



# AVOIDING THE DISTRESS OF SIDEWALKS ASSESSMENTS

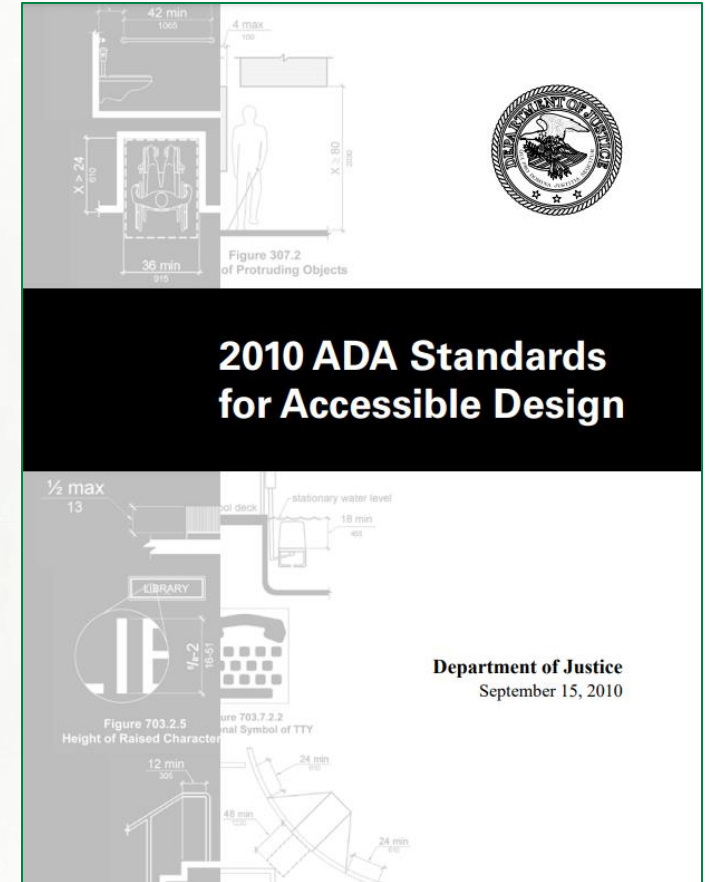
SOUTH CENTRAL ARC USER GROUP

April 24, 2024



- **ADA Compliance**

- 1990 Americans with Disabilities Act, Title II
- 2004 ADA Accessibility Guidelines - 36 Code of Federal Regulations Part 1190 - Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way
- 2010 ADA Standards for Accessible Design
- 28 CFR 35.150



- **Liability**
  - **Los Angeles California – 2014 - \$1.4 billion settlement. ~\$46 million per year <sup>1</sup>**
  - **Philadelphia Pennsylvania – 2019 - install or repair 10.000 curb ramps <sup>2</sup>**

<sup>1</sup><https://www.bloomberg.com/news/articles/2015-04-07/why-l-a-s-1-4-billion-sidewalk-repair-ada-settlement-is-such-a-big-deal>

<sup>2</sup><https://pennrecord.com/stories/642044415-judge-oks-class-action-settlement-with-city-of-philadelphia-over-proper-sidewalk-access>



- **Maintenance**
  - **Reactive vs. Proactive -**  
Most repairs are based on complaint calls
  - **Limited funding – Most bang for the buck**
  - **Strategic Planning – Identify risks**



# ASSESSMENT PURPOSE and APPROACH

- **Condition Inventory of:**
  - **Pavement areas, edge of pavement, and markings**
  - **Roadside assets**
  - **Curbing**
  - **Trees in right of way**
  - **Sidewalks and bike lanes**
- **Americans with Disabilities/Accessibility**
  - **Ramps**
  - **ADA Assessments**
- **Complete Streets**
  - **Beyond a sidewalks assessment, the purpose includes necessary data to support roadways designed and operated for pedestrians, bicyclists, motorists and transit riders of all ages and abilities**



- **Cracking/ Vertical or Horizontal Displacement**



# DISTRESS TYPES

- Cross slope / Run slope



## Obstruction



## *Walking Paths Less than 4 Feet*





## Overgrowth / Vegetation



## Drop off



## Spalling



## Ponding



## Longitudinal Cracking



# SIDEWALK DATA COLLECTION

- **Conduct inspections and accurate mapping of sidewalks and their surroundings**
- **Sensor technology later supporting geospatial (GIS) processes**
- **Asset management data for issuance of future maintenance/rehabilitation work orders**
- **Collect design quality data quickly, cost-effectively**
- **Observe conditions with lidar, imagery and sidewalk profiler**
- **Linear referenced sidewalk data with the asset management system's roadway segments**
- **Geographic coordinates for GIS mapping for use in planning activities**
- **Overall Condition Index (OCI) to classify sidewalks most needing repair**
- **Collection rate ~ 36+ *sidewalk miles a day, 1-person, one system!***

# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

- What about these?
- Testing indicate accuracies\*:
  - Absolute accuracies of  $\pm 3$  cm (1") horizontally
  - $\pm 7$ mm (0.25") vertically,
  - Relative accuracy of  $\pm 3$  cm (1").
  - Measuring range - iPhone has a maximum range of 5 m (16.4')
  - For large scenes multiple passes (frames) are required, new frames required for large angular displacements
  - With only a distance range of 5 m, the iPhone is limited to smaller scale projects
- These results were only achieved after:
  - Establishing a **control network of 24 targets at sub-millimeter geometric accuracy**
  - Use of real-time 3D mapping package for consumer mobile devices



# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

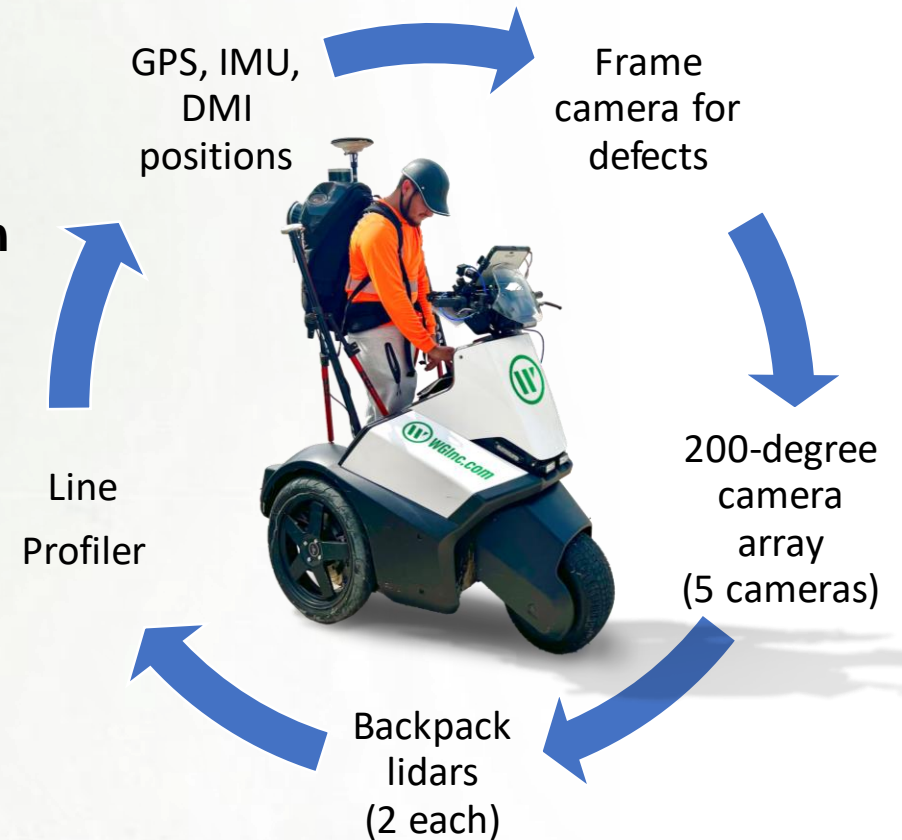
- **Safety and control**
- **Speed and efficiency**
- **Clean energy, quiet and non-intimidating to pedestrians**
- **Affordability to our clients and WGI for operation, as compared to labor-intensive fielding collections**
- **Electric standup vehicle (ESV), height, width, weight, visibility considerations**
- **Dependability of ESV - military, police grade vehicle**
- **Form-factor comparable to mobility scooters made sense**
- **Adaptability allows human interactions with multiple sensors and controller configuration**
- **Quick charging with auxiliary power**
- **Multisensor integration with positioning and orientation systems**



