

Updates on the Crossing-i System for Highway/Rail Grade Crossing Inspection

MnDOT Results Overview, Jan. 20, 2022

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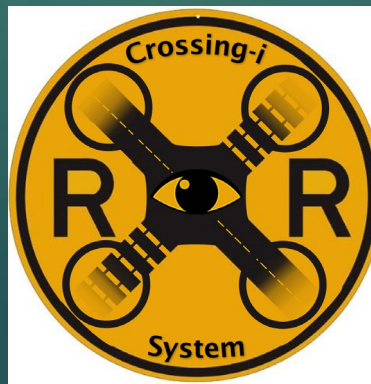
PASI LAUTALA



Michigan
Technological
University

Introduction

- ▶ Project goals:
 - ▶ Develop a drone-based grade crossing inspection system
 - ▶ Humped crossing analysis
 - ▶ Visual sight lines
 - ▶ Railway infrastructure assessment
 - ▶ Determine if & how drone data can be used for automated assessments of railway crossings
- ▶ Phase I SBIR resulted in new Crossing-i system
- ▶ FRA Research Report for Phase I:
<https://railroads.dot.gov/elibrary/automated-drone-based-inspection-system>



Phase II SBIR

- ▶ Phase II Focus
 - ▶ Commercialization
 - ▶ Developing Automated Tools
- ▶ Automated Profile Assessment Tool
 - ▶ Identifies the potential for a vehicle to become hung up on a crossing
 - ▶ Able to assess any vehicle configuration
- ▶ Railroad Grade Crossing Viewshed Tool
 - ▶ Identifies if crossings meet sight line requirements
 - ▶ Uses AASHTO Greenbook guidelines by default but can use any custom input for assessment

2021 Crossings

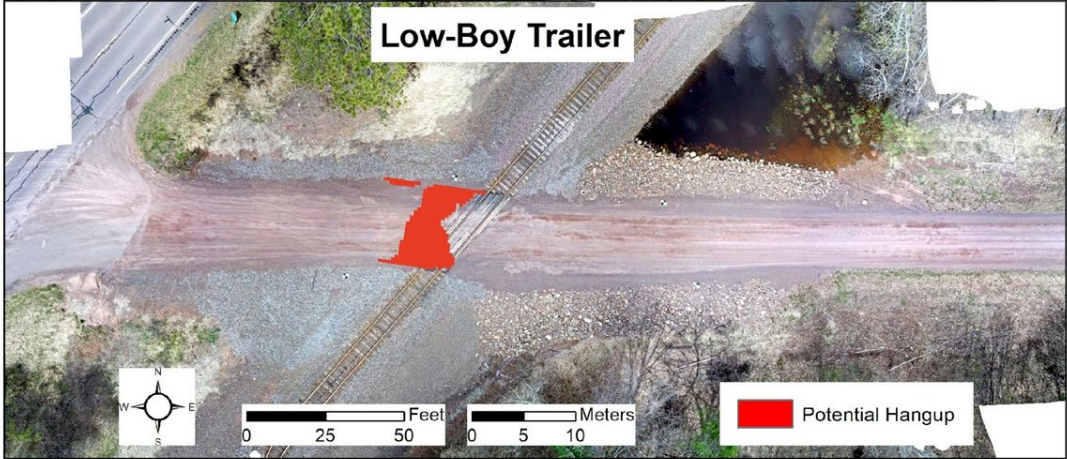
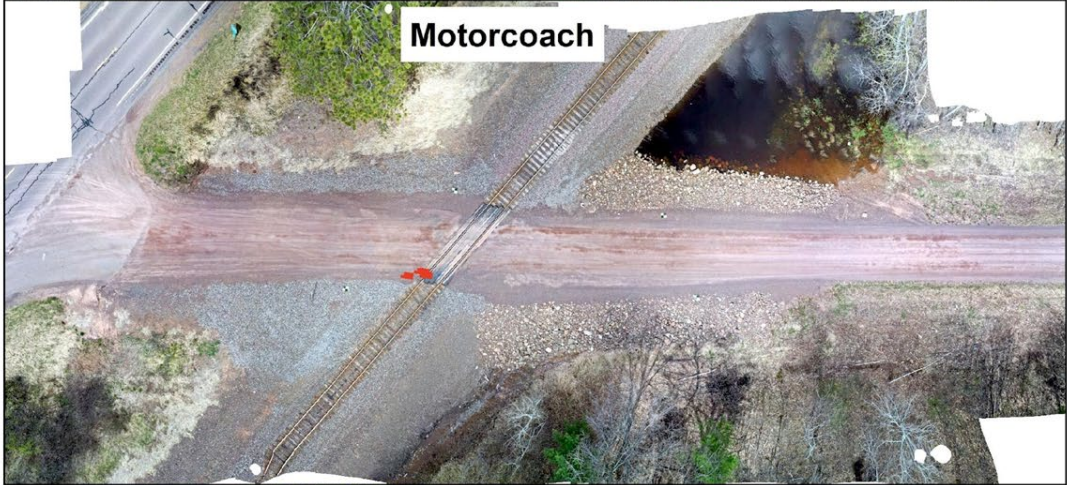
- ▶ Michigan - LSRC
 - ▶ 6 Sites
- ▶ Indiana - IDOT
 - ▶ 7 Sites
- ▶ Illinois - ICC
 - ▶ 1 Site with 3 crossings
- ▶ Minnesota - MnDOT
 - ▶ 12 Sites
- ▶ Wisconsin - WisDOT
 - ▶ 6 Sites (Nov. 2021)



