

Advances in NDE Technology

WHAT'S NEW?

Glen Simula, Owner
GS Infrastructure, Inc.



The state of America's deteriorating infrastructure presses us to find solutions to assess, with limited funds and resources.



Current NDT Evaluation Methods



Chain Dragging



Reach-all Truck

Hammer Sounding



Automating and Enhancing NDE



IR/HD Visual
DMI

Collection
Software

GPR





- Eliminate Lane Closures
- Safety
- Reduce manual data collection
 - Data integrity
 - Efficiency in both cost and time savings
- More data acquired
- Accuracy
- Asset Management

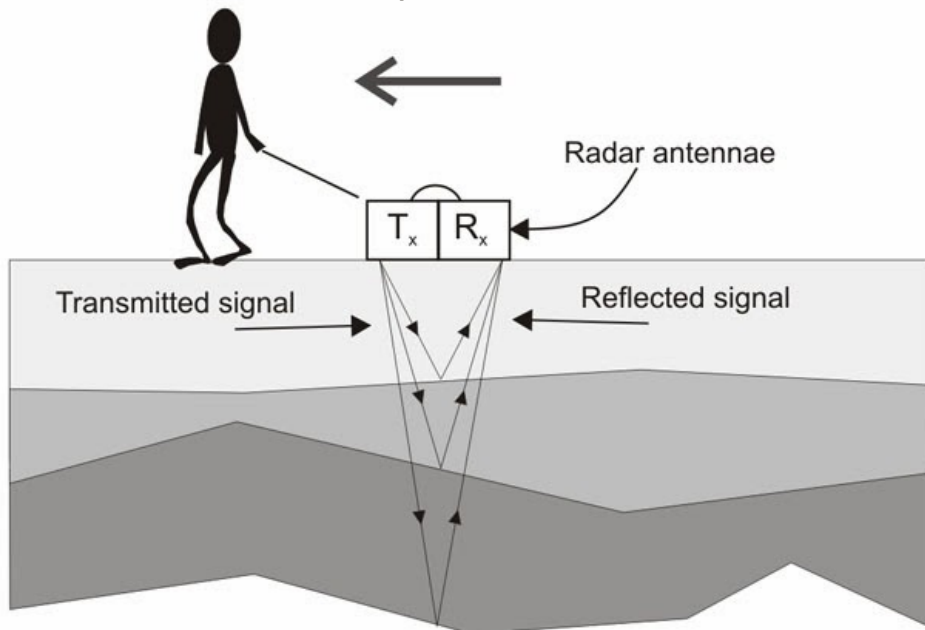
GPR Technology – Where It Started.



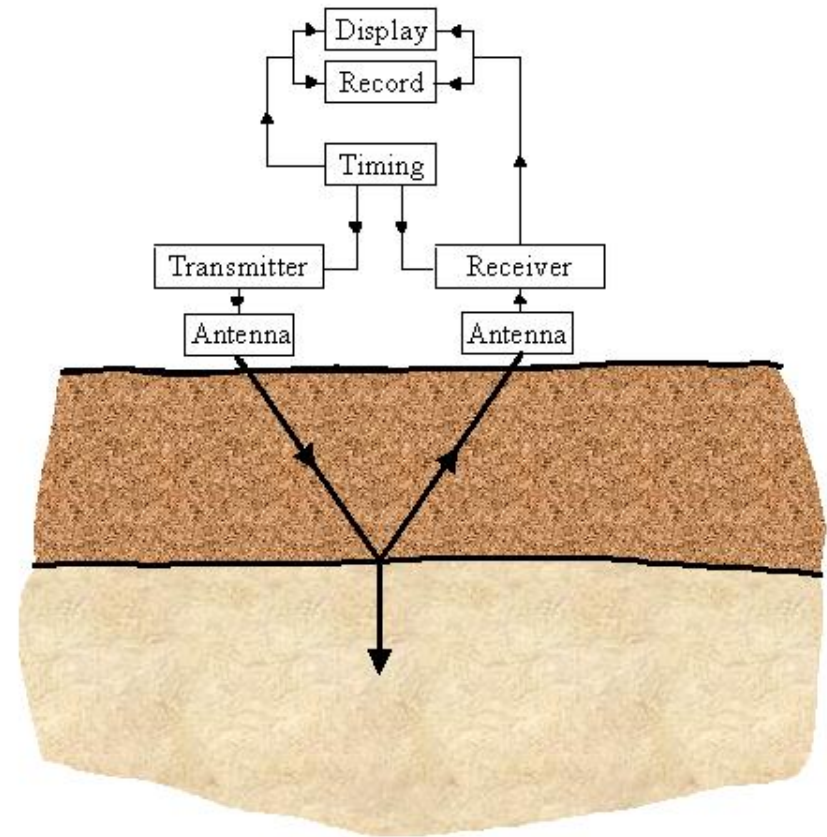
Original or Standard GPR is a 2 Dimensional (2D) Wave Transmission Method

Transmits Electromagnetic (EM or Radio) Waves at a Fixed (**Single**) Frequency Signal

Data is Collected in 2D (Time and Distance)



ASTM Specifications



ASTM Specifications:

ASTM 6087 “Standard Test Method for Evaluating Asphalt-Covered Concrete Bridge Decks Using Ground Penetrating Radar”

ASTM D6432 “Standard Test Method for Using the Surface Ground Penetrating Radar Method for Subsurface Investigation”

GPR Technology – Now.

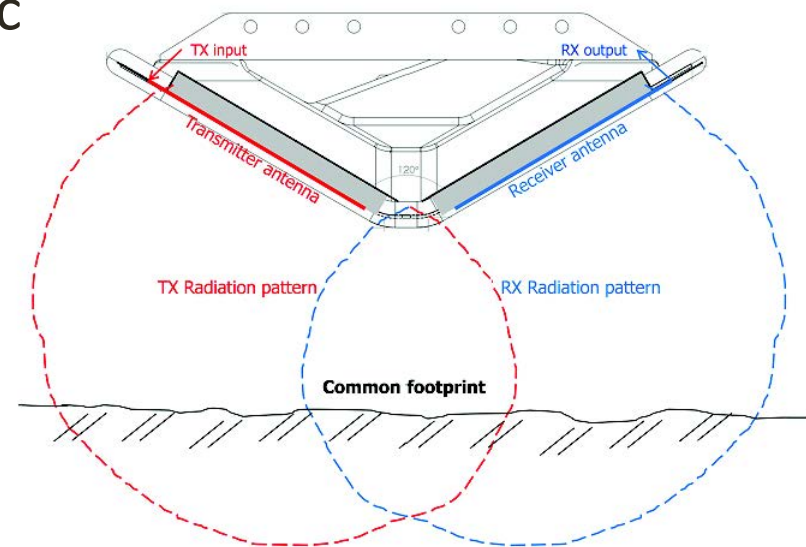


GPR is a noninvasive, nondestructive testing tool for mapping subsurface conditions

A GPR unit transmits electromagnetic energy into the ground.

Energy encounters a buried object or a boundary between materials having different dielectric constants or varying densities

Energy is reflected, refracted or scattered back to the surface



3D GPR Specifications



The three-dimensional (3D) array used by GS Infrastructure gives the analyst the ability to determine depth of defects, as well as sf areas