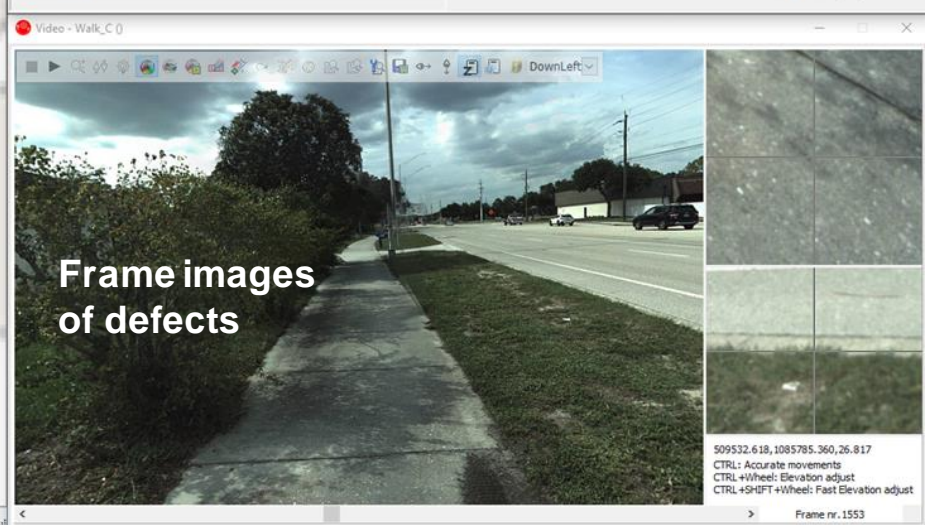
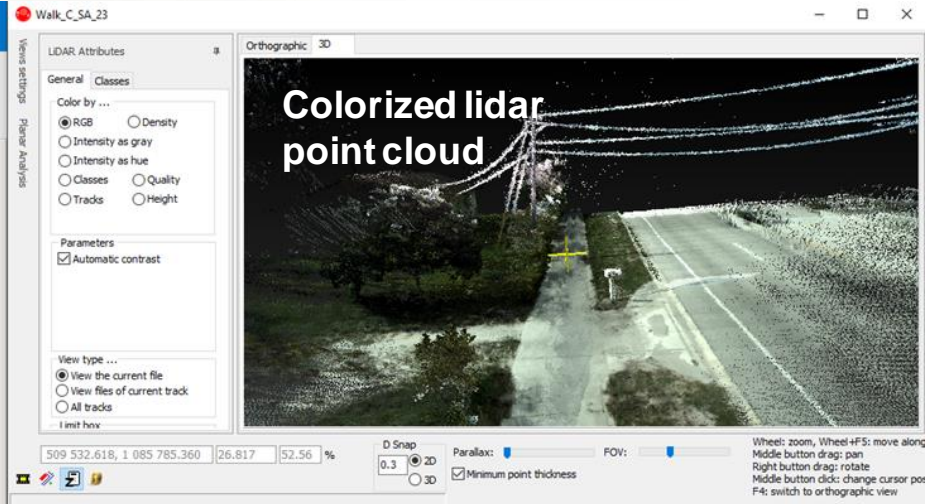
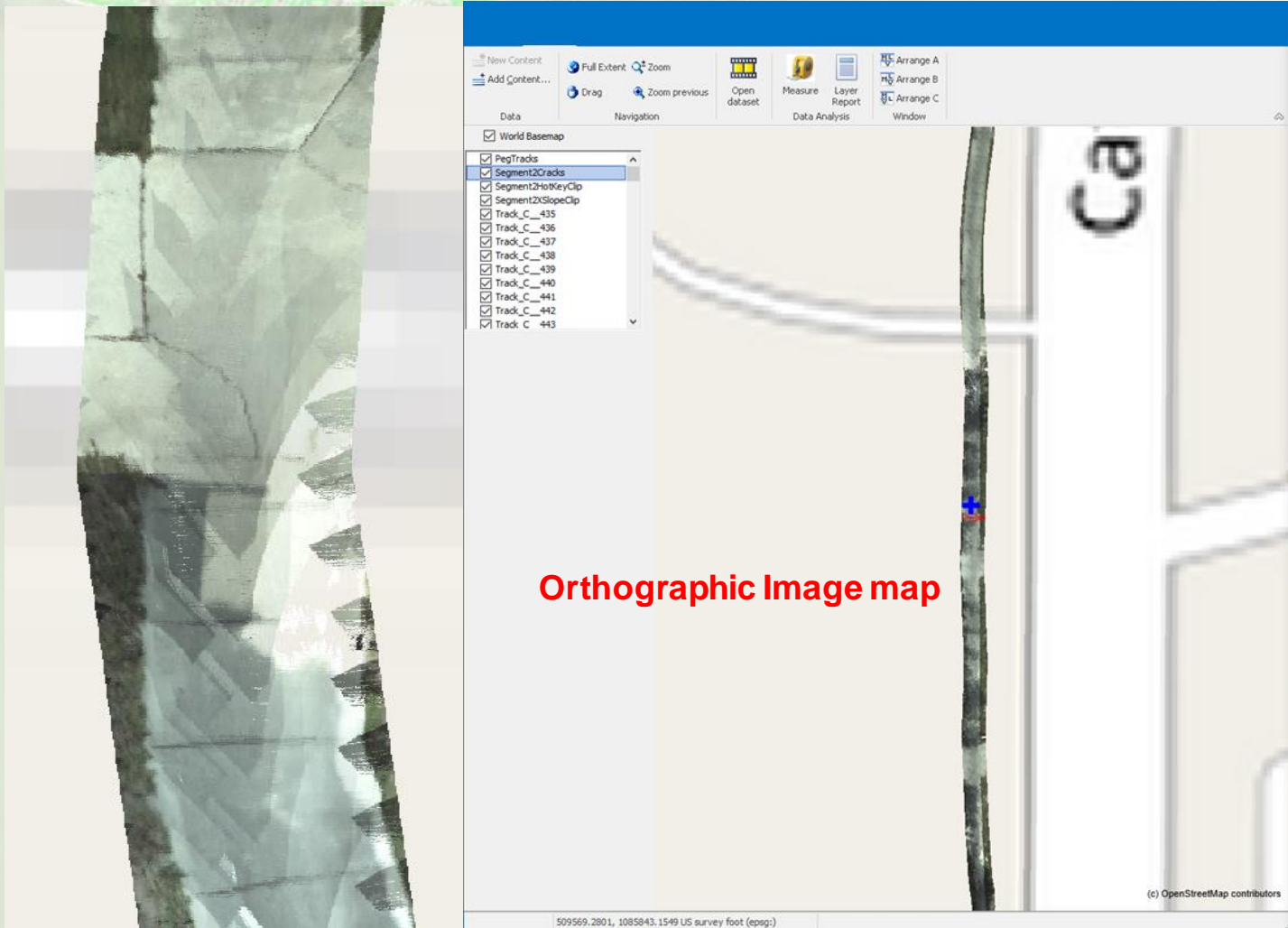


# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

- Identify edges and defects along the sidewalk.
- Imagery collected using multiple cameras on the ESV
- Close-range, survey-grade on the ESV
- IMU for slope and tilt (lidar and profiler IMUs)
- Keypad used to record a GPS coordinate location using preloaded hot keys for many defect types
- IMU supplements GPS for sensor trajectories
- GPS of image photocenters collected by front and back and side facing cameras



# SIDEWALK DATA VISUALIZATIONS

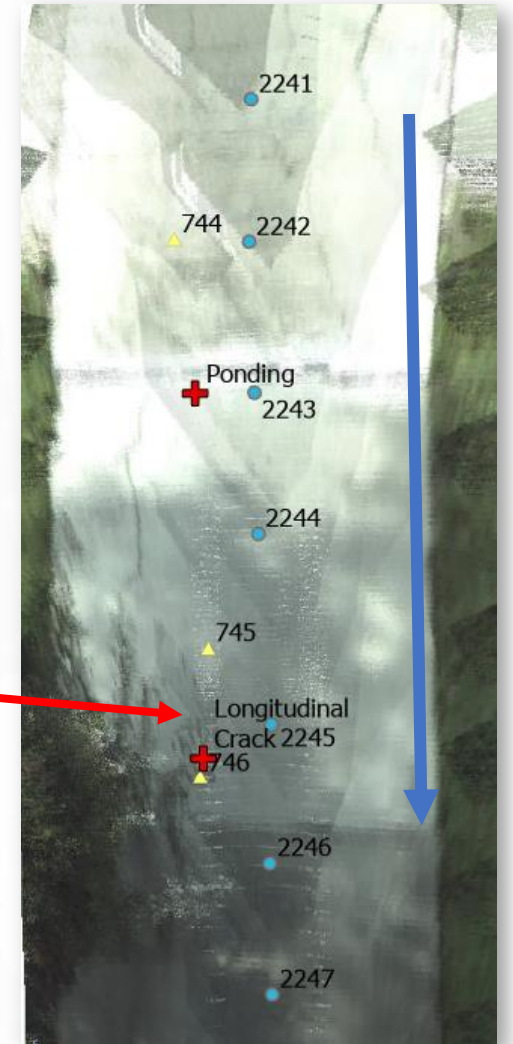


# SIDEWALK FIELD DATA COLLECTION

- Attribution for sidewalk segments includes photocenters for all images
- Using imagery, the sidewalk defects can be reviewed for defect type



Image from the rear facing camera.  
(Point labeled 2245)



## Example:

- Profile length  
1.325 miles
- Horizontal scale  
is compressed
- From POB a small  
hill begins +/- 1 mile
- From POB, first  
defect is at 15.5'  
0.37" deep  
.95" wide

Images




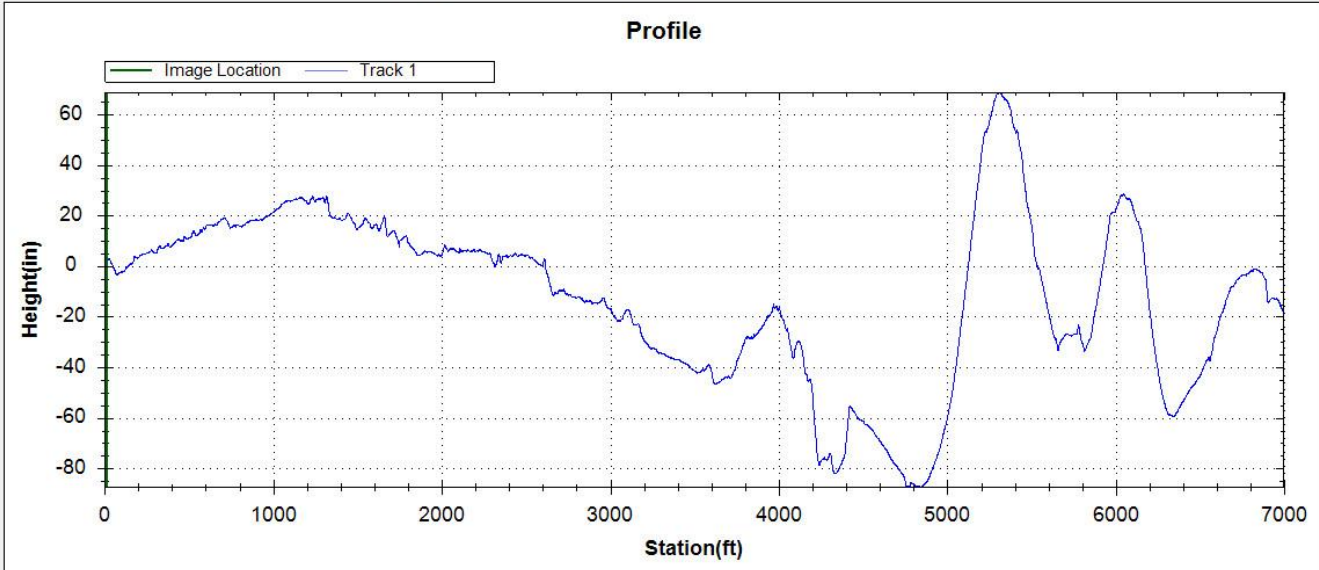
Image Info Settings  
Load Images  
Pop-Out Image

Image Player  
Play

Image directory not found.