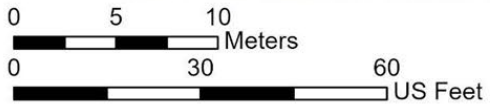
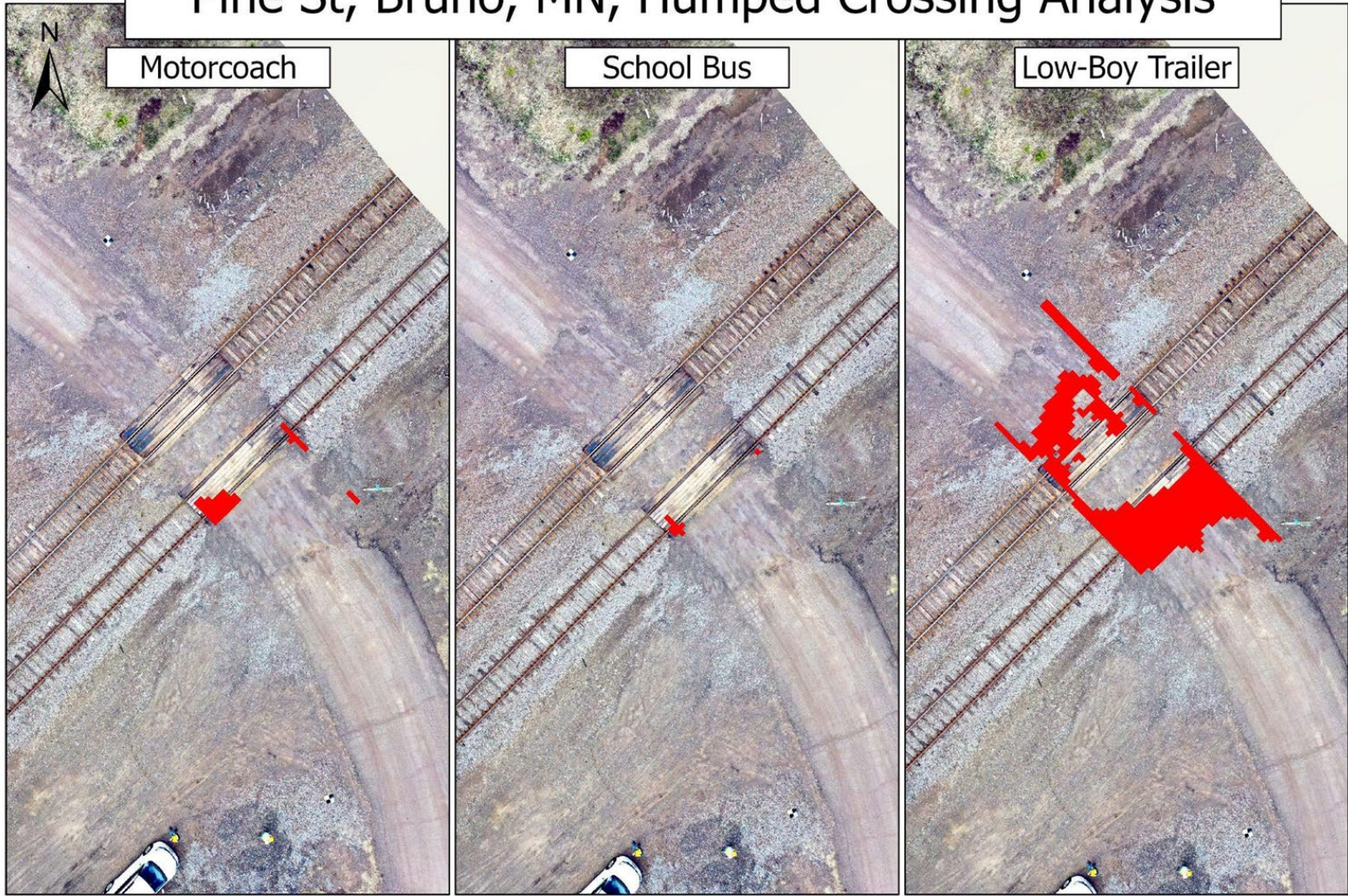
Automated Profile Assessment Tool

- ▶ Identifies the potential location where a vehicle could impact the ground at a crossing
- ▶ Vehicle configurations automatically tested, more can be added:
 - ▶ Low-Boy Trailer
 - ▶ Wheel Base – 30 ft
 - ▶ Ground Clearance – 5 inches
 - ▶ Motorcoach
 - ▶ Wheel Base – 27 ft
 - ▶ Ground Clearance – 7 inches
 - ▶ School Bus
 - ▶ Wheel Base – 23 ft
 - ▶ Ground Clearance – 7 inches

Root Rd.
(#076421X)
humped
crossing
analysis results
example



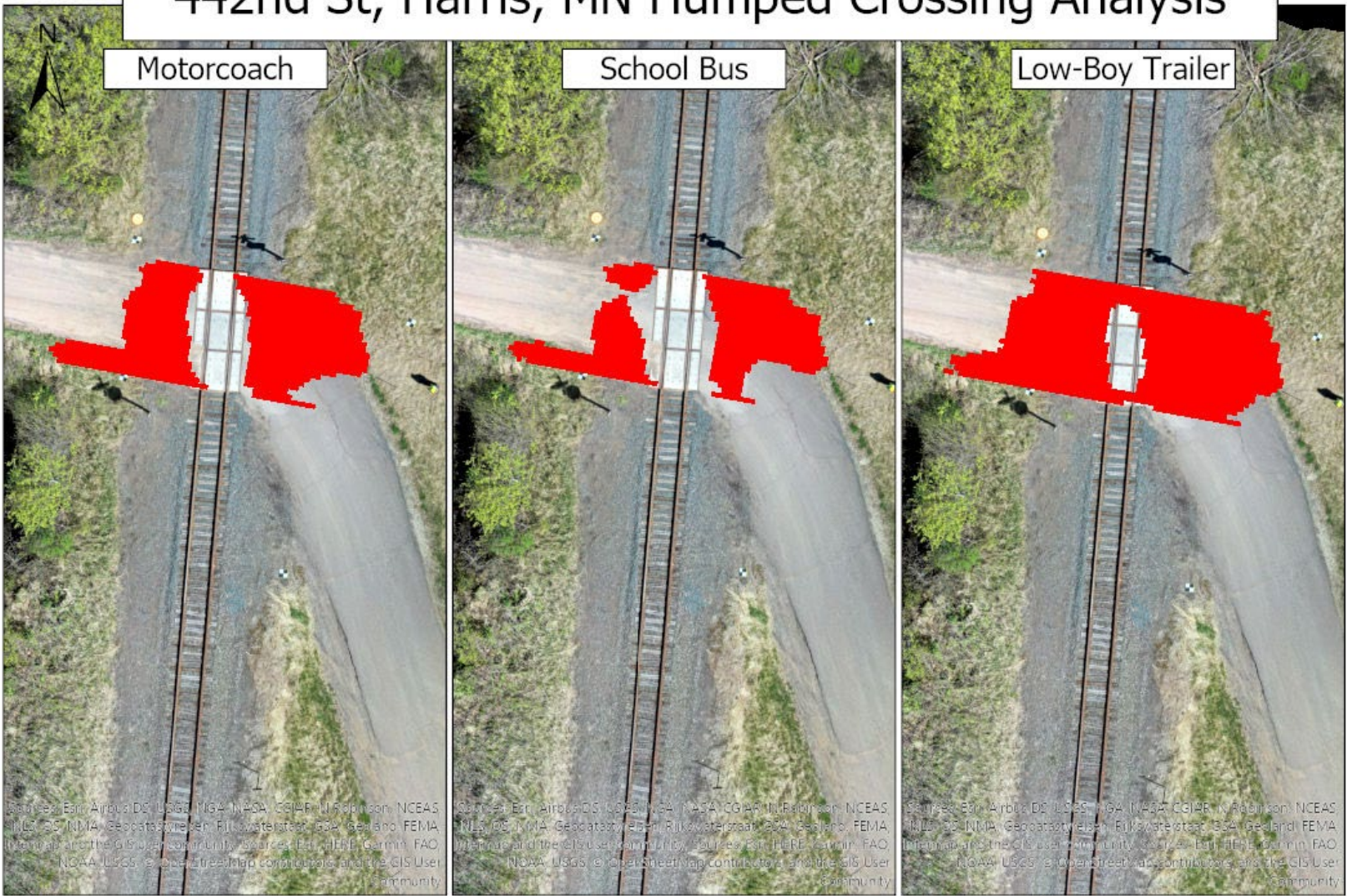
Pine St, Bruno, MN, Humped Crossing Analysis



