

DRAFT

# **Maryland Asphalt IC Demonstration Report**

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## Project Site

MD 170, MD

June 24-26, 2014

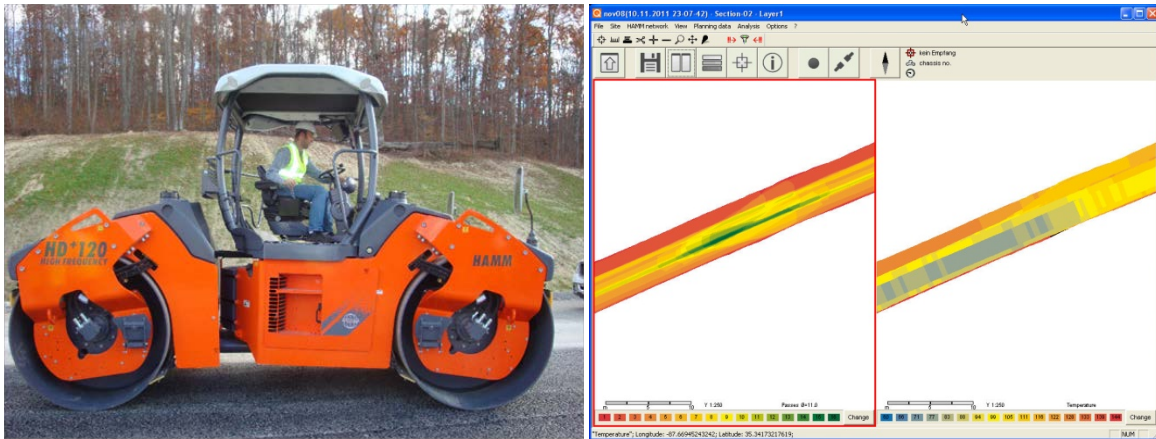
The Maryland site is located at MD 170, next to the BWI airport. The Test Bed 1 location is on the northbound right-turn lane. The Test Bed 2 location is on the southbound travel lane. The Caterpillar IC roller (CB54 XW) was used as the breakdown roller. The Hamm IC roller (HD+ 120) was used as the intermediate roller. After half way of Test Bed 1, the Hamm IC roller was used as the break down roller while the Caterpillar IC roller was switch to the intermediate position. The majority of Test Bed 2 areas were next to trees that block GPS reception.

## Project Test Beds

TB		Description	Date	Machine
✓	1	NB right turn lane	6/24	CAT/Hamm
	2	NB right turn lane	6/24	Hamm/CAT
✓	3	SB slow lane	6/25	CAT/Hamm
	4	SB slow lane	6/25	CAT/Hamm

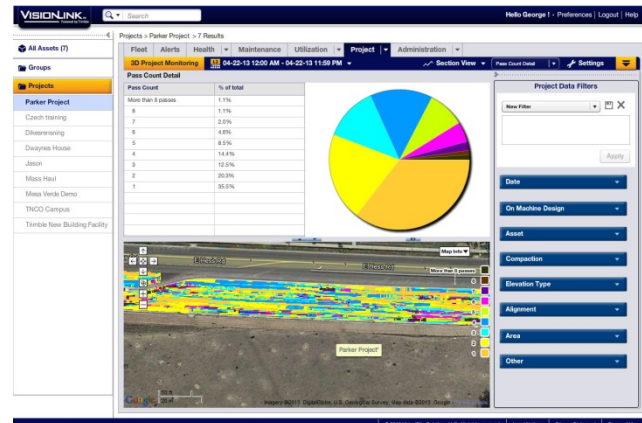
# IC Rollers

## HAMM Double-Drum IC Roller



Manufacturer/ Vendor	HAMM/Wirtgen
Model Name	HCQ (Hamm Compaction Quality)
Model Number	HD+ 90 / HD+ 110, HD+ 120 / HD+ 140
Drum Width	78" w/offset to 84.7"
Machine Weight	Operating wt. 27,569 lbs. w/max of 32,187 lbs.
Amplitude Settings	High/Low - .028/.011 in. (0.71/0.27 mm)
Frequency Settings	Variable from 2700 - 4020 vpm
Auto-Feedback	NA
Measurement System	HAMM Compaction Quality (HCQ)
Measurement Value	HMV, density estimator, temperature, passes
Measurement Unit	[unitless, % compaction, °C, color coded]
Documentation System	HCQ with ability to export to Veda
Contact	Tim Kowalski (615) 594-4604 tkowalski@Wirtgenamerica.com

