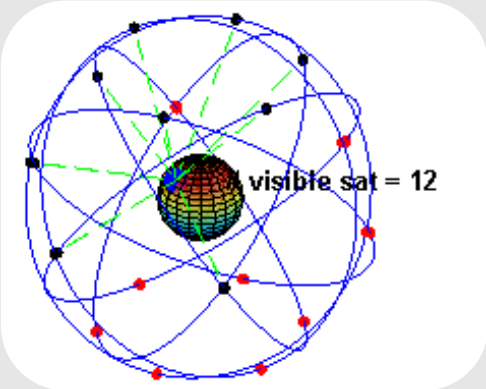
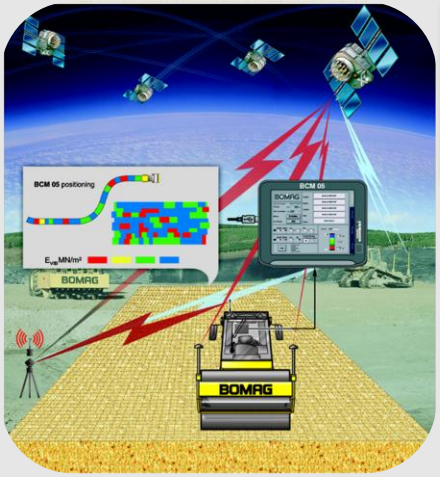
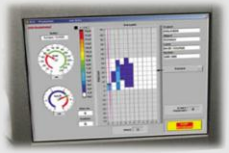
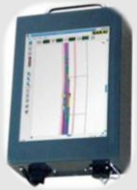
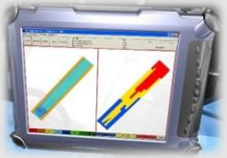










INTELLIGENT COMPACTION

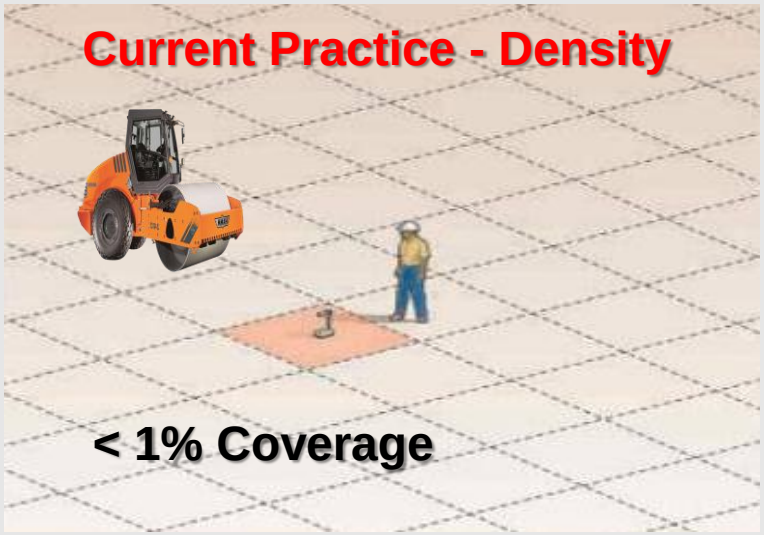
More Science Than Art

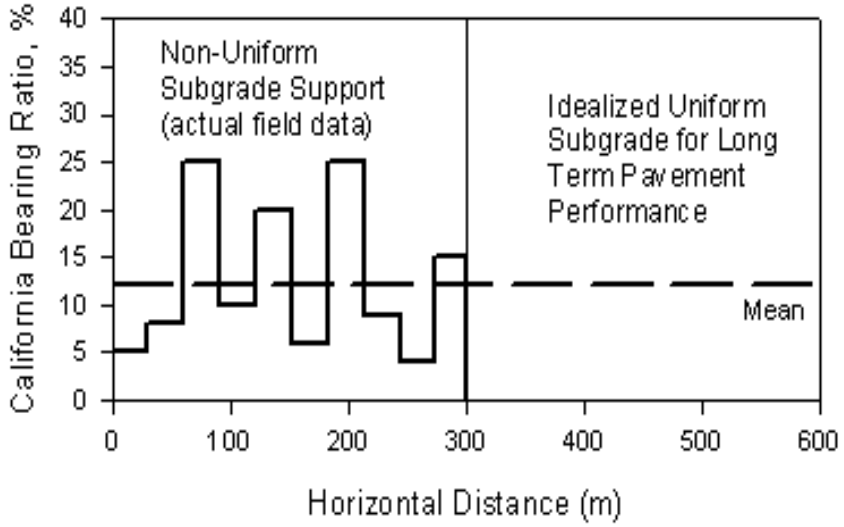
Jimmy Si, Ph.D., P.E.
Richard Williammee, P.E.
San Antonio, TX, Mar. 23, 2015

Table of Contents

Why use IC?

- Good pavement requires a uniform foundation to build on
- Current compaction methods do not meet the needs

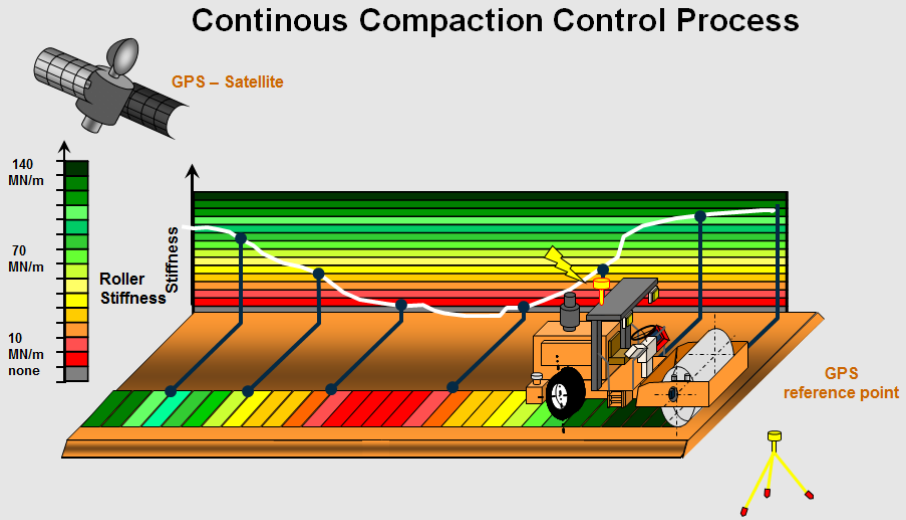




Fatigue life increases **70%** on average with uniform support

What is it?

