Performance of Interstate Rubblization in Illinois

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Acknowledgment and Disclaimer

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A report of the findings of
ICT PROJECT R27-193-2
Flexible Pavement Design
(Full-depth Asphalt and Rubblization)

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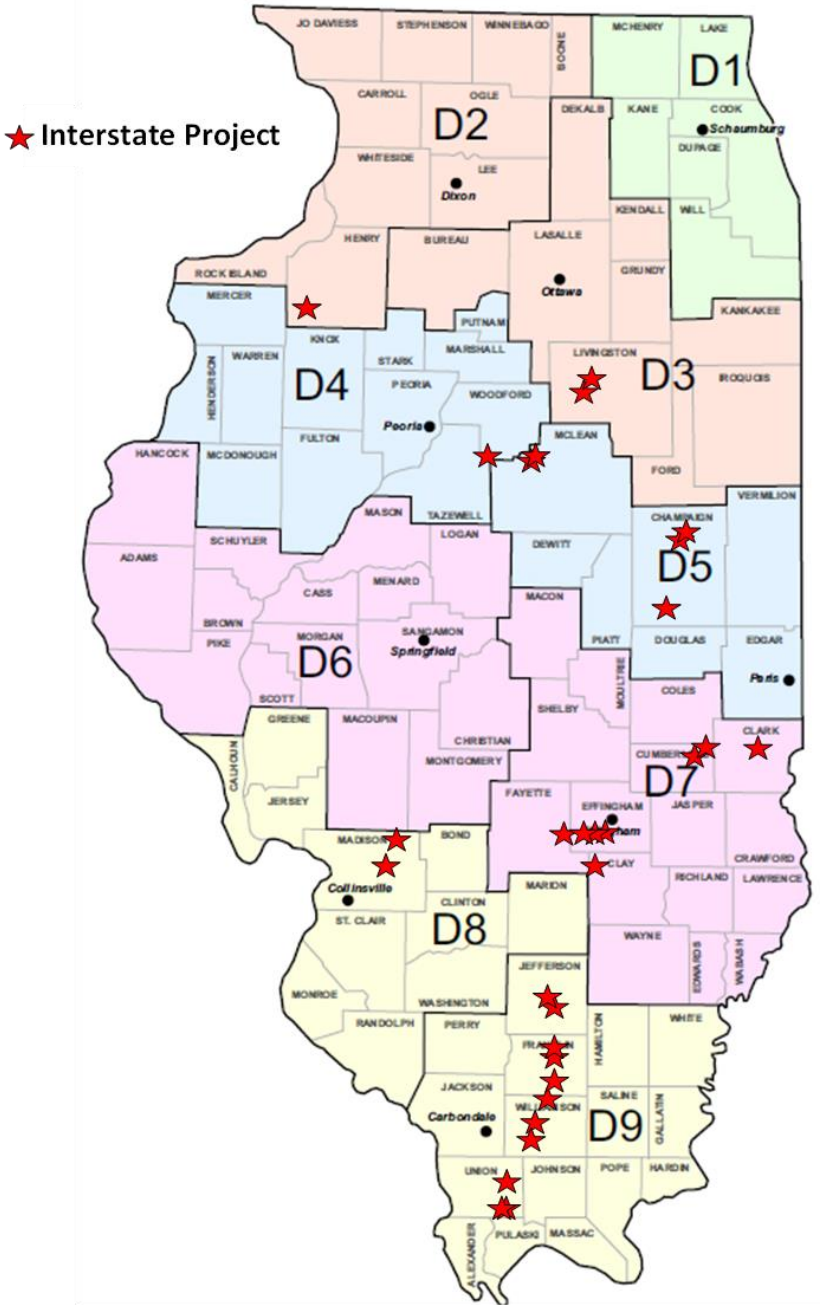
Rubblization Process

Projects Since 1990

- Majority on I-57 and I-70
- Tend to be 10” Jointed Reinforced PCC or badly “D”-Cracked Continuously Reinforced Concrete Pavement (CRCP).
- High patching cost is why rubblizing was selected
- Bulk of projects in last 15 years
- IL 9.5 and SMA surfaces
- Variety of neat and Polymer PG asphalts used



R27-193-2 Study Approach

Limit study to Interstates due to better data quality

Summarize Pavement Management Data:

- Condition Rating Survey (CRS) Values
  9.0 (New) - 1.0 (Impassable)
- Rutting
- International Roughness Index (IRI)
- Traffic converted to 18,000 lb. Equivalent Single Axle Loads (ESAL's)

R27-193-2 Study Approach cont.

