



# ***2006 GIS-T Symposium Columbus Ohio***

## ***High Speed Geo-referenced Bridge Clearance Data Collection at Ohio DOT***

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Having a bad day?



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Is your vertical clearance  
database updated and  
accurate?



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What can be done to help  
prevent this?



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## *Geo-Referenced Vertical Clearance Measurements*

- ④ Helps to prevent vehicle - structure collisions
- ④ Saves DOT and the state thousands of dollars in repairs
- ④ Saves lives and prevents injuries





## *Geo-Referenced Vertical Clearance Measurements*

- ④ Improves over-sized vehicle routing
- ④ Helps maintain bridge database accuracies
- ④ Complies with reporting regulations to FHWA



## *Ohio DOT's previous manual data collection*

- ④ Vertical clearance measurements were collected manually with surveying equipment and measuring rods
- ④ ODOT inspectors used hand held lasers to verify
- ④ These methods required closure of lanes and traffic control



## *Ohio DOT's previous manual data collection*

- Ⓢ Time consuming to collect measurements
- Ⓢ Initial inventory generally completed from design plans
- Ⓢ Measurements collected first opportunity after project completion
- Ⓢ No GPS reference data collected



## *Ohio DOT's previous manual data collection*

- ④ Limited to having personnel available to help close traffic
- ④ Caused traffic disruption
- ④ Safety concerns for workers collecting data



## *Manual Measurement Method*

- ⓐ Subject to human judgment and human errors
- ⓐ Have to try to visually pick lowest part of bridge
- ⓐ Physically holding rod is hard, add wind and makes it almost impossible to get accurate readings



## *VCMS mounted on service vehicle*



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## *Dedicated Service Vehicles*



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## *High Speed Automated VCMS*

- ② Laser based system mounted on a service vehicle
- ② Two people can collect dozens of structures a day
- ② Increased data collection speed
- ② Lanes are not closed, personnel stay in vehicle, no standing in traffic





## *High Speed Automated VCMS*

- ② Collect at highway speeds, no traffic disruption
- ② Increased accuracy
- ② Safest and most efficient method available

**Saves the DOT time and money!!!**



## *Ohio DOT's Original VCMS*

- ④ Ohio DOT purchased first generation of automated VCMS in 2004
- ④ Since the summer of 2004, Ohio DOT has collected vertical clearances on over 2,030 overhead bridge structures
- ④ The first version of the system collected at a 770 Hz sampling rate



## *Ohio DOT's Original VCMS*

- ② 2 lasers upward and 1 downward mounted in the center of the sensor bar
- ② Collected a measurement every 2 inches



## *Ohio DOT's Upgraded VCMS*

- ④ New generation of high-speed VCMS
- ④ Second downward laser is added
- ④ Sampling rate up to 5000 Hz



## *Ohio DOT's Upgraded VCMS*

- ④ Increased rate increases accuracy
- ④ A measurement is taken every 0.176 inch at 50 mph, every 0.264 inch at 70 mph



## *VCMS Output Data*

- ⓐ Output is text file containing clearance data
- ⓐ Raw binary data file containing bridge profiles
- ⓐ Structure information

Structure ID

County

Underpass

Overpass

Other customizable fields



## *Limitations of VCMS*

- ⓐ Weather (no precipitation)
- ⓐ Temperature (between 32° to 100°)
- ⓐ Lasers measure longitudinally (not transversely)



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## *VCMS Hardware*

- ④ 4 laser sensors (2 upward, 2 downward) attached to sensor bar in 2 towers
- ④ Trimble GPS integrated with data collection, tags all data with coordinates
- ④ Laptop computer controls system and is used to collect all data



## *Why Collect GPS?*

- ④ Helps correspond new data with multiple linear reference systems.
- ④ Provides visual dimension to non-visual data
- ④ GPS data provides a baseline location during the Quality Control (QC) process.