- A vibratory roller with a stiffness measurement system that records the material's stiffness in real time
- A GPS system that tracks the roller's position and pass counts in real time
- An in-cab display panel showing a color-coded map of stiffness, roller's position, and pass counts in real time



Display Panel

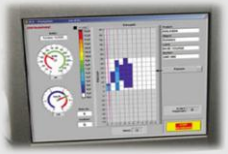
GPS Receiver

Accelerometer

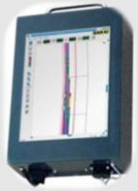
What is it? - IC Rollers and Measurements

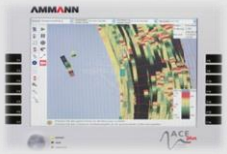


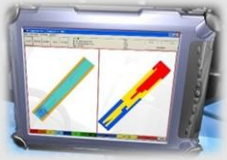








Caterpillar: CMV, MDP

Dynapac: CMV

Bomag: E_{VIB} *(MN/m²)*

Sakai: CCV

Case/Ammann: k_b *(MN/m)*

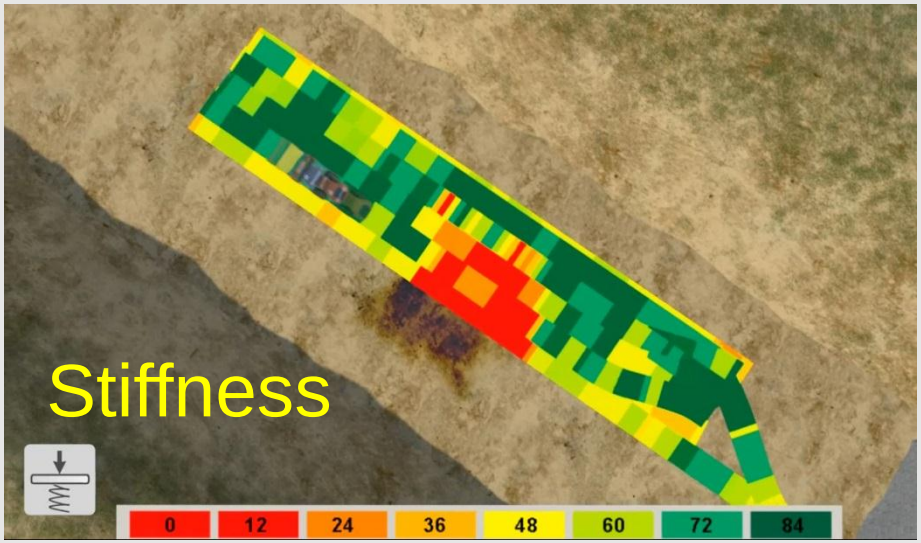
Hamm: HMV

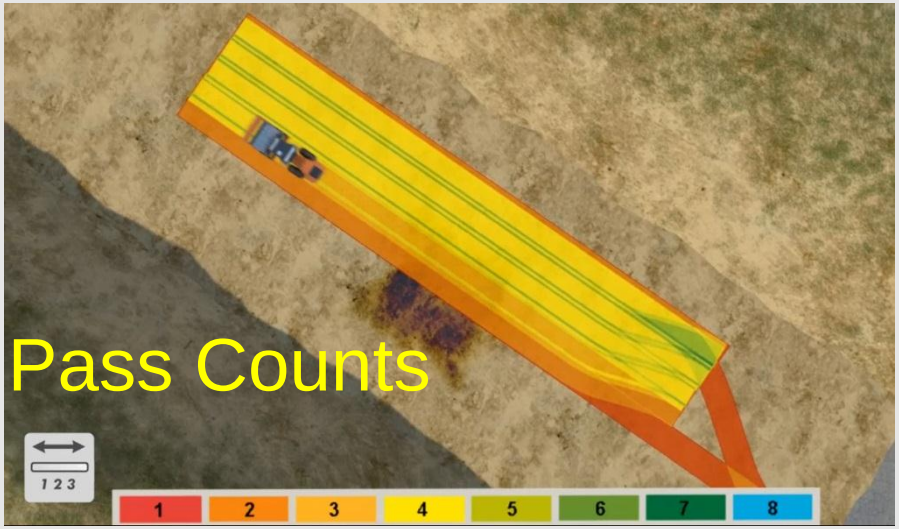
What is it? - TxDOT IC Retrofit Kit

IC Retrofit Kit

What information does IC provide?

- ✓ Stiffness
- ✓ Pass Counts



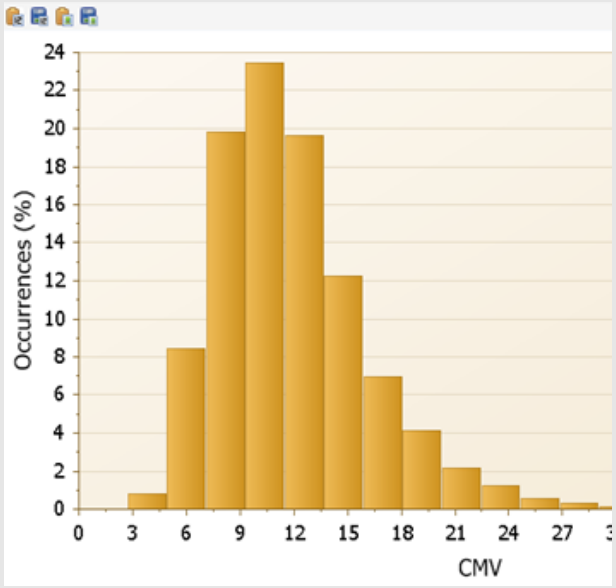


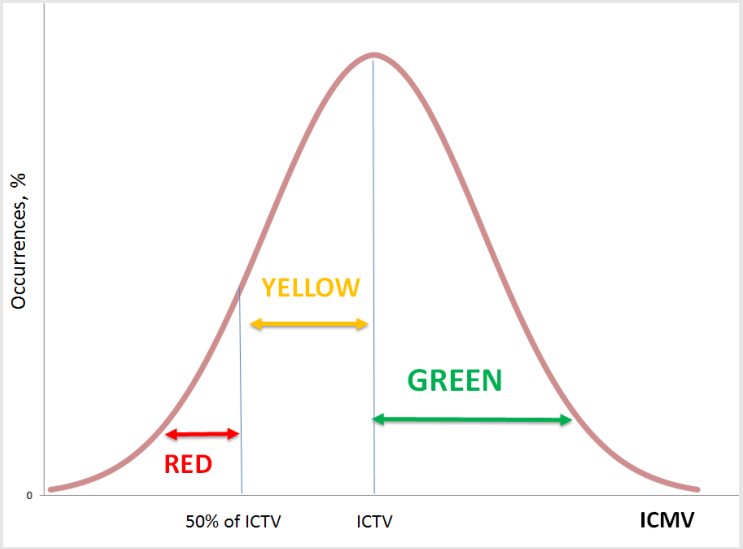
What information does IC provide?

- IC provides stiffness and pass counts in two separate data files:
  - All Passes Data: IC data (stiffness and pass counts) for all passes for a given area
  - Final Coverage Data: IC data (stiffness and pass counts) only for last pass for a given area

How to use the IC information?

