New Mexico DOT

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SHRP2 R06A
NDT Bridge Decks
= primarily GRP

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special thanks to:
Dr. Manuel Celaya, Advanced Infrastructure Design

NMDOT

Agenda

- Introduction
- Start with the end in mind
- Things of interest
- Executive Summary
- Details / Pretty Pictures
- Conclusions

Why GPR

Existing Equipment

Air Coupled (2 Antenna's)

2Ghz Frequency

Ground Coupled (4 Antenna's, 2/freq.)

400Mhz and 900Mhz Frequency

NMDOT CURRENT EQUIPMENT- SIR 30

Why NMSU

Ground Penetrating Radar (GPR) for Concrete Bridge Deck Evaluation

Daniel E. Diaz
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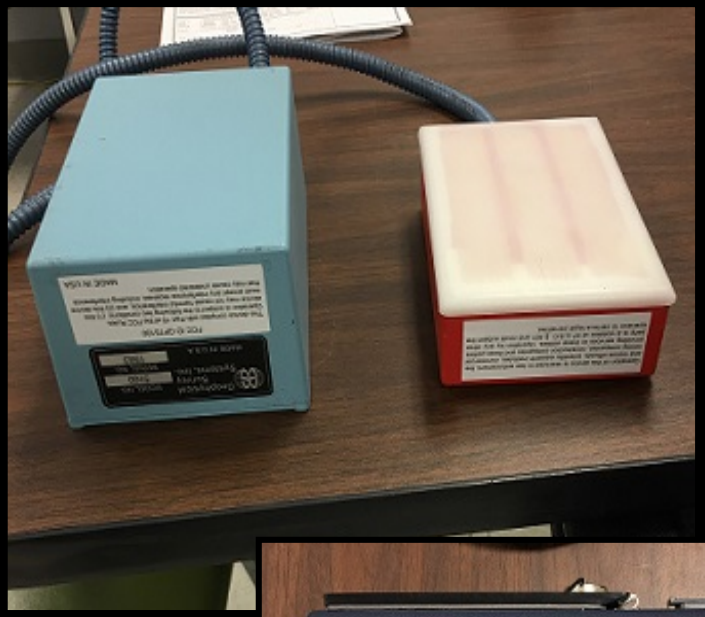
Department of Civil Engineering, New Mexico State University

STRUCTURAL SYSTEMS LABORATORY

NEW MEXICO STATE UNIVERSITY

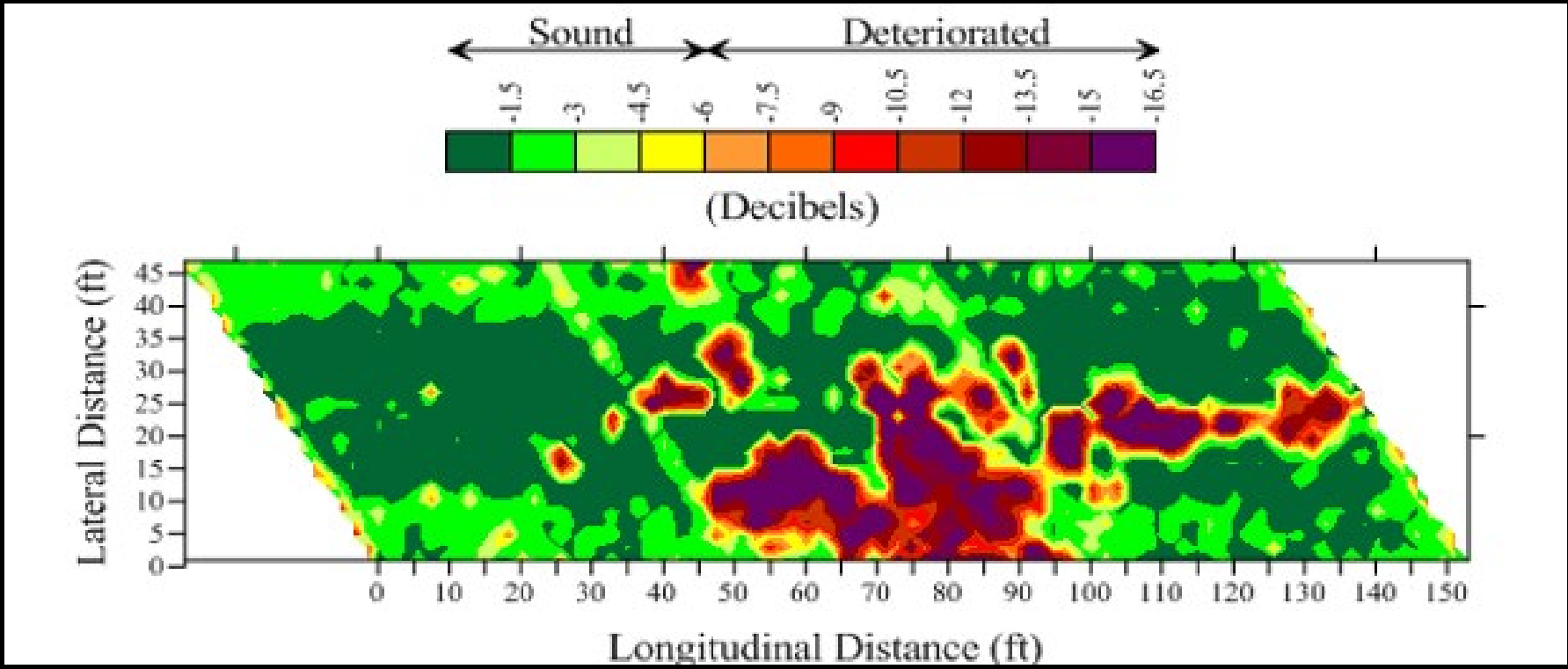
Existing Equipment



start with the end in mind

- At the end of the day, we intended to create a capability that we did not previous have.
- The capability needed to be readily accessible through our bridge inspection contract with NMSU.

pretty pictures = required



Things of Interest

- NMDOT does use chlorides (deicing salts) – but not in the whole state
- Unique and variable deterioration models
- Various and often unintentional overlays

Things of Interest

- Estimating quantities is not very scientific – we pay by actual quantity
- Difficulties in correlating preservation scope and budget

Things of Interest

- $14M in bridge preservation funds controlled by the State Bridge Engineer

Executive Summary

GPR is not the magic bullet

But it has value when applied appropriately

Decision must be project specific (bridge type, data need)

