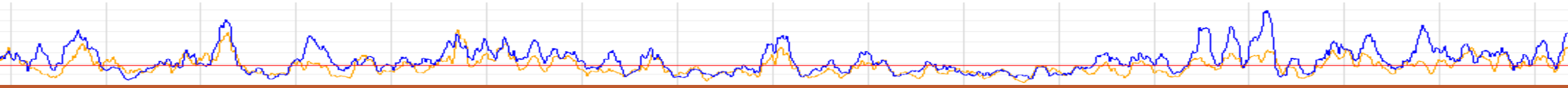
Roadway Profile Testing in North Carolina

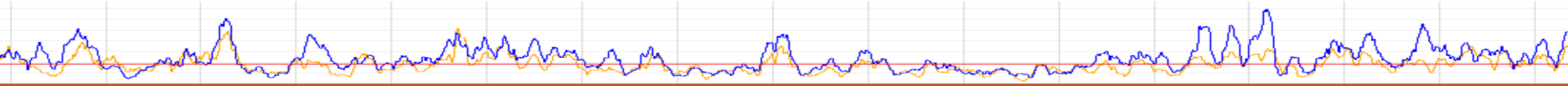
PAST PERFORMANCE AND LESSONS LEARNED

PRESENTED BY CHRISTOPHER BACCHI, TRIMAT MATERIALS TESTING, INC
AND NILESH SURTI, NCDOT



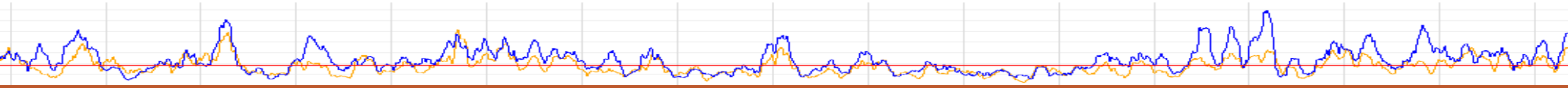
Why is Pavement Smoothness Important?

- Pavement Smoothness is important to the User (taxpayer, driver, etc.) – Research has shown that smoothness is the primary variable used by the public to judge the quality of roadways
- ***Smoother roads last longer*** – NCHRP, FHWA and NAPA research on newly constructed pavements
- ***Smoother roads are safer*** – increased roughness results in higher friction loss
- ***Smoother roads save money*** – lower fuel consumption and less maintenance costs for users

