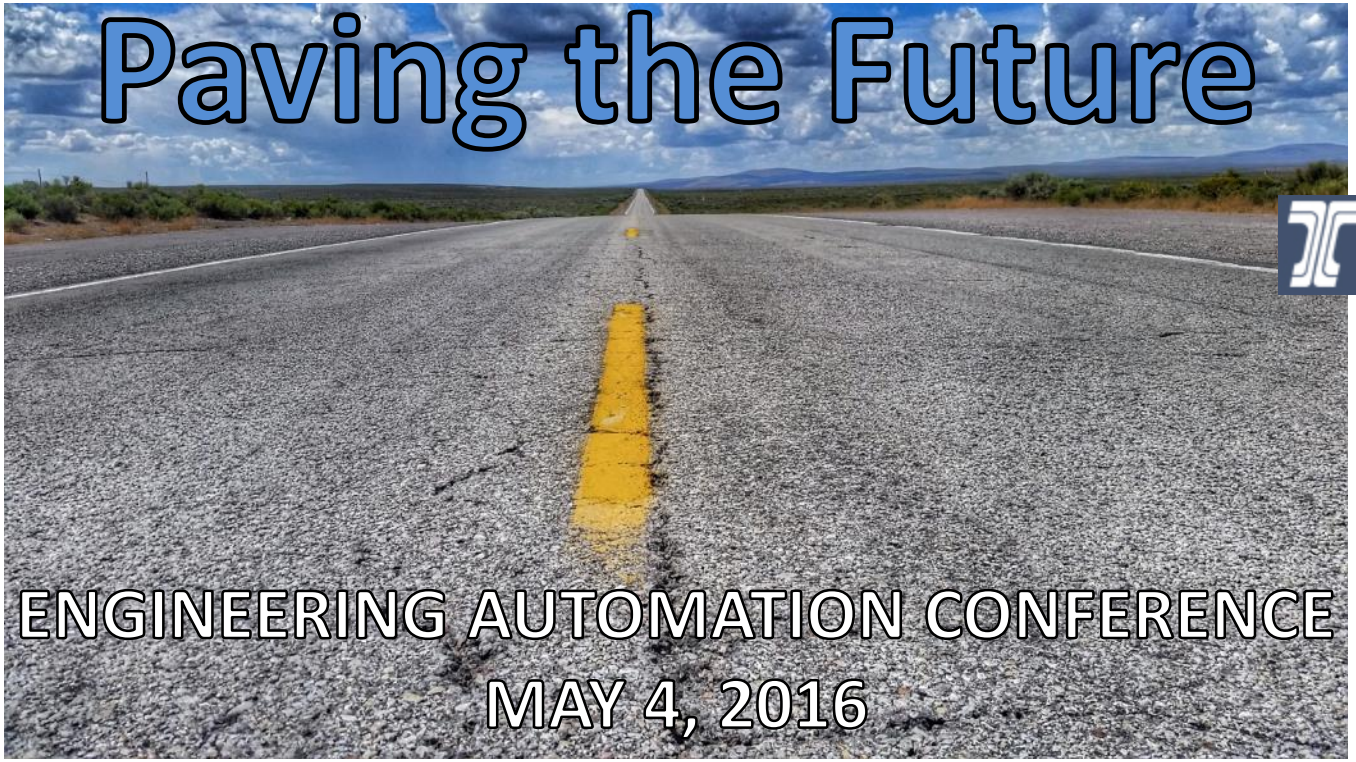
Intelligent Compaction



Oregon Department of Transportation

Chris Harris, P.E.

Construction Automation Engineer

Engineering Technology Advancement Unit

WHAT IS INTELLIGENT COMPACTION?

OREGON DEPARTMENT OF TRANSPORTATION

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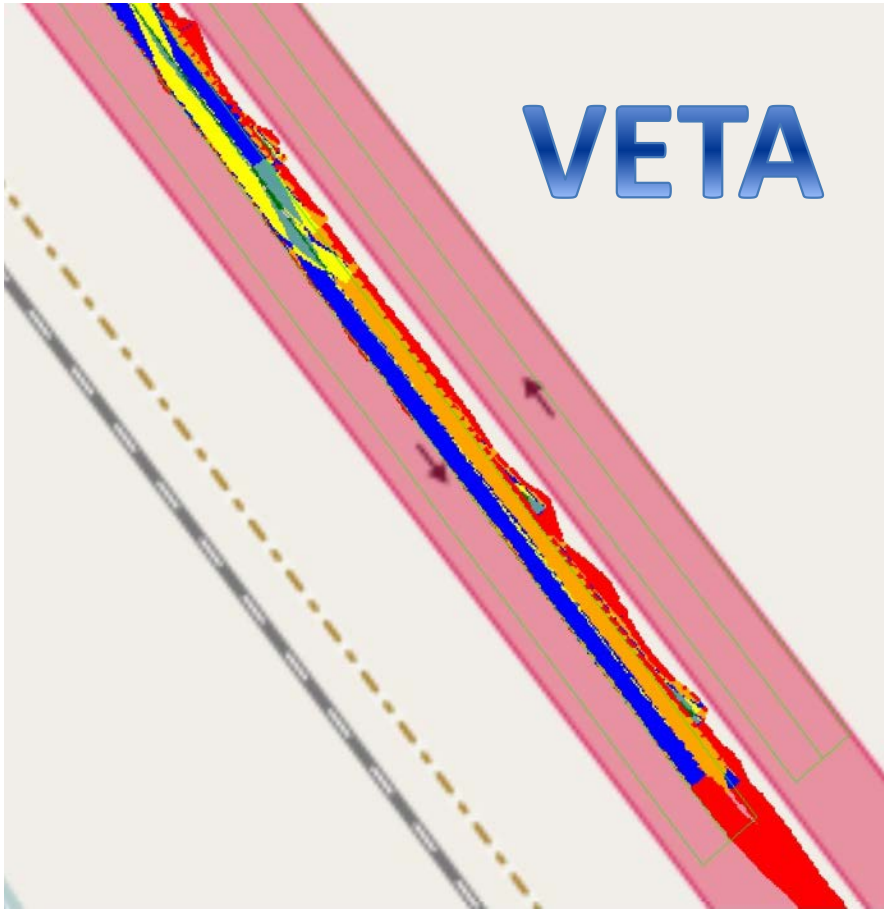
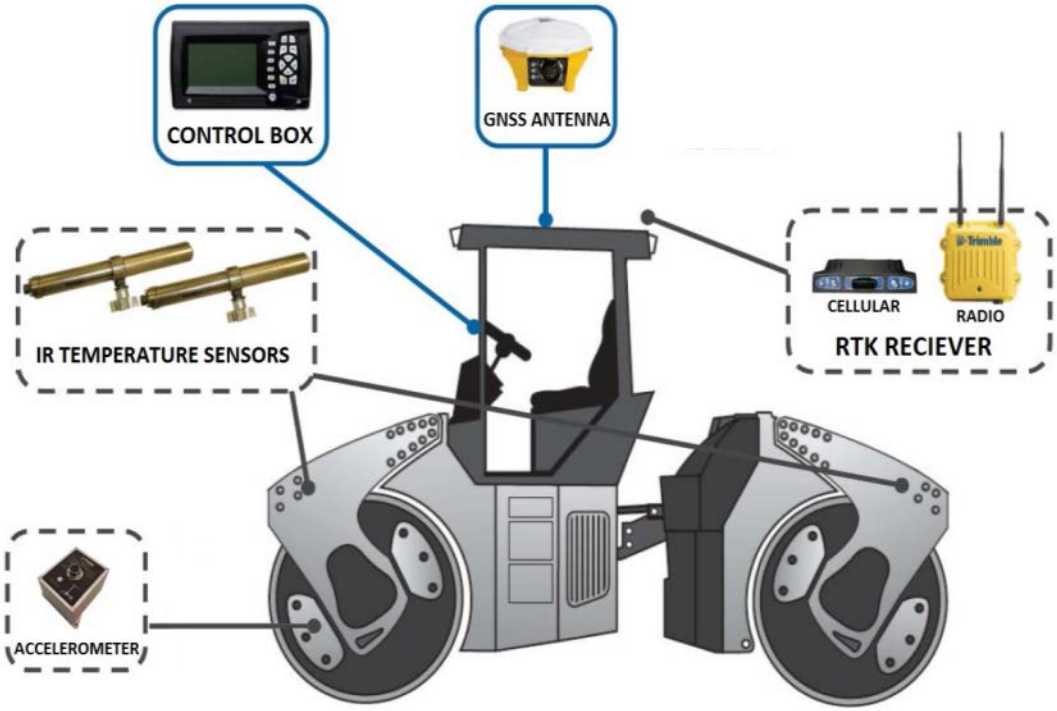
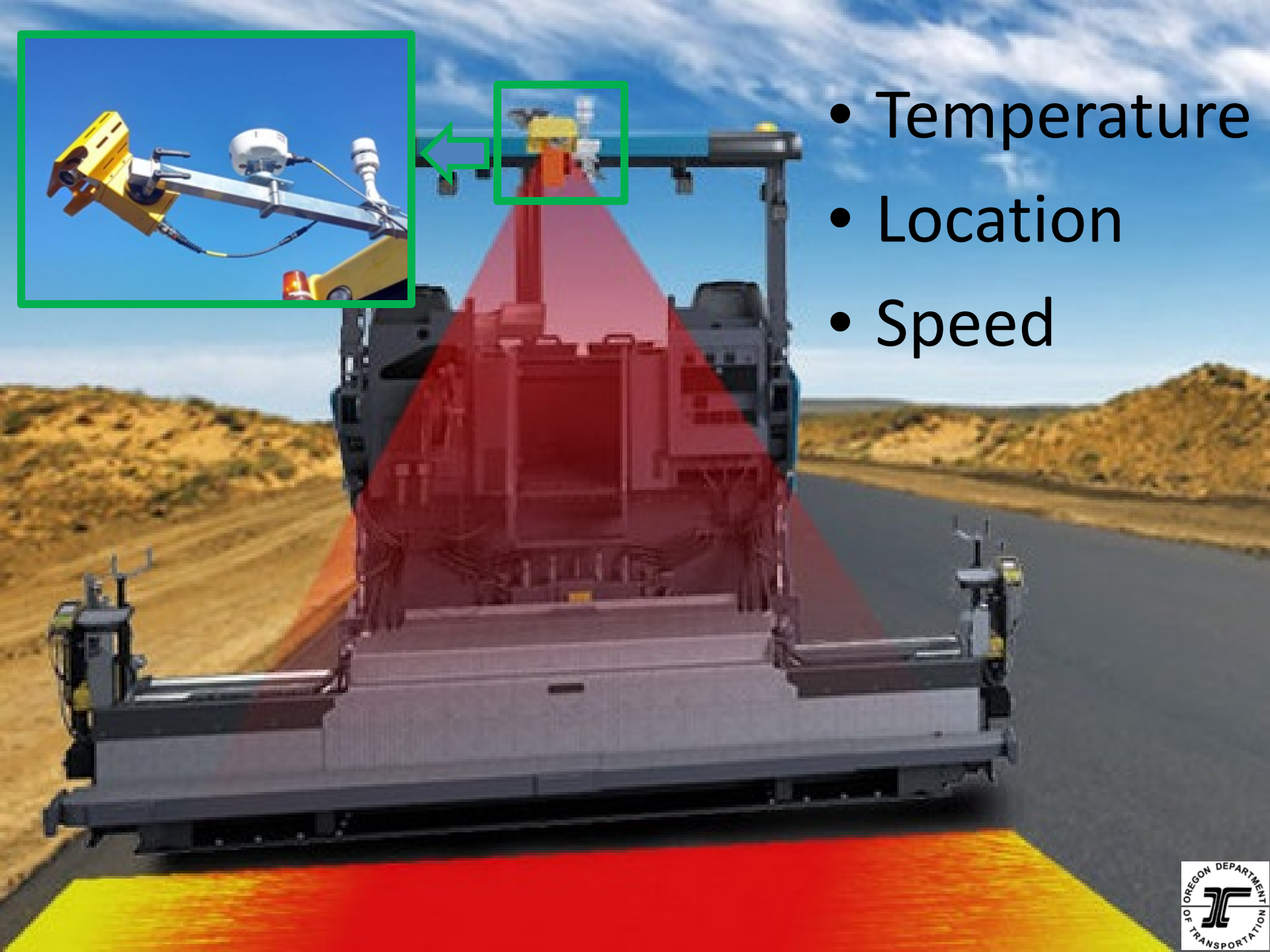

