



Transportation Engineering and Safety
Conference

ENGINEERING & GUIDE RAIL MANAGEMENT

GIS AS A PLATFORM FOR
CONDUCTING GUIDE RAIL
ASSESSMENT.

December 7, 2017

ENGINEERING & GUIDE RAIL MANAGEMENT

Project Background

Existing Conditions

Project Approach

Data Collection

Engineering Metrics

Summary of Findings

Moving Forward

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PROJECT BACKGROUND



- Perform a comprehensive inventory and assessment of existing guide rail installations.
- Accurately locate and map the existing guide rail installations.
- Document the existing physical and warranting conditions (hazards).
- Prioritize guide rail upgrades and removal using a systematic approach.
- Achieve Long-Term Savings.

PROJECT BACKGROUND

Project Sponsor

- Delaware Valley Regional Planning Commission
- Fully Funded: \$966,000

Project Purpose

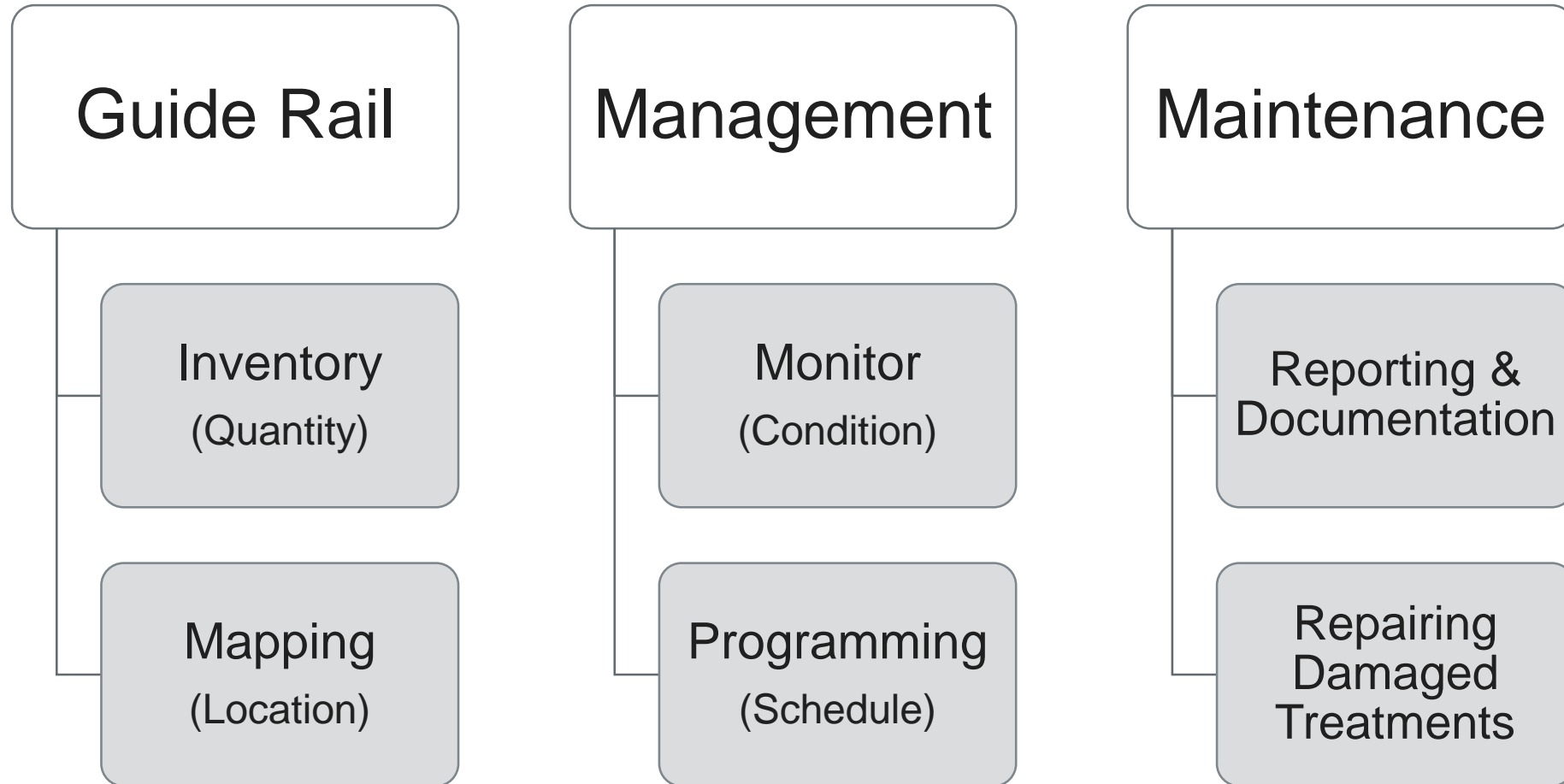
- Locate, Inventory & Assess
- Document & Report Design Conditions
- Upgrade Substandard Guide Rail

Project Need

- Prioritized Program of Improvements
- Establish a Maintenance Reporting System
- Improved Roadway Safety



