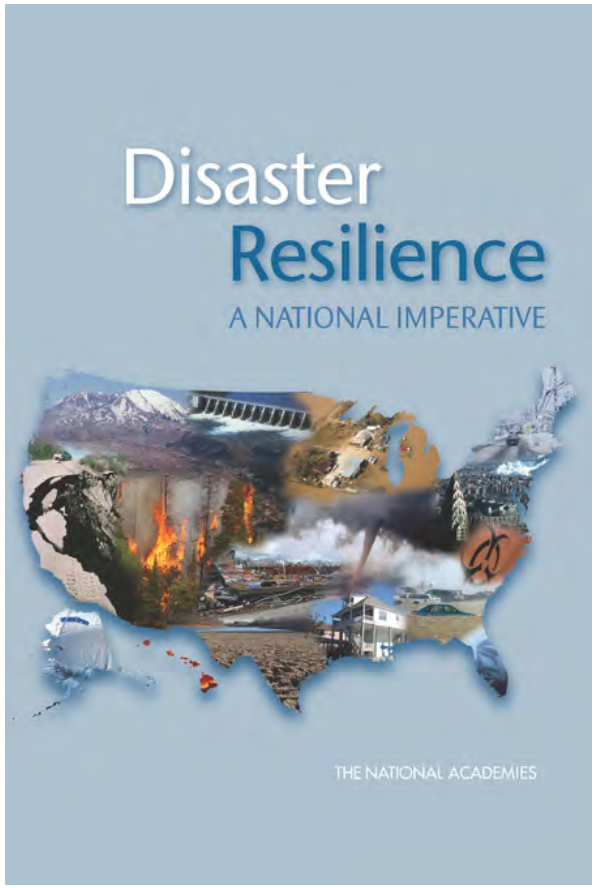
Resilient Pavement Structures in Texas

Andrew Wimsatt, Ph.D., P.E.
Texas A&M Transportation Institute
Lisa Lukefahr, P.E.
Texas Concrete Pavement Association

What is Resilience?

Definition 1.1

Resilience: The ability to prepare and plan for, absorb, recover from, or more successfully adapt to actual or potential adverse events.



Traditional vs. Emerging Objectives for Pavements

- Durability
  - Does not fail or disintegrate prematurely
- Resiliency
  - Can handle traffic after flooding, icing, drought, fire events
  - Can handle unexpected traffic loads (overall levels or individual super-heavy loads)

Pavement Performance

- Structural
  - Thickness Design
  - Withstand truck traffic loading and environmental effects without premature deterioration
- Functional
  - Ride Quality
  - Skid Resistance
  - Noise Reduction

Pavement Performance

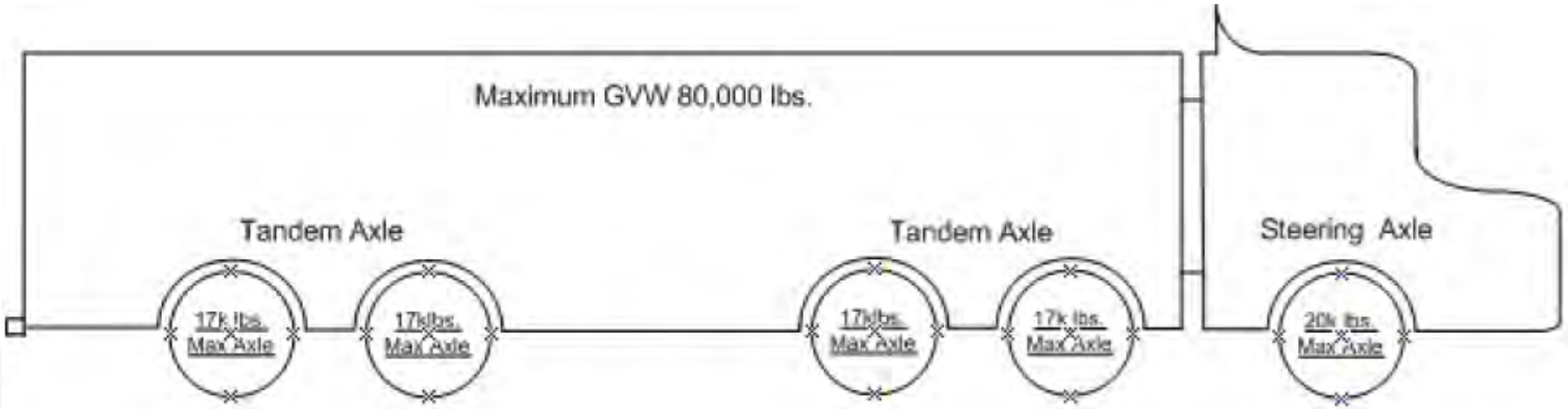
- Pavements are normally designed for a specific performance period (i.e., 30 year designs, overlay intervals of 10 to 15 years)
- However, *some* pavements in general have performed for much longer than we expected.

18 Kip Equivalent Single Axle Load (18KESAL)

D =14, PSIf=2.5

80,000 lb Gross Vehicle Weight 18 Wheeler

- 34,000 lb Tandem Axle: 1.97 18KESAL
- 34,000 lb Tandem Axle: 1.97 18KESAL
- 12,000 lb Steering Axle: 0.17 18KESAL
- Total – 4.11 18KESAL



105,000 lb Gross Vehicle Weight 18 Wheeler

- 46,000 lb Tandem Axle: 7.40 18KESAL
- 46,000 lb Tandem Axle: 7.40 18KESAL
- 13,000 lb Steering Axle: 0.25 18KESAL
- Total – 15.05 18KESAL

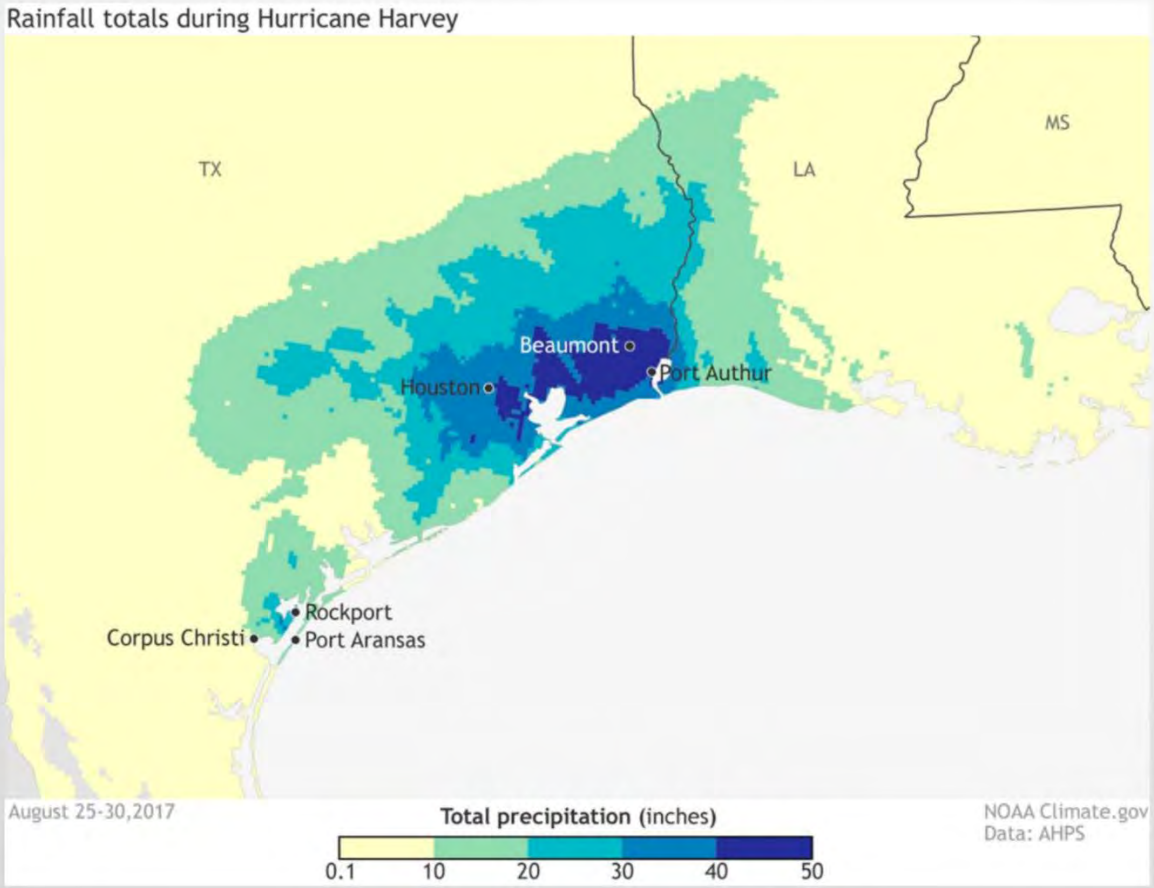
Continuously Reinforced Concrete Pavement (CRCP)

CRCP

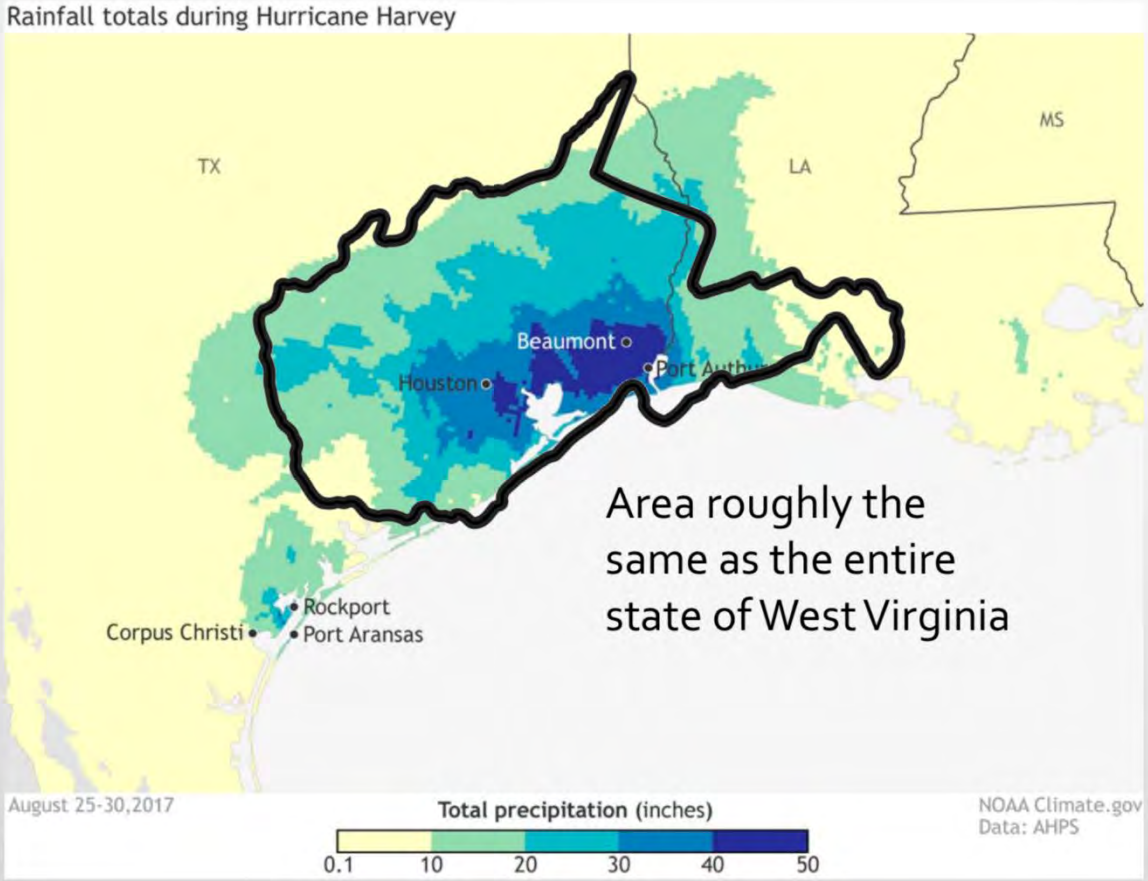
- No transverse joints except at bridge ends and construction joints
- Crack spacing varies from 3 feet to 15 feet
- TxDOT has used CRCP since the early 1950's

CRCP

Flooding During Hurricane Harvey

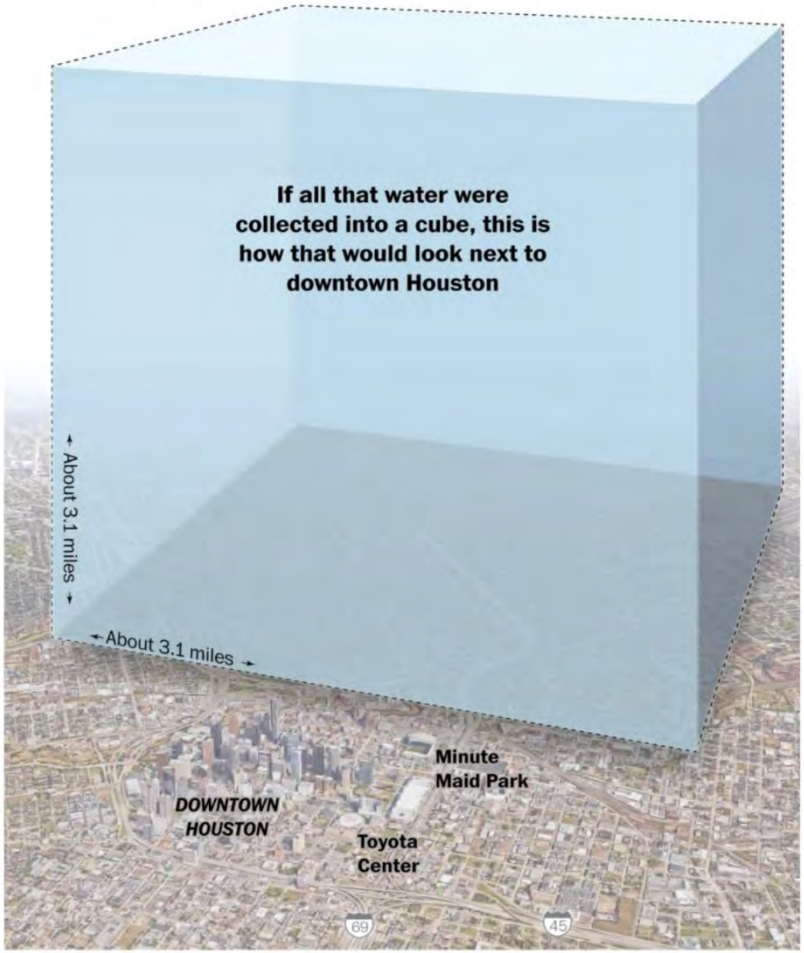


Flooding During Hurricane Harvey



What would 33 trillion gallons of water look like?

As of Saturday, Sep. 1, about 33 trillion gallons of rain have fallen along the Gulf of Mexico.



Sources: Ryan Maue, Capital Weather Gang, Google Earth

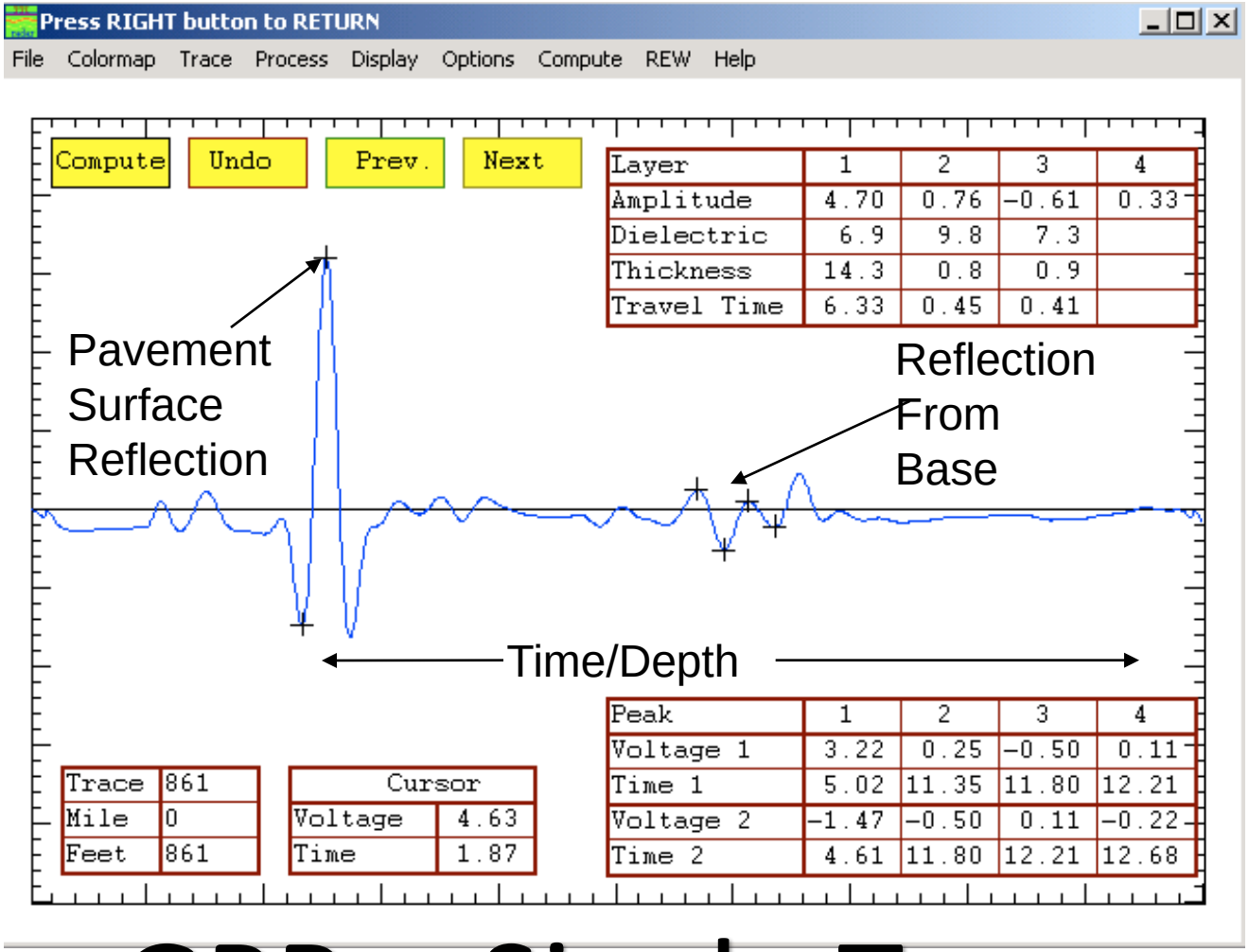
THE WASHINGTON POST

Air Coupled Ground Penetrating Radar (ACGPR)

- Penetration Depth of two to three feet
- Data collected every foot
- Operates at highway speeds
- Measures dielectric properties of pavement layers
- Detects pavement layer thicknesses and defects

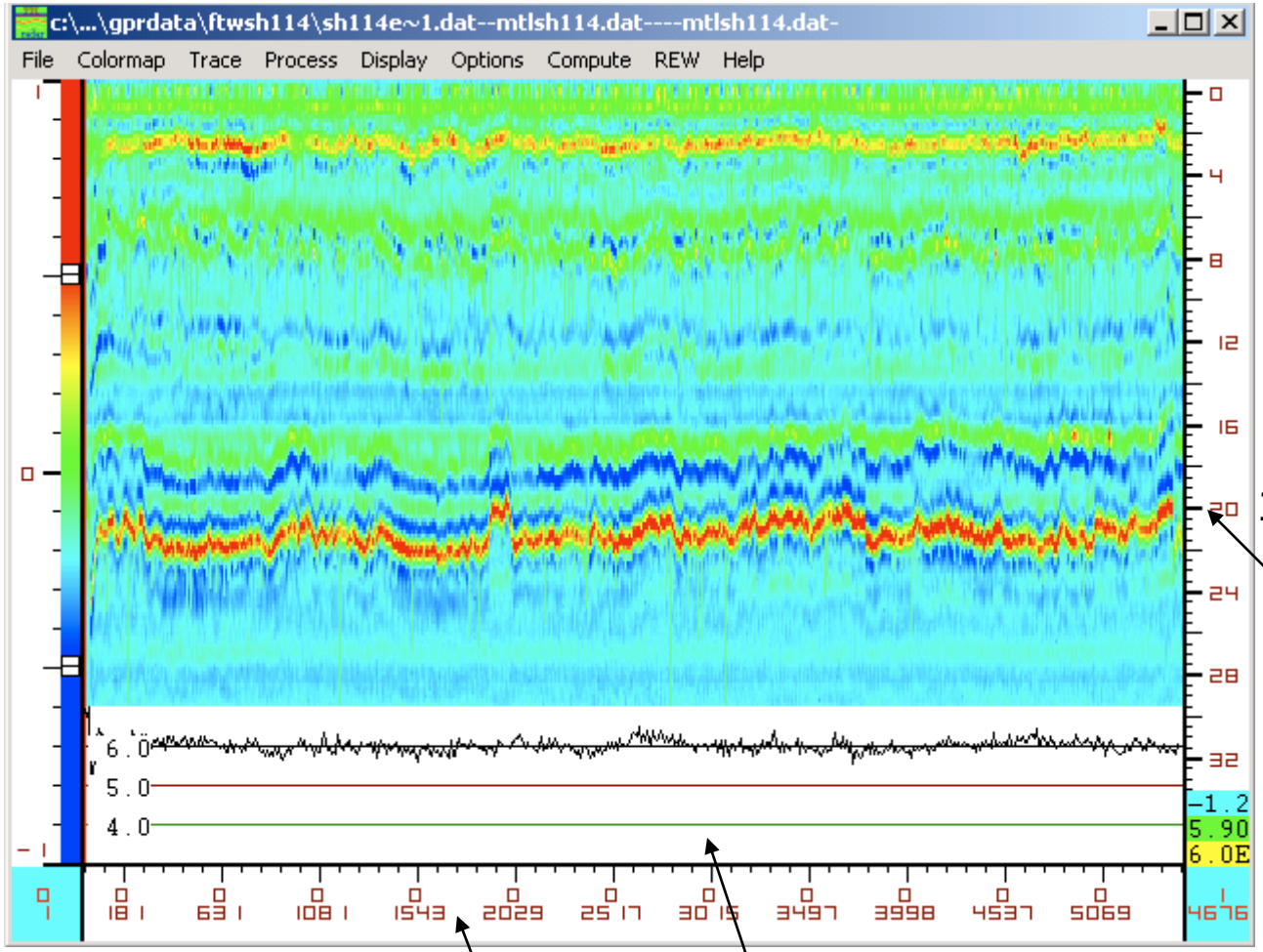
Normal Dielectric Values from ACGPR

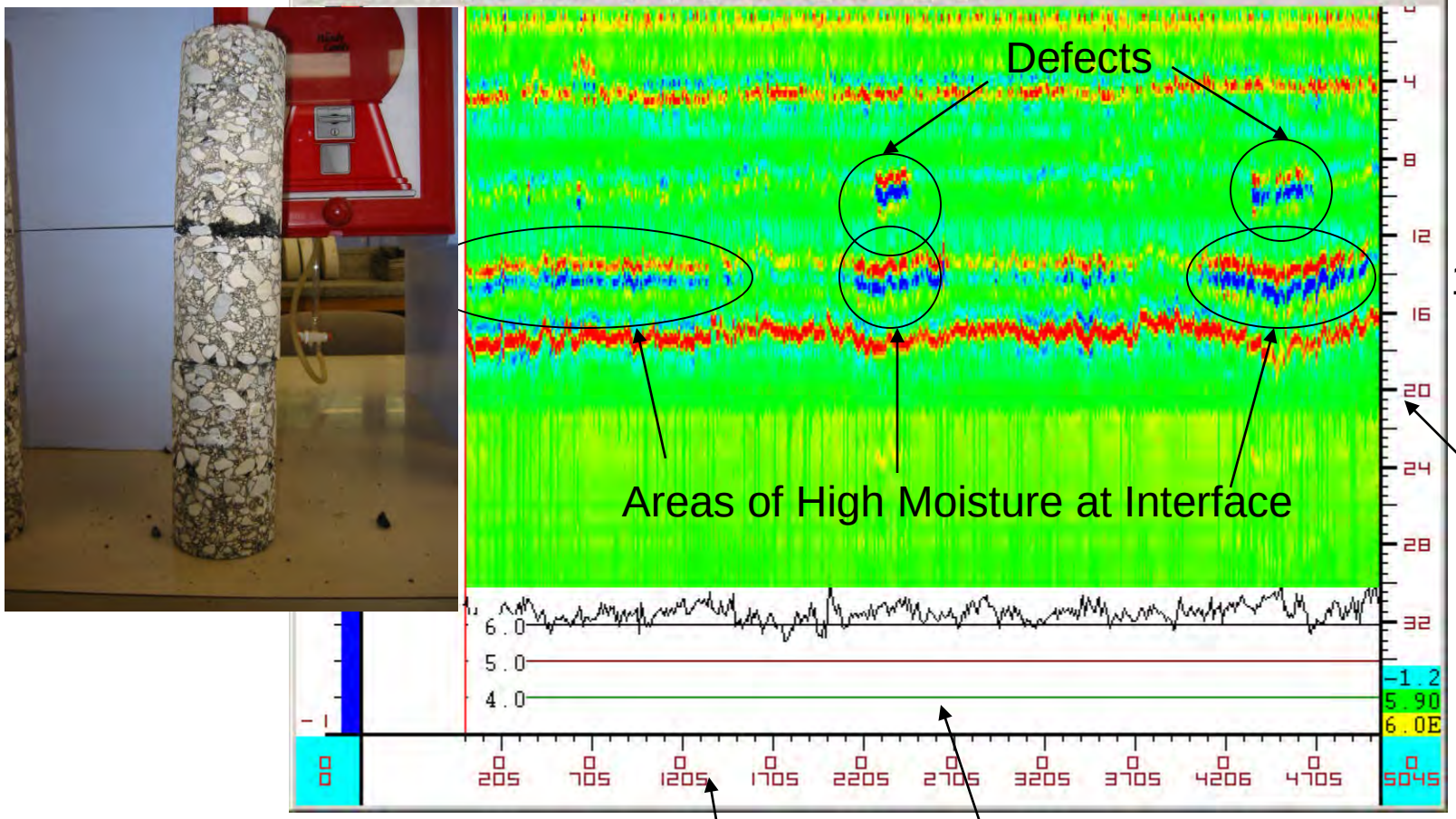
- Normal Aggregate ACP: 5.0 to 7.0
- Lightweight Aggregate ACP: 3.5 to 4.5
- Flexible (Granular) Base: 8.0 to 12.0
- Cement Treated Base: 6.0 to 8.0
- Concrete Pavement: 7.0 to 9.0
- Higher Values - Significant Moisture
- Lower Values - Excessive Air Voids
- Air: 1, Water: 81



GPR – Single Trace

GPR Data: Pavement in Good Condition, No Defects

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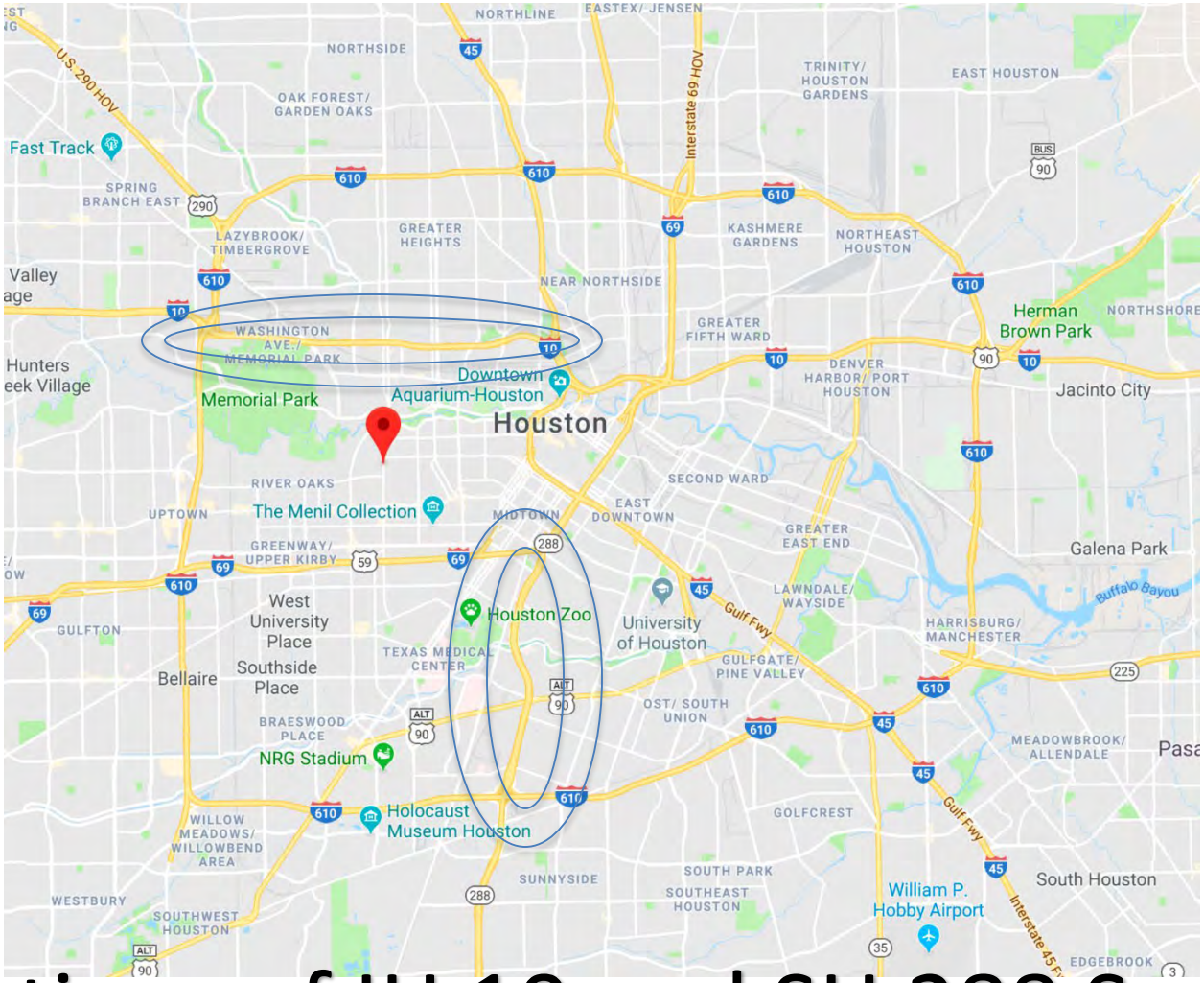
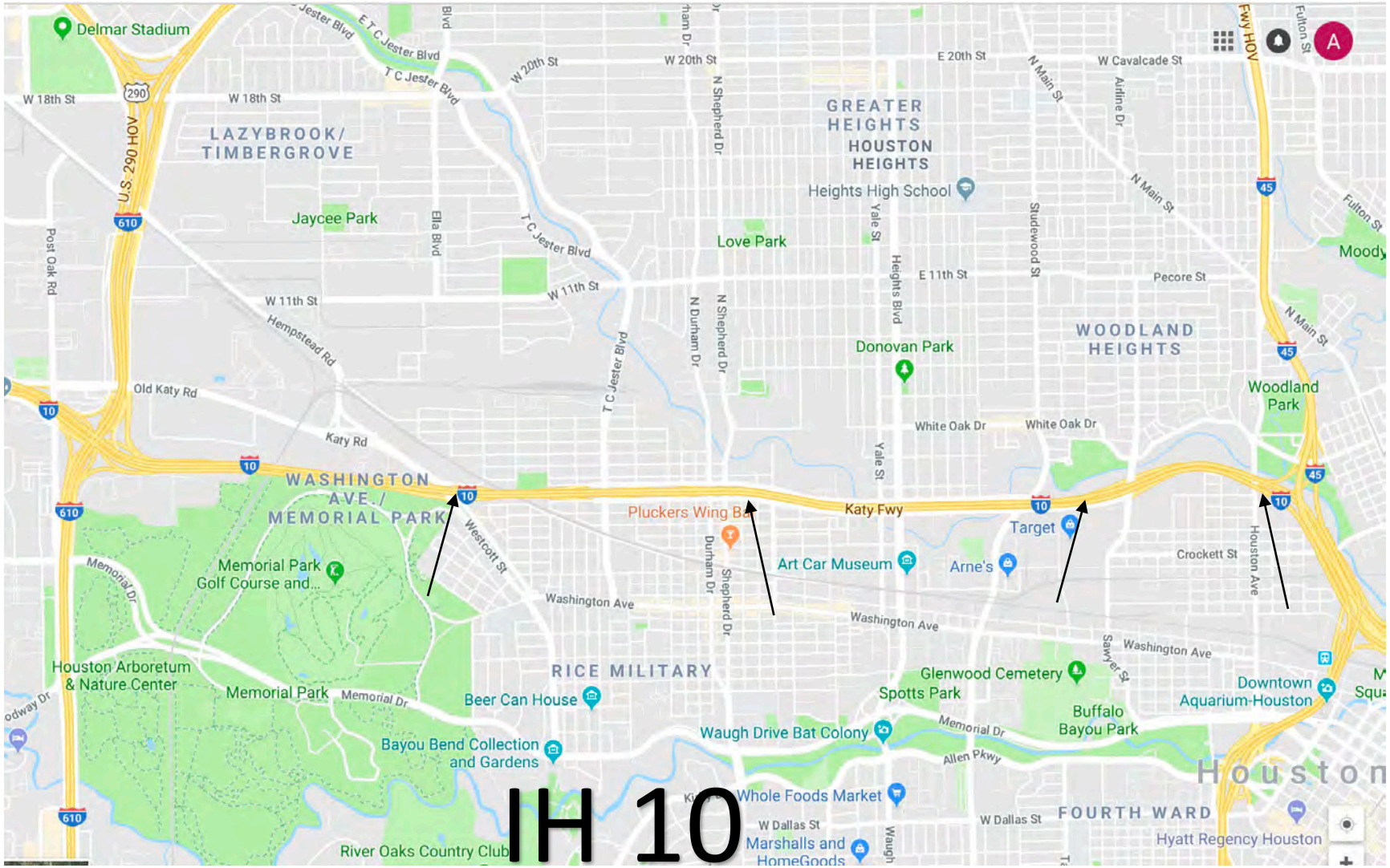
File Colormap Trace Process Display Options Compute REW Help
Defects
Areas of High Moisture at Interface
25 mm LSACP
19 mm ACP
Thickness Scale, inches
Distance Scale
Surface Dielectric Scale



Locations of IH 10 and SH 288 Sections


Delmar Stadium
W 18th St
290
U.S. 290 HOV
610
LAZYBROOK/
TIMBERGROVE
Jaycee Park
Post Oak Rd
Ella Blvd
T C Jester Blvd
W 20th St
N Shepherd Dr
GREATER
HEIGHTS
HOUSTON
HEIGHTS
Heights High School
Love Park
Yale St
Studewood St
Heights Blvd
E 20th St
W Cavalcade St
N Main St
Airline Dr
Fwy HOV
Fulton St
Moody
E 11th St
Pecore St
W 11th St
Hempstead Rd
N Durham Dr
Donovan Park
WOODLAND
HEIGHTS
Woodland
Park
Old Katy Rd
Katy Rd
White Oak Dr
WASHINGTON
AVE. /
MEMORIAL PARK
Pluckers Wing Bar
Katy Fwy
Target
Art Car Museum
Arne's
Crockett St
Houston Ave
Westcott St
Memorial Park
Golf Course and...
Memorial Dr
Washington Ave
Houston Arboretum
& Nature Center
Memorial Park
RICE MILITARY
Beer Can House
Glenwood Cemetery
Spotts Park
Downtown
Aquarium Houston
Buffalo
Bayou Park
Waugh Drive Bat Colony
Bayou Bend Collection
and Gardens
Allen Pkwy
Houston
Whole Foods Market
W Dallas St
FOURTH WARD
Hyatt Regency Houston
River Oaks Country Club
Marshalls and
HomeGoods
IH 10

IH 10 from IH 610 to IH 45

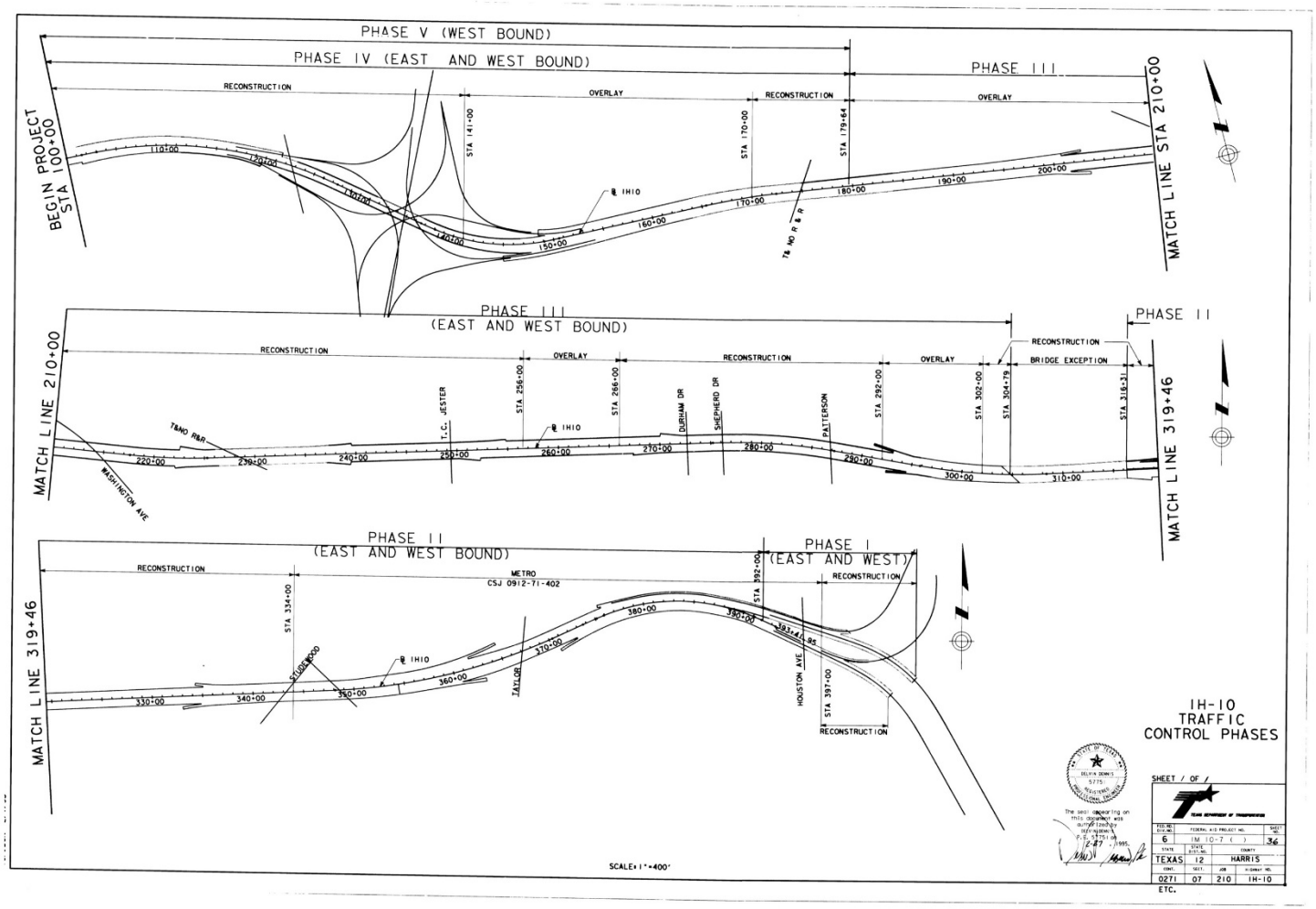
- Reconstructed from October 1995 to October 2000
- Used recycled crushed concrete aggregate in the CRCP
- Designed for 43 million 18KESALs using the 1986 AASHTO rigid pavement design procedure and TxDOT's recommended inputs.
- Estimated 92 million 18KESALS have travelled on IH 10 in the design lane from 2001 to 2016.
  - Same pavement is now on its 3rd life!
    - 2016 two way ADT of 226,390 with 6.4% trucks
    - For comparison, IH 10 near UTSA and FM 1604 has a 2016 two way ADT of 149,420 with 4.7% trucks
    - Would take more than twice as long in San Antonio to reach the same traffic loading condition as IH 10 in Houston

IH 10 from IH 610 to IH 45
Reconstructed Sections

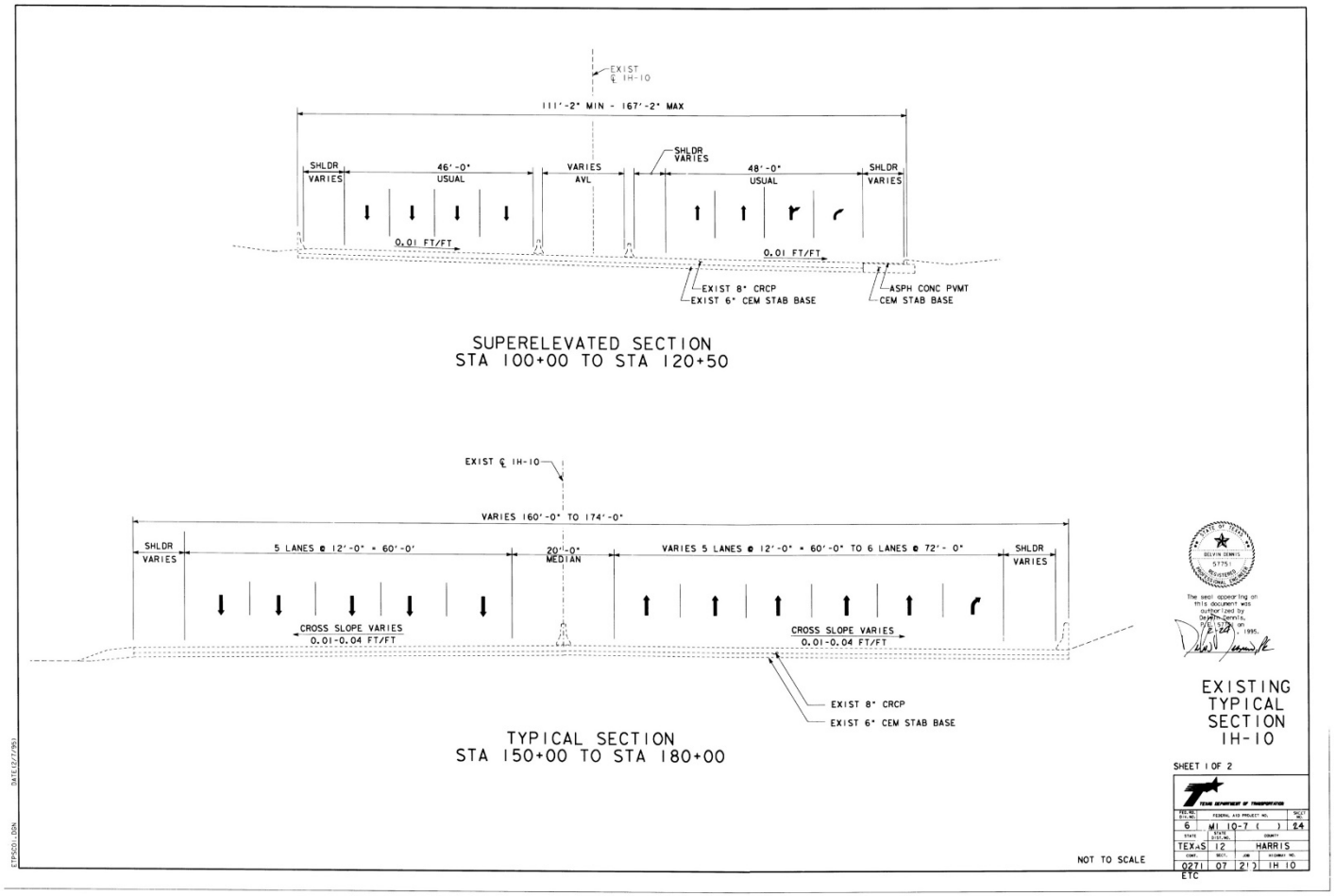
- 14” CRCP
- 3” Asphalt Stabilized Base
- 6” Lime Treated Subgrade

IH 10 from IH 610 to IH 45
Unbonded Concrete Overlay Sections

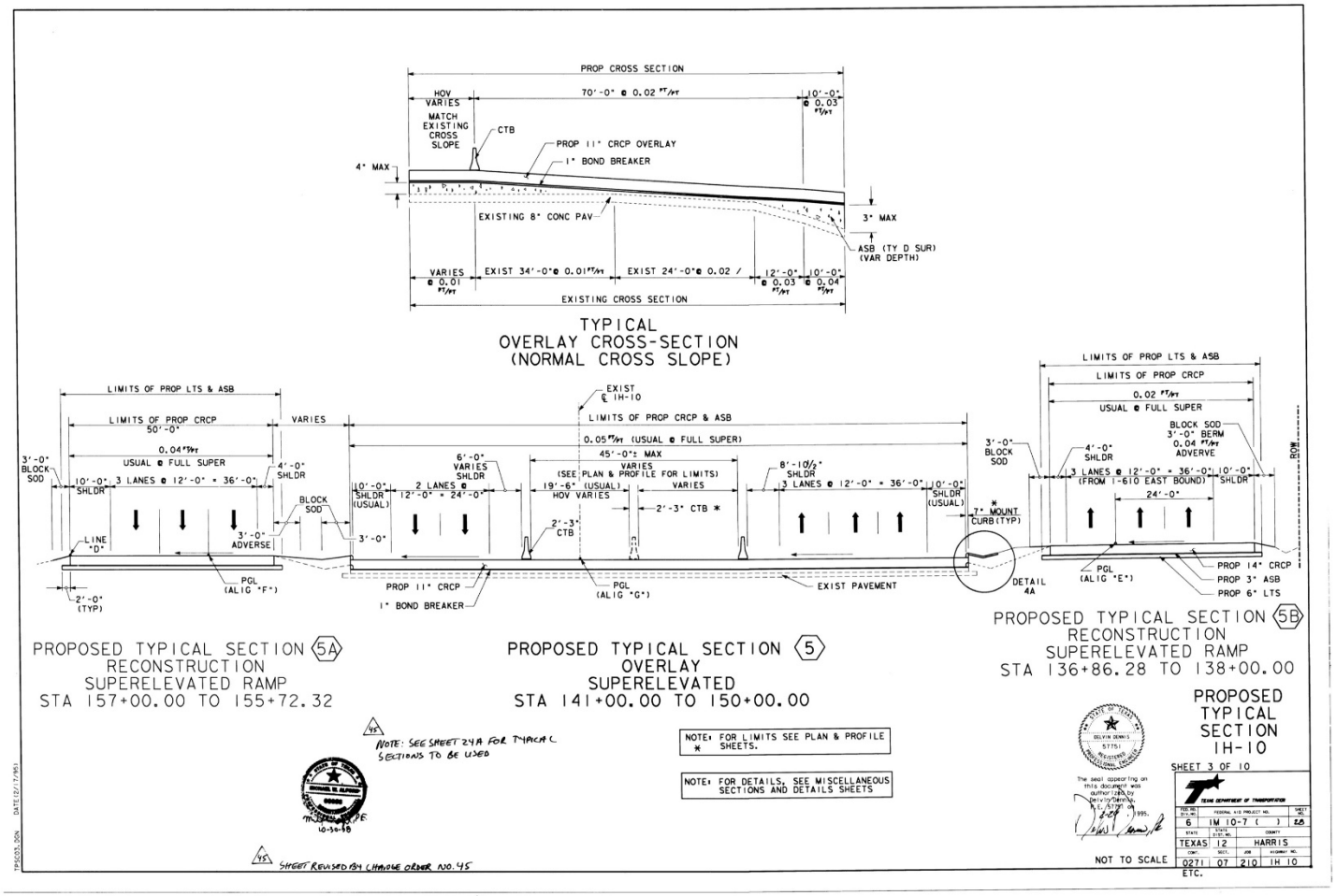
- 11” CRCP
- 1” Asphalt Stabilized Base
- 8” Existing CRCP
- 6” Existing Cement Stabilized Base


PHASE V (WEST BOUND)
PHASE IV (EAST AND WEST BOUND)
PHASE III
RECONSTRUCTION
OVERLAY
RECONSTRUCTION
OVERLAY
BEGIN PROJECT STA 100+00
STA 141+00
STA 170+00
STA 179+64
MATCH LINE STA 210+00
℄ IH10
T&NO R&R
PHASE III
(EAST AND WEST BOUND)
PHASE II
RECONSTRUCTION
OVERLAY
RECONSTRUCTION
OVERLAY
RECONSTRUCTION
BRIDGE EXCEPTION
MATCH LINE 210+00
T.C. JESTER
STA 256+00
STA 266+00
DURHAM DR
SHEPHERD DR
PATTERSON
STA 292+00
STA 302+00
STA 304+79
STA 316+31
MATCH LINE 319+46
WASHINGTON AVE
PHASE II
(EAST AND WEST BOUND)
PHASE I
(EAST AND WEST)
RECONSTRUCTION
METRO
CSJ 0912-71-402
STA 334+00
STA 392+00
RECONSTRUCTION
MATCH LINE 319+46
SLUDGE POND
TAYLOR
HOUSTON AVE
STA 397+00
RECONSTRUCTION
IH-10
TRAFFIC
CONTROL PHASES
SCALE: 1"=400'
SHEET / OF /
TEXAS
12
HARRIS
0271
07
210
IH-10
ETC.

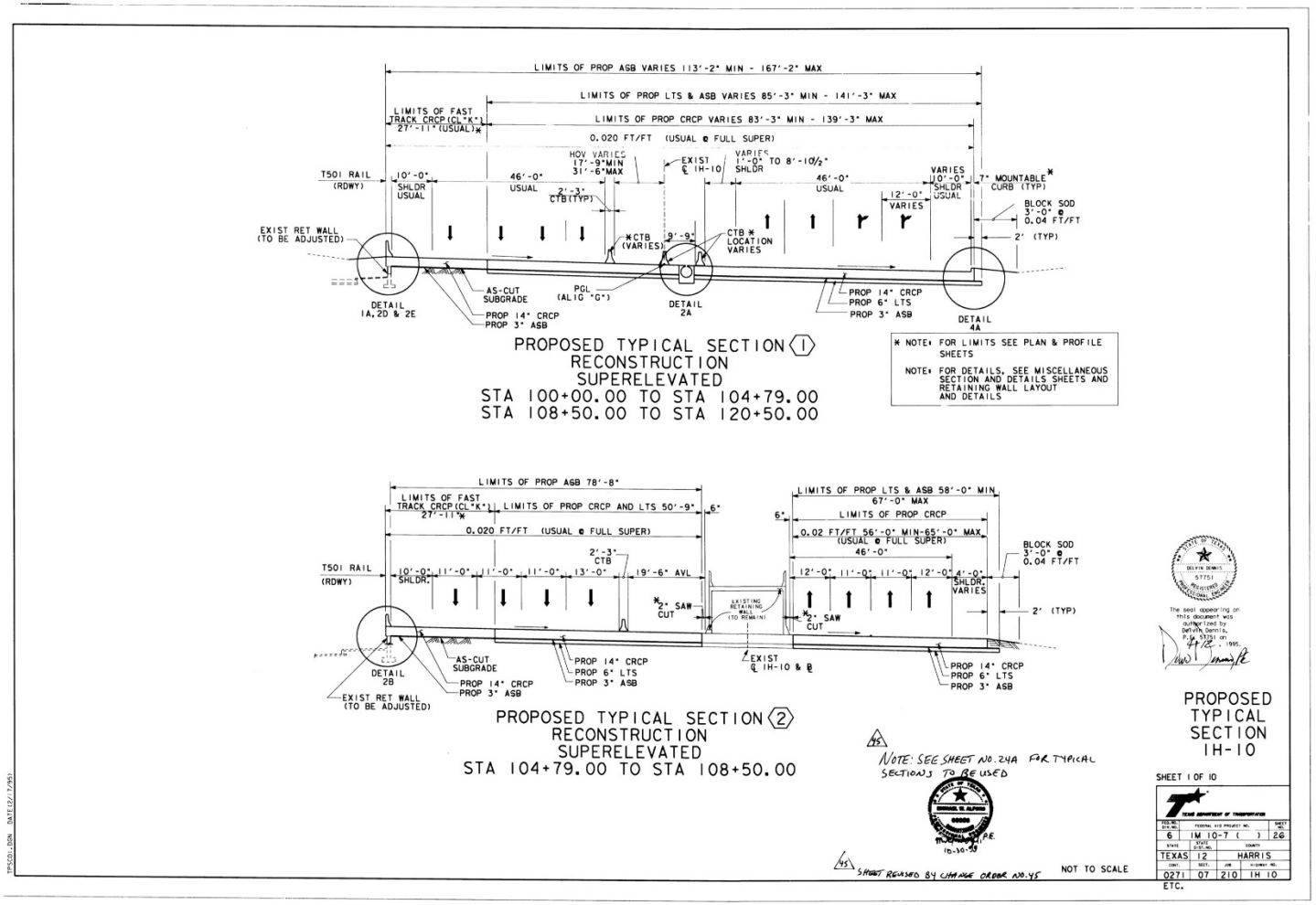
IH 10 Layout



IH 10 Typical Sections



IH 10 Typical Sections



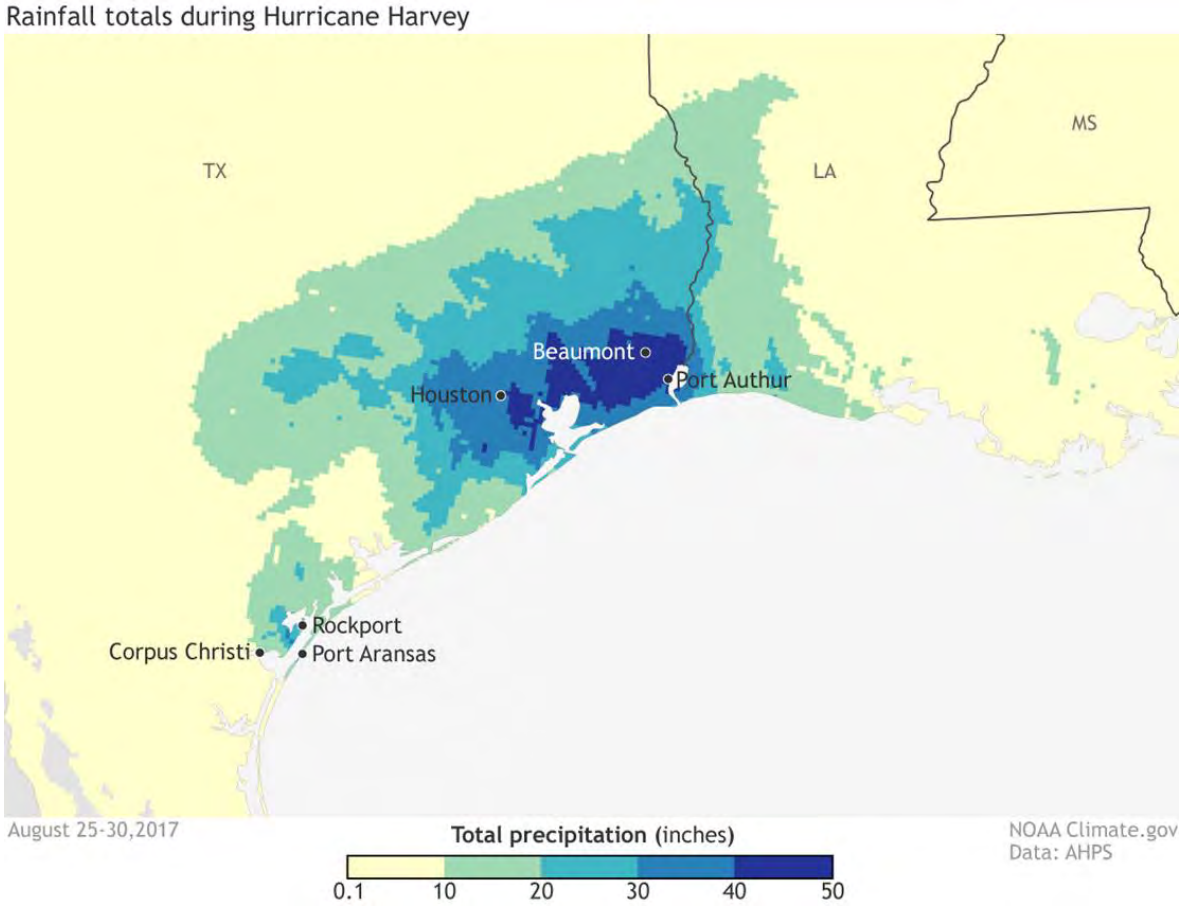
IH 10 Typical Sections

IH 10 from IH 610 to IH 45

- Has been flooded *at least* three times since reconstruction
- TxDOT Maintenance Expenditures for pavement-related* items from 2001 to 2016 on this section were $303,113, or $3,125/lane mile
  - Less than $200/year/lane mile up to this point

* Does not include trash pick-up, striping, etc.

Flooding During Hurricane Harvey



HOV Lane
NW Transit Center
EXIT 764
Memorial Park
NEXT RIGHT

#No584
7688
EXIT
Theater District
NEXT RIGHT
RIGHT LANE
MUST
EXIT

MIDTOWN PLAZA
EXIT 764
Washington Ave
Westcott St
1 MILE
EXIT 765A
T C Jester
Blvd
EXIT ONLY
15

N Durham Dr
N Shepherd Dr
Patterson St
TEXACO

HOV Lane
NW Transit Center

EAST
Downtown
EXIT 764
Washington Ave
Westcott St
EXIT ONLY

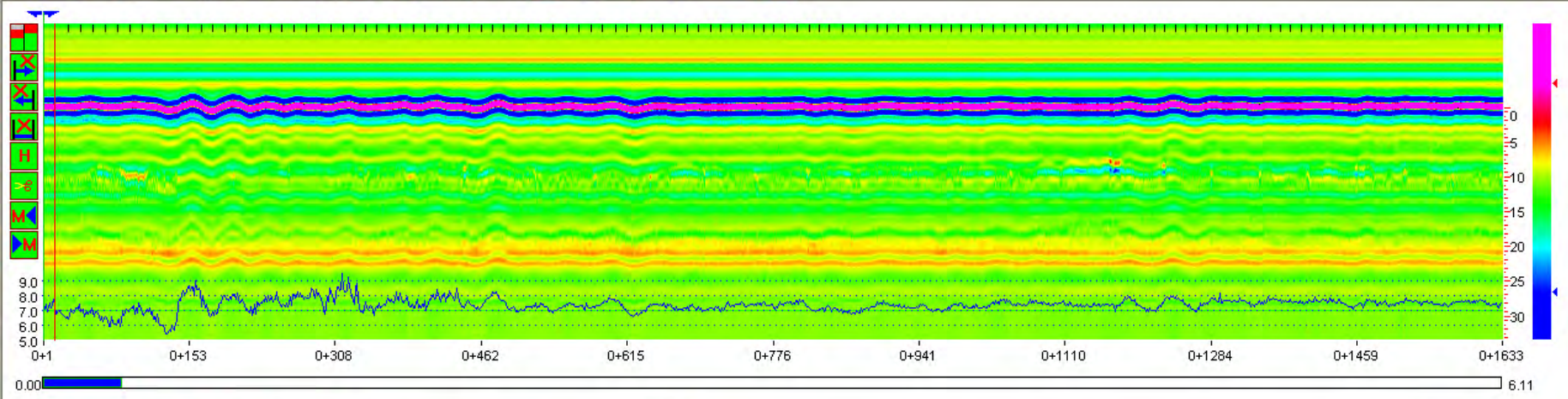
IH 10 after Harvey, Oct 2017

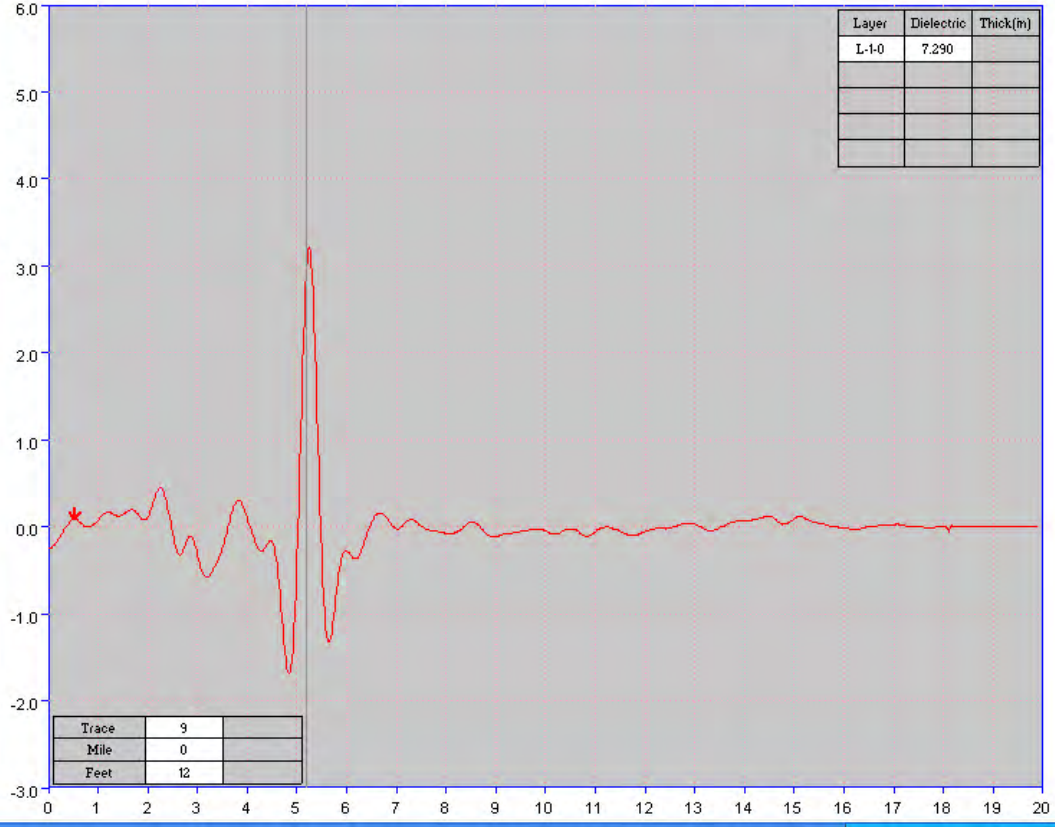
IH 10 Eastbound
Ground Penetrating Radar Data
October, 2017

GPS: Lat: 29.78028806 Log: 95.45424418 (Lat:(N) 29:46:49.0370 Log:(W) 95:27:15.2791

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080





GPS: Lat: 29.77891422 Log: 95.45102771 (Lat:(N) 29:46:44.0912 Log:(W) 95:27: 3.6998

File Tools Output KML Google Map

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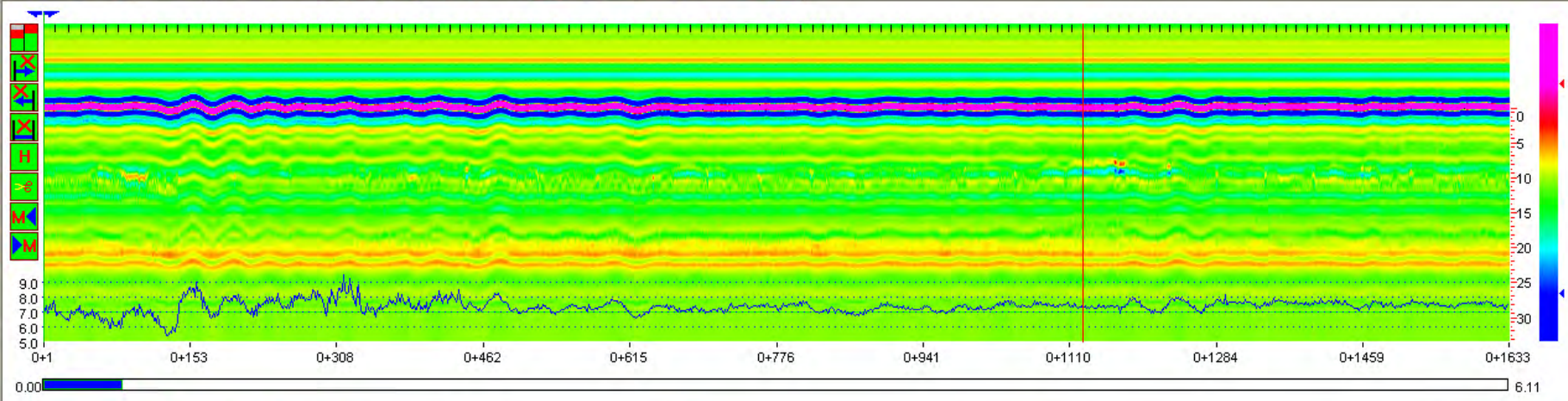

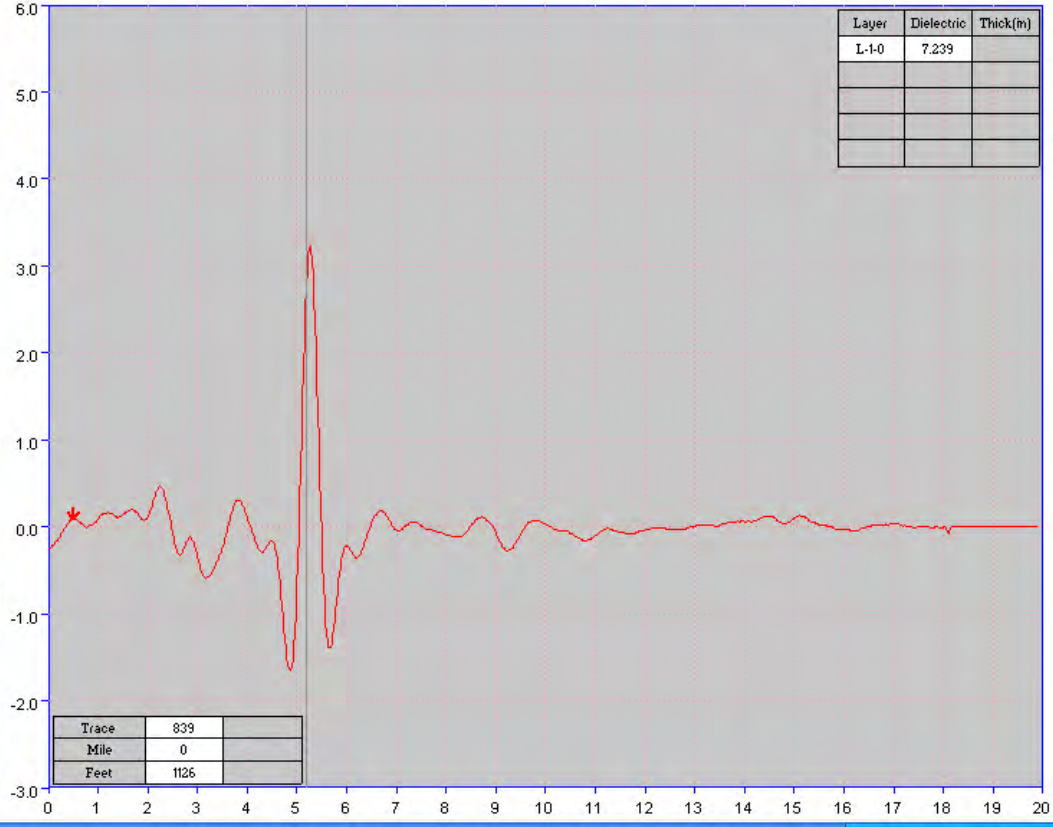

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File Tools Output KML Google Map

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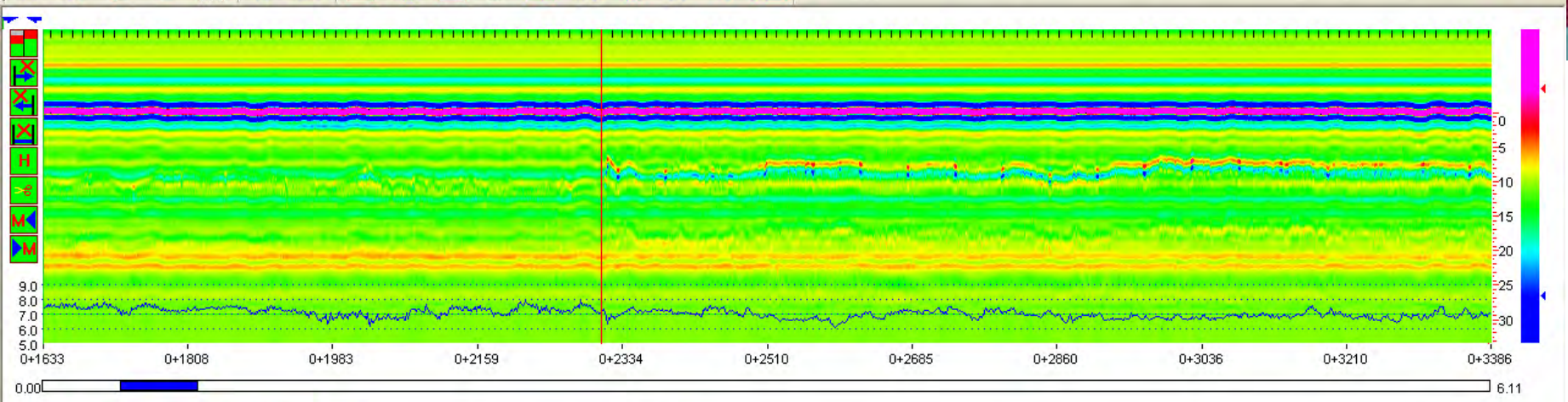

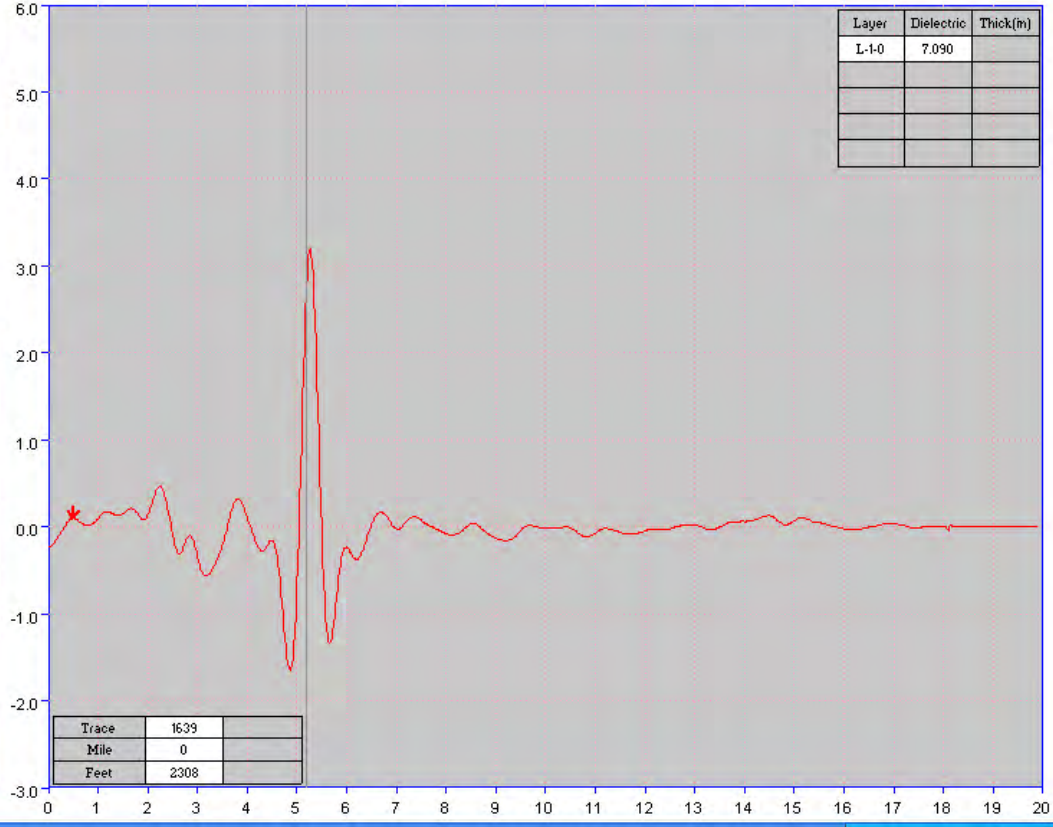

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File Tools Output KML Google Map

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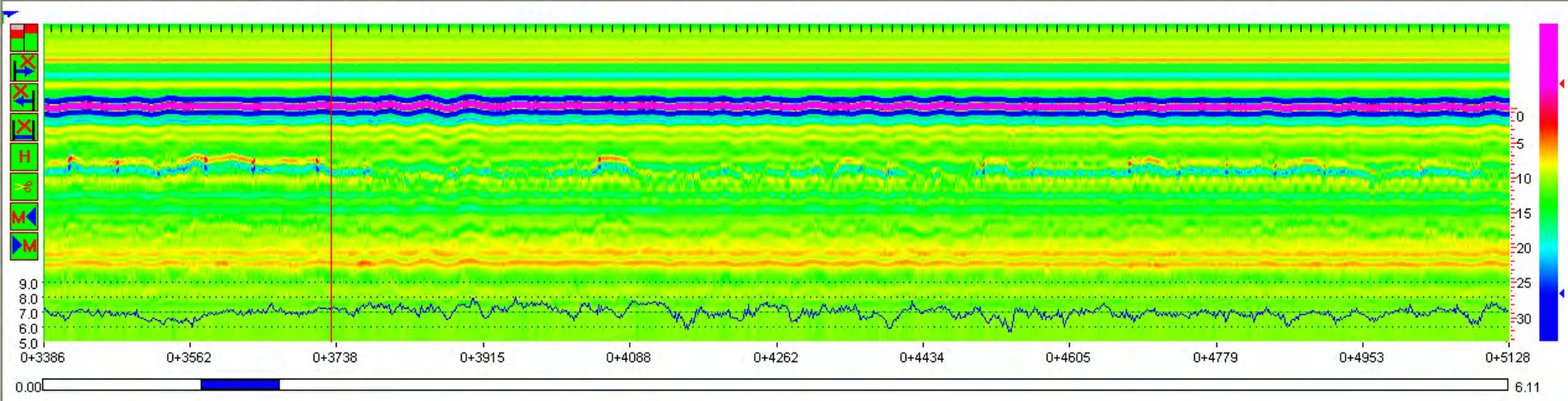

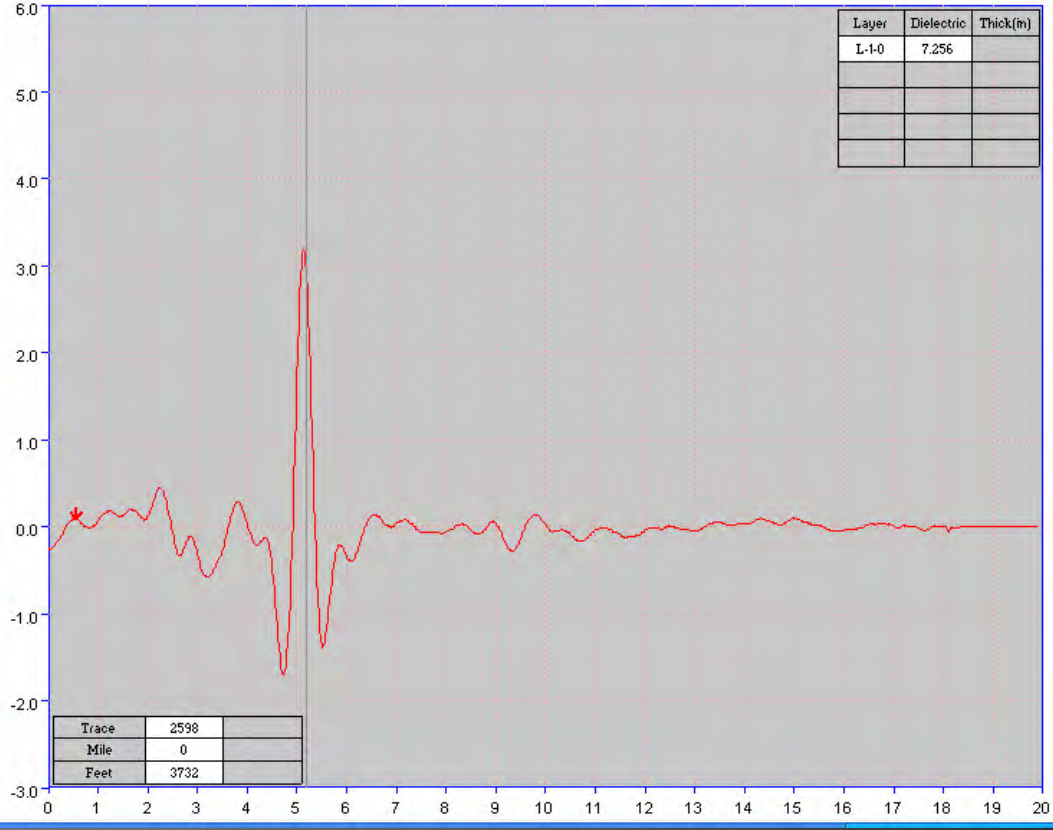

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File Tools Output KML Google Map

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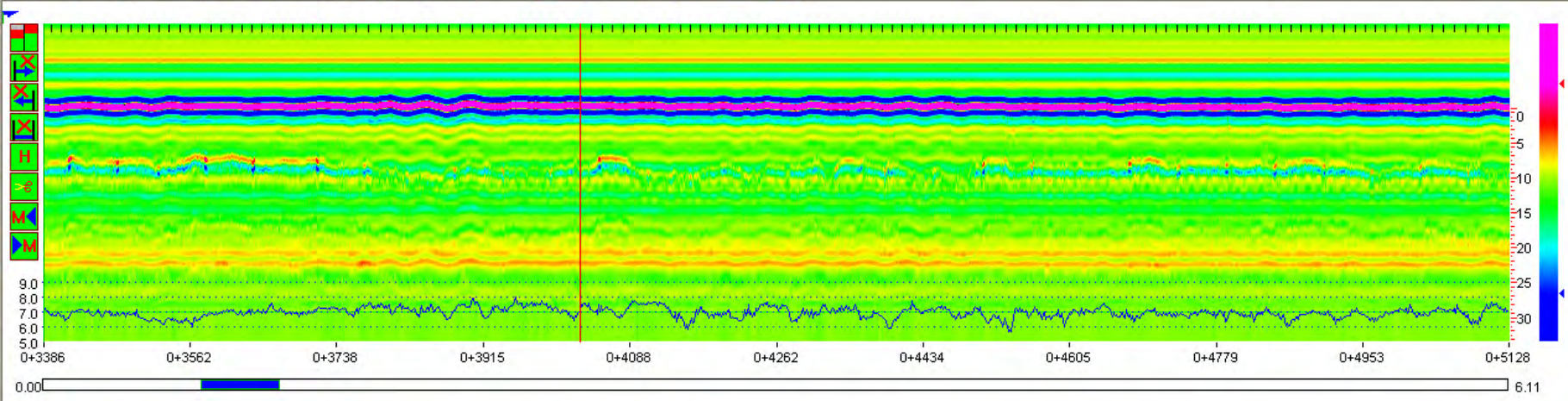

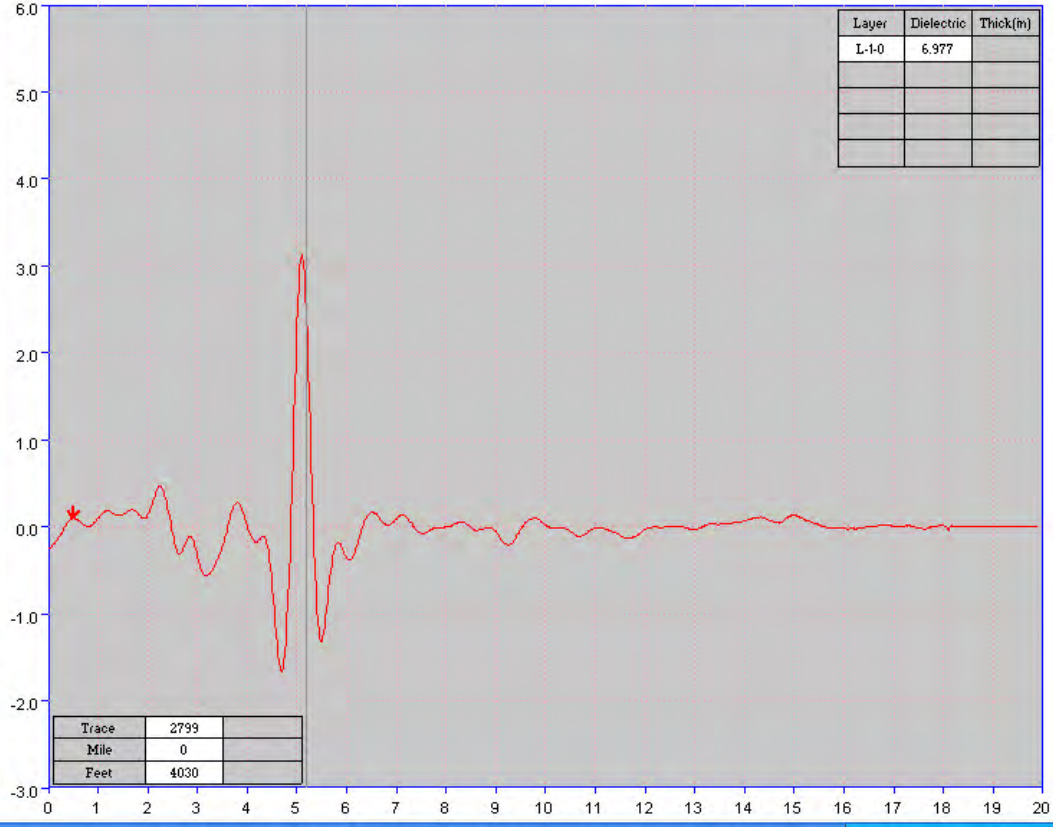

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File Tools Output KML Google Map

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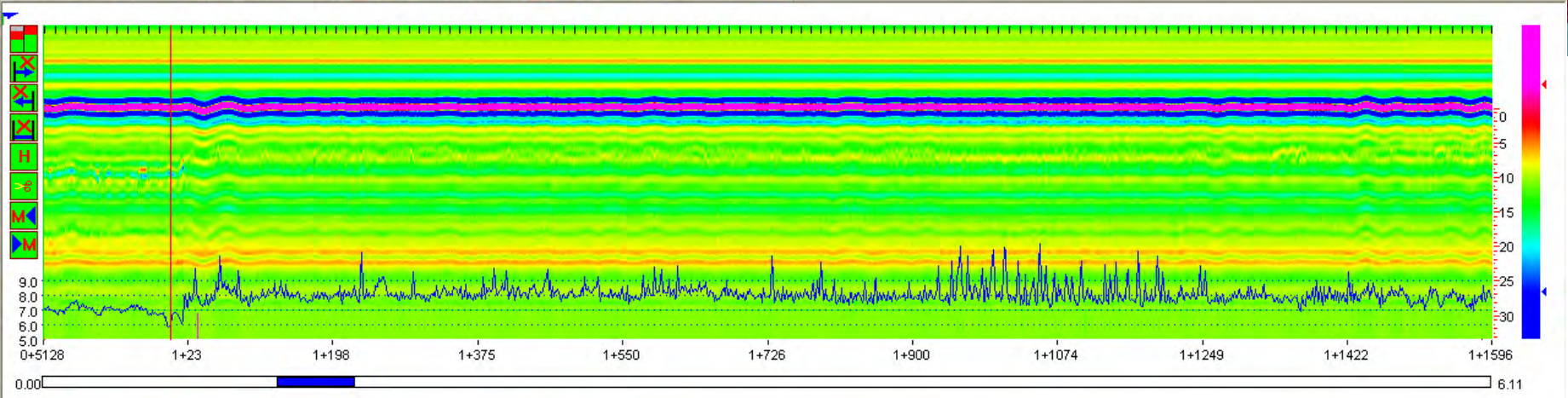

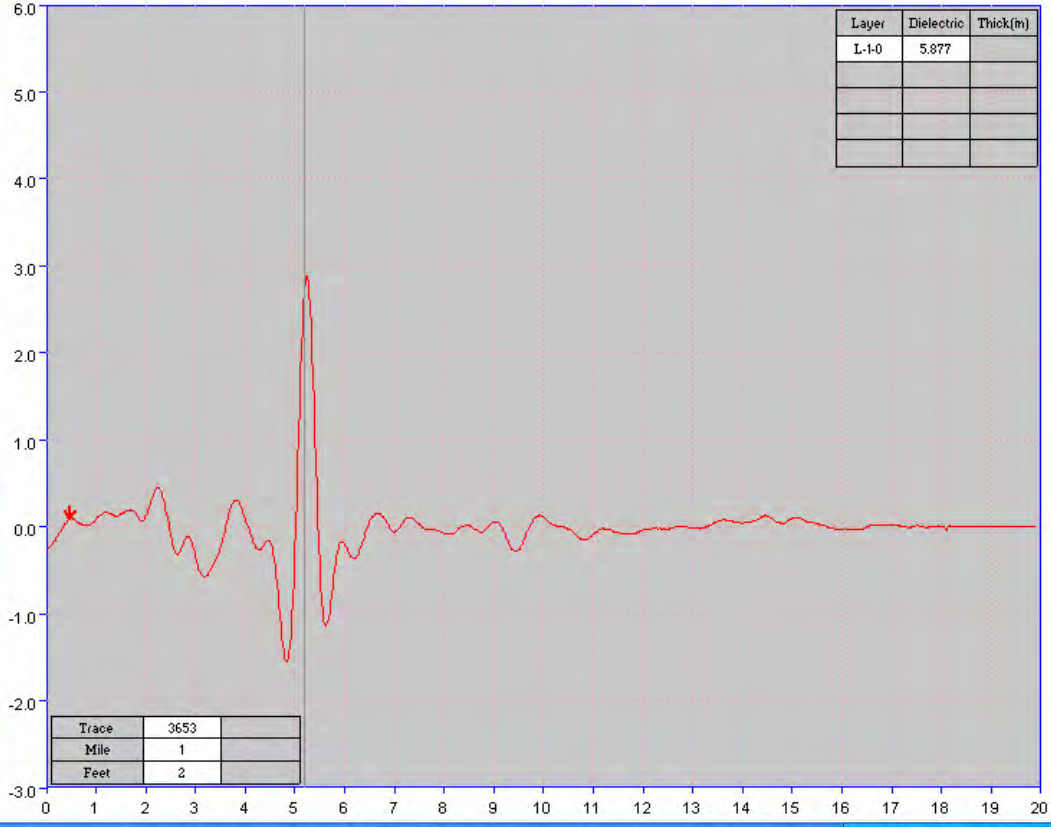

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File Tools Output KML Google Map