Hang Up Locations: 

Pine St Crossing ID#:076426G

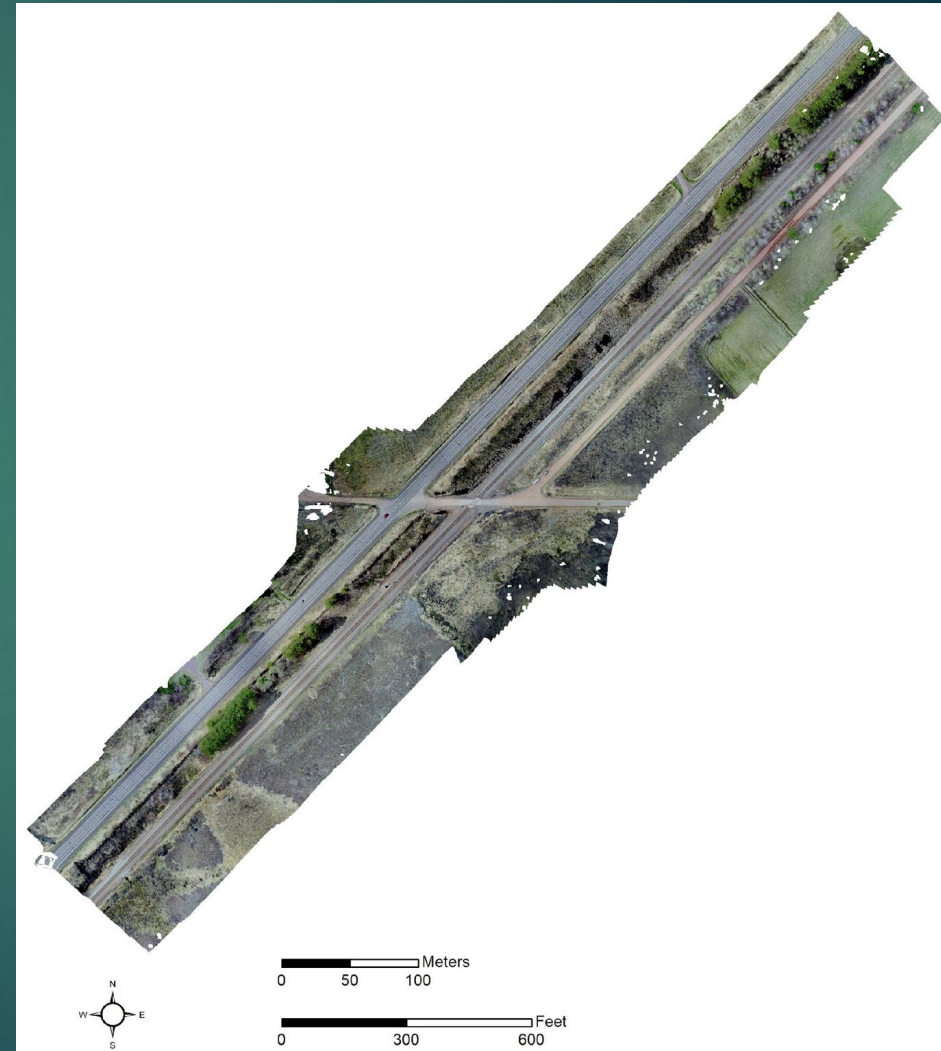
442nd St, Harris, MN Humped Crossing Analysis