Trace Profile Transverse Rut Texture Profile Google Maps

### Profile



Height (in) vs Station (ft) graph showing profile data for Track 1. The y-axis ranges from -80 to 60 inches, and the x-axis ranges from 0 to 7000 feet. A blue line represents the profile, showing a significant peak around station 5300.

Drag Mode: Zoom Station units: ft  
Zoom Axis: Both Height units: in

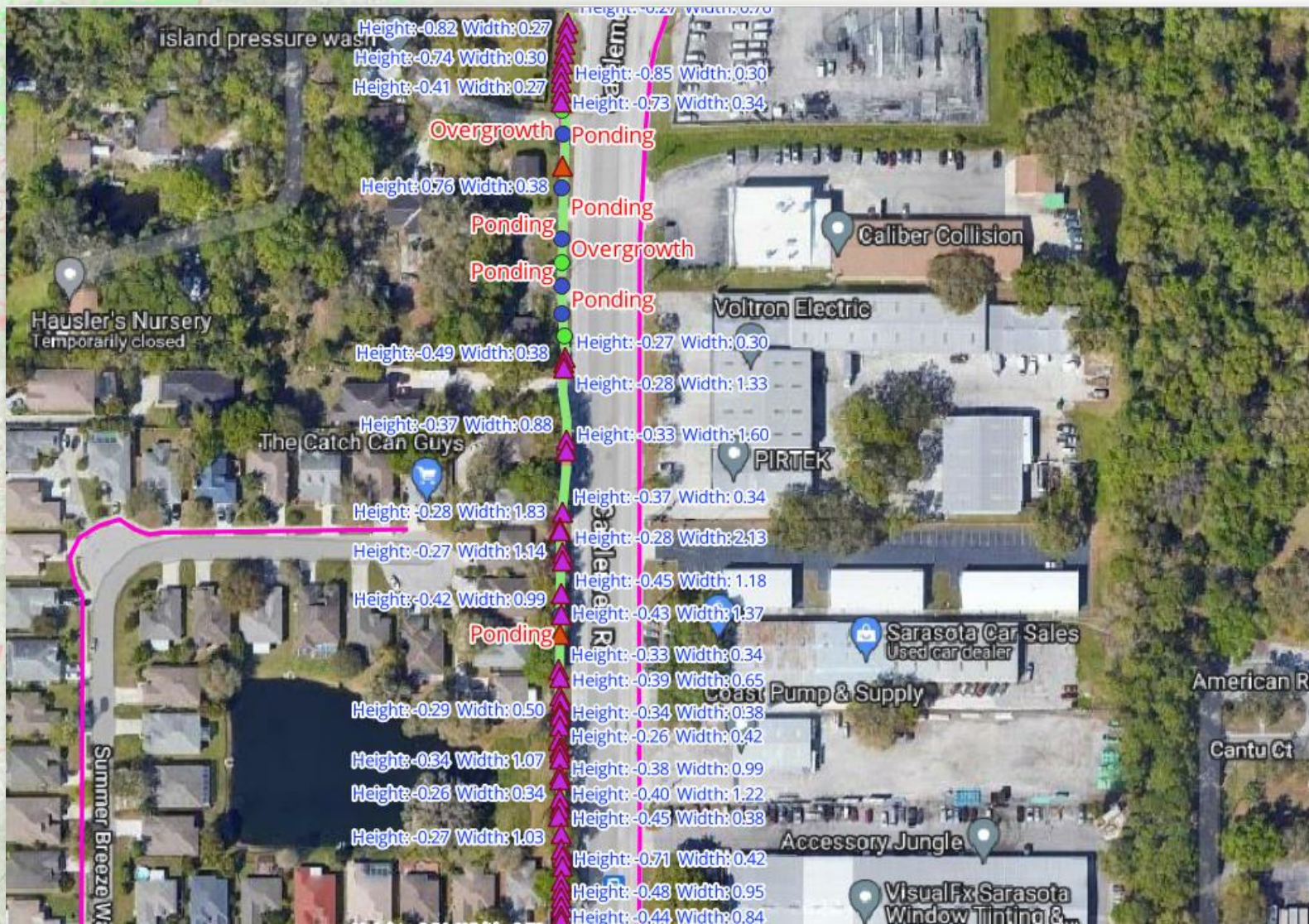
Image #	Station	Total Defects	Track 1 Defects	Track 2 Defects	Avg Seg RI	Seg #	T1 Seg RI	T2 Seg RI	Level Change (Type, Station, Depth, Width)
1	0+10.1 ft	1	1	N/A	522.156 in/mi	1	522.156 in/mi	N/A	Crack , 0+15.5 ft , -0.3737 in , 0.9541 in
2	0+20.0 ft	1	1	N/A	522.156 in/mi	1	522.156 in/mi	N/A	Crack , 0+21.1 ft , -0.4448 in , 0.2936 in Crack , 0+27.9 ft , -0.4111 in , 1.4679 in Crack , 0+29.6 ft , -0.7963 in , 1.6147 in Crack , 0+34.2 ft