Graph Trends

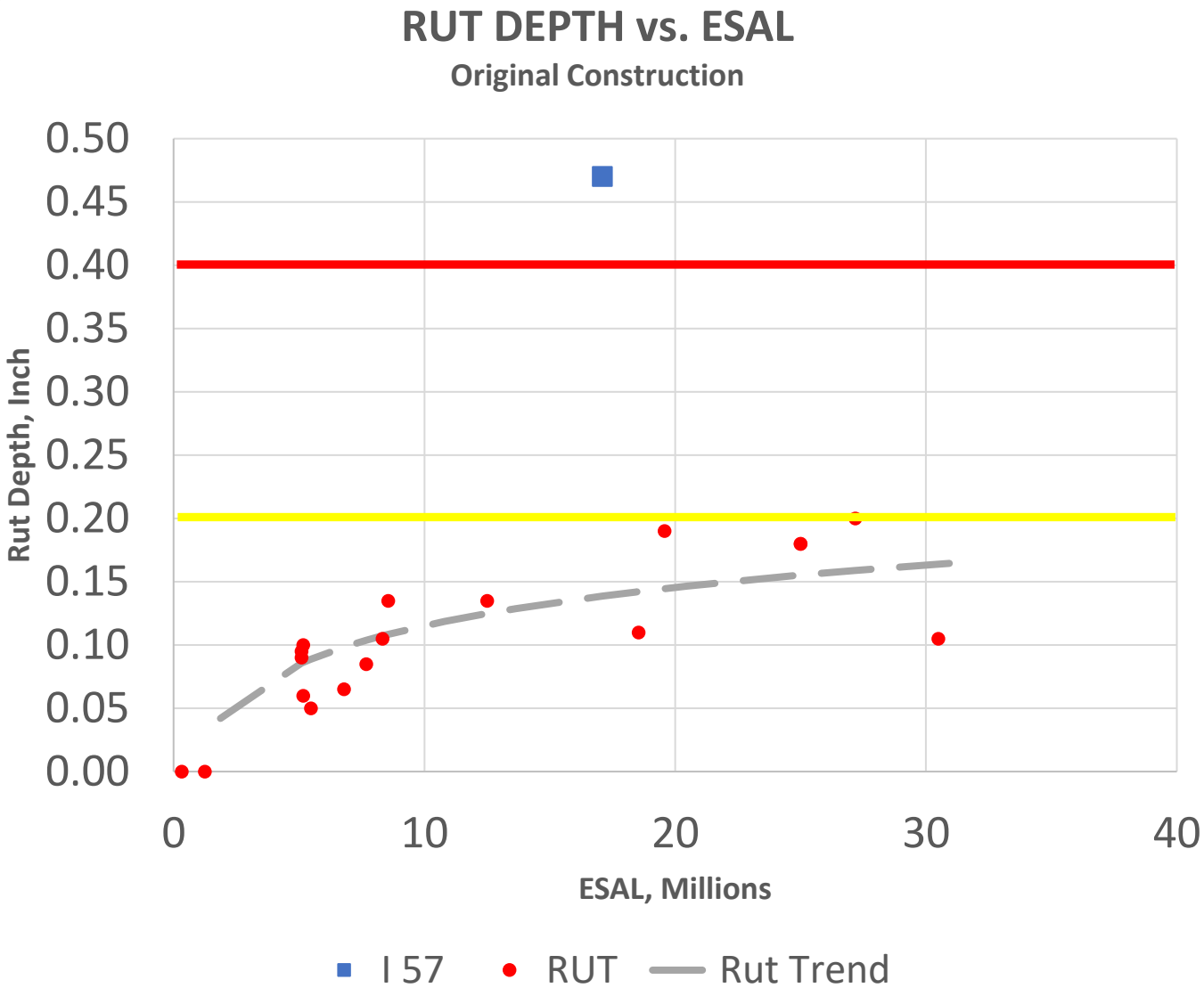
- CRS vs Age
- Rutting vs ESAL
- Design Thickness vs ESAL on Section

Review of Plans:

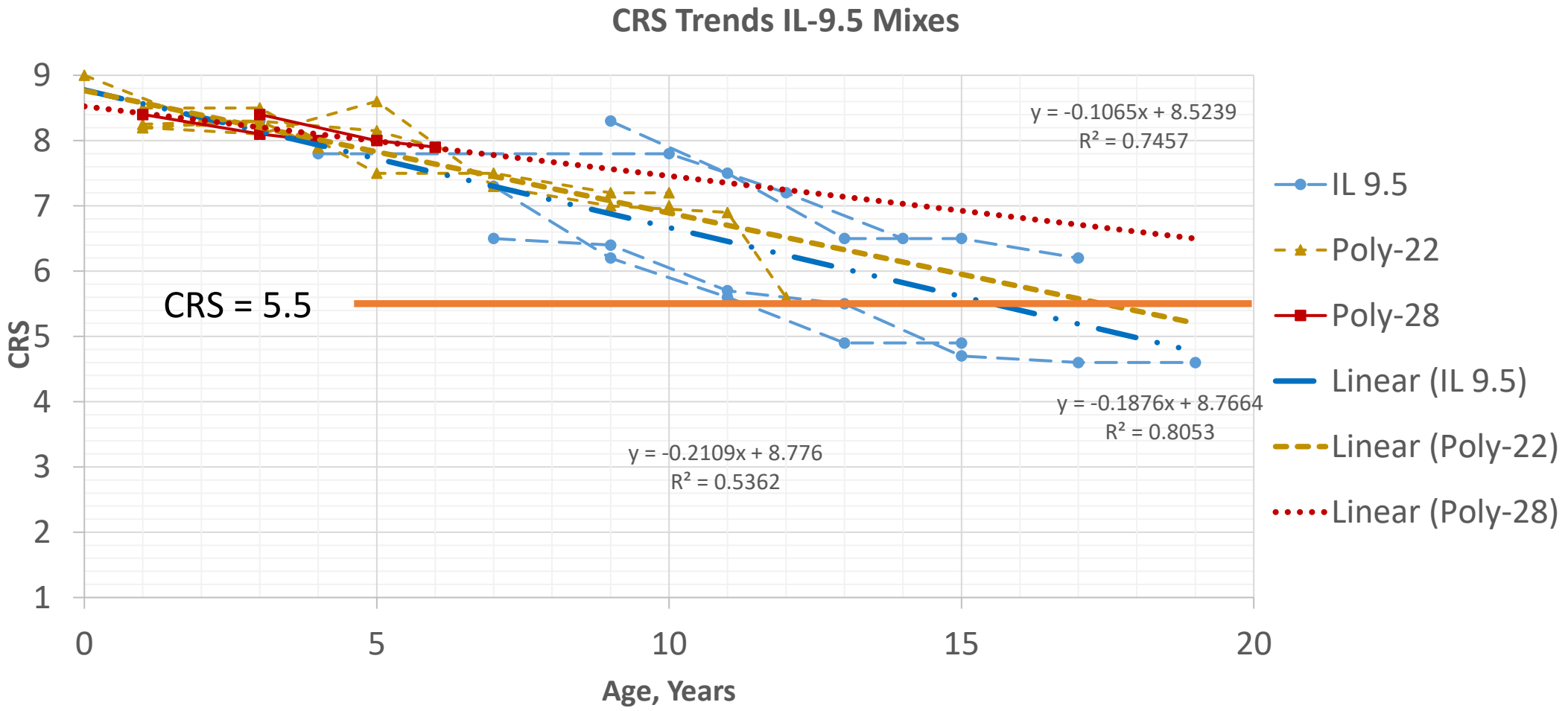
- Mixes and Performance Grade (PG) Asphalts
- Plan Details