PROBLEM STATEMENT



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EXISTING CONDITIONS

A. Types of Roadways

1. Non County Maintained Roadways
2. County Maintained Roadways (500 & Routes)

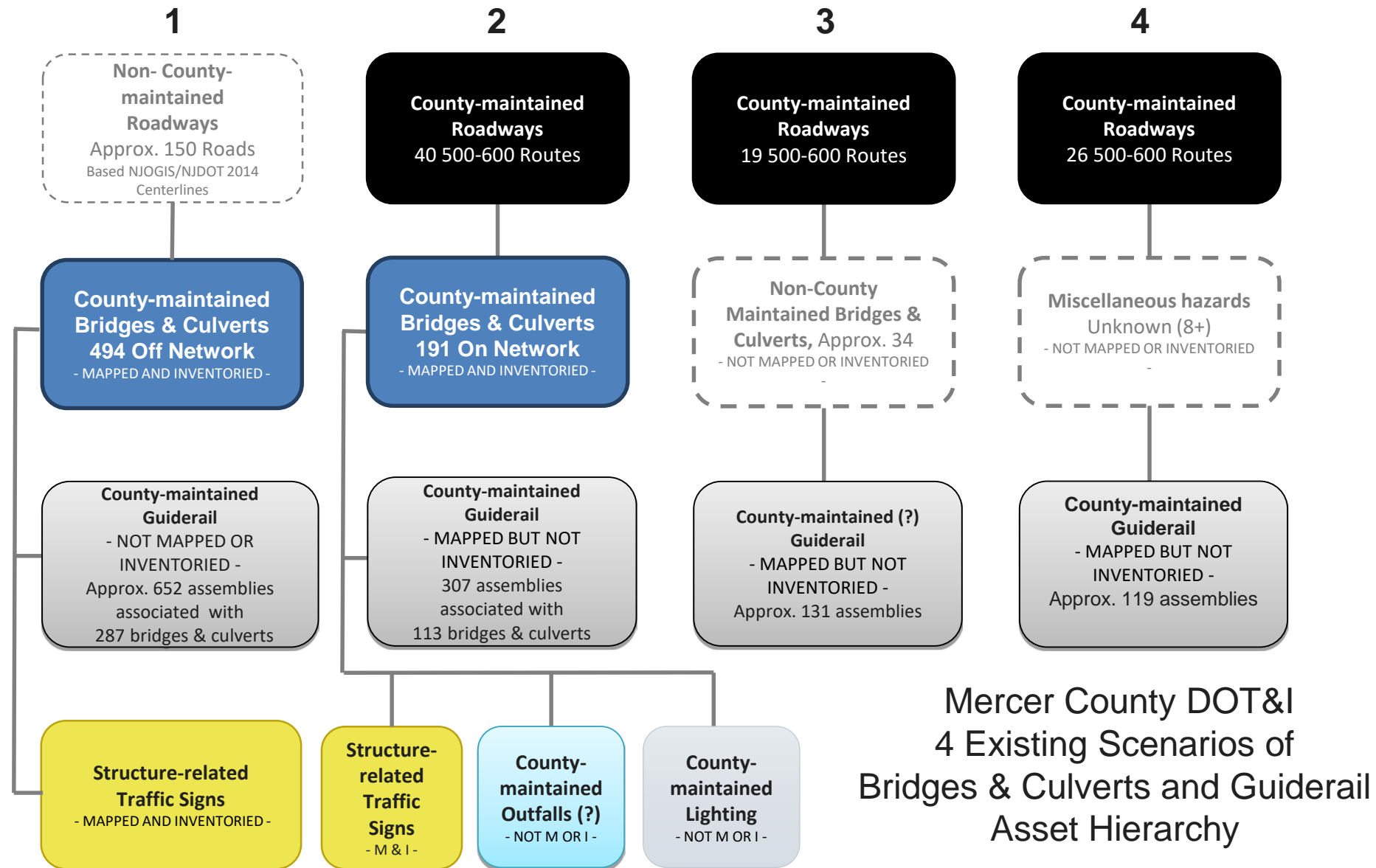
B. Types of Hazards

1. Bridges/Culverts
 - County – Maintained
 - Non County (State)
2. Miscellaneous Hazards/Warranting Obstructions

C. Existing Guide Rail

1. Mapped and Inventoried
2. Mapped, Not Inventoried
3. Not Mapped or Inventoried

ASSET HEIRARCHY



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PROJECT APPROACH

Scope of Services

- Complete On-Site Inventory
- Perform Engineering Assessments
- Prioritize Recommended Improvements

Technical Approach

- Led by JMT Technology Group
- Utilize Web-Based ArcGIS Online Platform
- “Real-Time” Data collection, Management and QC

TECHNICAL APPROACH

Define	Define Data Requirements
Establish	Establish Database Schema
Configure/Customize	Platform for Data collection, Management & QA/QC
Pilot	Pilot the Solution
Post-processing	Milepost assignments & Prioritization
Transfer	Transfer Solution to Client

TECHNICAL APPROACH

- Define Data Requirements

Develop database schema that supports business

Use available starting points

Ensure data supports asset location/data collection/photos

Integrate with existing GIS, asset management systems, & guiderail data

TECHNICAL APPROACH

Database Schema

- Guide Rail Leading/Trailing End Treatment
- Guide Rail Standard Data
- Guide Rail Condition Assessment
- Hazards/Warranting Obstructions
- Curb Start/End
- Rub Rail Start/End
- General Discrepancy Data
- Post processing (MP, prioritization, etc.)

36	GR Leading End Data	29	L_end_typ	Leading End Type	Field Determine	BCT, SRT, ET, ELT, CRT, QuadGuard, Buried, Other, Type A - Thrie Beam, Type A - W Beam	Text (20)	Required Before Delivery (No Nulls Allowed)	
37		30	L_end_fr	Leading End Flare	Field Determine	N/A, Straight, Parabolic	Text (10)	Required Before Delivery	
38		31	L_end_con	Leading End Condition	Field Determine	Acceptable; Not Acceptable	Text (15)	Required Before Delivery (No Nulls Allowed)	Not Acceptable = Priority 2
39		32	L_end_grd	Leading End Grading	Field Determine	Acceptable; Not Acceptable	Text (15)	Required Before Delivery (No Nulls Allowed)	Not Acceptable = Priority 3
40		33	L_end_no	Leading End Near Obstructions	Field Determine	Present; Not Present	Text (15)	Required Before Delivery (No Nulls Allowed)	Present = Priority 2
41		34	L_end_c_cm	Leading End Condition Comments			Text (255)		
42		35	L_end_com	Leading End Comments			Text (255)	Required in Leading End Near Obstructions =Present	