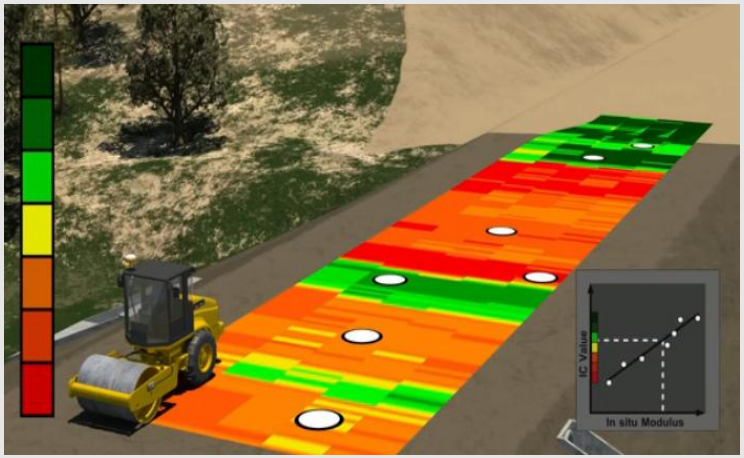
- ICMV (IC Measurement Values)
  - A whole set of IC data collected in a given area
  - ICMV is assumed in normal distribution
- ICTV (IC Target Value)
  - The average of ICMV
  - Color codes are based on ICTV

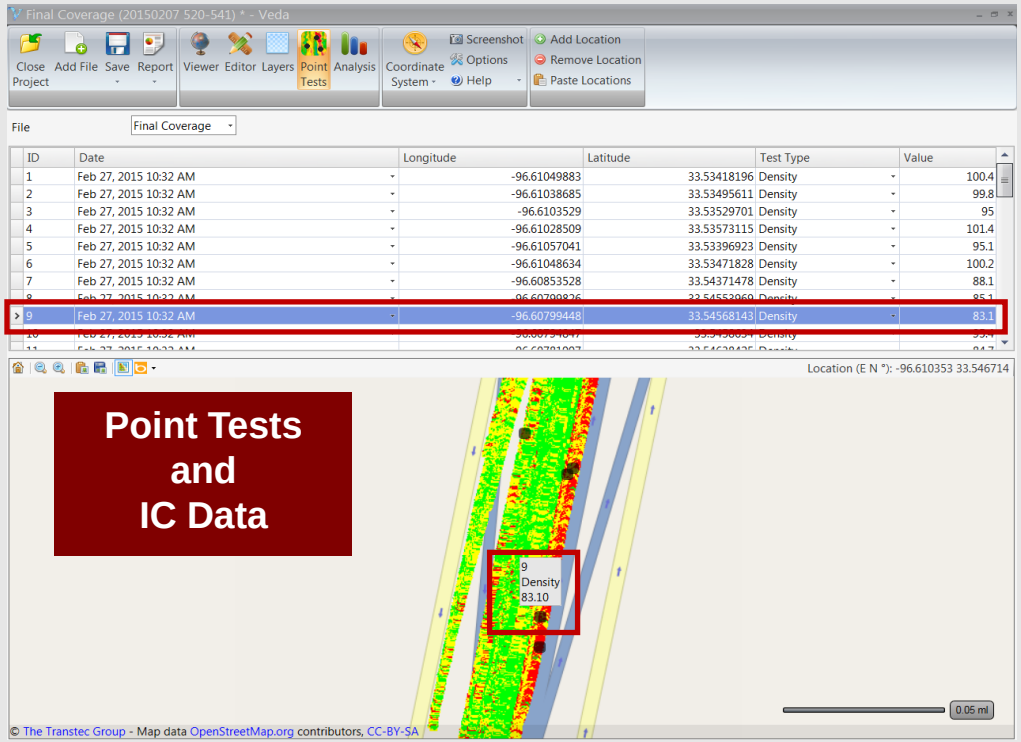




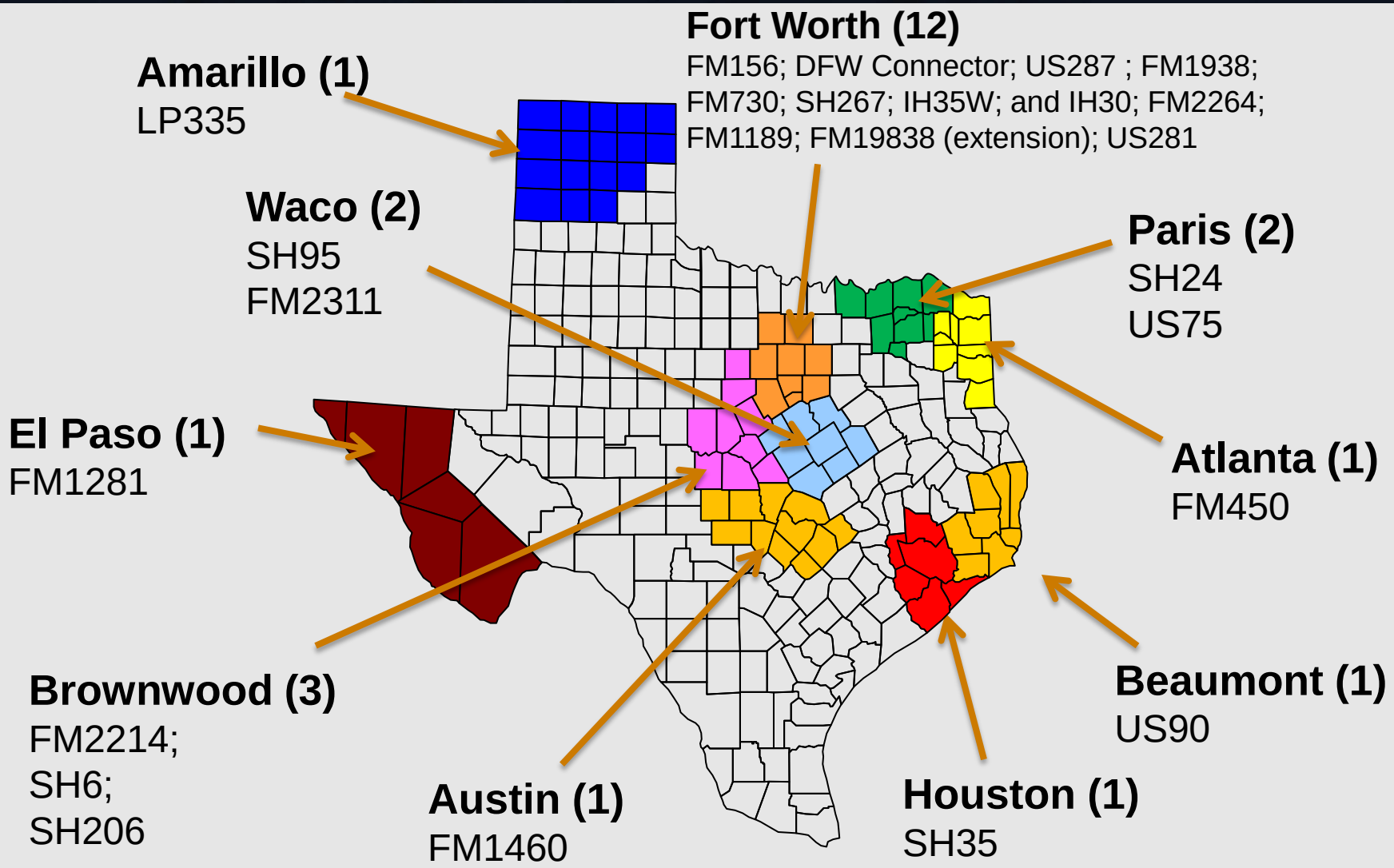
How to use the IC information?