Rutting vs ESAL

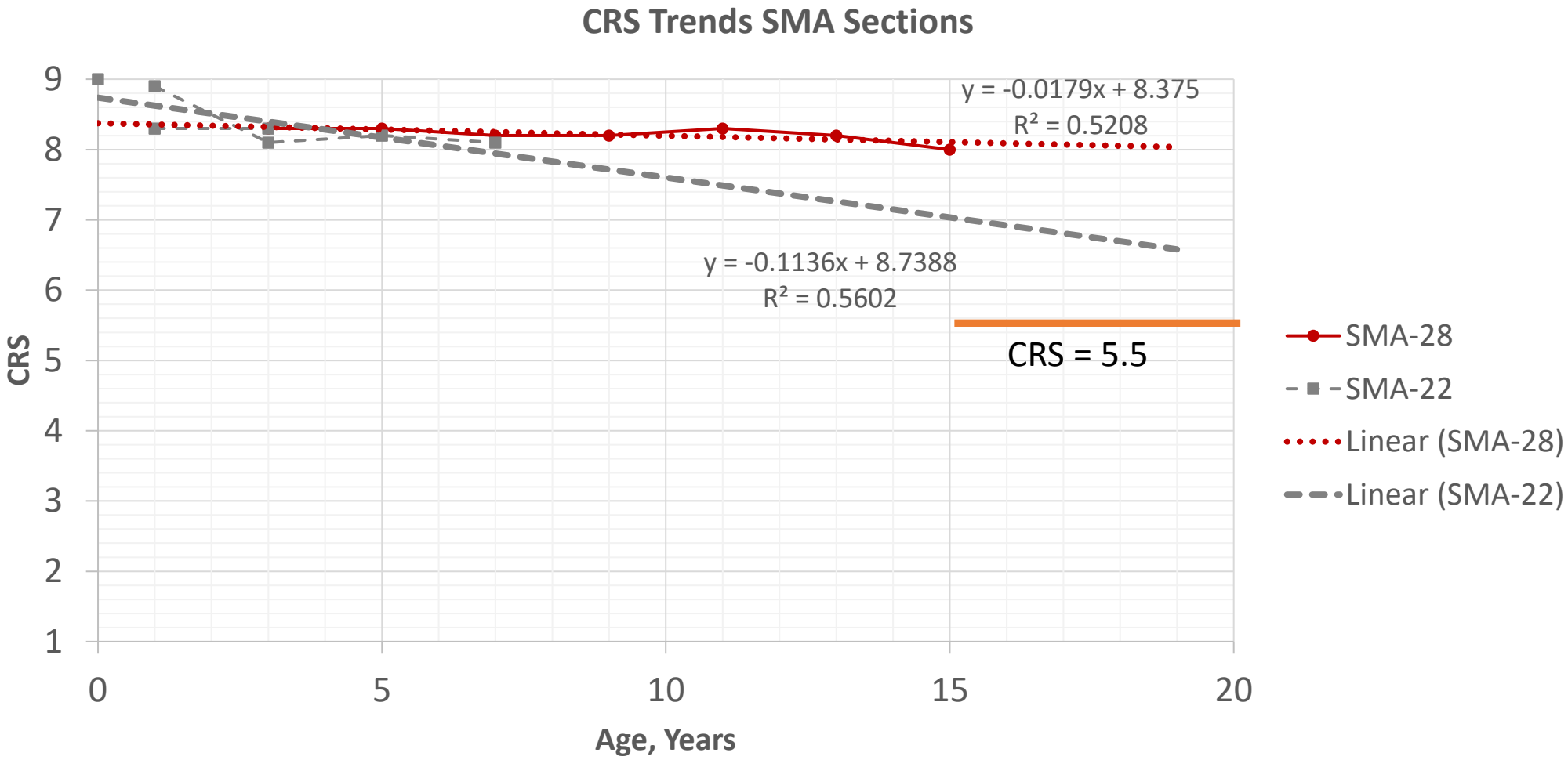
- Y = 0.1006LogX + 0.0146
- R^2 = 0.7262