GPS: N:3024684.3136256 E:353499.609742773 Z:17R

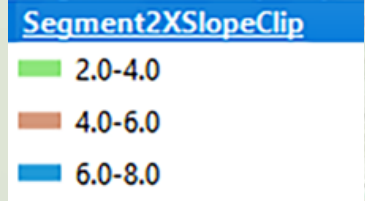
Run: Run 1

0.00 ft Go to Location Cancel Apply

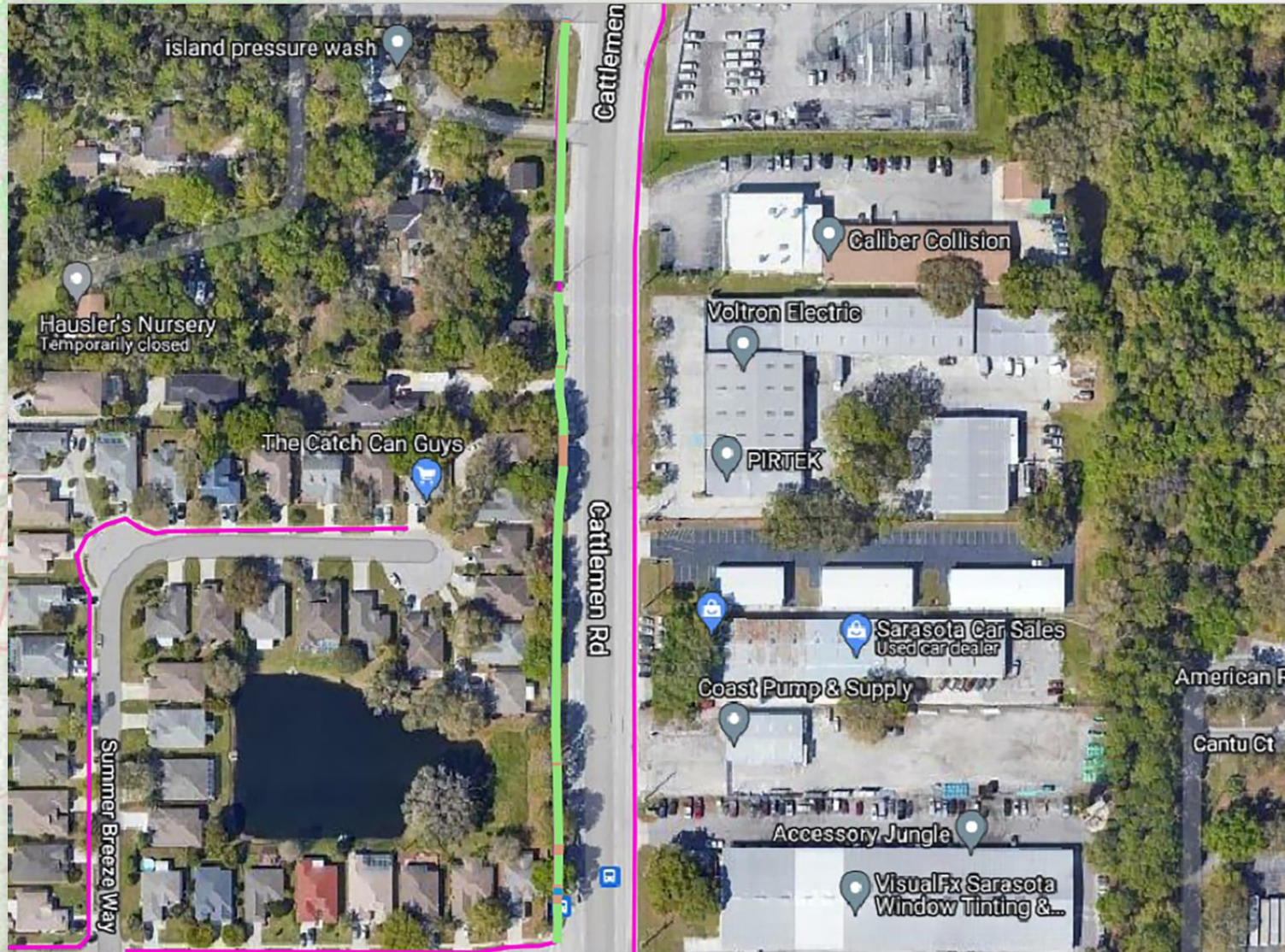
# SIDEWALK FIELD DATA ANALYSIS



# SIDEWALK FIELD DATA ANALYSIS



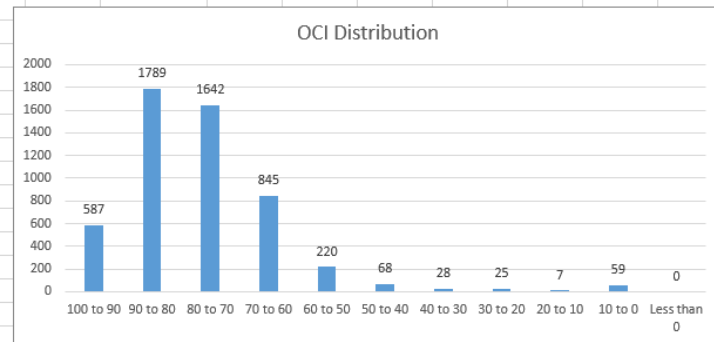
% Slope



- Configurable Defect Exclusion
- Defect severity weights are represented as empirical index values
- Outliers flagged to avoid skewing

Defect	Severity (Weight)
Crack/Opening < 0.25	1
Crack/Opening 0.25 < 0.5	1
Crack/Opening => 0.5	1
Vertical Displacement 0.25 < 0.5	1
Vertical Displacement 0.5 < 1.0	1
Vertical Displacement => 1.0	1
Pedestrian Access Route Width < 4 ft	1
Slab Width < 5 ft	1
Cross slope 3% < 4%	1
Cross slope 4% < 5%	1
Cross slope > 5%	1
Logitudinal Slope >5%	1
Drop Off Hazard	1
Overgrowth	1
Ponding	1
Obstruction	1
vertical clearance obstruction	1
Spalling	1
Longitudinal Crack	1
Width >4	1

OCI Min	0.1
OCI Max	101
OCI Median	79.26243
OCI Average	77.39109
Std Dev	14.73078
Mode	101



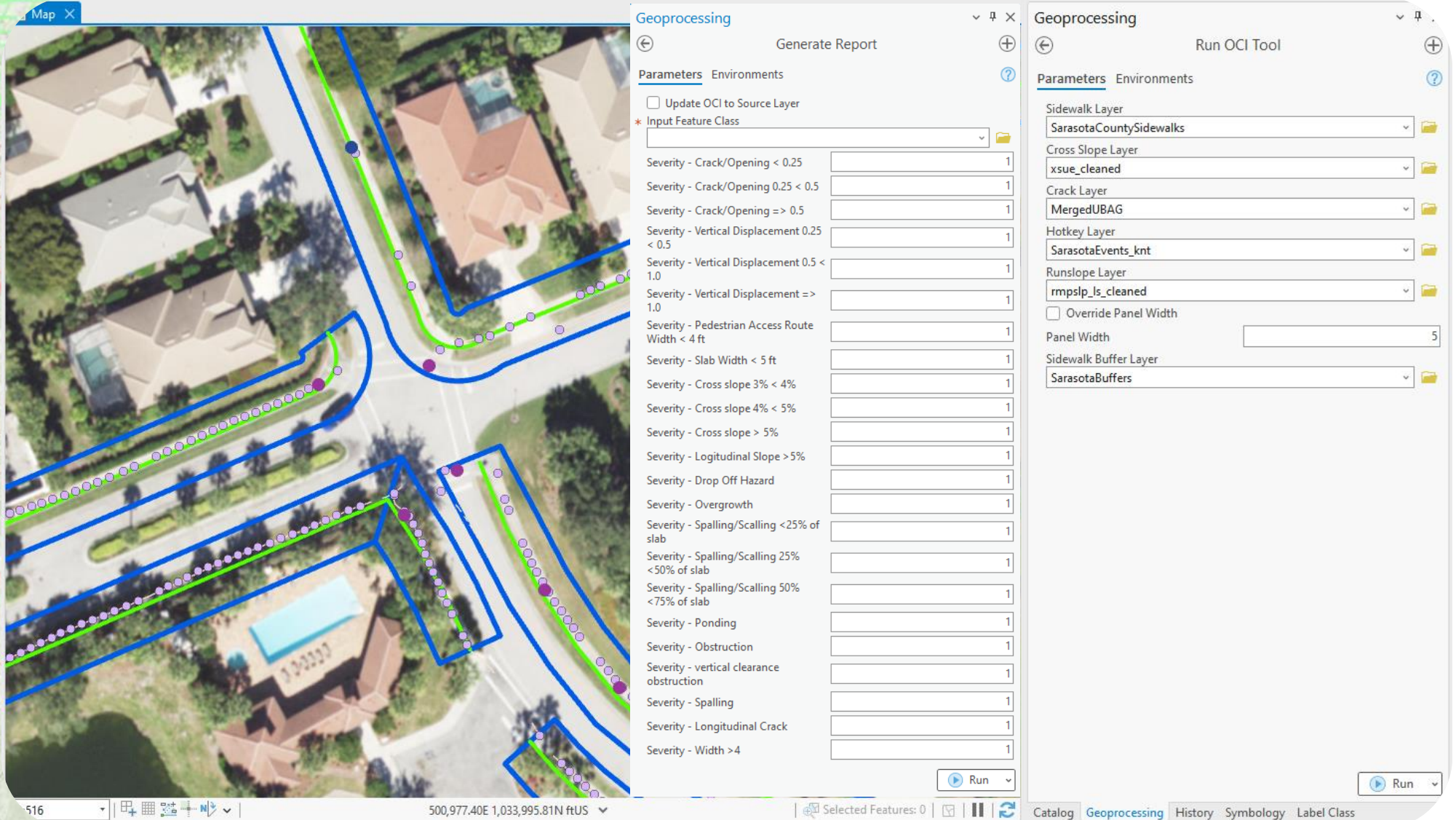
Adjust Weights here to see how it affects the entire data set.

Defect	Severity (Weight)
Crack/Opening < 0.25	3
Crack/Opening 0.25 < 0.5	10
Crack/Opening => 0.5	25
Vertical Displacement 0.25 < 0.5	3
Vertical Displacement 0.5 < 1.0	10
Vertical Displacement => 1.0	30
Pedestrian Access Route Width < 4 ft	10
Slab Width < 5 ft	5
Cross slope >2%	10
Logitudinal Slope >5%	10
Drop Off Hazard	10
Overgrowth	1
Spalling/Scalling <25% of panel	2
Spalling/Scalling 25% <50% of panel	5
Spalling/Scalling 50% <75% of panel	8
Ponding	5
Obstruction	30

Inspections determine the number of panels with each defect.

- Weighted Defect Score (WDS) = Number of Panels \* Weight
- WDS over sidewalk length (WDSOSL) = (WDS) / (Sidewalk Length)
- Sidewalk OCI = 100 - (WDSOSL)

# SIDEWALK DATA ANALYSIS OCI TOOL



The screenshot displays the OCI Tool interface, which includes a map view and two configuration panels. The map shows a residential area with sidewalks highlighted in blue and green, and various analysis points marked with purple and blue dots. The configuration panels are as follows:

### Geoprocessing

Generate Report

Parameters Environments

Update OCI to Source Layer

\* Input Feature Class

Severity - Crack/Opening < 0.25	1
Severity - Crack/Opening 0.25 < 0.5	1
Severity - Crack/Opening => 0.5	1
Severity - Vertical Displacement 0.25 < 0.5	1
Severity - Vertical Displacement 0.5 < 1.0	1
Severity - Vertical Displacement => 1.0	1
Severity - Pedestrian Access Route Width < 4 ft	1
Severity - Slab Width < 5 ft	1
Severity - Cross slope 3% < 4%	1
Severity - Cross slope 4% < 5%	1
Severity - Cross slope > 5%	1
Severity - Logitudinal Slope > 5%	1
Severity - Drop Off Hazard	1
Severity - Overgrowth	1
Severity - Spalling/Scalling < 25% of slab	1
Severity - Spalling/Scalling 25% < 50% of slab	1
Severity - Spalling/Scalling 50% < 75% of slab	1
Severity - Ponding	1
Severity - Obstruction	1
Severity - vertical clearance obstruction	1
Severity - Spalling	1
Severity - Longitudinal Crack	1
Severity - Width > 4	1

