

INDOT INITIATIVES FOR GEOTECHNICAL ASSET MANAGEMENT

Athar Khan

*Manager, Geotechnical Services
Indiana Department of Transportation*

Overview

- Background
- Geotechnical Asset Management Plan
- Geotechnical Assets
- Challenges
- Strategy & Planning
- Collect Asset Inventory
- Future Modifications
- Q & A ?

Background

- INDOT asset management programs
- Active programs
 - * Bridges
 - * Drainage Structures
 - * Traffic signs
 - * Pavements
- Proposed Programs
 - * Geotechnical



Geotechnical Asset Management Plan

Phase I

- Know your Assets
- Quantify Your Assets
- Data & Condition Assessment
- Condition based Ranking & Monitoring program

Geotechnical Asset Management Plan

Phase II

- Effective tool for planning
- Monitoring asset performance
- Risk Assessment
- Life cycle cost analysis
- Update inventory and condition assessments
- Program as a project
- Cost estimates for mitigation/ replacement

Geotechnical Assets ?

- Foundations
- Retaining Structures
- Slopes
- Embankments
- Landslides
- Tunnels
- Levees
- Geotechnical experimental features

Geotechnical Assets- Foundation

Drilled Shaft

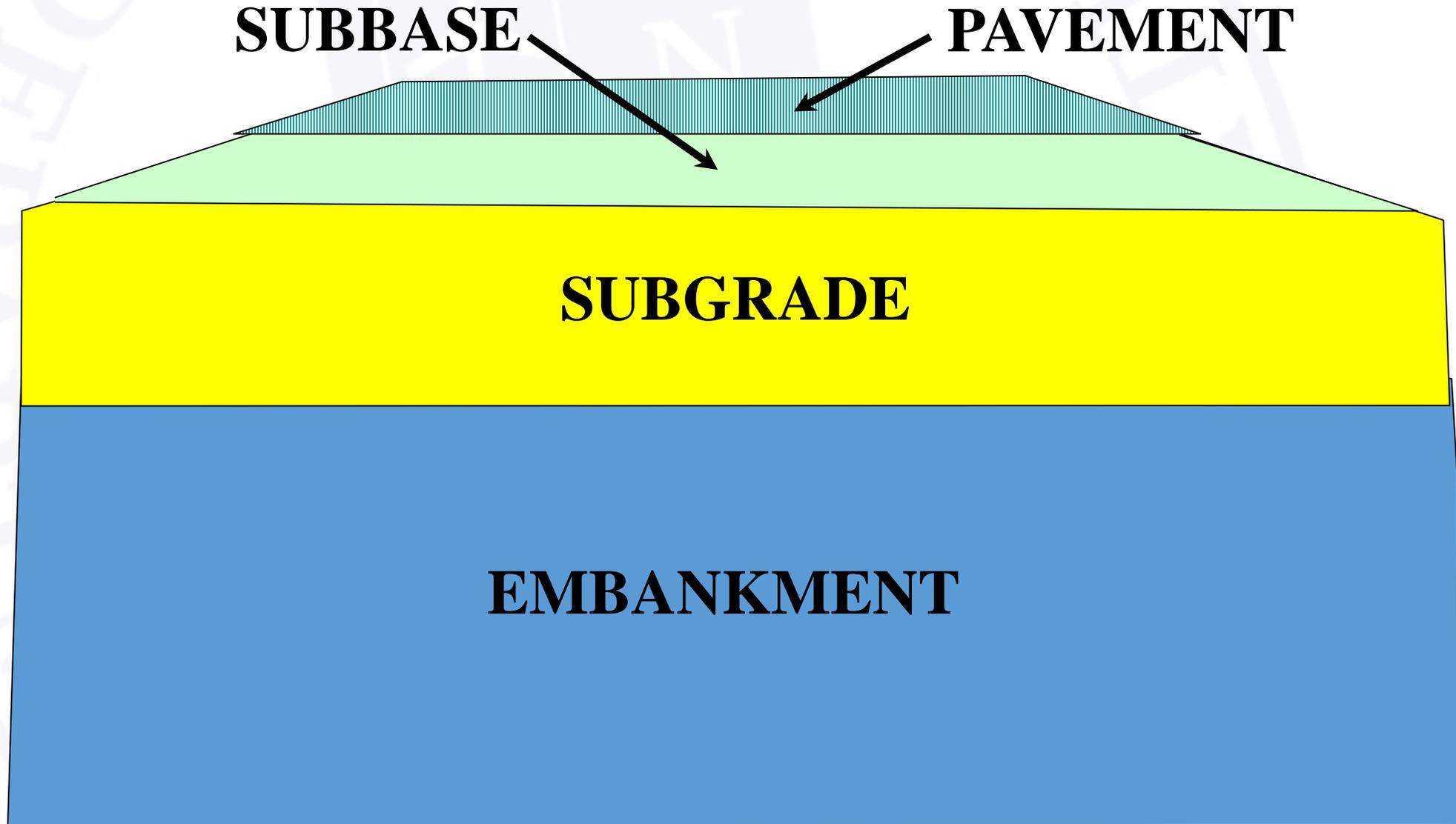


**S.R. 46 IN COLUMBUS, INDIANA OVER THE WHITE RIVER
45° ANGLE DRILLED SHAFT SOCKETED IN BEDROCK**

Piles inside MSE wall



Geotechnical Assets- Foundation



Geotechnical Assets- Precast Panel MSE Walls



Geotechnical Assets

Slope & Landslide



Geotechnical Assets

Levee



Tunnel



Geotechnical Experimental Features

- Coal Combustion By-products
- Foundry Sand
- Shredded Tires
- Crushed Glass
- EPS
- Light Weight Cellular Concrete
- Embankment over landfill