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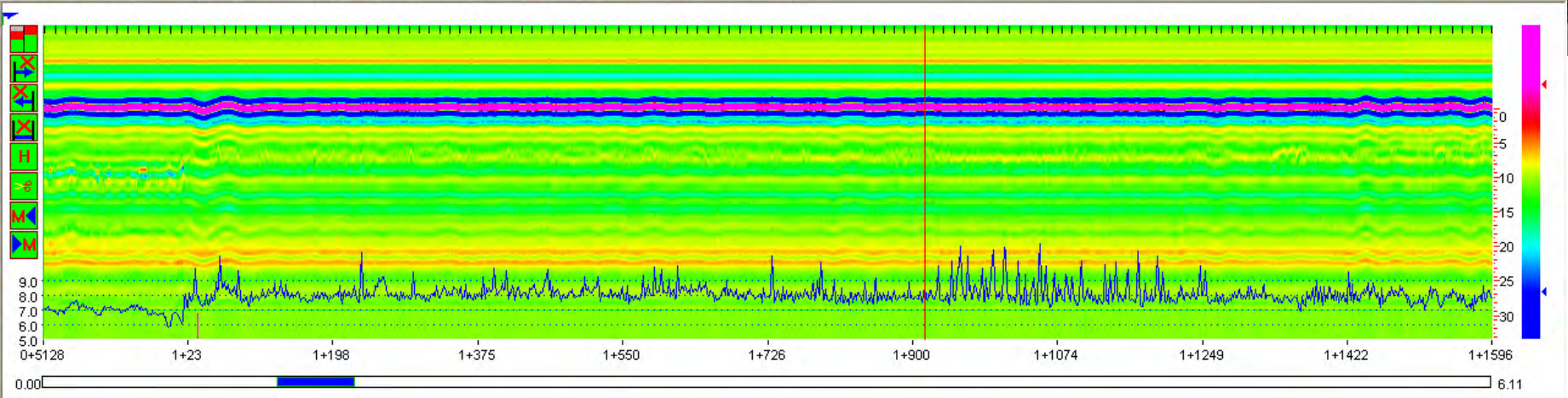

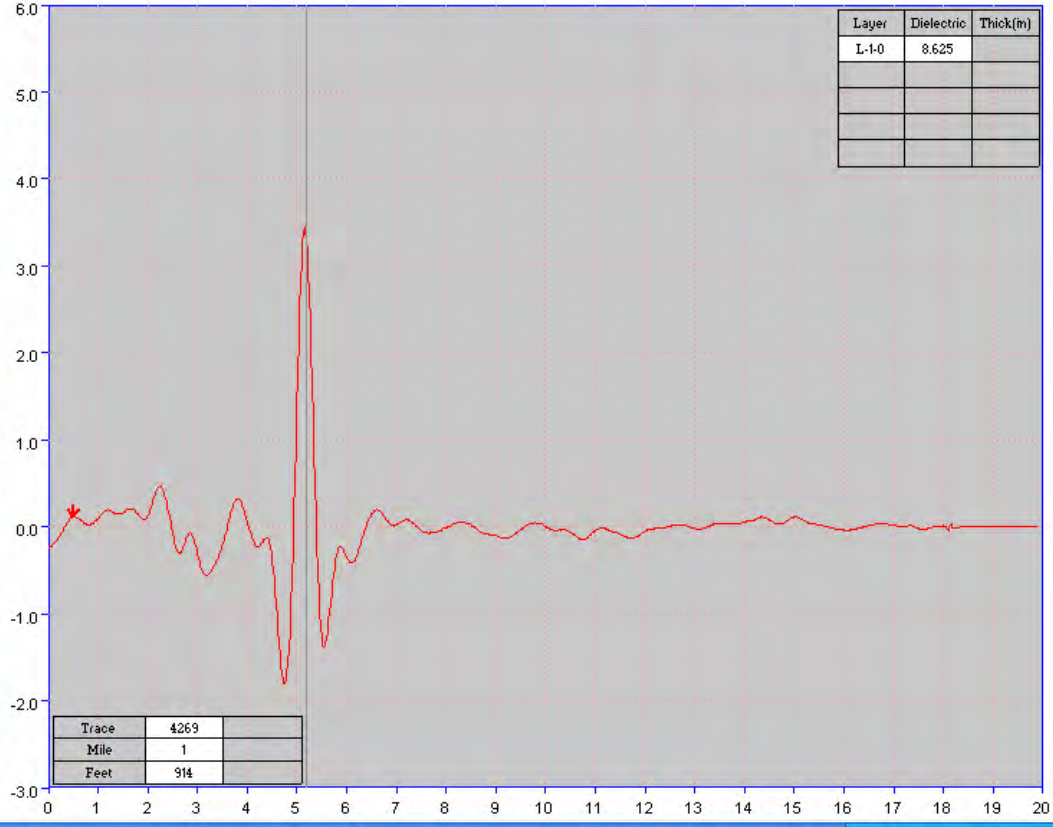

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File Tools Output KML Google Map

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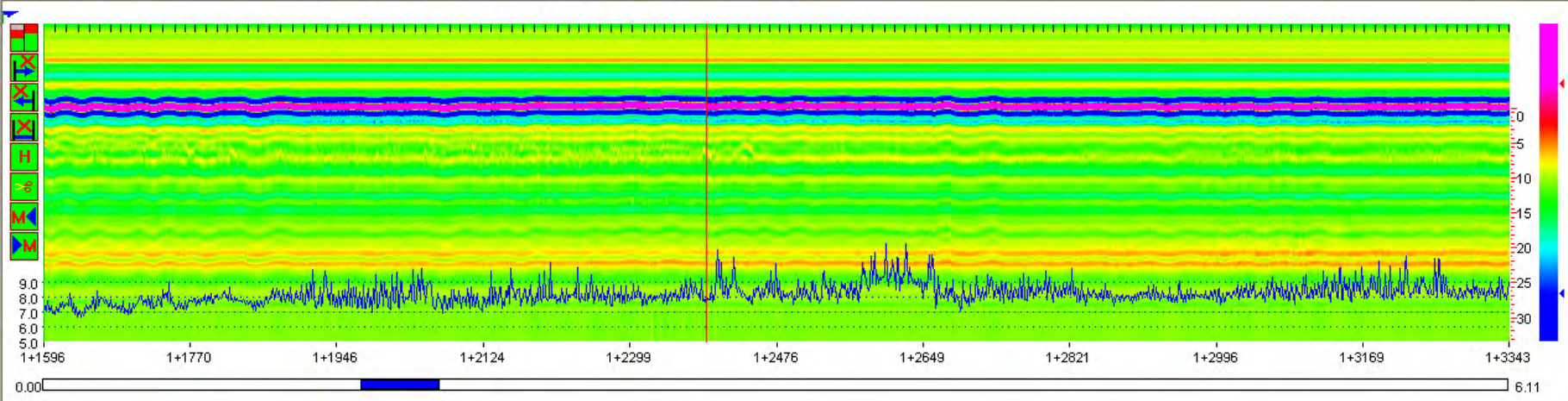
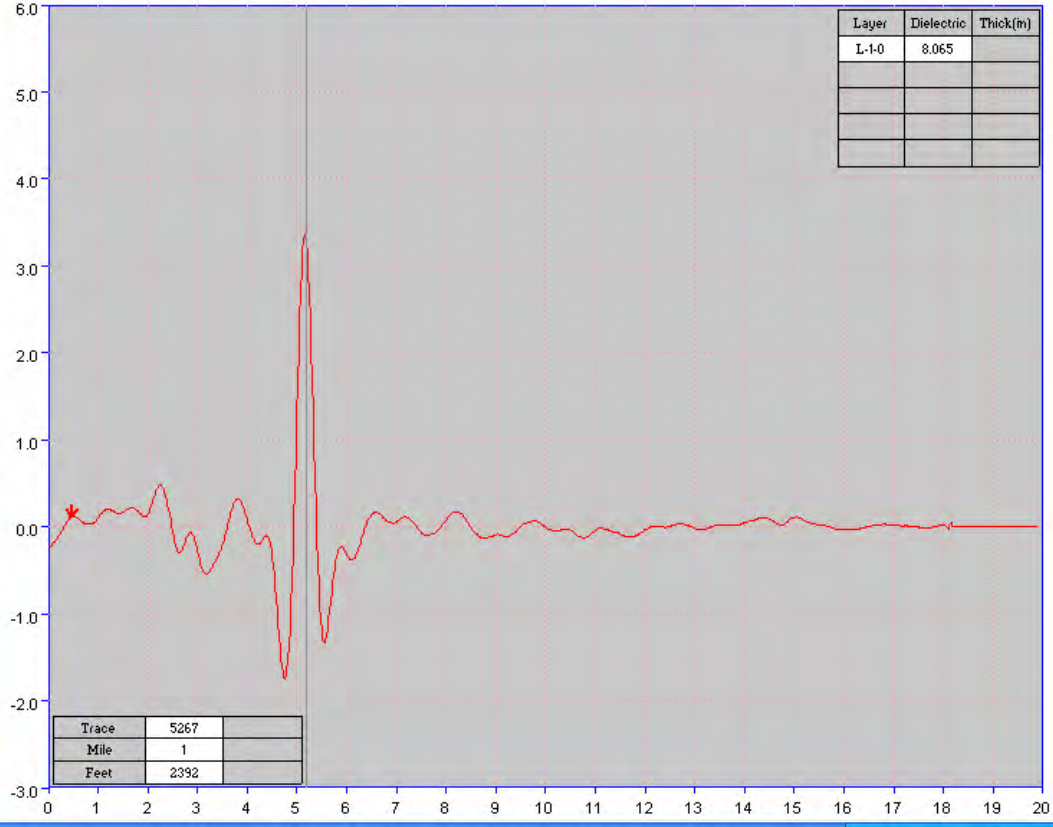
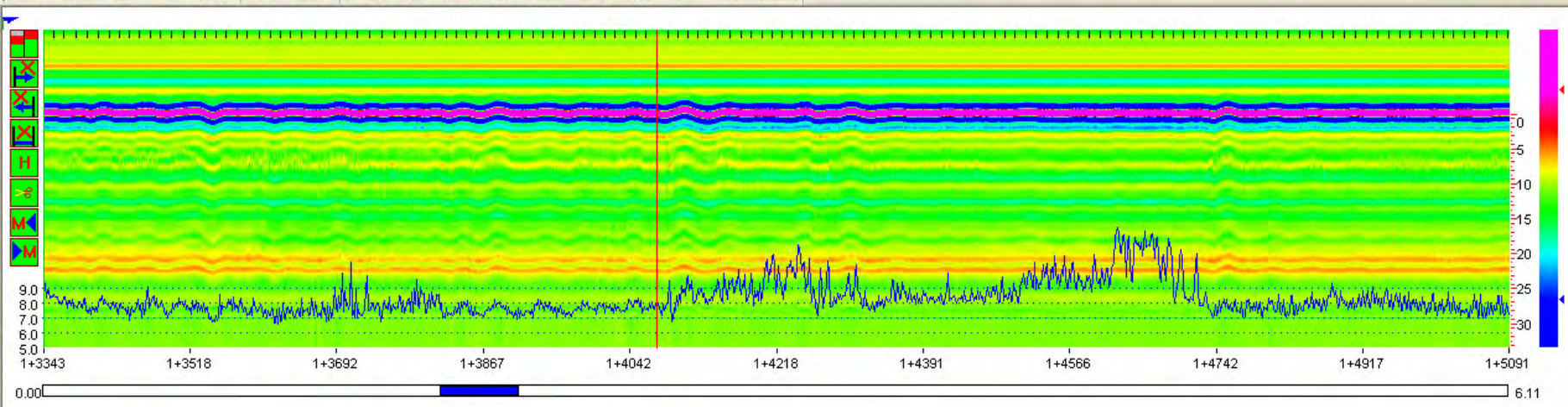


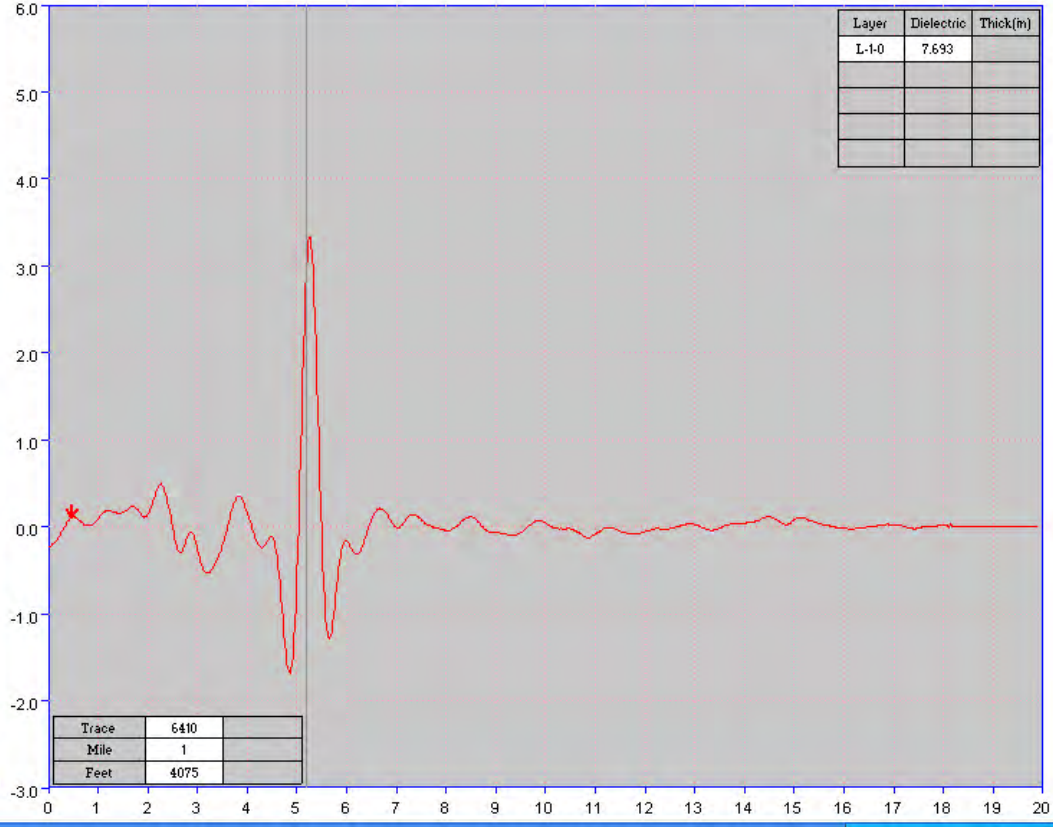


GPS: Lat: 29.77713307 Log: 95.42565437 (Lat:(N) 29:46:37.6790 Log:(W) 95:25:32.3557

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

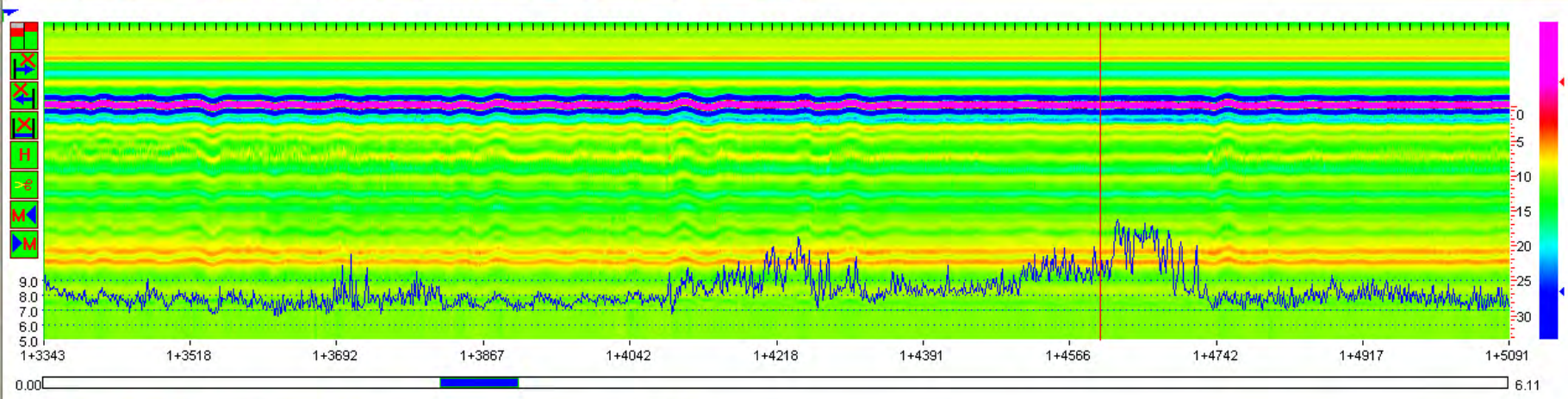


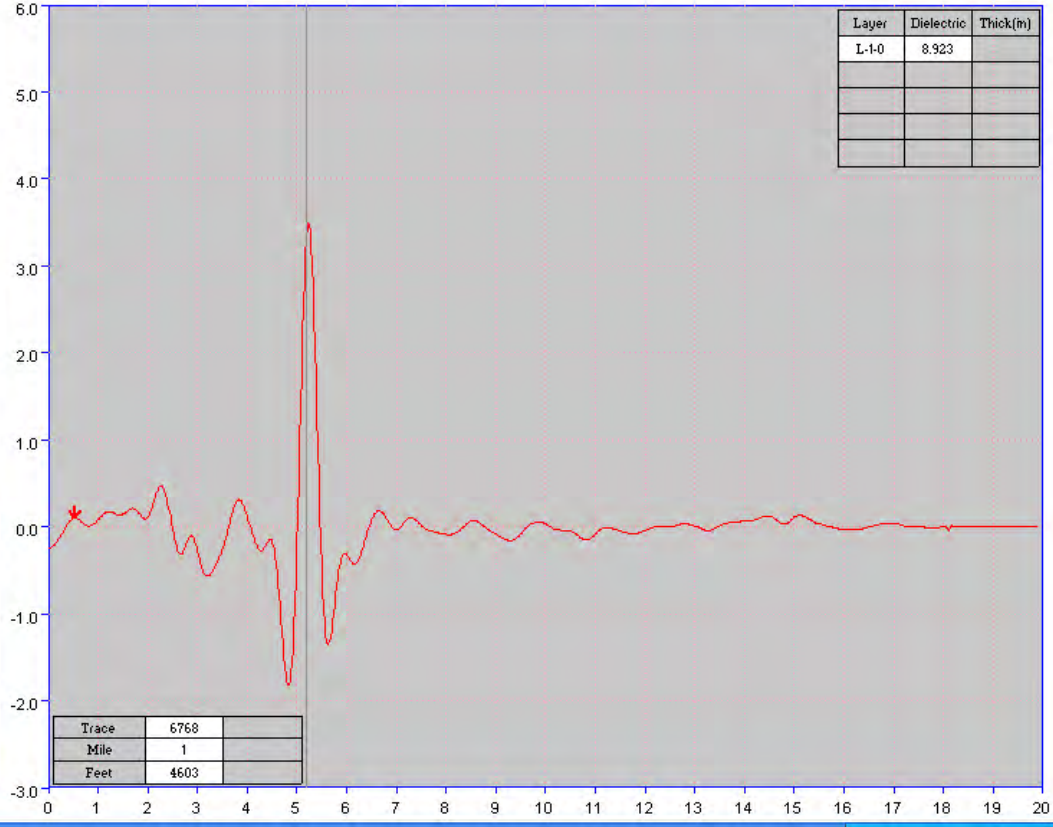


GPS: Lat: 29.77715330 Log: 95.42406467 (Lat:(N) 29:46:37.7519 Log:(W) 95:25:26.6328

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

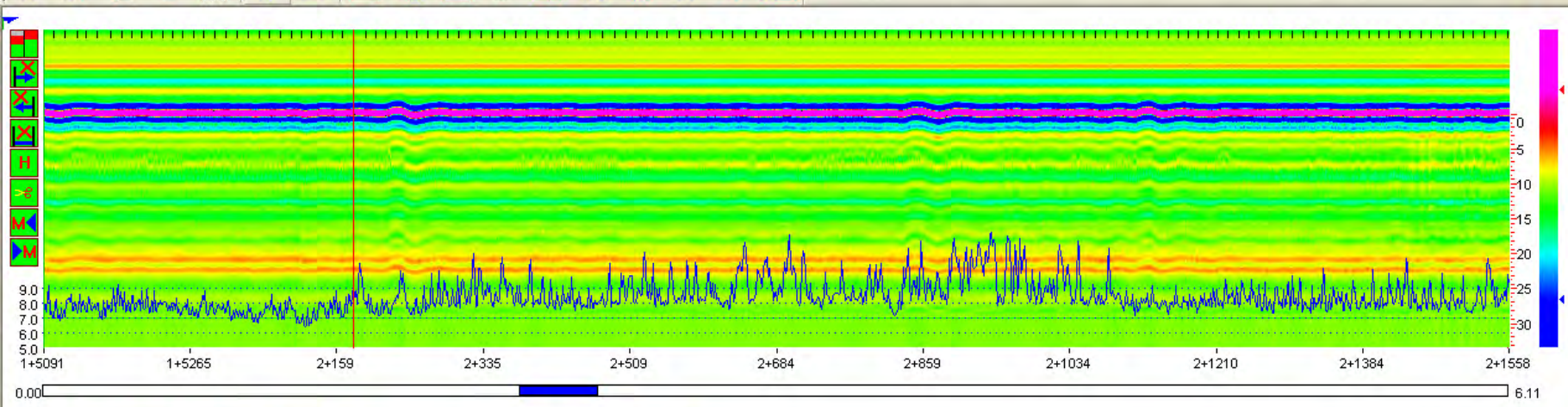


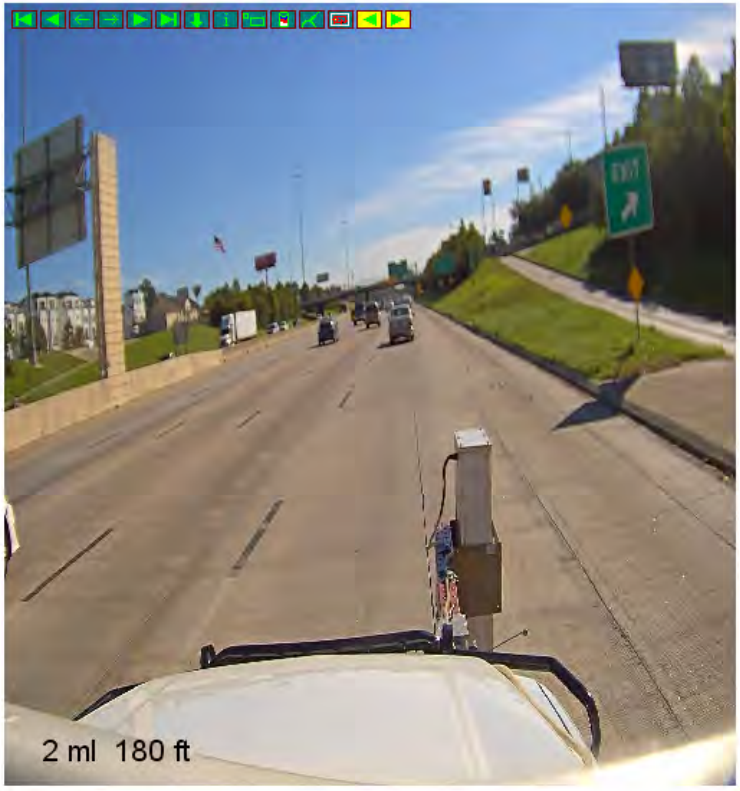


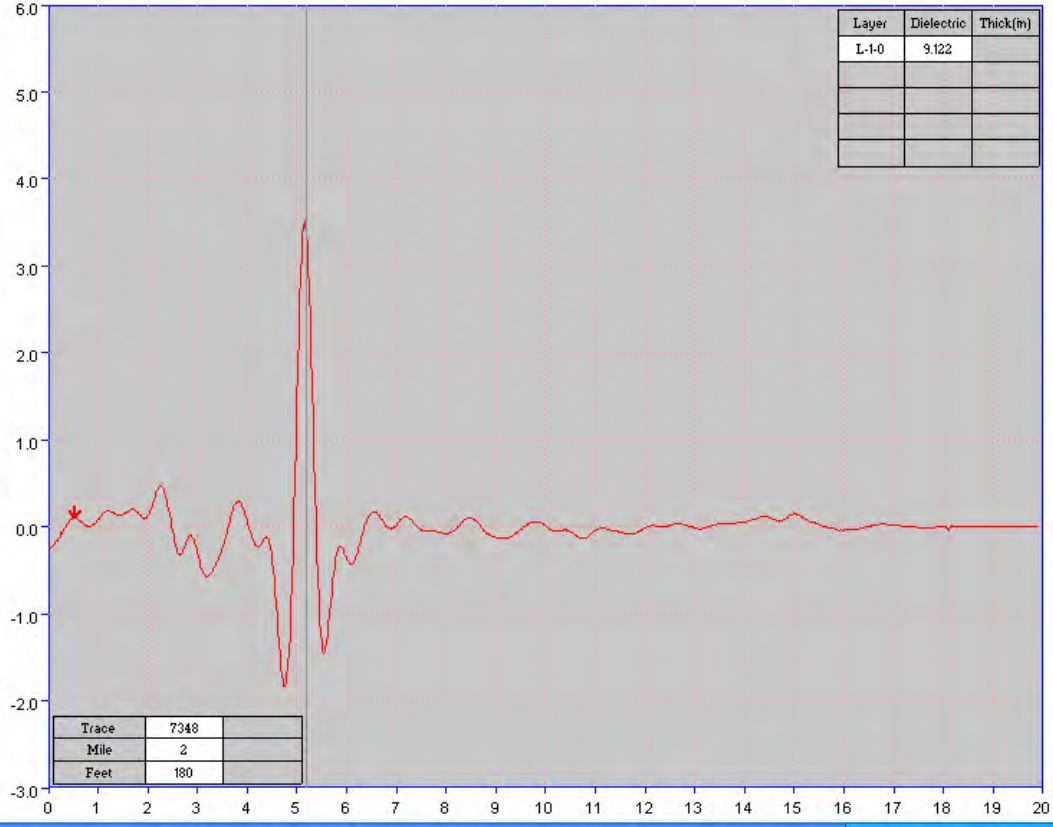
GPS: Lat: 29.77719323 Log: 95.42142047 (Lat:(N) 29:46:37.8956 Log:(W) 95:25:17.1137

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080



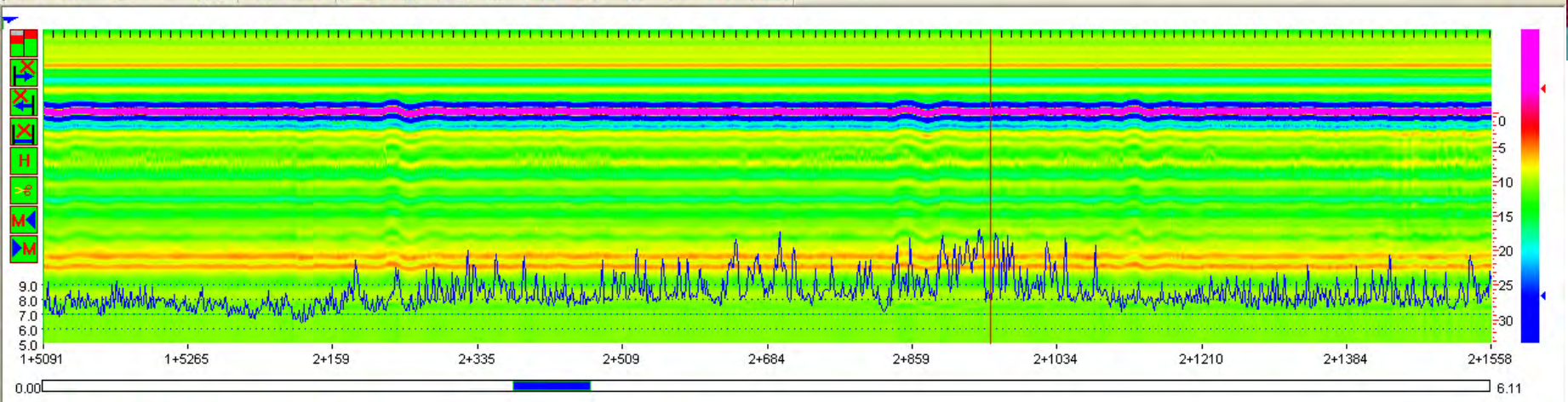


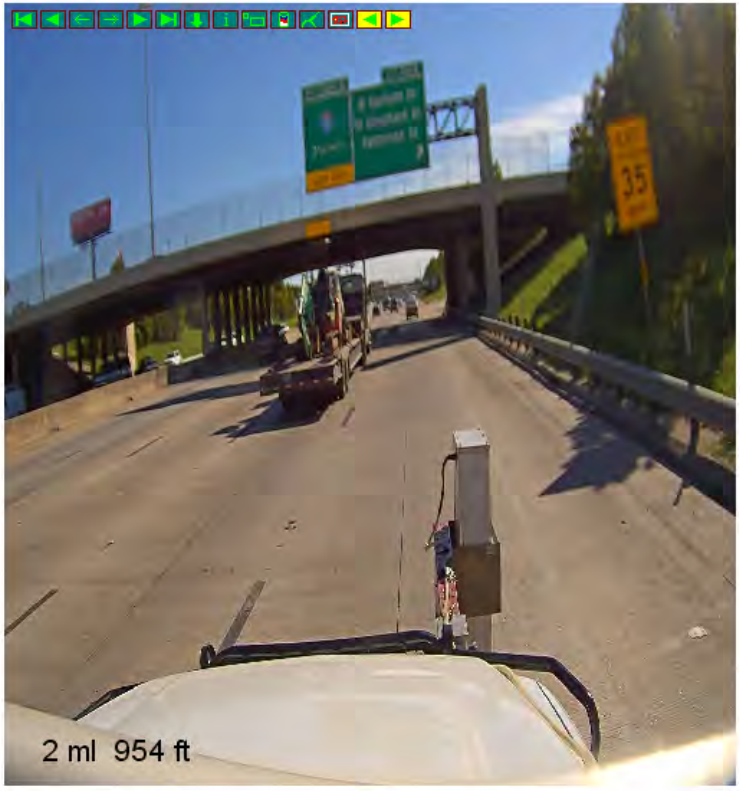


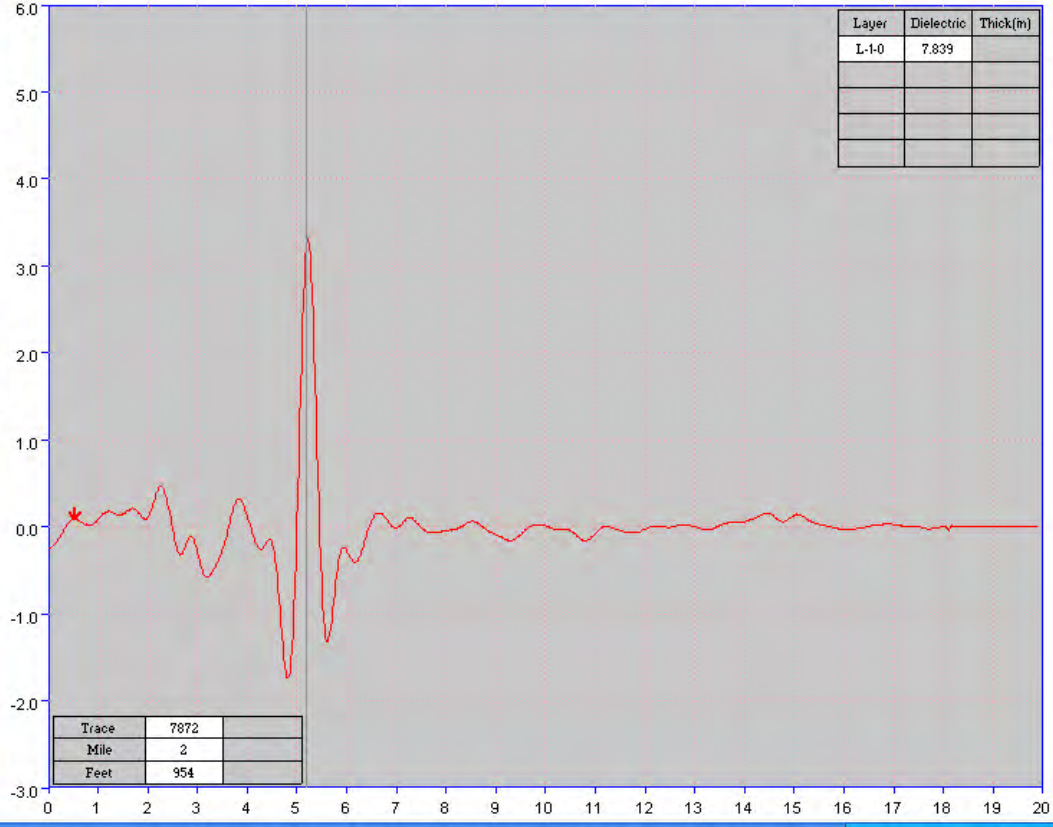
GPS: Lat: 29.77722350 Log: 95.41897160 (Lat:(N) 29:46:38.0046 Log:(W) 95:25: 8.2978

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080



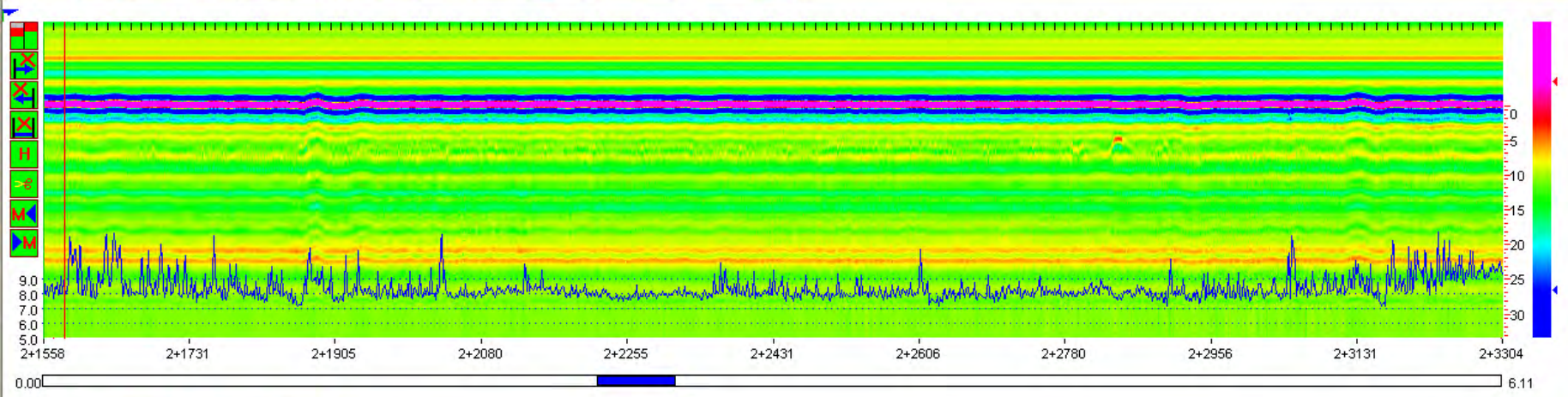


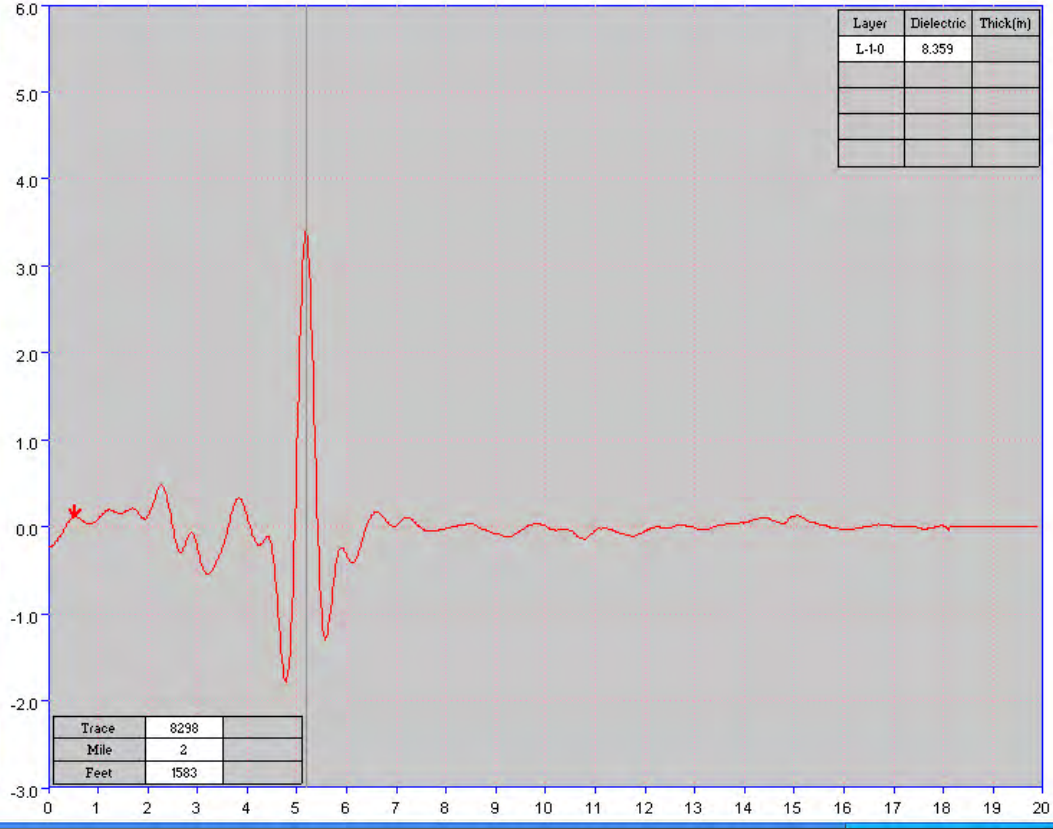


GPS: Lat: 29.77726278 Log: 95.41687333 (Lat:(N) 29:46:38.1460 Log:(W) 95:25: 0.7440

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

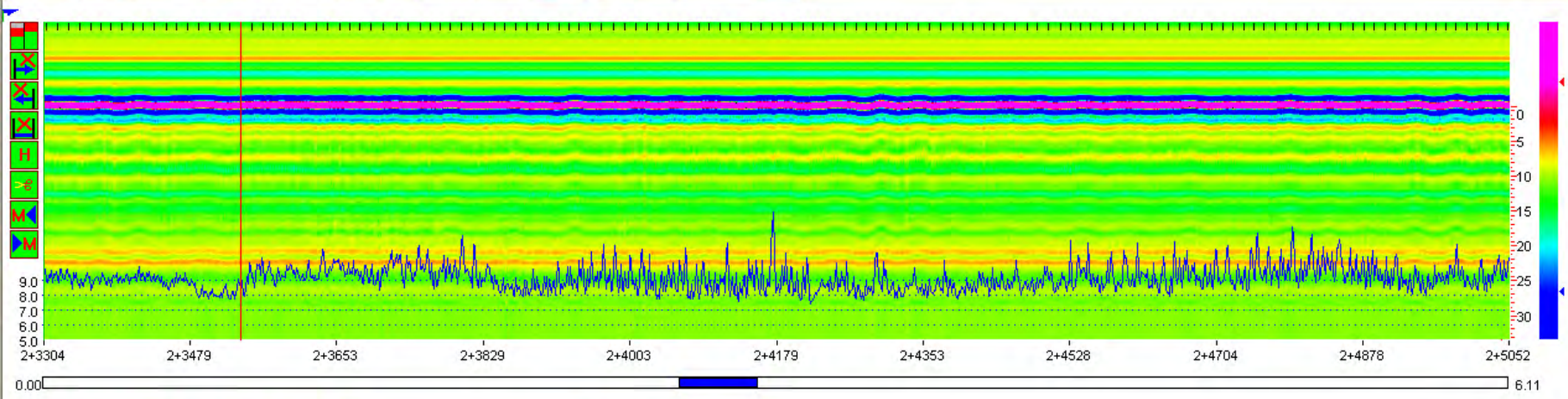


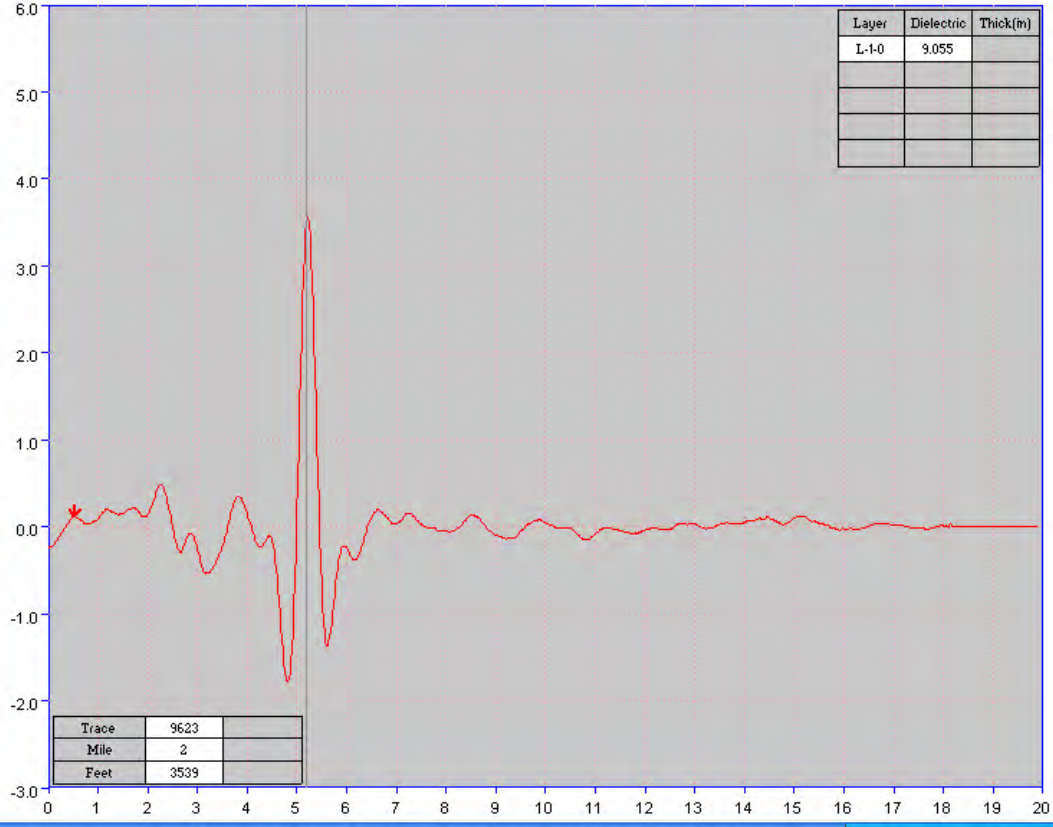


GPS: Lat: 29.77734301 Log: 95.41086412 (Lat:(N) 29:46:38.4348 Log:(W) 95:24:39.1108

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

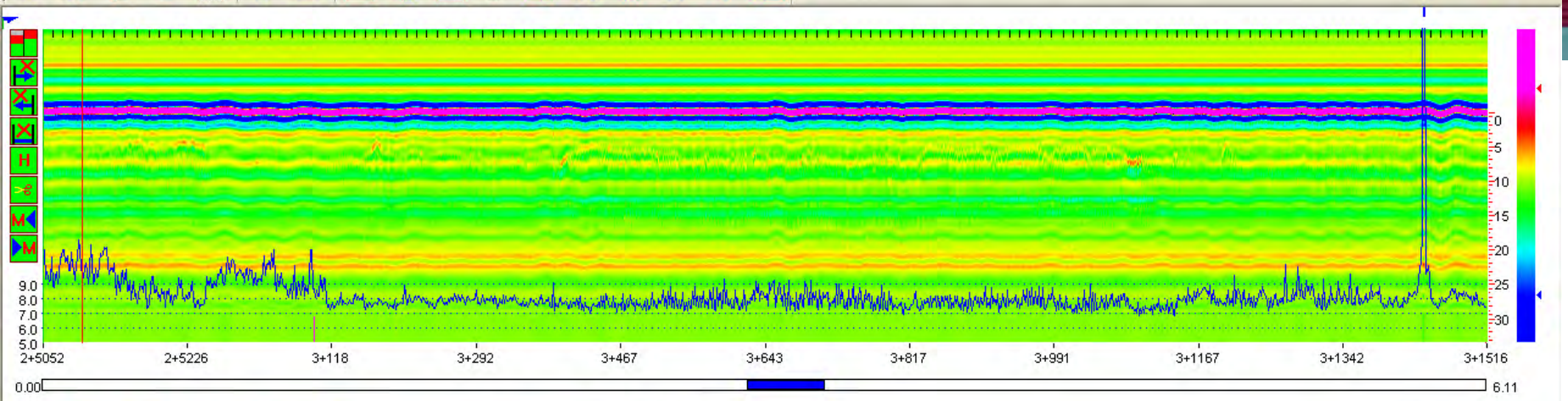


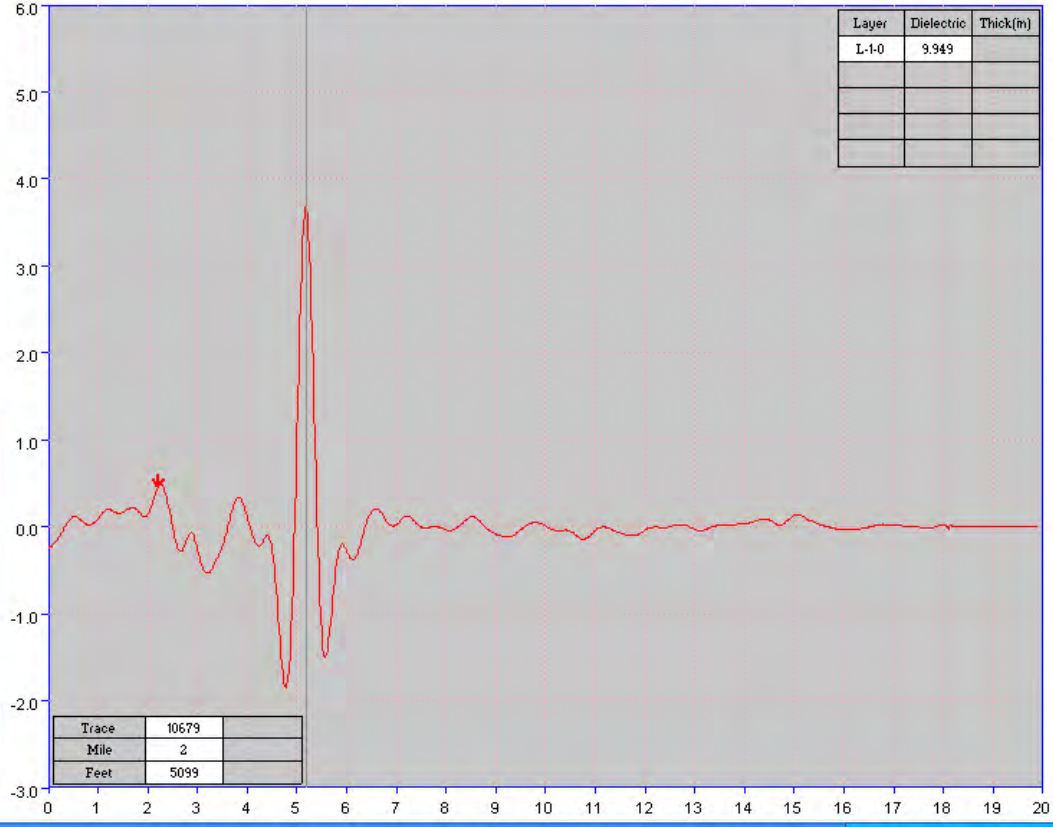


GPS: Lat: 29.77705595 Log: 95.40609611 (Lat:(N) 29:46:37.4014 Log:(W) 95:24:21.9460

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

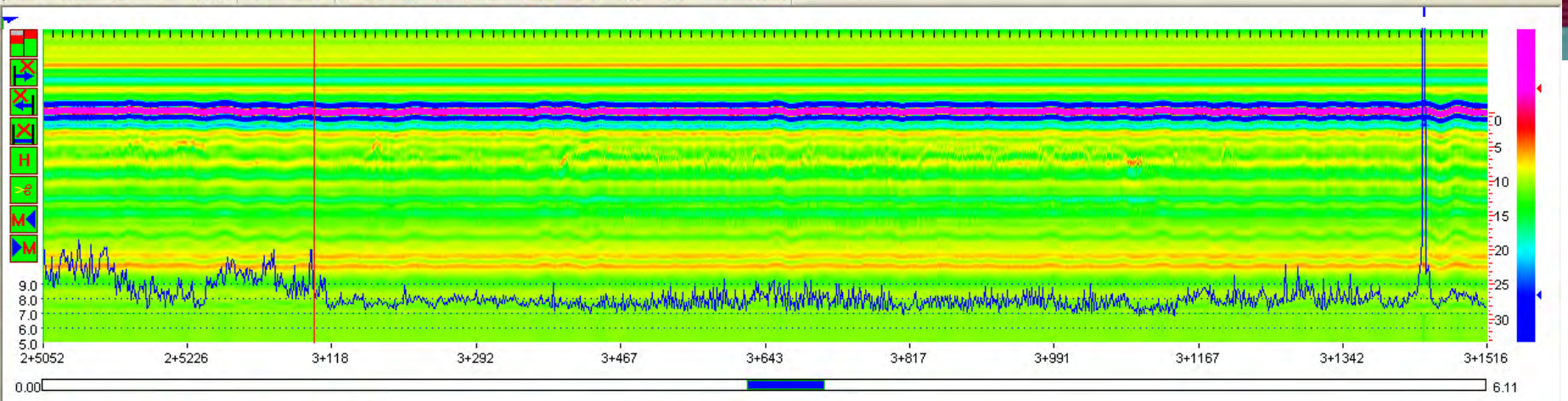


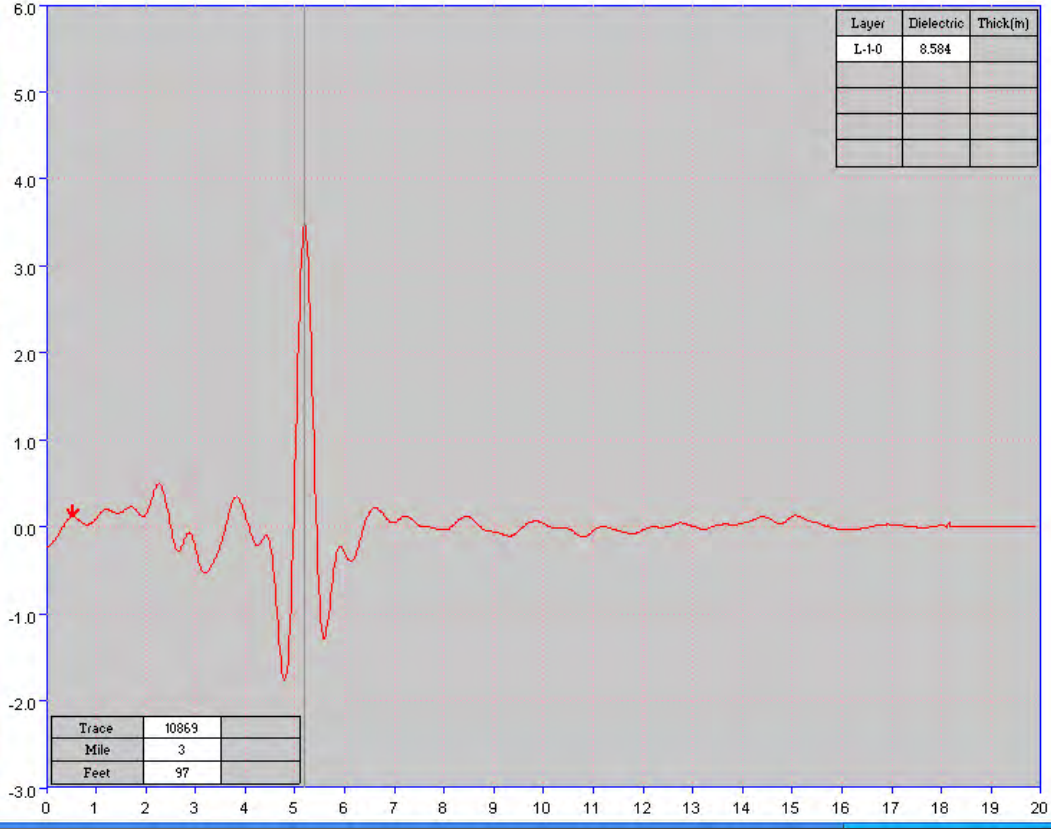


GPS: Lat: 29.77690583 Log: 95.40525513 (Lat:(N) 29:46:36.8610 Log:(W) 95:24:18.9185

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

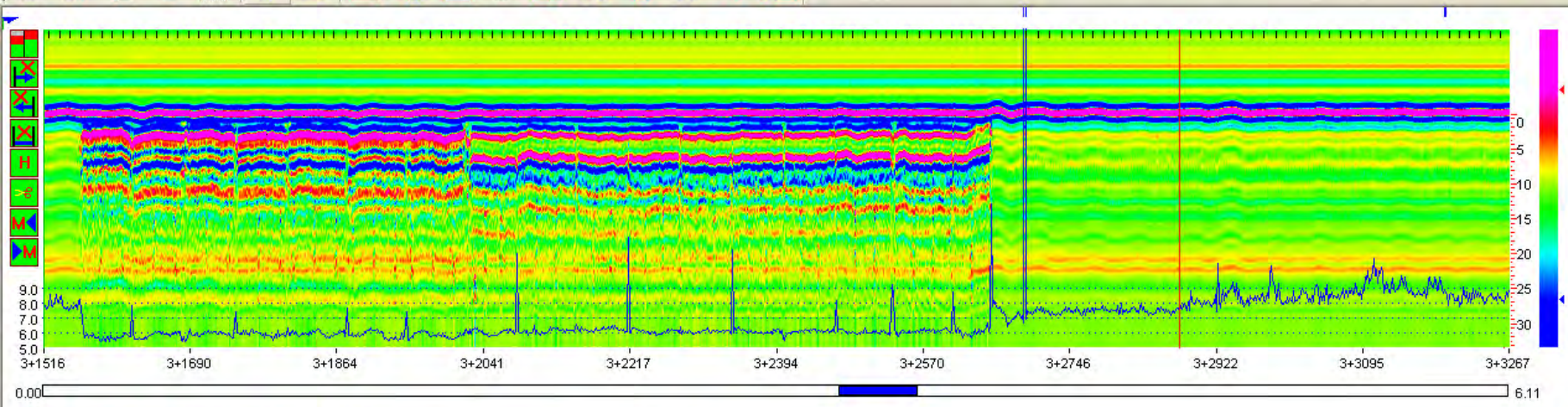


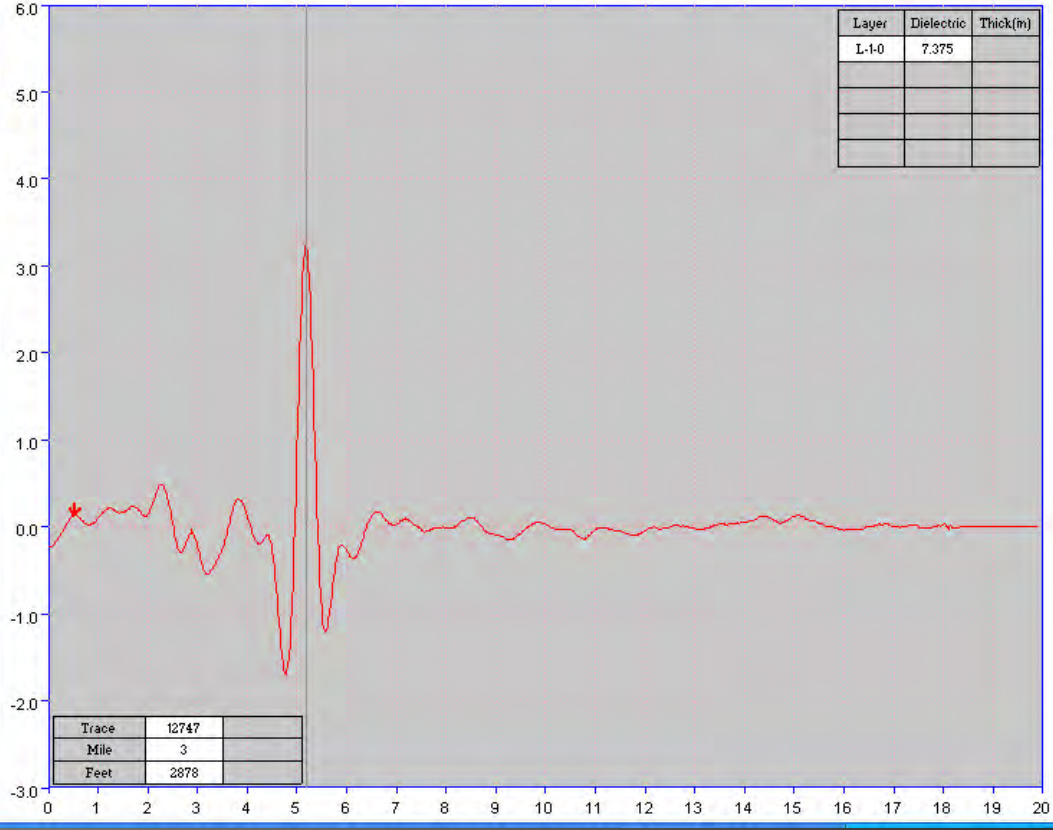


GPS: Lat: 29.77638043 Log: 95.39654673 (Lat:(N) 29:46:34.9696 Log:(W) 95:23:47.5682

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

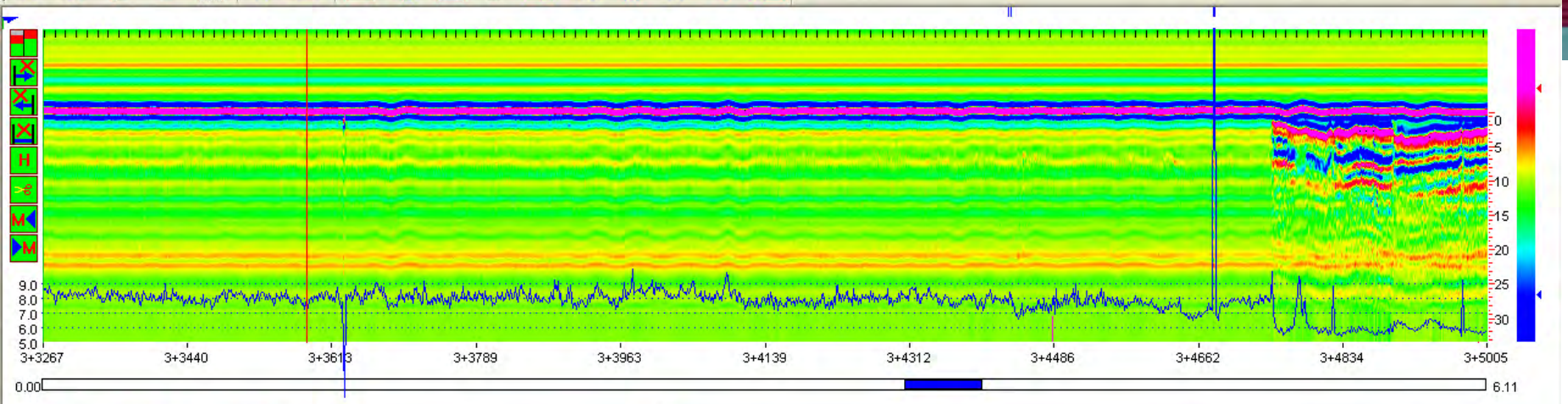


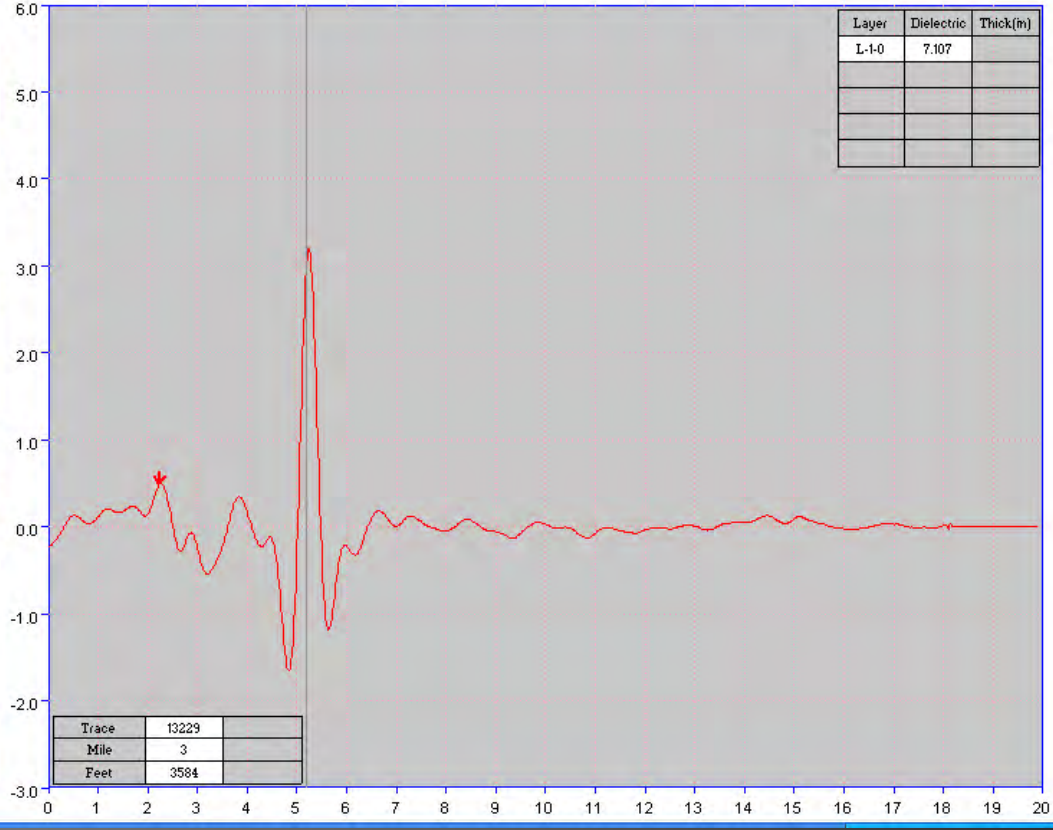


Locat:200

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

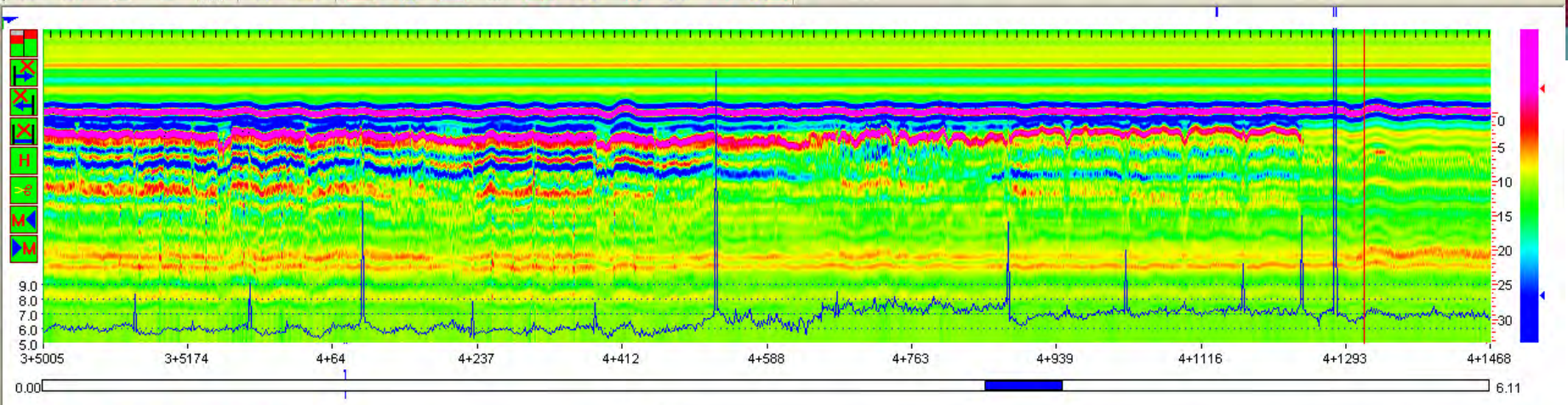


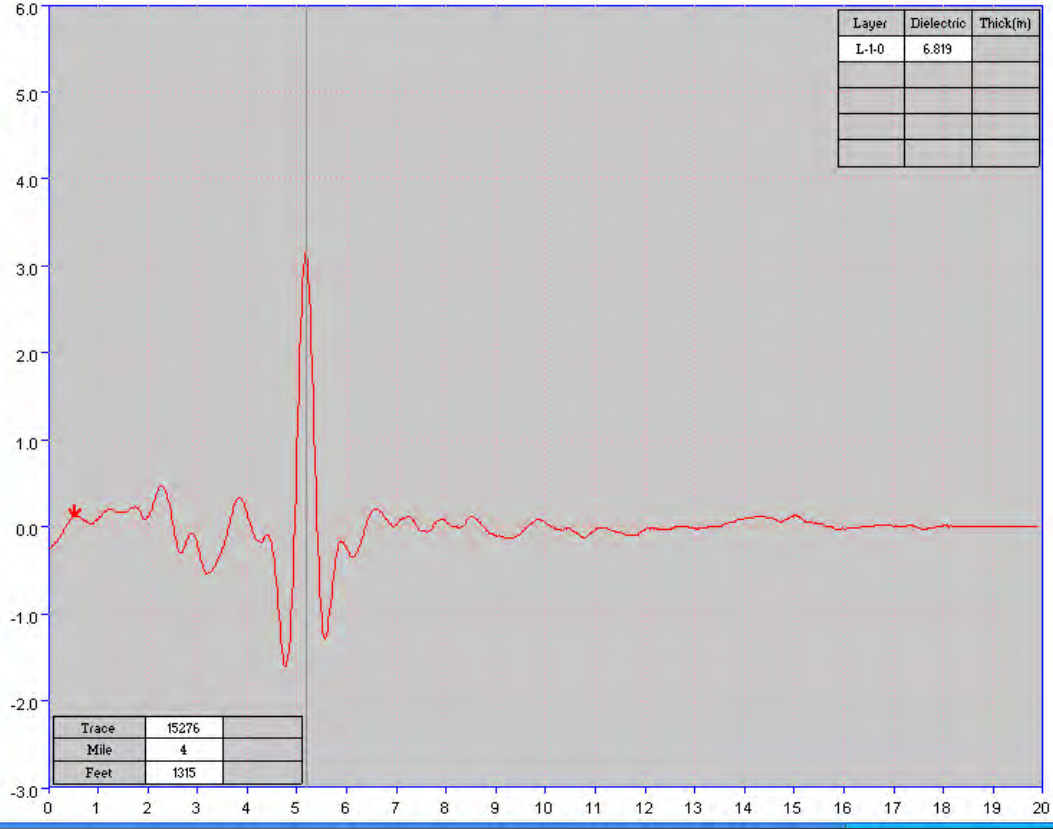


GPS: Lat: 29.77667951 Log: 95.38492069 (Lat:(N) 29:46:36.0462 Log:(W) 95:23: 5.7145

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

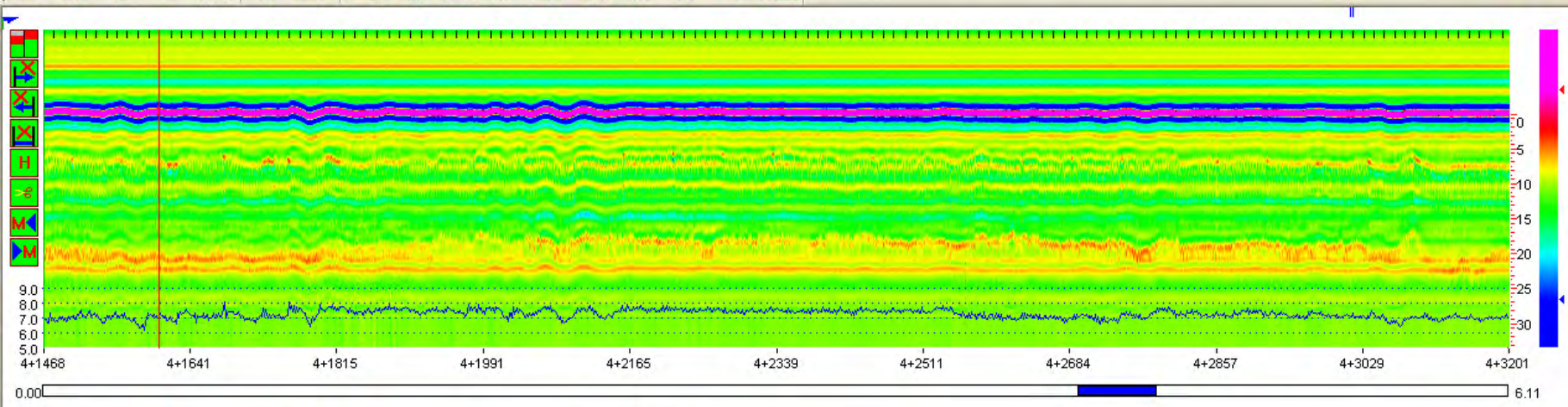


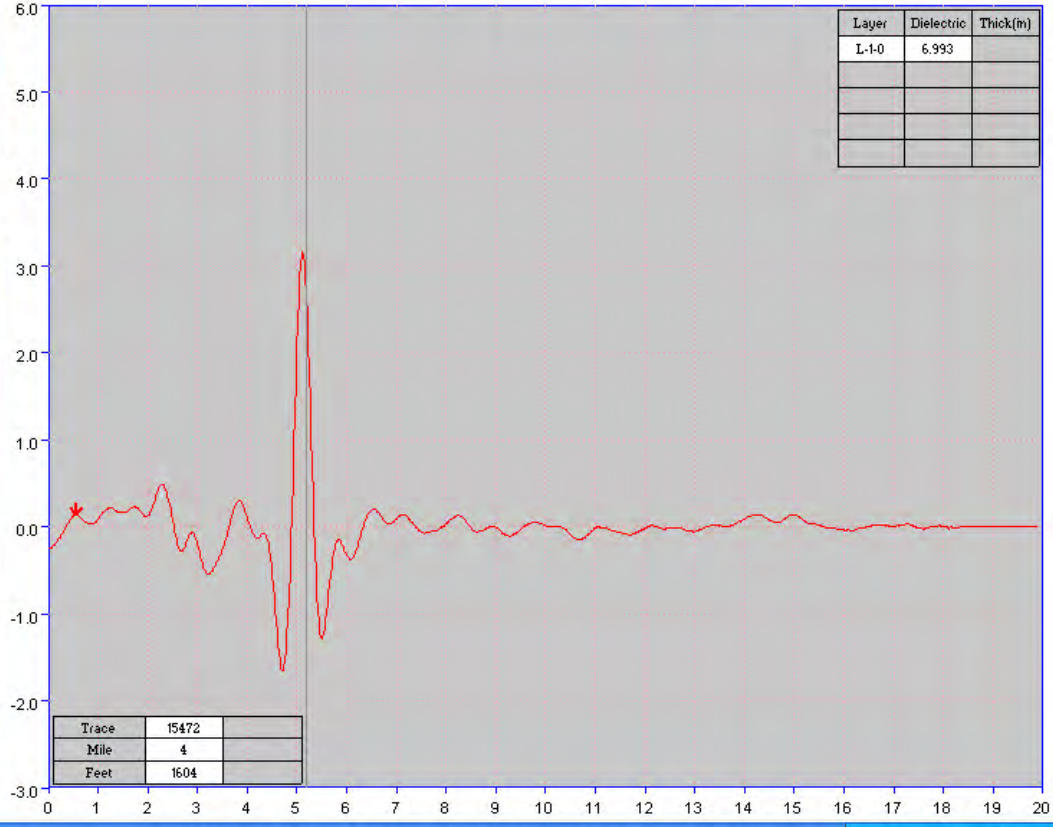


GPS: Lat: 29.77680075 Log: 95.38404137 (Lat:(N) 29:46:36.4827 Log:(W) 95:23: 2.5489

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

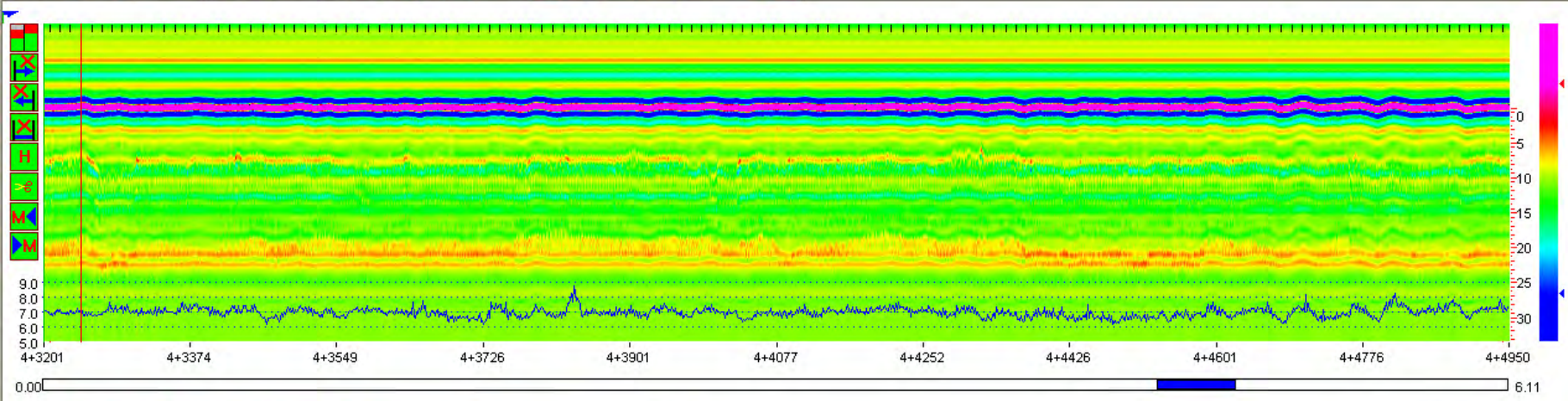


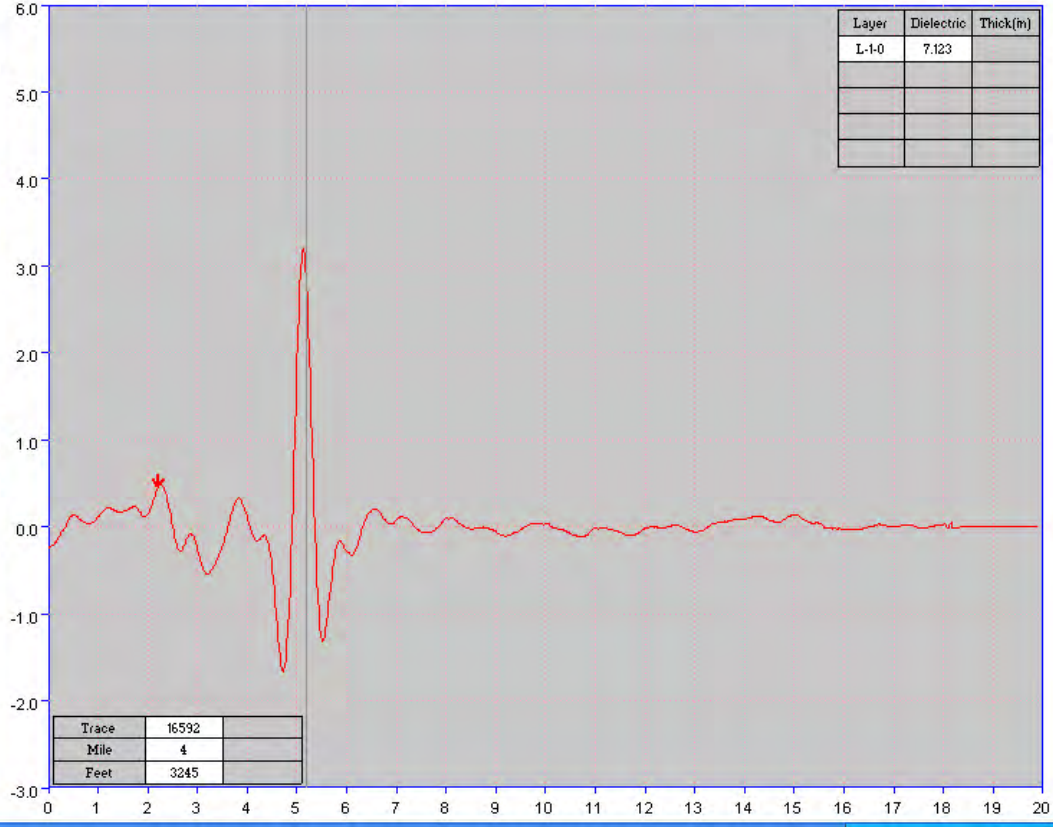


GPS: Lat: 29.77820582 Log: 95.37928690 (Lat:(N) 29:46:41.5409 Log:(W) 95:22:45.4328

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

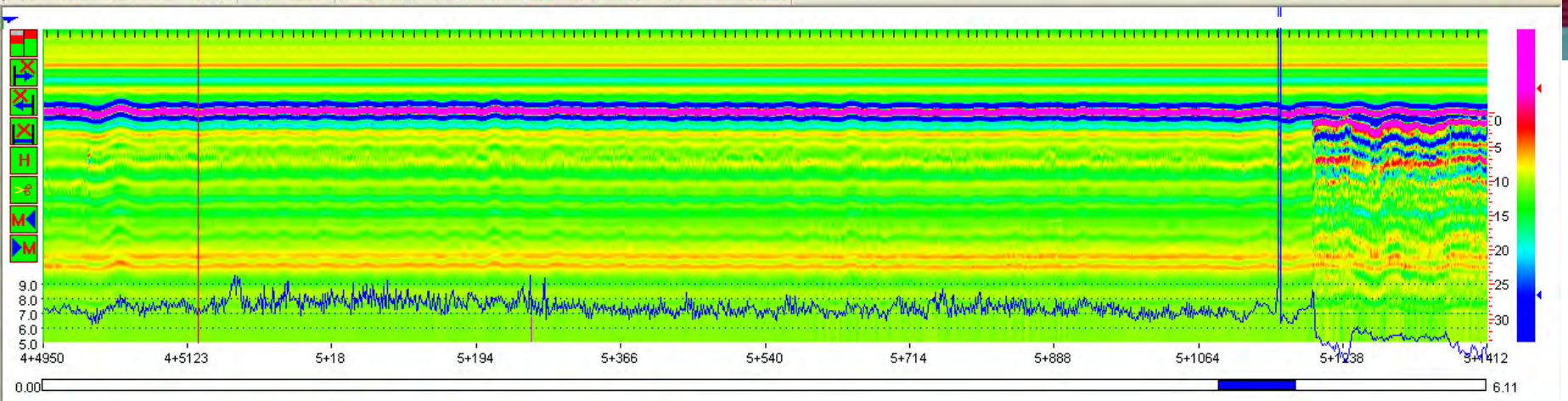


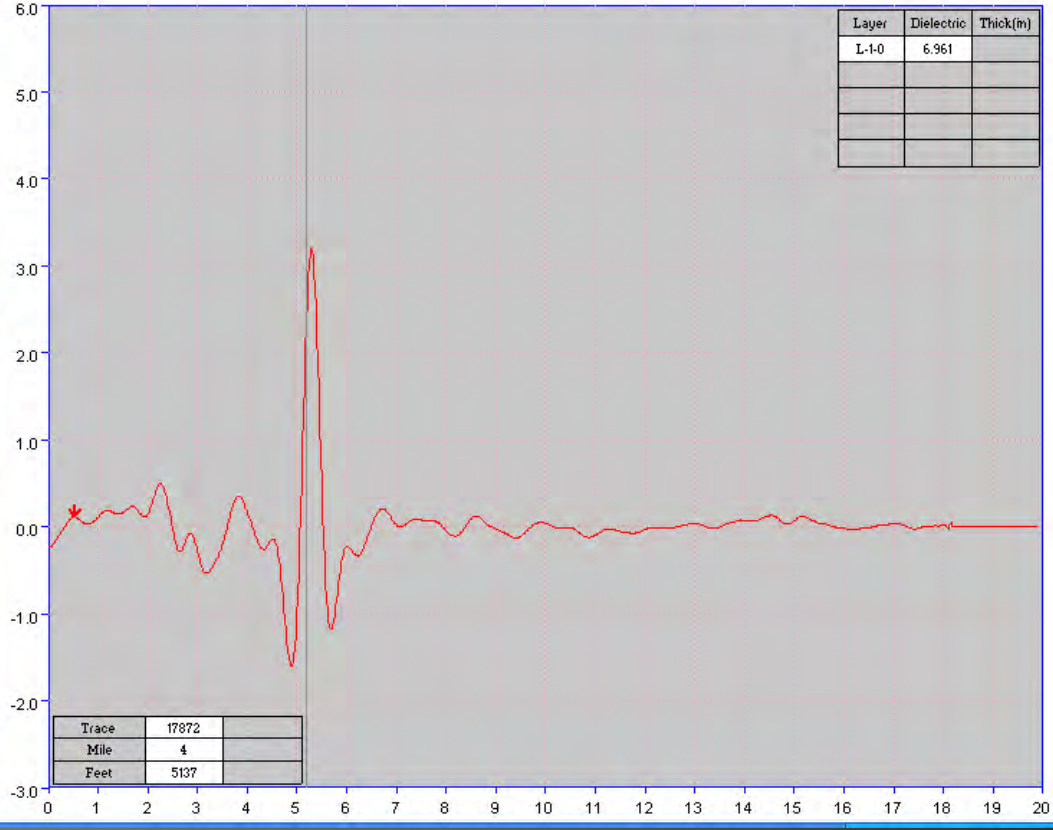


GPS: Lat: 29.77827752 Log: 95.37369369 (Lat:(N) 29:46:41.7991 Log:(W) 95:22:25.2973

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

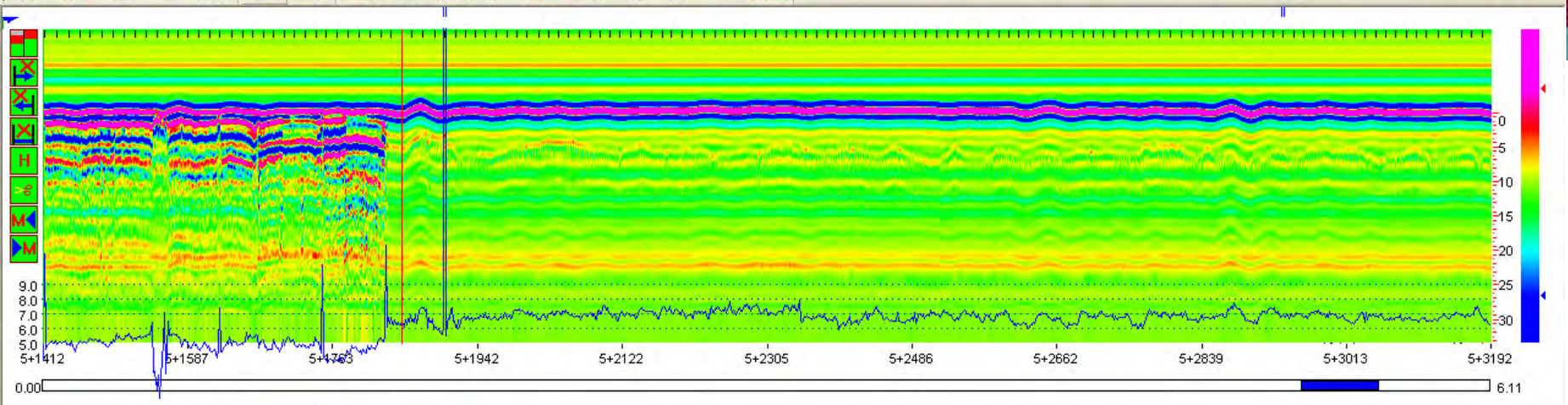


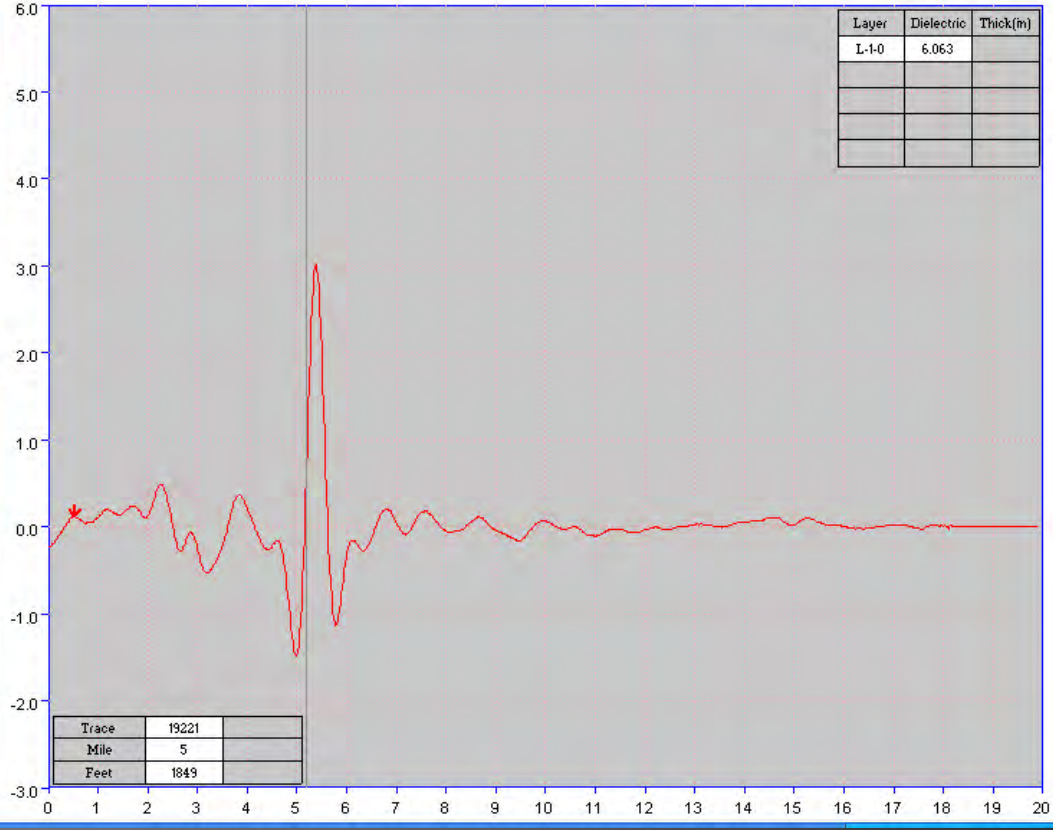


GPS: Lat: 29.77498549 Log: 95.36877892 (Lat:(N) 29:46:29.9478 Log:(W) 95:22: 7.6041

