NORTH CAROLINA
Department of Transportation

SHRP2 – NDE Peer Exchange

David Snoke

1/31/19

Bridge Site Selection

Criterion:

- Three structures
- Decent amount of deck deterioration
- Relatively near each other
- No significant traffic control required

Goals:

- Compare NDE with our typical methods
- Investigate potential for preservation project

Bridge #7

SR Route
163 ft.
4238 sf.

Bridge #14

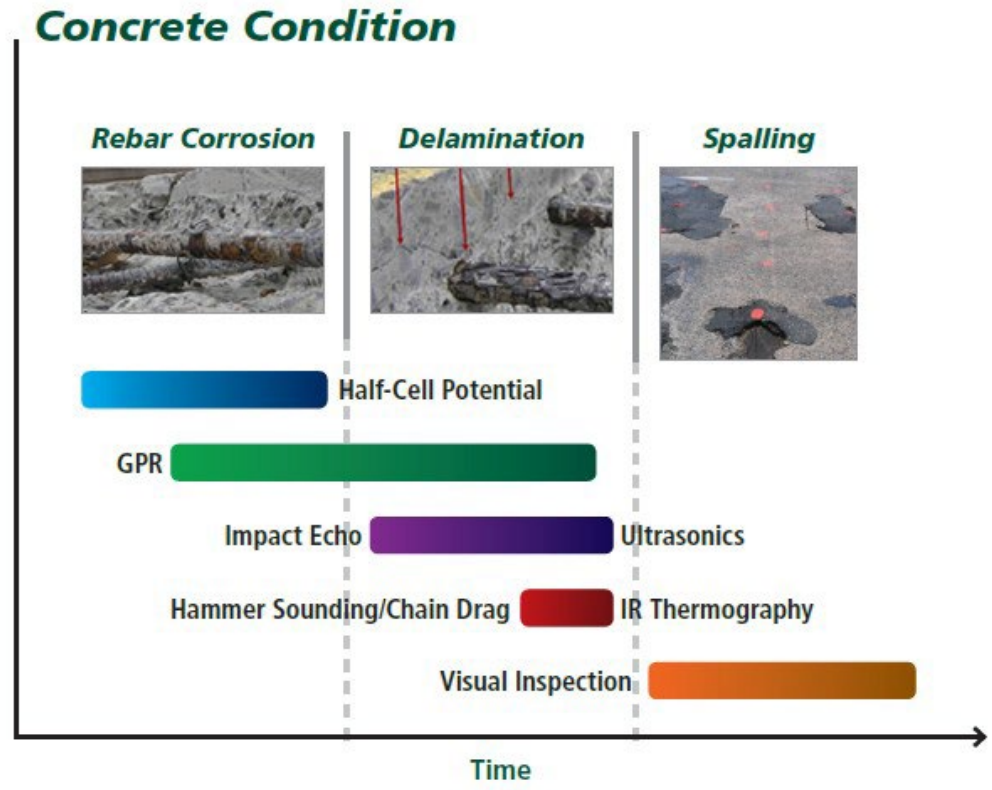
SR Route
244 ft.
8296 sf.

Bridge #18

SR Route
249ft.
13446 sf.

Gannett Fleming, BDI, and Infrasense

- Phase I high-speed scanning surveys to quantify and map concrete deterioration, delamination, patching, and spalling:
  - infrared thermography (IR)
  - ground penetrating radar (GPR)
  - high-resolution video (HRV)
- Phase II validation testing:
  - manual chain drag
  - deck acoustic response (SounDAR)
  - chloride penetration testing
  - rebound hammer testing



- GPR - results indicate that 17.4%, 14.4%, and 3.6% of Structures 7, 14, and 18, respectively, have a high probability of deterioration at the rebar level.