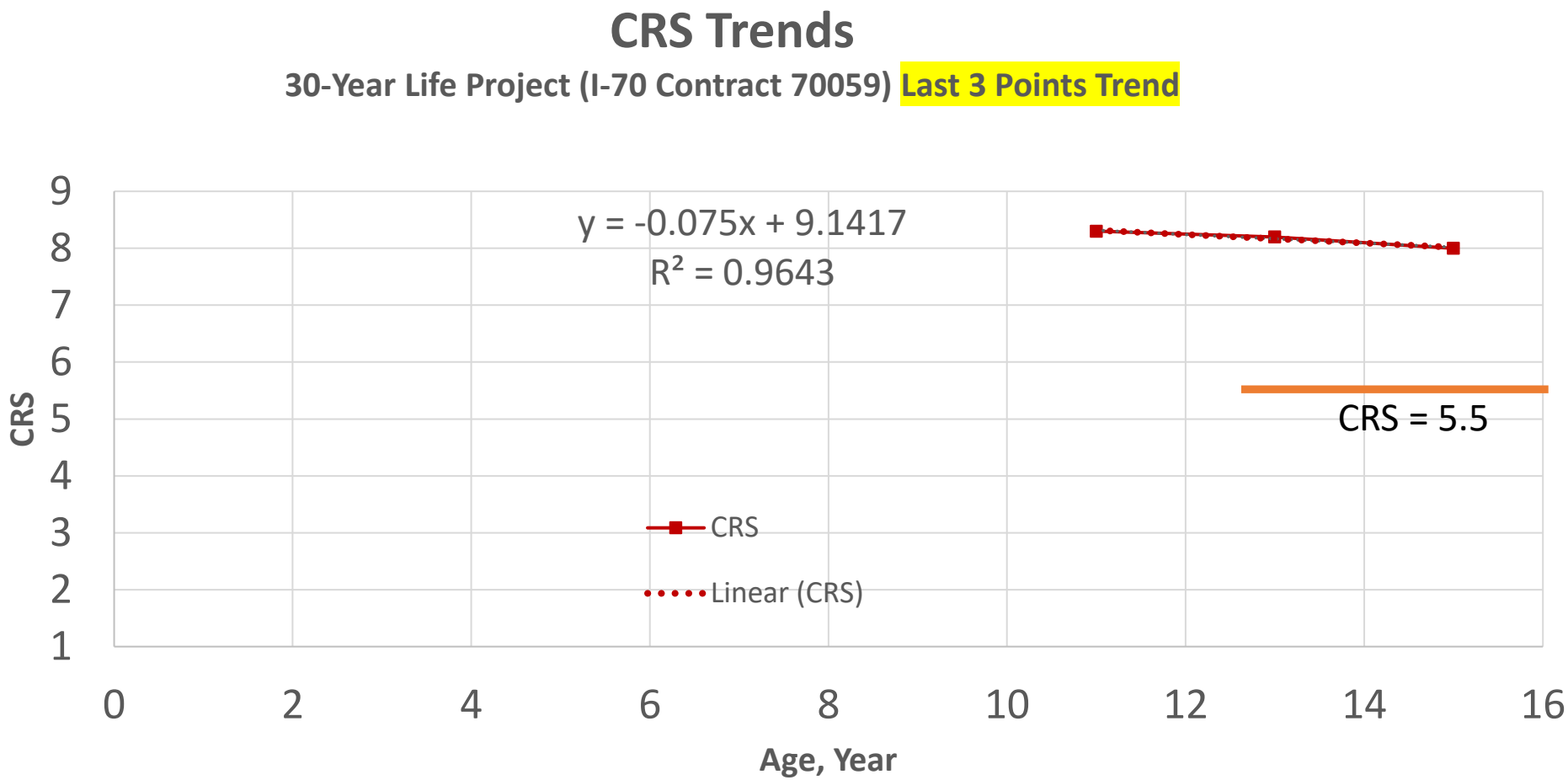
CRS vs. Section Age: IL 9.5



CRS vs. Section Age: SMA



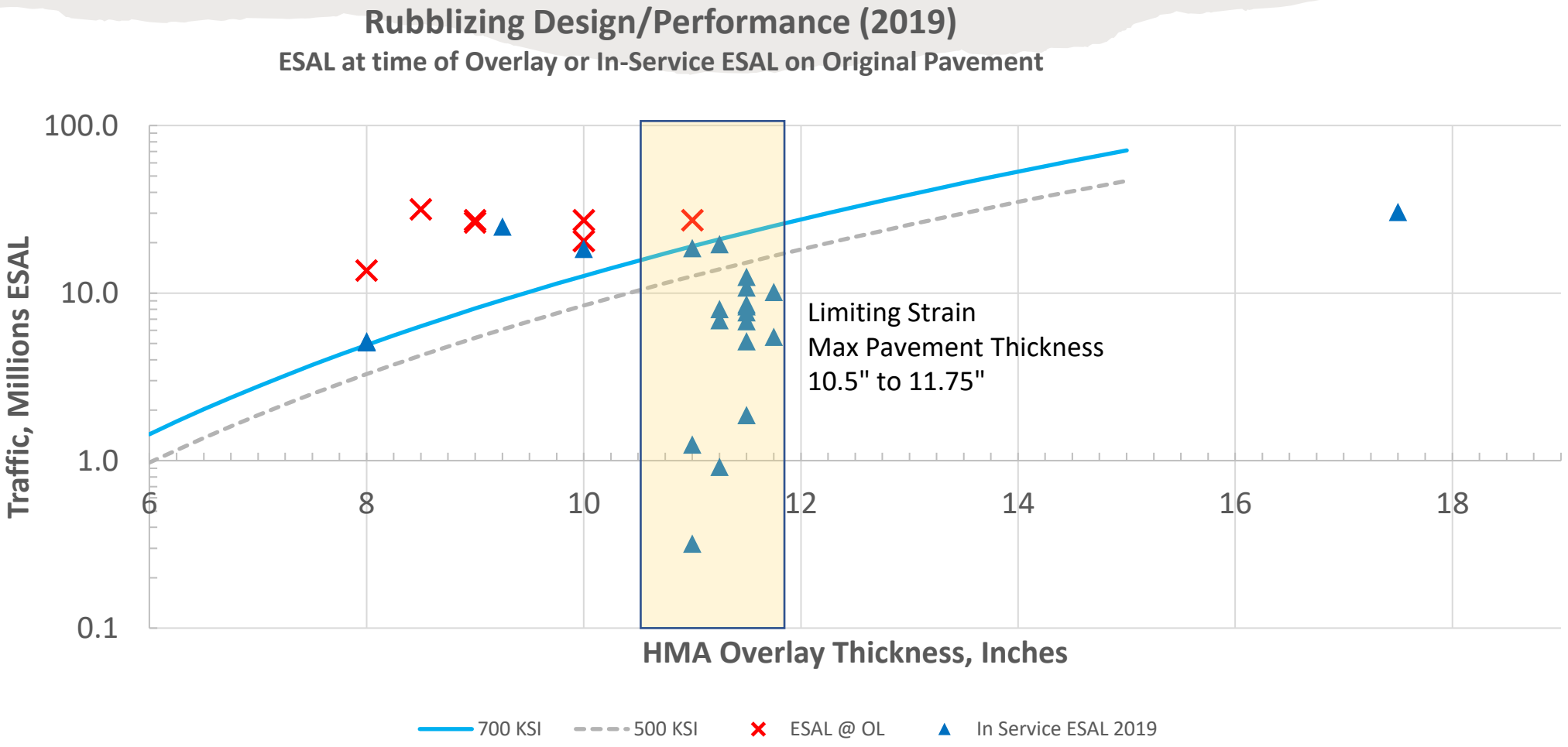
CRS vs. Section Age: SMA (I-70)