VETA



- Pass Count
- Temperature
- Speed
- Stiffness
- Vibe Frequency


• Temperature
• Location
• Speed
OREGON DEPARTMENT OF TRANSPORTATION

BENEFITS

AGENCY

- Ensure correct # of passes by each roller
- Monitor temperature of rolling and laydown
- Monitor roller and paver speed
- Track paver stop length and location
- Correlate density shots with roller info
- Delineate temperature segregation
- Delineate potential low density areas
- Delineate soft spots
- Record spot locations and overlay on compaction map

CONTRACTOR

- Provide nighttime vison to roller operators
- Real time data for density tech
- Monitor efficiency of roller pattern
- Catch changes in delivery temperature
- Find potential areas needing more compactive effort
- Balance trucking with paving speed
- Training tool for new roller operator
- Identify equipment issues quickly

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SURVEY DATA COLLECTION

NO PREVIOUS SURVEY DATA? NO PROBLEM!

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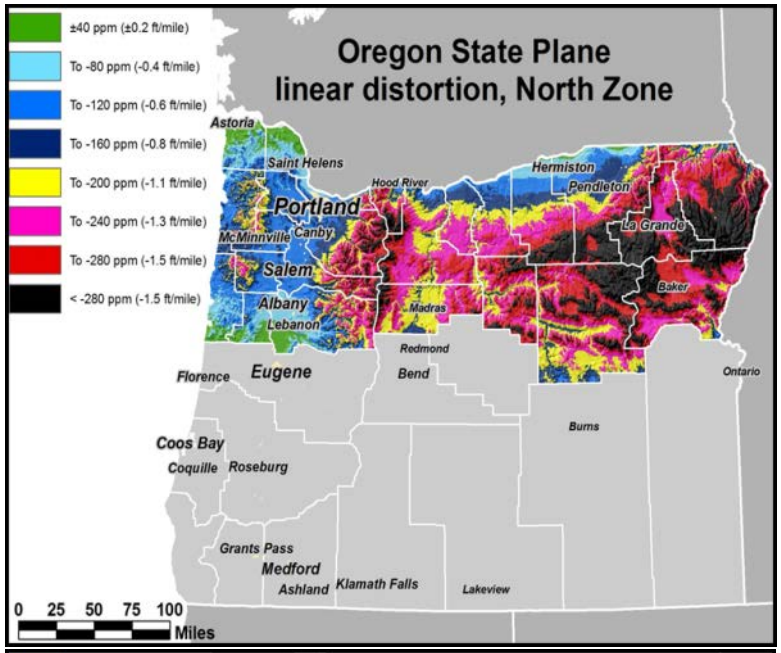
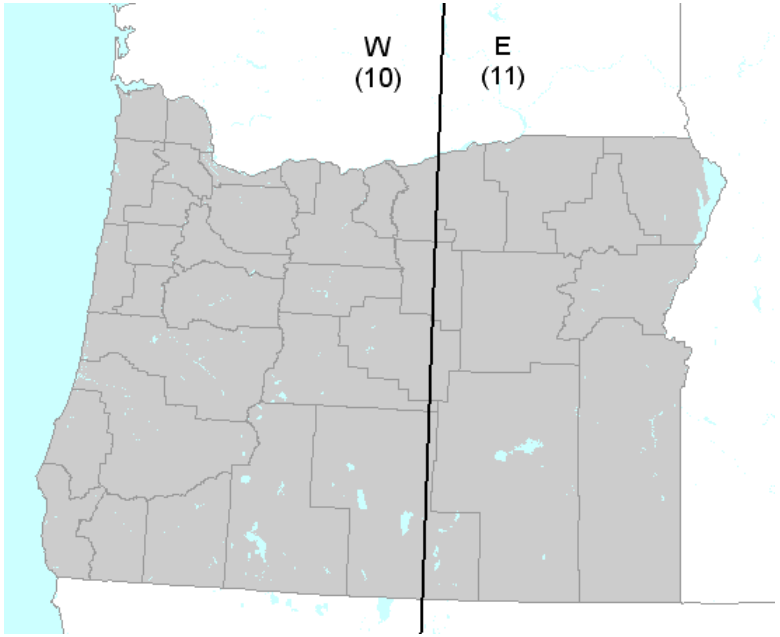
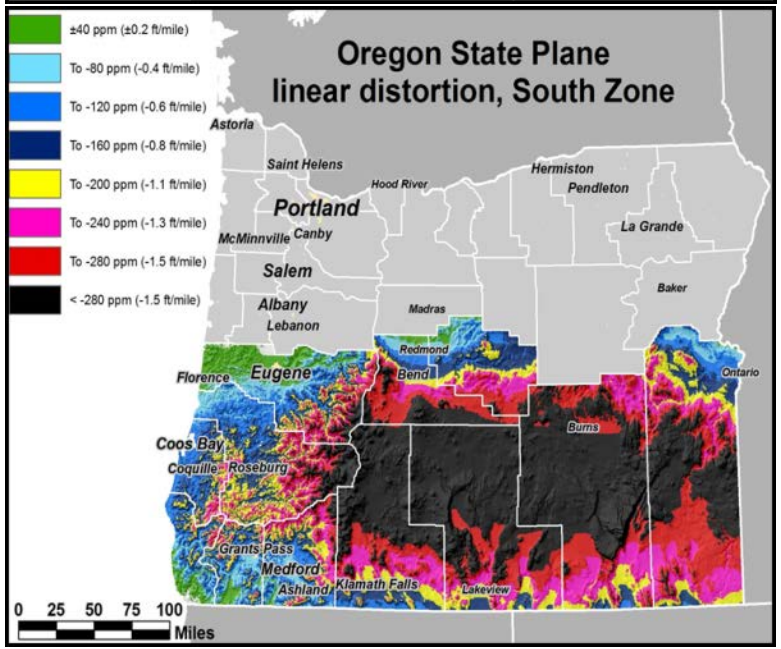
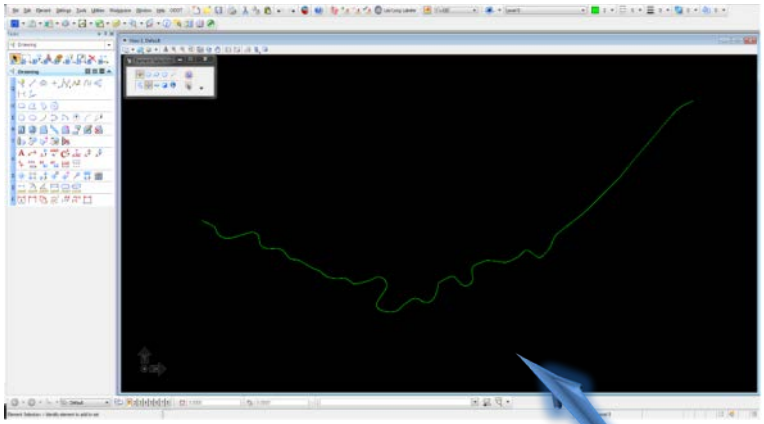
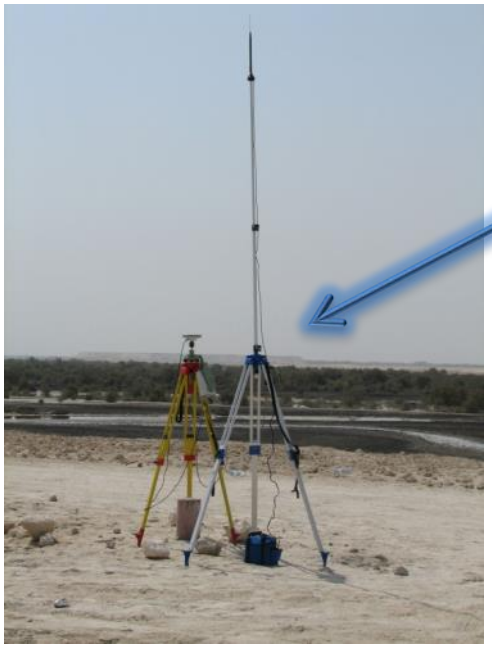
KNOW YOUR COORDINATE SYSTEM!