Automated analysis methods

Manual inspection



# *VCMS Collection QC*

## ⓐ Important Data Sets

Routes

Bridges

Orthophotos

Photolog

## ⓐ Common Mistakes

Complicated Interchanges/Bridge Designation

Lane Confusion

## ⓐ GPS QC Checks

Measurement within vicinity of assigned structure

Correct lane designation



## *VCMS GPS*



- Ⓢ High performance GPS with differential correction
- Ⓢ 1 to 3 meter accuracy in normal conditions
- Ⓢ Accurate data up to 70 mph
- Ⓢ GPS data linked to structure tagging and photolog images (latitude, longitude, and elevation location)





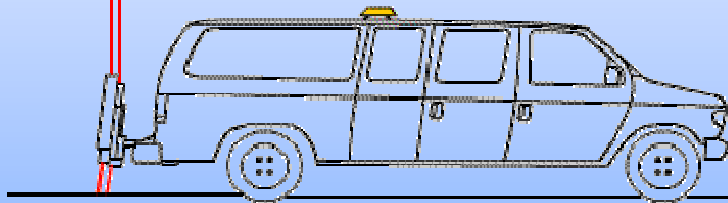
## *Automated VCMS Method*

- ② Vehicle travels at posted highway speeds
- ② Data is collected in each lane of travel
- ② The lowest point recorded in any of the lanes is the one reported to the DOT

