Automated Pavement Data Collection Solutions

Transportation Asset and Infrastructure Management Conference

October 28, 2019

Presentation Overview

Introduction

- Presenter
- What Is Pavement Management?

Services

- Project Level Services
- Network Level Services

Technology

- What Is LCMS?
- What Comes Out of LCMS?
- LCMS Workflows

Market

- Why Pavement Management Is Needed

Project Examples

Presenter

Ken Contrisciane

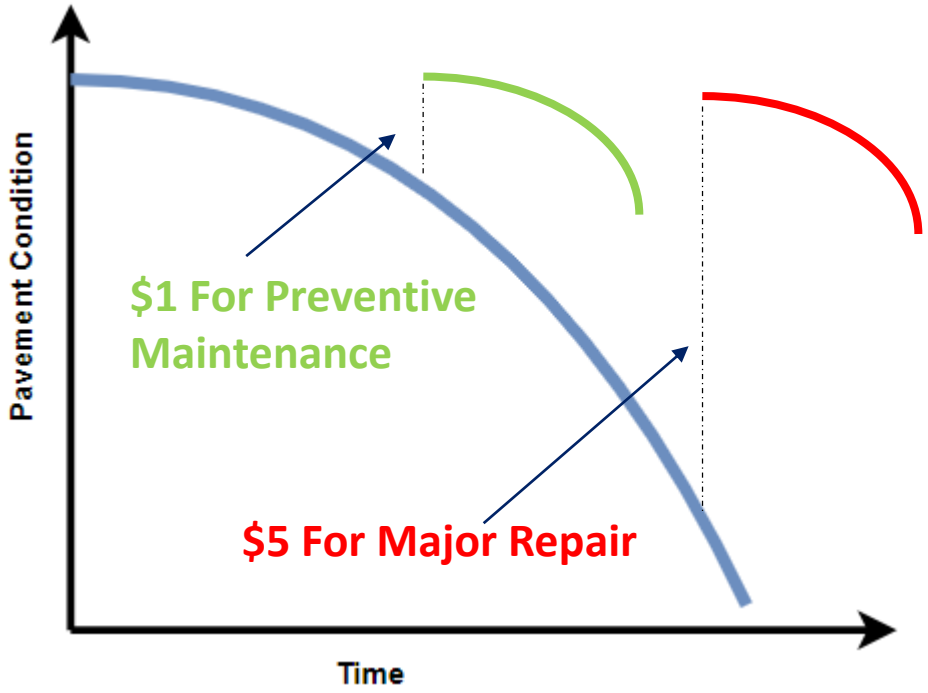
- Project Manager GIT – Hamilton, NJ
- 18+ years of service with Michael Baker
- Technical lead in automated pavement data collection
- Broad range of GIS related experience on numerous transportation asset management/inventory projects at local, county and statewide levels.

E: kcontrisciane@mbakerintl.com

O: 609-807-9551

What Is Pavement Management?

*"The science of managing limited resources effectively, by applying the **right treatment**, on the **right road** at the **right time**"*



Pavement Management Services

- Project Level
  - Engineering Design Services
  - Ground Penetrating Radar (GPR), Coring, FWD, Skid Testing
- Network Level
  - **Automated* Pavement Data Collection**
  - Custom data processing and categorization
  - Analysis and Reporting
  - Enterprise Pavement Management System Integration
    - Program Management
    - Project Prioritization
    - Training

Pavement Services - Project Level

- Traditional Pavement Data Collection
  - Coring
    - Pavement depth, type and subgrade
  - Falling Weight Deflectormeter (FWD)
    - Structural capacity testing
  - Ground Penetrating Radar (GPR)
    - Identify pavement type, thickness and voids

Pavement Services – Network Level

- **Automated* Pavement Data Collection**

LCMS - Laser **C**rack **M**easurement **S**ystem

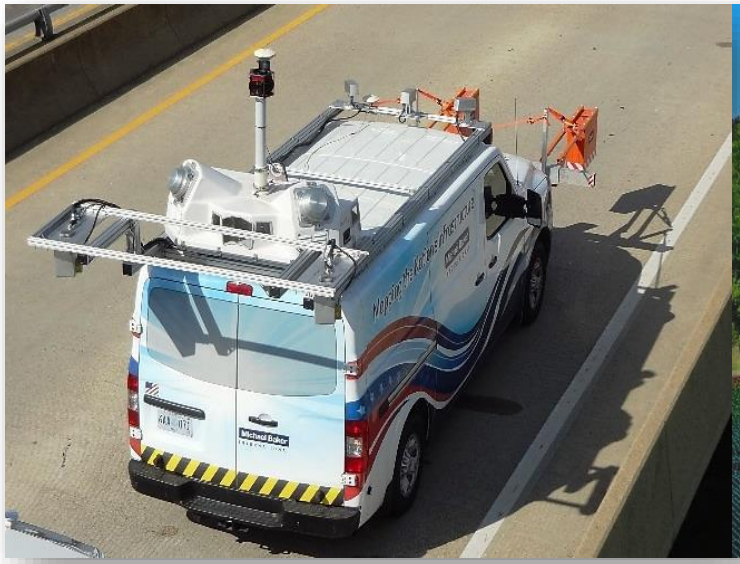
5 High Def ROW Cameras

High Speed Profiler (IRI)