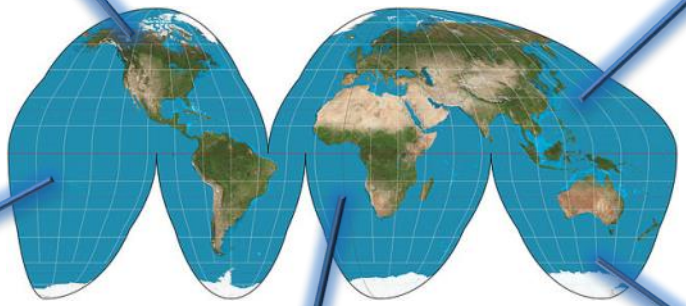


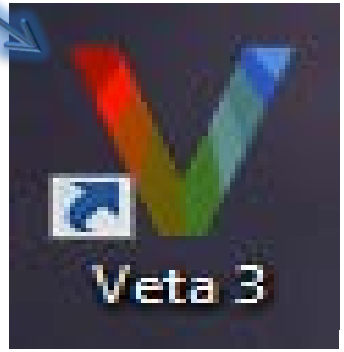












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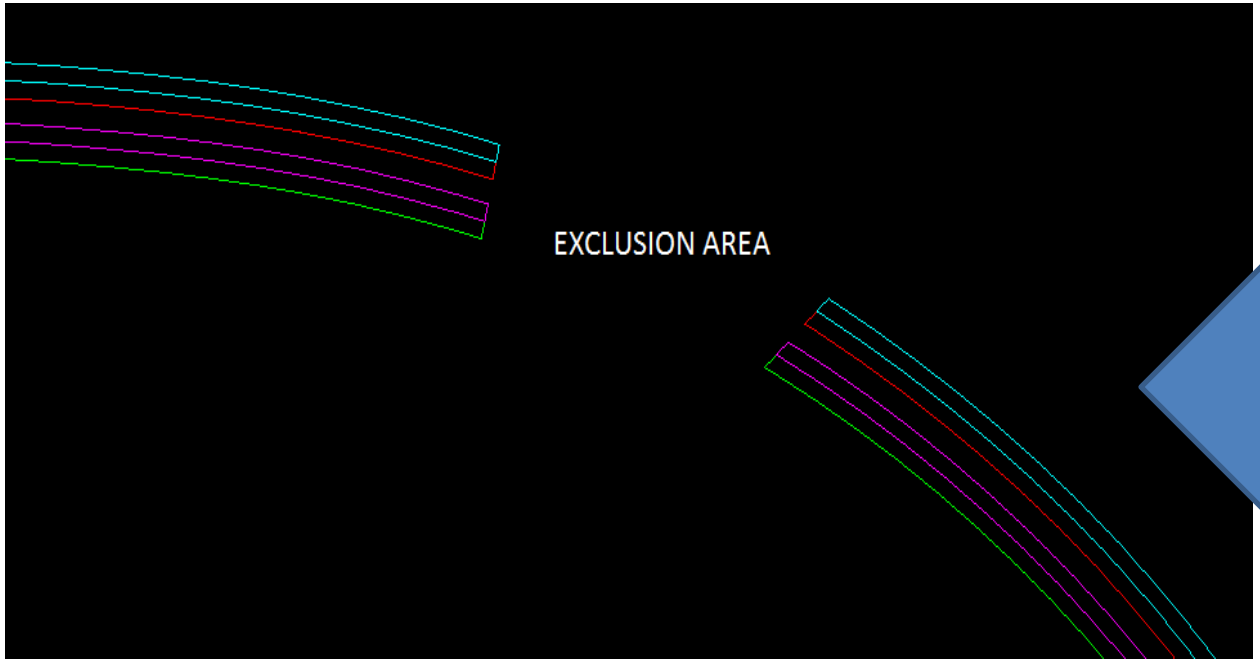
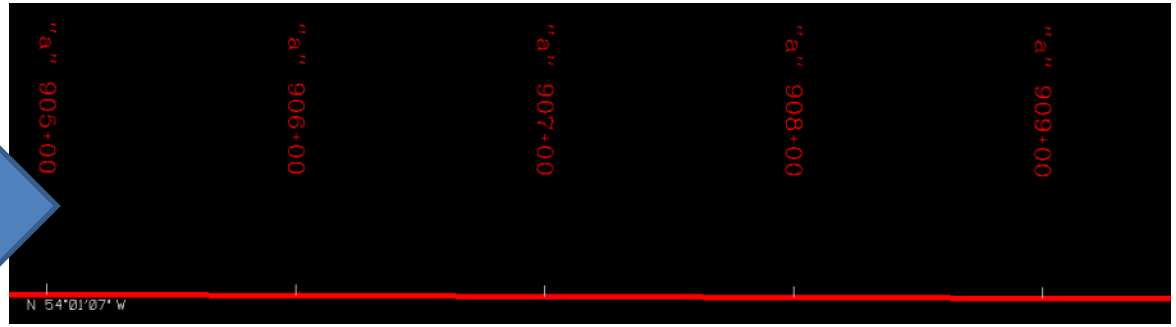
WHAT DO I NEED?



