



NACOE

**NATIONAL
ASSET CENTRE
OF EXCELLENCE**

Webinar – Implementation of Intelligent Compaction in Queensland

Presenters: Dr. Jeffrey Lee & Dr. George Chang

NACOE Project: *P105 Implementation Intelligent Compaction Technology for use
in Queensland*

AN INITIATIVE BY: Department of Transport and Main Roads & ARRB

Rosemary Pattison

Webinar Moderator



Professional

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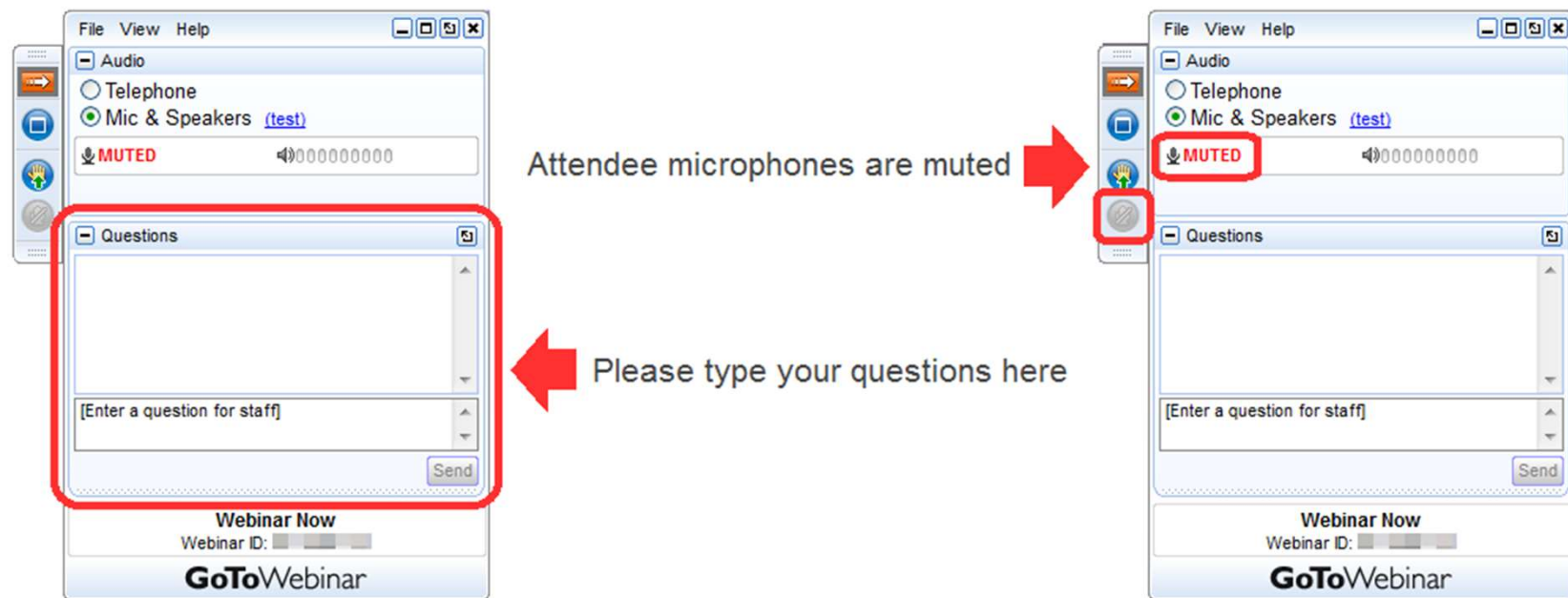
Housekeeping



Webinar is **60 mins**
inc. question time of **10-15 mins**



GoTo Webinar functions





Webinar Presenters



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NACOE

National Asset Centre of Excellence

- Collaboration between TMR and ARRB started in 2013
- Initial investment of \$4.2 million in 2019/20
- Areas of research include:
 - Pavement Technology
 - Asset Management
 - Structures
- Promote research to increase efficiency and productivity through innovations.



Presentation Outline

- NACOE P105 – Aim and Research Progress
- PSTS116
- Compaction Auditing Areas
 - Cement Modified Layer (all roller passes)
 - Unbound Gravel Base (all roller passes)
 - Embankment (final roller pass)
 - Subgrade (final roller pass)
- Summary and Lessons Learnt
- Veta v6.0 New Features



NACOE P105

Implementation of Intelligent Compaction (IC) Technology in Queensland

- Aim –
 - Explore and facilitate the possible implementation of IC technology
 - Assess the suitability of IC to be used for either or both QC/QA
 - Establish a consistent data standard/protocol for IC technology
- Project commenced in FY19/20
 - Literature review
 - Intelligent Compaction Data Management (ICDM) workshop
 - Webinar
- This year, FY20/21
 - Draft guideline for demonstration trial
 - Engage industry group and equipment manufacturers for feedback
 - Conduct compaction auditing in a major TMR project
 - Knowledge transfer (this webinar)

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Implementation of Intelligent Compaction (NACOE P105)

Intelligent compaction (IC) refers to the use of a compaction roller equipped with an integrated roller measurement system (often using an accelerometer mounted on the drum), and a survey-grade precision GPS unit. If used for asphalt compaction, infrared temperature sensors are also used. The IC technology has an on-board computer display that provides the operator with real-time feedback of the stiffness of compacted materials and roller passes. For asphalt application, infrared temperature sensors are also mounted on the roller to track asphalt surface temperature during compaction.

The main advantage of IC technology is the improvement of construction quality control, efficiency and uniformity, as well as the reduction in construction and maintenance cost. It can provide contractors with timely feedback of the compaction and can be used to pre-map the condition of existing layers before placing the next lift. The technology also captures and securely stores the compaction process information as permanent geo-referenced records.

First ICDM Workshop in Australia

IC technology has been increasingly used in Europe, Asia, and the United States, and as part of the NACOE P105 project, the first two-day Intelligent Compaction Data Management (ICDM) workshop in Australia was held in South East Queensland on 3 – 4 June 2019. The event was delivered by Dr. George Chang (Transtec Group) and Dr. Jeffrey Lee (Australian Road Research Board).

Veta
INTELLIGENT CONSTRUCTION

ICDM-Veta Workshop
Intelligent Construction Data Management

The first day of the event covers the basics of intelligent compaction, and the participants have a hands-on experience of using the Veta software and explore its data management and analytical capability. On the second day of the event, a field demonstration was conducted using a Dynapac smooth drum roller with a Trimble IC retrofit kit at a test strip. Participants include members from Transport and Main Roads and Local Government representatives.



Day 1: Classroom lecture and Veta hands-on



Day 2: Field demonstration

IC Field Demonstration

Description and Site Preparation

During the field demonstration, the IC roller was used to compact a general fill area (60 m by 23 m). The test strips were prepared at three different moisture contents, namely WET (about 10% volumetric moisture content), OPTIMUM (about 8%), and DRY (about 6%). The exercise familiarised participants with IC technology and

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demonstrated how to use a test strip to establish a target ICMV value and roller passes for process control.



Preparing the surface of the test strip



Moisture conditioning and roller compaction



IC Roller and, In-situ Spot Tests

IC Technology used in the Field Demonstration

To complete the IC demonstration, the contractor used:

- A 15-ton Dynapac CA4600D single drum roller with Trimble retrofit kit. The roller operates at 30 Hz and has two settings in amplitude (i) 120 kN and (ii) 270 kN.
- A Trimble IC retrofit kit that include: RTK GPS, Compaction Meter Value (CMV) measurements, and an onboard computer display
- Online VisionLink data-managing software



Dynapac CA4600D 15-ton single drum



Trimble IC Retrofit Kit: Accelerometer of the CMV system

PSTS Intelligent Compaction - Earthworks and Pavements

Project Specific Technical Specification

Transport and Main Roads Specifications
PSTS116 Intelligent Compaction – Earthworks and Pavements

January 2020

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PSTS IC steps

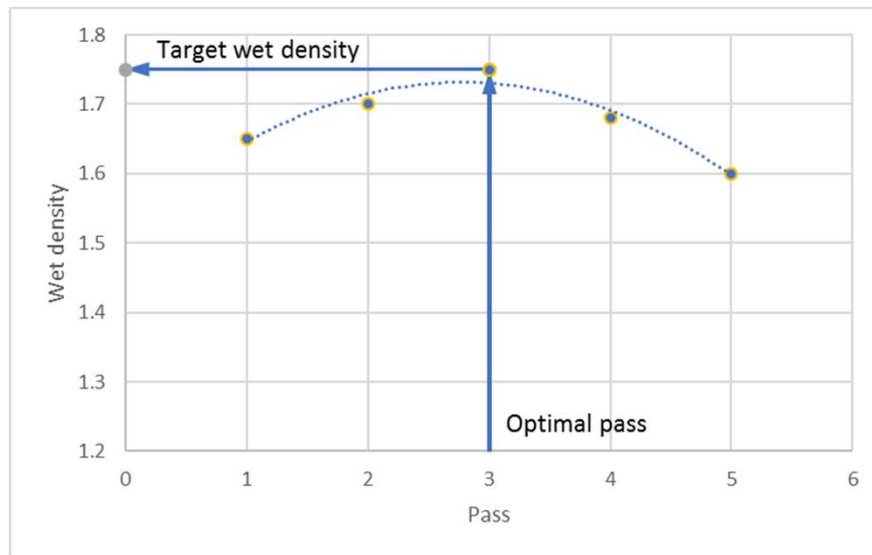
PSTS 116 (Table 7.4.2)

Step	Description
1	Undertake the first roller pass using nominated rollers and rolling pattern
2	At nominated locations of the lot, measure using both LWD and NDG
3	Undertake subsequent roller passes, repeat Steps 1 and 2 until specified compaction standard has been achieved.
4	At the completion of compaction, use IC equipped roller to map the entire lot
5	After the final pass, undertake a final suite of LWD and NDG
6	Plateau Analysis - Analyse the compaction data by plotting roller passes against stiffness and insitu density
7	Determine target ICMV using Veta software for analysis

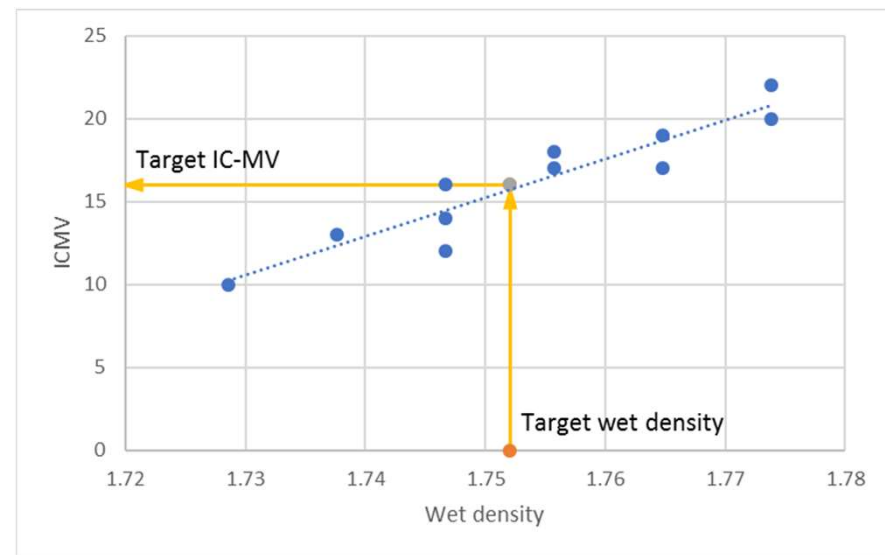
Each pass undertaken by an ICC roller

Only final pass undertaken by an ICC roller

Plateau testing and Target ICMV



Example of plateau testing analysis



Example of Target ICMV analysis

Revision of the target ICMV

The target IC-MV shall be checked at the frequencies shown in Table 7.5.