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Nine Bridges

6134

6840

6932

6939

7032

7113

7299

8845

8852

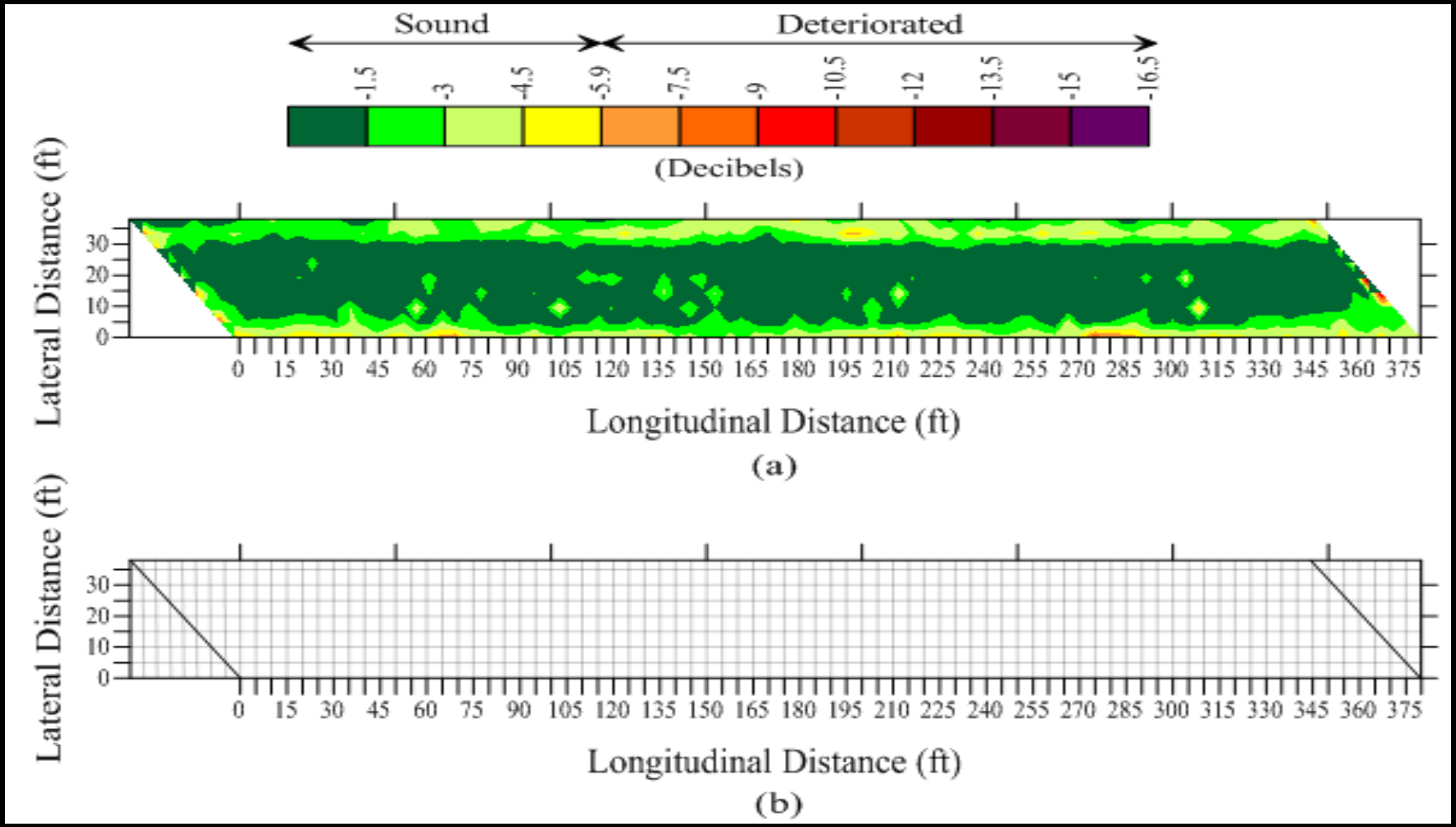
GPR Evaluation Results: Bridge 8845

GPR Evaluation Results: Bridge 8845

- AASHTO Girder

- From most current inspection report:
  - Deck: 7
  - Superstructure: 7
  - Substructure: 7
- Deck inspection reports:
  - Isolated transverse and longitudinal cracks up to 1/32" with light leaching (Underside)
  - Transverse and vertical cracks up to 1/16" with light leaching (Deck edges)

GPR Evaluation Results: Bridge 8845



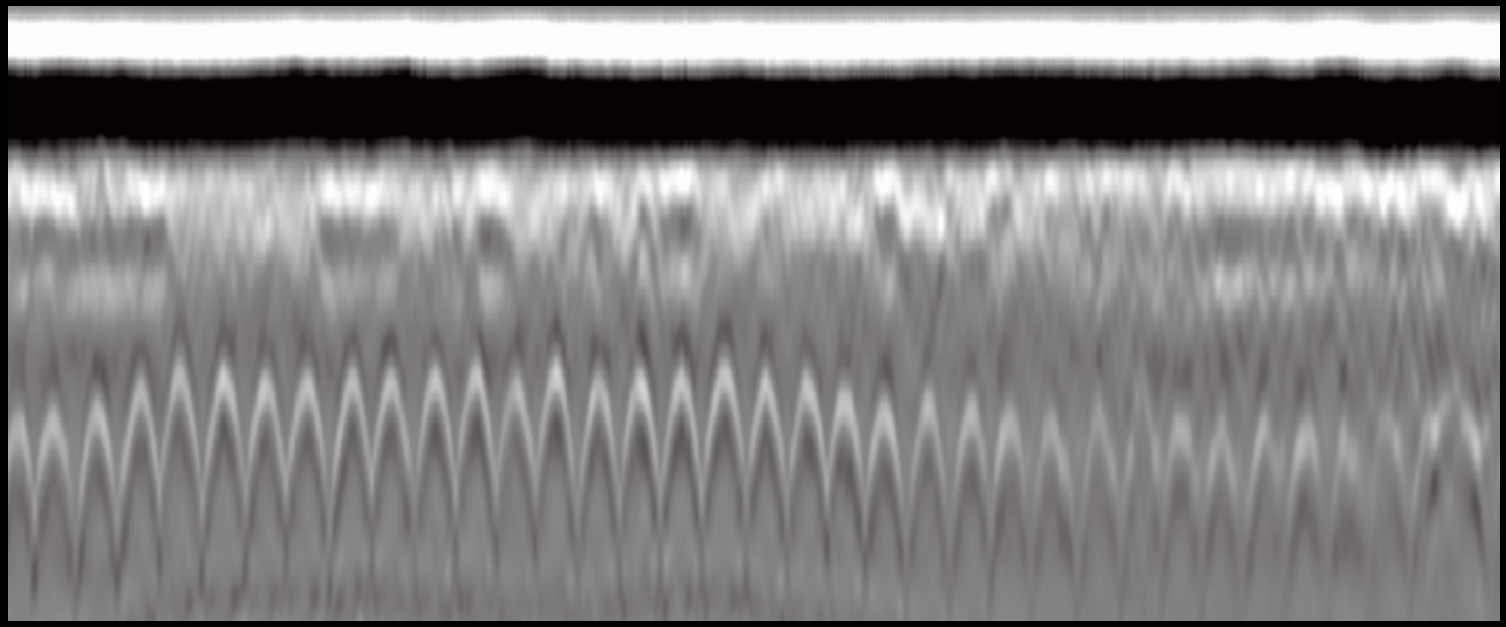
GPR Evaluation Results: Bridge 6840

GPR Evaluation Results: Bridge 6840

- AASHTO Prestressed Girder

- From most current inspection report:
  - Deck: 4
  - Superstructure: 5
  - Substructure: 6
- Deck inspection reports:
  - Transverse and longitudinal cracks up to 1/8” with heavy leaching (deck edges); transverse and longitudinal cracks up to 1/16” with heavy leaching and rust stains near joints

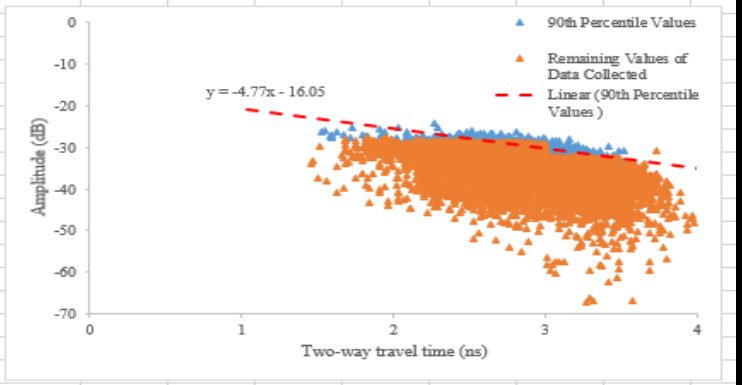
GPR Evaluation Results: Typical B Scan from Bridge 6840