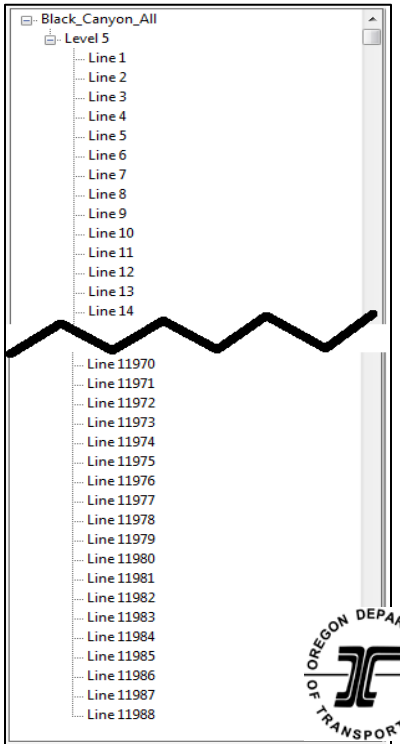
LANE SHAPES

STATIONING

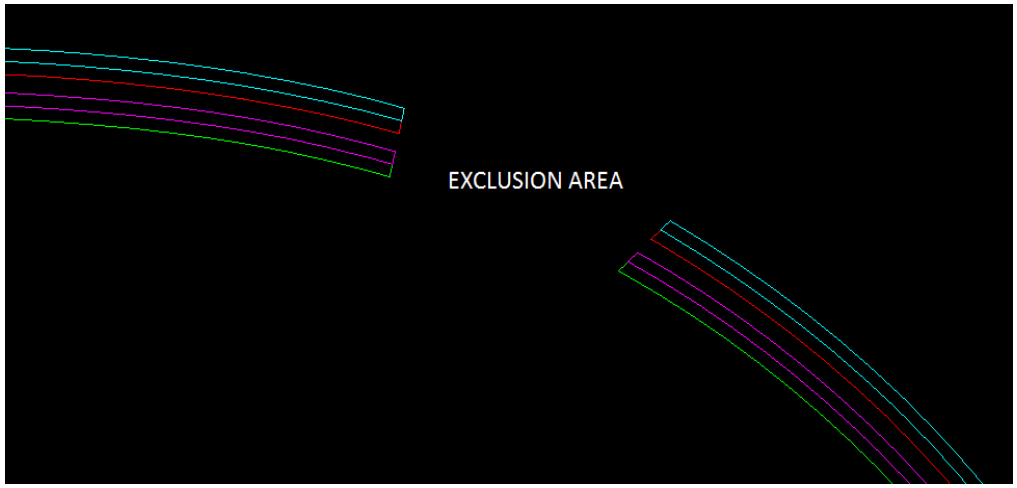


Design

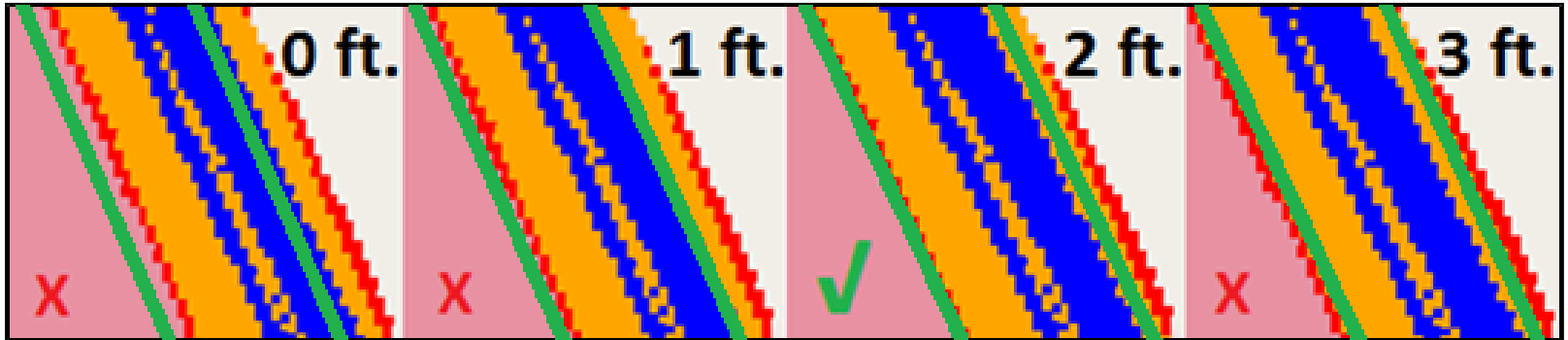
2D NOT 3D



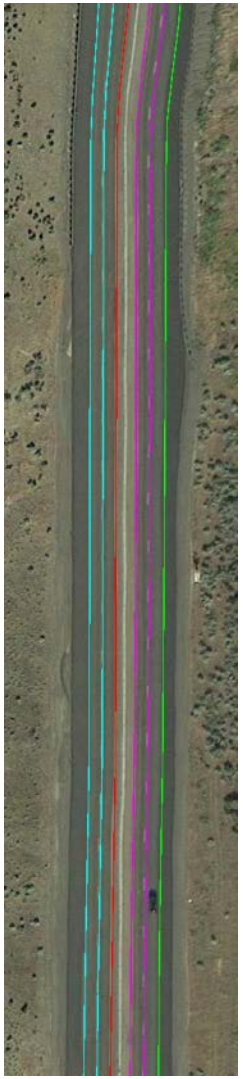
.dgn Lane Shapes



- Travel lanes and adjacent auxiliary lanes
- Exclude ramps, shoulders, non-continuous turn lanes, and side streets
- Usually created from lanes line



.kmz Lane Shapes



- Google Earth files
- Matching vs. Non-Matching Projections
- Both work as long as all equipment uses the same projection
- Non-Matching – more difficult to locate physical location of data point on roadway
- Used for Veta data trimming

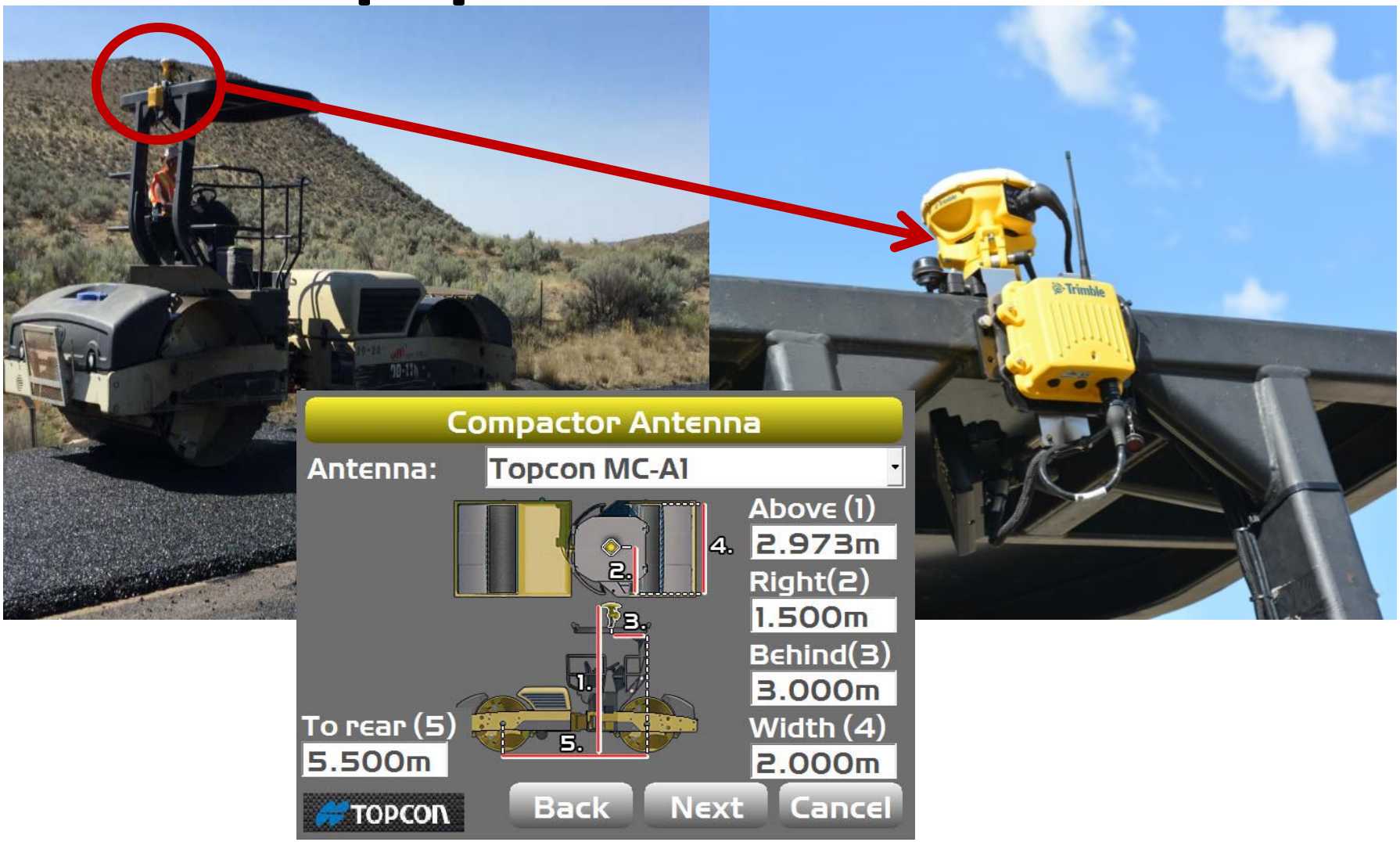
SITE SETUP

ROVER CHECK ON CONTROL POINTS TO VALIDATE COORDINATE SYSTEM

CONTROL POINT EVALUATION

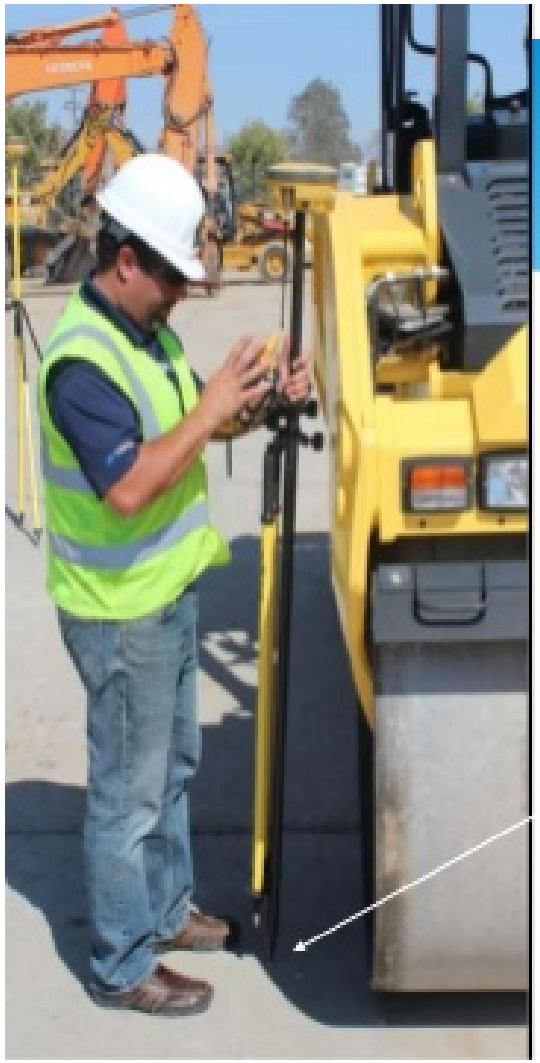
CORRECTORS
SET UP BASE STATION AND REPEATERS IF NECESSARY
OR
EVALUATE ORGN COVERAGE