TECHNICAL APPROACH

JMT ArcGIS Online Technology Solution

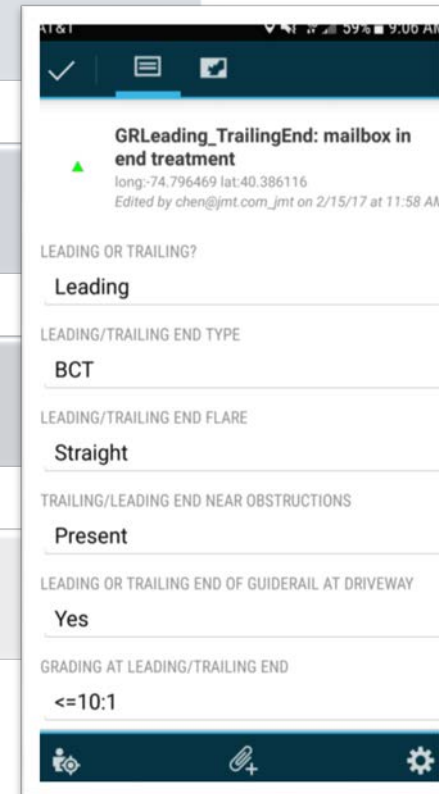
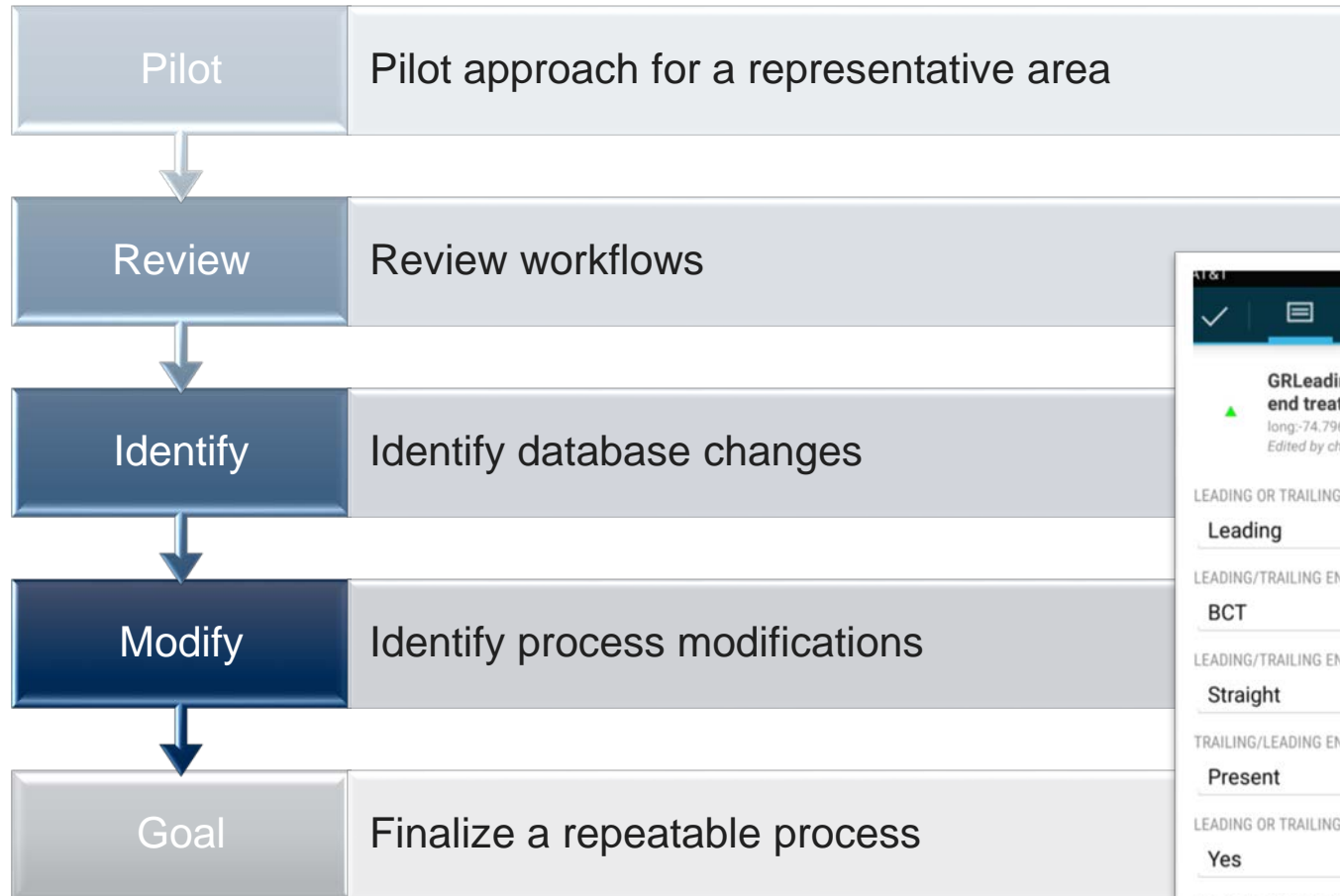
The screenshot shows the ArcGIS Online web map interface for a project titled "MC Guide Rails 4_3". The map displays an aerial view of a road and a creek labeled "Jacobs Creek". A black line represents the rail alignment, with various colored markers and lines indicating different data layers. The legend on the left lists the following categories and symbols:

- Leading/Trailing End**
 - Leading: Green triangle
 - Trailing: Red triangle
- GR Standard Data**: Black circle
- Rub Rail Start**: Green square
- Rub Rail End**: Red square
- Curb Start**: Green circle
- Curb End**: Red circle
- Hazards**: Red diamond
- General Discrepancy Data**: Blue circle
- Condition Assessment**: Purple circle
- MC Hazard Groups**: Black cross

The interface includes a search bar at the top right with the text "Find address or place", a scale bar at the bottom left showing 0, 20, and 40 feet, and a "POWERED BY esri" logo at the bottom right. The URL in the browser address bar is "jmt.maps.arcgis.com/home/webmap/viewer.html?webmap=ec3d92af29804386aed8c857988cc8b2".

TECHNICAL APPROACH

Pilot the Solution (Field Test)



TECHNICAL APPROACH

Web-Based Management & QC

Home ▾ MC Guide Rails 6_5 New Map ▾ Create Presentation Jonathan ▾

Details Add Edit Basemap Analysis Save Share Print Directions Measure Bookmarks Find address or place

About Content Legend

Contents

- Site Visit Required
- fishnet Collector6 5
- Rub Rail Start
- Rub Rail End
- Curb Start
- Curb End
- Hazards
- General Discrepancy Data
- Condition Assessment
- MC Hazard Groups
- MC-Bridges And Culverts
- MC Guiderail Assembly Lengths
- MC Roads
- DVRPC Traffic Counts
- No Guide Rail
- Topographic

(1 of 2)
No Guide Rail: bridge parapet
Comments parapet
Attachments:
No Guide
Rail_1_0_ArcGISApp_1491832978584.jpg
No Guide
Rail_1_0_ArcGISApp_1491832910046.jpg
Edited by JCarr@jmt.com_jmt on 5/1/17 at 9:35 PM
Zoom to Get Directions Edit

412 (2688x1512)
services1.arcgis.com/oS5ru2iHb8I5viTv/arc...
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Bucks County, PA, Mercer County, NJ, State of New Jersey, Esri, HERE, Garmin, INCREMENT P, Intermap, USGS, EPA, USDA | Recipients of DVRPC digital files will credit DVRPC as the...

