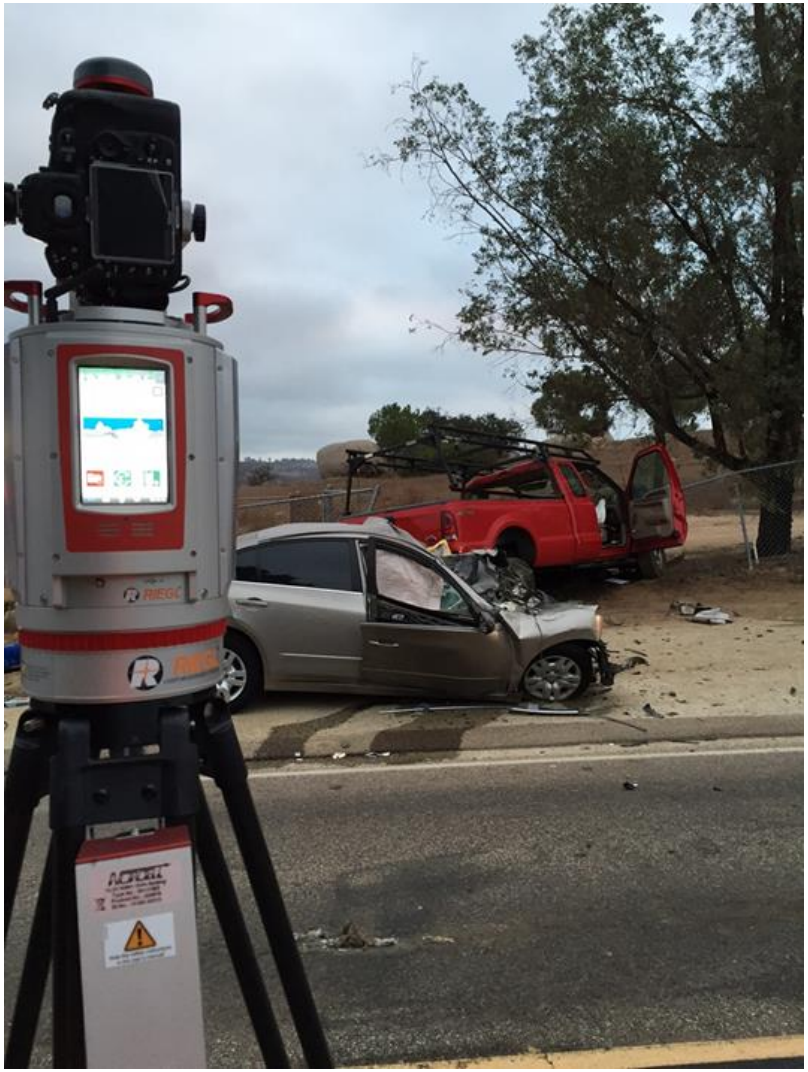
Using 3D Laser Scanning to Expedite Crash Scene Investigations and Reduce Secondary Crashes



Dave Foster, Forensic Consultant
Jillian Kreider, Communications Specialist
RIEGL

RIEGL: Public Safety and Forensics

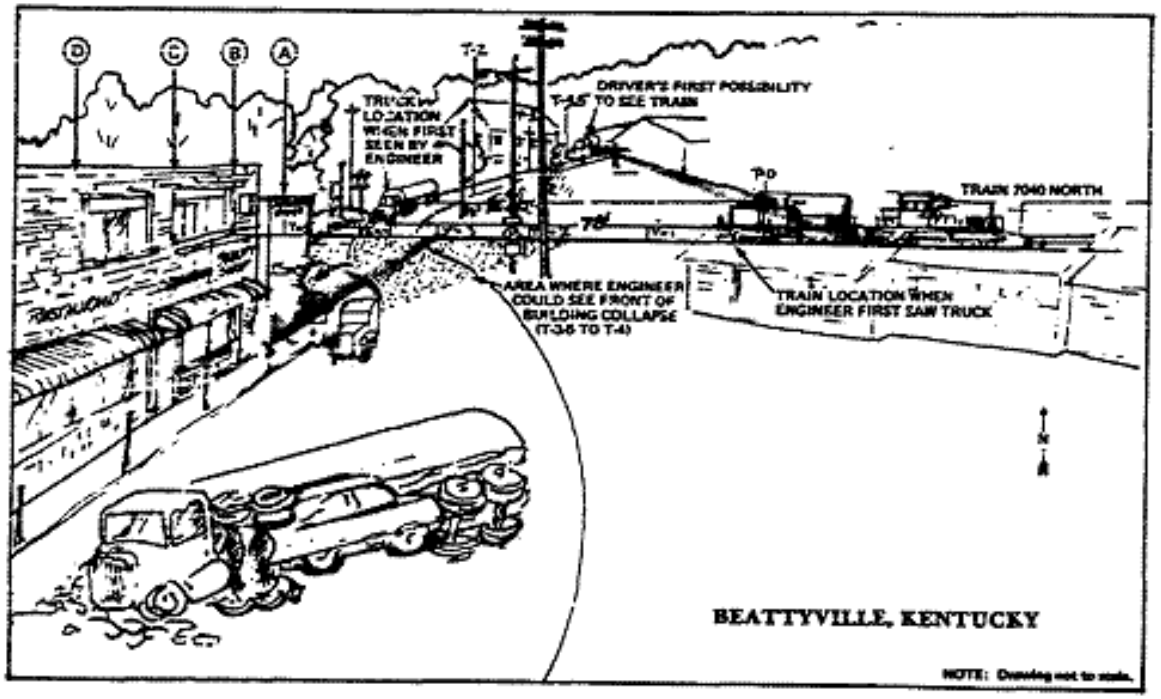


Figure 2. Artist's conception of accident site.

Documenting crash scenes has moved on since this sketch was produced!

Agenda

- Who is *RIEGL*?
- CFX/FDOT FHP Pilot Project Update
- How to deploy a 3D Laser Scanner + Scene Setup
- Live Demo – How to Collect a Serious or Fatal Crash
- Working in your 3D Crash Scene
- How to Go from your 3D Crash to your 2D Line Drawing
- Additional Uses

RIEGL®

Innovation in 3D

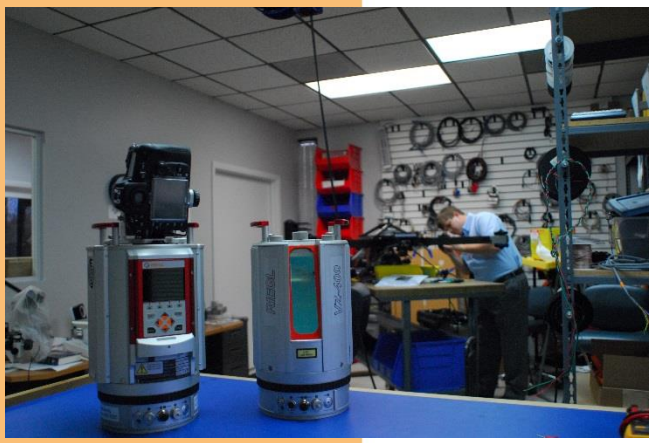
RIEGL Introduction

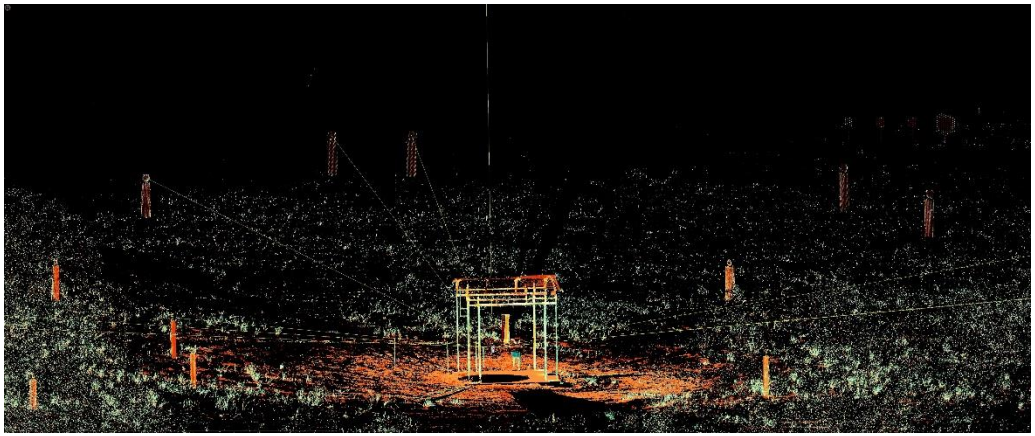
- Laser scanning benefits to the forensic world:
  - More complete, objective evidence gathering
  - Reduced time surveying the scene – significant time savings
  - Enhanced investigative standards and improved reputation to organizations

About *RIEGL*

The *RIEGL* USA office is located in Orlando, FL. This hub in Central Florida carries out sales, marketing, training, service, and support for our North American customers.

We have a certified 50+ acre scanner calibration field and a service center in the state. With these facilities, *RIEGL* USA offers quick turnaround services to our North American customers.





BREAKING NEWS ALERT
"KING" STAHLMAN BAIL BONDS
2 KILLED IN HEAD-ON CRASH IN VALLEY CENTER
OTESTERS GATHER OUTSIDE REP. DARRELL ISSA'S OFFICE DEMONSTRATING AGAIN
NEV
3m 14s
5:00
78°
@NEWS8

Surveying Equipment Technology Pilot Program

- Extensive research
- More than three years and several hundreds of thousands of dollars to perform a scientific based approach
- Data has been evaluated by a third party Engineering Consultant
- Corey Quinn, Director of Operations CFX

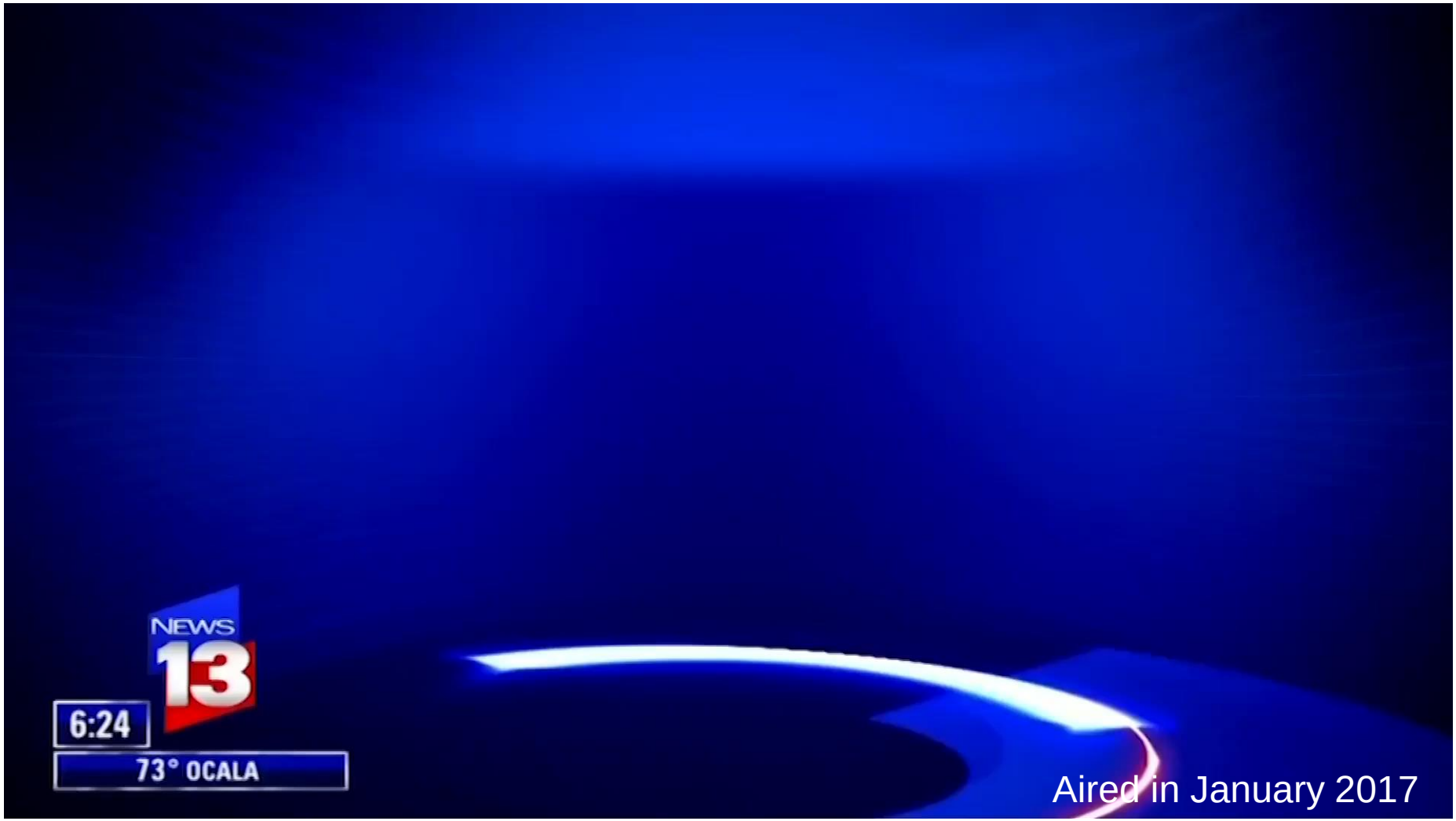
Pilot Project Update

Original demonstration/ technical competition

- *RIEGL* ranked #1 in the following categories
  - Ease of use, speed, precision, environmental reliability, customer support, compatibility to Crash Zone, and cost
- Training conducted and pilot began in Nov. 2016

- *RIEGL* LiDAR data from over 134 crashes submitted to the pilot project team from Troop D Orlando
- Side by side comparison w/ Total Station
  - Significant time savings w/ the *RIEGL*
  - Collection of more and accurate evidence
- Requires only one Corporal

Training of FHP Corporals at CFX headquarters



Aired in January 2017

Recent Crash – Case Study

- Total Station started 25 minutes before RIEGL arrived.
- RIEGL scan took 25 minutes
- Total Station was finished an hour after the RIEGL

- Total time saved using RIEGL = 1 hour 25 minutes

Comments by Corporals in Troop D Orlando

- *This was a lengthy scene with a lot of car and body debris scattered. Using a Total Station to collect this scene would have taken approximately 4.5 hours. I did 15 scan positions with the RIEGL in roughly an hour.*