Equipment Calibration



PRECISE MEASURING OF ROLLER DIMENSIONS AND LOCATION OF GNSS ANTENNA

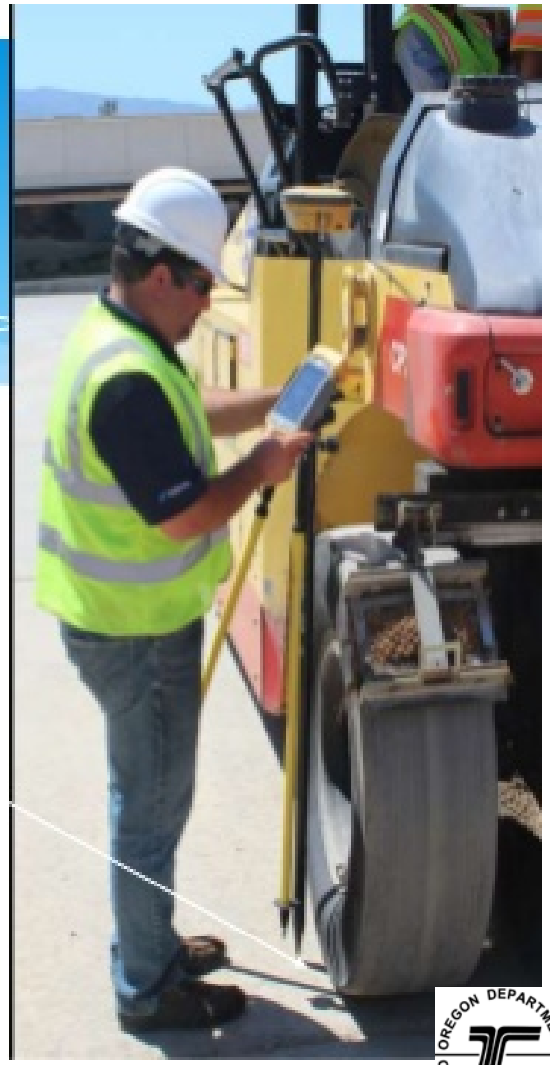
EQUIPMENT CHECK POINT



Each Day
Calibrate Roller to
Rover GPS

"Benching In"

GPS Reading of Marked Center Drum of Roller with Programed Offset Must be Within 6" of Rover Reading

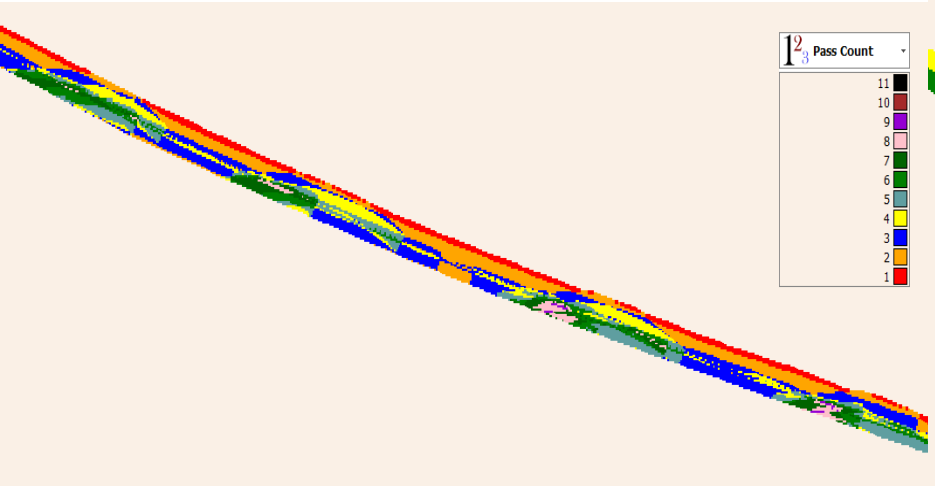


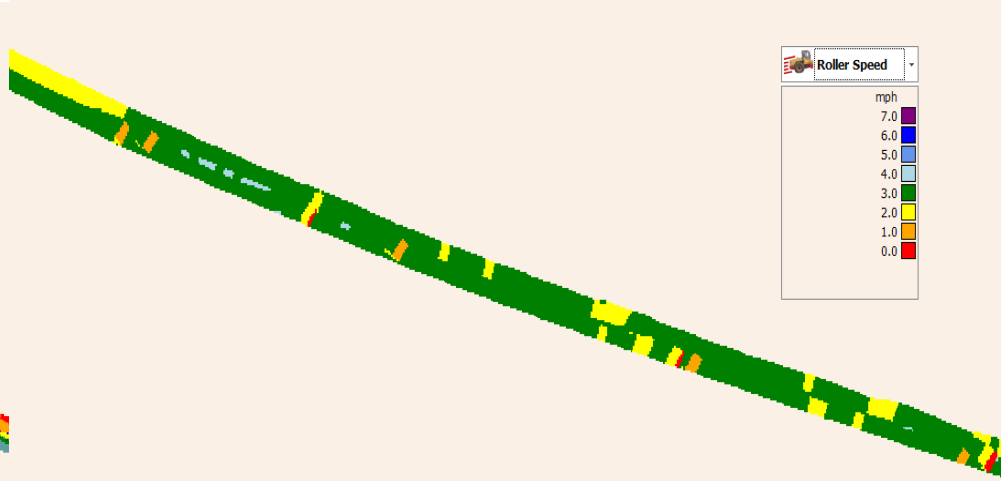
Thermal Calibration

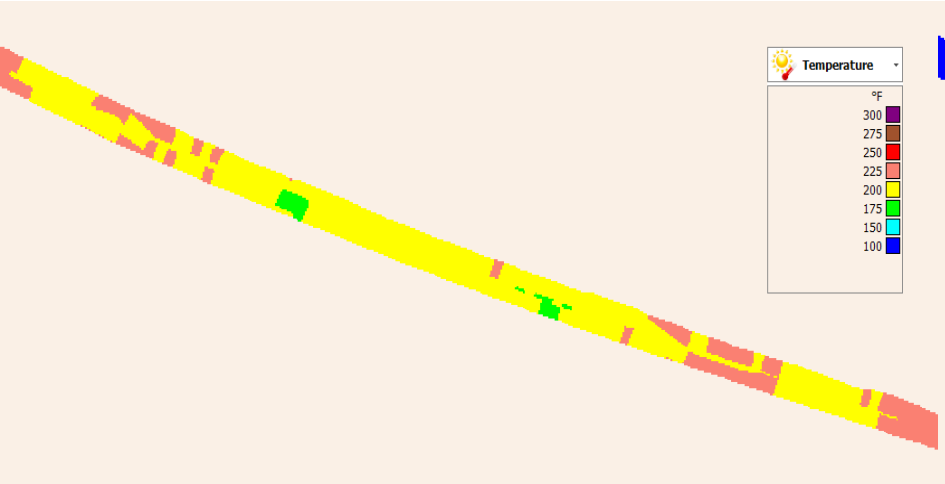
- Thermal Imaging System – Paver
- Roller Temperature Measurements
  - Check against calibrated measuring device
  - Must be within 3 degrees or 1.5% of reading