## Caterpillar Double Drum IC rollers

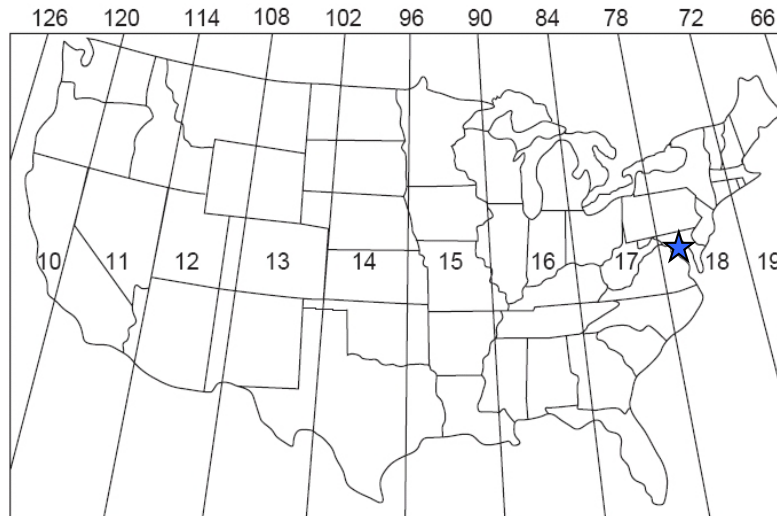


Manufacturer	Caterpillar
Model Name	Tandem vibratory roller
Model Number	CB54 XW
Drum Width	79"
Machine Weight	Operating wt. 26,300 lbs. Static linear load 165 lb/in.
Amplitude Settings	TBA"
Frequency Settings	TBA vpm
Auto-Feedback	NA
Measurement System	Compaction Meter Value (CMV)
Measurement Value	CMV
Measurement Unit	[unitless]
Documentation System	VisionLink
Contact	Bryan Downing, 763-493-7533 Downing_Bryan_J@cat.com

## Global Positioning System (GPS)

### Grid Reference

UTM-18N is the preferred coordinate reference for all devices.



### Trimble GPS

- A Trimble GPS receiver and a radio will be mounted on the Caterpillar IC roller.
- The Trimble Internet Base Station Services (IBSS) will be used to provide RTK correction signals.
- A hand-held Trimble GPS rover will be used for in-situ point measurements.

### OmniStar GPS

- A GPS receiver with OmniStar subscription will be mounted on the HAMM IC machine.
- A hand-held OmniStar GPS rover may be used for in-situ point measurements.

# Test Plan

## On-site Activities

Schedule	Activities
Day 0 Monday (June 23)	<ul style="list-style-type: none"> <li>Conduct IC rollers/GPS setup and trial runs (equipment vendors and FHWA IC team only) at the staging area. (2PM-5PM)</li> </ul>
Day 1 Tuesday (June 24)	<ul style="list-style-type: none"> <li>Conduct project briefing at the staging area and IC training for roller operators (7AM-8AM).</li> <li>Start paving with one IC roller at breakdown and another IC roller at intermediate position.</li> <li>Select a 500-ft section as a test strip to establish the rolling pattern. Conduct NG/GPS/LWD-a testing immediately behind the paver and at selected locations after each breakdown and intermediate roller pass within the test strip.</li> <li>Perform production compaction using the rolling pattern.</li> <li>Conduct NG/GPS/LWD-a at selected locations after the finishing rolling</li> </ul>
Day 2 Wednesday Night (June 25)	<ul style="list-style-type: none"> <li>Set up the GPS base station and IC roller/GPS system (by 7AM).</li> <li>Start paving with one IC roller at breakdown and another IC roller at intermediate position.</li> <li>Conduct NG/GPS/LWD-a testing immediately behind the paver and at selected locations after each breakdown roller pass within the 1500-ft section.</li> <li>Conduct NG/GPS/LWD-a testing at selected locations after each intermediate roller pass within the 1500-ft section.</li> <li>After the finishing rolling, mark 60 locations within the 1500-ft paved section. Conduct NG/GPS tests at marked locations. Conduct LWD-a tests at designated locations. Conduct coring at the marked locations.</li> </ul>
Days 3 Thursday (June 26)	<ul style="list-style-type: none"> <li>Conduct the Open House event including presentation and equipment demonstration from 8AM to noon</li> </ul>

- GPS: A base station and a rover will be provided by Sitech West.
- NG: Nuclear density gauge.
- LWD-a: Lightweight deflectometer for asphalt tests.
- Coring: 60 X 4" cores will be taken.
- Core tests: Bulk density testing of cores will be performed within 30 days after the demo.