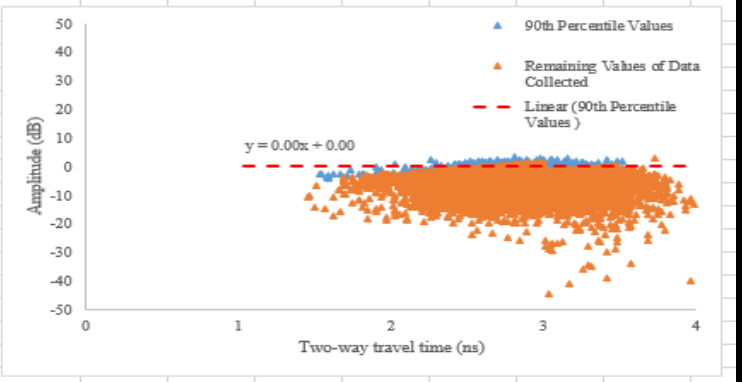


– Reflection amplitudes picks, X and Y location coordinates, and two-way travel time are obtained using Radan 7

GPR Evaluation Results: Excel Processing Bridge 6840

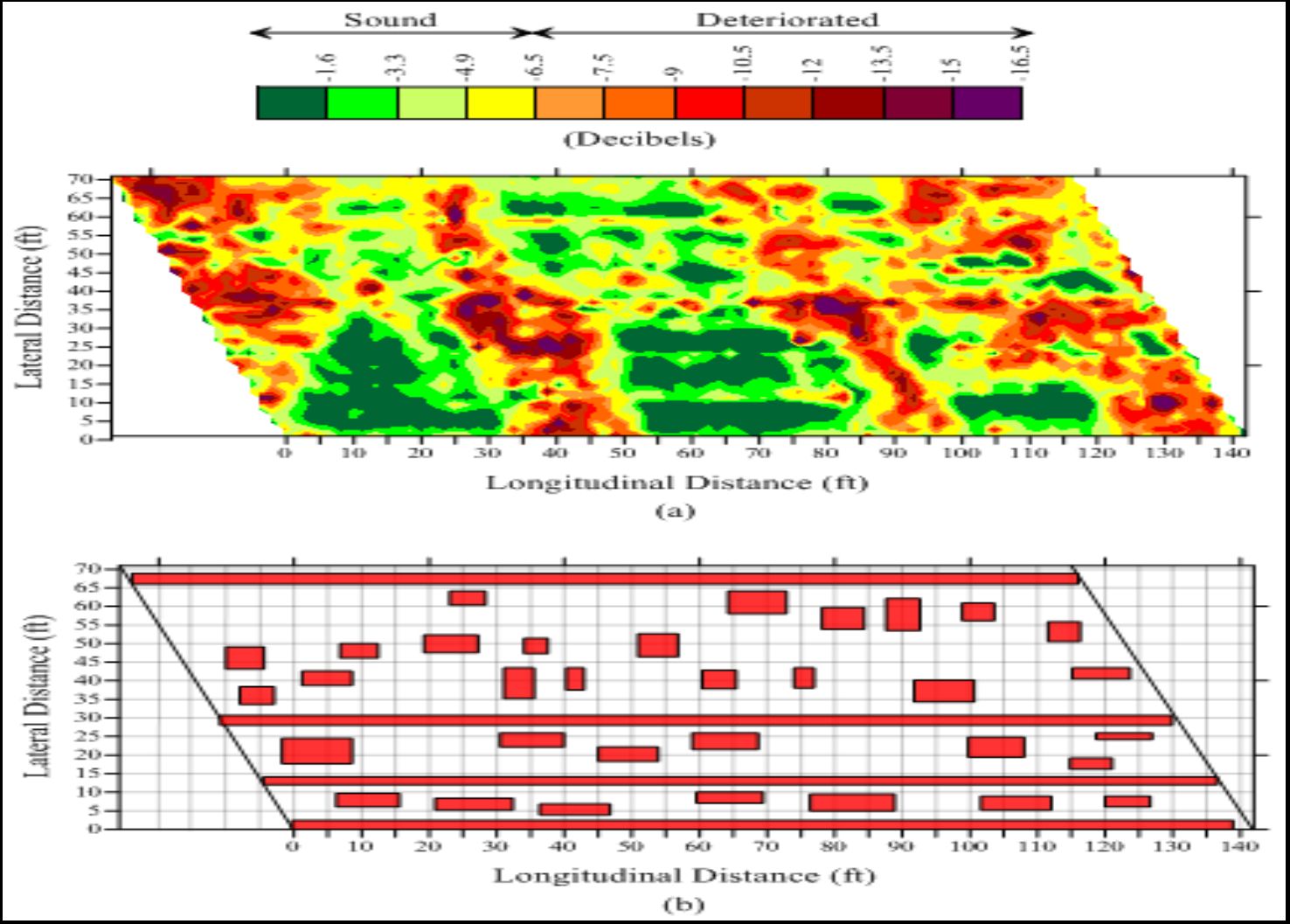
	A	B	C	D	E	F	G	H	I
1	Remaining Values					90th Percentile Values			
2	-23.261	67	-33.8	1.453		loc x	loc y	amp	twtt
3	-22.969	67	-33.13	1.469		52.9327	71	-27.54	1.594
4	111.469	71	-37.36	1.5		33.1322	71	-27.48	1.906
5	20.6257	71	-29.87	1.516		53.8454	71	-27.47	1.719
6	-22.51	67	-38.22	1.563		103.305	71	-27.42	1.578
7	-20.218	67	-40.88	1.625		37.5611	71	-27.31	1.813
8	96.4439	71	-34.45	1.625		21.0602	71	-27.17	1.594
9	105.041	71	-31.9	1.656		46.8062	3	-27.16	1.828
10	112.982	69	-39.63	1.672		46.7175	1	-27.02	1.797
11	104.173	71	-32.36	1.672		36.6495	71	-27.02	1.922
12	106.648	71	-33.79	1.688		51.196	71	-26.89	1.594
13	103.261	71	-30.75	1.688		48.6778	71	-26.85	1.672
14	110.99	71	-30.33	1.688		140.908	3	-26.3	1.938
15	100.699	71	-29.23	1.688		49.5029	71	-26.26	1.625
16	99.831	71	-28.49	1.688		50.3708	71	-26.1	1.531
17	102.479	71	-28.43	1.688		52.0649	71	-25.91	1.547
18	47.1052	1	-27.94	1.688		-24.386	67	-25.47	1.906
19	108.386	71	-33.62	1.703		116.158	71	-25.29	1.734
20	95.575	71	-30.99	1.719		104.837	5	-28.33	2.313
21	105.867	71	-30.99	1.719		85.1171	3	-28.33	2.375
22	111.772	71	-32.27	1.734		68.9948	69	-28.31	2.094
23	112.635	69	-37.24	1.75		73.177	3	-28.29	2.297
24	99.0496	71	-32.42	1.75		-4.27	17	-28.29	2.297
25	4.99363	71	-29.59	1.75		67.9803	3	-28.29	2.328
26	5.90526	71	-29.5	1.75		3.46754	5	-28.28	2.484
27	101.612	71	-29.5	1.75		130.148	23	-28.28	2.5
28	47.8526	71	-28.24	1.75		77.8223	5	-28.27	2.234
29	114.335	71	-31.76	1.766		111.328	7	-28.27	2.484
30	112.641	71	-31.62	1.766		18.0107	5	-28.27	2.5
31	97.2253	71	-29.9	1.766		11.4285	31	-28.27	2.5
32	140.092	3	-32.17	1.781		74.0364	3	-28.23	2.266
33	107.561	71	-32.16	1.781		69.2948	1	-28.22	2.328
34	-20.843	67	-36.26	1.797		67.1642	3	-28.21	2.375
35	139.792	3	-36.21	1.797		64.1239	1	-28.2	2.109