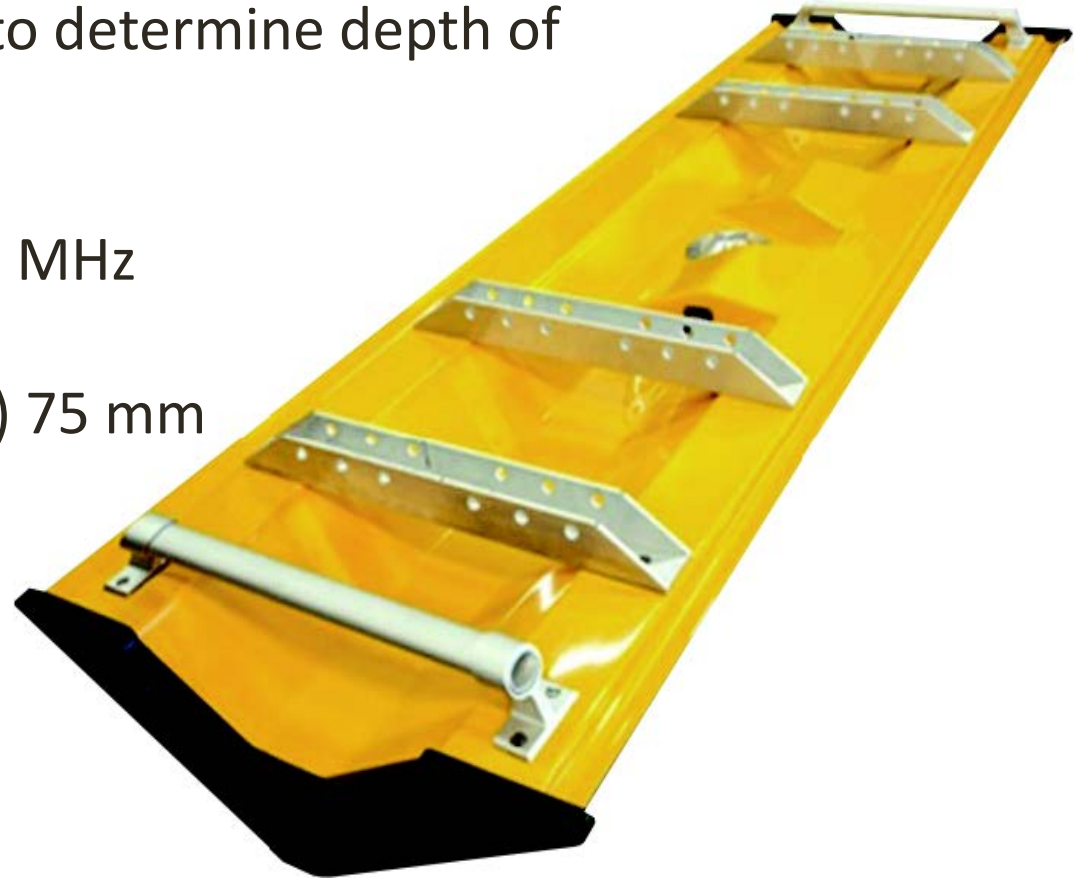
Frequency Range 200-3000 MHz

Number Of Channels 21

Channel Spacing (Cross-Line) 75 mm

Antenna Width 1.8 m

Effective Scan Width 1.575 m

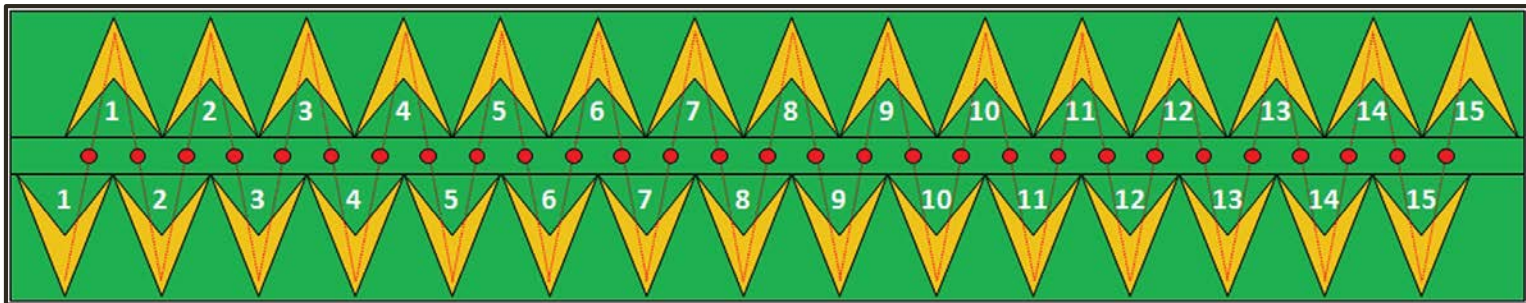


3D GPR Antenna Array



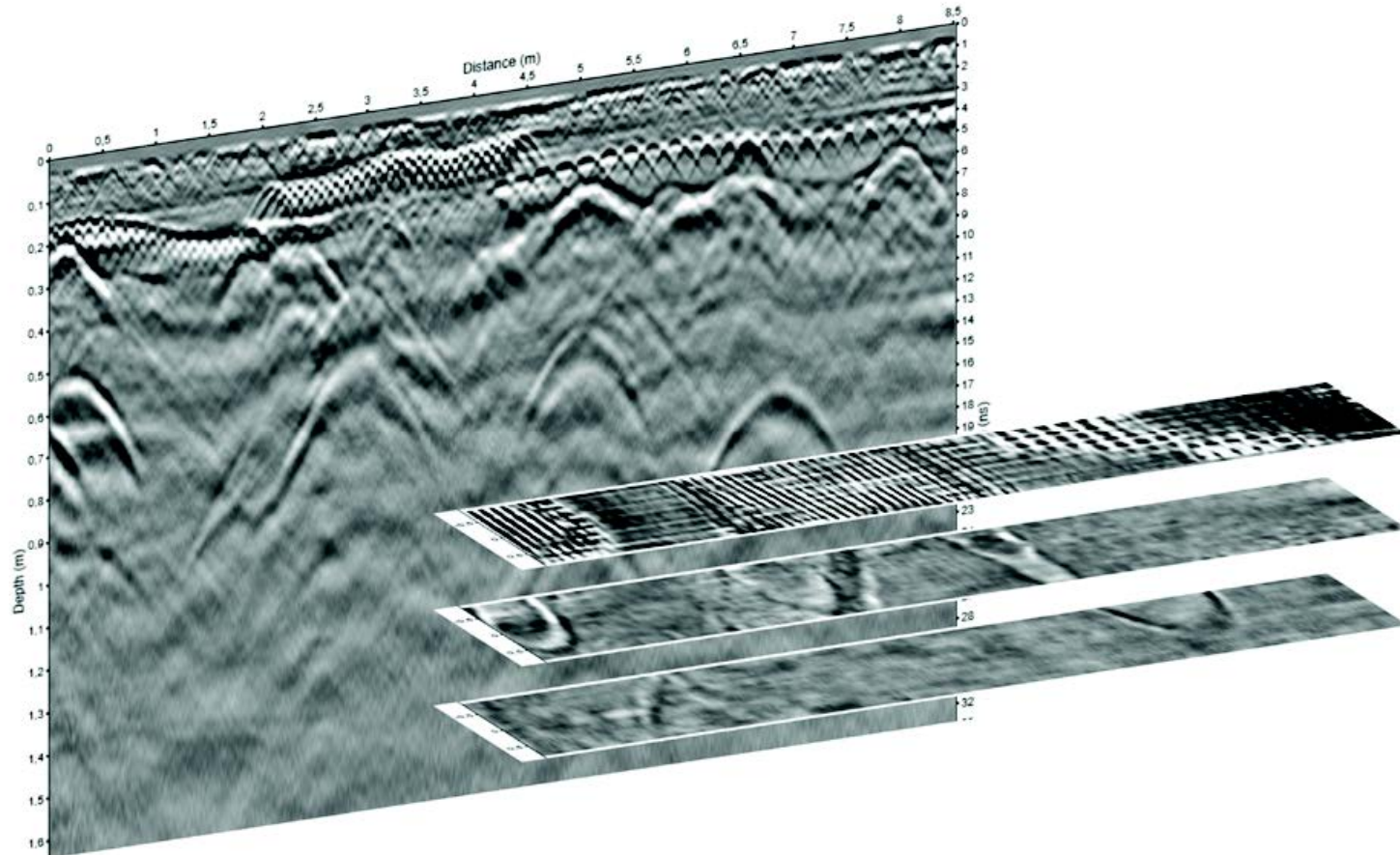
A transmitting multi-antenna array sends out a **Step** Frequency Signal

A receiving multi- antenna array records the changes in the return signal



Display of channel array, displacement of elements and channels of the standard scan pattern.

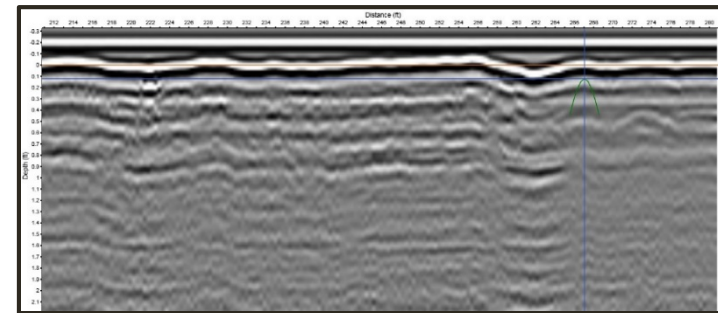
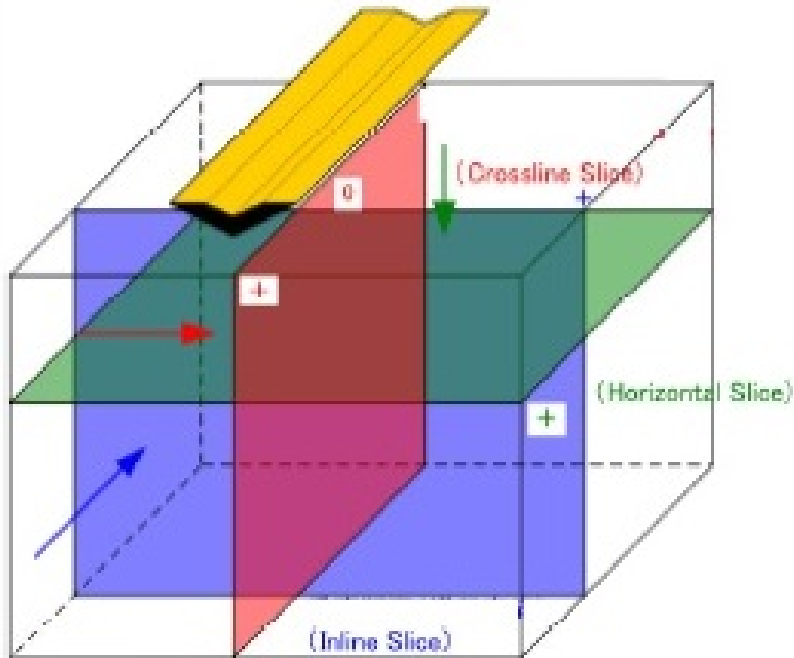
Results in Time, Distance, Depth



3D Image of Radar Array



The **BLUE** vertical section shows the traveling direction of the antenna

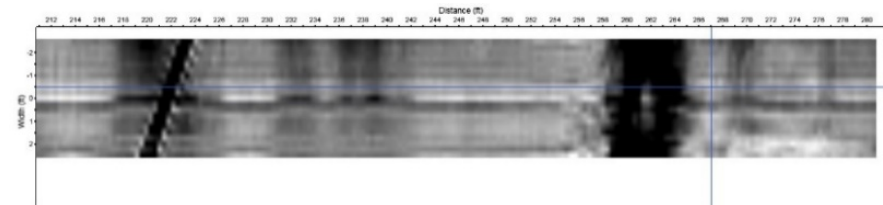
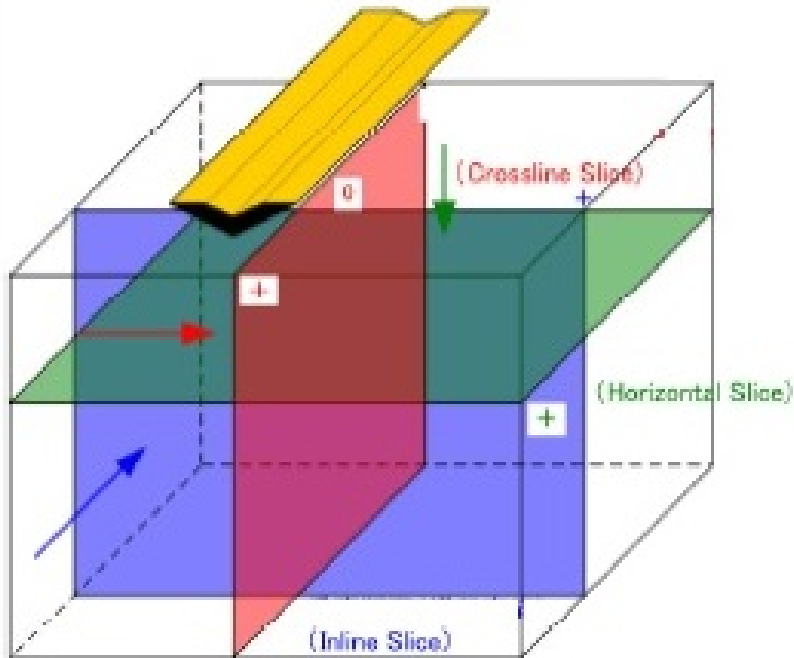