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Project Background

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Data Collection

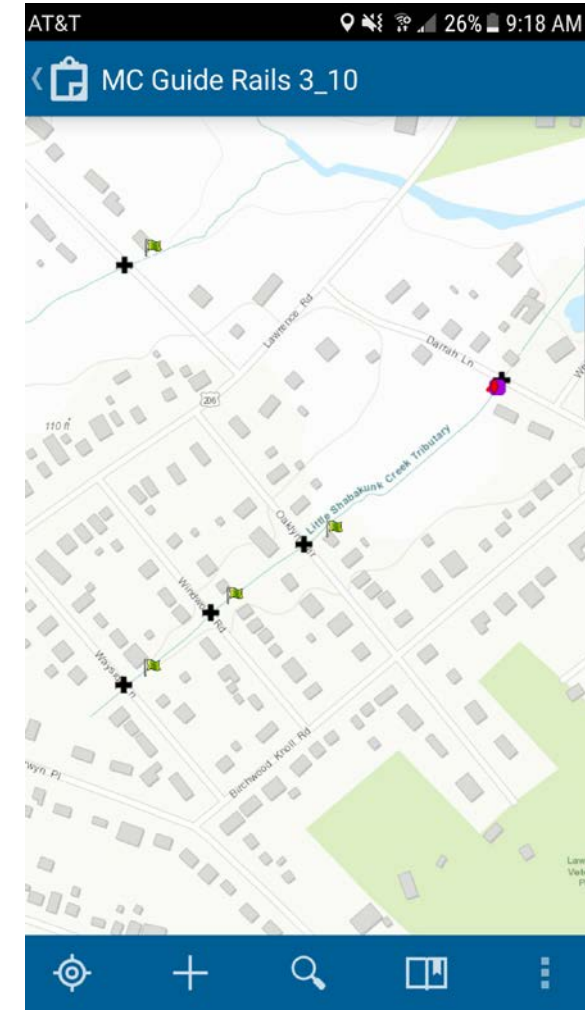
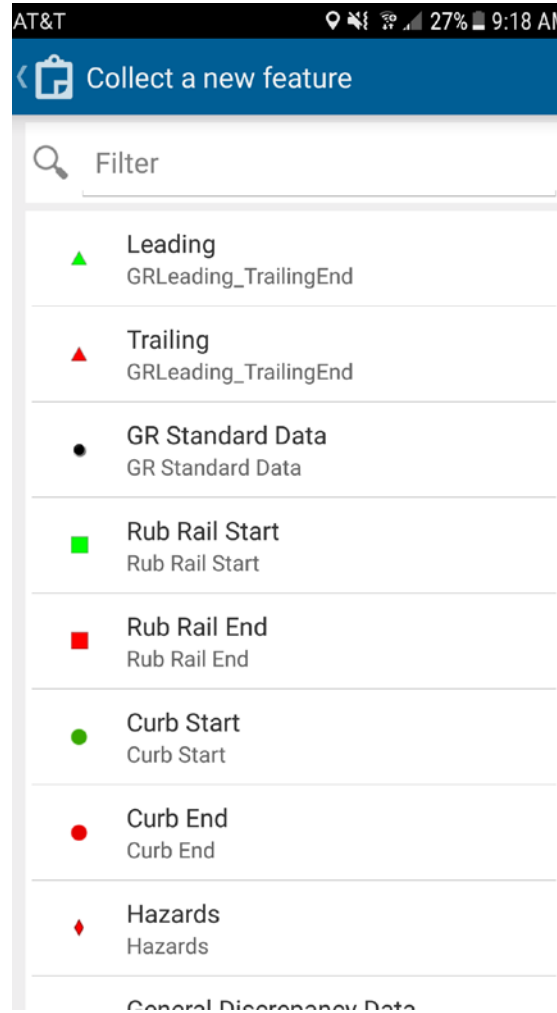
Engineering Metrics

Summary of Findings

Moving Forward

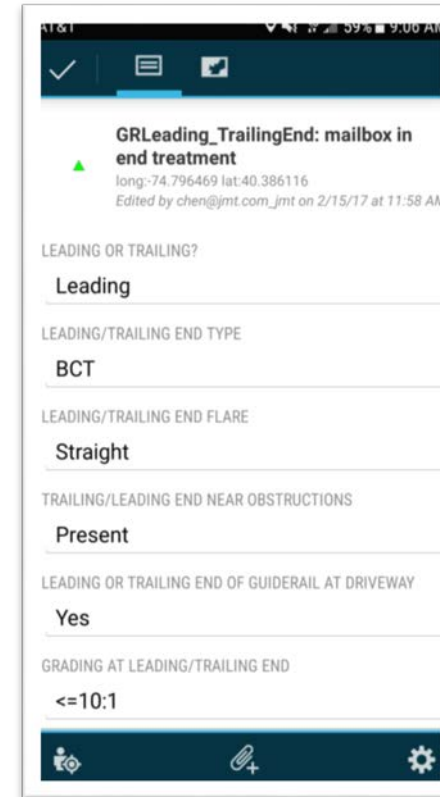
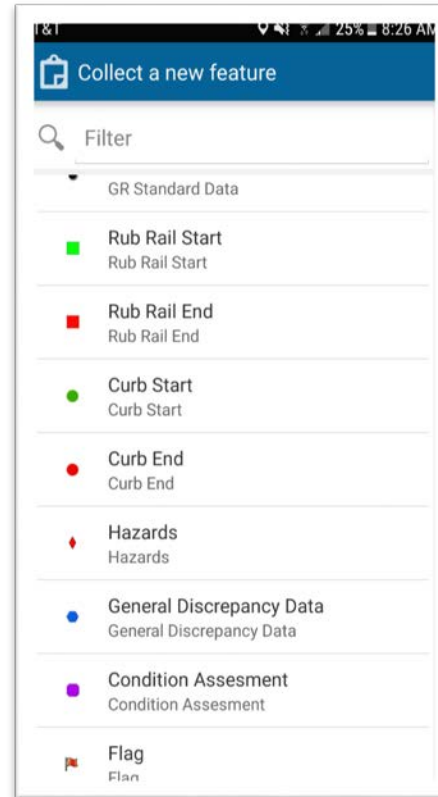
DATA COLLECTION

- **ArcGIS Platform**
- **Web-Based Online Management**
- **GIS Collector Application**
- **Verizon Ellipsis Tablets**