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

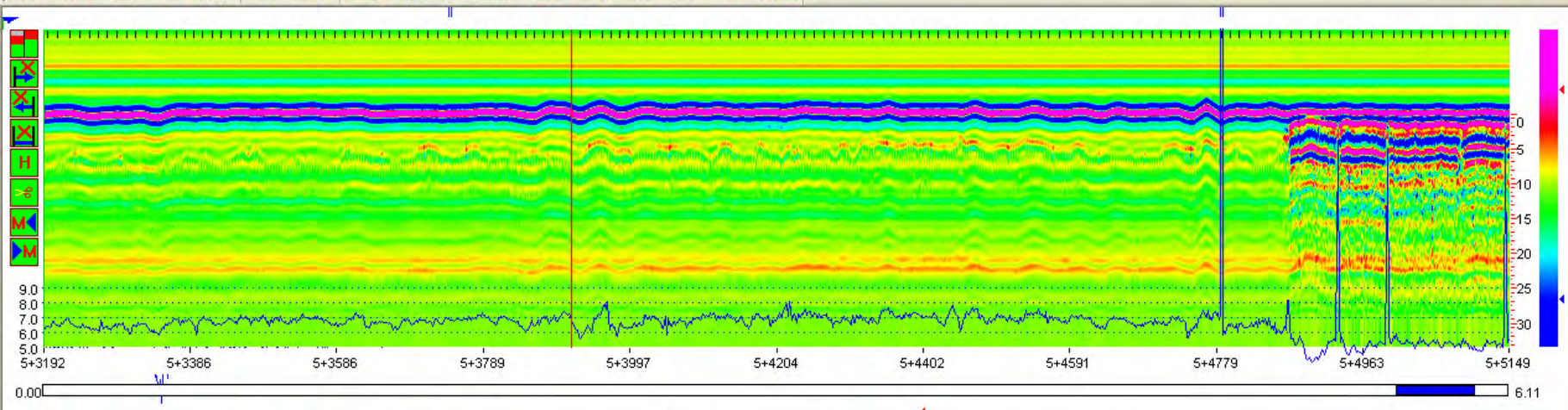


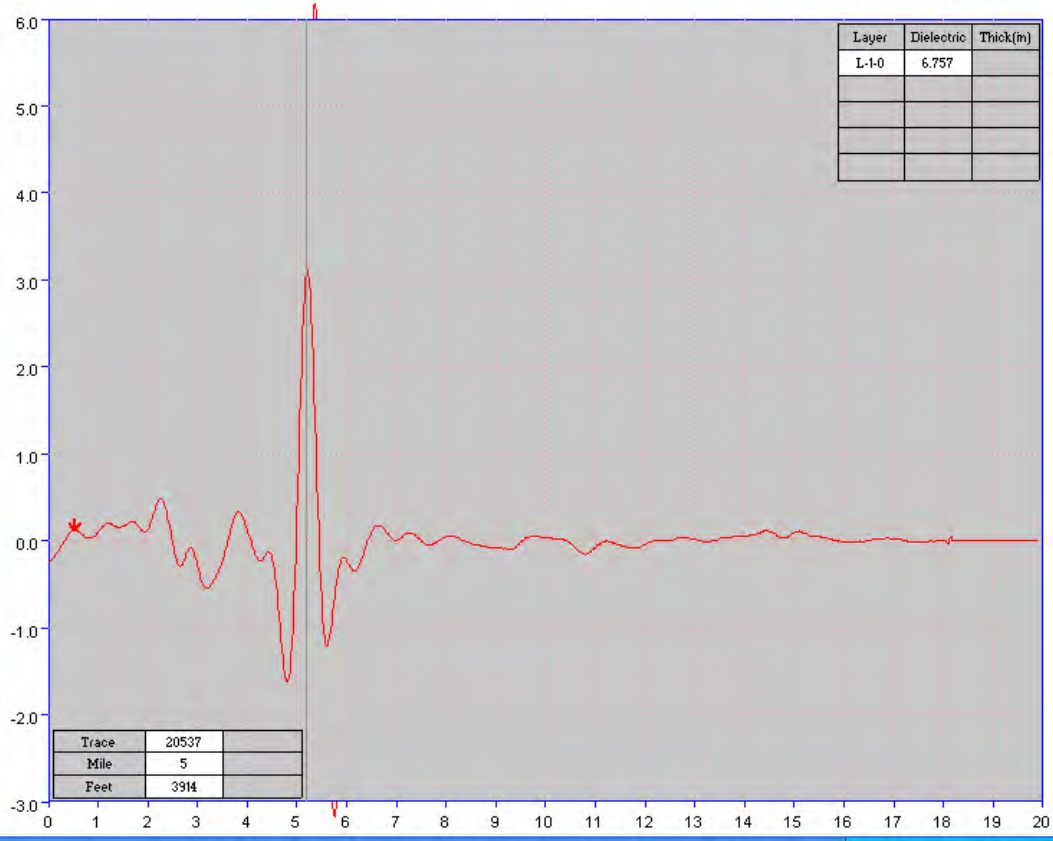


GPS: Lat: 29.77008923 Log: 95.36587987 (Lat:(N) 29:46:12.3212 Log:(W) 95:21:57.1675

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080

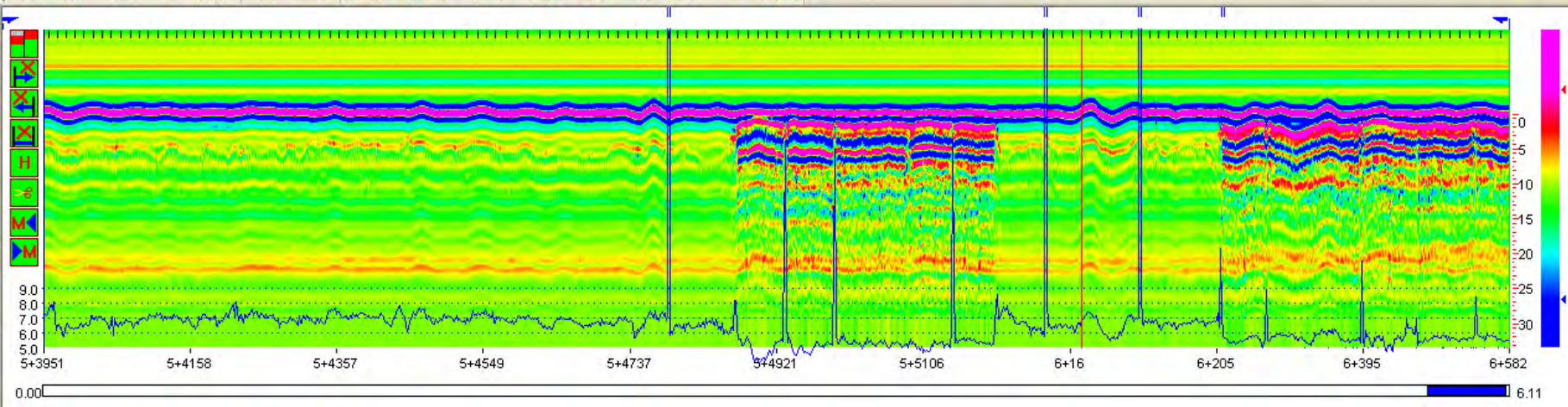


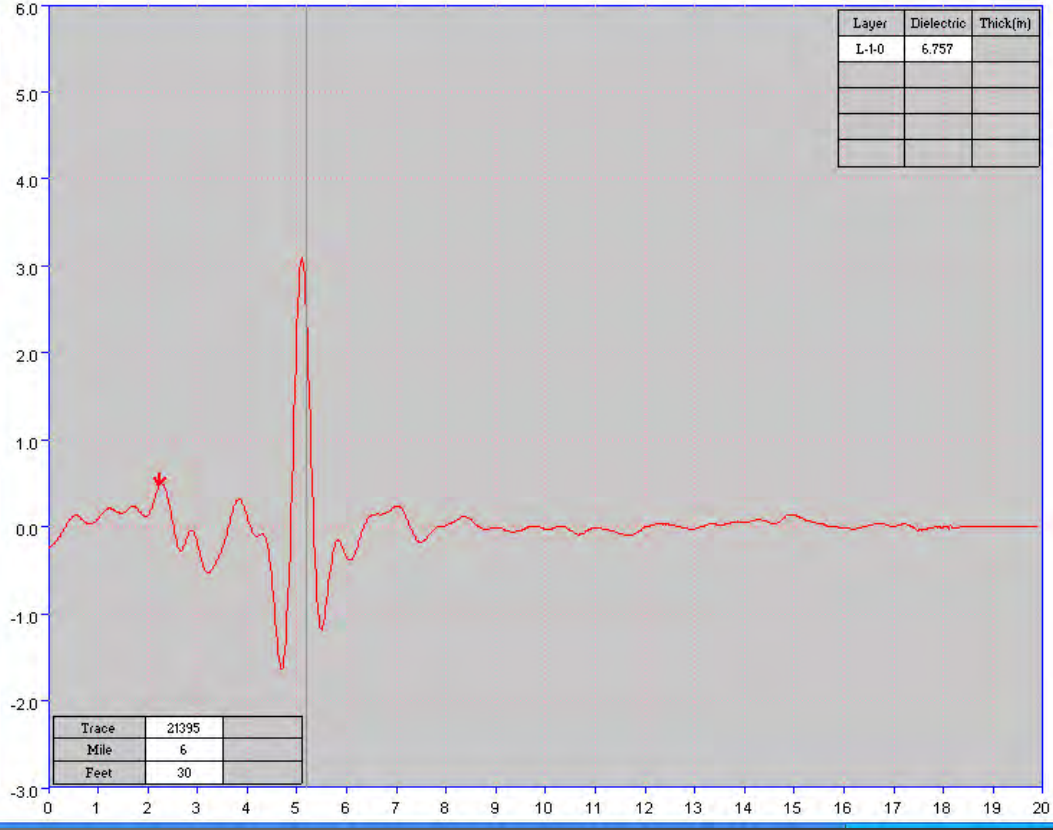


GPS: Lat: 29.76771007 Log: 95.36260448 (Lat:(N) 29:46: 3.7562 Log:(W) 95:21:45.3761

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10eb.PRJ.txt | ih10eb.DAT | GPR:21741 VID:2522 GPS:429 FWD:0 RDD:0 | 0.00 to 6.1 V:6.0196 B: 1.5313 | T:10-16-2017(09:07:54) | C: 4/2/2016(| 1920X1080



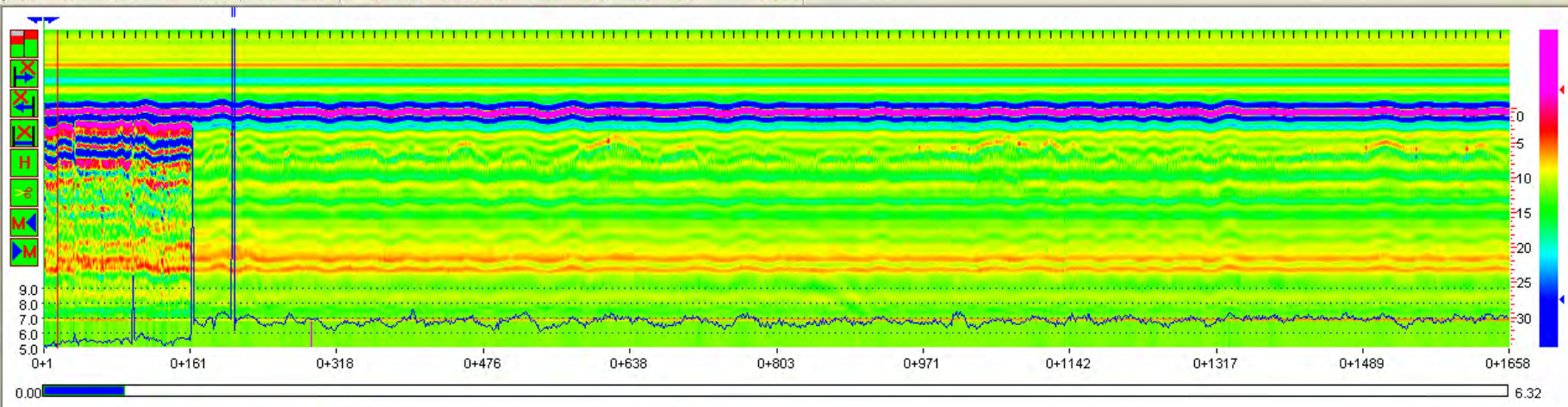


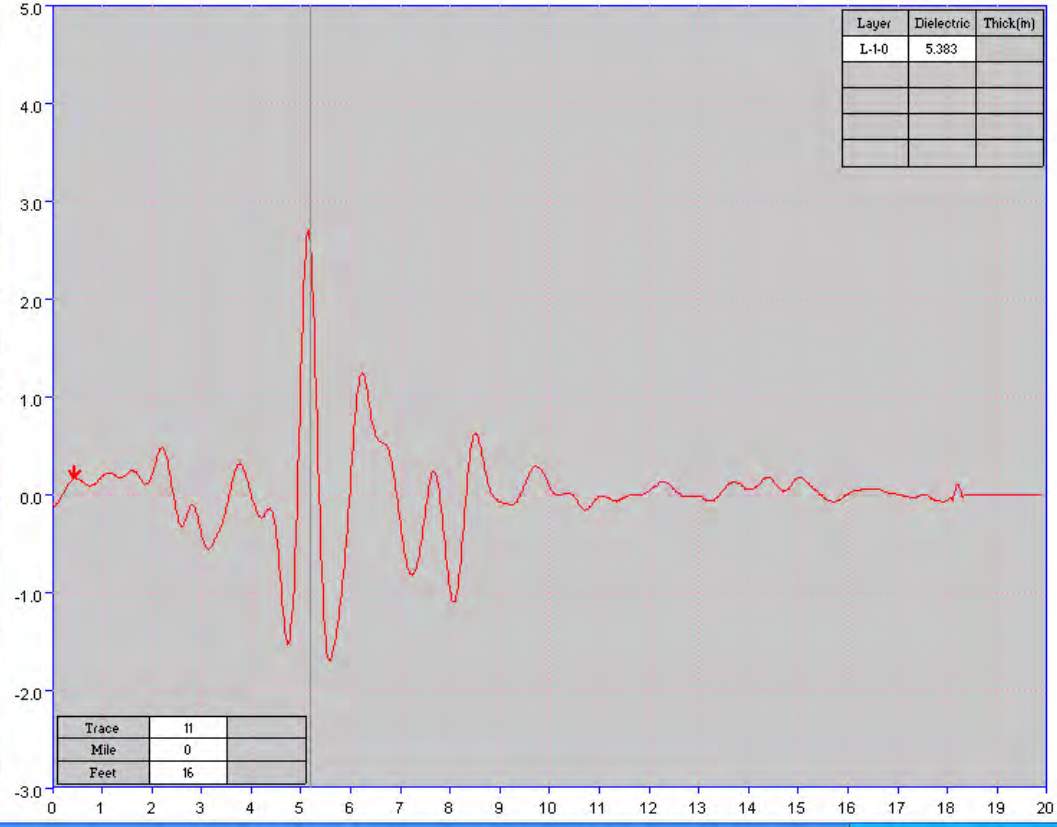
IH 10 Westbound
Ground Penetrating Radar Data
October, 2017

GPS: Lat: 29.76576955 Log: 95.35150197 (Lat:(N) 29:45:56.7704 Log:(W) 95:21: 5.4071

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

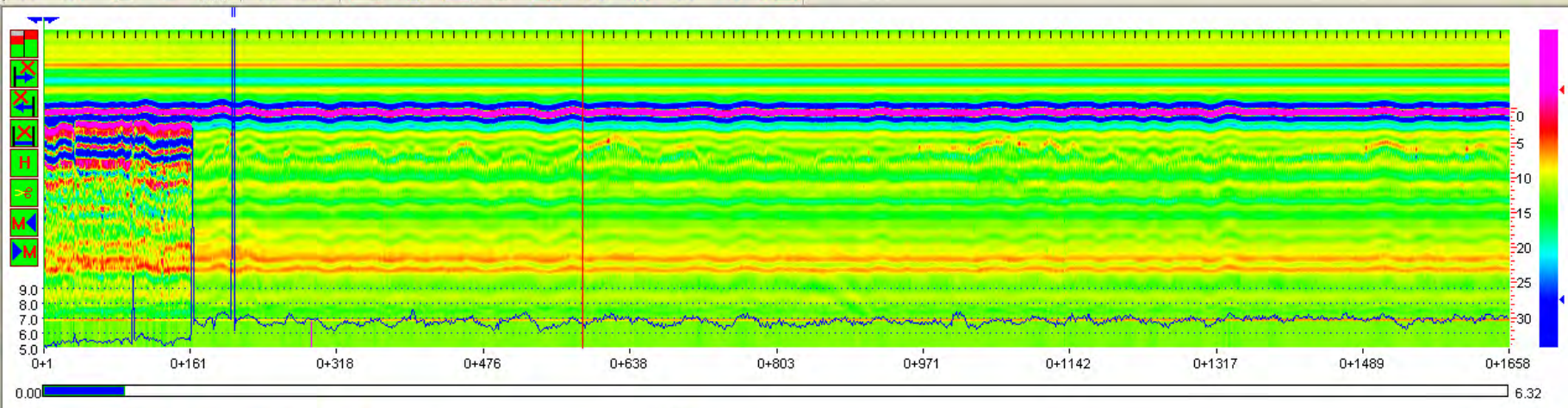


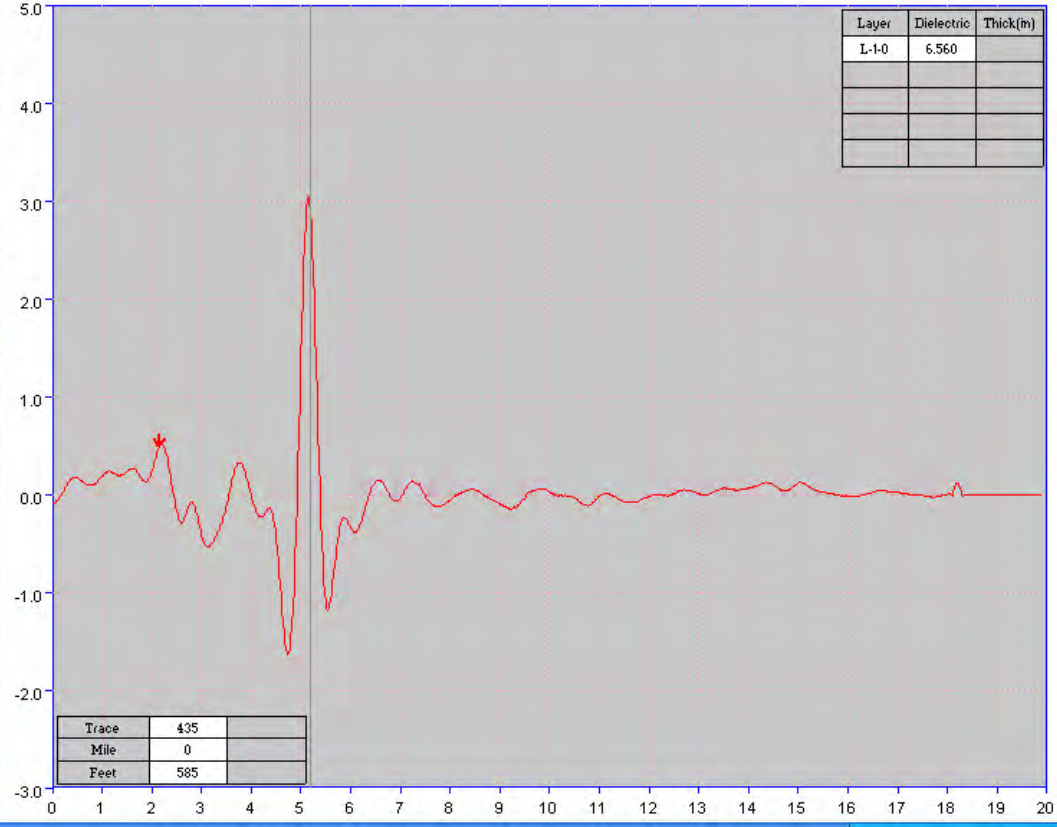


GPS: Lat: 29.76840027 Log: 95.36249687 (Lat:(N) 29:46: 6.2410 Log:(W) 95:21:44.9887

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

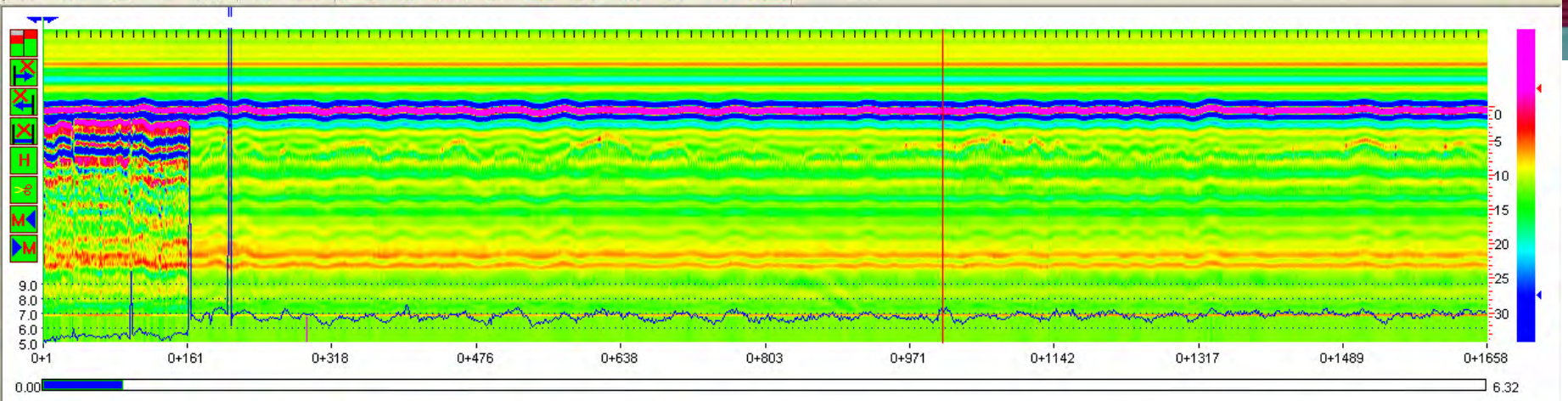


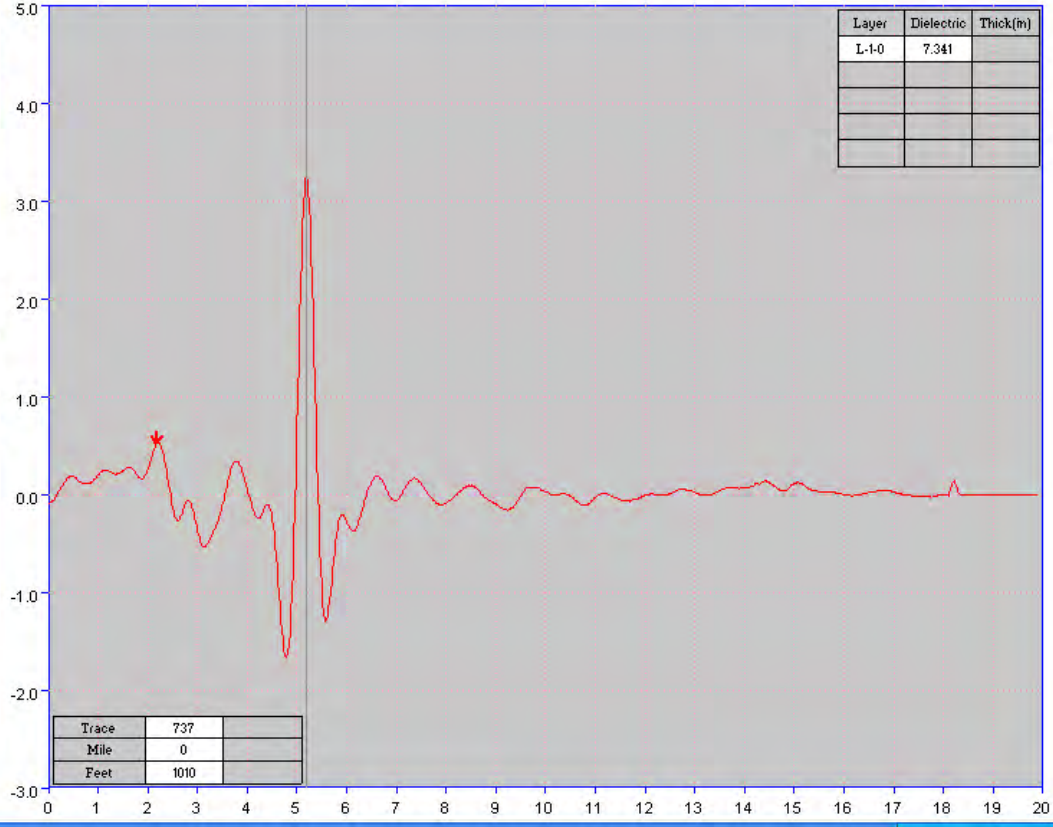


GPS: Lat: 29.76911186 Log: 95.36349641 (Lat:(N) 29:46: 8.8027 Log:(W) 95:21:48.5871

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

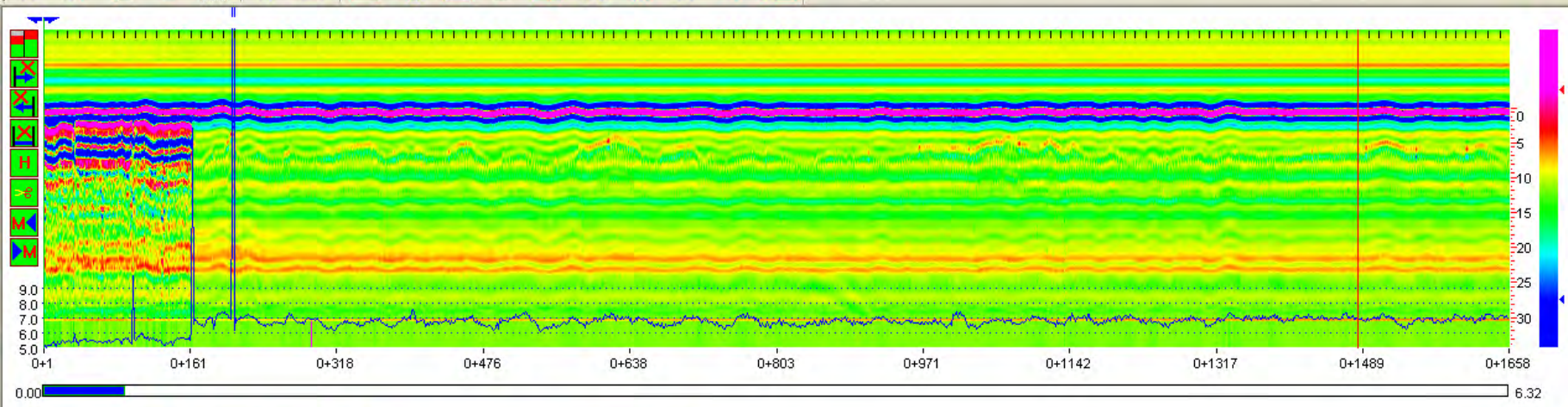


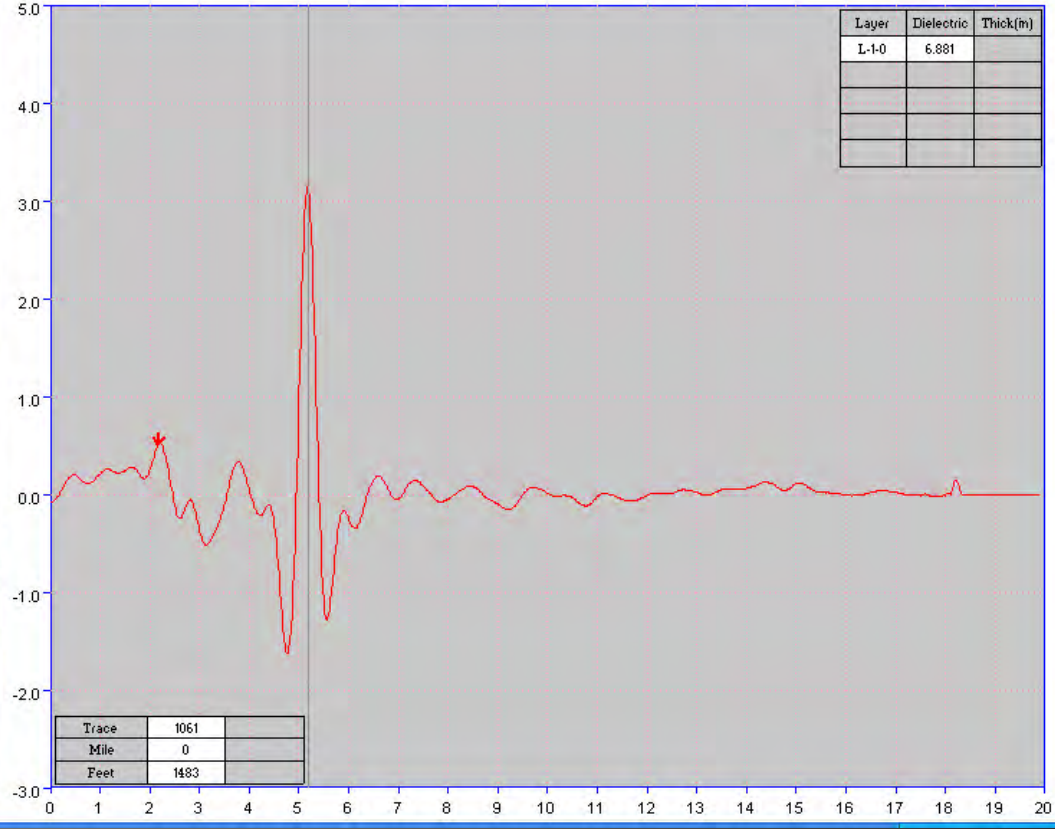


GPS: Lat: 29.77000059 Log: 95.36452814 (Lat:(N) 29:46:12.0021 Log:(W) 95:21:52.3013

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

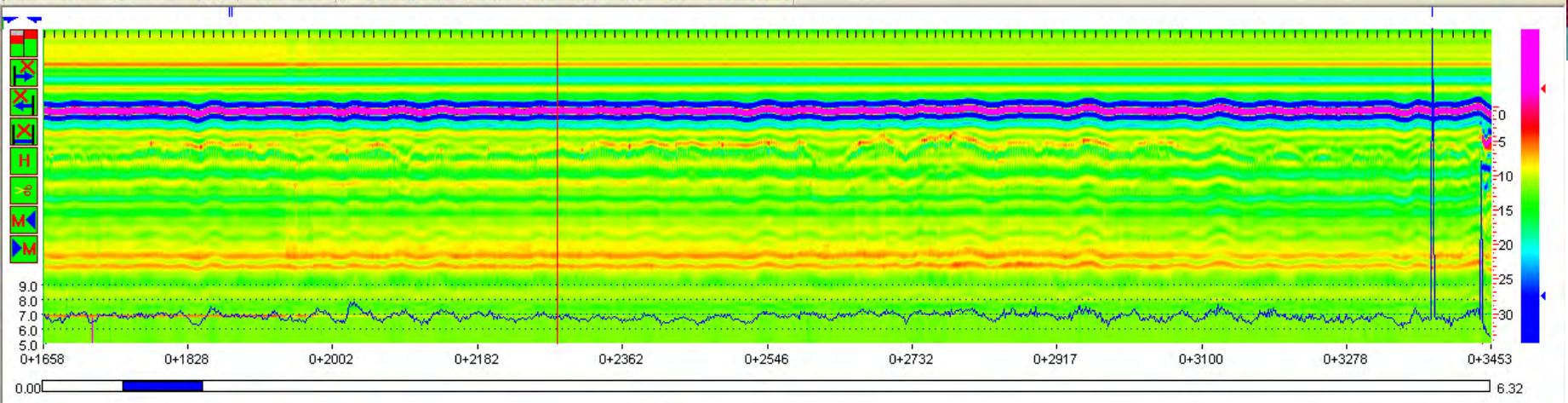


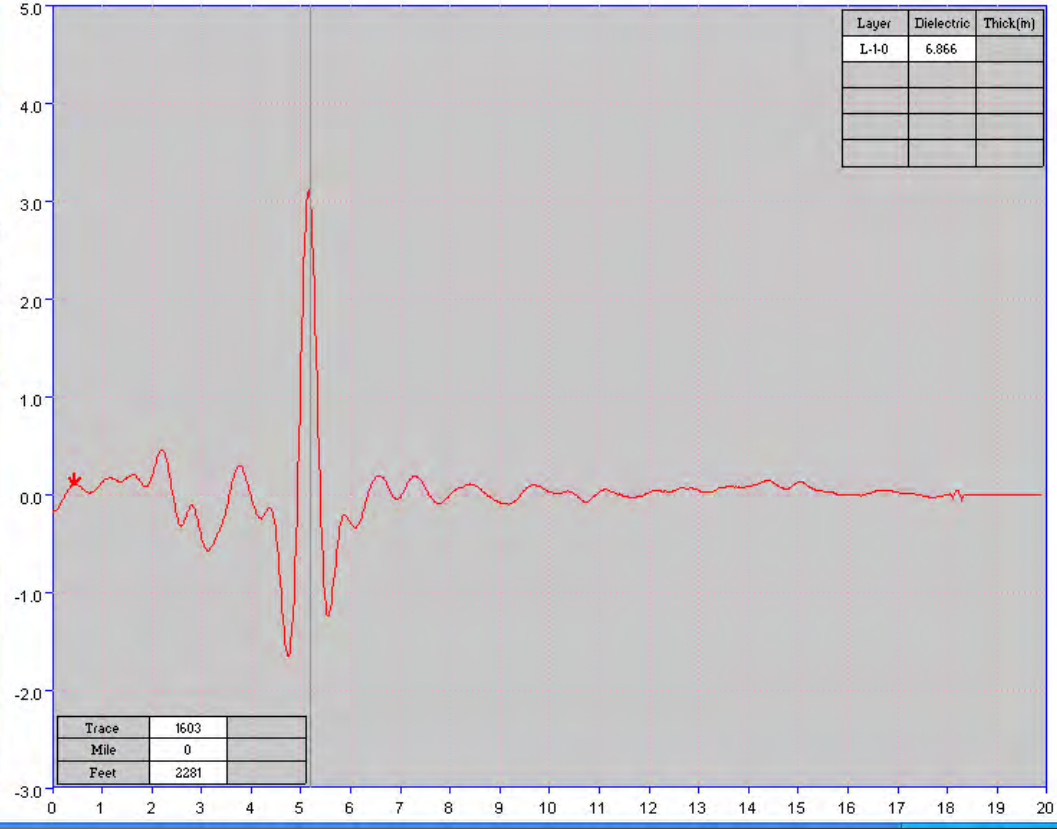


GPS: Lat: 29.77193810 Log: 95.36599405 (Lat:(N) 29:46:18.9771 Log:(W) 95:21:57.5786

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

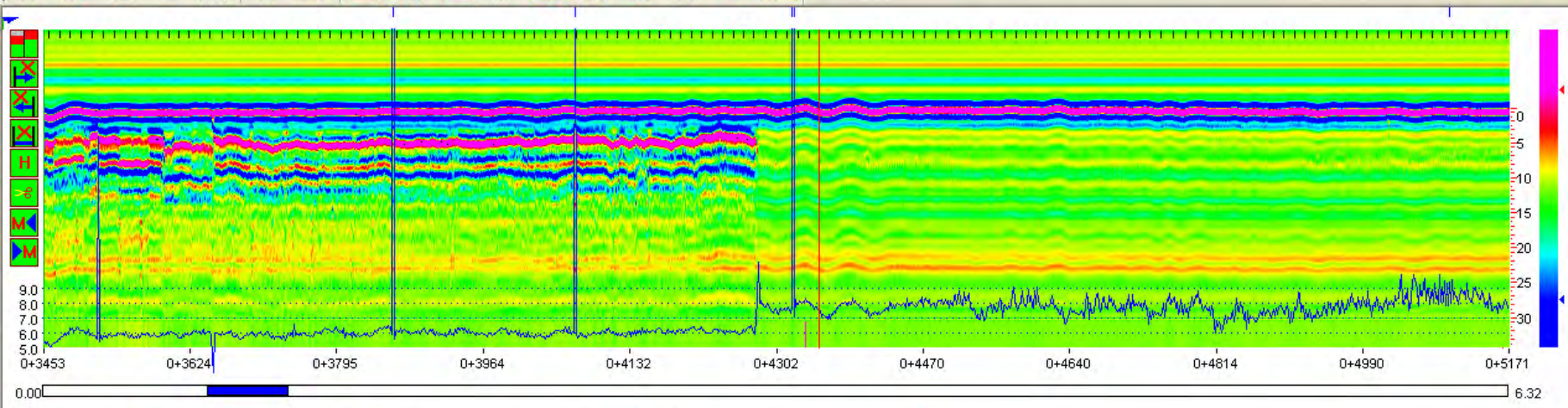


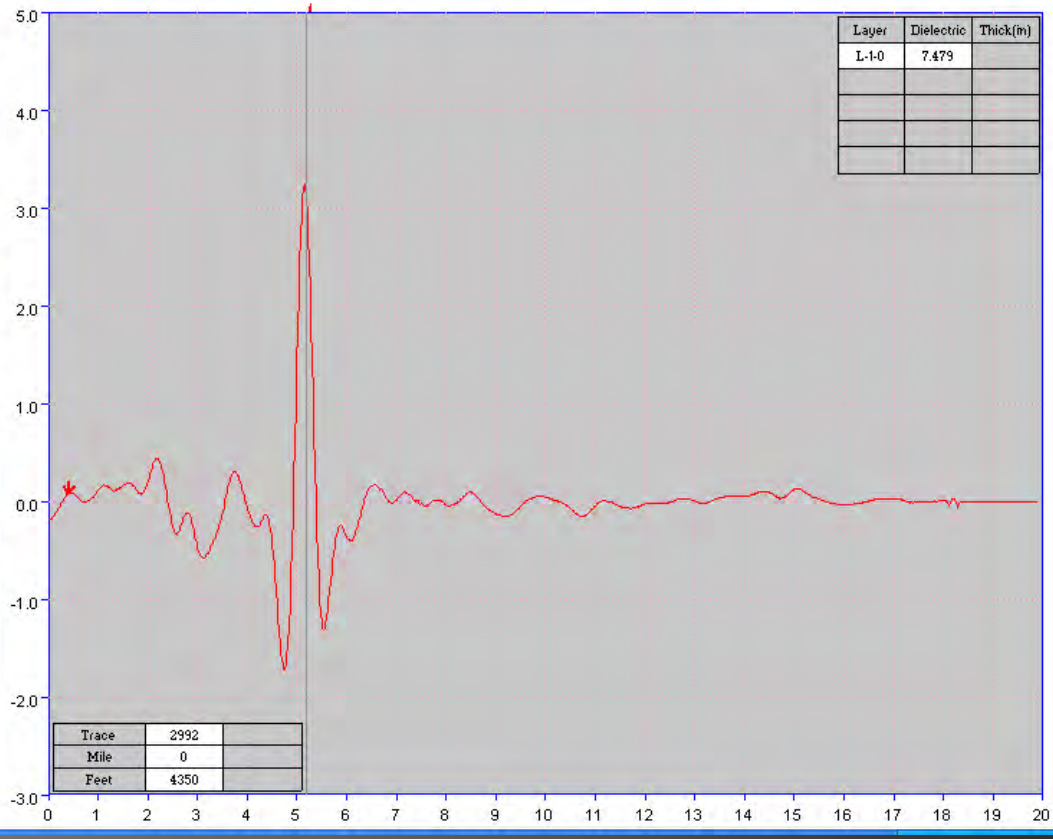


GPS: Lat: 29.77681860 Log: 95.36906047 (Lat:(N) 29:46:36.5470 Log:(W) 95:22: 8.6177

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

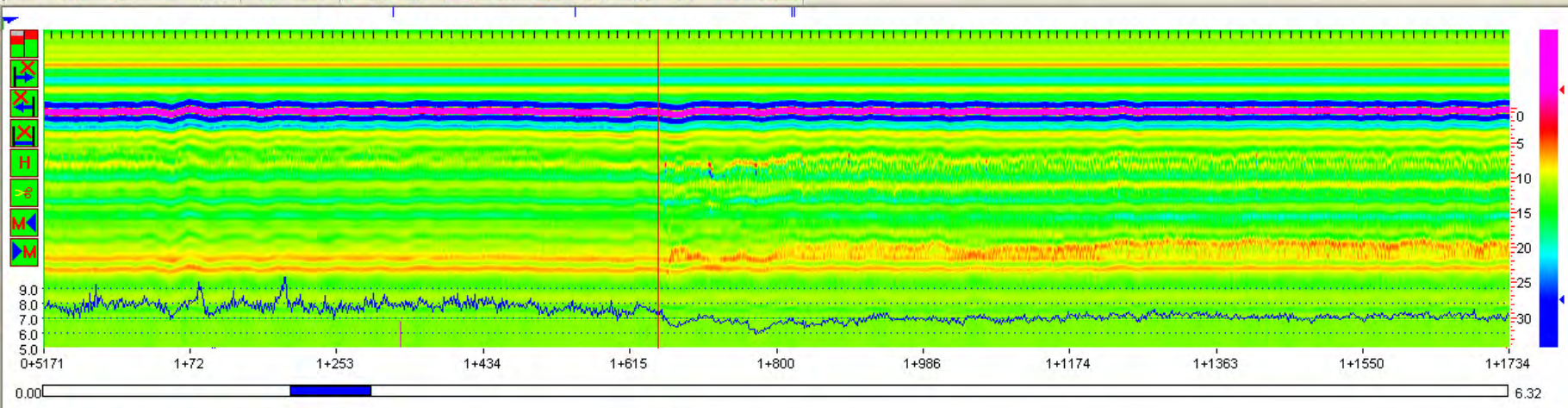


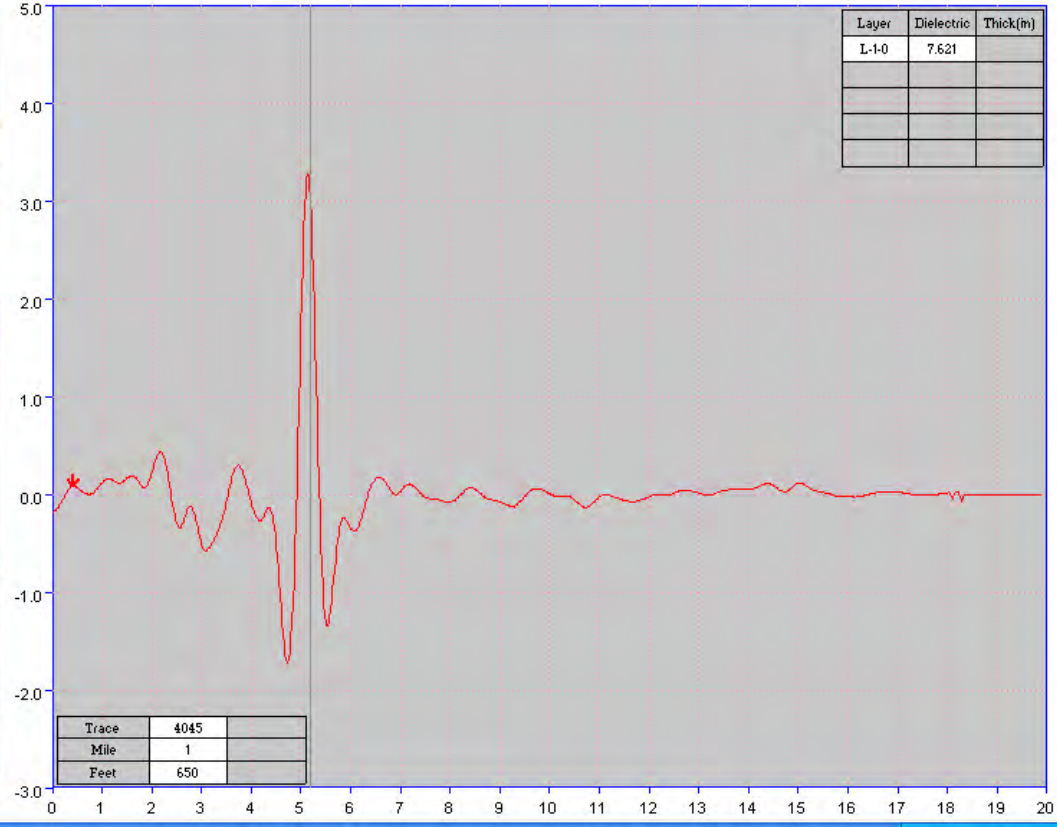


GPS: Lat: 29.77864133 Log: 95.37335587 (Lat:(N) 29:46:43.1088 Log:(W) 95:22:24.0811

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

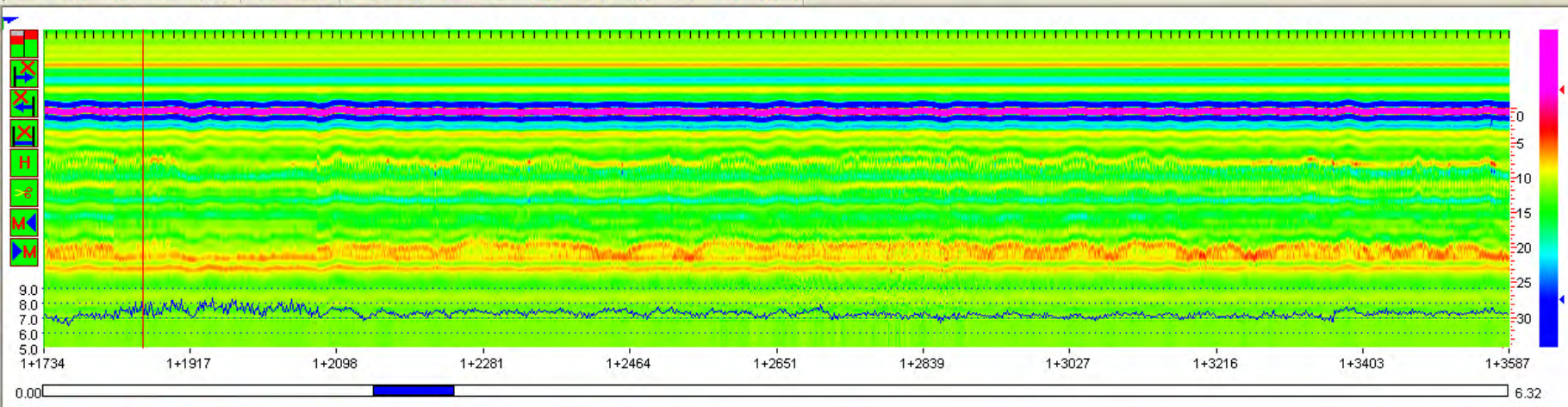


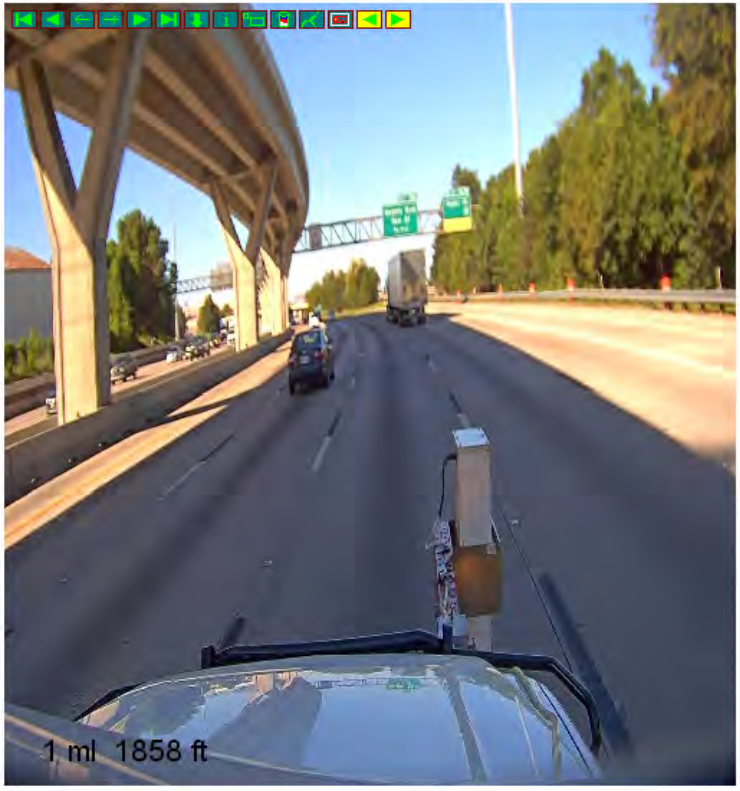


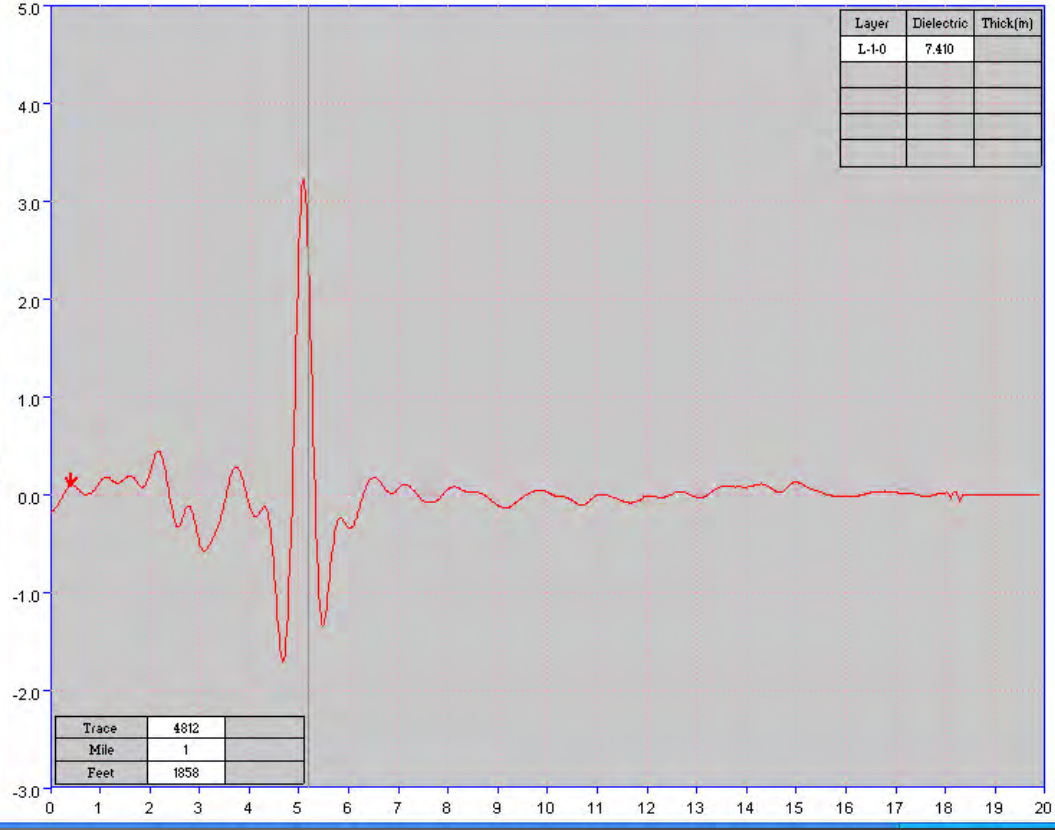
GPS: Lat: 29.77917007 Log: 95.37699565 (Lat:(N) 29:46:45.0122 Log:(W) 95:22:37.1844

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



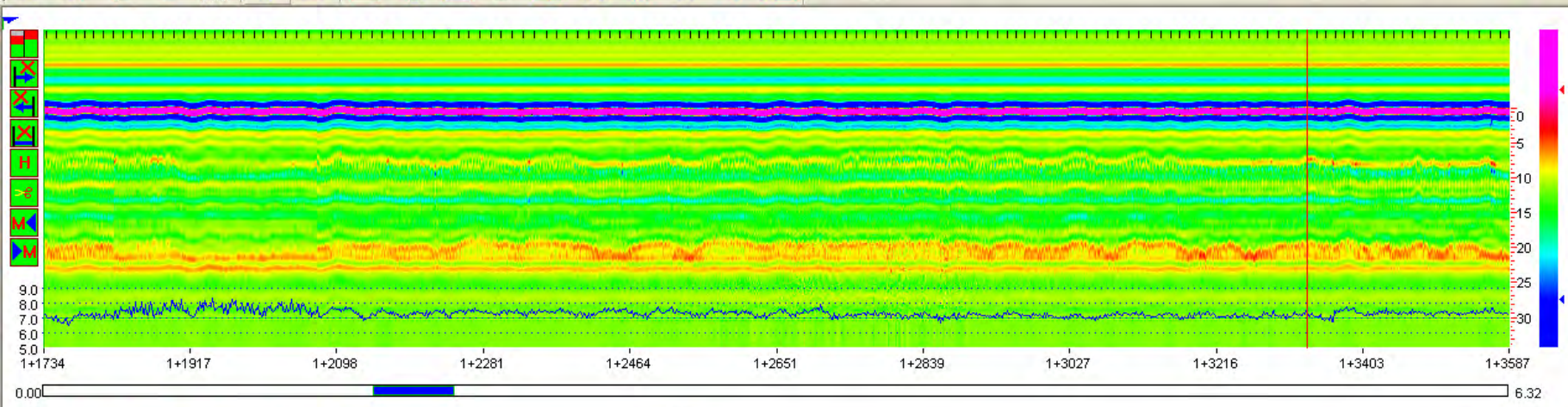


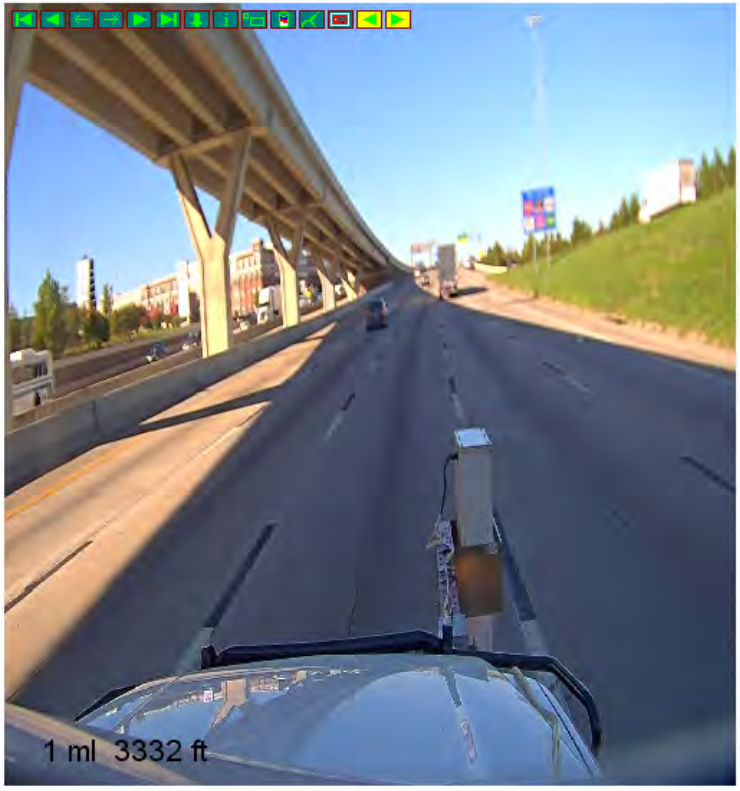


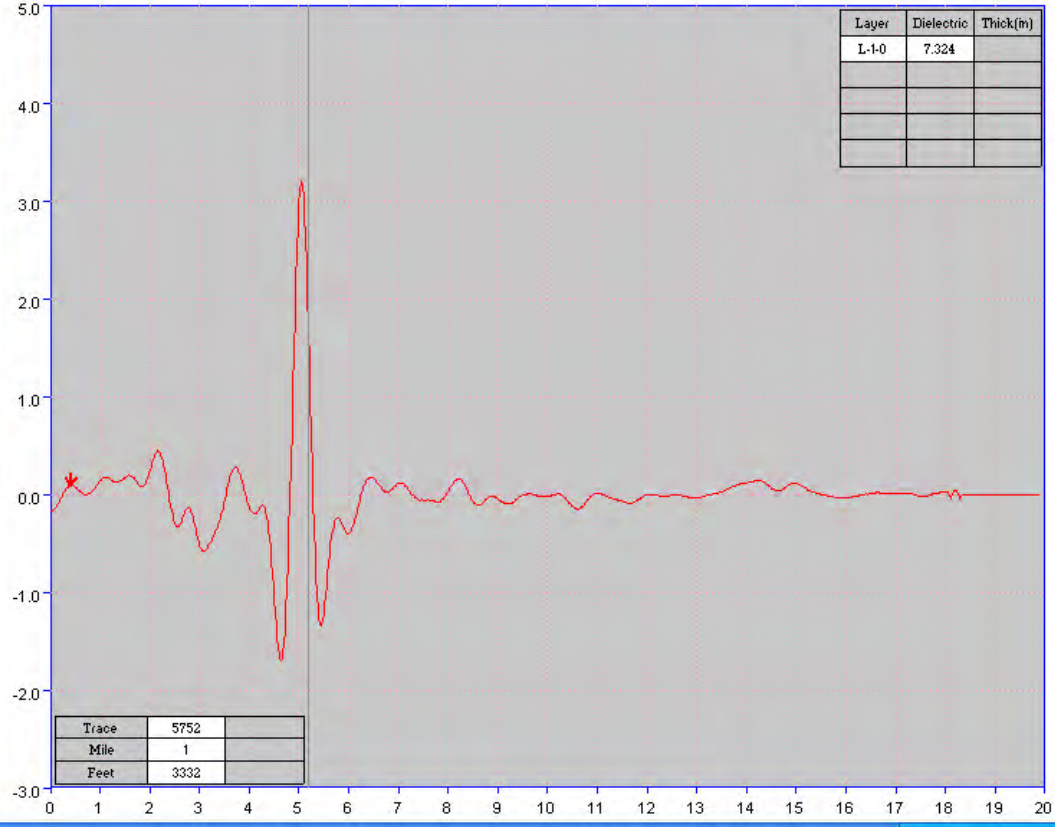
GPS: Lat: 29.77782477 Log: 95.38148212 (Lat:(N) 29:46:40.1692 Log:(W) 95:22:53.3356

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



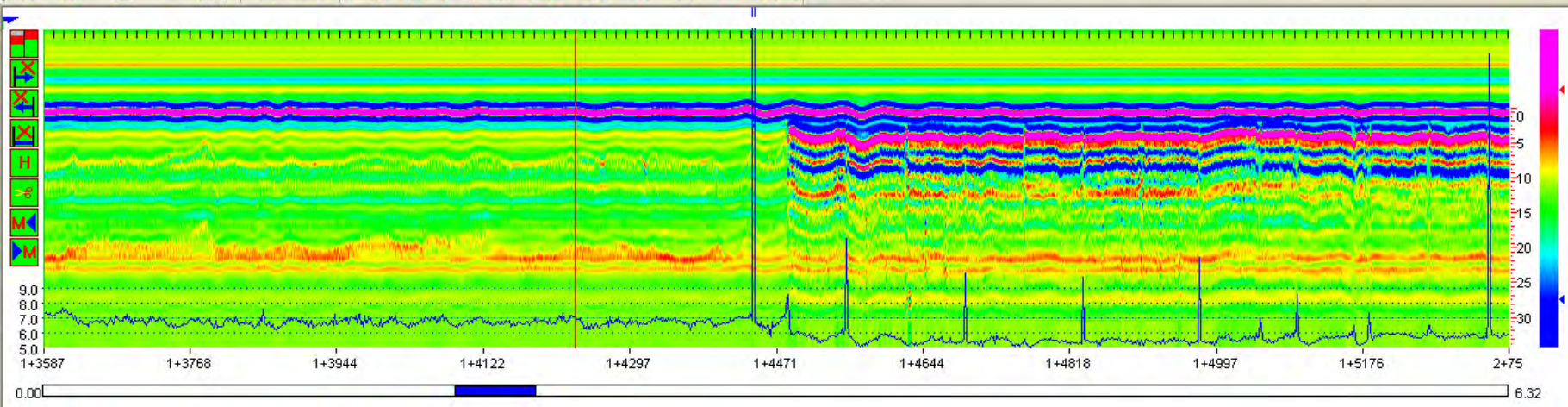


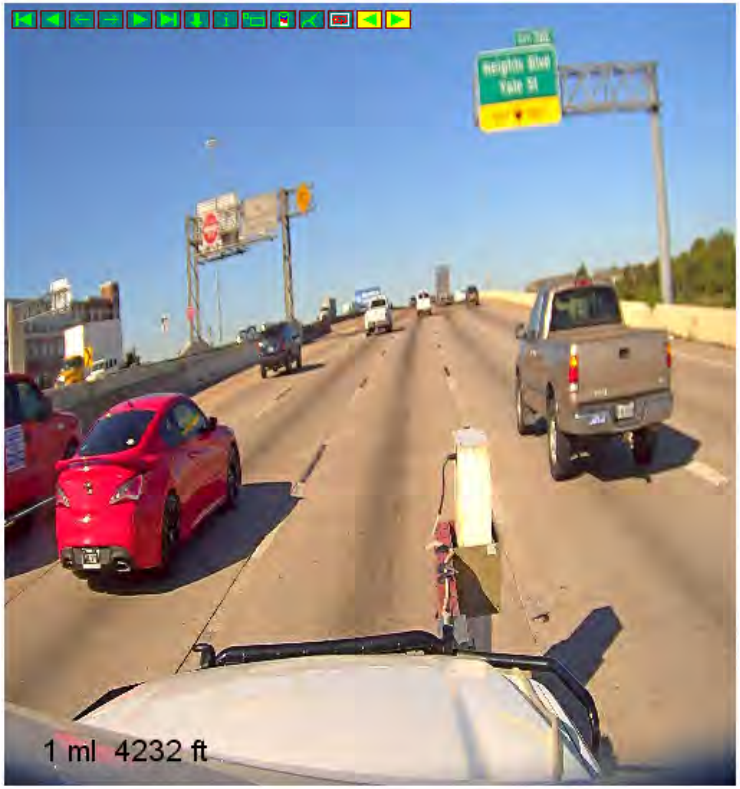


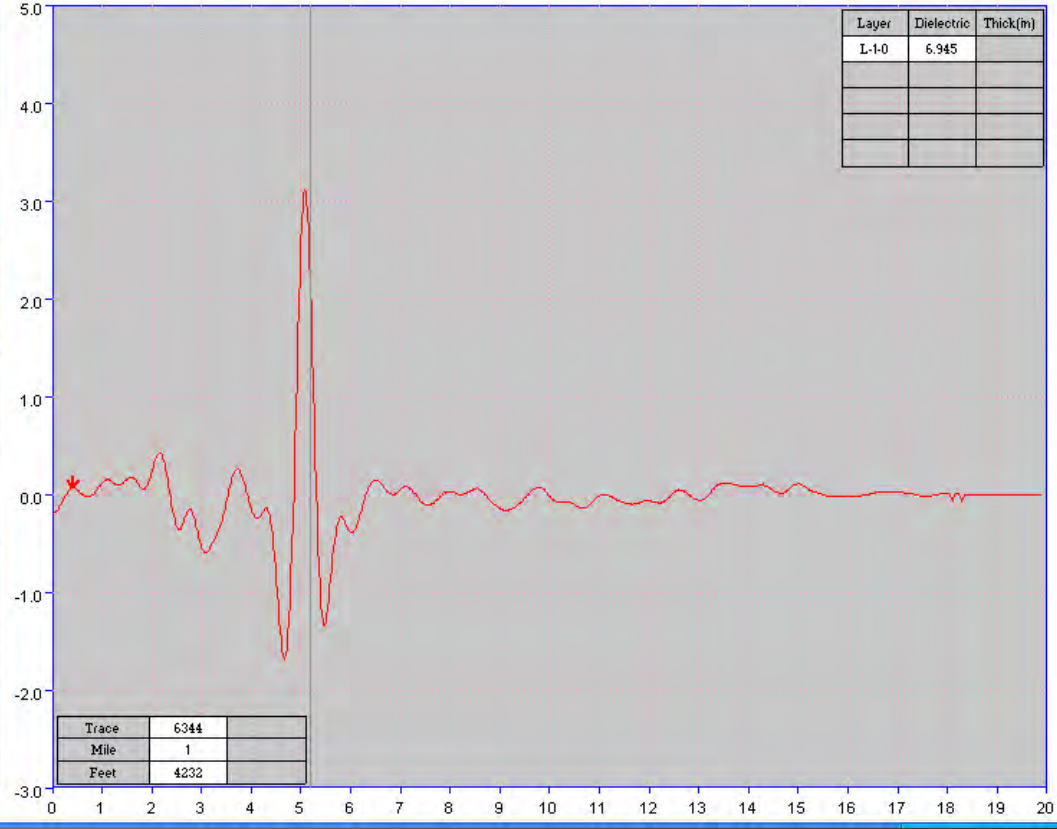
GPS: Lat: 29.77721444 Log: 95.38417222 (Lat:(N) 29:46:37.9720 Log:(W) 95:23: 3.0200

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



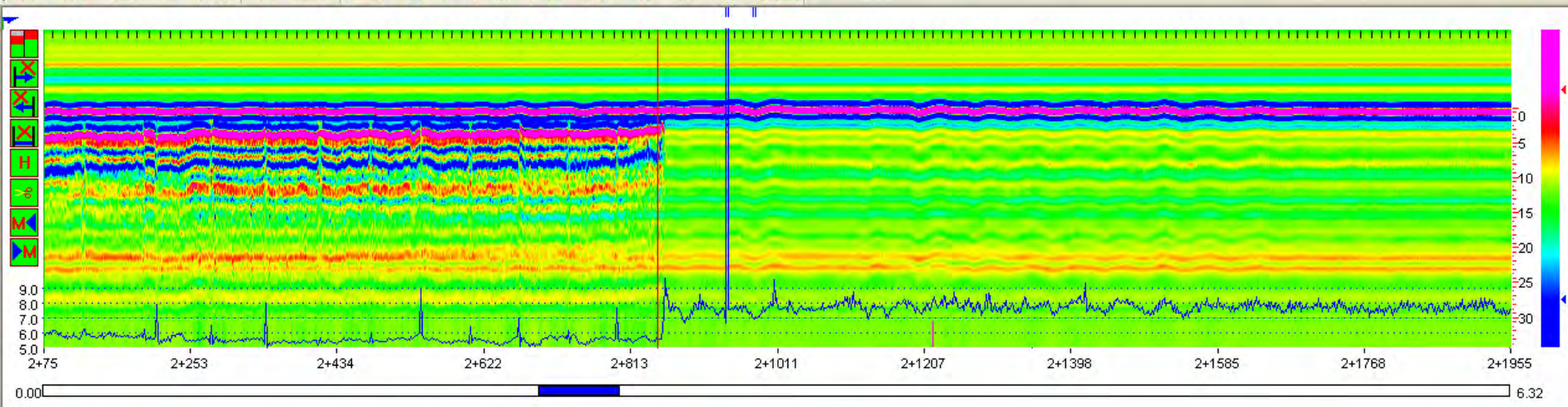


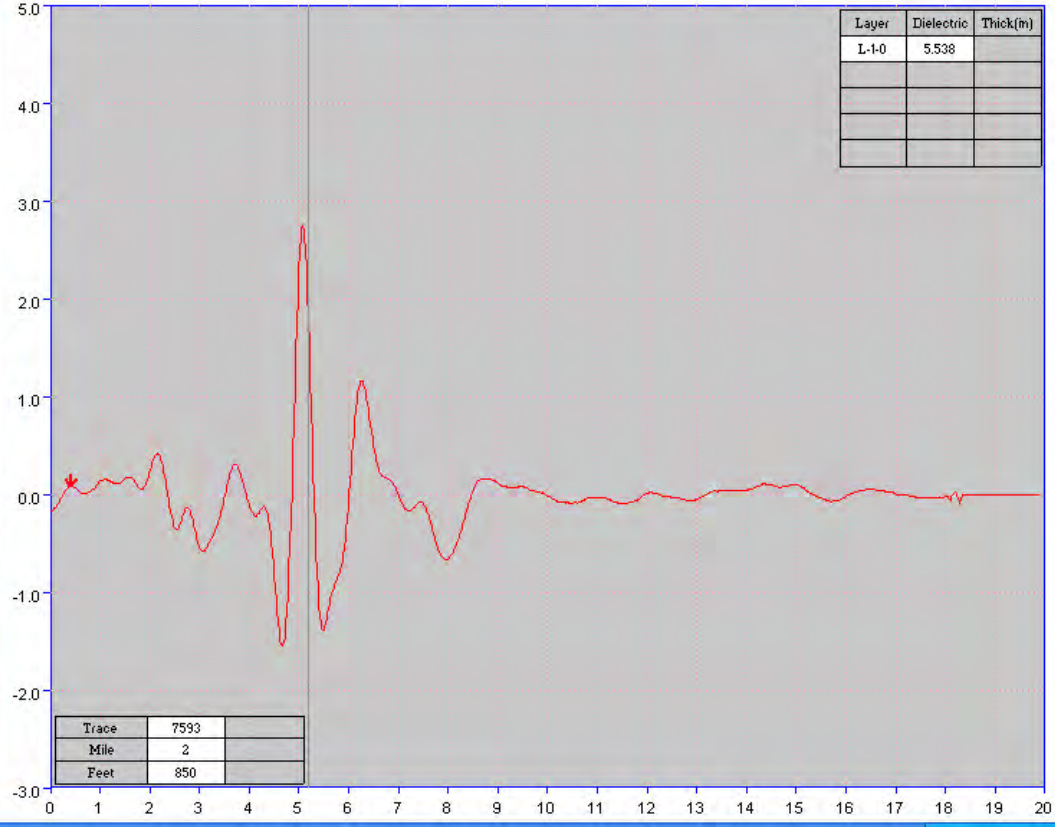


GPS: Lat: 29.77686686 Log: 95.38994833 (Lat:(N) 29:46:36.7207 Log:(W) 95:23:23.8140

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

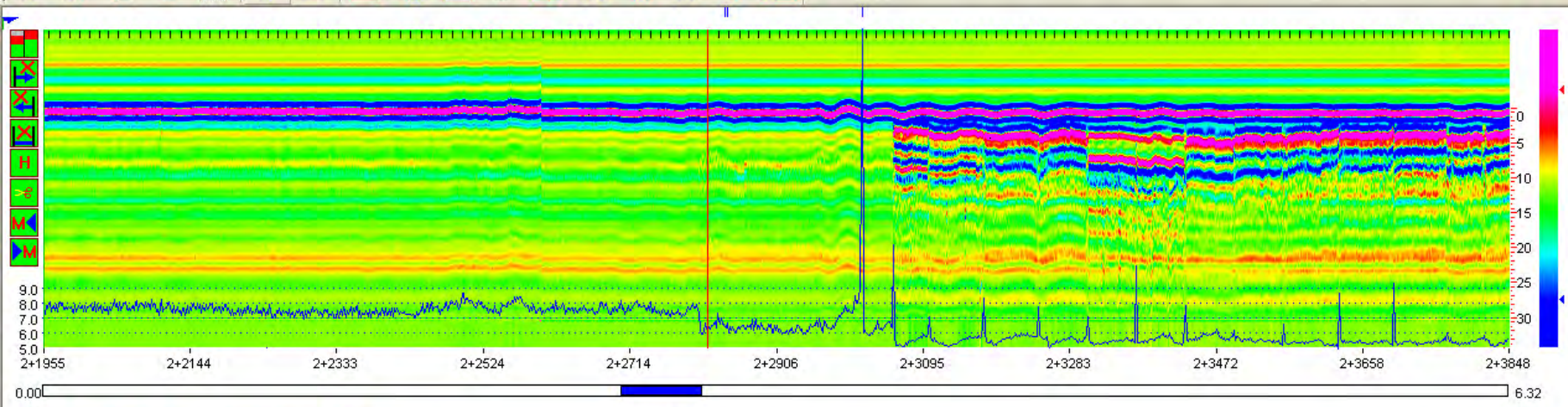


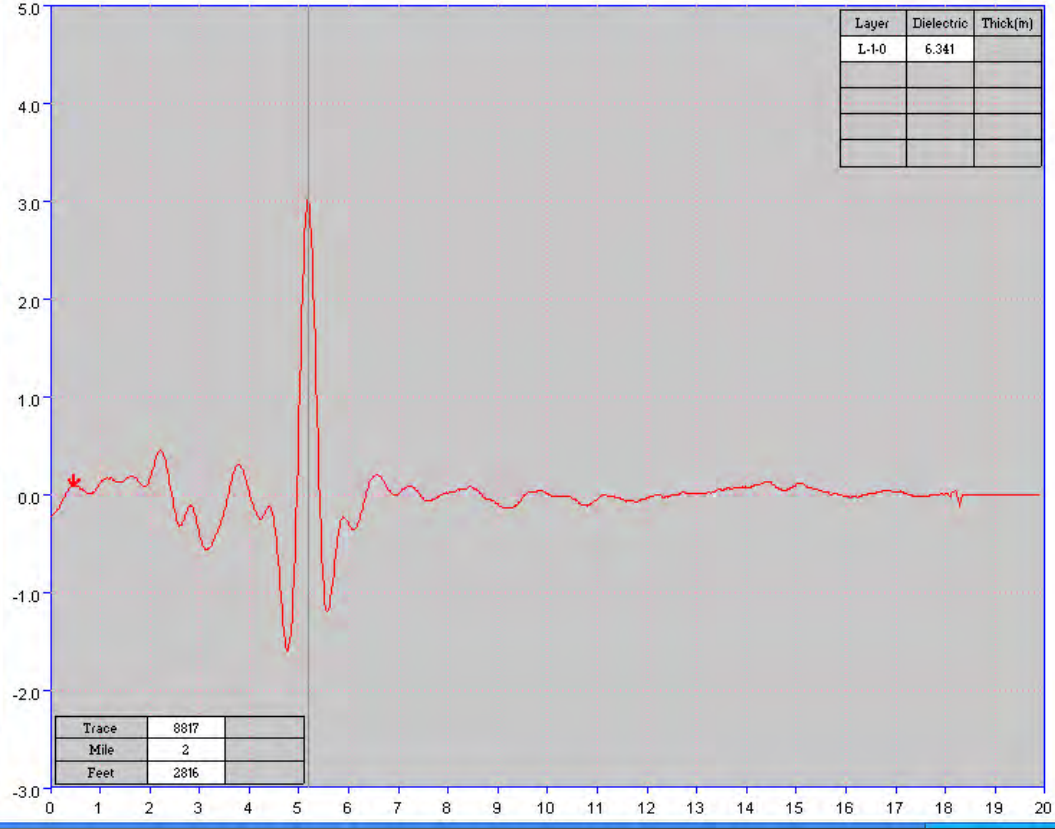


GPS: Lat: 29.77672330 Log: 95.39610069 (Lat:(N) 29:46:36.2039 Log:(W) 95:23:45.9625

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

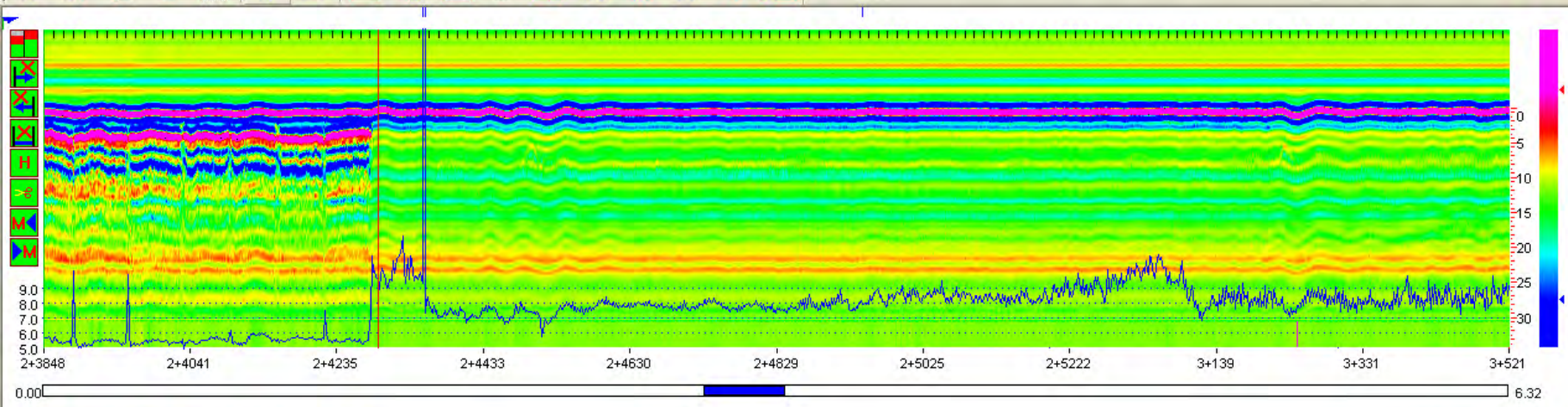


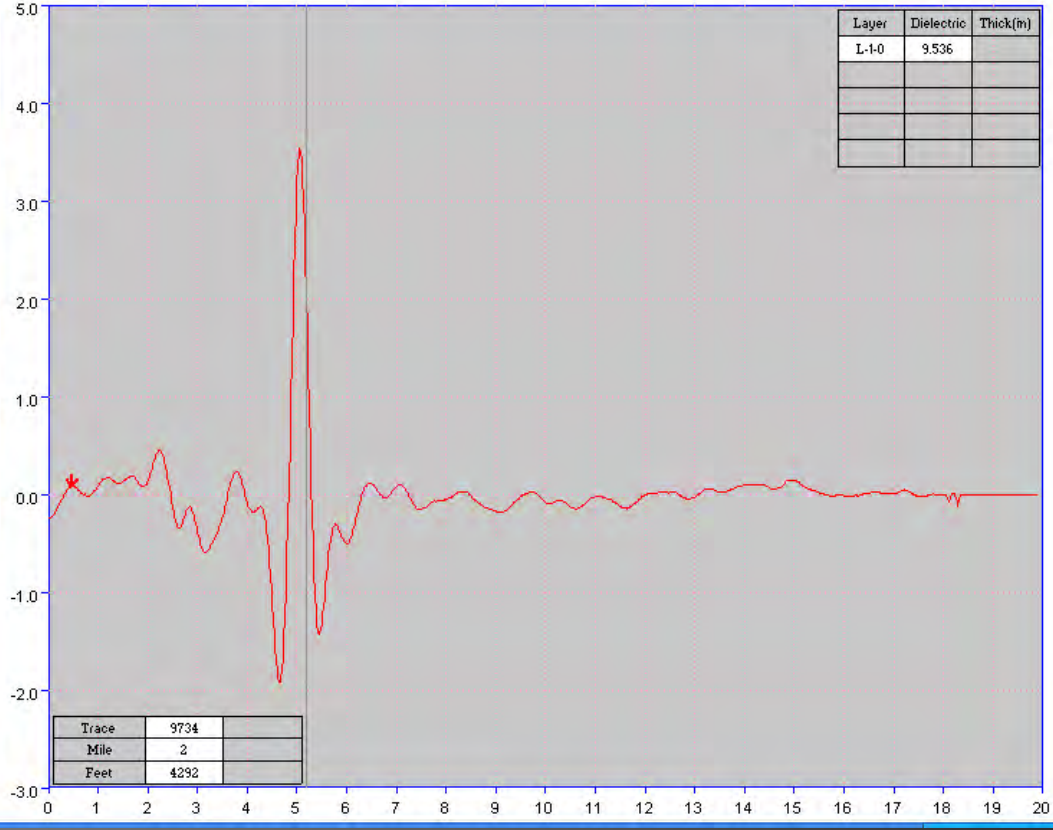


GPS: Lat: 29.77665608 Log: 95.40076343 (Lat:(N) 29:46:35.9619 Log:(W) 95:24: 2.7484

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

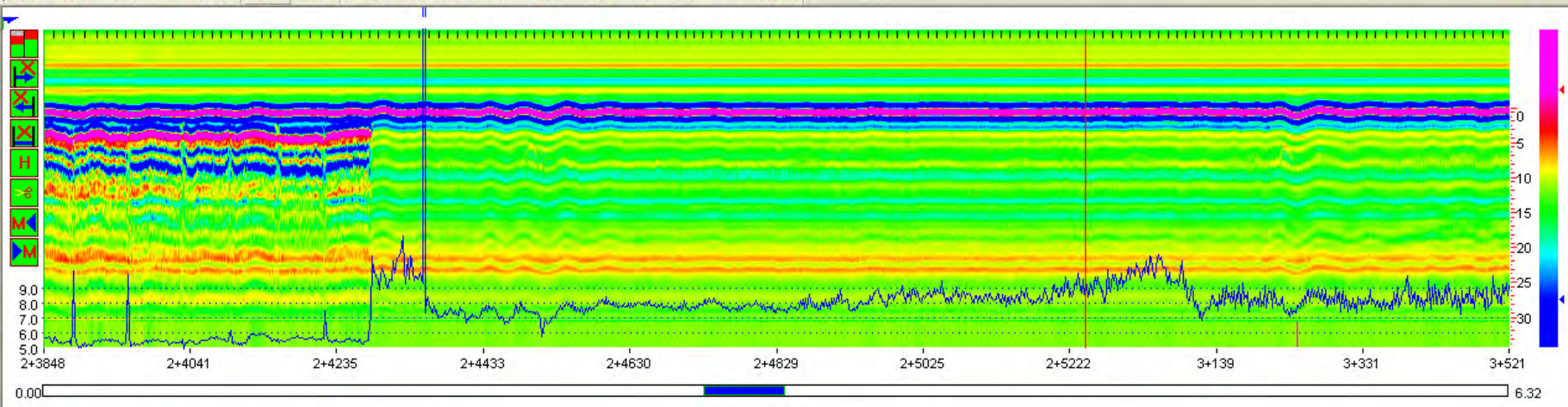


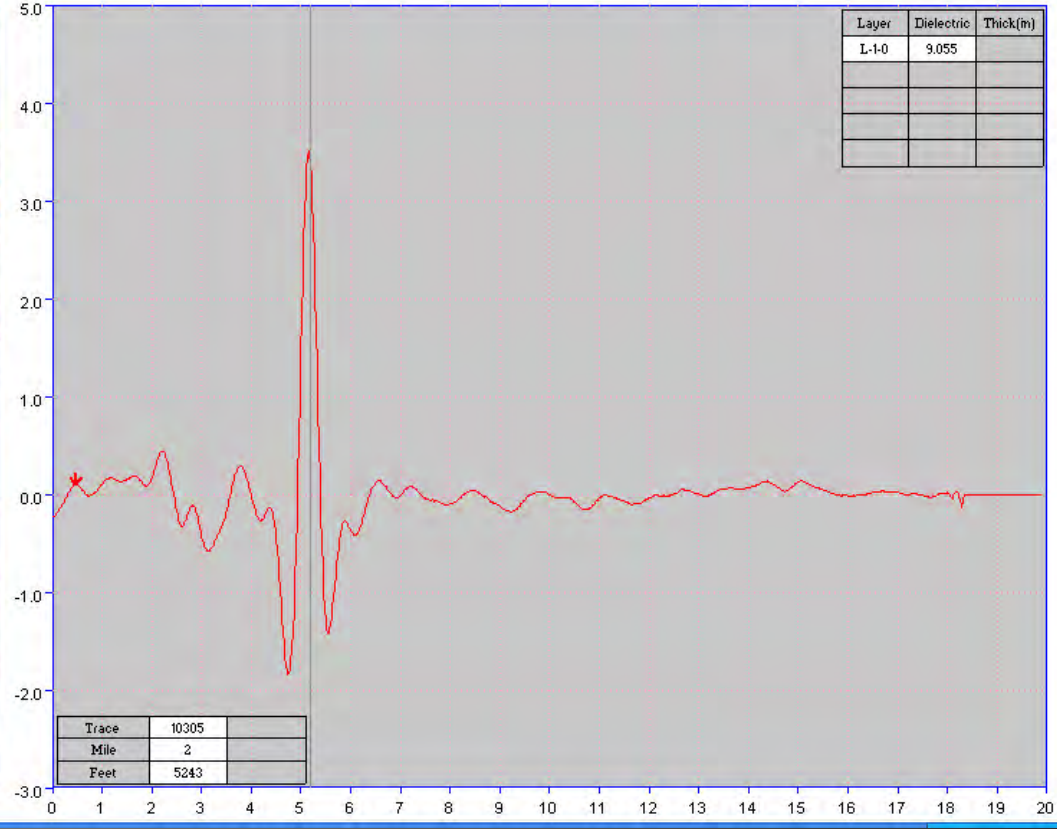


GPS: Lat: 29.77695935 Log: 95.40366000 (Lat:(N) 29:46:37.0536 Log:(W) 95:24:13.1760