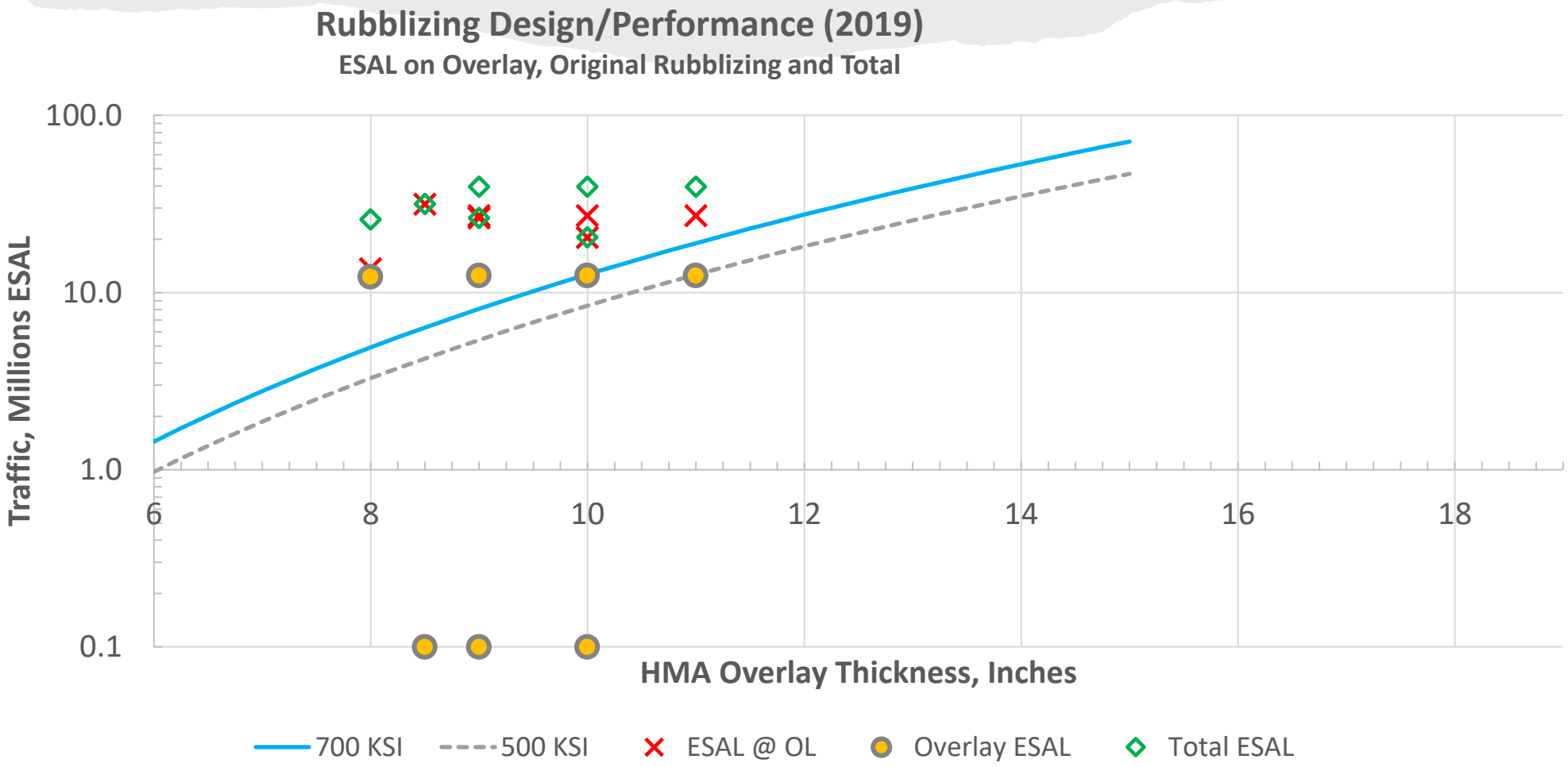
Projected years to CRS of 5.5 for Various HMA Surfaces