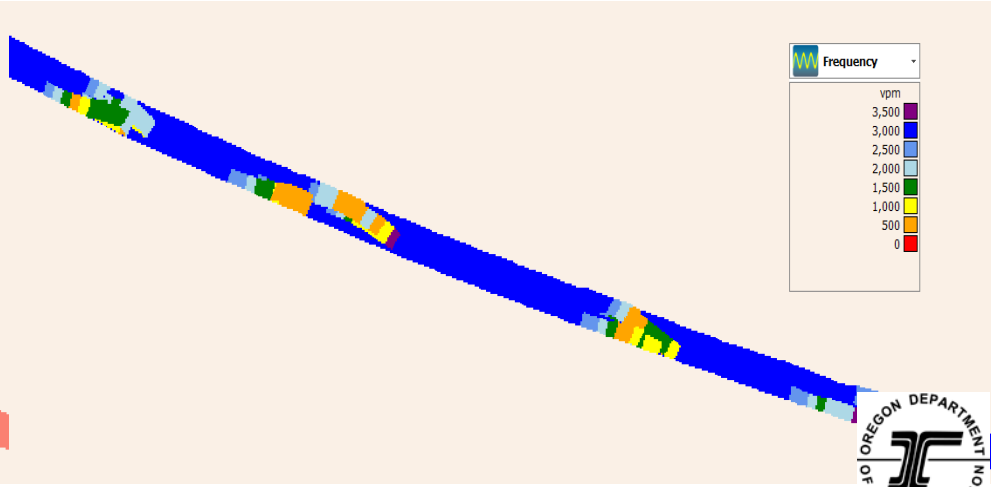
EVERY ODOT QUALITY ASSURANCE OFFICE HAS CALIBRATION EQUIPMENT

DATA TYPES

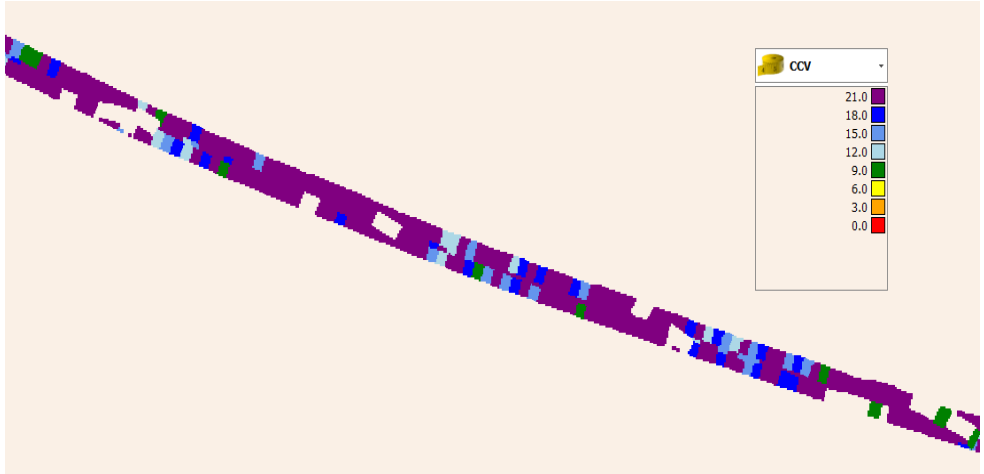

Pass Count
11
10
9
8
7
6
5
4
3
2
1

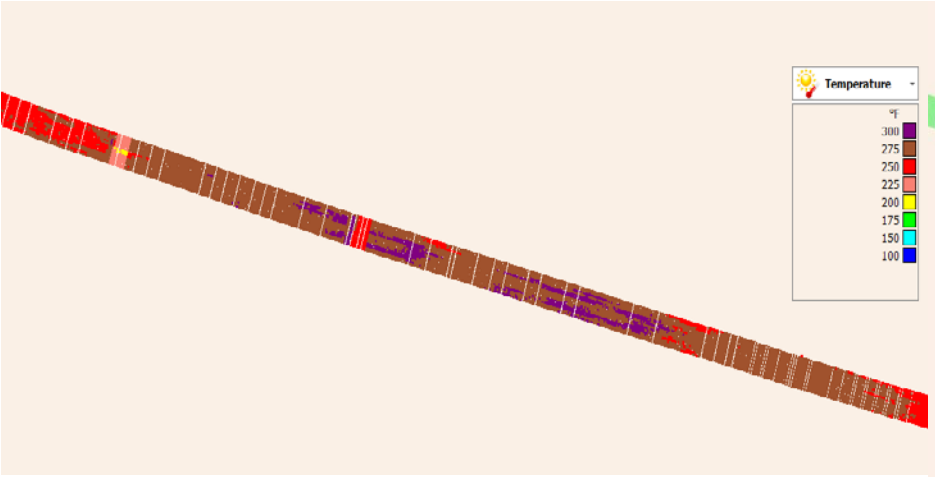

Roller Speed
mph
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0

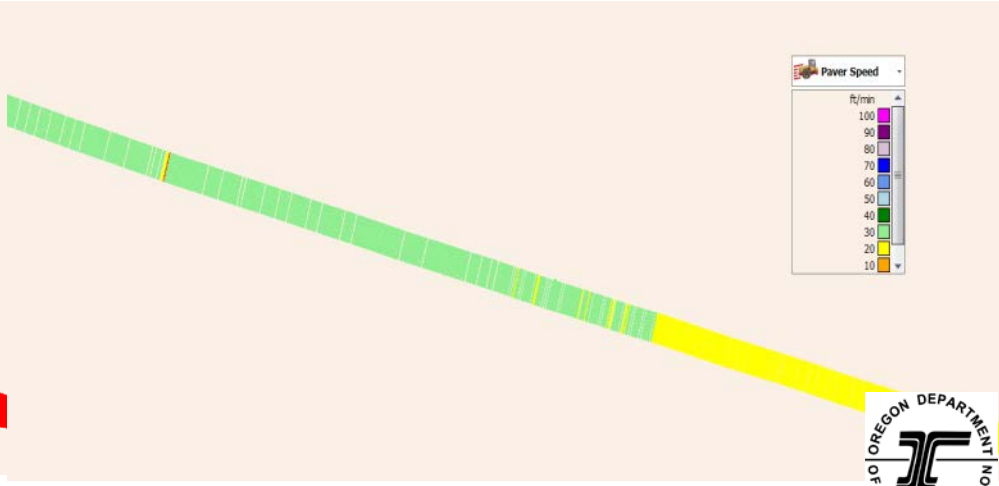

Temperature
°F
300
275
250
225
200
175
150
100


Frequency
vpm
3,500
3,000
2,500
2,000
1,500
1,000
500
0

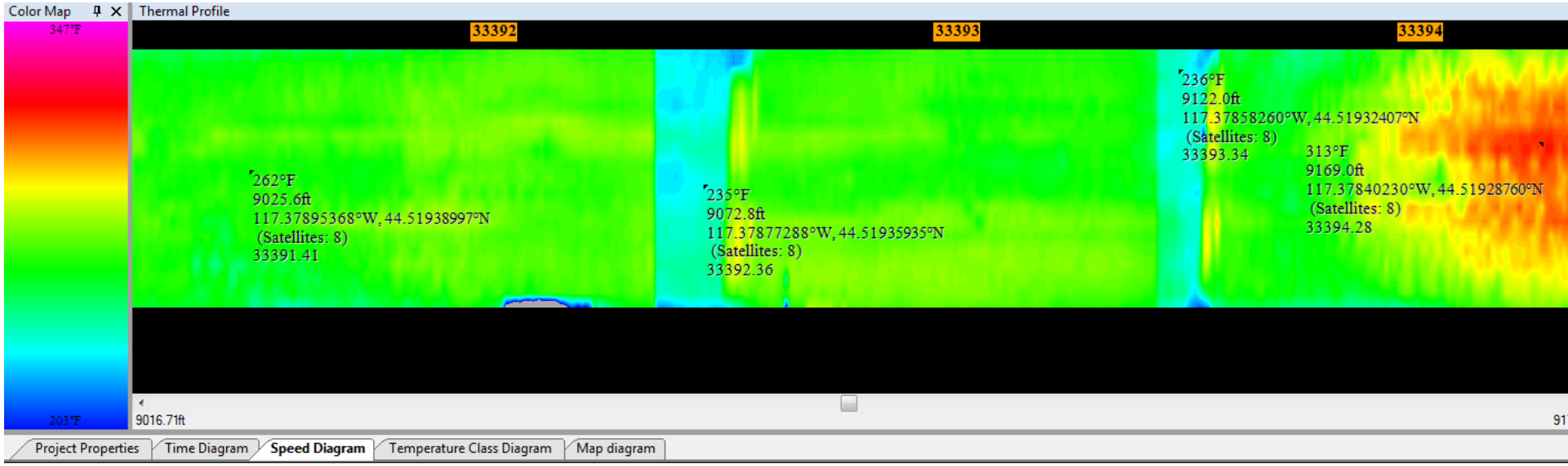
DATA TYPES

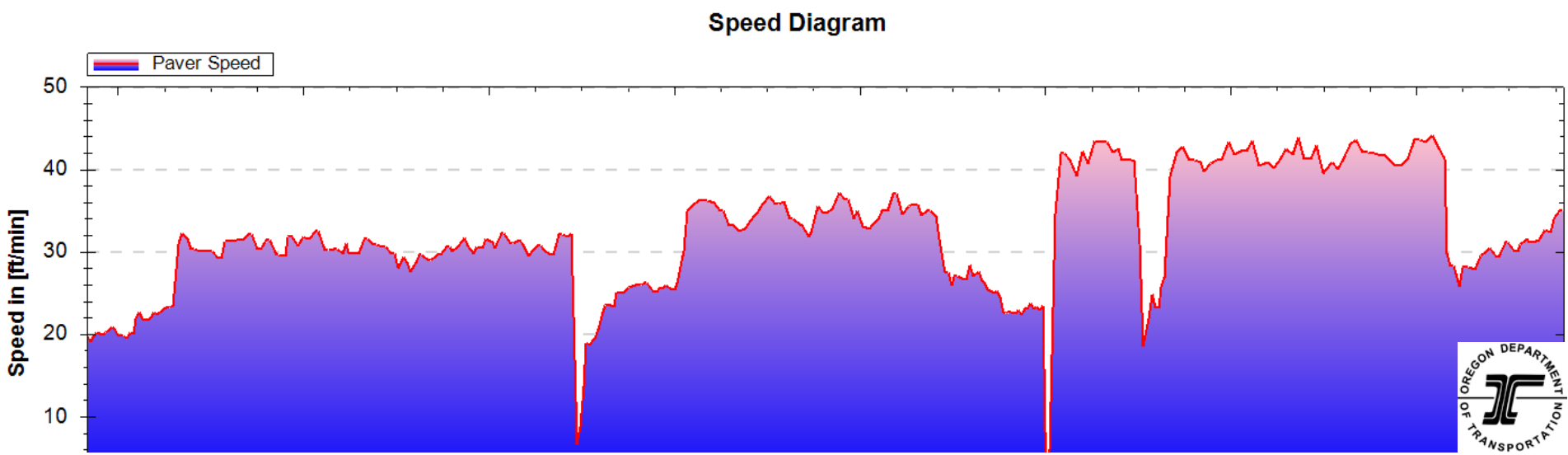

CCV
21.0
18.0
15.0
12.0
9.0
6.0
3.0
0.0


Temperature
°F