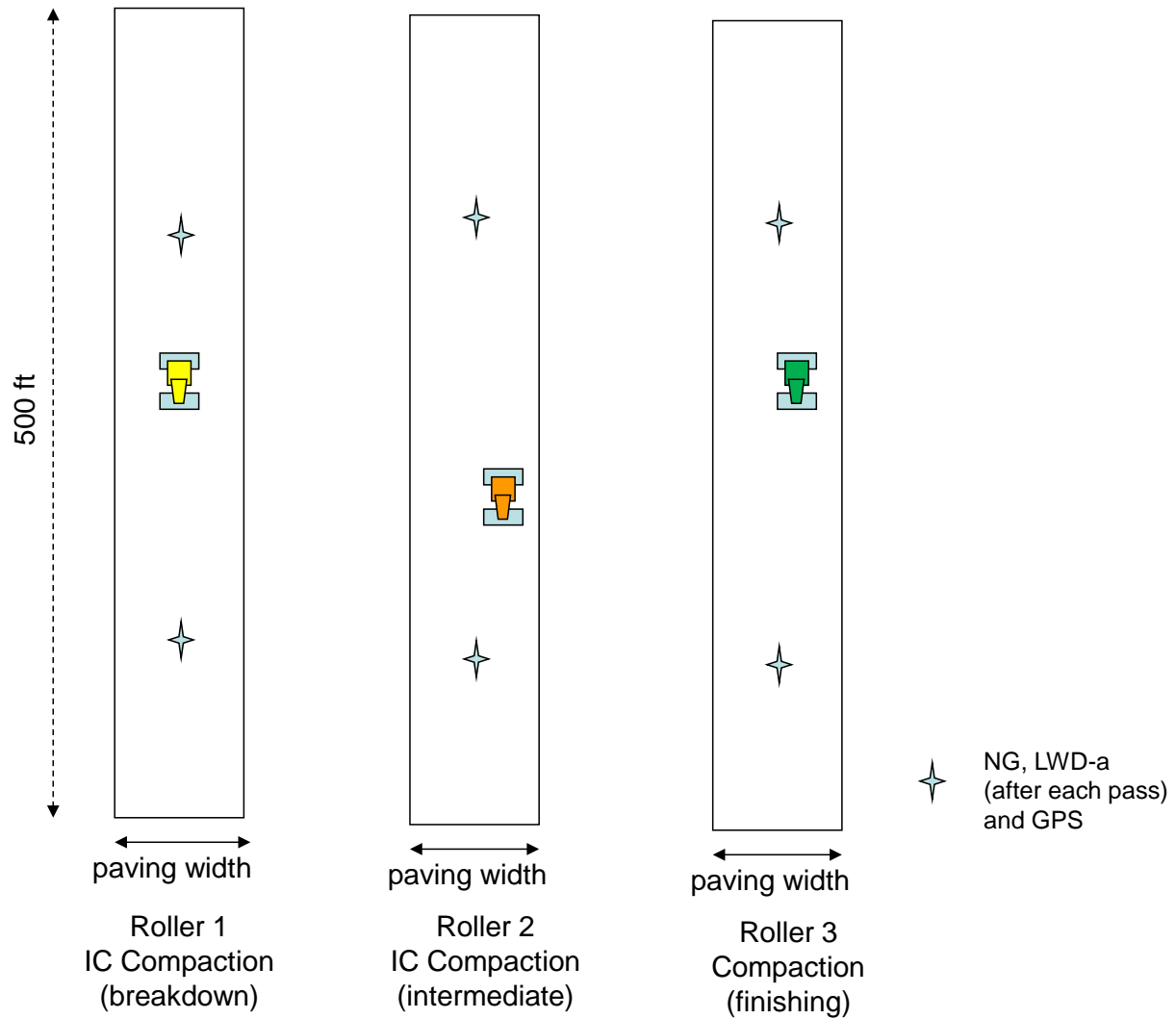
## Machine Settings

Date	TB	Machine	Setting	Spot Tests	Notes/Comments
Day 1	1A	IC 1	0.3mm at 4000 vpm	NG, GPS, LWD-a	Breakdown compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS/LWD-a tests after each roller pass at selected locations within the test section.
	1B	IC 2	Low amp at 4000 vpm	NG, GPS, LWD-a	Intermediate compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS/LWD-a tests after each roller pass at selected locations within the test section.
	1C	Roller3	Static	NA	Finishing rolling 1. Compact with normal roller passes.
Day 2	2A	IC 2	Low amp at 4000 vpm	NG, GPS, LWD-a	Breakdown compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	2B	IC 1	0.3mm at 4000 vpm	NG, GPS, LWD-a	Intermediate compaction for asphalt base course. 1. Compact with normal roller passes. 2. NG/GPS LWD-a tests after each roller pass at selected locations within the test section.
	2C	Roller3	Static	NG, GPS, LWD-a, Coring	Finishing rolling 1. Compact with normal roller passes. 2. NG/GPS/LWD-a/Coring tests after the finishing rolling at marked locations within the test section.

