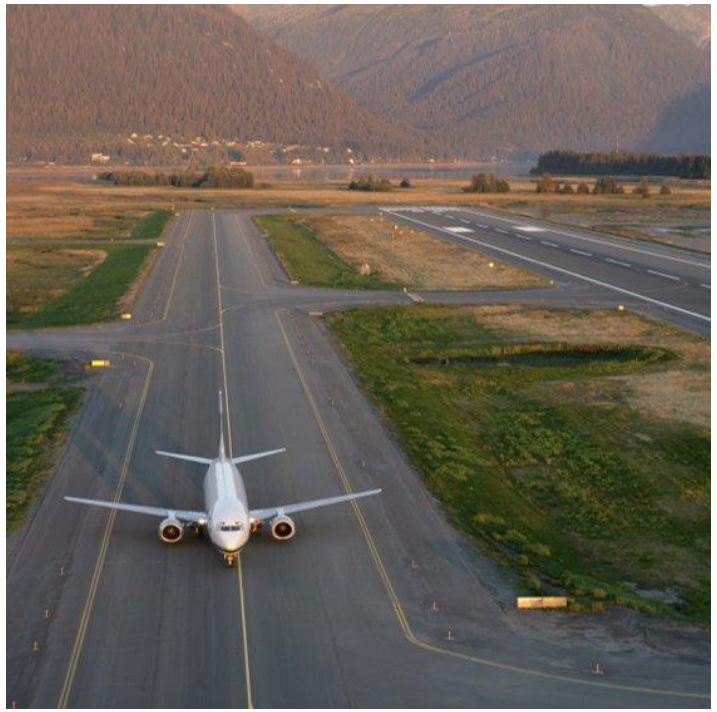
2. Pavement Audit
   - Pavement condition assessment
   - Visual Pavement Condition Survey
   - Data analysis using PAVER
   - State of good repair
   - Replacement value
   - Long Term Work Program

3. Conclusions

Asset Audit Scope

A Tangible Asset Audit **can include**:

- Buildings and IT systems
- Utilities
  - Airside & landside electrical systems
  - Sewer, stormwater and water networks
- Airside and landside pavements
- ARFF trucks
- Airport maintenance equipment



Asset Audit Scope

1. Reviewed **documentation**
2. Interviews
3. Visual "**walk-through**" assessment (interior and exterior)
4. Identified and **financially quantified**:
   - Local deficiencies
   - Components that have or will soon achieve their EUL
5. Provided corresponding order-of-magnitude **costs for work**

State of Good Repair

Summary of the audit findings results

- Review **existing condition**
  - Attend to pre-requisites of use?

- Assess **maintenance** practices
  - Maintenance frequency?
  - Proper maintenance practices?

Types of recommendations

- Identified systems or components to be **repaired or replaced**

Immediate-Term → Short-Term → Long-Term

EXAMPLE:

➢ Airport Terminal Building Short-Term Recommendations

ATB Short-Term Recommendations
Conduct study to determine the cause of water infiltration into the basement of the building. The study should provide repair options and associated construction costs.
Repair/replacement of damaged exterior composite panels on the perimeter of the building.
Conduct painting of stair and handrails.
Conduct renewal of painted concrete finishes.
Conduct replacement of carpet in offices and Passenger hold area.
Conduct cleaning of exterior trench drain and related piping on the north side of the building.

Opinions of Cost and Planning

- Accounts for the **current** and **lifecycle** repair/replacement expenditures over the next years

EXAMPLE:

➢ Airport Terminal Building Expenditure Costs Summary

Term	Total Opinion of Cost ($)*
Immediate-Term (Year 0)	-
Short-Term (Year 1)	100,000
Mid-Term (Years 2 to 5)	800,000
Long-Term (Years 6 to 10)	1,000,000
Total Cost	1,900,000

*hypothetical cost numbers

Opinions of Cost and Planning

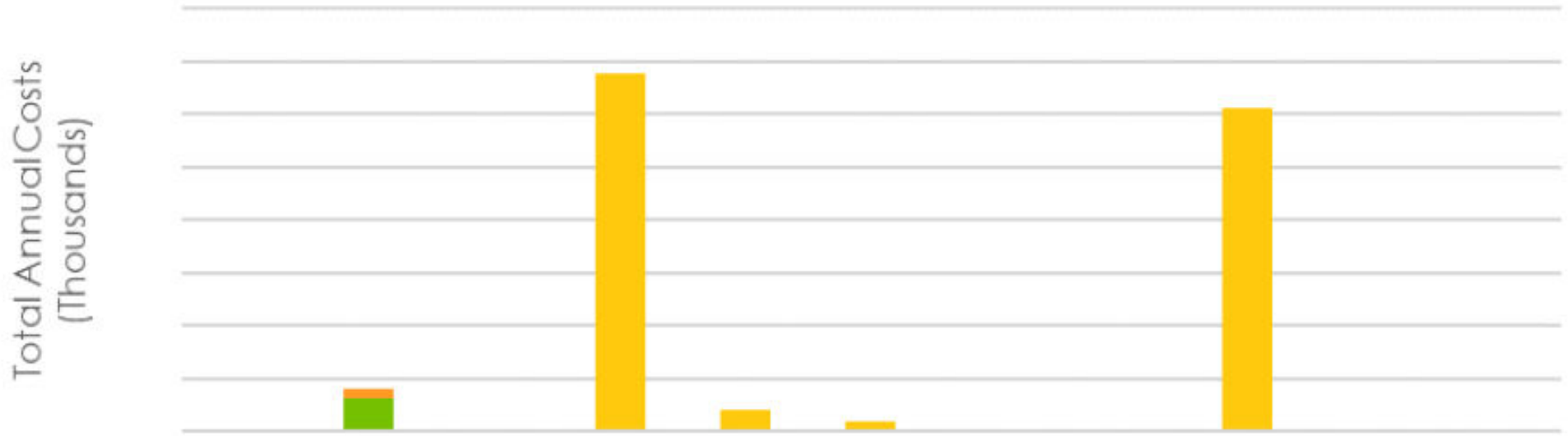
- Priority Rating System

  Describes the **urgency** of the recommended actions (repair/replacement)