**Vertical Section, Traveling Direction
(Inline Slice)**

3D Image of Radar Array



The **GREEN** horizontal section depicts a top view of the antenna array

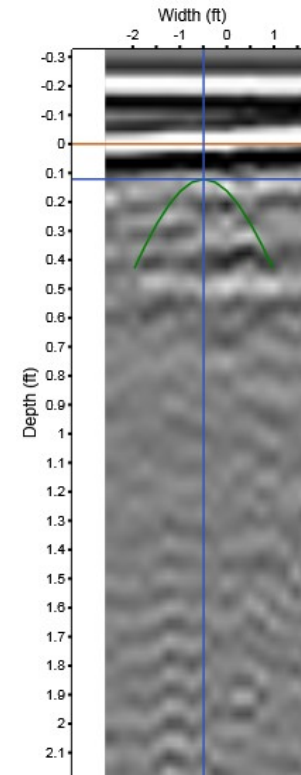
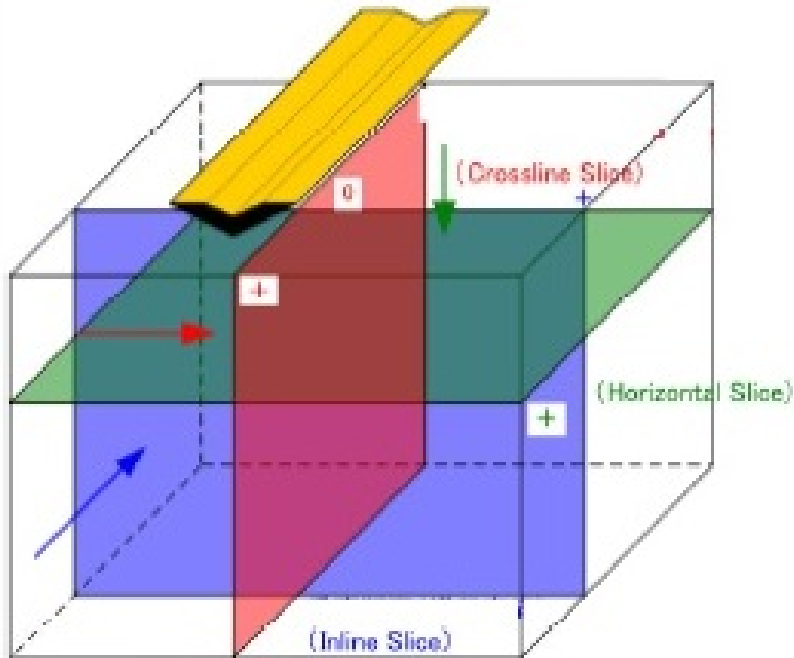


Horizontal Section
(Horizontal Slice)