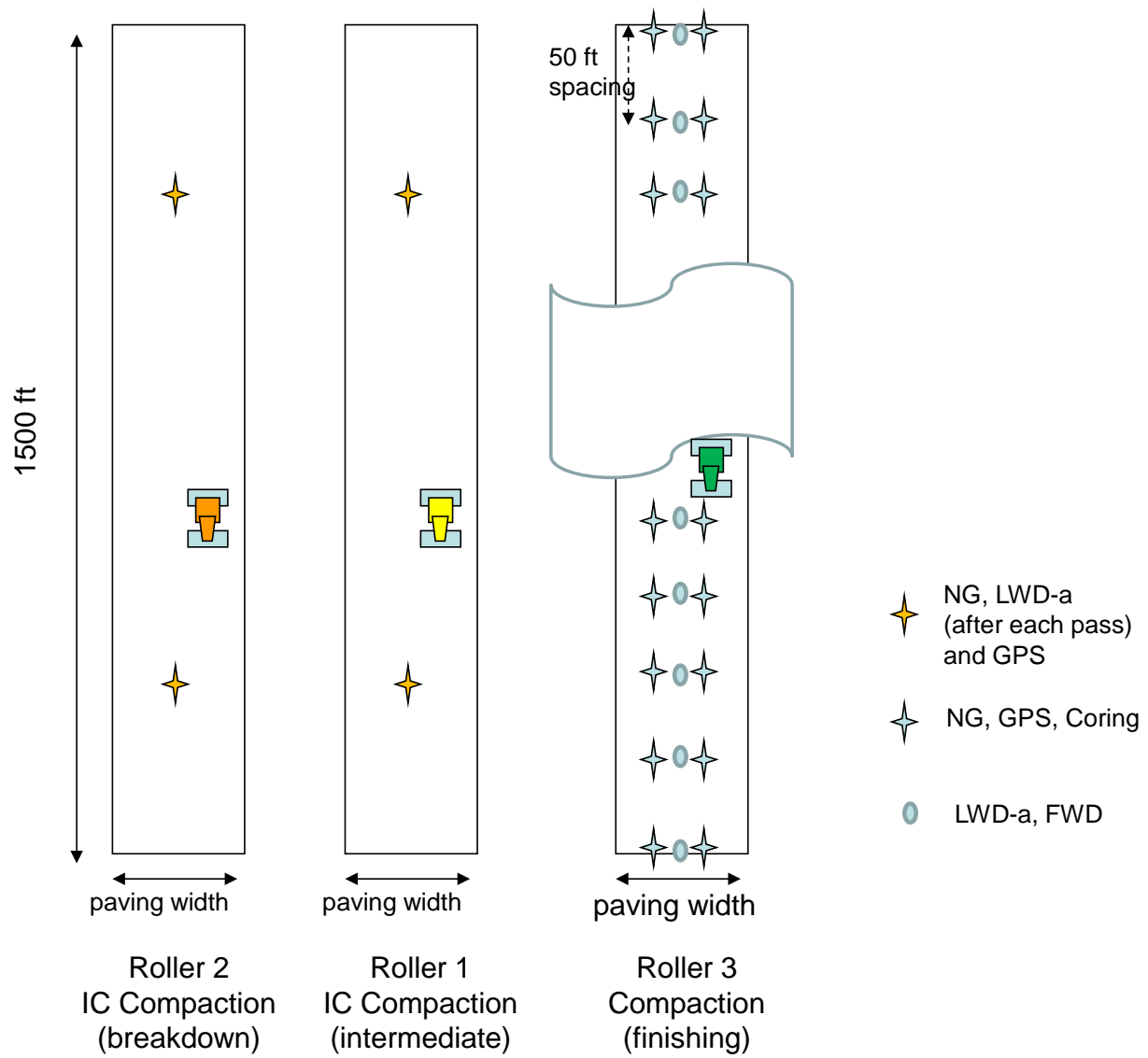
\*. The rolling pattern will be designated by the contractor.

\*. Roller3: conventional finishing roller (if applicable)

## Day 1 – Test Plan



## Day 2 – Test Plan



\*FWD test is eliminated.

# Analysis Results

The IC maps and statistics for the Caterpillar IC data (breakdown position) are presented in Figure 1 and Figure 2.

## Comments on Caterpillar Data:

- ICMV: The mean CMV value is 67.6 with standard deviation of 23.5.
- Temperature: The mean surface temperature is 152°F with standard deviation of 40°F. The temperature records appeared to be lower than manual measurements with infra guns.
- Pass Counts: The recorded mean roller passes is 2 but with 60% at pass number one. The records were not consistent with onsite manual counts up to 7 passes.
- Frequency: The mean frequency is 3,880 vpm.
- Compaction curve: The curve grows monotonically without an apparent optimal value.
- The GPS reception was poor at this test bed due to tree coverage and the use of VRS. Based on the above observation, the Caterpillar data appeared to be questionable. Further investigation of the VisionLink export is warranted.

The IC maps and statistics for the Hamm IC data (intermediate position) are presented in Figure 3 and Figure 4.

## Comments on Hamm Data:

- ICMV: The mean HVM value is 42 with standard deviation of 15.8.
- Temperature: The mean surface temperature is 202°F with standard deviation of 31°F.
- Pass Counts: The recorded mean roller passes is 4.
- Frequency: The mean frequency is 2,678 vpm.
- Compaction curve: The ICMV curve stays flat without a significant optimum.
- The GPS reception was poor at this test bed due to tree coverage. However, the OmniSTAR appeared to be less affected than VRS.