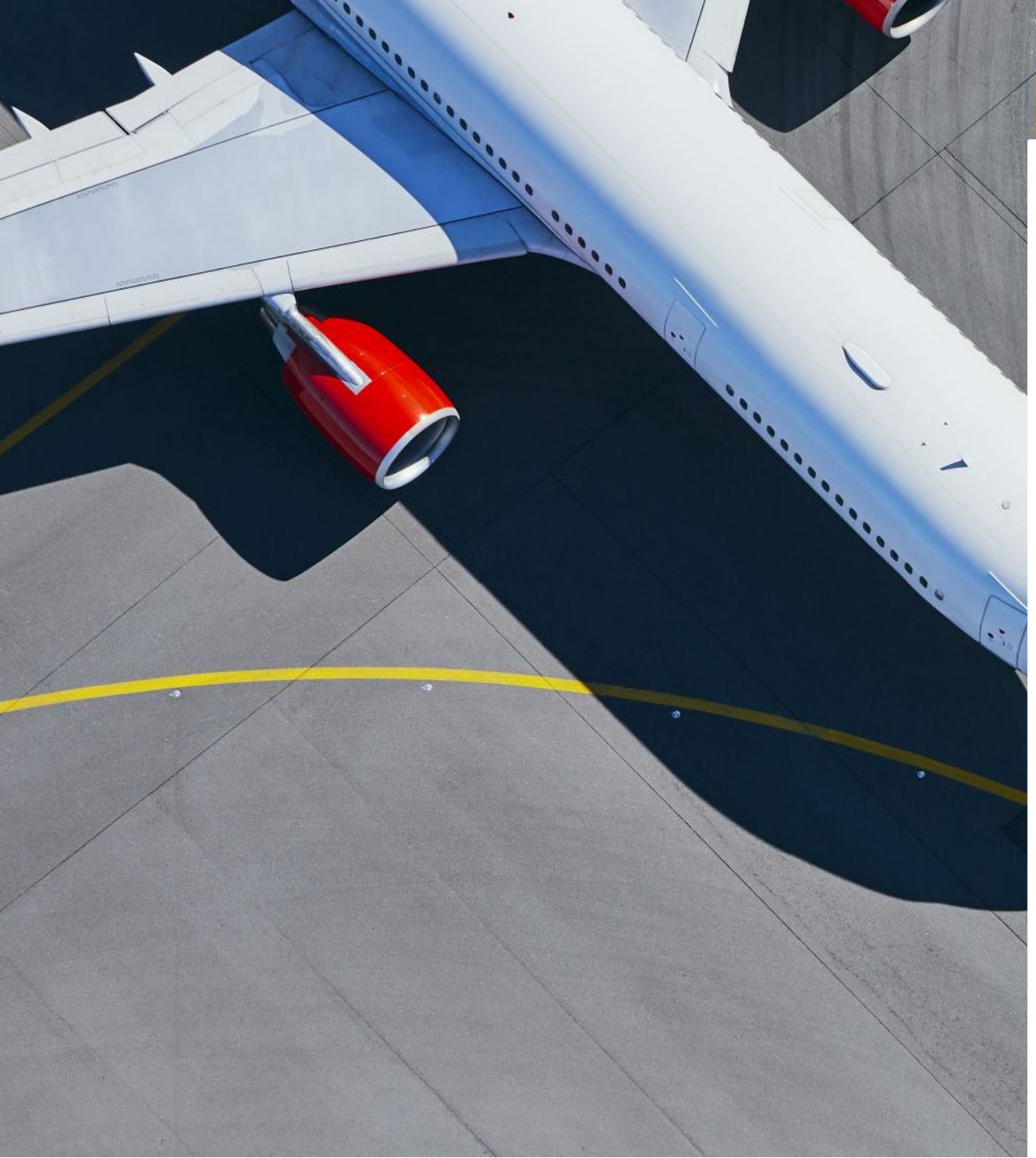
1	2	3	4	5
Currently Critical	**Potentially Critical**	**Necessary – Not Yet Critical**	**Recommended**	**N/A**
Require prompt action to prevent injury (within 90 days)	Action required within the short term (1 year of the evaluation)	Action recommended within the next 2 to 5 years	Action recommended within the next 6 to 10 years	Does not require any action

Opinions of Cost and Planning

- Annual Cost of Airport Terminal Building Separated by Priority Rating



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Currently Critical	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-
Potentially Critical	$-		$-	$-	$-	$-	$-	$-	$-	$-	$-
Necessary - Not Yet Critical	$-	$-	$-				$-	$-		$-	$-
Recommended	$-		$-	$-	$-	$-	$-	$-	$-	$-	$-



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   - Pavement condition assessment
   - Data analysis using PAVER
   - State of good repair
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Pavement Condition Assessment

Visual Pavement Condition Survey

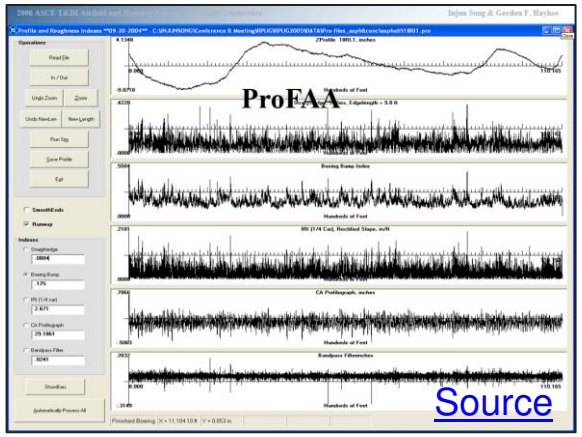
Non-Destructive Pavement Evaluation

Destructive Pavement Evaluation

Airport Pavement Management

Pavement Condition Assessment

- Non-Destructive Pavement Evaluation
  - Functional
    - Roughness
    - Skid Resistance
  - Structural
    - Falling/Heavy Weight Deflectometer (F/HWD)
    - Air-coupled Ground Penetrating Radar (GPR)