In-situ point tests such as NDG and DCP are performed based on the color-coded maps





TxDOT IC Projects



TXDOT Fort Worth District IC Projects

- FM156 (FHWA Demonstration Project)
  - FHWA/Pooled-fund study IC demonstration
- FM1938 (Highway for Life Project)
  - TxDOT retrofit kit implementation
- DFW Connector Design-Build Project
- US 287 in Mansfield
- FM 731 at Lake Weatherford
- US 67 Bypass north of Cleburne
- IH 35W in North Fort Worth
- SH 267 Bypass around Dublin

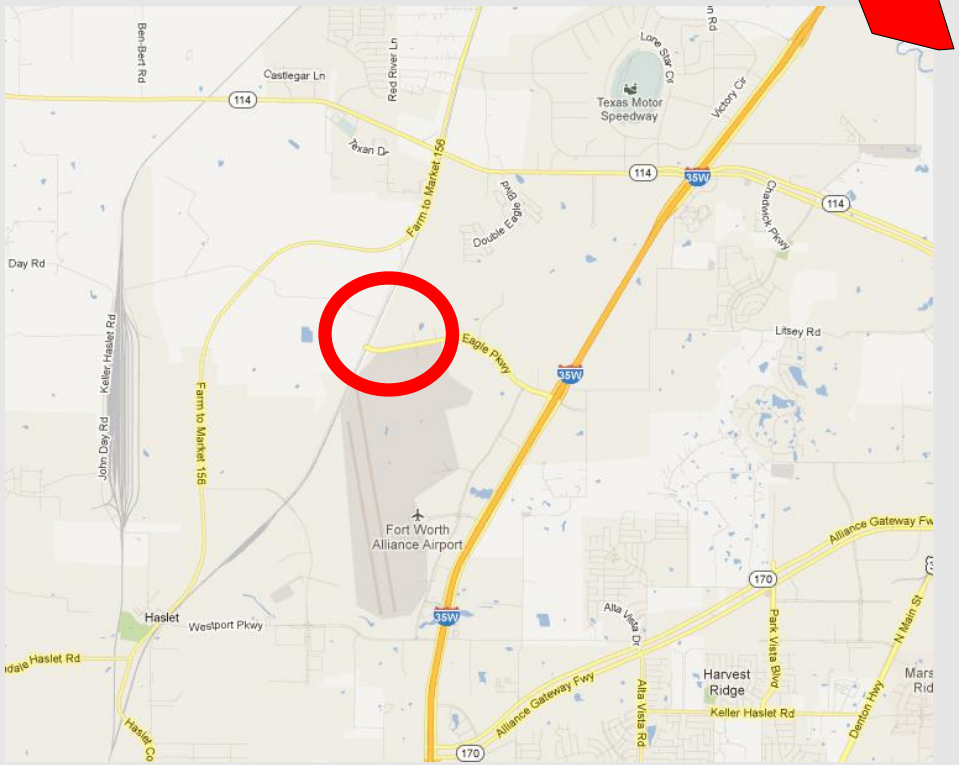
Intelligent Compaction

- FM 156 (North Fort Worth at Alliance Airport)
- FHWA/TPF IC Study
- Cohesive subgrade, Lime treated subgrade, and Aggregate Base (Flex Base)

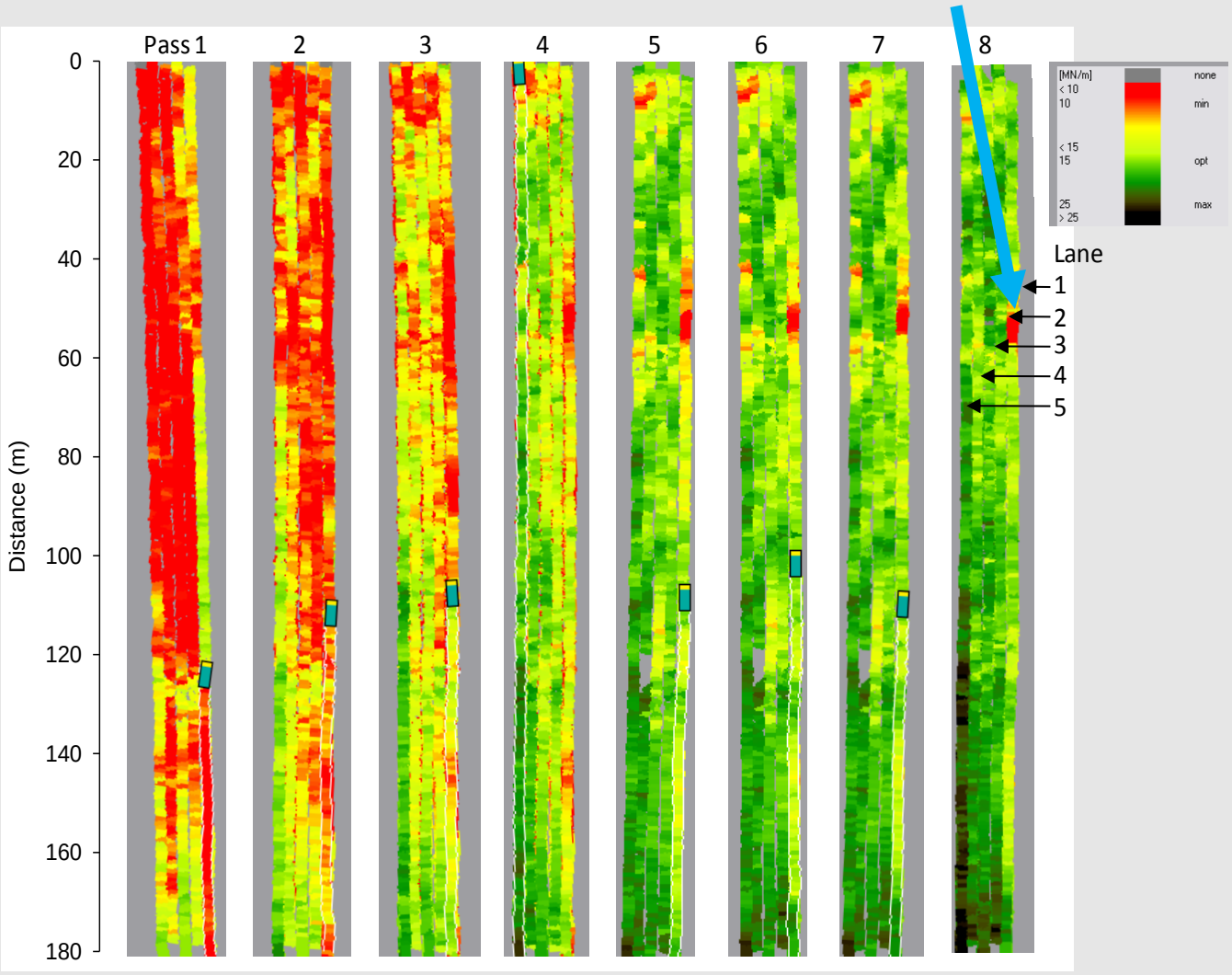
padfoot drum IC roller

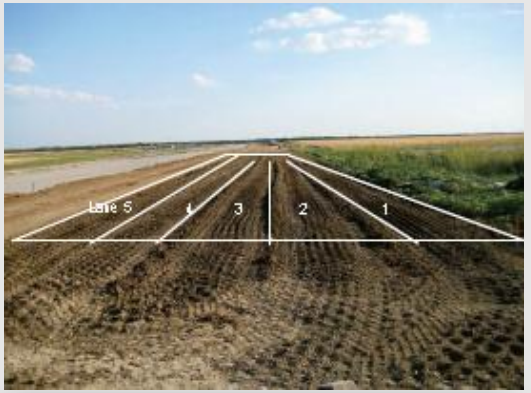
smooth drum IC roller

Dynapac Single Smooth drum IC roller



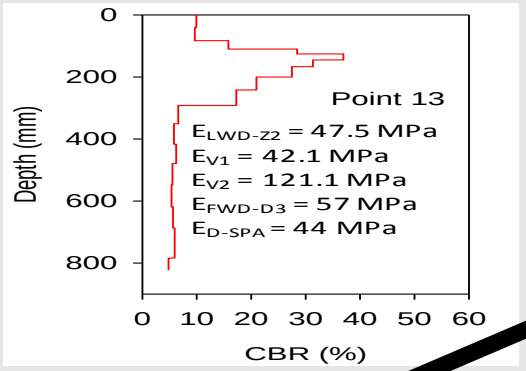
K_s shows compaction progress and a soft area