Laser Crack Measurement System

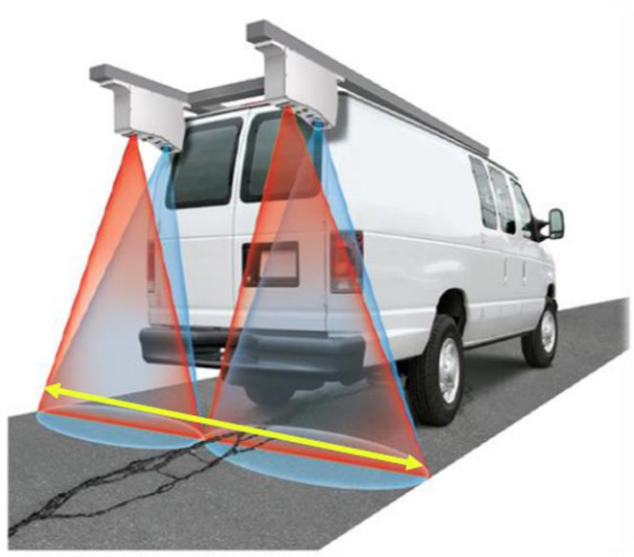
Laser Crack Measurement System

- What is LCMS and how does it work
- What comes out of LCMS
- LCMS Workflows



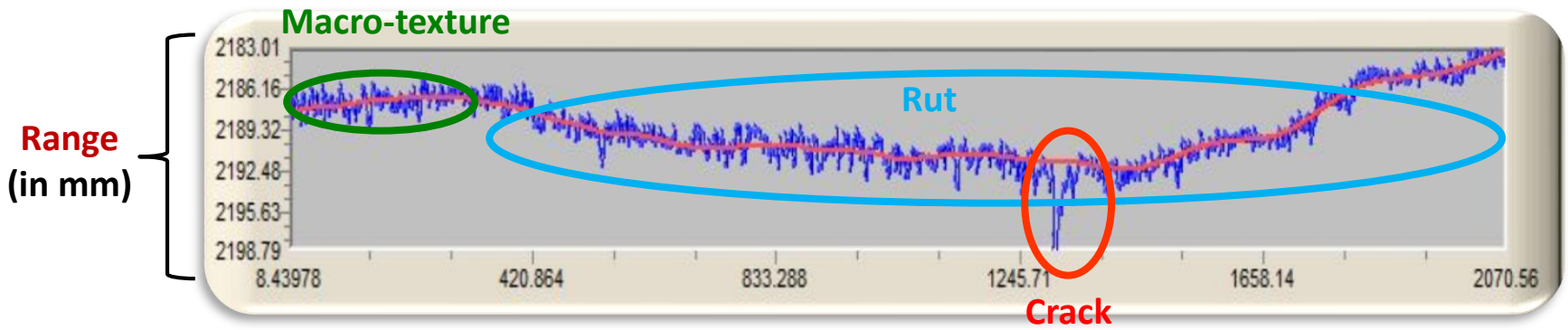
What is LCMS?

- Mobile-based Automatic* Pavement Distress Detection
  - Double Laser Sensor Array
- One Inventory, Many Outputs
- Pavement Management *Tool*

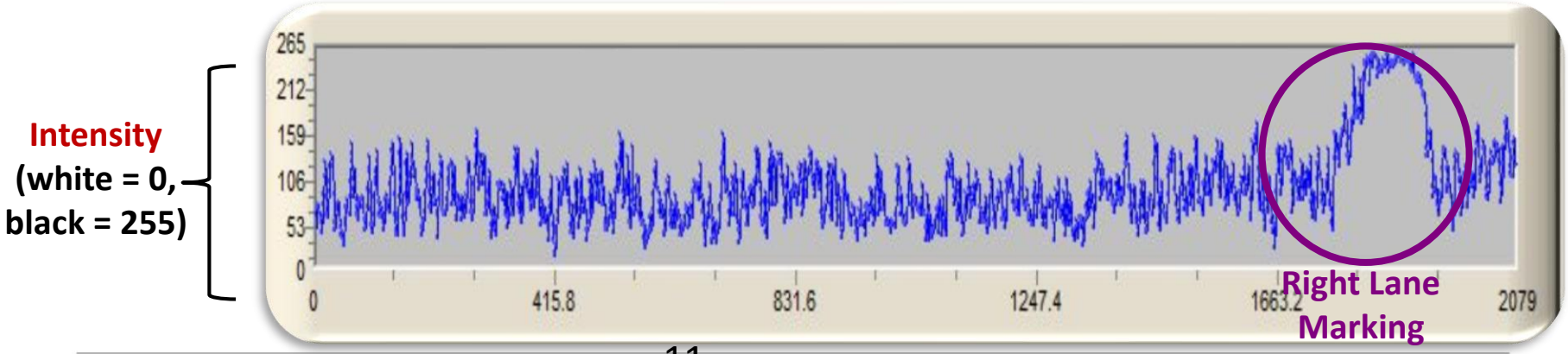


How LCMS Works

- Sensors Detect Two Primary Attributes:
  - **Range**: Distance between sensor and ground



  - **Intensity**: Laser intensity (greyscale)



Michael Baker INTERNATIONAL
We Make a Difference
"…the strength of the Pack is the Wolf, and the strength of the Wolf is the Pack…"

