
**Geophysical Survey
Hickory Haven and Samary Forest
Holly Lane and Whippoorwill Road
Manakin-Sabot, Virginia**

Prepared For:

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August 2019

FES Project No. 19197

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1.0 Introduction

Forrest Environmental Services, Inc. (FES) performed a geophysical survey at Hickory Haven and Samary Forest located on Holly Lane and Whippoorwill Road in Manakin-Sabote, Virginia on the 30th and 31st July 2019 and 5th and 6th August 2019. The survey consisted of a seismic refraction survey (SR) to determine depth to bedrock and bedrock rippability.

13 seismic refraction (SR) lines were conducted at the site. The SR survey covered approximately 4,600 linear feet.

The geophone spacing was 10 feet and used 24 geophones for the SR lines 1 through 8. The total distance of SR lines 1 through 13 was approximately 250 feet during collection.

The Hickory Haven site is located within the Piedmont Physiographic Province of Virginia. The site geology includes the Mylonite Gneiss. No bedrock outcrops or float were observed during the section. The site consists of grass field.

Topographically, the site slopes downhill mostly to the south. Survey locations and physical features are shown in Figure 1. Details of the geophysical survey are described in the following sections

2.0 Equipment and Procedures

Seismic refraction theory is based upon the physical characteristics of compressional waves as they travel through the subsurface. The velocity of these waves is dependent upon the density of the travel medium.

Seismic refraction measures density, thickness, and depth of geological strata using sound (acoustic) waves transmitted into the subsurface. Sound waves travel at different velocities in various soils and rocks and are refracted at the interface between layers. Geophones receive the vibrations of the sound energy and translate them to electrical signals. The signals are displayed on a seismograph.

Refraction soundings use the travel times of compressional sound waves (P-Waves) to determine depth to bedrock, the thicknesses, and velocities of subsurface materials. Refraction sounding is based on measuring the first-arrival travel time from the sound source to the geophone. The first-arrival time versus distance to the geophone is plotted and the data is inverted into a model of subsurface velocities.

The seismic refraction survey used a 24-channel Geode Seismograph that was connecting to a laptop which collected data from a geophone spread consisting of 24 10-Hertz geophones. The source was a 12-pound hammer striking an aluminum plate and stacked 6 to 8 times at five different positions per array. Seismic lines 1 through 13 used geophones at 10 foot intervals. Line 1 through 13 sources were placed at 10 feet from each end at stations 0 feet and 250 feet and three sources at the middle of the seismic array at stations 65 feet, 125 feet, and 185 feet.

3.0 Interpretation Methods

The seismic refraction method is based on three important assumptions:

- Acoustic velocity increases with depth;
- Sufficient acoustic velocity contrast exists between layers to allow differentiation between adjacent strata of interest; and
- The layers have sufficient thickness to permit detection.

Time versus distance plots of the first-arrival sound waves were used to locate depth of bedrock. The inverse of the slope of the time versus distance curves is the velocity of the strata.

Filters, sampling intervals, etc., were all performed in field. The raw data was reduced and interpreted using WinSIP Software (Rimrock Geophysics, Inc.). WinSIP aids in determining "first picks". Rayfract Seismic Refraction Tomography Software (Intelligent Resources, Inc.) was used to calculate arrival times, constructing time vs. distance graphs, and forming seismic cross-sections. The ground surface elevations were determined by interpolating between contours from a USGS topographic quadrangle map.

Typical seismic overburden seismic velocities are approximately less than 2,500 feet/second (purple). Weathered or soft rock seismic velocities typically range from 2,500 to 5,000 feet per second (blue and green). Bedrock velocities typically measure greater than 5,000 feet per second (yellow to red).

4.0 Survey Results

The objective of the SR survey was to locate determine depth to bedrock and bedrock rippability.

SR Line 1 indicates depth to bedrock about 10 feet below ground surface at approximately 140 feet East to about 30 feet below ground surface at approximately 1,050 feet East (Figure 2).

SR Line 2 indicates depth to bedrock about 20 feet below ground surface at approximately 0 feet North to about 25 feet below ground surface at approximately 210 feet North (Figure 3).

SR Line 3 indicates depth to bedrock appears to be about 45 feet below ground surface at approximately 0 feet East to about 35 feet at approximately 220 feet East (Figure 4).

SR Line 4 indicates depth to bedrock appears to be about 12 feet to 18 feet below ground surface (Figure 5).

SR Line 5 indicates depth to bedrock appears to be about 10 feet below ground surface (Figure 6).

SR Line 6 indicates depth to bedrock about 15 feet to 20 feet below ground surface (Figure 7).

SR Line 7 indicates depth to bedrock appears to be about 10 feet at approximately 110 feet East to about 20 feet below ground surface at approximately 440 feet East (Figure 8).

SR Line 8 indicates depth to bedrock appears to be about 20 feet at approximately 50 feet East to about 35 feet below ground surface at approximately 180 feet East (Figure 9).

SR Line 9 indicates depth to bedrock appears to be about 60 feet below ground surface (Figure 10).

SR Line 10 indicates depth to bedrock appears to be about 16 feet to 20 feet below ground surface (Figure 11).

SR Line 11 indicates depth to bedrock appears to be about 40 feet at approximately 250 feet East to about 60 feet below ground surface at approximately 70 feet East (Figure 12).

SR Line 12 indicates depth to bedrock appears to be about 20 feet to 25 feet below ground surface (Figure 13).

SR Line 13 indicates depth to bedrock appears to be about 20 feet below ground surface (Figure 14).

The geophysical survey indicated depth to bedrock to be about 10 feet below ground surface at the eastern section of Holly Lane to about 70 feet below ground surface south of Whippoorwill Road. Bedrock appears to be typically require removal by blasting, ripping, or hoe-ramming, rock trenching/sawing or other suitable rock excavation methods.