Table 7.5 – Frequencies for the revision of the target IC-MV

Interval	Action
1st Lot	Determine target IC-MV as per the procedure detailed in Clause 7.4.2.
Monthly	Review target IC-MV in accordance with the procedure detailed in Clause 7.4.2.
Intermediate lots	Use the most recently determined target IC-MV to report the IC data of each lot (refer to Clause 8.2).

For the purpose of the initial IC trials, revision of the target IC-MV may need to occur more frequently than shown in Table 7.5 to help develop the trial.

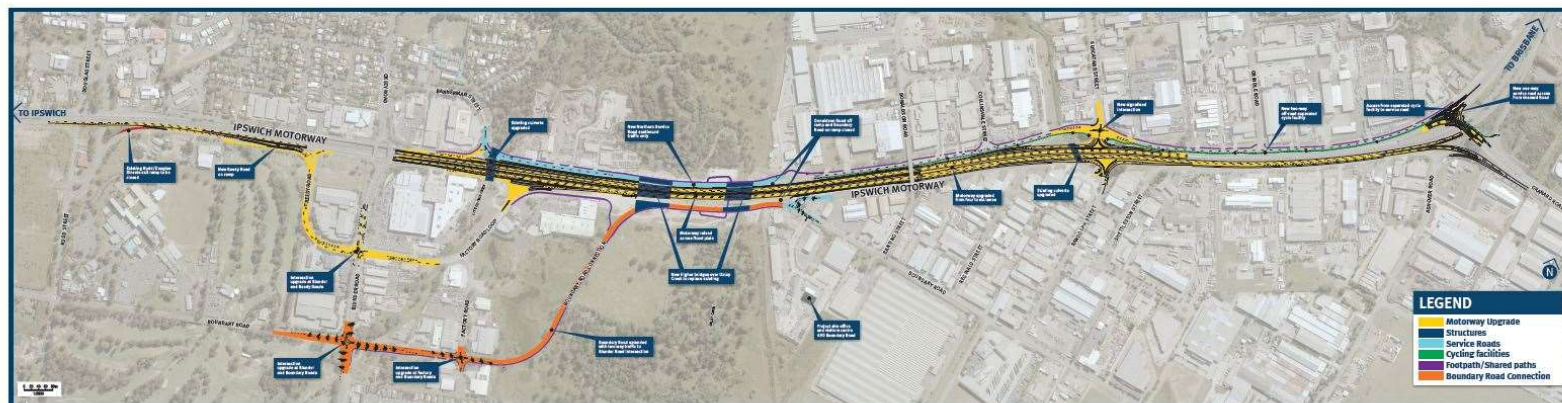
Compaction Auditing

Ipswich Motorway Upgrade: Rocklea to Darra — Stage 1

- Overview
 - Highest priority stage of motorway upgrade
 - \$400M joint 50/50 funding Australian & Queensland Governments
 - Construction commenced October 2017, expected completion early 2021
 - Contractor Bielby Hull Albem Joint Venture (BHAJV)
- Project scope
 - 3 km Granard Road interchange to just east Oxley Roundabout
 - 4 → 6 lanes, wider shoulders and reducing number of entry/exit ramps
 - Higher bridges over Oxley Creek flood plain
 - New service road connections over Oxley Creek and Boundary Road Connection
 - Improved Cycle & Pedestrian Facilities
- **Acknowledge on-site support from BHAJV and R2D project team**

Ipswich Motorway Upgrade: Rocklea to Darra

Stage 1 (Granard Road to Oxley Road)



Design March 2019





Rocklea to Darra - Stage 1 project | May 2020 New bridges and lanes over Oxley Creek and construction of Boundary Road Connection

Progression of Roller Compactor



 Author taken at Brisbane, Australia



Author taken at Saitama, Japan

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Trimble IC Retrofit System



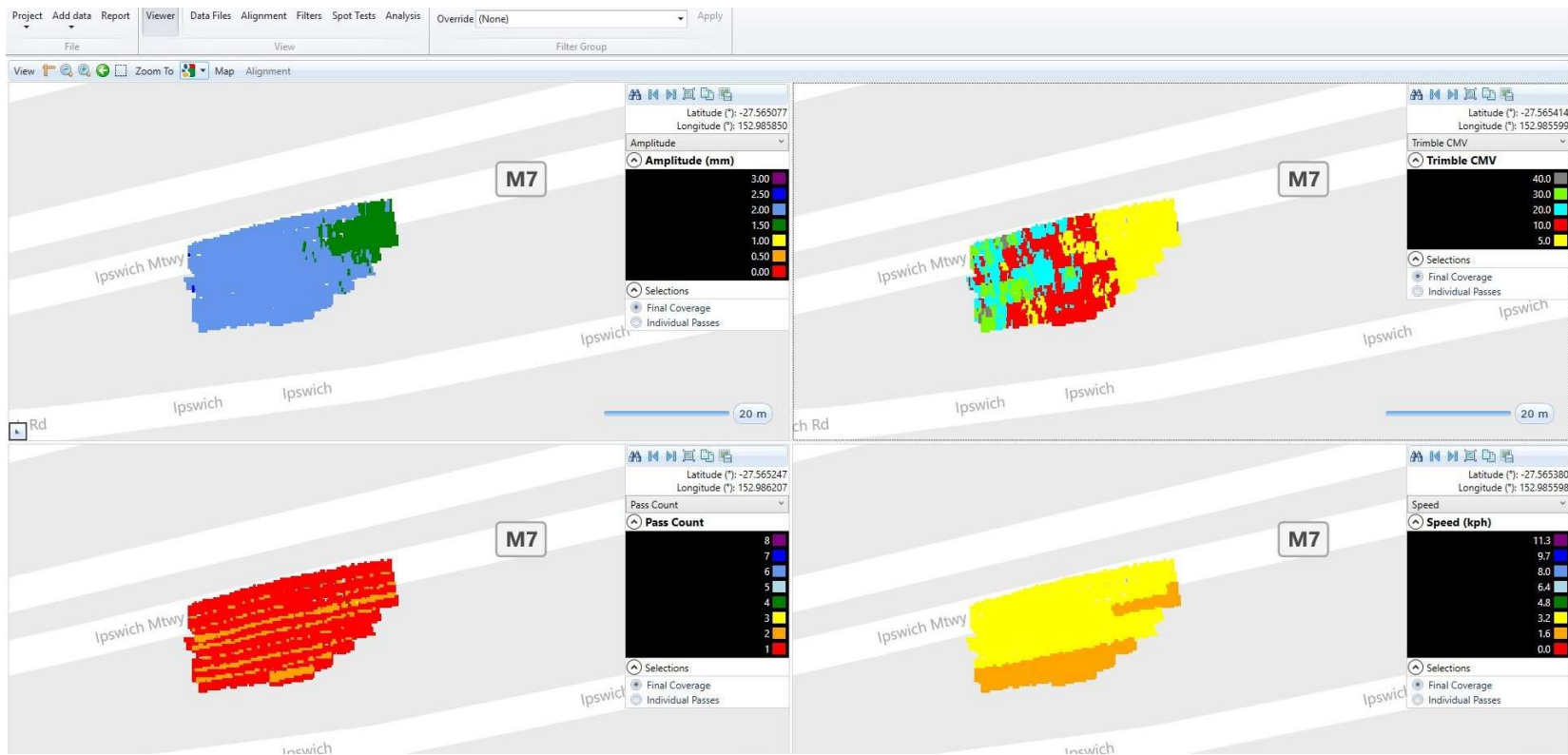
CMV - Compaction Meter Value

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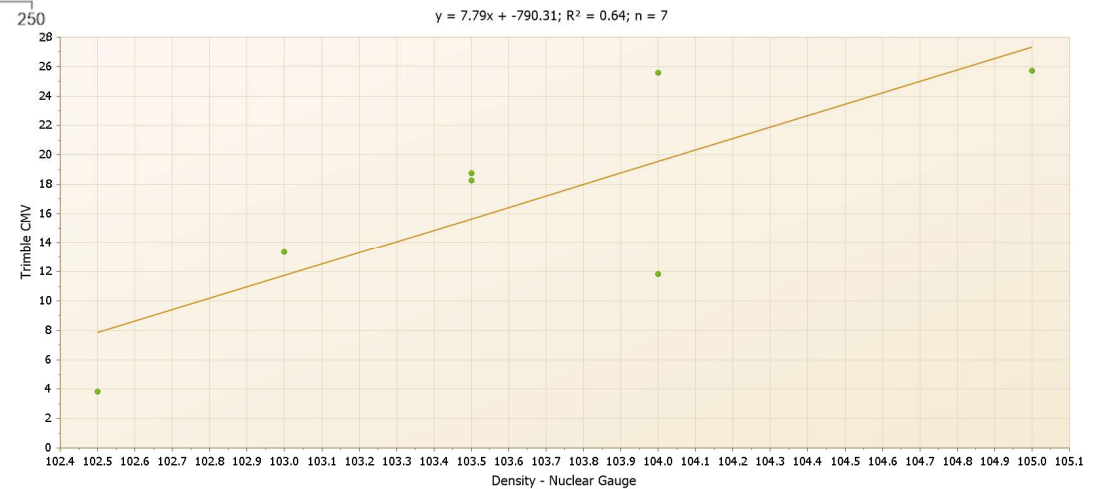
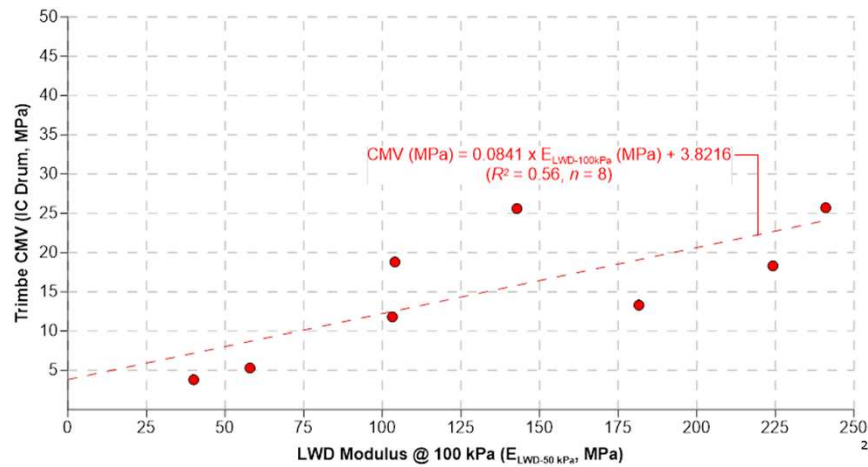