Run

### Geoprocessing

Run OCI Tool

Parameters Environments

Sidewalk Layer

SarasotaCountySidewalks

Cross Slope Layer

xsue\_cleaned

Crack Layer

MergedUBAG

Hotkey Layer

SarasotaEvents\_knt

Runslope Layer

rmpslp\_ls\_cleaned

Override Panel Width

Panel Width

5

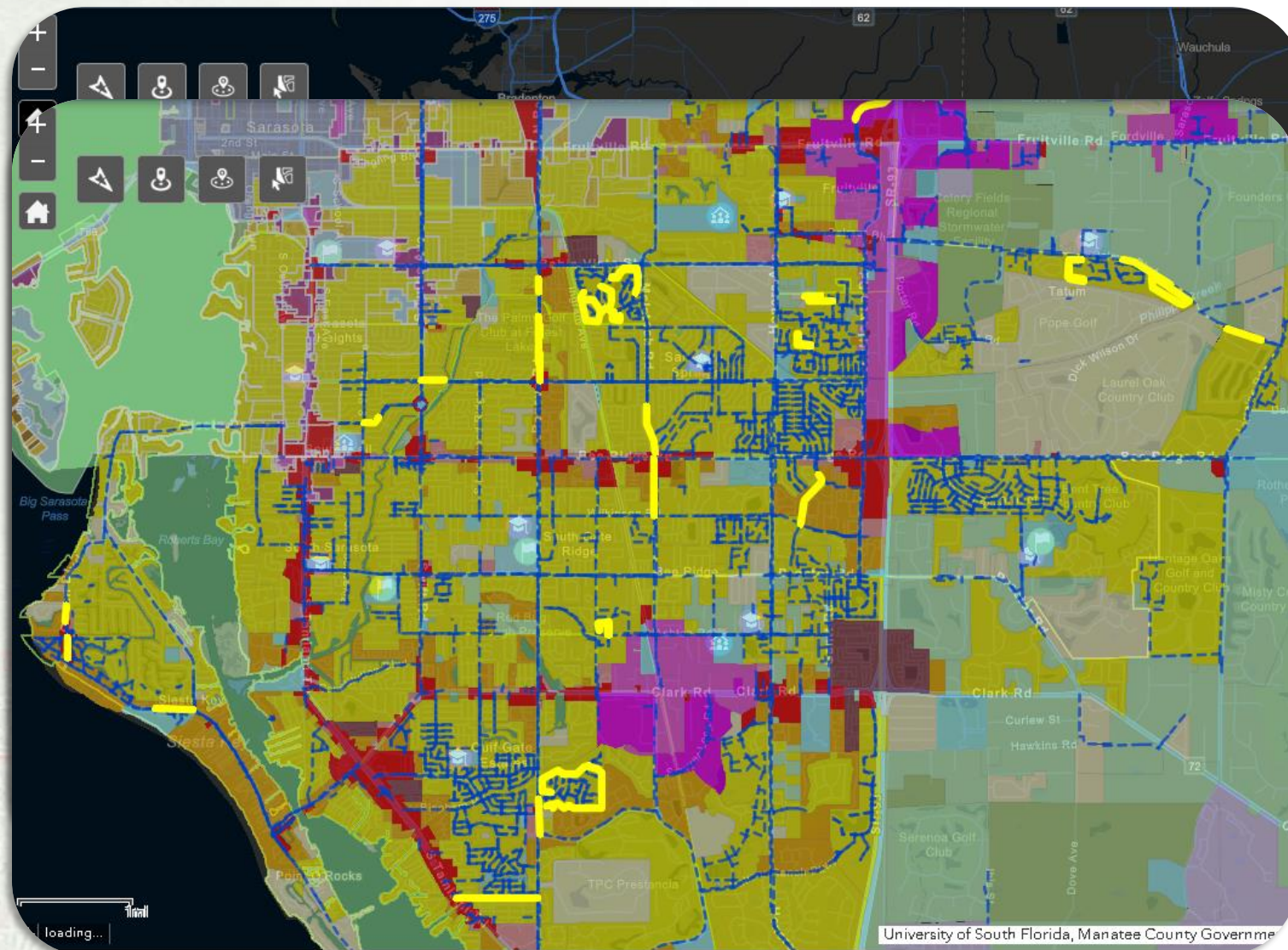
Sidewalk Buffer Layer

SarasotaBuffers

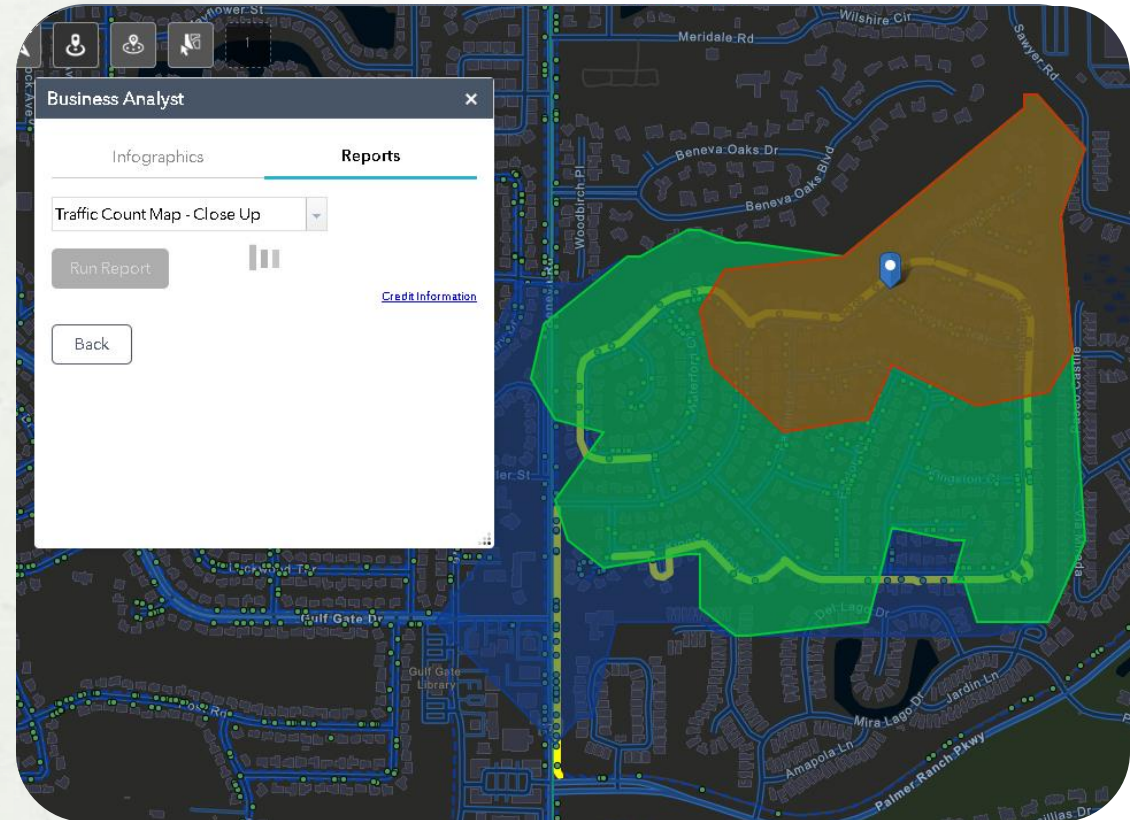
Run



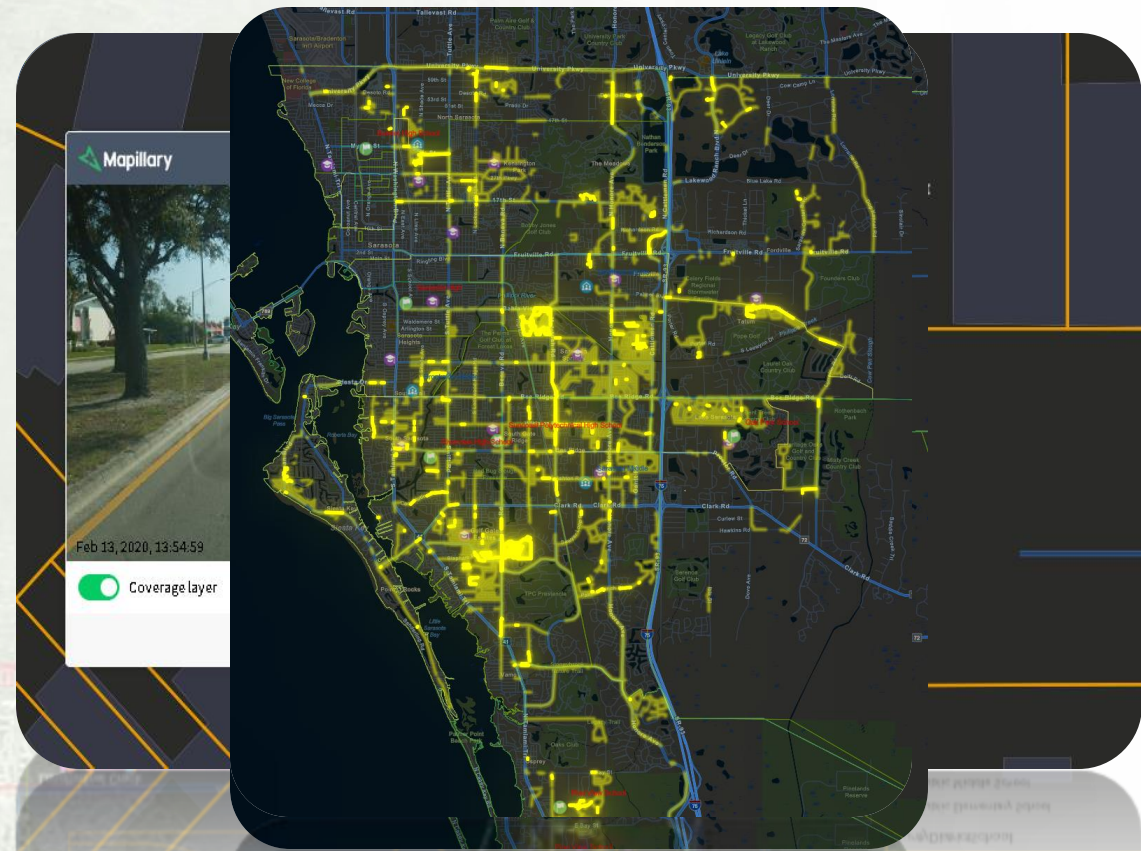
- **Customized Tools for OCI Calculations on the fly**
- **Importation of Existing Public GIS datasets**
- **Flexible Widget Integration**
- **Multiple Viewing Options**
- **Census Information Reporting**