3D Image of Radar Array



The **RED** vertical section shows the crossline slice



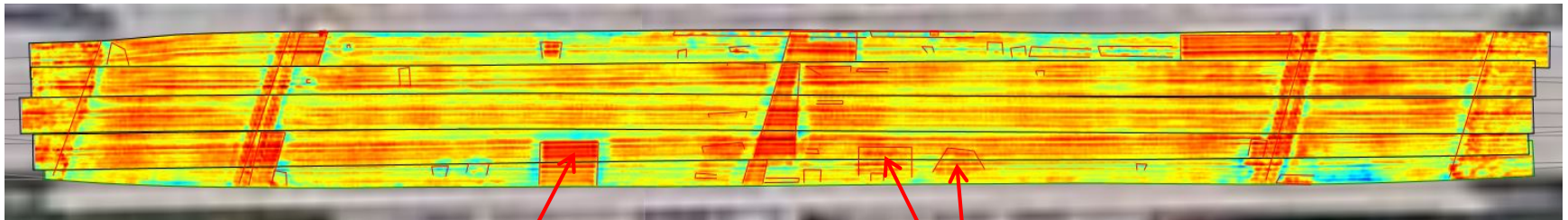
Vertical Section
Antenna Direction

3D GPR Bridge Deck - Collection



Deterioration around Expansion Joint

Spalling

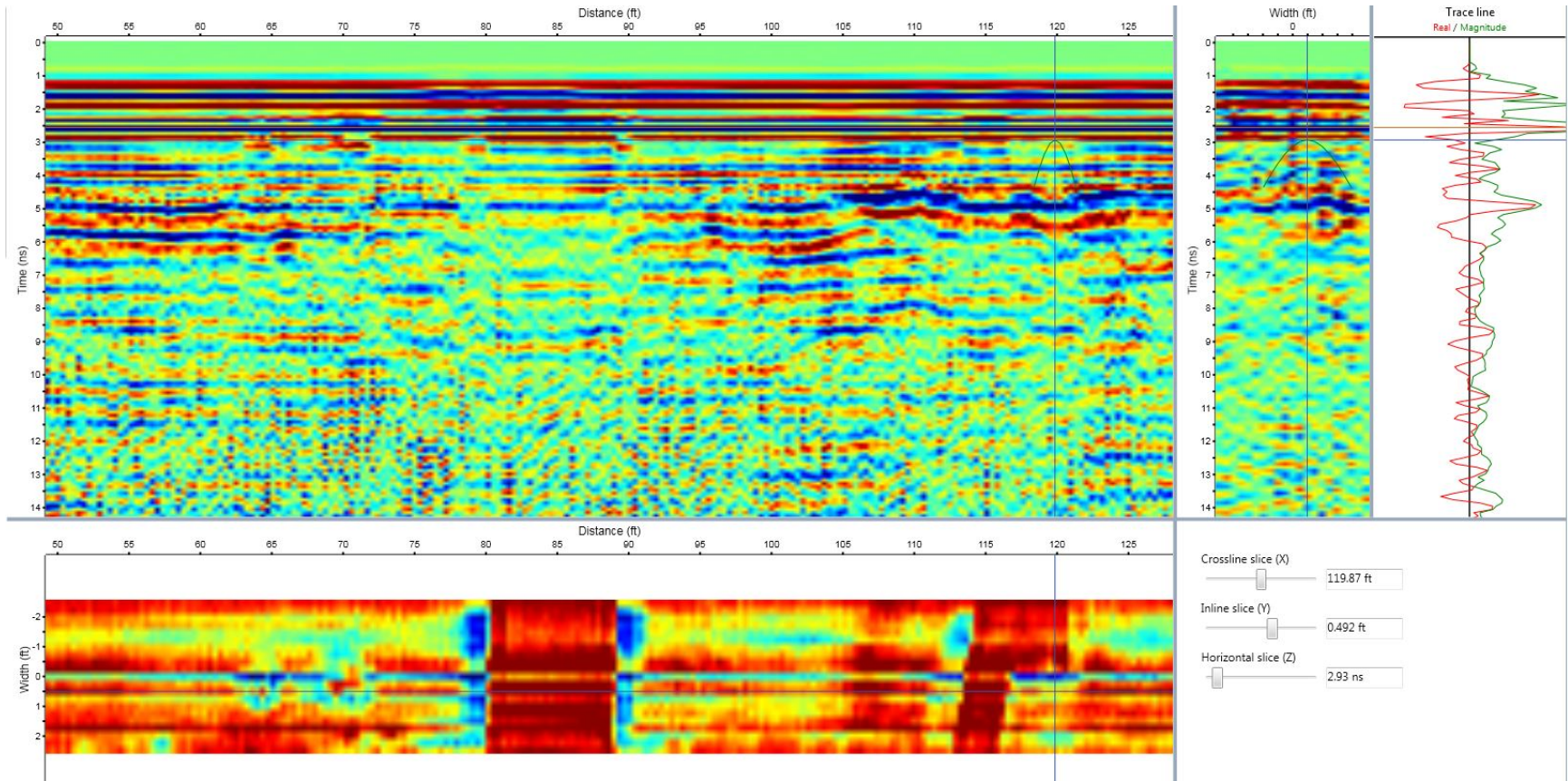


Patching

Potential Delaminations

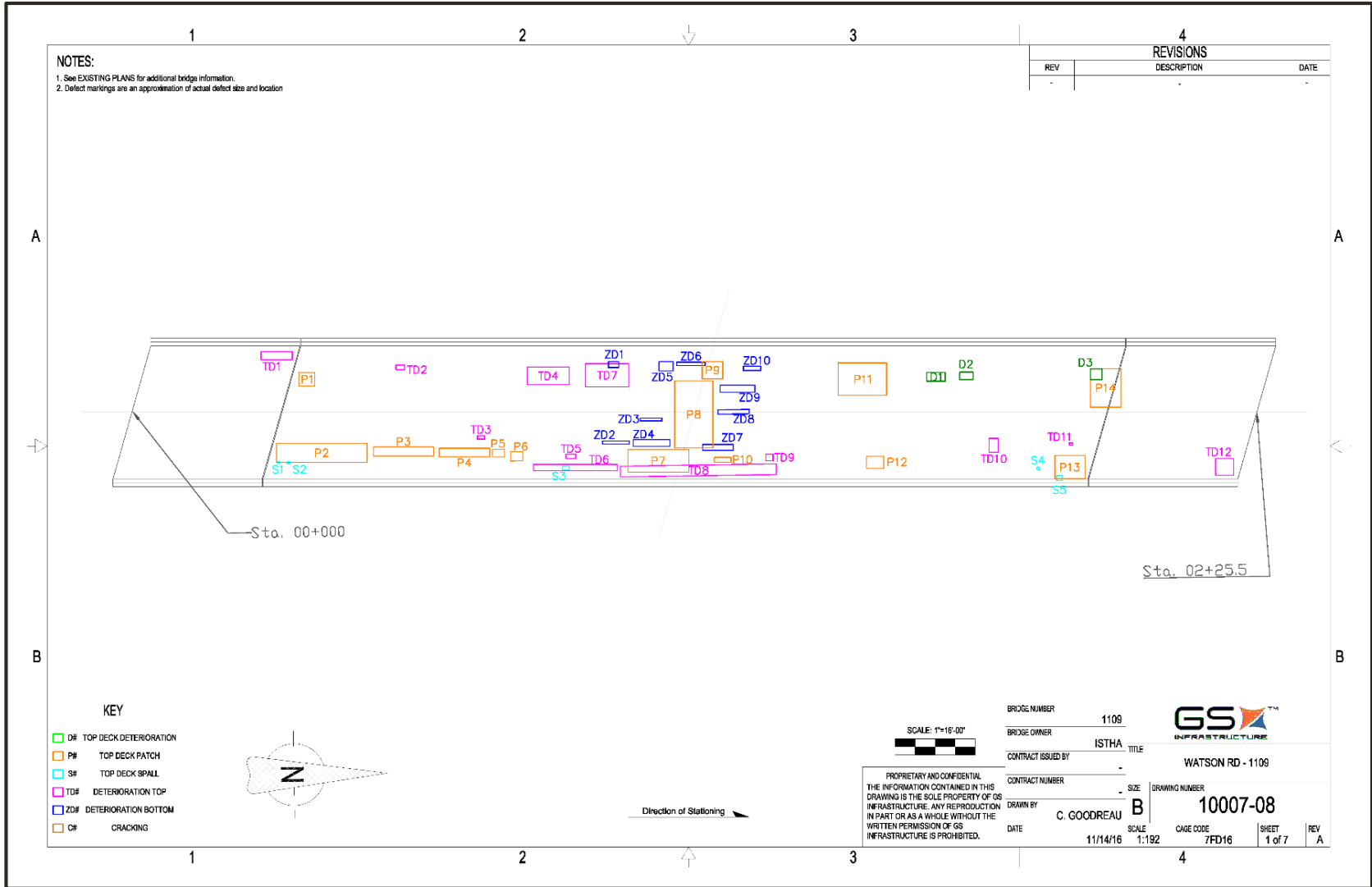
Watson Road, DeKalb IL

3D GPR Bridge Deck - Analysis



Watson Road, DeKalb IL

3D GPR Bridge Deck – CAD Deliverable



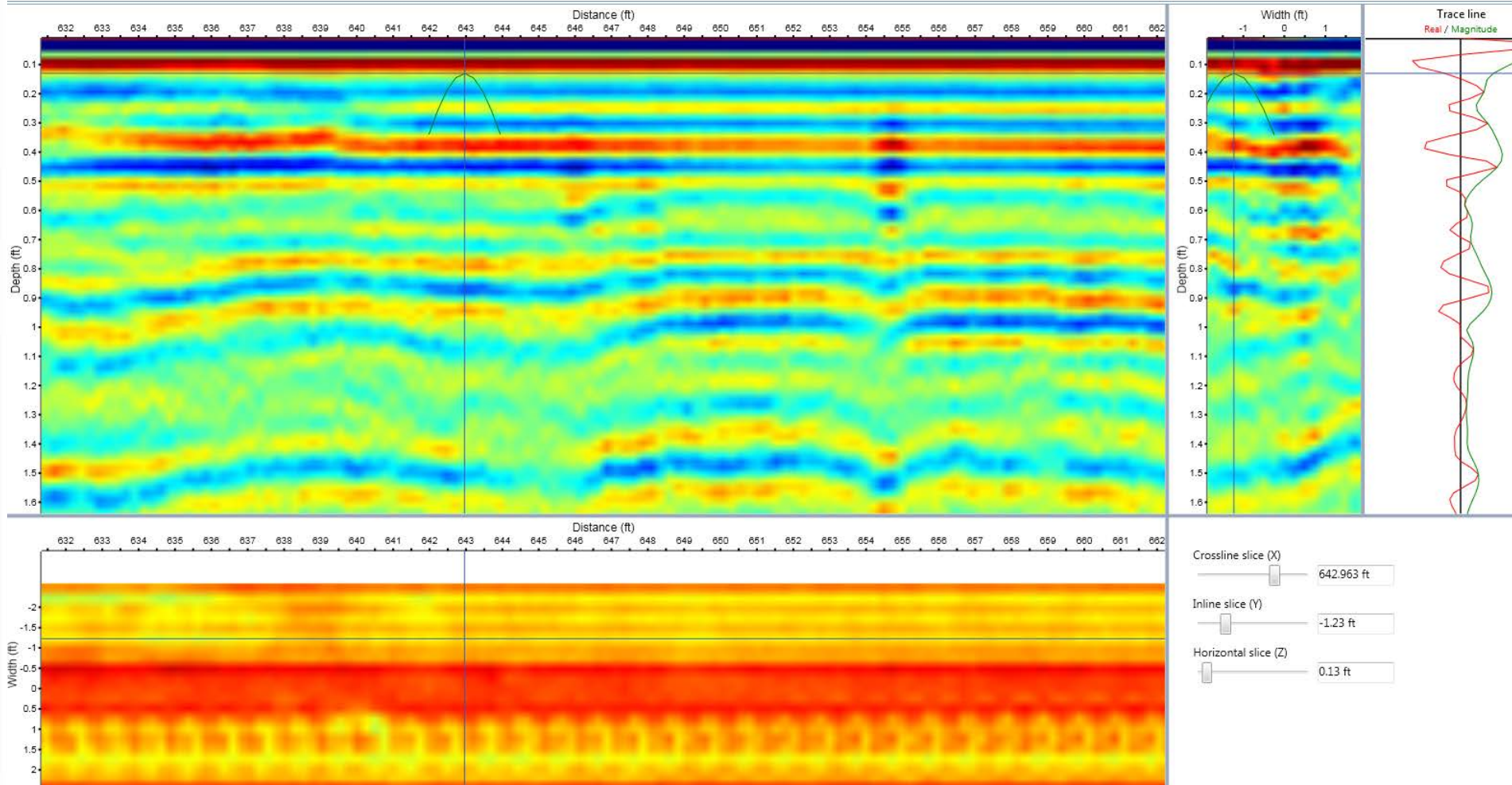
Watson Road, DeKalb IL

3D GPR Bridge Deck - Automated Reporting

1109 Watson Road						
Defect Type	NDE Method	Scan Element	# of Defects	Total Scan Area (SF)	Total Defect Area (SF)	% Total Defect Area of Total Scan Area
Deck Surface Deterioration (D#)	Visual & GPR	Deck Top (lanes only)	3	5,975.75	15.53	0.3%
Patch (P#)	Visual & GPR	Deck Top (lanes only)	14	5,975.75	444.95	7.4%
Spalls (S#)	GPR	Deck Top (lanes only)	5	5,975.75	2.81	0.05%
Top Deterioration (TD#)	GPR	Deck Top (lanes only)	12	5,975.75	191.42	3.2%
Bottom Deterioration (ZD#)	GPR	Deck Top (lanes only)	10	5,975.75	52.58	0.9%
				Total Indications	707.29	11.84%