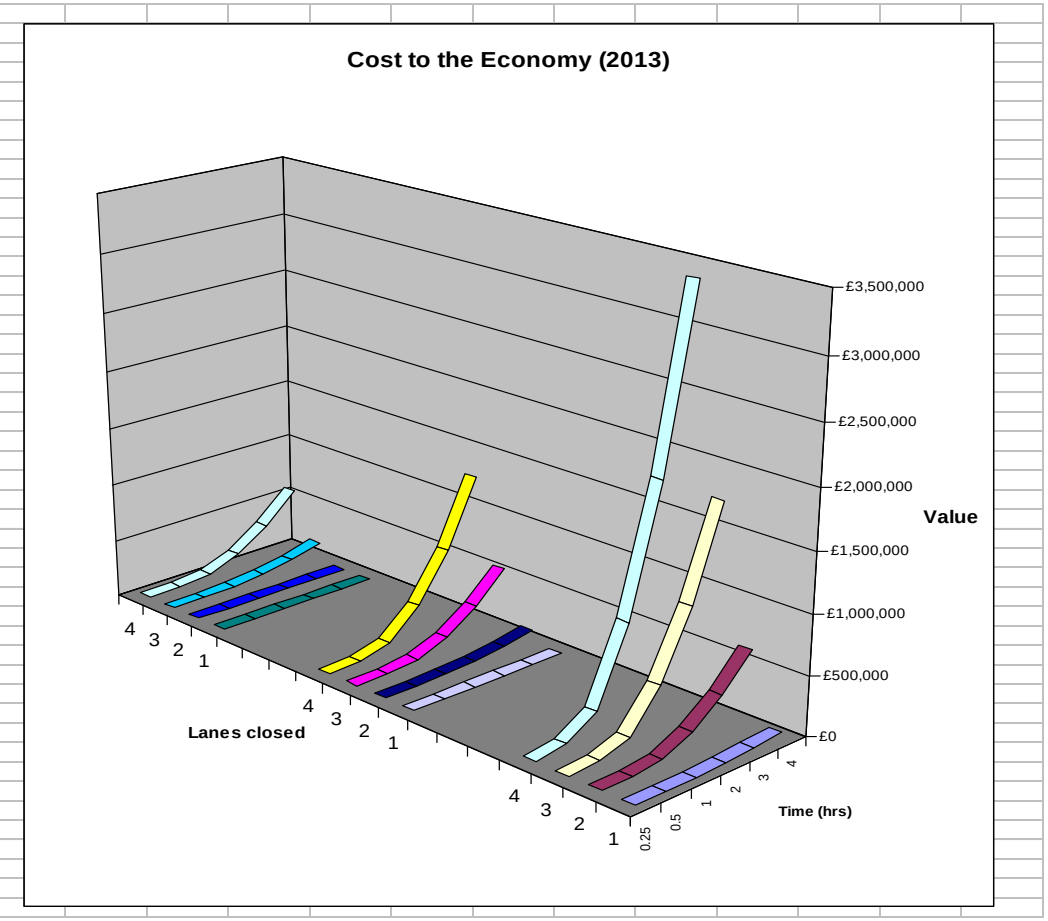
2/11/2017	There was a lot going on in this scene, with debris scattered across a lengthy area. We also had V-1 come to final rest in a tree surrounded with vegetation. This would have taken approximately 6 hours to collect with the total station. I captured 23 scans with the VZ in about an hour and a half. I would not have gotten ANY of the detail of this scene without the VZ. The delay in road reopening was due to removal of vehicle from tree and also cleaning up and taking care of the boat and other vehicle.

- *The VZ was extremely helpful on the curved road. Measuring the curve in both directions would have taken a lot of time. It would have taken me approximately 3 hours to collect this with the Total Station. (Based on the completed form the LiDAR survey took 45 minutes to complete at this scene)*

What Does Laser Scanning Mean for Law Enforcement?

- LiDAR scans create a court admissible, highly accurate 3D model far superior to previous documentation methods in a fraction of the time

Economic Impact – Time & Cost



PREVIOUS METHODS

Average of 200 – 400 points per scene

* Collection Time = 2 – 5 hours. Approximately 100 pts/hour

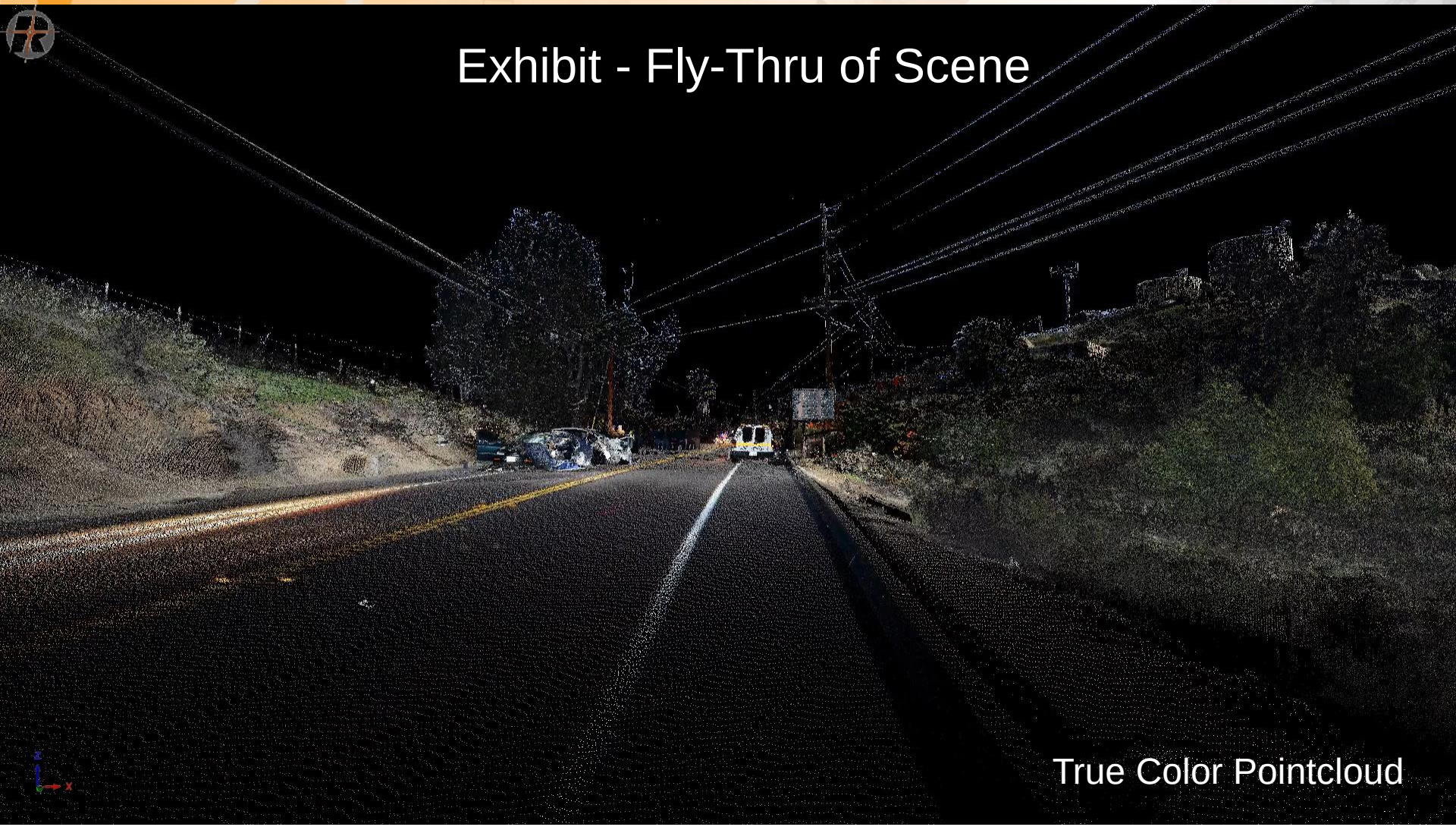
RIEGL VZ-400i

Average of 10-12 scan positions per scene

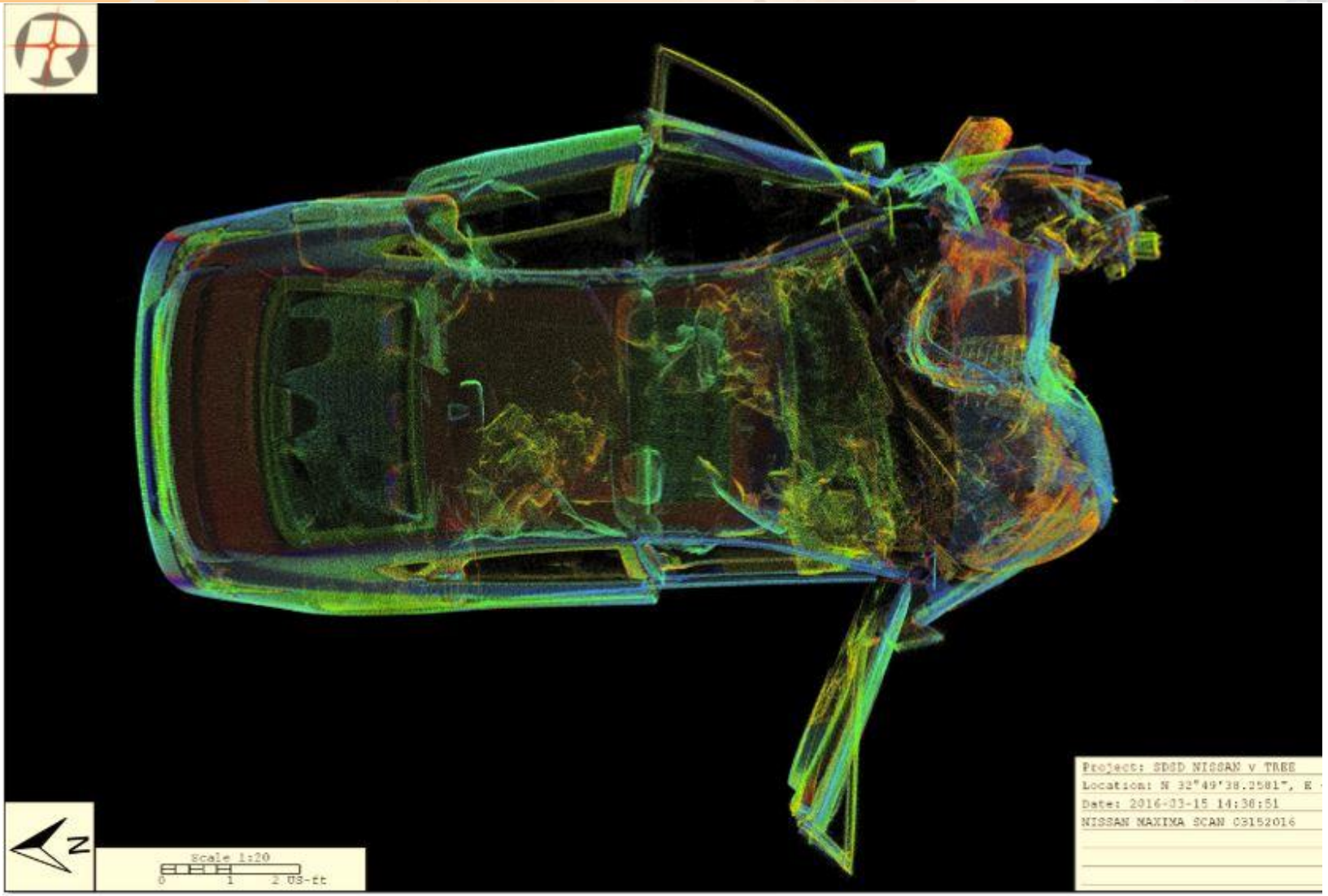
*Average Collection Time = 30 - 40 minutes. Up to 500,000 pts/second

Preliminary information provided by Florida Highway Patrol in connection with the CFX pilot project

Exhibit - Fly-Thru of Scene



I-4 Corridor – Lake Monroe Area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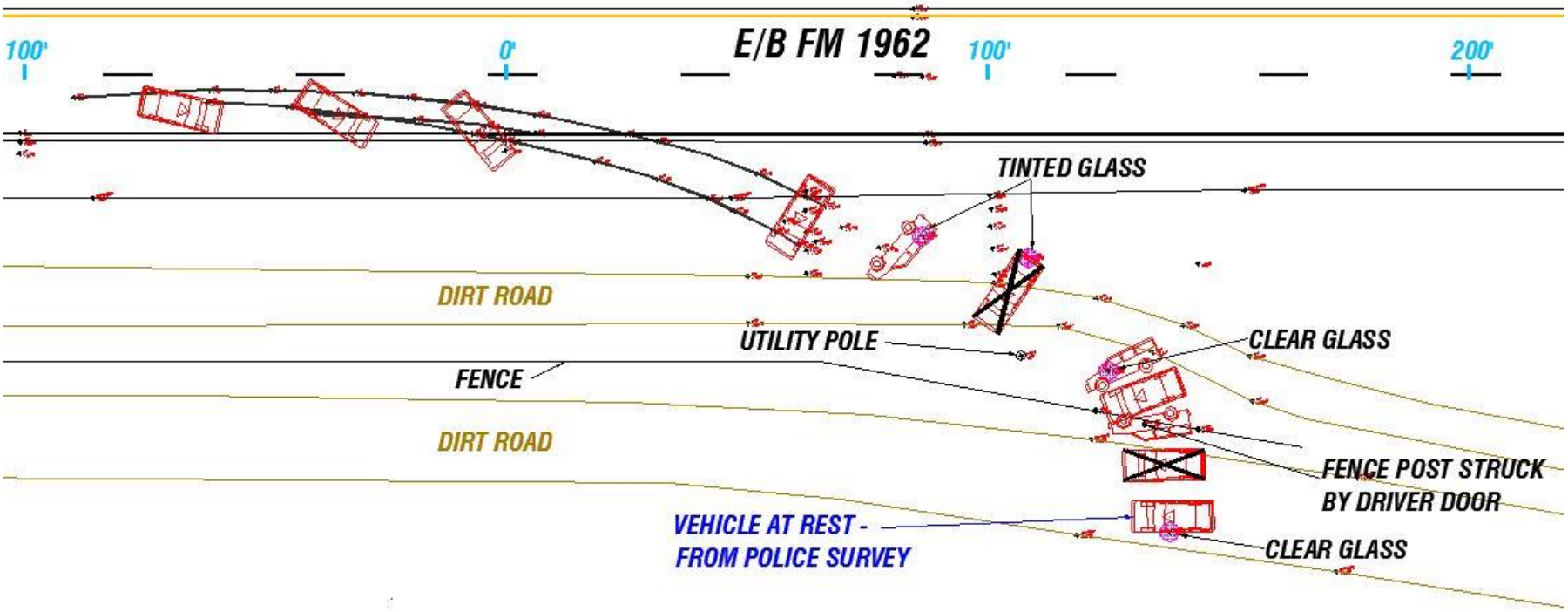
Location: N 32°49'38.2581", E
Date: 2016-03-15 14:30:51
NISSAN MAXIMA SCAN 03152016
N
Scale 1:20
0 1 2 US-ft