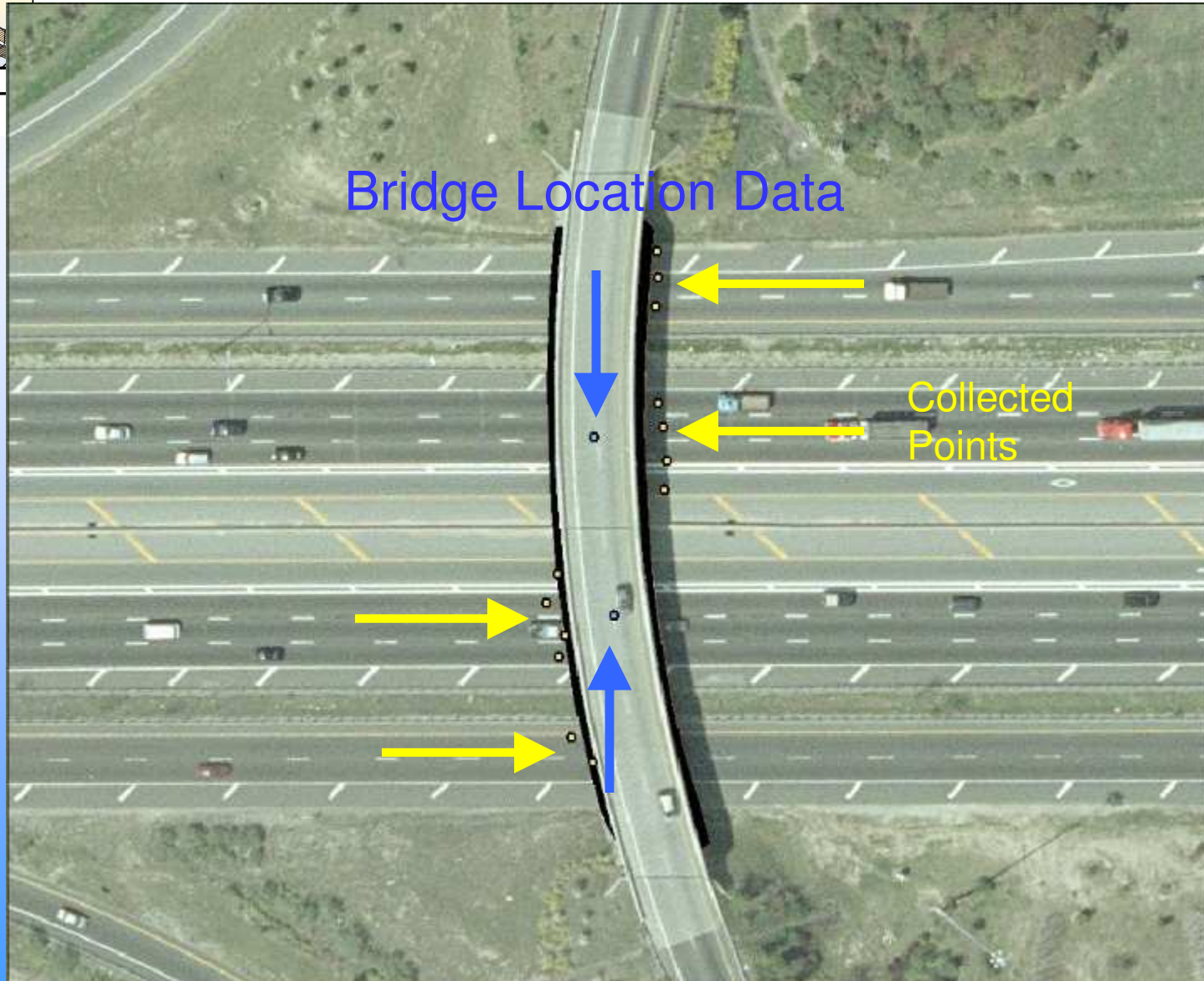


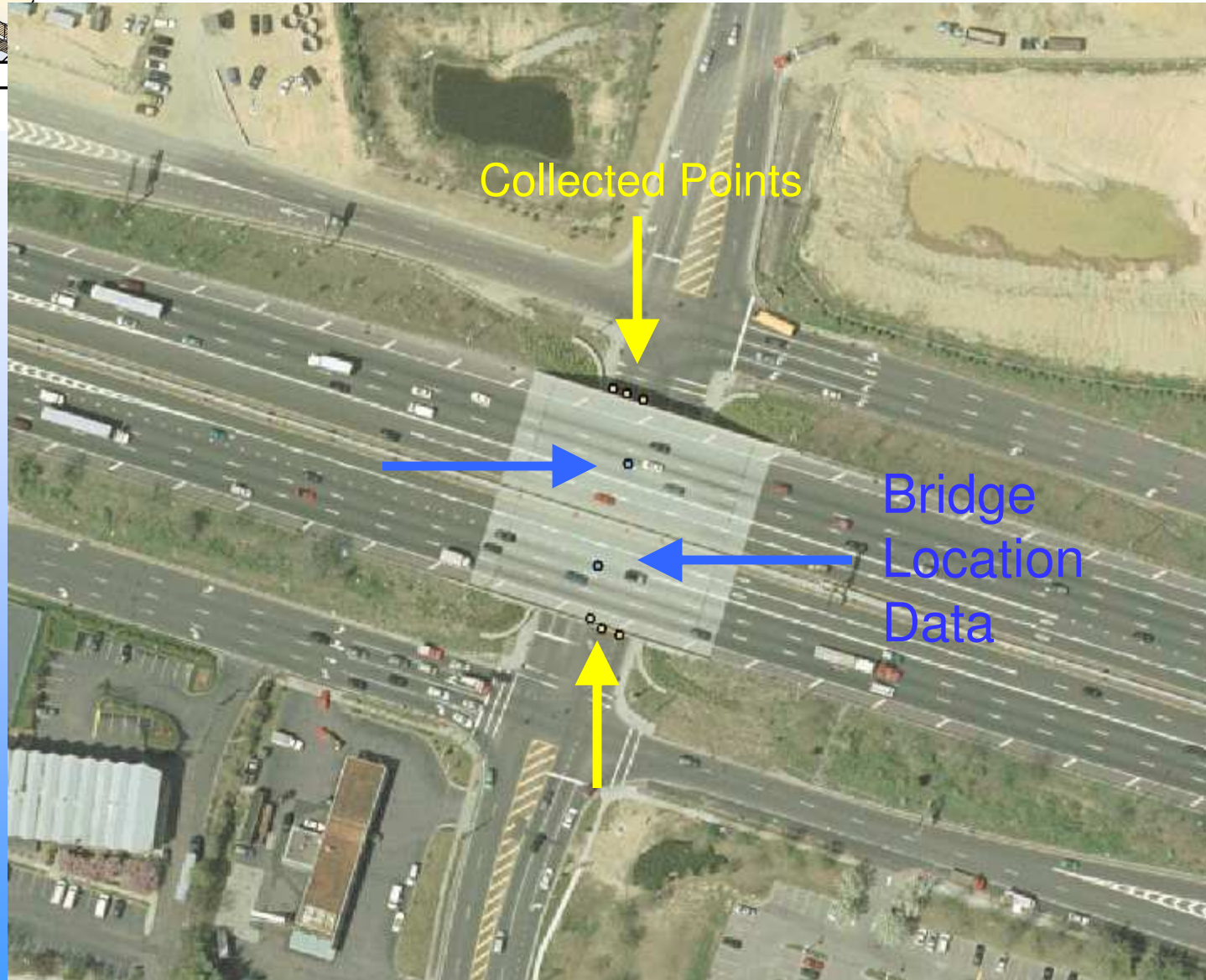
## *Automated VCMS Method*

- ④ GPS data is collected with each measurement that is recorded
- ④ Data is easily transferred from vehicle to database
- ④ Optional digital camera captures images of structures to help with QC/QA









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## *VCMS Data Collector software*

- ④ Controls VCMS hardware from the passenger seat of data collection vehicle
- ④ Able to view continuous graphical profile of overhead structures
- ④ Real-time QC of data as it is collected



## *VCMS Data Collector software*

- ② View numerical measurement values instantly as they are collected
- ② Customize routes for data collection
- ② Customize measurement units and data resolution



# VCMS Data Collector software

/Volumes/RAID-D/NY VCMS/2 Processed GPS Check/Region1-1\_871/Region1-1\_871.vct

Begin End Group Structures Plot Mode Trigger Camera Pause Resume

Scroll Wrap Preview Saved

25' 0.00"

0' 0.00"

Right Left

GPS

Latitude: 42°56' 16.00" N  
 Longitude: 89°22' 10.00" W  