Watson Road, DeKalb IL

3D GPR - Rebar



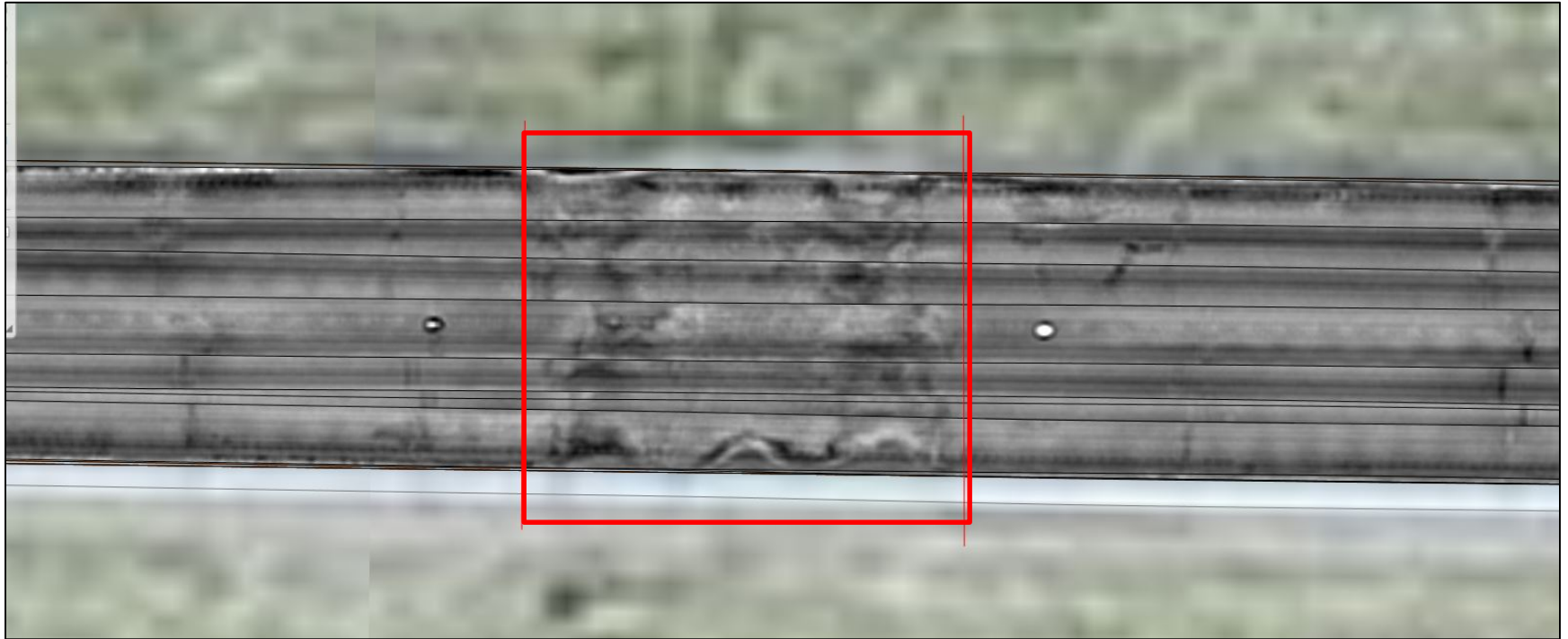
Houghton, MI

3D GPR - Culvert



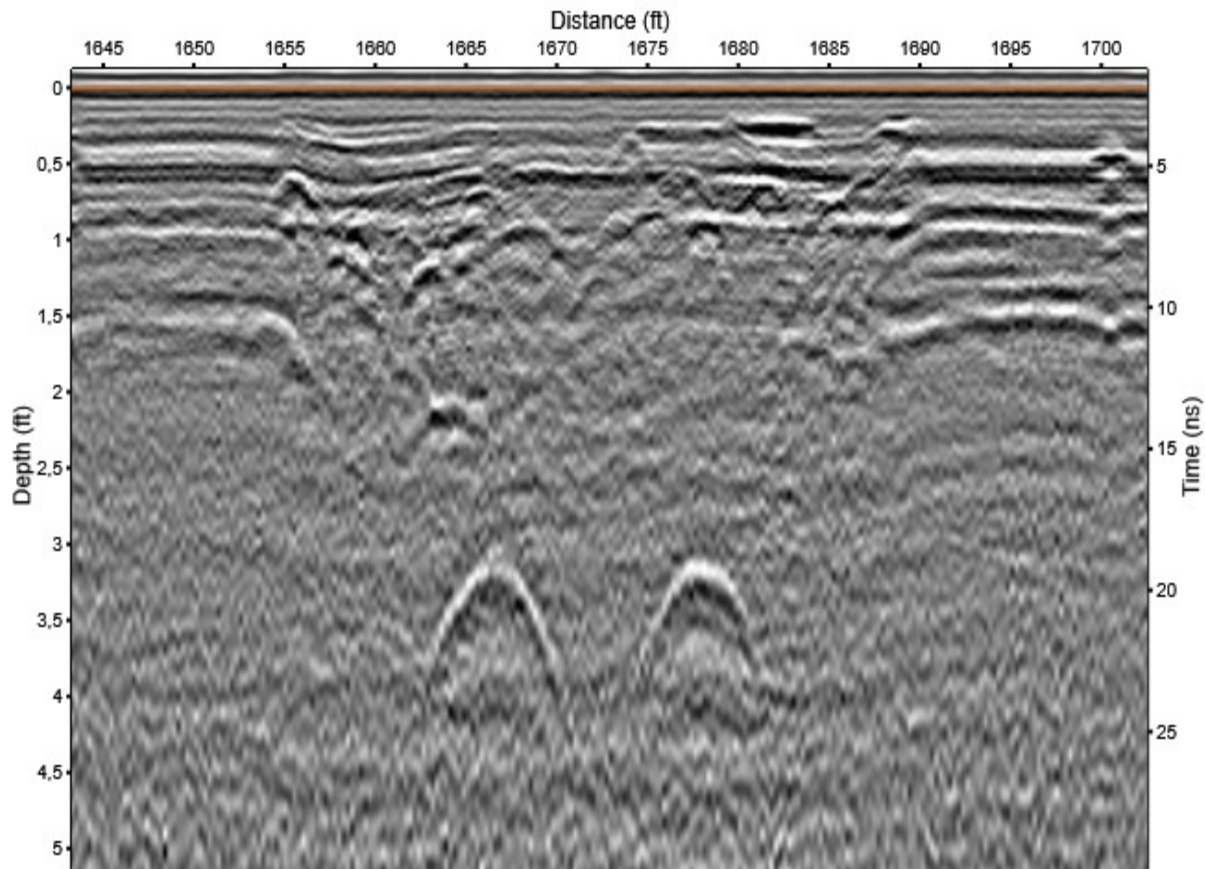
Devils Lake, ND

3D GPR - Culvert



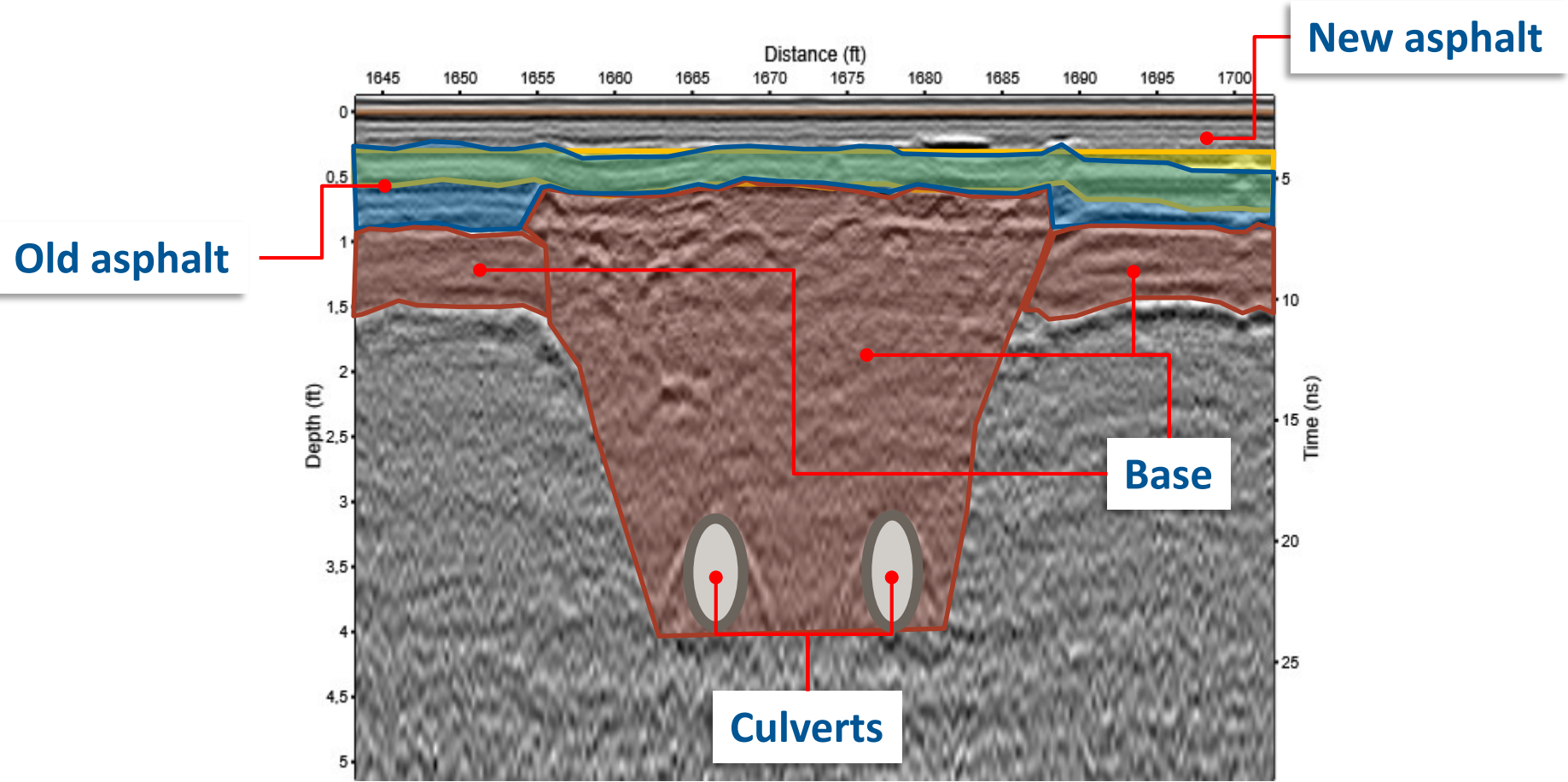
Devils Lake, ND

3D GPR - Culvert



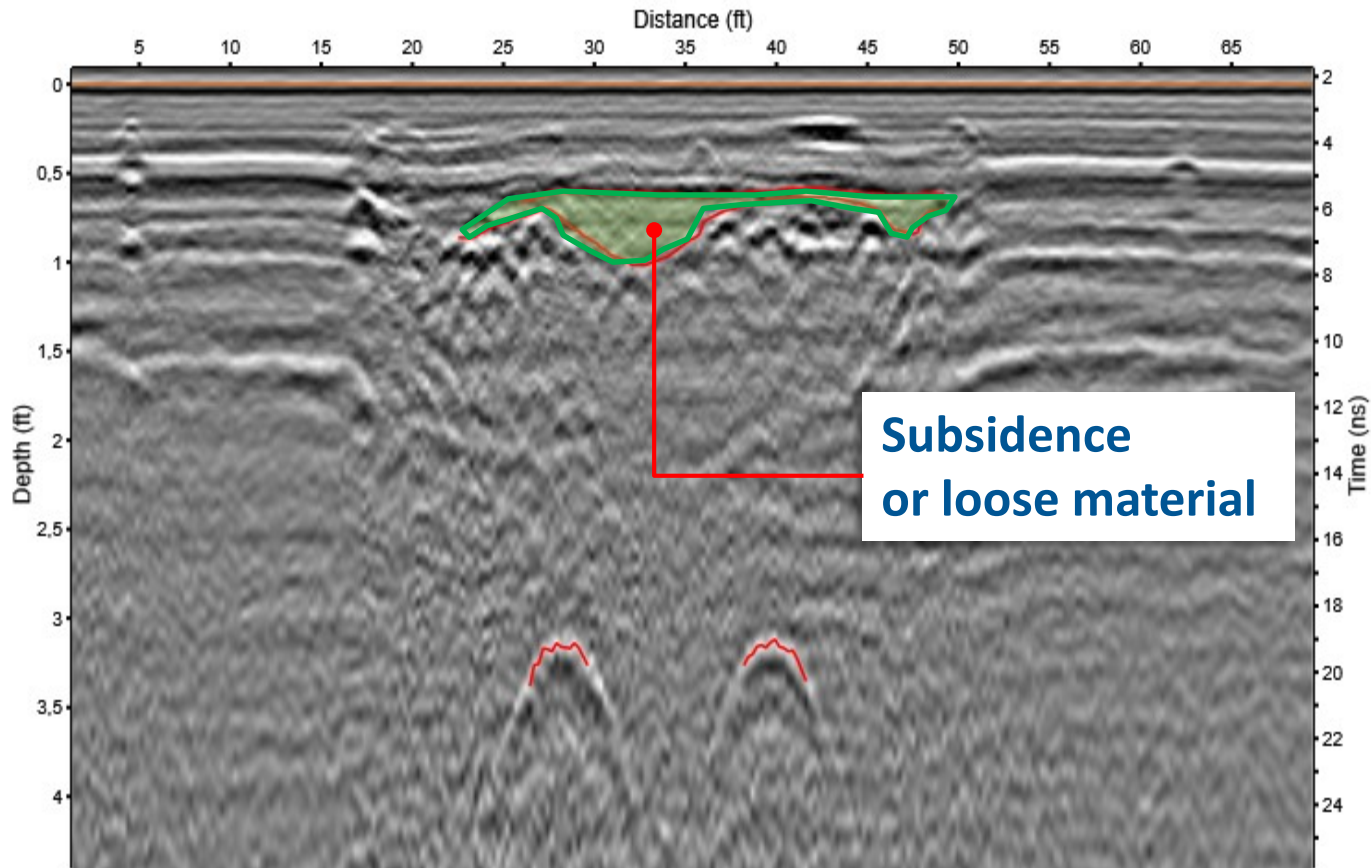
Devils Lake, ND

3D GPR - Culvert



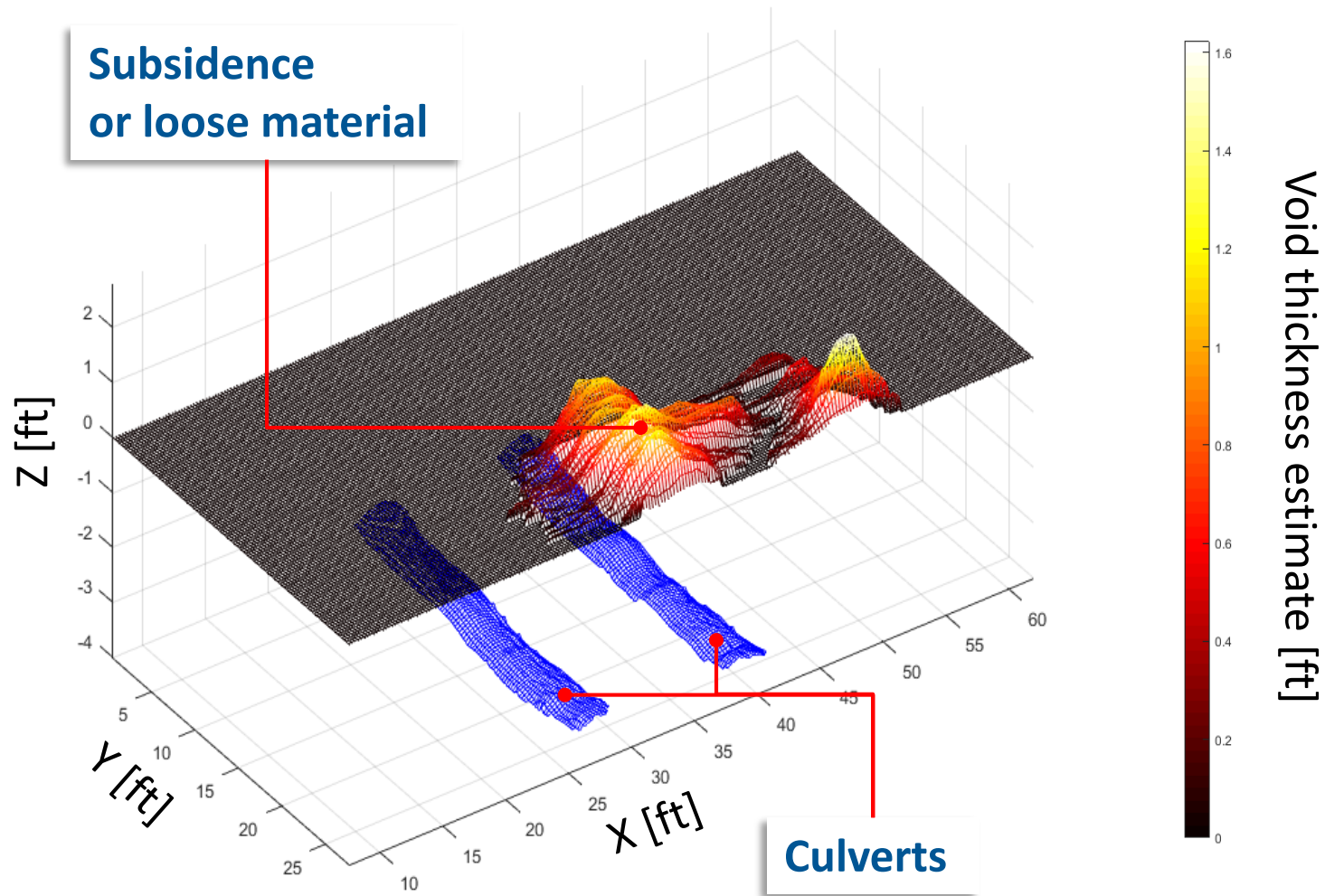
Devils Lake, ND

3D GPR - Culvert



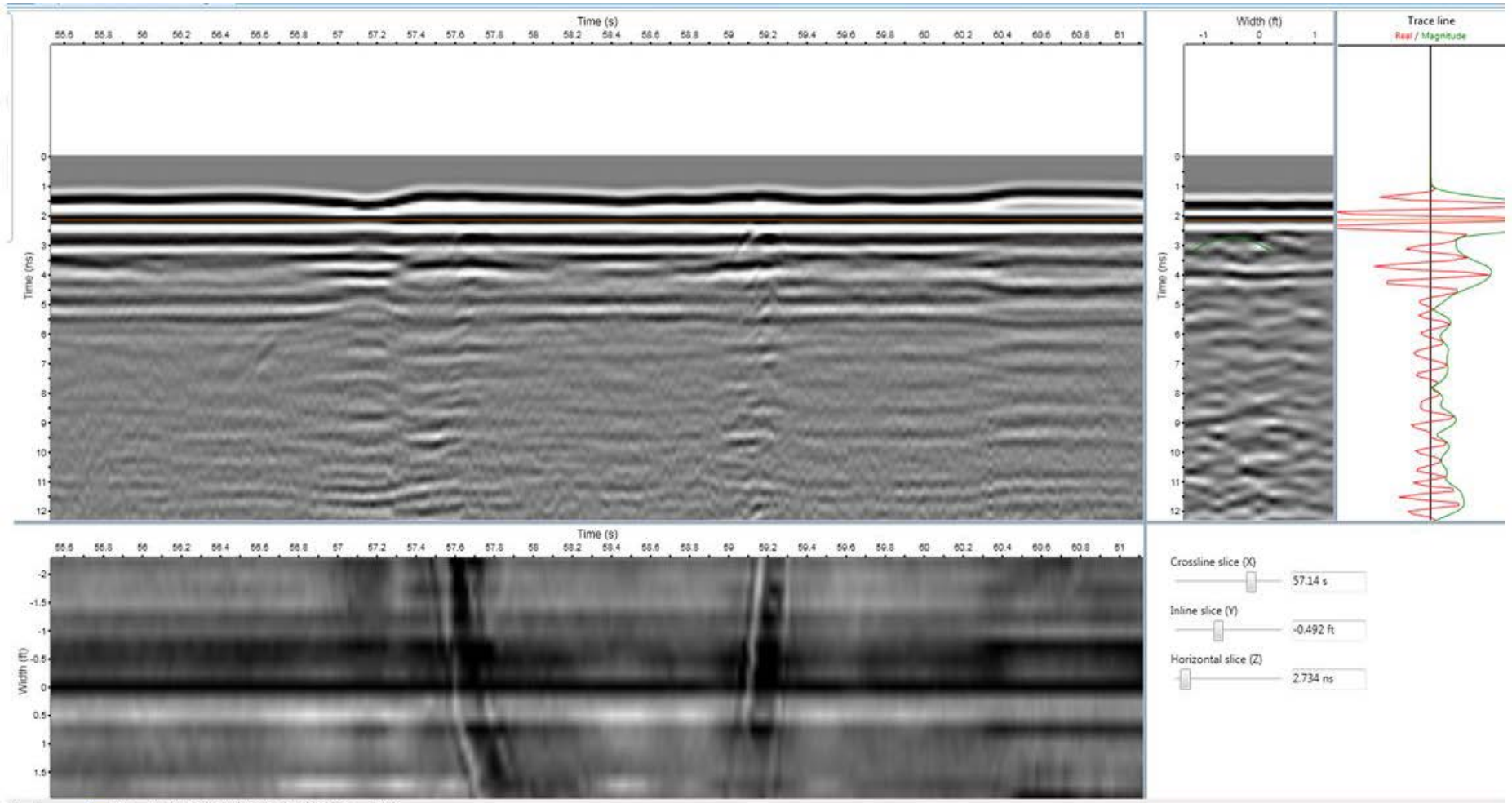
Devils Lake, ND