Photo 1 - SR Line 10



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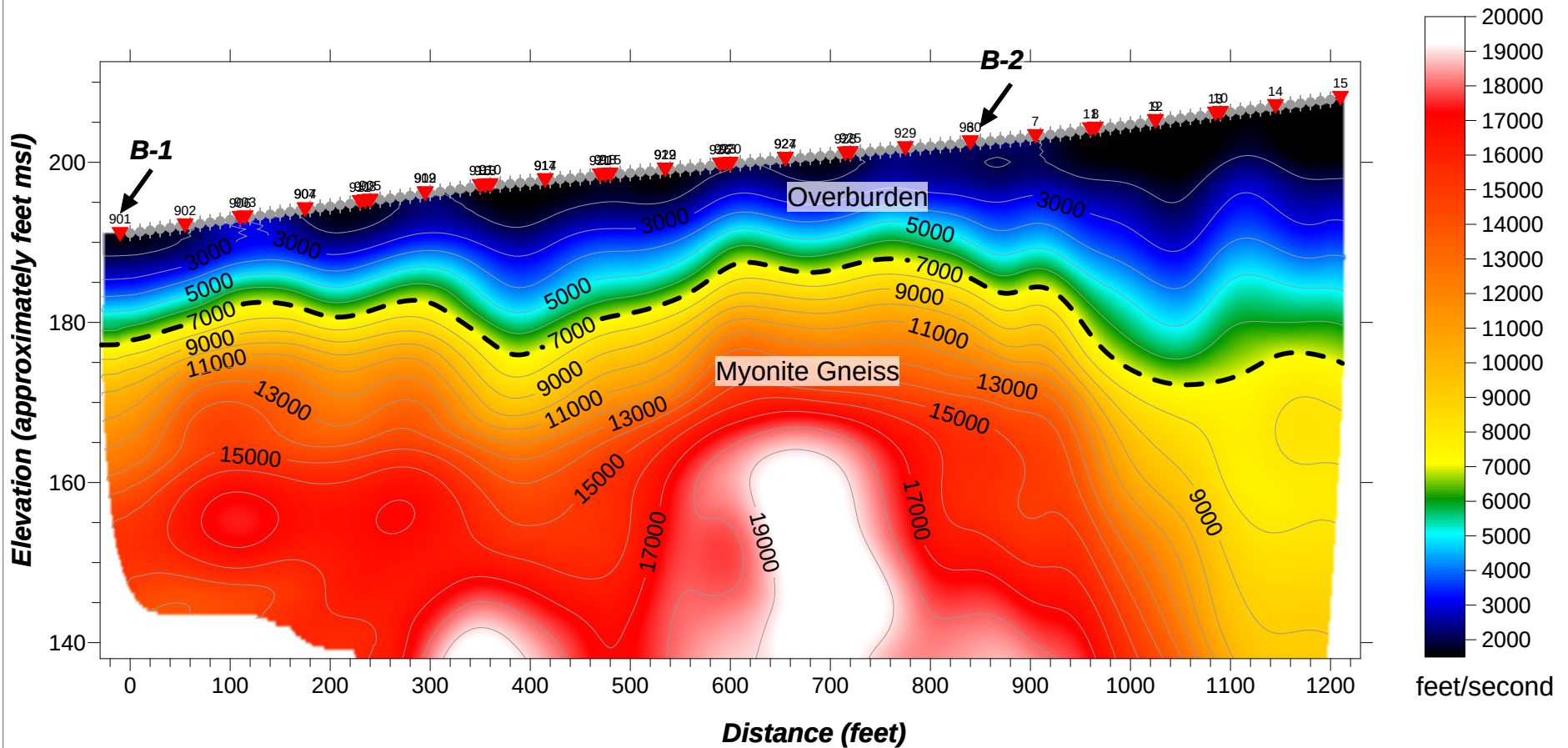
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DATE August 2019	SCALE 1 inch ~ 500 ft	TITLE Geophysical Site Map Hickory Haven and Samary Forest Holly Land and Whippoorwill Road Manakin-Sabot, Virginia	
DRAWN BY	APPROVED BY		
JOB NO. 19197	DWG. NO./REV. NO. THHVAF1	CLIENT Timmons Group	FIGURE 1

SR Line 1 RMS error 0.8%=0.38ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35