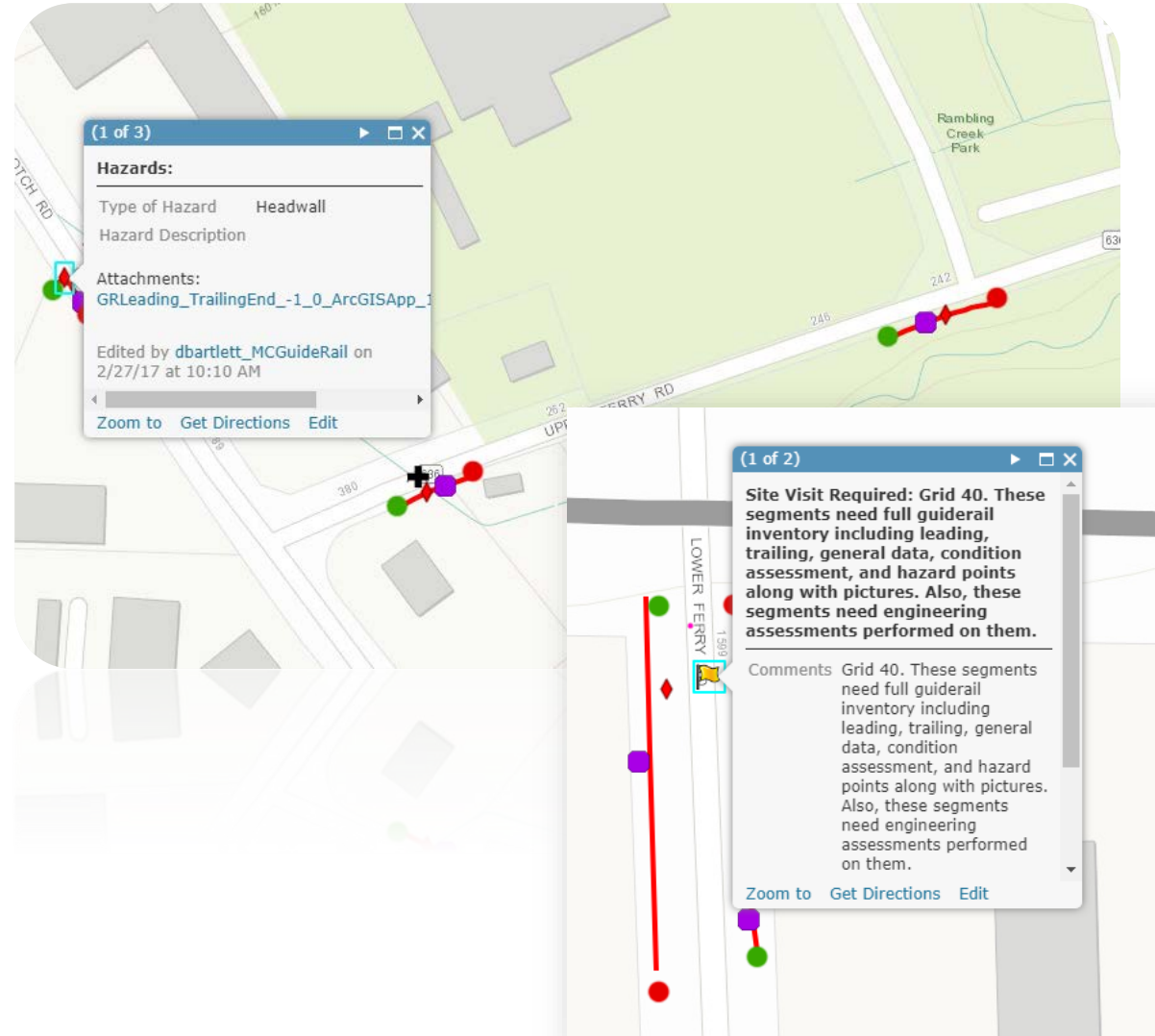
DATA COLLECTION

- **Over 80 Data Collection Elements**
- **Categorized by Type**
 - Rub Rail (Start/End)
 - Curb (Start/End)
 - End Treatments
 - Standard Data
 - Hazards
 - General Discrepancy Data
 - Conditions Assessment
 - Flags



DATA COLLECTION

- All Information Geo-Coded
- Data Options
 - Drop Down Menus
 - Data Inputs
 - Alpha-Numeric Options
 - Notes
 - Photos
- Changes / Edits are Tracked
- Pre-Screen Locations
 - Input Prior to Field Visits

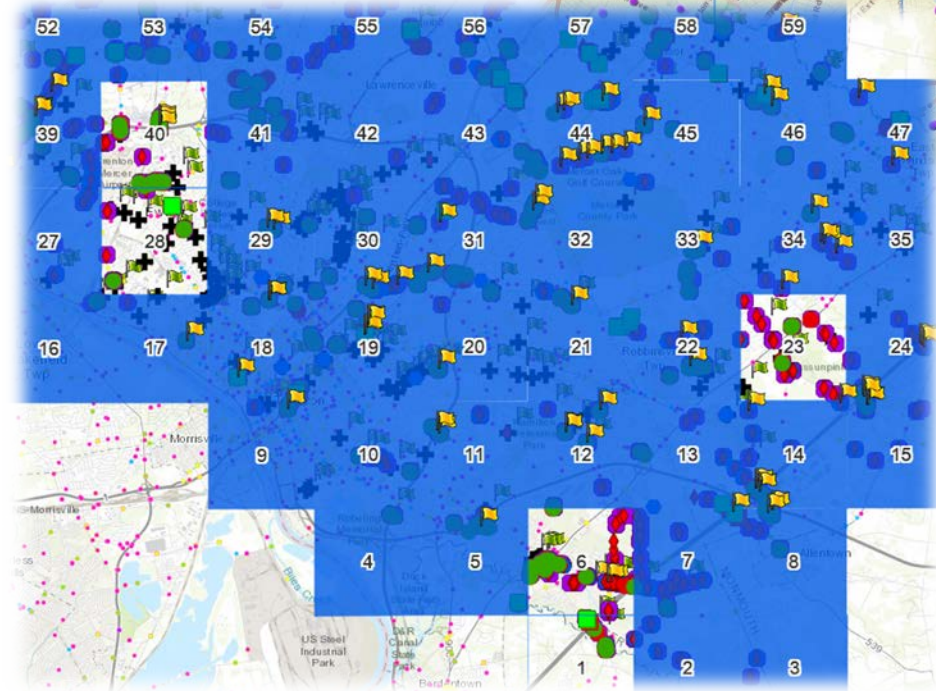
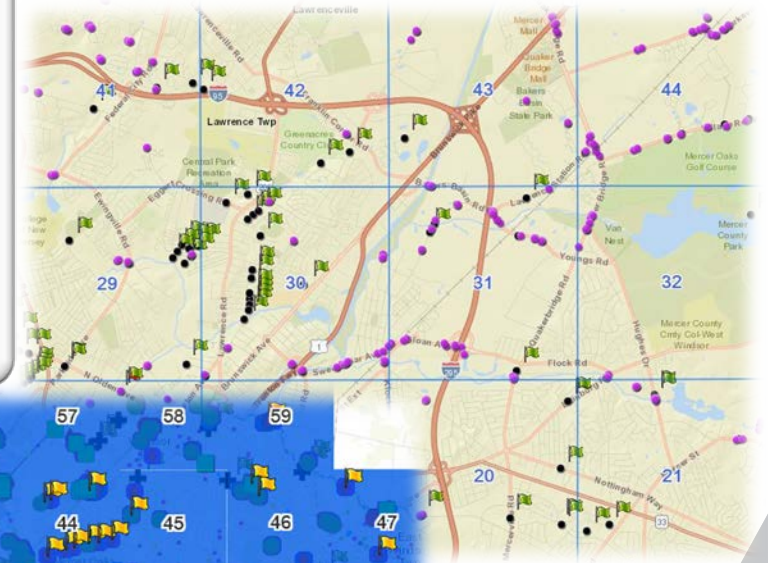