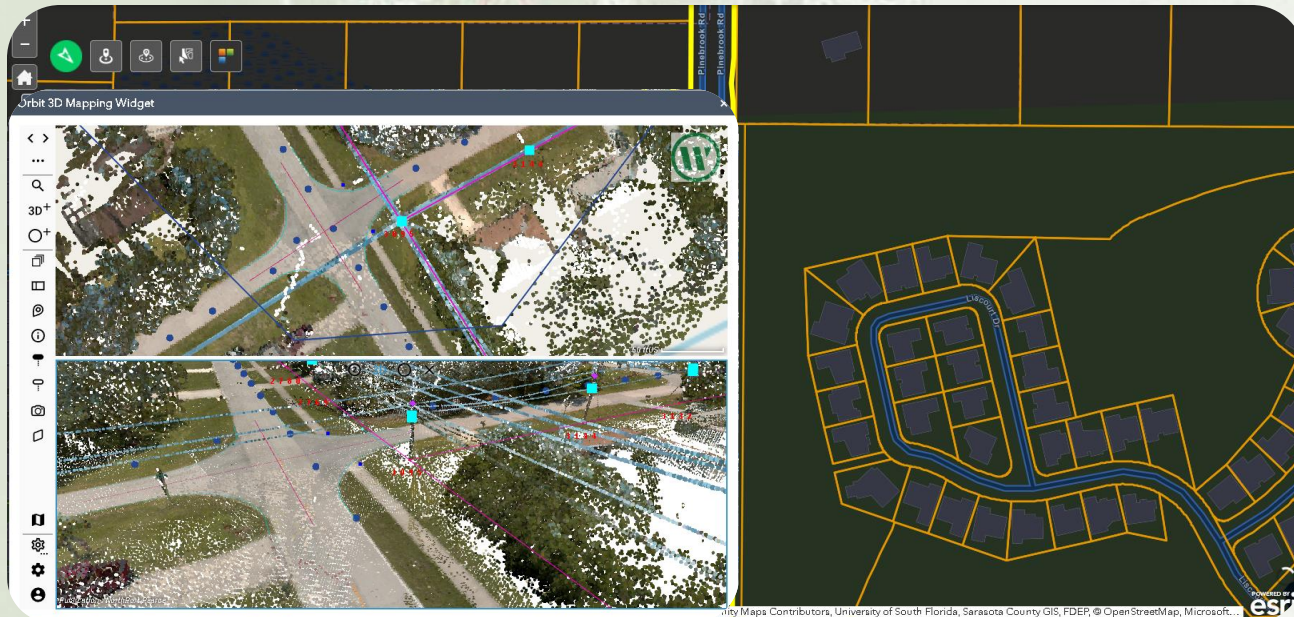
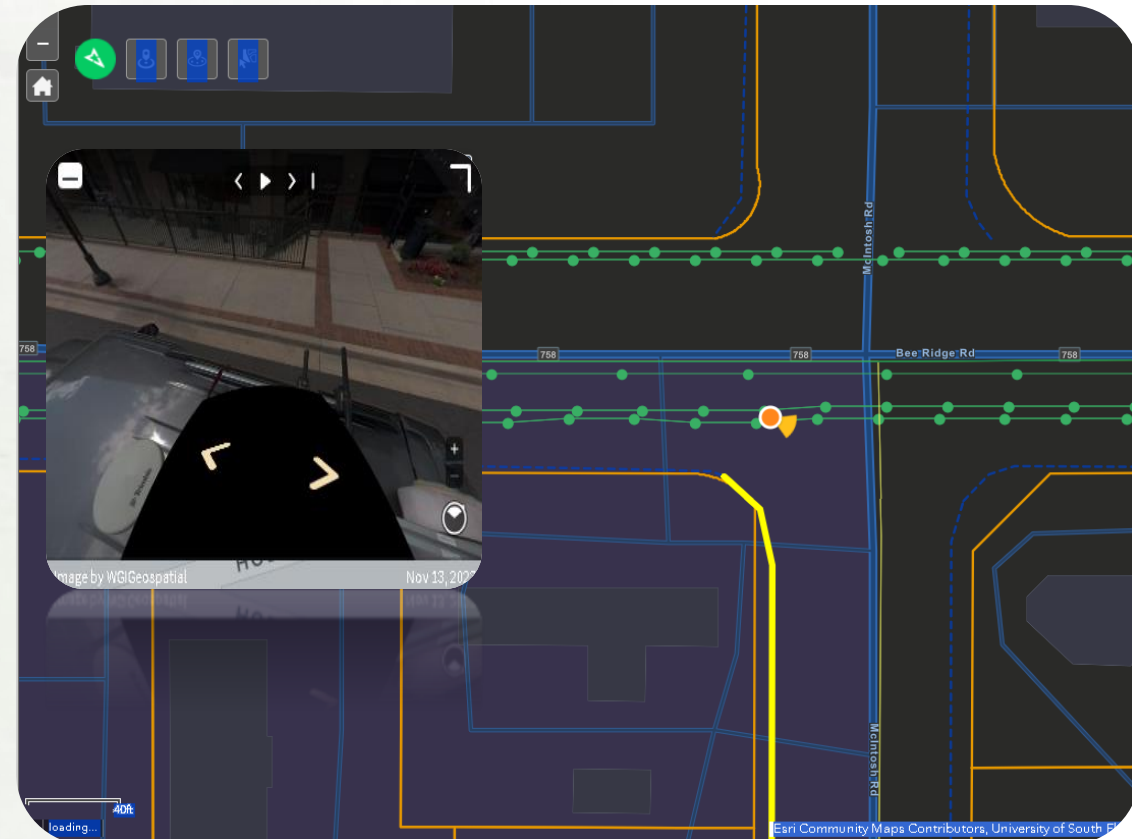
- **Accurate Insights**
- **Enhanced Planning**
- **Visual Infographics**
- **Streamlined Decision-Making**



- **High-Level OCI Review AND In-Depth inspection**
- **Utilize Defect Types Queries**
- **Overlay Multiple Iterations for OCI score comparisons**
- **Chart Defect Condition Index**



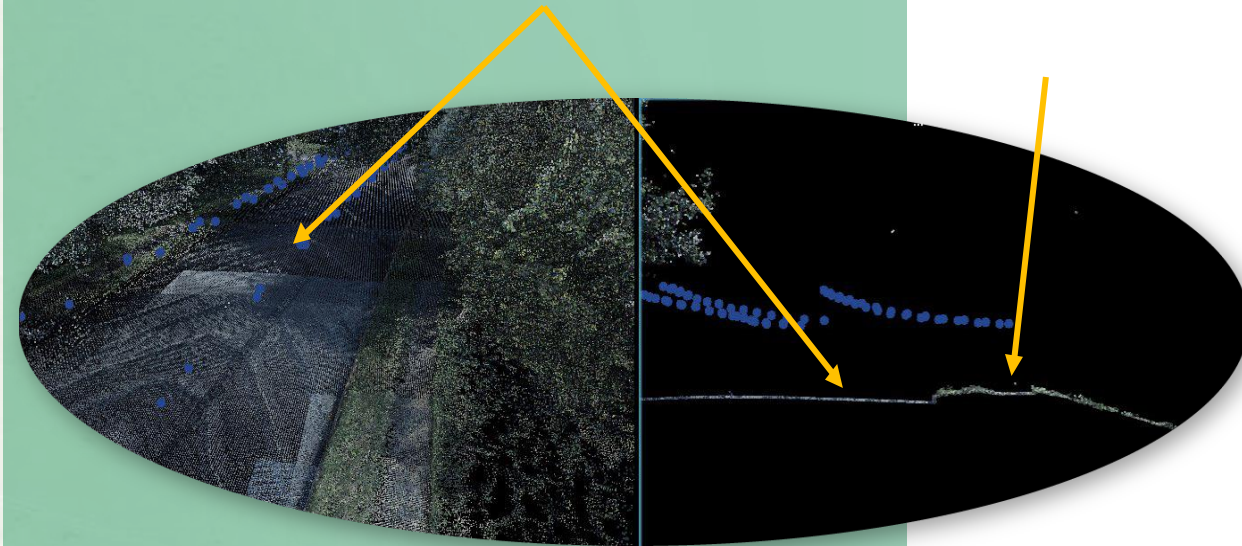
- **Street View Inspections**
  - **Open-Source Imagery**
  - **Project Curated Street Imagery**
- **Host Point Cloud data for additional Analysis**



# SIDEWALK DATA ANALYSIS

- **LiDAR for:**
  - *Widths, obstructions, drop-off locations*
  - *Pedestrian access*
- **Profiler for:**
  - *Slope and cross slope,*
  - *Crack width and depth*
  - *Panel separation*
- **Data is georeferenced**
- **Office reviews to create GIS features**
- **System assigns OCI for the defined sidewalk segments**