300
275
250
225
200
175
150
100

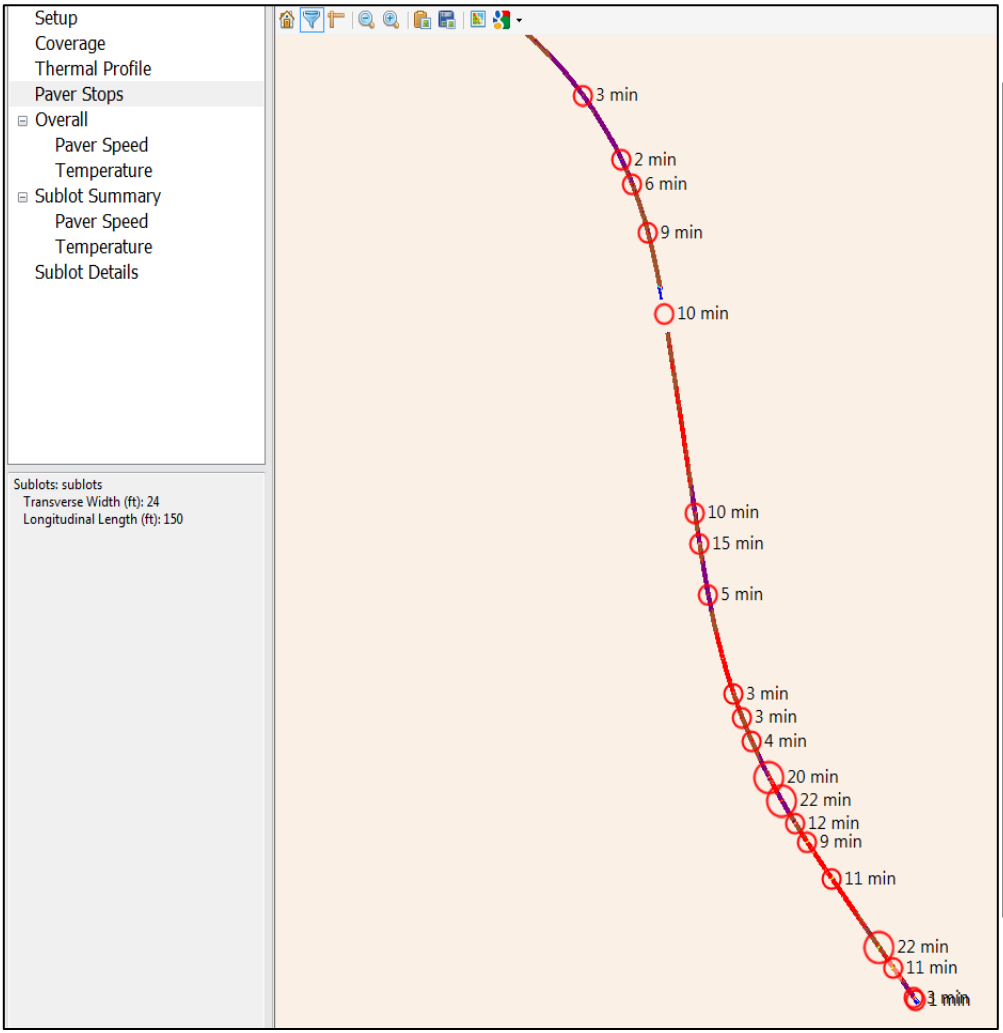

Paver Speed
ft/min
100
90
80
70
60
50
40
30
20
10

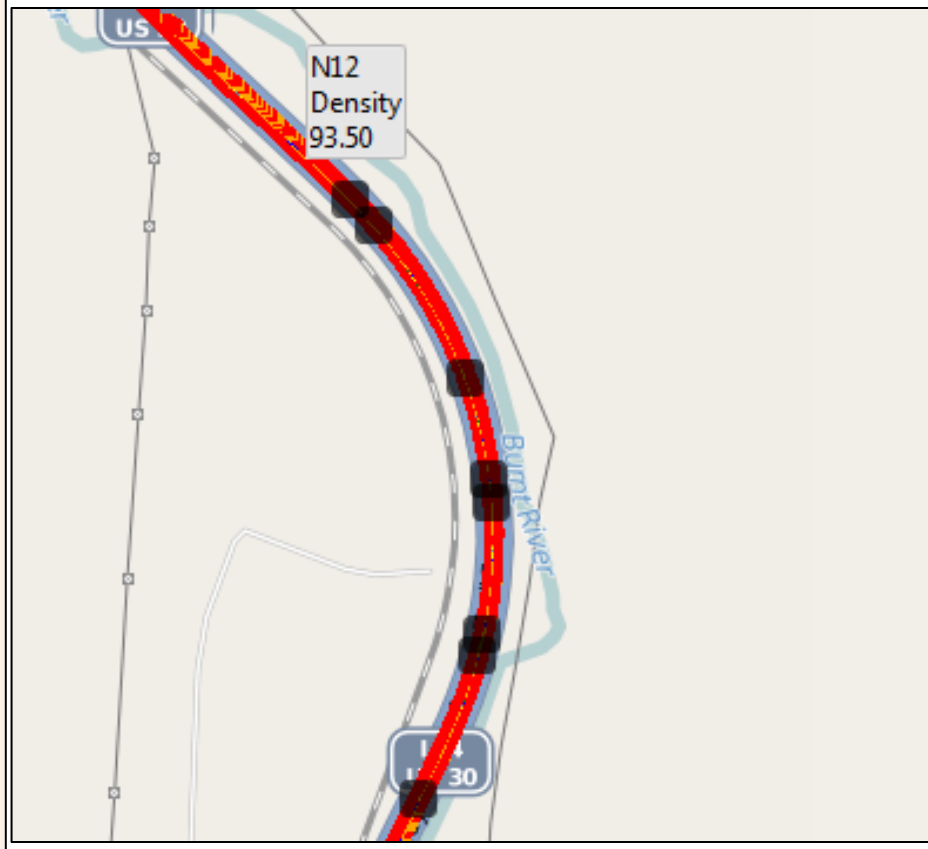
DATA TYPES


Color Map
Thermal Profile
347°F
203°F
33392
33393
33394
262°F
9025.6ft
117.37895368°W, 44.51938997°N
(Satellites: 8)
33391.41
235°F
9072.8ft
117.37877288°W, 44.51935935°N
(Satellites: 8)
33392.36
236°F
9122.0ft
117.37858260°W, 44.51932407°N
(Satellites: 8)
33393.34
313°F
9169.0ft
117.37840230°W, 44.51928760°N
(Satellites: 8)
33394.28
9016.71ft
Project Properties
Time Diagram
Speed Diagram
Temperature Class Diagram
Map diagram