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

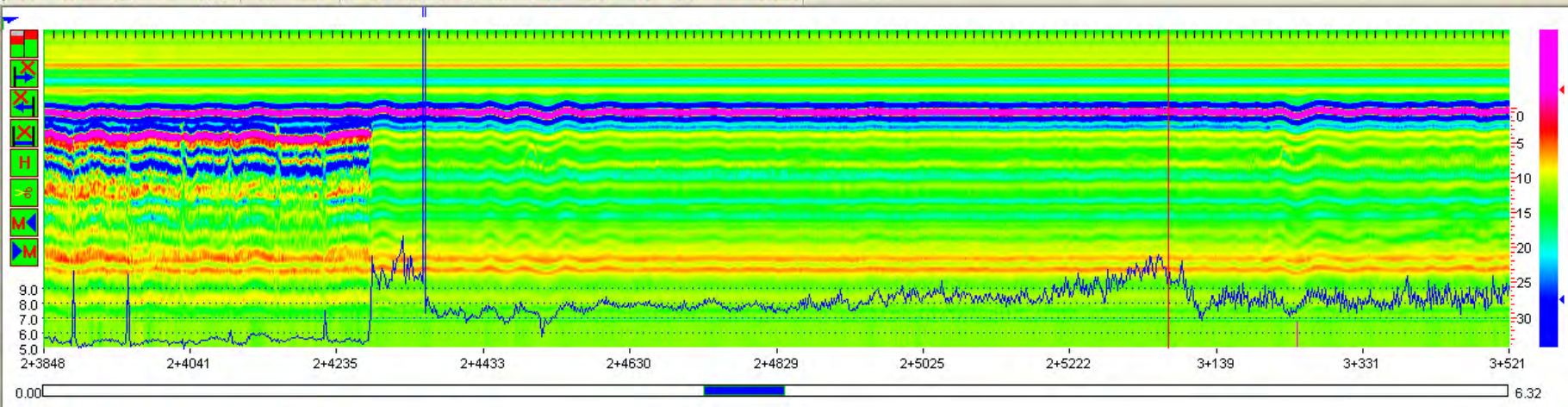


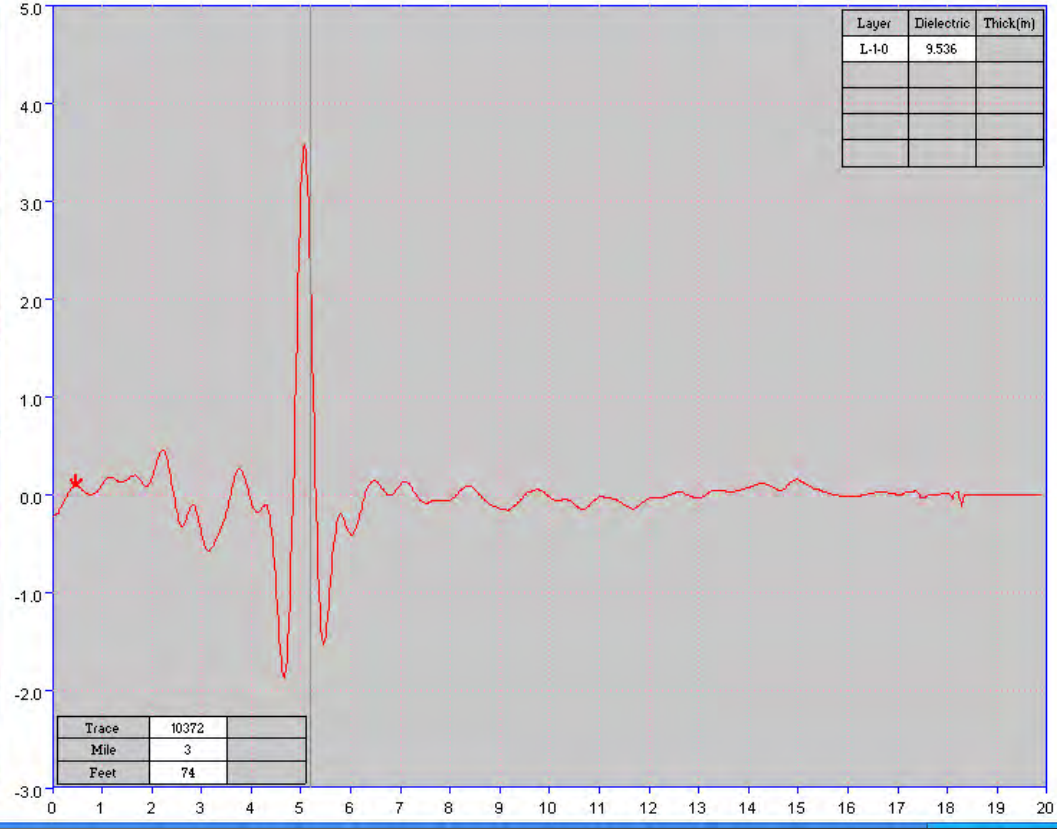


GPS: Lat: 29.77701490 Log: 95.40399961 (Lat:(N) 29:46:37.2536 Log:(W) 95:24:14.3986

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

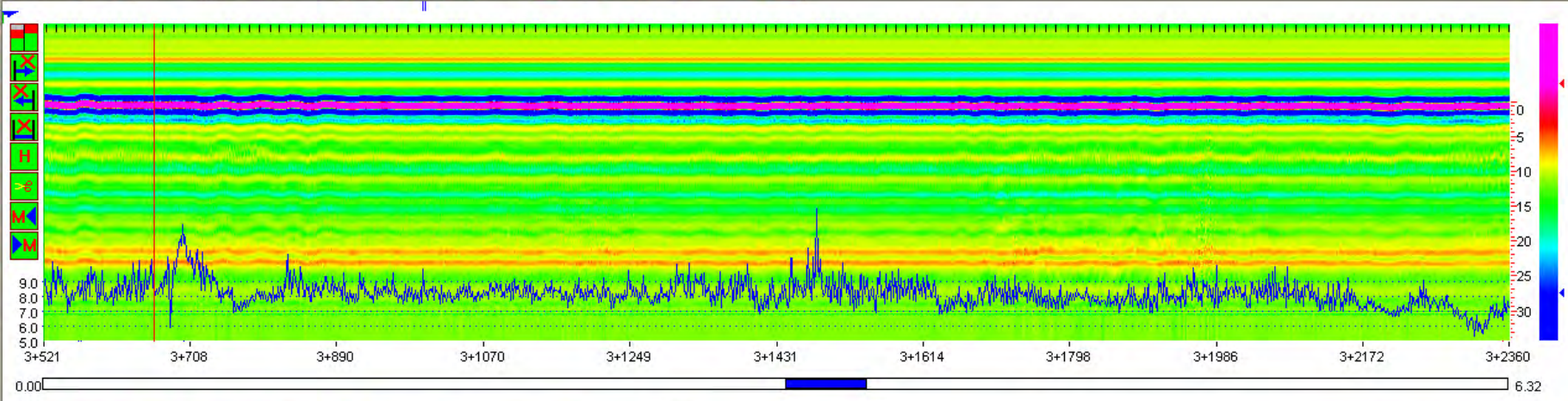


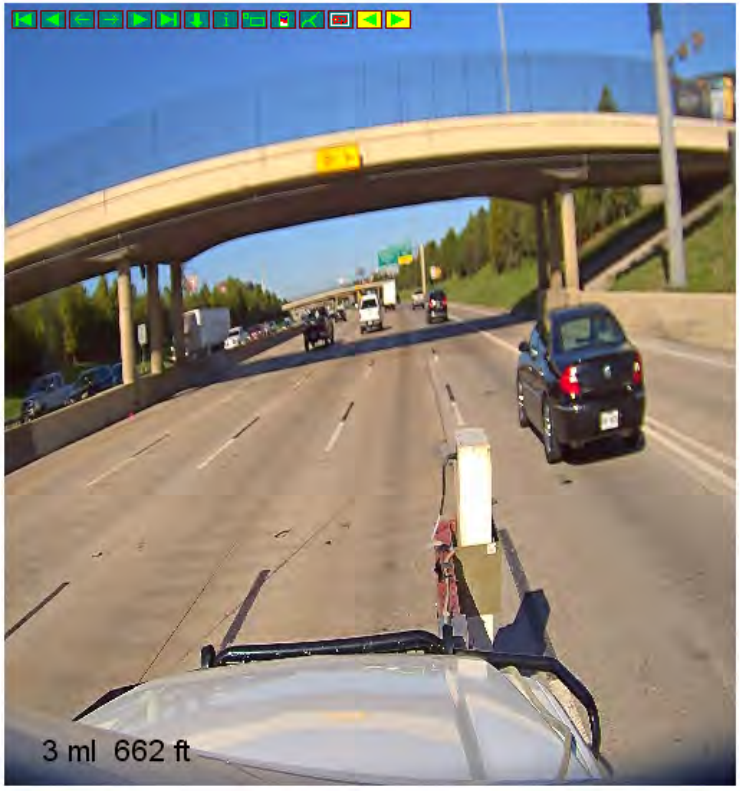


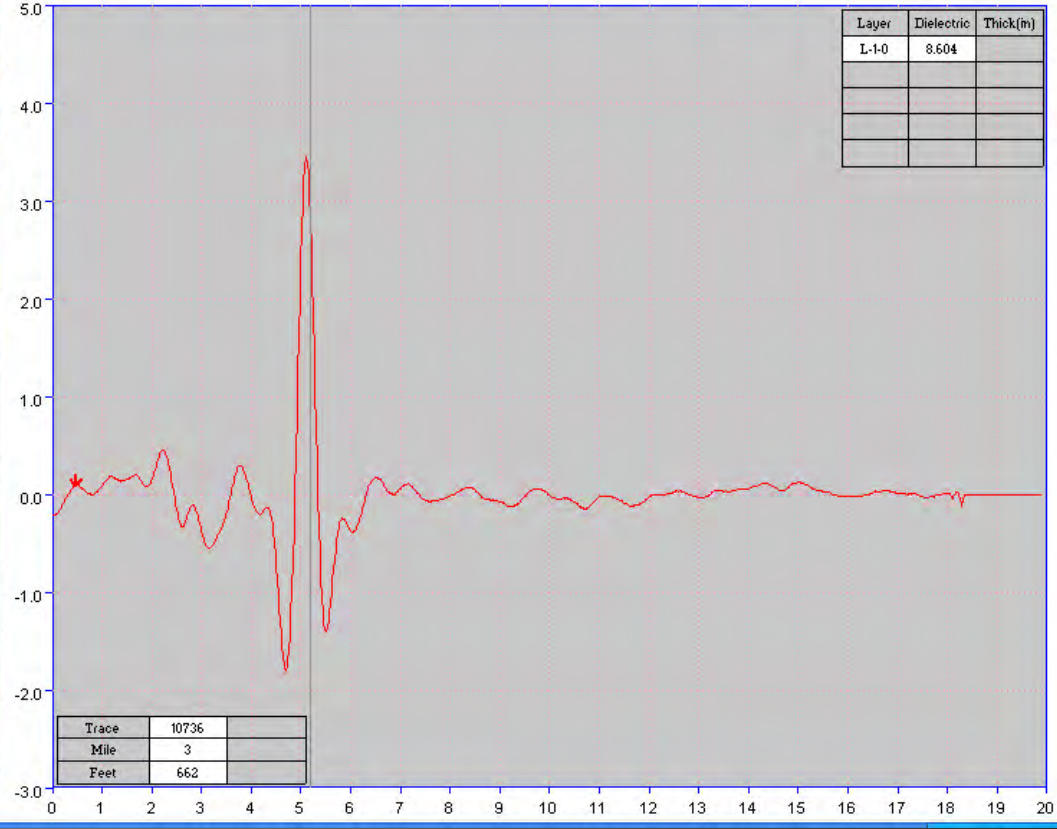
GPS: Lat: 29.77731917 Log: 95.40578467 (Lat:(N) 29:46:38.3490 Log:(W) 95:24:20.8248

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



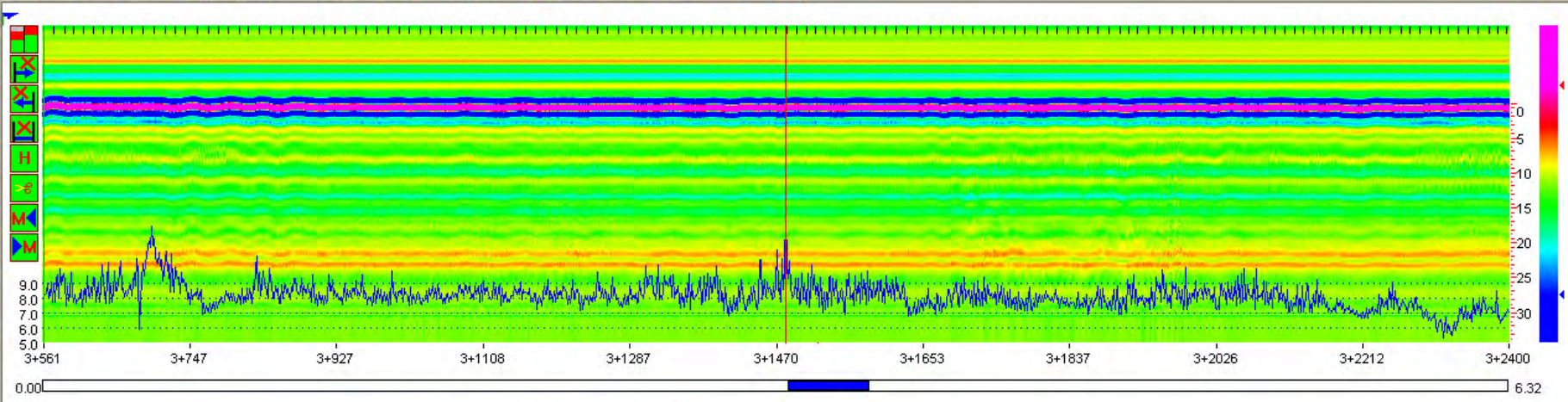


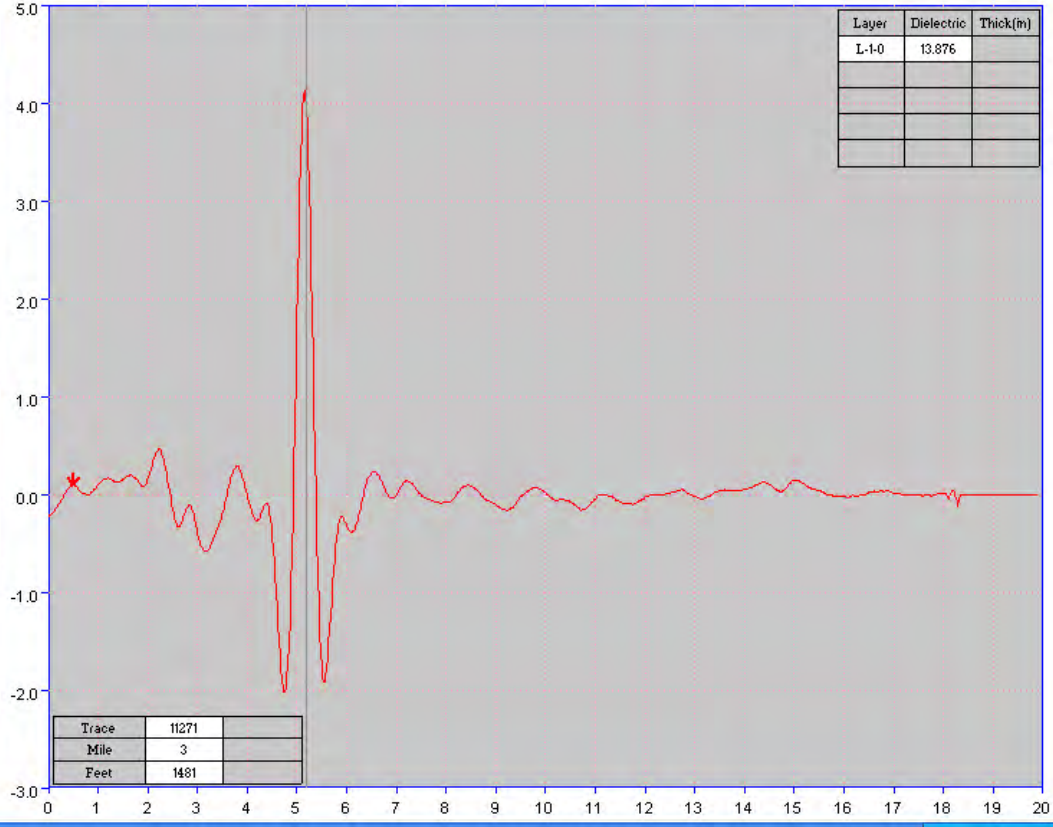


GPS: Lat: 29.77763929 Log: 95.40828262 (Lat:(N) 29:46:39.5014 Log:(W) 95:24:29.8174

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

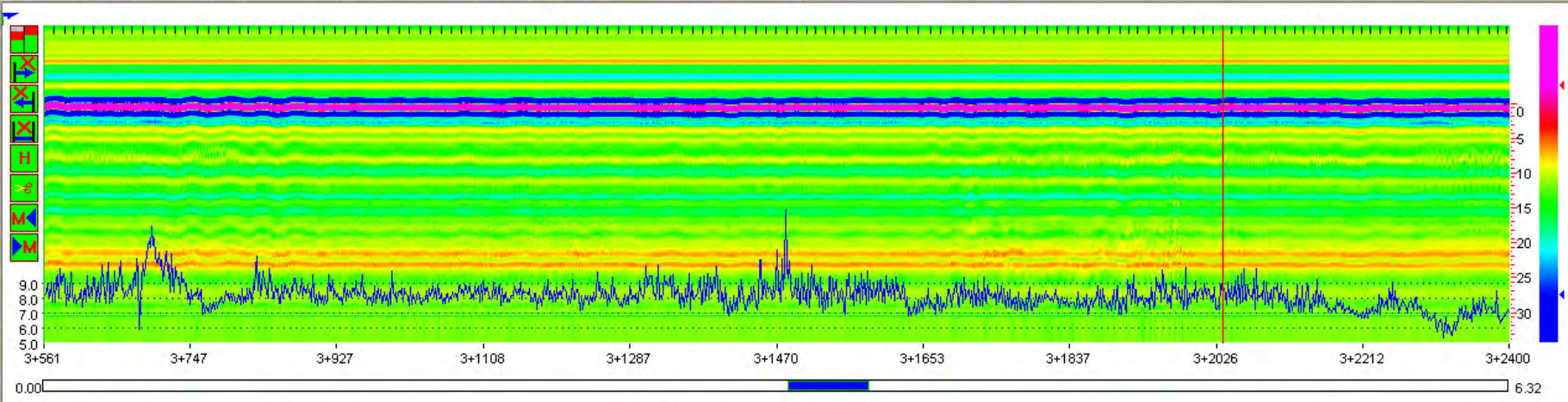


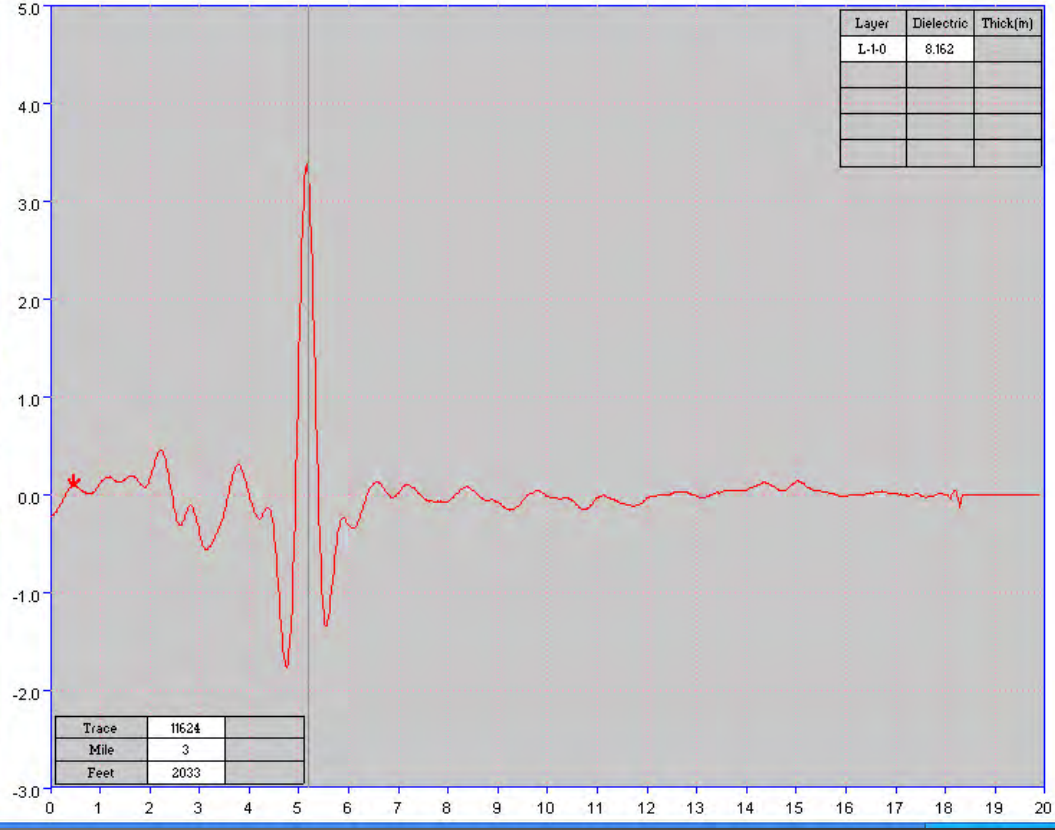


GPS: Lat: 29.77769000 Log: 95.40996529 (Lat:(N) 29:46:39.6840 Log:(W) 95:24:35.8751

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

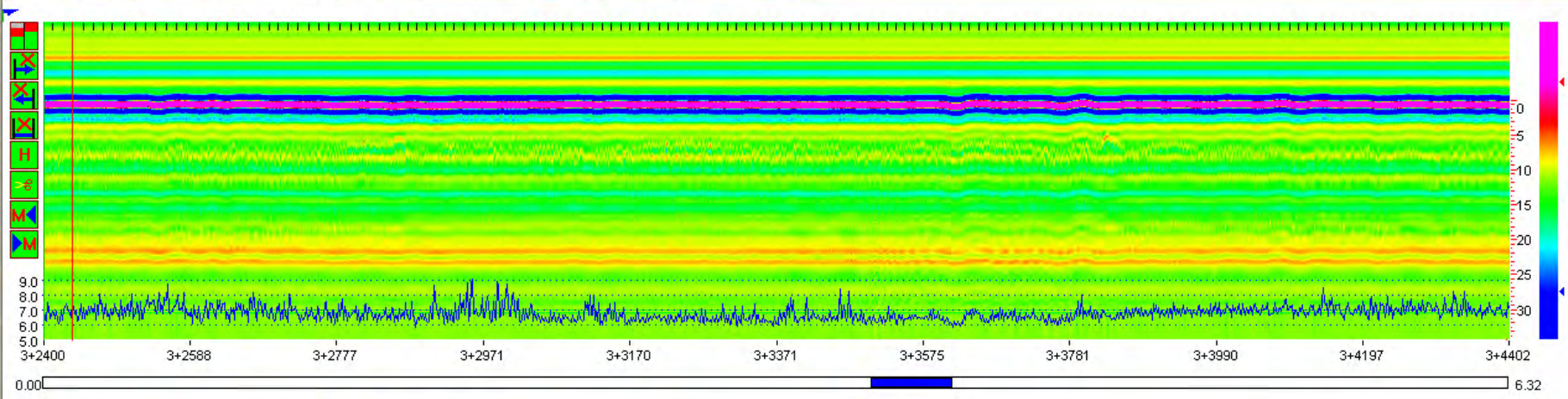


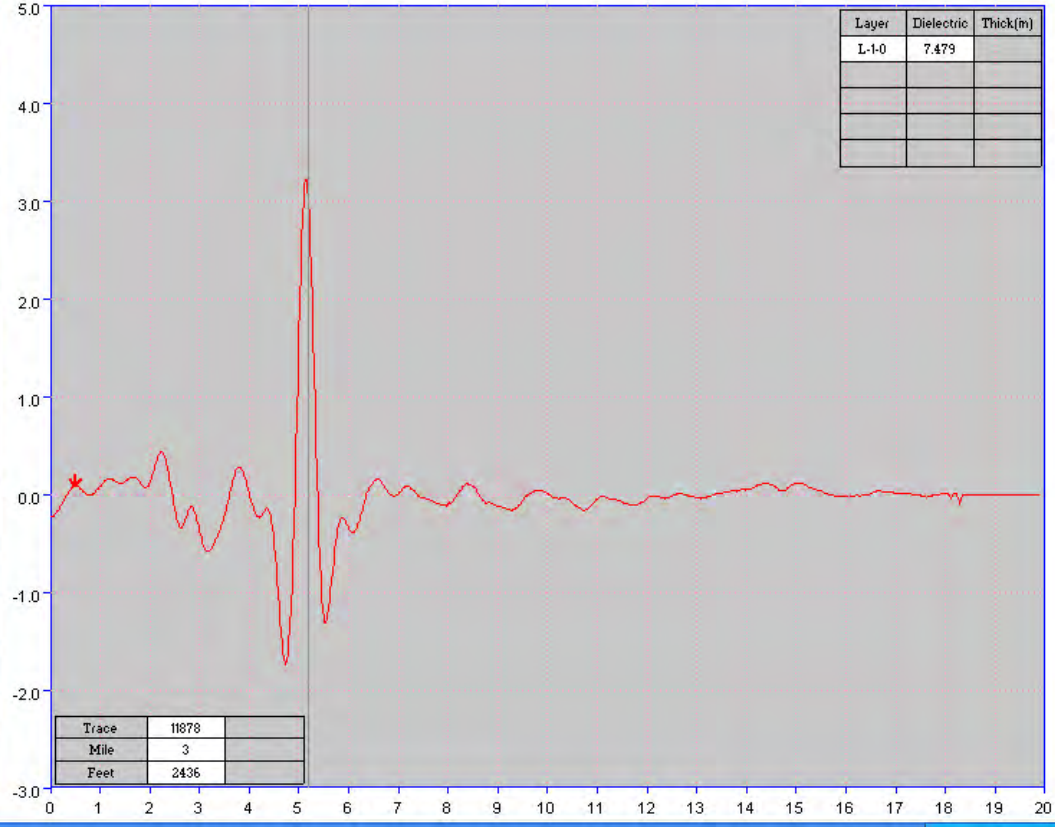


GPS: Lat: 29.77766833 Log: 95.41120530 (Lat:(N) 29:46:39.6060 Log:(W) 95:24:40.3391

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

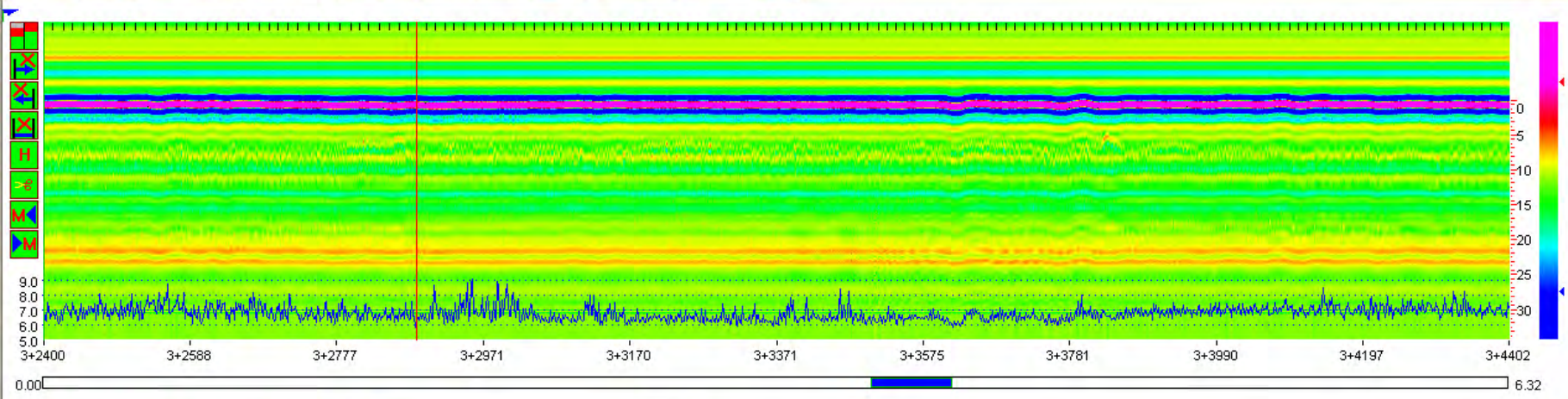


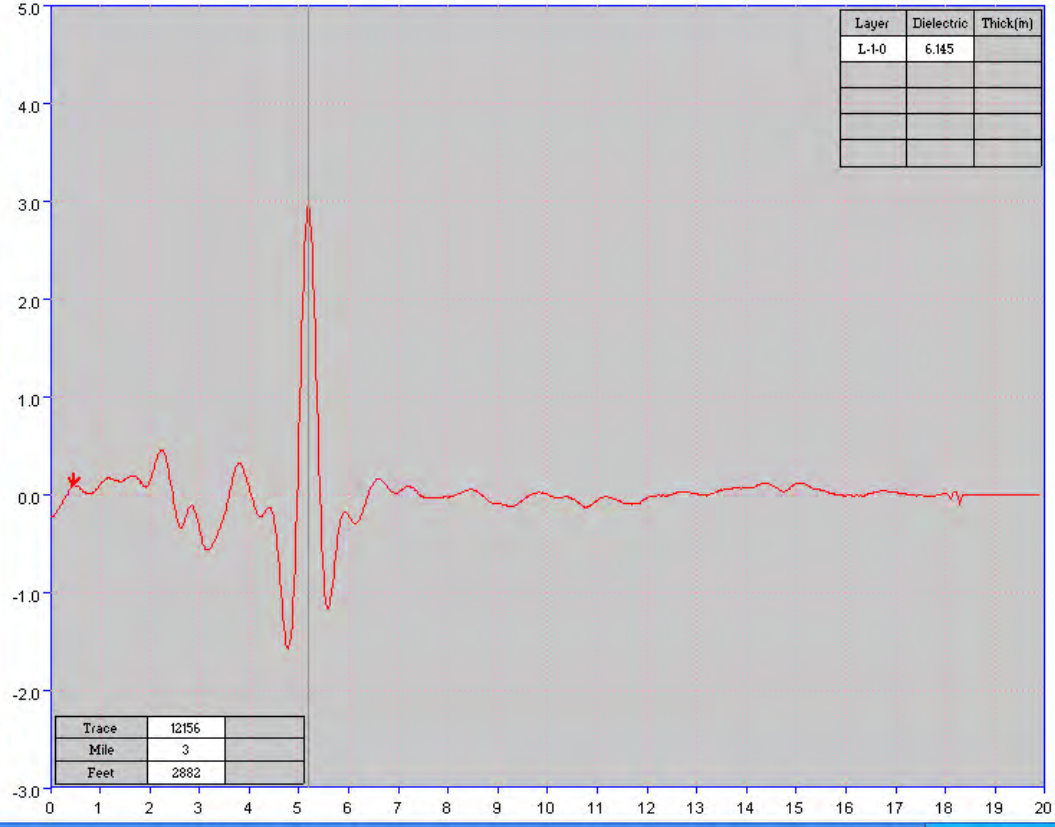


GPS: Lat: 29.77765567 Log: 95.41256833 (Lat:(N) 29:46:39.5604 Log:(W) 95:24:45.2460

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

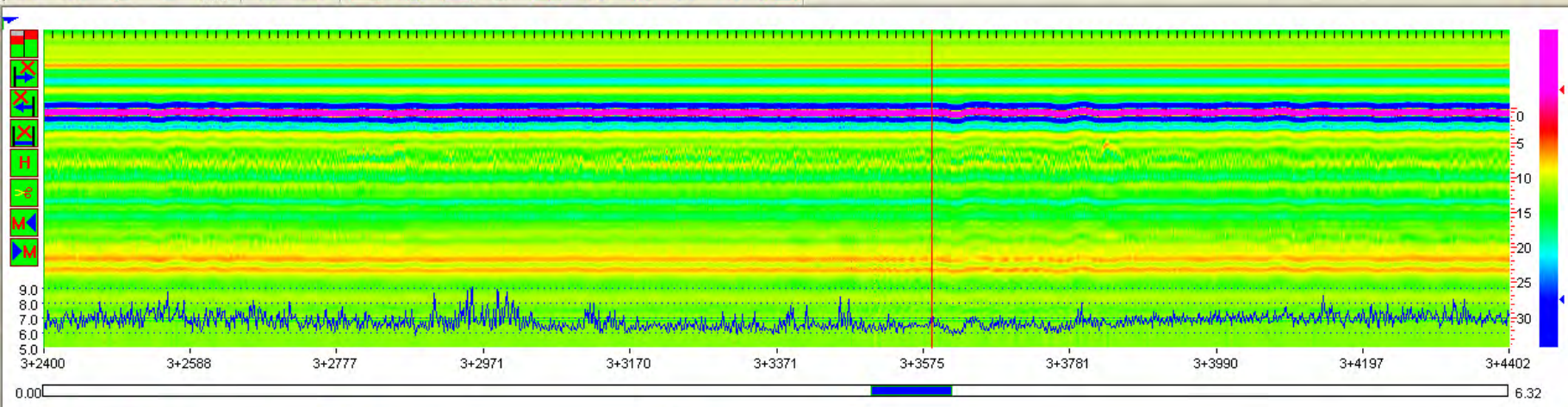


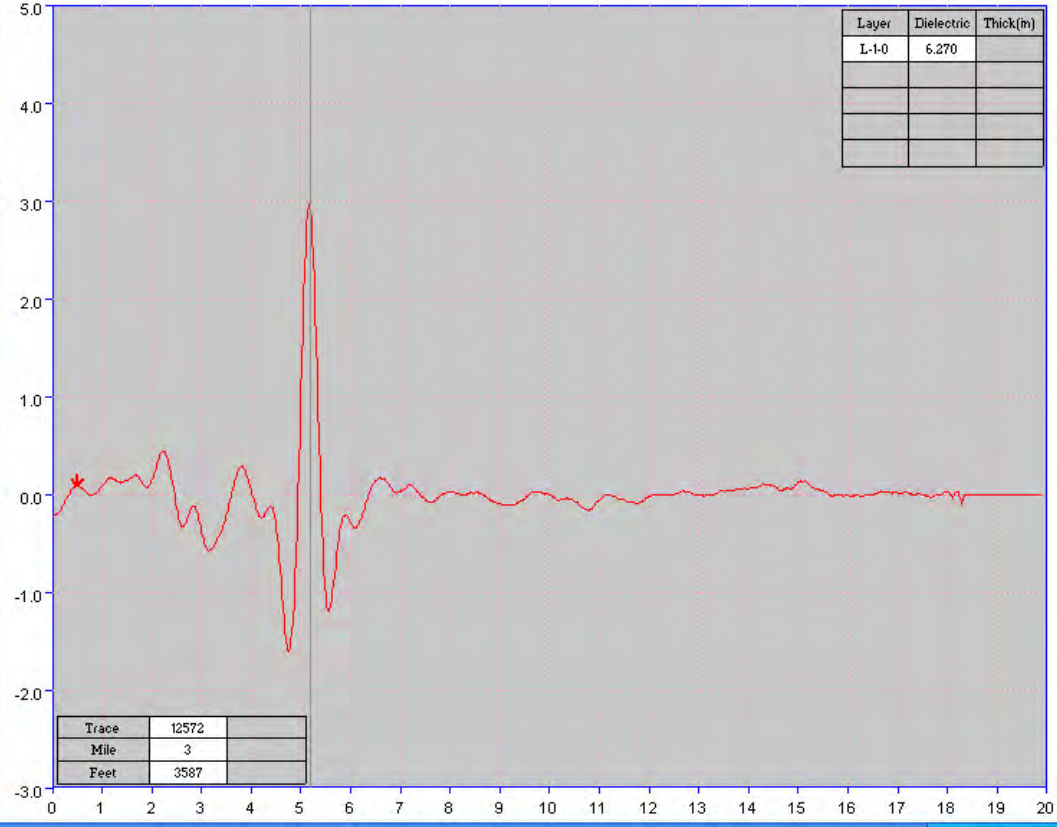


GPS: Lat: 29.77762830 Log: 95.41497513 (Lat:(N) 29:46:39.4619 Log:(W) 95:24:53.9105

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

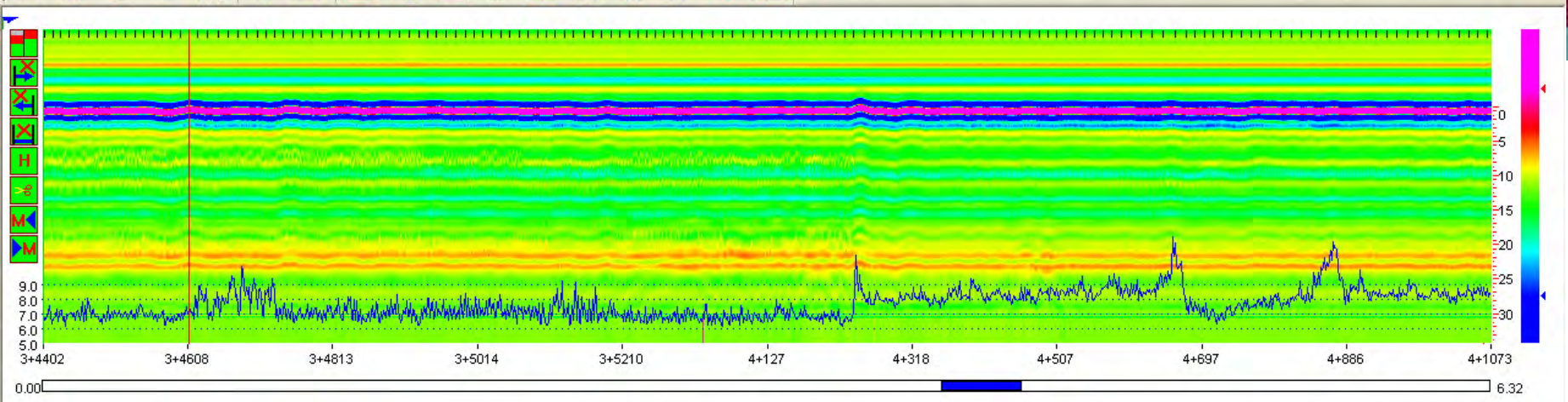


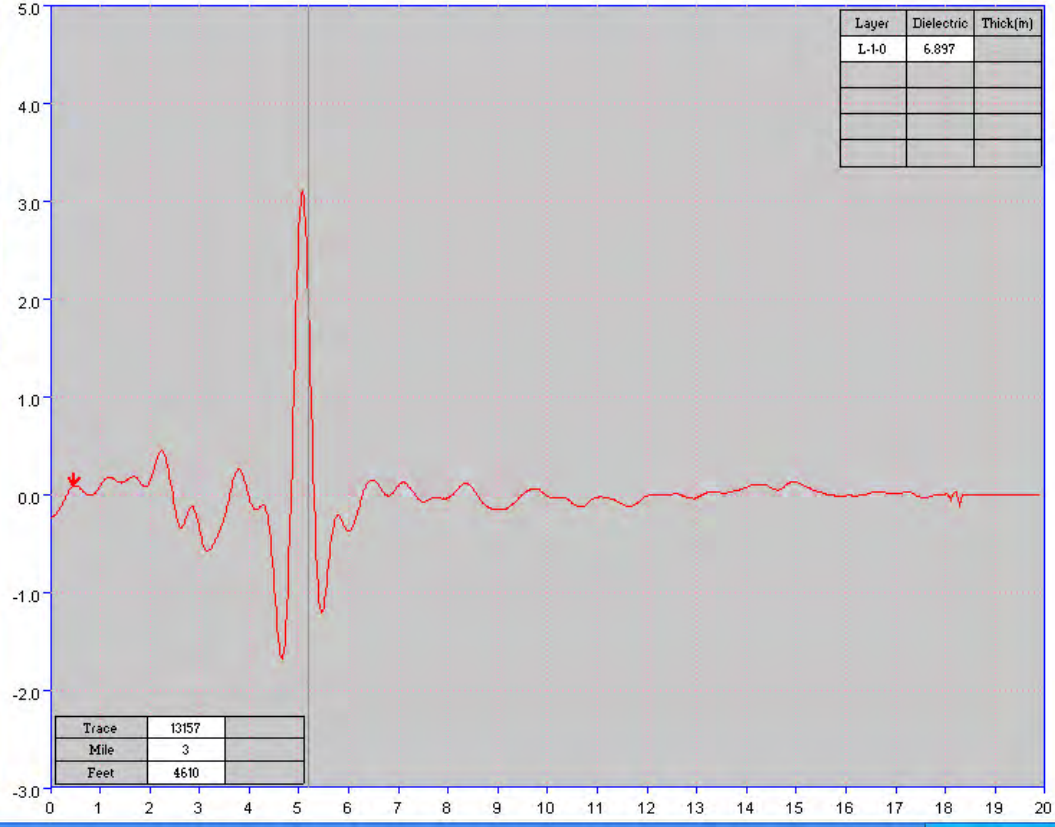


GPS: Lat: 29.77758637 Log: 95.41811765 (Lat:(N) 29:46:39.3109 Log:(W) 95:25: 5.2235

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

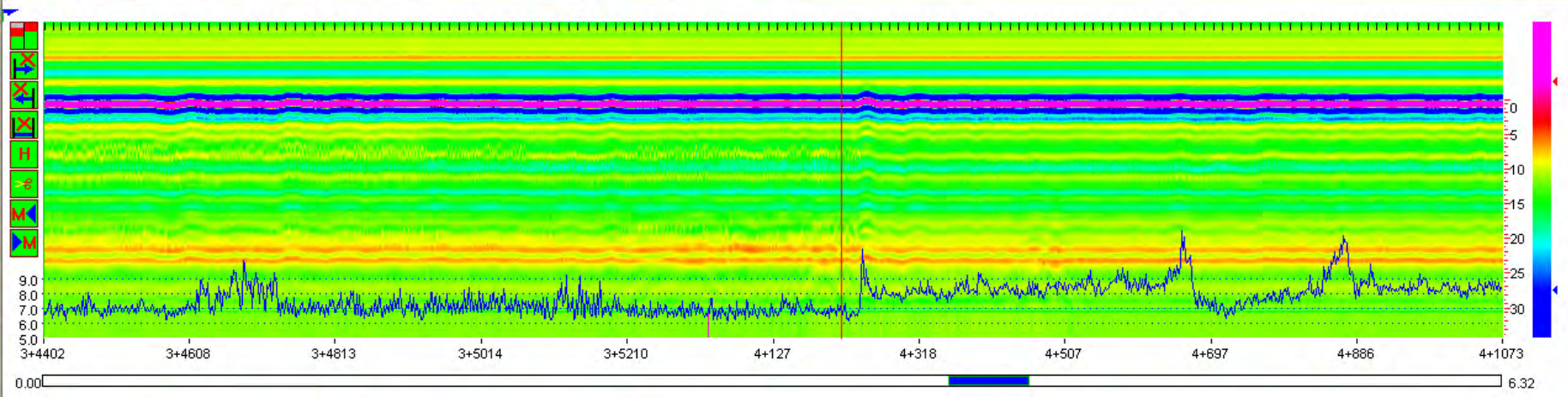


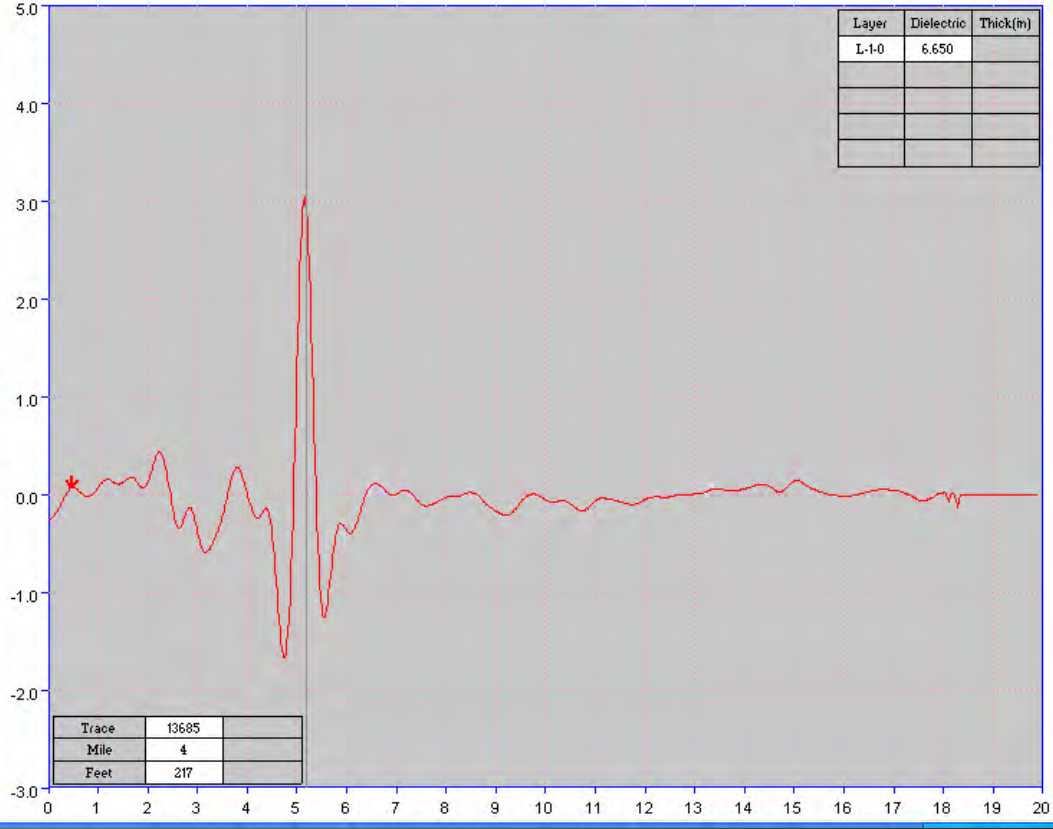


GPS: Lat: 29.77754676 Log: 95.42085500 (Lat:(N) 29:46:39.1684 Log:(W) 95:25:15.0780

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

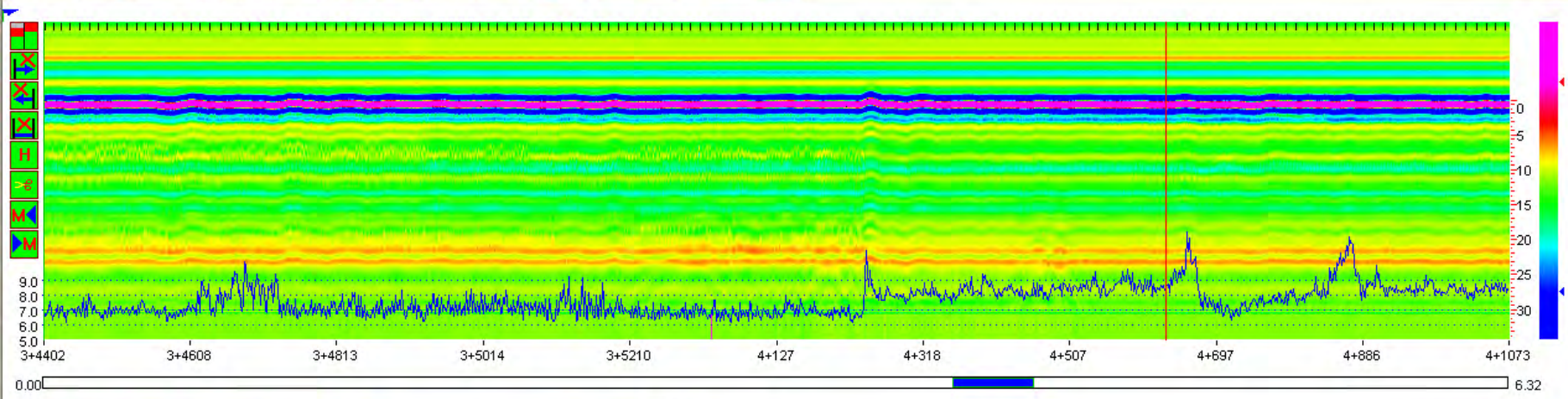


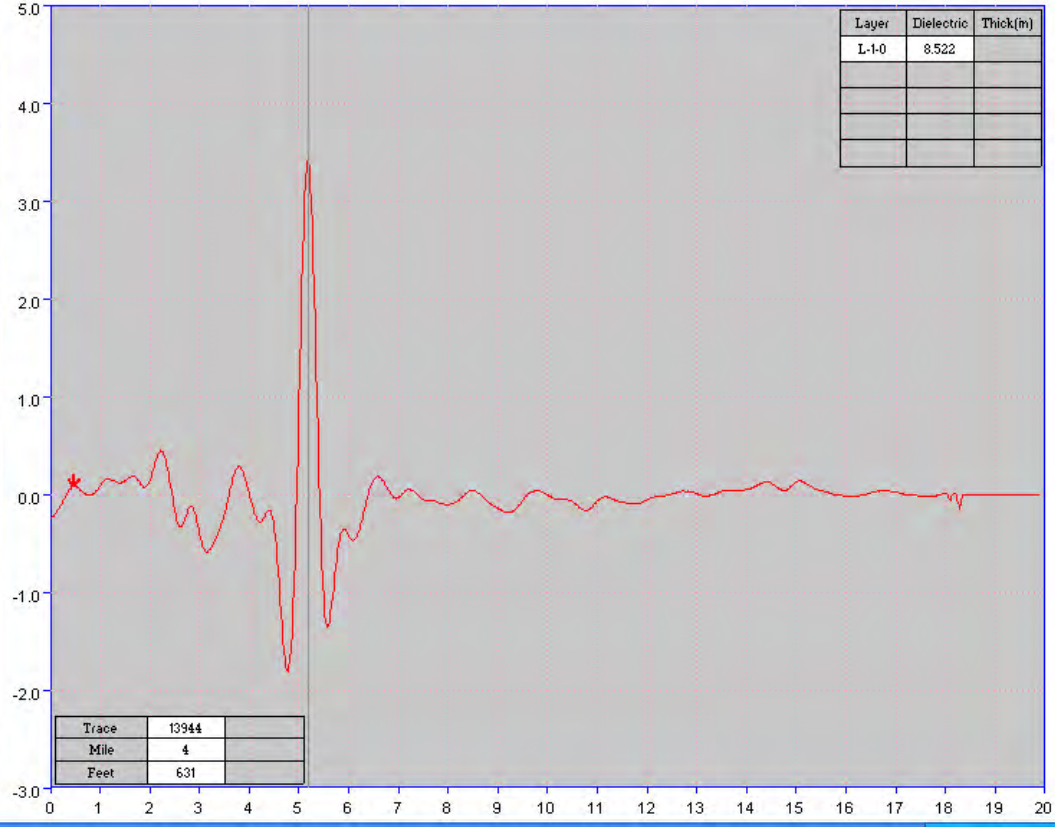


GPS: Lat: 29.77752716 Log: 95.42213216 (Lat:(N) 29:46:39.0978 Log:(W) 95:25:19.6758

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

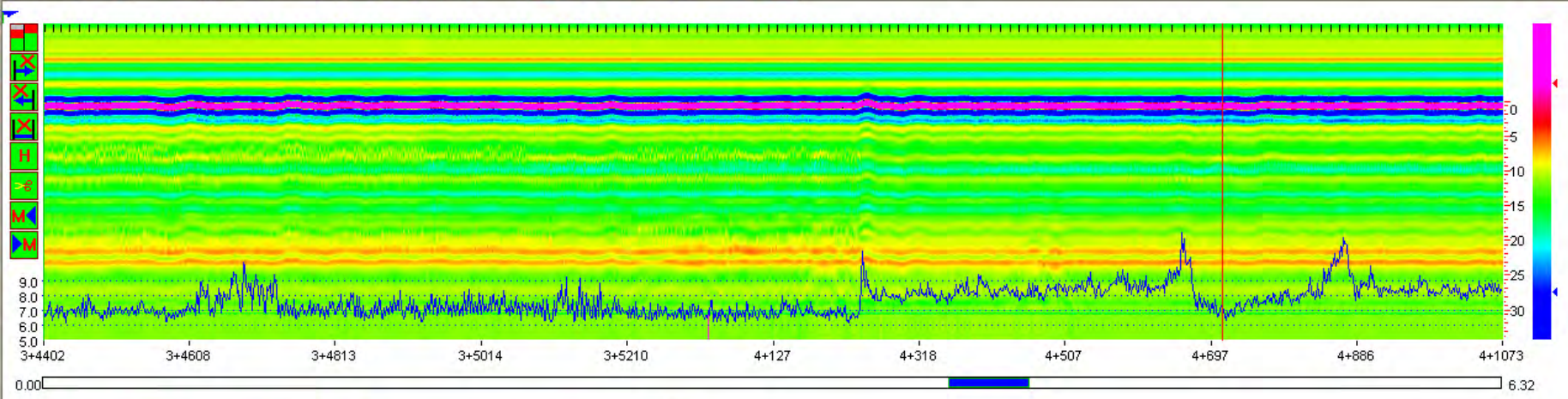


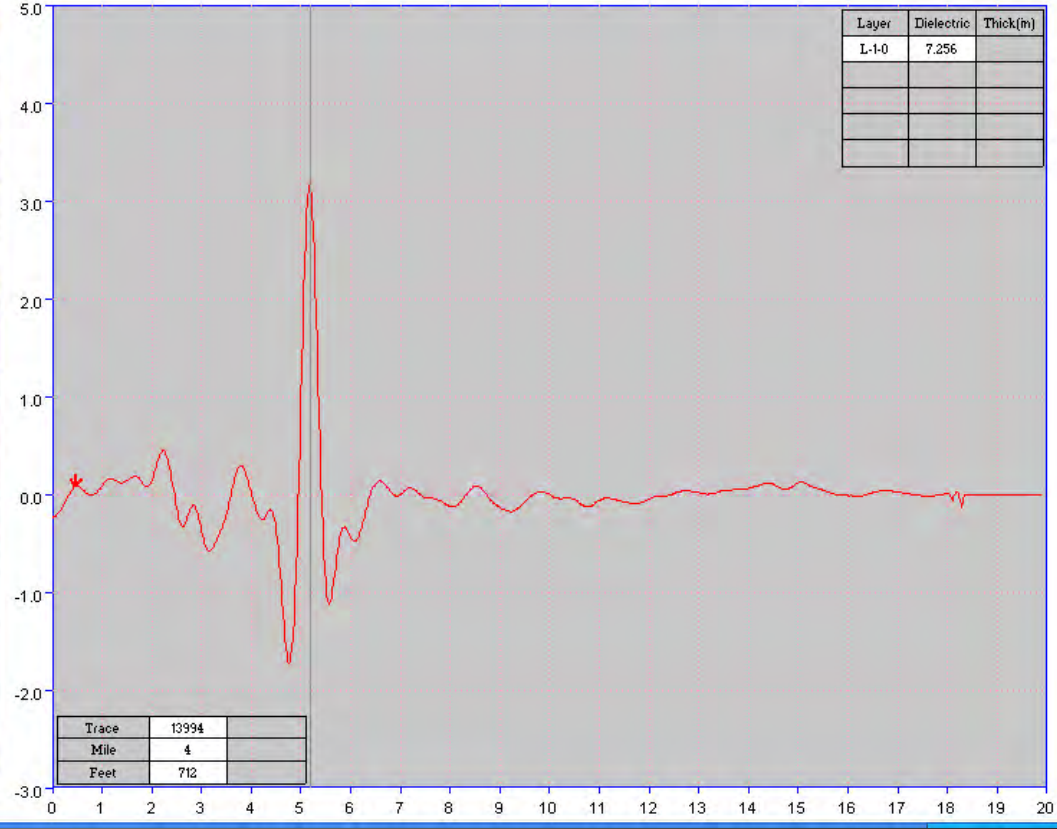


GPS: Lat: 29.77752225 Log: 95.42237725 (Lat:(N) 29:46:39.0801 Log:(W) 95:25:20.5581

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

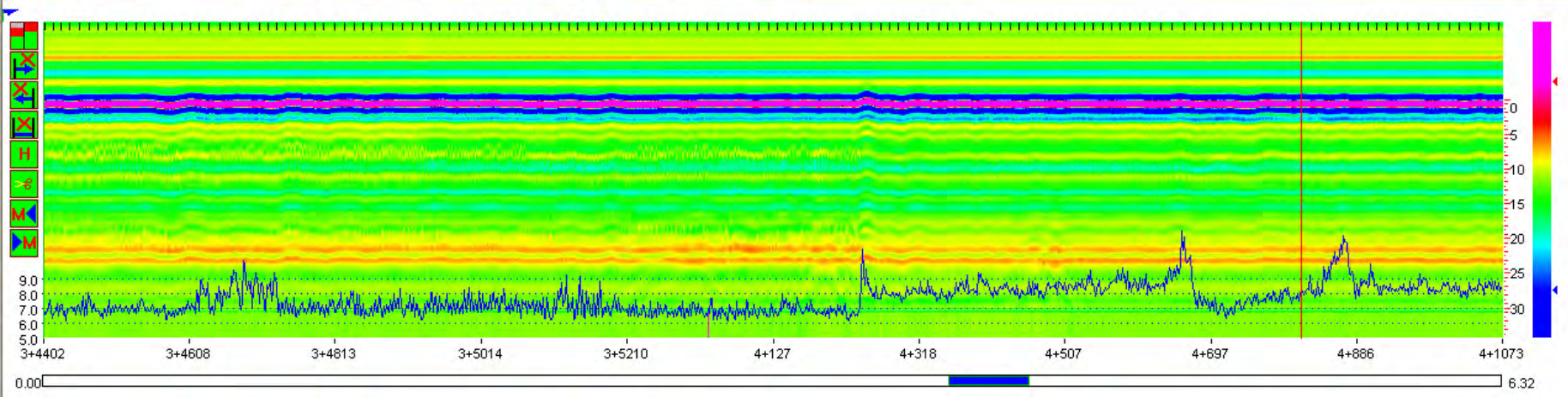


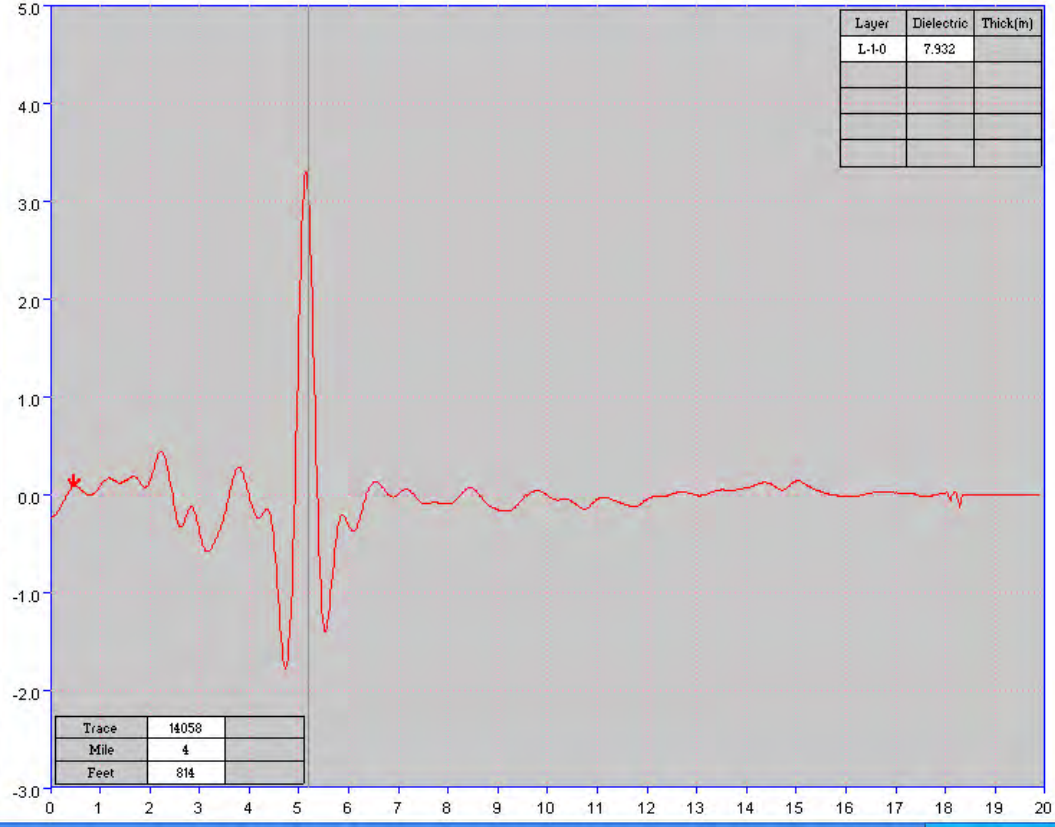


GPS: Lat: 29.77751590 Log: 95.42269363 (Lat:(N) 29:46:39.0572 Log:(W) 95:25:21.6971

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

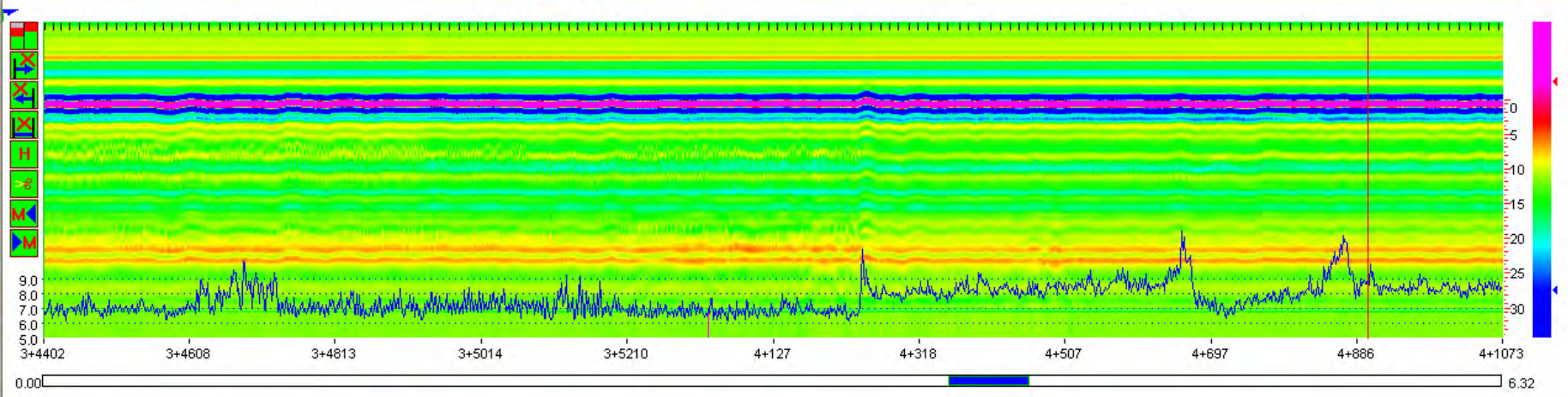


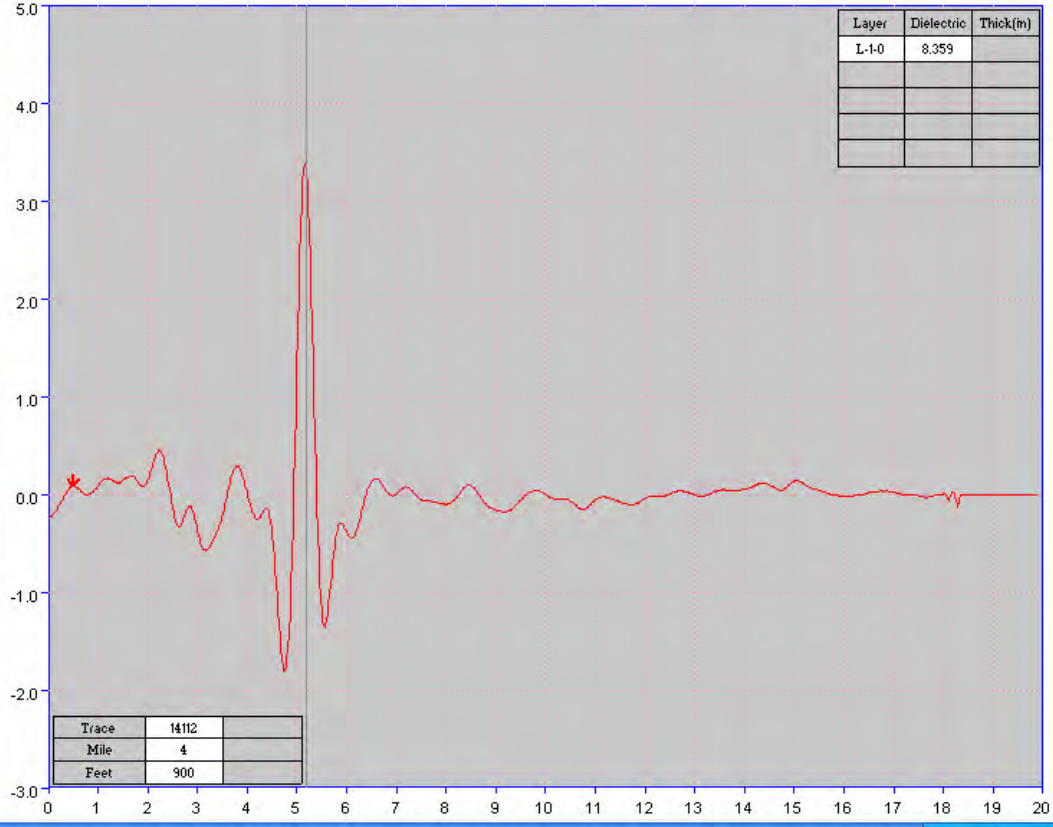


GPS: Lat: 29.77750923 Log: 95.42295468 (Lat:(N) 29:46:39.0332 Log:(W) 95:25:22.6368

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

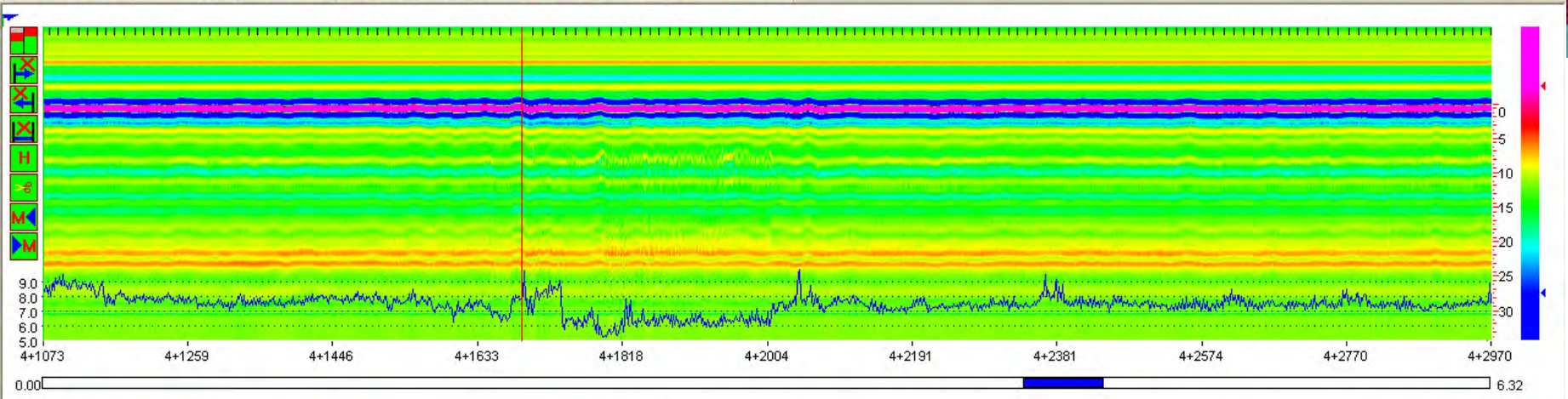


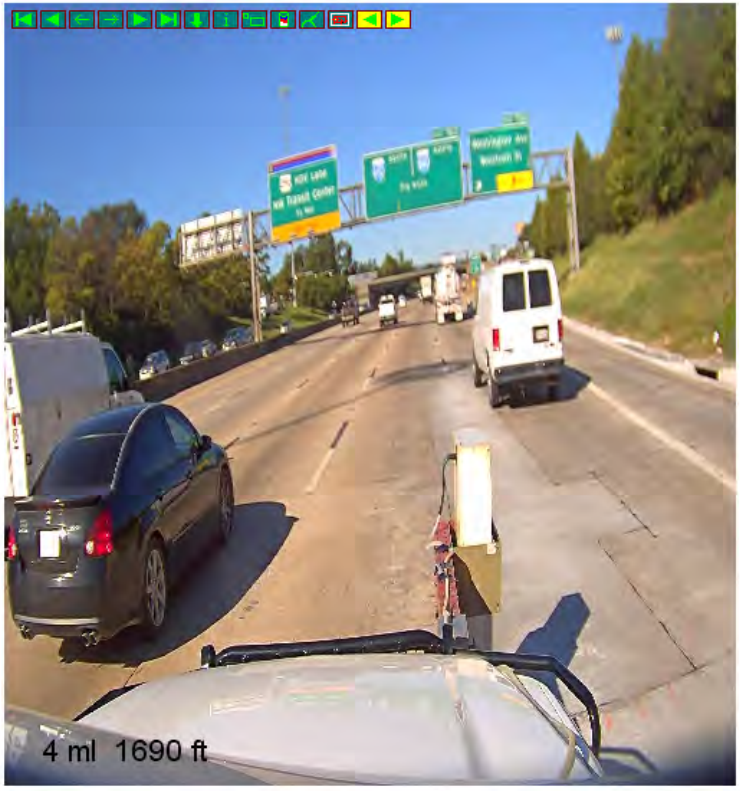


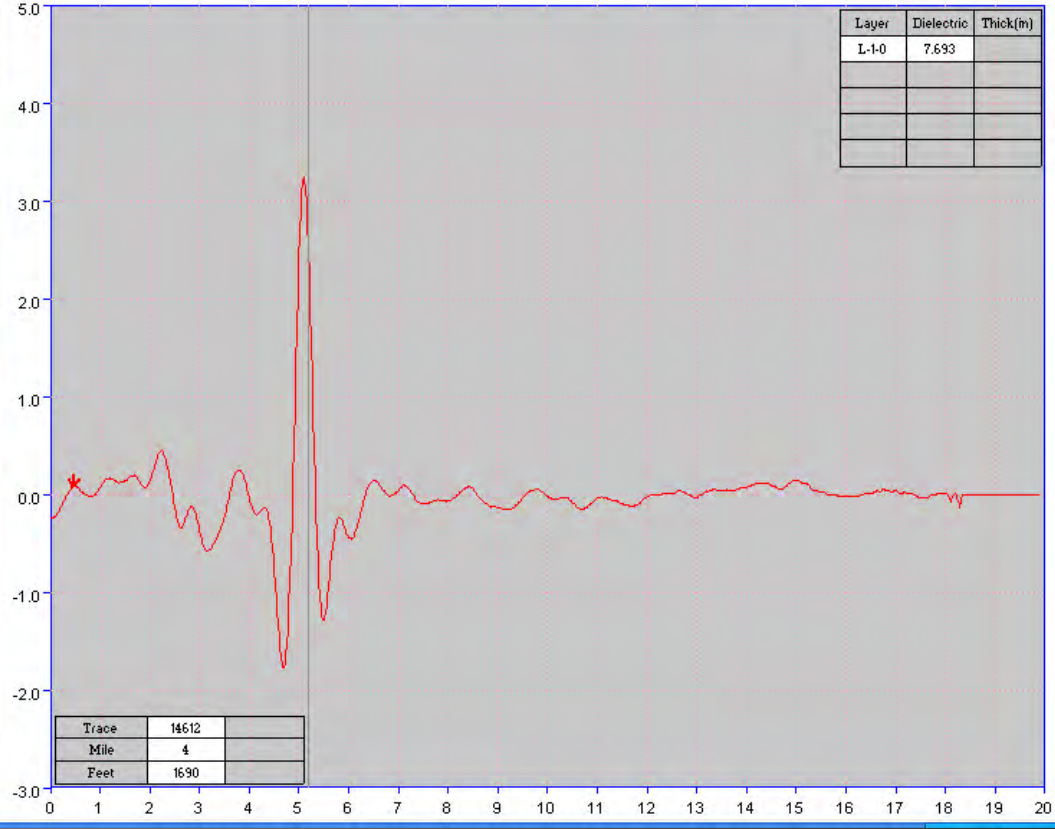
GPS: Lat: 29.77746752 Log: 95.42538340 (Lat:(N) 29:46:38.8831 Log:(W) 95:25:31.3802

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



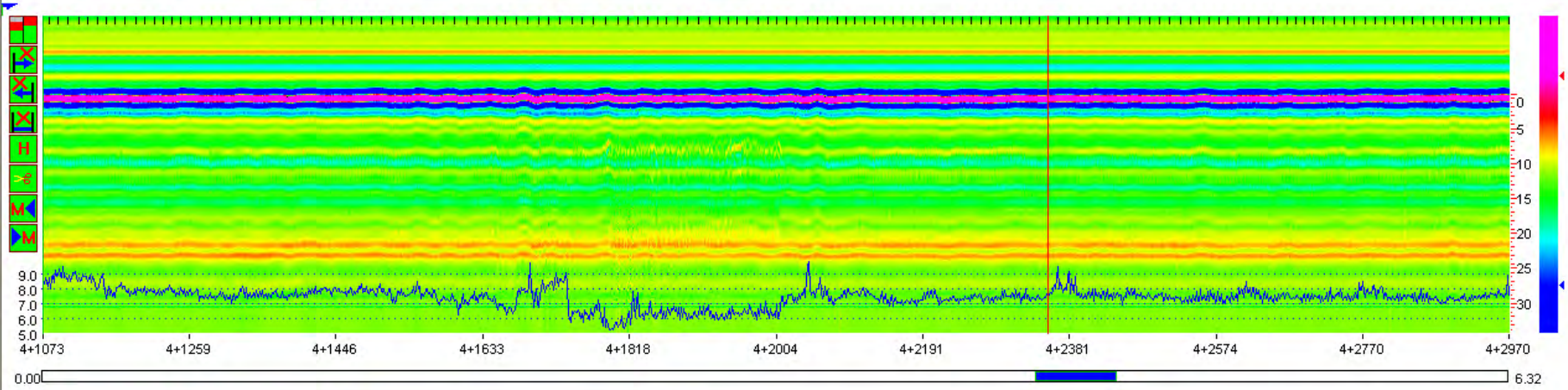


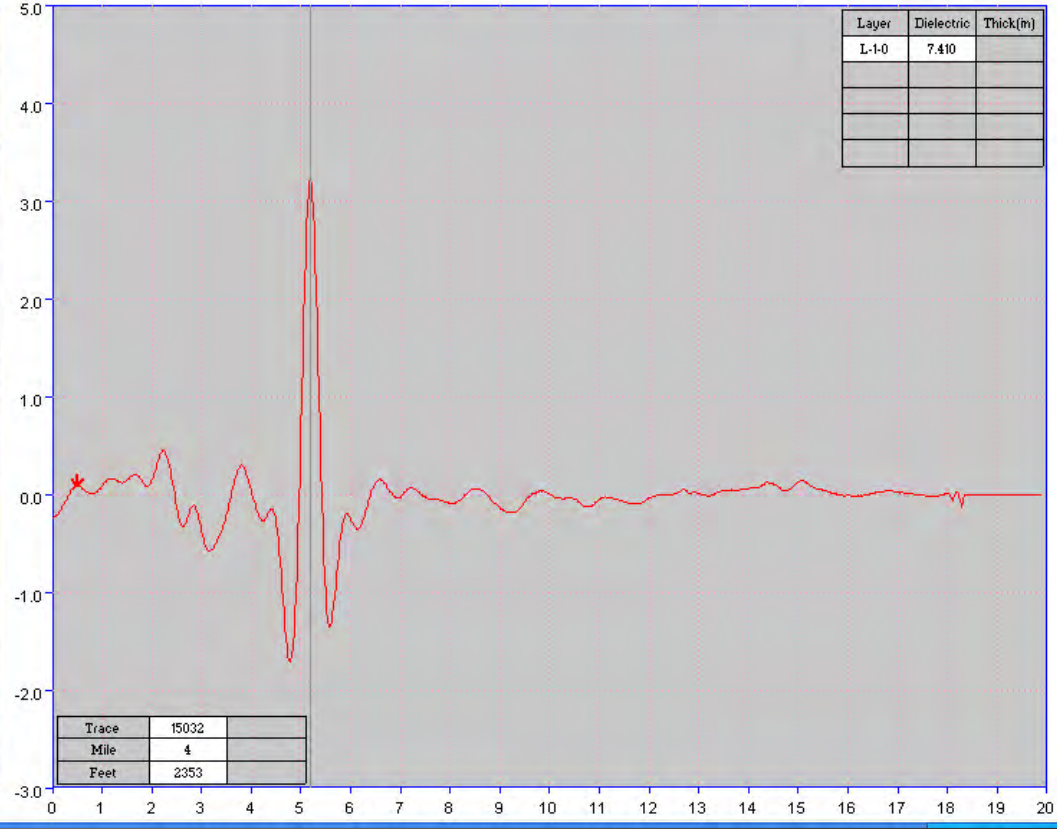


GPS: Lat: 29.77752207 Log: 95.42741163 (Lat:(N) 29:46:39.0794 Log:(W) 95:25:38.6819

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

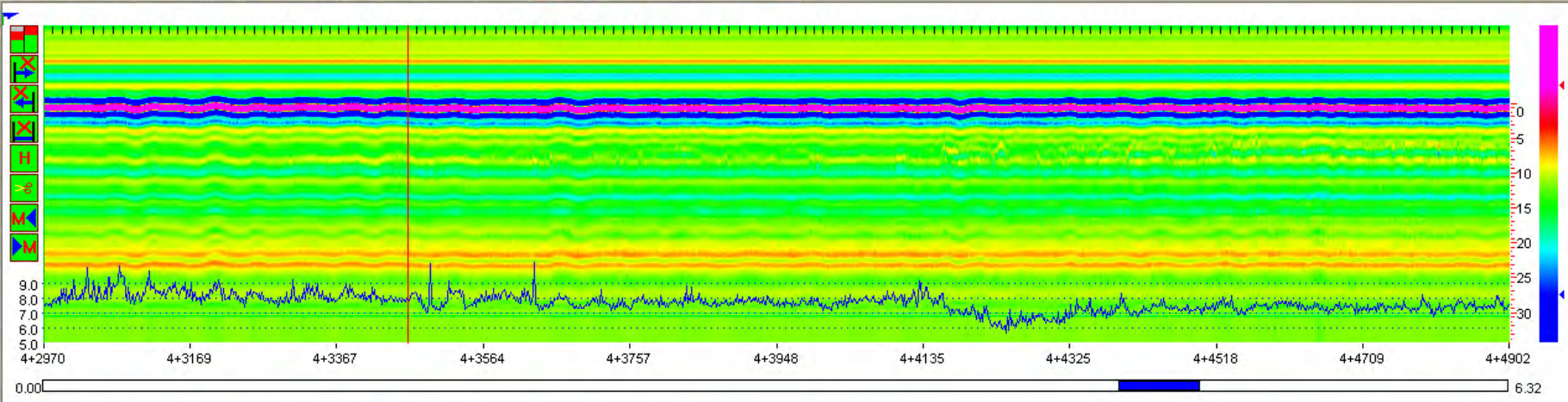


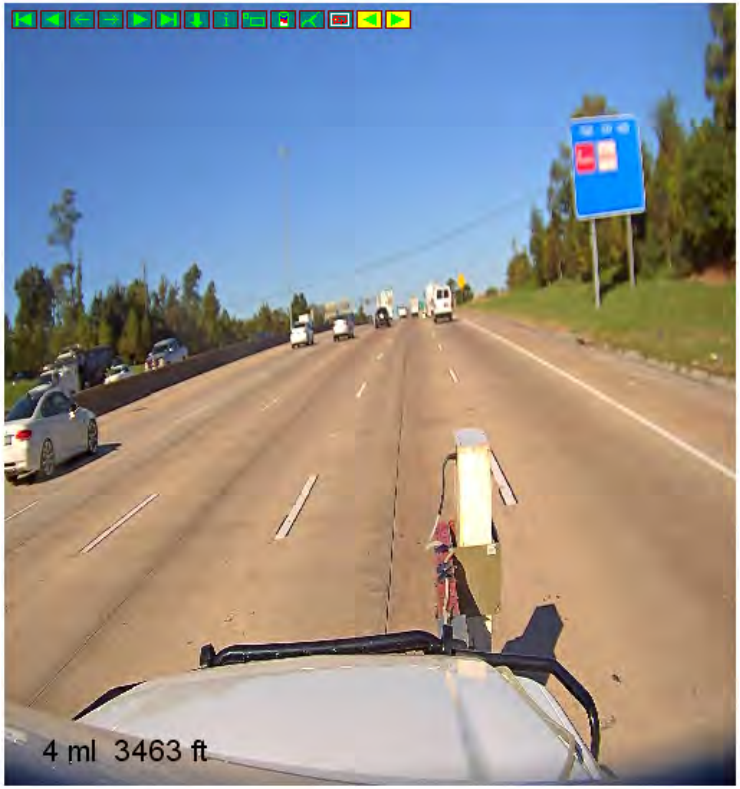


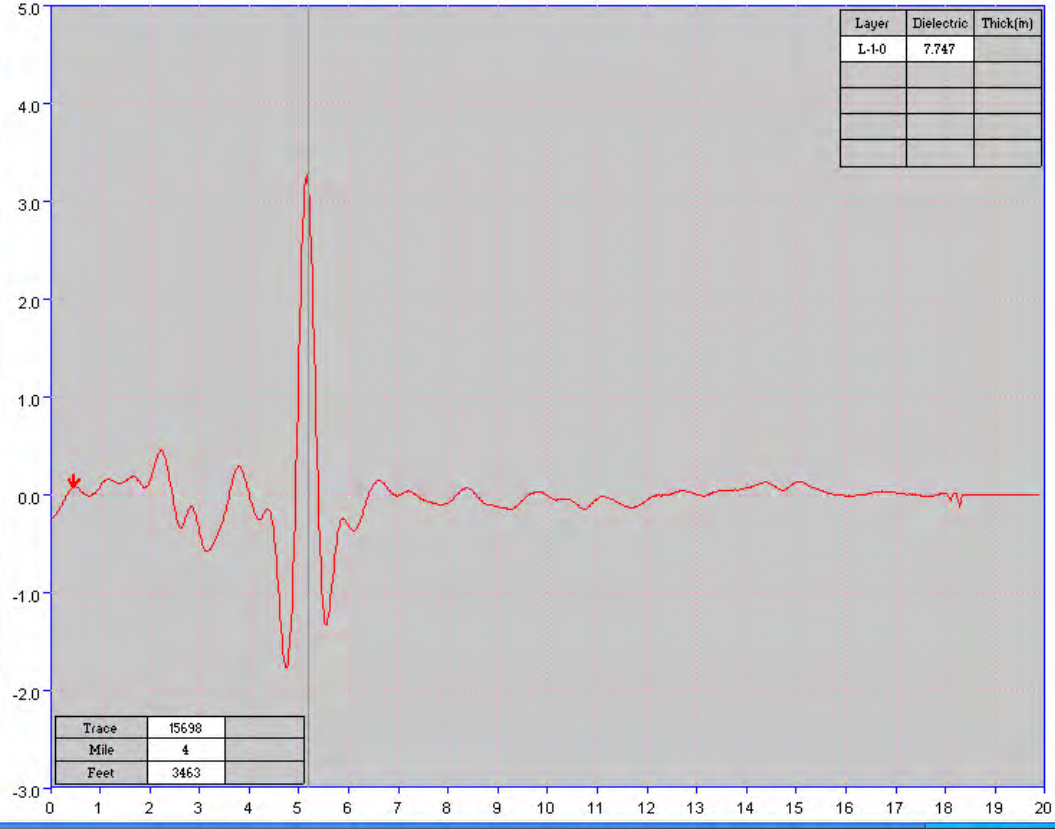
GPS: Lat: 29.77785453 Log: 95.43080160 (Lat:(N) 29:46:40.2763 Log:(W) 95:25:50.8858

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080



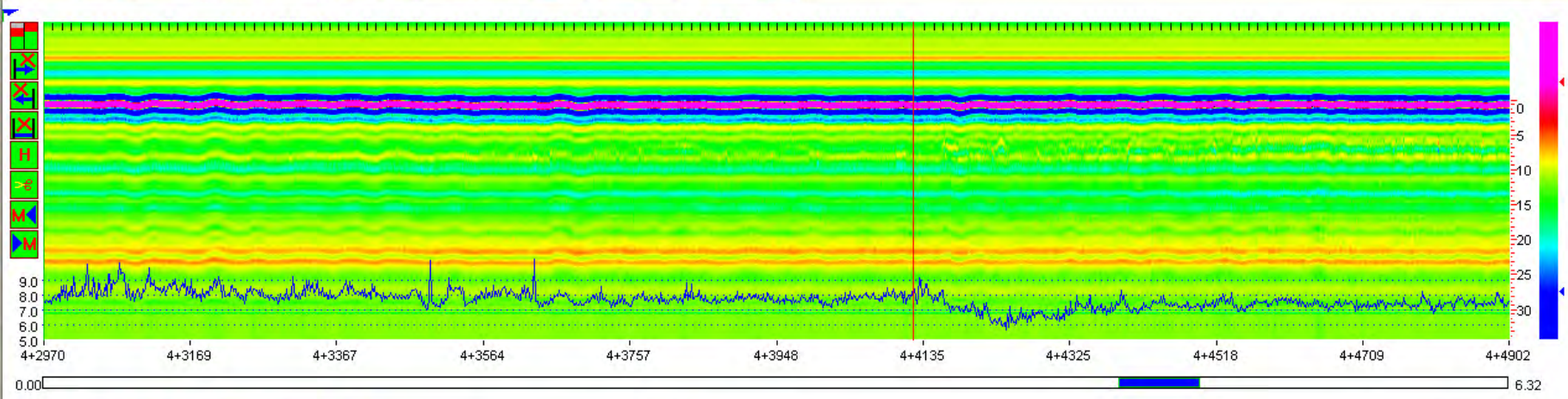


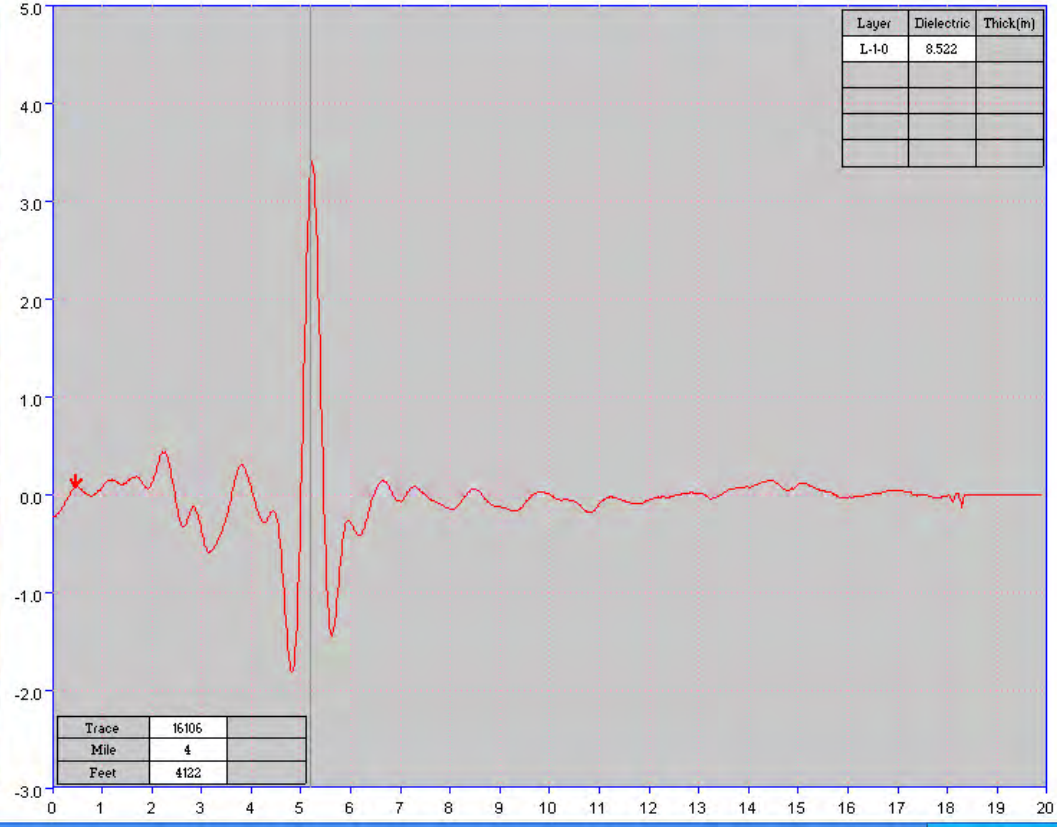


GPS: Lat: 29.77811147 Log: 95.43306415 (Lat:(N) 29:46:41.2013 Log:(W) 95:25:59.0309