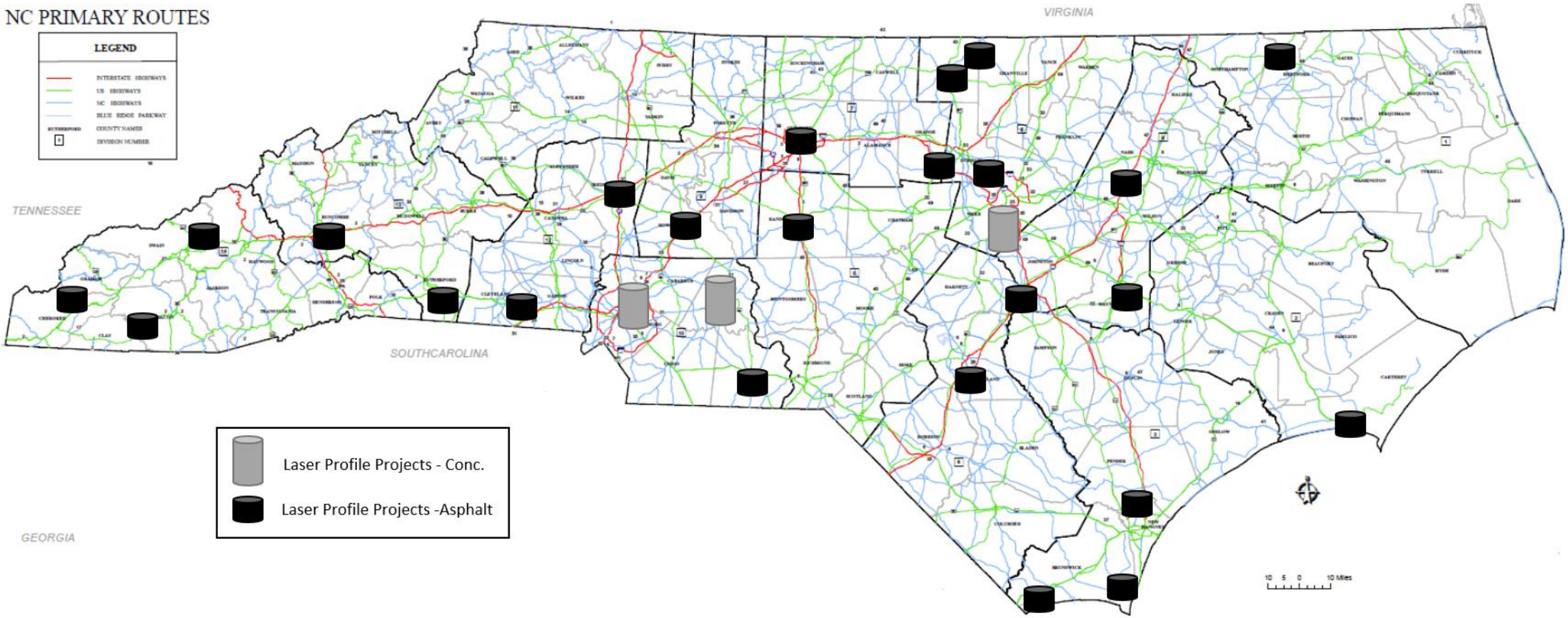


Definitions

- Inertial Profiler – Device that utilizes an accelerometer to measure accelerations, a laser transducer to measure distance (or height), and DMI (or GPS) to measure longitudinal distance
- International Roughness Index (IRI) – A mathematic transformation of a true road profile presented in units of slope (in/mi). (80's, NCHRP, World Bank)
- Mean Roughness Index (MRI) – Average of two wheelpath IRI measurement
- Localized Roughness (LR) - Isolated areas of roughness, which by themselves can cause a significant increase in the overall reported smoothness index.
  - *LR is a constant moving average of the IRI and indicates what the overall section IRI will be*

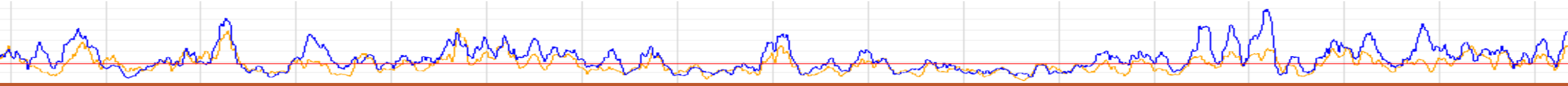


Some Projects In NC



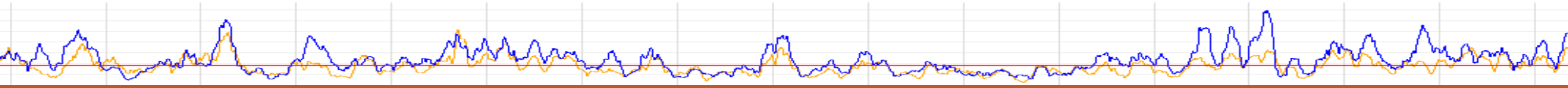
Project and Mix Types Where IRI has been Performed

- All surface mix type, S9.5B, 9.5C, etc
- Open Graded Friction Courses (avg. < 45 in/mi)
- Concrete – diamond ground and plain
- Binder mixes (when final lift is placed in one lift)
- SR Routes where 2 lifts of asphalt are placed
- Interstates
- NC Routes
- US Routes
- Airports (PI)
- Federal Roadways
- Bridges (<100 in/mi)



NCDOT Specification Review

- Where is Final Surface Testing (FST) required?
- Required on **Asphalt Pavement** when:
  - 2 or more lifts of asphalt
  - Speed limit is > 45 mph
  - Map length is > 1 mile
  - Contractor still has the option to do HEARNE Straightedge!
  - Intent is on **Mainline Pavement including AUX and CD travel lanes** only!
  - <u>NOT REQUIRED:</u>
    - SR routes
    - Where it is **NOT PRACTICAL! – Examples:** Pre-existing subgrade conditions like soft soils or alligator cracking, multiple driveways, Y-lines, crossovers, number of utilities.