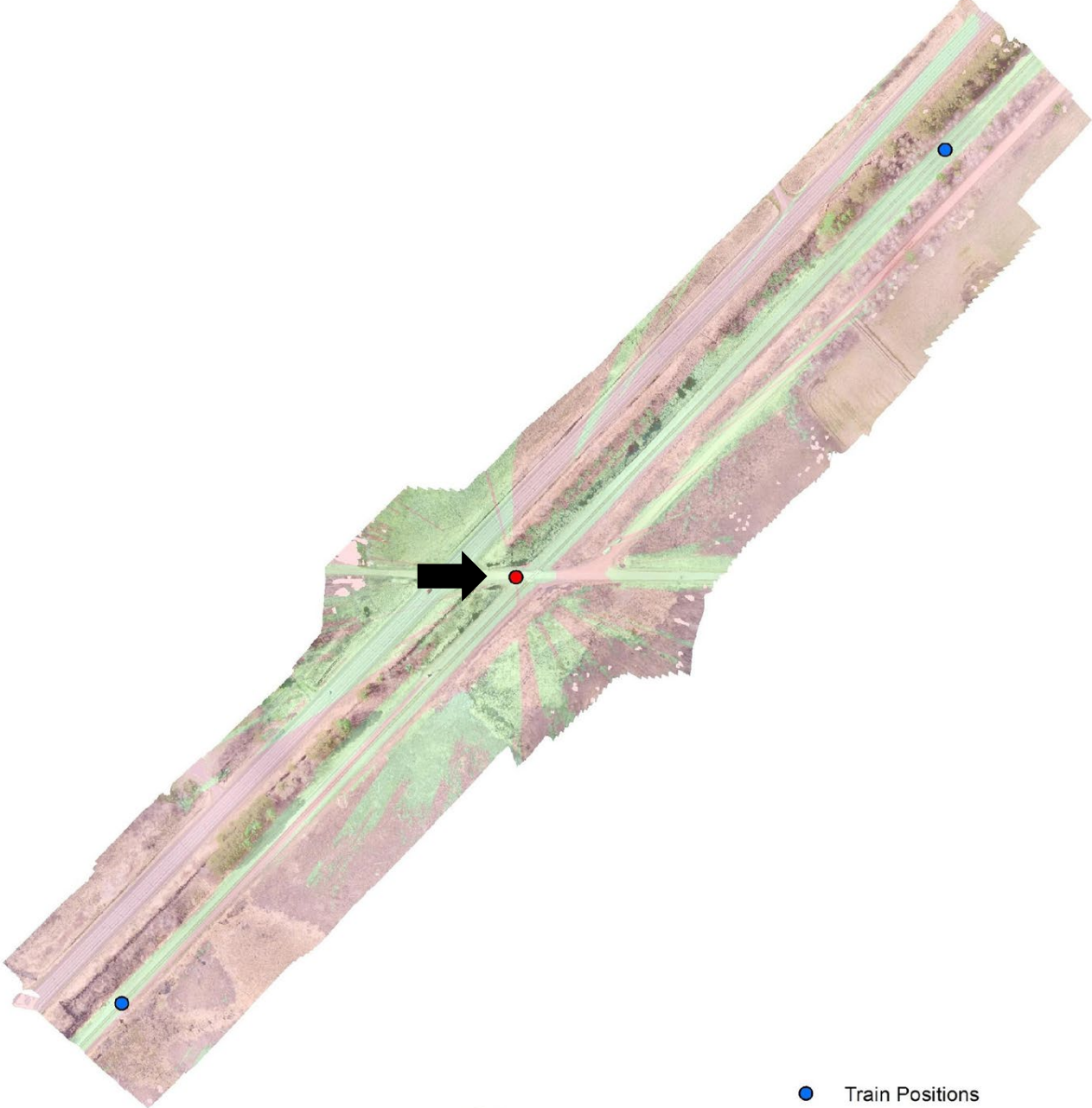


Erickson Rd. (076437U) Crossing in Minnesota – Viewshed Tool results

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- ▶ Stop sign at crossing
- ▶ Typical train speed is 1 – 50 mph
 - ▶ BNSF / NLX line Duluth to Twin Cities
- ▶ AASHTO Greenbook train distance: 1,202 ft

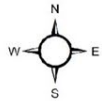
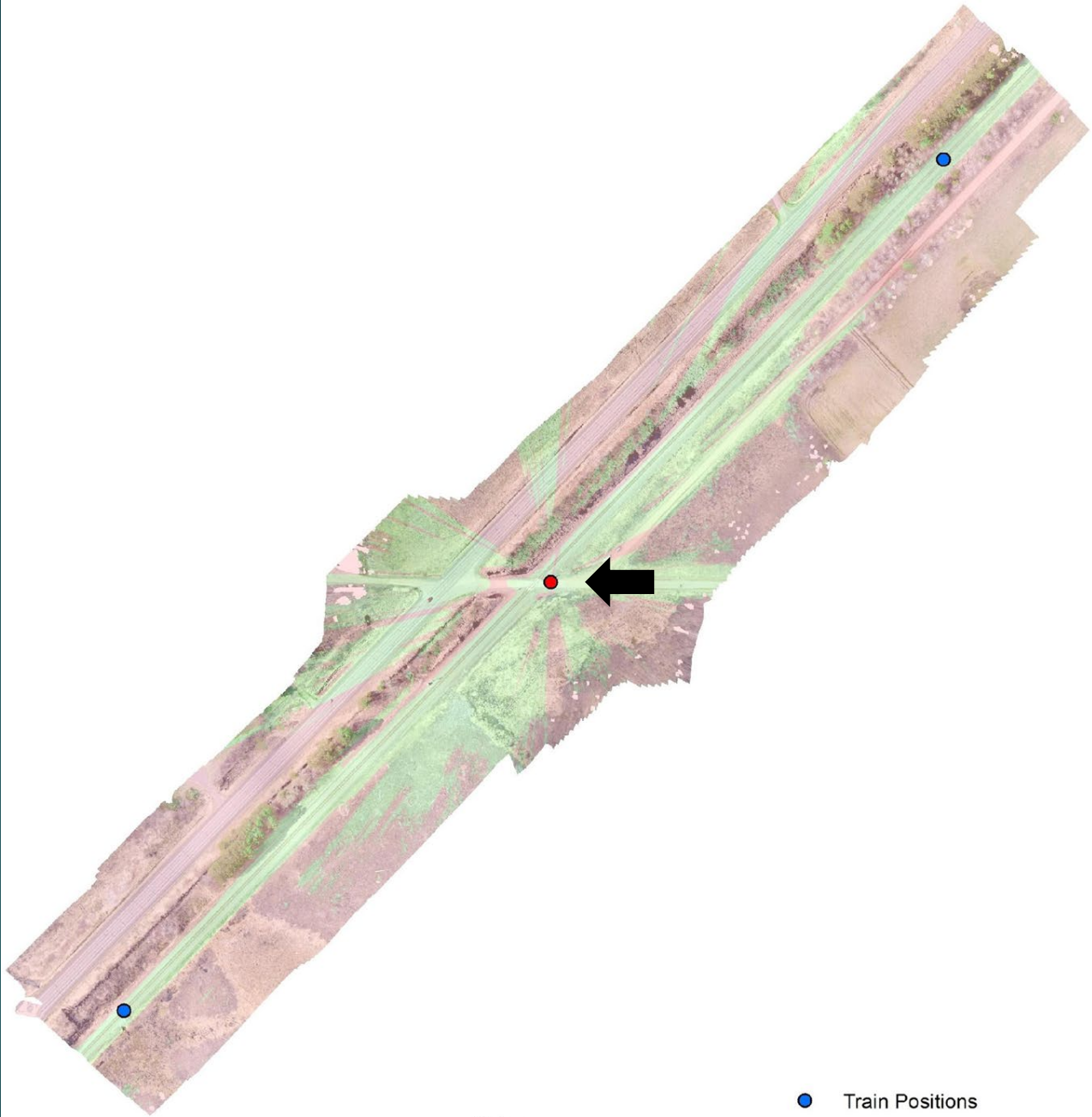