Earthwork Embankment

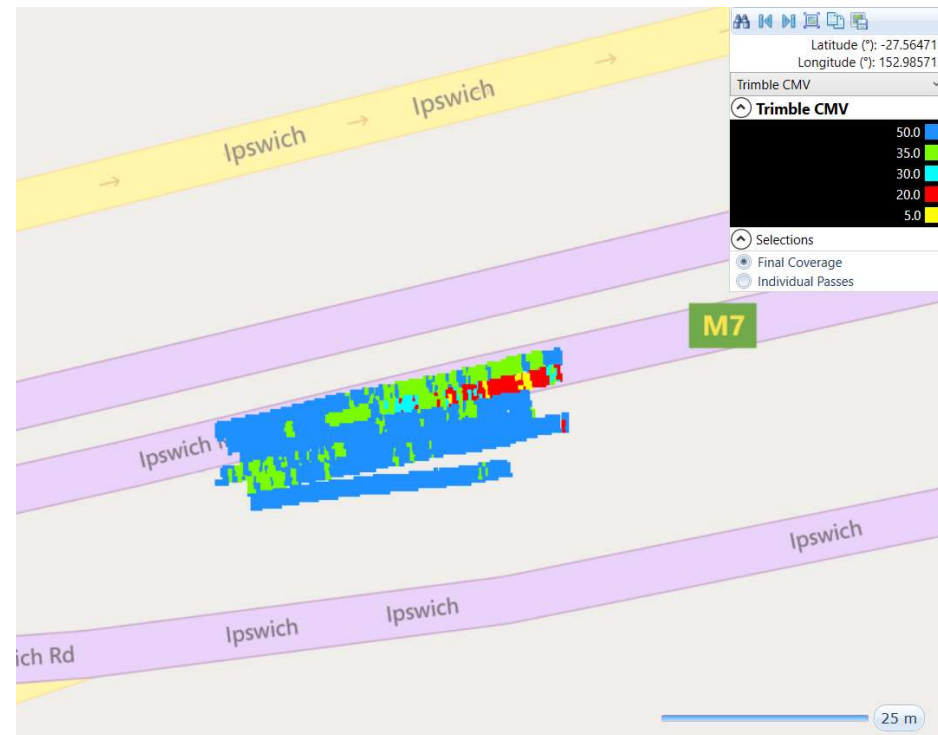


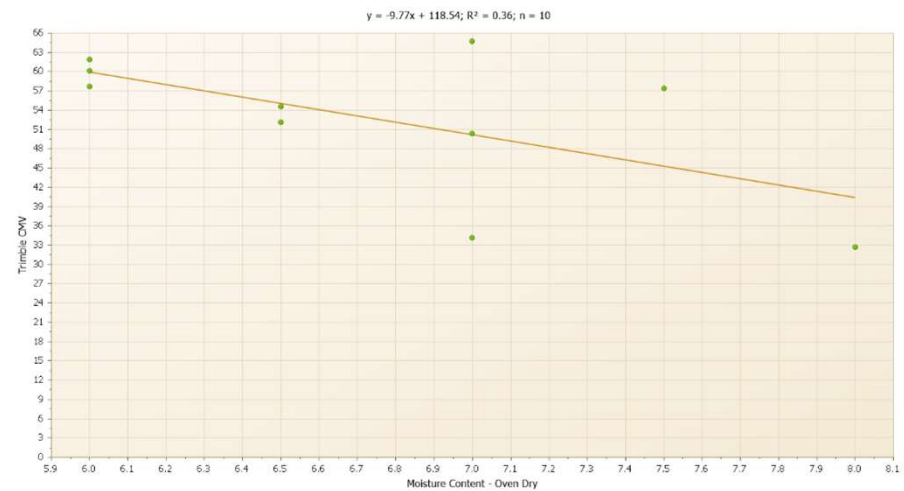
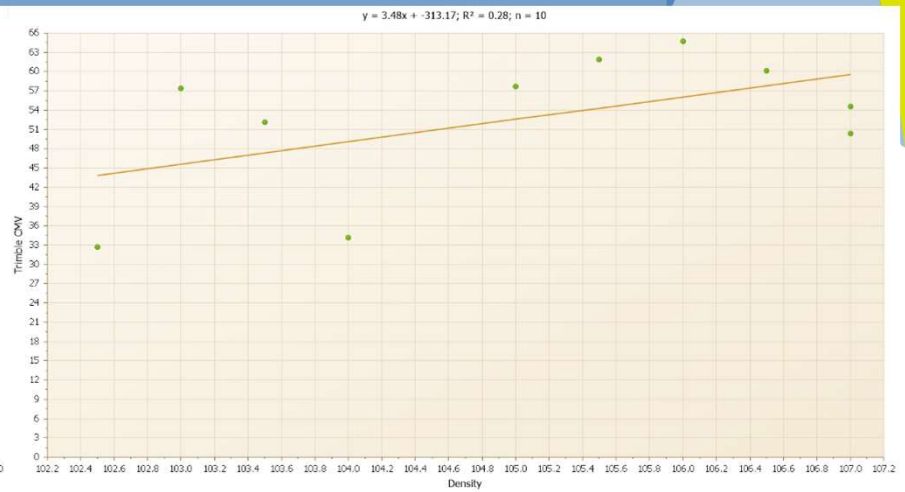


CMV Correlations



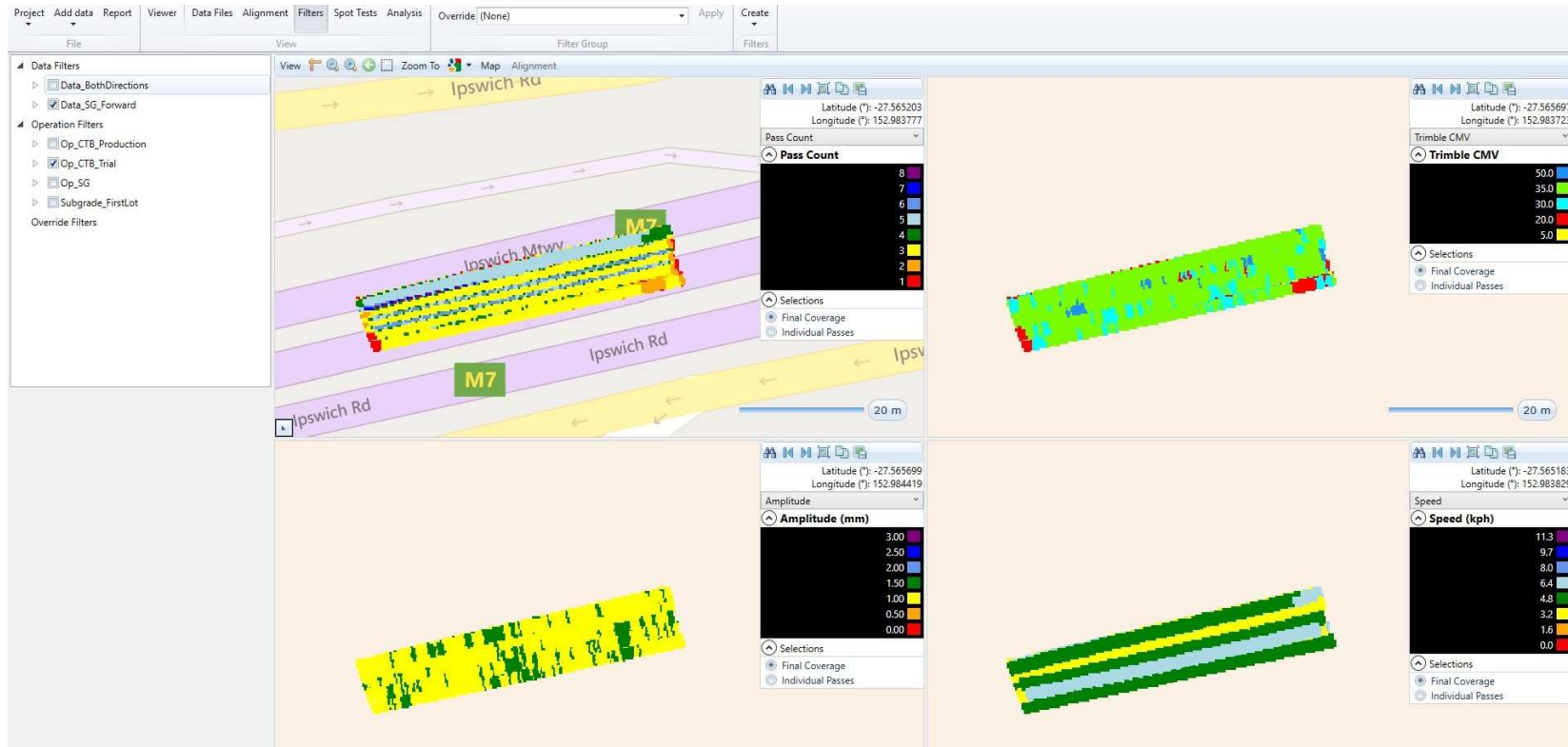
Subgrade



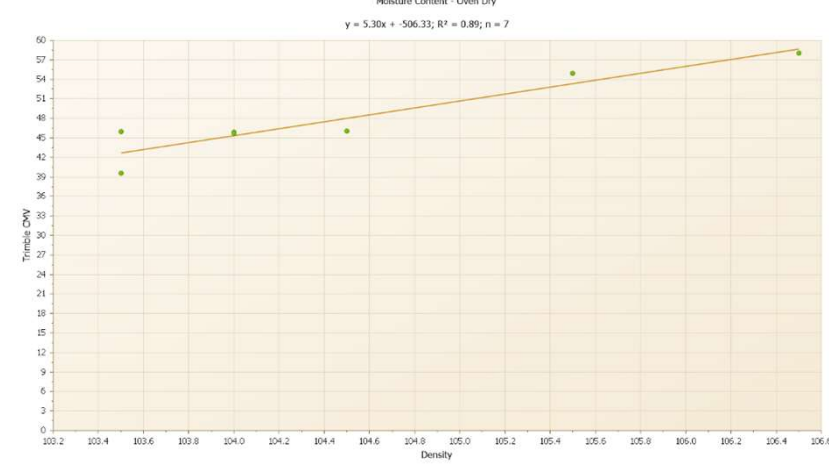
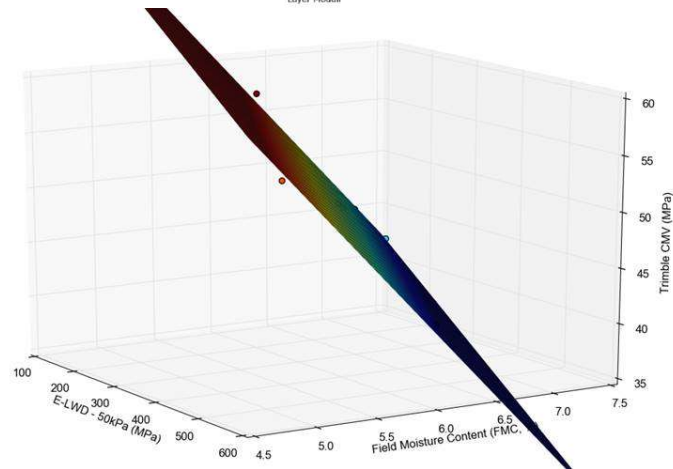
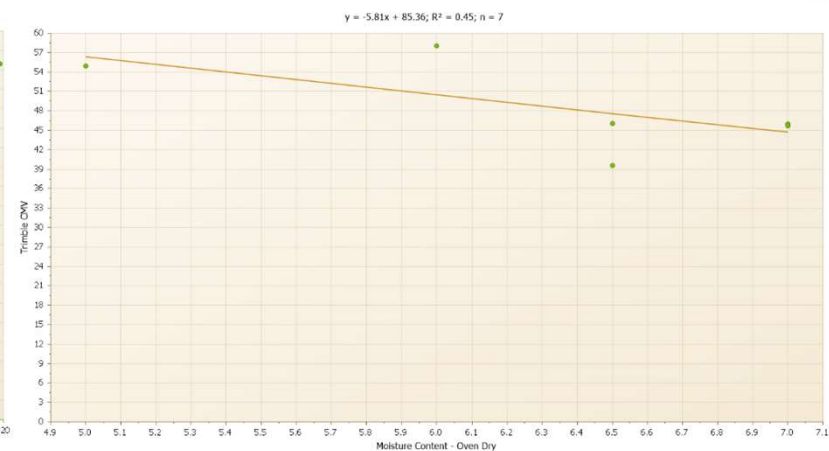
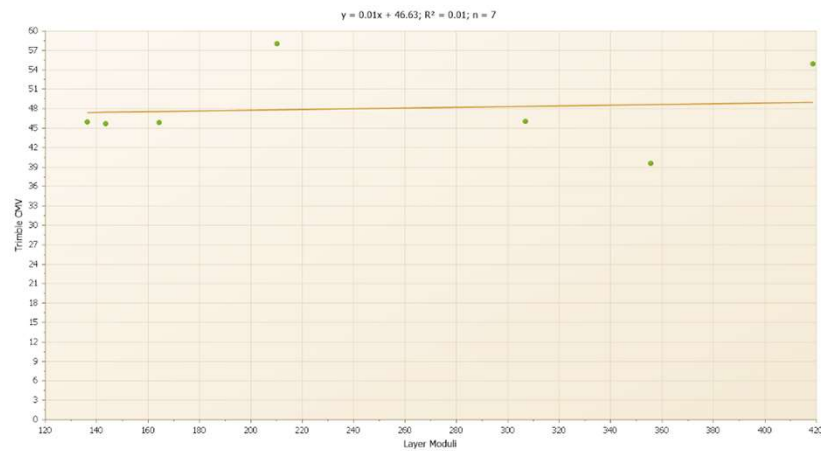