DATA COLLECTION

- **Engineers Perform On-Site Inspection**
 - By Route
 - By Grid
- **Address Field Issues**
 - Photos
 - Flags
- **Project Management via Dashboard**
 - Track Progress
 - Identify Issues

Location

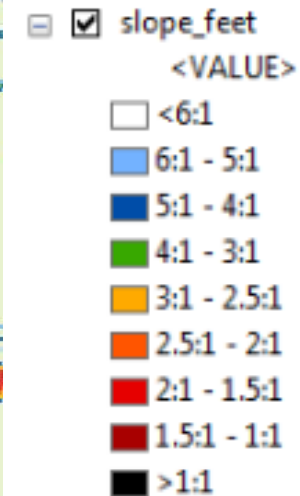
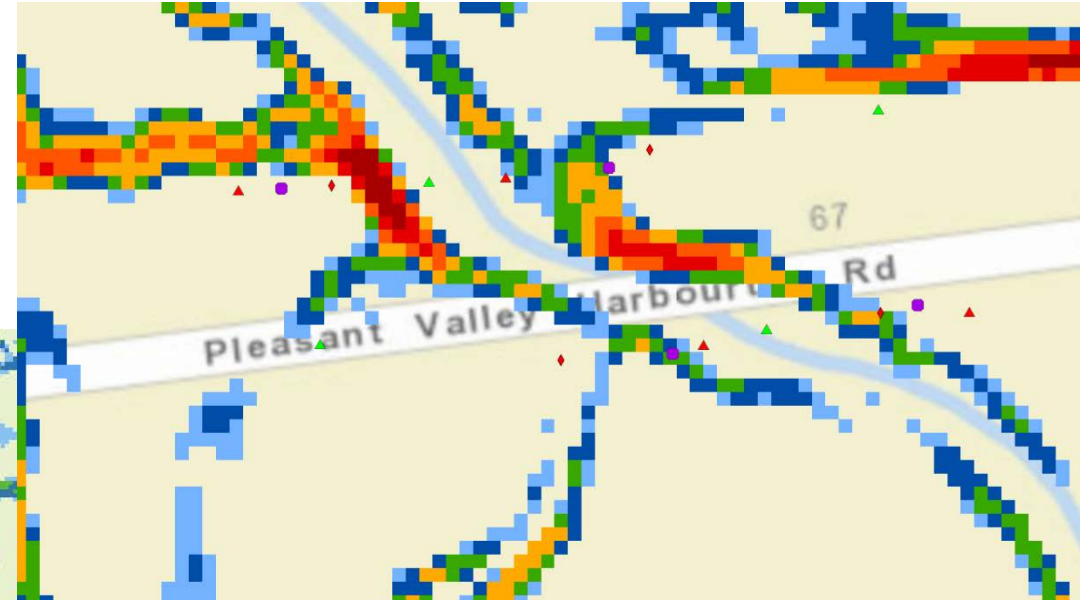
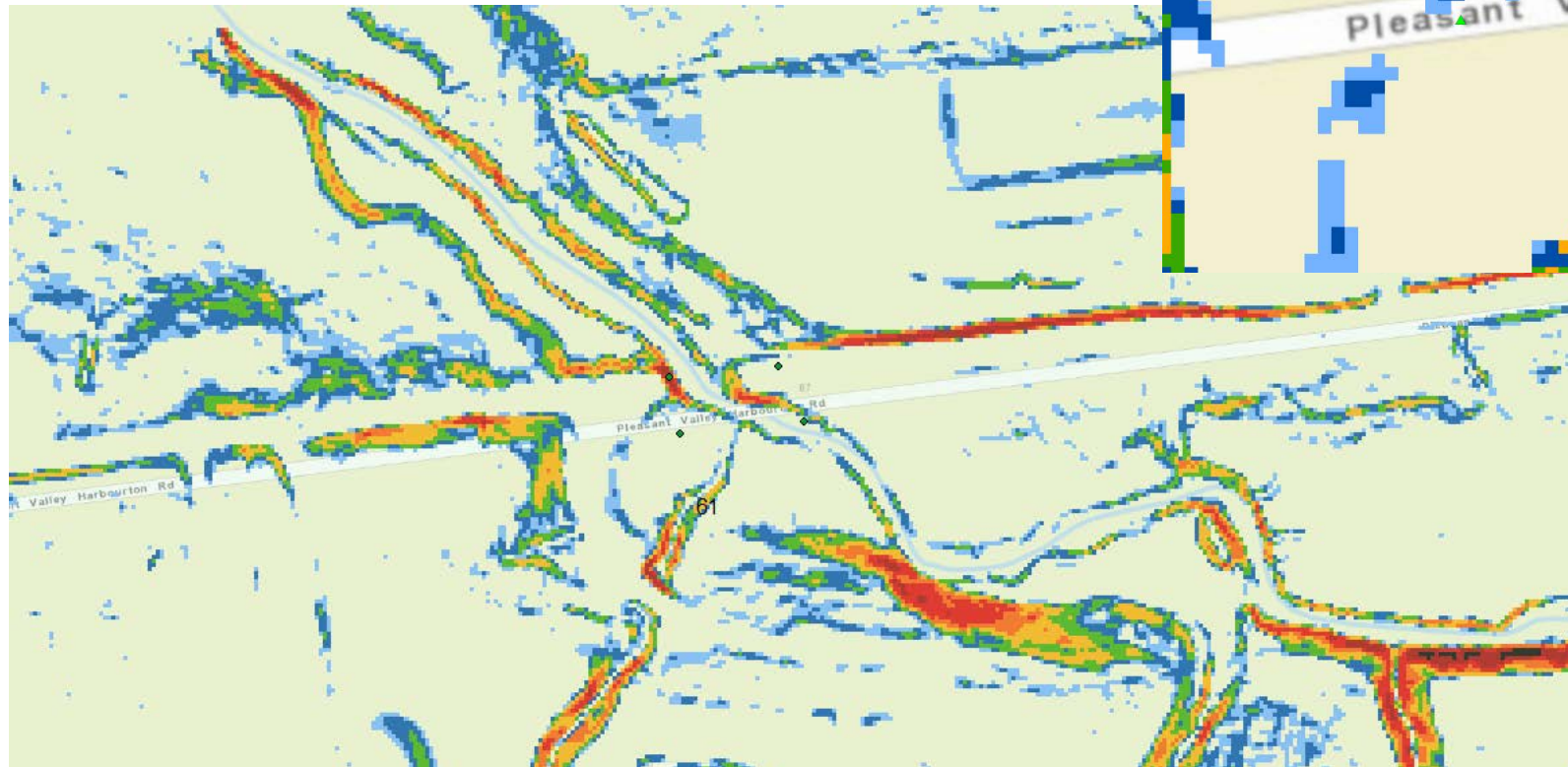
- ◆ Not Inventoried - Default
- ◆ Field Inventory
- ◆ In House Population
- ◆ Needs Field Review
- ◆ Needs Office Review
- ◆ Reviewed in House