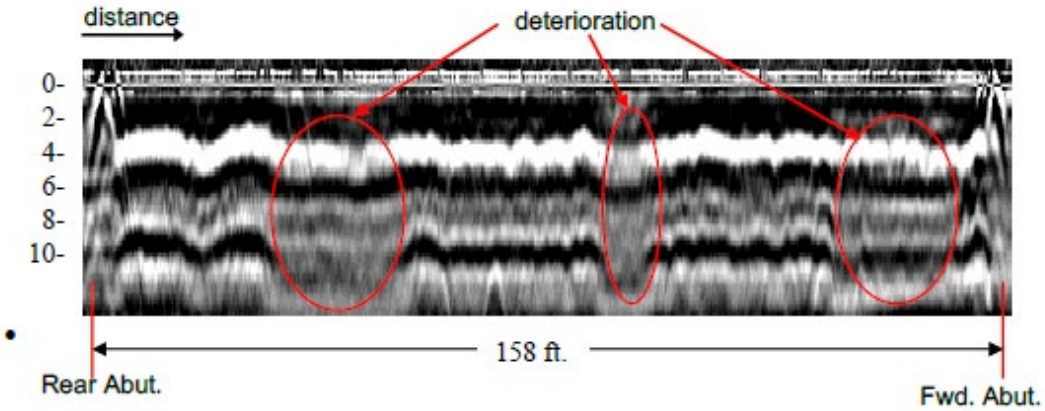


Figure 4 – Sample GPR Bridge Data with Probable Areas of Deterioration

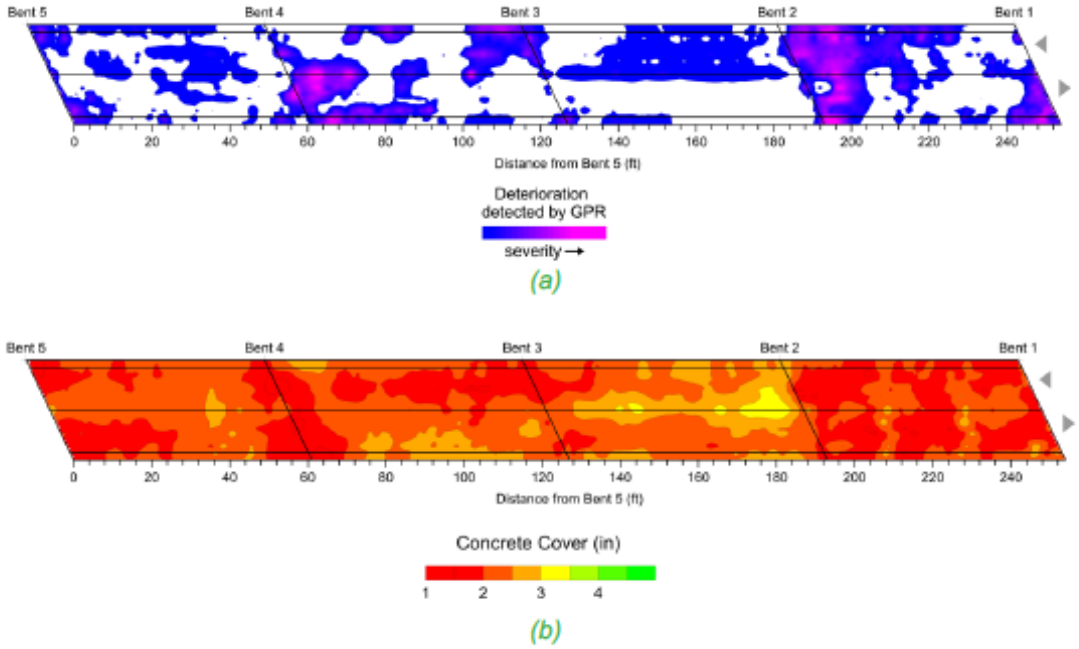


Figure 5 – Sample GPR Bridge Results Identifying Deteriorated Areas (a) and Rebar Cover (b)

- IR and HRV - results indicate that 5.2%, 4.6%, and 2.0% of Structures 7, 14, and 18, respectively, are delaminated.