2D Line Drawing



Demo – Mock Scene

VZ-400i Instrument Highlights

- The most effective laser scanner in the market
  - Under 2 minutes per position
  - Collects up to 500,000 points/sec
- Real-time onboard registration & processing
- User friendly workflows
- Durable, rugged, and can operate in rain or night
- Inclination sensor levels data

RiSOLVE – Processing & Visualization Software

- Fully automatic registration
  - One-touch solutions, filtering, true color, reflectance
- Virtual scene can be accessed at any time.
  - Corroborate witness statements, sight lines, obstructions
  - Minimize need to return to the scene
- Coordinate Export Tool to Crash Zone
  - FHP Corporals selecting up to 700 points within scene for export to create 2D line drawing in under 1 hour
- Produce a variety of exhibits for court purposes

Live Demo of Processing Scene Data within RiSOLVE

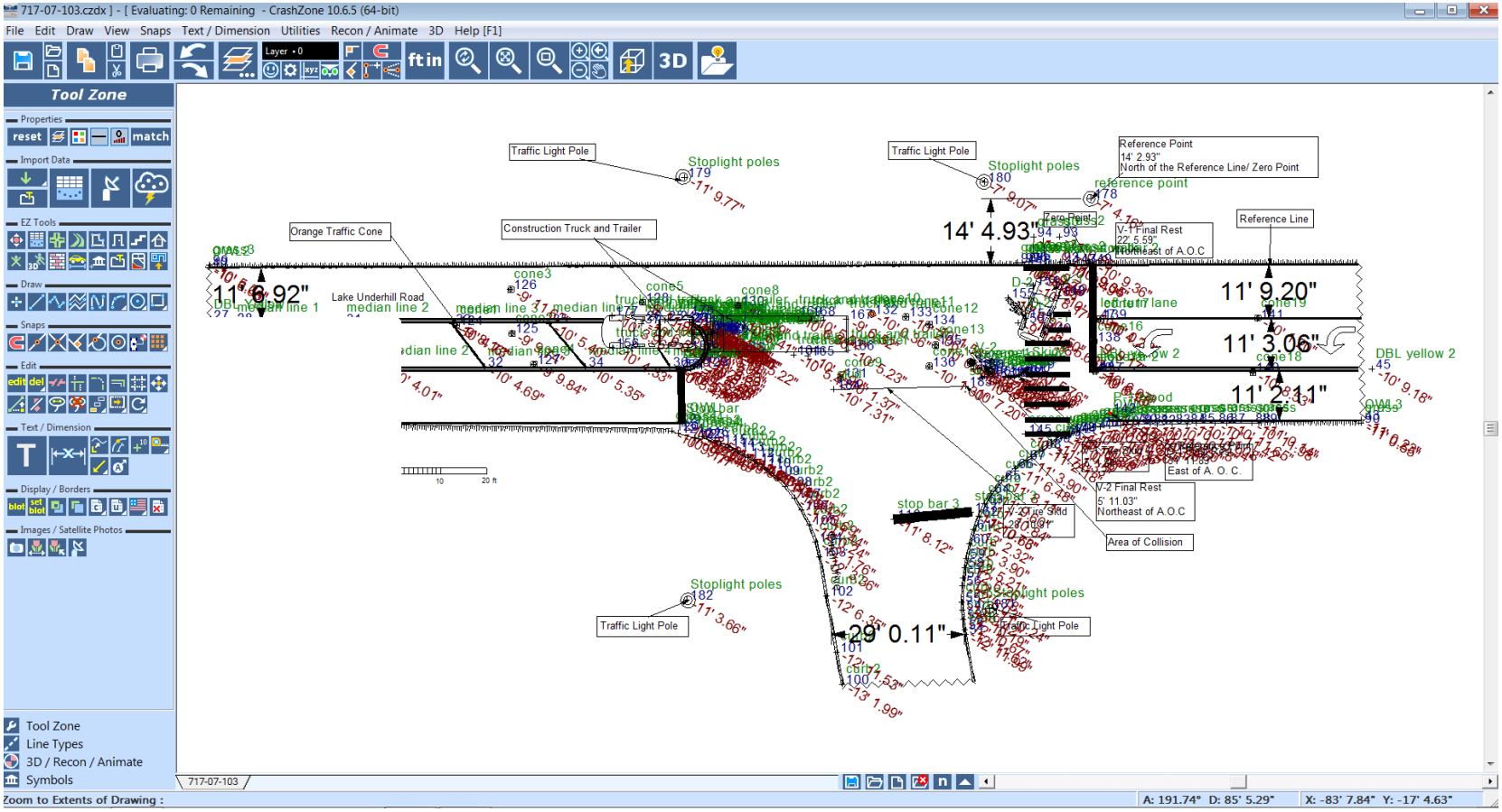
Coordinate Export Tool – 2D Line Drawing in Crash Zone

1	-175.339 I	-7.856 US	-10.580 U	OWL
2	-79.410 U	-7.822 US	-10.711 U	OWL
3	-177.411 I	4.016 US-	-10.318 U	DBL Yellow
4	-81.037 U	3.959 US-	-10.463 U	DBL Yellow
5	-79.758 U	3.959 US-	-10.467 U	DBL Yellow
6	-78.384 U	4.045 US-	-10.464 U	DBL Yellow
7	-77.490 U	4.457 US-	-10.466 U	DBL Yellow
8	-76.709 U	4.952 US-	-10.455 U	DBL Yellow
9	-75.954 U	5.666 US-	-10.458 U	DBL Yellow
10	-75.319 U	6.594 US-	-10.448 U	DBL Yellow
11	-74.944 U	7.550 US-	-10.442 U	DBL Yellow
12	-74.825 U	8.318 US-	-10.436 U	DBL Yellow
13	-74.763 U	9.309 US-	-10.423 U	DBL Yellow
14	-74.847 U	10.127 US	-10.428 U	DBL Yellow
15	-75.190 U	11.184 US	-10.451 U	DBL Yellow
16	-75.917 U	12.534 US	-10.479 U	DBL Yellow
17	-76.471 U	13.104 US	-10.487 U	DBL Yellow
18	-72.633 U	12.102 US	-2.181 US	DBL Yellow
19	-75.142 U	12.982 US	-6.595 US	DBL Yellow
20	-77.873 U	14.018 US	-10.507 U	DBL Yellow
21	-78.263 U	14.171 US	-10.514 U	DBL Yellow
22	-78.539 U	14.238 US	-10.304 U	DBL Yellow
23	-78.829 U	14.225 US	-10.177 U	DBL Yellow
24	-81.546 U	14.633 US	-10.529 U	DBL Yellow
25	-84.080 U	14.671 US	-10.529 U	DBL Yellow
26	-88.827 U	14.631 US	-10.531 U	DBL Yellow
27	-183.519 I	14.711 US	-10.322 U	DBL Yellow
28	-178.516 I	14.015 US	-10.297 U	median line 1
29	-168.201 I	4.337 US-	-10.294 U	median line 1

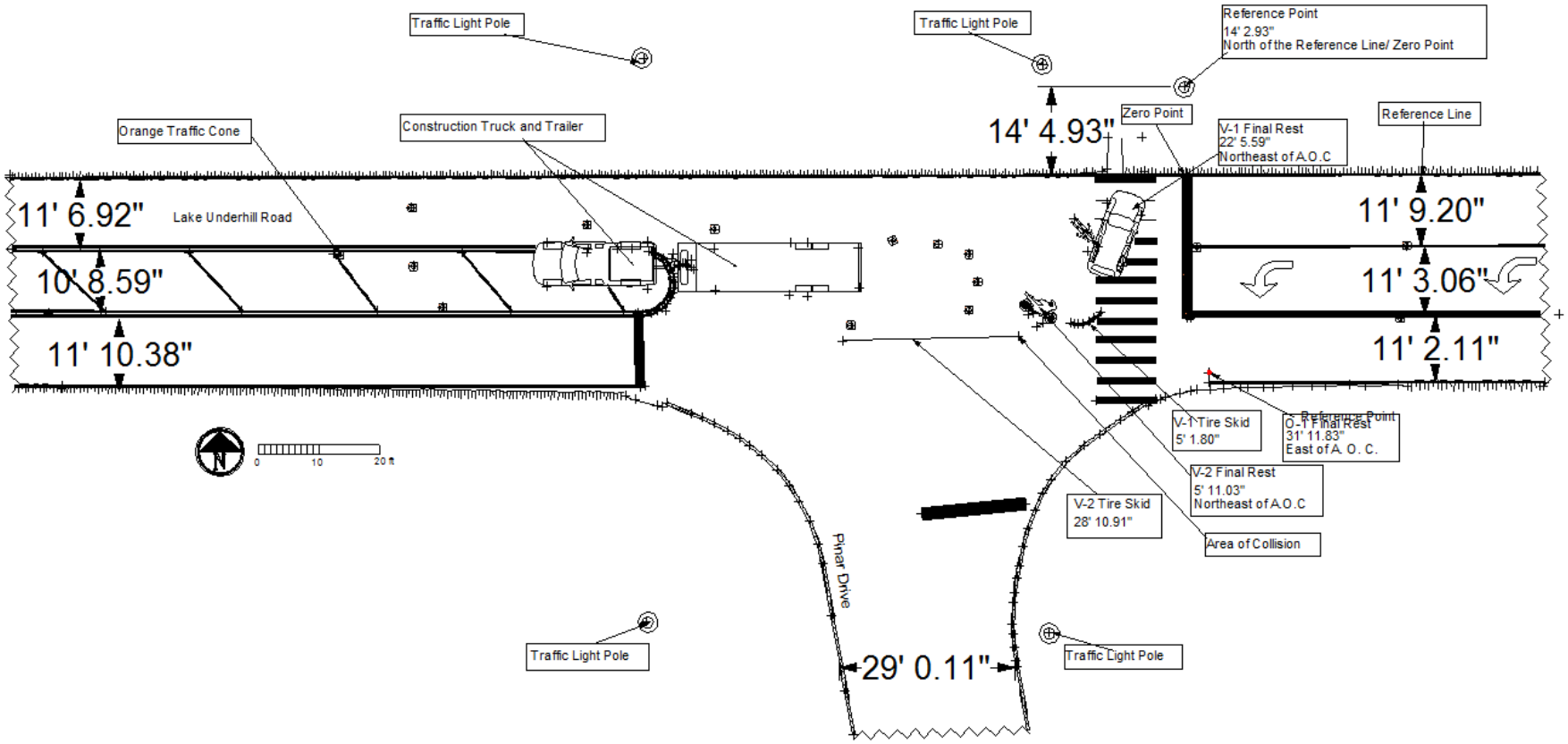
57	-18.694 U	-41.721 U	-12.598 U	curb
58	-18.363 U	-39.372 U	-12.522 U	curb
59	-17.966 U	-37.321 U	-12.434 U	curb
60	-17.310 U	-34.090 U	-12.325 U	curb
61	-16.451 U	-31.116 U	-12.193 U	curb
62	-15.311 U	-28.152 U	-12.055 U	curb
63	-14.064 U	-25.438 U	-11.903 U	curb
64	-12.671 U	-23.184 U	-11.800 U	curb
65	-10.350 U	-20.244 U	-11.676 U	curb
66	-7.387 US	-17.727 U	-11.540 U	curb
67	-4.782 US	-15.800 U	-11.325 U	curb
68	-1.418 US	-13.458 U	-11.182 U	curb
69	0.581 US-	-12.152 U	-11.111 U	curb
70	2.786 US-	-10.669 U	-11.015 U	curb
71	3.264 US-	-11.112 U	-11.017 U	grass
72	5.240 US-	-10.060 U	-10.907 U	grass
73	6.087 US-	-9.650 US	-10.897 U	grass
74	8.421 US-	-9.046 US	-10.870 U	grass
75	10.210 US	-8.680 US	-10.863 U	grass
76	11.137 US	-8.565 US	-10.846 U	grass
77	13.313 US	-8.449 US	-10.850 U	grass
78	15.615 US	-8.237 US	-10.855 U	grass
79	18.313 US	-8.045 US	-10.864 U	grass
80	19.576 US	-8.017 US	-10.873 U	grass
81	22.141 US	-7.985 US	-10.879 U	grass
82	23.775 US	-8.075 US	-10.892 U	grass
83	26.925 US	-7.954 US	-10.898 U	grass

169	-55.572 U	15.702 US	-10.530 U	truck and trailer
170	-68.178 U	14.711 US	-10.534 U	truck and trailer
171	-71.799 U	12.755 US	-9.392 US	truck and trailer
172	-72.951 U	12.304 US	-9.406 US	truck and trailer
173	-73.789 U	11.752 US	-10.464 U	truck and trailer
174	-74.642 U	11.556 US	-10.462 U	truck and trailer
175	-74.954 U	13.742 US	-10.508 U	truck and trailer
176	-79.128 U	15.804 US	-10.510 U	truck and trailer
177	-95.618 U	15.679 US	-10.330 U	truck and trailer
178	9.214 US-	41.262 US	-7.347 US	reference point
179	-79.701 U	45.835 US	-11.814 U	Stoplight poles
180	-14.138 U	44.901 US	-7.756 US	Stoplight poles
181	-13.066 U	-48.337 U	-11.020 U	Stoplight poles
182	-79.301 U	-46.497 U	-11.305 U	Stoplight poles
183	-18.131 U	0.221 US-	-10.600 U	skid
184	-47.038 U	-0.438 US	-10.609 U	skid
185	-15.007 U	1.983 US-	-10.552 U	scrape
186	-14.123 U	2.462 US-	-10.540 U	scrape
187	-16.518 U	3.949 US-	-10.487 U	scrape1
188	-15.706 U	4.076 US-	-10.491 U	scrape1
189	-4.501 US	4.223 US-	-10.480 U	Skid2
190	-5.628 US	3.287 US-	-10.505 U	Skid2
191	-6.496 US	2.675 US-	-10.520 U	Skid2
192	-7.533 US	2.292 US-	-10.531 U	Skid2
193	-8.271 US	2.313 US-	-10.523 U	Skid2
194	-8.967 US	2.305 US-	-10.530 U	Skid2
195	-9.409 US	2.530 US-	-10.537 U	Skid2