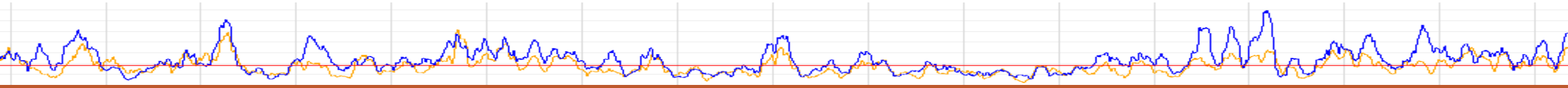
NCDOT Specification Review

- Where is Final Surface Testing (FST) required?
  - Required on **Concrete Pavement** when:
    - New concrete pavement
    - **Mainline + Auxiliary + Collector/Distributor travel lanes**
    - Diamond ground concrete pavement - SP shows that IRI testing needs to be done

NCDOT Specification Review (cont.)

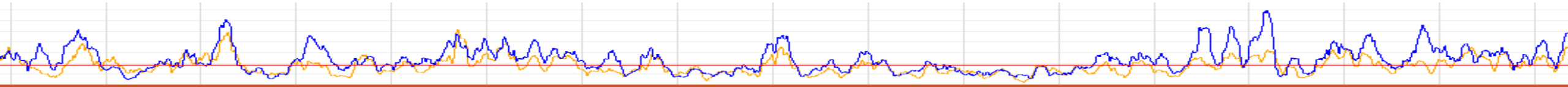
- Same spec for concrete and asphalt with the exception of Hearne
- ProVAL is the free program used to analyze the data
- Smoothness numbers for every 528-ft (0.10 mile) in Table 610-7
- MRI is average of IRI numbers in both wheelpaths

TABLE 610-7 MRI PRICE ADJUSTMENT PER 0.10-MILE SECTION	
MRI after Completion (Inches Per Mile)	**Price Adjustment Per Lane (0.10-Mile Section)**
45.0 and Under	$200.00
45.1-55.0	PA = 600 – (10 * MRI)
55.1-70.0	Acceptable (No Pay Adjustment)
70.1-90.0	PA = 650 – (10 * MRI)
Over 90.1	Corrective Action Required



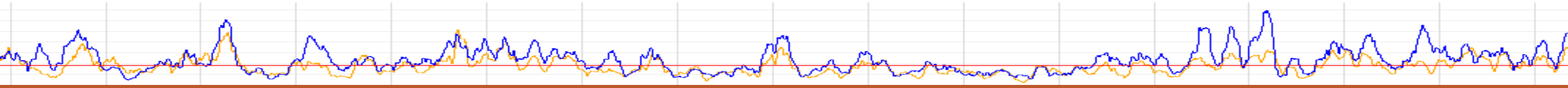
NCDOT Specification Review (cont.)

- Same spec for concrete and asphalt with the exception of Hearne
- Localized roughness
  - Checking for “bumps in 25-ft sections”
  - Program checks along the entire roadway in 25-ft continuous sections
  - Identifies all bumps where smoothness number is **165 in/mile or greater**
  - This is a separate report in ProVAL called the “SAM” report
  - Consultant will submit these results in their FINAL REPORT
  - Contractor MUST discuss corrective action with RE
  - RE will approve locations that need corrective action
  - RE will apply Pay Adjustment on non-corrective action locations as necessary using the formula **(LR = (165-LR)*5)** provided in the Asphalt Superpave Special Provision