- Information obtained from Radan 7 exported to Excel for further processing

GPR Evaluation Results: Bridge 6840



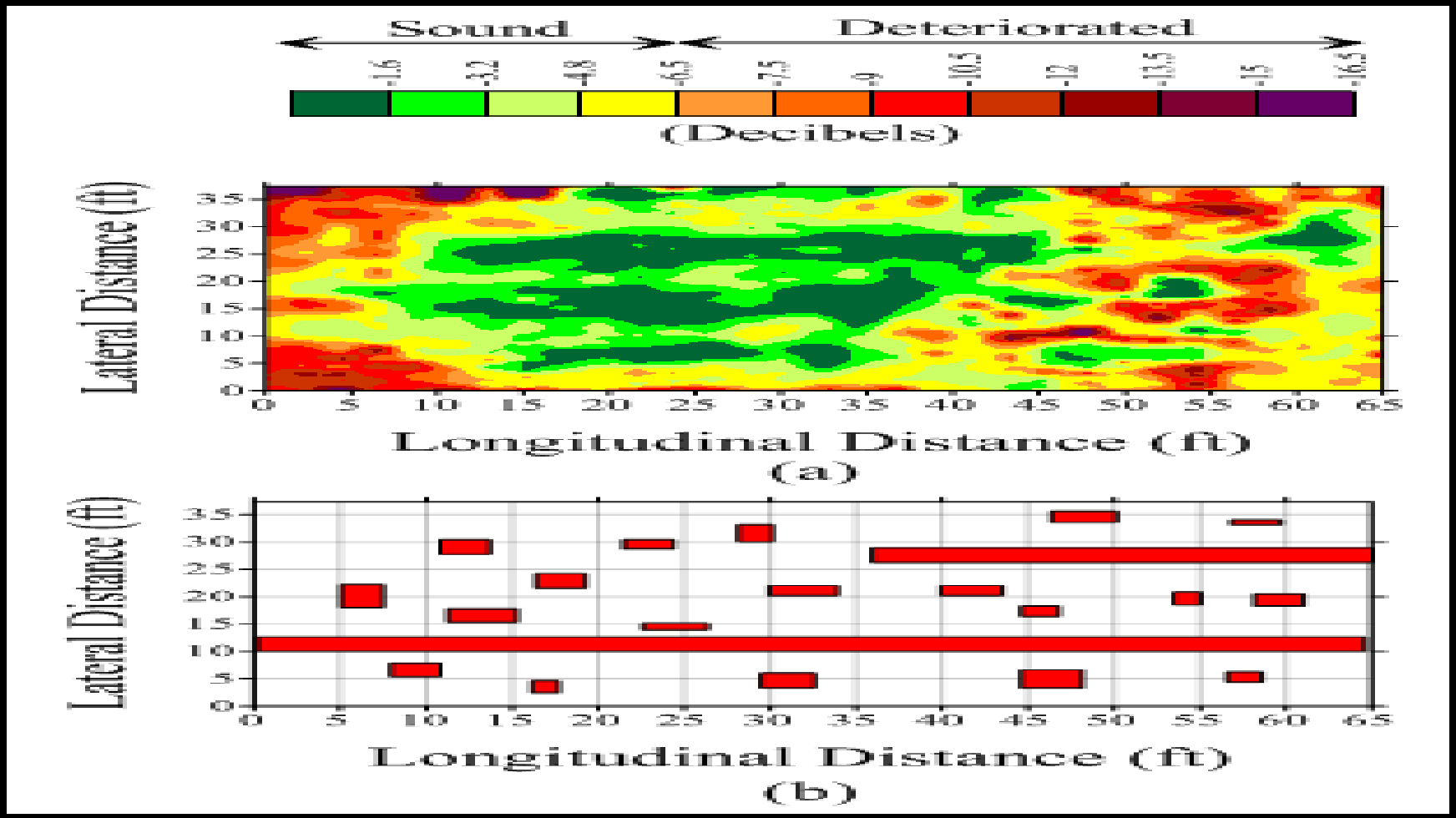
GPR Evaluation Results: Bridge 6932

GPR Evaluation Results: Bridge 6932

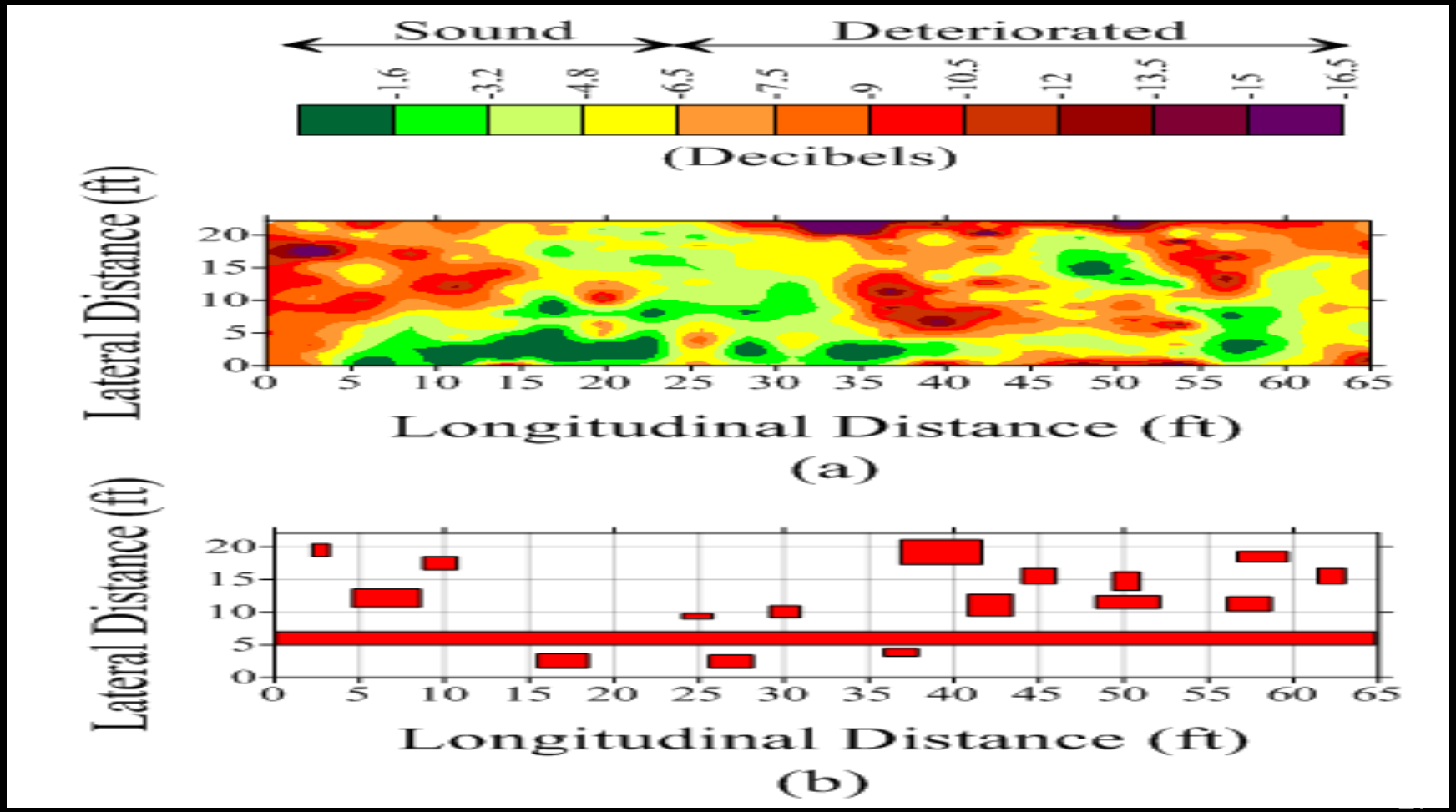
- Concrete Slab Bridge – Asphalt Overlay