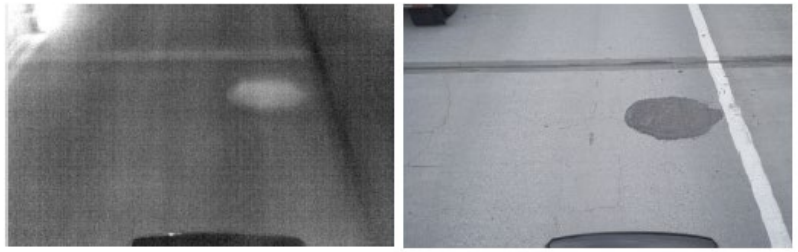


Figure 7 - Sample Infrared and Visual images

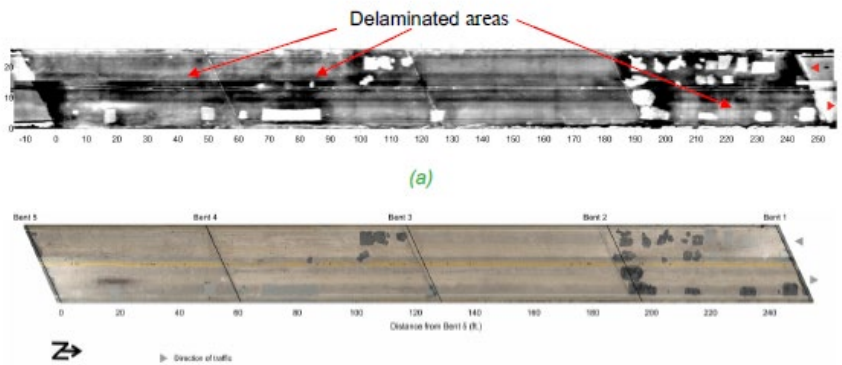


Figure 8 – Sample Stitched (a) IR and (b) HRV Images

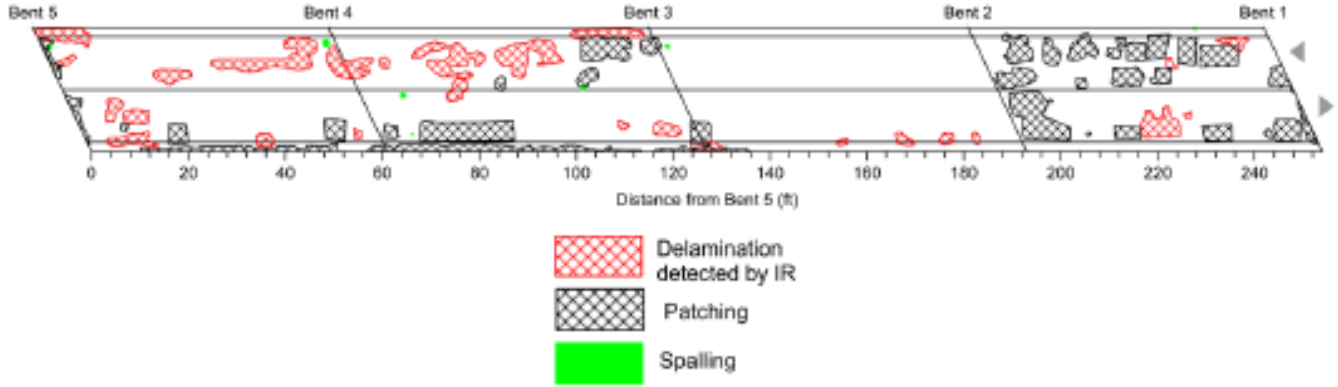