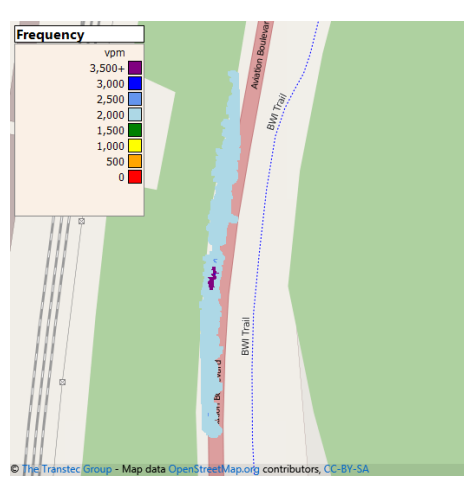
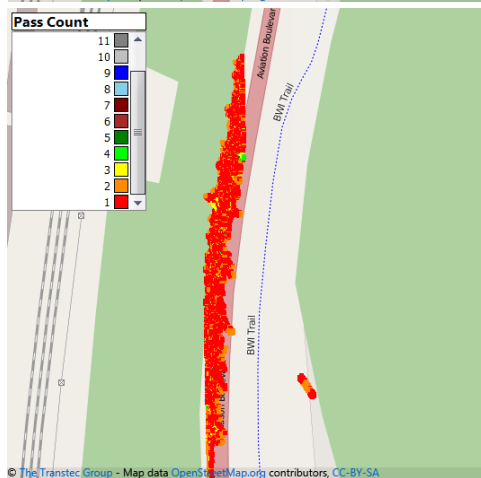
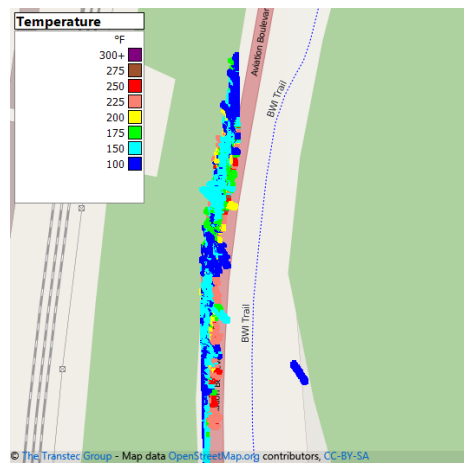
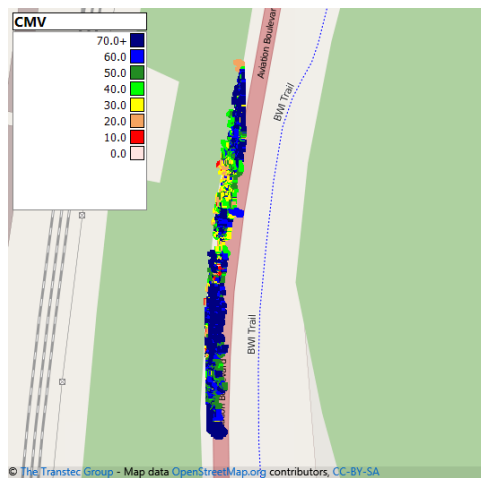
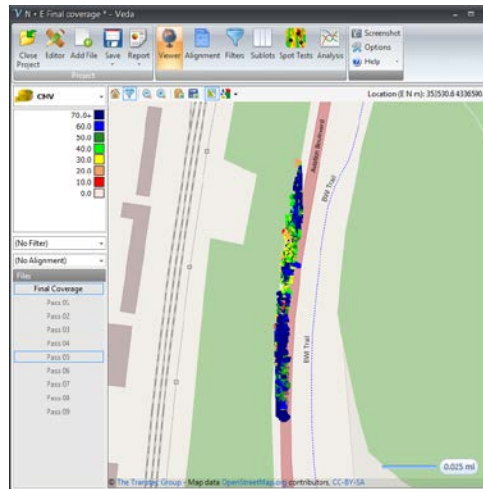
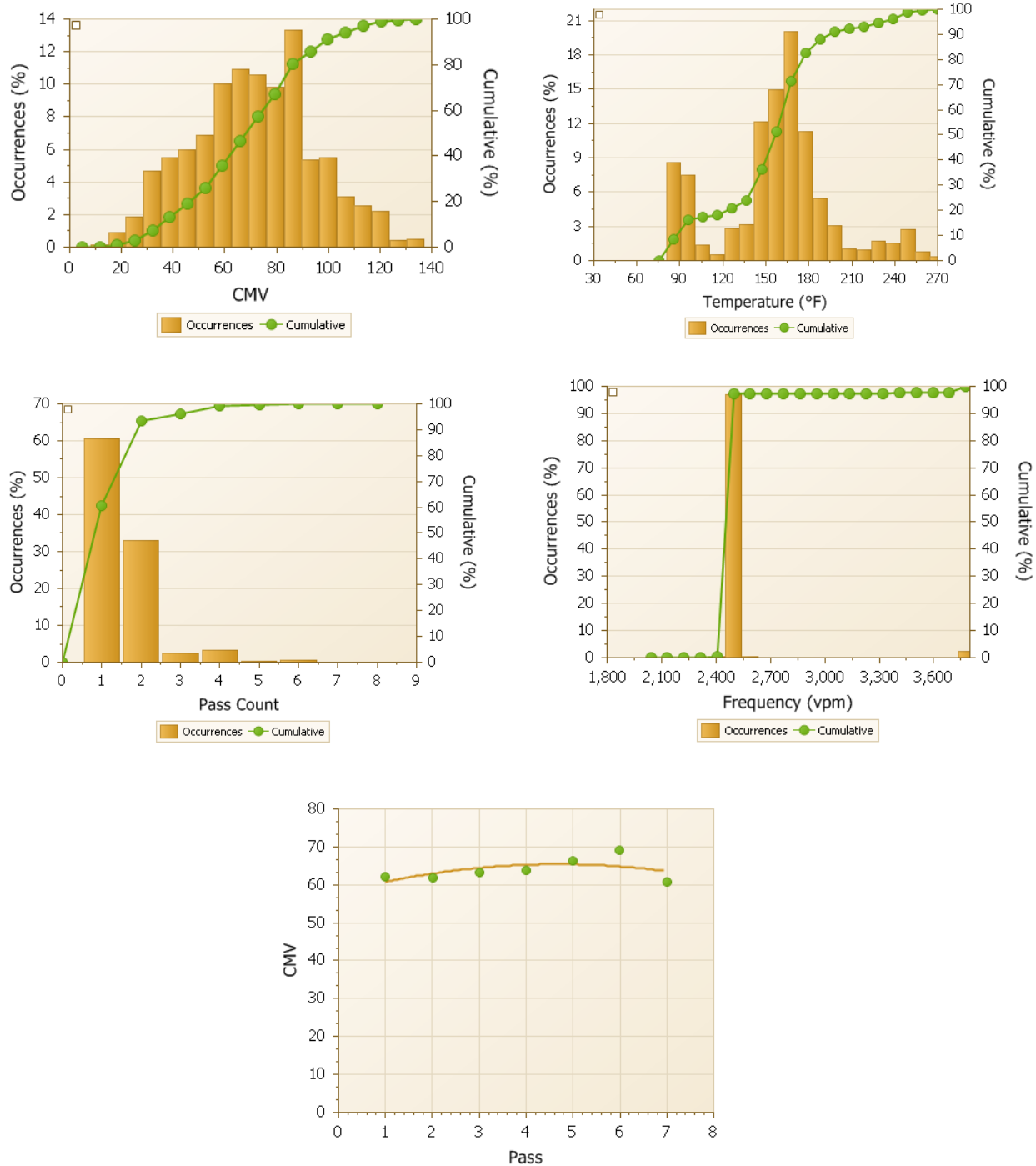