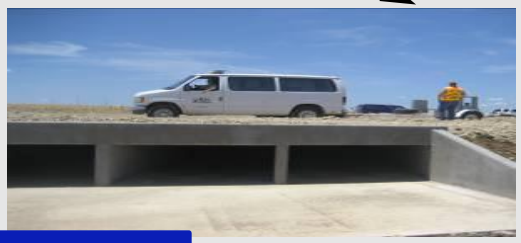




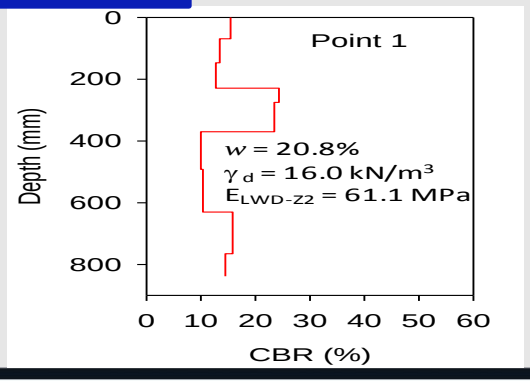
Case/Ammann Single-drum padfoot IC roller

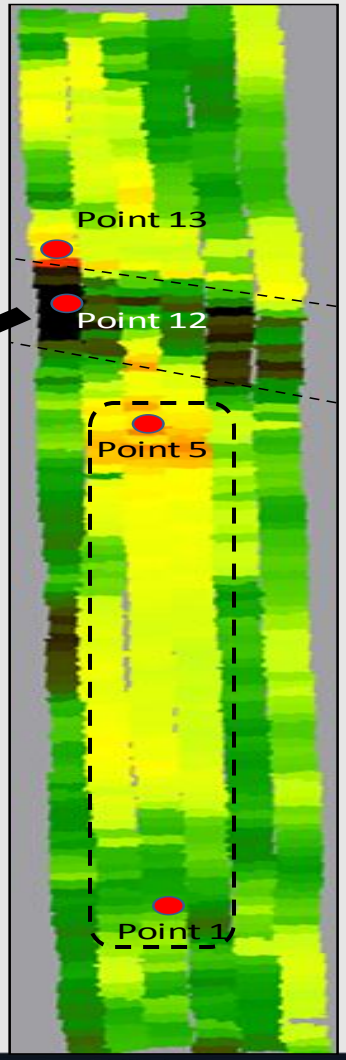
Detect Underground Structures

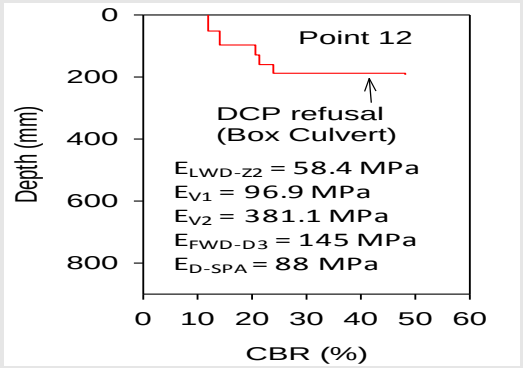


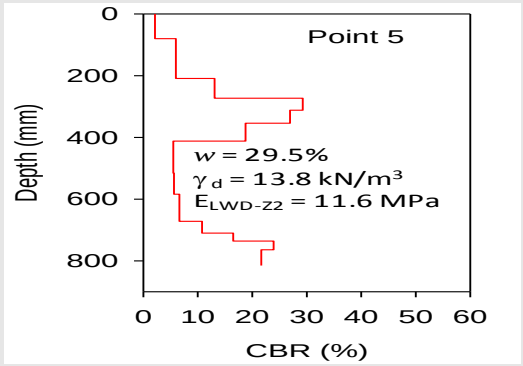


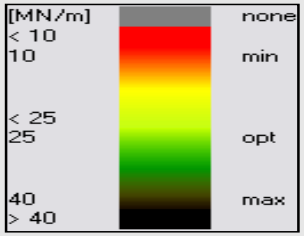
Box Culvert



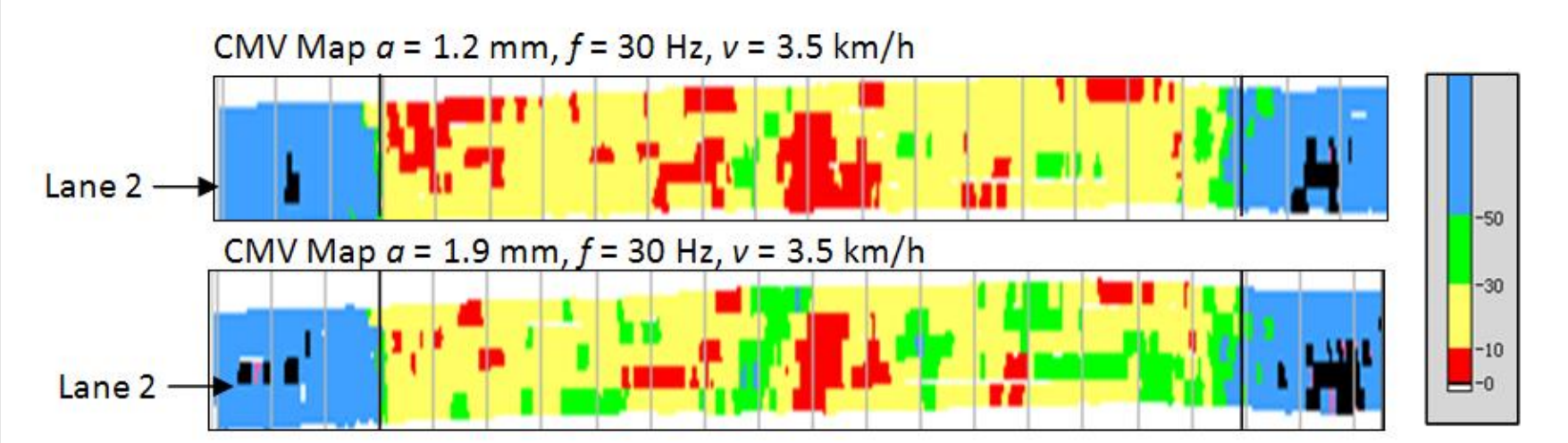






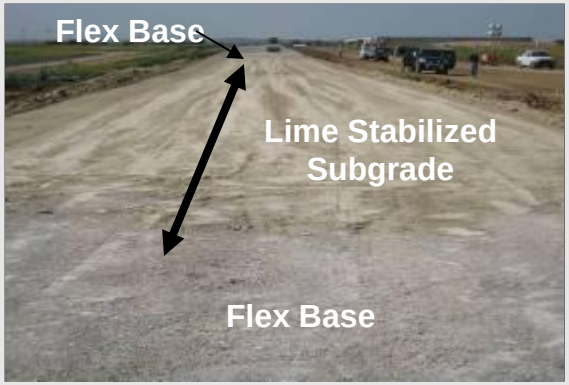


Differentiate Different Materials



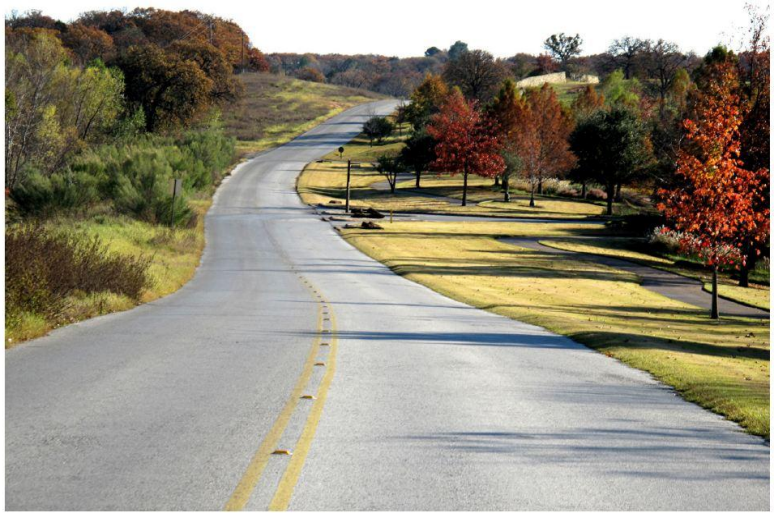
Flex Base **Lime Treated Subgrade** **Flex Base**