Geotechnical Experimental Features

Foundry Sand Construction



Landfill Embankment, Dynamic Compaction
I-164 over U.S. 41 Vanderburgh County



Geotechnical Experimental Features- EPS



Geotechnical Experimental Features

Tire Shreds/EPS as Backfill

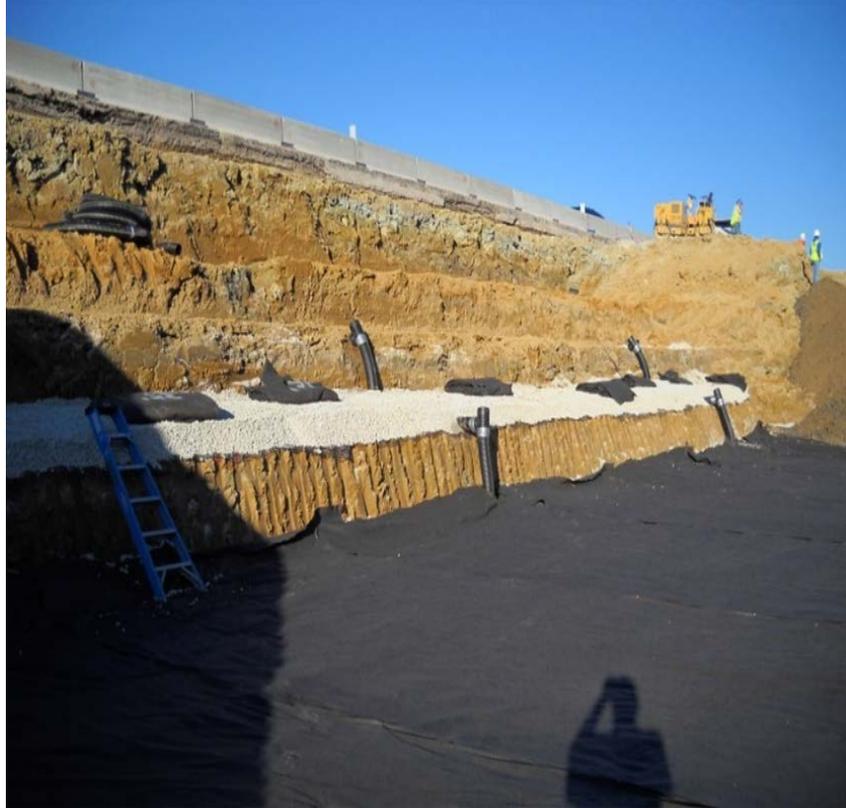


Marion County Coal Ash Project



Geotechnical Experimental Features

Shredded Tires



Slide Correction on I-74

7/10th mile East of SR-1 and I-74



Light Weight Cellular Concrete
Evansville, Vanderburgh County

Shredded Tires



SR19 at CR46

Intersection Improvement

Geotechnical Experimental Features

Crushed Glass



Waste Foundry Sand



Tire Chips



Coal Ash



Geotechnical Experimental Features

Andela Hopper used to crush glass



Shredded Tires for US31 in Marshall County



Buceville, Indiana Crushed Glass Project



Hauling and compacting the mixture



Challenges

- Classify assets
- Geotechnical Structures- Above ground
 - * Retaining Walls
 - * Embankments
 - * Landslides
 - * Slopes
- Geotechnical Structures- Below ground
 - * Spread footing
 - * Shafts
 - * Piles
 - * Subgrade
- Defects are not visible for underground structures
- Difficult to inspect & assess conditions
- Natural & Human activities may affect