0 50 100 Meters

0 300 600 Feet

- Train Positions
- Vehicle Position
- Not Visible
- Visible

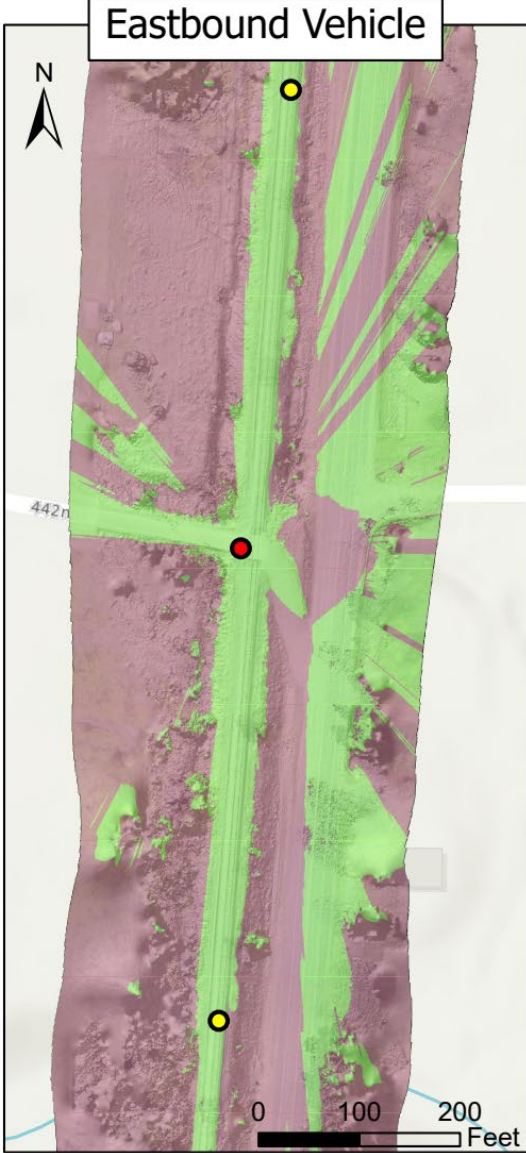
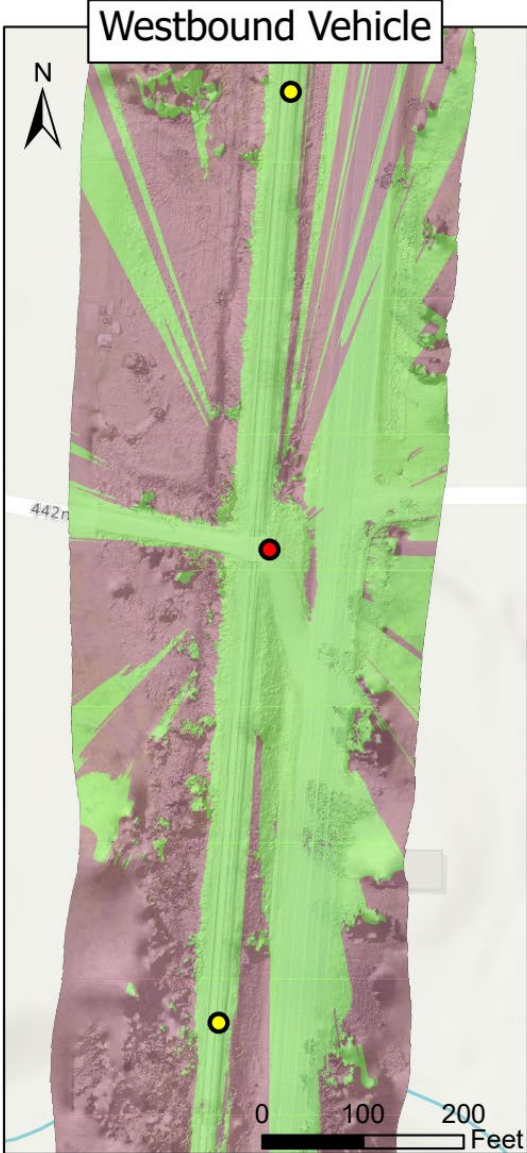