Subgrade Pre-mapping





Subgrade area pre-map using IC roller, before CMB placement in the morning on the next day



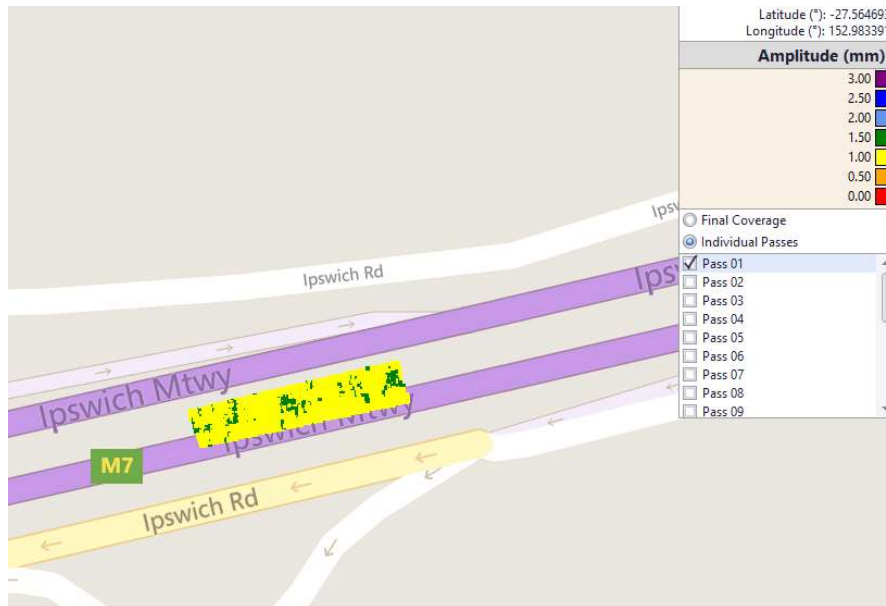
Cement Modified Layer



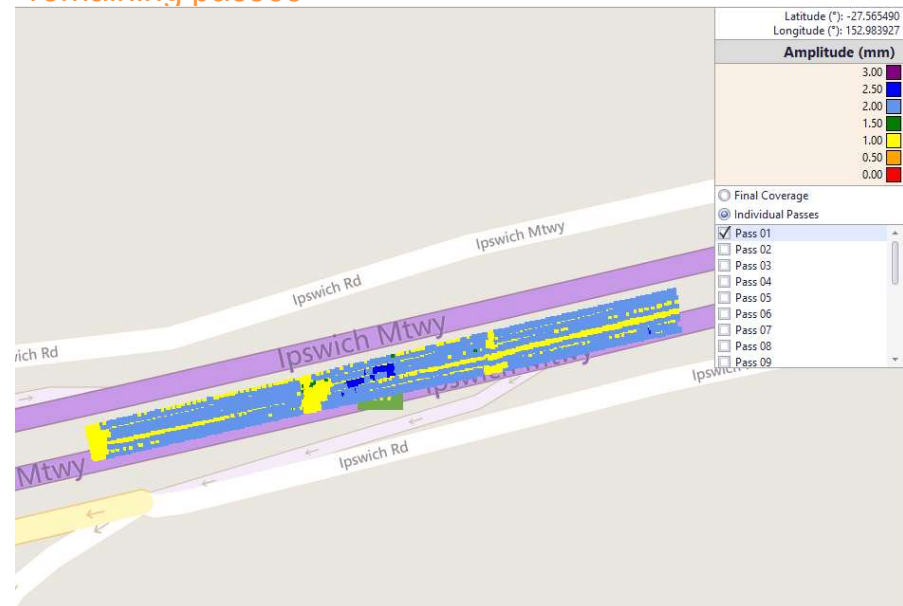


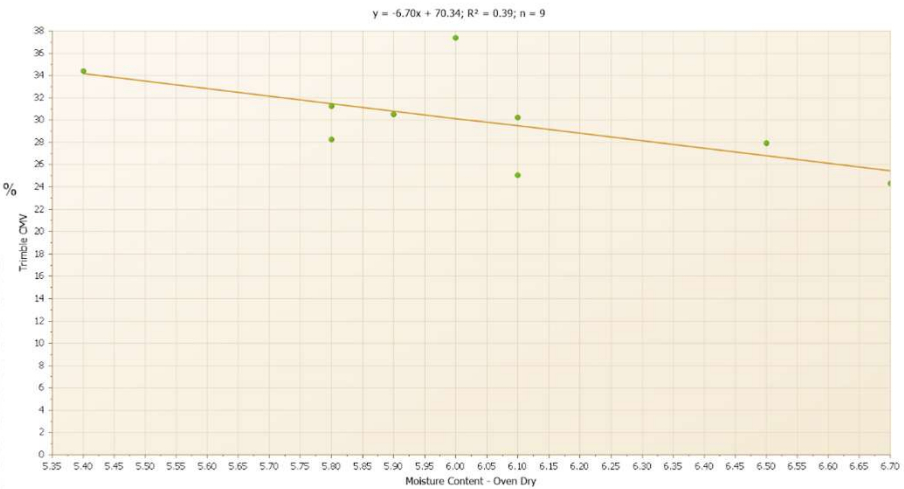
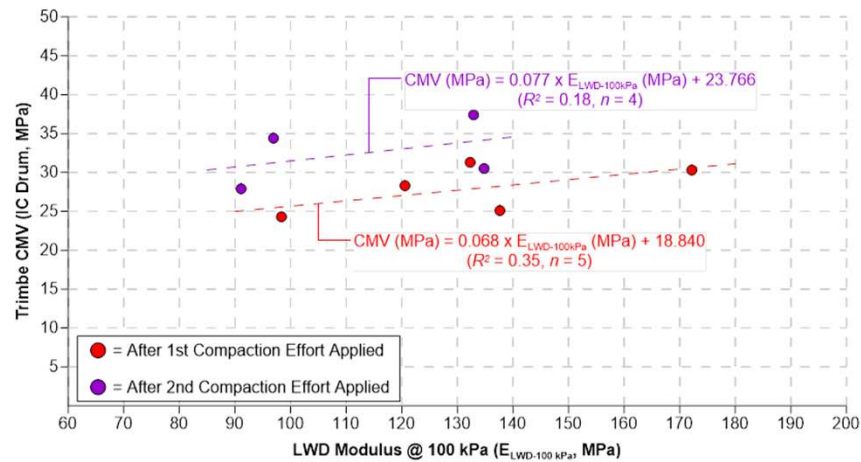
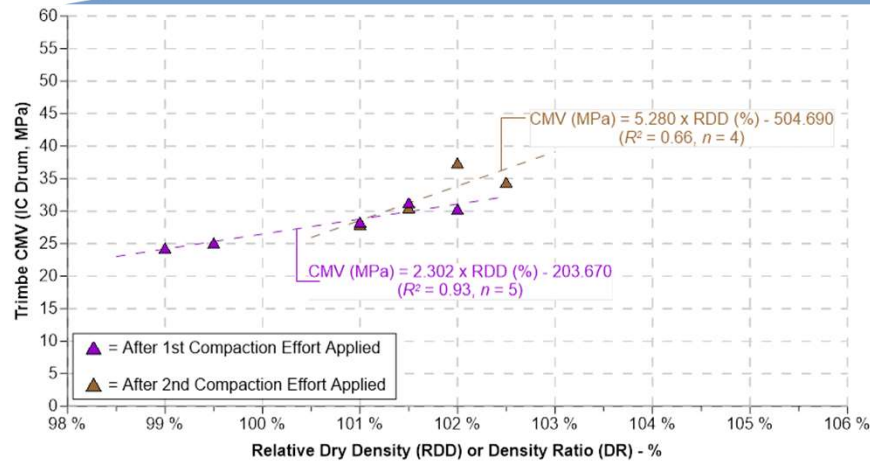
Different vibration sequence (Trial vs Production)

Trial Area – low vibration on all passes



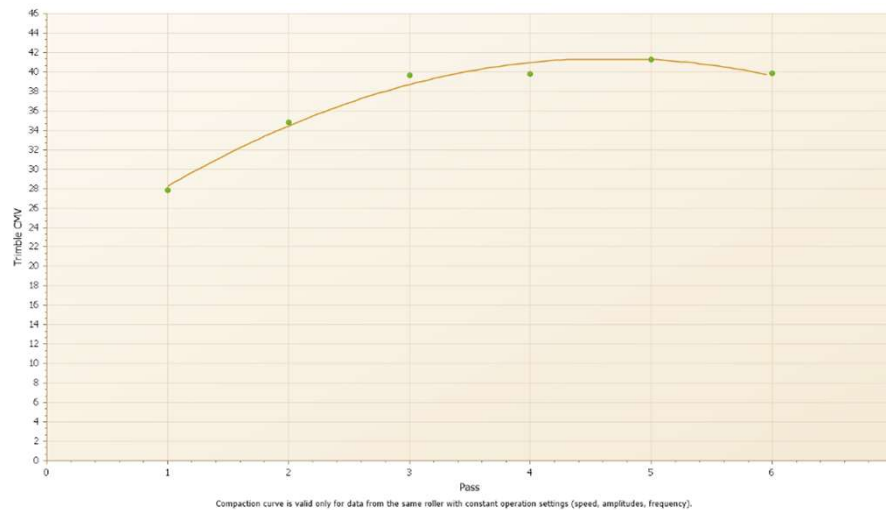
Production – first pass high amplitude, then low on remaining passes