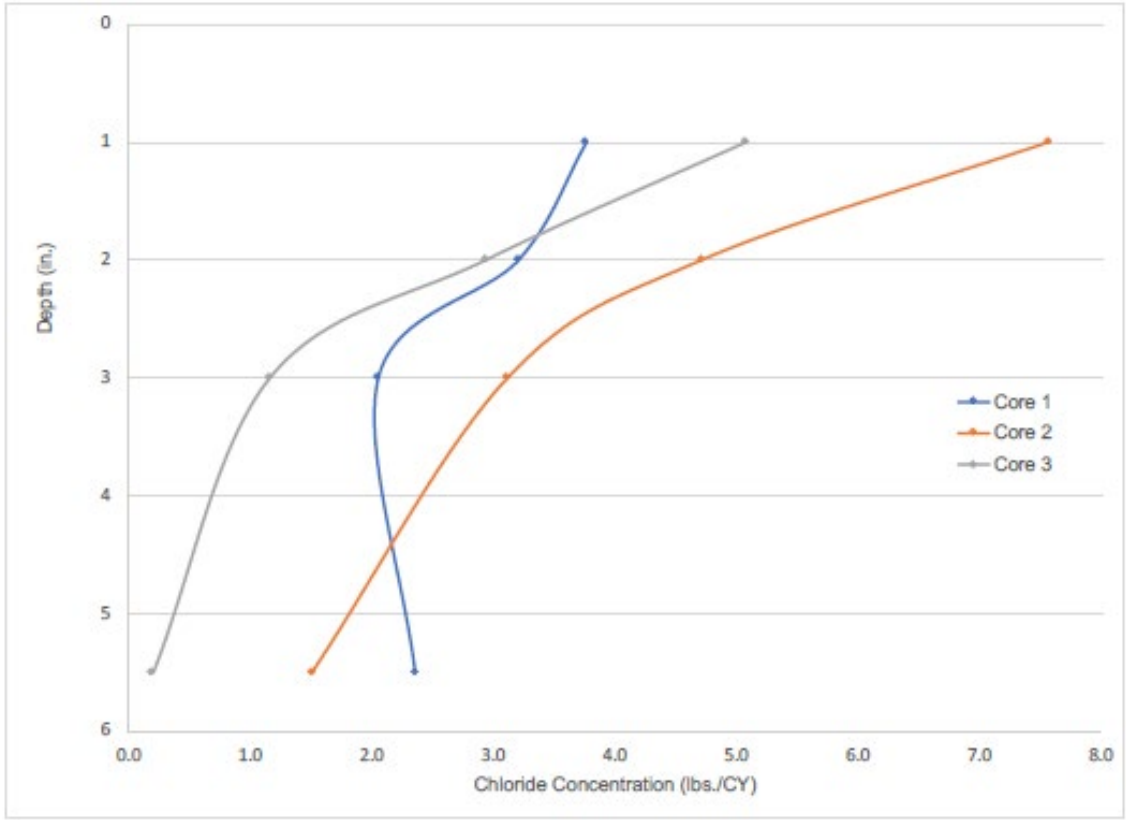


Figure 9 – Sample Finalized Plan Area Map Showing IR Delaminations, Visual Patches, and Spalling

VALIDATION TESTS: Chloride Samples

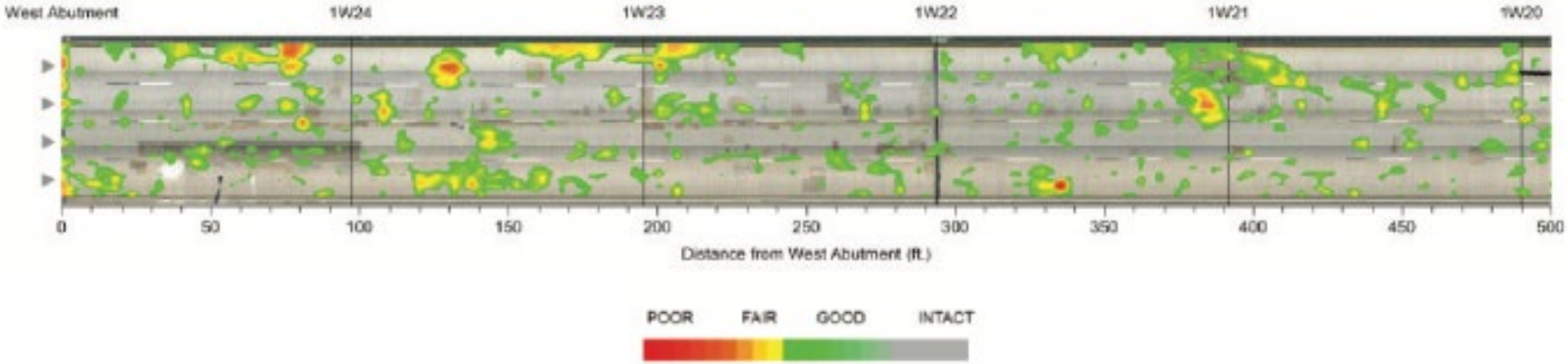
Table 4 – Chloride Ion Penetration Test Results