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

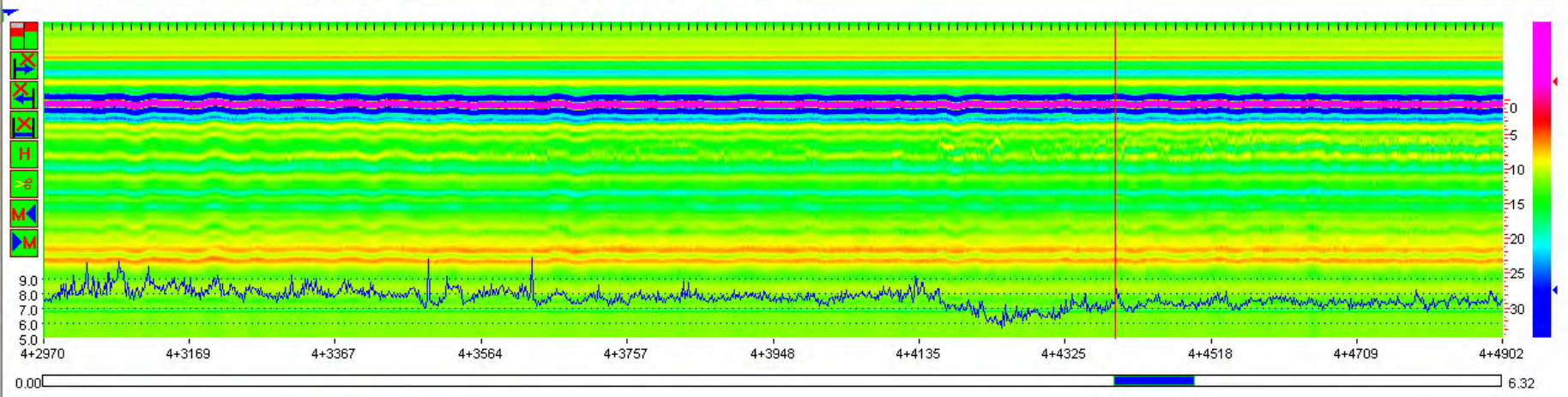


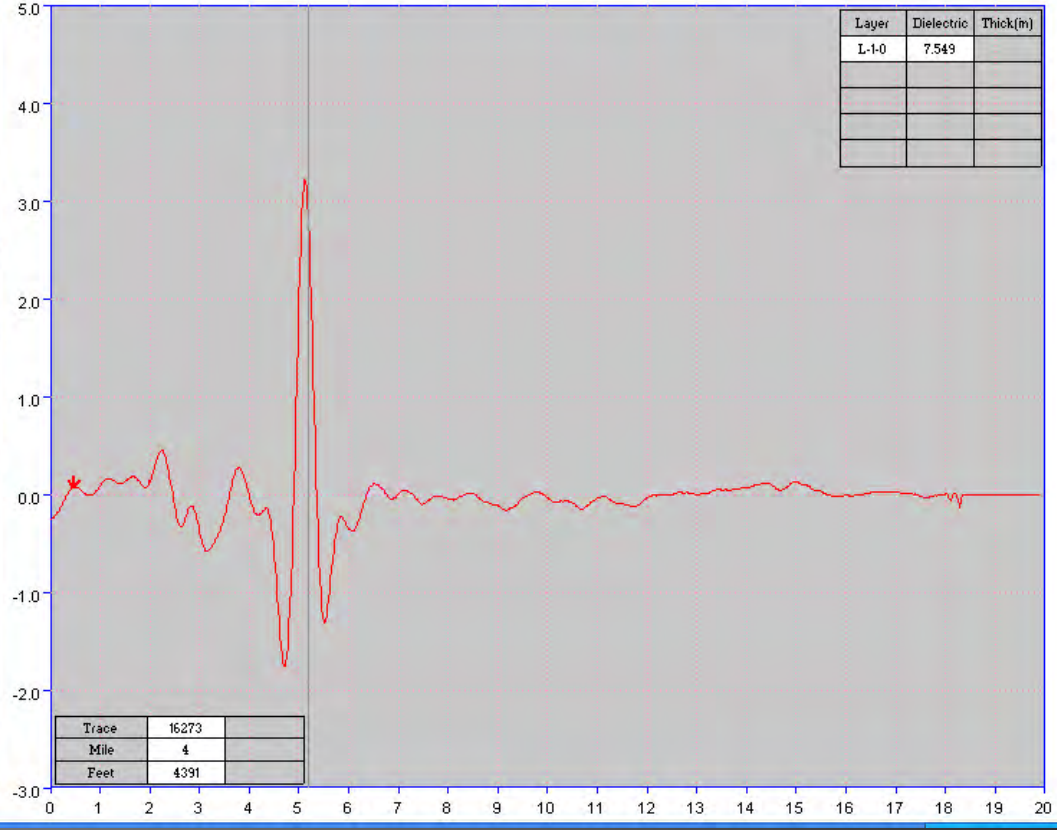


GPS: Lat: 29.77819500 Log: 95.43374667 (Lat:(N) 29:46:41.5020 Log:(W) 95:26: 1.4880

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

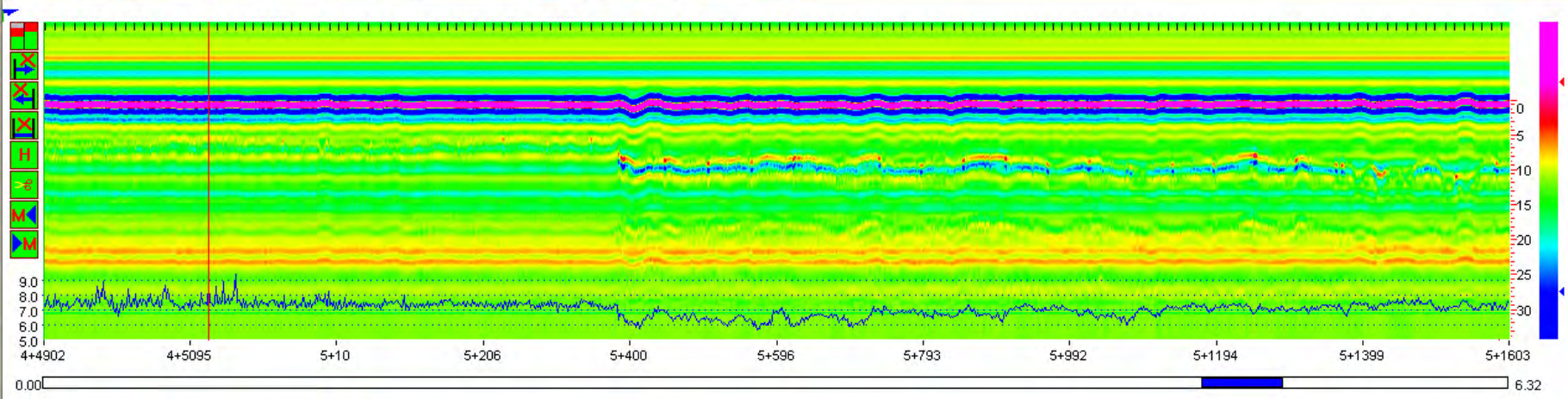


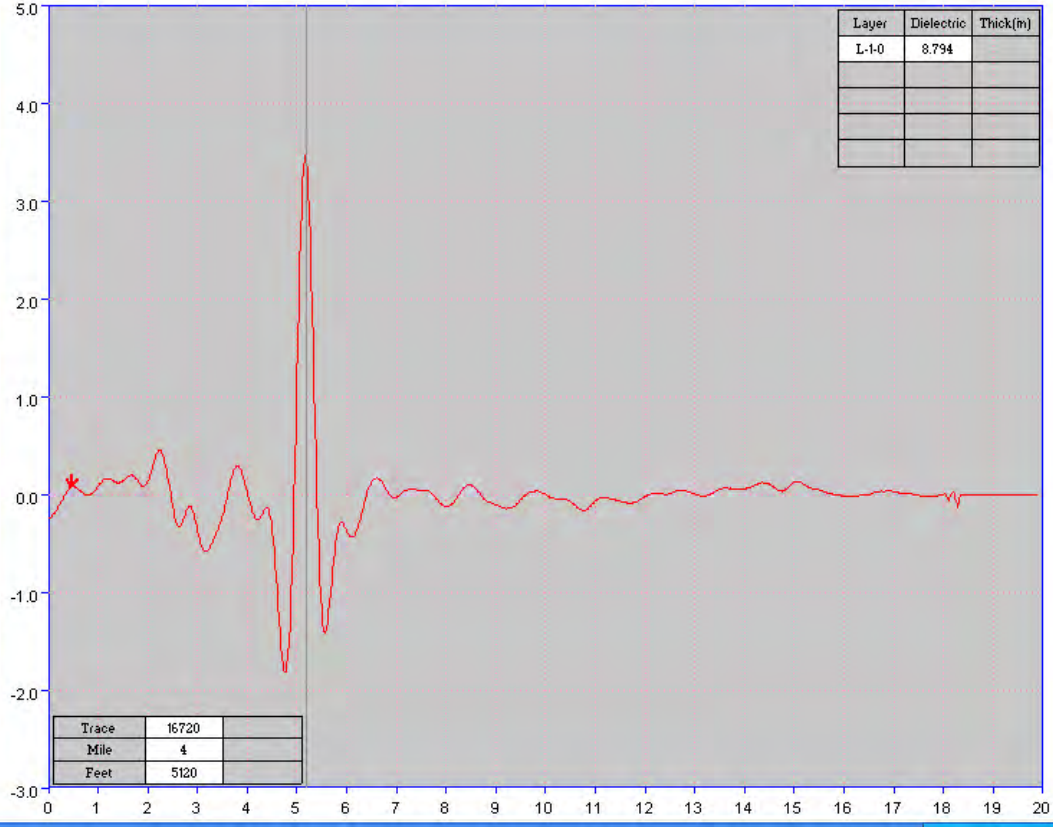


GPS: Lat: 29.77845111 Log: 95.43608778 (Lat:(N) 29:46:42.4240 Log:(W) 95:26: 9.9160

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

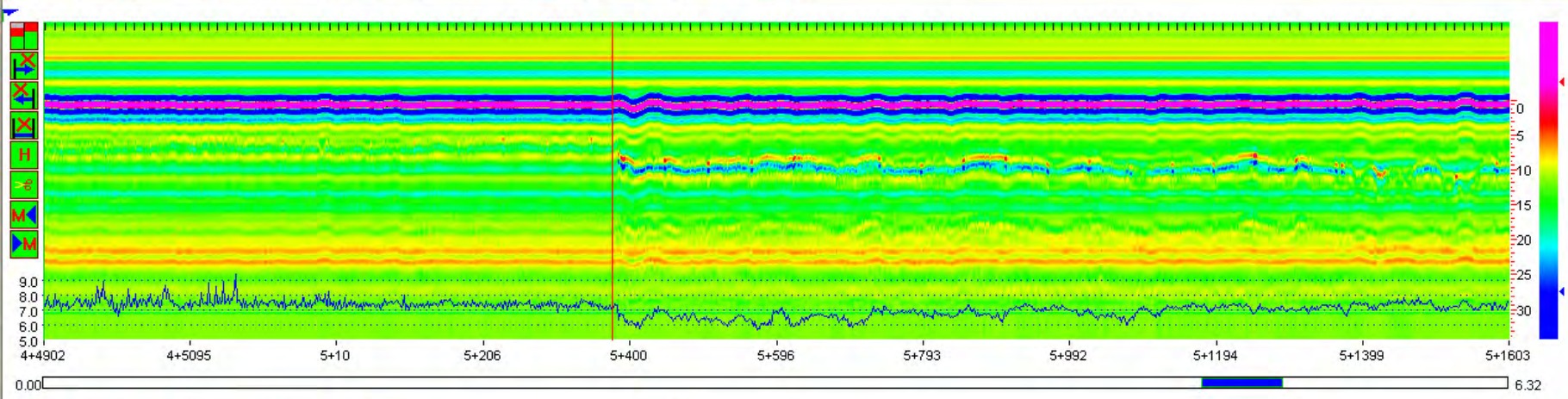


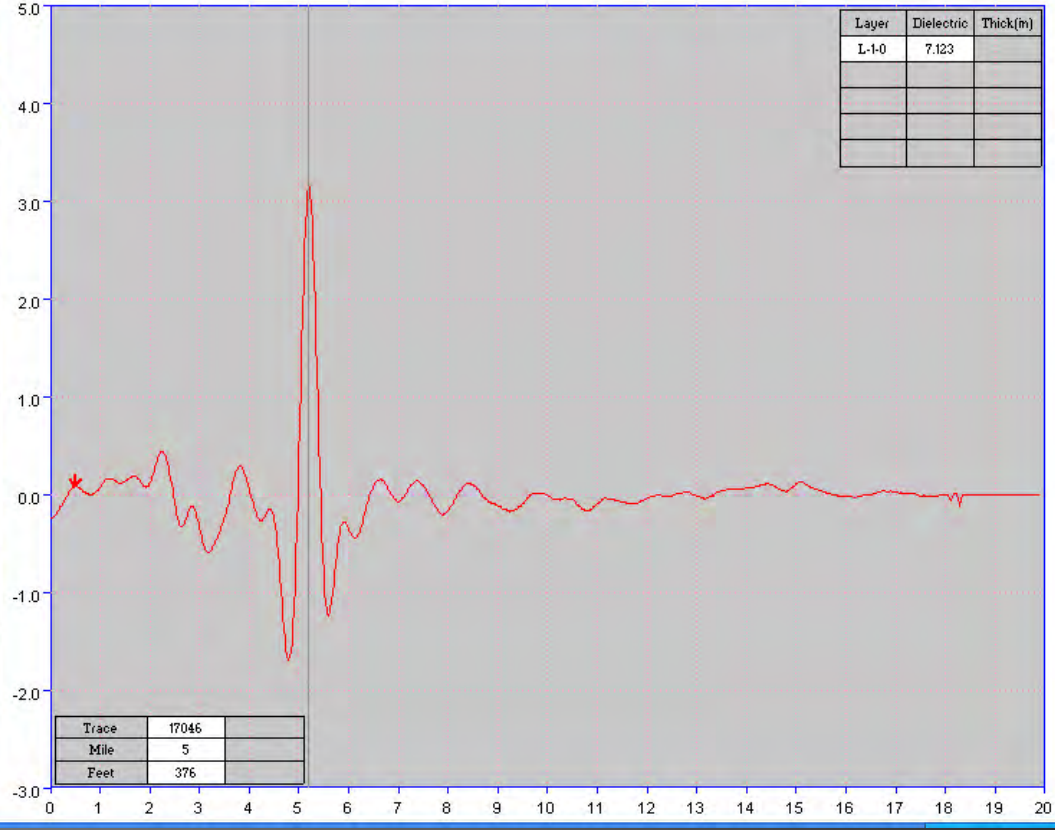


GPS: Lat: 29.77862820 Log: 95.43771876 (Lat:(N) 29:46:43.0615 Log:(W) 95:26:15.7875

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

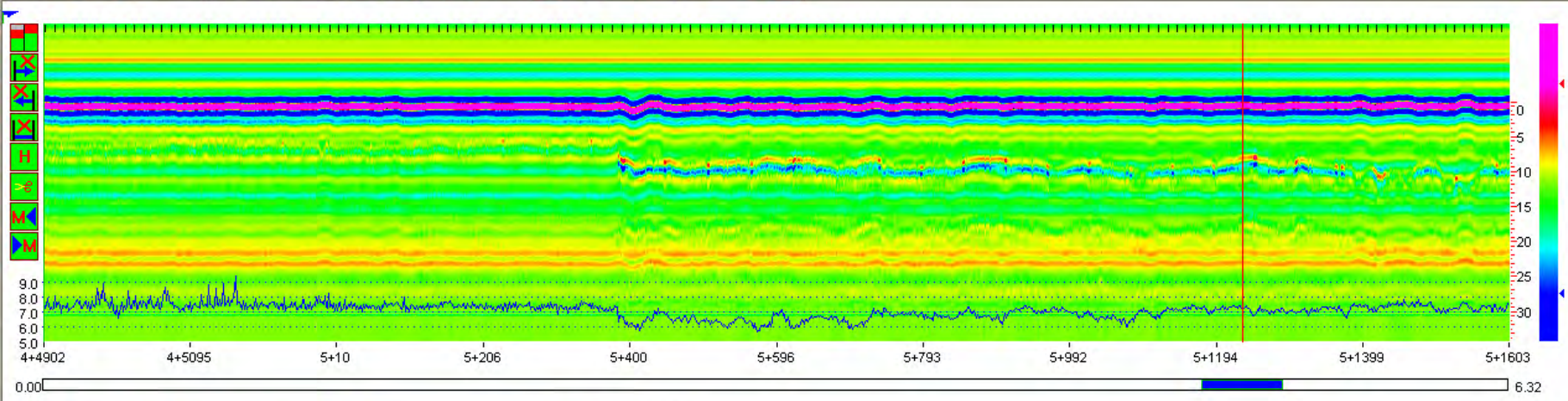


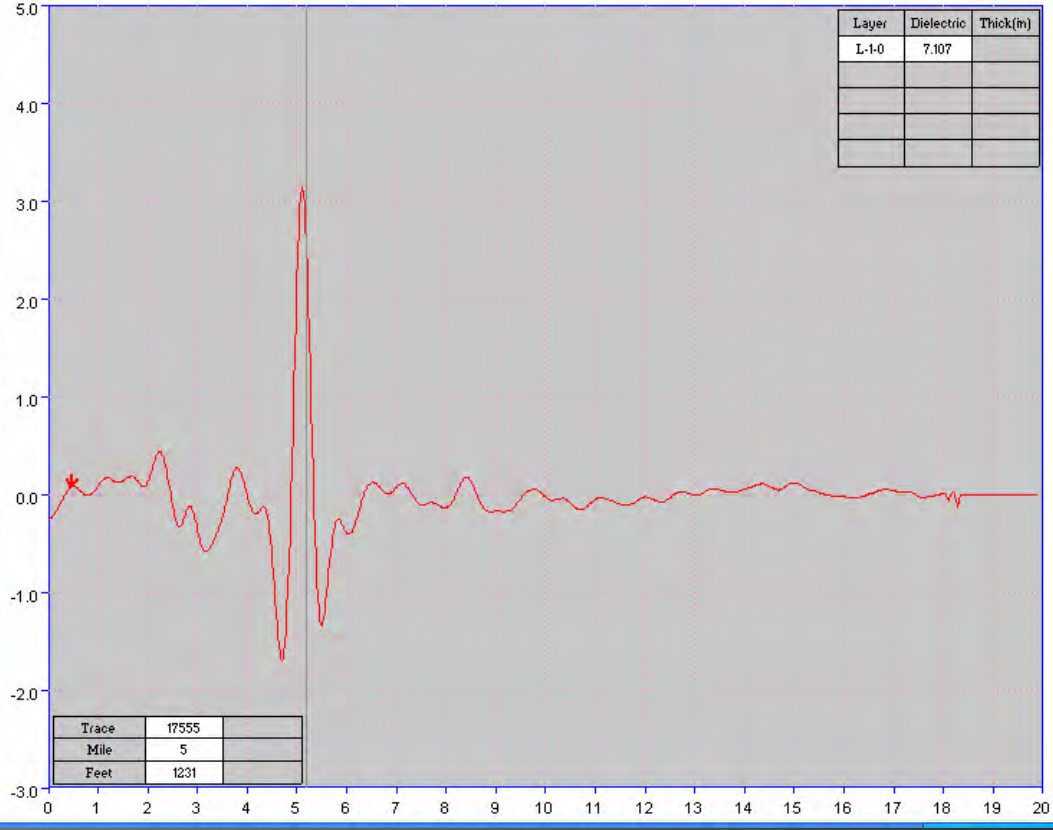


GPS: Lat: 29.77893092 Log: 95.44030487 (Lat:(N) 29:46:44.1513 Log:(W) 95:26:25.0975

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

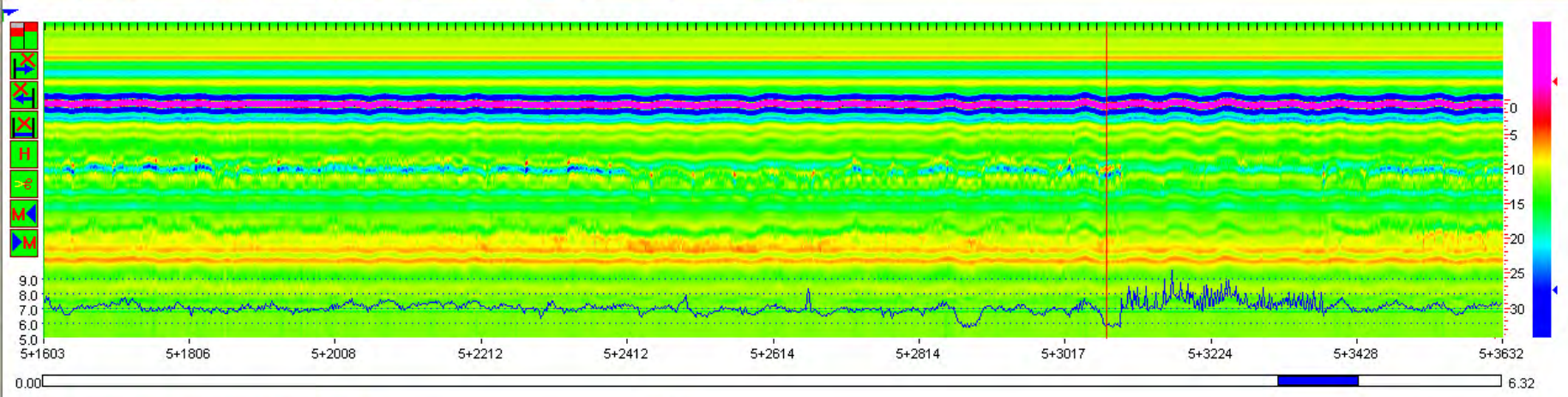


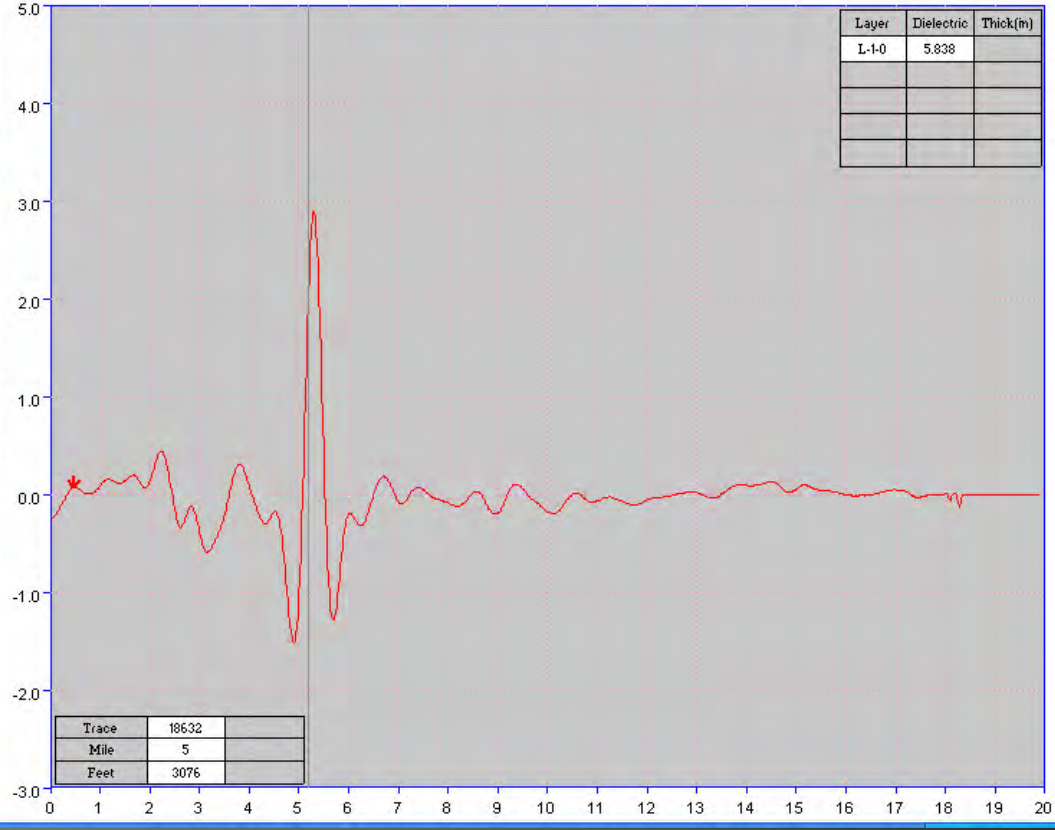


GPS: Lat: 29.77927833 Log: 95.44595892 (Lat:(N) 29:46:45.4020 Log:(W) 95:26:45.4521

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

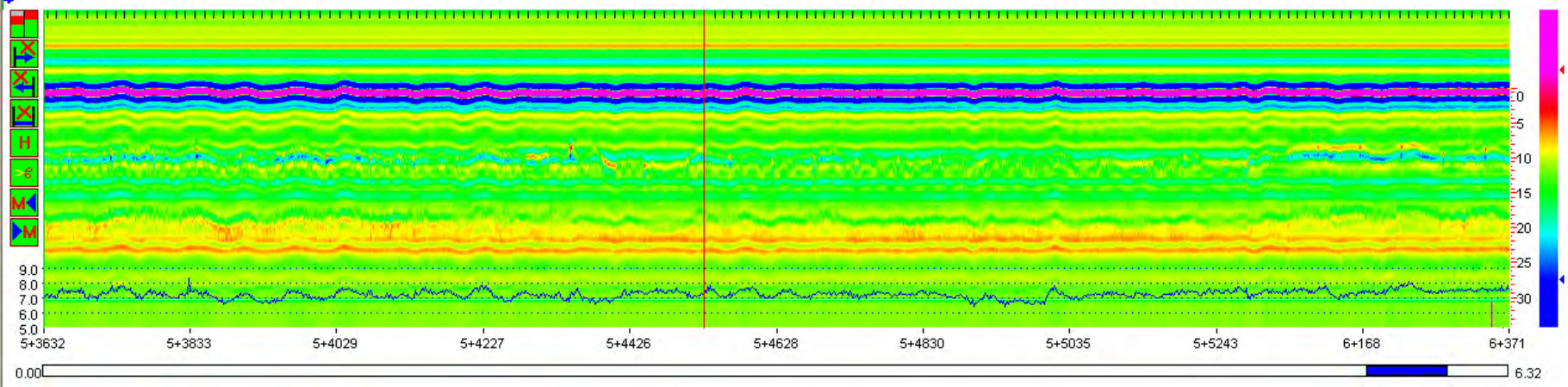


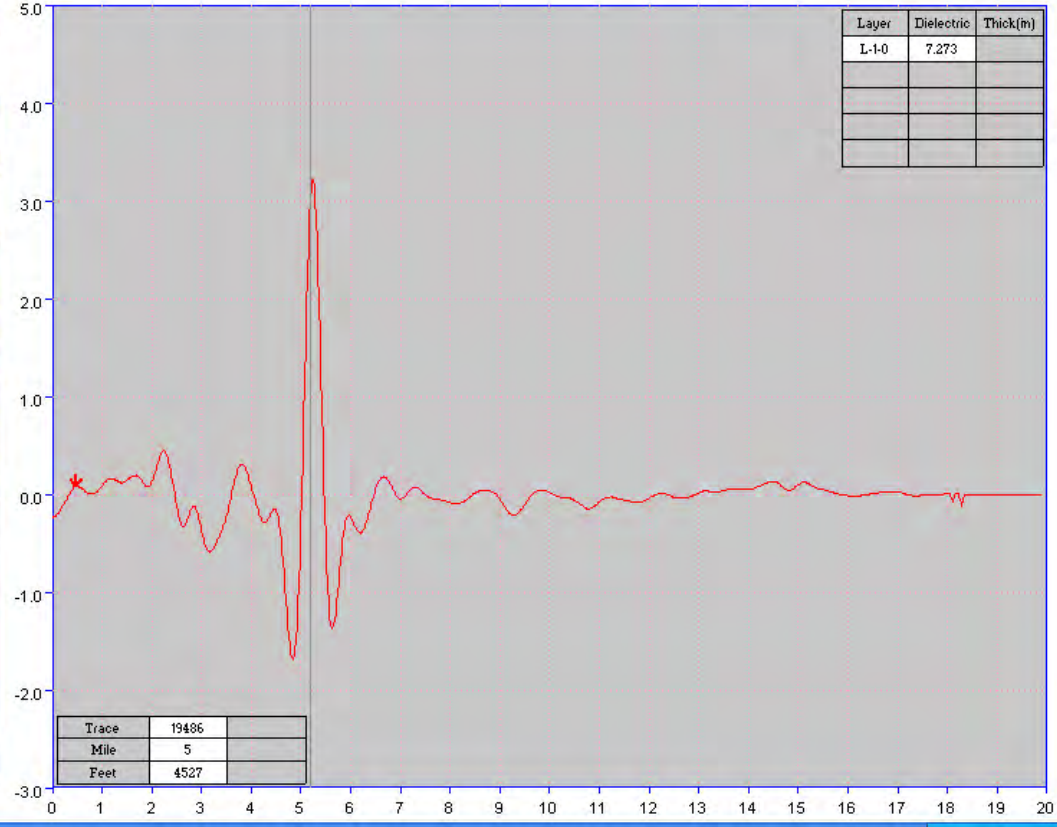


GPS: Lat: 29.77940833 Log: 95.45063098 (Lat:(N) 29:46:45.8700 Log:(W) 95:27: 2.2715

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

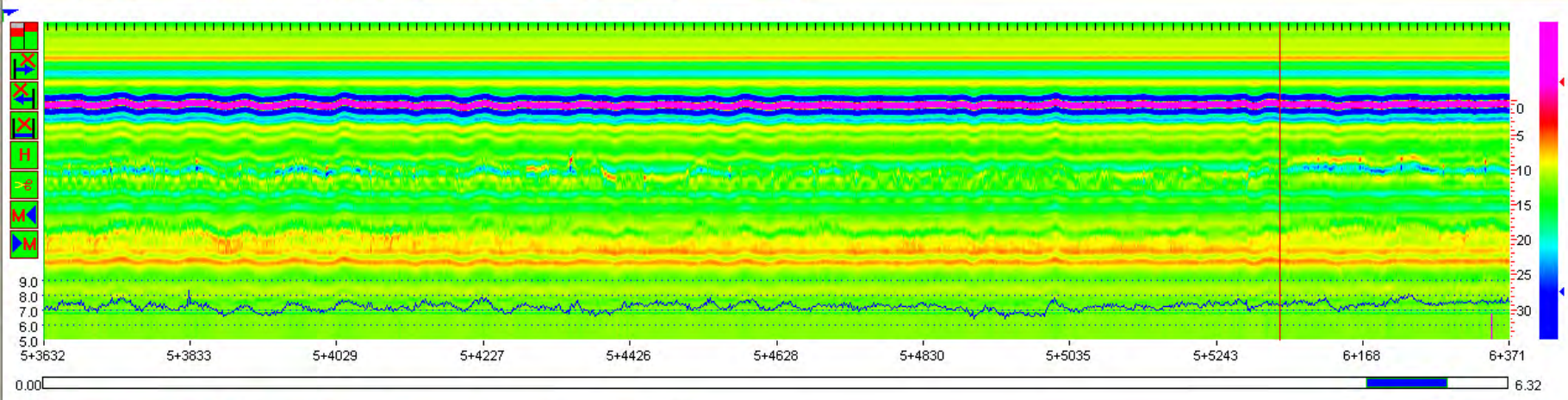


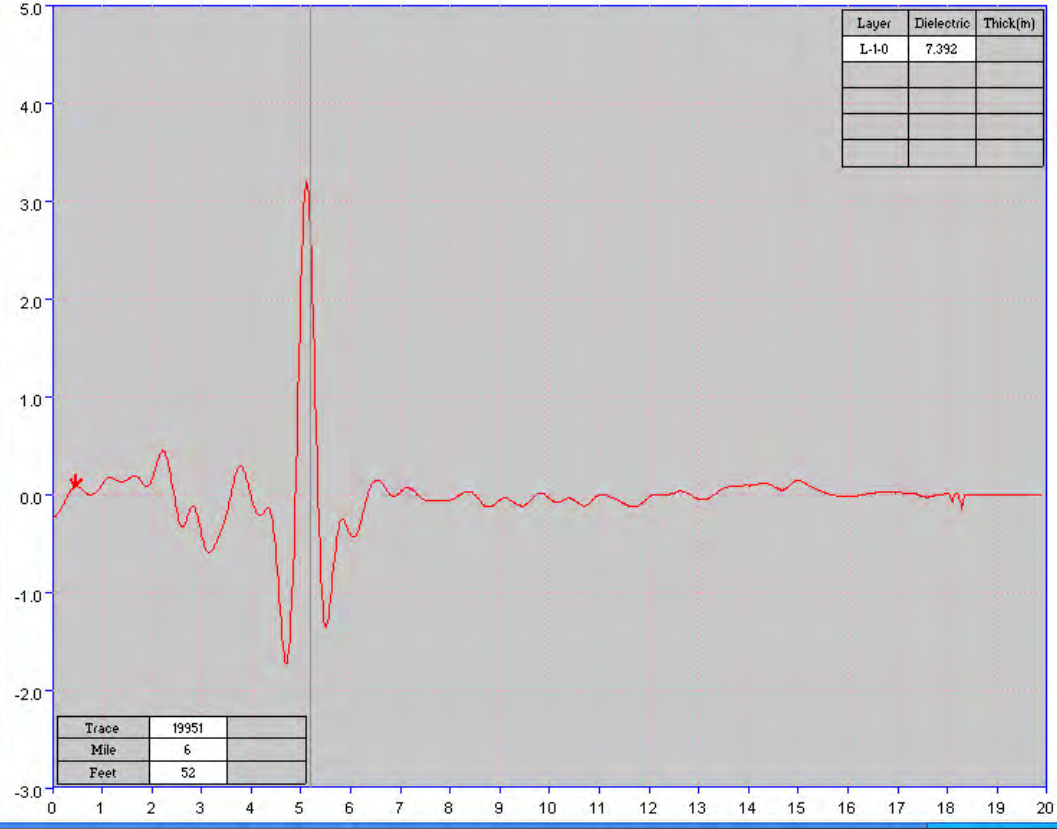


GPS: Lat: 29.78027190 Log: 95.45291523 (Lat:(N) 29:46:48.9788 Log:(W) 95:27:10.4948

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

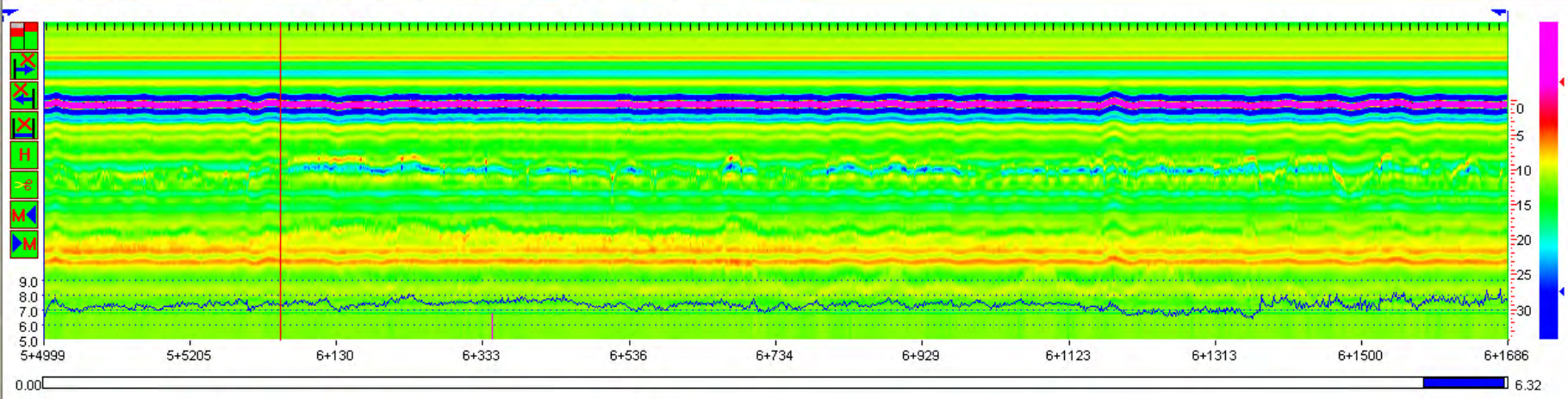


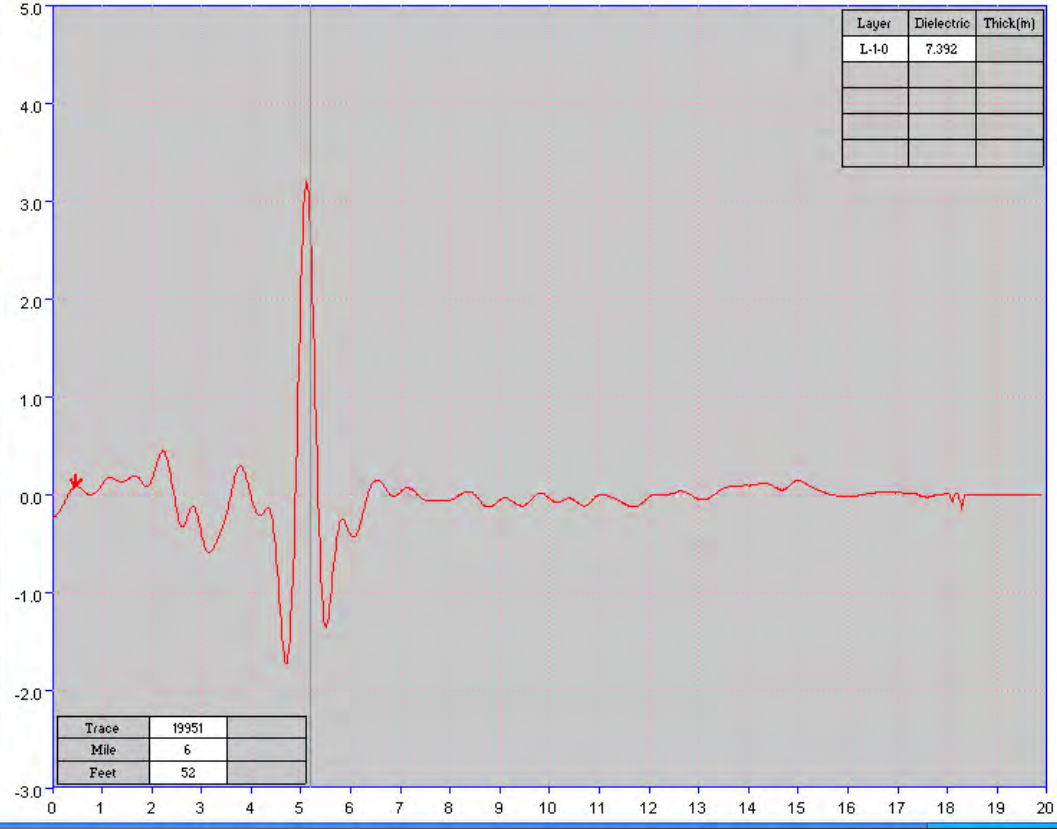


GPS: Lat: 29.78027190 Log: 95.45291523 (Lat:(N) 29:46:48.9788 Log:(W) 95:27:10.4948

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080

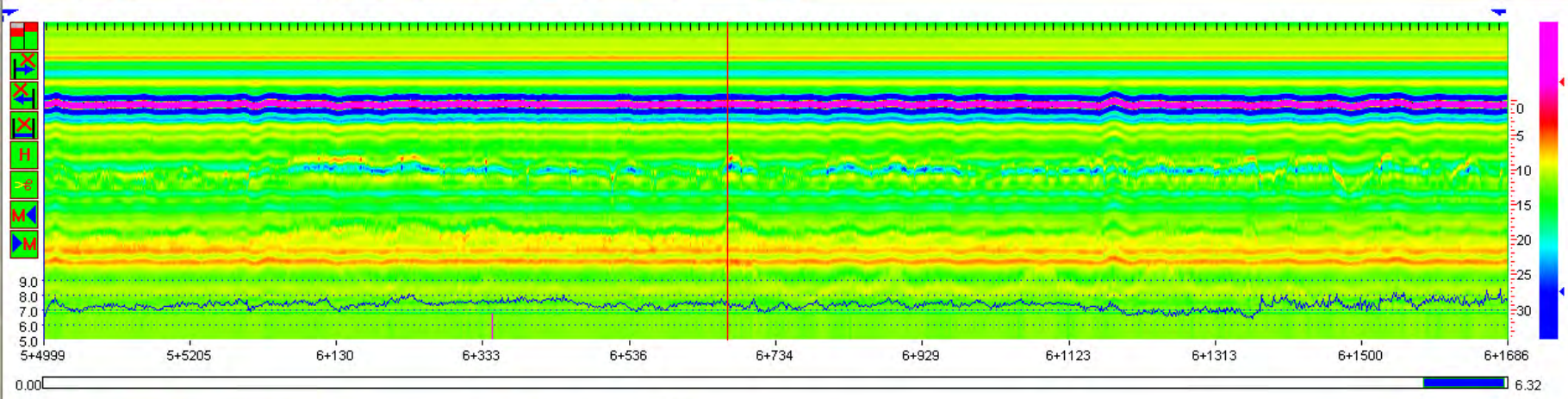


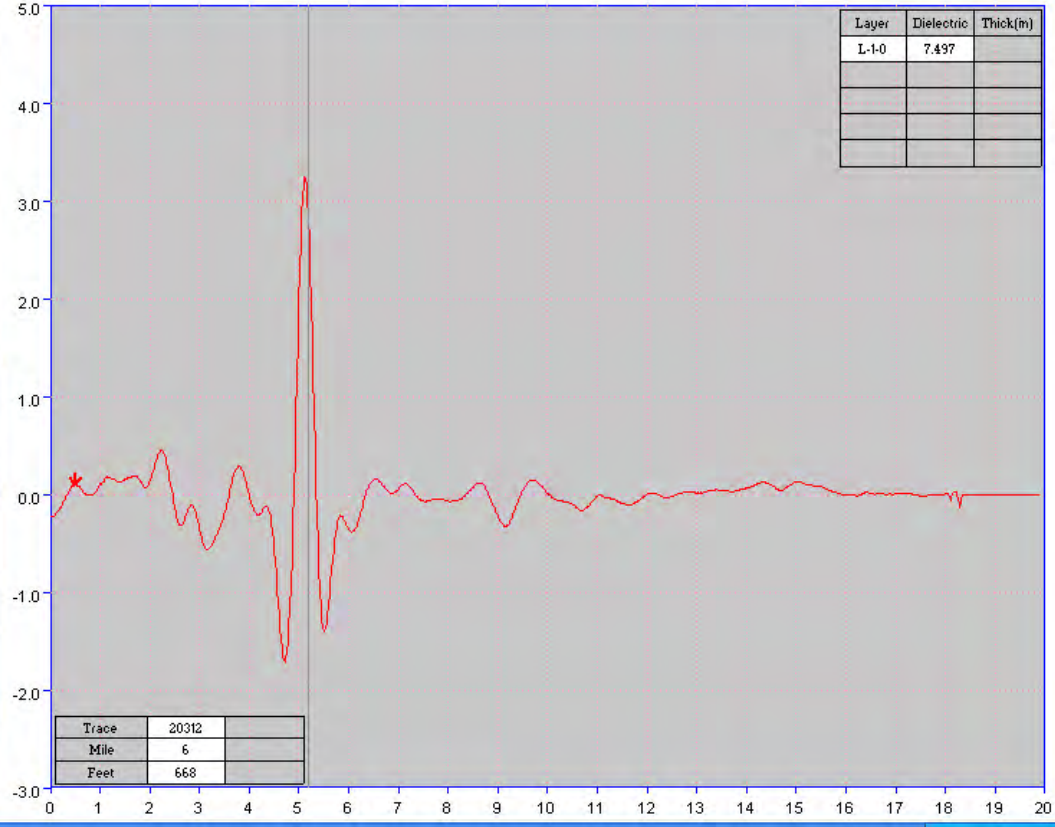


GPS: Lat: 29.78127304 Log: 95.45443343 (Lat:(N) 29:46:52.5829 Log:(W) 95:27:15.9604

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | ih10wb.PRJ.txt | ih10wb.DAT | GPR:20943 VID:2593 GPS:414 FWD:0 RDD:0 | 0.00 to 6.3 | V:6.0196 B: 1.5313 | T:10-16-2017(08:57:08) | C: 4/2/2016(| 1920X1080





MONTROSE
Escape The Room Texas
Weights + Measures
MIDTOWN
EAST DOWNTOWN
Houston Community College
Trader Joe's
The Menil Collection
Rothko Chapel
Academy Sports + Outdoors
Consulate General of Mexico
BOULEVARD OAKS
MUSEUM PARK
GREATER THIRD WARD
Museum of Fine Arts, Houston
Children's Museum of Houston
Texas Southern University
Blaffer Art Museum
THAMPTON
Houston Museum of Natural Science
Rice University
Hermann Park
Houston Zoo
University of Houston
SOUTH CENTRAL HOUSTON
TEXAS MEDICAL CENTER
MACGREGOR
RIVERSIDE TERRACE
Michael E. DeBakey VA Medical Center
The Woman's Hospital of Texas
SOUTH SIDE
NRG Arena
GRIDIRON
Gulf Fwy
South Fwy
Old Spanish Trail
Holcombe Blvd
Yellowstone Blvd
S Loop E Fwy
Google

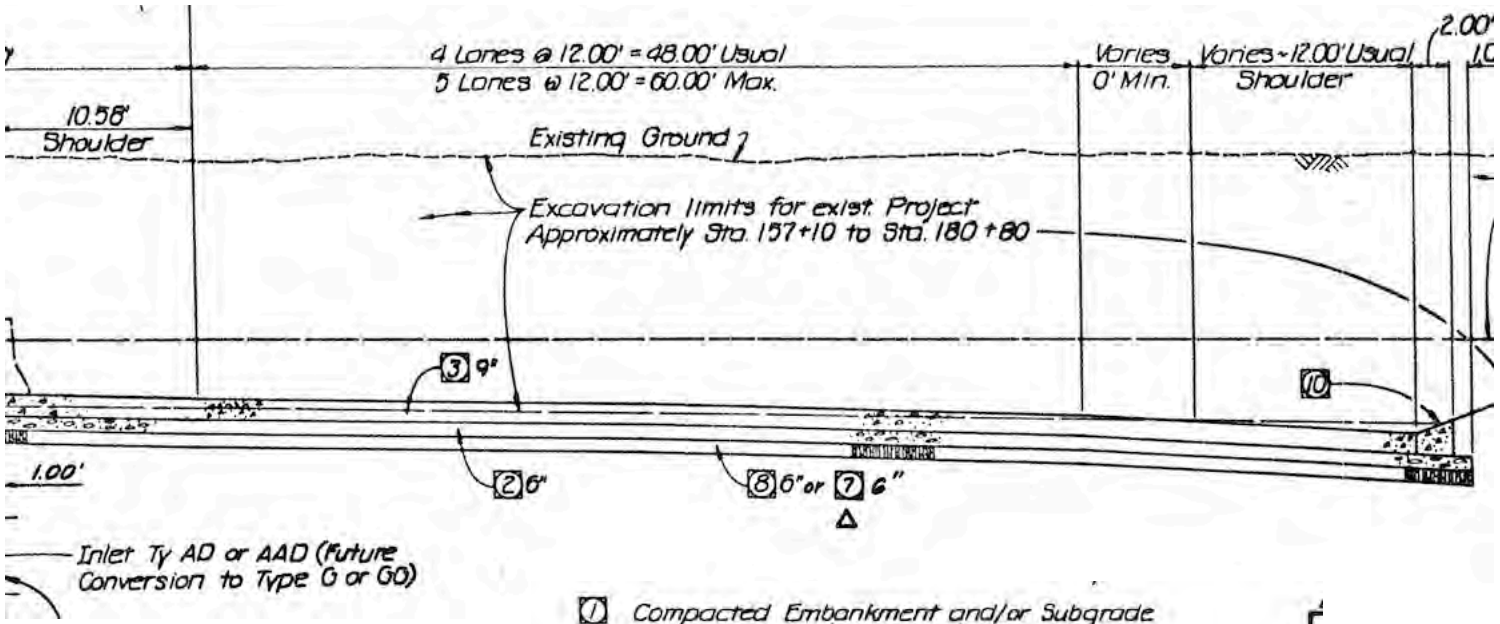
SH 288

SH 288 from Southmore to Yellowstone

- MacGregor to Yellowstone opened around 1983
- Southmore to MacGregor opened around 1984
- Expected to perform for about 7 million 18KESALs according to the 1993 AASHTO rigid pavement design procedure using TxDOT's recommended inputs.
- Estimated 22 million 18KESALS have travelled on SH 288 in the design lane from 1983 to 2016.
  - Same pavement is on its 4th life!
  - 2016 two way ADT of 145,504 with 9.4% trucks
  - For comparison, IH 10 near UTSA and FM 1604 has a 2016 two way ADT of 149,420 with 4.7% trucks
  - Would take almost twice as long in San Antonio to reach the same traffic loading condition as SH288 in Houston

SH 288 from Southmore to MacGregor

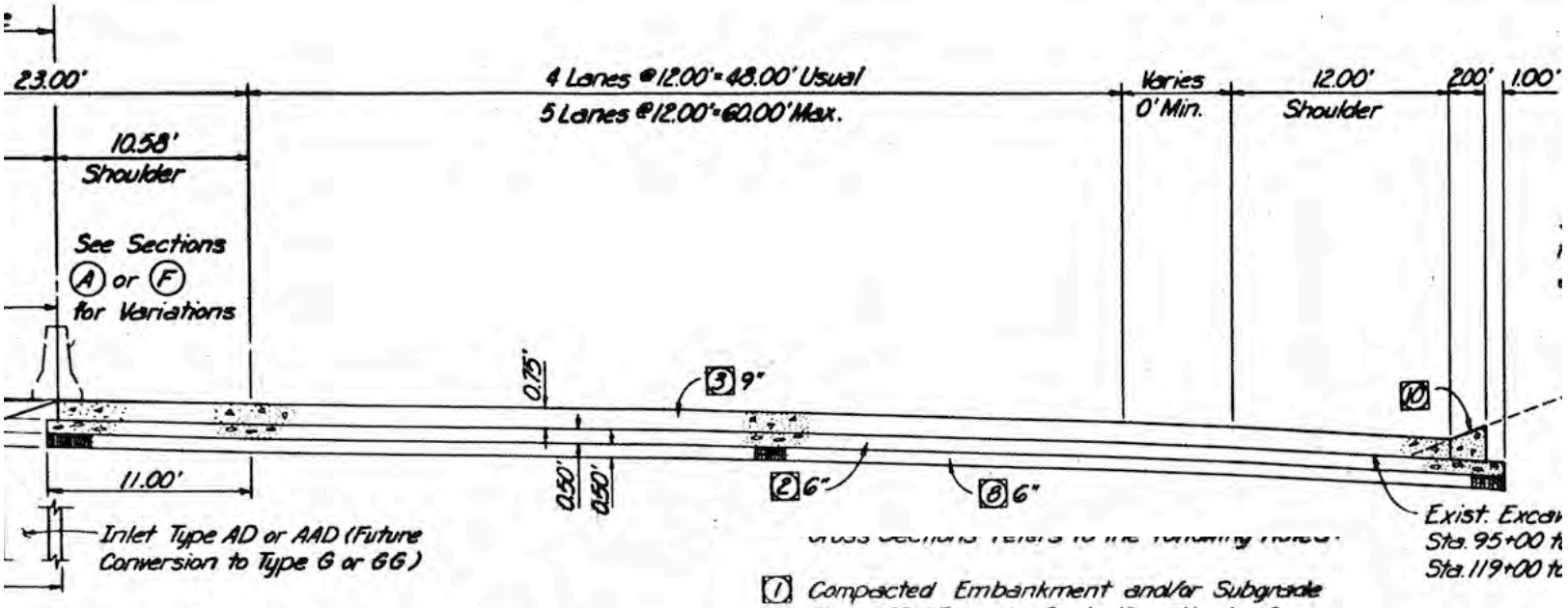
- 9” CRCP
- 0.75” Asphalt Concrete Pavement (assumed)
- 5.25” Cement Stabilized Base (assumed)
- 6” Lime Treated or Cement Treated Subgrade (depending on the subgrade type)
- Note: TxDOT allowed either cement or asphalt stabilized base, but if cement stabilized base was used, 0.75” ACP was required on top. If ASB was used, the total thickness was 6” ASB.



1. Compacted Embankment and/or Subgrade
2. Stabilized Base
3. Concrete Pavement (Contin Reinf)
4. Class A Concrete Riprap
5. Type N Concrete Riprap
6. Mono Curb (6 in.)
△ 7. Cem Treat (Exist Matl) (6 In) (Sta. 157+00 to 180+00±)
8. Lime Treated Subgrade (Sta. 180+00± to 204+83±)
9. Dowel Curb (6 in.)
10. Concrete C & G (Ty L)

SH 288 from MacGregor to Yellowstone

- 9” CRCP
- 0.75” Asphalt Stabilized Base (assumed)
- 5.25” Cement Stabilized Base (assumed)
- 6” Lime Treated Subgrade
- Note: TxDOT allowed either cement or asphalt stabilized base, but if cement stabilized base was used, 0.75” ASB was required on top. If ASB was used, the total thickness was 6” ASB.



FREEWAY HALF SECTION
(1)△

(1) Compacted Embankment and/or Subgrade Item 132, "Density Control" method of compaction will govern, "Rolling (proof)" will not be required.
(2) Stabilized Base
(3) Concrete Pavement (Contin Reinf)
(4) Class A Concrete Riprap
(5) Type N Concrete Riprap
(6) Mono Curb (6 in.)
(7) Asphaltic Concrete Pavement
(8) Lime Treated Subgrade
(9) Dowel Curb (6 in.)
(10) Concrete C&G (Ty L)

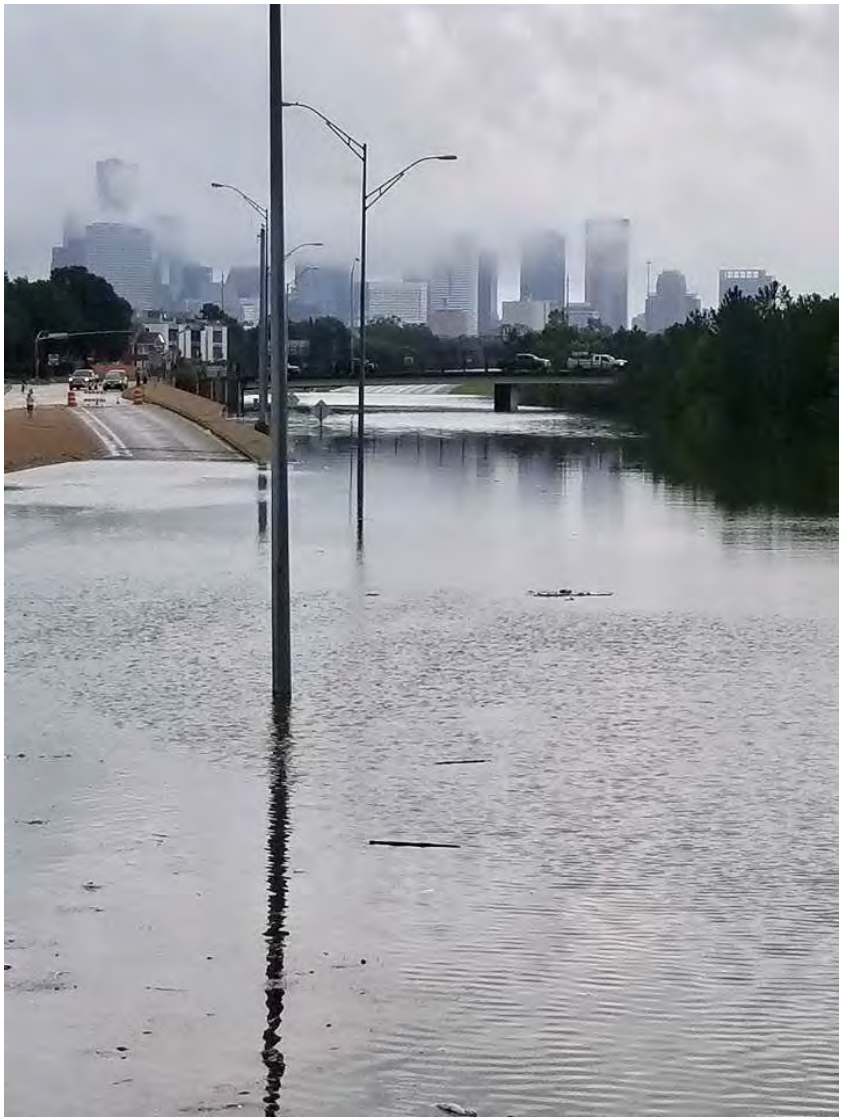
SH 288 from Southmore to Yellowstone

- Has been flooded *at least* three times since it's been constructed
- TxDOT pavement* maintenance expenditures on this section from 1993 to 2016 were $206,598, or $11,738/lane mile
  - $510/year/lane mile (for a pavement well past design life)
- Note: no TxDOT maintenance expenditures are available before 1993

* Does not include trash pick-up, striping, etc.

IAH
TEXAS 288 TO 45
Dallas
Galveston
69 59 NORTH
Cleveland
SPEED LIMIT 60
16FT
SOUTHMORE ST

15 FT 9 IN



SH 288 after Harvey, Oct. 2017

Texas A&M Transportation Institute

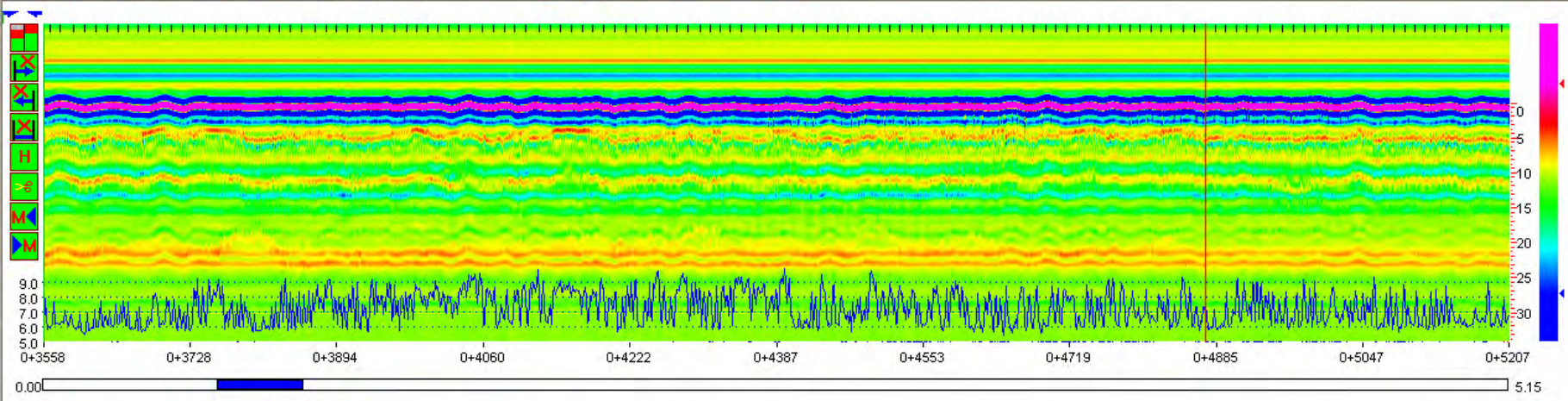
Time and Resources

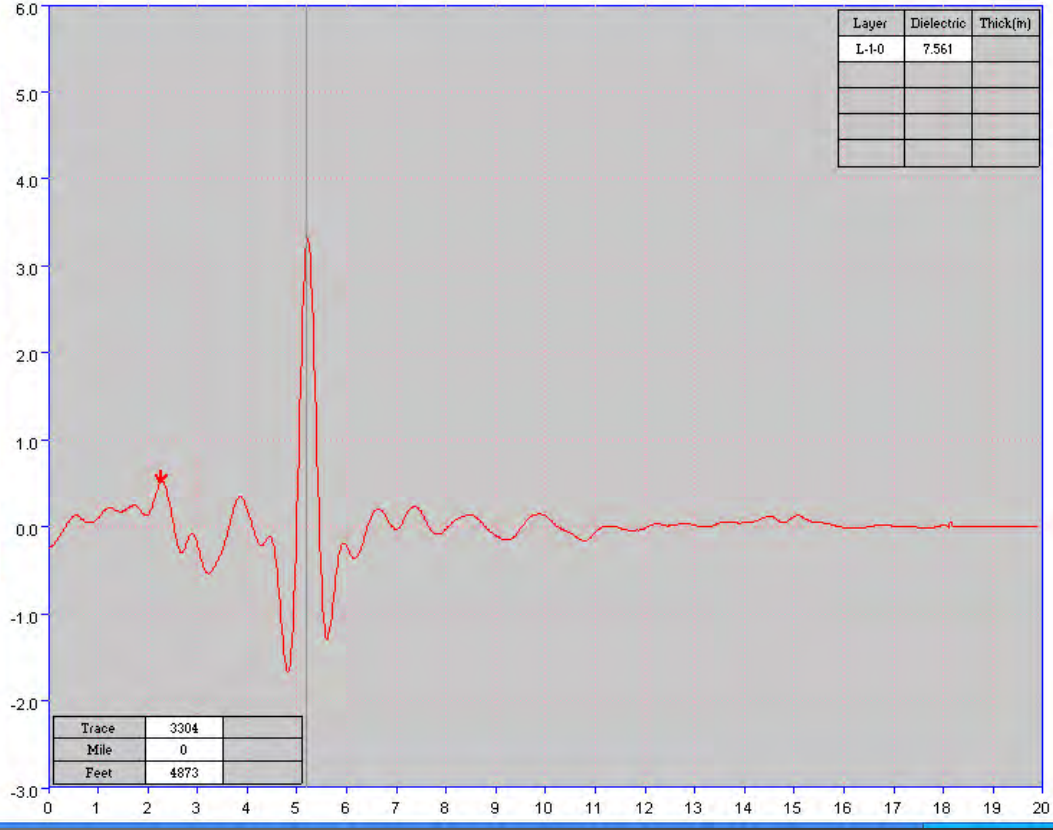
SH 288 Northbound
Ground Penetrating Radar Data
October, 2017

GPS: Lat: 29.67947739 Log: 95.38128716 (Lat:(N) 29:40:46.1186 Log:(W) 95:22:52.6338

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

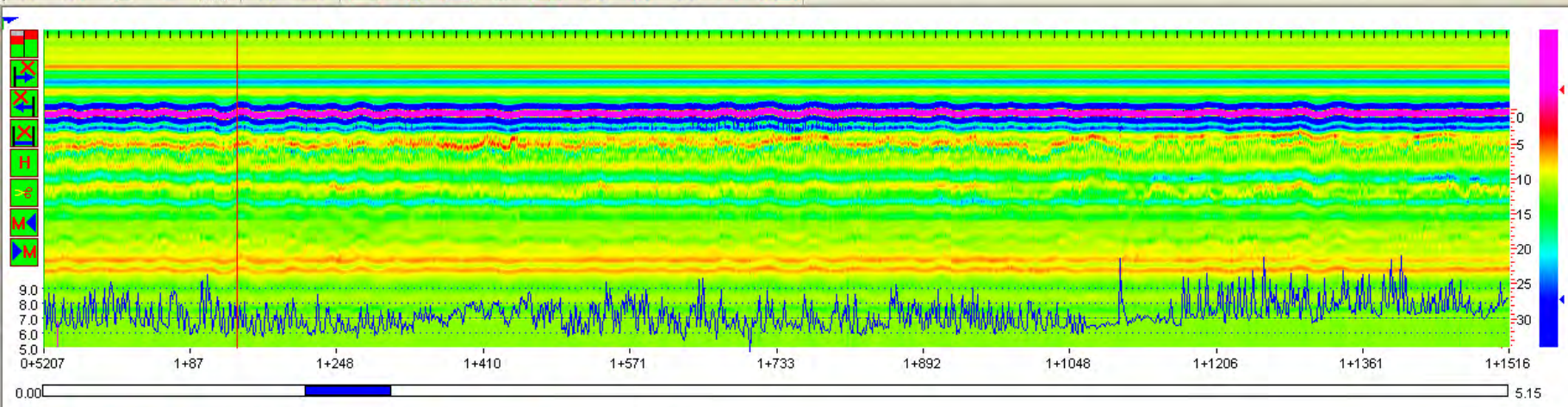


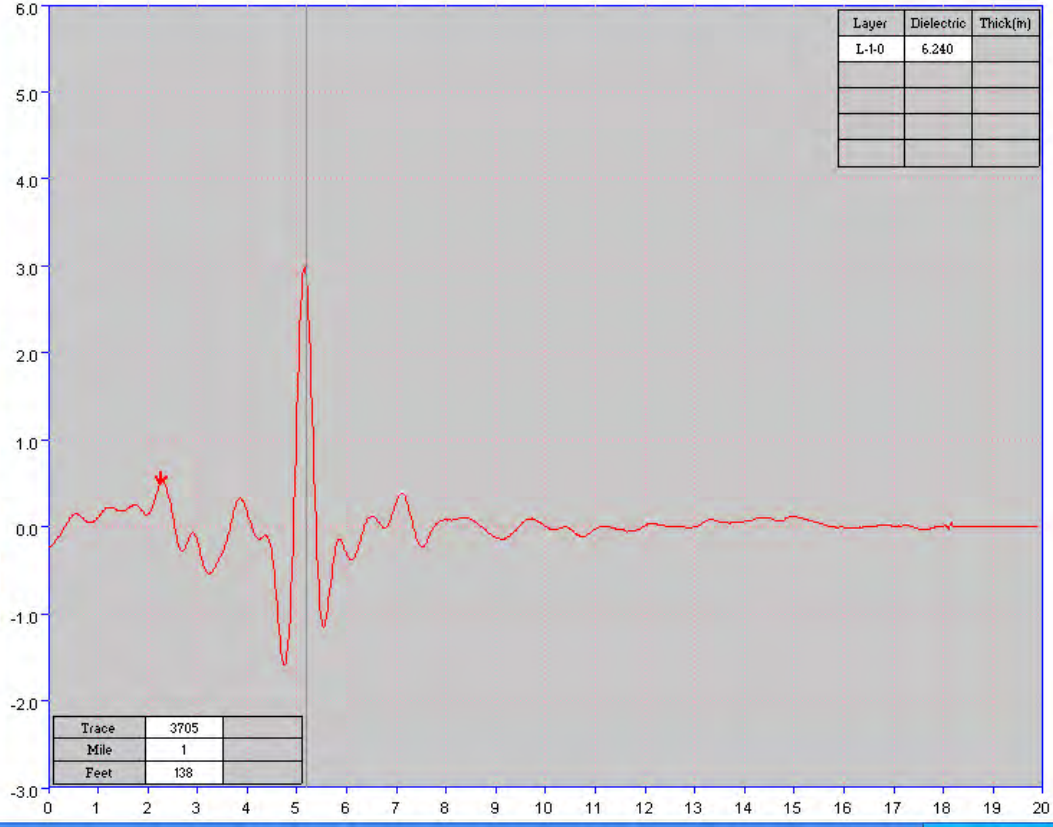


GPS: Lat: 29.68092347 Log: 95.38094953 (Lat:(N) 29:40:51.3245 Log:(W) 95:22:51.4183

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

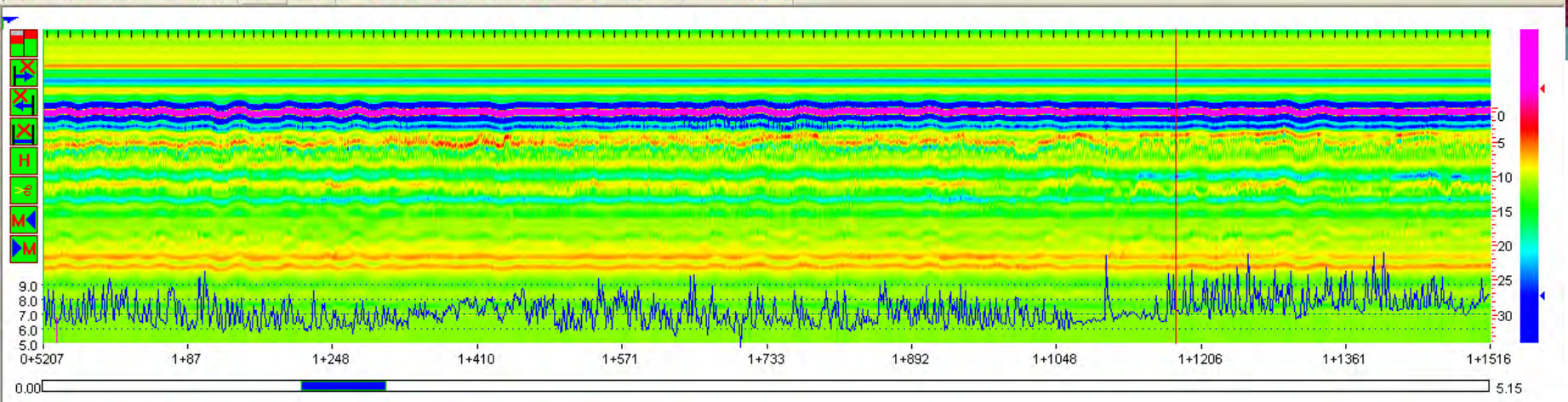


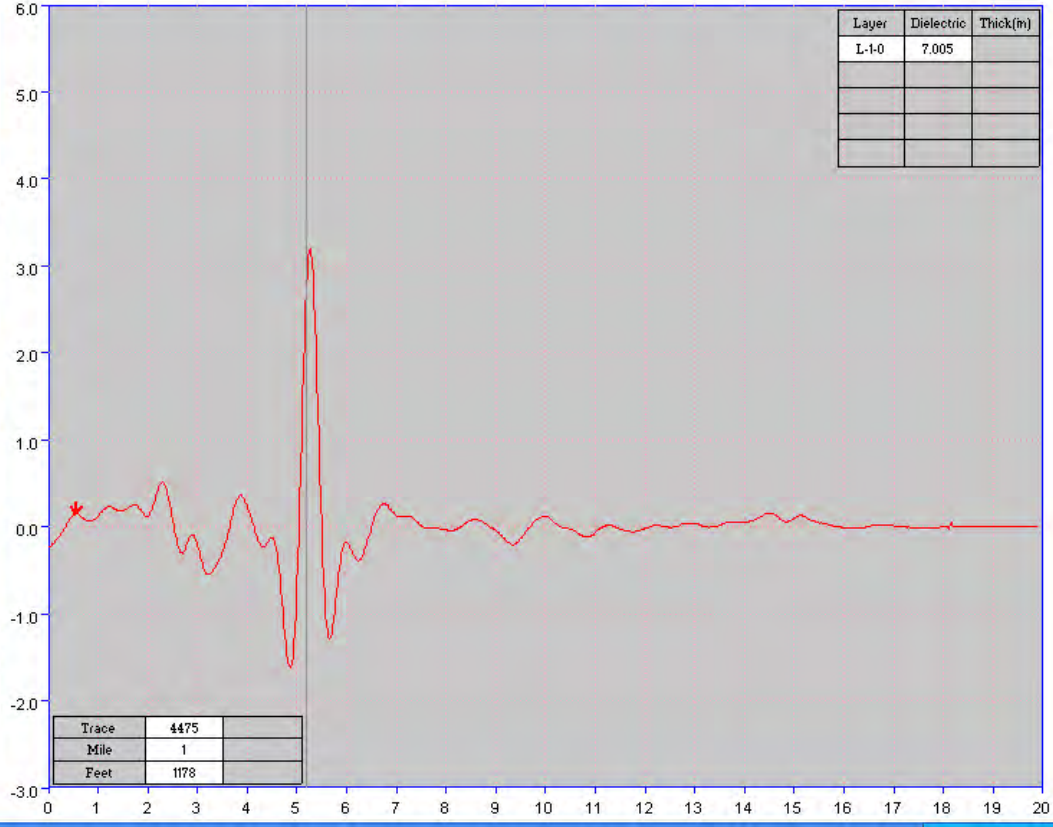


GPS: Lat: 29.68348549 Log: 95.37973049 (Lat:(N) 29:41: 0.5478 Log:(W) 95:22:47.0298

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

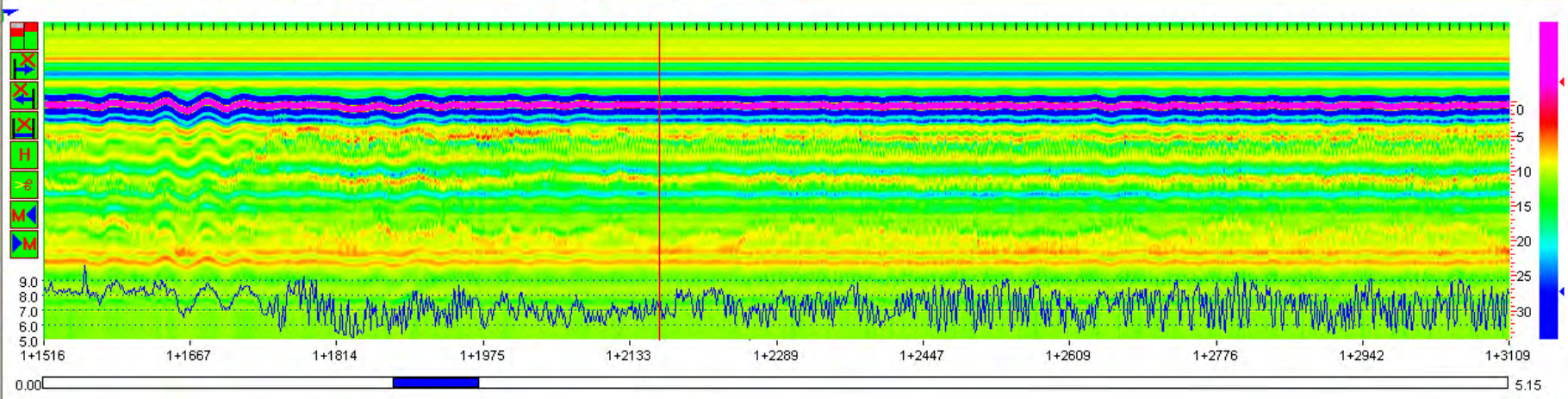


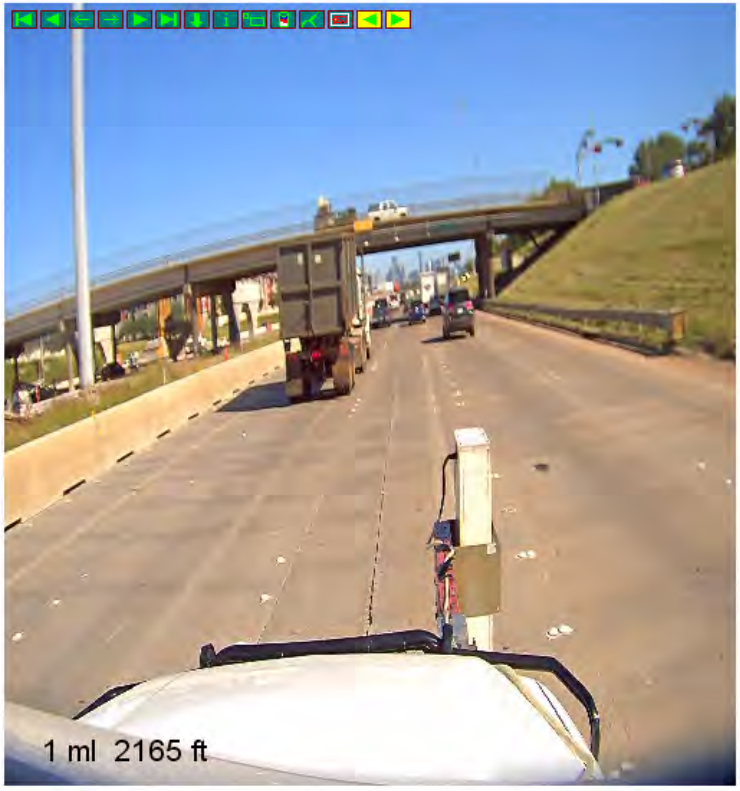


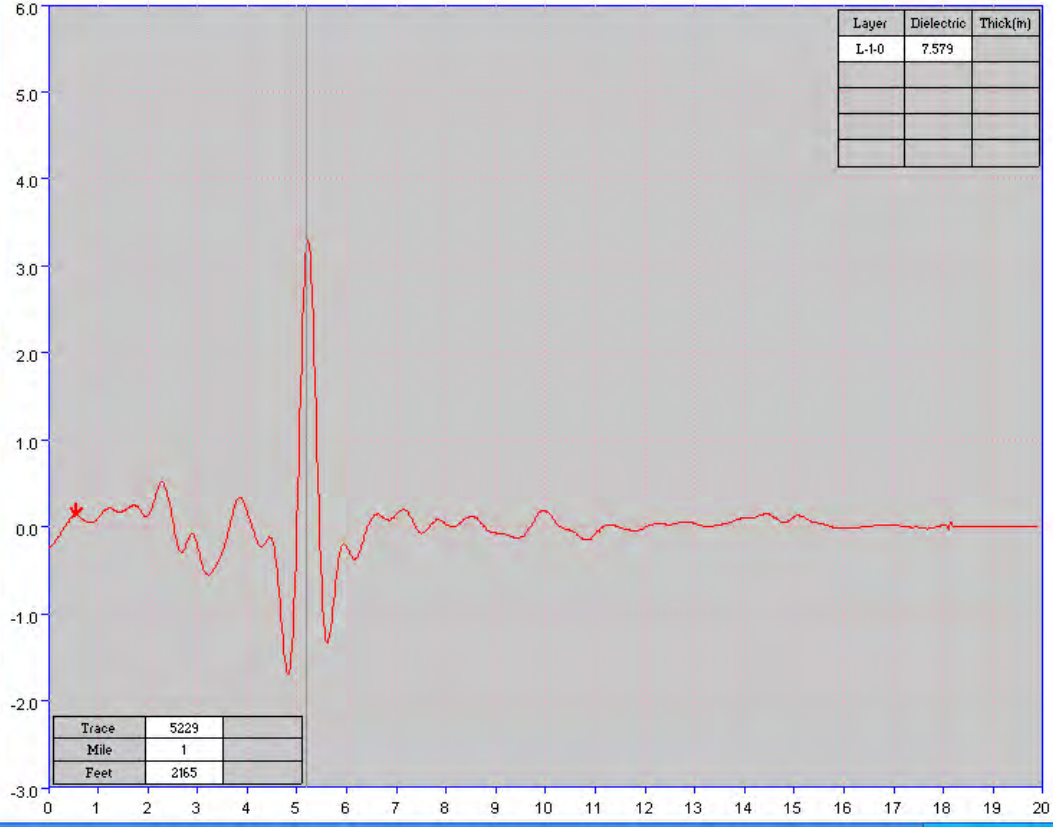
GPS: Lat: 29.68600623 Log: 95.37890737 (Lat:(N) 29:41: 9.6224 Log:(W) 95:22:44.0665

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080



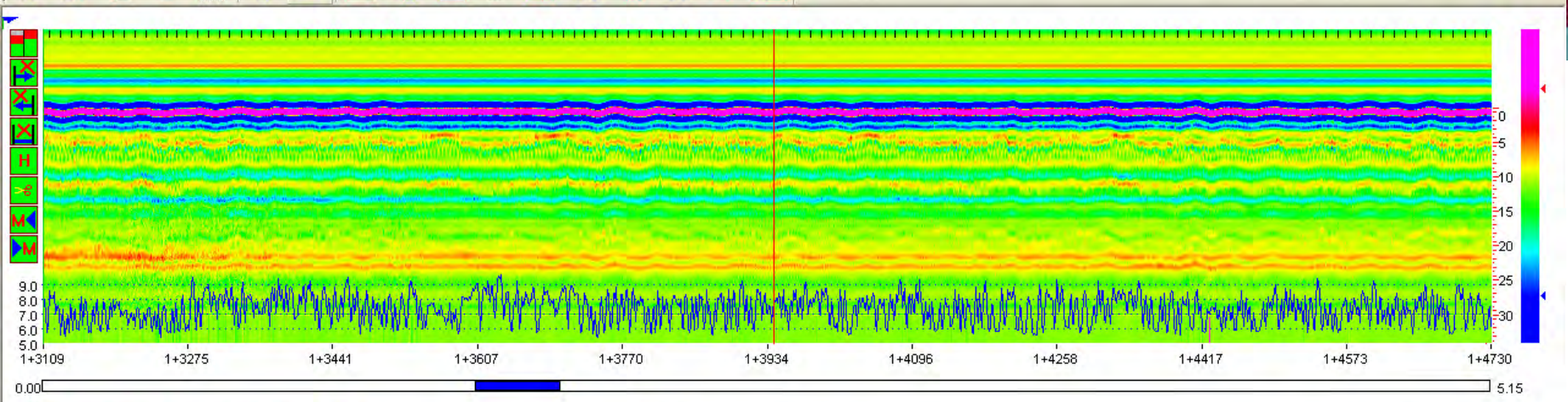


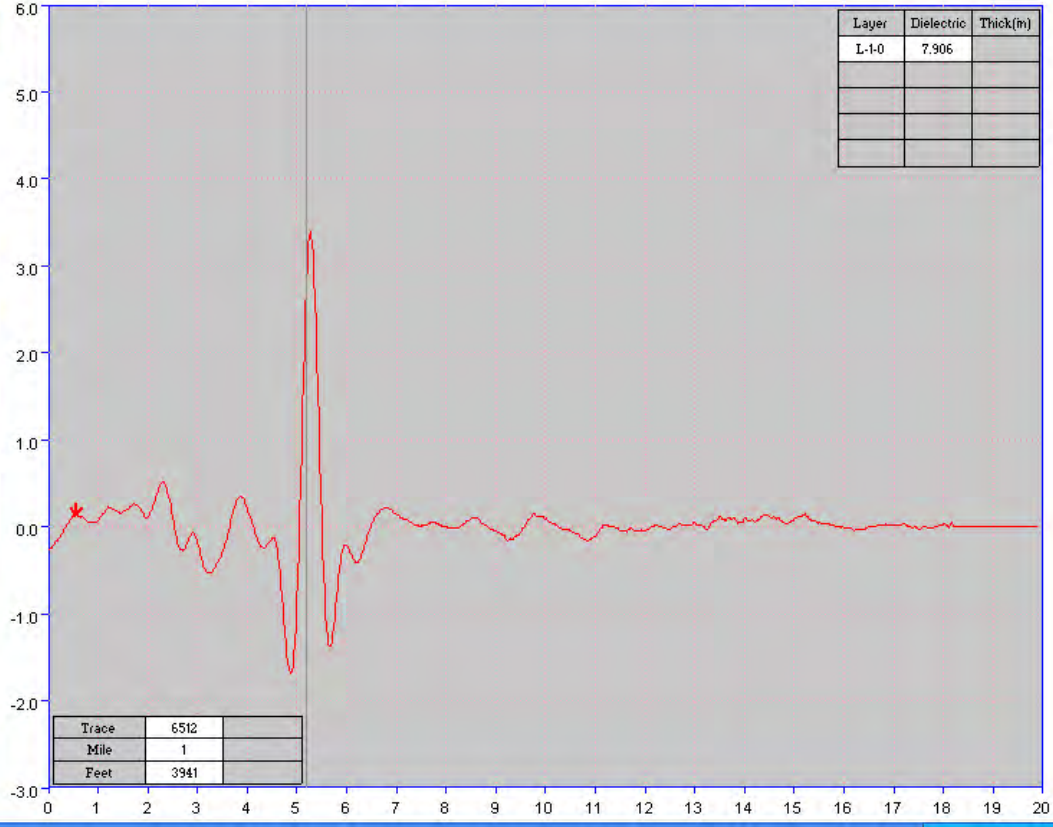


GPS: Lat: 29.69083016 Log: 95.37773480 (Lat:(N) 29:41:26.9886 Log:(W) 95:22:39.8453