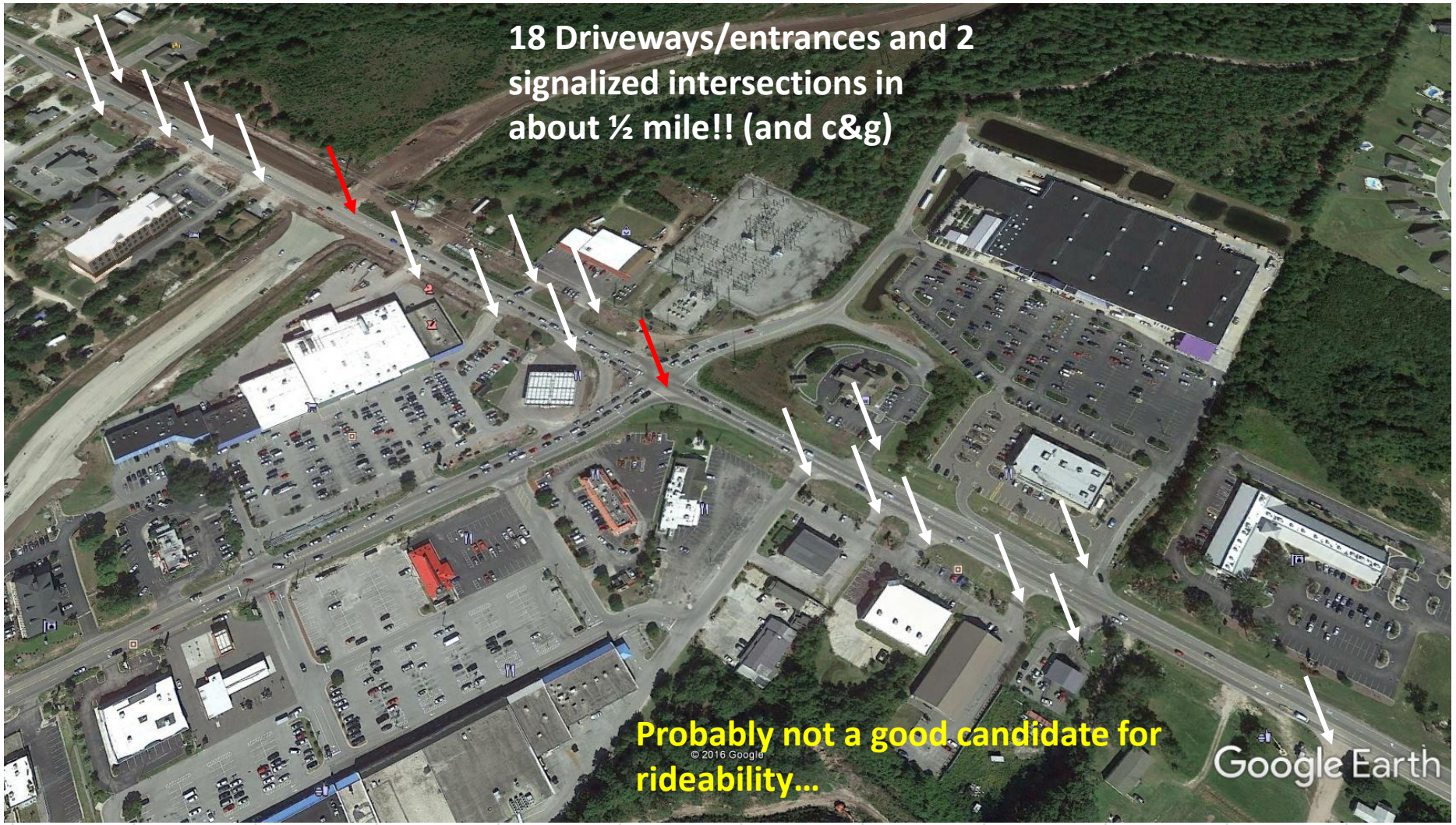


Process for IRI Testing - Contractor

- Confirms testing is required (spec. review)
- Reviews feasibility on all project roadways
  - Y-line – case by case basis
  - Ramps, Loops, transitions – not to be tested!
- Discusses any concerns with NCDOT – Important
- **Submit Plans and or KML files to profiler**
- May perform internal QC on ride quality on initial lifts (binder or surface)
  - Use Hearne
  - “Seat of Pants”
  - Schedule preliminary IRI testing for informational purposes
- Repair areas with high Localized Roughness – Corrective Action (discuss later)
- Run Final Surface test



Some Considerations…..