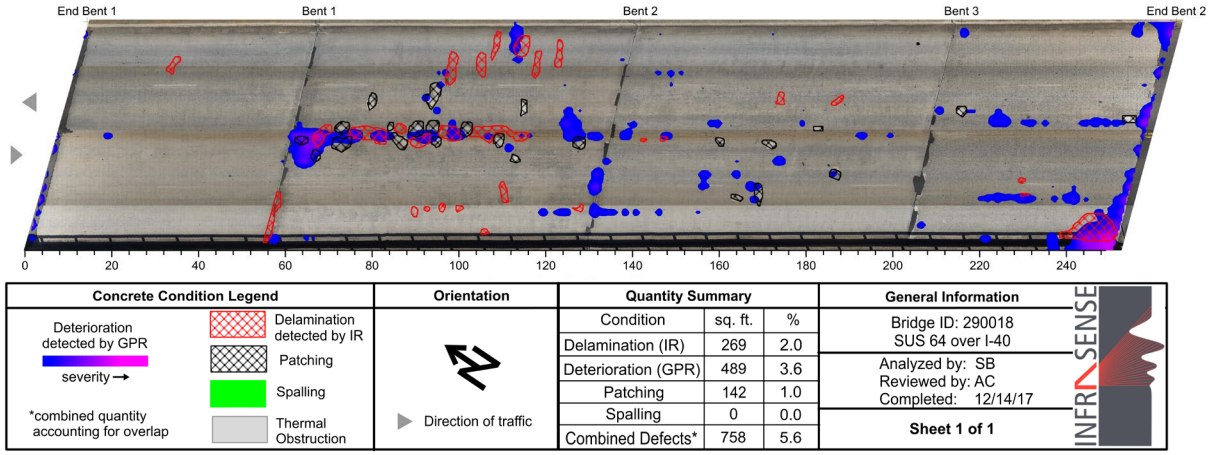
Bridge	Core	Lane Direction	Distance from Near Shoulder (ft)	Distance from Approach Abutment (ft)	Depth (inches)	%Cl by Weight	lbs/CY	Rebar Cover (in)
290007	1	West	5	78	5	0.05	1.85	2.0
					3	0.05	2.09	
					2	0.09	3.55	
					1	0.04	1.50	
	2	East	4	140	5	0.01	0.20	2.5
					3	0.02	0.95	
					2	0.05	2.01	
					1	0.10	4.01	
	3	East	7	50	5	0.04	1.73	3.0
					3	0.03	1.35	
					2	0.04	1.46	
					1	0.04	1.69	
290014	1	South	8	90	5.5	0.06	2.36	2.0
					3	0.05	2.06	
					2	0.08	3.21	
					1	0.09	3.77	
	2	South	9	156	5.5	0.04	1.51	1.5
					3	0.08	3.12	
					2	0.12	4.72	
					1	0.19	7.57	
	3	South	8	168	5.5	0.01	0.20	1.5
					3	0.03	1.16	
					2	0.07	2.95	
					1	0.13	5.09	
290018	1	South	4	248	6	0.01	0.27	1.0
					3	0.07	2.72	
					2	0.07	2.99	
					1	0.13	5.31	
	2	South	10	168	6	0.00	0.13	2.3
					3	0.04	1.58	
					2	0.06	2.58	
					1	0.14	5.56	
	3	South	10	30	6	0.01	0.20	3.0
					3	0.06	2.33	
					2	0.10	3.93	
					1	0.18	7.14	