 Altitude: 292.42 m  
 Heading: 1°  
 Num SV: 10  
 GPS fix

Location: 0.0000

Positive Negative

FINDING PPU...  
 FINDING PPU...  
 FINDING PPU...  
 FINDING PPU...  
 FINDING PPU...

Ref	Clearance	Flag	Comment	Location	Latitude
0	N/A ; N/A	I			42°
1	16.122 ; 16.119	Reverse	Washington Ave.		42°
2	17.006 ; 16.823	2P			42°
3	19.191 ; 18.858	2P			42°
4	16.439 ; 16.470	2P			42°
5	15.679 ; 15.608	2P			42°

Add

Control	Comment	RID	MEASURE	DIRECTION	REGION	CO_NUMBER	CO_NAME	BIN	CARRIED	Lane 1	Lane 2	Lane 3
15.279		8711107	5.69	Primary	1	1	ALBANY	5513500	BEAVER DI	40	60	N
15.811		8711107	6.94	Primary	1	1	ALBANY	5513520	CLAPPER R	41	61	N
15.672		8711107	8.25	Primary	1	1	ALBANY	5513530	WEMPLE R	42	62	N
15.260		8711107	12.59	Primary	1	1	ALBANY	5513580	NEW SCOT	45	65	N
18.442		8711107	12.2	Primary	1	1	ALBANY	1060300	85 (85 1	46	66	N
14.299		8711107	11.53	Primary	1	1	ALBANY	5513600	RUSSELL R	47	67	N
15.288		8711107	10.5	Primary	1	1	ALBANY	5513610	SCHOOLH	48	68	N
14.377		8711107	16.94	Primary	1	1	ALBANY	1015970	20 (20 1	49	69	N
20.452		8711107	9.85	Primary	1	1	ALBANY	5524420	CROSSCAT	50	73	7