Source

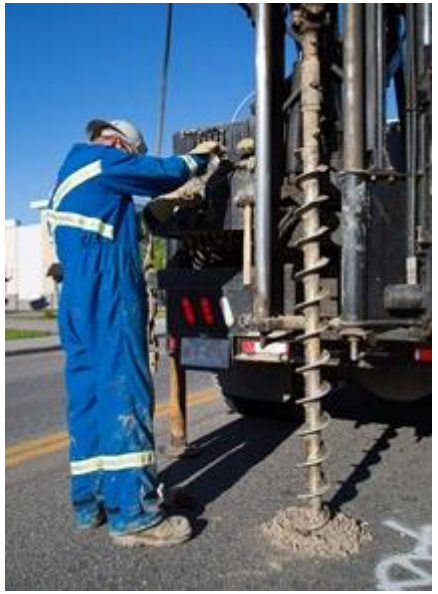

Source

Airport Pavement Management

Pavement Condition Assessment

Destructive Pavement Evaluation

- Coring
- Augering
- Shelby Tube
- Trenching



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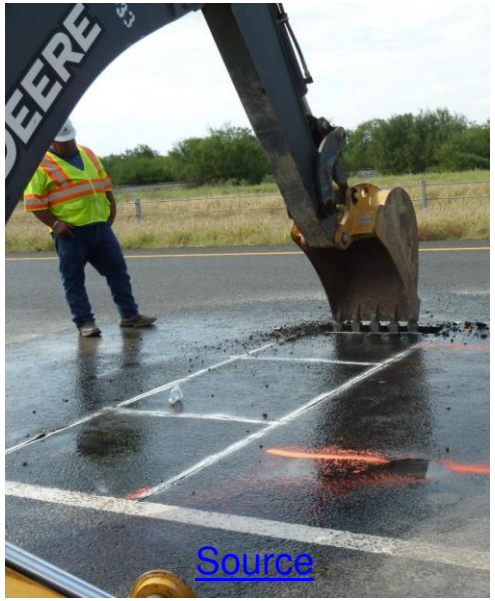


Source

Visual Pavement Condition Survey

- Divide Pavement Sections by **Branch Use**

Branches are further subdivided into sections. Contiguous areas with **uniform construction, maintenance, usage, and history**.

Branch Use	Number of Sections
Runway	16
Taxiway	2
Apron	7
Access Road	23
Helipad	5
Parking Lot	21
Total	74

Visual Pavement Condition Survey

Aircraft-serving pavements (i.e., runways, taxiways, aprons)	**ASTM D5340-20**: Standard Test Method for Airport Pavement Condition Index Surveys.
Groundside or non-aircraft serving pavements (i.e., service roads and access roads)	**ASTM D6433-20**: Standard Practice for Roads, and Parking Lots Pavement Condition Index Surveys.

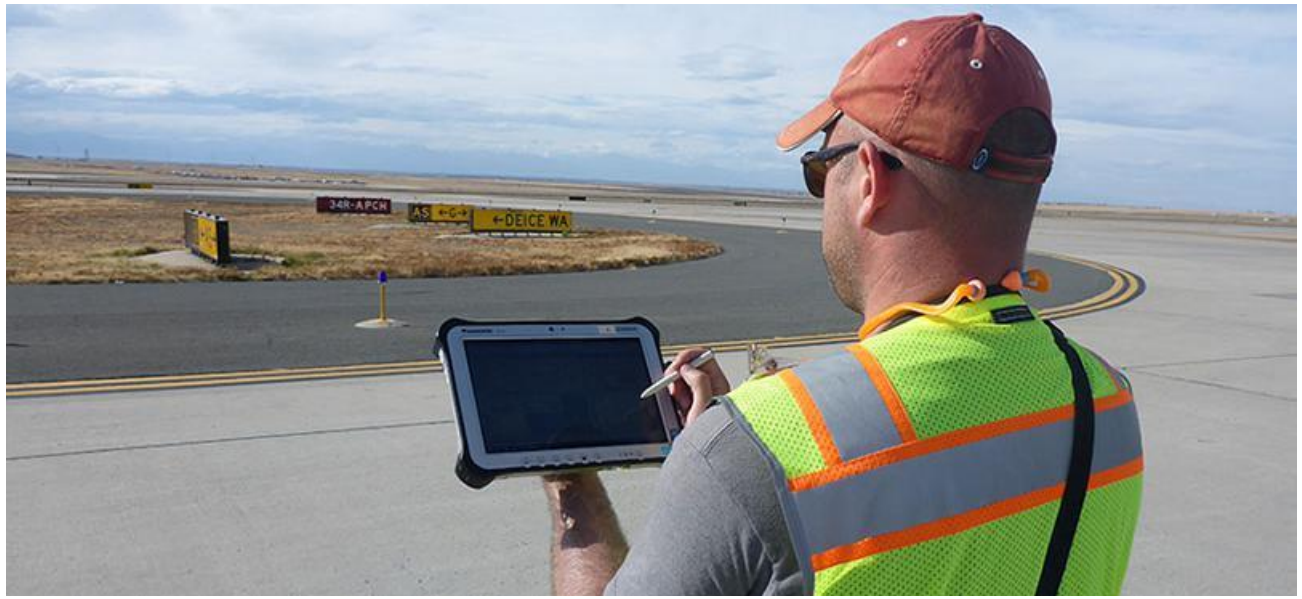
Random **sampling** technique

Visual Pavement Condition Survey

Type
e.g., Transverse Cracking, Rutting, Raveling, etc.

Extent:
How much is there?

Severity:
How bad is it?
Low/ Moderate/ High



Visual Pavement Condition Survey

- ASTM 5340-20 (Aircraft-serving pavements)

Flexible Pavement Distresses		Rigid Pavement Distresses	
1. Alligator Cracking 2. Bleeding 3. Block Cracking 4. Corrugation 5. Depression 6. Jet-Blast Erosion 7. Joint Reflection Cracking 8. Longitudinal & Transverse Cracking	9. Oil Spillage 10. Patching and Utility Cut Patching 11. Polished Aggregate 12. Raveling 13. Rutting 14. Shoving 15. Slippage Cracking 16. Swell 17. Weathering	1. Blowup 2. Corner Break 3. Cracks: Longitudinal, Transverse, and Diagonal 4. Durability “D” Cracking 5. Joint Seal Damage 6. Patching, Small 7. Patching, Large and Utility Cuts 8. Popouts 9. Pumping	10. Scaling 11. Settlement or Faulting 12. Shattered Slab/Intersecting Cracks 13. Shrinkage Cracking 14. Spalling (Longitudinal and Transverse Joint) 15. Spalling (Corner) 16. Alkali Silica Reaction (ASR)

Visual Pavement Condition Survey

- ASTM 6433-20 (Groundside Pavements)

Flexible Pavement Distresses		Rigid Pavement Distresses	
1. Alligator Cracking 2. Bleeding 3. Block Cracking 4. Bumps and Sags 5. Corrugation 6. Depression 7. Edge Cracking 8. Joint Reflection Cracking 9. Lane/Shoulder Drop Off	10. Longitudinal & Transverse Cracking 11. Patching and Utility Cut Patching 12. Polished Aggregate 13. Potholes 14. Railroad Crossing 15. Rutting 16. Shoving 17. Slippage Cracking 18. Swell 19. Weathering/Raveling	1. Blowup/Buckling 2. Corner Break 3. Divided Slab 4. Durability “D” Cracking 5. Faulting 6. Joint Seal Damage 7. Lane/Shoulder Drop-Off 8. Linear Cracking 9. Patching, Large, and Utility Cuts (Large)	10. Patching, Small 11. Polished Aggregate Popouts 12. Pumping Punchout 13. Railroad Crossing 14. Scaling/Map Cracking/Crazing 15. Shrinkage Cracking 16. Spalling, Corner 17. Spalling, Joint