Coordinate Export Tool – 2D Line Drawing in Crash Zone



Final 2D Line Drawing in Crash Zone



RiSOLVE – View Types

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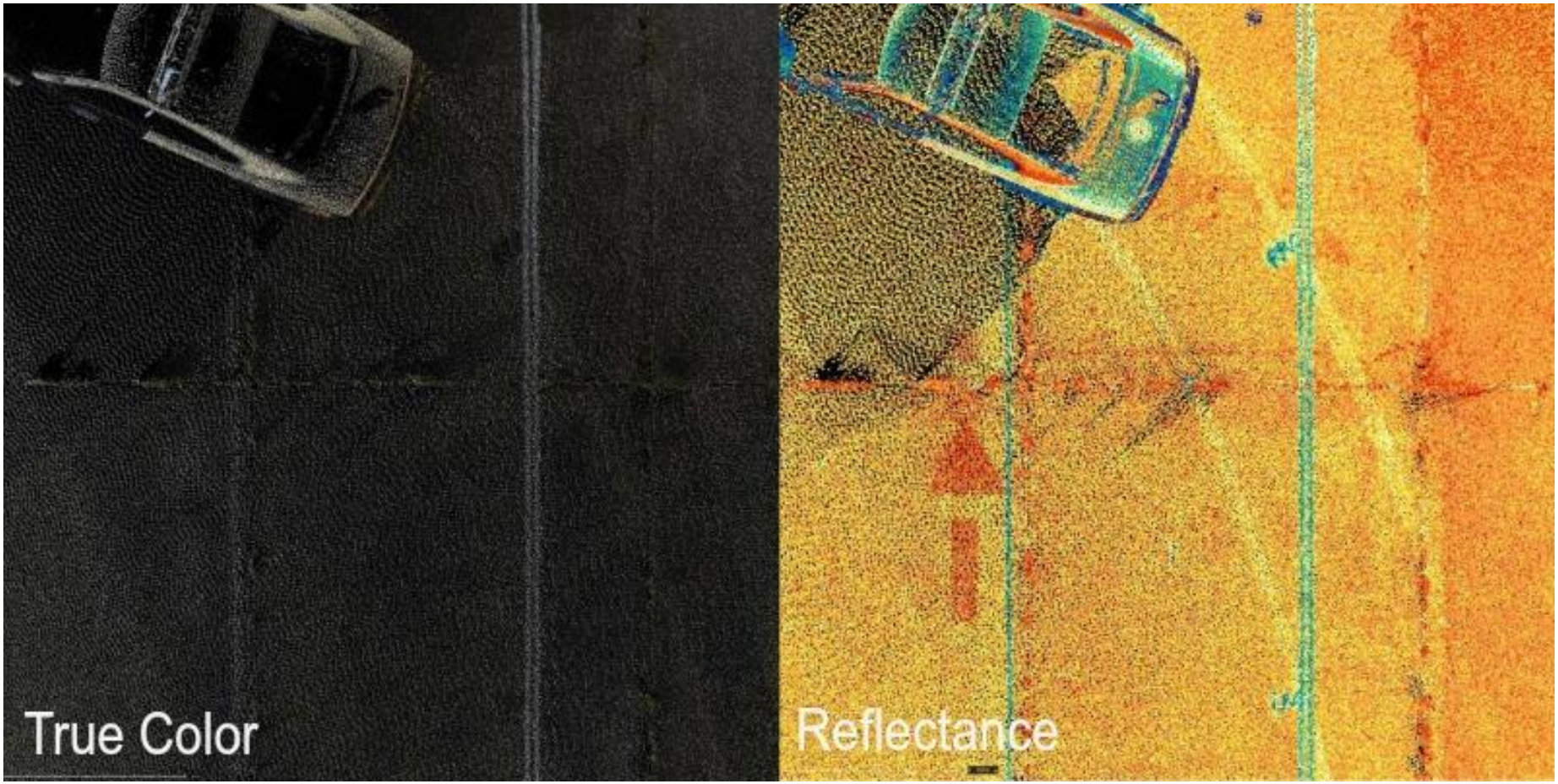
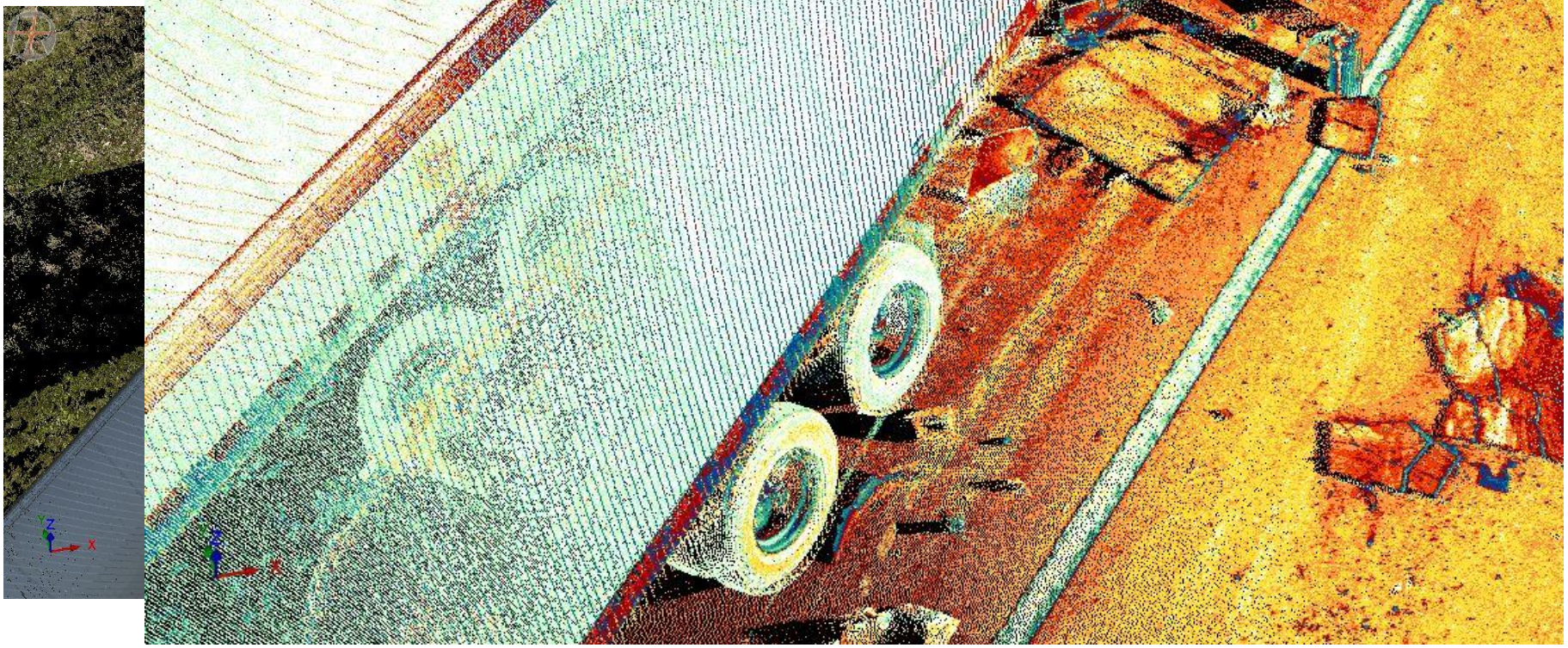
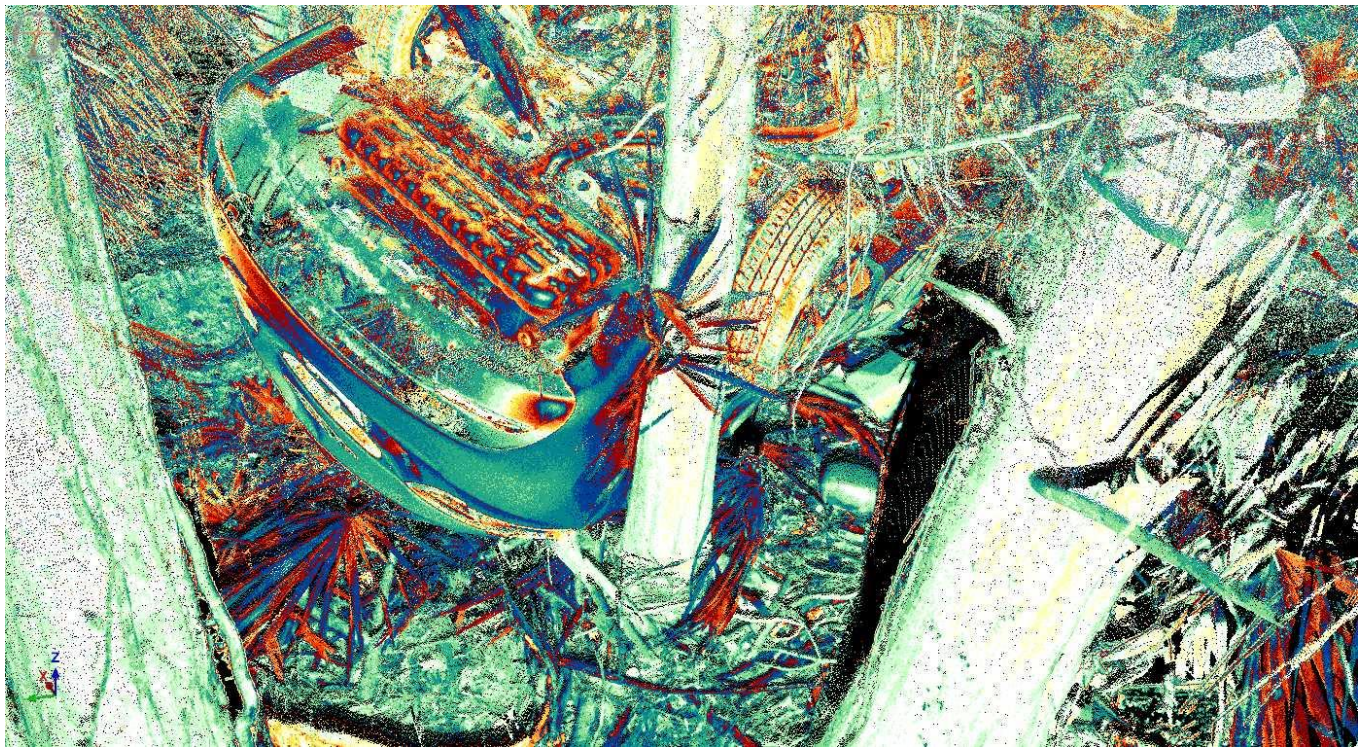