Add Remove

Auto-Assign References Scroll Down Select Add Remove



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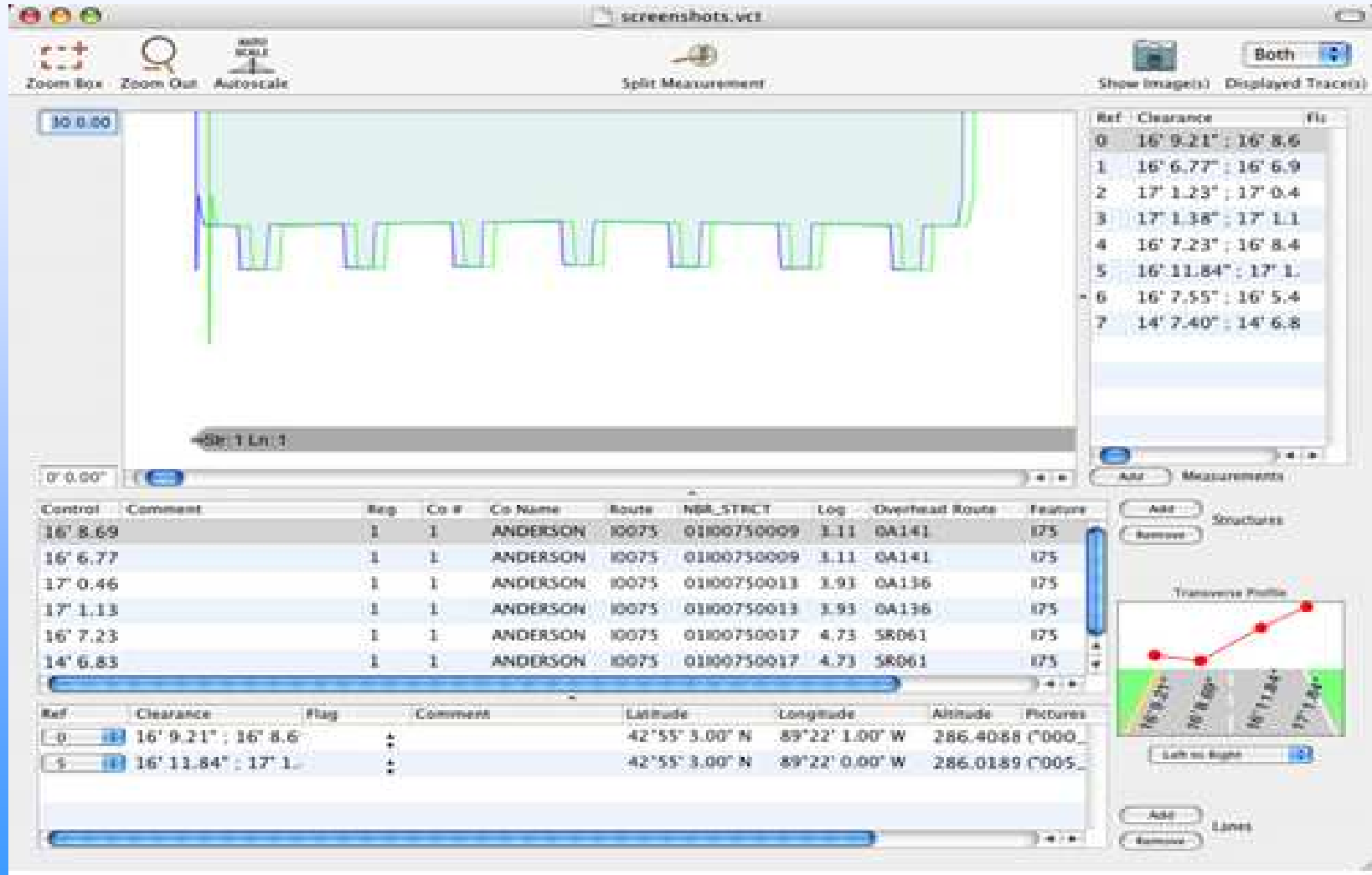


## *VCMS Data Viewer software*

- ② The control clearance is clearly displayed for each structure
- ② View the continuous profile of an entire route
- ② Contains magnification features
- ② Display data in feet, inches or feet and inches
- ② Structure imaging and DMI options available for upgrades to system