West

East



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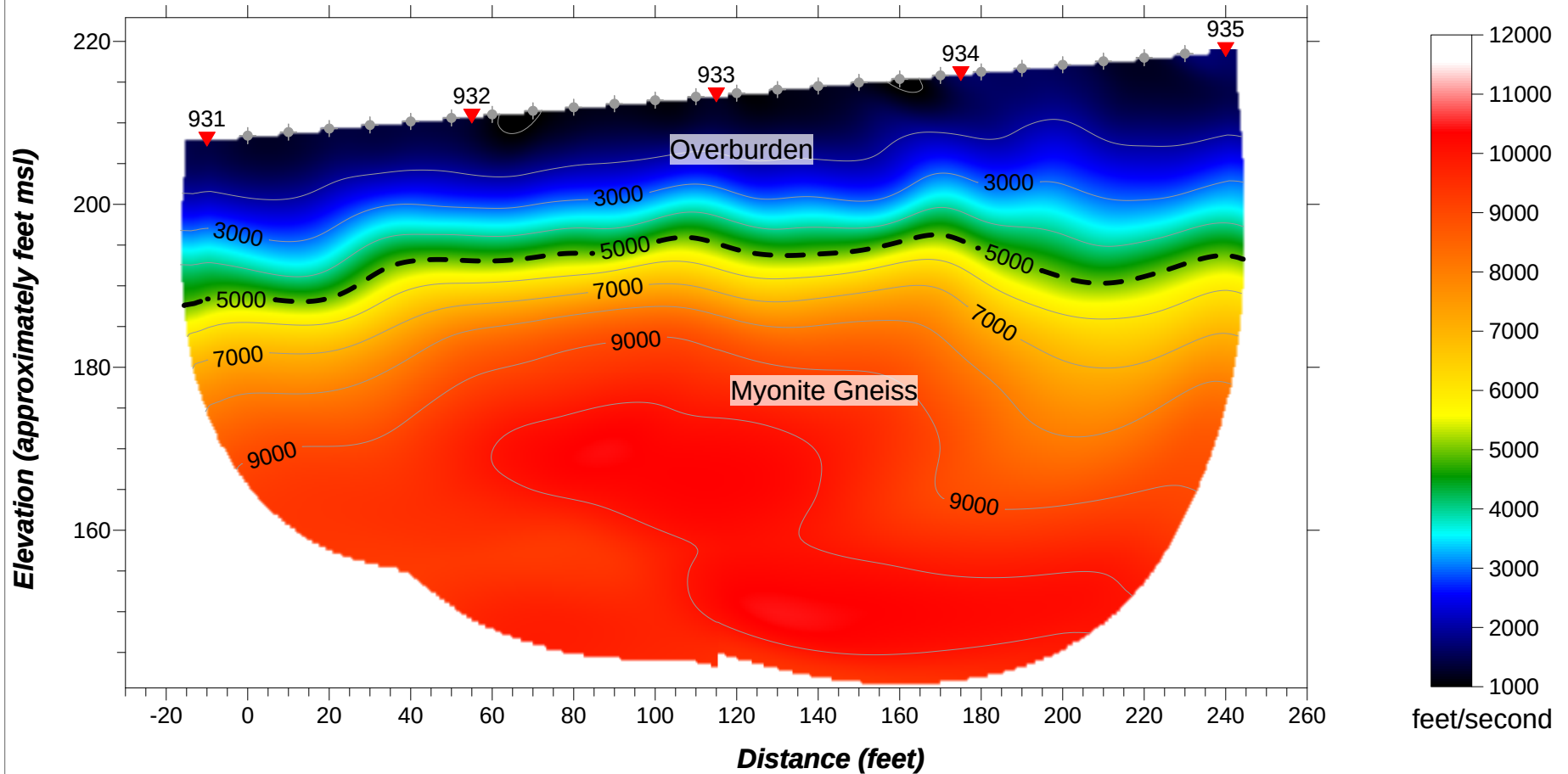
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SR Line2 RMS error 0.9%=0.42ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Vers. 3.35

South

North



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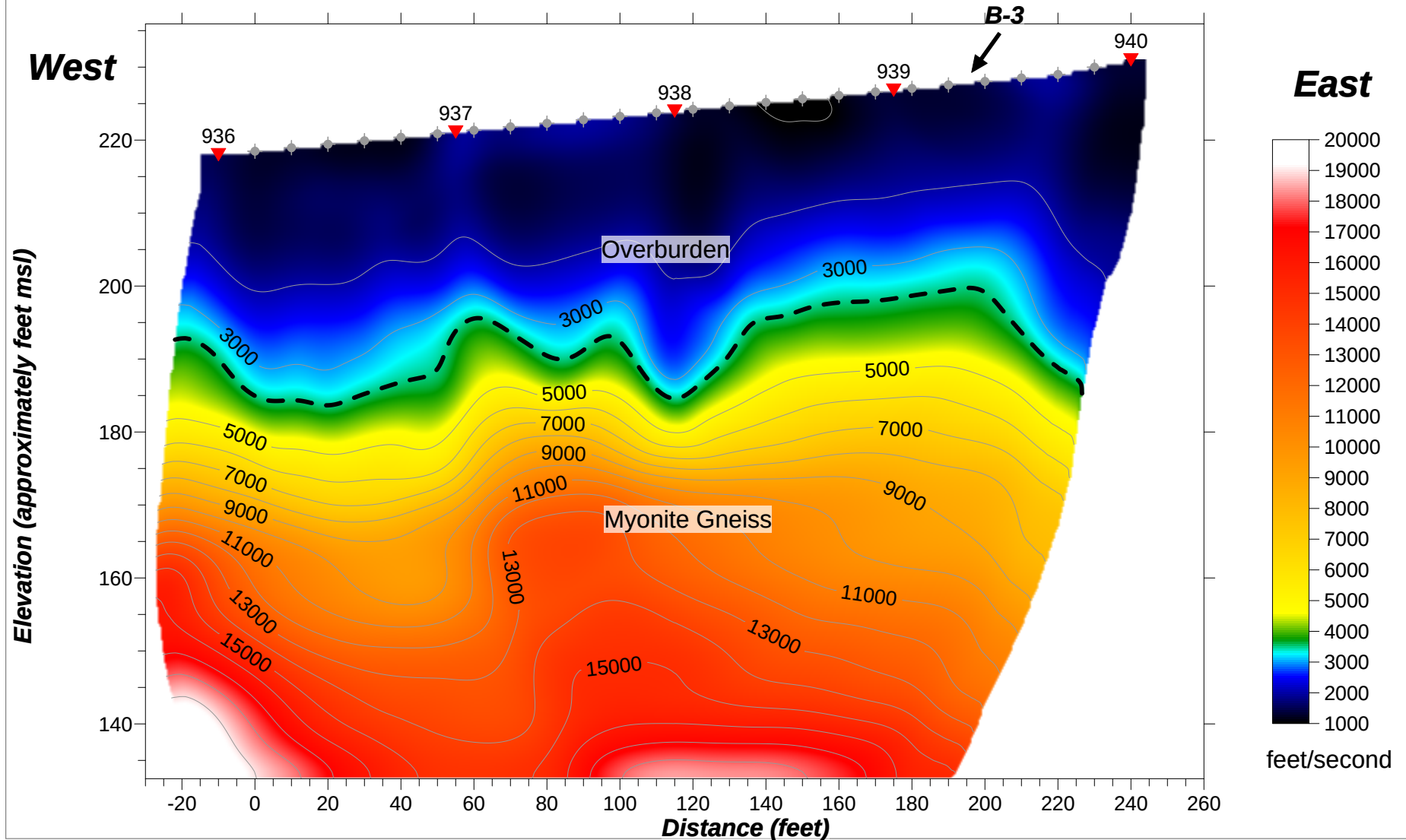