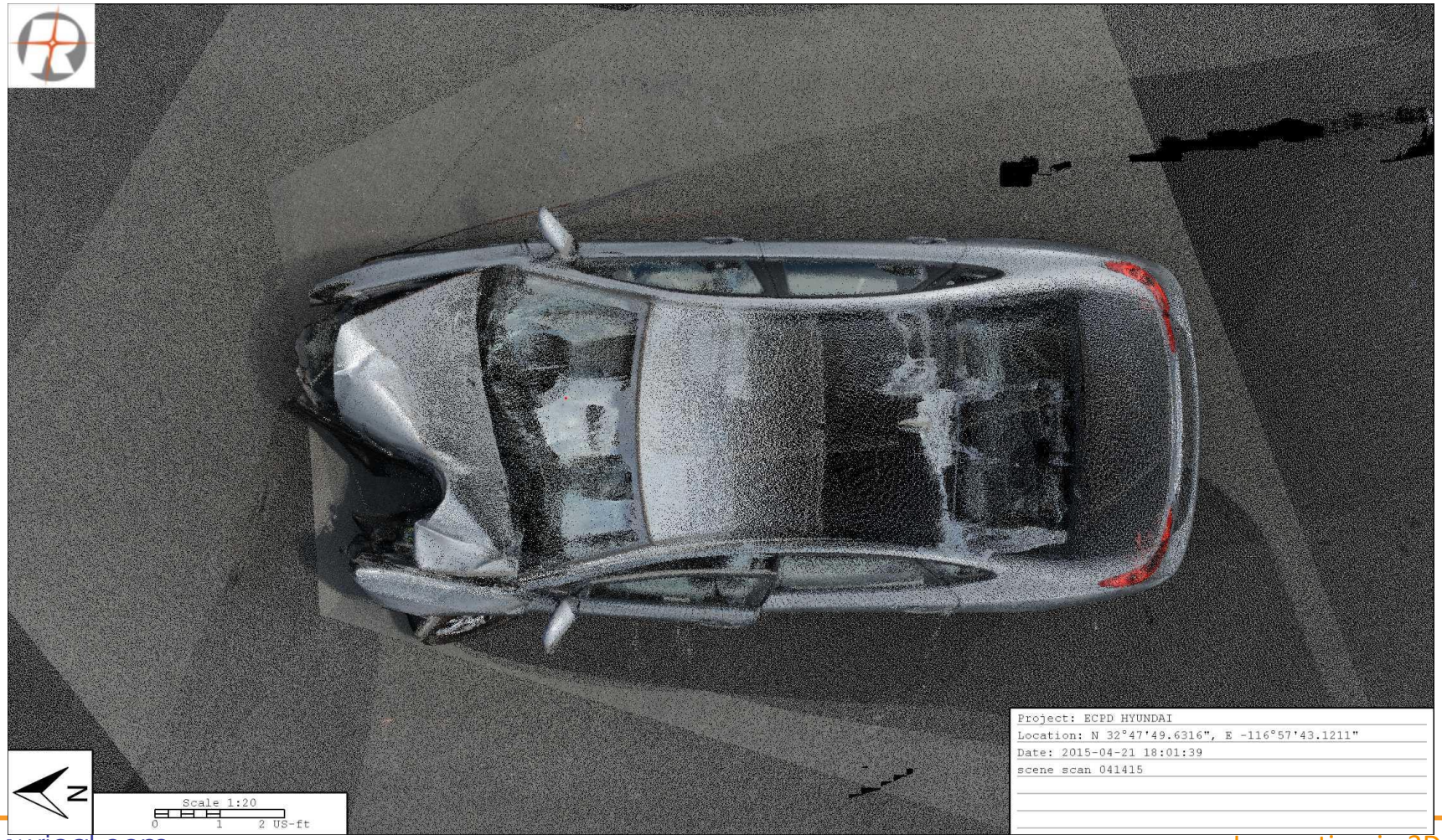


Online Waveform Processing & Multiple Returns: Vegetation Penetration



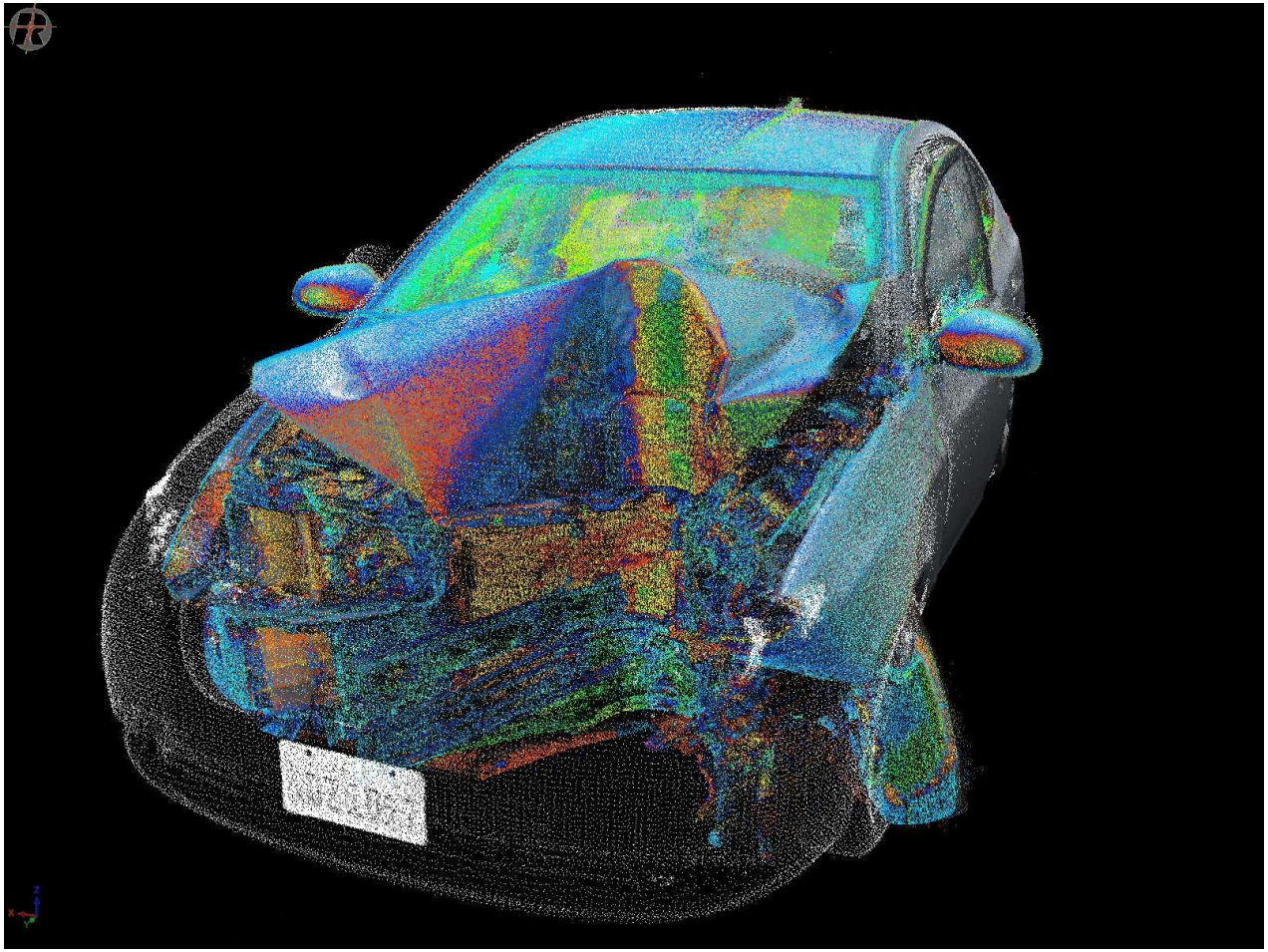
Scanner Performing to Highlight Speed and Data Captured; Online Waveform Processing

Scan Data Plot View of Subject Vehicle

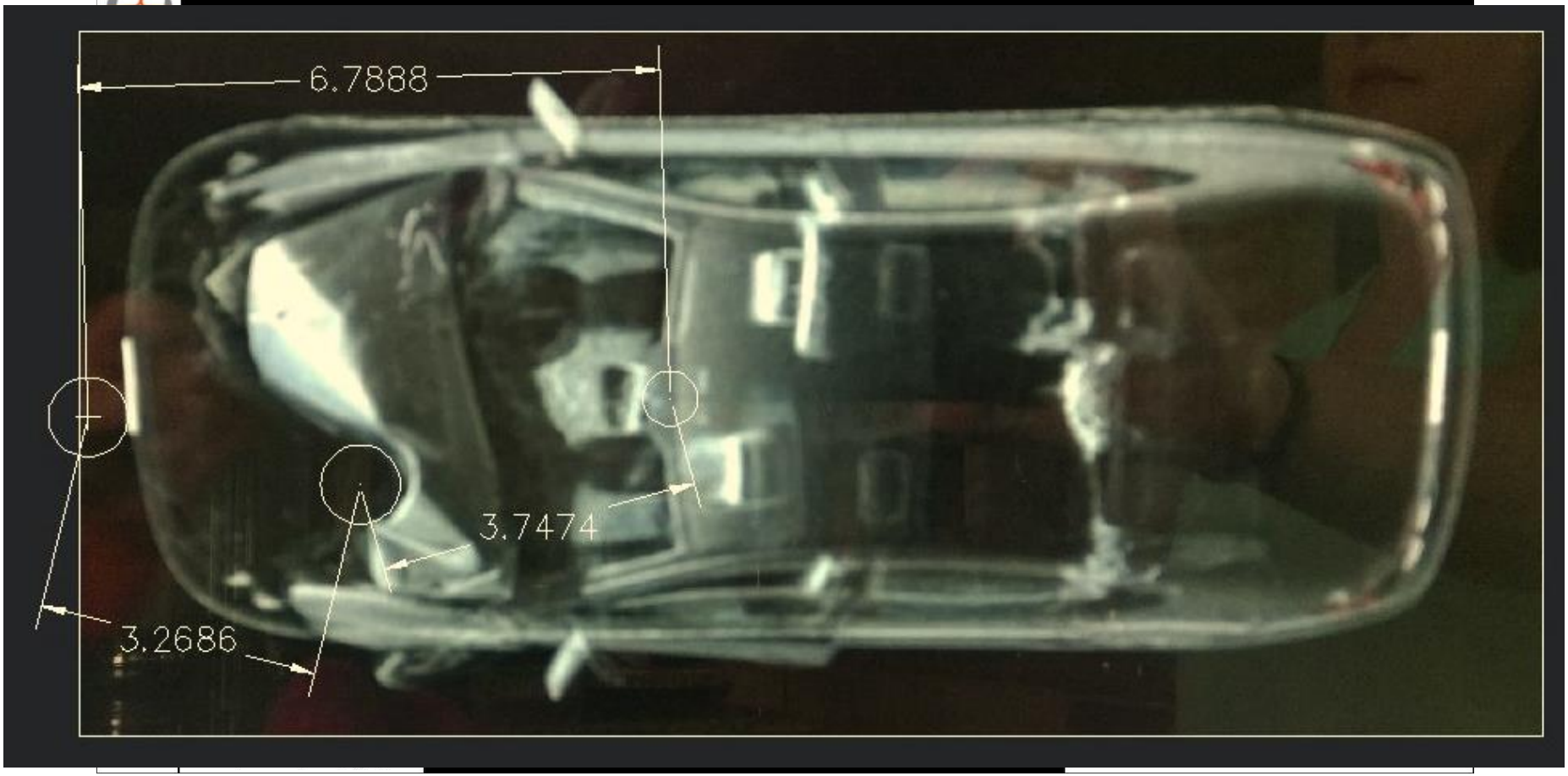


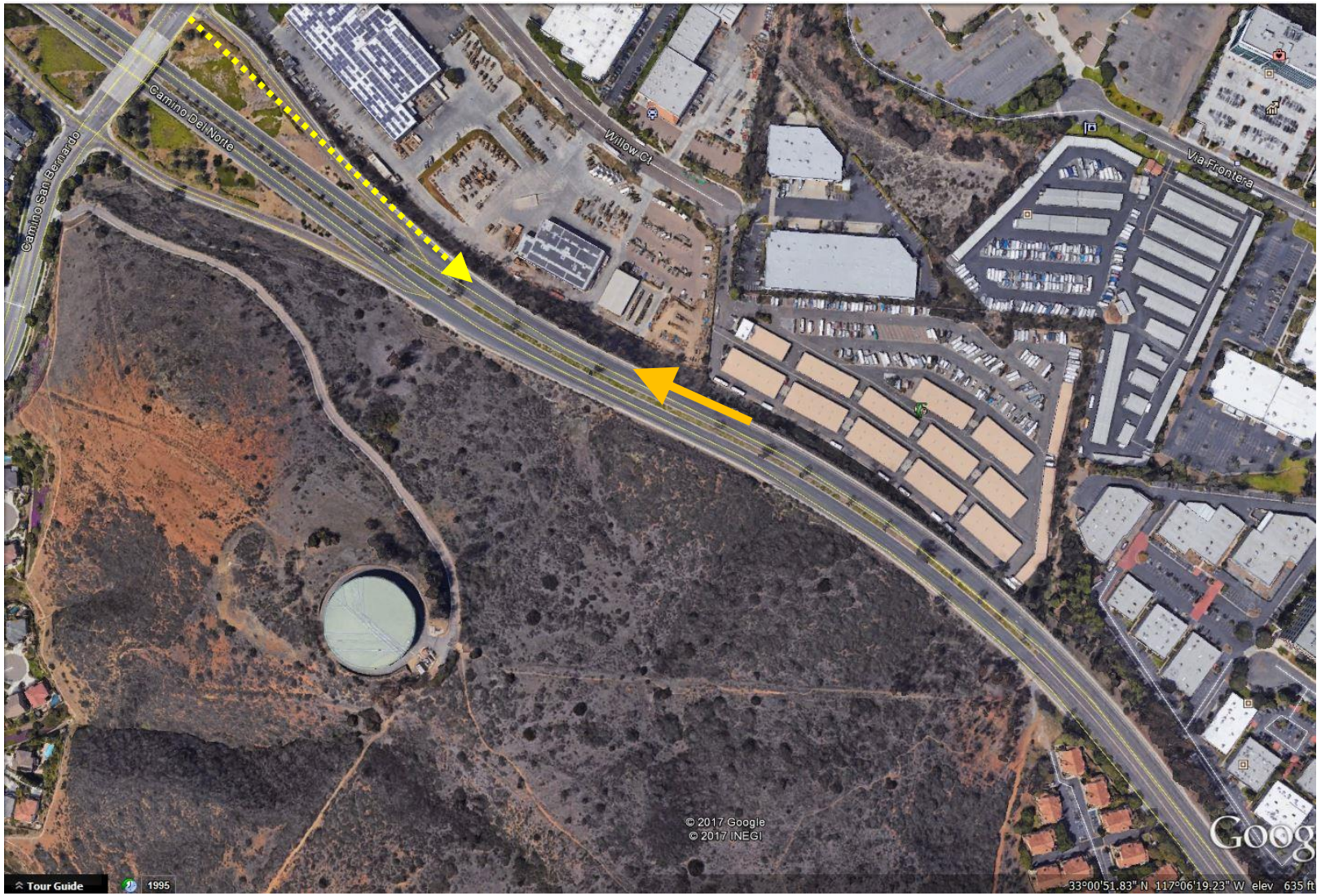
Scan Data Plot View of Hyundai Exemplar

Undamaged Hyundai Scanned & Overlaid on Scan of Damaged Hyundai to Show Area of Collapse



Ortho View of Scanned Exemplar Overlaid on Top of Subject Hyundai




Camino San Bernardo
Camino Del Norte
Willow Ct
Via Frontera
© 2017 Google
© 2017 INEGI
Tour Guide
1995
33°00'51.83" N 117°06'19.23" W elev 635 ft

Panoramic Image of Scene During Laser Scans Using a *RIEGL* VZ-400 Terrestrial Laser Scanning System