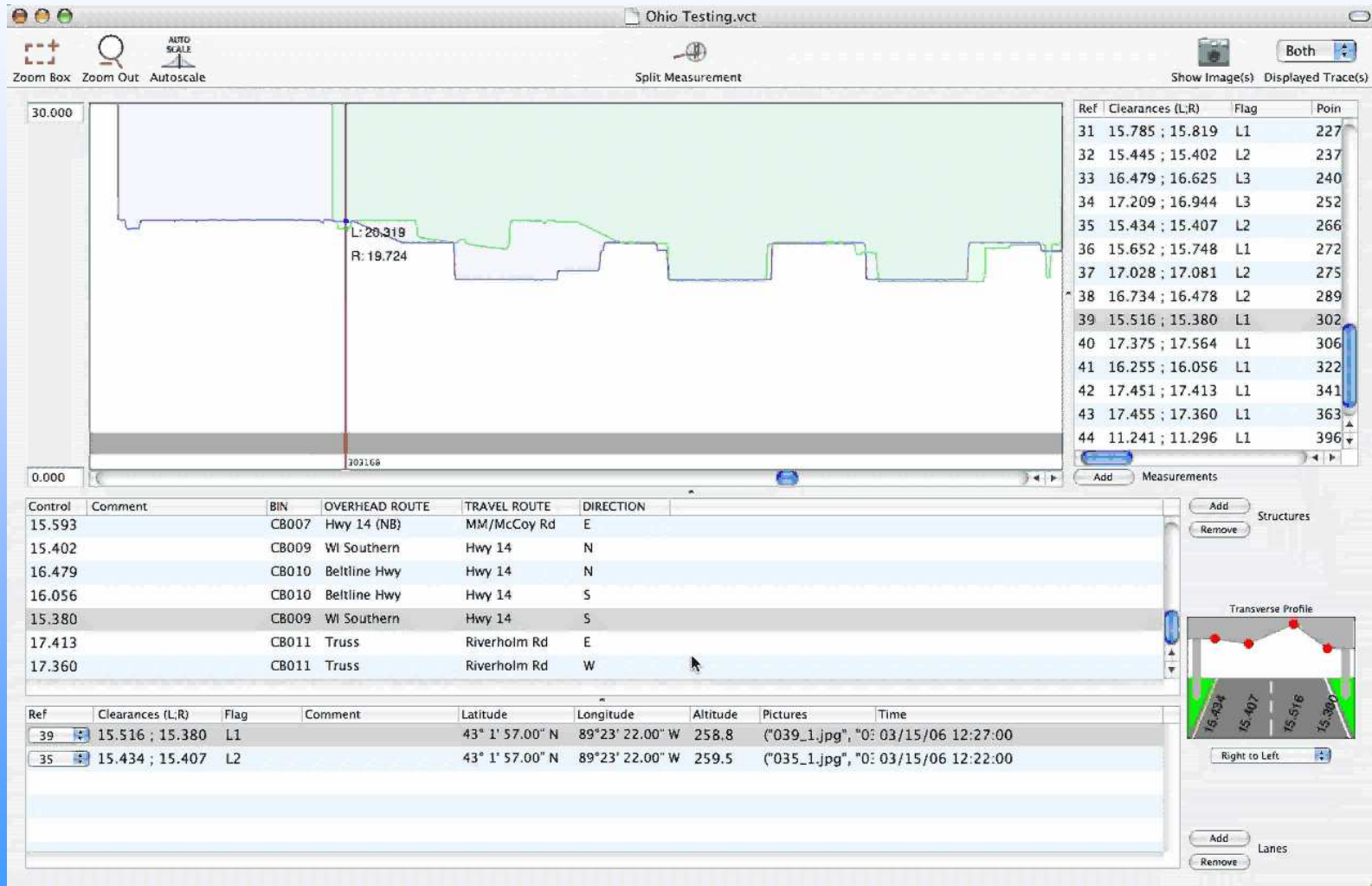


# VCMS Data Viewer software



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## *VCMS Installation*

- ④ VCMS can be mounted on any vehicle with a 2 inch receiving hitch
- ④ One person is able to lift and mount the VCMS on vehicle
- ④ Takes but a few minutes to connect the VCMS to power supply and laptop computer
- ④ DOT can use multiple vehicles for data collection



## *Ohio DOT's Data*

- ④ All data is currently stored in MS Excel spreadsheets
- ④ If lower clearance is found by VCMS, measurements are double checked using VCMS
- ④ Used to check and verify their current data inventory of the Bridge Management System (BMS)



## *Ohio DOT's Data*

- ④ Districts are notified about discrepancies
- ④ Districts are requested to verify and/or correct the BMS data



## *Future of Automated VCMS*

- ④ 3-D Scanning laser at highway speeds
- ④ Digital camera system mandatory
- ④ Measure horizontally as well as vertically



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***THANK YOU!***

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MITCH CAYA

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