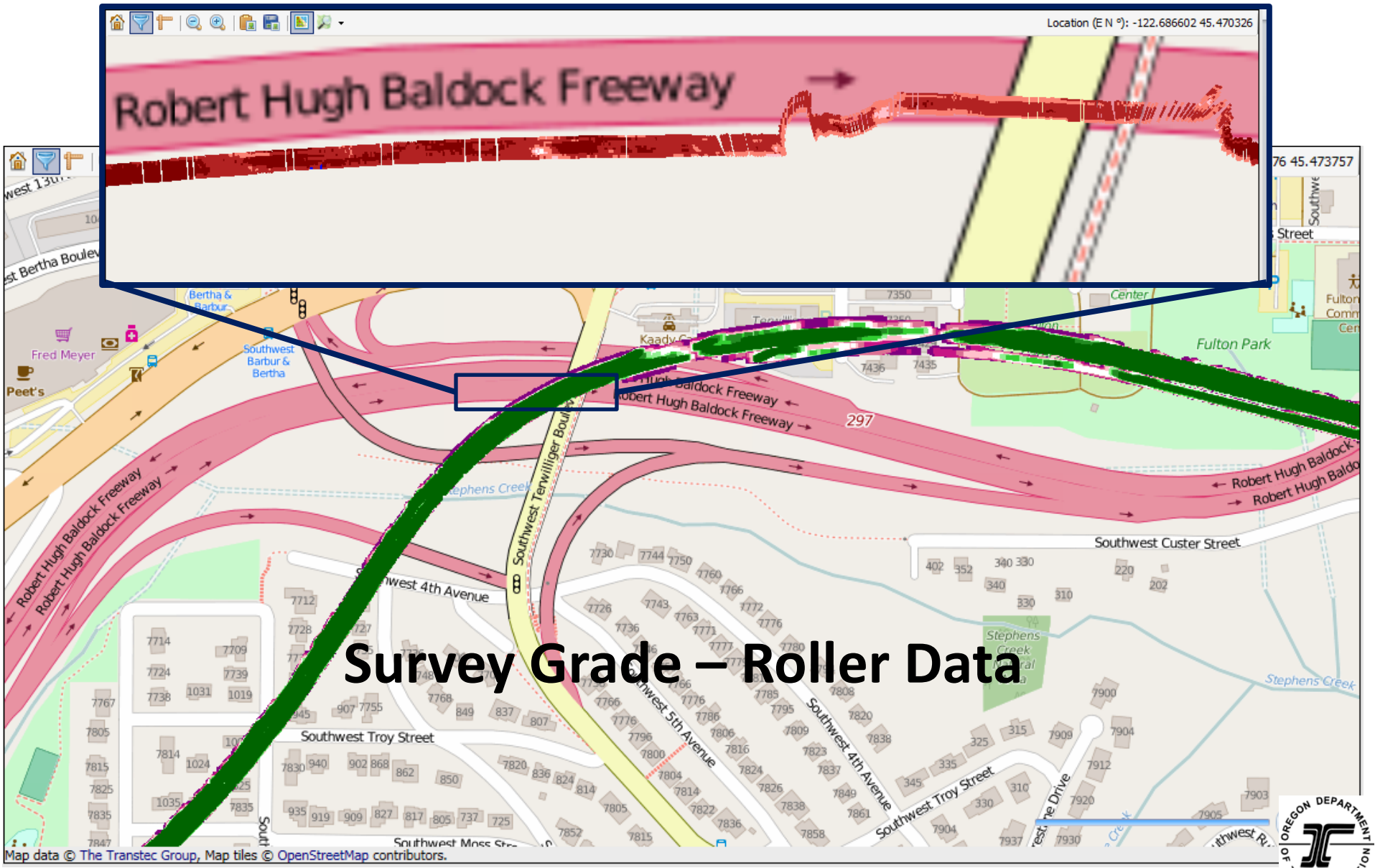

Speed Diagram
Paver Speed
Speed in [ft/min]
50
40
30
20
10

DATA TYPES


Setup
Coverage
Thermal Profile
Paver Stops
Overall
Paver Speed
Temperature
Sublot Summary
Paver Speed
Temperature
Sublot Details
Sublots: sublots
Transverse Width (ft): 24
Longitudinal Length (ft): 150
3 min
2 min
6 min
9 min
10 min
10 min
15 min
5 min
3 min
3 min
4 min
20 min
22 min
12 min
9 min
11 min
22 min
11 min


N12
Density
93.50
Burnt River

Mapping Grade – Paver Data

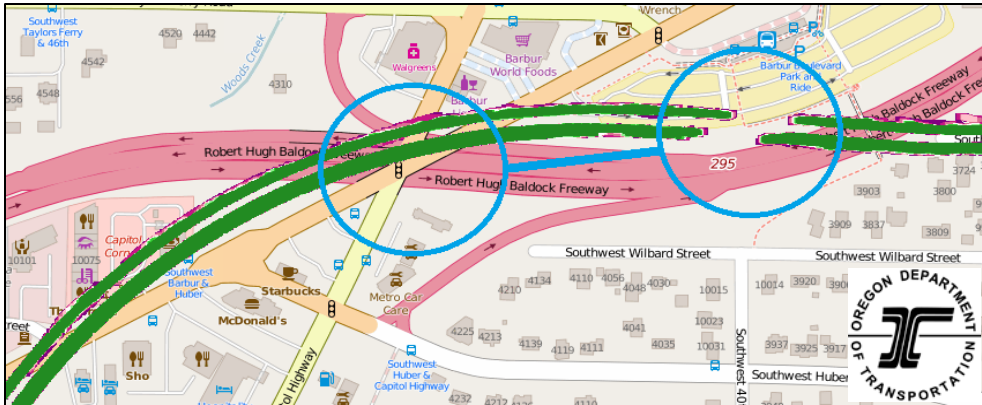


SPOT DATA COLLECTION

- CONTRACTOR PROVIDED ROVER
  - QC/QA Density Shots
- AGENCY ROVER/POSITIONING TOOL
  - Start/Stop locations
  - Edge of pavement
  - Additional points of interest
- If no agency tool is available, request additional data from contractor or contact the ETA unit for support.

Challenges

- Mixed coordinate systems
- Can’t relate Northing/Easting data to Station or Milepoint in software
- Loss of data under bridges and areas with tall buildings
- Adjusting alignment file for paving offsets
- Available staff to review in timely manner
- Software bugs



History of IC in Oregon

2014

- APAO/ODOT Advanced Pavers Workshop - Presentation "Improved Asphalt Density Quality Control with Intelligent Compaction" by Antonio Nieves FHWA
- Contract Change Order for 1 IC Roller on C14648 I-84: Arlington - Tower Road, Kerr Contractors Oregon

2015

- Intelligent Compaction Data Management Workshop, FHWA
- Contract Change Order to add IC on all rollers for
  - C14754 I-84: Nelson Point - Lime Sec., Kerr Contractors Oregon
  - C14747 US-20: Black Canyon - Harper Project, Roy Houck Construction
  - C4770 I5: Marquam Bridge - Capitol Highway, Oregon Mainline Paving

2016

- Joined Pooled Fund "Enhancement to the Intelligent Construction Data Management System (Veda) and Implementation".
- Bid 3 projects with full IC for construction in 2016:
  - US30: NW McNamee Rd - NW Bridge Ave
  - I-84: Jordan Rd - Corbett
  - I-5: S. Medford - N. Ashland Paving
- Formed IC Framework and Technology Working Groups (ODOT, Contractors, Vendors)

USER GUIDE & TRAINING

OREGON
DEPARTMENT
OF
TRANSPORTATION

Technical Services
Engineering Automation Section

Ron Singh, PLS
Engineering Automation Manager
Chief of Surveys
(503) 986-3033

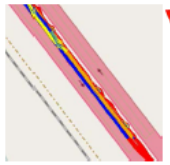
Intelligent Compaction User Guide

Chris Harris, P.E.
Construction Automation Engineer

Engineering Technology
Advancement Unit
4040 Fairview Industrial Drive SE
Salem, OR 97302-1142
(503) 986-5397

22 April 2016

Intelligent Compaction Training



VETA
INTELLIGENT CONSTRUCTION

What: This is a comprehensive, 4-hour course on Intelligent Compaction (IC) technology, requirements, Veta analysis techniques, and resources available for project support.

Who: This course is developed for ODOT project management staff that will be administering an IC project. The information will also be applicable for any contractor that is constructing an IC project or interested in using IC on a future project.

How: Contact the Engineering Technology Advancement Unit to schedule a class:
EngineeringTechnologyAdvancment@odot.state.or.us

OR

Christopher Harris, P.E.
Construction Automation Engineer
Engineering Technology Advancement Unit
Christopher.Harris@odot.state.or.us
Office: (503)986-5367
Cell: (503)302-9390

Training can be provided at the TLC building in Salem or at your local office. Each attendant should have access to a computer with Veta 3.011 or higher installed. Software can be downloaded for free at www.intelligentcompaction.com/veta/current-version/. This software is listed on the ODOT ICARe approved software list.

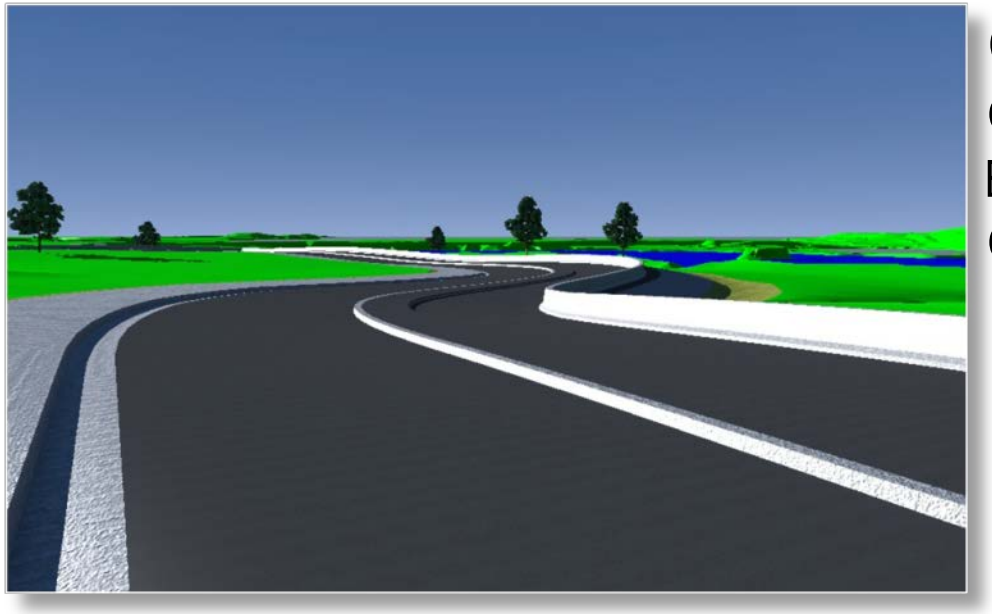
AGENDA

1. Introduction to Intelligent Compaction
2. Survey
3. Design
4. Construction
5. Critical Items
6. Resources and Future Development
7. Veta Software Exercises

More Information about IC can be found at:
ODOT Internal: http://transnet.odot.state.or.us/hwy/eta/Pages/Intelligent-Compaction.aspx
External: http://www.oregon.gov/ODOT/HWY/ETA/Pages/Intelligent-Compaction.aspx

OREGON DEPARTMENT OF TRANSPORTATION

Thank You!



Chris Harris, P.E.
Construction Automation Engineer
Christopher.Harris@odot.state.or.us

ETA Email: EngineeringTechnologyAdvancement@odot.state.or.us
Internet: www.oregon.gov/ODOT/HWY/ETA/Pages/default.aspx
Intranet: http://transnet.odot.state.or.us/hwy/eta/SitePages/Home.aspx