DATA COLLECTION

Aerial LiDAR

- Verify Slope Criteria
- Pre-Screen Locations
- Identify Warranting Conditions



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CONDITION ASSESSMENT

The FHWA Standard Functional Table (inset below) is the basis for the functional scoring.

The FHWA uses this table to assess the extent of damage and Assign **Functionality**

The FHWA Functionality Categories are listed as follows:

Guide Rail no Longer Reasonably Functional;

Guide Rail Should Function Adequately under a majority of impacts; and,

Should not impair the Guide Rail's Ability to perform.

STANDARD SECTION OF W-BEAM			
EXTENT OF DAMAGE			FUNCTIONALITY
RAIL ELEMENT SEPARATED			1
RAIL ELEMENT TORN			1
TOP OF RAIL HEIGHT < 24"			1
RAIL ELEMENTS INTACT	<6"	AMOUNT OF BROKEN/BENT OR SEPARATED POSTS	
		0	3
		1-2	2
FULL SPLICES	6" - 12"	≥3	1
		0-2	2
TOP OF RAIL HEIGHT ≥25**	≥18"	NOT APPLICABLE	1

* Guardrail less than 26" should be considered for replacement.

FUNCTIONALITY CATEGORIES

- 1 Guardrail no longer reasonably functional
- 2 Guardrail should function adequately under a majority of impacts
- 3 Should not impair the guardrail's ability to perform

PRIORITIZATION

The FHWA Functional Scoring System is utilized as the baseline to develop a standardized rating scale for comparing guide rail assemblies for the project.

- **Existing, To Remain**

Guiderail is installed with crash-worthy end-treatments, no extensive damage to physical conditions and immediate improvements are not warranted.

- **Acceptable, To Be Improved**

Guiderail does not require full replacement, but has been assessed in need of minor repairs, upgrades, or improvements based upon the existing conditions.

- **Damaged, To Be Replaced**

Guiderail assessed to be damaged to the point where it will not function properly.

PRIORITIZATION

- The FHWA Functional Scoring System is customized to develop a Zero (0) to Ten (10) Rating Scale for prioritizing guide rail.
- Other Design Criteria utilized to evaluate Guide Rail included:
 - Roadway Information:** Posted Speed Limit, AADT, Crash History.
 - Design Features:** Length of Need, post spacing, warranting analysis.
 - Rail Elements:** Rail height, spacer blocks, bolt connections and washers.
 - End Treatments:** Type, Condition, proximity to fixed objects/utility poles.

CONDITIONS ASSESSMENT			
Rail Element			
Top of Rail Height =	<24		
Rail Element Condition =	Intact		
Rail Element Alignment =	Aligned		
No. of Broken, Bent, or Separated Posts =	2		
Rail Element Functionality =	1		
Spacer Blocks			
Spacer Block Material =	None		
No. Damaged Blocks =			
Spacer Block Comments =			
Spacer Block Functionality =	1		
Bolts			
Bolts Connecting Rails, Spacers, and Posts =	Present		
No. Incomplete Bolt Connections =	1		
Bolt Functionality =	2		
Posts			
Post Spacing at Obstruction =	Typical		
Post Functionality =	0		
Total Functional Score =		4	
			FHWA Functional Score = 1

STANDARD SECTION OF W-BEAM			
EXTENT OF DAMAGE		FUNCTIONALITY	
RAIL ELEMENT SEPARATED		1	
RAIL ELEMENT TORN		1	
TOP OF RAIL HEIGHT < 24"		1	
RAIL ELEMENTS INTACT	<6"	AMOUNT OF BROKEN/BENT OR SEPARATED POSTS	
		0	3
FULL SPLICES	6" - 12"	1-2	2
		≥3	1
TOP OF RAIL HEIGHT ≥25"	≥18"	0-2	2
		≥3	1
		NOT APPLICABLE	1

* Guardrail less than 26" should be considered for replacement.