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SR Line 3 RMS error 1.8%=1.29ms 20 WET iters. 50Hz Width 4.0% initial GRADIENT.GRD Vers. 3.35



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SR Line 3
Hickory Haven and Samary Forest
Cedar Circle
Manakin-Sabot, Virginia

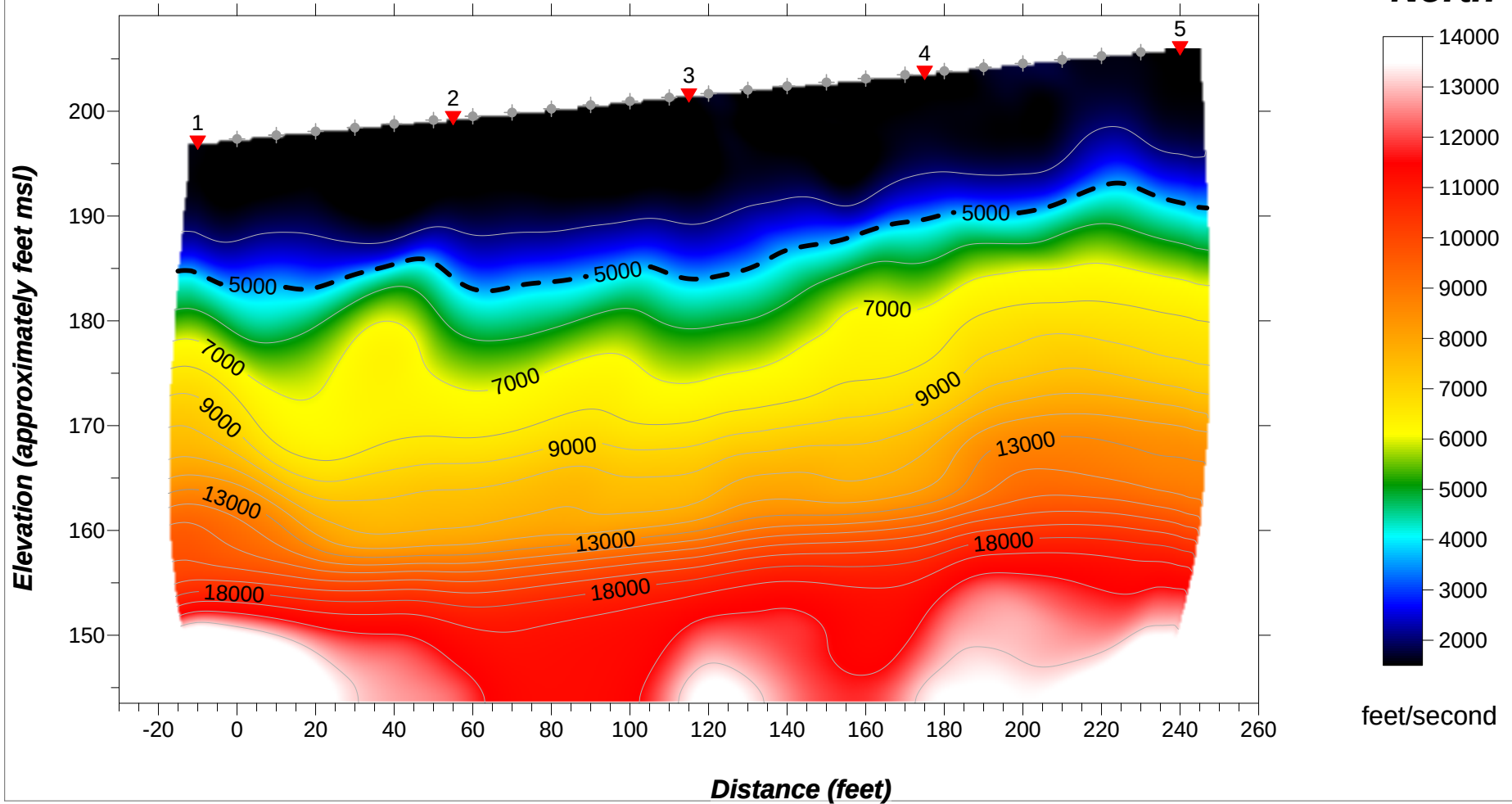
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Timmons Group

FIGURE
4

SR Line 4 RMS error 0.9%=0.58ms 20 WET iters. 50Hz Width 4.0% initial GRADIENT.GRD Vers. 3.35