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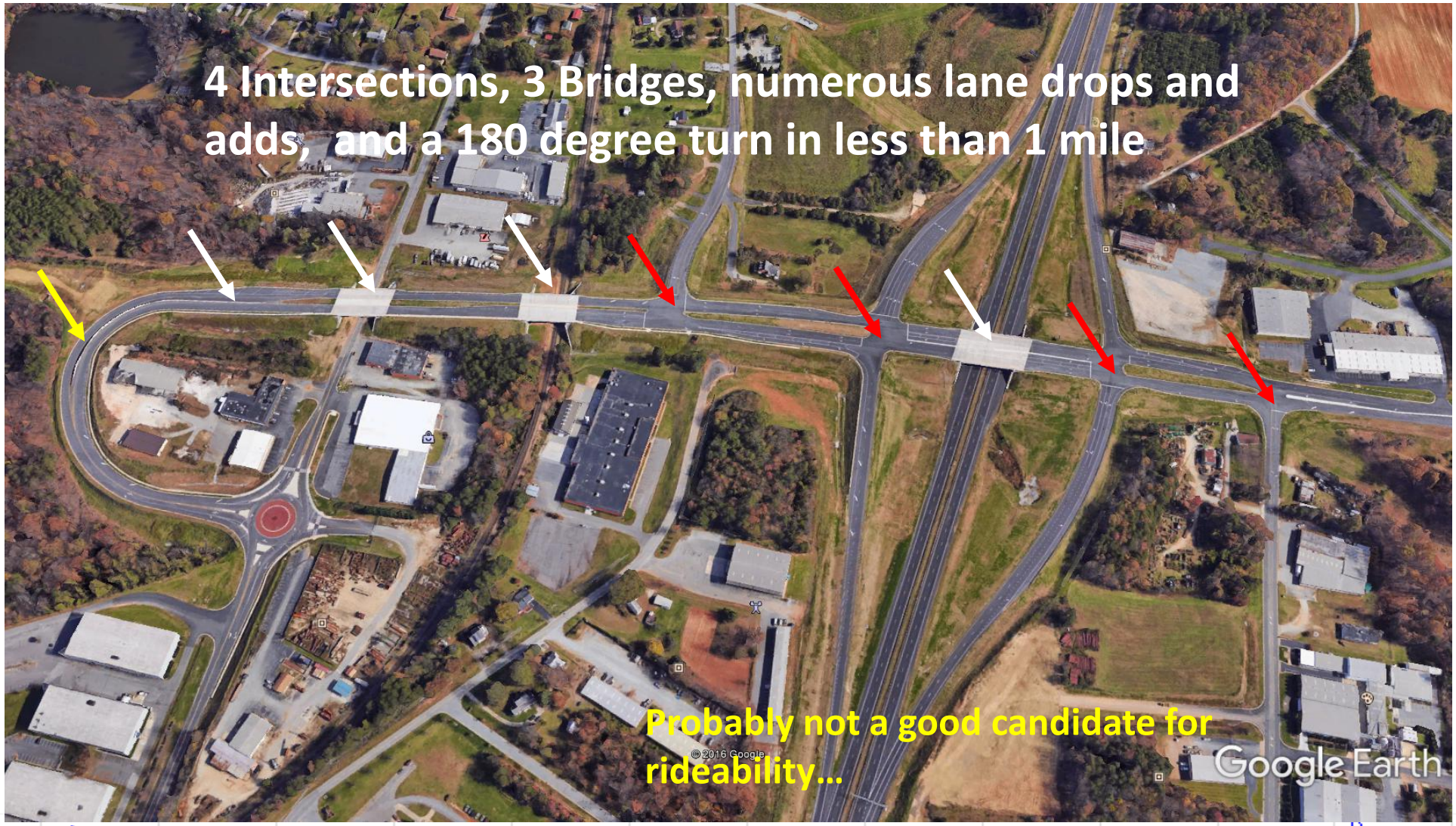
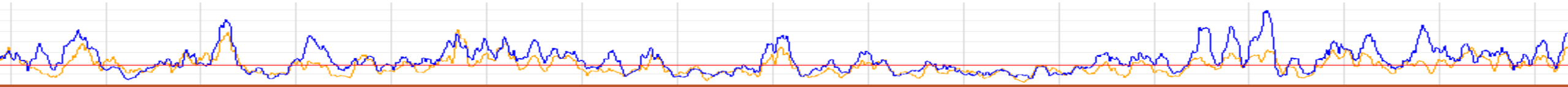