0 50 100 Meters

0 300 600 Feet

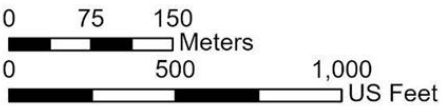
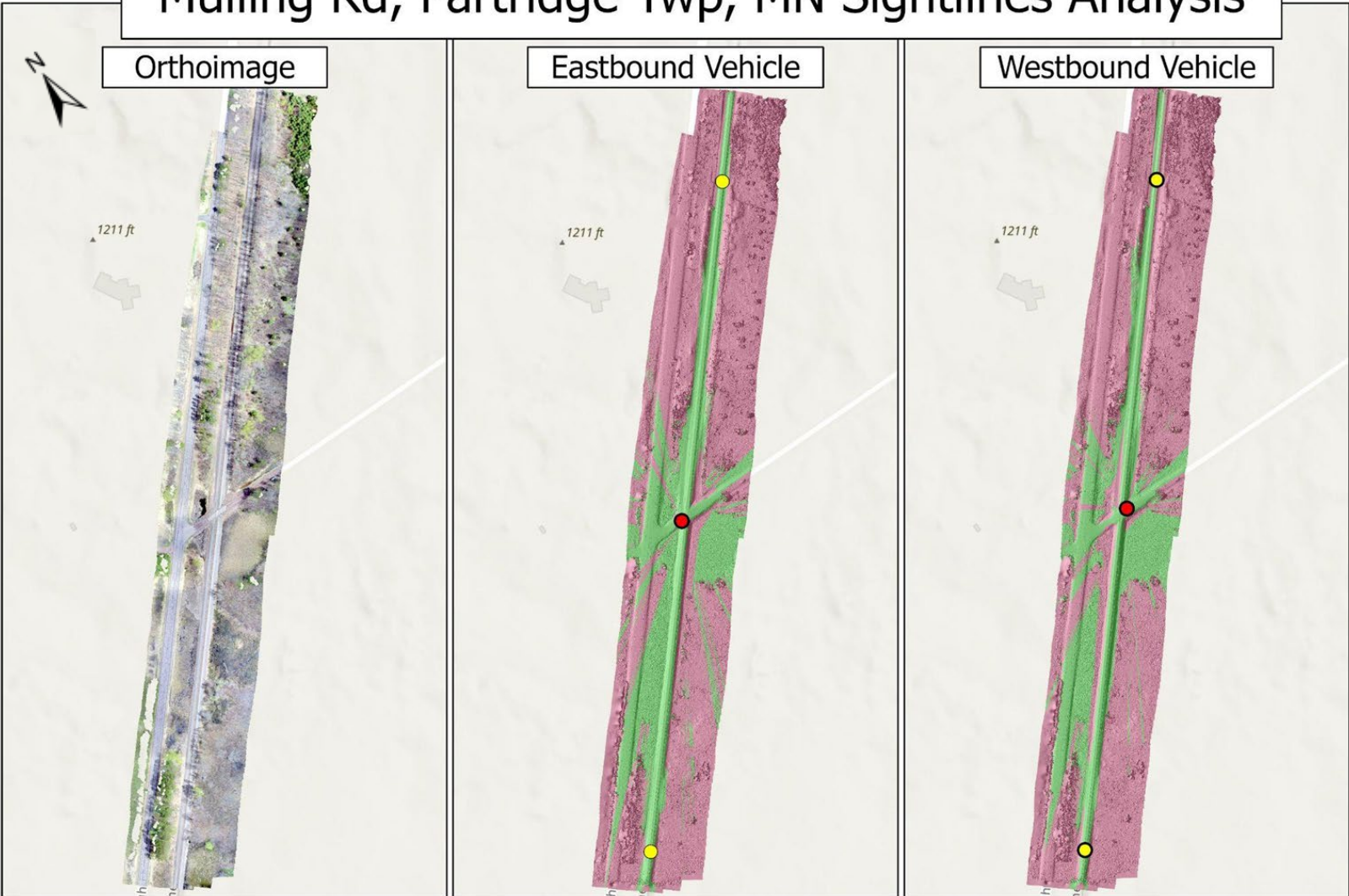
- Train Positions
- Vehicle Position
- Not Visible
- Visible

442nd Street - DOT# 082750K



Visible:		Vehicle Location:	
Not Visible:		Train Locations:	

Mulling Rd, Partridge Twp, MN Sightlines Analysis



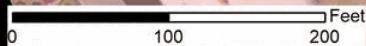
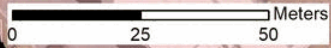
Visible: ■ Vehicle Location: ●
Not Visible: ■ Train Locations: ●

Mulling Rd Crossing ID#:076420R

Y:\gis_lab\project\MTRI_Inc\USDOT_DroneBasedGradeCrossings\GIS_Projects

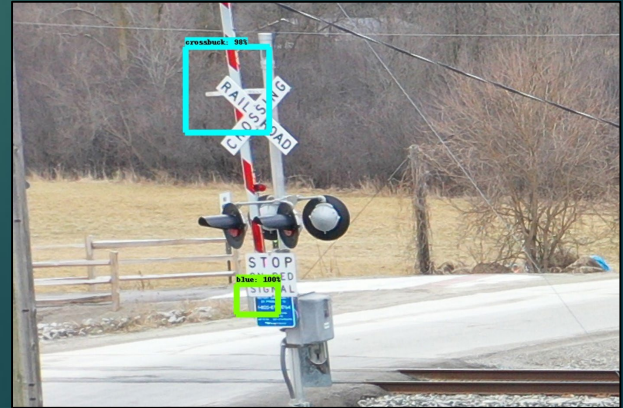
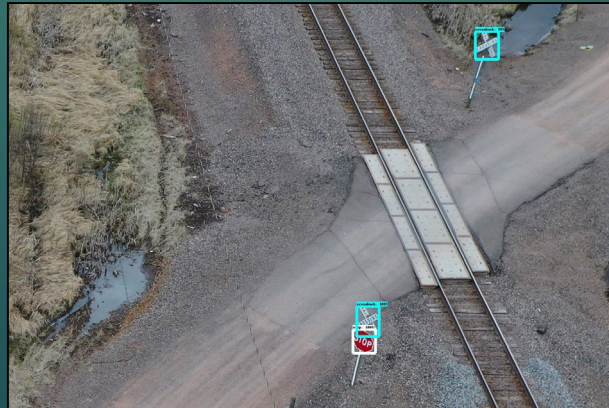


- Vehicle Position
- Not Visible
- Visible



Machine learning sign detection – MTRI inc. Erickson Rd. examples & others

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Crossing-i data portal web application

- ▶ We are completing development of a web application that enables customers to:
 - ▶ Search and view crossings in the GCIS crossing database
 - ▶ Order analyses for selected crossings
 - ▶ View and download Crossing-i analysis results & reports for selected crossings
 - ▶ Can give guest access

Crossing-i

Home | Log out

Welcome, **Demo user!**

Click on a table header to sort.
Click again to reverse order.