3D GPR - Culvert



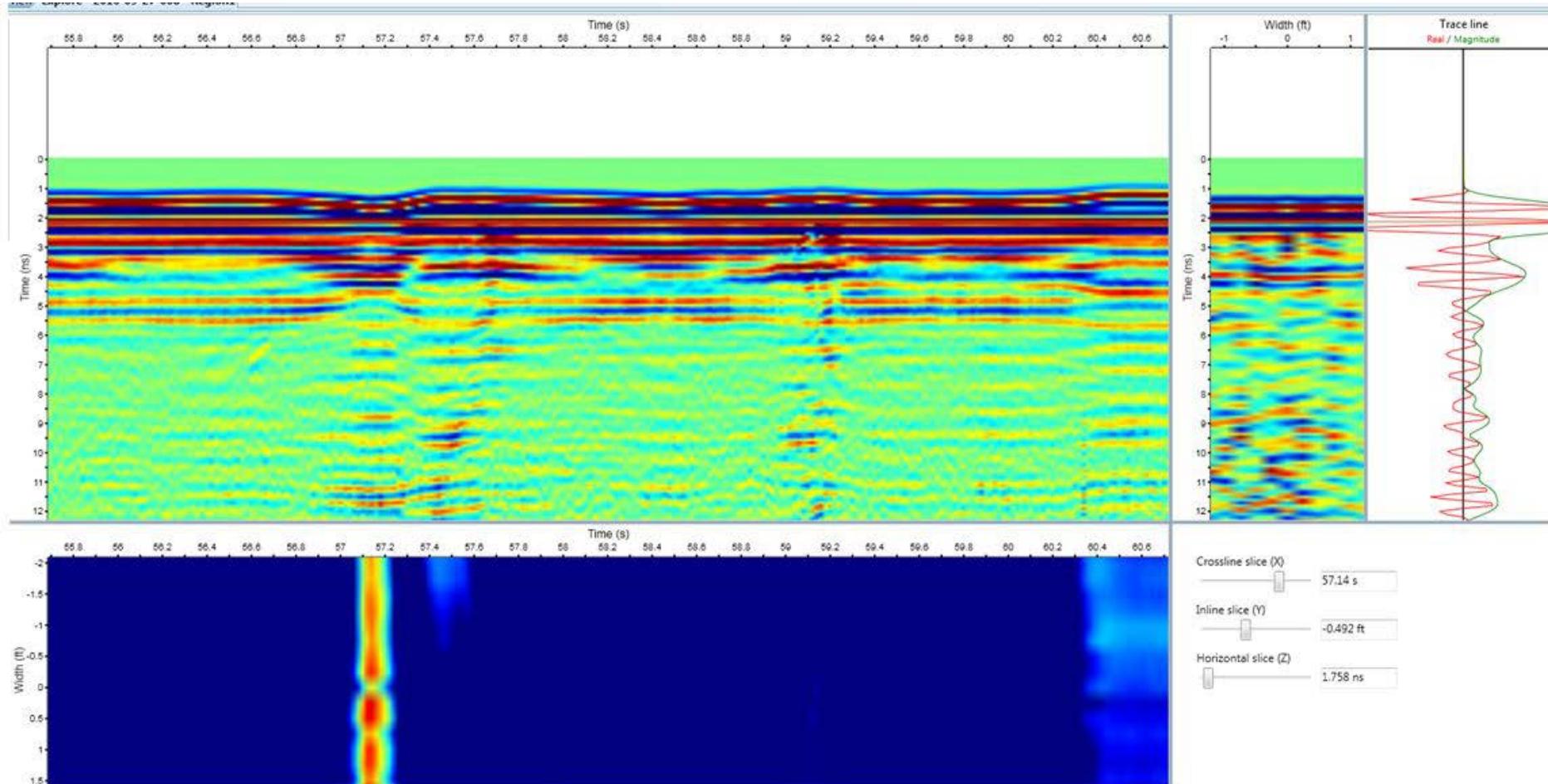
Devils Lake, ND

3D GPR - Utilities



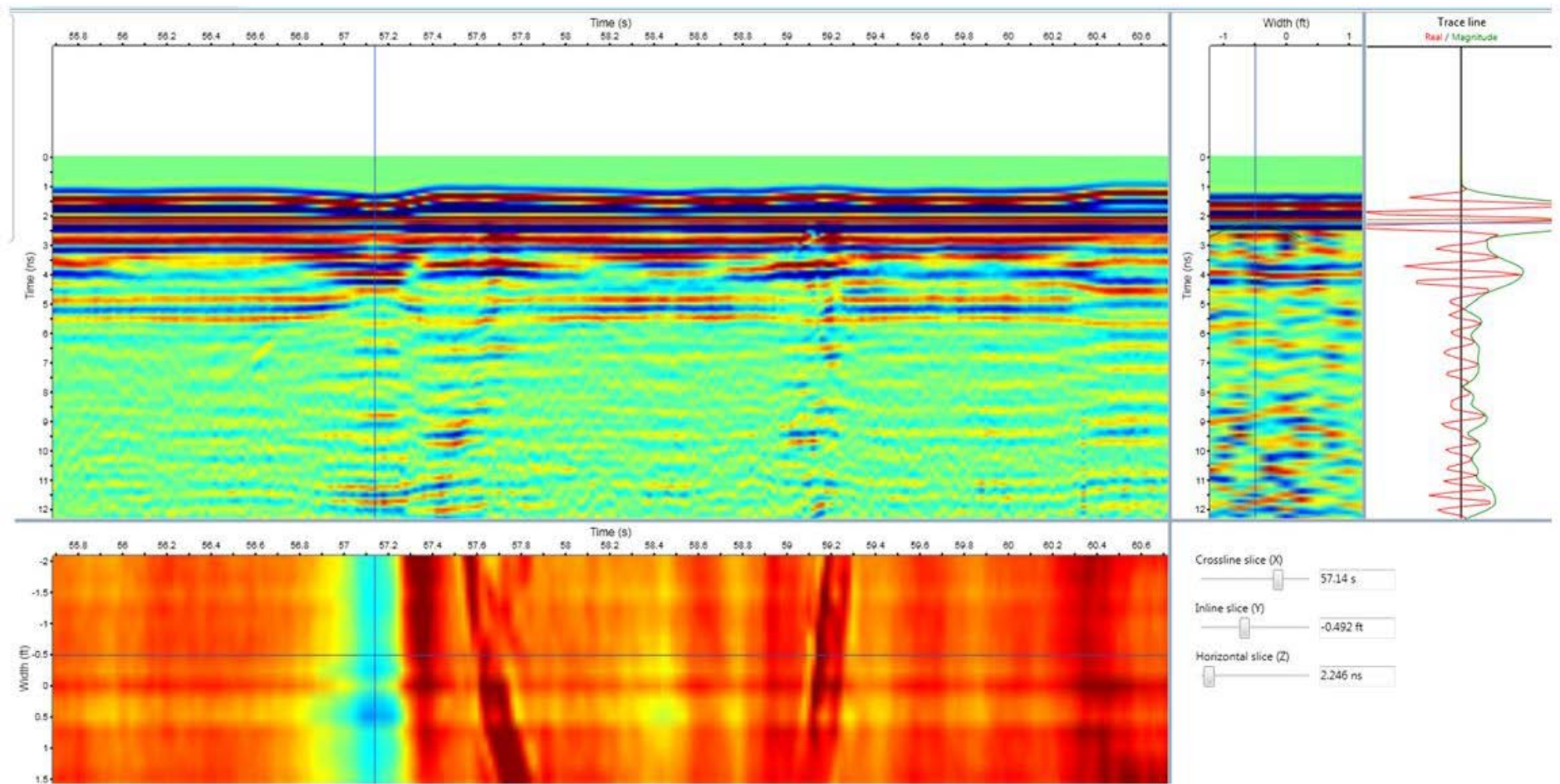
Houghton, MI

3D GPR - Utilities



Houghton, MI

3D GPR - Utilities



Houghton, MI

Infrared Thermography (IR) - Substructure





Substructure and Underdeck IR Collection



Ground Platform

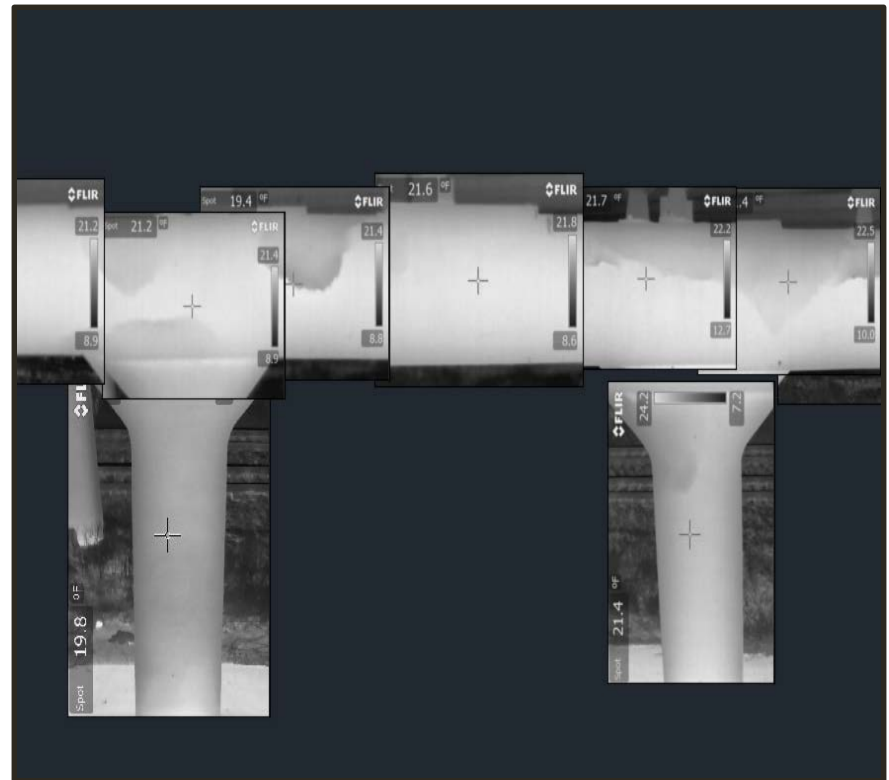


Maritime Platform

IR Substructure - Collection



IR Photos Collected in Field