- Quantify assets

Strategy and Planning

- Limited in-house resources
- Prioritization of assets
- Development of Criteria & guidelines
- Selection of consultants
- Collection of data
- Implementation

INDOT Priorities

- Retaining Structures
- Landslides
- Projects with Experimental Features
- Other Assets

Collect Asset Inventory

- Hired consultants
- Collector App, ESRI (GIS based)
- Consultants inspect assets as per INDOT inspection manuals
- Collect inventory- Office
 - * Plans
 - * Reports
- Collect inventory- Field
 - * Permissions / Coordination
 - * Inspection & Condition rating

Collect Asset Inventory

If issues discovered during inventory collection, immediate steps are needed-

- INDOT reviews & takes action depending on conditions
- Direct district offices for immediate inspections
- Perform risk assessments
- Mitigation/ Replacement
- Assets are contained



Retaining Wall Asset Program

Retaining Wall Asset Program

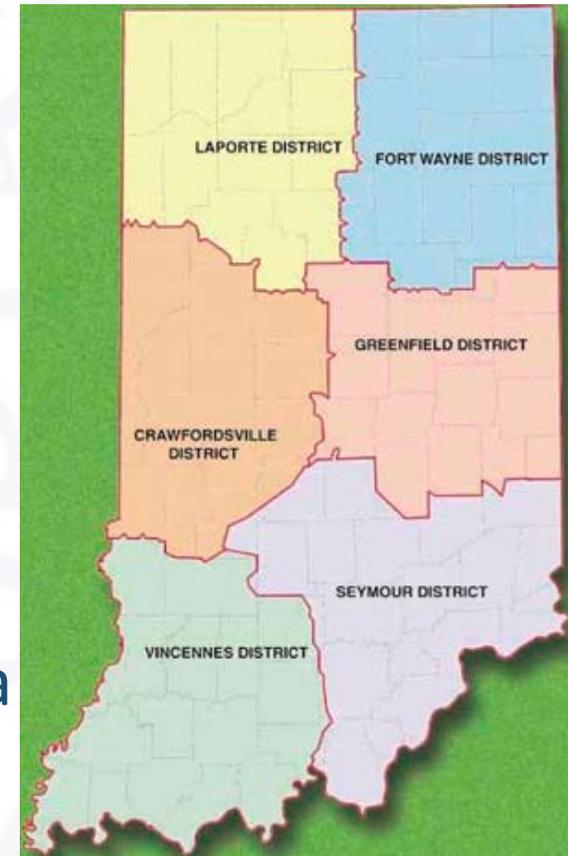
- Streamline In-house resources
- Drafted INDOT Inspection Manual for Retaining walls
- Hired consultants with experience in GAM
- Using ArcGIS, ESRI application to input data
- Condition ratings of walls recorded
- Monitoring Program → Interface to Phase II