Surface Mix Group	Asphalt Binder Grade	Y-Intercept	Slope	R^2	Years to CRS of 5.5
IL-9.5	AC-20-PG64-22	8.78	−0.211	0.54	16
IL-9.5	Poly PGXX-22	8.77	−0.188	0.81	17
IL-9.5	Poly PGXX-28	8.52	−0.107	0.75	28
SMA	Poly PGXX-22	8.74	−0.114	0.56	28
SMA	Poly PGXX-28	8.38	−0.018	0.52	160
SMA (Last 3 data points)	Poly PGXX-28	9.14	−0.075	0.96	49

Design vs. Performance: Original Section



Design vs. Performance: Overlaid Sections



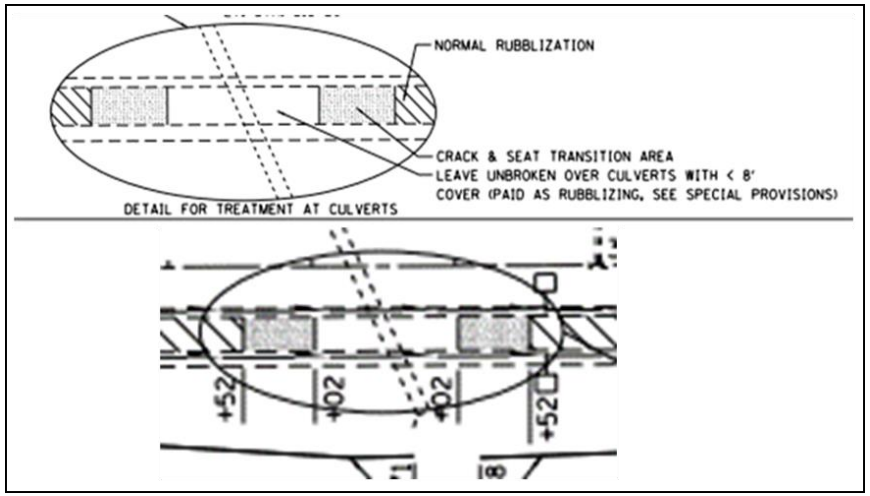
Plan Review

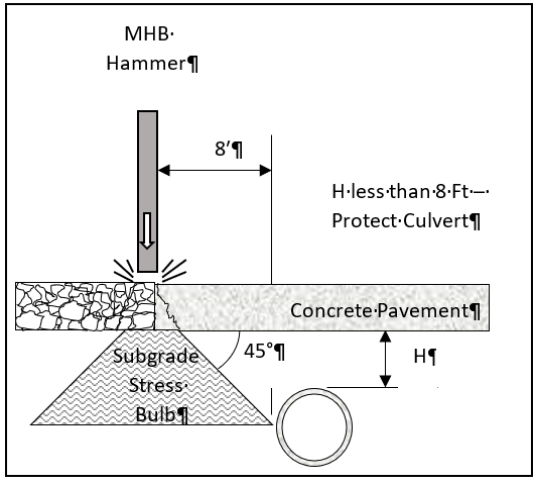
Underdrains

- Early projects may or may not have replaced underdrains (4” some 6”)
- Rubblizing increases “water retention or storage” ability of the pavement
- Water bleeding at sags (if underdrains not replaced)
- Water high in calcium carbonate – once exposed to air precipitates out dries white
- No structural problems seen – Potential for frost heave??

Plan Review

- **Gaps to Protect Culverts**
  - Several Plan Sets Include Excessively Long Gaps of Crack and Seat and Unbroken Pavement
  - Amount Non-Rubblized Usage Exceeded 10% of Some Projects
  - Simple Evaluation Indicates 8 feet of Alternative Pavement Breakage Needed
  - May Need to Instrument and Study to Resolve





Study Findings

- Good to Excellent Performance – Exceeding Design Expectations
- Design Process is Conservative
- Rutting not Excessive – I-57 Rutting Cause Known (Level Binder)
- Softer PG Asphalts in Surface = Increase Life
- Limiting Strain Criterion – Controlling Thickness on Many Projects
- Some Plans Included Exceptionally Long Non-Rubblized Segments for Protection of Underground Structures

Recommendations for Improved Performance

- Replace IL-9.5 Surface Using PGXX-22 with
  - SMA w/PGXX-22 or
  - IL 9.5 w/PGXX-28
- SMA w/PGXX-28 Would Provide Best Performance (Limited Data)
- Adopt shorter Buffer when Rubblizing next to Underground Structures
- Study Mix Modulus and Fatigue Outcomes of Recycled HMA Mixes
- Revisit Limiting Strain Criterion of 70 Microstrain with Softer PG Asphalts and Recycled HMA Mixes

Standard Specifications for Road and Bridge Construction – January 1, 2022

SECTION 441. HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH) ON RUBBILIZED PCC

441.01 Description. This work shall consist of constructing hot-mix asphalt (HMA) pavement (full-depth) on a rubblized portland cement concrete (PCC) pavement.

Traffic Speed Deflectometer

Surface Condition vs Structural Condition

- CRS = f (Distresses, IRI, Rutting, Faulting)
  - Primarily a measure of surface condition
  - Indirect measure of structural condition
- Deflection testing is the most commonly used measure of pavement structural condition.
  - Measures pavement response to loading
- Surface condition may or may not match structural condition.