Visual Pavement Condition Survey

Survey Samples

Sample unit:

- Approx. 450 m^2 for asphalt sections
- Approx. 20 contiguous slabs for concrete sections

# Sample Units per Section	# Samples in Survey
1 to 5 sample units	1 sample unit
6 to 10 sample units	2 sample units
11 to 15 sample units	3 sample units
16 to 40 sample units	4 sample units
Over 40 sample units	10%

Visual Pavement Condition Survey

Survey Samples

Visual Pavement Condition Survey

Pavement Condition Index (PCI) - Categories

PCI	Condition	Possible Treatment Category	Potential Life Remaining
86 - 100	Good	Routine Maintenance Activities	12 to 20 years
71 – 85	Satisfactory	Preventive Maintenance Activities	10 to 15 years
56 – 70	Fair	Light Rehabilitation	7 to 10 years
41 – 55	Poor	Heavy Rehabilitation	3 to 7 years
26 – 40	Very Poor	Partial to Full Reconstructions	0 to 5 years
11 – 25	Serious		
0 – 10	Failed		

Visual Pavement Condition Survey

- **Critical PCI** values → identify "needs"
- ↑ Priority branches ↑ threshold
- No true industry standards. Typically range from **50** to **70**

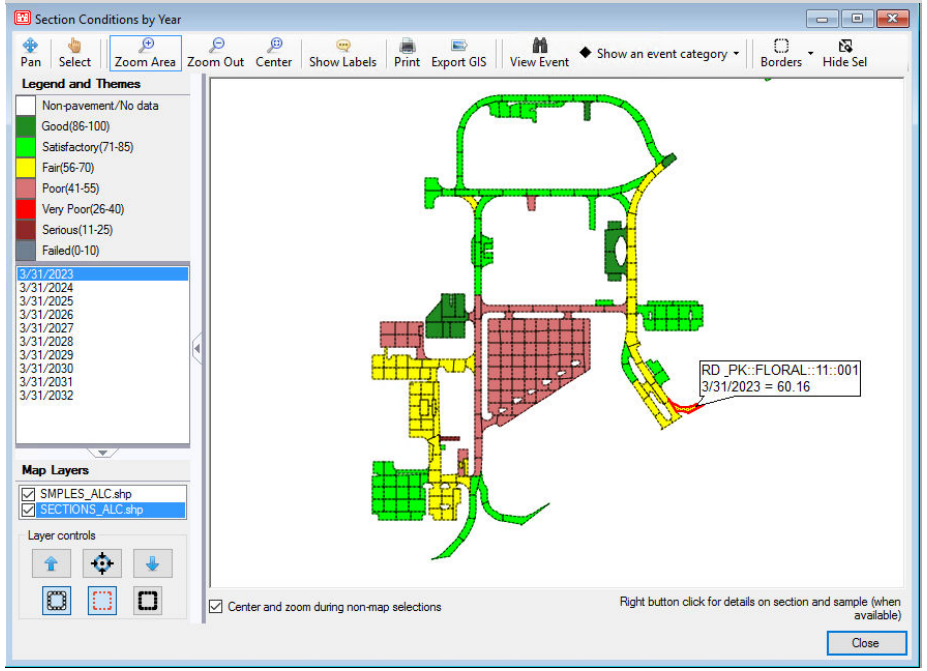
Critical PCI by Family Model

Family Model	Critical PCI
AC for Aircraft – Major	70
AC for Aircraft - Intermediate	65
AC for Aircraft – Minor	60
AC for Ground Vehicles	50
ACP for Aircraft	65
PCC for Aircraft	60