Retaining Wall Asset Program

- Structures that are visible above ground (> 5 ft.)
- Priority
 - * State owned structures
 - * LPA owned structures
 - * Others
- Finding retaining walls through Google Maps
- Searching one route at a time
- Cross-checking our inventory for info

Retaining Wall Asset Program

- One consultant per two districts
 - * La Porte & Fort Wayne- RII (Northern IN)
 - * Crawfordsville & Greenfield- WSP (Central IN)
 - * Vincennes & Seymour- CTL (Southern IN)
- Ensure not to overlap with the Bridge Inventory data



Retaining Wall Asset Program

Inventory challenges

- Many dated structures without any records
- Design Data available only for last 10 -15 years
- Many structures and their locations are unknown
- Asset life of such structures is unknown
- Physically searching undocumented structures

Retaining Wall Collector App



Legend-

- Masonry
- RC Cantilever
- RC Counterfort
- Pre-stressed Concrete
- Cantilever Sheet Pile
- Anchored Bulkhead
- Diaphragm
- Bored Pile
- Soldier Pile
- Reinforced Earth
- MSE
- Timber
- Bin
- Wire

Retaining Wall Collector App

Fields for data input in app

- Vendor name- CTL / RII / WSP
- Arrival date & time- 4/25/2018, 11:17 AM
- Departure date & time- 4/25/2018, 11:17 AM
- Observer name- xyz
- Weather Condition- Sunny 62°F
- Wall Type- MSE
- Associated Feature- Bridge abutment
- Incenteroid facing direction- West
- Wall Facing Type- Precast concrete panel
- Panel height- 5 ft.
- Panel width- 10 ft.
- Wall design method- LRFD
- Latitude- 41.06792471
- Longitude- -85.01113566
- Altitude- 235.2605231
- Wall height- 22ft
- NBI- 000000
- Des- 1234567
- Public Safety Rating- Green

Retaining Wall Collector App

(1 of 2)

DOTGIS.Retaining_Wall:I-65

OBJECTID	81400
Vendor name	Resource Internation
Workflow Status	Collected
Arrival date and time	8/27/2018, 11:32 AM
Departure date and time	8/27/2018, 11:59 AM
Observer name	Kevin Jones
Weather Condition	90F Sunny
Wall Type	MSE
WALLID	

Associated Features: Bridge Abutment

Zoom to Edit Show Related Records

The screenshot shows a map of Indiana with a data entry form overlaid. The form contains fields for object ID, vendor name, workflow status, arrival and departure times, observer name, weather condition, wall type, and wall ID. The map background shows major cities like Gary, Fort Wayne, Muncie, Crawfordsville, Greenfield, and Indianapolis.

(1 of 2)

Collection Location	Field & Office
CREATED_USER	KeJones1@indot.IN.g
CREATED_DATE	8/24/2018, 1:07 PM
LAST_EDITED_USER	KeJones1@indot.IN.g
LAST_EDITED_DATE	8/27/2018, 11:59 AM
Retaining Wall	State
Owner	
NBI	038020
DES	0201046/0201049
Public Safety Rating	Green
Wall Condition	
Additional Comments	

Zoom to Edit Show Related Records

The screenshot shows a map of Indiana with a detailed record view overlaid. The record view displays metadata such as collection location, user, dates, and specific details about the retaining wall like NBI, DES, and public safety rating. The map background shows major cities like Gary, Fort Wayne, Muncie, Crawfordsville, Greenfield, and Indianapolis.

Retaining Walls Rating Codes

Wall Rating Codes

- Code 9- Excellent (Recently installed or recently repaired)
- Code 7- Good (No repairs needed, next inspection to be examined)
- Code 5- Fair (Significant defects, frequent inspections)
- Code 3- Poor (Structural issues, repair by qualified contractor)
- Code 1- Critical (Failing or failed, major mitigation or replacement)