Figure 1. Caterpillar IC maps (breakdown), TB03, MD site.



**Figure 2. Caterpillar IC statistics(breakdown), TB03, MD site.**

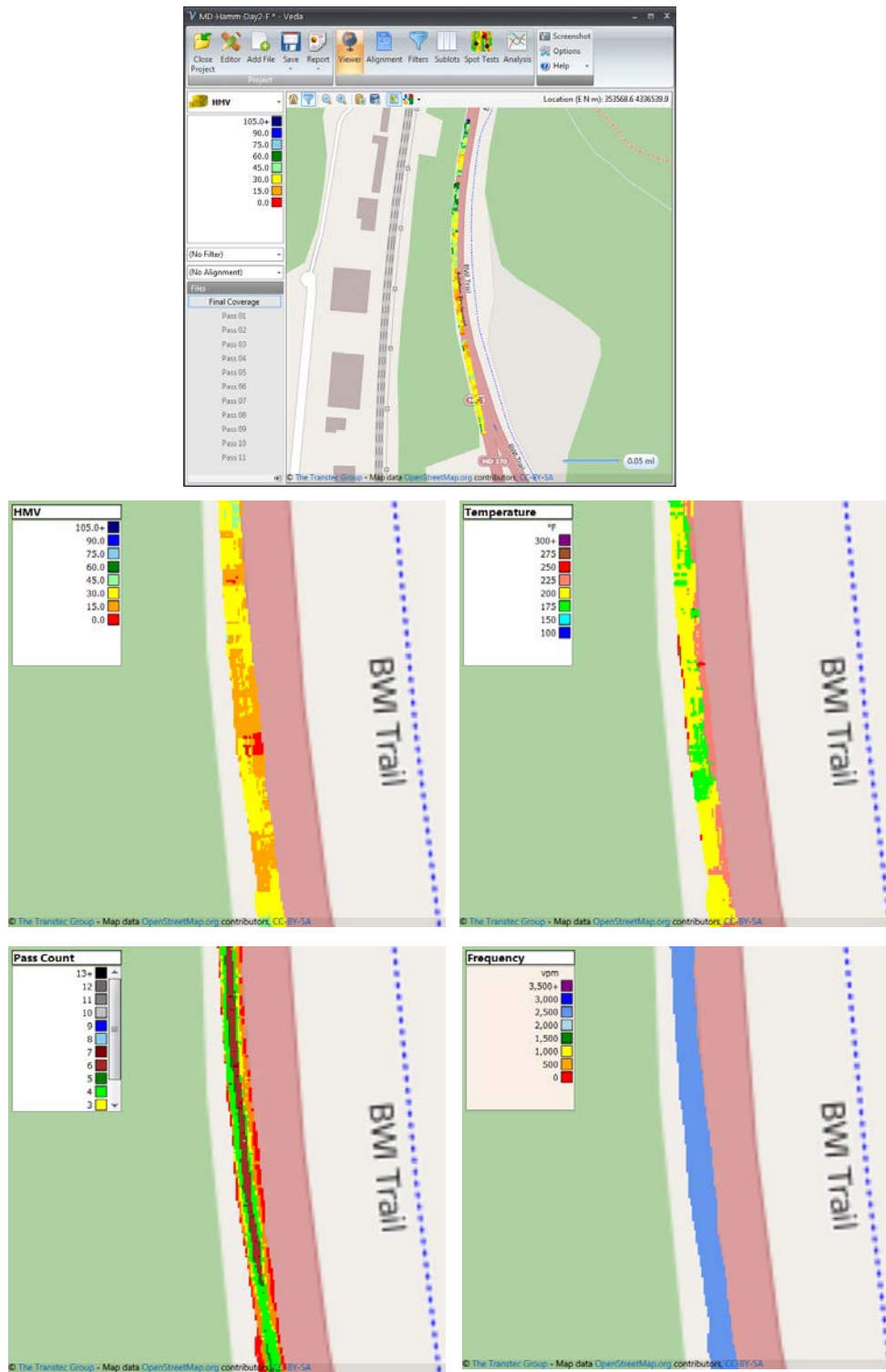
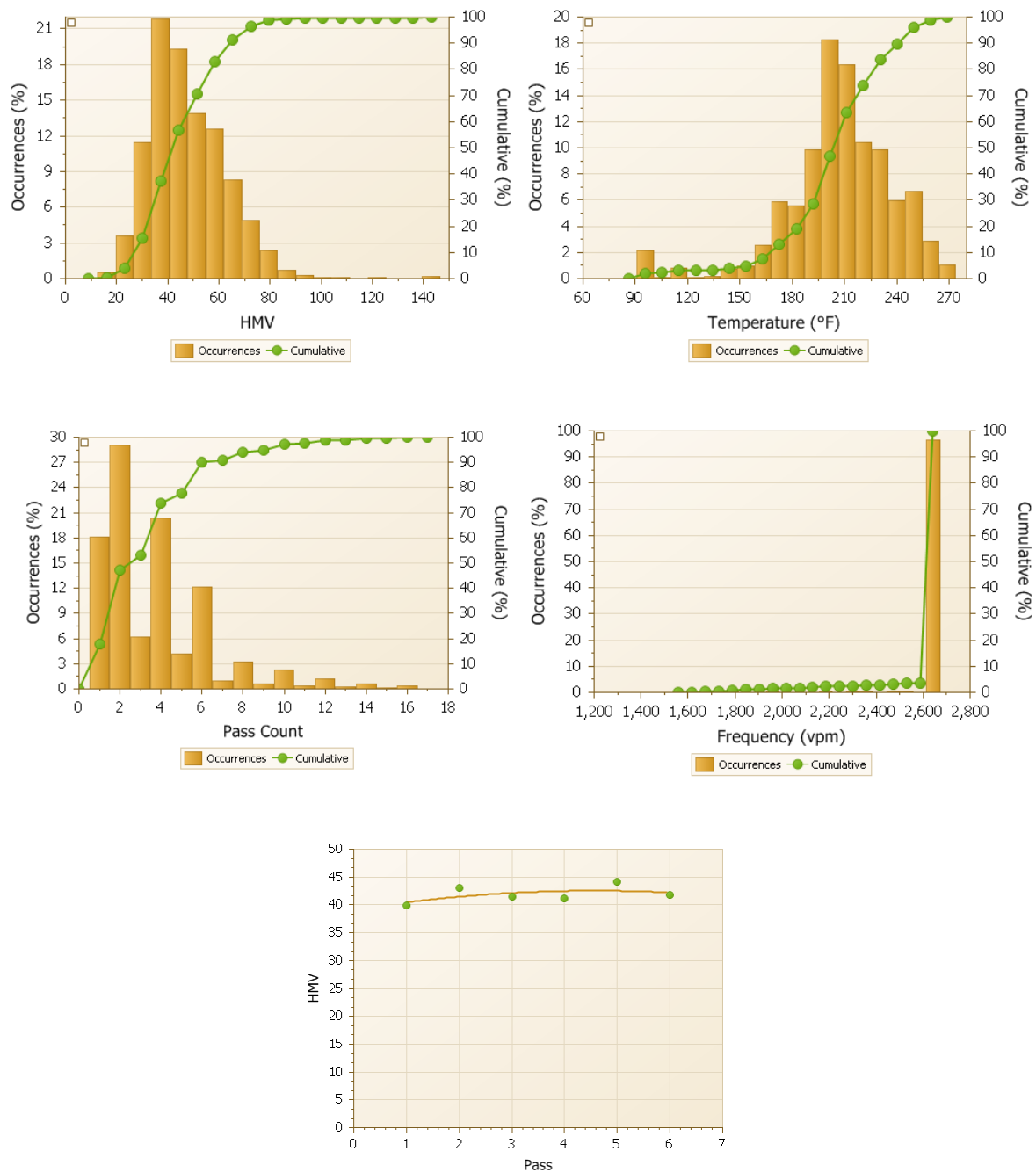