Add crossing +
Bulk add from CSV +

CROSSING	STREET	CITY	STATE	LAST UPD.	OUTPUTS
<input type="checkbox"/> + 676428R	Mulling Rd	ASKOV, MN	2022-01-20	5	
<input type="checkbox"/> + 882758K	442ND ST	HARRIS, MN	2022-01-14	12	
<input type="checkbox"/> + 363649L	BURNHAM AVENUE	BURNHAM, IL	2022-01-17	5	
<input type="checkbox"/> + 386135J	SAM ANDERSON RD	HAWTHORNE, WI	2022-01-17	11	
<input type="checkbox"/> + 258982N	BISSONETTE RD	OSCODA, MI	2021-11-17	8	
<input type="checkbox"/> + 478658H	WISCONSIN STREET	HOBART, IN	2021-11-17	11	
<input type="checkbox"/> + 478660J	COLORADO AVENUE	HOBART, IN	2021-11-17	11	
<input type="checkbox"/> + 478788J	BURNHAM AVENUE	BURNHAM, IL	2022-01-17	5	
<input type="checkbox"/> + 545235S	FLETCHER RD	CHELSEA, MI	2021-11-17	6	
<input type="checkbox"/> + 545238M	FREER RD DEXTER	CHELSEA, MI	2021-11-17	6	
<input type="checkbox"/> + 867226H	BURNHAM AVENUE	BURNHAM, IL	2022-01-17	5	

Basemaps +
Imagery ○
Street-Map ●

100 km
Leaflet

Crossing-i data portal web application: sight lines

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The screenshot displays the Crossing-i web application interface. At the top, there is a navigation bar with 'Home | Log out' and the MTRI, Inc. logo. Below this, a welcome message reads 'Welcome, Demo user!'. A section for user instructions includes 'Click on a table header to sort. Click again to reverse order.' and 'Add crossing + Bulk add from CSV +'. There are also icons for a list, download, and delete.

The main content area features a table of crossings. The first row is selected, showing details for crossing 082750K on 442ND ST in HARRIS, MN, updated on 2022-01-14, with 12 outputs. The table has columns for CROSSING, STREET, CITY, STATE, LAST UPD., and OUTPUTS.

CROSSING	STREET	CITY	STATE	LAST UPD.	OUTPUTS
<input checked="" type="checkbox"/> - 082750K	442ND ST	HARRIS, MN	MN	2022-01-14	12
<div style="display: flex; justify-content: space-between;">AnalysisOutputsLast upd.↓Map</div>					
Full report					
Full report					
2022-01-14 PDF					
Hangup analysis					
Lowboy trailer					
2021-11-17 TIF <input type="checkbox"/>					
Motorcoach					
2021-11-17 TIF <input type="checkbox"/>					
School bus					
2021-11-17 TIF <input type="checkbox"/>					
Visual sightlines analysis					
Line-of-sight (eastbound)					
2021-11-15 TIF <input checked="" type="checkbox"/>					
Line-of-sight (westbound)					
2021-11-14 TIF <input type="checkbox"/>					
Imagery/elevation					
Hangup - DEM					
2021-11-17 TIF <input type="checkbox"/>					
Hangup - Hillshade					
2021-11-17 TIF <input type="checkbox"/>					
Hangup - Imagery (0.5 cm)					
2021-11-15 TIF <input type="checkbox"/>					
Sightlines - DEM					
2021-11-17 TIF <input type="checkbox"/>					
Sightlines - Hillshade					
2021-11-17 TIF <input type="checkbox"/>					
Sightlines - Imagery (1.5 cm)					
2021-11-15 TIF <input type="checkbox"/>					

Below the table, there are several other crossing entries:

- + 163649L BURNHAM AVENUE BURNHAM, IL 2022-01-17 5
- + 1861153 SAM ANDERSON RD HAWTHORNE, WI 2022-01-17 11
- + 250982N BISSONETTE RD OSCODA, MI 2021-11-17 8

The right side of the interface shows a map of the selected crossing. The map displays a vertical road labeled 'Forest Boulevard' and a horizontal road labeled 'Old Sawmill Road'. A red shaded area indicates the sightline analysis. Two circular callouts on the map show '20 mph 480 ft' and '0 mph 0 ft'. The map includes a 'Basemaps' menu with 'Imagery' and 'Street Map' options, and a scale bar for 50 meters.

Crossing-i data portal web application: hangup analysis

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Crossing-i MTRi, Inc.

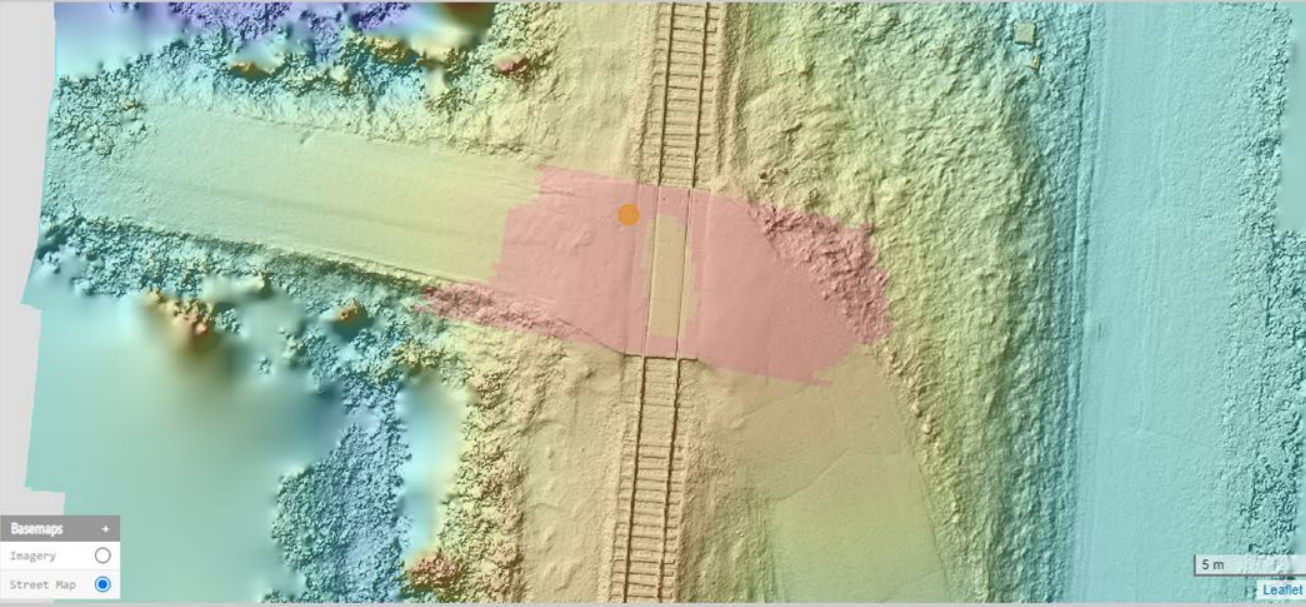
Home | Log out

Welcome, **Demo user!**

Click on a table header to sort.
Click again to reverse order.