- From most current inspection report:
  - Deck: 5
  - Superstructure: 5
  - Substructure: 6
- Deck inspection reports:
  - Vertical, horizontal, transverse and map cracks up to 1/4" (deck edges); transverse and map cracks up to 1/16", areas of moderate leaching, and spalls up to 6" by 5" (Underside)

GPR Evaluation Results: Bridge 6932 (Southbound Lanes and Left Turn Lane)

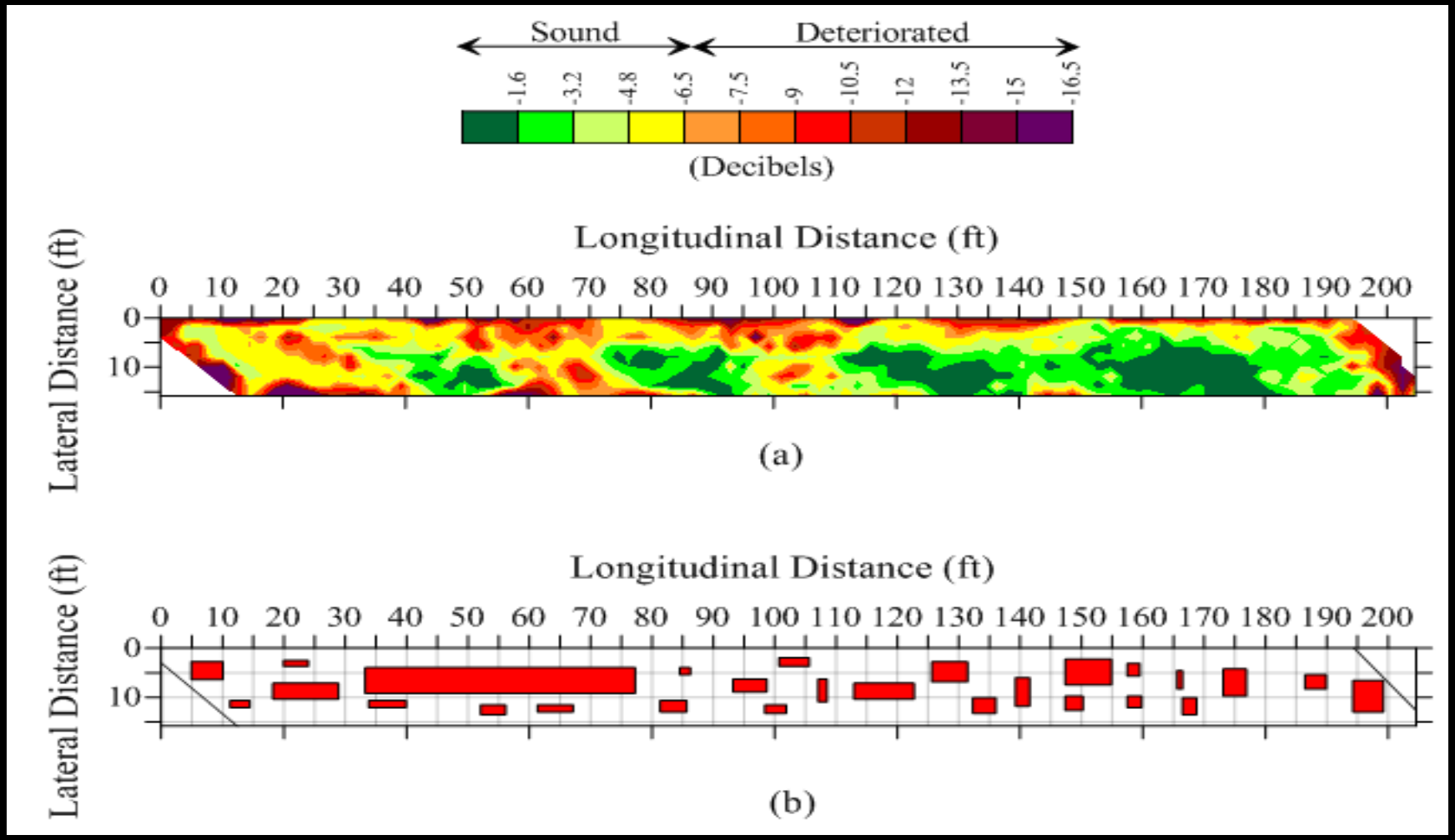


GPR Evaluation Results: Bridge 6932 (Northbound Lanes)