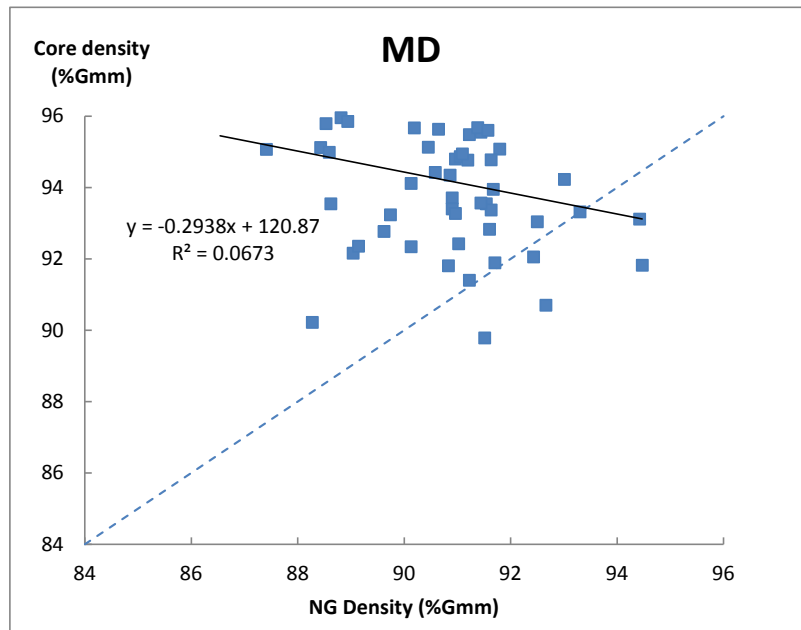
Figure 3. Hamm IC maps (intermediate), TB03, MD site.



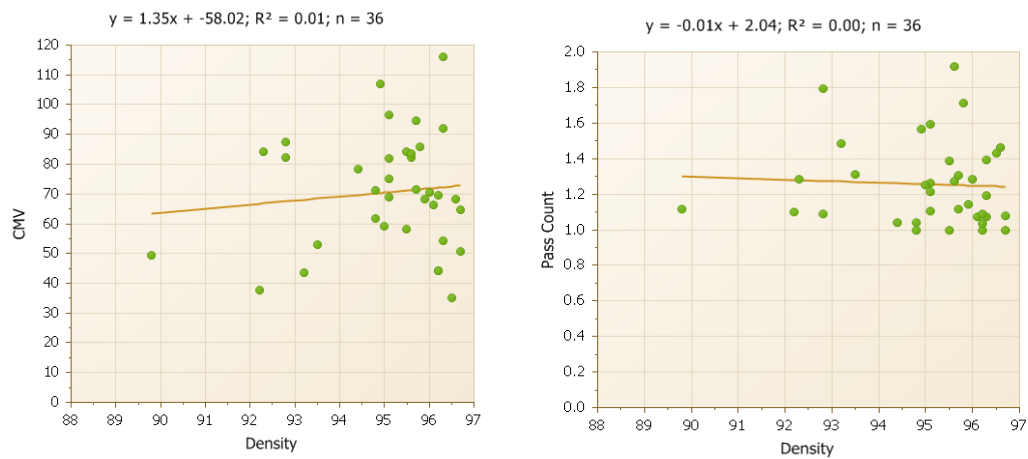
**Figure 4. Hamm IC statistics (intermediate), TB03, MD site.**



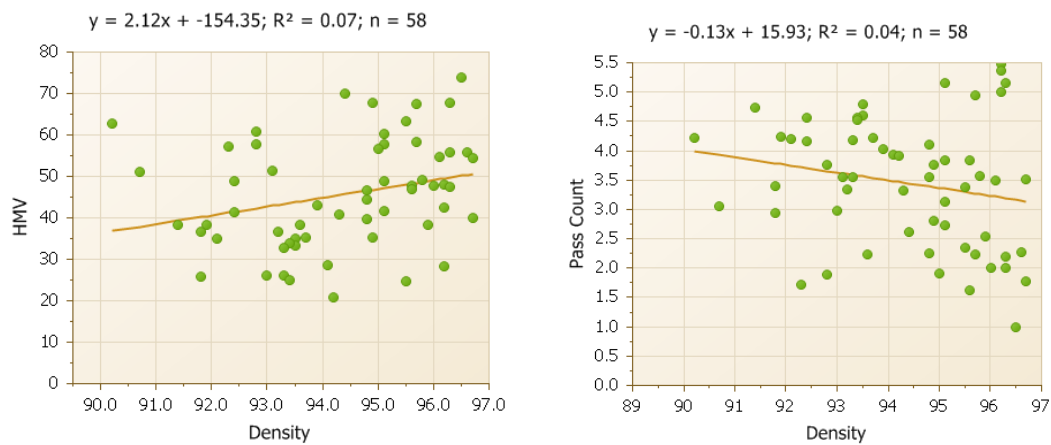
The correlation analysis results are presented as follows:



**Figure 5. Correlation between core densities and NG measurements, TB03, MD site.**



**Figure 6. Correlation between core densities and Caterpillar IC measurements (breakdown roller), TB03, MD site.**



**Figure 7. Correlation between core densities and Hamm IC measurements (intermediate roller), TB03, MD site.**