Add crossing +
Bulk add from CSV +

CROSSING	STREET	CITY	STATE	LAST UPD.	OUTPUTS
<input checked="" type="checkbox"/>	082758K 442ND ST	HARRIS, MN	2022-01-14	12	  
Analysis	Outputs	Last upd.		Map	
Full report	Full report	2022-01-14		PDF	
Hangup analysis	Lowboy trailer	2021-11-17		TIF	<input checked="" type="checkbox"/>
	Motorcoach	2021-11-17		TIF	<input type="checkbox"/>
	School bus	2021-11-17		TIF	<input type="checkbox"/>
Visual sightlines analysis	Line-of-sight (eastbound)	2021-11-15		TIF	<input type="checkbox"/>
	Line-of-sight (westbound)	2021-11-14		TIF	<input type="checkbox"/>
Imagery/elevation	Hangup - DEM	2021-11-17		TIF	<input type="checkbox"/>
	Hangup - Hillshade	2021-11-17		TIF	<input checked="" type="checkbox"/>
	Hangup - Imagery (0.5 cm)	2021-11-15		TIF	<input type="checkbox"/>
	Sightlines - DEM	2021-11-17		TIF	<input type="checkbox"/>
	Sightlines - Hillshade	2021-11-17		TIF	<input type="checkbox"/>
	Sightlines - Imagery (1.5 cm)	2021-11-15		TIF	<input type="checkbox"/>
<input type="checkbox"/>	183649L BURNHAM AVENUE	BURNHAM, IL	2022-01-17	5	
<input type="checkbox"/>	186115J SAM ANDERSON RD	HAWTHORNE, WI	2022-01-17	11	
<input type="checkbox"/>	256982N BISSONNETTE RD	OSCODA, MI	2021-11-17	8	
<input type="checkbox"/>	428658W WISCONSIN STREET	HOBART, IN	2021-11-17	13	



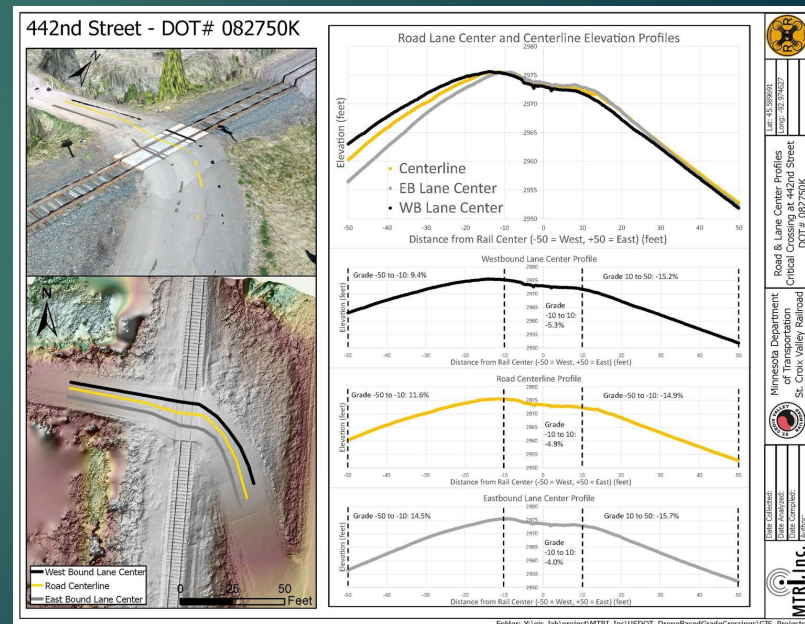
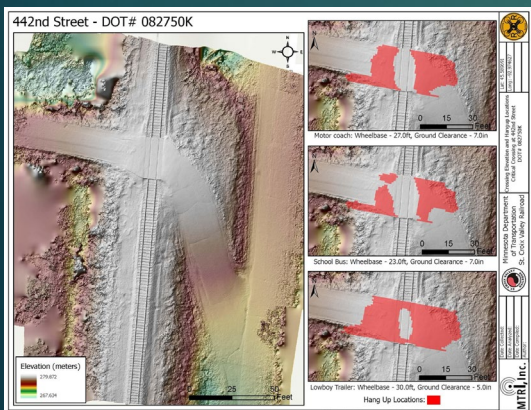
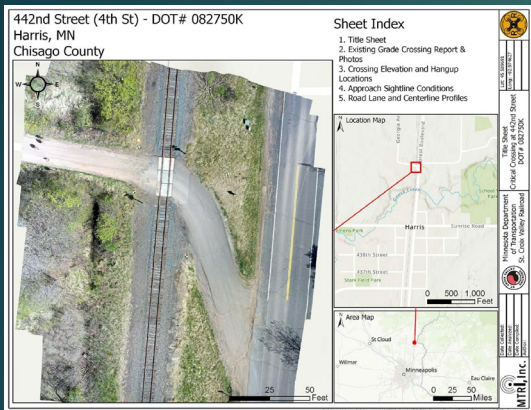
Basemaps +
Imagery
Street Map

Example Crossing-i report

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PDF contains: Overview, crossing database info, UAS / ground photos, symbolized hang-up location results, symbolized viewshed results, elevation profile views

442nd Street (#082750K)



MINNESOTA DEPARTMENT OF TRANSPORTATION
 CROSSING INFORMATION REPORT
 PROJECT: 11-13-2019
 DATE: 02/19/2020
 ROAD: 442ND STREET
 DOT#: 082750K
 COUNTY: ST. CROIX VALLEY RAILROAD

Folder: Y:\gis_mdb_project\MTR1_TheUSDOT_DroneBasedGradeCrossings\GIS_Projects\

Opportunities for follow-up?

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- Full NLX survey?
- Other priority locations for MnDOT?
- Ready for deployment