How LCMS Works

RANGE INTENSITY

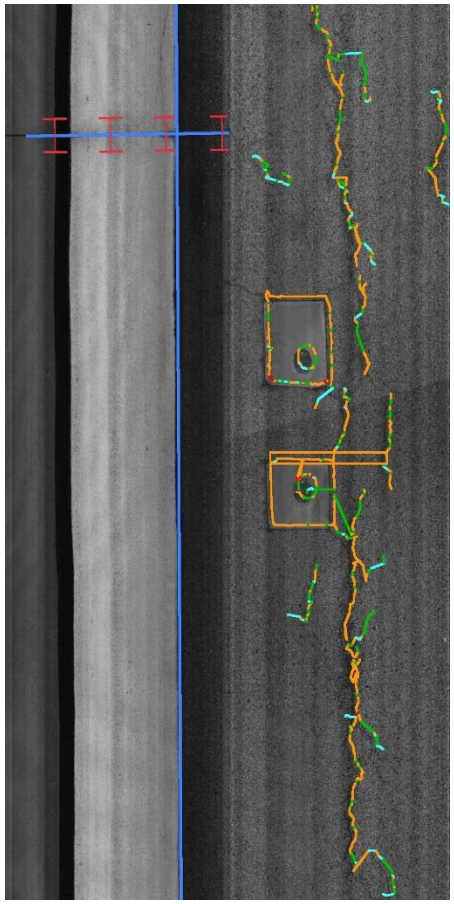
Crack Severity

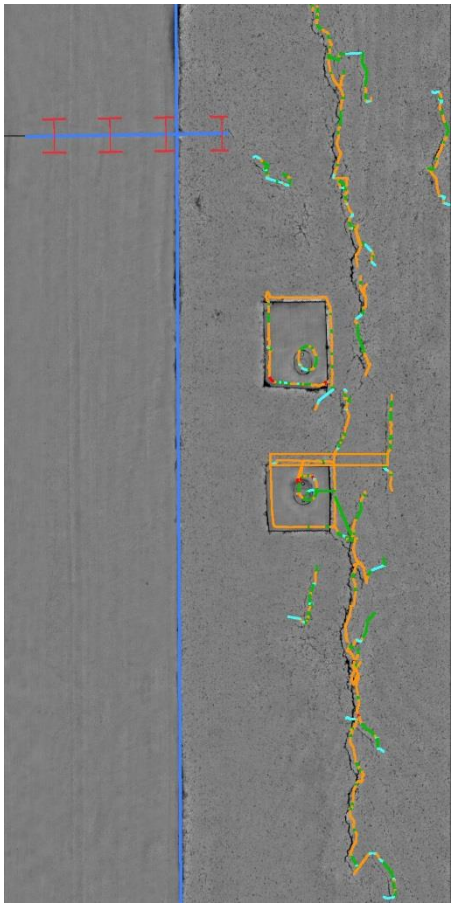
Very Weak

Weak

Medium

Severe





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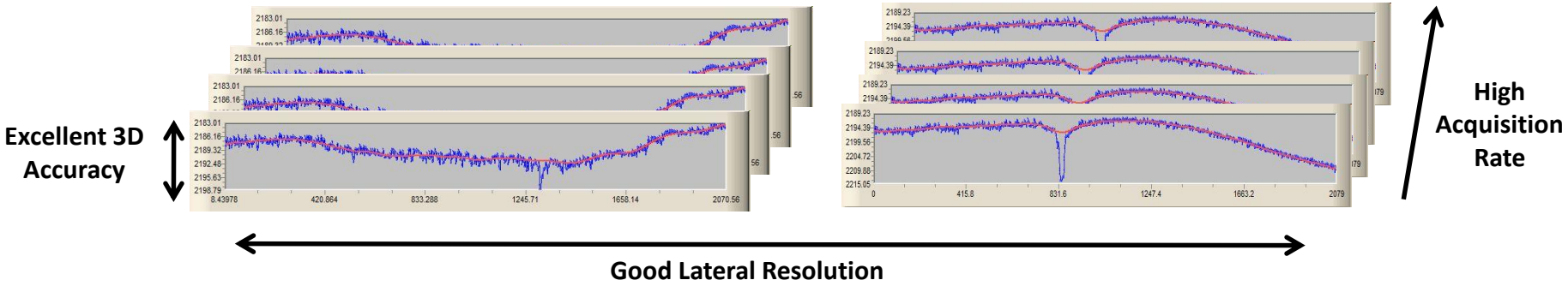
How LCMS Works



LCMS Specifications	
Acquisition Rate	11,200 profiles/s
Range Accuracy	0.5mm
Lateral Resolution	1mm (FOV = 4m)
Nbr of points/sec	45 million 3D and 2D points/s

1 Gigabyte of data per mile

What Comes Out of LCMS?

- One Inventory, Many Outputs
  - Pavement Condition Features:
    - **Transverse Profile**
    - **Sealed Cracks**
    - **Transverse Cracks**
    - **Bleeding**
    - **Potholes**
    - **Rutting**
    - **Joint Faulting**
    - **Alligator Cracking**
    - **Longitudinal Cracks**
    - **Raveling**
    - **Macro Texture**
    - **International Roughness Index (IRI)**

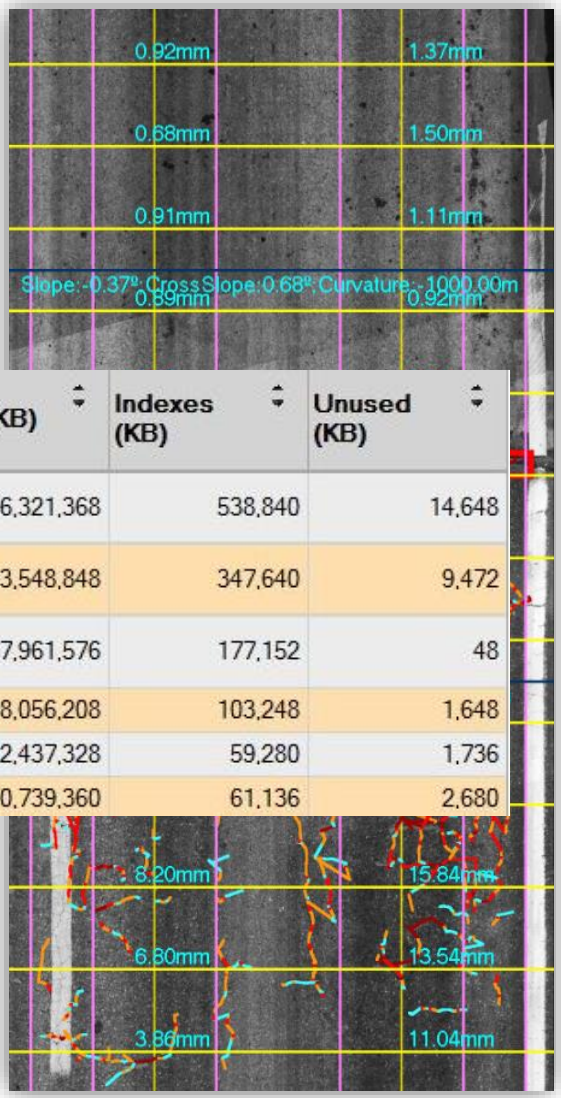
What Comes Out of LCMS?

- Raw Data: XML and Imagery

```
<SurveyInfo>
<SurveyID>1111252515</SurveyID>
<SurveyPath>D:\Pavemetrics Software and Data\Data\Road\DataSet1</SurveyPath>
<SensorEnable>
<Left>Yes</Left>
```

Table Name	# Records	Reserved (KB)	Data (KB)	Indexes (KB)	Unused (KB)
dbo.P_CRACK_NODE	1,746,573,349	96,874,856	96,321,368	538,840	14,648
dbo.P_RAVELING_ZONE_REPORT	1,132,196,128	73,905,960	73,548,848	347,640	9,472
dbo.S_BLOCK_CRACK_NODES	1,520,640,088	68,138,776	67,961,576	177,152	48
dbo.P_CRACK_NODE_WP	289,695,088	18,161,104	18,056,208	103,248	1,648
dbo.P_RUT_MEASUREMENT	157,008,886	12,498,344	12,437,328	59,280	1,736
dbo.P_SEALED_CRACK_PERIMETER_NODE	289,665,333	10,803,176	10,739,360	61,136	2,680

```
<TimeBegin_s>1.272</TimeBegin_s>
<TimeEnd_s>1.657</TimeEnd_s>
<NbProfiles>1000</NbProfiles>
<SectionLength_m>5.000</SectionLength_m>
<Speed_kmh>46.728</Speed_kmh>
<AcquisitionResolution_mm>5.000</AcquisitionResolution_mm>
</RoadSectionInfo>
```