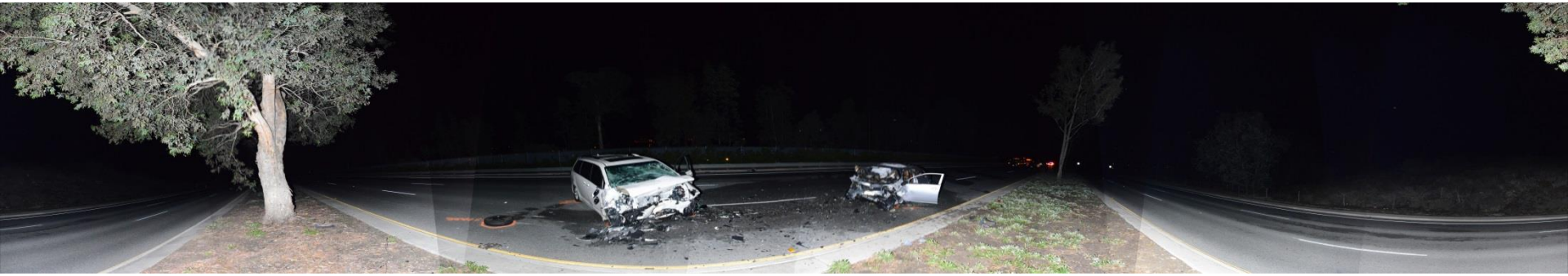
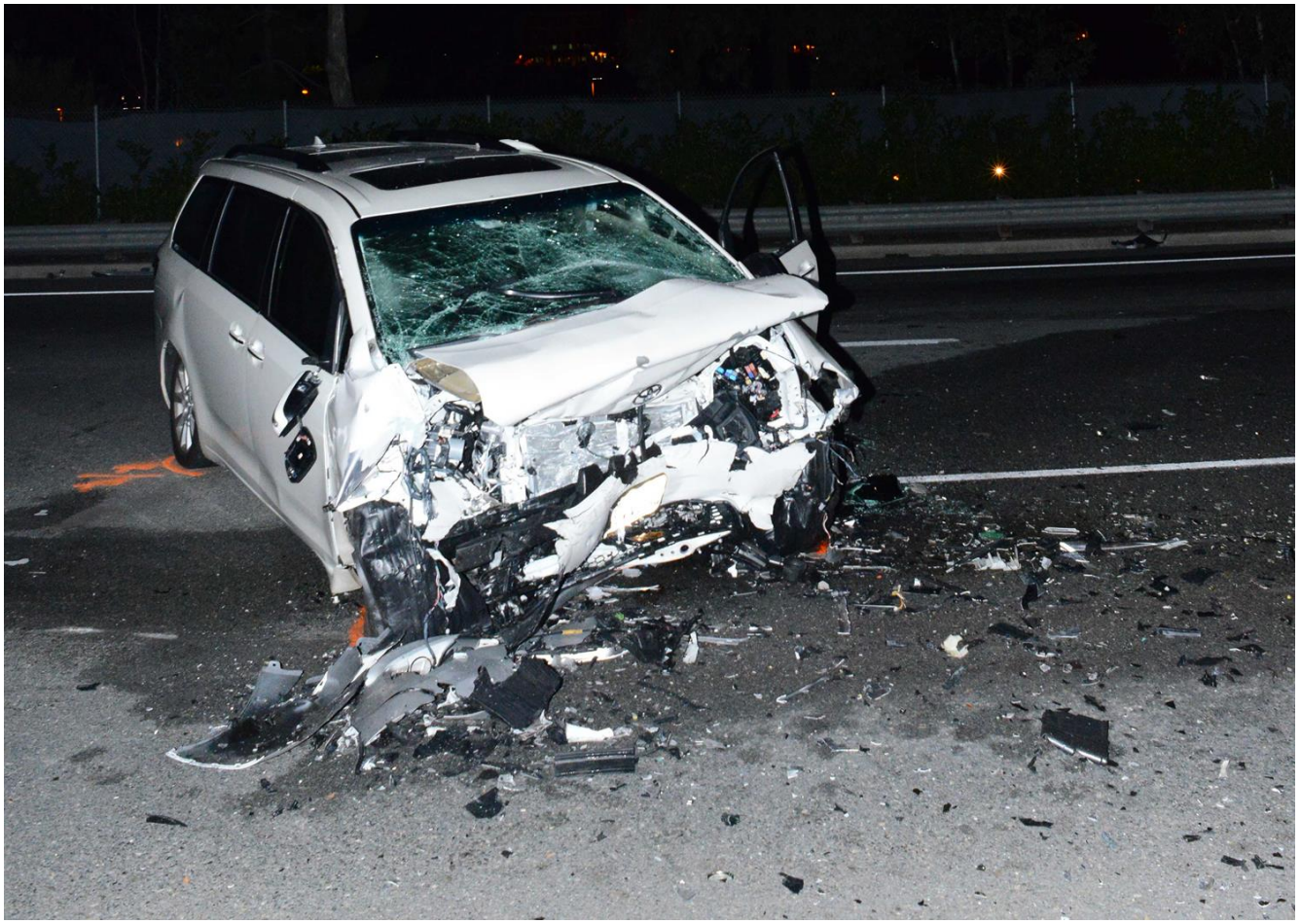
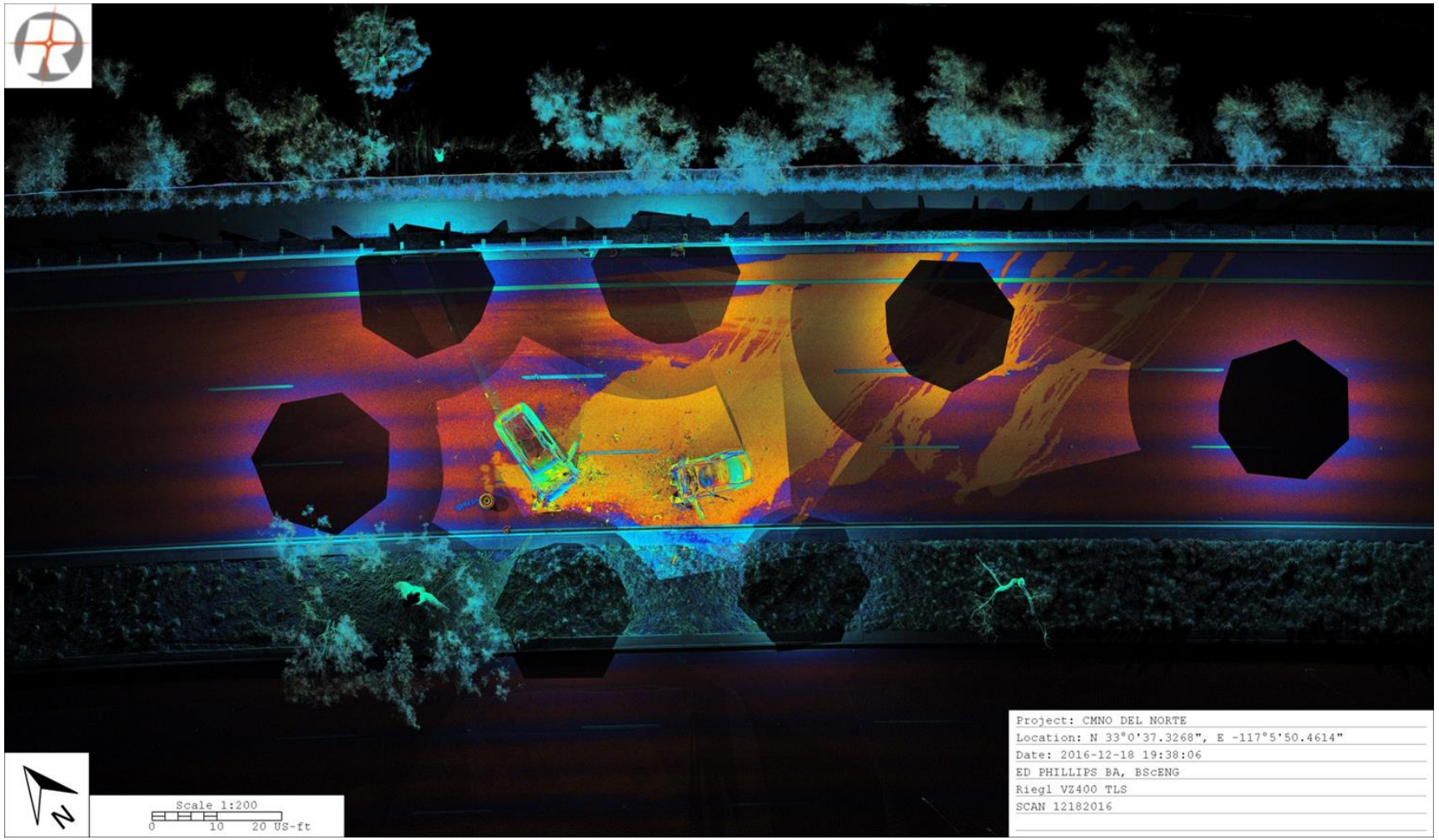


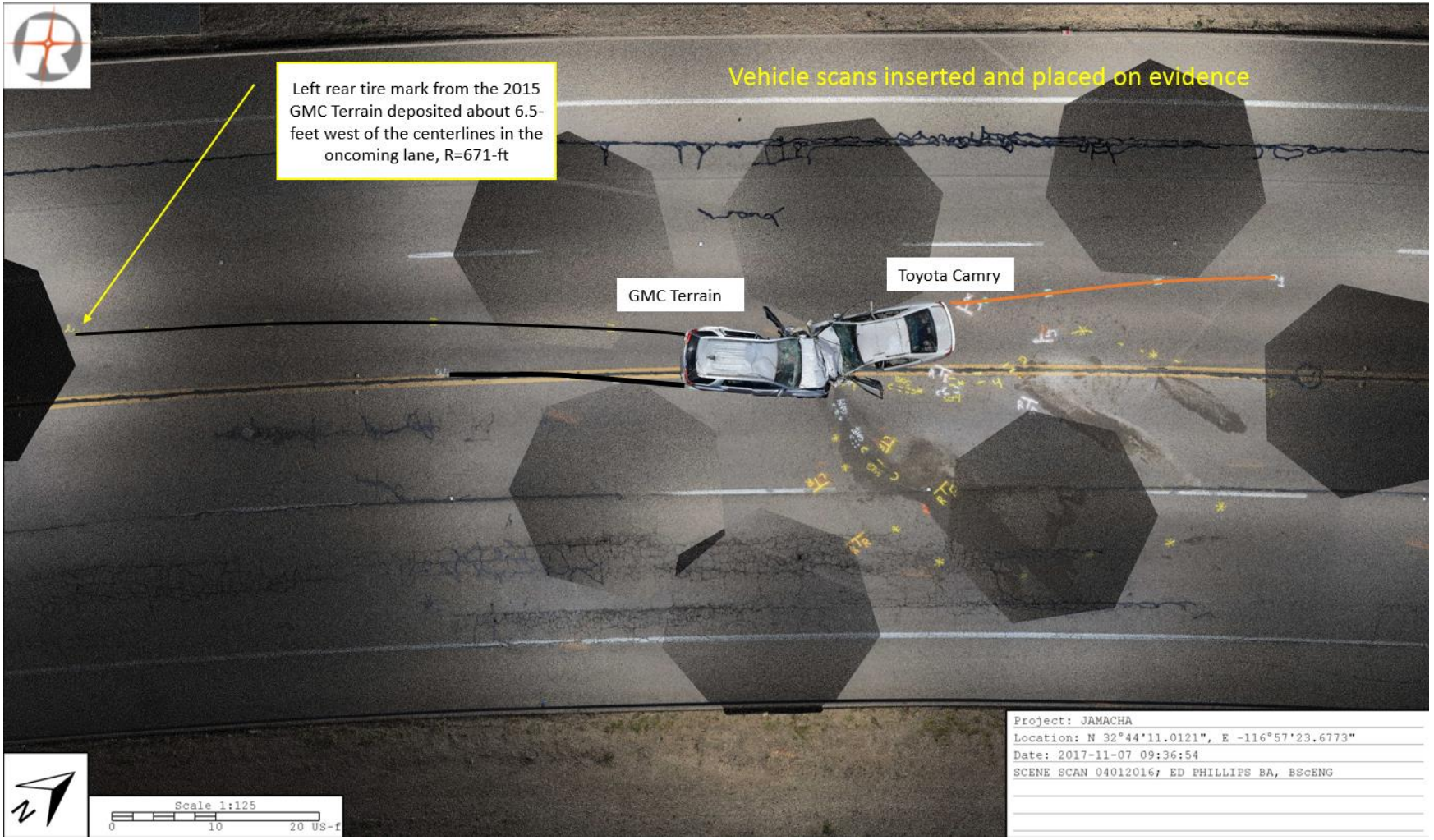
Image from Nikon Camera Mounted on the *RIEGL* VZ-400 Captured During Laser Scans of the Corolla

Image from Nikon Camera Mounted on the *RIEGL* VZ-400 Captured During Laser Scans of the Sienna



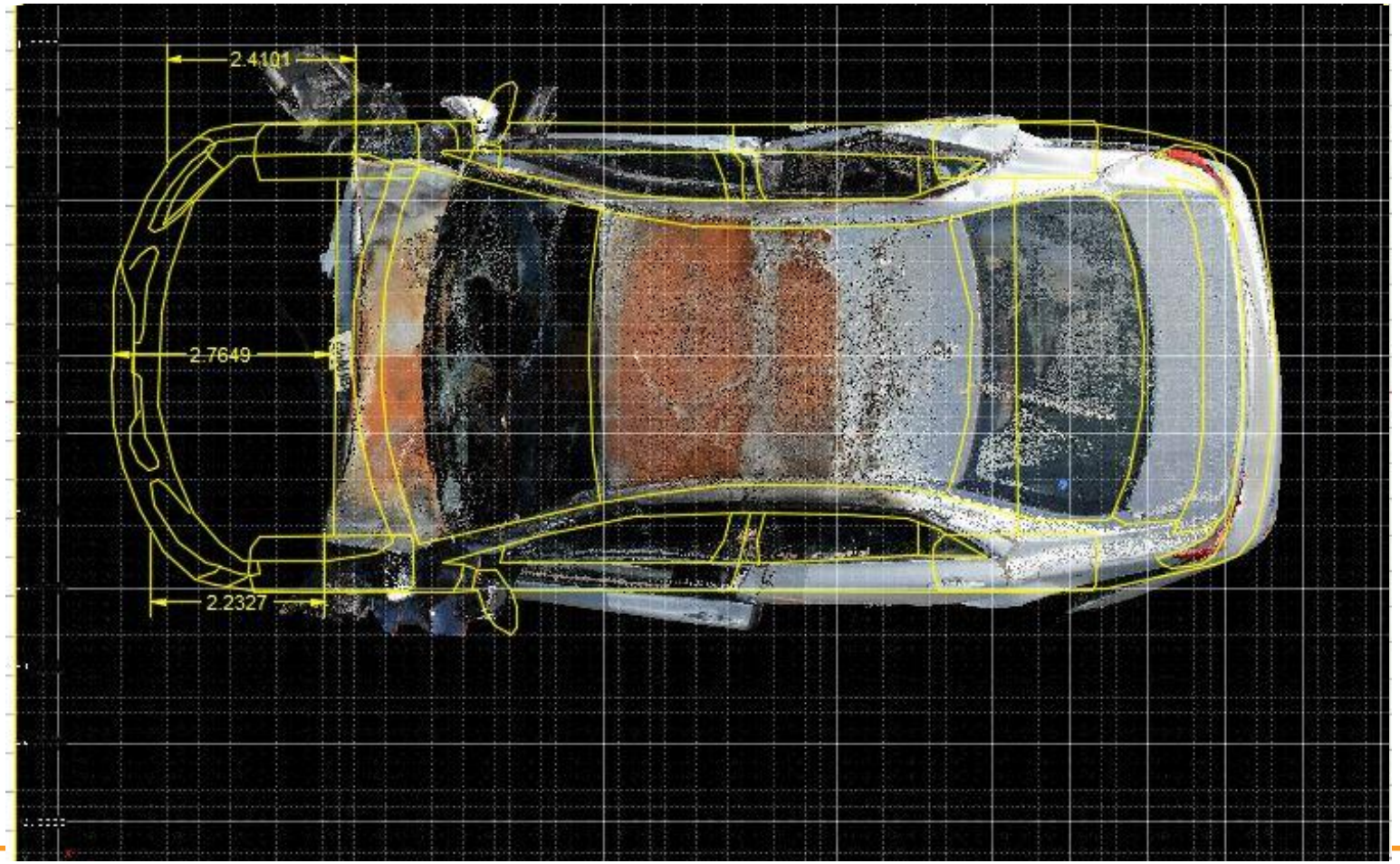
RIEGL VZ-400 Plot View Scan Data: Night of Collision