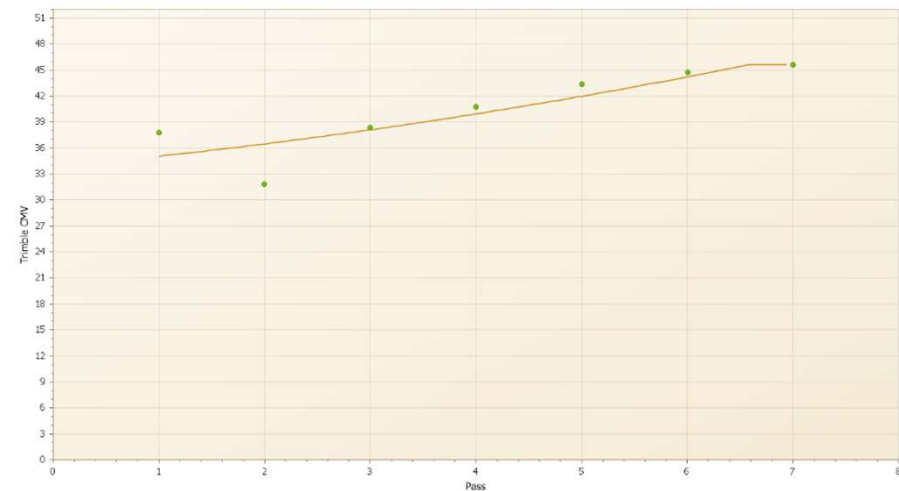
Compaction Curves

Trial Area – low vibration on all passes

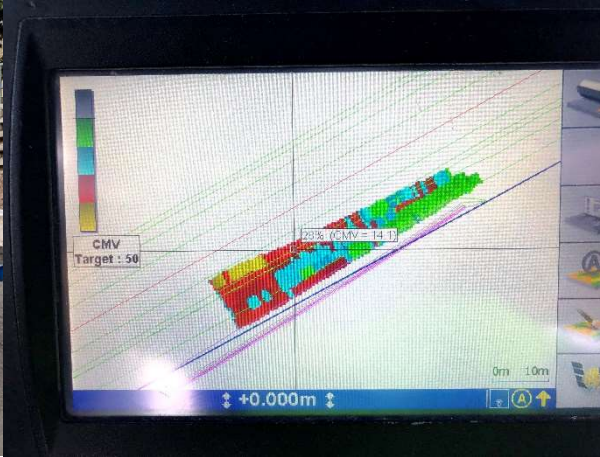


Compaction curve is valid only for data from the same roller with constant operation settings (speed, amplitudes, frequency).

Production – first pass high amplitude, then low on remaining passes



Compaction curve is valid only for data from the same roller with constant operation settings (speed, amplitudes, frequency).



Summary and Lessons Learnt

- Project Specific Technical Specification PSTS116 developed
- Compaction auditing using IC technology at Ipswich Motorway Upgrade Project (March and May 2020), the first major roadwork project.
- Using IC map to identify spot test locations, instead of random spot test locations
- Both density and LWD can be well correlated to CMV, but the exact correlation and strength depends on material type.
- Moisture content consistently has an effect on CMV.
- Important to get a wide range of value for correlation (i.e. weak, medium, strong)
- Interim target CMV identified for cement modified layer (based on plateau testing analysis)



Questions?

Veta 6

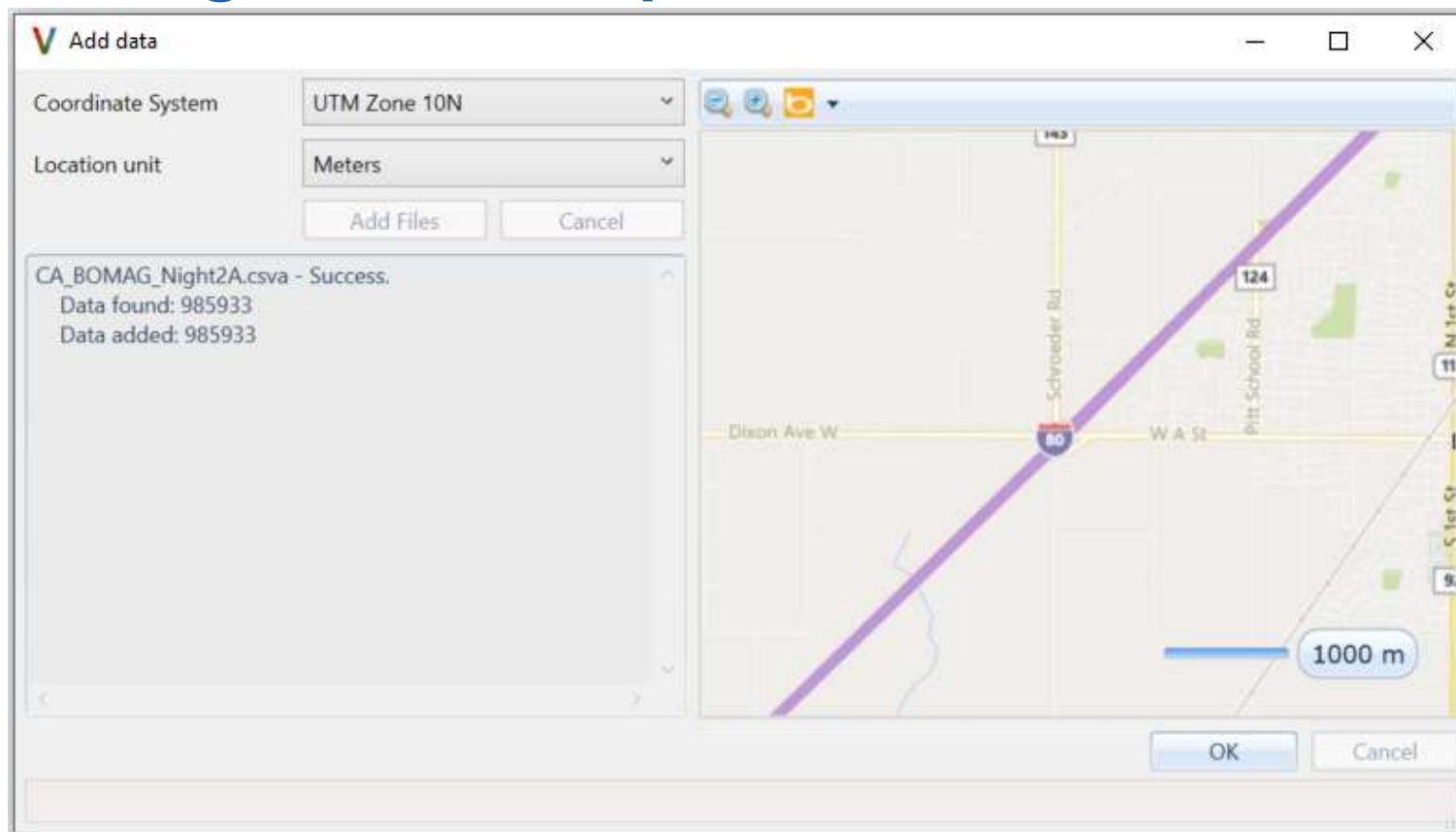
- New Interface and Enhanced Functions
- Support Both GDA94 and GDA2020