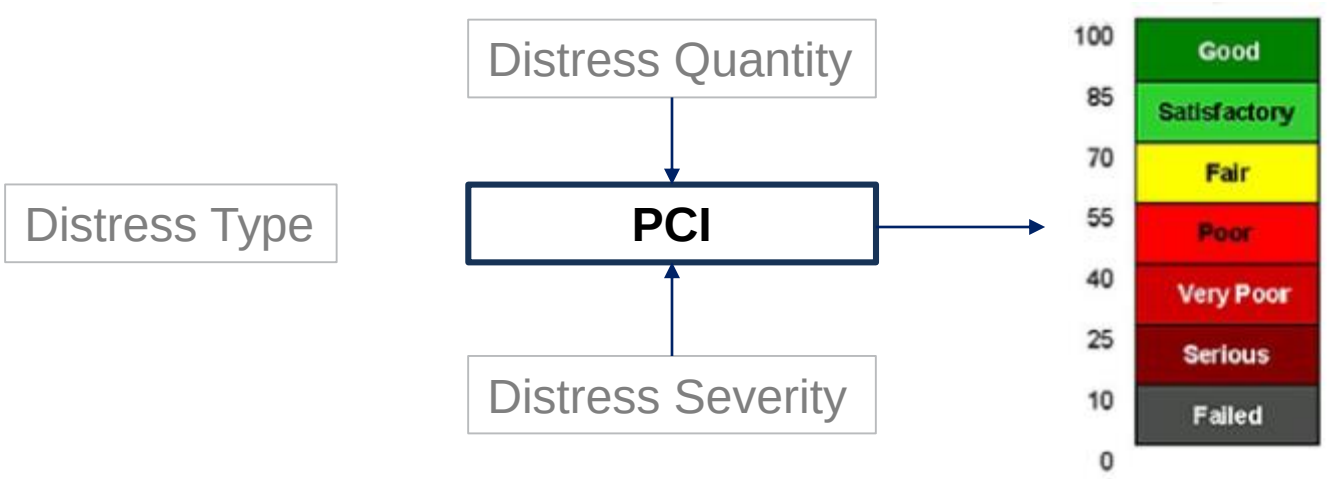


What Comes Out of LCMS?

What Does **NOT** Comes Out of LCMS?

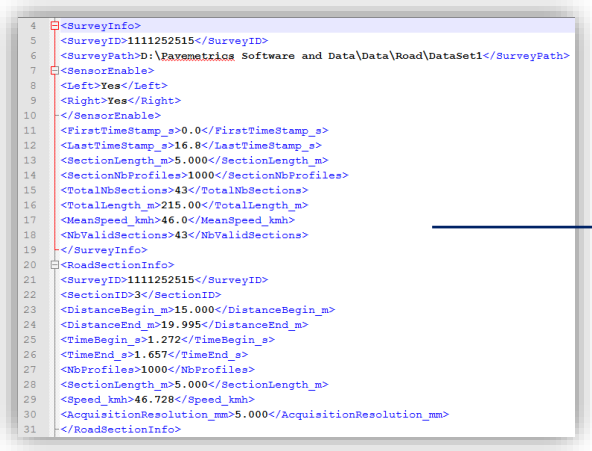
Pavement Condition Index (PCI)

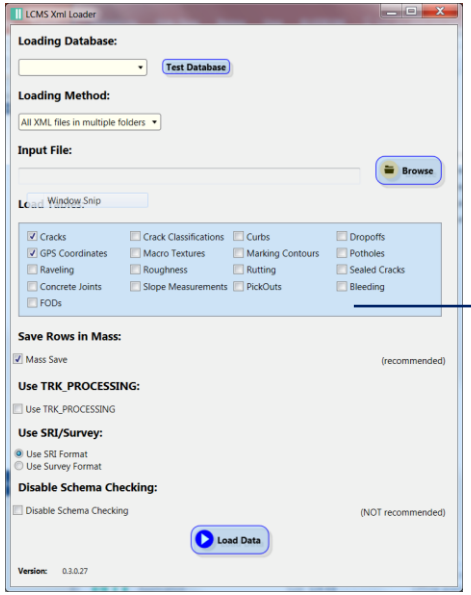
- An indicator of overall performance of pavement **surface**
- Scores from **0** to **100** based on established standards

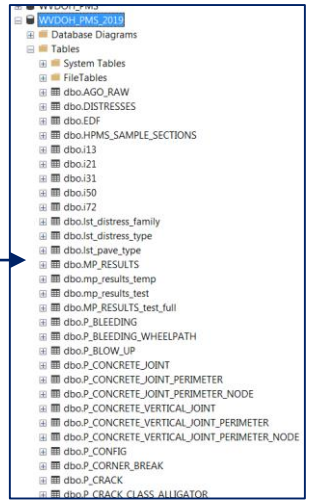


LCMS Post Processing Workflow

- Defined LCMS Enterprise Database Schema
- Processing Tools & Applications
  - Field Data Checker
  - XML Data Loader
  - ROW Imagery Loader
  - **Distress Selector**