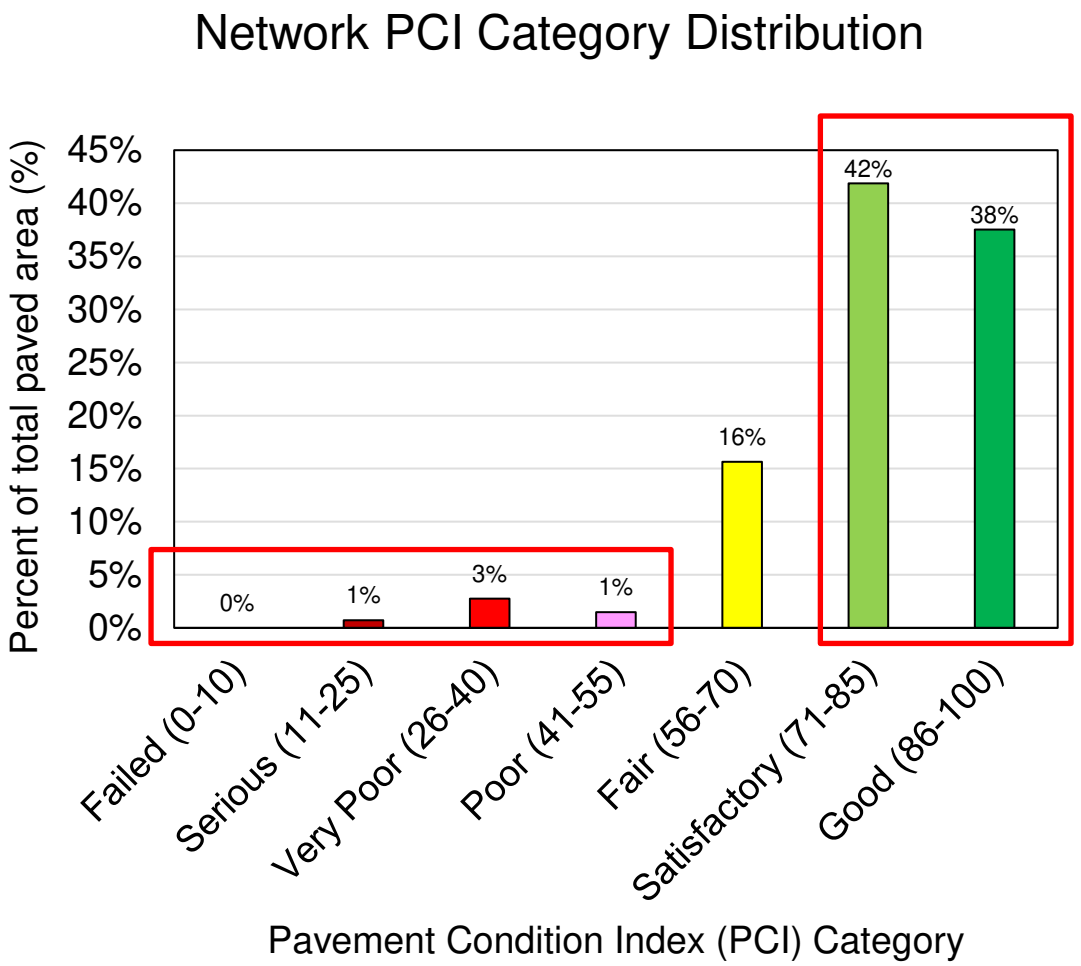
Visual Pavement Condition Survey

Visual Pavement Condition Survey

PAVER pavement management program



Data Analysis Using PAVER



less than 5% in poor to serious condition

~ 80% in good or satisfactory condition

Data Analysis Using PAVER

Network Pavement Condition Index Results **by Section**

Branch ID	Section ID	Surface	Use	Section Rank	Area (sq.m.)	Inspection Date	PCI	PCI Category	Critical PCI	Above or Below Critical?
APR-EAST	APREAST-S1	AC	APRON	P	13,291	10-26-2022	66	Fair	60	Above
APR-I	APRMAIN-S2	PCC	MAIN APRON	P	4,955	10-26-2022	100	Good	60	Above
APR-I	APRMAIN-S3	AC	MAIN APRON	P	-	-	-	-	65	-
APR-I	APRMAIN-S1	AC	MAIN APRON	P	8,421	10-26-2022	74	Satisfactory	65	Above
APR-WEST	APRWEST-S1	AC	APRON	P	10,694	10-26-2022	59	Fair	60	Below
APR-WEST	APRWEST-S2	AC	APRON	P	9,882	10-26-2022	27	Very Poor	60	Below
APR-WEST	APRWEST-S3	AC	APRON	P	11,965	10-26-2022	60	Fair	60	Below
AR	242-APR-S1	AC	ROADWAY	S	386	10-26-2022	52	Poor	50	Above
AR	242-PRK-S1	AC	ROADWAY	S	369	10-27-2022	93	Good	50	Above
AR	242-PRK-S2	AC	ROADWAY	S	1,033	10-26-2022	75	Satisfactory	50	Above
AR	242-PRK-S3	AC	ROADWAY	S	1,211	10-26-2022	59	Fair	50	Above
AR	242TREK-S1	AC	ROADWAY	S	201	10-27-2022	65	Fair	50	Above
AR	242TWRLNS1	AC	ROADWAY	S	389	10-27-2022	54	Poor	50	Above
AR	242TWYA-S1	AC	ROADWAY	S	882	10-26-2022	100	Good	50	Above
AR	EXCFLTCRS1	AC	ROADWAY	S	708	10-26-2022	90	Good	50	Above
AR	EXCFLTCRS2	AC	ROADWAY	S	1,370	10-26-2022	92	Good	50	Above
AR	HELI-LN-S1	AC	ROADWAY	S	2,202	10-26-2022	73	Satisfactory	50	Above
AR	HELI-SC-S1	AC	ROADWAY	S	2,182	10-26-2022	100	Good	50	Above

In this example, the asset is operated and maintained under subtenant lease arrangement

Data Analysis Using PAVER

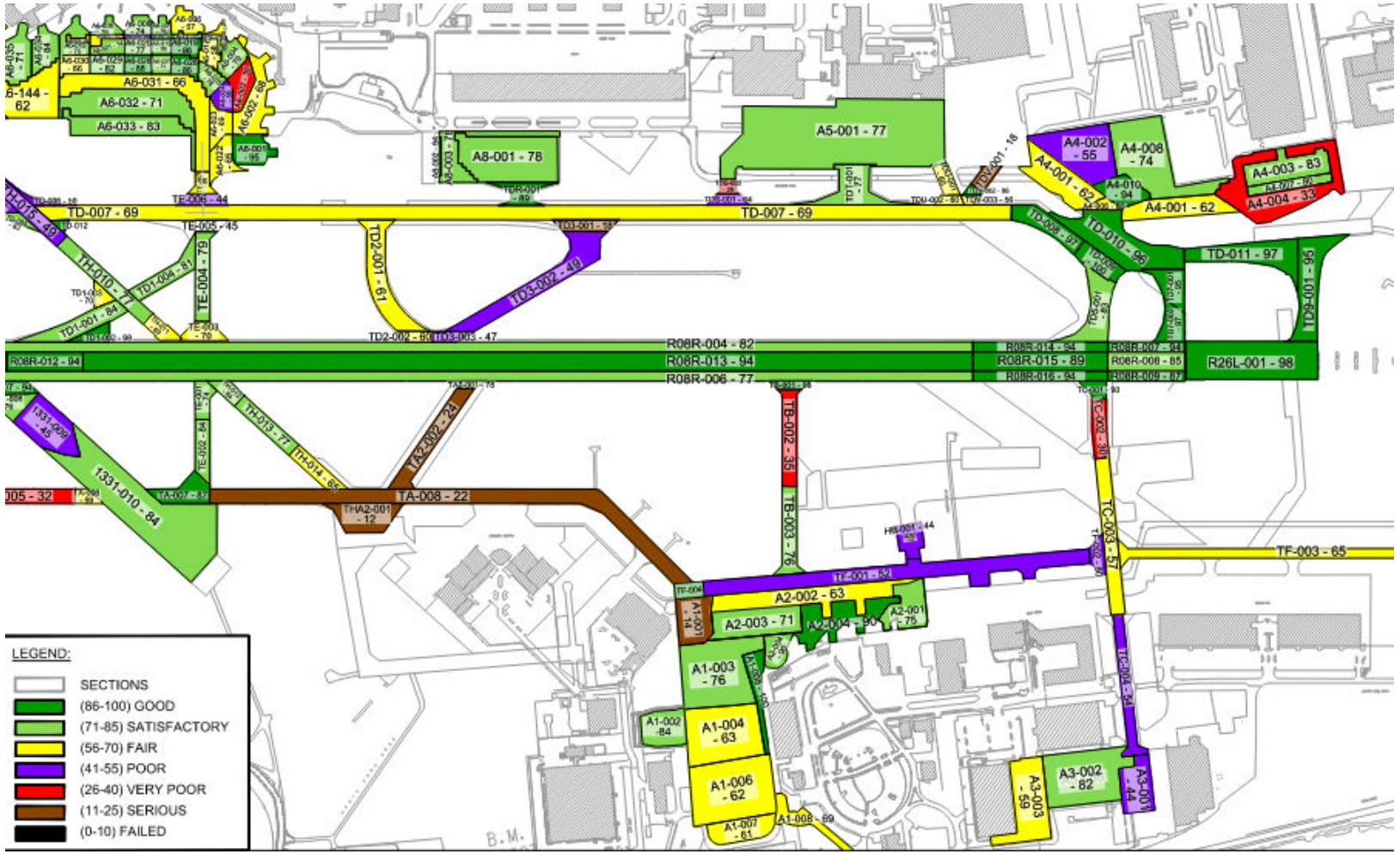
Network Pavement Condition Index Results **by Branch Use**