FWD vs TSD

Falling Weight Deflectometer (FWD)	Traffic Speed Deflectometer (TSD)
• Trailer or truck mounted • Requires traffic control • Load plate and sensors rest on pavement surface • Limited productivity per day of testing	• Device mounted in semi-trailer • Data collected at traffic speed • Pavement response measured with Doppler lasers • Much more data collected per day • Comprehensive pavement assessment

IDOT’s New Truck-Mounted KUAB FWD

FHWA Transportation Pooled Fund Studies

- Demonstration of Network Level Pavement Structural Evaluation with Traffic Speed Deflectometer - TPF-5(282)
  - 2014-15 (9 states participating)
  - Testing performed by Greenwood Engineering
- Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs) - TPF-5(385)
  - 2019-23 (26 states participating)
  - Testing performed by ARRB Systems

Comprehensive Pavement Assessment Capabilities

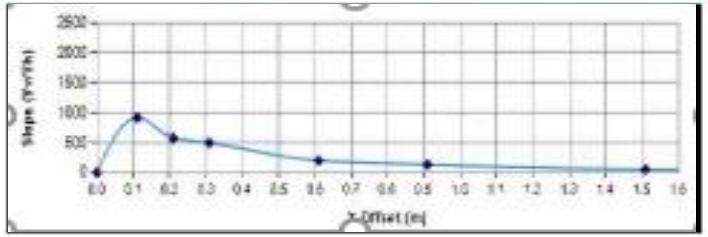
+ 3D Roughness
Full Lane

+ 3D Rutting
Full Lane

+ 3D Cracking
Full Lane

+ 3D Surface Defects
Full Lane

Continuous Deflection Measurement
- Pavement velocity
- Full Deflection Bowl
- Applied Load
- Surface & Air Temperature