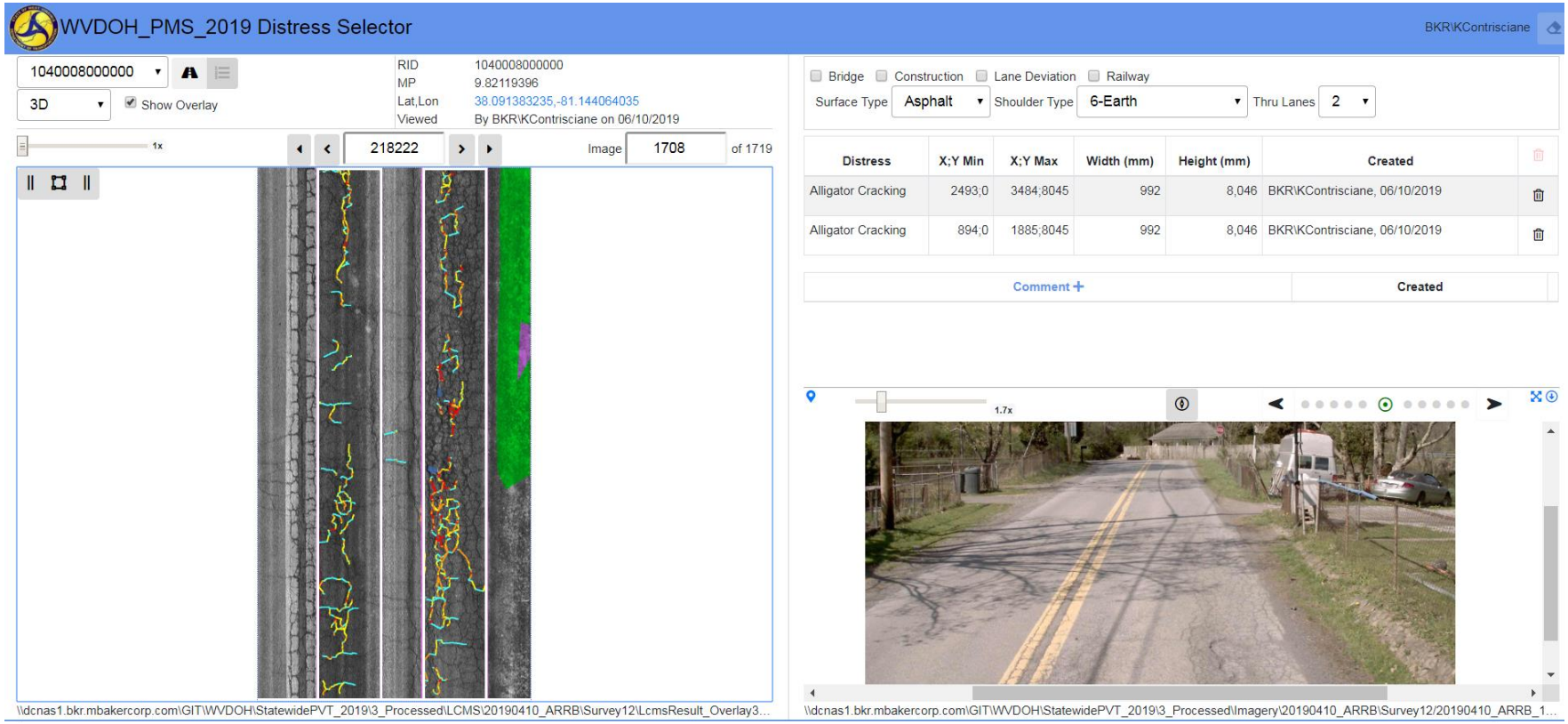






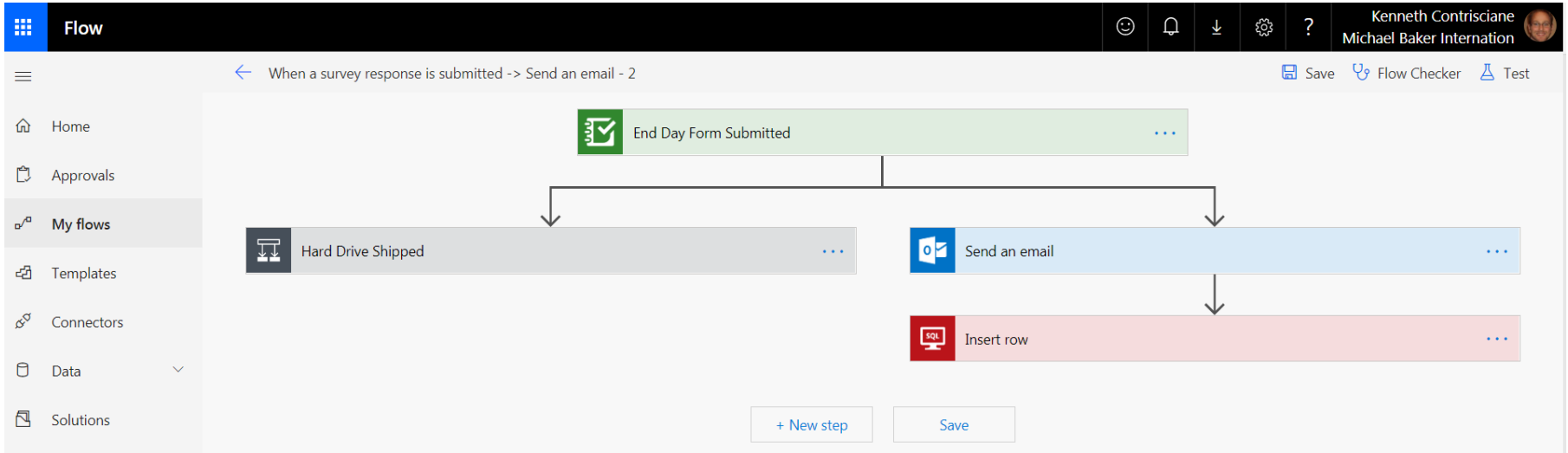
LCMS Post Processing Workflow

- Distress Selector Application
  - LCMS cannot classify certain types of distress. Distress Selector fills the gap.



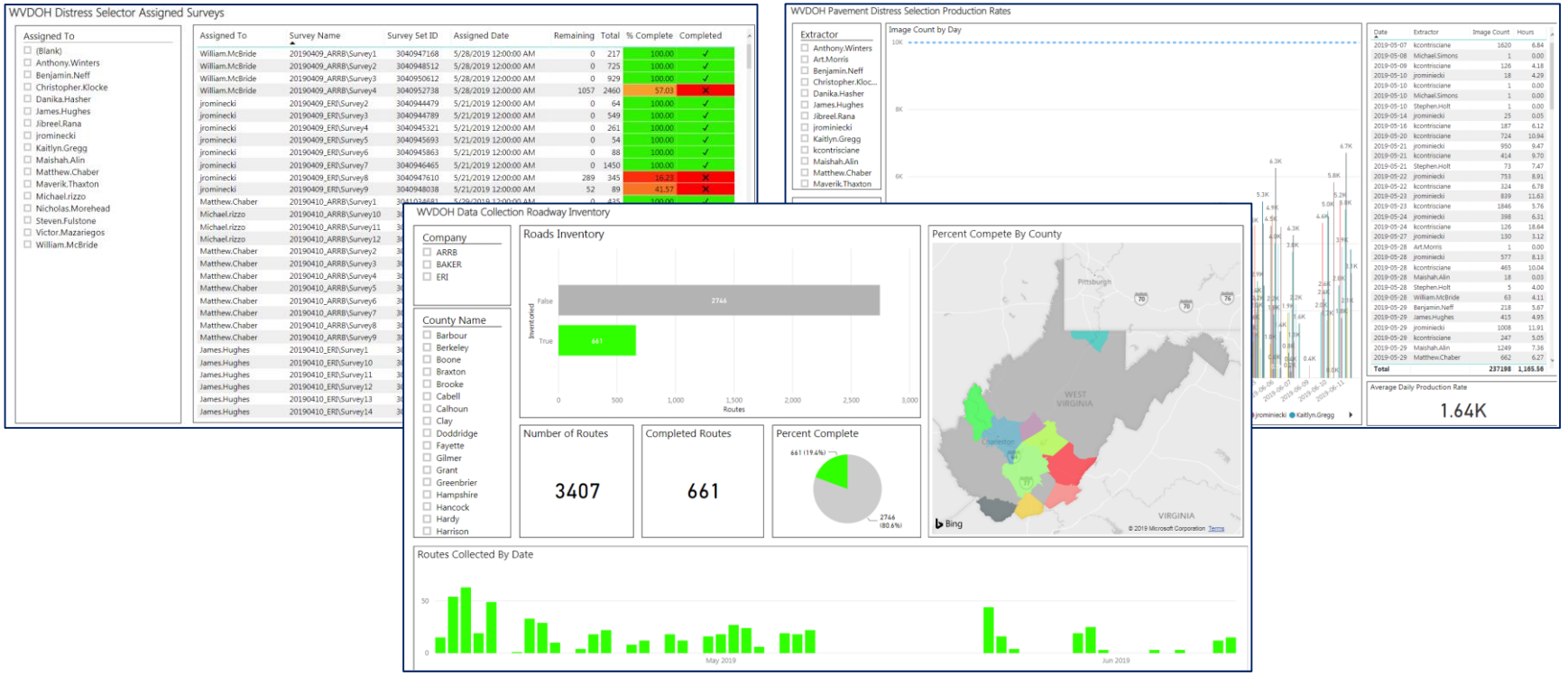
LCMS Post Processing Workflow

- Robust Tracking System
  - Field Collection Tracking
    - ArcGIS Online, Collector, Survey123 & Microsoft Flow



LCMS Post Processing Workflow

- Robust Tracking System
  - Office Processing Tracking
  - Microsoft PowerBI



Why LCMS?