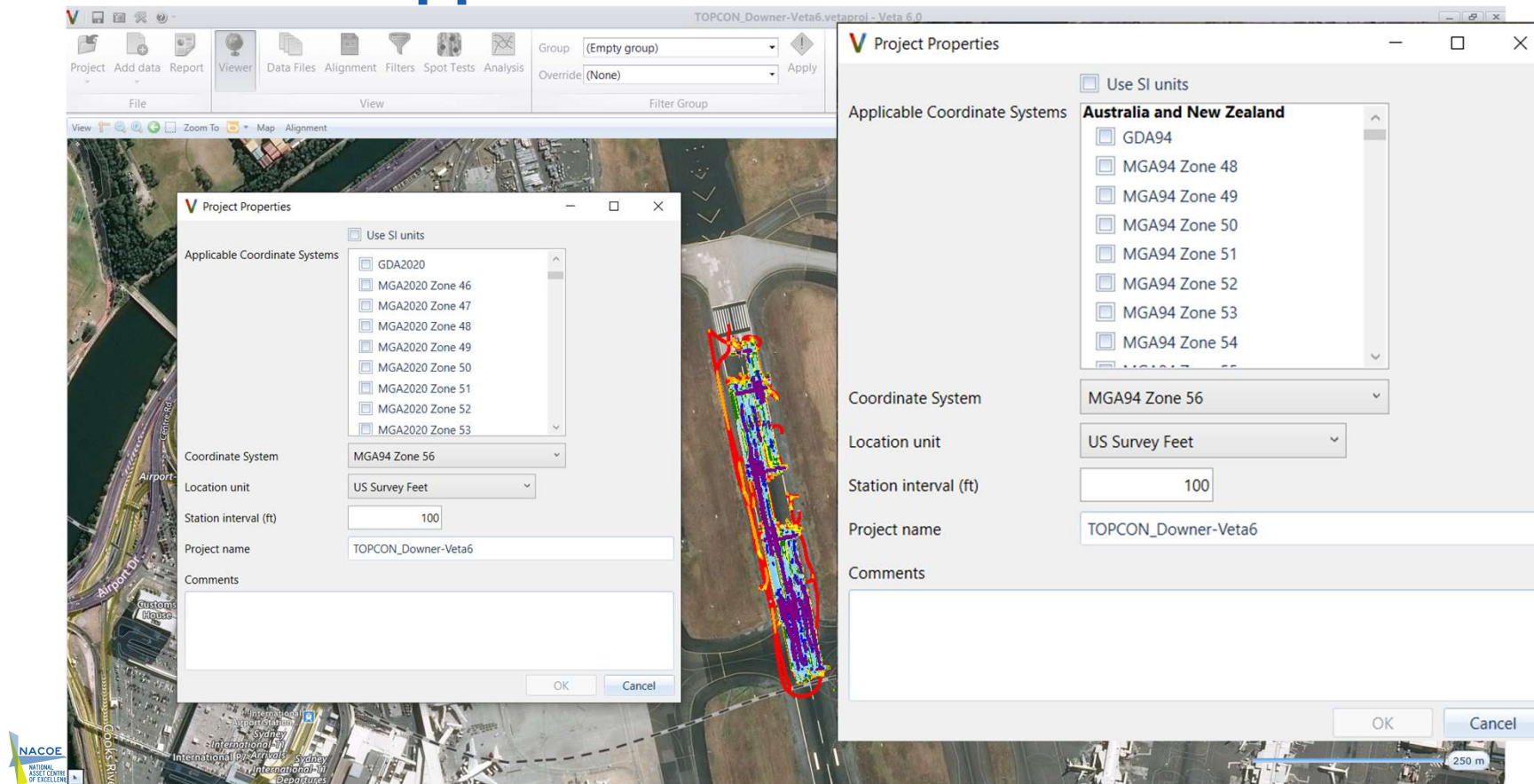
FREE DOWNLOAD

www.IntelligentConstruction.com

Re-Designed Data Import Wizard

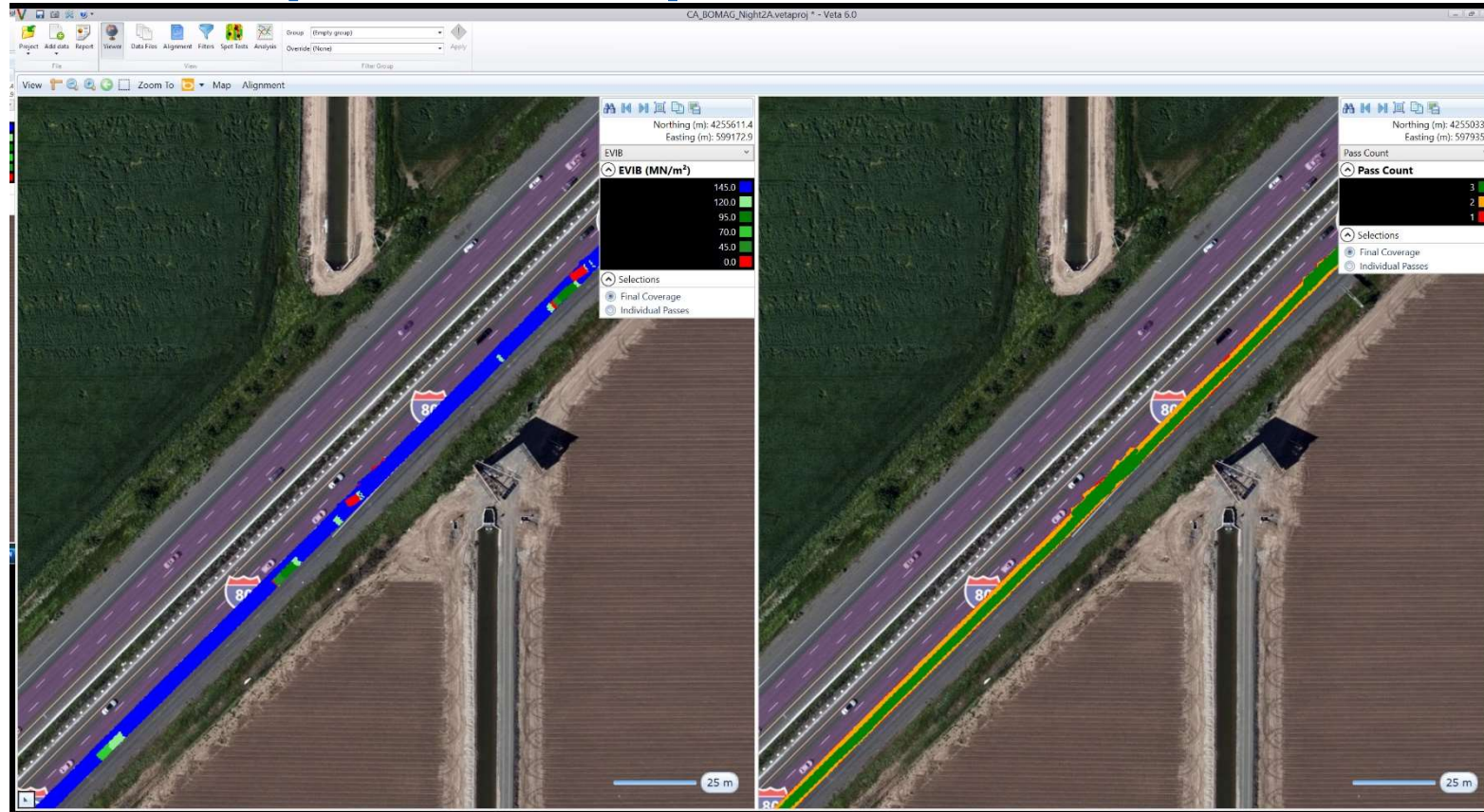


GDA2020 Support

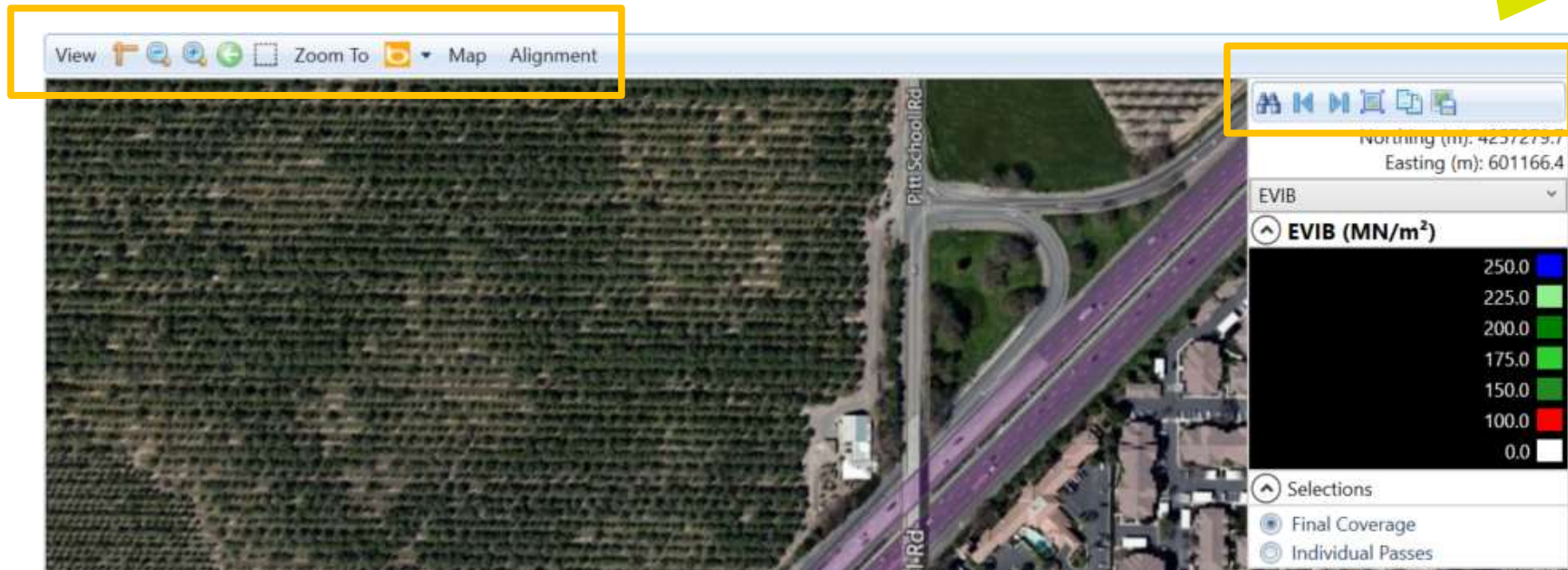


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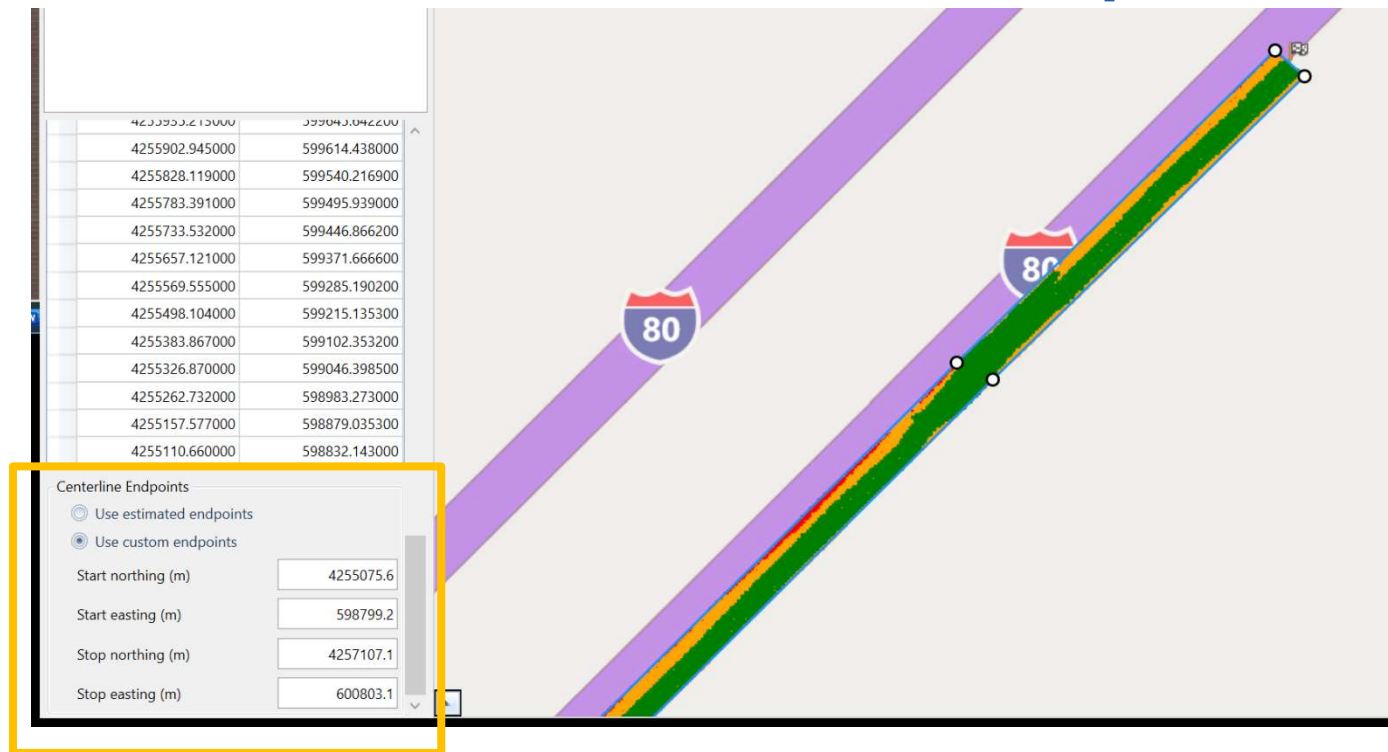
View Multiple Data Maps