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

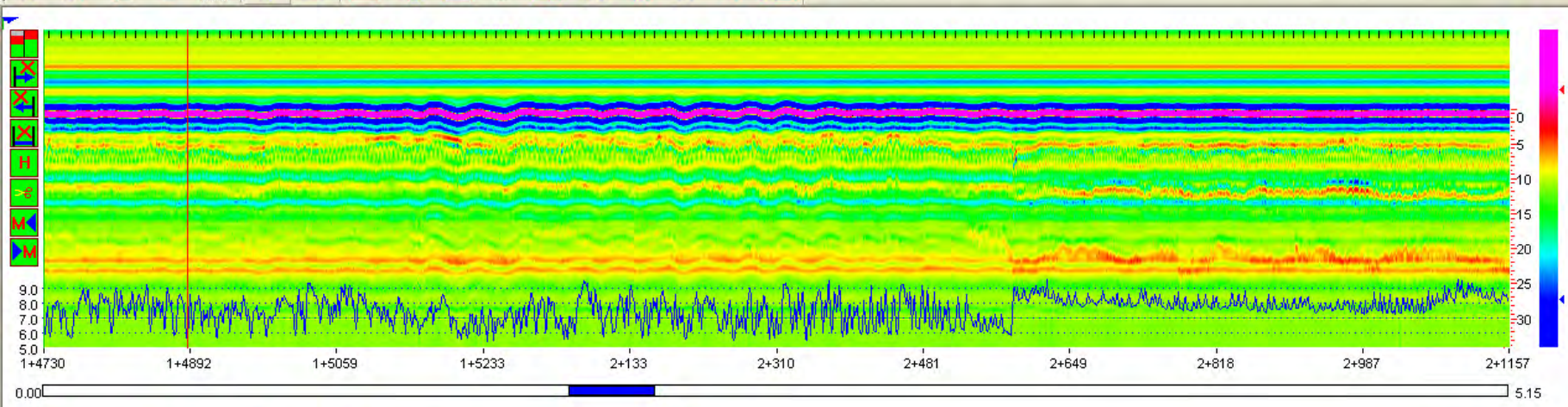


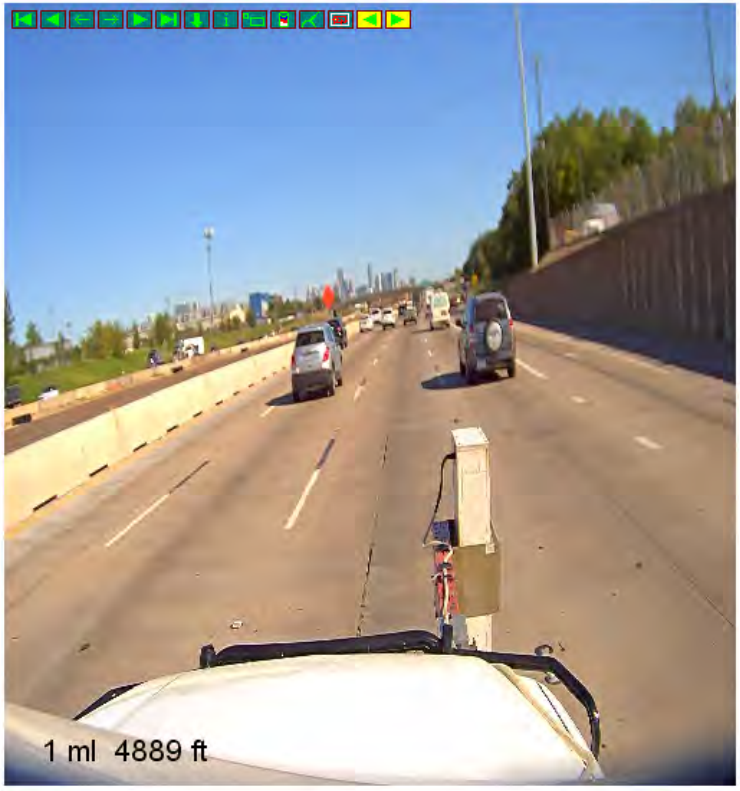


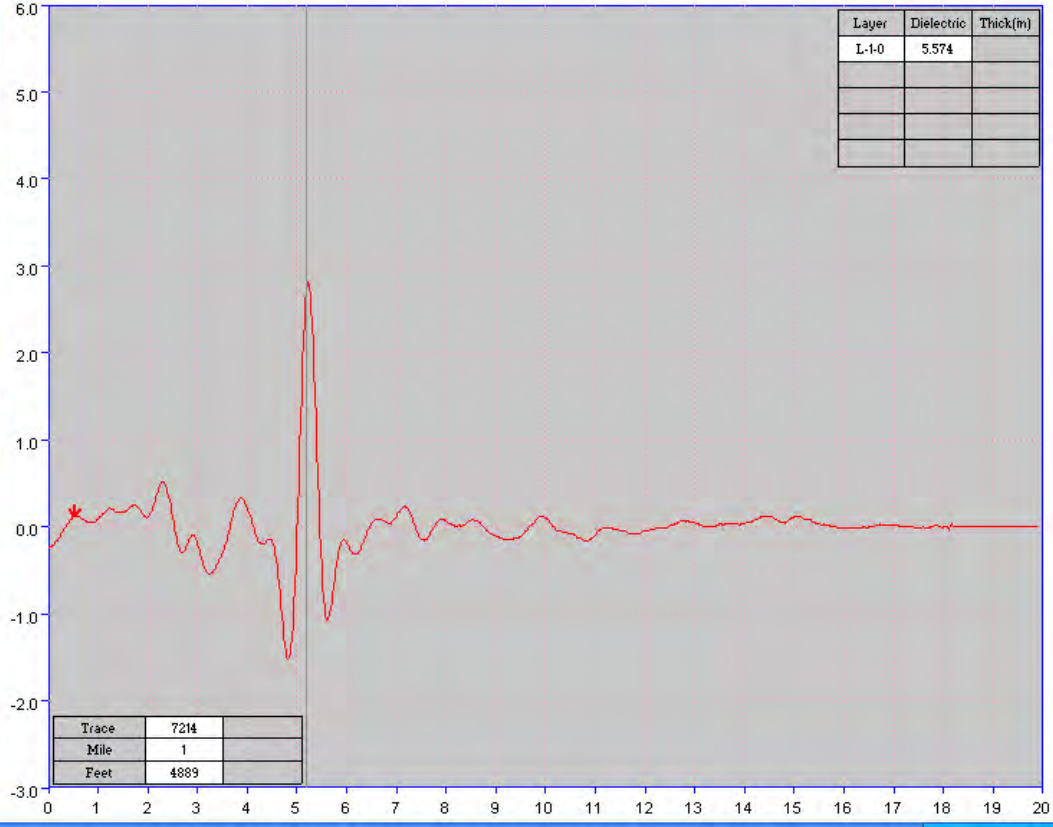
GPS: Lat: 29.69329801 Log: 95.37708026 (Lat:(N) 29:41:35.8728 Log:(W) 95:22:37.4889

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080



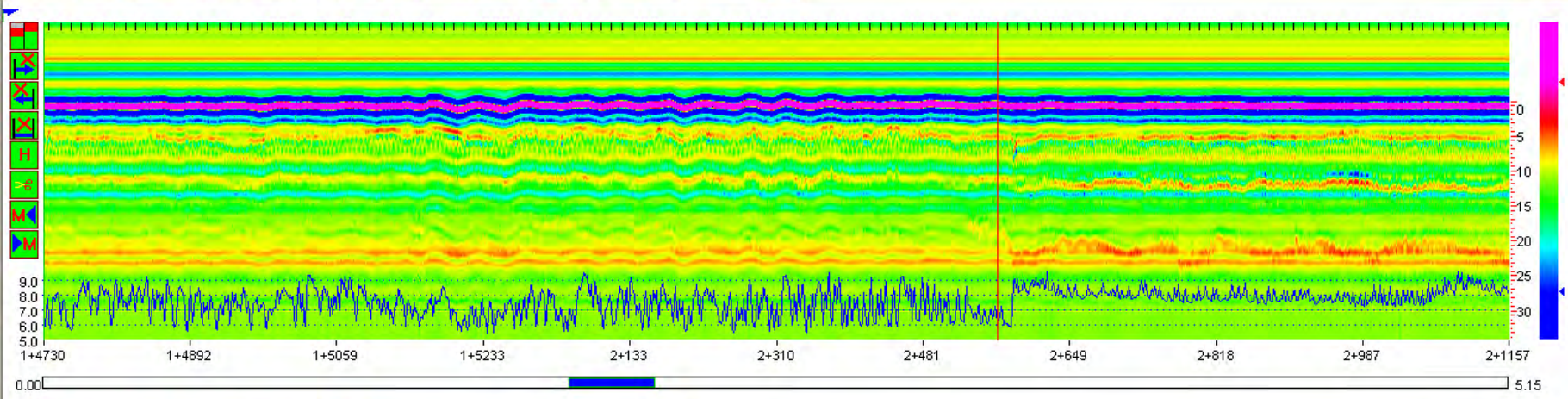


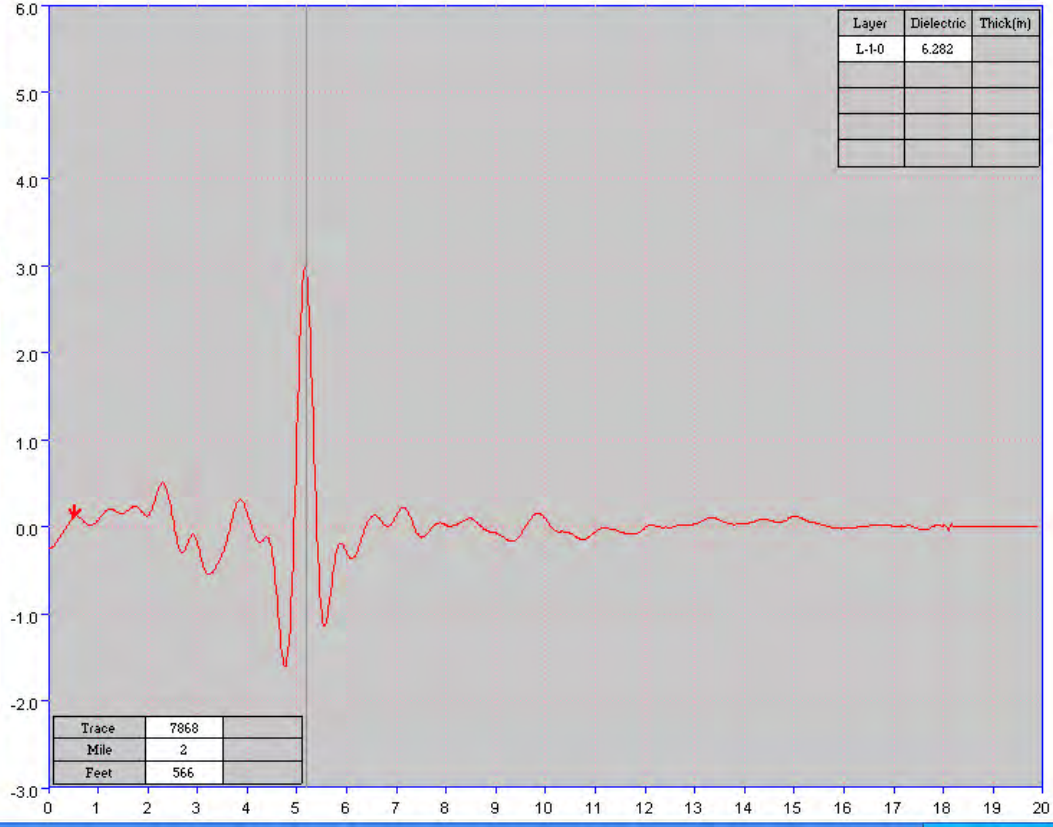


GPS: Lat: 29.69577938 Log: 95.37633824 (Lat:(N) 29:41:44.8058 Log:(W) 95:22:34.8176

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

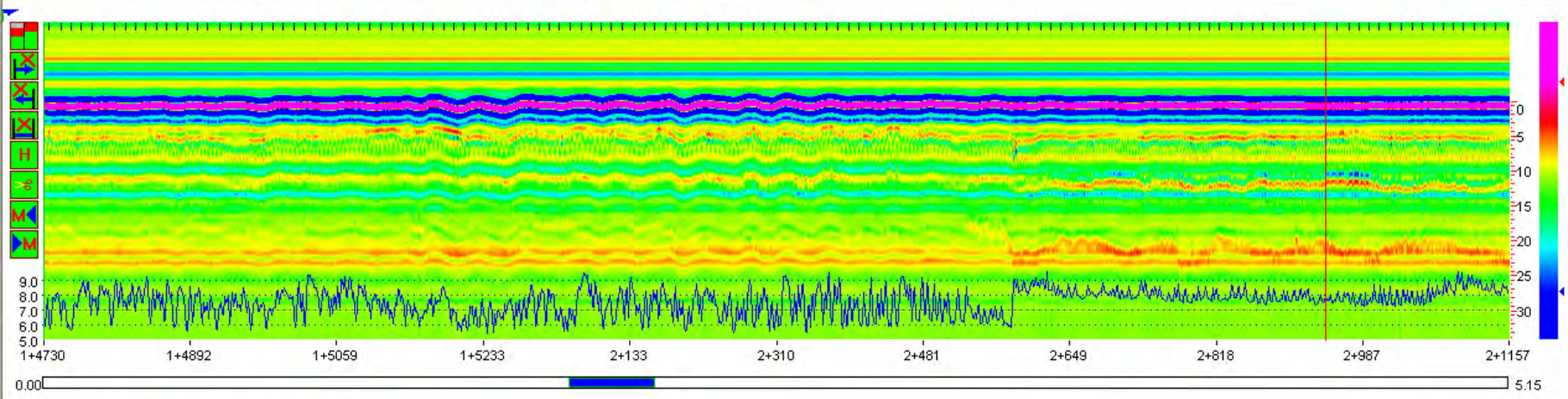


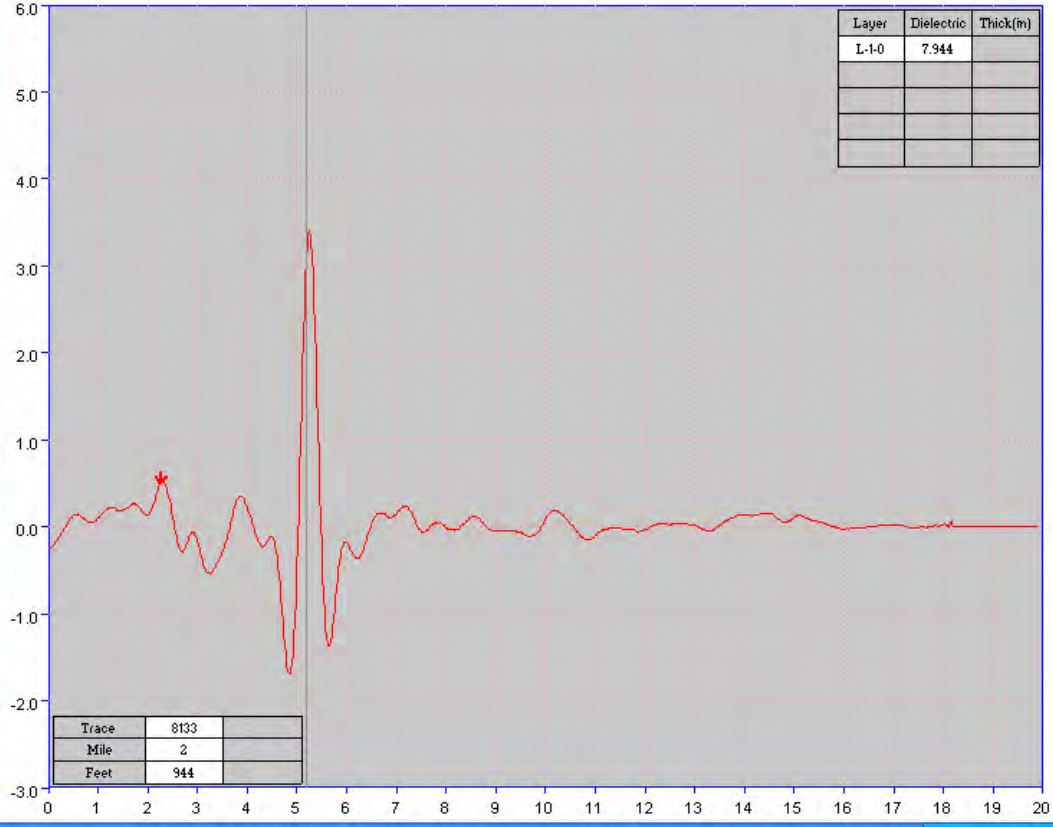


GPS: Lat: 29.69675160 Log: 95.37603700 (Lat:(N) 29:41:48.3058 Log:(W) 95:22:33.7332

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

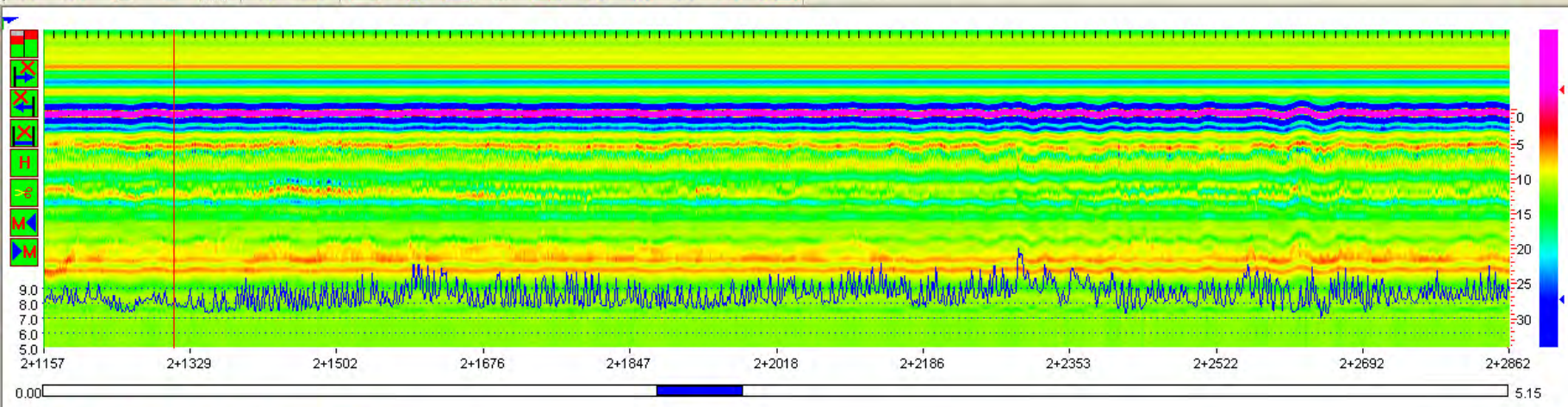


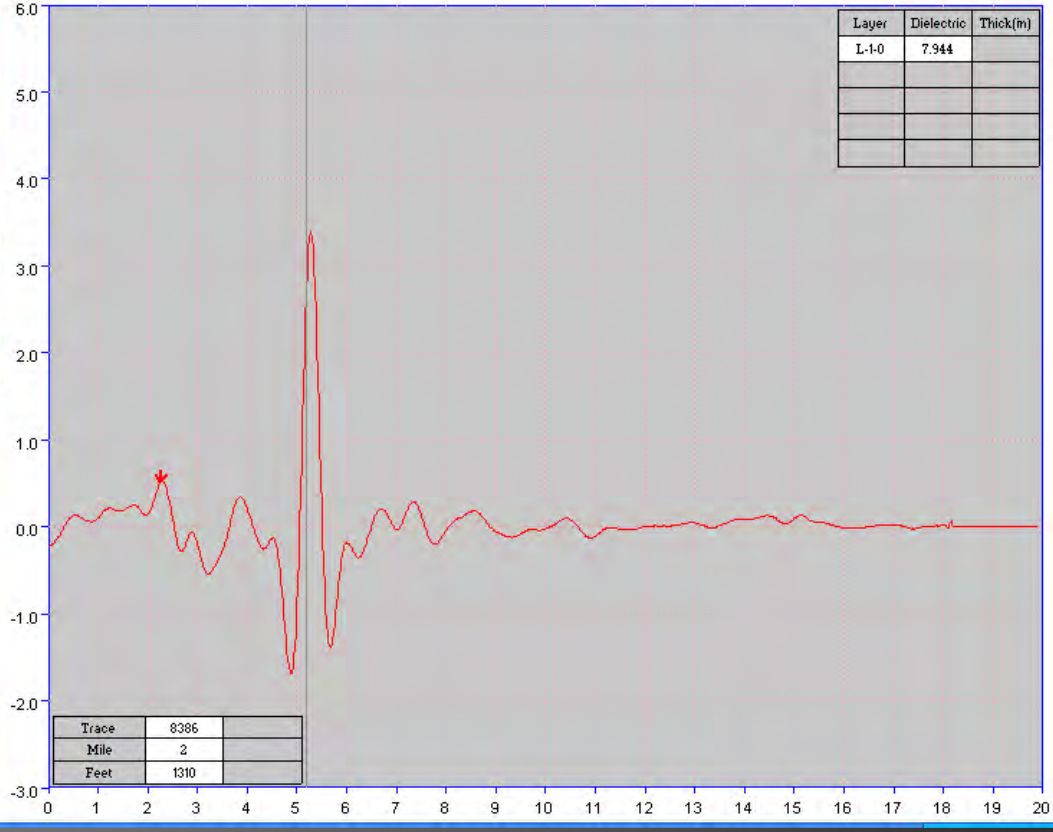


GPS: Lat: 29.69770062 Log: 95.37573578 (Lat:(N) 29:41:51.7222 Log:(W) 95:22:32.6488

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

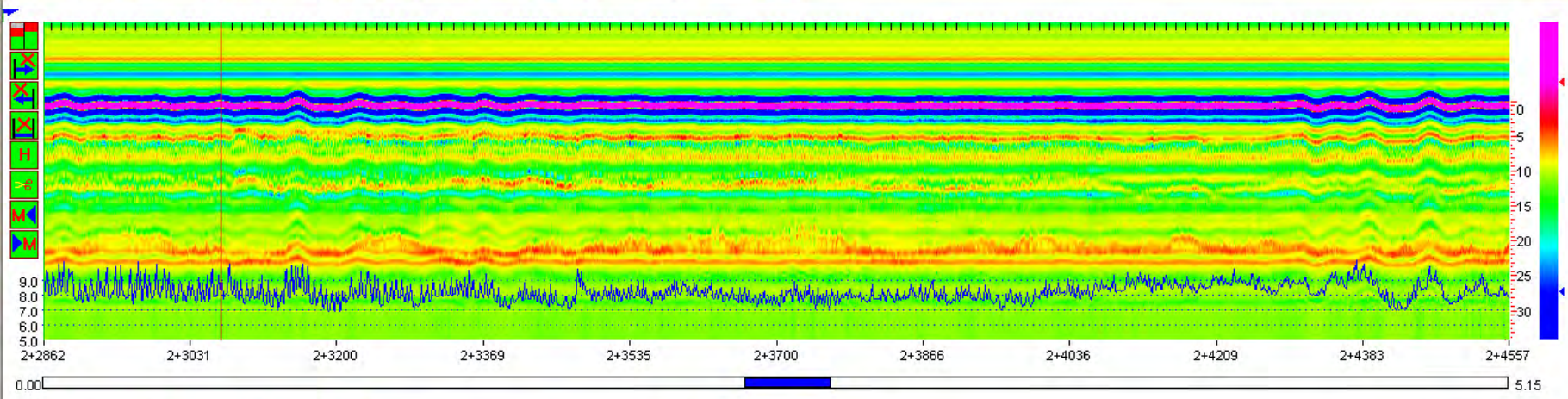


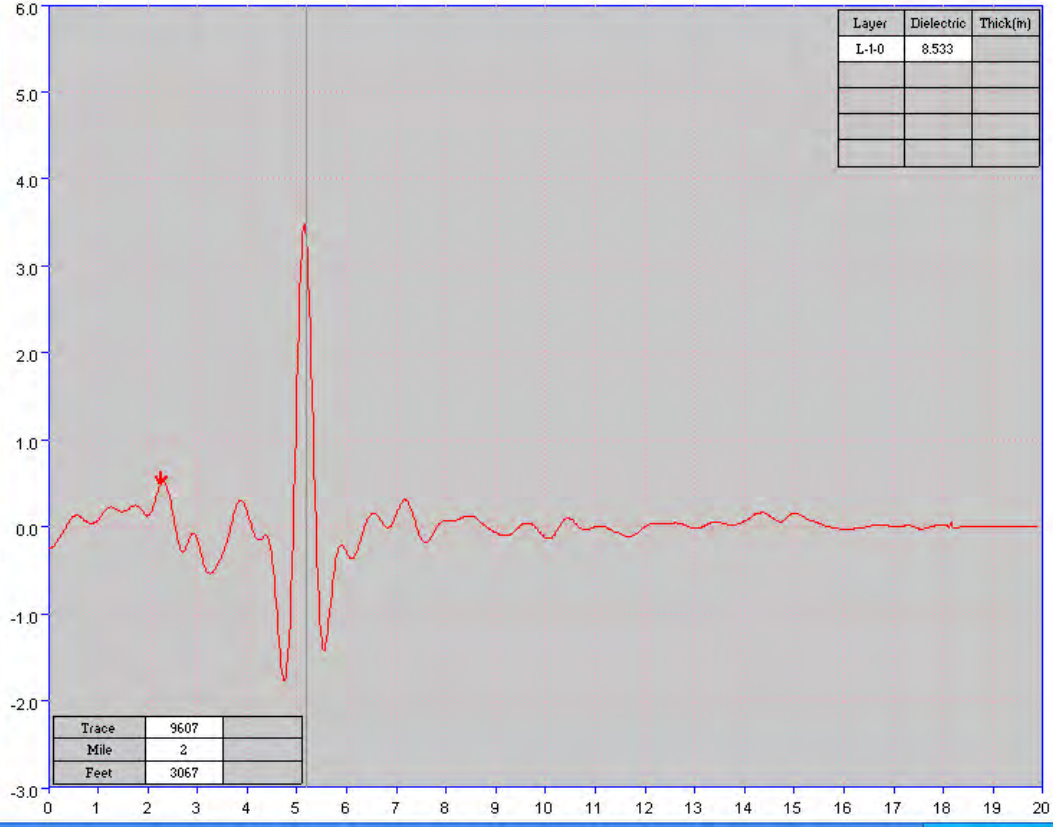


GPS: Lat: 29.70248441 Log: 95.37450961 (Lat:(N) 29:42: 8.9439 Log:(W) 95:22:28.2346

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

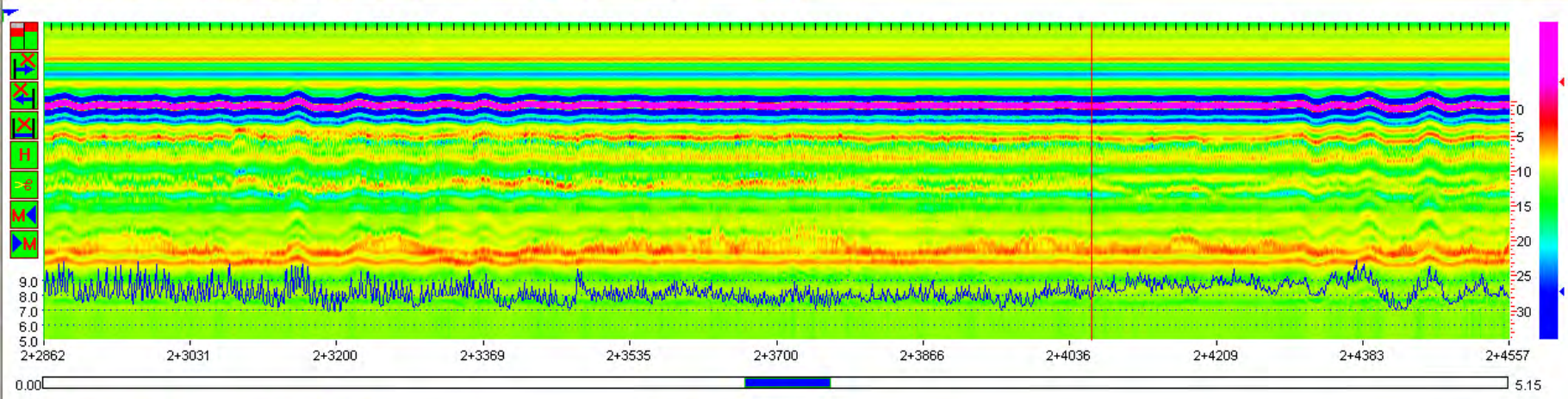


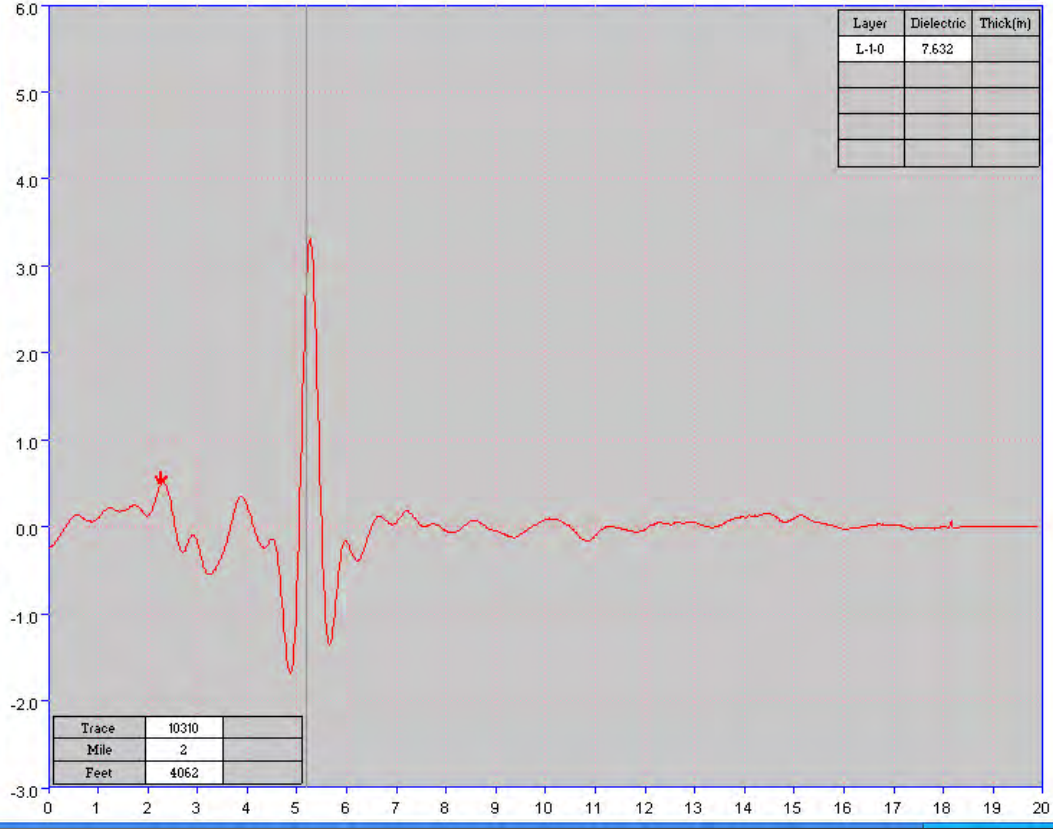


GPS: Lat: 29.70512245 Log: 95.37476382 (Lat:(N) 29:42:18.4408 Log:(W) 95:22:29.1498

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

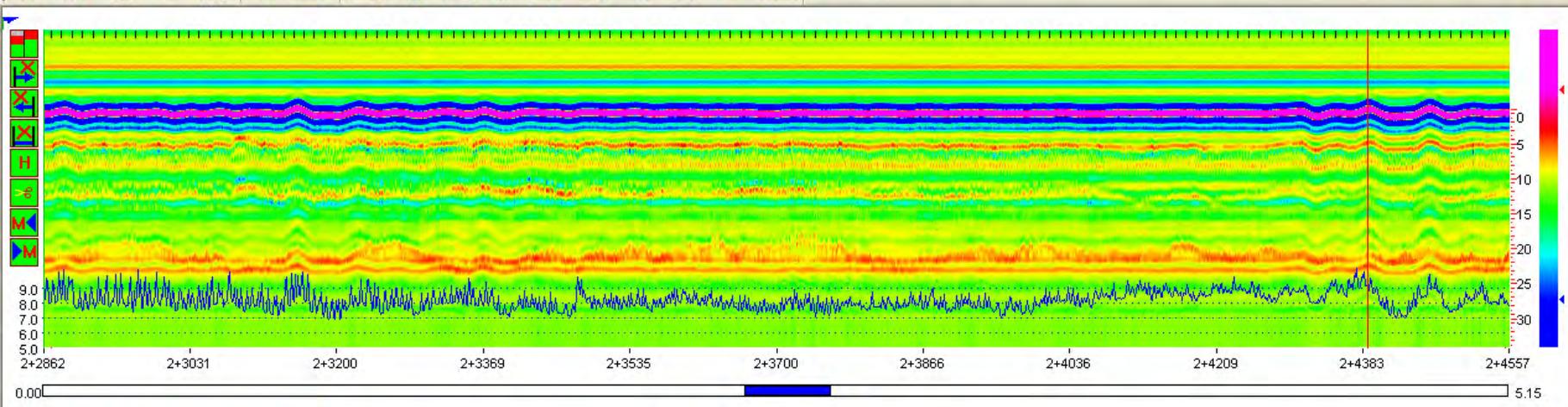


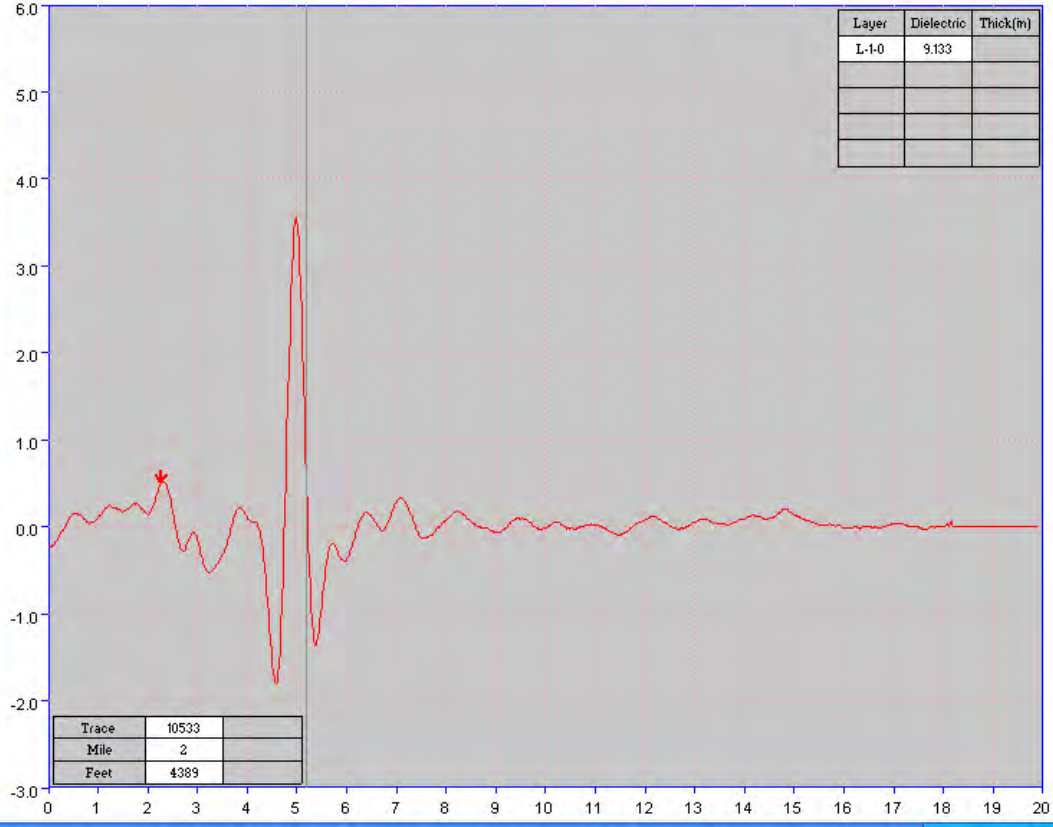


GPS: Lat: 29.70595577 Log: 95.37503107 (Lat:(N) 29:42:21.4408 Log:(W) 95:22:30.1118

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

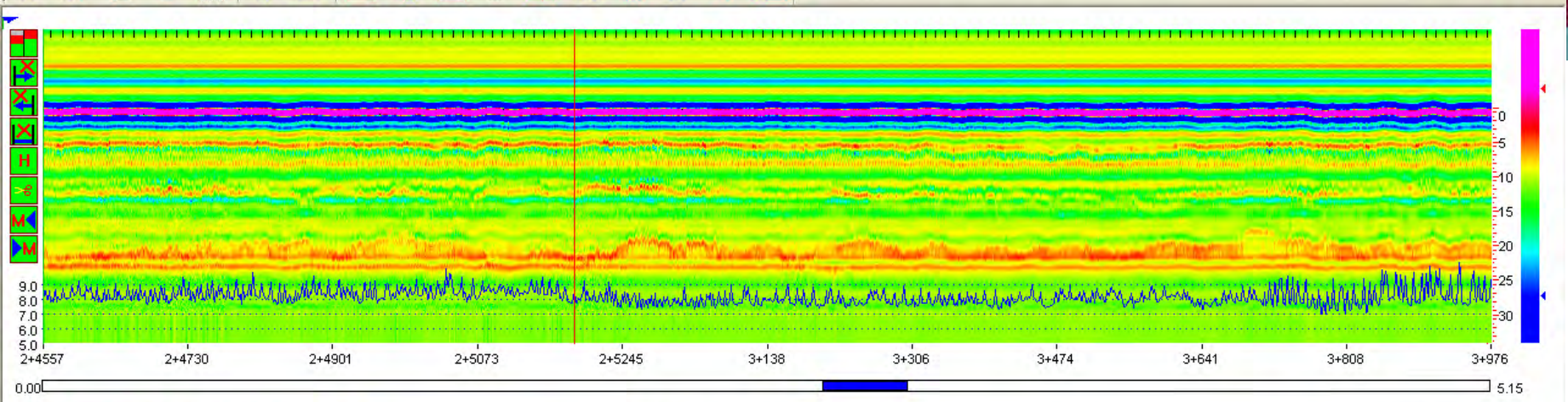


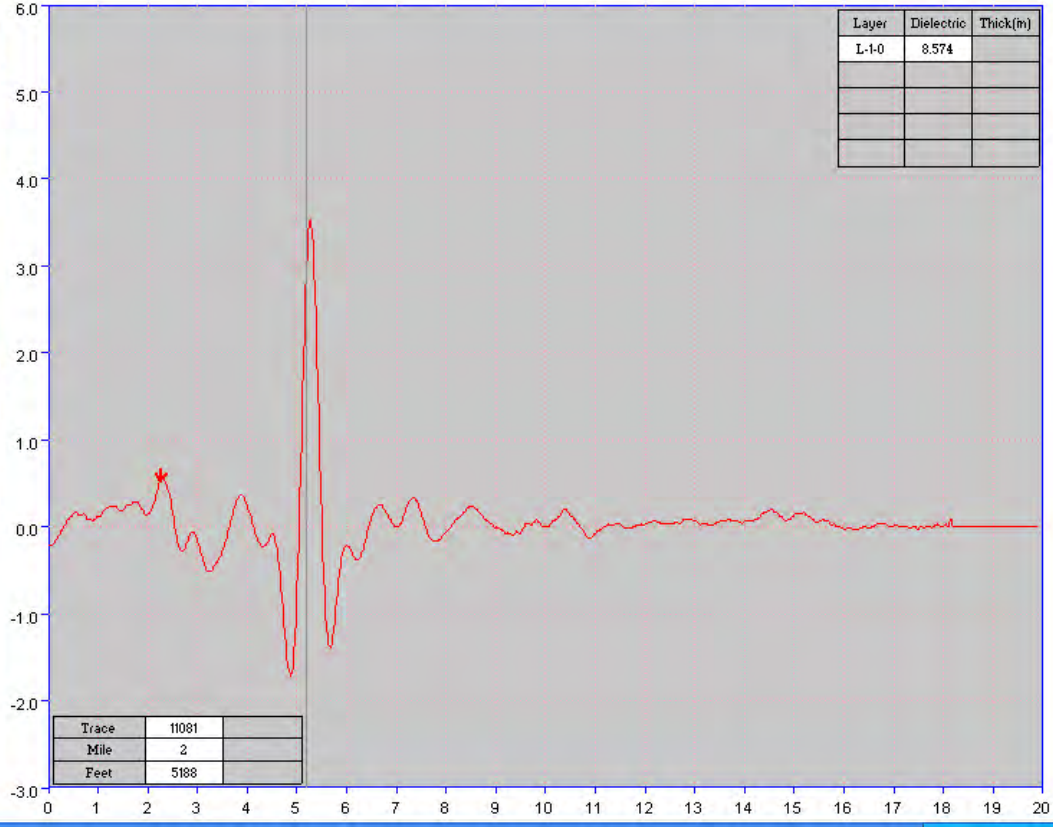


GPS: Lat: 29.70790578 Log: 95.37604931 (Lat:(N) 29:42:28.4608 Log:(W) 95:22:33.7775

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

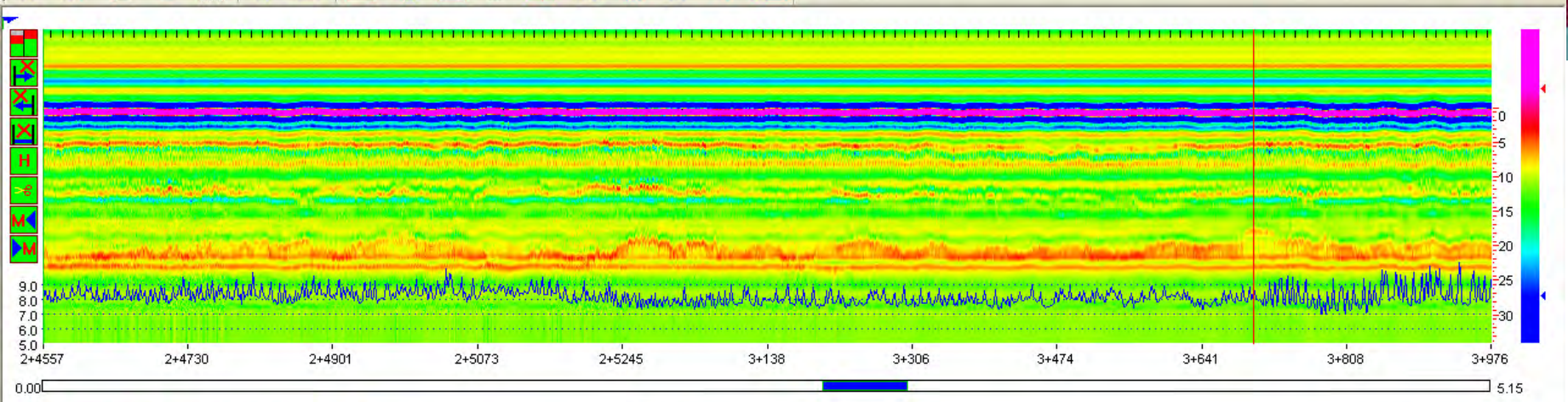


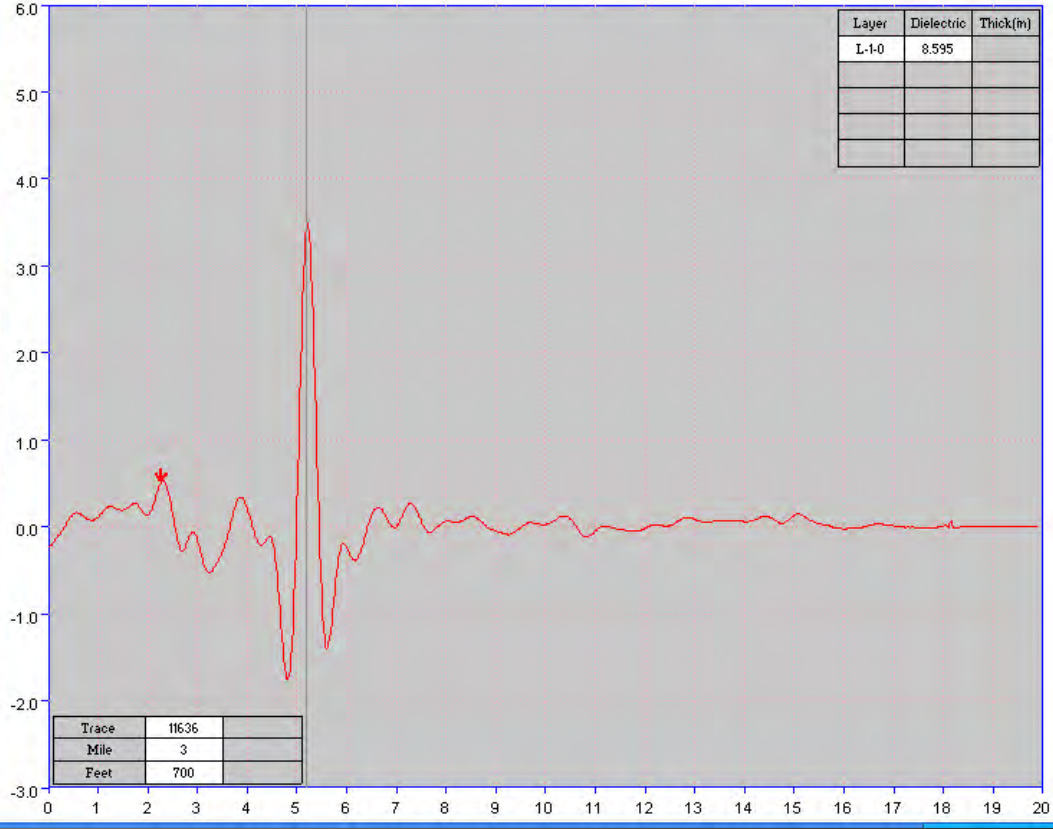


GPS: Lat: 29.70982147 Log: 95.37710667 (Lat:(N) 29:42:35.3573 Log:(W) 95:22:37.5840

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

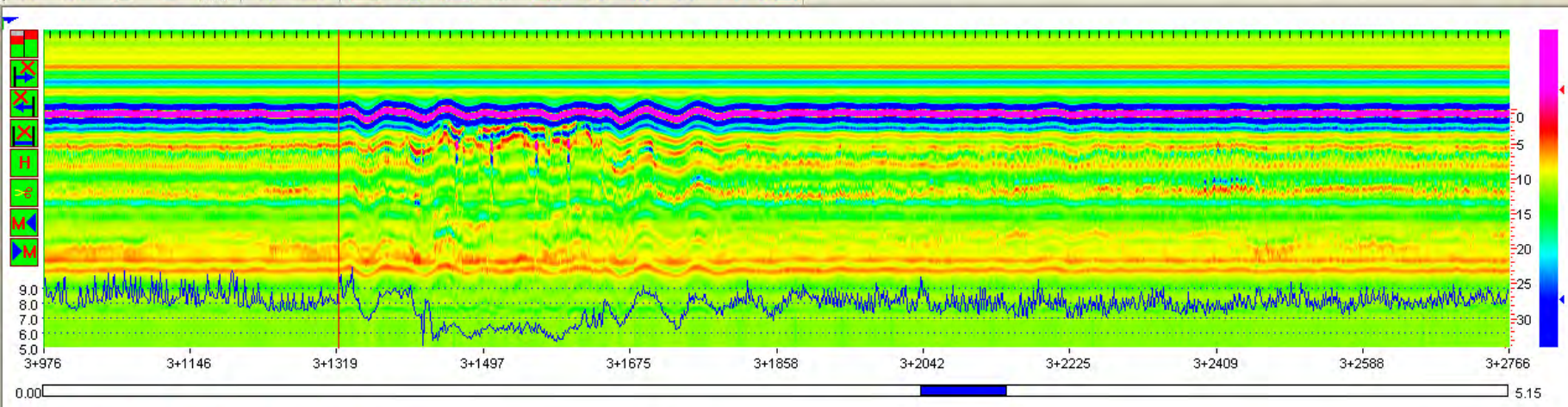


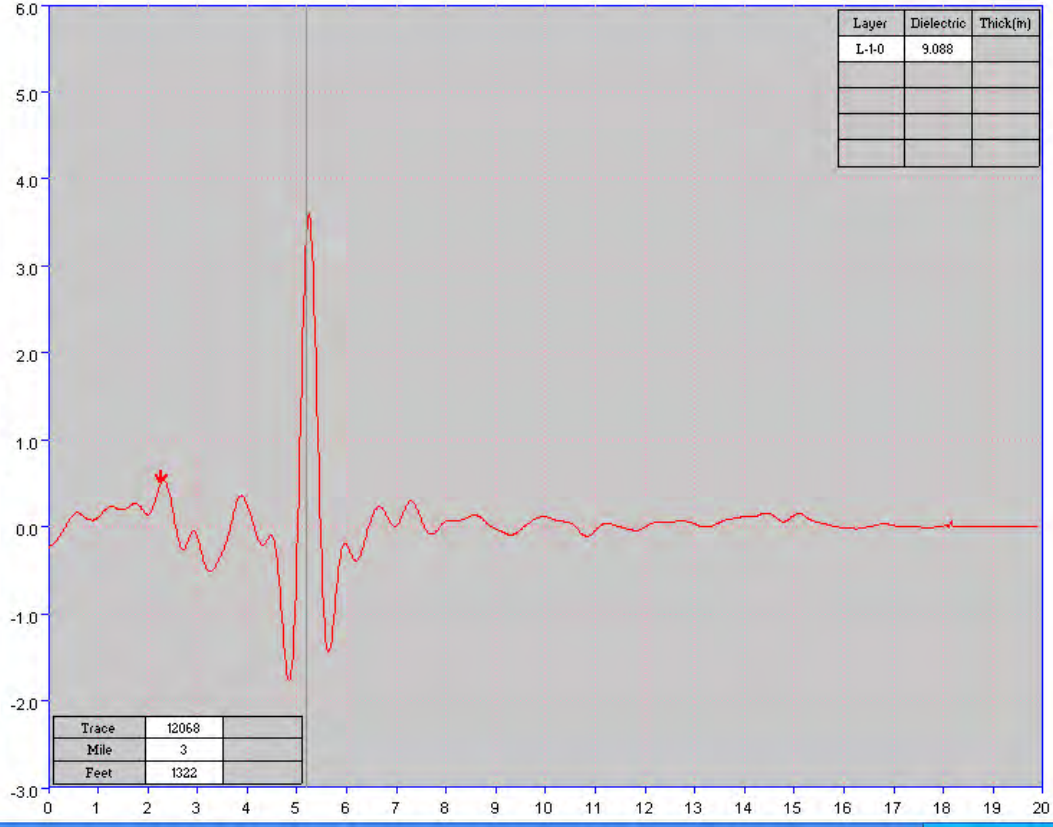


GPS: Lat: 29.71137127 Log: 95.37778225 (Lat:(N) 29:42:40.9366 Log:(W) 95:22:40.0161

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

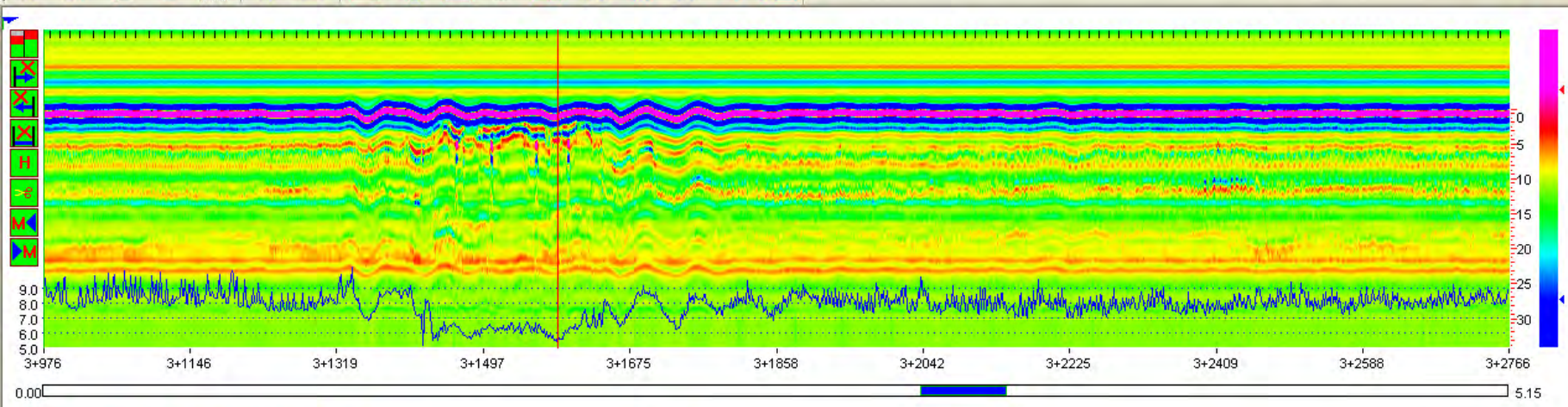


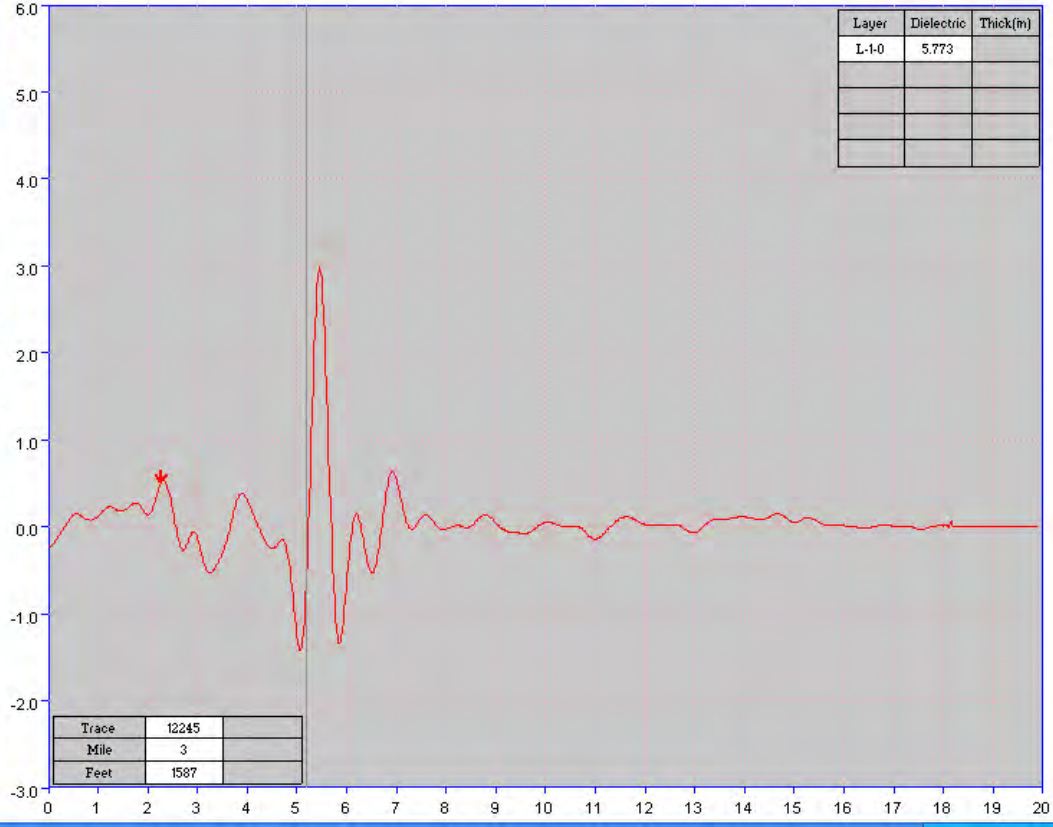


GPS: Lat: 29.71204856 Log: 95.37802507 (Lat:(N) 29:42:43.3748 Log:(W) 95:22:40.8902

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

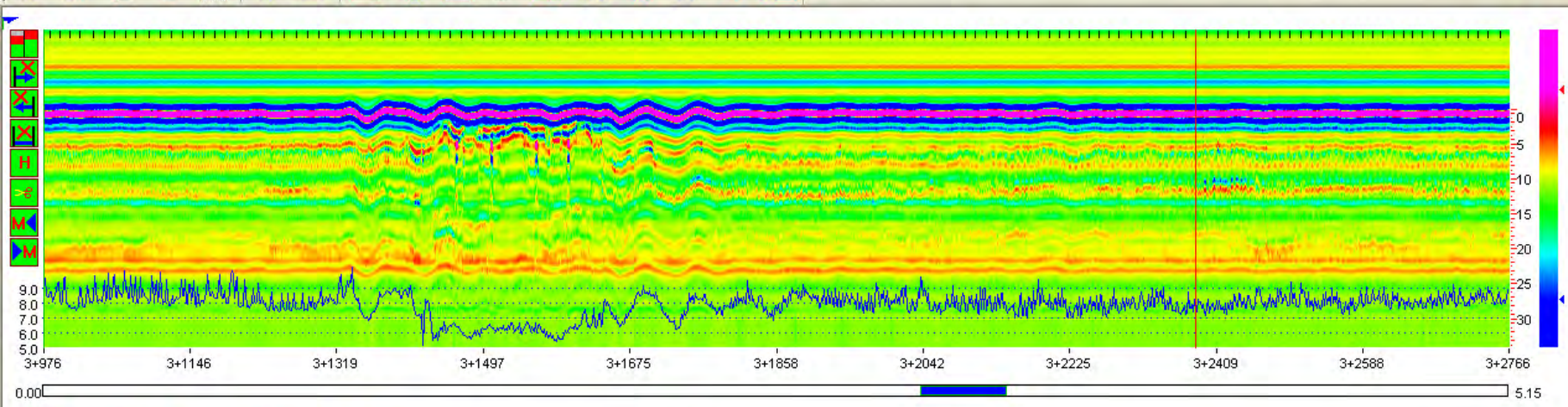


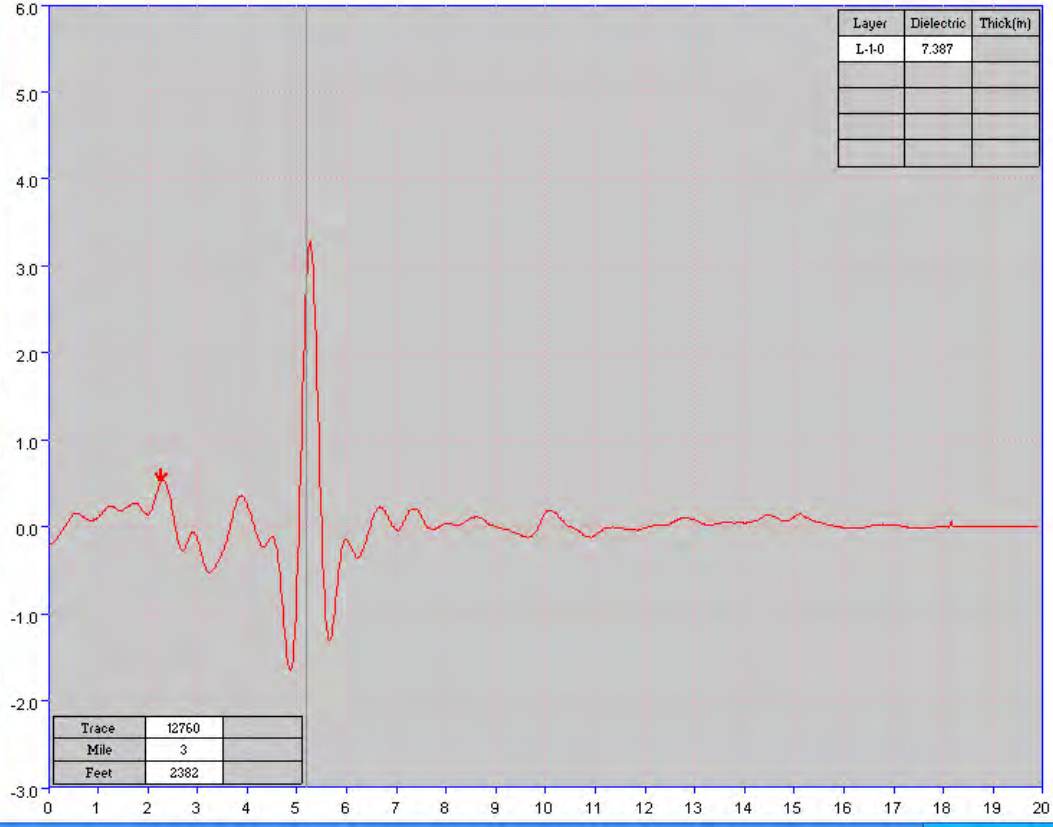


GPS: Lat: 29.71419765 Log: 95.37851392 (Lat:(N) 29:42:51.1115 Log:(W) 95:22:42.6501

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

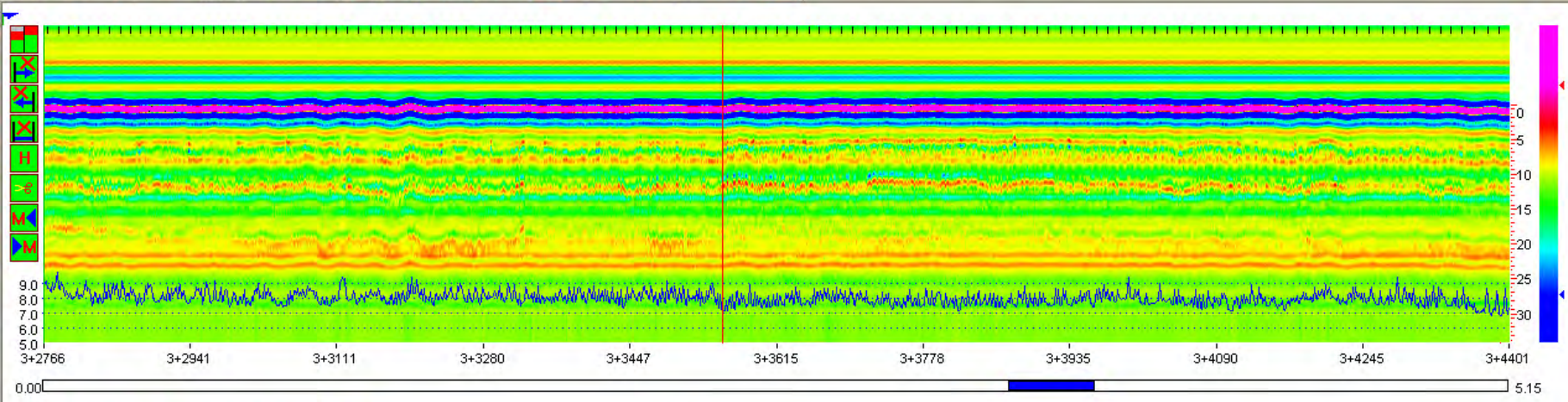


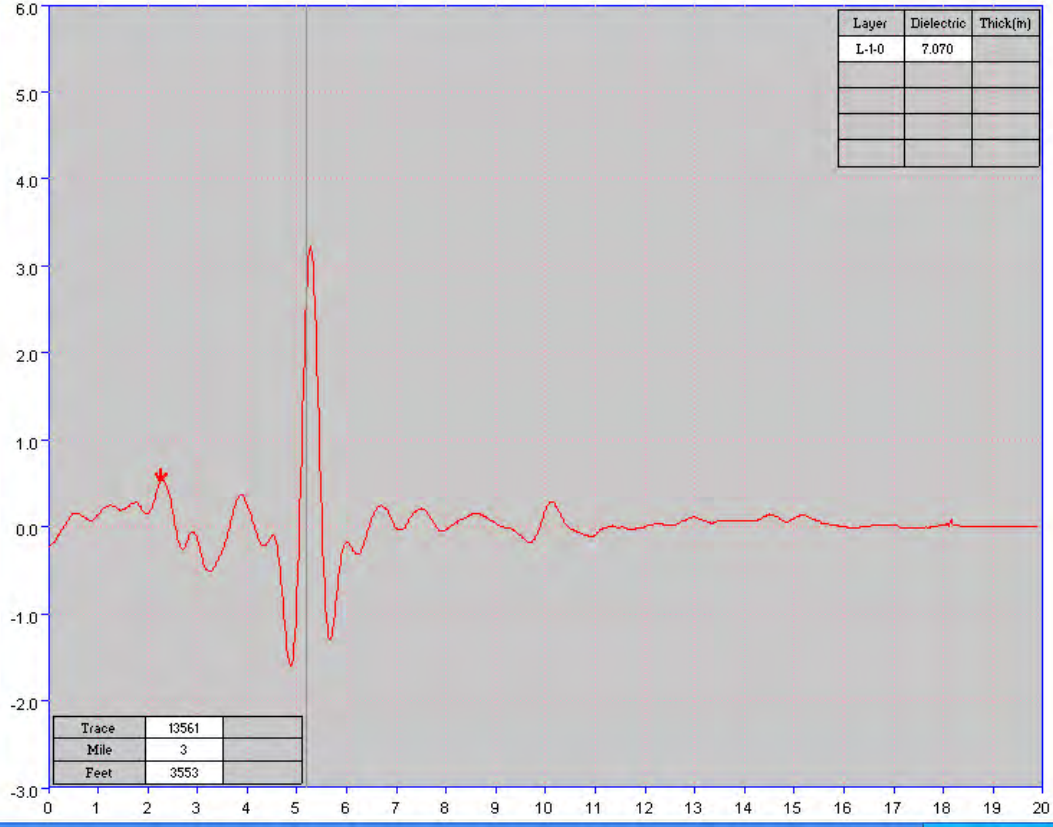


GPS: Lat: 29.71743947 Log: 95.37809373 (Lat:(N) 29:43: 2.7821 Log:(W) 95:22:41.1374

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

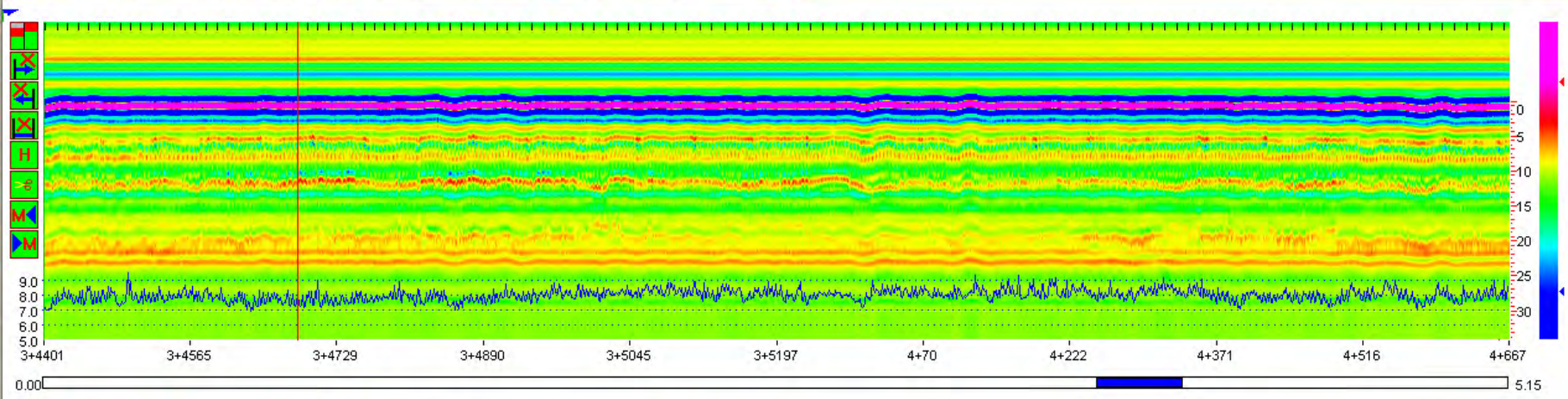


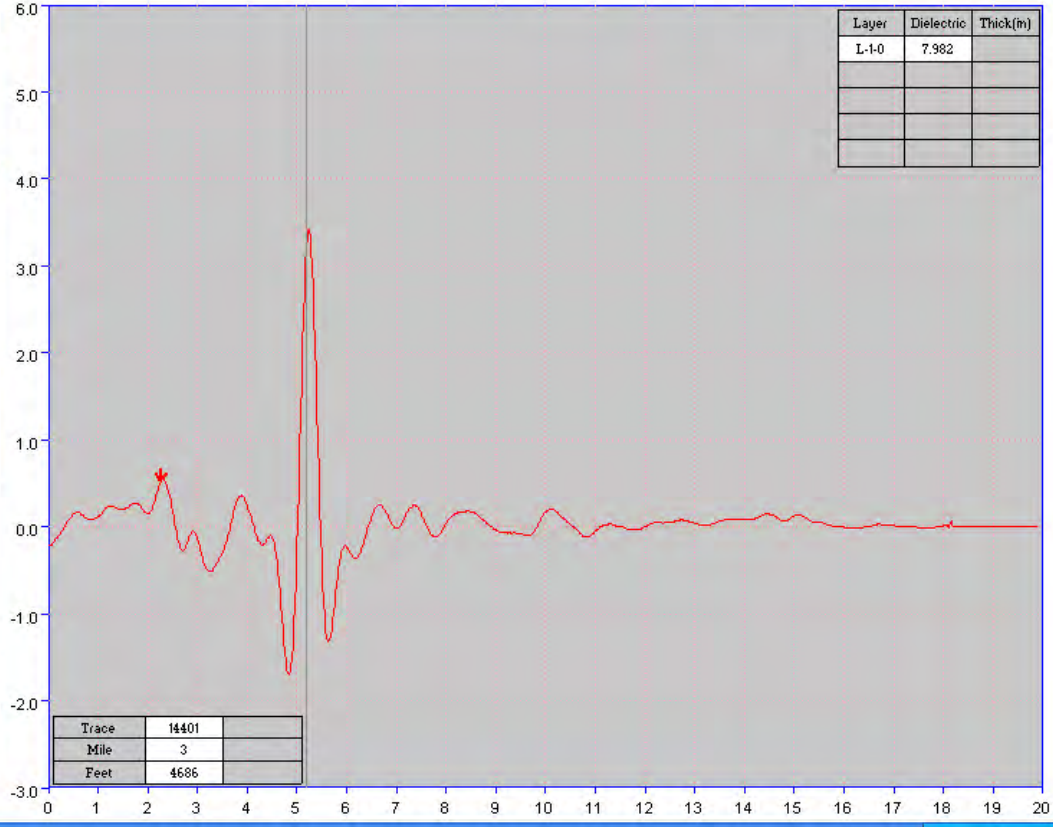


GPS: Lat: 29.72037634 Log: 95.37720676 (Lat:(N) 29:43:13.3548 Log:(W) 95:22:37.9444

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

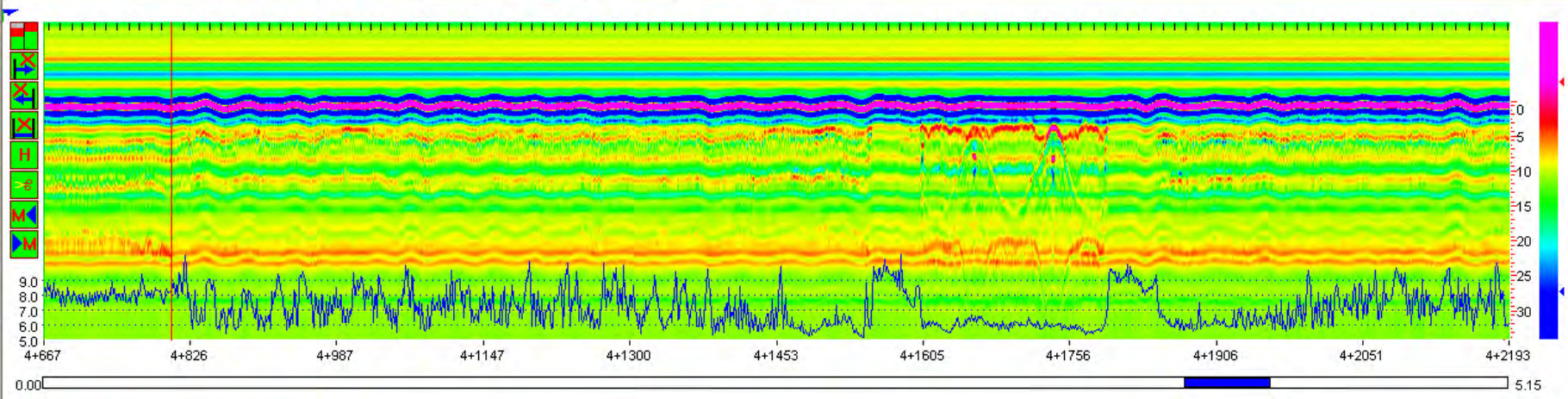


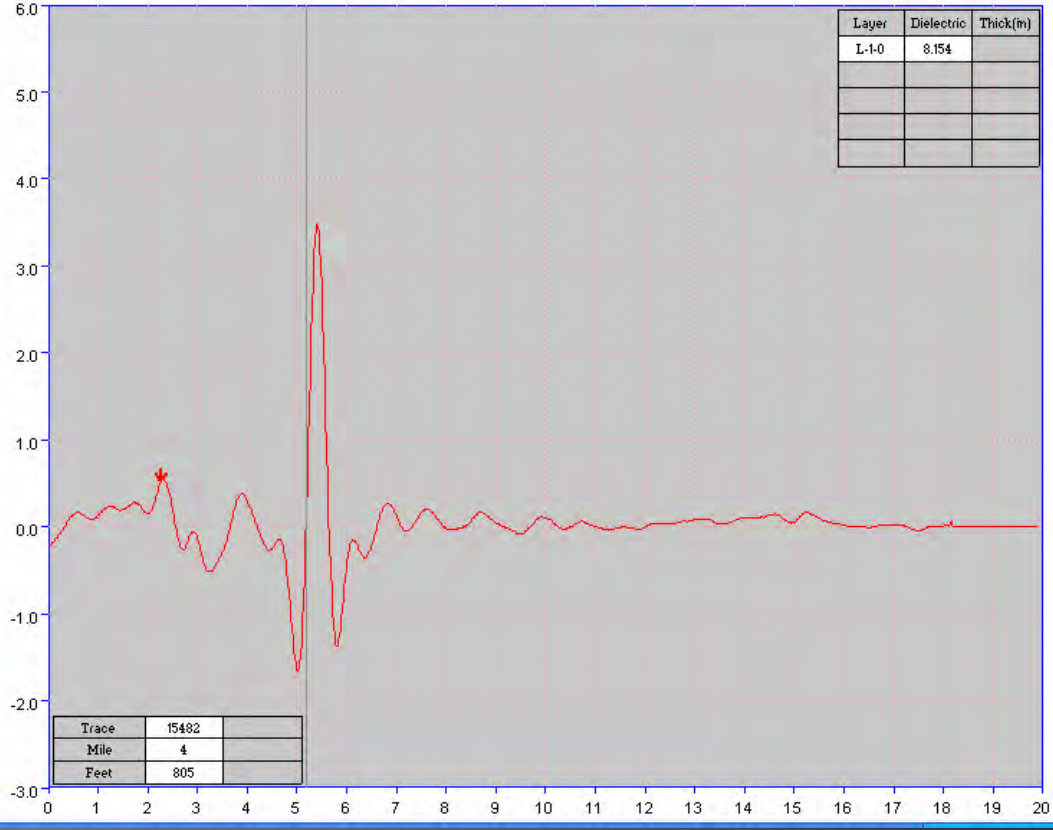


GPS: Lat: 29.72395157 Log: 95.37597000 (Lat:(N) 29:43:26.2256 Log:(W) 95:22:33.4920

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

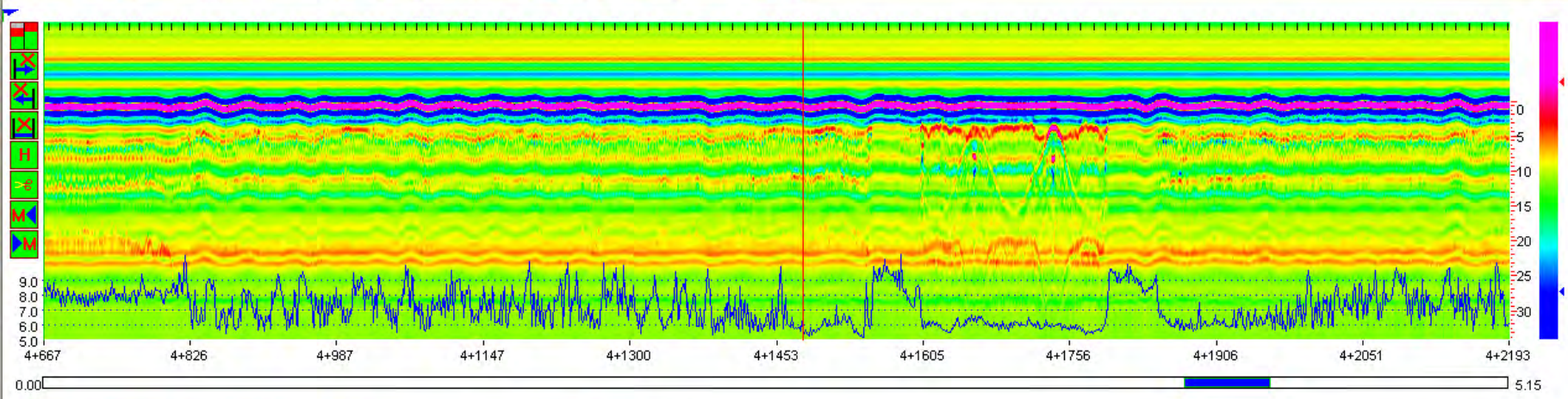


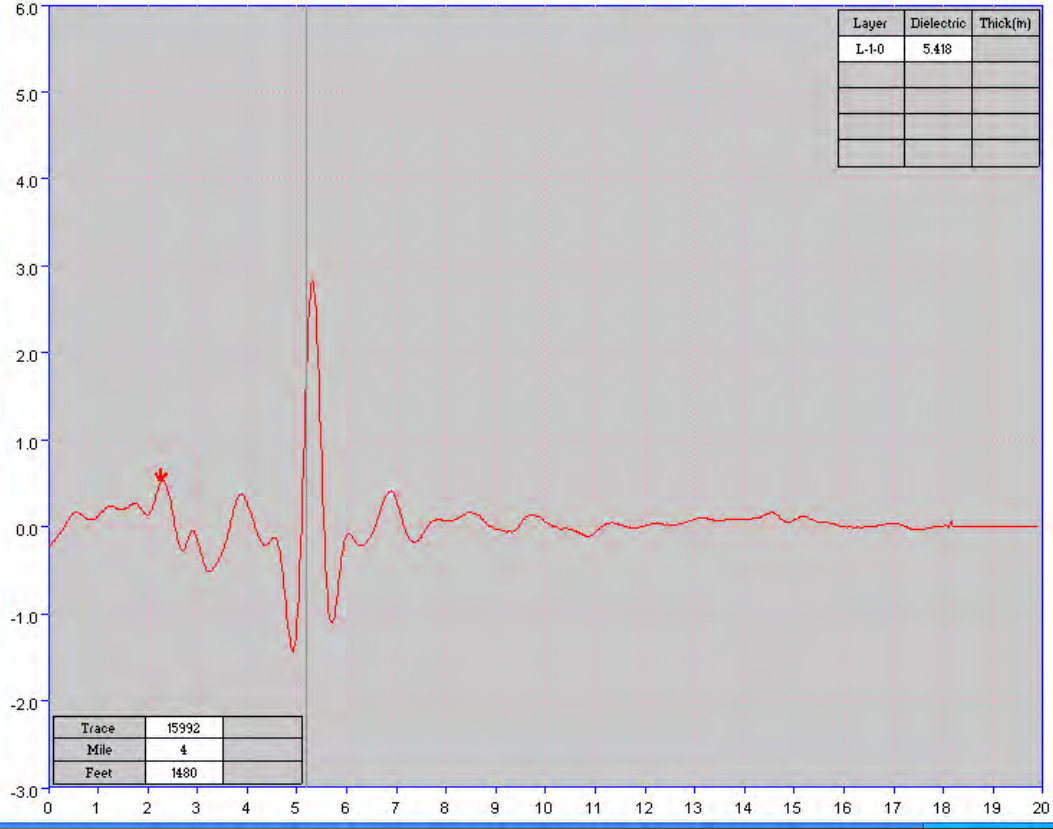


GPS: Lat: 29.72555271 Log: 95.37498056 (Lat:(N) 29:43:31.9898 Log:(W) 95:22:29.9300

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

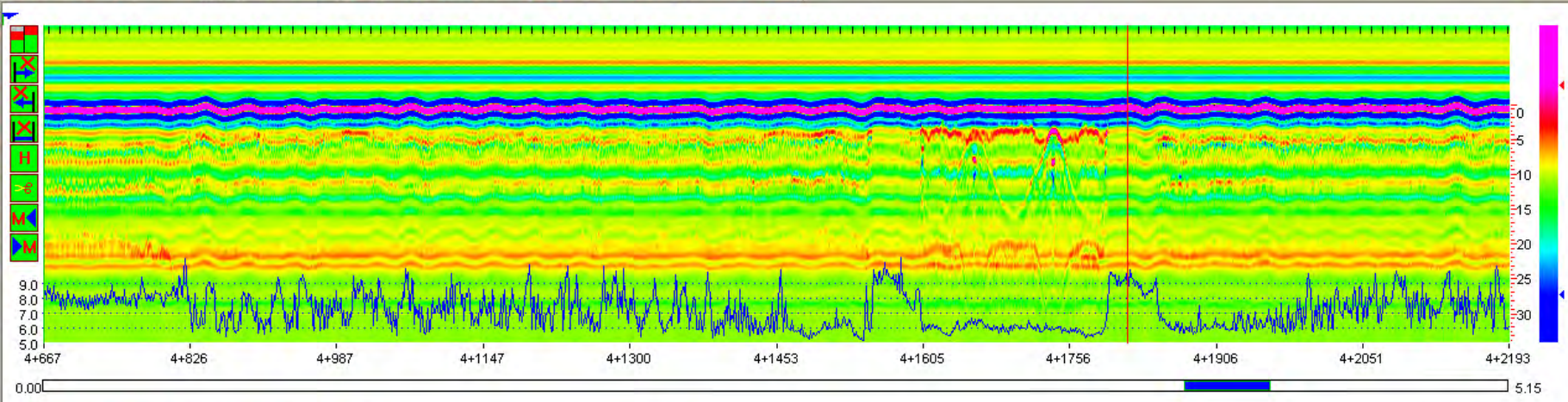


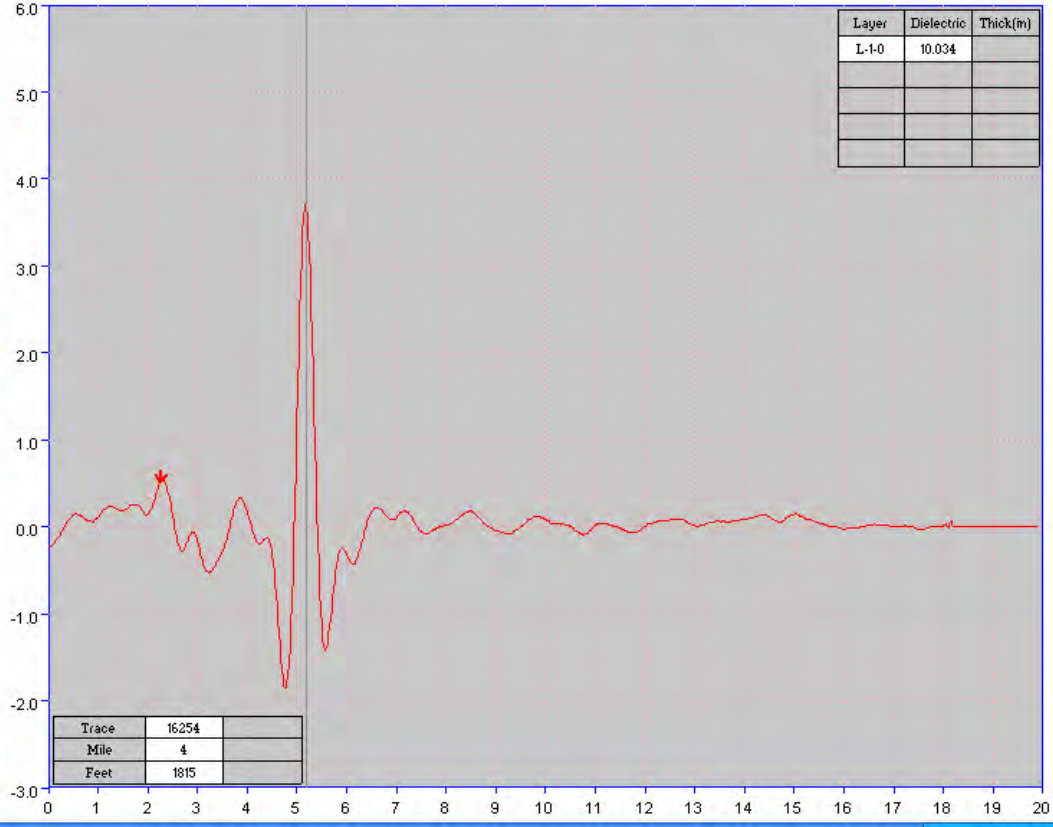


GPS: Lat: 29.72630101 Log: 95.37439101 (Lat:(N) 29:43:34.6836 Log:(W) 95:22:27.8076