Left rear tire mark from the 2015 GMC Terrain deposited about 6.5-feet west of the centerlines in the oncoming lane, R=671-ft
Vehicle scans inserted and placed on evidence
GMC Terrain
Toyota Camry
Scale 1:125
0
10
20 US-f
Project: JAMACHA
Location: N 32°44'11.0121", E -116°57'23.6773"
Date: 2017-11-07 09:36:54
SCENE SCAN 04012016; ED PHILLIPS BA, BScENG

Scene Fly-Through Exported from RiSOLVE

Overlay of Undamaged 2010 Toyota Corolla Over Scanned Subject Vehicle



NHTSA 6310 – 2009 Toyota Corolla: 35 MPH Into Fixed Barrier. Average Crush about 1.5 ft.

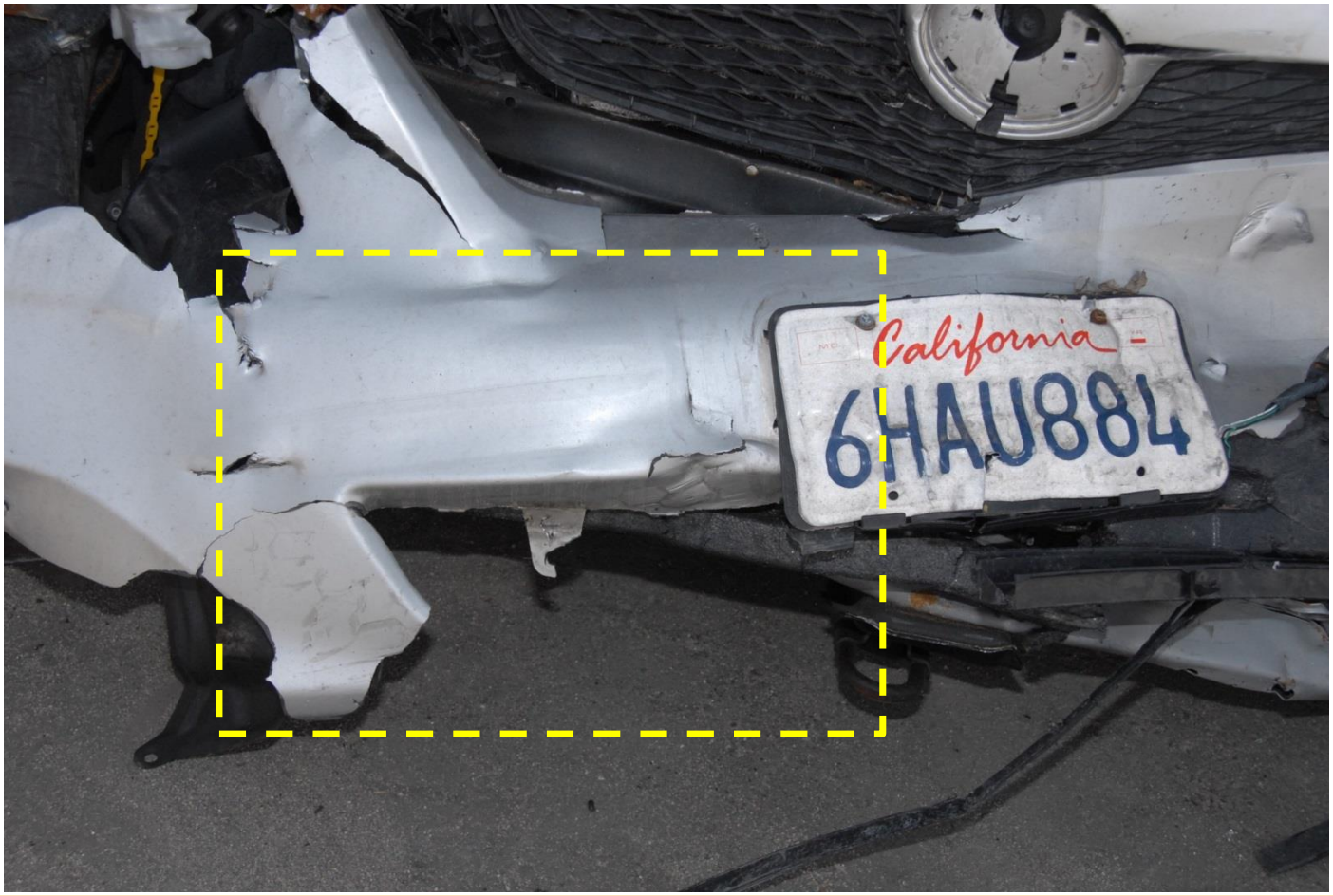
NHTSA 6745 – 2010 Toyota Corolla: Impact Speed 35 MPH
Average Crush 1.55 ft.

Contrasting 35 MPH Fixed Barrier Damage Pattern to our Subject Sienna

NHTSA 35.1 MPH impact in to a fixed barrier involving a 2013 Toyota Sienna.

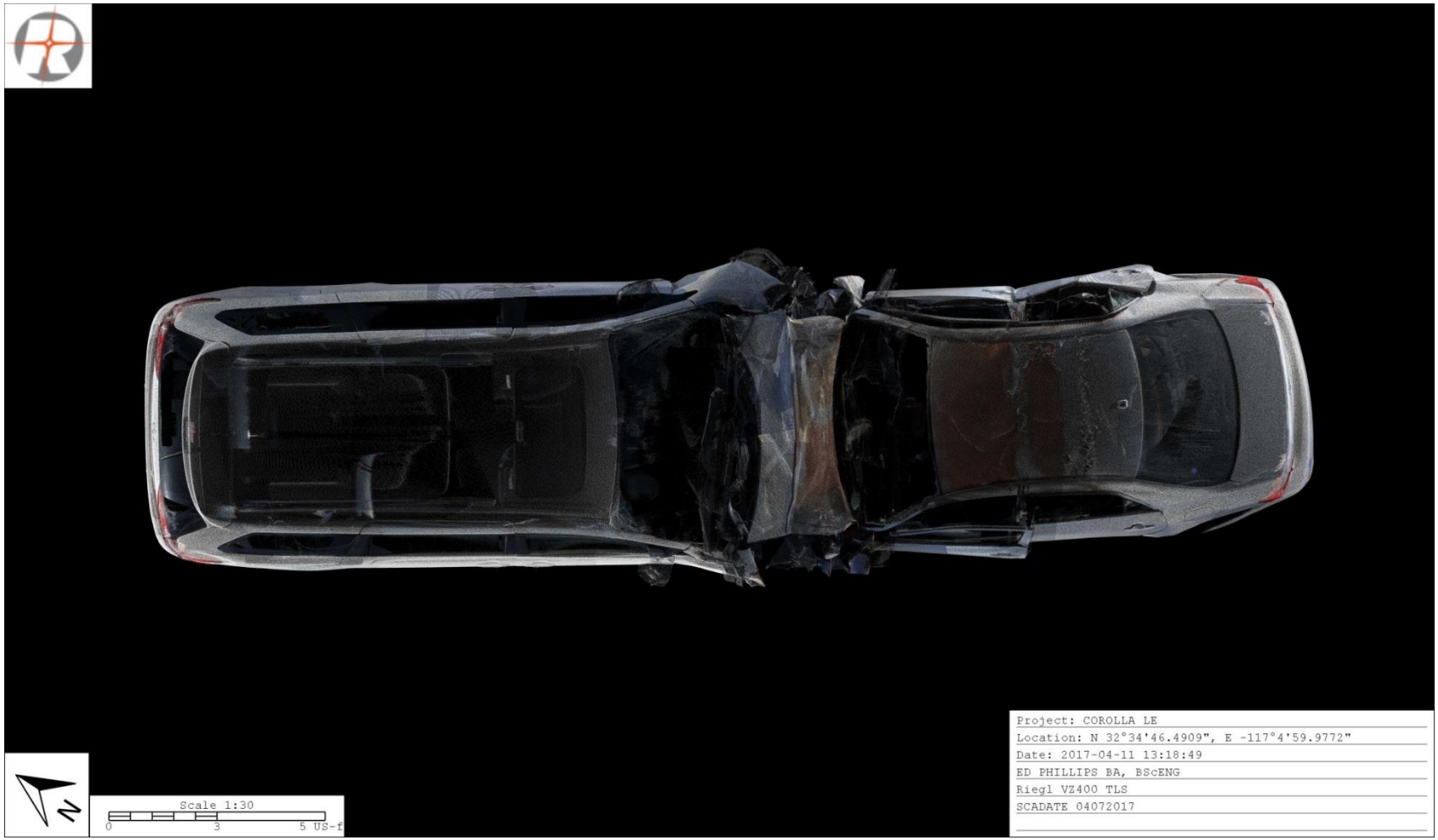
Bayne 2015 Toyota Sienna shows greater structural collapse suggesting higher speed change. Note displacement of right front tire.

Indications of Embossing on the 2010 Toyota Corolla LE Impressing From the Front of the Sienna



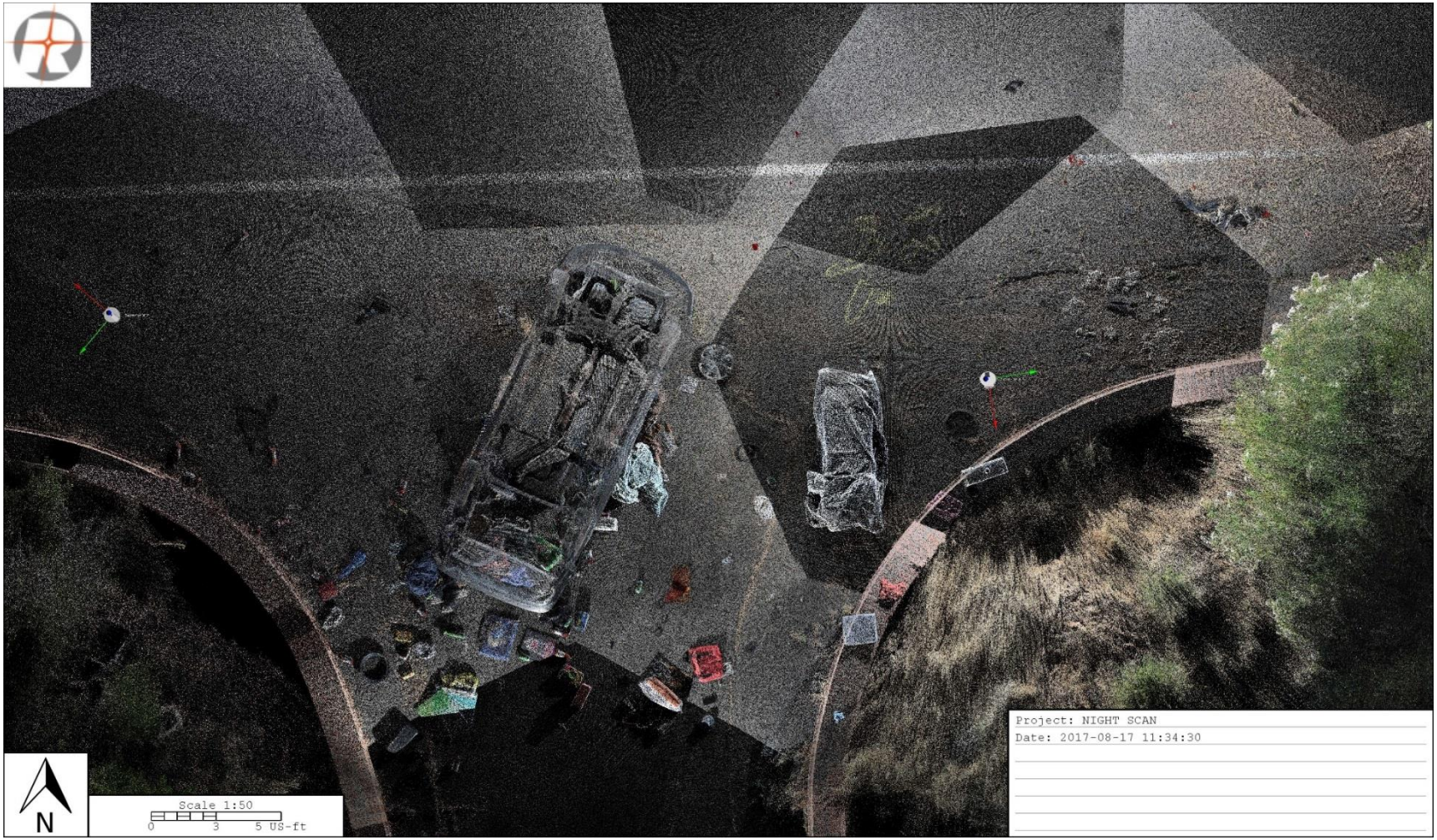
Indications of Embossing on the 2015 Toyota Sienna Limited Impressing From the Front of the Corolla (Speed Match at Components)