Branch Use	# Sections	Pavement Area (sq.m.)	Weighted Average PCI	PCI Category
RUNWAY	9	102,360	80	Satisfactory
SECONDARY RWY	7	87,005	91	Good
TAXIWAY	3	57,435	84	Satisfactory
MAIN APRON	3	13,377	84	Satisfactory
APRON	4	45,833	54	Poor
HELIPAD	5	5,214	88	Good
ROADWAY	23	35,843	76	Satisfactory
PARKING	21	67,975	88	Good
Network	75	415,040	81	Satisfactory

In this example, the asset is operated and maintained under subtenant lease arrangement

Data Analysis Using PAVER

Pavement Condition Map by Section



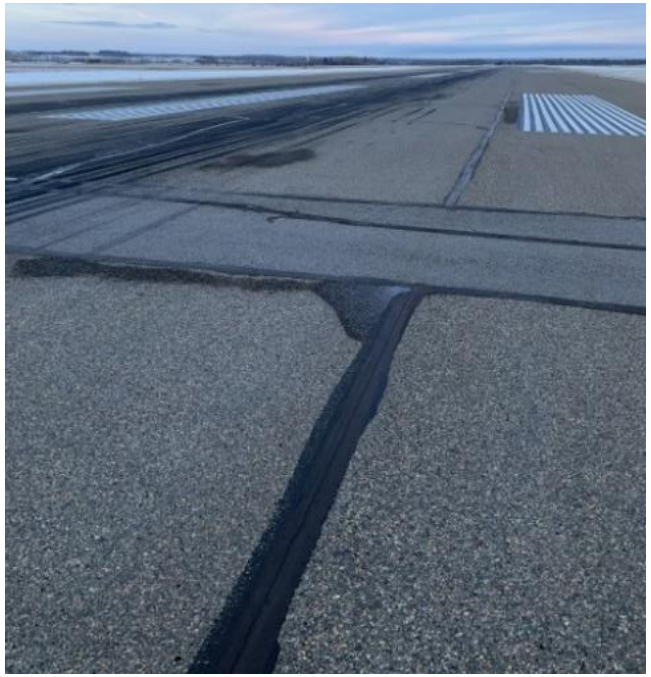
Data Analysis Using PAVER

- Sections below critical PCI

Branch ID	Section ID	Surface	Use	Critical PCI	PCI
APR-WEST	APRWEST-S1	AC	APRON	60	59
APR-WEST	APRWEST-S2	AC	APRON	60	**27**
APR-WEST	APRWEST-S3	AC	APRON	60	60
PL	N-TERM-S1	AC	PARKING	50	**25**
PL	TKR-BS-S1	AC	PARKING	50	**36**
RWY12-30	RWY1230S6K	AC	RUNWAY	70	69