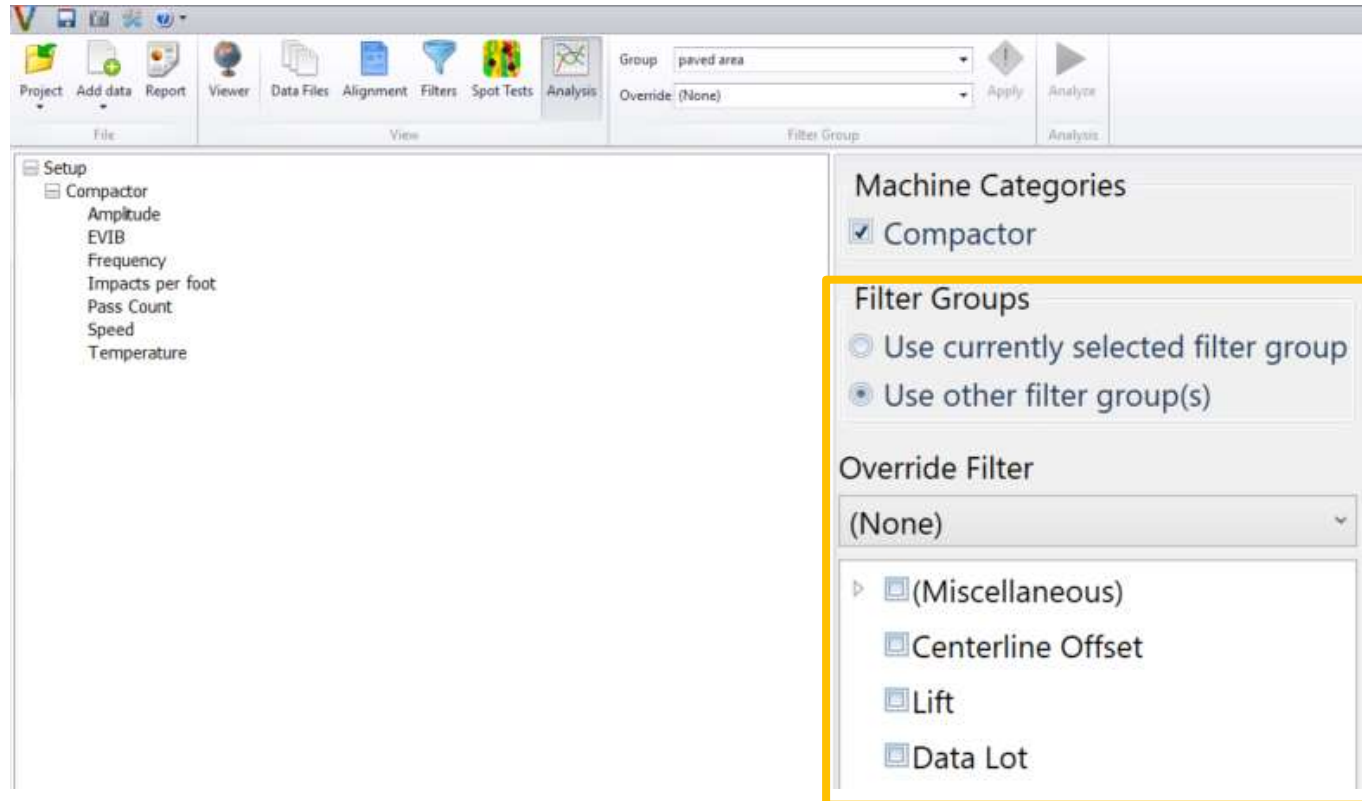
Re-Designed Viewing Controls



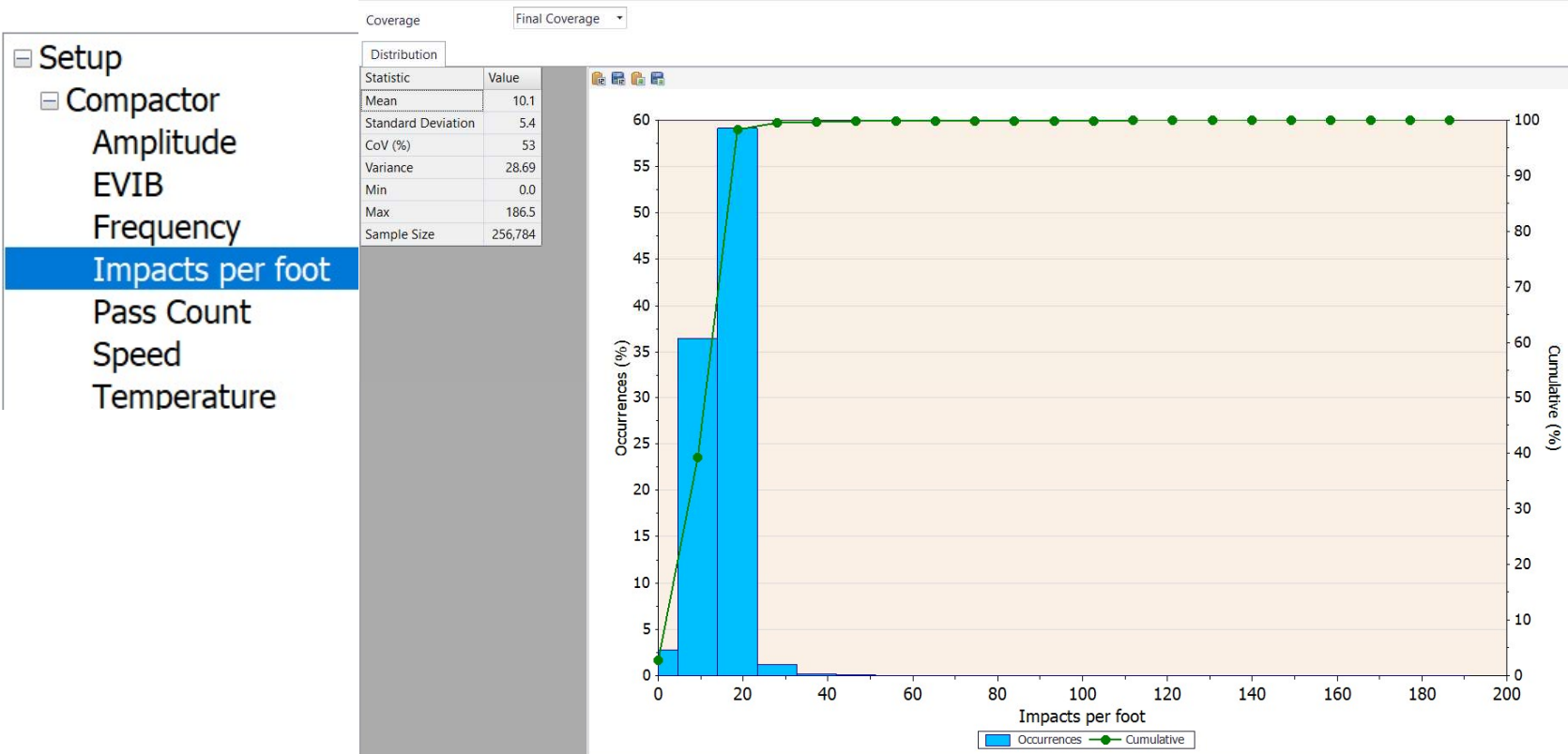
Estimated or Customized Sublot Endpoints



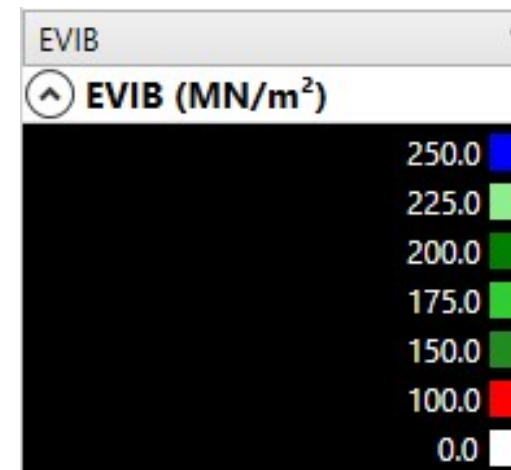
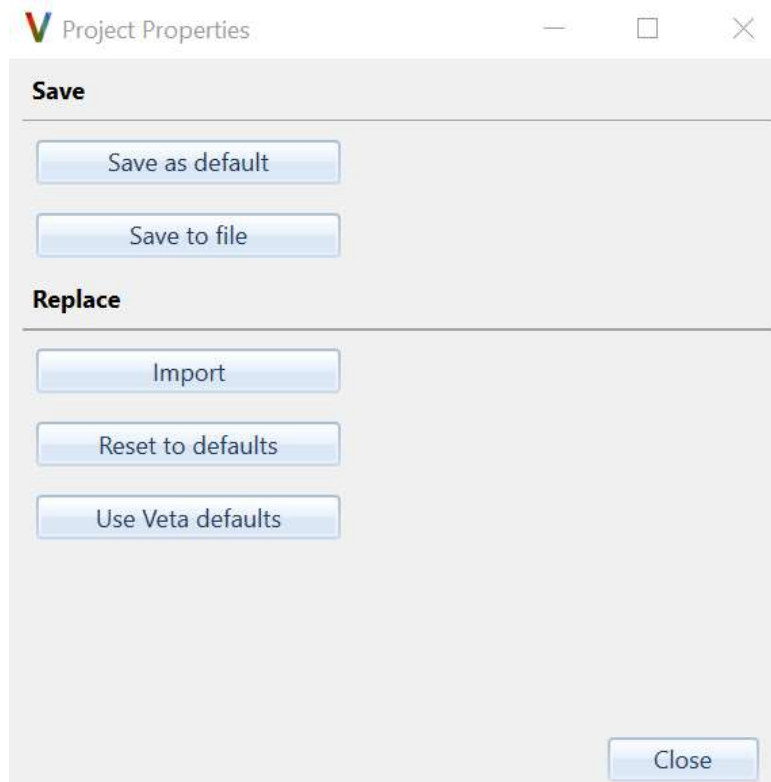
Analysis with Flexible Filter Selection