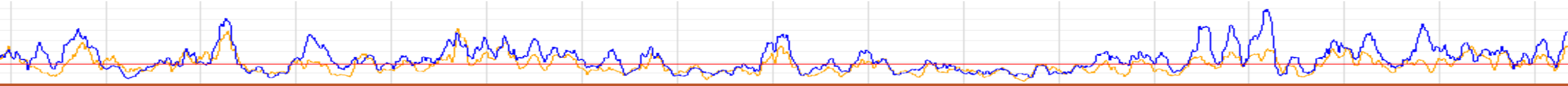
Process for IRI Testing – NCDOT

- Confirm with Contractor that testing is required (spec. review)
- Reviews feasibility on all project roadways
  - Y-lines, Ramps, Loops, CD lanes, transitions, curb and gutter, short sections
- Ride the Roadway and use “seat of pants” judgment as a start and note concerns
- Ensure NCDOT is aware of date of testing and onsite during testing
- Receive raw test results when testing is complete (thumb drive)
- RE receives final report from Contractor



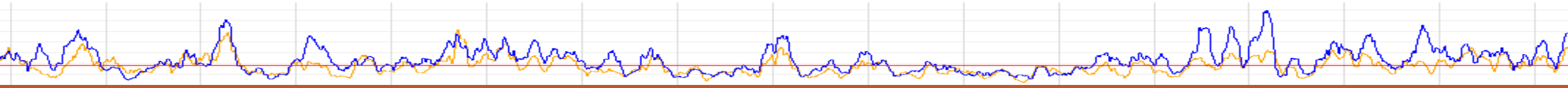
Process for IRI Testing – NCDOT (cont)

- Submit report and raw data to Pavement Management
- NCDOT Resident and Pavement Management (PMU) review report
- PMU will run ProVal on raw data and compare results to Contractor submitted final report
- Resident will verify incentive/disincentives
- Resident will verify “corrective action” locations
- Meeting with Contractor to discuss corrective action locations
- Contractor will propose corrective action measures
- ***Resident must approve all locations that need corrective action and corrective action repair methods!***



Process for IRI Testing – NCDOT and Contractor

- Contractor performs corrective action (grinding, mill and fill, etc.)
- IRI is re-run on corrected sections
- If action is unsuccessful, Resident will decide on pay adjustment or require additional corrective action to be taken
  - Formula: PA = (165-LR) x 5
- Resident determines final pay adjustment



Process for IRI Testing – NCDOT (cont)

- Sample report, MRI tables:

LWP IRI

RWP IRI

Calc Based on 610-7

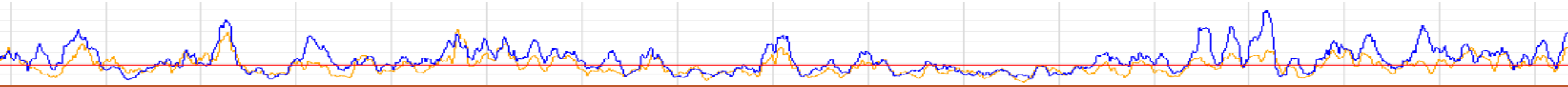
Any visible anomalies

Avg or MRI

Reference Station	Start Sta.	Stop Sta. (ft)	Length (ft)	ODS 1 (RoLine3K) - IRI (in/mi)	ODS 2 (RoLine3K) - IRI (in/mi)	MRI, (in/mi)	Incentive/ Disincentive	Comments
	0	528	528	131.67	116.88	124.28	Corr Action Req	Single Lift
	528	1056	528	93.55	78.60	86.08	$ (210.76)	Water Valve
	1056	1584	528	104.49	112.56	108.52	Corr Action Req	
	1584	2112	528	109.63	91.80	100.72	Corr Action Req	Old Intersection
	2112	2640	528	66.35	54.12	60.24	No Pay Adj	
	2640	3168	528	64.65	51.03	57.84	No Pay Adj	
	31	6	528	61.00	49.70	55.35	No Pay Adj	
	36	4	528	61.47	63.72	62.60	No Pay Adj	
	42	2	528	51.30	70.04	60.67	No Pay Adj	
	47	0	528	66.84	49.55	58.20	No Pay Adj	Culvert
	52	8	528	58.72	57.95	58.34	No Pay Adj	
	58	6	528	67.76	67.66	67.71	No Pay Adj	Intersection
	6336	6750	414	70.23	74.72	72.48	$ (74.75)	Intersection
					AVG	74.85	$ (285.52)	

Project Stations – if plans and KML files are provided!

Start and Stop stations – Not Project Stations!



Process for IRI Testing – NCDOT (cont)

- Sample report, LR tables:

WB Lane 1 LWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)	Comments
2082	2116	34	238.51	Sta 92+50 LLT

WB Lane 1 RWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)	Comments
3727	3754	26	210.47	Sta 69+00 LMED
4278	4300	22	177.34	Sta 65+50 LMED
516	546	31	190.06	Sta 50+00 LMED

WB Lane 2 LWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)
none			

WB Lane 2 RWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)
none			

WB Lane 3 LWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)	Comments
none				

WB Lane 3 RWP

Start Distance (ft)	Stop Distance (ft)	Distance (ft)	IRI (in/mi)	Comments
none				

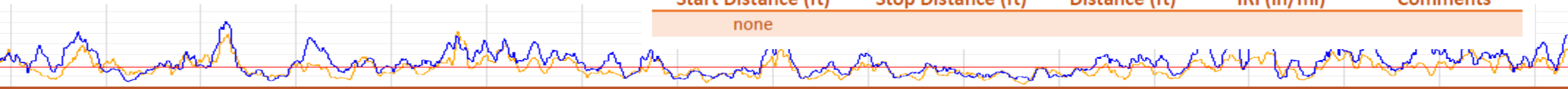
Wheelpath Description

Start and Stop stations – Not Project Stations!

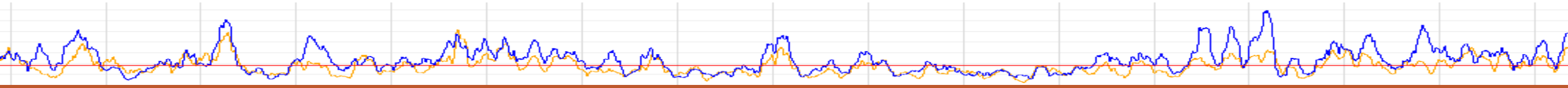
Project Stations and/or anomalies

Length of localized roughness

IRI values for LR section

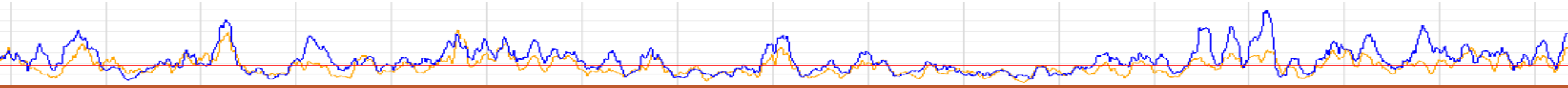


Google Earth file - KML



Current Issues Going Forward

- Current NCDOT certification and calibration (?)
- Elimination of curb and gutter sections
- Percent improvement spec for re-surfacing



Lessons Learned

- Not a lot experience with IRI across the state
- Understanding of raw data limitations
- Corrective action is difficult when LR is below 200 in/mi
- Some projects apply IRI specification blindly