- **Speed**
  - Can operate at normal traffic speeds (up to 60 MPH)
- **Accuracy**
  - Millimeter level crack detection capability
- **Repeatability**
  - Consistent and reliable results
- **Day or Nighttime Operation**
  - Efficiency
- **Safety**
  - Crews stay in vehicle

Why Pavement Management Is Need?

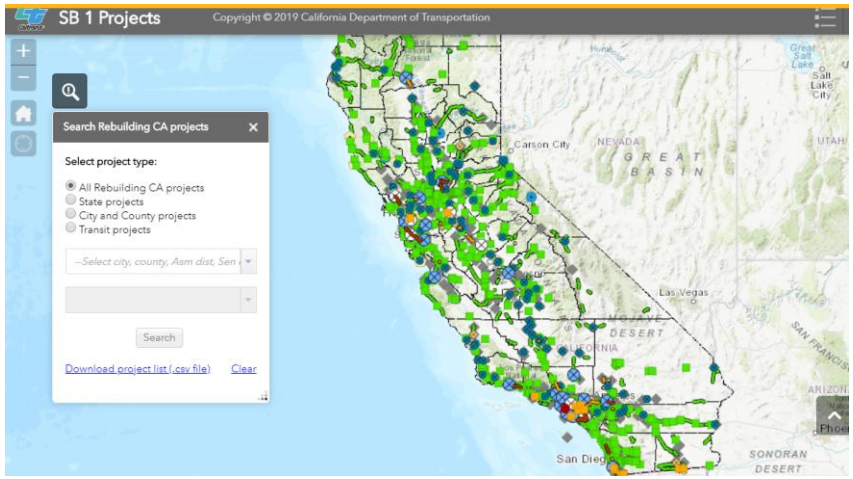
Regulations

- **Highways & Roads – FAST Act**
  - National Pavement Performance Measures established in 2018
  - State DOT's required to collect & report certain aspects of pavement condition
    - ***IRI, Rutting, Cracking Percent, Faulting***
  - Equipment & Operator Certification
  - Potential $$$ penalties if not met
- **Airports – AC 150/5380-7B**
  - Discusses Airport Pavement Management Program (PMP)
  - Required for certain projects funded with federal $$$
  - Key component of PMP is ability to track & collect pavement data

Why Pavement Management Is Needed?

Regulations – State Specific

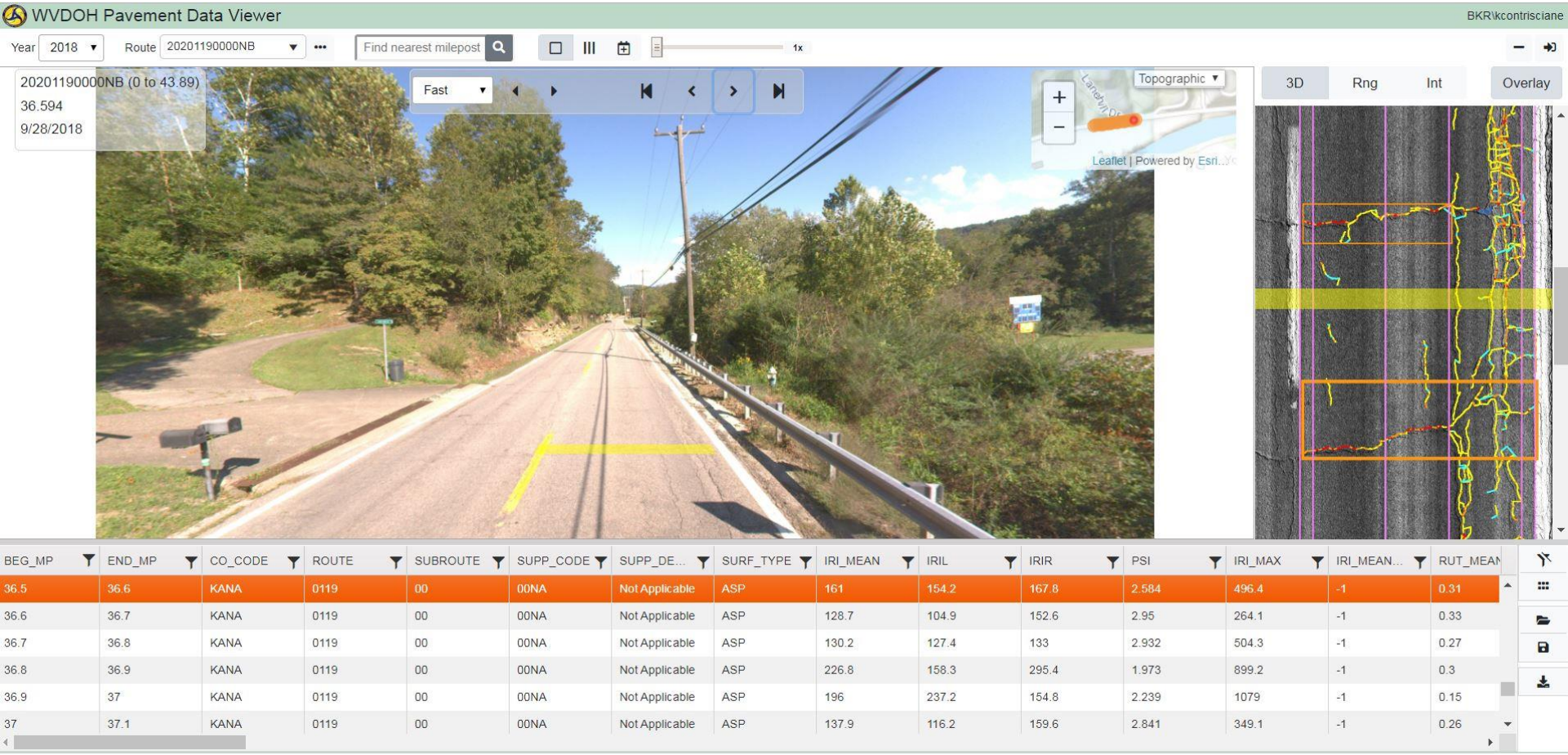
- Case Example: California
  - **SB 1 –** Road Repair & Accountability Act of 2017
    - Dedicates $54 billion (state funding) towards transportation infrastructure improvement and repair.
    - Split equally between the state highway system and local agencies (cities / counties)