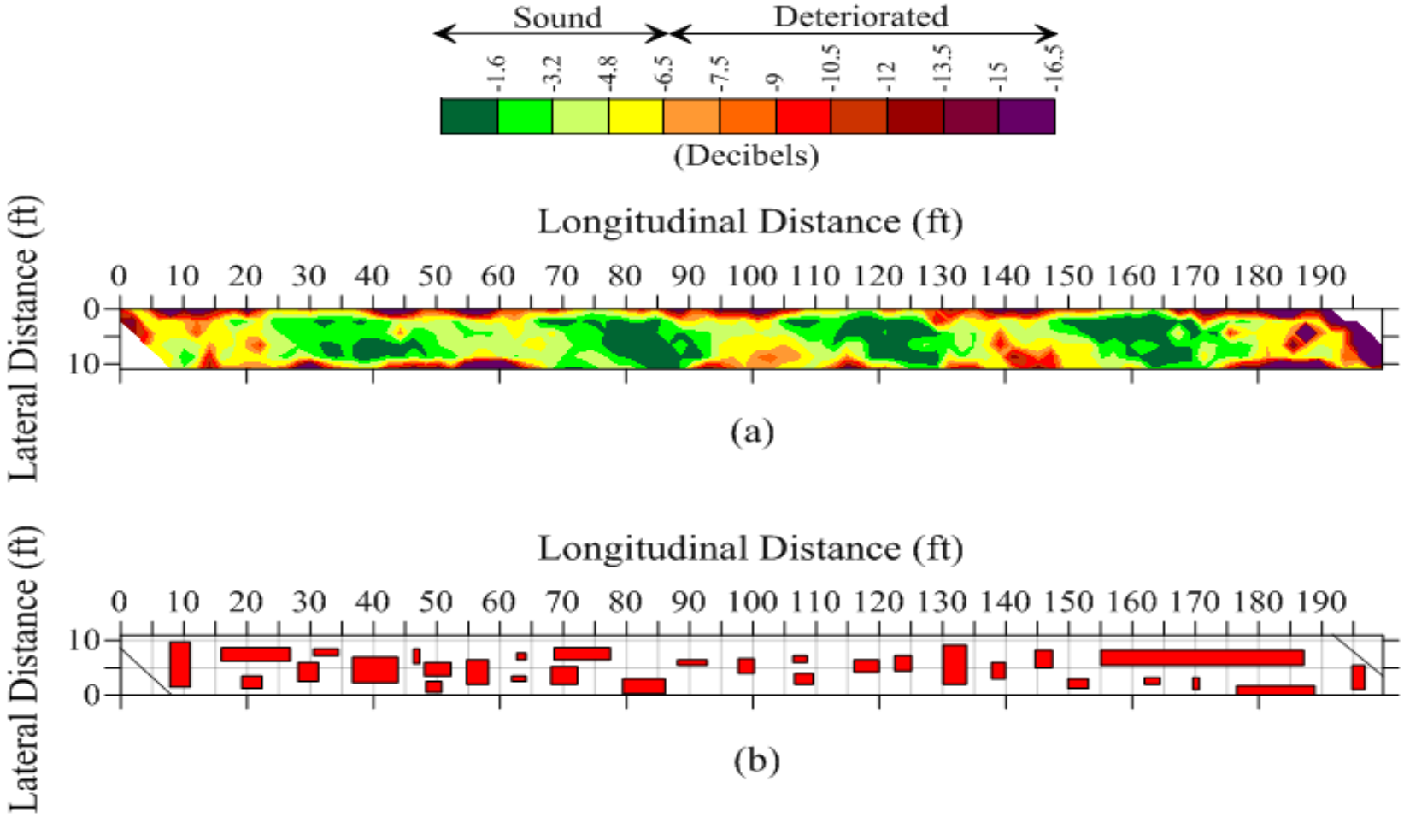


GPR Evaluation Results: Bridge 6939 (slab)

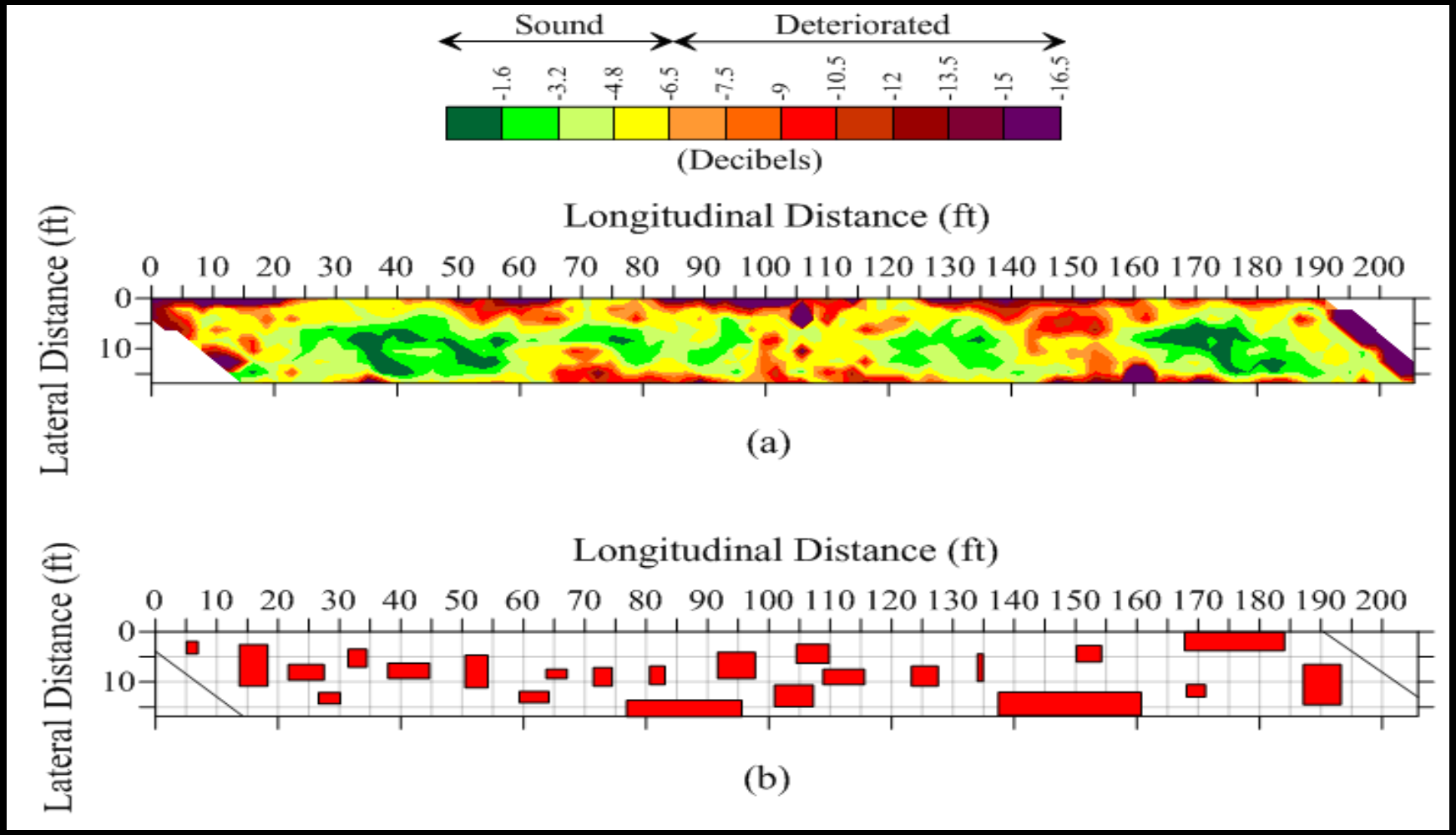
GPR Evaluation Results: Bridge 6939 (Southbound Outside Lane and Shoulder)



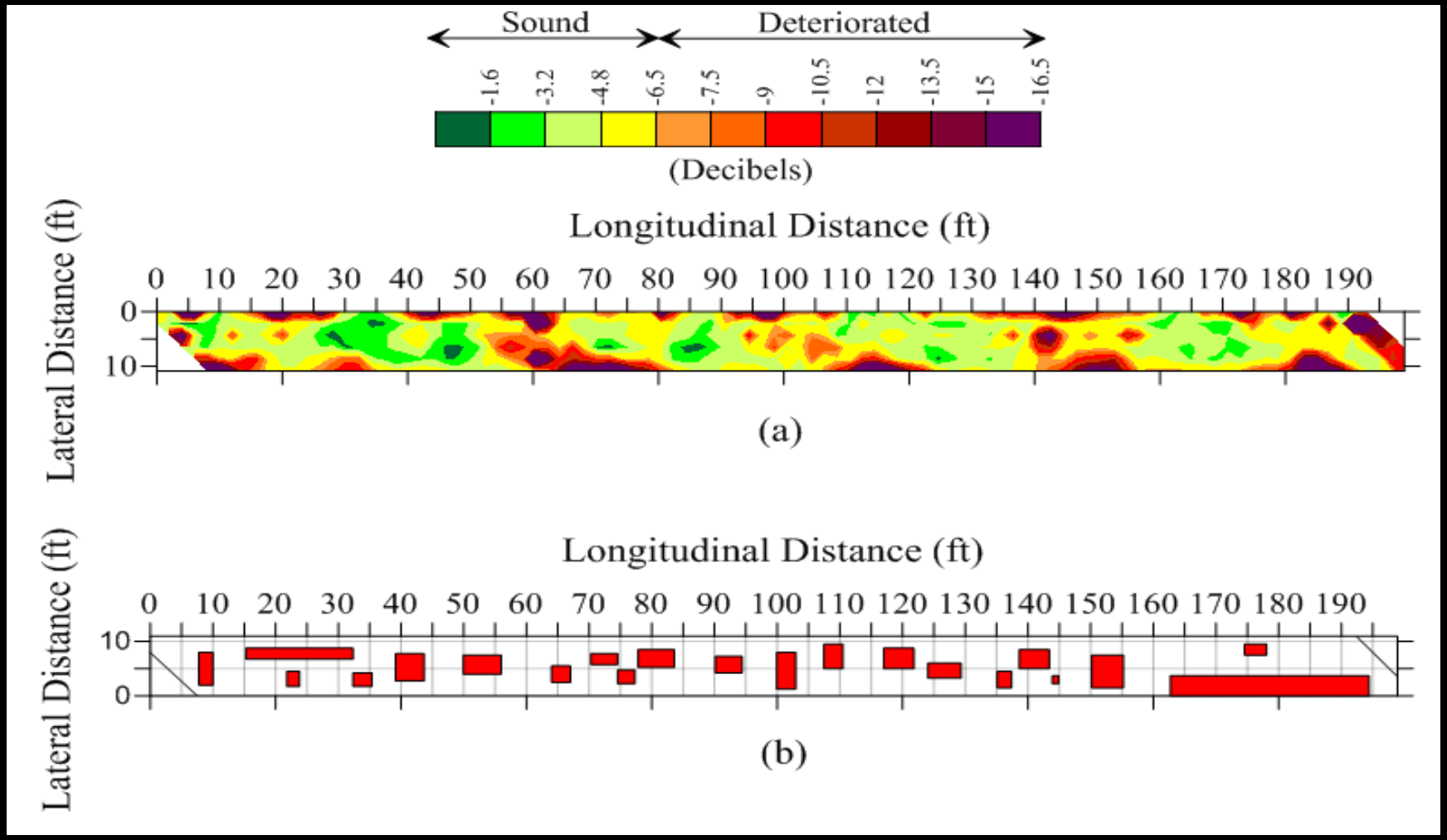
GPR Evaluation Results: Bridge 6939 (Southbound Inside Lane)