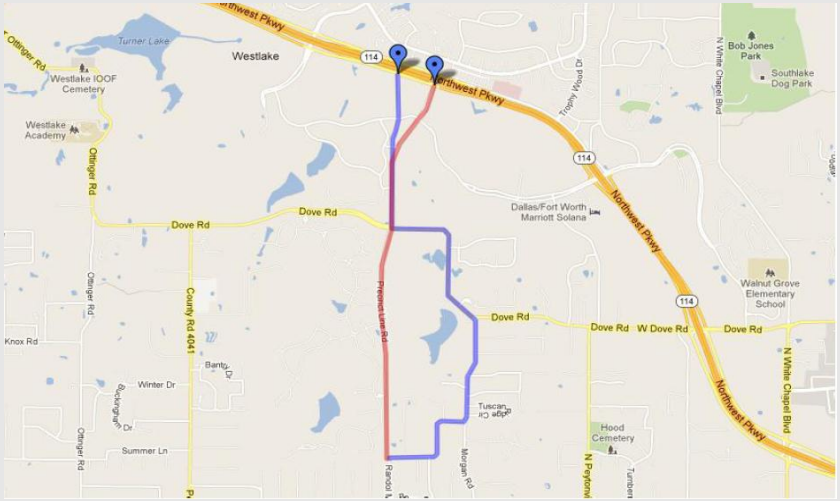
Dynapac
Single
Smooth drum
IC roller



Intelligent Compaction

- **Project Length : 2.205 Miles**
  Estimated Cost: $16.5M
  Estimated Duration: 367 Working Days



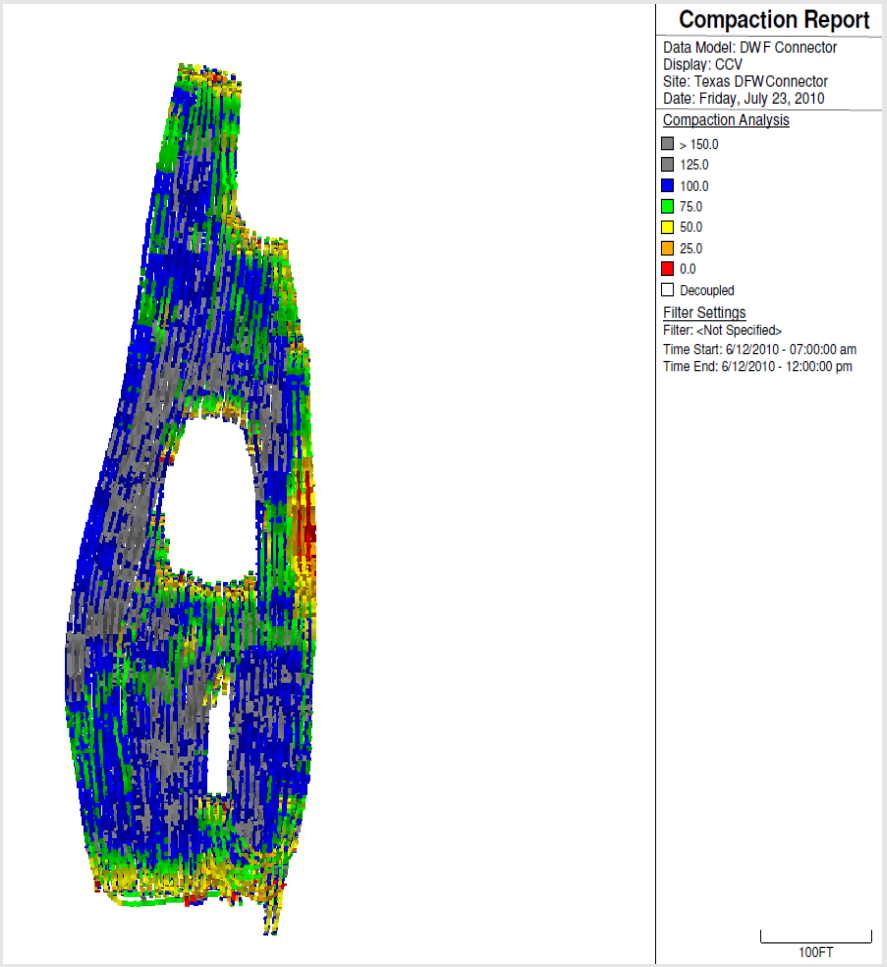


- Provides a more complete picture of the area being worked
- Less labor required
- Less time required due to testing

DFW Connector Design-Build Project

- $1.1 billion CDA Design-Build project
- Groundbreaking Feb. 17, 2010
- Expected completion 2014; complete 2013
- Approximately half the construction time needed for traditional contracts