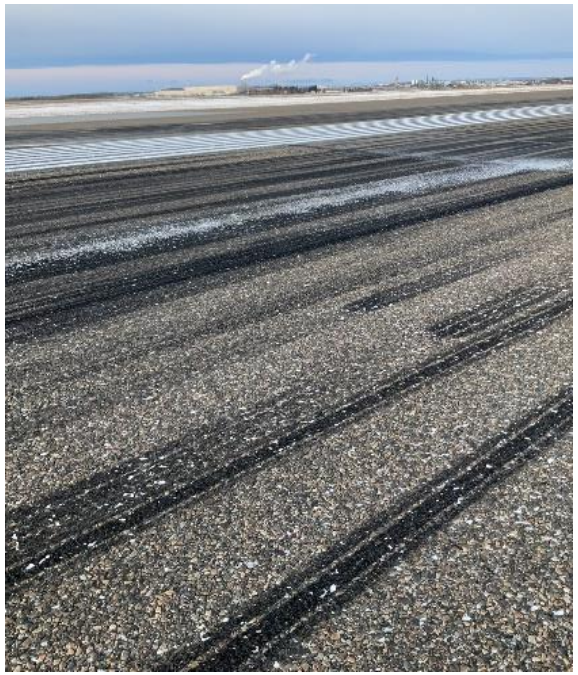
State of Good Repair

Runway



Crack seals and patching mostly in good condition

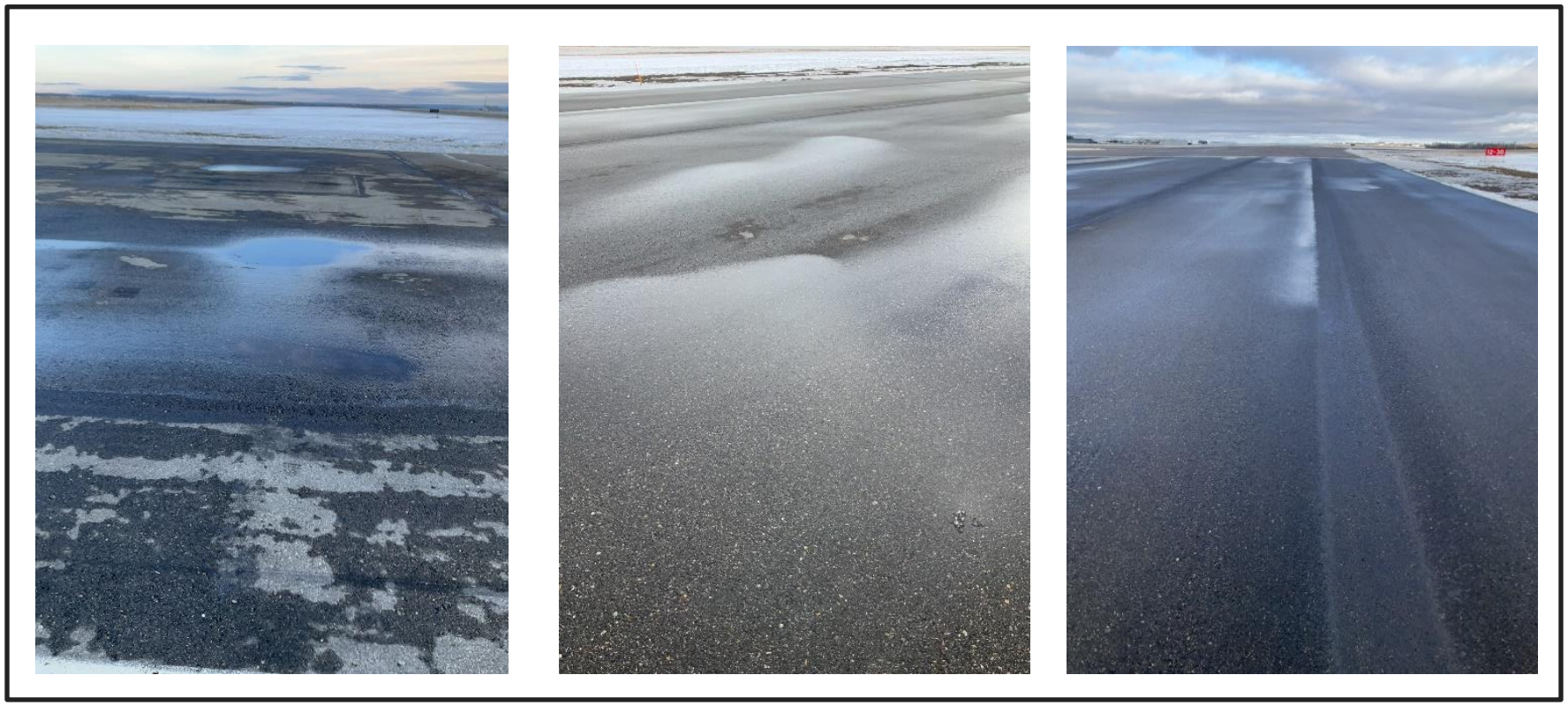
Isolated spots with rutting and spalling



Rutting near landing area

State of Good Repair

Runway



Premature distresses and depressions

State of Good Repair

Runway

Longitudinal cracks
(construction joints)

Patching

State of Good Repair

Runway

Transverse Cracking

Improper shoulder slope

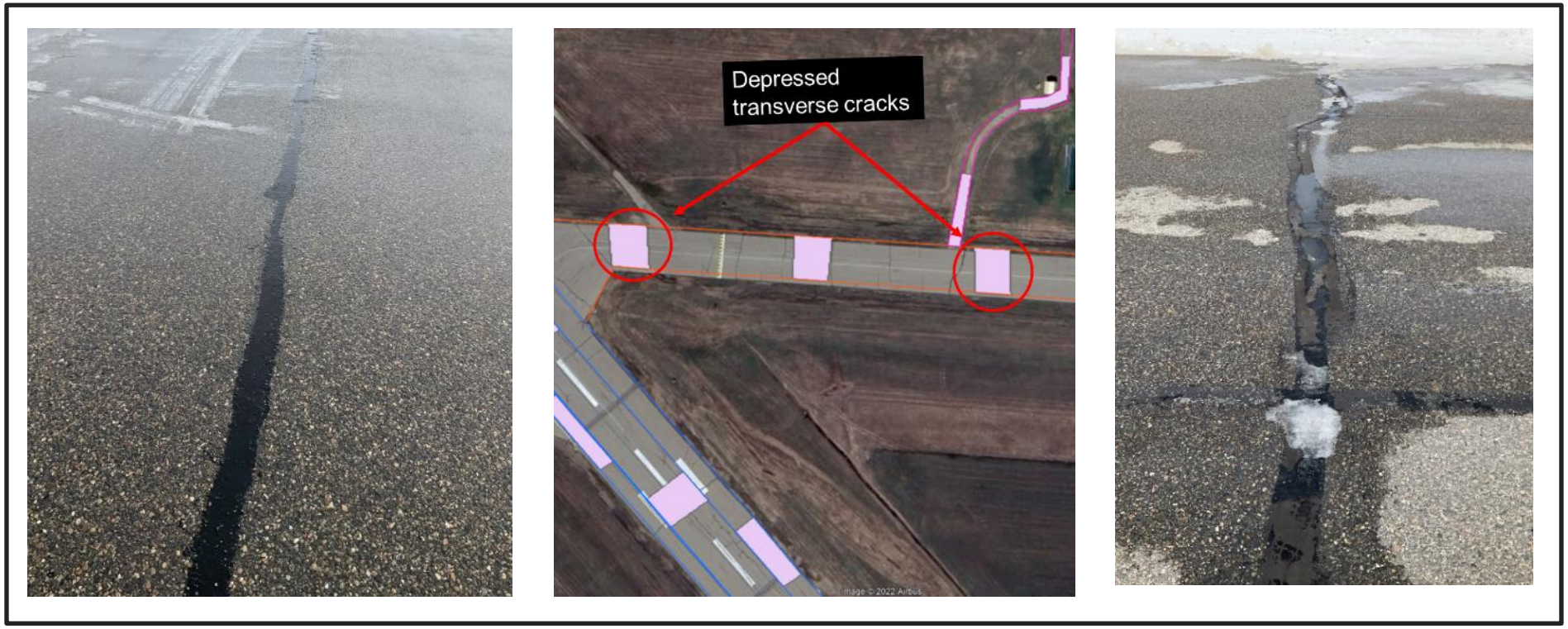
State of Good Repair

Runway

Mild Weathering and Raveling

State of Good Repair

Taxiways

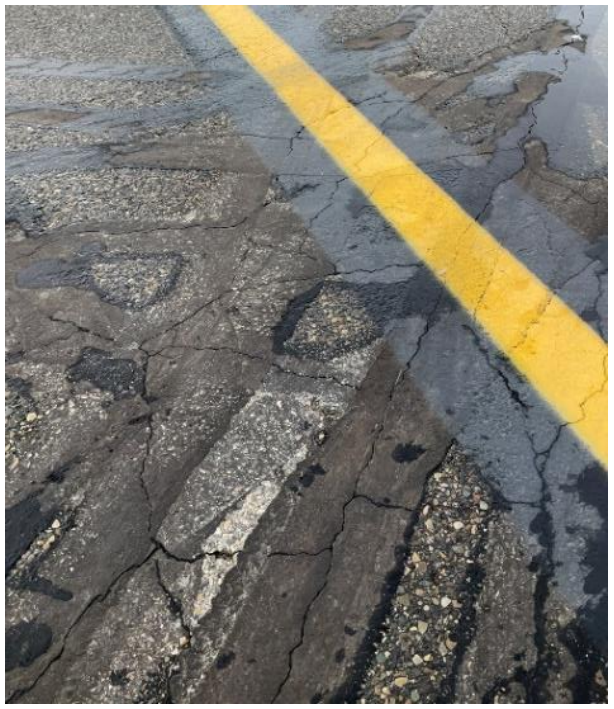


Cracks sealed, mostly in good condition

State of Good Repair

Main Apron: Flexible (commonly used for de-icing)