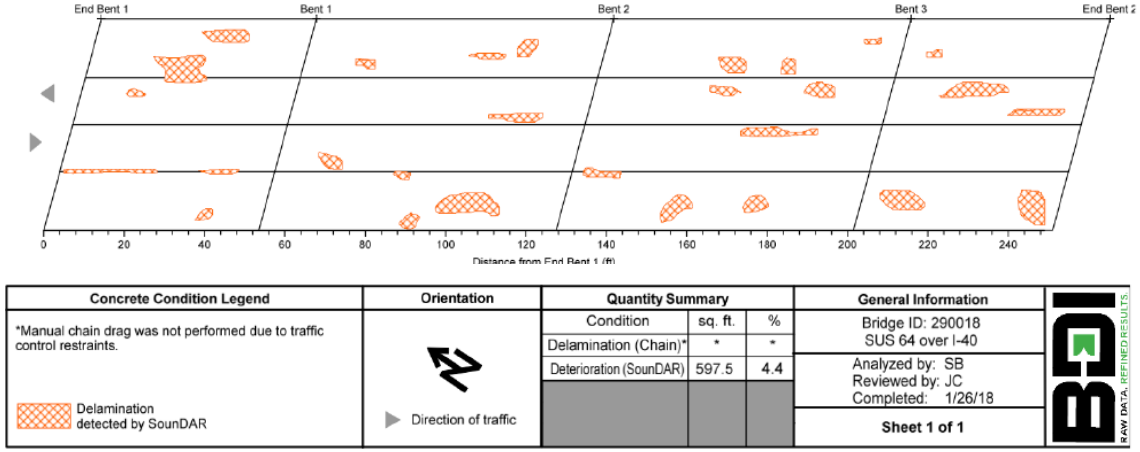
Chloride Ion Penetration - results indicate that Structures 7, 14, and 18 had max chlorides of 4.01, 7.57, and 7.14 lbs./CY, with 33%, 75%, and 67%, having concentrations over 2.0 lbs./CY.

- Sounding – Manual chain drag and SounDAR. Results show indications of delamination.