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

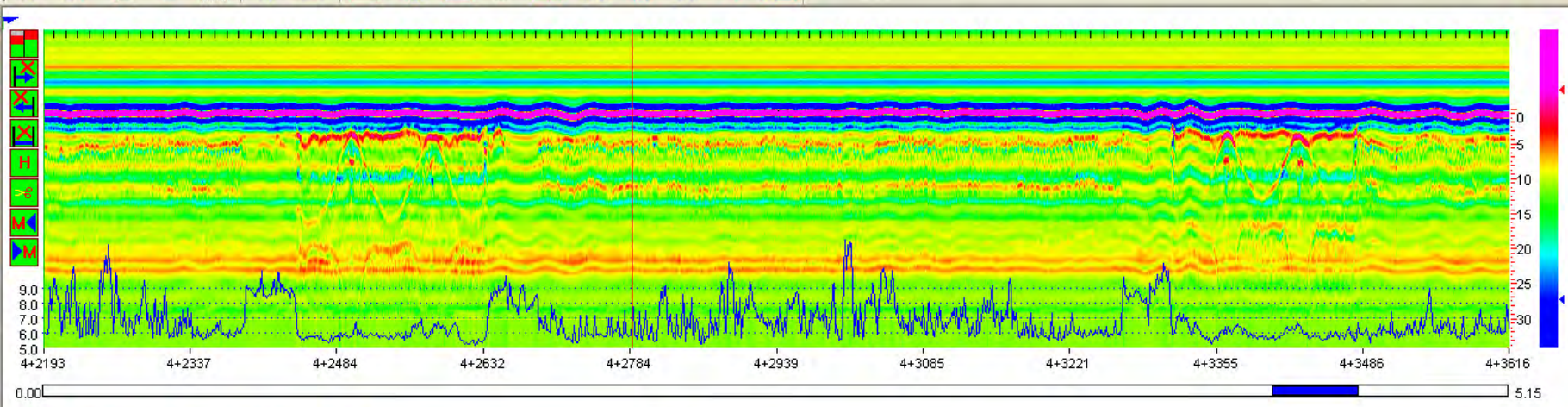


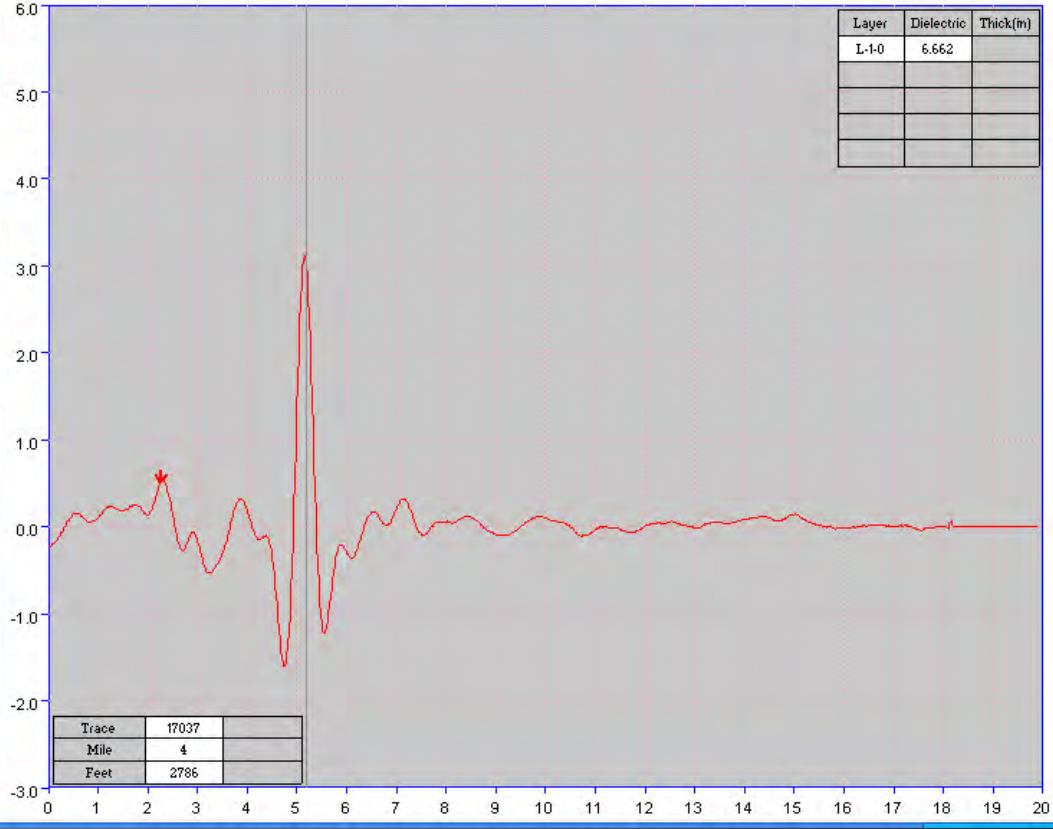


GPS: Lat: 29.72860373 Log: 95.37261941 (Lat:(N) 29:43:42.9734 Log:(W) 95:22:21.4299

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

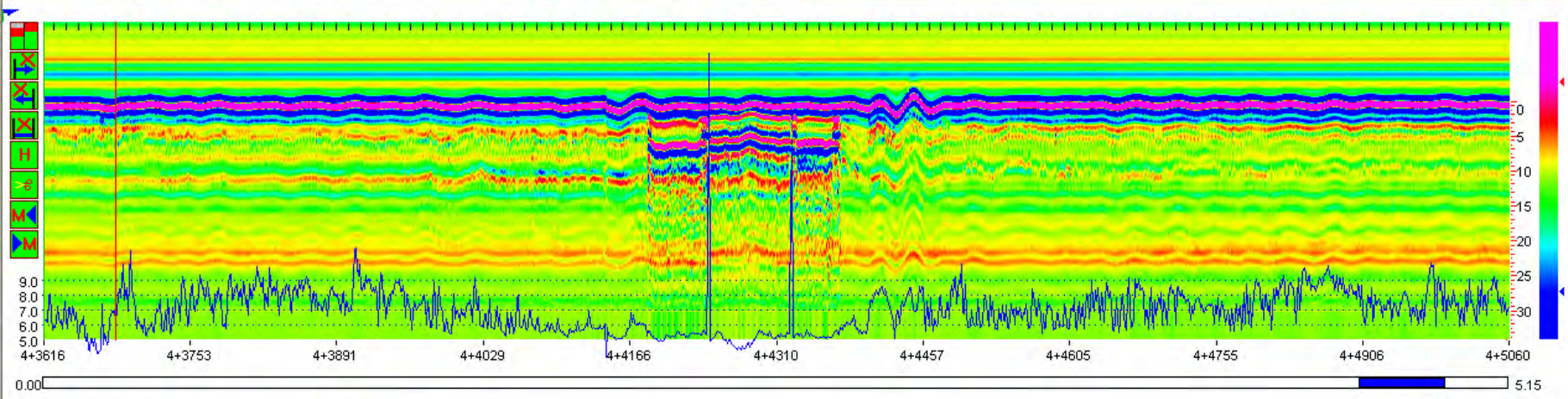


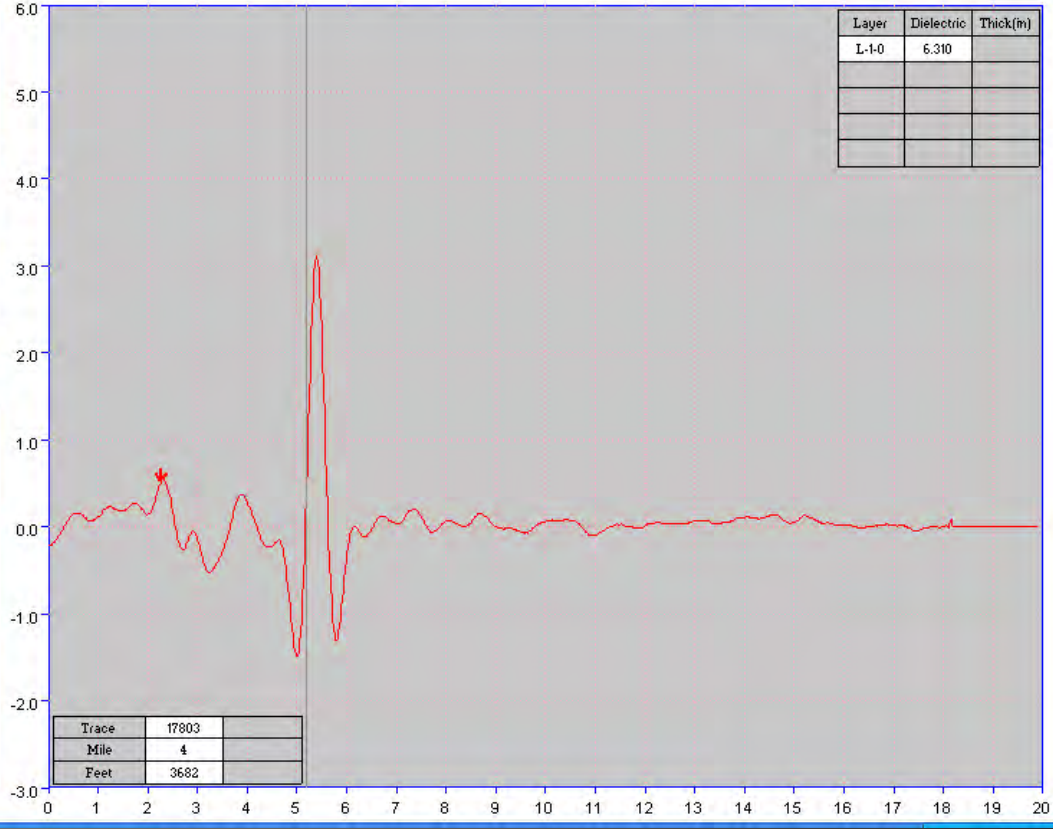


GPS: Lat: 29.73086497 Log: 95.37167143 (Lat:(N) 29:43:51.1139 Log:(W) 95:22:18.0172

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

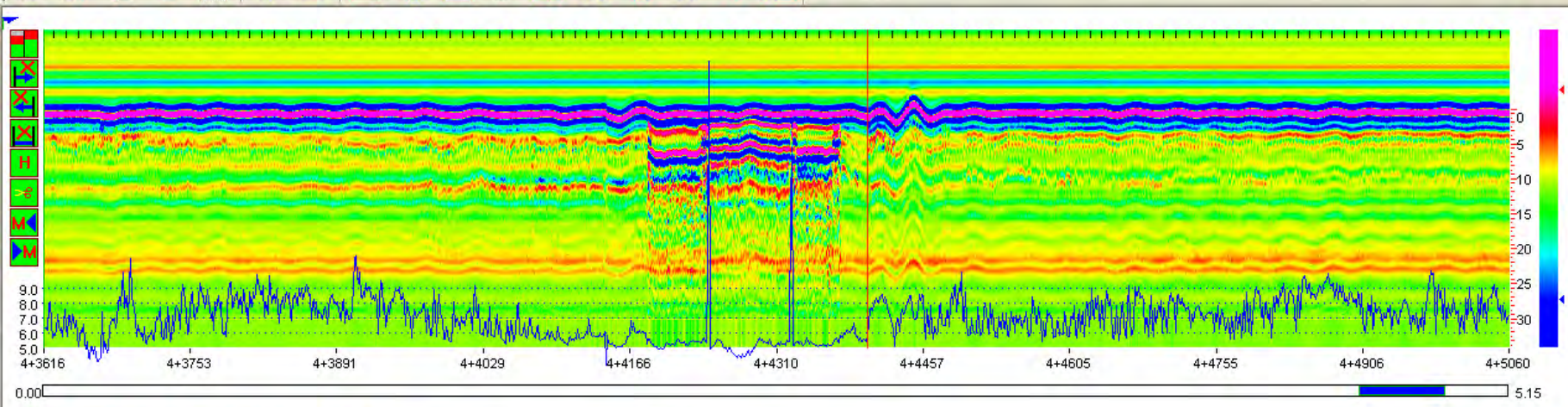


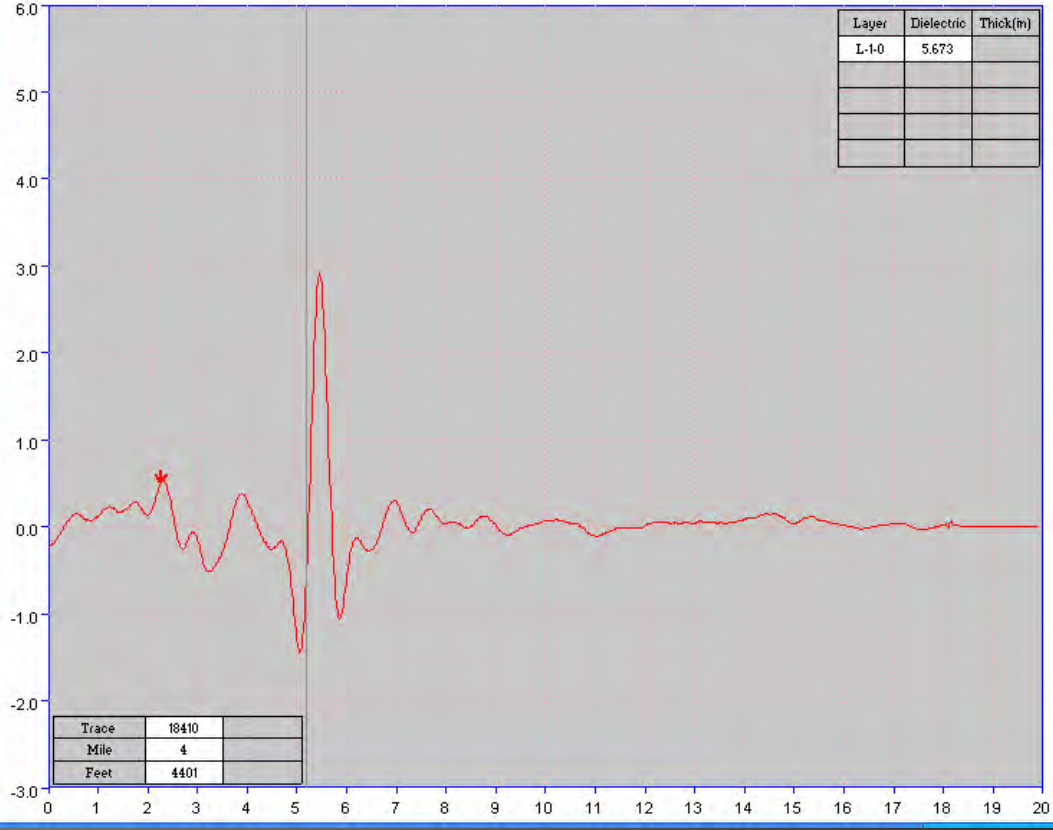


GPS: Lat: 29.73267895 Log: 95.37100631 (Lat:(N) 29:43:57.6442 Log:(W) 95:22:15.6227

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080

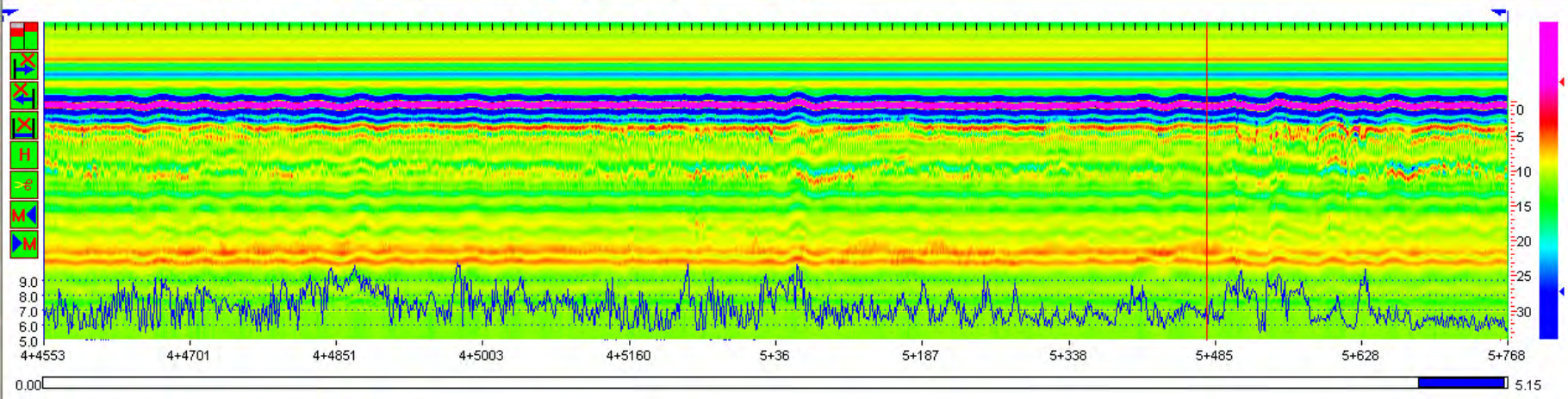


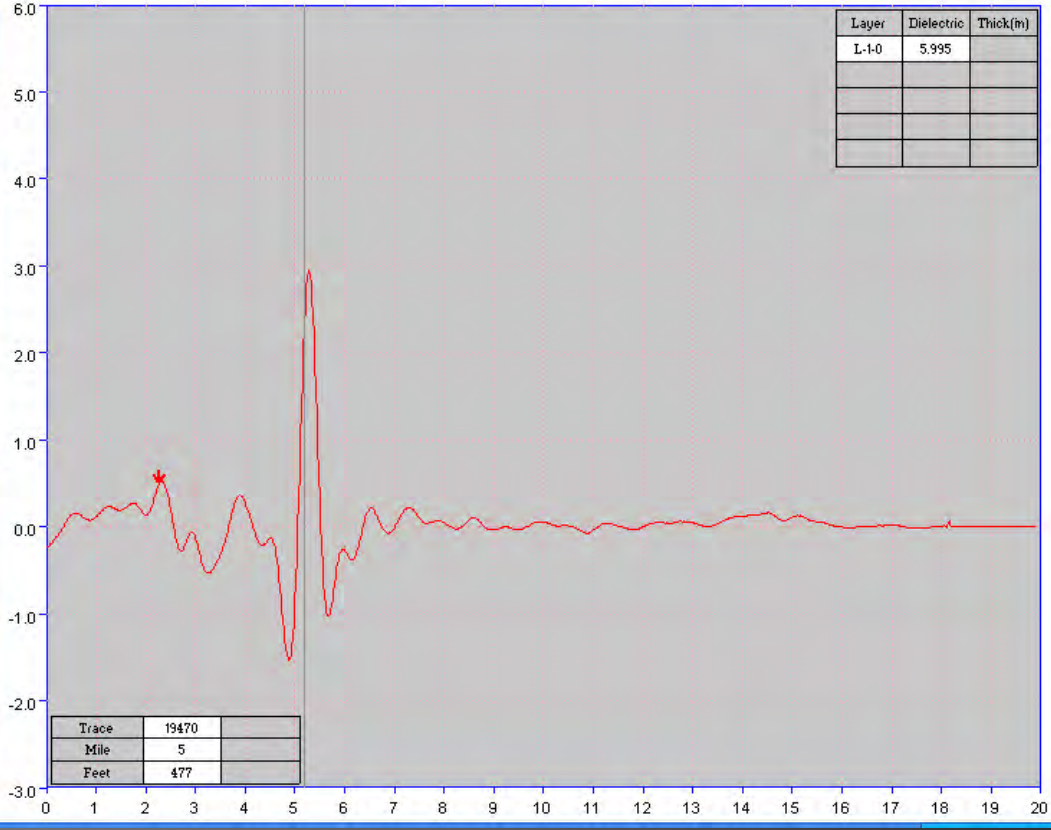


GPS: Lat: 29.73576399 Log: 95.36880242 (Lat:(N) 29:44: 8.7504 Log:(W) 95:22: 7.6887

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288nb.PRJ.txt | 288nb.DAT | GPR:19714 VID:2188 GPS:390 FWD:0 RDD:0 | 0.00 to 5.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:29:54) | C: 4/2/2016(| 1920X1080





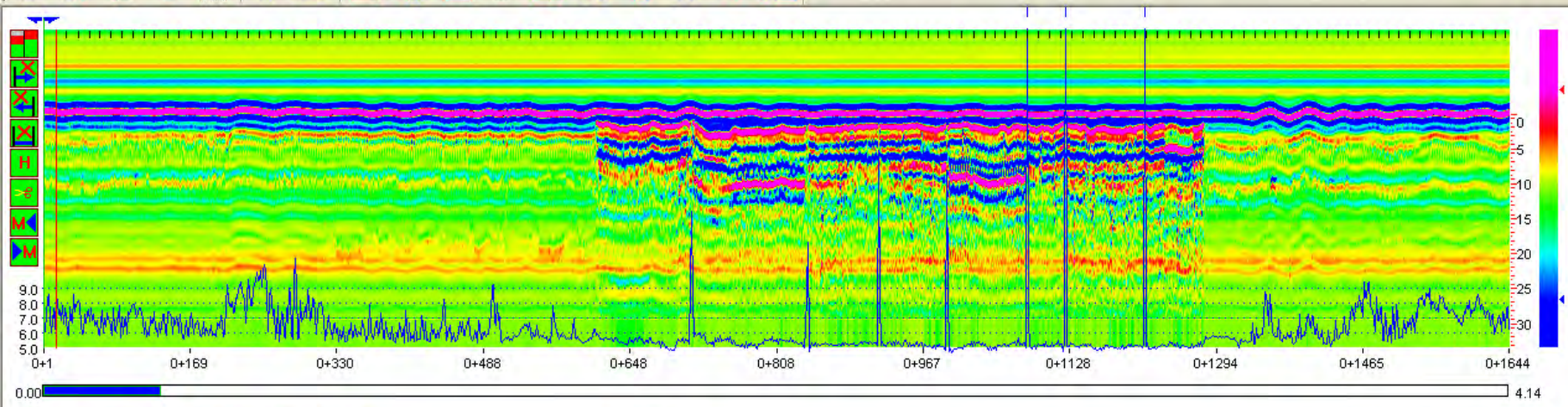
Texas A&M Transportation Institute

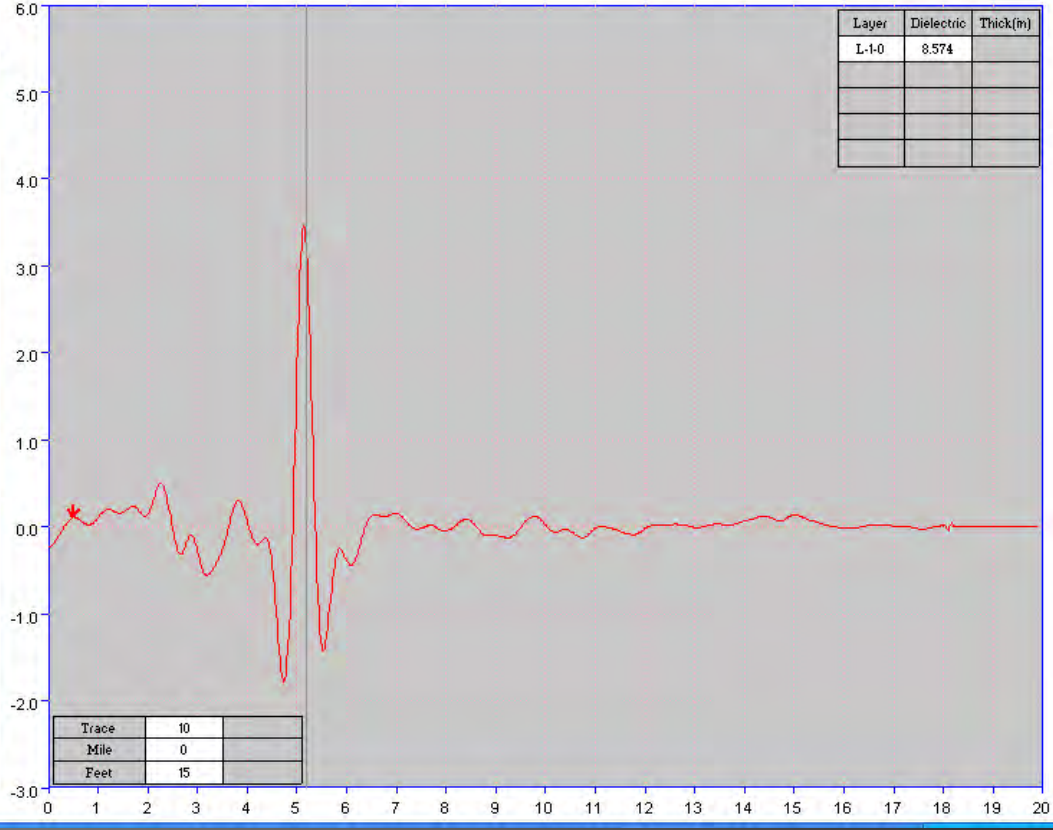
SH 288 Southbound
Ground Penetrating Radar Data
October, 2017

GPS: Lat: 29.75305283 Log: 95.36528667 (Lat:(N) 29:45:10.9902 Log:(W) 95:21:55.0320

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

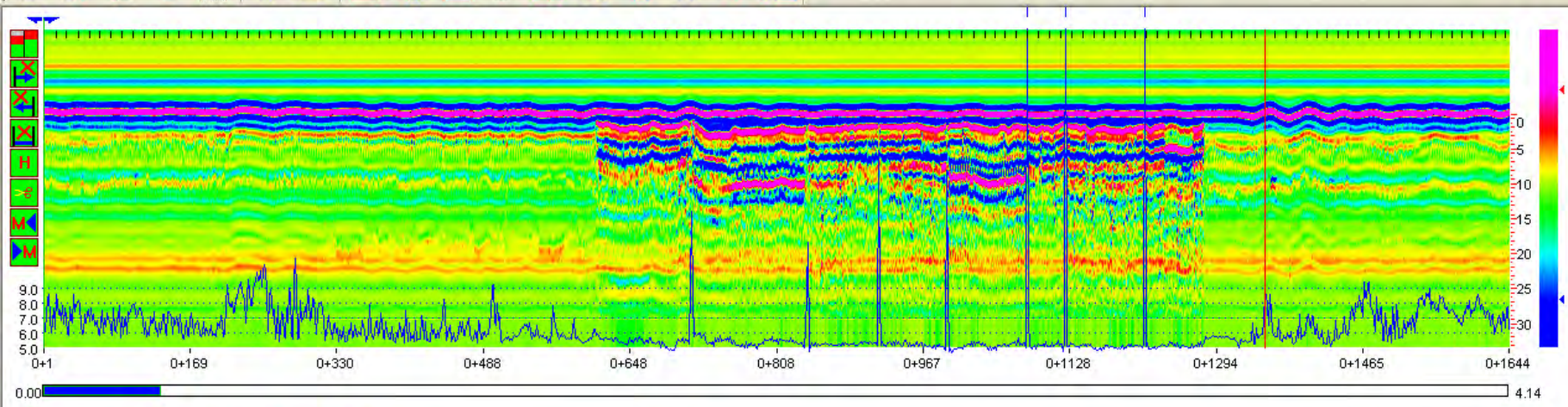


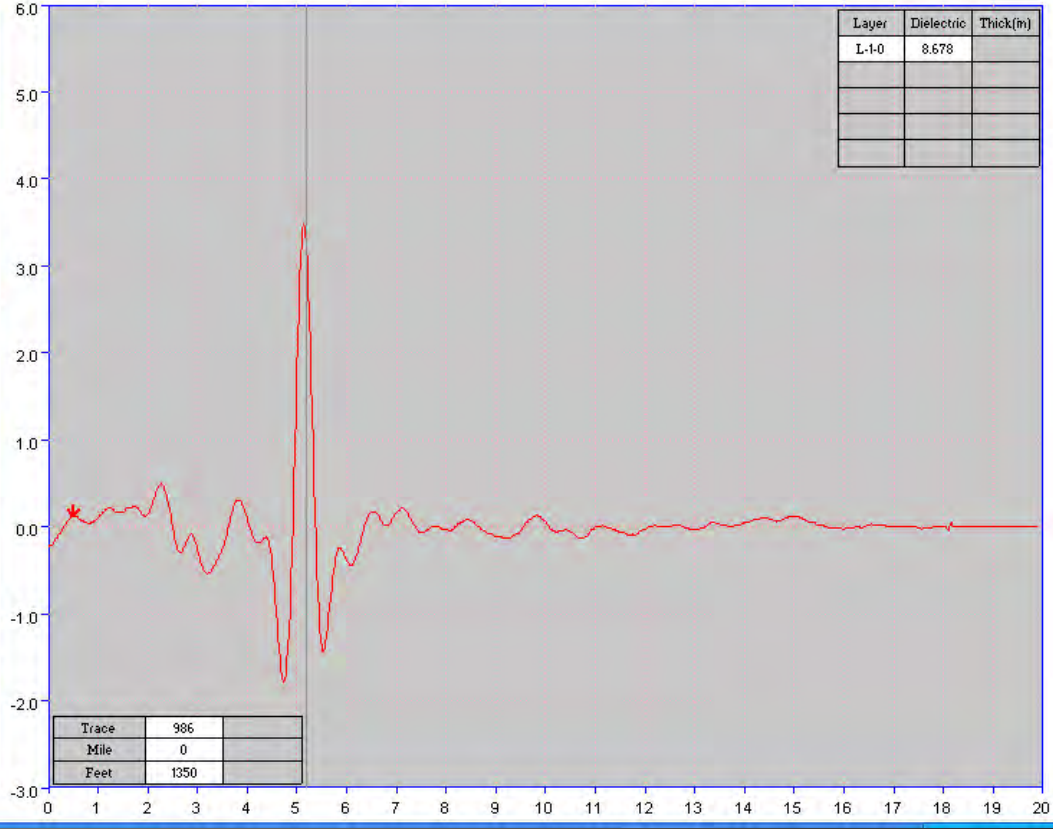


GPS: Lat: 29.73262428 Log: 95.37189510 (Lat:(N) 29:43:57.4474 Log:(W) 95:22:18.8224

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

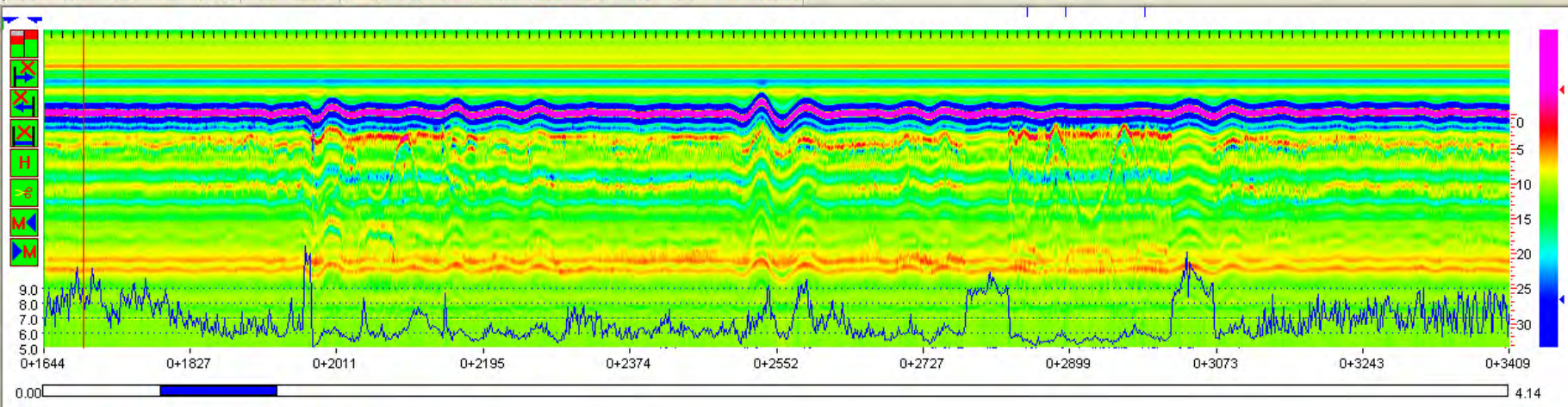


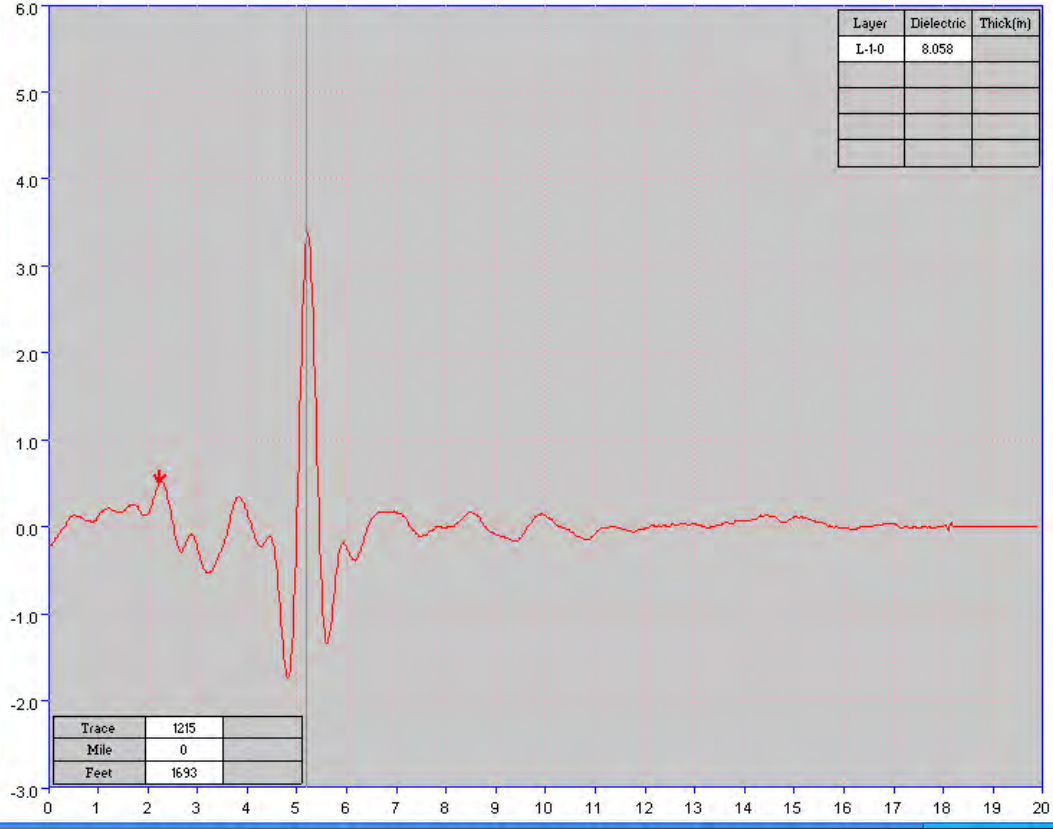


GPS: Lat: 29.73175227 Log: 95.37215067 (Lat:(N) 29:43:54.3082 Log:(W) 95:22:19.7424

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

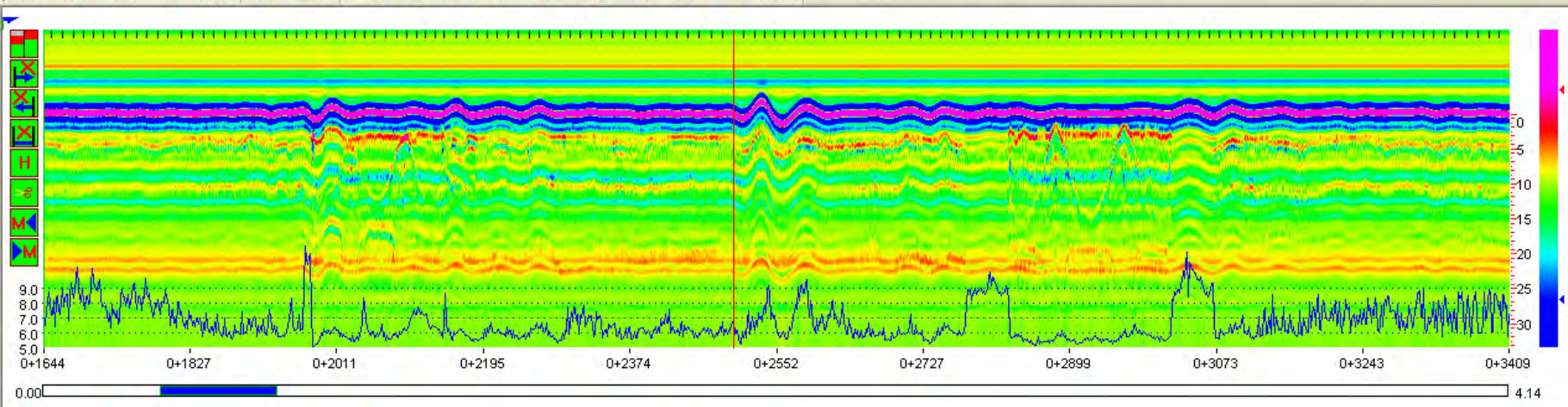


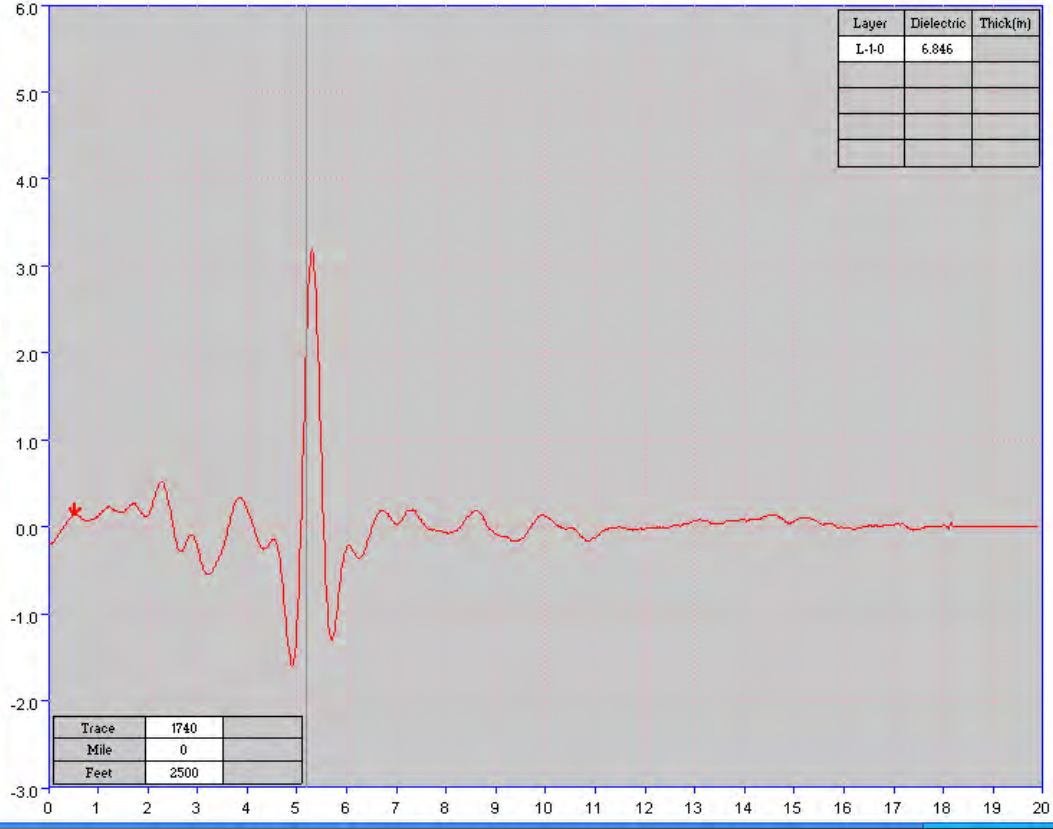


GPS: Lat: 29.72968200 Log: 95.37285693 (Lat:(N) 29:43:46.8552 Log:(W) 95:22:22.2850

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

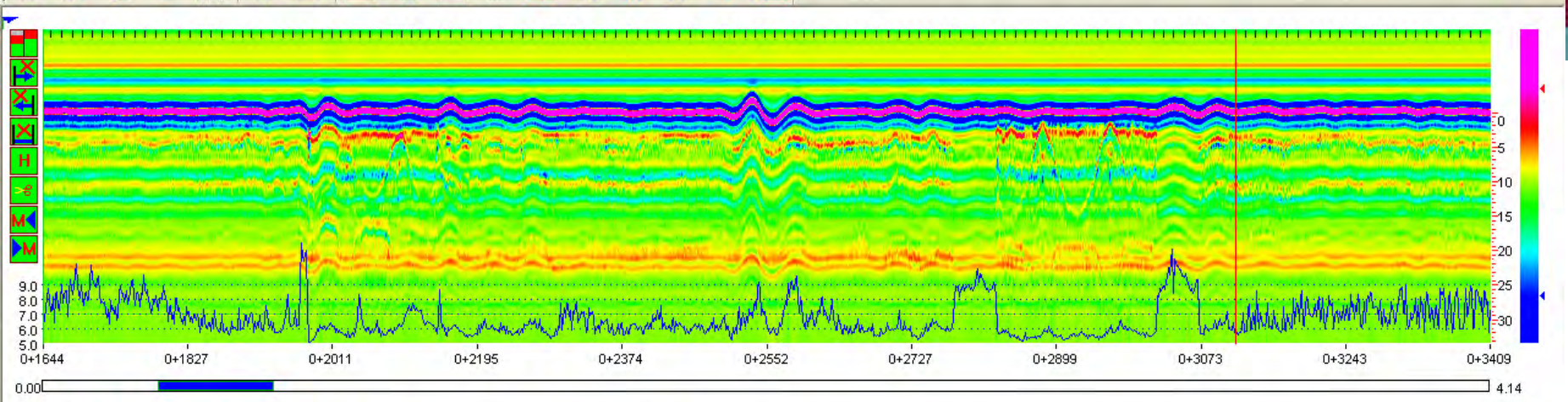


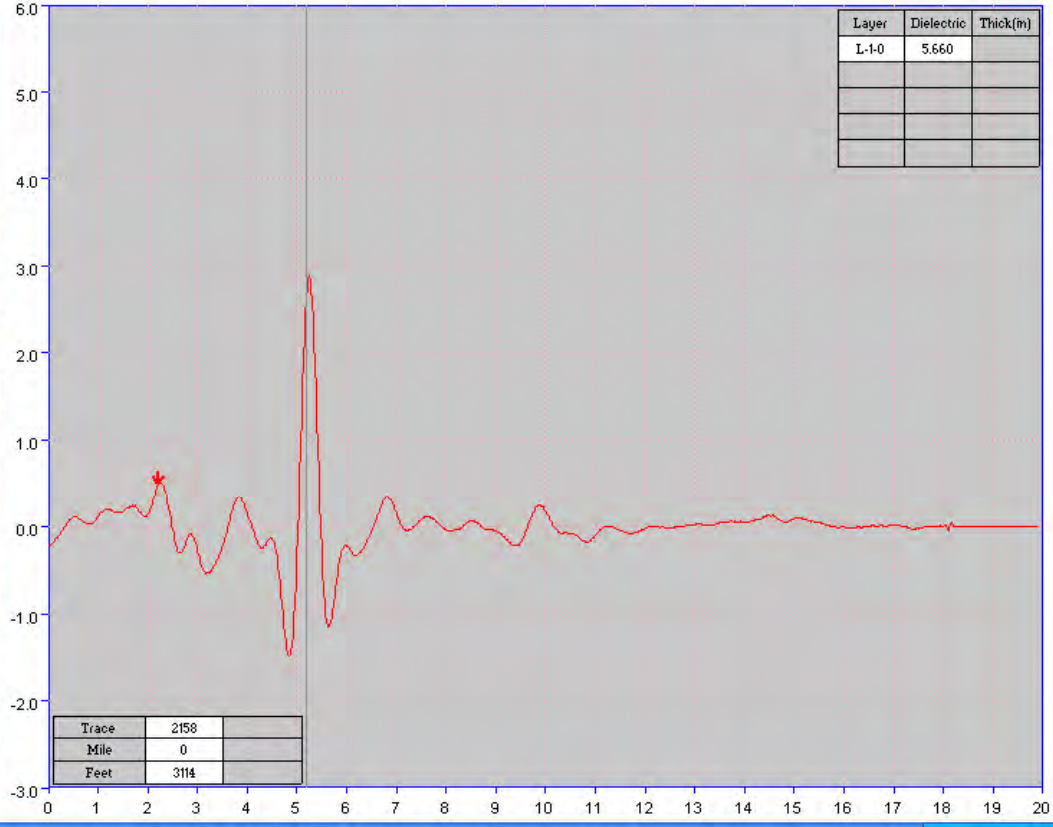


GPS: Lat: 29.72823387 Log: 95.37375747 (Lat:(N) 29:43:41.6419 Log:(W) 95:22:25.5269

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

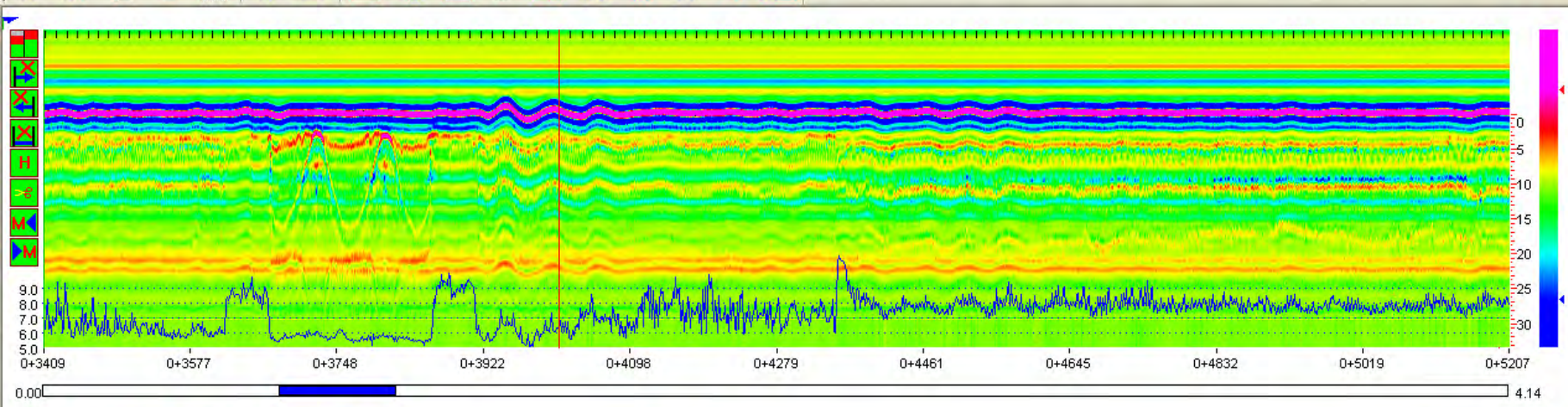


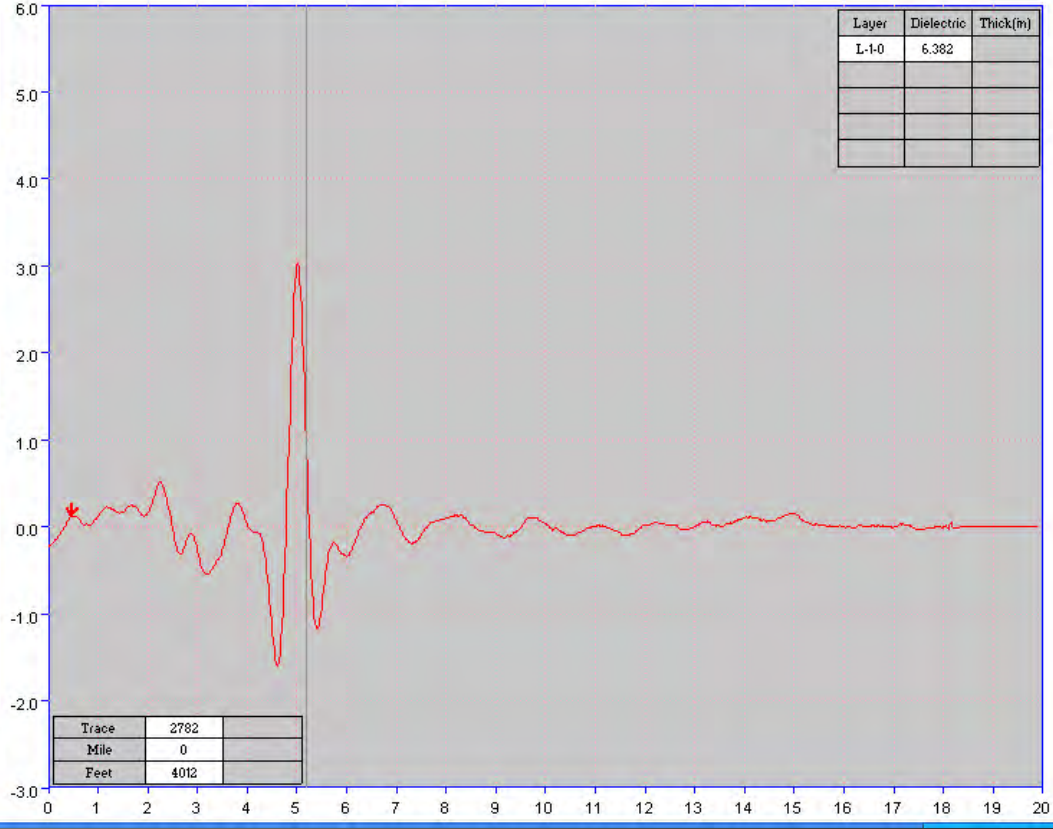


GPS: Lat: 29.72625735 Log: 95.37531863 (Lat:(N) 29:43:34.5265 Log:(W) 95:22:31.1471

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

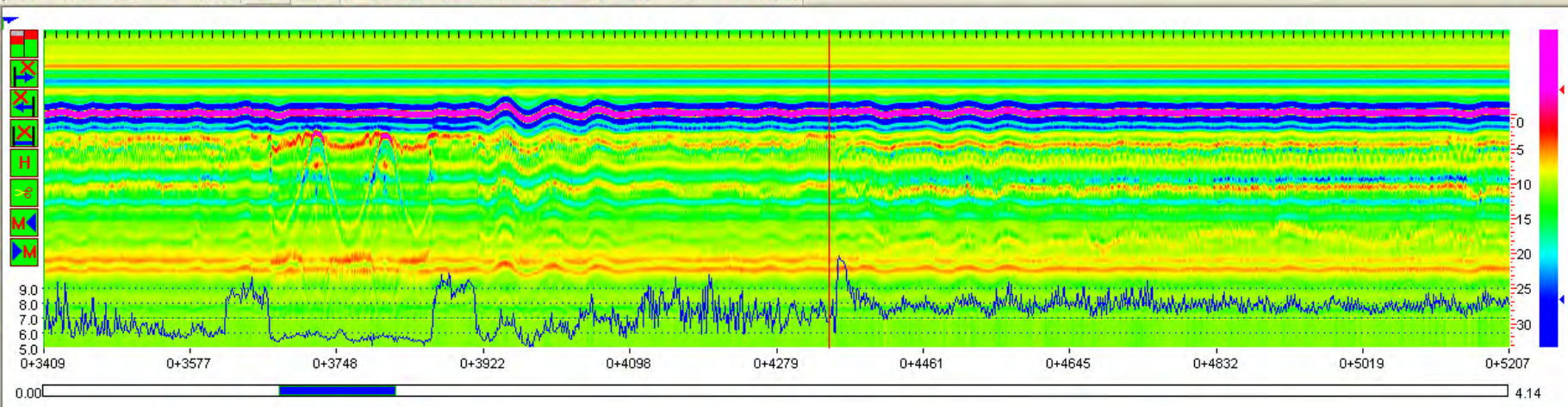


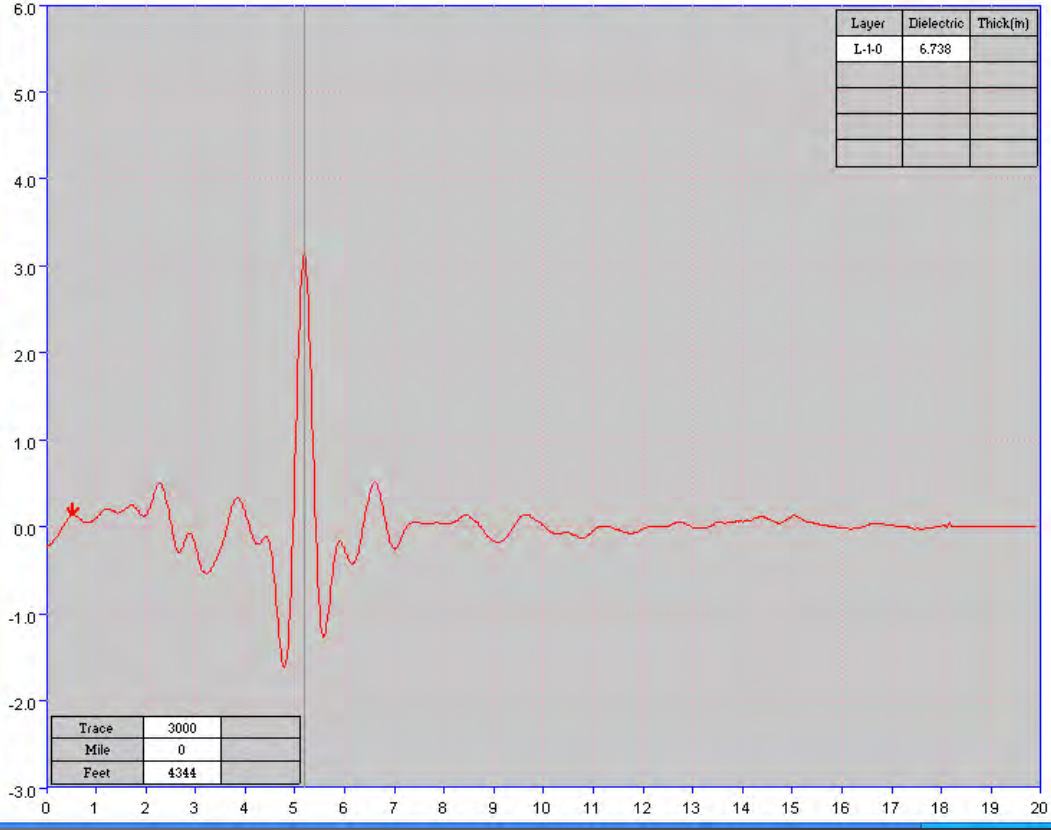


GPS: Lat: 29.72539059 Log: 95.37596657 (Lat:(N) 29:43:31.4061 Log:(W) 95:22:33.4796

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

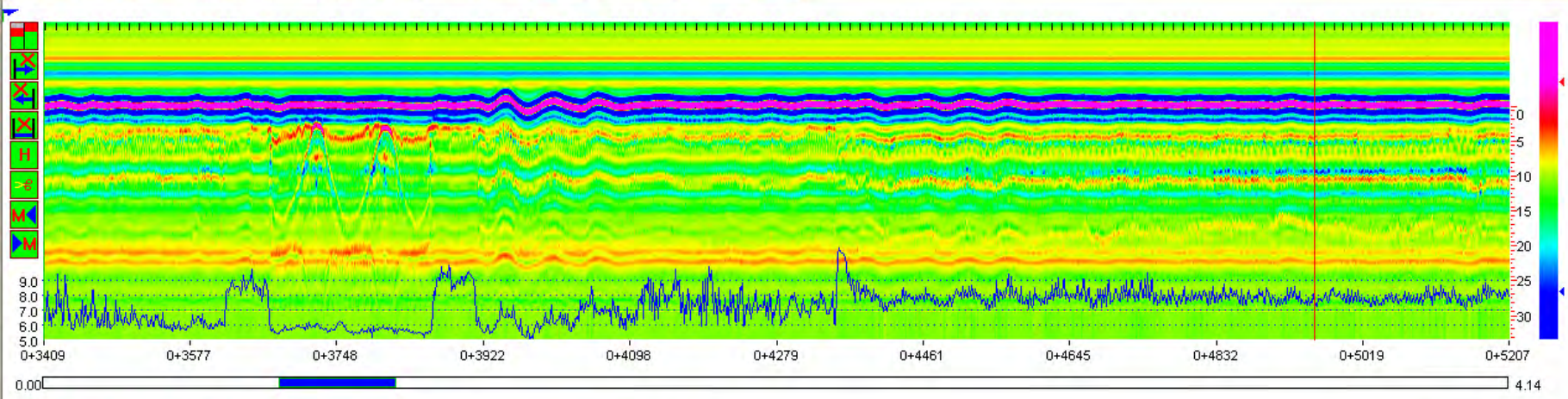


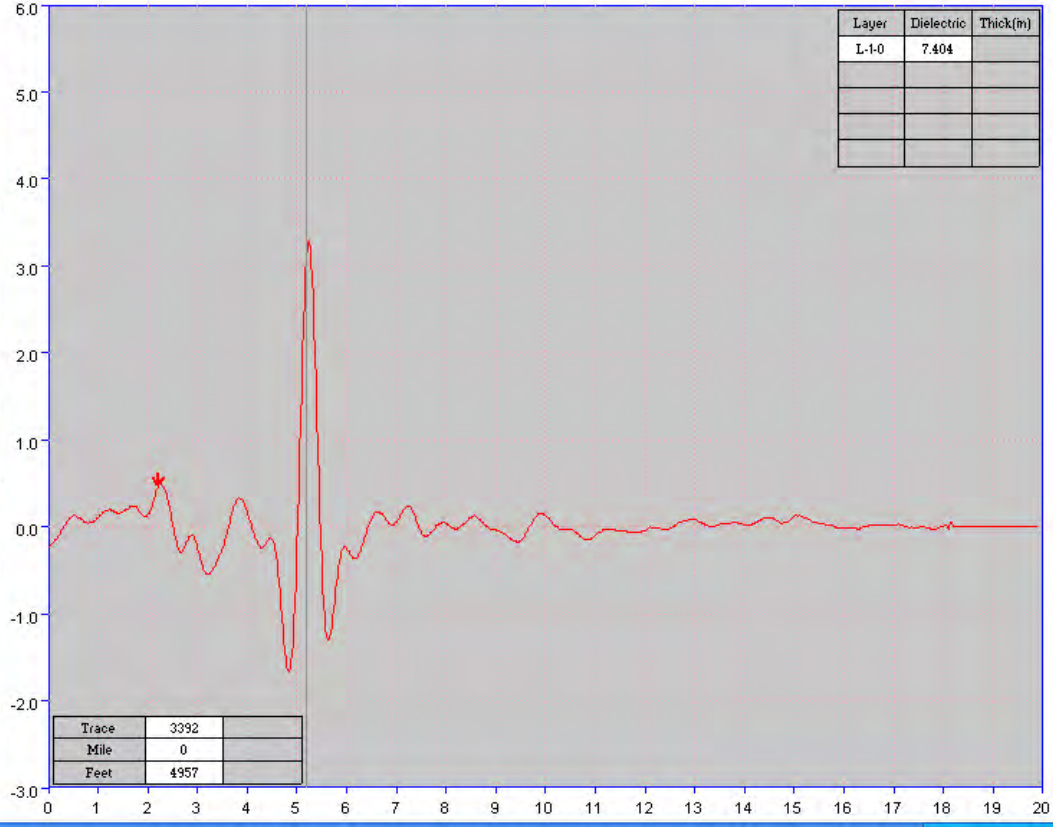


GPS: Lat: 29.72387281 Log: 95.37679500 (Lat:(N) 29:43:25.9421 Log:(W) 95:22:36.4620

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

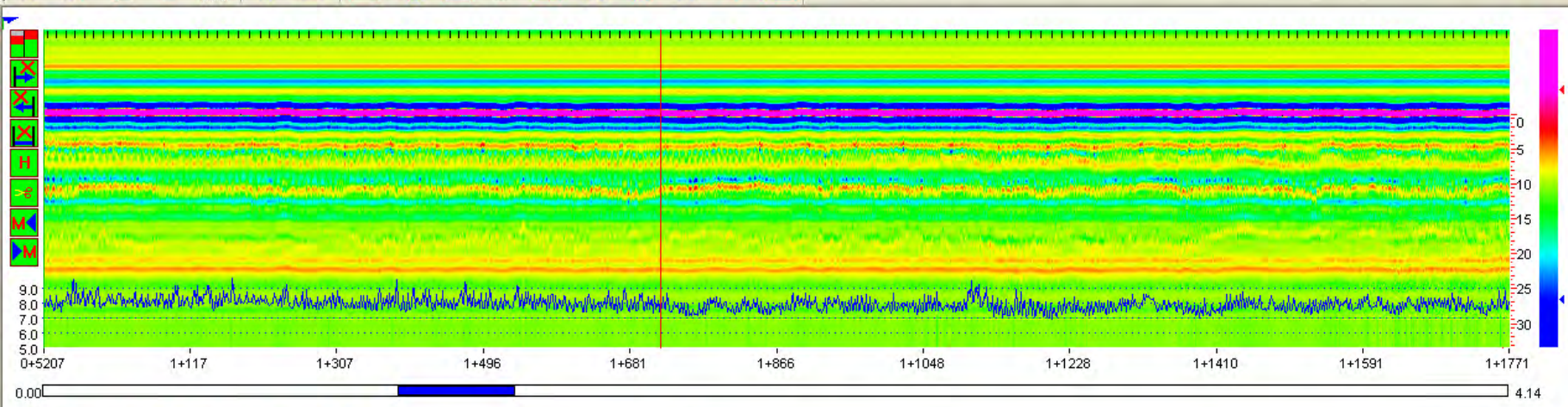


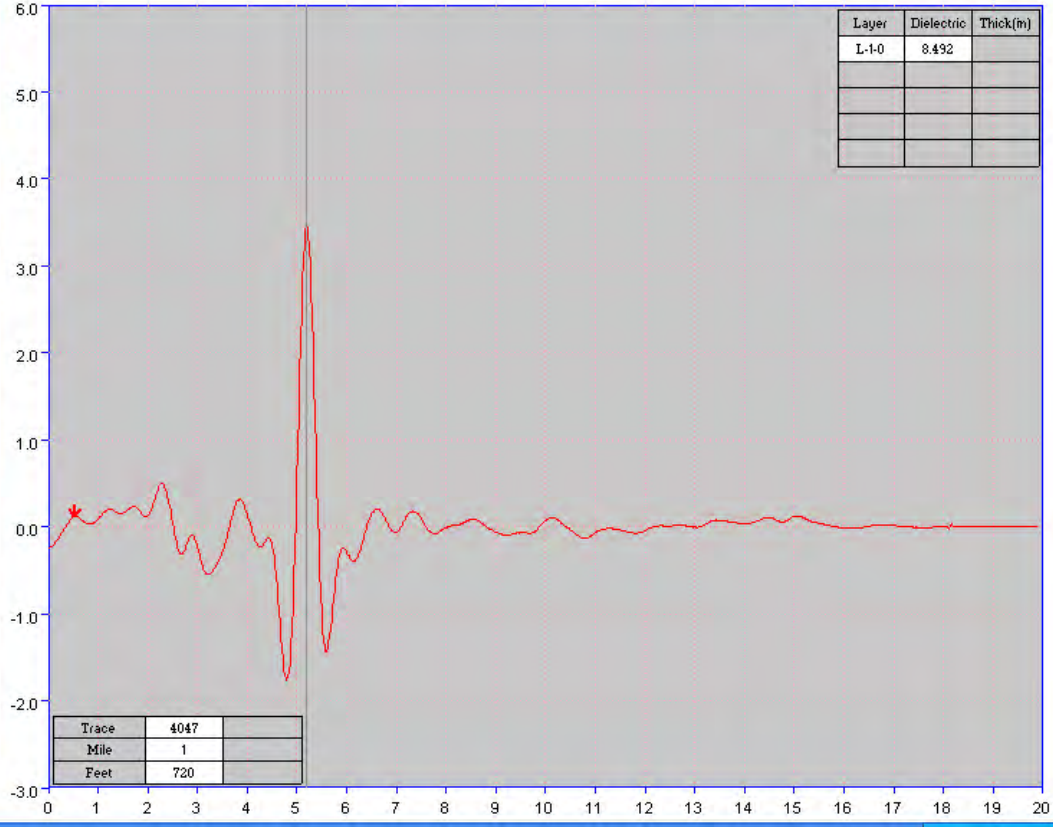


GPS: Lat: 29.72117392 Log: 95.37767304 (Lat:(N) 29:43:16.2261 Log:(W) 95:22:39.6229

File Tools Output KML Google Map

C:\Documents and Settings\a-wims 288sb.PRJ.txt 288sb.DAT GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 0.00 to 4.1 V:6.0196 B: 1.5313 T:10-16-2017(09:20:22) C: 4/2/2016(1920X1080

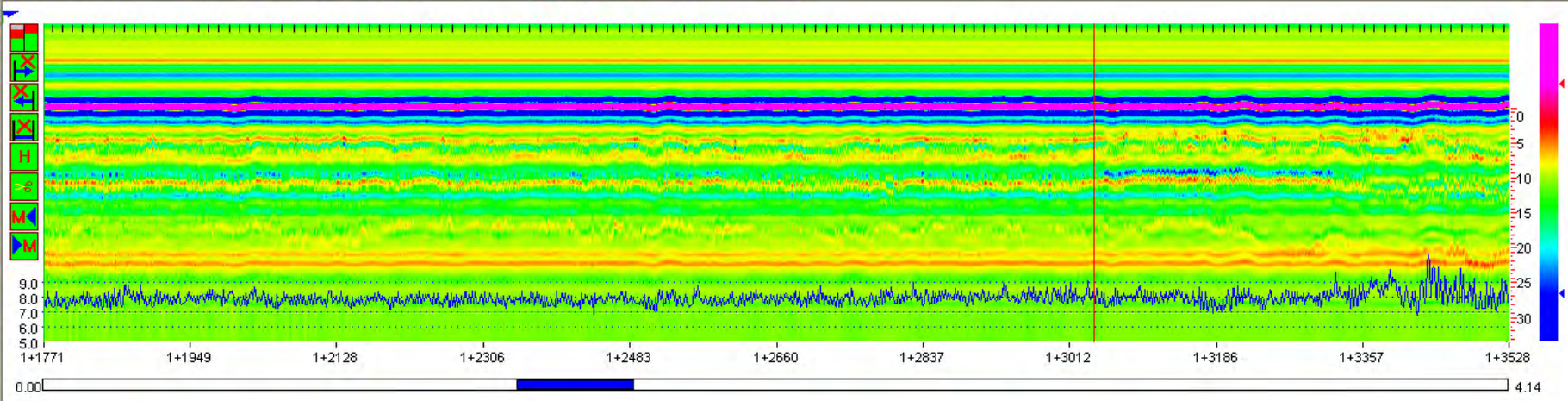


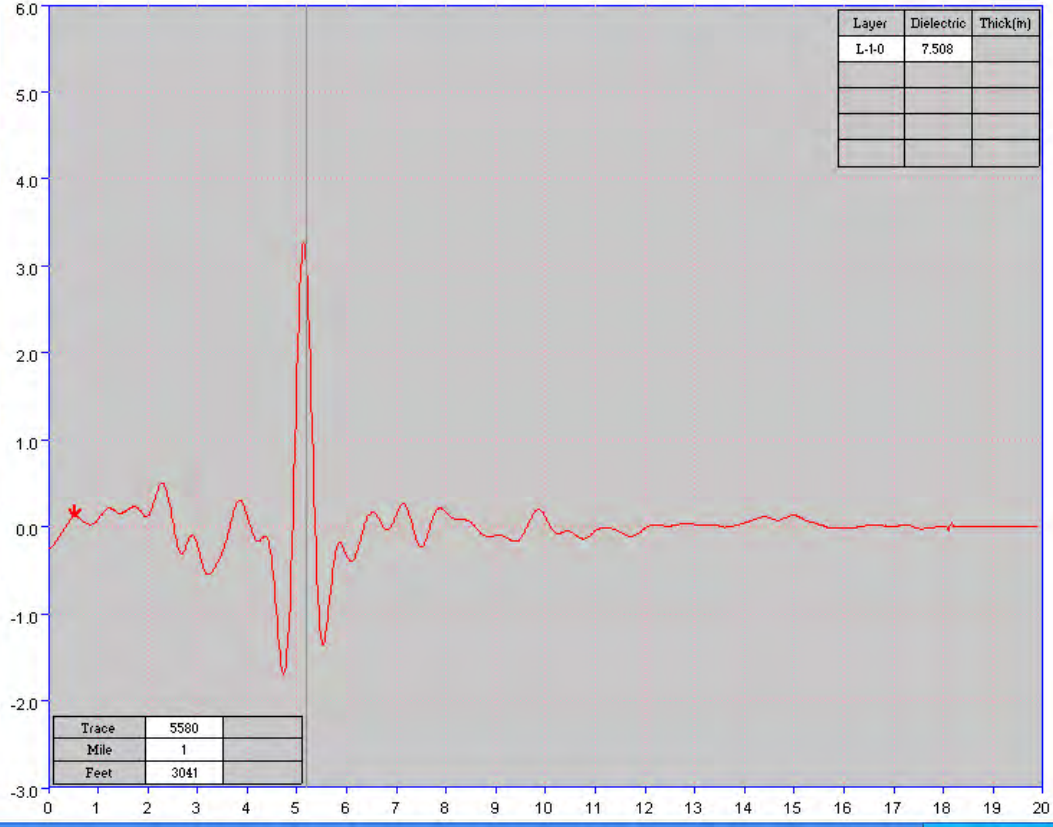


GPS: Lat: 29.71510167 Log: 95.37921056 (Lat:(N) 29:42:54.3660 Log:(W) 95:22:45.1580

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

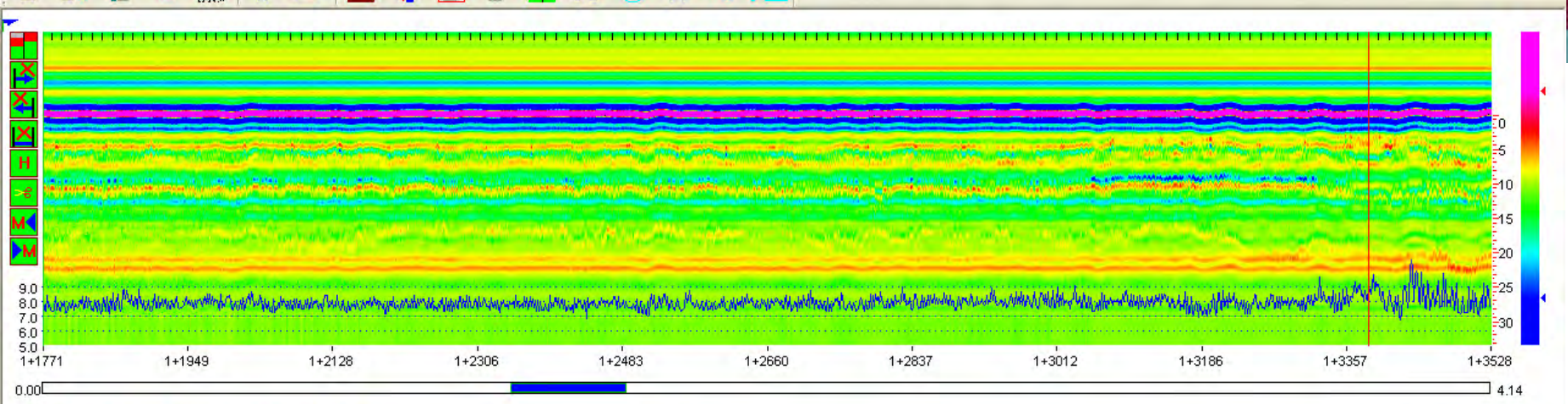


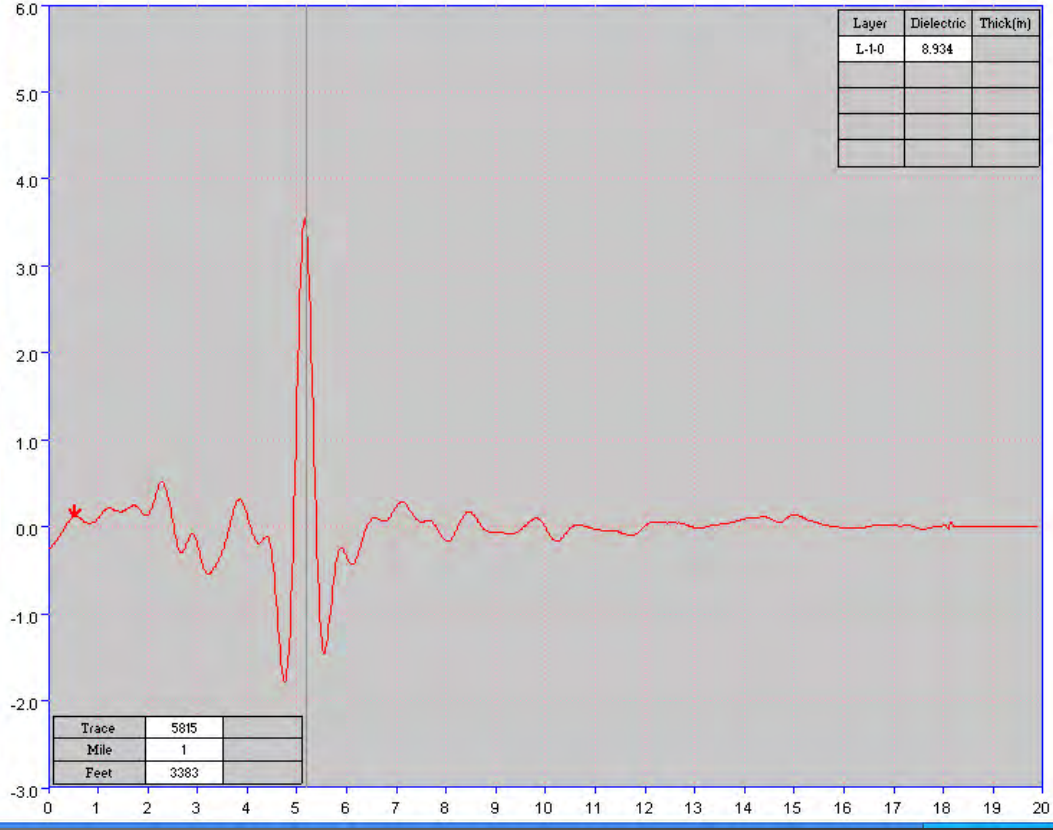


GPS: Lat: 29.71418549 Log: 95.37919373 (Lat:(N) 29:42:51.0678 Log:(W) 95:22:45.0974

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

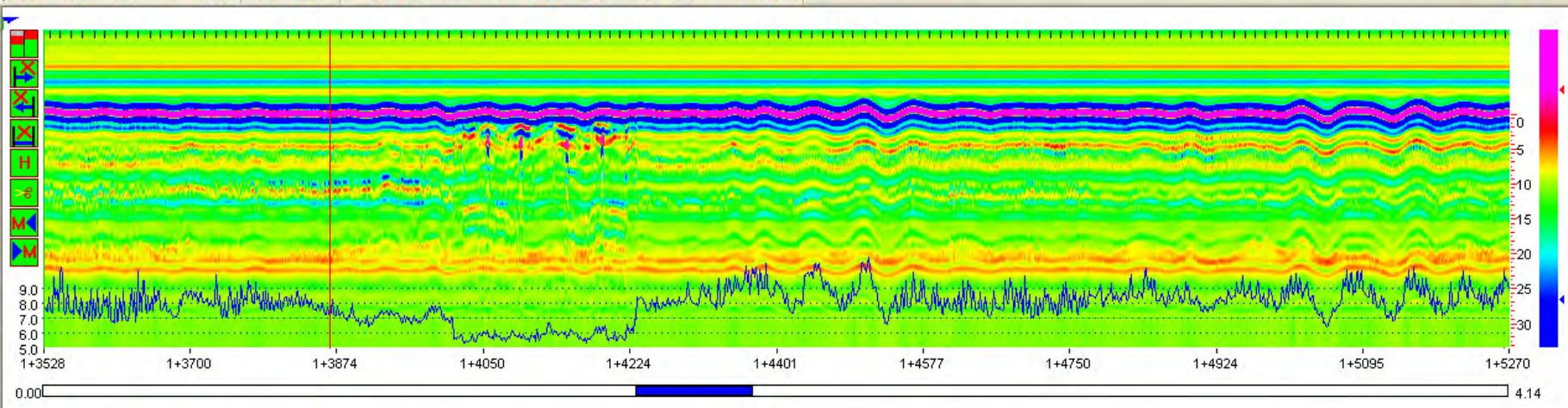


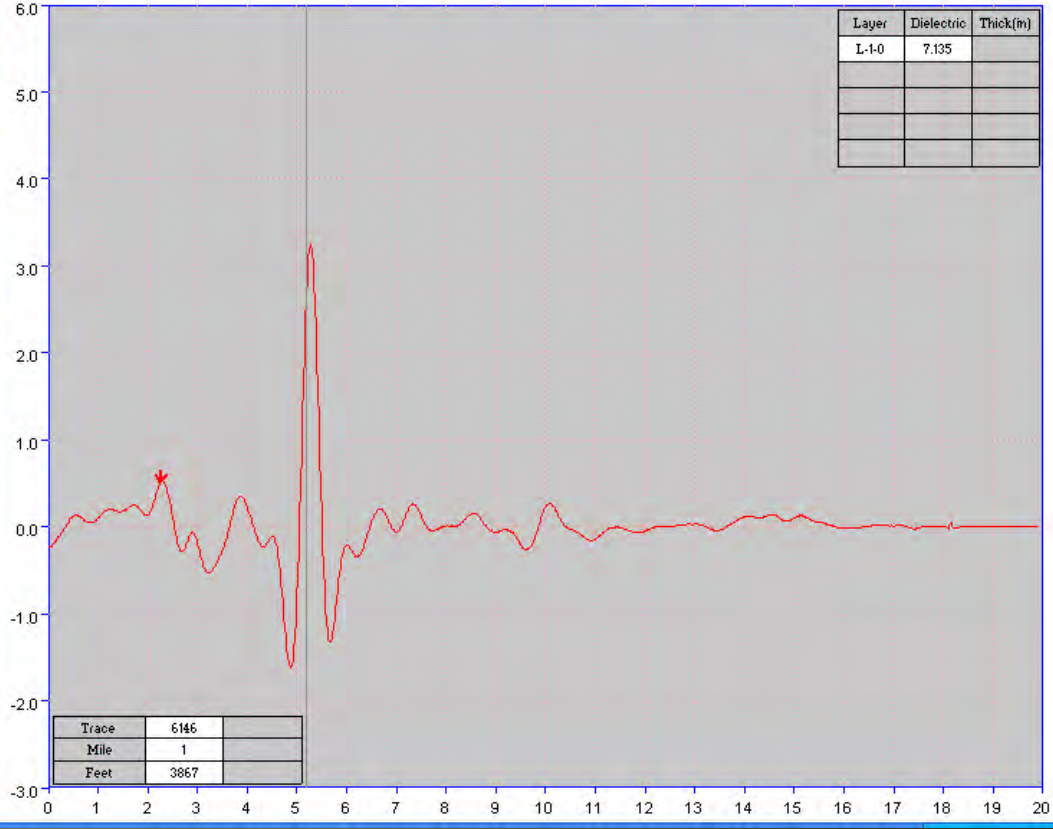


GPS: Lat: 29.71290471 Log: 95.37900931 (Lat:(N) 29:42:46.4569 Log:(W) 95:22:44.4335

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

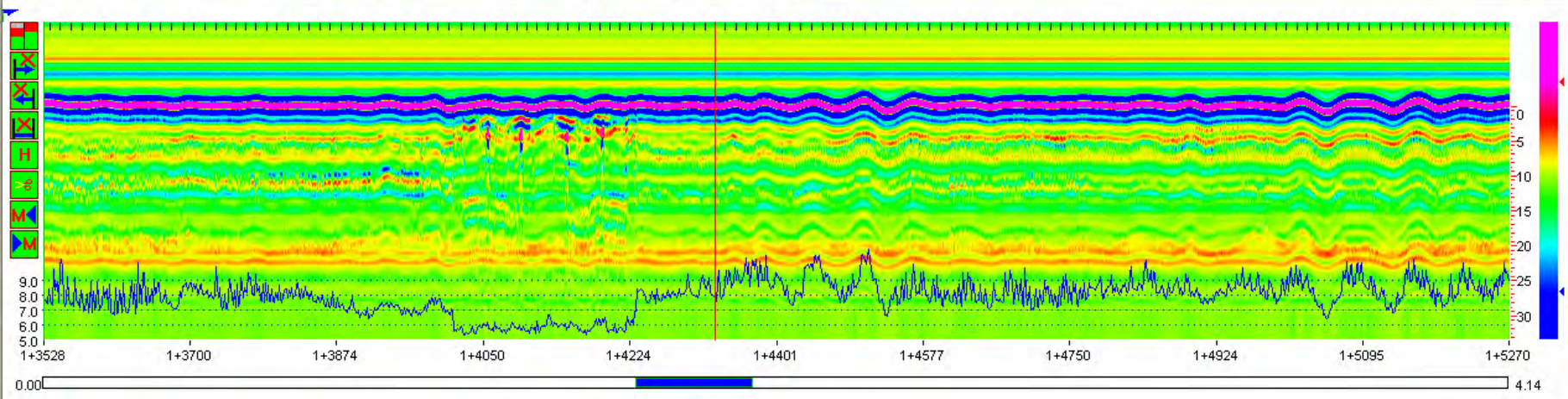


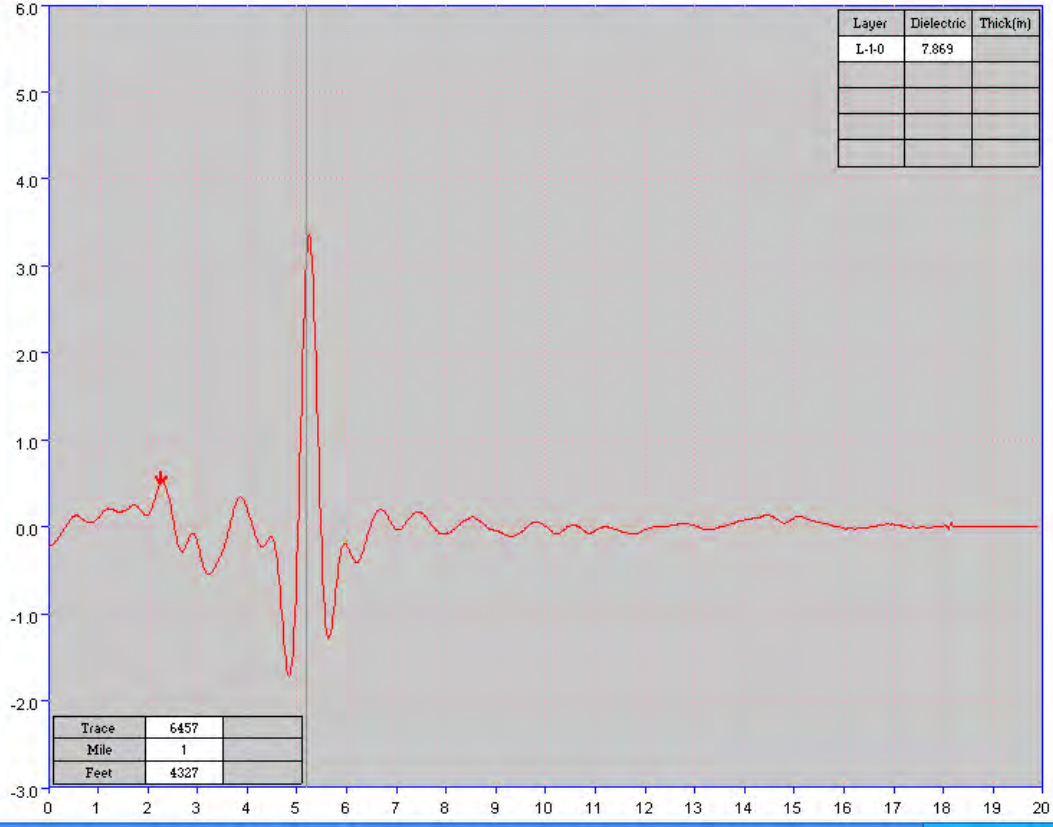


GPS: Lat: 29.71170500 Log: 95.37869343 (Lat:(N) 29:42:42.1380 Log:(W) 95:22:43.2964

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

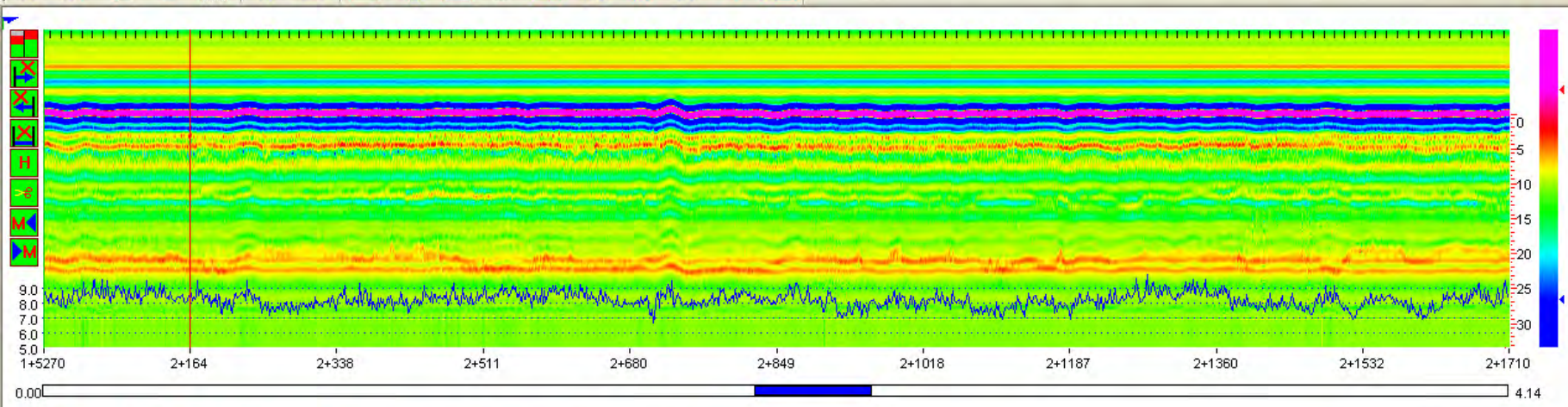


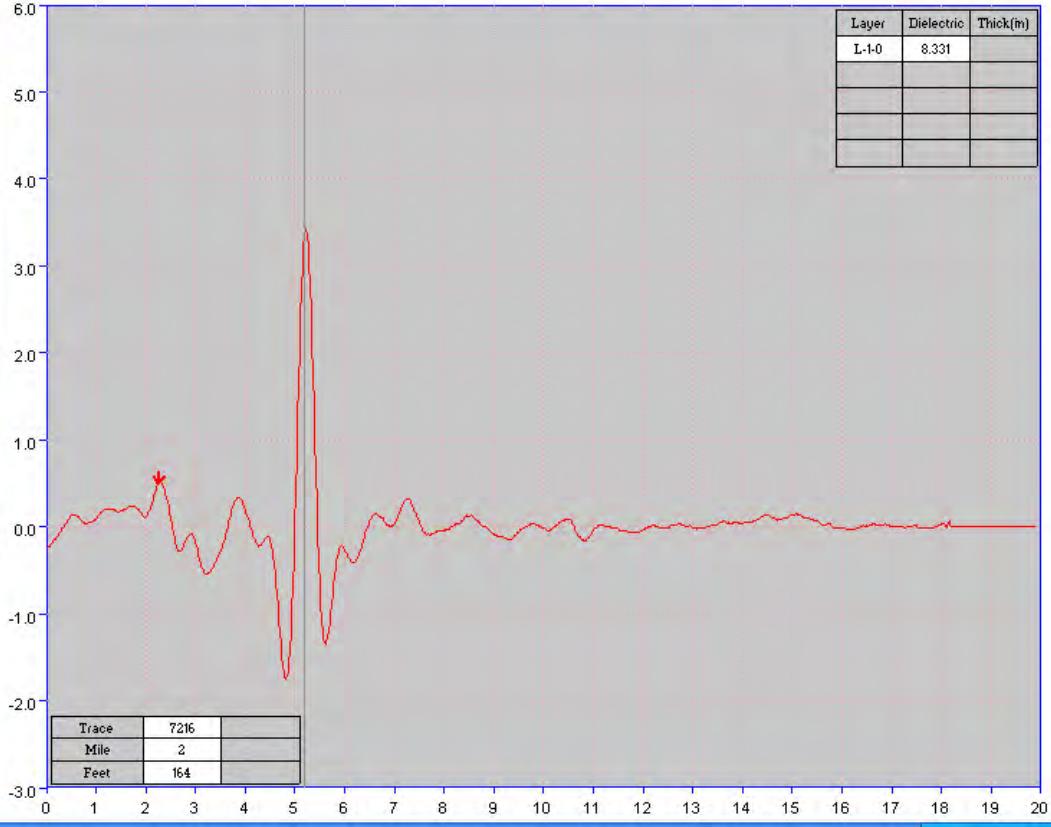


GPS: Lat: 29.70875064 Log: 95.37731144 (Lat:(N) 29:42:31.5023 Log:(W) 95:22:38.3212