Retaining Walls Rating Codes

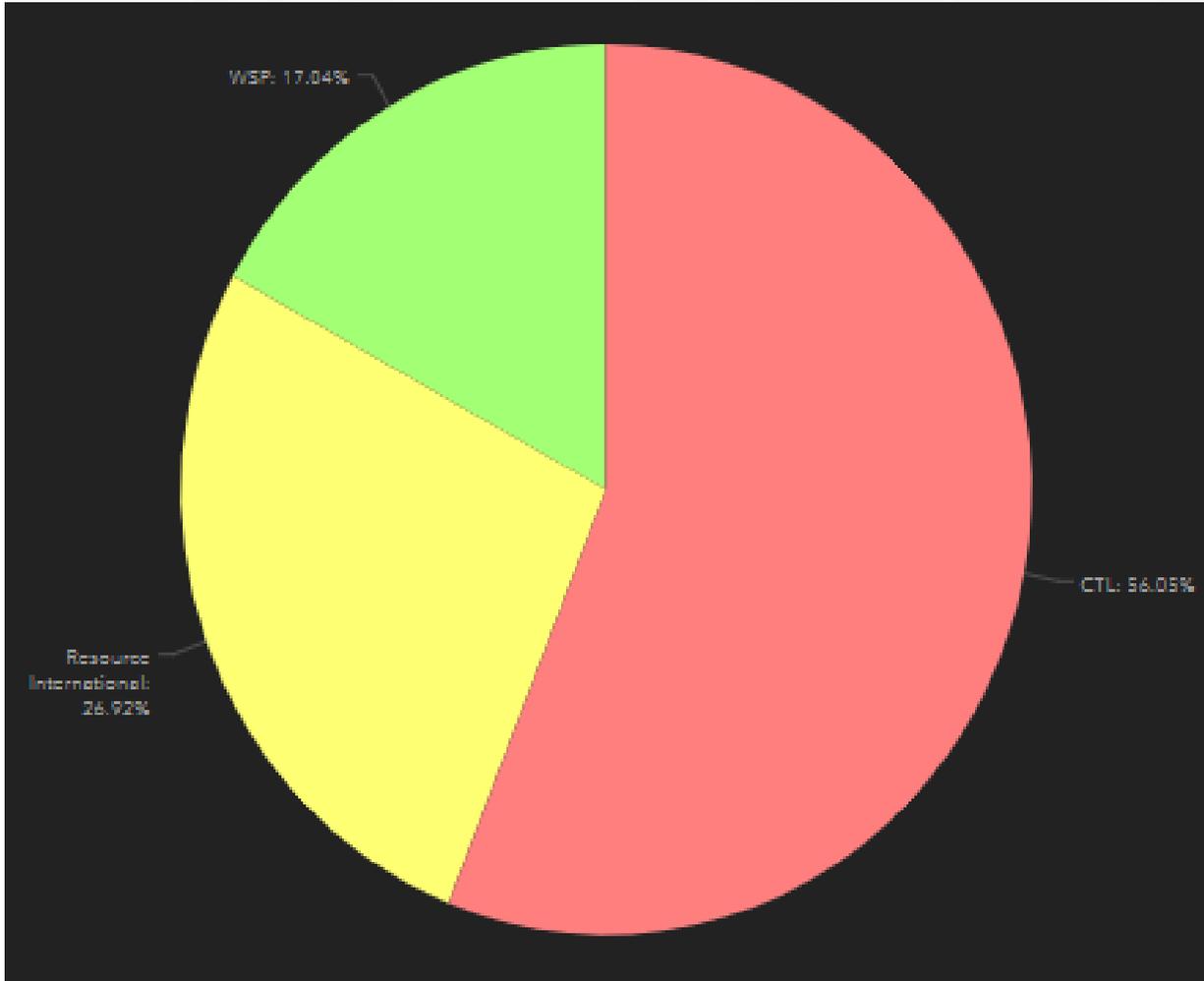
Public Safety Rating Codes

- Green flag- No danger of failure
- Orange flag- Repairs needed
- Yellow flag- Public safety issue, closure of lane/ traffic
- Red flag- Roads relying on wall for support are closed