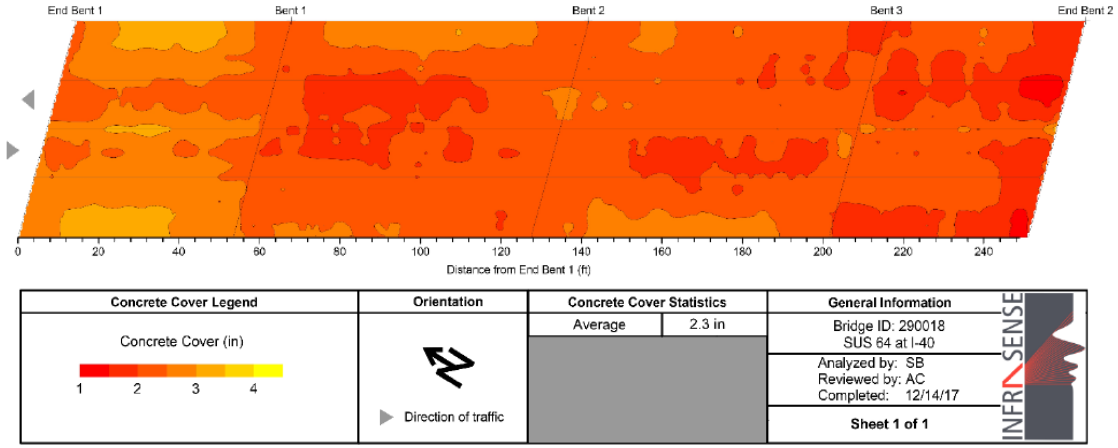




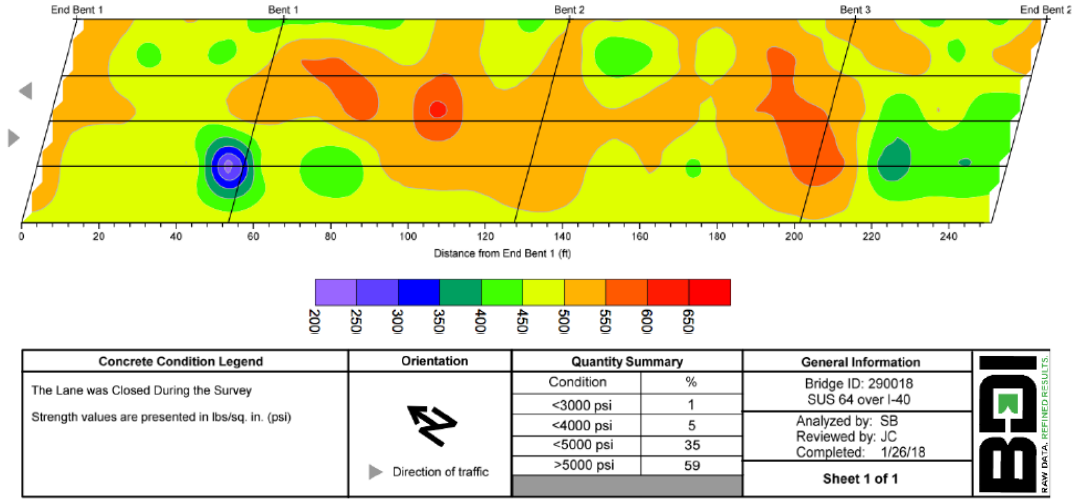
GPR and IR (Concr. Defects)



SounDAR (Delaminations)



GPR (Concrete Cover)



Impact Hammer (Conc Strength)

AS-BUILT REPAIR QUANTITY TABLE		
TOP OF DECK REPAIRS		
	ESTIMATE	ACTUAL
SCARIFYING BRIDGE DECK	1,435 SY	
CLASS II SURFACE PREPARATION	59.2 SY	
CLASS III SURFACE PREPARATION	0.5 SY *	
CONCRETE FOR DECK REPAIR	177.6 CU. FT.	
HYDRO-DEMOLITION OF BRIDGE DECK	1,435 SY	
LATEX MODIFIED CONCRETE OVERLAY - VES	85.5 CY	
PLACING AND FINISHING LMC-VES OVERLAY	1,435 SY	
GROOVING BRIDGE FLOORS	12,200 SF	