Vehicles Aligned from *RIEGL* VZ-400 Laser Scan Data



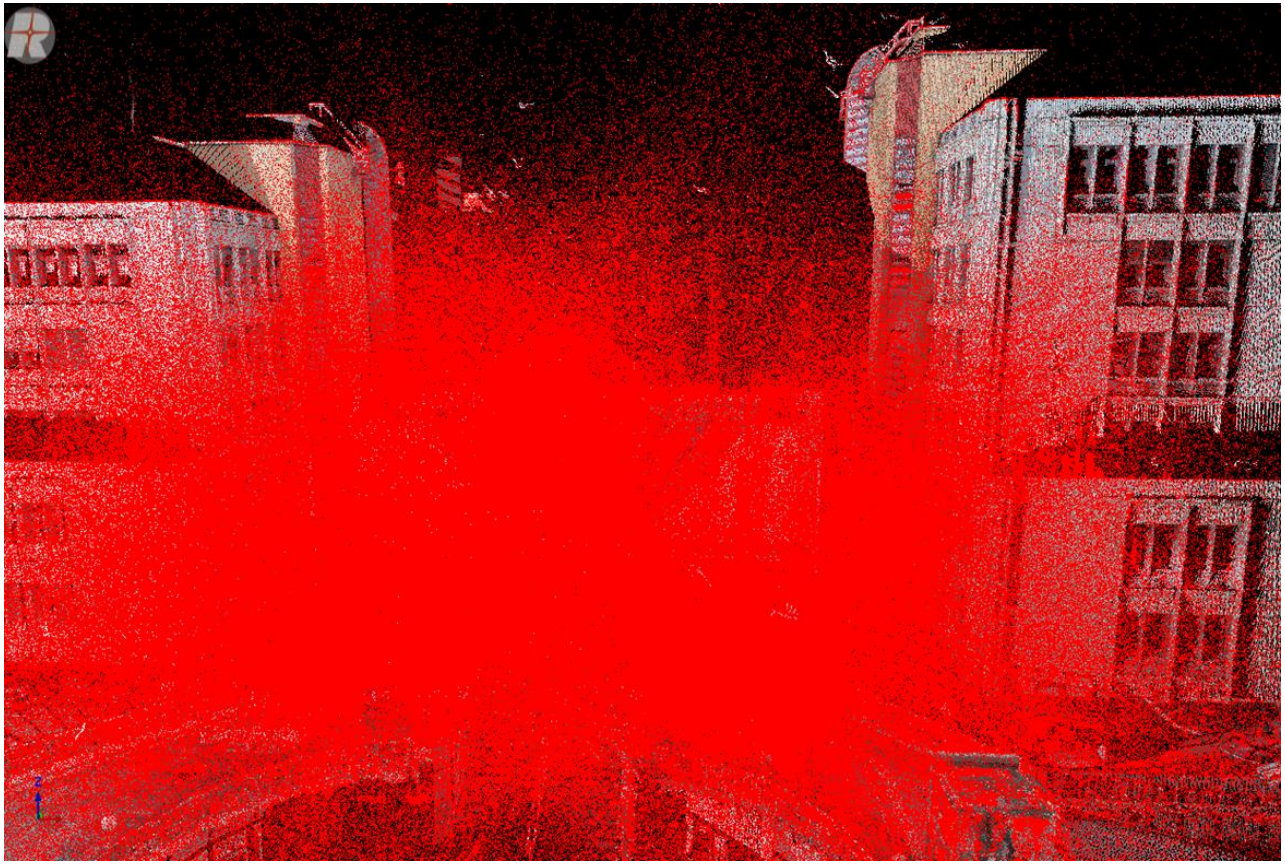
Fly-Through of Vehicles: Scanned Separately & Modeled to Represent Structural Damage at Impact in RiSOLVE

Rural Area, No Artificial Lighting Other Than Camera Flash



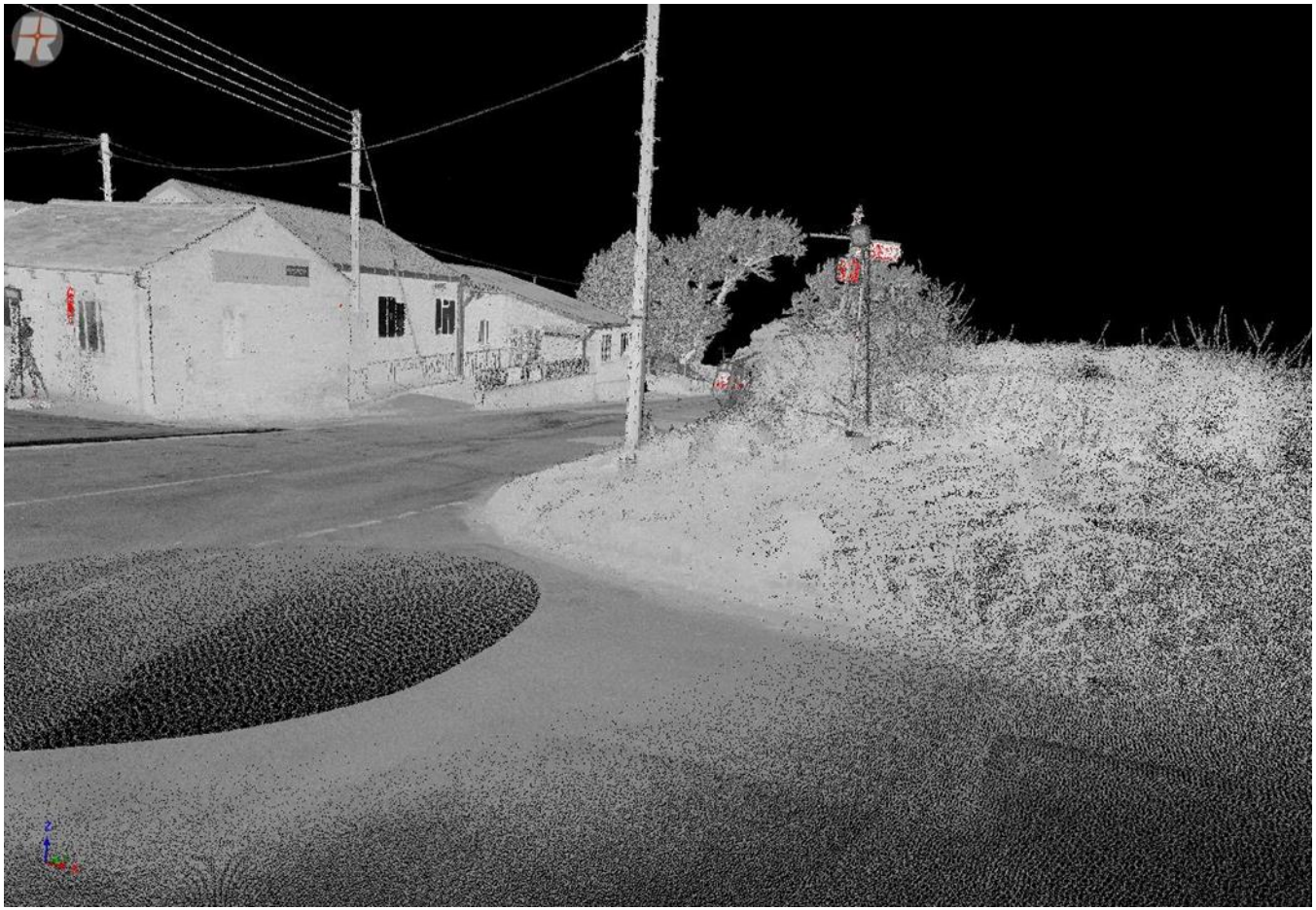
Scale 1:100
0 5 10 US-ft
Project: OPD HEAD ON
Date: 2017-08-18 14:28:50
Ed Phillips, BA, BScEng
Riegl VZ 400

Scanning in Adverse Conditions



Results of Attribute Filter

Data Analysis



Scene Interrogation

Sight Lines & Obstructions

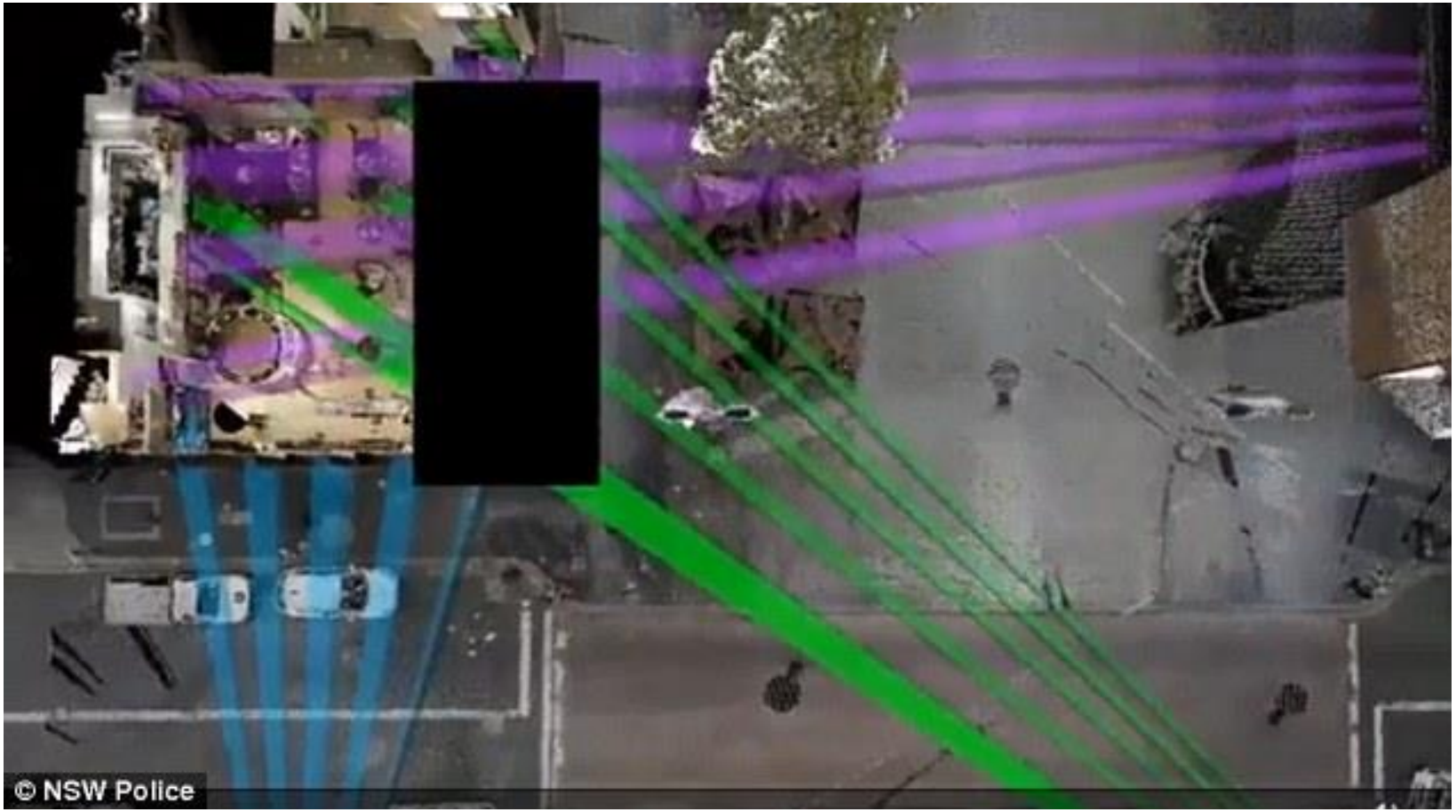
Positions and View Points

Rain Filter

Testimony in San Diego Superior Court in which *RIEGL* 3D Laser Scan Data has been Admitted

- Peo. v. Kersbergen Trial 04/01/2015 El Cajon Courthouse
- Peo. v. Cady Trial 05/18/2015 Downtown HOJ
- Peo. v. Masiello Trial 02/01/2016 Vista Courthouse
- Peo. v. Heinzel Trial 08/03/2016; N-24 Vista Courthouse (SCN299323)
- Peo. v. Nuno Trial 03/14-15/2017 Downtown HOJ
- Peo. v. Bayne; Preliminary Hearing 07/25/2017 Downtown HOJ D53
- Peo. v. FLORES; Trial 10/xx/2017 Vista Courthouse
- Peo. v. Pastor; Trial 10/xx/2017 Vista Courthouse
- Peo. v. Teague CE349557; Trial 03/01/2016; El Cajon D9

Position Points with True Data



Source: Daily Mail - UK

Position Points with True Data

Source: Daily Mail - UK

What Makes This Technology So Important?

- Technology driven tools to become more efficient in clearing roadways
- Freezes the scene in time
- Operates in a variety of weather
- Provides efficiency in which fatal crashes are investigated
- Provides increased safety to law enforcement with quick scene capture
- Increases commuter experience on the roadways
- Reduces secondary crashes as a result of re-opening the roadway quicker
- Scan data provides more detailed depiction of the crash for court / criminal cases

Why *RIEGL*?

User Friendly
- Automated instrument AND software
- Simplicity and ease of use
- Touch Screen Interface
- One-touch workflows

Superior technology best suited for use in the elements
- The fastest laser scanner on the market, speed of 1.2 million points per second
- Range of up 800m
- Certified accuracy of 3mm at 800m in range
- IP64 Rating

Superior Maintenance
- The most reliable
- Software that is valid indefinitely
- Service and repairs on instruments performed in FLORIDA with loaner units during service period

Technical Support
- Outstanding personal customer support
- 24-hour phone support
- Online resources – manuals, quick user guides, and training modules
- Florida based service & support

Warranty
- Two-Year warranty included with price
- Expected lifecycle minimum of eight years

Deliverables
- Simple Coordinate Export Tool within RiSOLVE to create reconstruction diagram
- Automatic plot exhibits
- Exports to a variety of 3rd party software, including Crash Zone
- Ability to create plot views, fly throughs, and visualizations

Training
- *RIEGL* accredited training
- Conducted by instructors with Law Enforcement background in the field of traffic crash reconstruction
- Standard & advanced certifications

Cost
- All inclusive hardware and software package for three years
- Competitive initial price
- Lowest lifecycle cost over time

QUESTIONS?

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Innovation in 3D