GPR Evaluation Results: Bridge 6939 (Northbound Outside Lane and Shoulder)



GPR Evaluation Results: Bridge 6939 (Northbound Inside Lane)



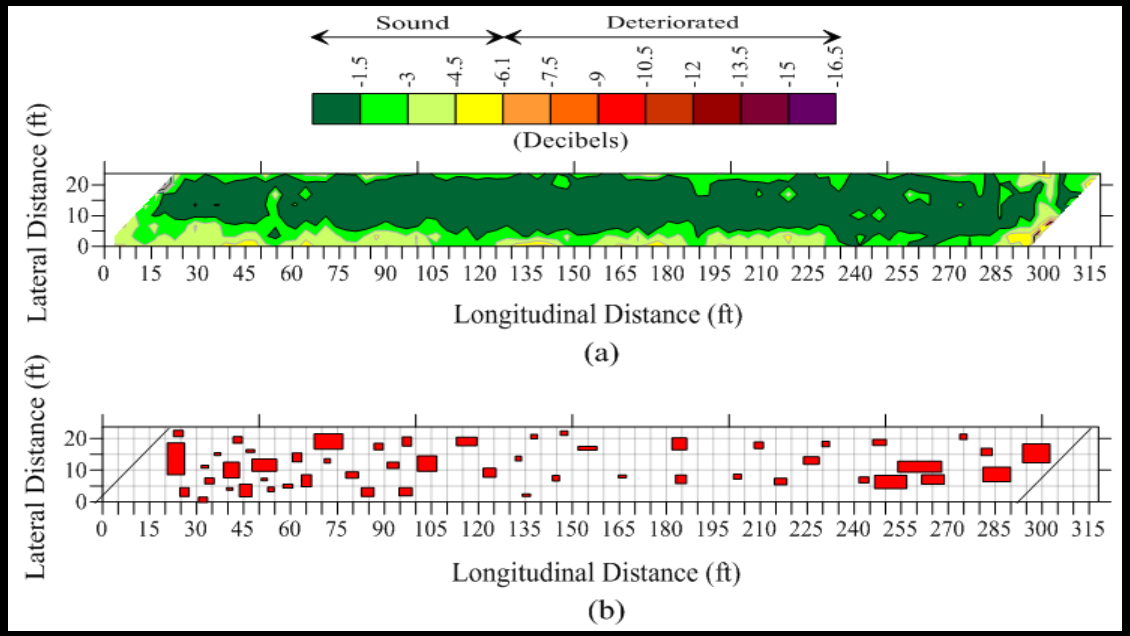
GPR Evaluation Results: Bridge 7032

GPR Evaluation Results: Bridge 7032

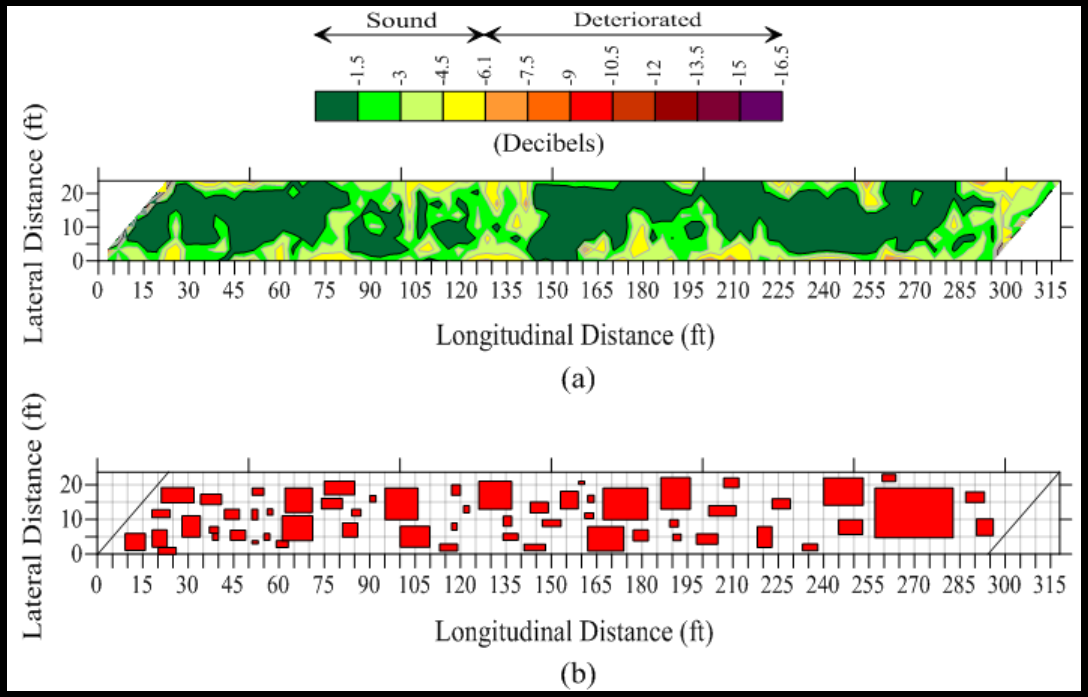
- **THIS BRIDGE HAS A COMPLETELY DELAMINATE LATEX MODIFIED CONCRETE DECK OVERLAY**

- From most current inspection report:
  - Deck: 5
  - Superstructure: 5
  - Substructure: 5
- Deck inspection reports:
  - Vertical, transverse, longitudinal cracks up to 1/4”; exposed rebar up to 22’, spalls up to 8’x6”, apparent delaminations up to 28’, and minor leaching and water stains (Deck edges)

GPR Evaluation Results: Bridge 7032 (East Bound)



GPR Evaluation Results: Bridge 7032 (West Bound)