PCI is near the **lower limit of the "good"** classification range



Sealed cracks, some partially failed

Transverse Cracking

State of Good Repair

Main Apron: Rigid

Joint sealant in moderate condition

State of Good Repair

Helipads

Cracks w/ poor sealant and depression

Joint damage and faulting on concrete helipads

Sample helipad locations

State of Good Repair

Roadways

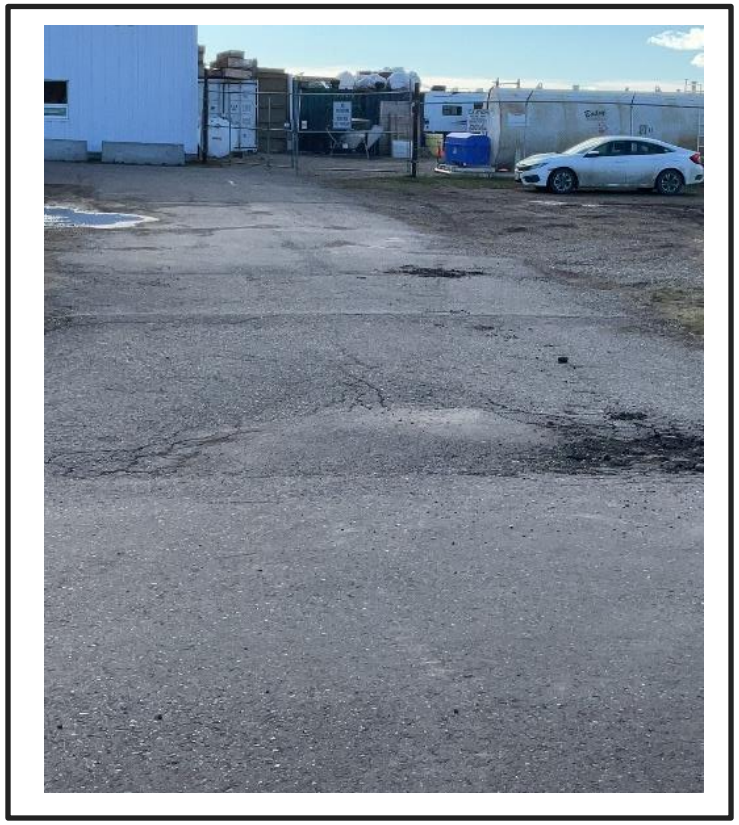
Edge cracking with vegetation

Ramping patch in poor condition

State of Good Repair

Equipment and Tenant Parking Areas

Pavement distortions



Alligator cracking

Replacement Value

Removal of the existing structure

Construction of a new structure

Standard pavements based on existing structures

- **Airside:** runways, taxiways, aprons, and helipads
- **Groundside:** roadways and parking lots

Replacement Value

RUNWAYS+TAXIWAYS+APRONS+HELIPADS		
Service	**Quantity**	**Unit**
Removal		
Asphalt Milling	41,900	m^3
Granular excavation	311,950	m^3
Construction		
Asphalt	118,440	Tons
Asphalt Tack Coat	644,520	m^2
Granular Base	238,560	Ton
Granular Subbase	483,170	Ton
Subgrade prep	354,490	m^2
Other		
Line Marking	2,160	m^2
Top soil + seeding	32,230	m^2

ROADWAY+PARKING		
Removal		
Asphalt Milling	7,910	m^3
Granular excavation	52,710	m^3
Construction		
Asphalt	19,370	Ton
Asphalt Tack Coat	210,830	m^2
Granular Base	39,020	Ton
Granular Subbase	95,380	Ton
Subgrade prep	115,960	m^2
Other		
Line Marking	4,220	m^2
Top soil + seeding	10,550	m^2

Quantity per Pavement Replacement Service

Replacement Value

Class of work including Labor, Plant and Material	Unit of Measure	Unit Cost	
Removals			
Full Depth Asphalt Removal	m^3	$	42.55
Existing granular excavation	m^3	$	34.50
Proposed Works			
Subgrade preparation	m^2	$	2.30
Granular Base (Supply and compact 100% MPmdd)	Ton	$	36.80
Granular Subbase (Supply and compact 98% MPmdd)	Ton	$	33.35
HMAC Pavement	Ton	$	218.50
Asphalt tack coat	m^2	$	1.44
150mm Topsoil + seed	m^2	$	13.23
Line Marking	m^2	$	12.00

Replacement Service Unit Costs
based on recent BC quotes

Replacement Value

Branch Use	Replacement Cost
Runway	$30,000,000
Secondary Runway	$20,000,000
Taxiway	$15,000,000
Main Apron	$6,000,000
Apron (General Aviation)	$12,000,000
Helipad	$1,000,000
Parking	$9,000,000
Roadway	$5,000,000

- Cost of engineering services. **10%** of removal and construction
- **15%** Contingency

Replacement Cost per **Branch Use:** hypothetical cost numbers

Long Term Work Programs

Runway example (hypothetical cost numbers)

Description	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Full Pavement Structure Rehab										$30,000,000.00		$30,000,000.00
Edge Lights and Cables					$800,000							$800,000
Airfield Guidance Signs					$150,000							$150,000
Approach lights										$200,000.00		$200,000.00

Long Term Work Programs

- Do Nothing Budget
  - Highlights the detrimental effect of not spending any money on airfield pavements
- Steady State
  - Identifies the cost to maintain the existing network PCI at its current condition
- Improved Network/Asset State
  - Identifies the cost to maintain the network at a target PCI (e.g., 75)
- Maintain Network/Asset Deficiency
  - Identifies the cost to maintain network at a specified deficiency (e.g., 20%)
- Unlimited Budget
  - Assumes unlimited funding over the analysis period, which represents the theoretical maximum value to keep all its airfield pavements in good condition.

Conclusions

Small **regional** airports can have great benefits from a tangible asset audit, regardless of the size of commercial operations

Cost-effective **asset management** leads to wise investments:

Doing the right thing, to the right asset, at the right time

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Q&A