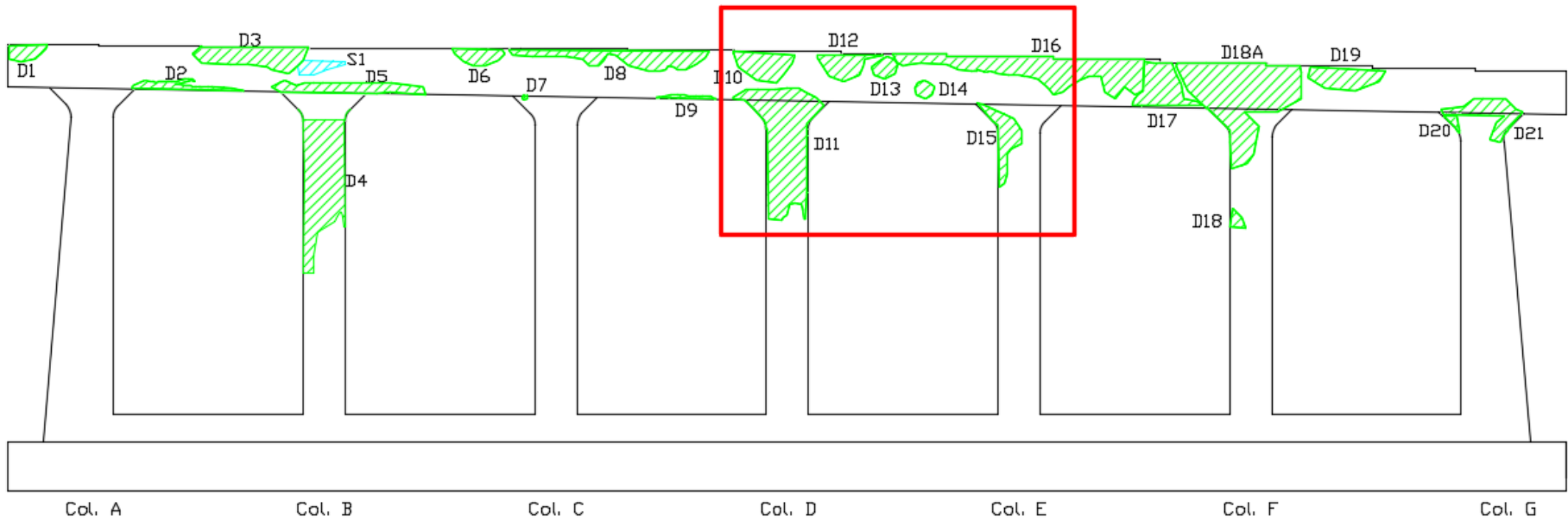


IR Substructure - Analysis



IR Analysis

IR Substructure - CAD Deliverable



IR Delamination Locations

IR Substructure – Automated Reporting



Bent #2 Summary						
Defect Type	NDE Method	Scan Element	# of Defects	Total Scan Area (SF)	Total Defect Area (SF)	% Total Defects
Delamination (D#)	IR and HD Visual	Columns A-G & Bent Cap	59	3,906.00	427.35	10.94%
Spalls (S#)	IR and HD Visual	Bent Cap	1	3,906.00	2.51	0.06%
				Total Indications	429.86	11.01%