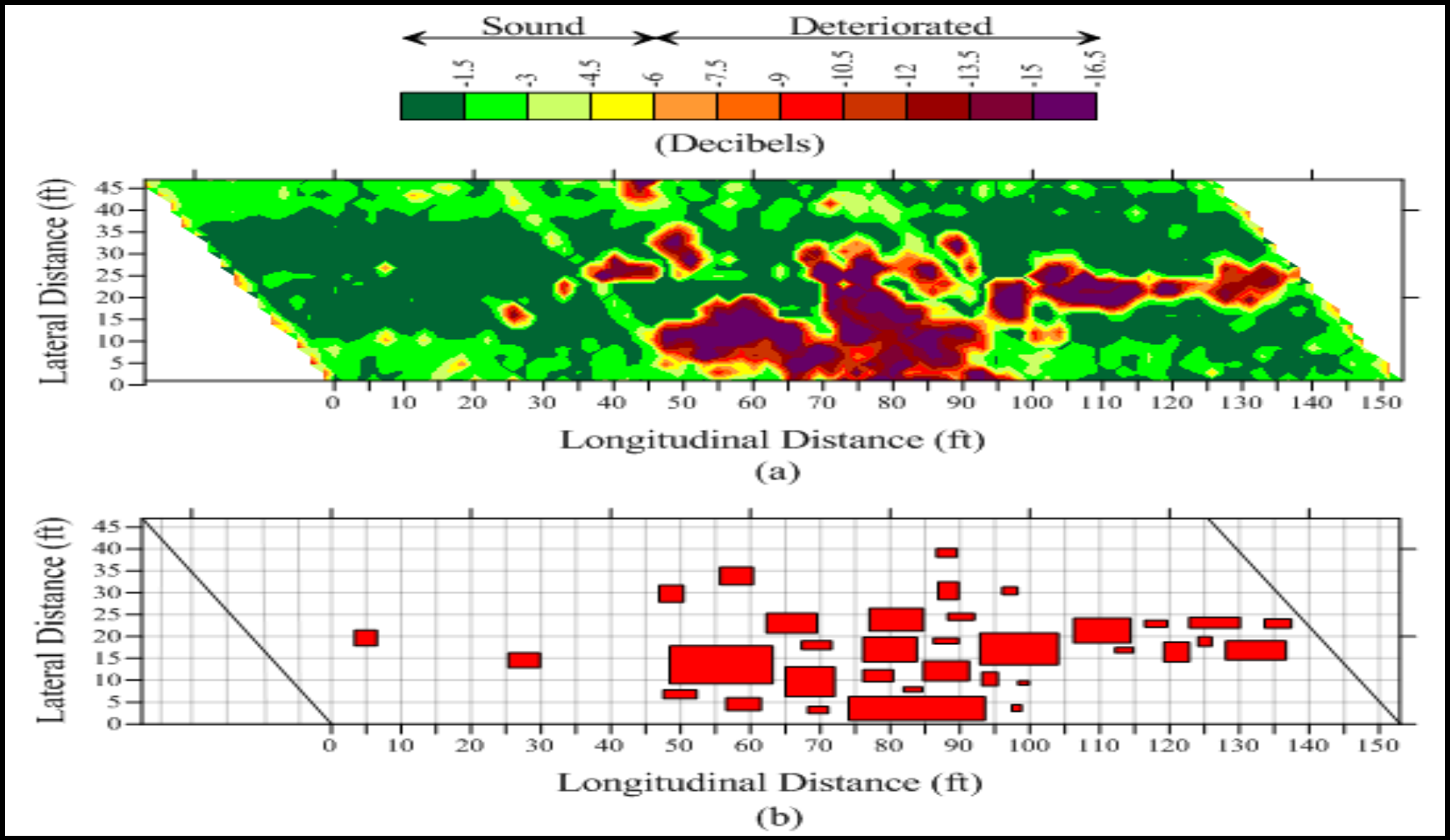
GPR Evaluation Results: Bridge 7113

GPR Evaluation Results: Bridge 7113

- AASHTO Girder – construction defect (cover)

- From most current inspection report:
  - Deck: 5
  - Superstructure: 7
  - Substructure: 7
- Deck inspection reports:
  - Transverse cracks up to 1/16" and minor leaching (Deck edges); transverse and map cracks up to 1/16", exposed rebar, and spalls (Top of Deck); Rust stains at the joint locations (Underside)

GPR Evaluation Results: Bridge 7113



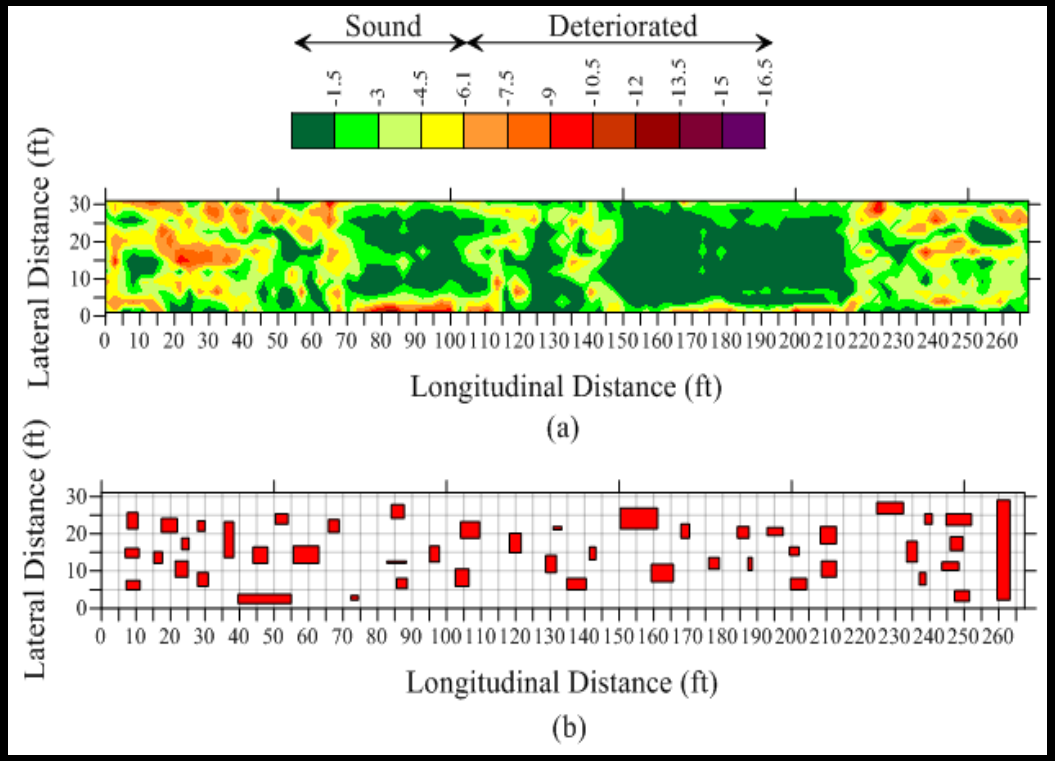
GPR Evaluation Results: Bridge 7299

GPR Evaluation Results: Bridge 7299

- Grant Application

- From most current inspection report:
  - Deck: 5
  - Superstructure: 5
  - Substructure: 5
- Deck inspection reports:
  - Transverse and vertical cracks up to 1/8” with heavy leaching (Deck edges); transverse and longitudinal cracks up to 1/8” with heavy leaching (Underside)

GPR Evaluation Results: Bridge 7299



“Normal Deck”

- It works to help determine whether a deck is a preservation candidate verses replacement.

“Slab Deck”

- Good as first pass
- Second pass (more detailed) really necessary as DEPTH of the areas of concern is critical to decision / quantity

Overlay

- Seems to work in “seeing through” asphalt
- Seems to work with “seeing through” epoxy overlay (by extension, will likely work with polyester overlay)

- Does NOT seem to work with latex modified overlay

Successful Project

- We learned a lot
- We developed a capability that we did not previous have
- Research value, published research
- Developing a remarkable engineer Daniel Diaz

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