South

North



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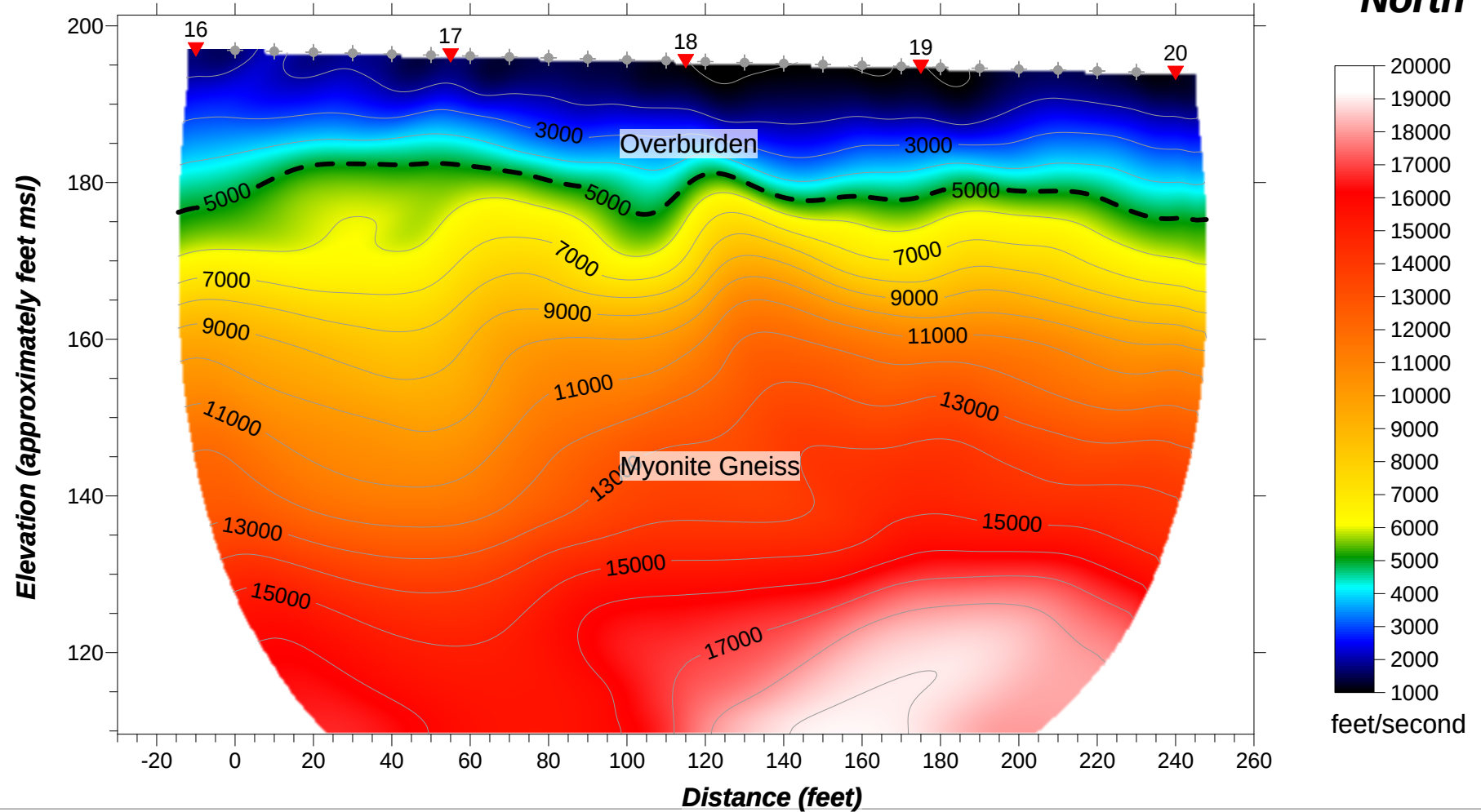
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DATE August 2019	SCALE shown	TITLE SR Line 4 Hickory Haven and Samary Forest Holly Lane Manakin-Sabot, Virginia	FIGURE 5
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SR Line 5 RMS error 0.9%=0.33ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35

South

North



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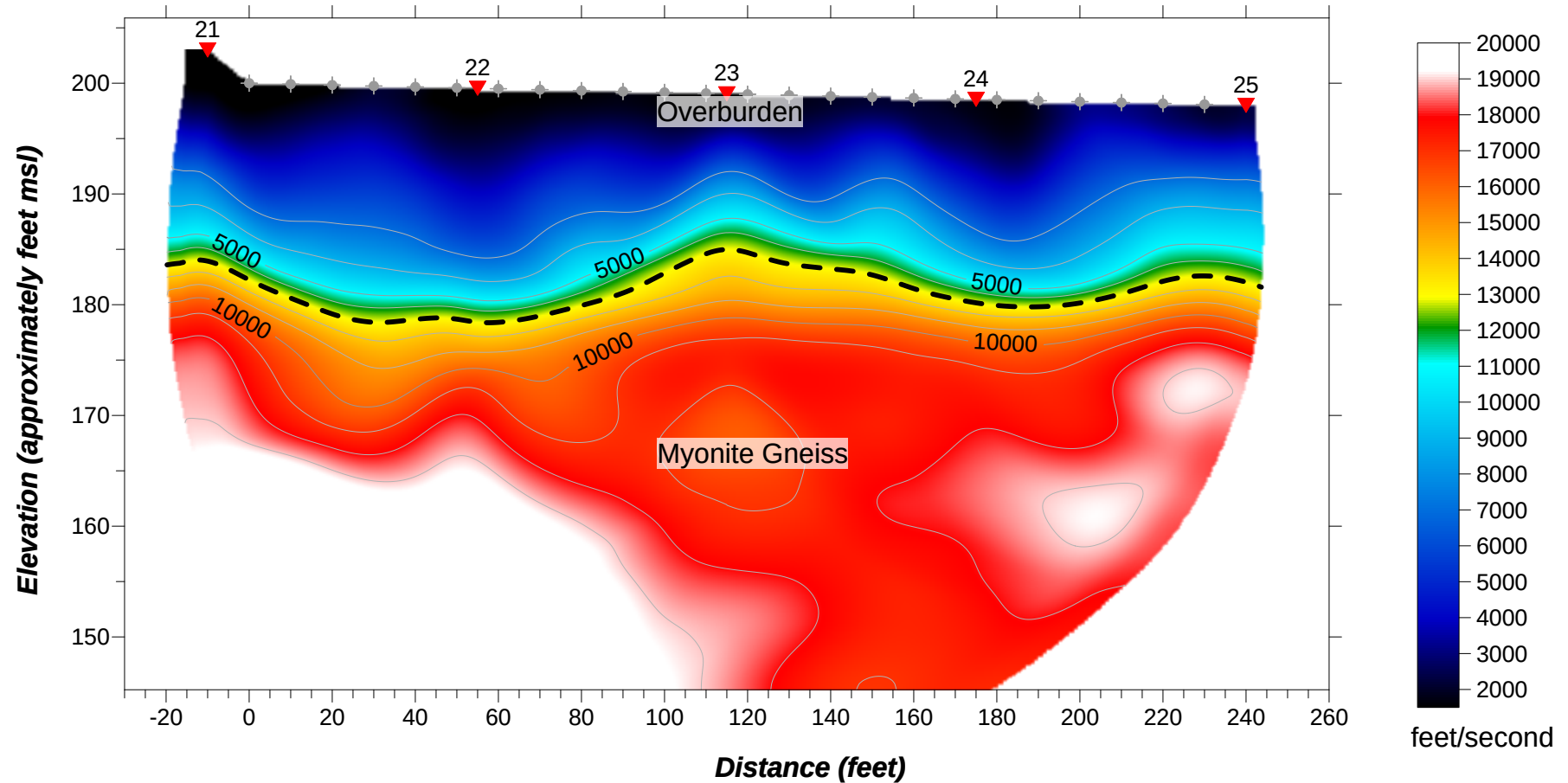
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SR Line 6 RMS error 1.4%=0.30ms 20 WET iters. 50Hz Width 2.2% initial GRADIENT.GRD Vers. 3.35