Retaining Walls Defects

- Abrasion/ wear (concrete)
- Freeze-thaw damage
- Masonry displacement
- Mortar breakdown
- Patched area masonry
- Rust stains
- Split/ spall masonry
- Settlement
- Backfill Leakage
- Damage
- Delamination/ Spall
- Erosion
- Exposed rebar/ fabric
- Efflorescence
- Graffiti
- Vegetation
- Bulging
- Corrosion
- Cracking
- Connection
- Distortion
- Horizontal rotation
- Separation
- Vertical rotation

Retaining Wall App Dashboard



Collector app showing percentage of walls collected by consultants up to date

Poor or failing walls up to date

Problems & Corrections

MSE Retaining Wall- Backfill loss



Causes-

- Fabric tear-off
- Incorrect installation of panels
- Vandalism
- Construction mistakes
- Incorrect fabrication of panels
- Damaged fabric during construction

Possible Solutions-

- Backer rod system and sealant
- Bituminous joint filler

MSE wall showing backfill loss



← Before
Repair

After →
Repair



An aerial photograph showing a two-lane asphalt road that has been partially blocked by a large landslide of dark, jagged rocks and debris. The landslide originates from a steep, rocky cliffside on the right. In the upper left, a line of cars is stopped on the road, and several people are visible. Further down the road, two workers in high-visibility vests are standing near the debris. The road has double yellow lines and a white edge line. A yellow curb is visible on the right side of the road. The overall scene depicts a significant infrastructure challenge in a mountainous or hilly region.

Landslide Asset Program

Landslide Asset Program

- Streamline In-house resources
- Customized INDOT Template for Landslide Inventory Program
- Using ArcGIS, ESRI application to input data
- Condition ratings of landslides developed
- Transition to Phase II as a programming tool

Landslide Asset Program

Criteria for Landslide Inventory

- Landslide length
- Affected slope height
- Pavement affected length
- Pavement affected width
- Pavement lateral displacement
- Pavement vertical displacement
- Potential For Additional Slope Failure

Landslide Asset Program

- Pilot program to collect landslides Inventory
- Route Assessment for potential landslides
- Hired consultants with landslide experience
- Currently, slope assessment along the routes are in progress