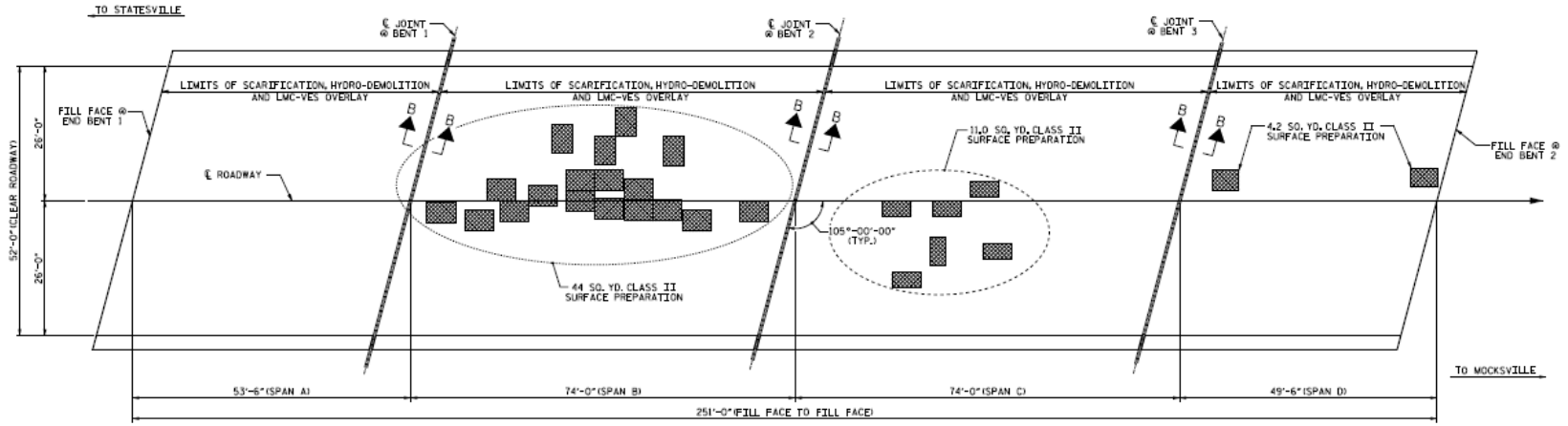
TOP OF DECK REPAIR QUANTITIES REPRESENT ESTIMATED VALUES OF CLASS II SURFACE PREPARATION AND CONCRETE DECK REPAIR FOR LMC-VES OVERLAY AFTER REMOVAL OF UNSOUND CONCRETE. (MIN. 2" CLEAR TO SAWCUT). FOR OVERLAY SURFACE PREPARATION FOR LATEX MODIFIED CONCRETE-VES, SEE SPECIAL PROVISIONS.

NOTES:

REPAIR LOCATIONS AND ESTIMATED QUANTITIES ARE GIVEN WITH THE BEST INFORMATION AVAILABLE. IF ADDITIONAL REPAIRS NOT SHOWN ON THE DRAWINGS ARE DEEMED NECESSARY BY THE ENGINEER, THE ENGINEER WILL NOTE ON THE DRAWINGS THE APPROXIMATE LOCATIONS AND DESCRIPTION OF THE REPAIRS AND ADJUST THE ACTUAL QUANTITIES ENTERED INTO THE AS-BUILT REPAIR QUANTITY TABLE.

FOR SECTION B-B, SEE "JOINT DETAILS" SHEET.

* CLASS III SURFACE PREPARATION IS NOT ANTICIPATED. A TOKEN PAY ITEM IS INDICATED FOR PRICING PURPOSES IN THE EVENT UNANTICIPATED CLASS III AREAS ARE ENCOUNTERED.



PLAN OF SPANS A, B, C AND D

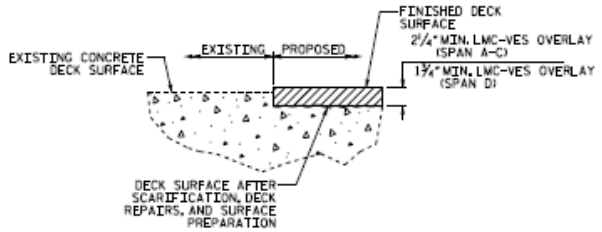
APPROX. CLASS II SURFACE PREPARATION

EPOXY RESIN INJECTION (ERI)

PROJECT NO. I-5823

DAVIE COUNTY

BRIDGE NO. 18



DETAIL OF LATEX MODIFIED CONCRETE OVERLAY

(FINISHED SURFACE OF THE LATEX MODIFIED CONCRETE OVERLAY IS APPROXIMATED)

LMC Overlay Plans

Comparison Table

Bridge #	GPR (% Deterioration)	IR - HRV (% Delam)	Sounding (% Delam)	Chlorides (max lbs/CY)	Chlorides (% > 2lb/cy)
7	17.4	5.2	21.1	4.01	33
14	14.4	4.6	14.4	7.57	75
18	3.6	2.0	4.4	7.14	67

Final Thoughts

- Main Benefits
  - Reduced impact on traffic
  - Impressive amount of data and visualization
- Immediate Uses
  - Scoping of preservation projects for High Value Bridges or when traffic impact needs minimized
- Long Term Possibilities
  - Asset management decision making
  - Potential for NBI Inspections