North

South



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SR Line 6
Hickory Haven and Samary Forest
Holly Lane
Manakin-Sabot, Virginia

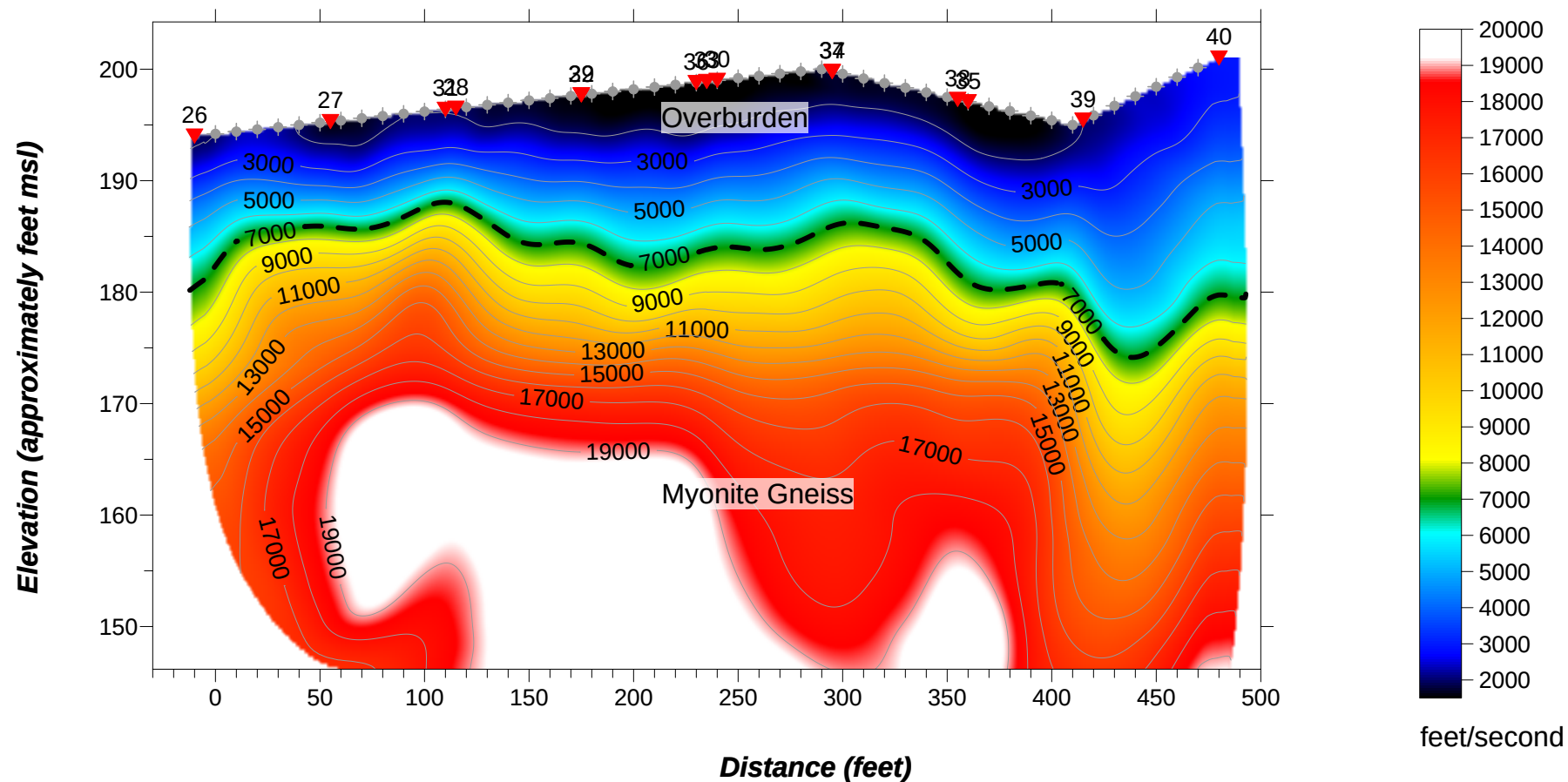
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FIGURE
7

SR Line 7 RMS error 1.0%=0.28ms 20 WET iters. 50Hz Width 2.5% initial GRADIENT.GRD Vers. 3.35

West

East



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THHVAF8

TITLE
SR Line 7
Hickory Haven and Samary Forest
Holly Lane
Manakin-Sabot, Virginia