- ✓ • **Methodology for sidewalk conditioning rating**



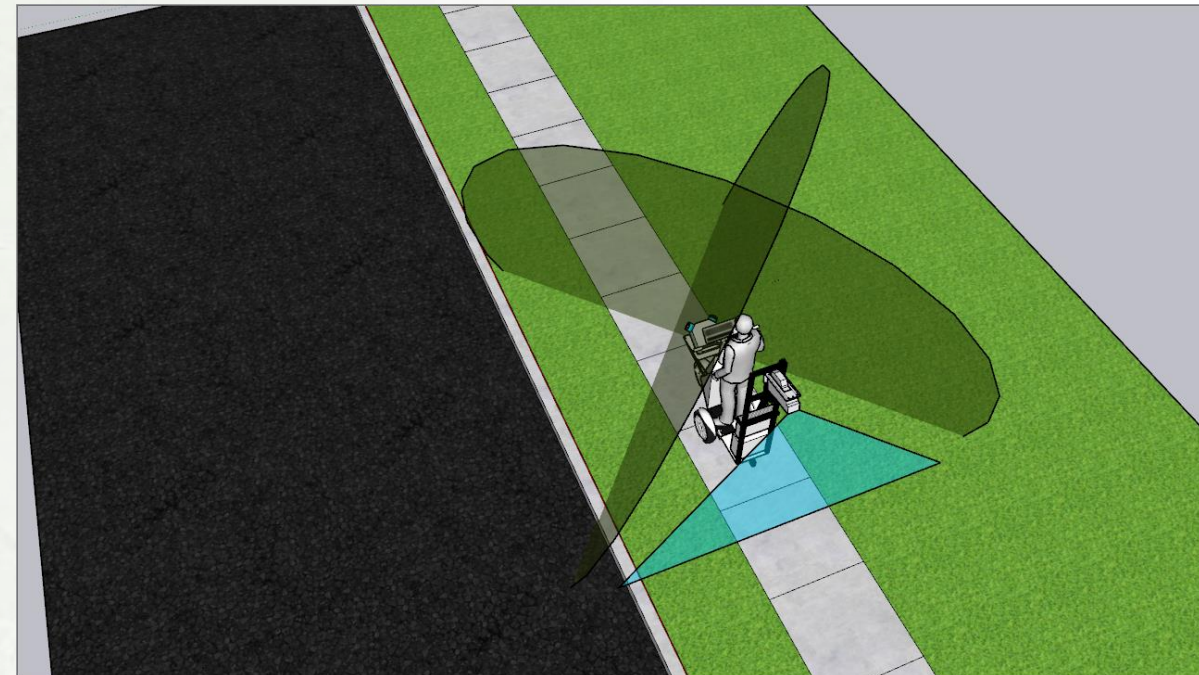
**COLORIZED LiDAR POINT CLOUD  
AND PROFILE**

- **Complimentary technology, surpassing basic data needs**
  - *Safe and efficient*
  - *High benefits with superior value*



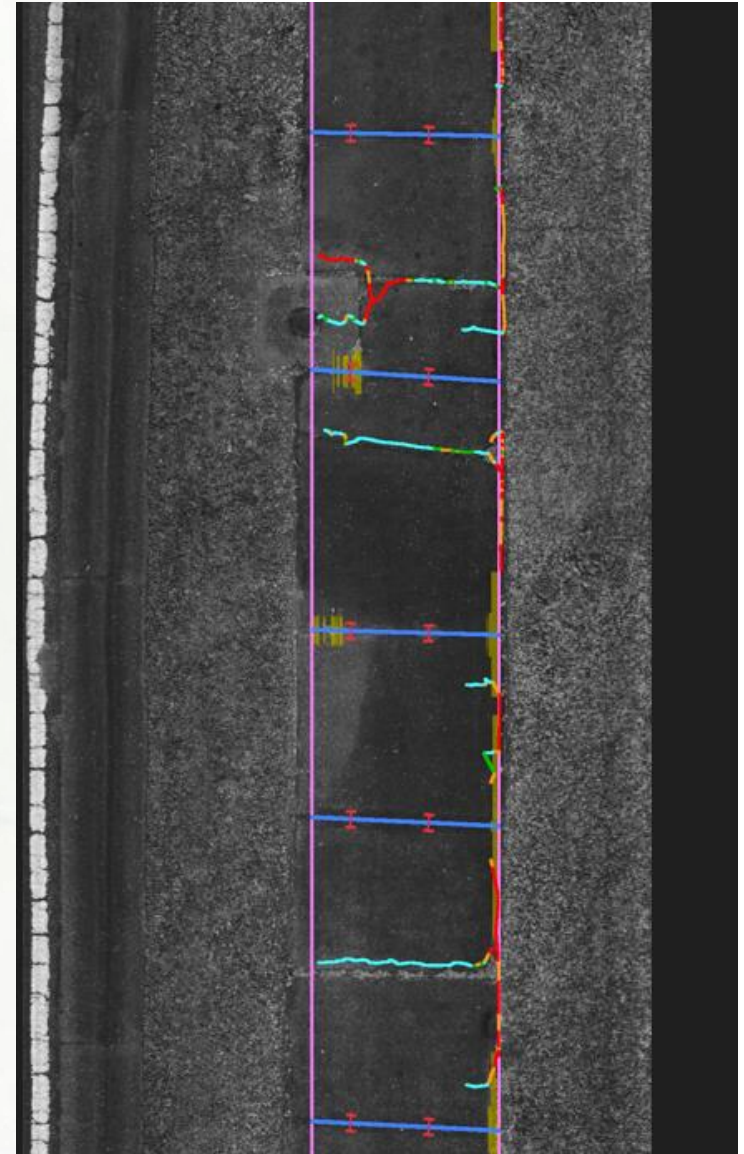
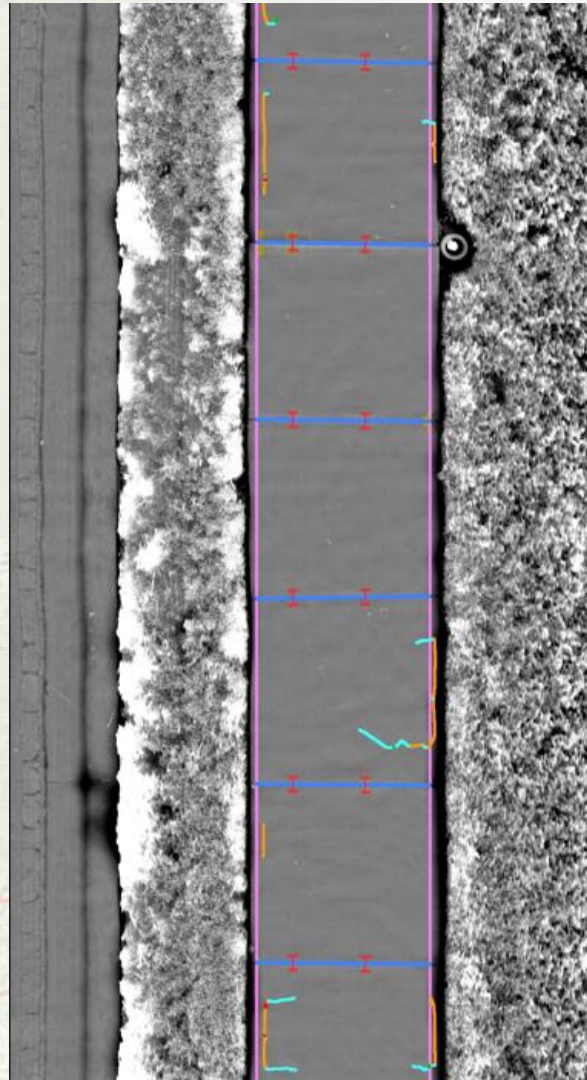
# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

- Profiler is wide scan angle vs. single line scan, optimal height
- Imagery collected using multiple cameras mounted on the ESV
- Cross-scanning/dual scanning lidar mounted on the ESV
- Fix-mounted lidars eliminating operator fatigue
- A high-precision mapping-grade IMU integrated with profiler and lidars
- Panoramic 360° camera
- ESV has more power and longer range
- Full asset inventory capability for all assets (e.g., mapping grade system for structure FFE and addresses, utilities)



# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

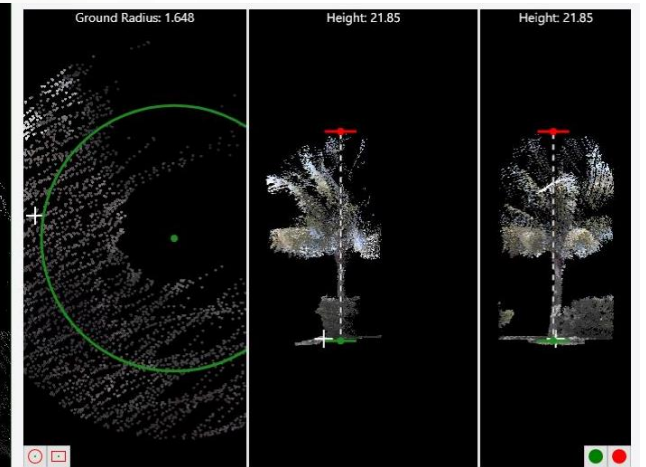
- Pavement scanner output
- Automatic defect detection





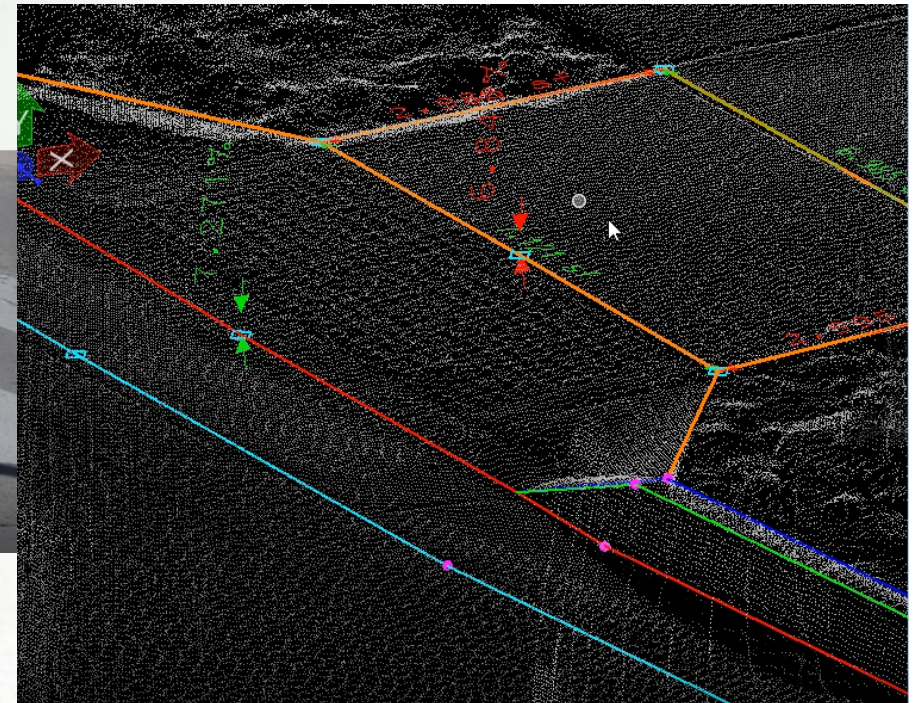
# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

- Mapping grade data
  - Laser's range and precision accuracy of 10 mm (0.40") at 100 meters (0.62 mile) with 600,000 pulses per second.
  - 250 scan lines / second and up to 600 kHz pulse repetition rate.
  - Imagery and lidar data are abundantly useful for a myriad of purposes (e.g., tree inventories in right of way)
- Sidewalk distresses:
  - Extremely high-density laser system used at close range
  - Measurement accuracy (including depth) of 1 mm.