Project Examples

- West Virginia Department of Highways (WVDOH)
  - Pavement Data Viewer
- Pennsylvania Turnpike Commission (PTC)
  - PTC Pavement Data Viewer
- Dallas Fort Worth Airport (DFW)
  - ArcGIS Web Application
- BWI Airport
  - Runway Blister Analysis

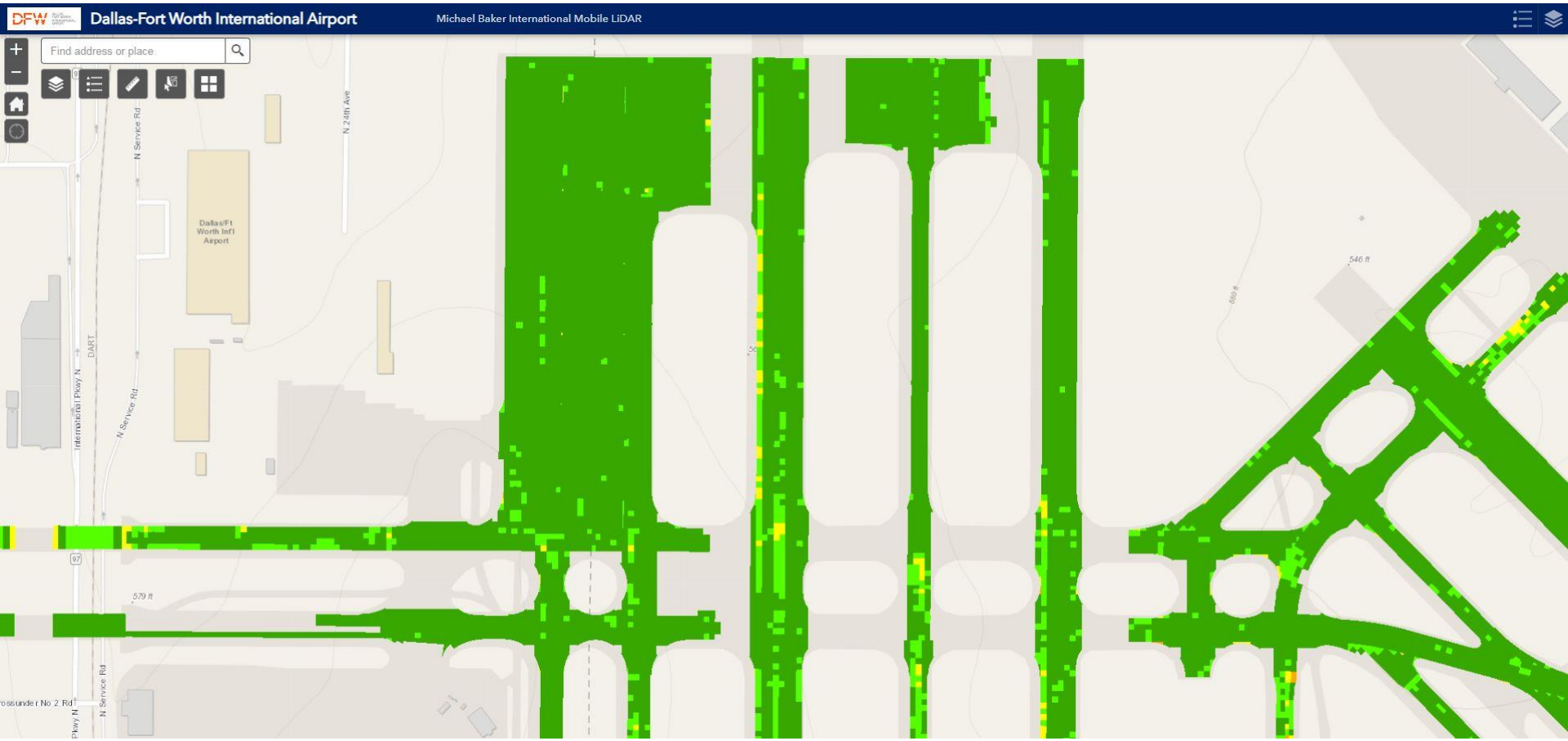
West Virginia DOH Pavement Data Viewer



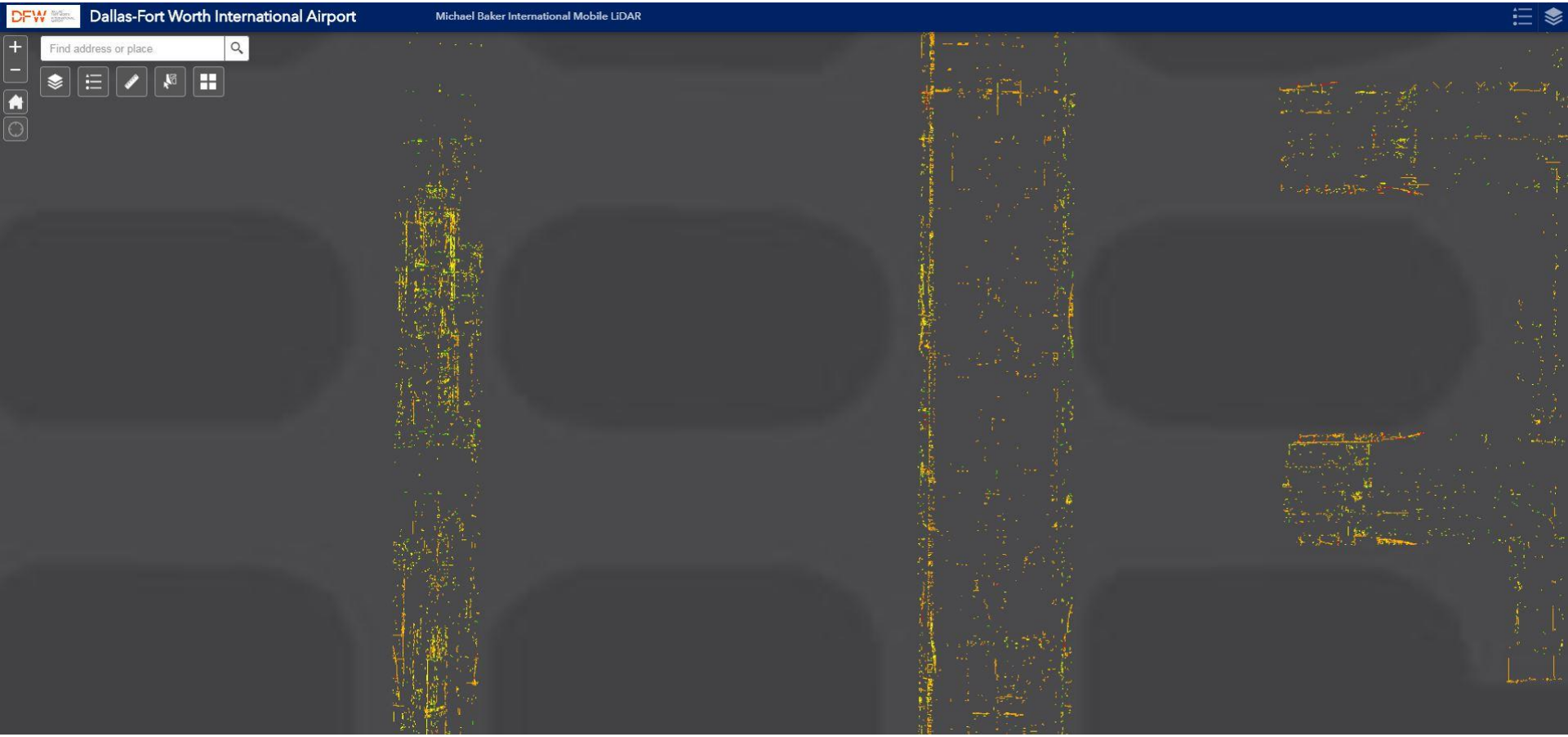
BEG_MP	END_MP	CO_CODE	ROUTE	SUBROUTE	SUPP_CODE	SUPP_DE...	SURF_TYPE	IRI_MEAN	IRIL	IRIR	PSI	IRI_MAX	IRI_MEAN...	RUT_MEAN
36.5	36.6	KANA	0119	00	00NA	Not Applicable	ASP	161	154.2	167.8	2.584	496.4	-1	0.31
36.6	36.7	KANA	0119	00	00NA	Not Applicable	ASP	128.7	104.9	152.6	2.95	264.1	-1	0.33
36.7	36.8	KANA	0119	00	00NA	Not Applicable	ASP	130.2	127.4	133	2.932	504.3	-1	0.27
36.8	36.9	KANA	0119	00	00NA	Not Applicable	ASP	226.8	158.3	295.4	1.973	899.2	-1	0.3
36.9	37	KANA	0119	00	00NA	Not Applicable	ASP	196	237.2	154.8	2.239	1079	-1	0.15
37	37.1	KANA	0119	00	00NA	Not Applicable	ASP	137.9	116.2	159.6	2.841	349.1	-1	0.26