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

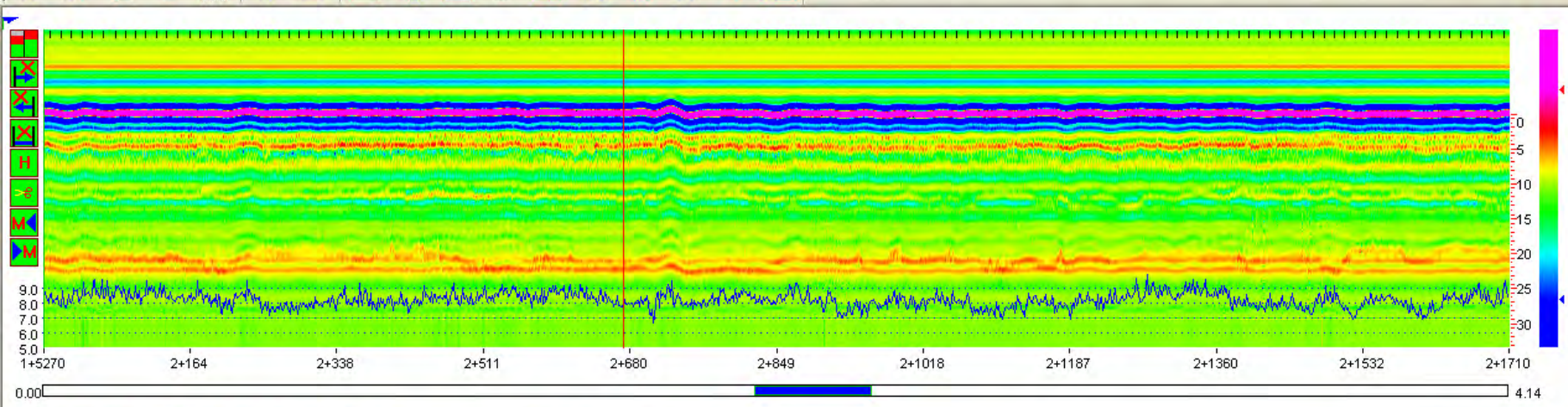


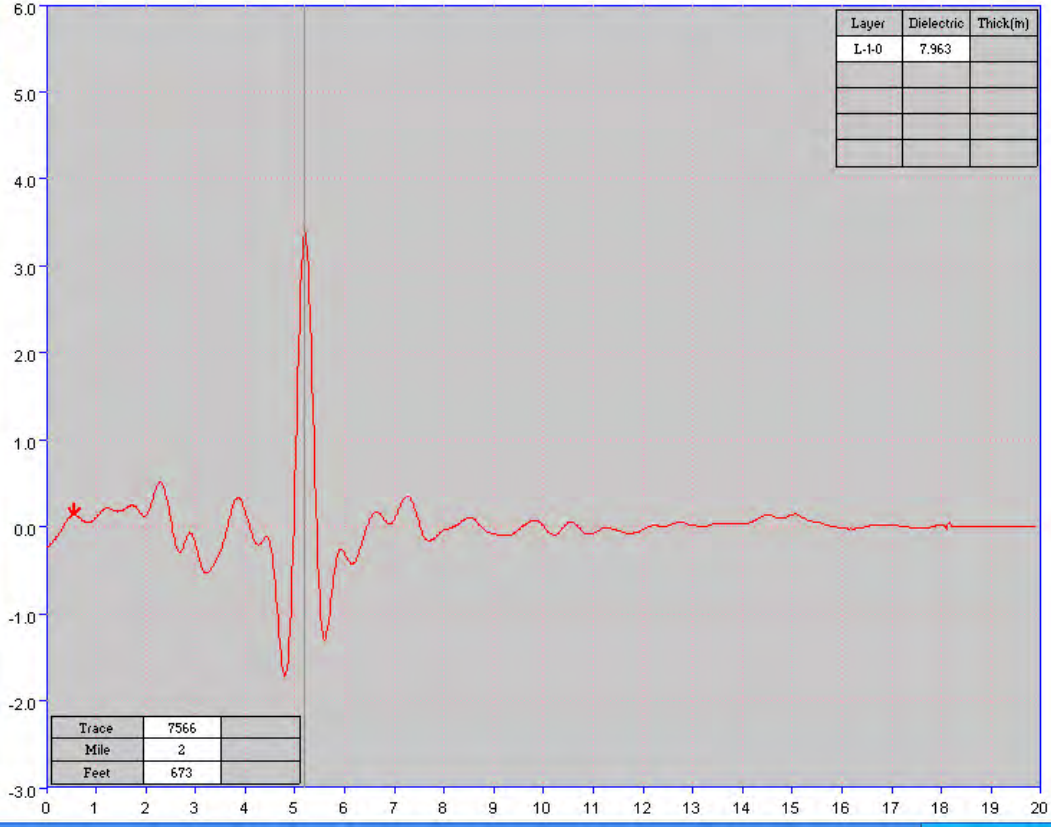


GPS: Lat: 29.70752588 Log: 95.37660931 (Lat:(N) 29:42:27.0932 Log:(W) 95:22:35.7935

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

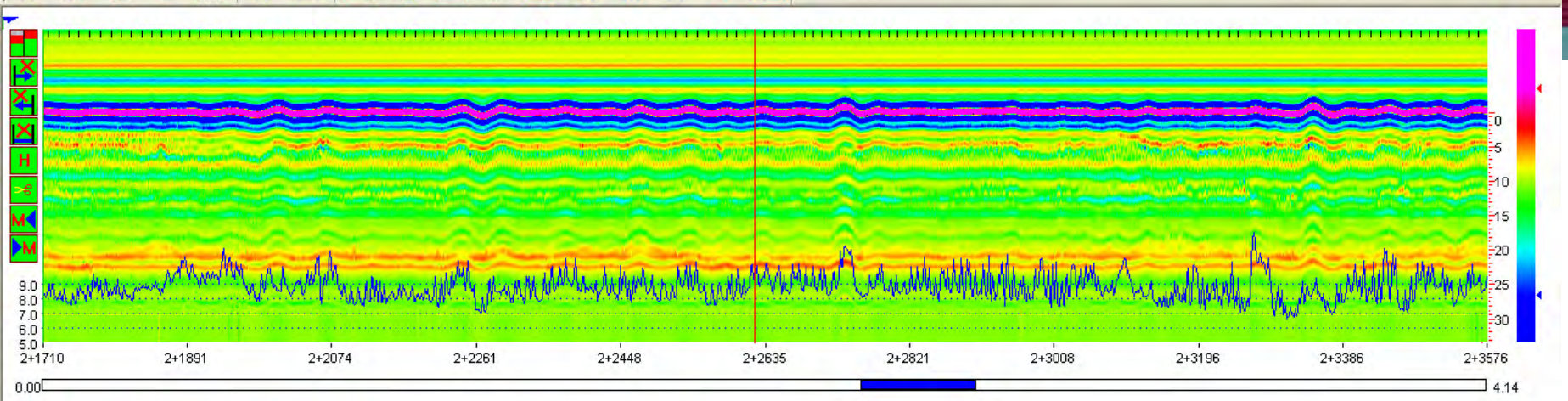


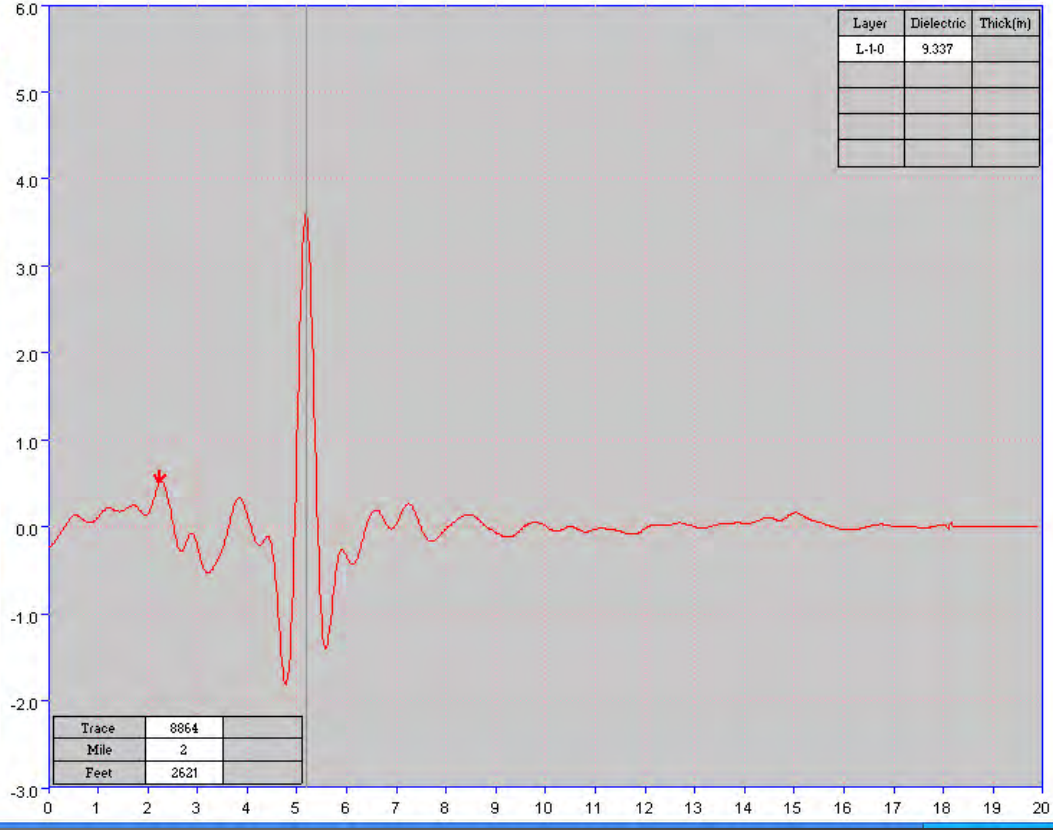


GPS: Lat: 29.70253631 Log: 95.37521480 (Lat:(N) 29:42: 9.1307 Log:(W) 95:22:30.7733

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

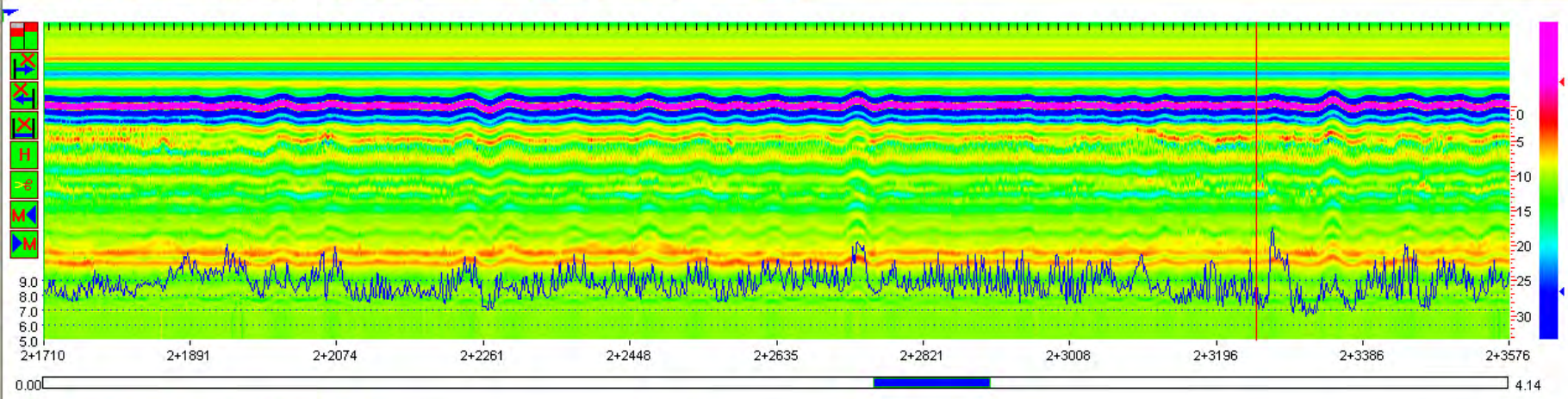


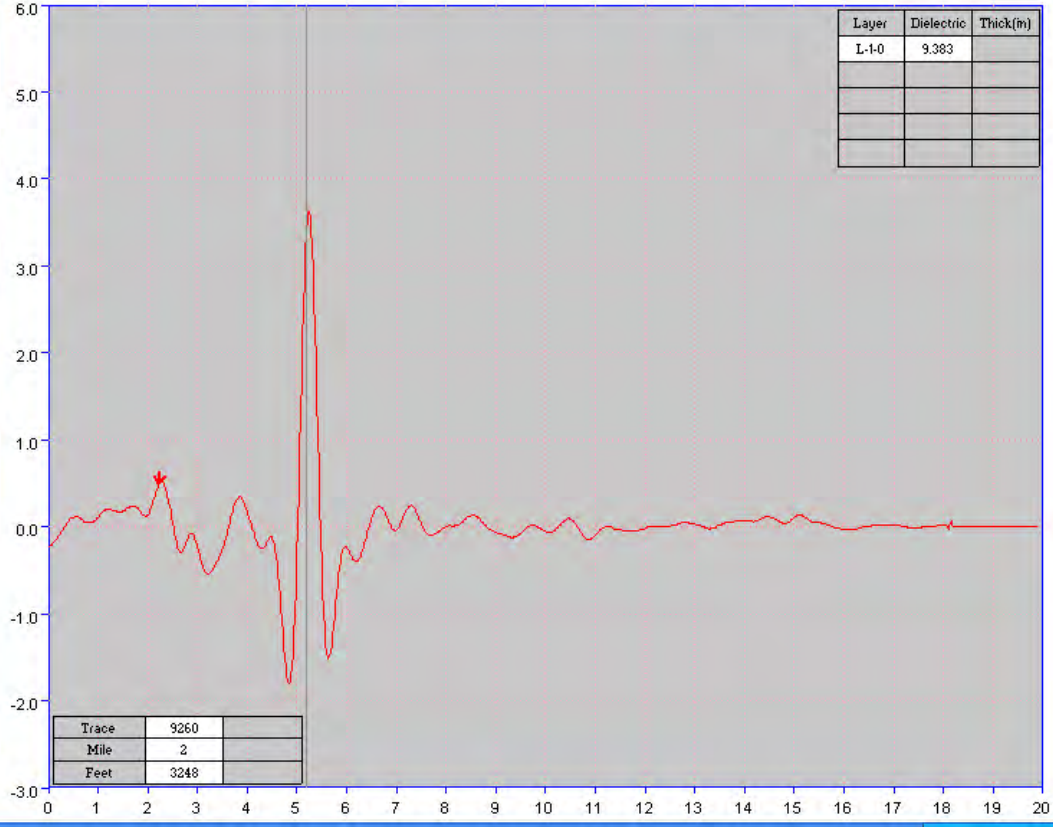


GPS: Lat: 29.70088353 Log: 95.37550118 (Lat:(N) 29:42: 3.1807 Log:(W) 95:22:31.8042

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

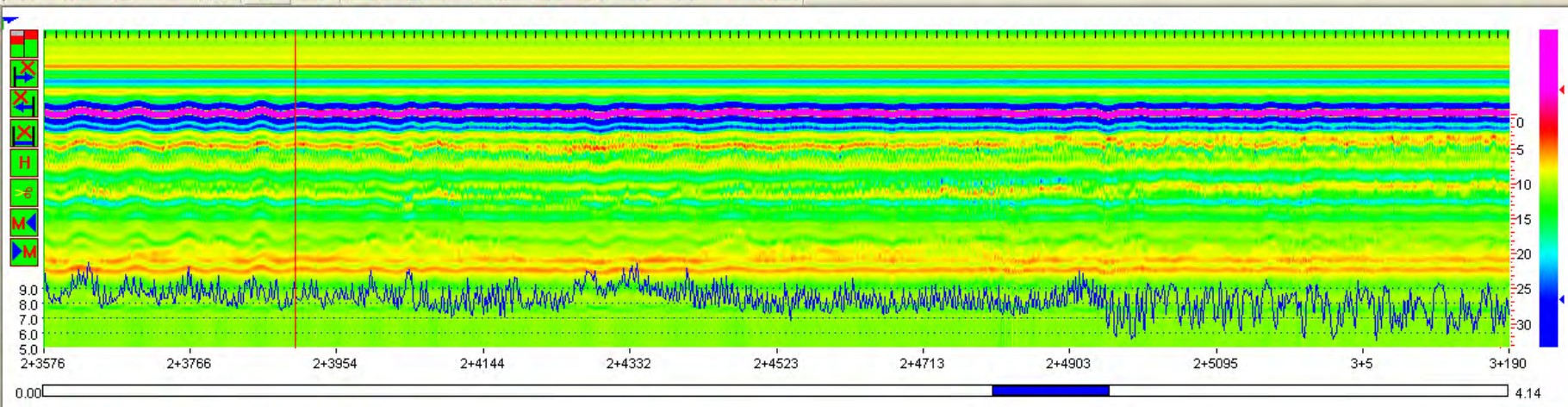


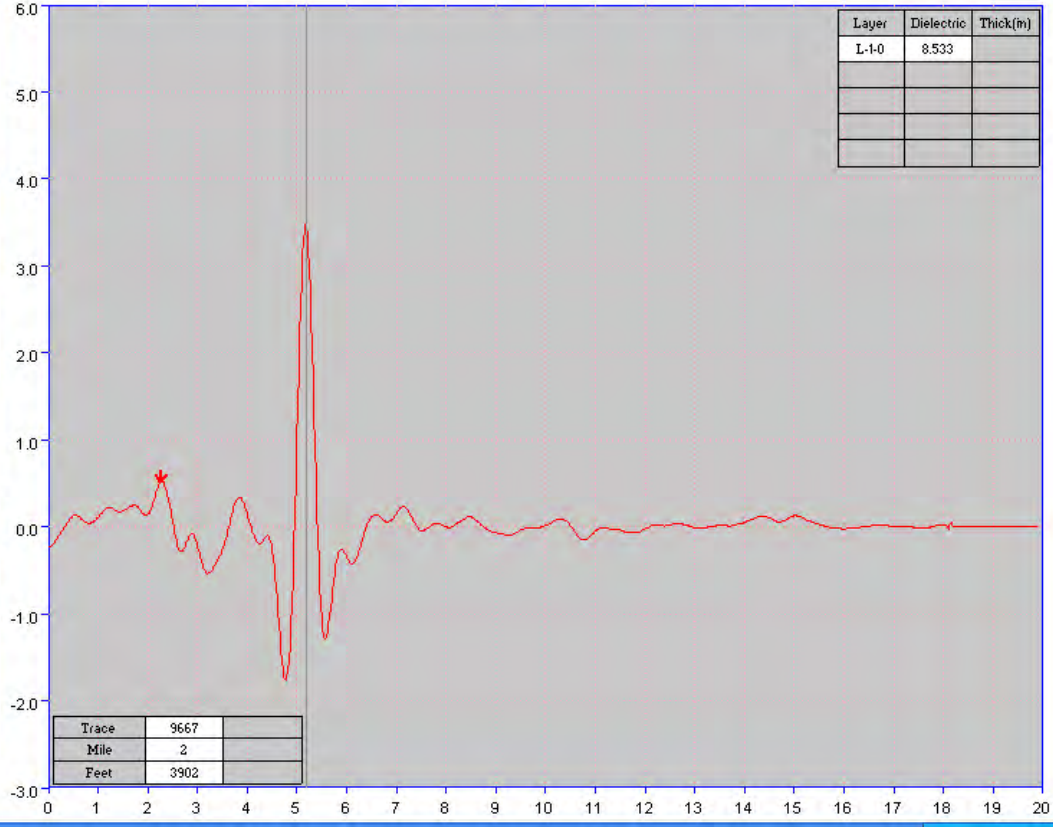


GPS: Lat: 29.69918873 Log: 95.37601480 (Lat:(N) 29:41:57.0794 Log:(W) 95:22:33.6533

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

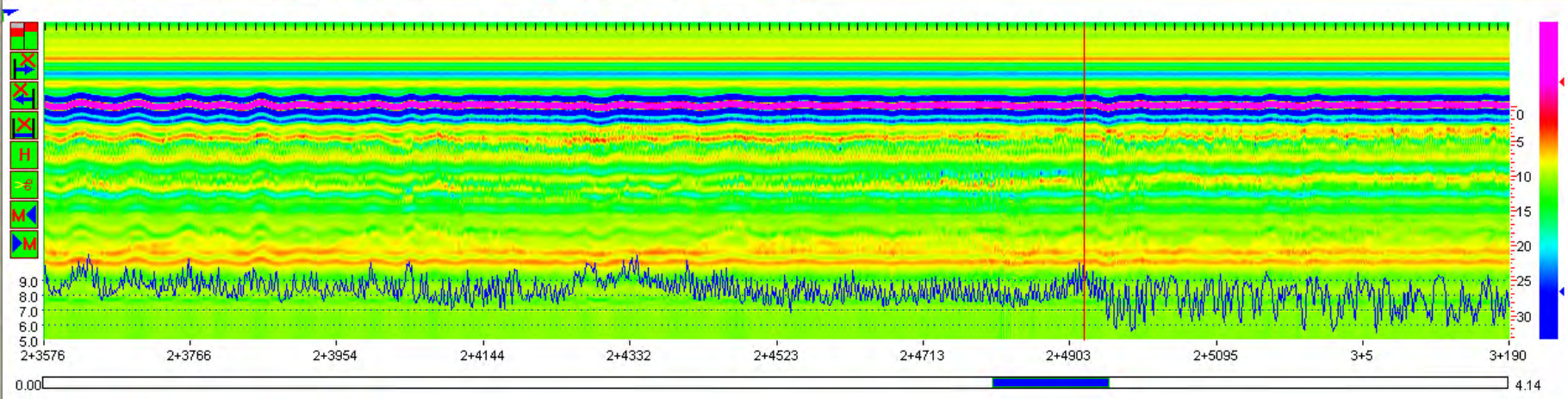


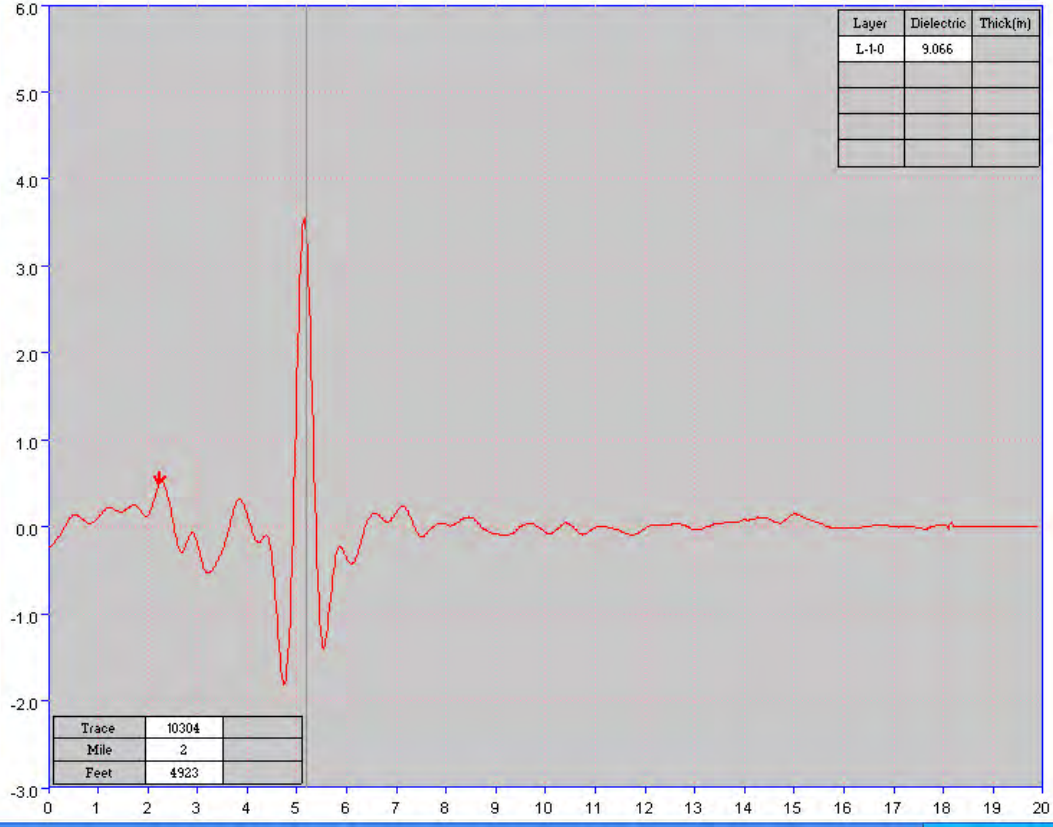


GPS: Lat: 29.69632650 Log: 95.37685133 (Lat:(N) 29:41:46.7754 Log:(W) 95:22:36.6648

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

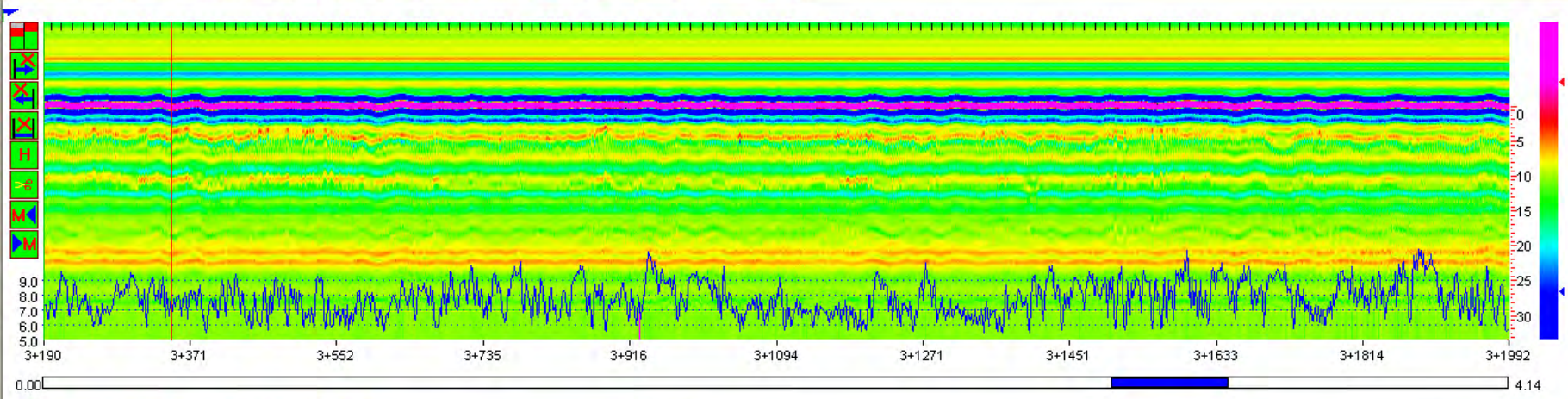


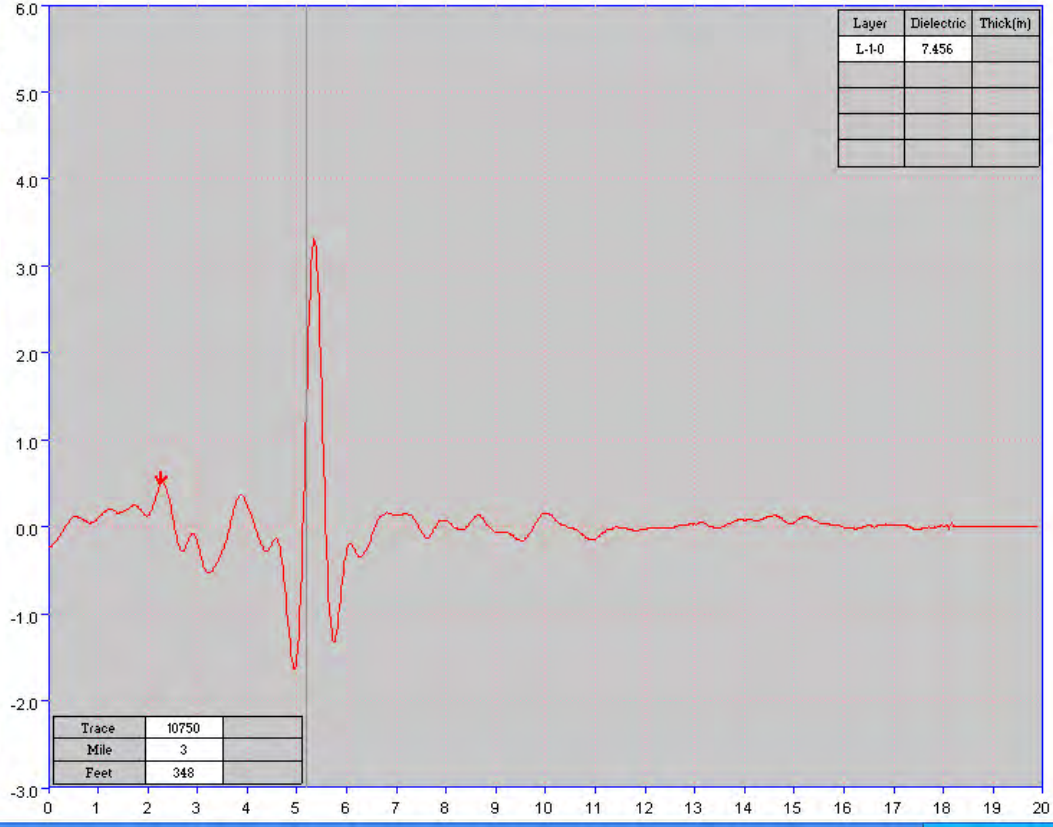


GPS: Lat: 29.69449756 Log: 95.37740692 (Lat:(N) 29:41:40.1912 Log:(W) 95:22:38.6649

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

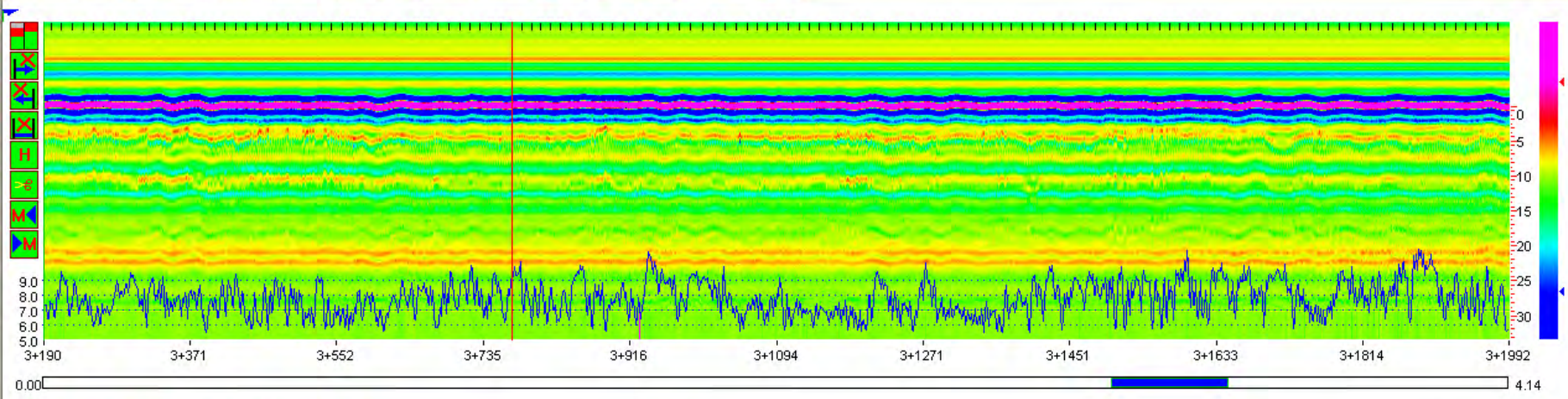


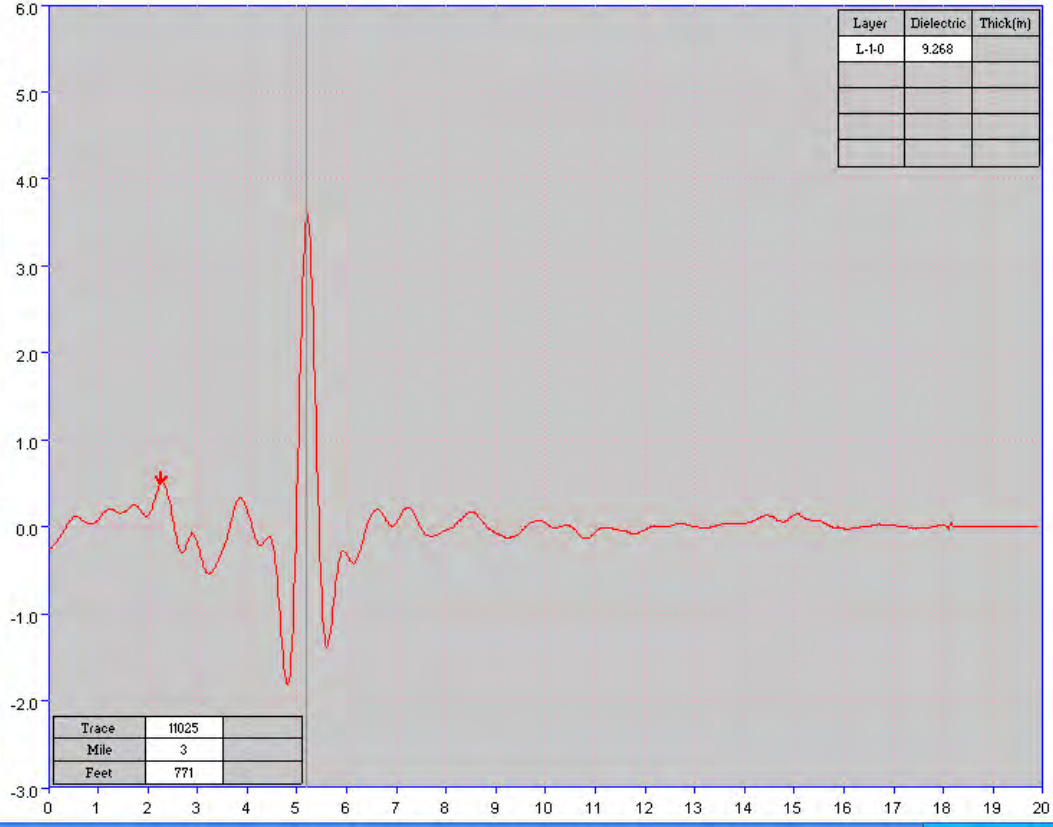


GPS: Lat: 29.69339637 Log: 95.37771990 (Lat:(N) 29:41:36.2269 Log:(W) 95:22:39.7916

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

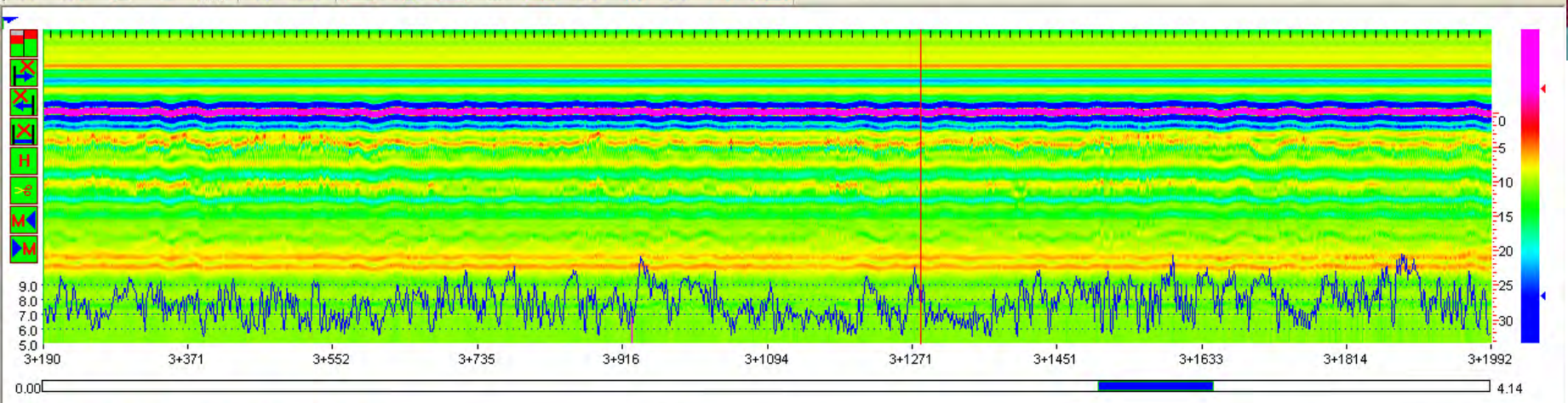


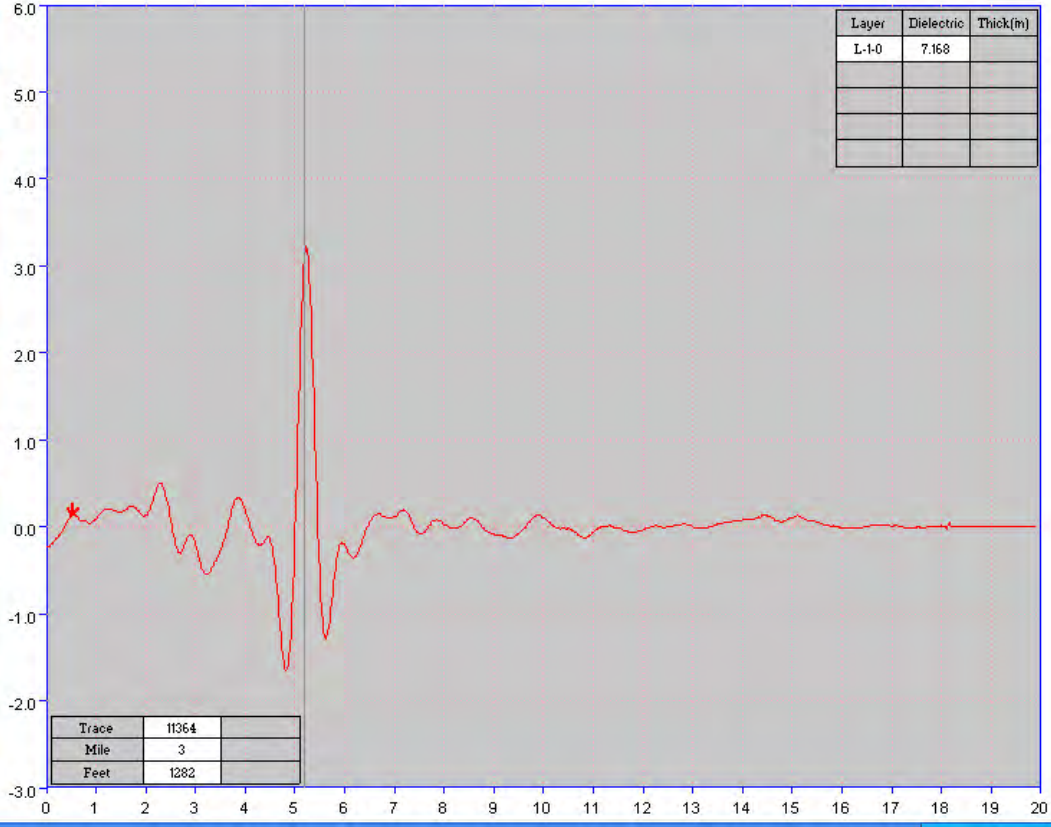


GPS: Lat: 29.69206444 Log: 95.37807869 (Lat:(N) 29:41:31.4320 Log:(W) 95:22:41.0833

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

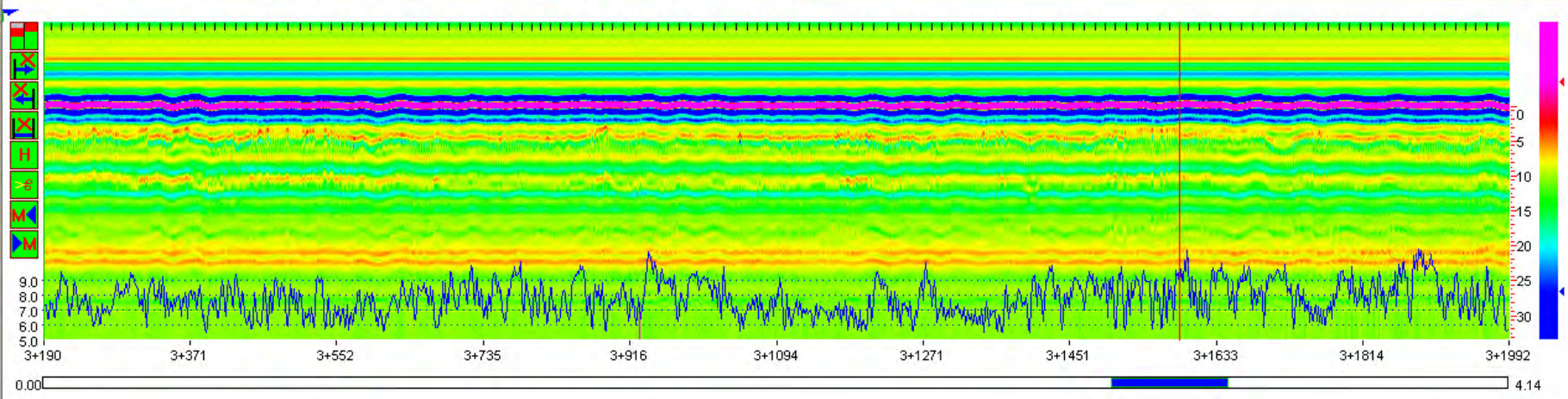


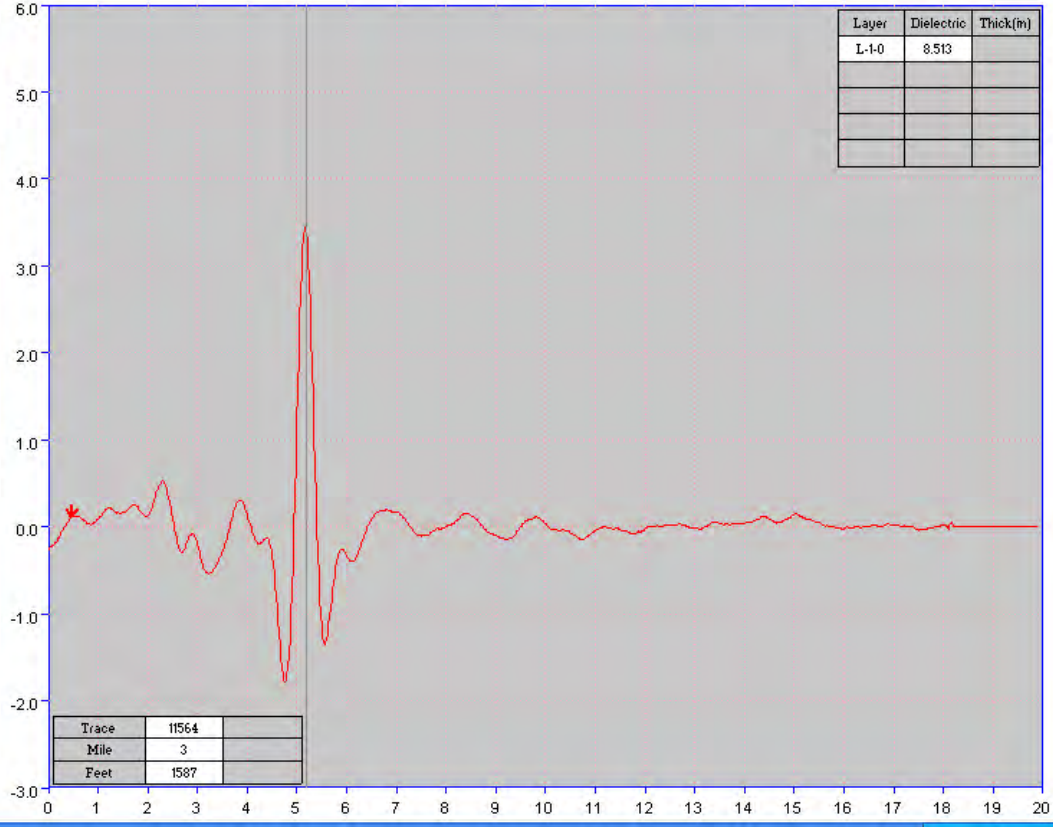


GPS: Lat: 29.69126827 Log: 95.37829108 (Lat:(N) 29:41:28.5658 Log:(W) 95:22:41.8479

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

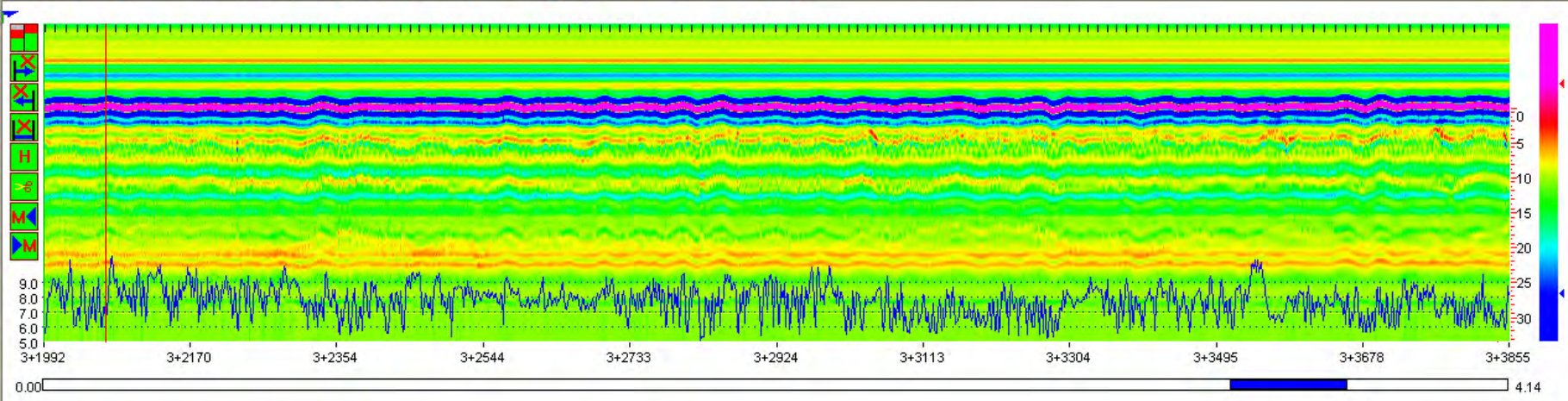


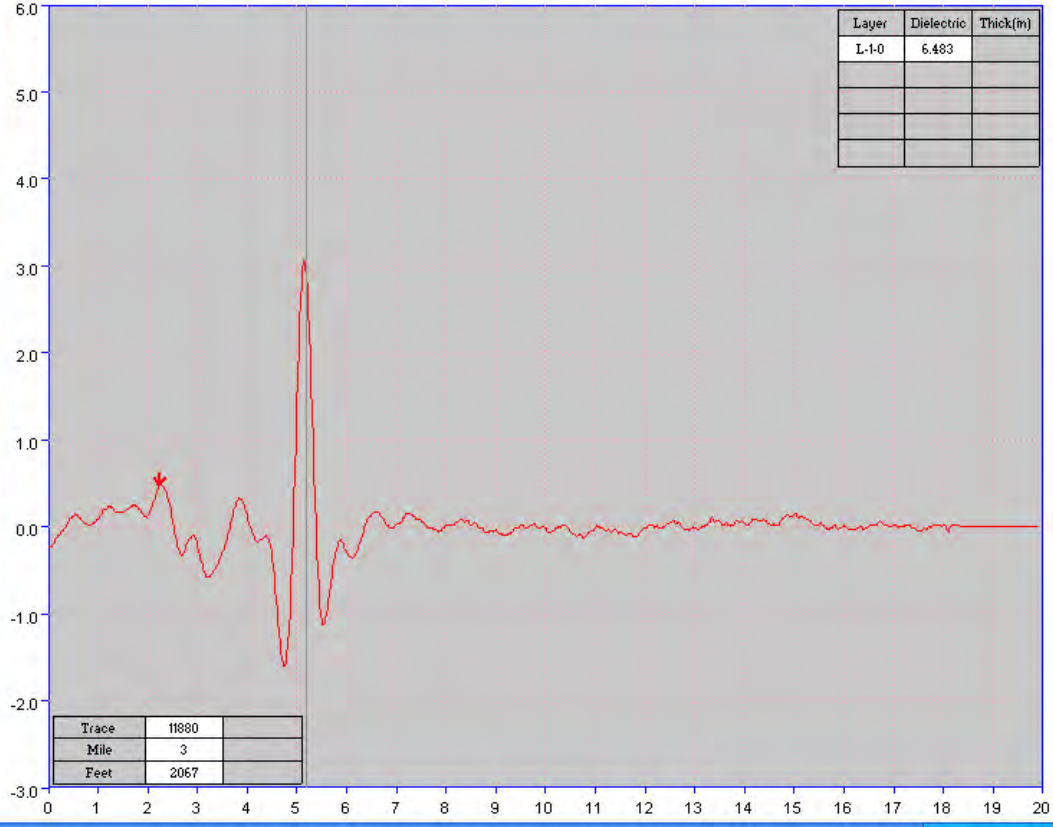


GPS: Lat: 29.69002095 Log: 95.37864428 (Lat:(N) 29:41:24.0754 Log:(W) 95:22:43.1194

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

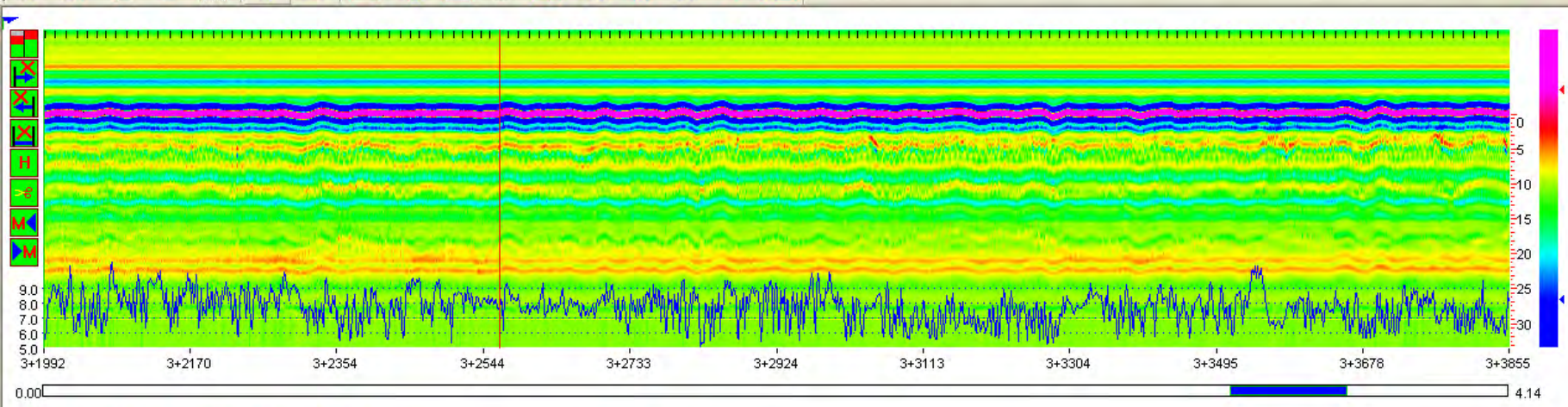


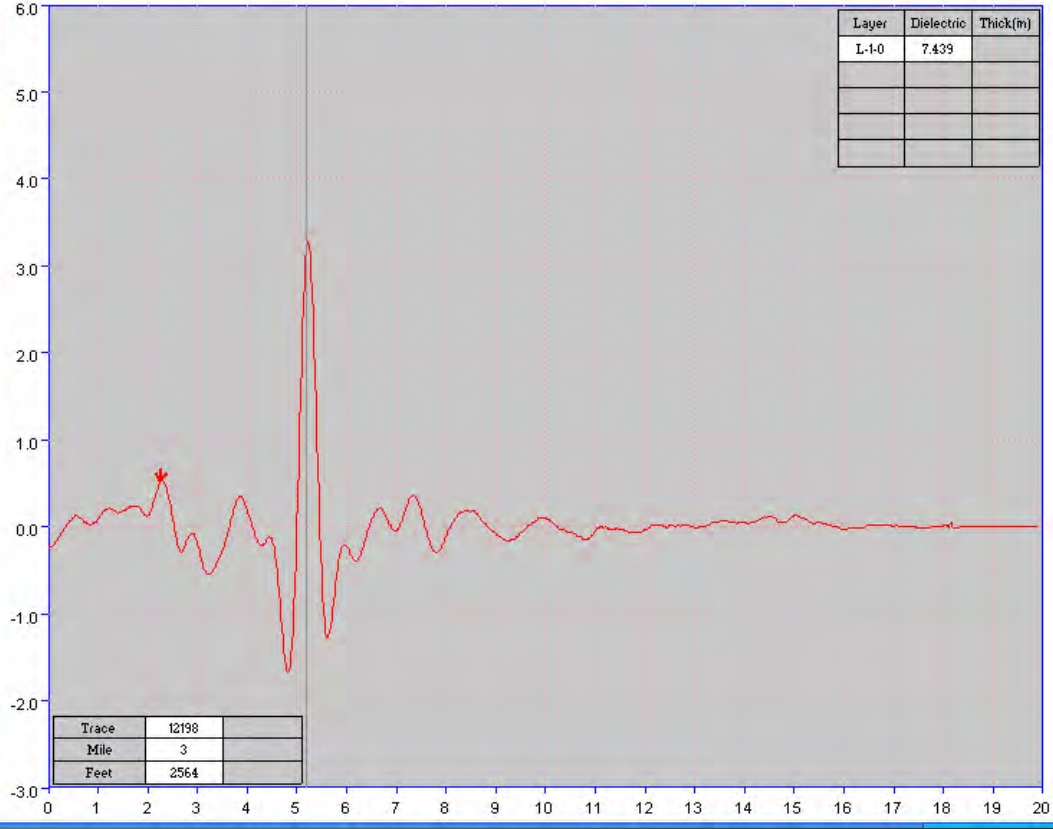


GPS: Lat: 29.68873716 Log: 95.37901510 (Lat:(N) 29:41:19.4538 Log:(W) 95:22:44.4544

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

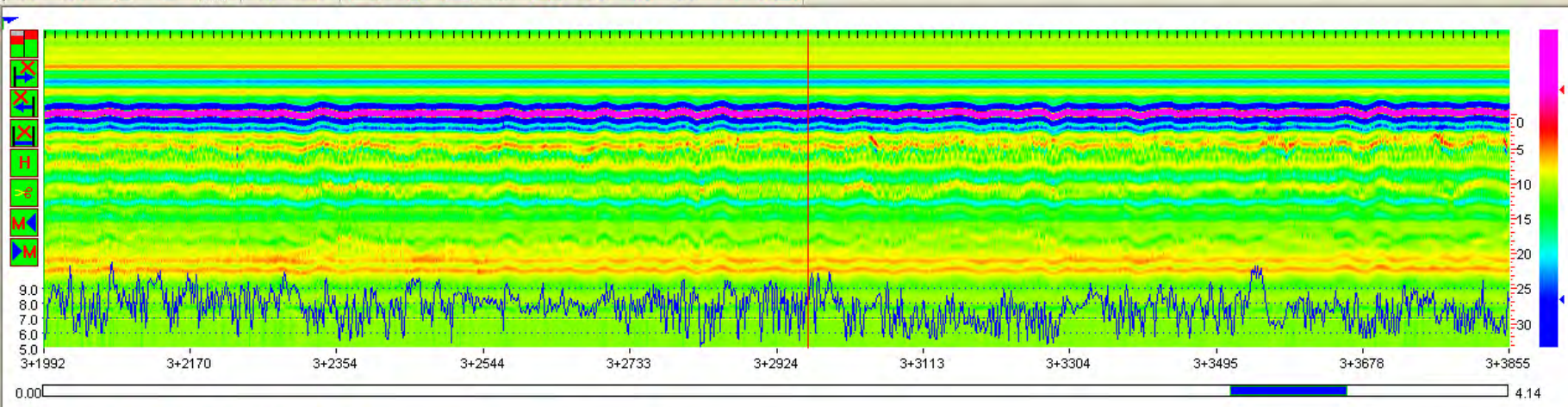


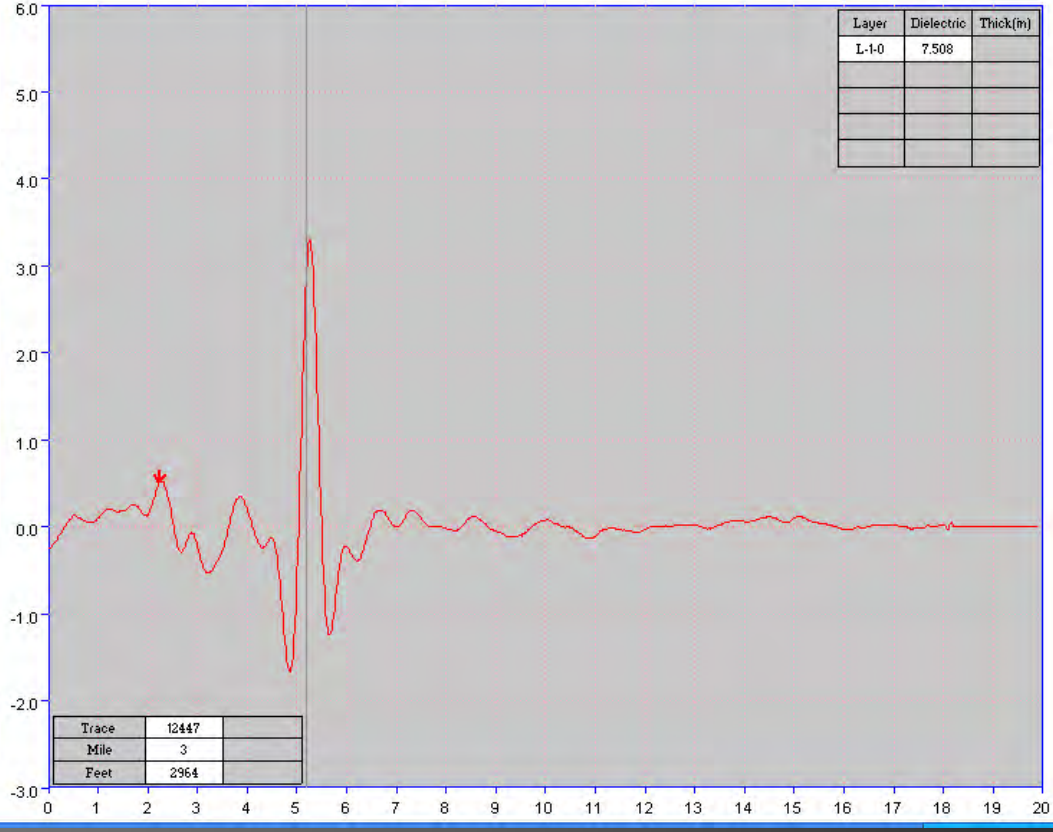


GPS: Lat: 29.68770608 Log: 95.37933853 (Lat:(N) 29:41:15.7419 Log:(W) 95:22:45.6187

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

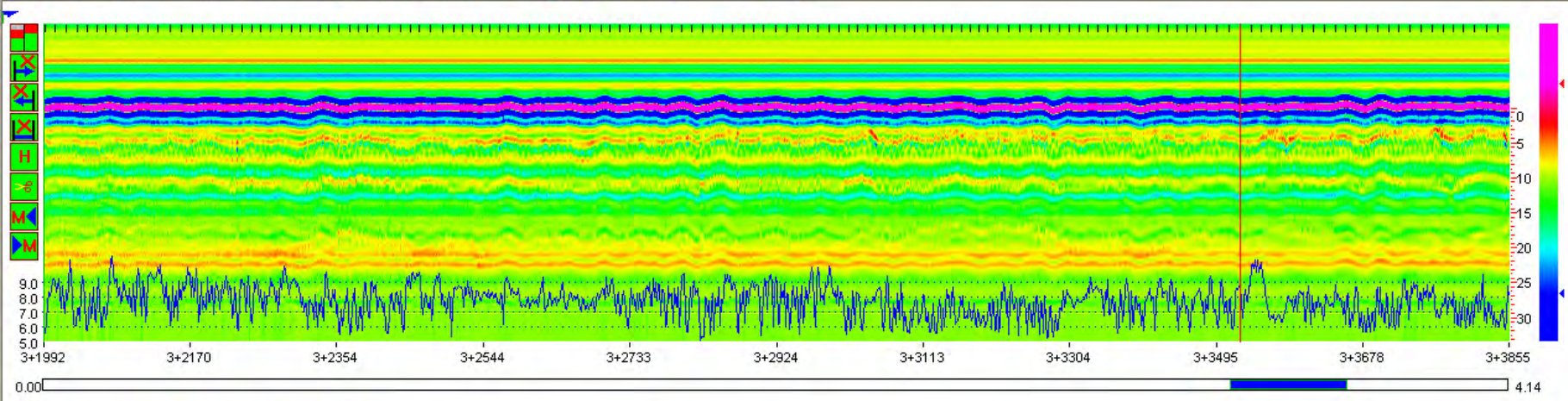


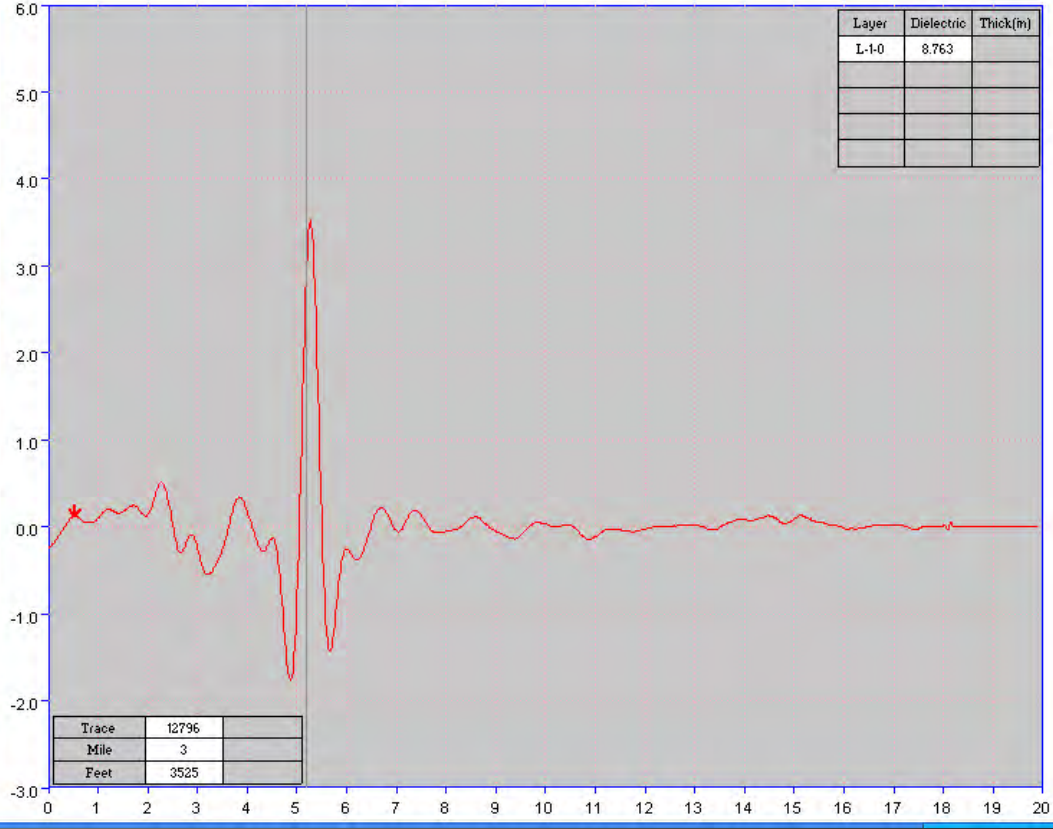


GPS: Lat: 29.68629219 Log: 95.37993621 (Lat:(N) 29:41:10.6519 Log:(W) 95:22:47.7704

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

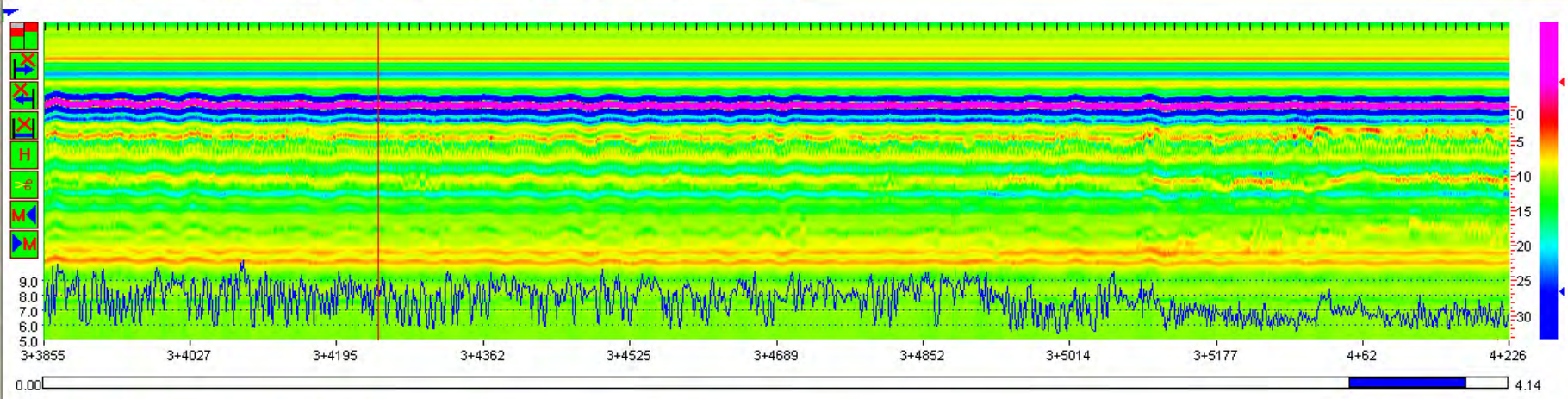


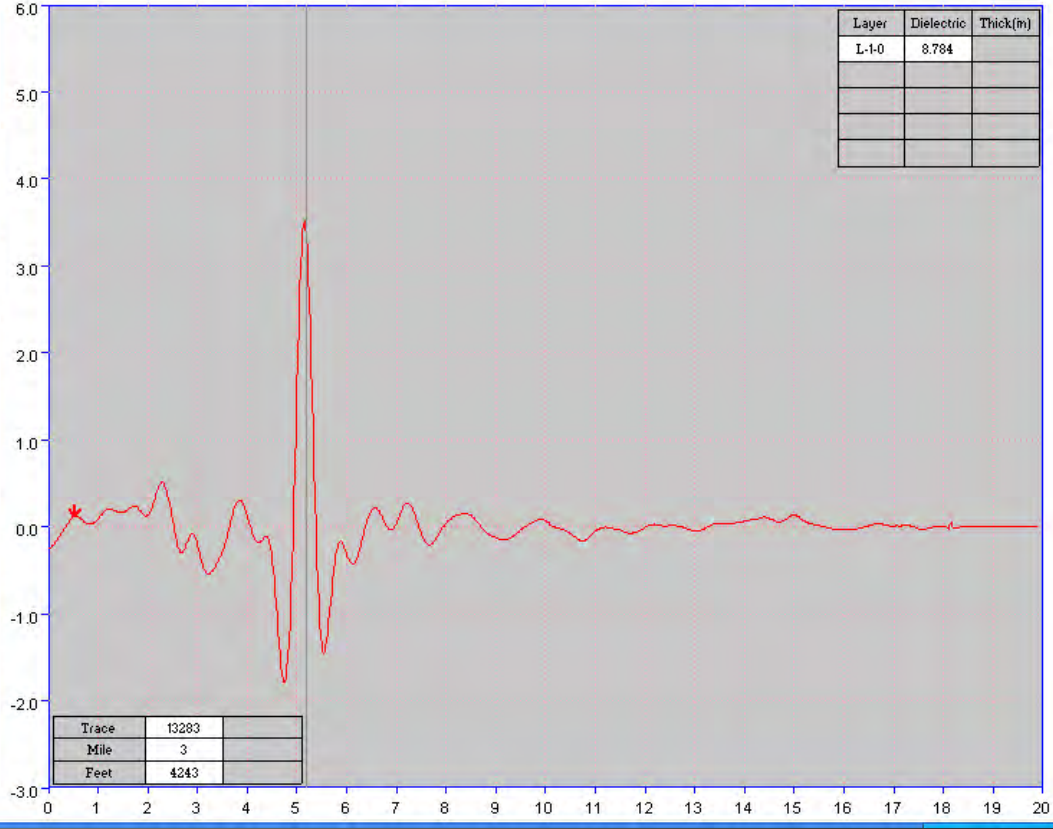


GPS: Lat: 29.68448217 Log: 95.38071687 (Lat:(N) 29:41: 4.1358 Log:(W) 95:22:50.5807

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

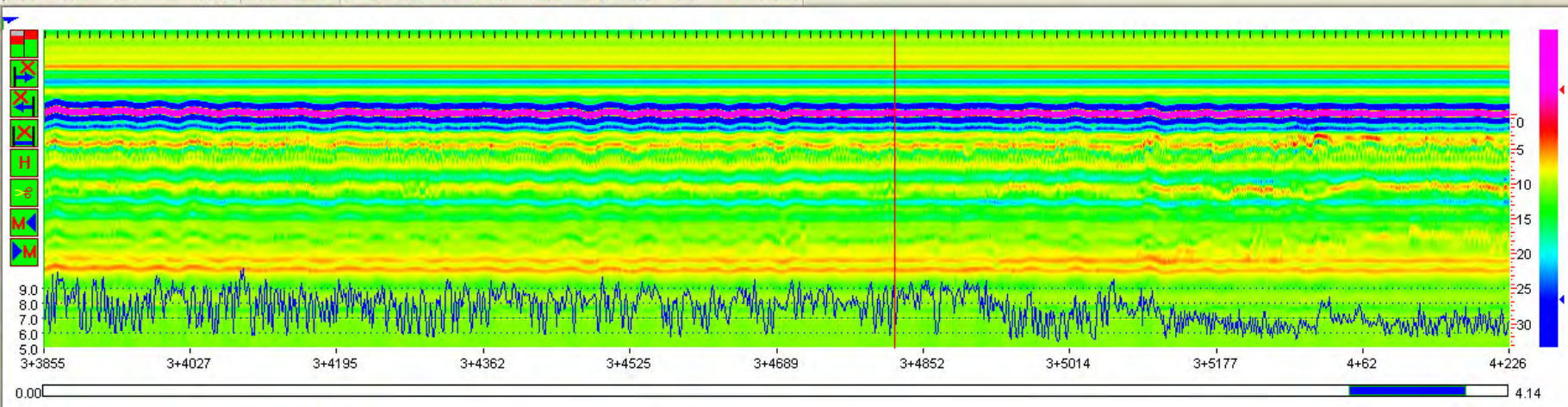


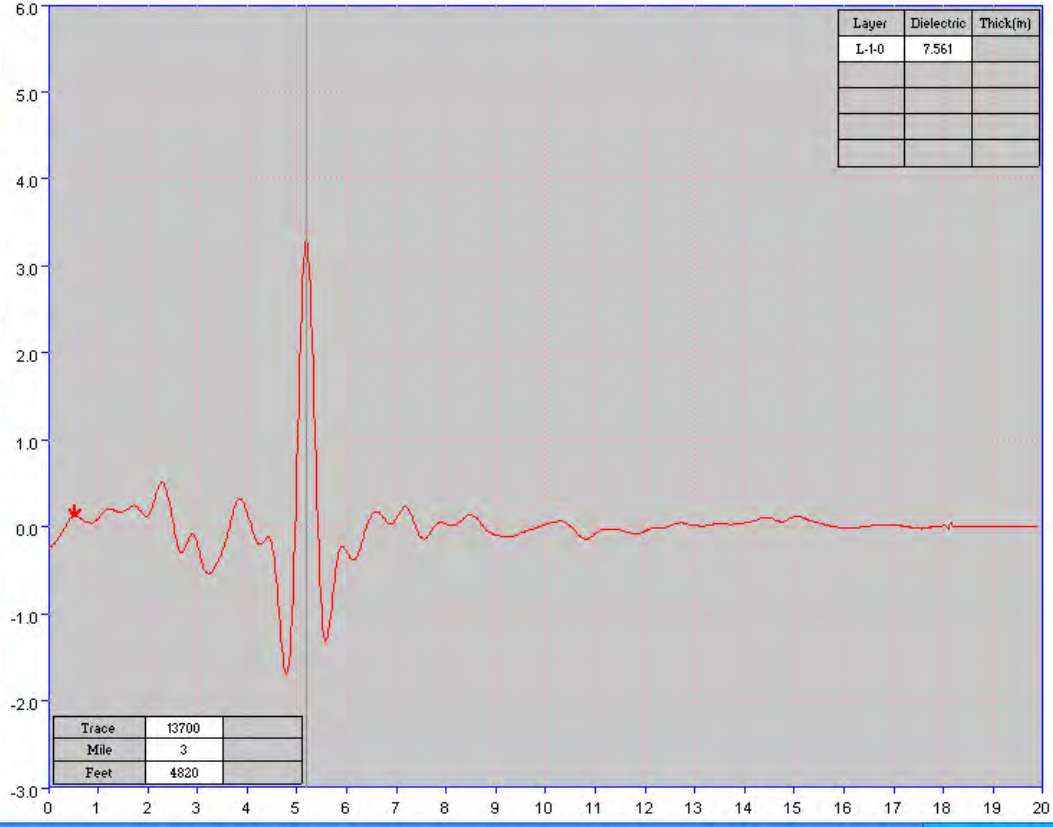


GPS: Lat: 29.68293193 Log: 95.38081337 (Lat:(N) 29:40:58.5549 Log:(W) 95:22:50.9281

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

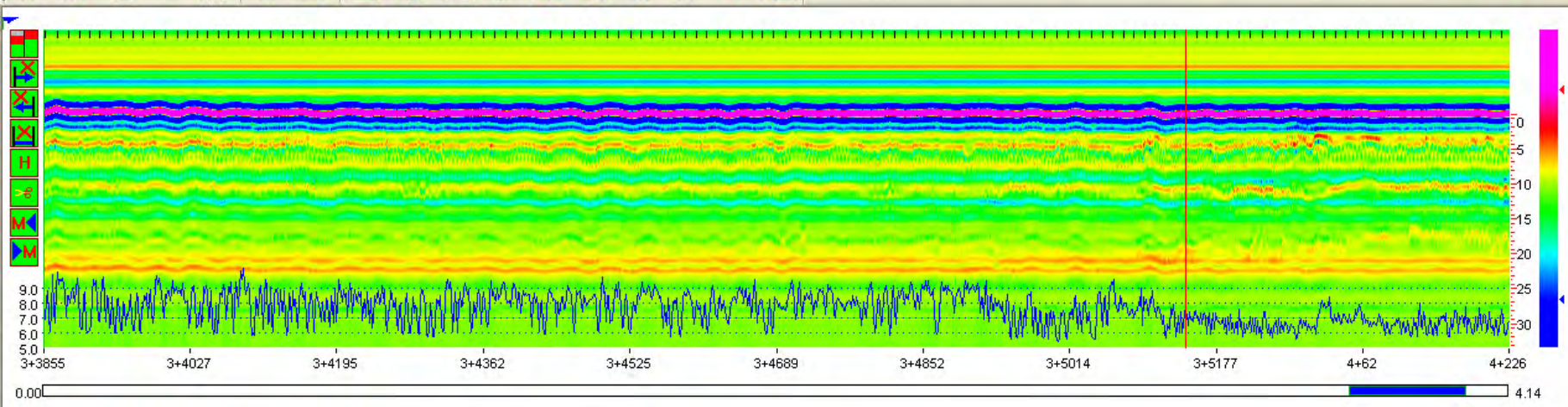


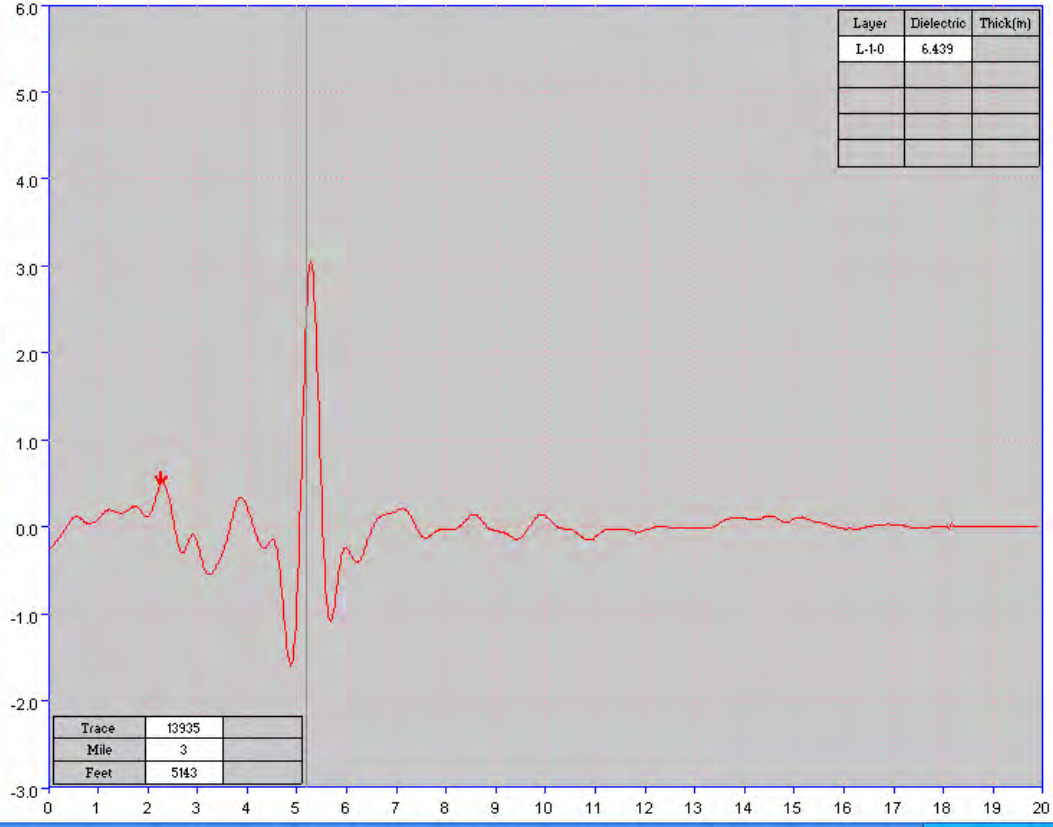


GPS: Lat: 29.68188324 Log: 95.38091670 (Lat:(N) 29:40:54.7796 Log:(W) 95:22:51.3001

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080

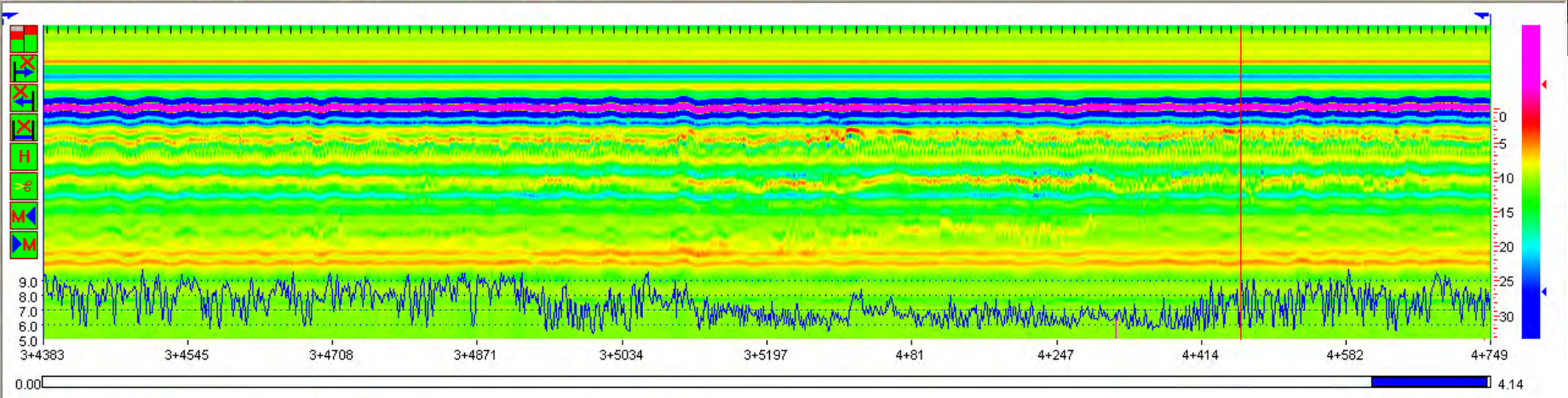


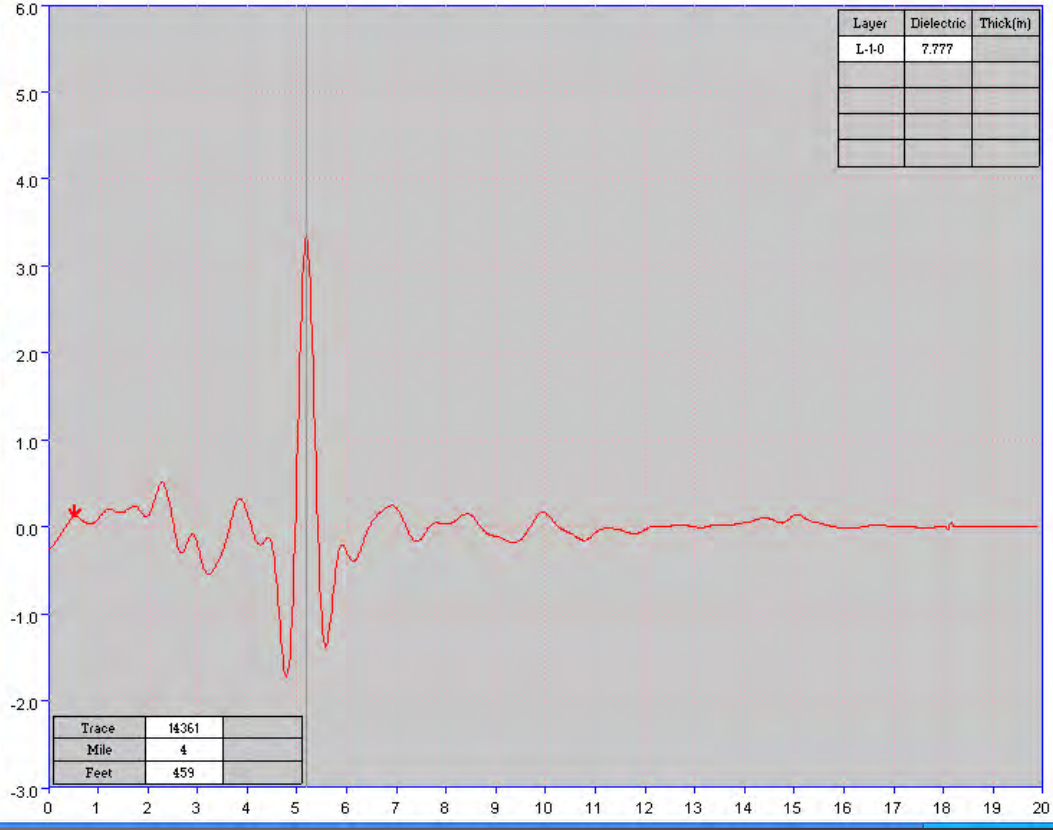


GPS: Lat: 29.68033569 Log: 95.38130268 (Lat:(N) 29:40:49.2085 Log:(W) 95:22:52.6896

File Tools Output KML Google Map

C:\Documents and Settings\a-wims | 288sb.PRJ.txt | 288sb.DAT | GPR:14566 VID:1712 GPS:288 FWD:0 RDD:0 | 0.00 to 4.1 | V:6.0196 B: 1.5313 | T:10-16-2017(09:20:22) | C: 4/2/2016(| 1920X1080





Resiliency Requires Quick Responses

- Must Drive Over Saturated Pavements
- Using Heavy Vehicles (overweight restrictions waived for relief efforts)

And Even after Days of Harvey

Soldiers from the 79th Quartermaster Company assists in Hurricane Harvey rescue efforts. Army Times, September 1, 2017

- With exception of only one area on non-TxDOT road where Buffalo Bayou eroded behind retaining wall and under pavement, no CRCP repairs needed

Crews repair a flood-damaged section of the southbound lanes of the West Sam Houston Tollway on September 8 in this photo by the Harris County Toll Authority

How Did These CRCP Sections in Houston Perform So Well Despite Repeated Saturation Cycles and Excessive Traffic Levels?

- Heavily stabilized, erosion-resistant bases that retain strength even when saturated
- Reinforced concrete to distribute load over saturated bases

Conclusions

- Using heavily stabilized bases and subgrades results in waterproof layers
- There is more traffic, and more truck traffic, in most urban areas of Texas than pavement designers are using for pavement designs

Based on many examples, we conclude:

- The CRCP pavement system is resilient to extreme weather events like flooding and extreme traffic loading conditions