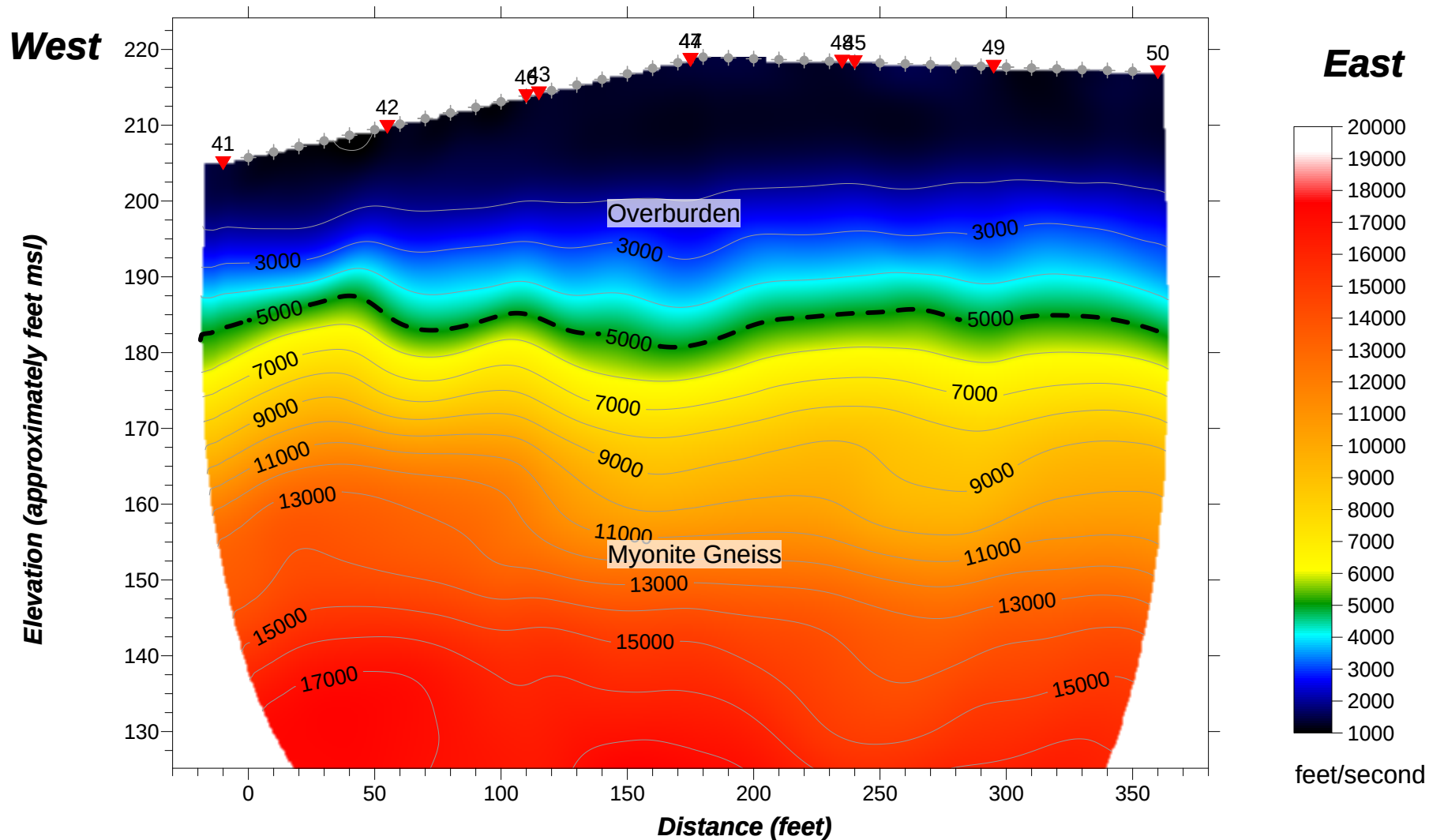
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FIGURE

8

SR Line 8 RMS error 0.8%=0.44ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Vers. 3.35



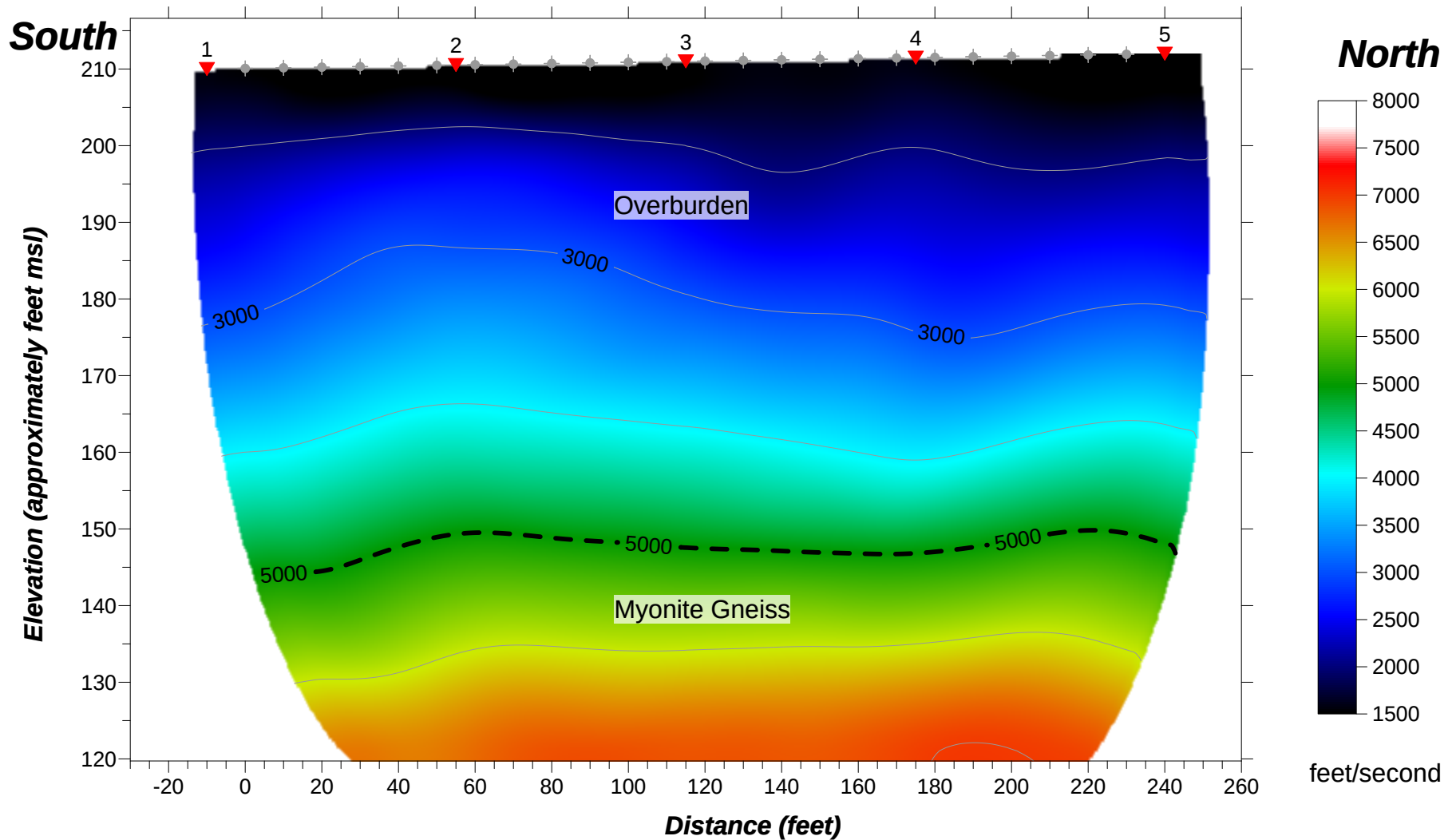
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SR Line 9 RMS error 0.7%=0.54ms 20 WET iters. 50Hz Width 9.0% initial GRADIENT.GRD Vers. 3.35