+ Roughness
Left & Right wheel paths

+ Texture
Centre & Both wheel paths

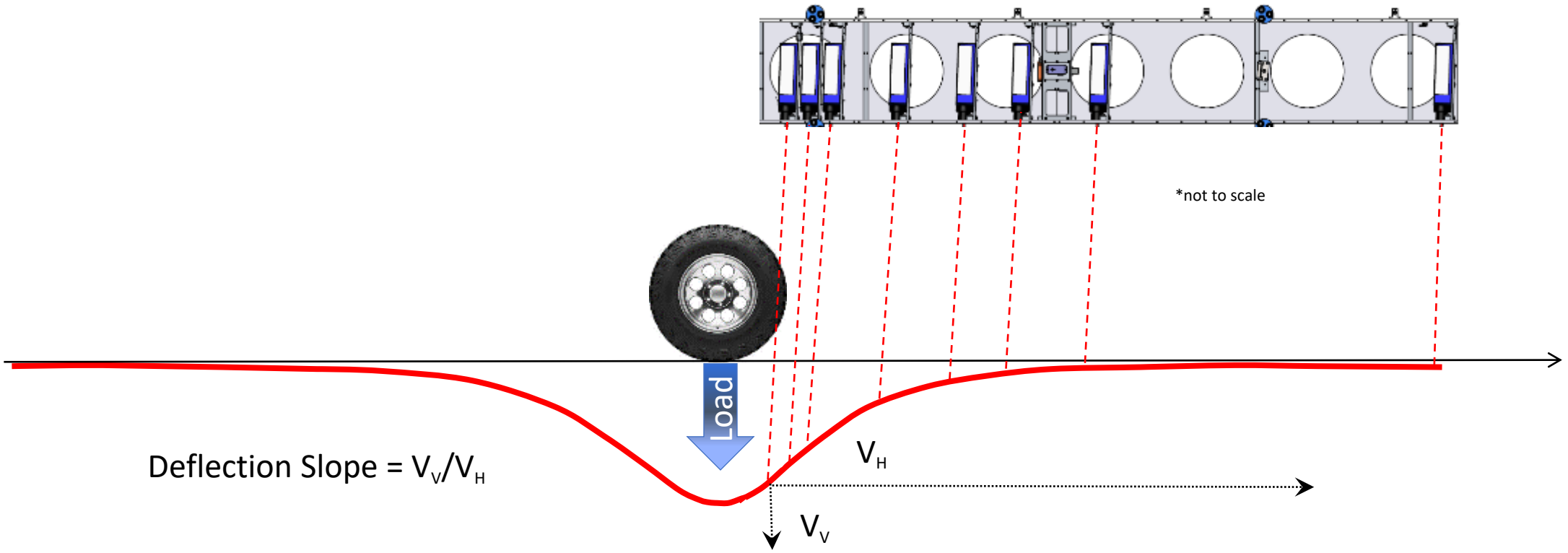
+ GNNS DGPS
geospatial location

+ Geometry
Crossfall, Grade, Horizontal & Vertical curvature

+ Digital Imaging System

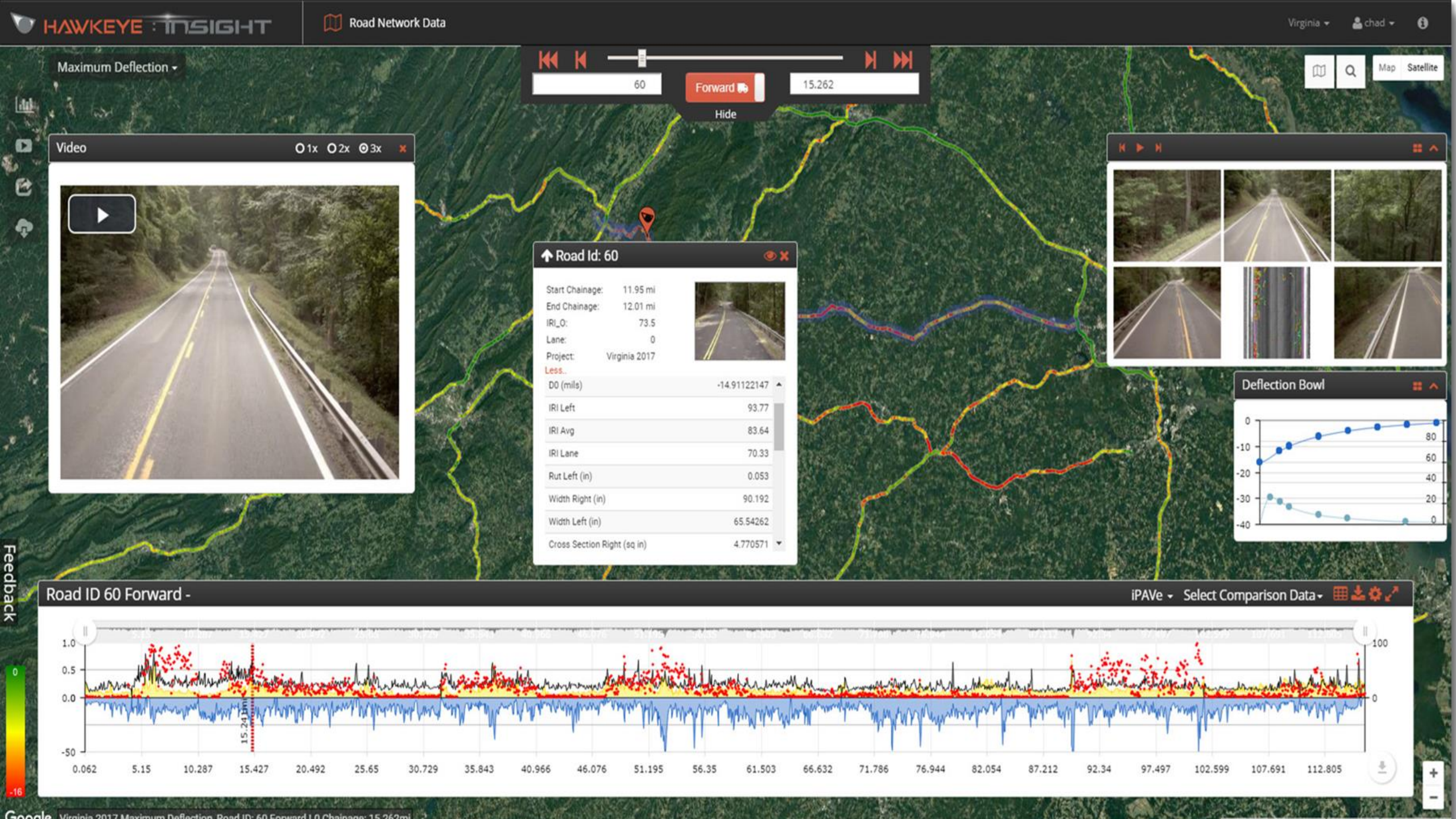
Simultaneous collection of Functional + Structural data = Comprehensive Pavement Assessment

iPAVe Structural Data Collection



iPAVe2 Data Collection Enhancements

- Additional sensors (11 now, 7 previously)
- New Doppler lasers with higher resolution
- Automation of calibration procedures to improve and facilitate data quality
- Camera upgrades to 4K to improve image quality
- DGPS upgrade to improve positioning capabilities
- Ground Penetrating Radar (GPR) to be added in 2022


HAWKEYE : INSIGHT
Road Network Data
Virginia
chad
Maximum Deflection
60
Forward
15.262
Hide
Map
Satellite
Video
1x
2x
3x
Road Id: 60
Start Chainage: 11.95 mi
End Chainage: 12.01 mi
IRI_O: 73.5
Lane: 0
Project: Virginia 2017
Less..
D0 (mils) -14.91122147
IRI Left 93.77
IRI Avg 83.64
IRI Lane 70.33
Rut Left (in) 0.053
Width Right (in) 90.192
Width Left (in) 65.54262
Cross Section Right (sq in) 4.770571
Deflection Bowl
Road ID 60 Forward -
iPAVe
Select Comparison Data
Feedback
Google

Primary Applications for TSD Data

- Help identify “weak” (or structurally deficient) areas that can be then investigated further at the project level
- Differentiate sections that may be good candidates for preservation from those that would likely require a heavier treatment
- Provide network-level data to calculate a “structural health index” that can be incorporated into a pavement management system

Sections Tested in Illinois

- Full-Depth HMA, HMA / Rubblized PCC, HMA / PCC, Unbonded Concrete Overlays, Cold In-place Recycling
- 2014: I-57, I-72, I-74, US 51, IL 29, Champaign CH 1
- 2015: I-39, I-57, I-74, I-72, I-155, US 51, IL 29, IL 130, Champaign CH 1
- 2019: I-57, I-70
- 2020: I-39, I-55, I-57, I-72, I-74, I-155
- 2021: I-55, I-72, I-74, I-474, IL 91
- Limited to approximately 250 miles (1 day of testing)

District 6 I-55 Corridor Study

- Tested southbound I-55 throughout District 6
- Attempted to identify areas with more severe distress (mainly D-cracking) in underlying concrete pavement to help prioritize rehabilitation
- Result – Deflections were low throughout, making it difficult to discriminate between sections
- GPR data could help identify weaker areas?

I-55 “Point of Interest”

Early Observations

- TSD results are repeatable.
- TSD deflections may not match FWD deflections exactly, but trends are similar.
- TSD deflections were observed to be low on all sections with only a few obvious exceptions (such as shoulder measurements or localized failures).
- Pavements with lower CRS values may still exhibit low deflections, indicating surface distress only and no structural failures.

Future Efforts

- Pooled fund study continues through 2023
- Data analysis by U of I under ICT R27-233
- Currently looking for sections to test in summer of 2022
- Could either repeat testing done previously to see if there are any changes or test new sections

Acknowledgement

Jerry Daleiden, P.E.

ARRB Systems

Questions?

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