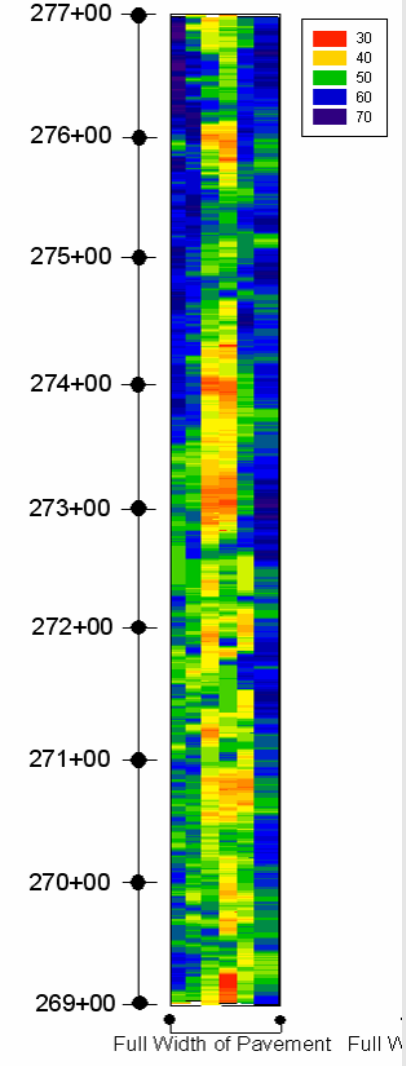
Dallas/Fort Worth Connector



Courtesy Dr. David White Iowa State University

Courtesy Mark Morrow NorthGate Constructors

July 2010



DFW Connector Project

Compaction Target Value (CTV) = 42

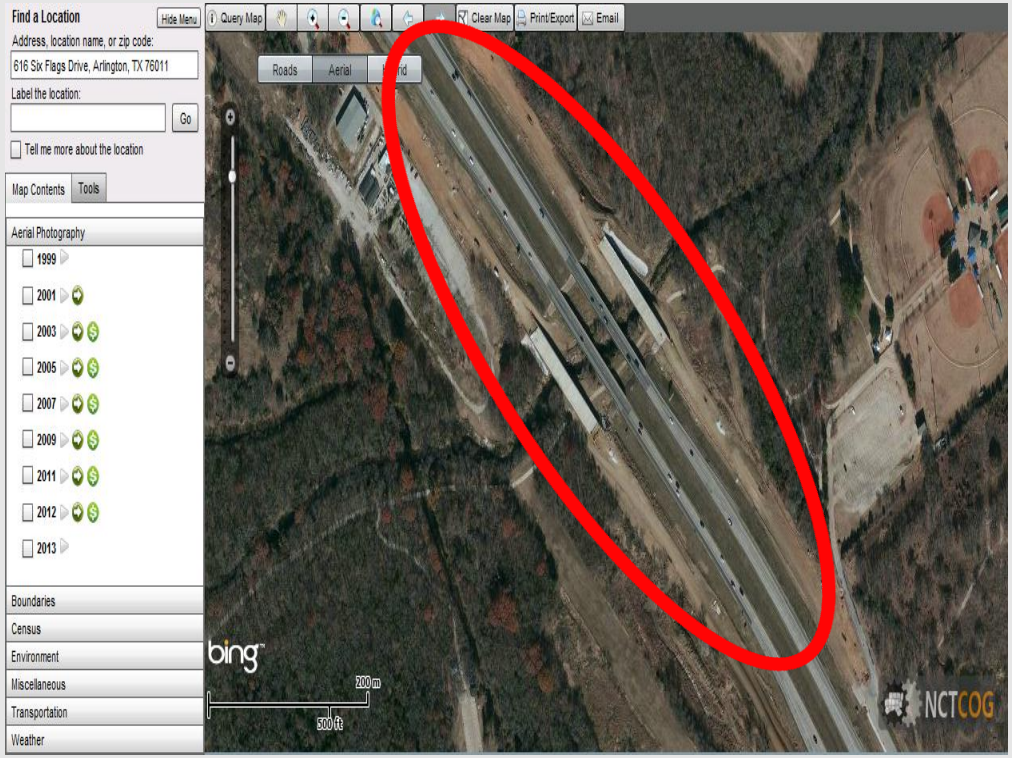
% Target	CCV	IC Data	
>130%	55	26%	} 94%
90-130%	38 - 55	68%	
80-90%	34 - 38	4%	
70-80%	29 - 34	1%	
<70%	< 20		

Current TxDOT QA Criteria:

>90% of IC Data should be equal to or greater than the CTV

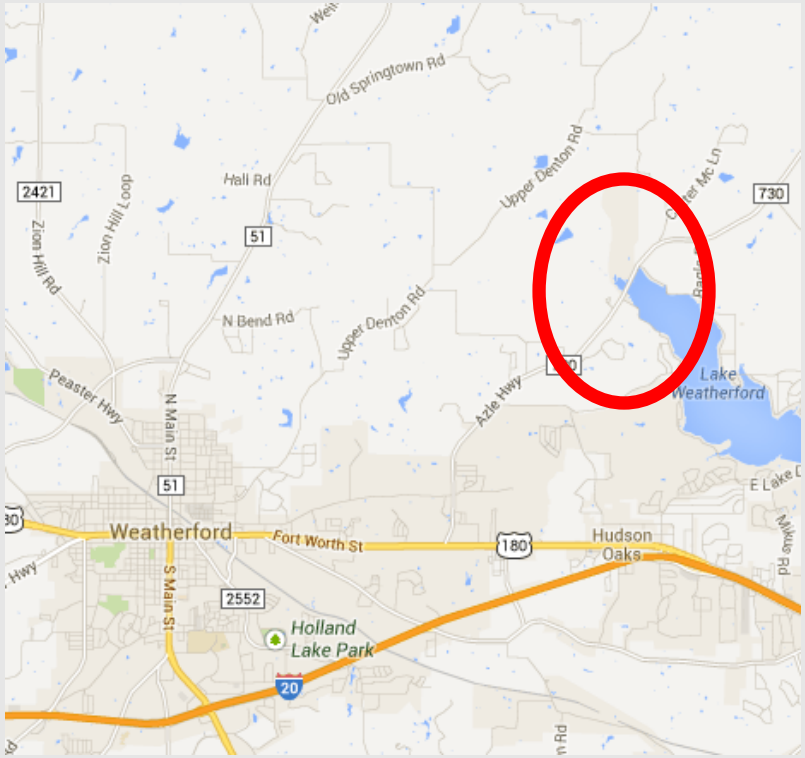
Intelligent Compaction

- US 287 (Mansfield TX)
- New frontage roads and bridges
- Lime treated subgrade
- Testing of 4 separate locations with DCP, DSPA, IC, and NDG