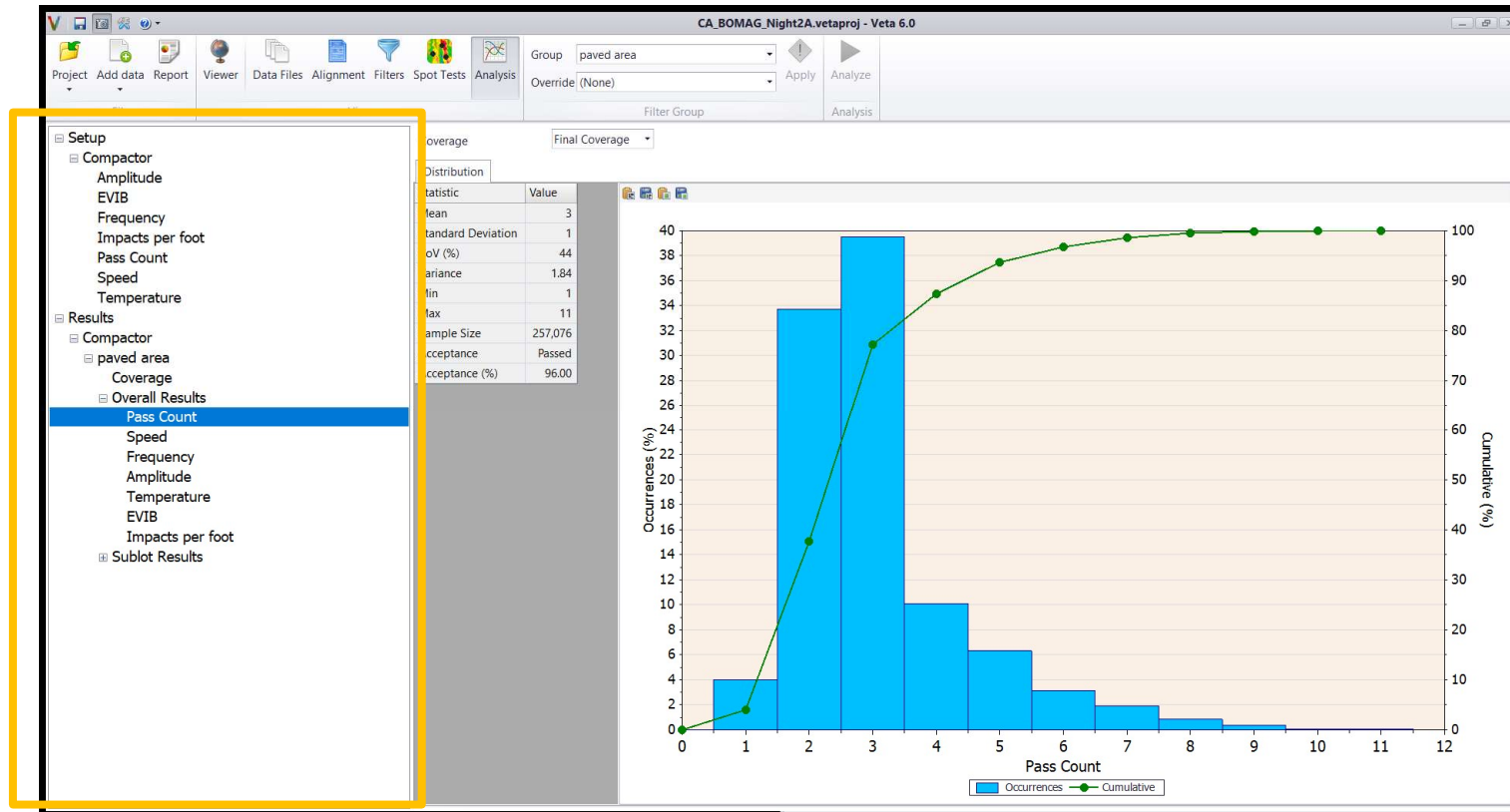
New Impacts per Foot Analysis



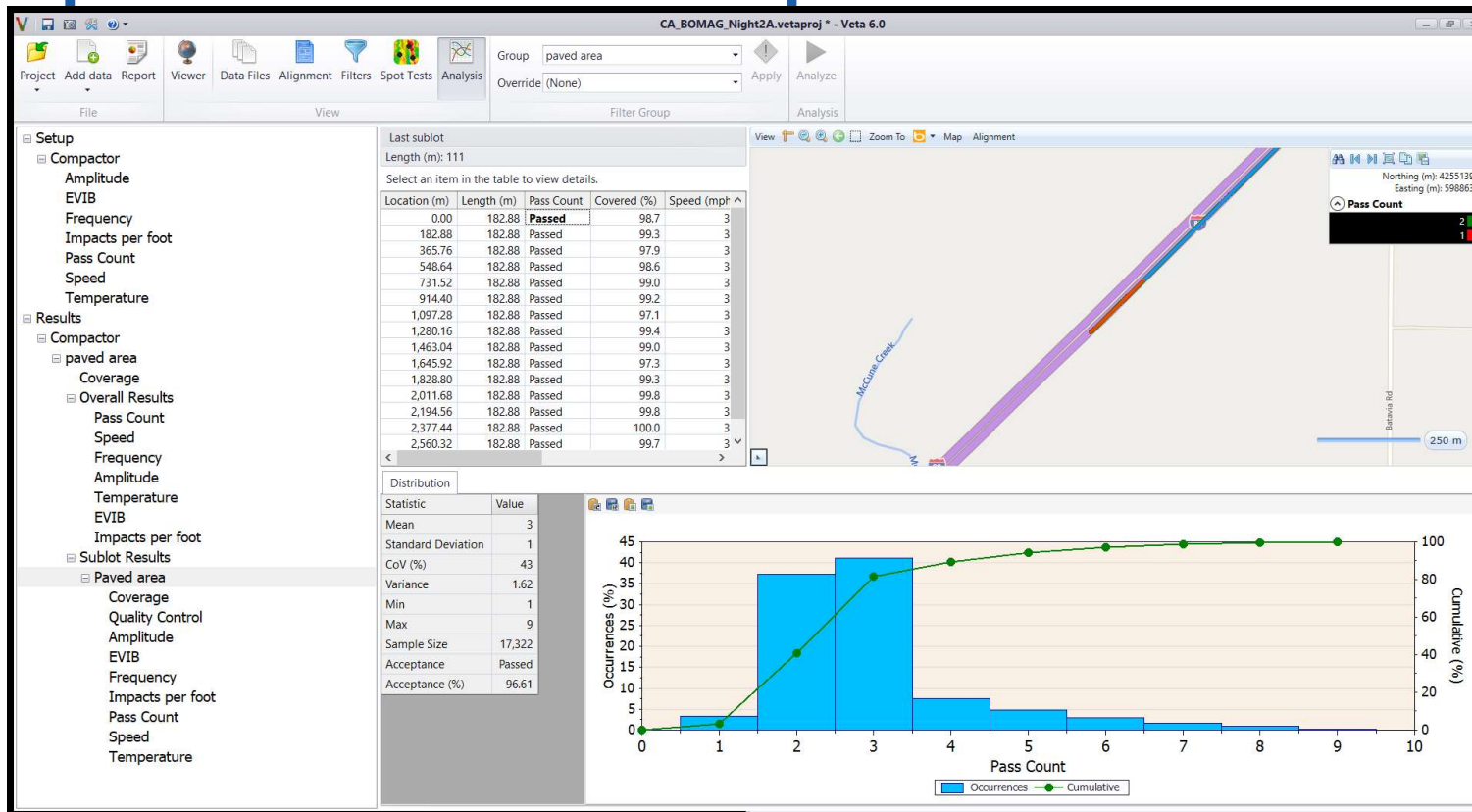
Manage Color Legends



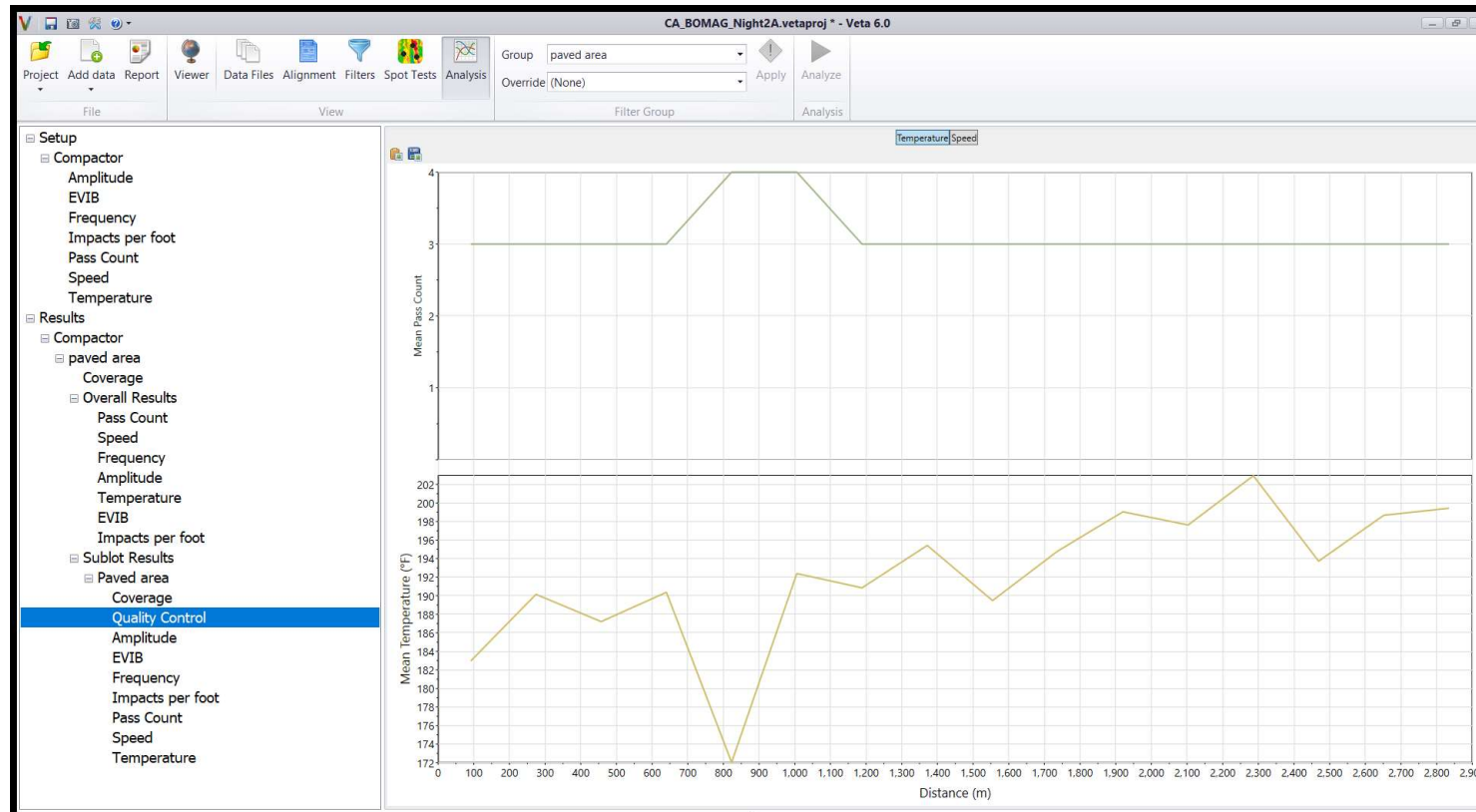
Re-Designed Analysis



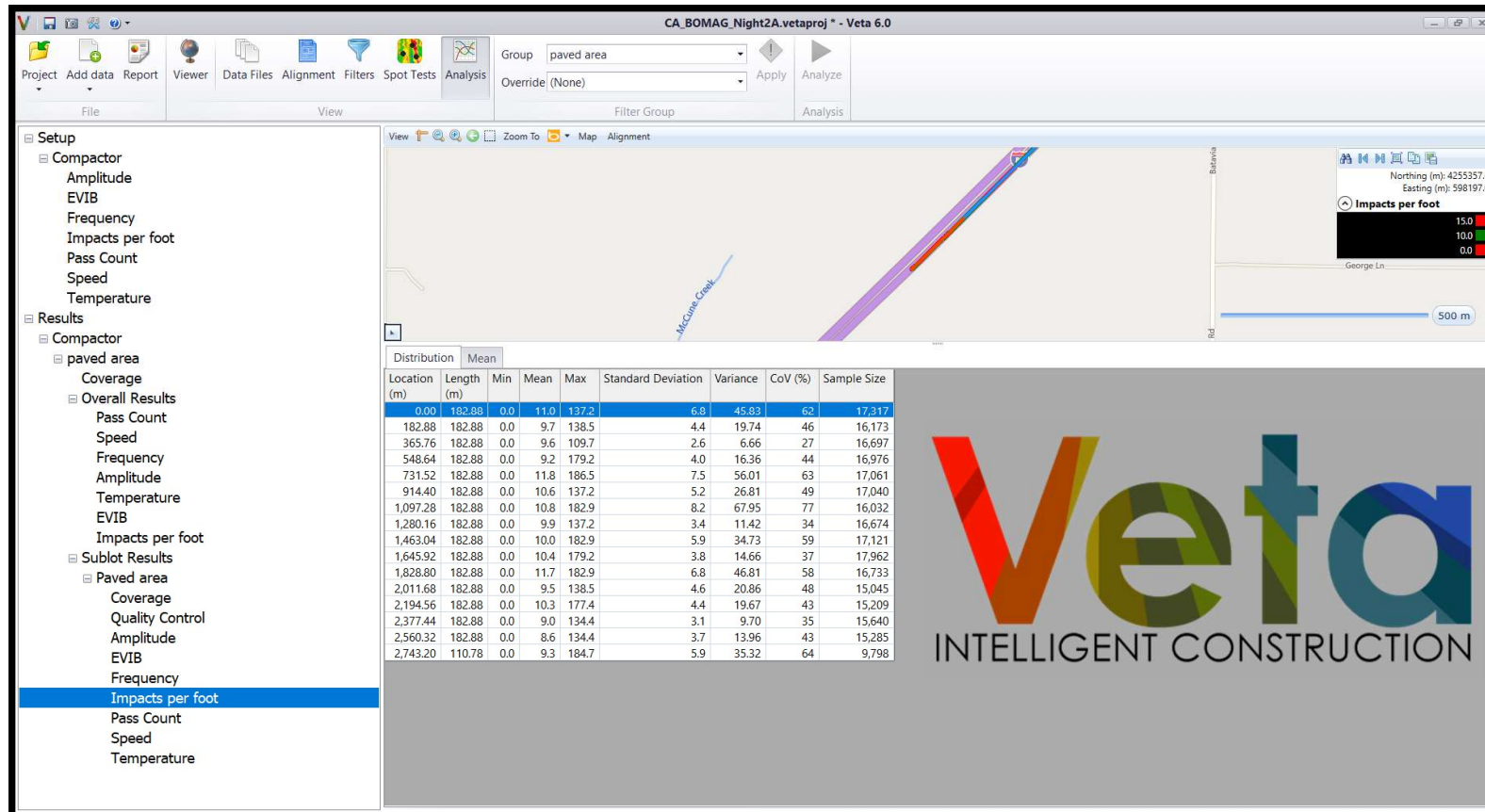
Comprehensive Sublot Report



Sublot QC Charts



Sublots Impacts per Foot Report





ANY
QUESTIONS?



Closing Remarks