Pennsylvania Turnpike Pavement Data Viewer

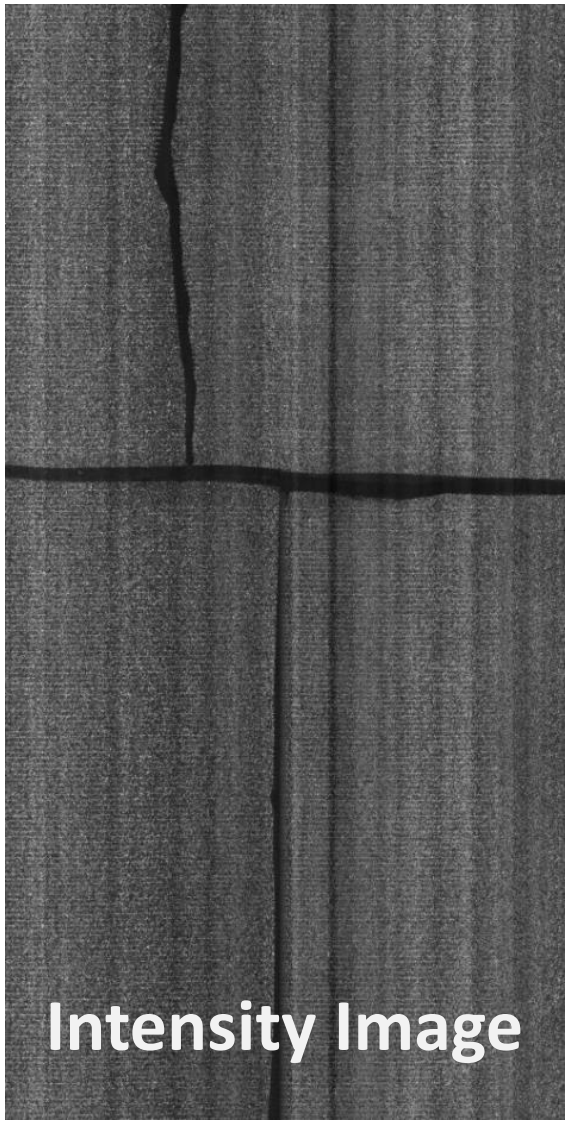
Dallas Fort Worth Airport ArcGIS Web Application

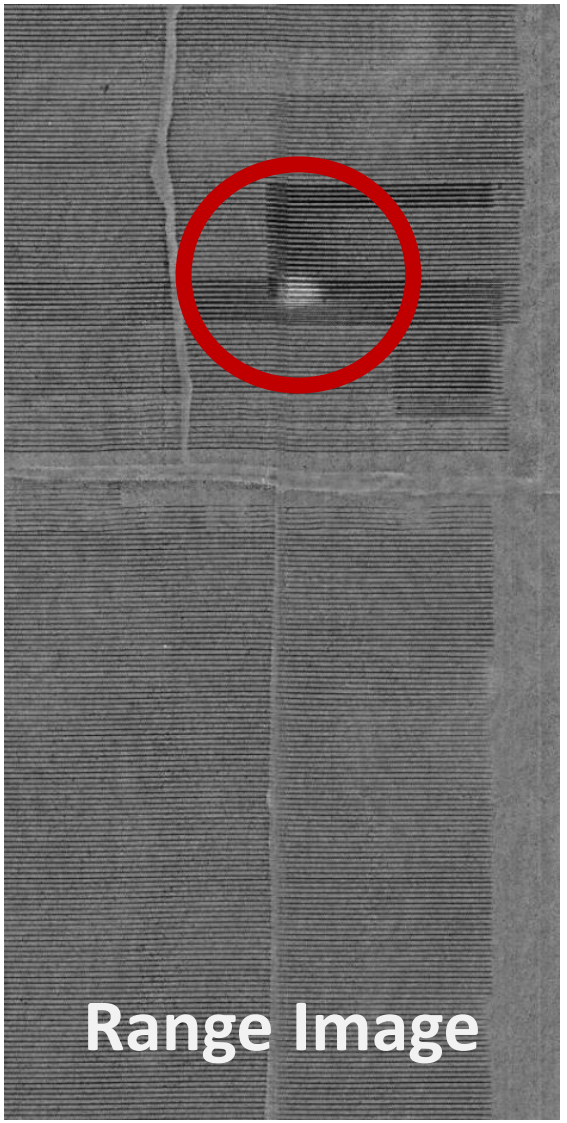


Dallas Fort Worth Airport ArcGIS Web Application



BWI Airport Runway Blister Analysis





QUESTIONS?

Thank you!

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