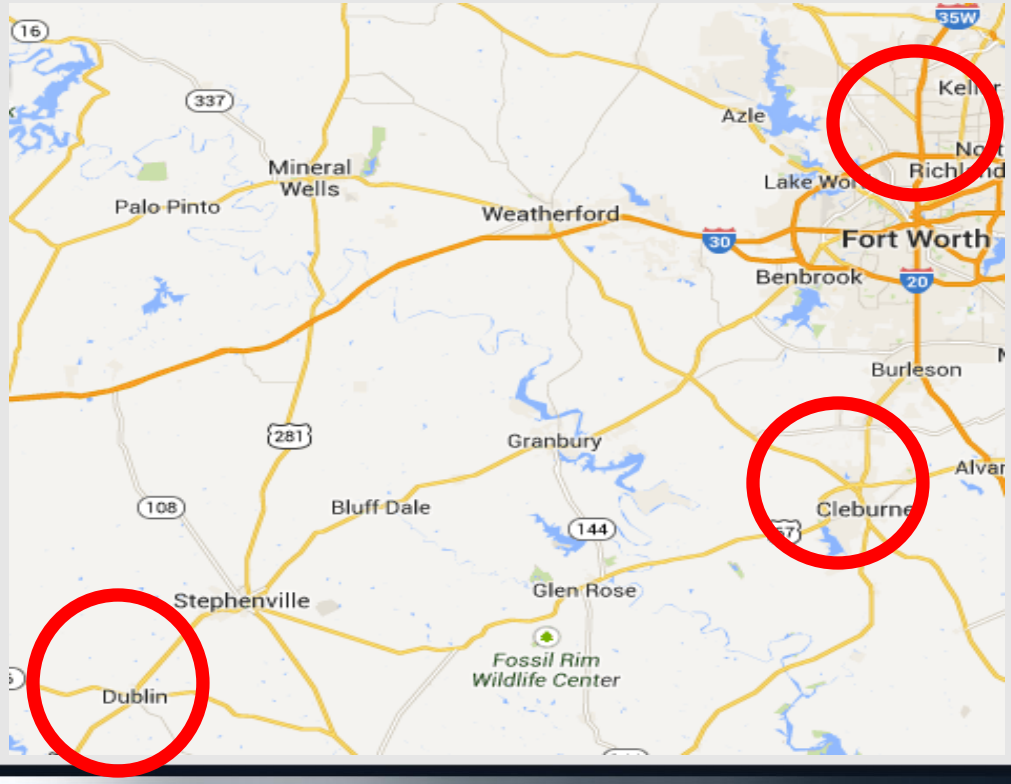
Intelligent Compaction

- FM 730 (over Lake Weatherford headwaters)
- New bridge on roadway realignment
- Wet to inundated natural ground, 5’ rockfill embankment, low PI soil embankment, lime treated subgrade, and flex base



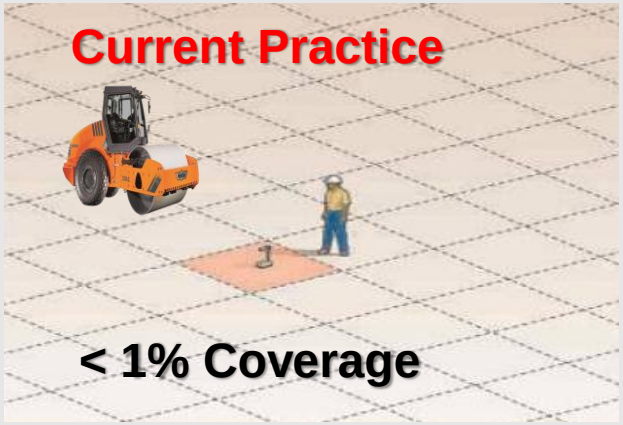
Intelligent Compaction

- US 67 (widen to 4 lane divided section) –
- SH 267 (construction of a new 4 lane divided bypass)
- IH 35W (Reconstruction of a freeway section)
- Natural field crushed rock, lime treated subgrade, and flex base



IC benefits

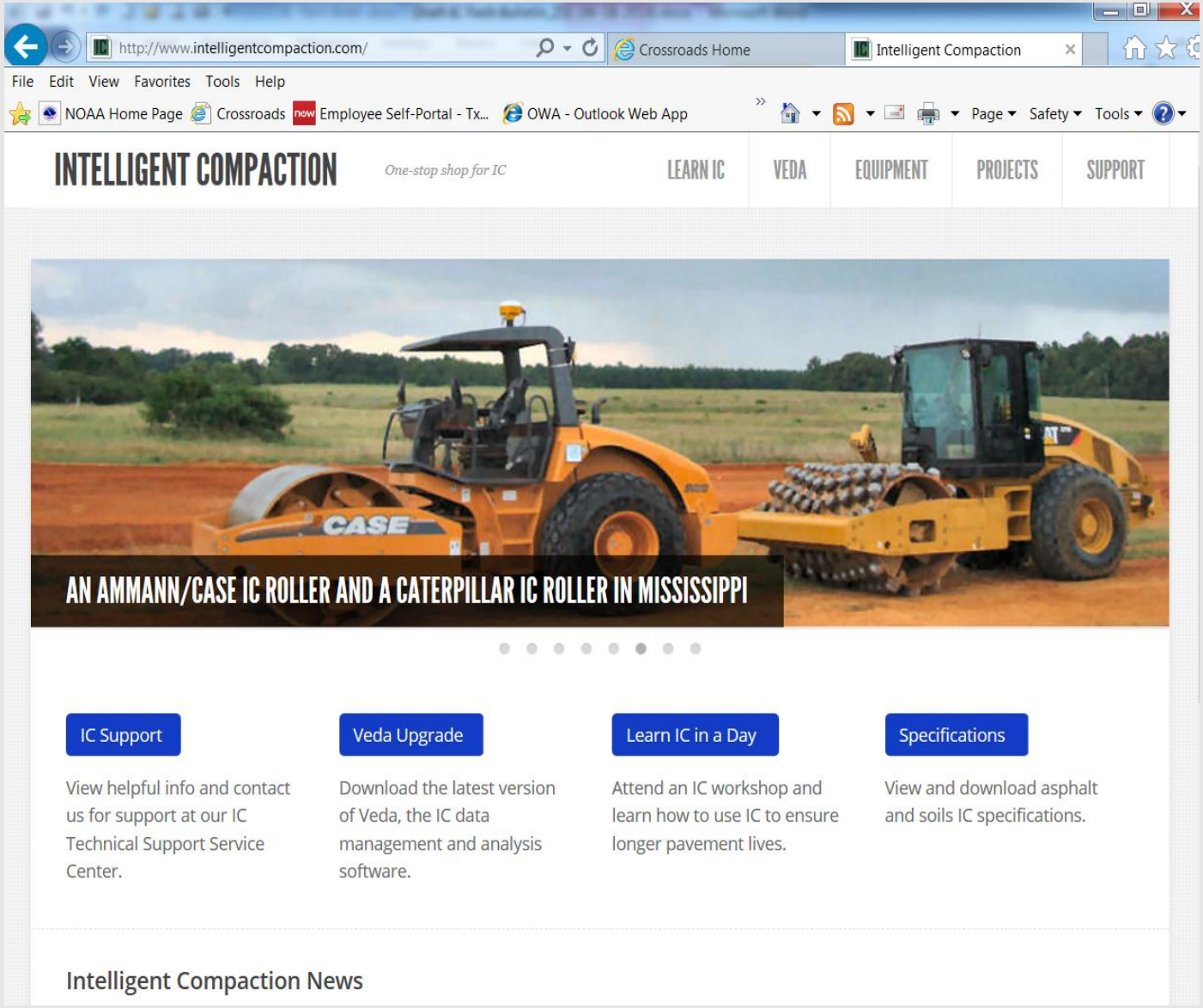
- Provides uniformity information
  - ✓ Covers 100% of the compacted area
  - ✓ Tracks roller's position and pass counts
- Identifies areas of poor compaction
- Selects areas to test for QC/QA
- Eliminates guesswork and reduces risk of rework
- Optimizes efficiency, maximizes productivity and minimizes costs
- Improves safety in construction zones



IC Challenges

- Executive leadership and champions
- Extensive training for both DOT's staff and contractors
- GPS system setup
- Data management including data collection, conversion, and analysis

IC resources – www.intelligentcompaction.com



Questions?

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