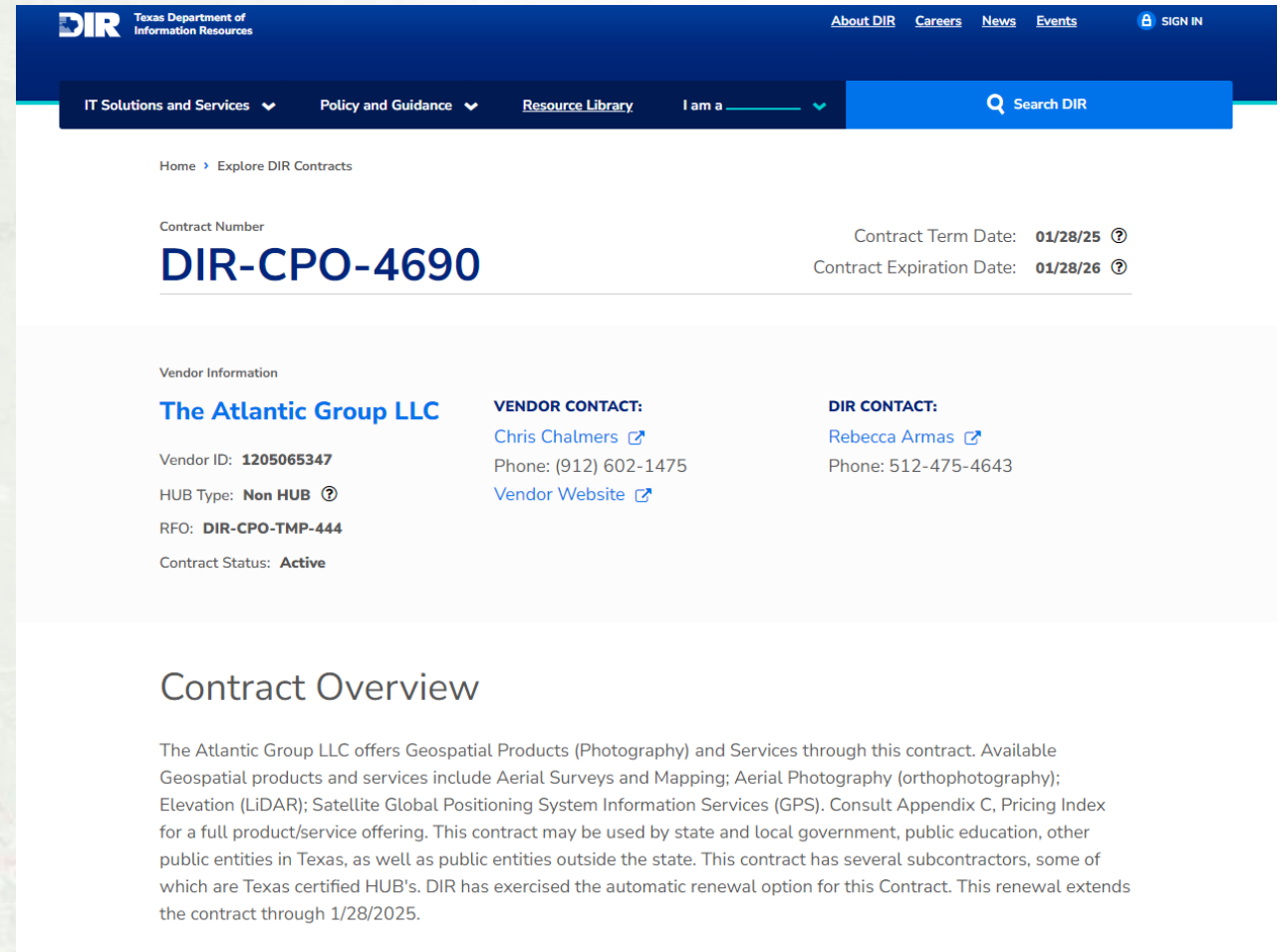


# SIDEWALK COLLECTION SYSTEM CONSIDERATIONS

- ADA ramp measurements and self assessments are “low-lying fruit”
- WGIGEO.tech platform provides independent viewing and measurement from lidar data, includes ArcGIS plugin and Mobile app if doing field visitations
- 3<sup>rd</sup> party AR option for integrations with lidar point cloud data
- Data is provided for client-generated measurements, reporting, GIS and asset management integrations



- Any County, City, State Agency, or State University in the SCAUG geographic area can purchase from WGI on this contract
- TXDIR / StratMap contract information: <https://dir.texas.gov/contracts/dir-cpo-4690>



The screenshot shows the DIR website interface. The top navigation bar includes links for About DIR, Careers, News, Events, and a SIGN IN button. Below the navigation bar, there are dropdown menus for IT Solutions and Services, Policy and Guidance, Resource Library, and I am a. A search bar labeled "Search DIR" is also present.

The main content area displays the contract details for DIR-CPO-4690. The contract number is prominently displayed in large blue text. To the right, the contract term date is 01/28/25 and the contract expiration date is 01/28/26. Below this, the vendor information is provided, including the vendor name "The Atlantic Group LLC", vendor ID "1205065347", HUB Type "Non HUB", and RFO "DIR-CPO-TMP-444". The contract status is listed as "Active".

Vendor Contact Information:

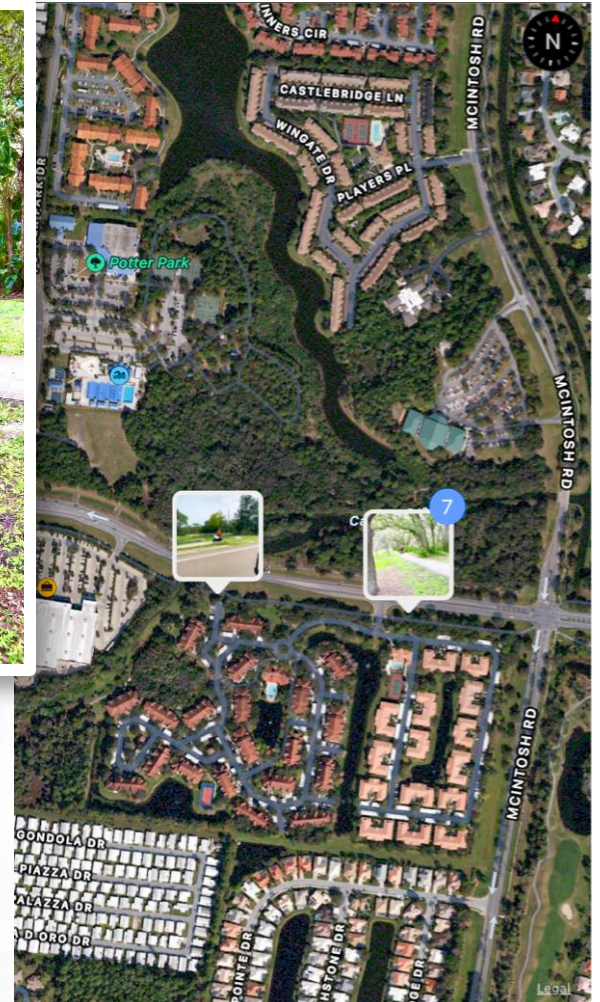
Vendor Contact	DIR Contact
Chris Chalmers	Rebecca Armas
Phone: (912) 602-1475	Phone: 512-475-4643
Vendor Website	

### Contract Overview

The Atlantic Group LLC offers Geospatial Products (Photography) and Services through this contract. Available Geospatial products and services include Aerial Surveys and Mapping; Aerial Photography (orthophotography); Elevation (LiDAR); Satellite Global Positioning System Information Services (GPS). Consult Appendix C, Pricing Index for a full product/service offering. This contract may be used by state and local government, public education, other public entities in Texas, as well as public entities outside the state. This contract has several subcontractors, some of which are Texas certified HUB's. DIR has exercised the automatic renewal option for this Contract. This renewal extends the contract through 1/28/2025.

# WGI's GEOSPATIAL SERVICES

- **Surveying and Mapping**
- **Geographic Information Systems**
- **Asset Management Collections**
- **Subsurface Utility Engineering**
- **Aerial LiDAR/Imagery Collection and Processing**
  - *Manned Aircraft*
  - *UAS*
- **Terrestrial LiDAR Collection and Processing**
  - *Mobile*
  - *Static*
- **Hydrographic Surveying**
- **Pavement Condition Surveying**





**Thank You**

**Any Questions?**

**[Seth.Adams@wginc.com](mailto:Seth.Adams@wginc.com)**