Landslide Asset Program

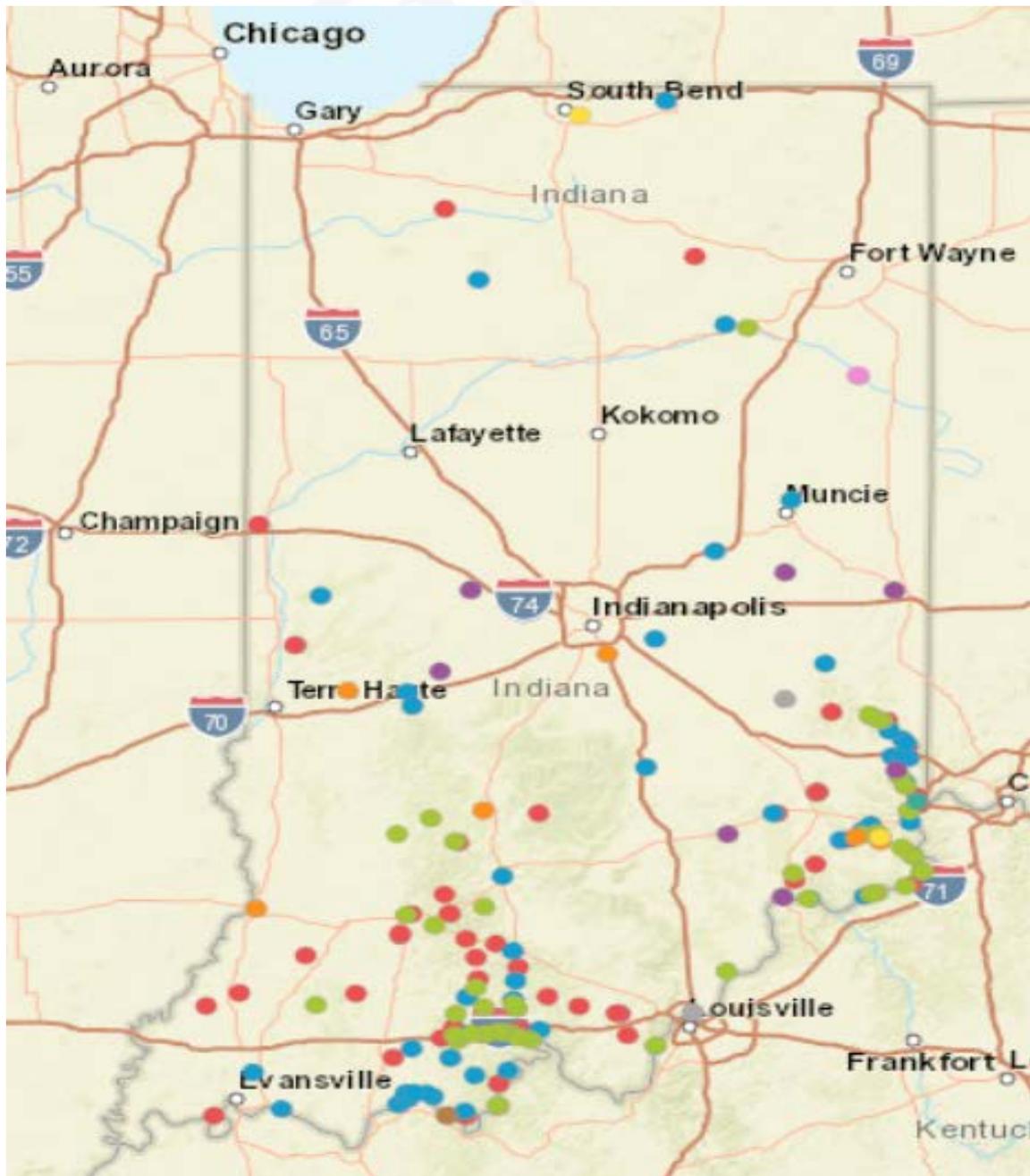
Five routes selected for assessment

Route	From	To	Miles
SR 262	US 50	SR 56	15.3
SR 1	US 50	I 74	15.3
SR 156	SR 250	SR 262	11
US 52	SR 101	SR 46	13.7
SR 62	SR 145	SR 66	14.5

Landslide Asset Program

In-app data entry template

Vendor	Earth Exploration
Status	Verified - Consultant
Slope Type	Fill
Total Slope Height (ft)	10
Slope Steepness	2 : 1
Preliminary Cause	Groundwater and embankment fill on natural slope of likely high PI
Possible Solutions	Nails
Possible Solutions Cost	\$1,300 to \$1,500/ft plus pavement and incidentals
Existing Remedial Activities	None
DES	
ROUTE_POST_AND_OFFSET	12.2, Right



Landslides

Legend-

- Active emergency repair required
- Active, Consider for acceleration
- Active, monitor
- Historical
- Historical/New Activity
- In construction
- Slide Must Go
- Suspended
- Other

Problems & Corrections

Slope Failure on US 52



Cause of Slope Failure- Sliding

Sliding- downslope movement of a coherent block of earth material

Problems & Corrections

Slope Failure Treated On US 52



Type of Repair- Soil Nail Wall

Cost of Repair= **\$225,000**

Cost of Replacement= \$ 1,447,300

Road closed for maintenance= 21 days

Asset new life= **35 years**

Problems & Corrections

Landslide On SR 237



Causes-

- Slope measured steeper than 2:1
- Inadequate benching
- Unknown mines behind slope
- Rain water swept in mines
- Destabilized slope causing damage

Problems & Corrections

After Correction On SR 237



Type of Repair- Soil Nail Wall + Drilled Pier Wall

Cost of Repair= **\$781,250**

Cost of Replacement= \$ 1,529,500

Road closed for maintenance= 141 days

Asset new life= **40 - 35 years**

Future modifications

New Technologies

- Use of Drones to assess inaccessible terrain
- LiDAR to assess inside conditions
- GPR to assess inside conditions

Future Modifications



- Using GPR to track the reinforcement behind the panels
- Forensic investigation validating the construction as per design

Future Modifications



- Crew performing coring for forensic investigation