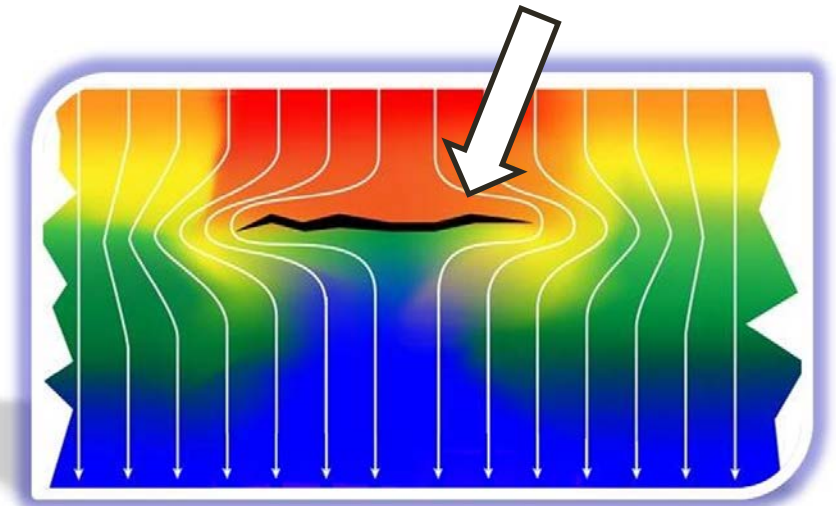
38th Street over CSX Railroad Bent # 2						
Face	Delamination D#	Area (ft ²)	Max. L (ft)	Avg. W (ft)	Reference Feature	Notes
W	D1	2.51	2.73	0.92	Bent Cap	North end
W	D2	2.66	7.98	0.33	Bent Cap	Between Col. A and Col. B
W	D3	10.64	8.29	1.28	Bent Cap	Between Col. A and Col. B
W	D4	24.23	2.93	8.26	Col. B	Midpoint to top of column
W	D5	6.83	11.09	0.62	Bent Cap	Above Col. B
W	D6	3.34	3.60	0.93	Bent Cap	Between Col. B and Col C.
W	D7	0.08	0.08	1.00	Col. C	Top of Col. C
W	D8	11.26	14.27	0.79	Bent Cap	Above Col. C
W	D9	0.79	4.17	0.19	Bent Cap	Between Col. C and Col. D
W	D10	6.59	4.45	1.48	Bent Cap	Above Col. D
W	D11	29.07	78.06	0.37	Col. D/Bent Cap	Top of Col. D and in to bent cap
W	D12	4.95	4.66	1.06	Bent Cap	Above Col. D
W	D13	1.94	1.88	1.03	Bent Cap	Between Col. D and Col. E
W	D14	1.21	1.39	0.87	Bent Cap	Between Col. D and Col. E
W	D15	5.78	3.24	1.78	Col. E	Top of Col. E
W	D16	24.84	17.81	1.39	Bent Cap	Above Col. E
W	D17	8.74	4.90	1.78	Bent Cap	Between Col. E and Col F.
W	D18	0.90	1.11	0.81	Col. F	Center of Col. F
W	D18A	33.58	8.86	3.79	Bent Cap/Col. F	Top of Col. F and into bent cap
W	D19	6.78	5.43	1.25	Bent Cap	Between Col. F and Col. G
W	D20	0.64	1.15	0.56	Col. G	Top of Col. G
W	D21	6.50	69.90	0.09	Bent Cap/Col. G	Top of Col. G and in to bent cap
N	D22	15.68	9.75	1.90	Col. F	Top of column
N	D23	2.00	3.50	1.02	Col. E	Top of column
N	D24	0.75	8.41	2.02	Col. D	Top of column
N	D25	12.66	2.50	0.05	Col. D	Top of column
N	D26	3.70	6.21	0.84	Col. C	Top of column
N	D27	1.50	3.20	0.74	Col B	Top of column
N	D28	5.62	7.47	1.25	Col B	Top of column
E	D29	4.80	3.63	1.61	Bent Cap	Between Col. G and Col. F

IR - Bridge Deck



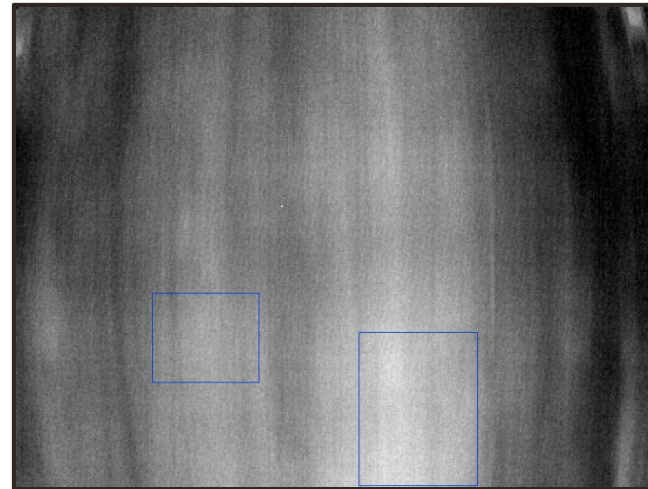
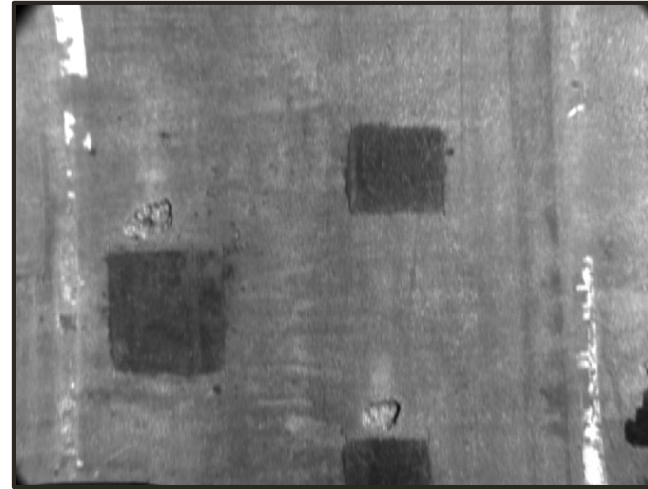
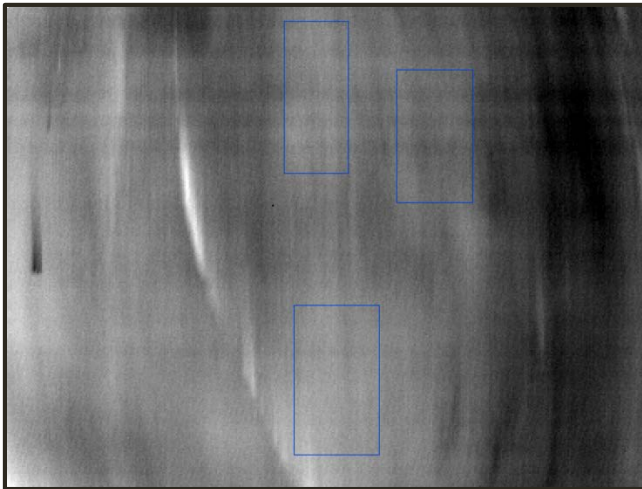
IR detects the energy differential on a surface caused by voids and objects beneath the surface.

These voids and objects are affected by natural diurnal heating and cooling cycles.

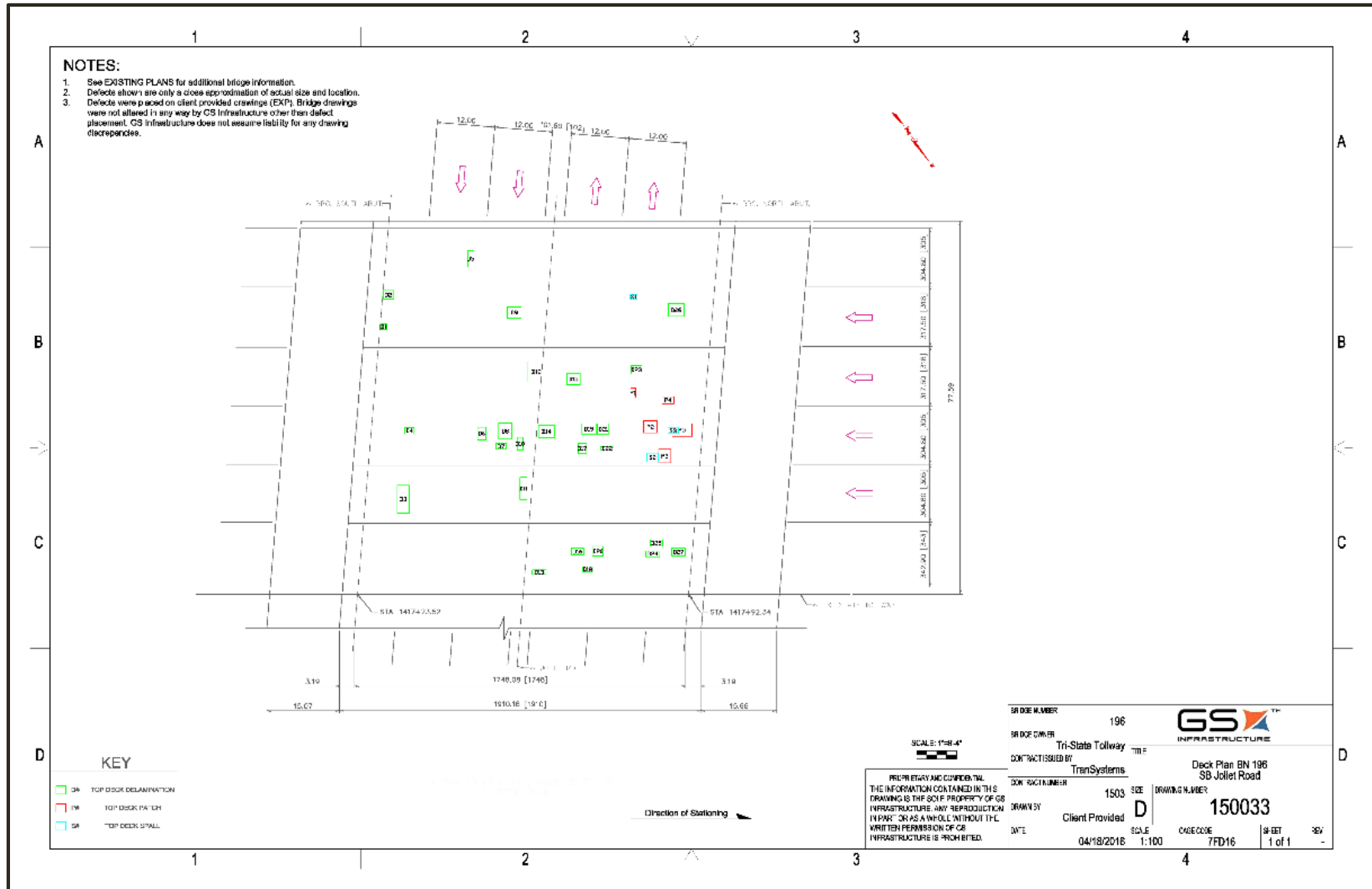




Bridge Deck IR



IR Bridge Deck – CAD Deliverable



IR Bridge Deck – Automated Reporting



Defect Type	NDE Method	Scan Element	# of Defects	Total Scan Area (SF)	Total Defect Area (SF)	% Total Defect Area of Total Scan Area
Indication of Delamination (D#)	IR	Deck Top (lanes only)	27	5,365	144.42	2.69%
Patch (P#)	Visual	Deck Top (lanes only)	5	5,365	30.32	0.57%
Spall (S#)	Visual	Deck Top (lanes only)	3	5,365	8.49	0.16%

Patch (P#)	Length (FT)	Width (FT)	Area (SF)	Station Final	Offset (LT or RT)	Notes
P1	1.08	2.04	2.20	1417+80.80	L41.9	
P2	2.88	2.46	7.08	1417+84.41	L34.8	
P3	2.56	2.82	7.24	1417+87.40	L28.7	
P4	2.43	1.40	3.39	1417+88.06	L40.3	
P5	4.01	2.60	10.41	1417+90.98	L34.1	
Total			30.32			

Spall (S#)	Length (FT)	Width (FT)	Area (SF)	Station Final	Offset (LT or RT)	Notes
S1	1.42	1.09	1.55	1417+80.94	L61.8	
S2	2.47	1.79	4.42	1417+84.85	L28.4	
S3	2.14	1.17	2.52	1417+89.11	L34.0	
Total			8.49			

Thank You!



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