FUNCTIONALITY CATEGORIES
 1 Guardrail no longer reasonably functional
 2 Guardrail should function adequately under a majority of impacts
 3 Should not impair the guardrail's ability to perform

Vegetation within 4' of Guide Rail =	Not Present
Utility Poles Present =	Present
Utility Poles Location =	Behind
Utility Poles Comments =	<4 ft behind GR
Fixed Obstructions Present =	Present
Fixed Obstructions Location =	Behind
Fixed Obstructions Comments =	Bridge Railing

PRIORITIZATION

- The Final Prioritization & Functional Scoring System creates nine classifications of Guide Rail.
 - Low, Medium and High Priority within the Three (3) Classifications

PRIORITY LEVEL CATEGORIZATION					
Total Functional Score =	10				
Length of Need =	225				
Leading End Treatment =	SKT				
Trailing End Treatment =	GR Attachment				
Design Speed/A.D.T. Class =	40-50 MPH: Over 6,000				
				Classification	
Priority Level		Low	Medium	High	Description of Condition
A	Functional, To Be Maintained	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
B	Acceptable, To Be Improved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
C	Damaged, To Be Replaced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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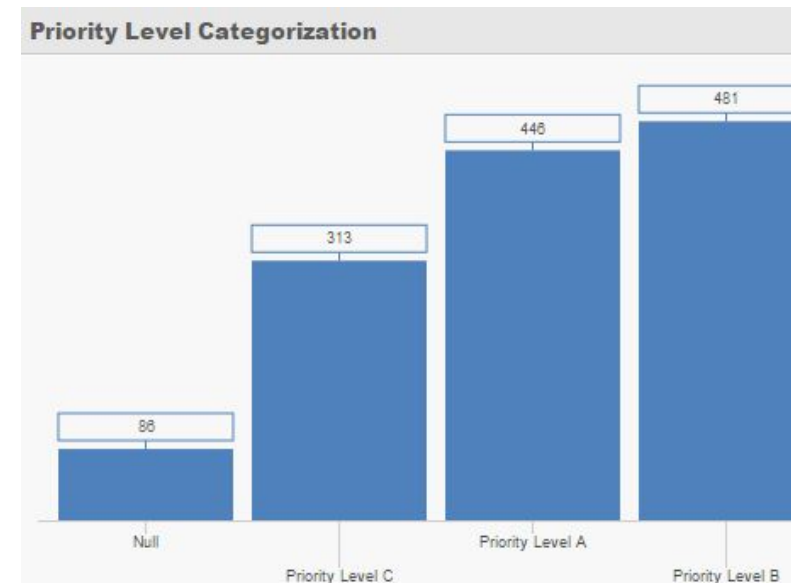
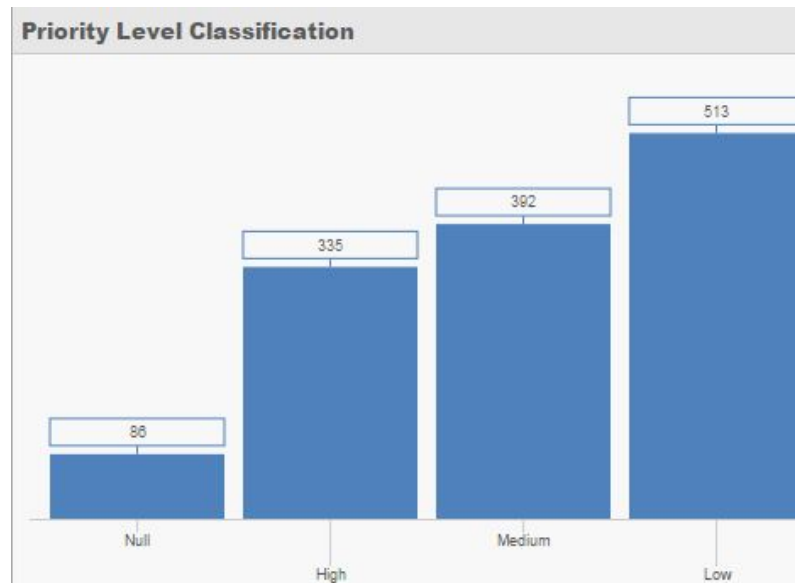
Summary of Findings

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CONDITION ASSESSMENT

Guide Rail Prioritization Matrix

Priority Level		Low	Medium	High	Total
A	Functional, To Be Maintained	135	154	157	446
B	Acceptable, To Be Improved	181	169	131	481
C	Damaged, To Be Replaced	197	69	47	313
Total		513	392	335	1,240



SUMMARY OF FINDINGS

Guide Rail Inventory Summary

- 1,326 Guide Rail Assemblies Mapped
- 1,240 Guide Rail Assemblies Inventoried
- 2,551 Guide Rail End Treatments Inventoried
- 275 Off-Network Bridges/Culverts with No Guide Rail Assemblies
- 47 High-Priority Guide Rail Assemblies

Guide Rail End Treatment Inventory Summary

- 148 SKT
- 85 FLEAT
- 71 ET2000
- 428 BCT
- 6 ELT
- 115 SRT
- 23 CRT
- 504 GR Attachment
- 7 Impact Attenuator
- 134 Flared End
- 12 Turned Down
- 351 Rounded End
- 97 End Anchor
- 3 BIB
- 443 Other (Shovel Shaped)
- 124 Bullnose

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IMPLEMENT IMPROVEMENTS

- Nine Classifications of Guide Rail
- Short –Term and Long-Term Improvements
 - The **short-term recommendation** will address the immediate/high-priority improvements needed to improve guide rail functionality.
 - The **long-term recommendation** will identify the “planning-level” guide rail and/or roadside improvements which should be implemented to sustain guide rail compliancy and functionality.

<i>Priority Level</i>		<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Total</i>
<i>A</i>	<i>Functional, To Be Maintained</i>	<i>135</i>	<i>154</i>	<i>157</i>	<i>446</i>
<i>B</i>	<i>Acceptable, To Be Improved</i>	<i>181</i>	<i>169</i>	<i>131</i>	<i>481</i>
<i>C</i>	<i>Damaged, To Be Replaced</i>	<i>197</i>	<i>69</i>	<i>47</i>	<i>313</i>
<i>Total</i>		<i>513</i>	<i>392</i>	<i>335</i>	<i>1,240</i>

LESSONS LEARNED

- Pilot Field Test
- Bridge/Structure Attachments
 - Transition Segments
- Short –Term and Long-Term Improvements
 - Maintenance vs. Enhancements

NEXT STEPS

Program Improvements (Preliminary Cost Estimates)

Create a System Capable of Supporting Future Projects

- Identify Guide Rail for Removal
- Assess Critical Slopes
- Review Hazards & Warrants
- Identify Unprotected Warranting Conditions
- Complete Inventory of Structures (Bridges/Culverts)

Implement Design, Construction & Maintenance



CONTACT INFORMATION

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