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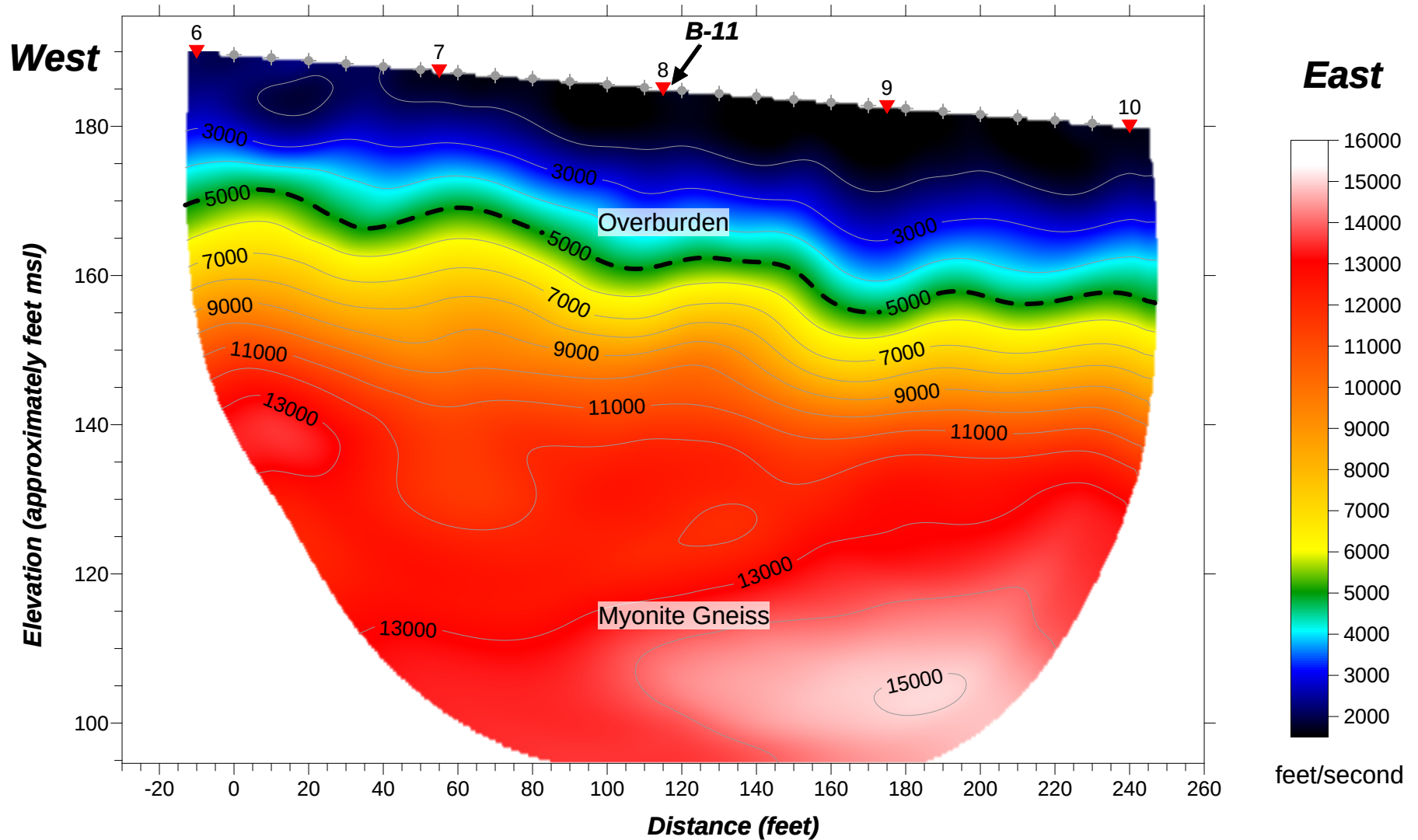
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SR Line 9
Hickory Haven and Samary Forest
Whippoorwill Road
Manakin-Sabot, Virginia

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FIGURE
10

SR Line 10 RMS error 1.0%=0.38ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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SR Line 10
Hickory Haven and Samary Forest
Whippoorwill Road
Manakin-Sabot, Virginia

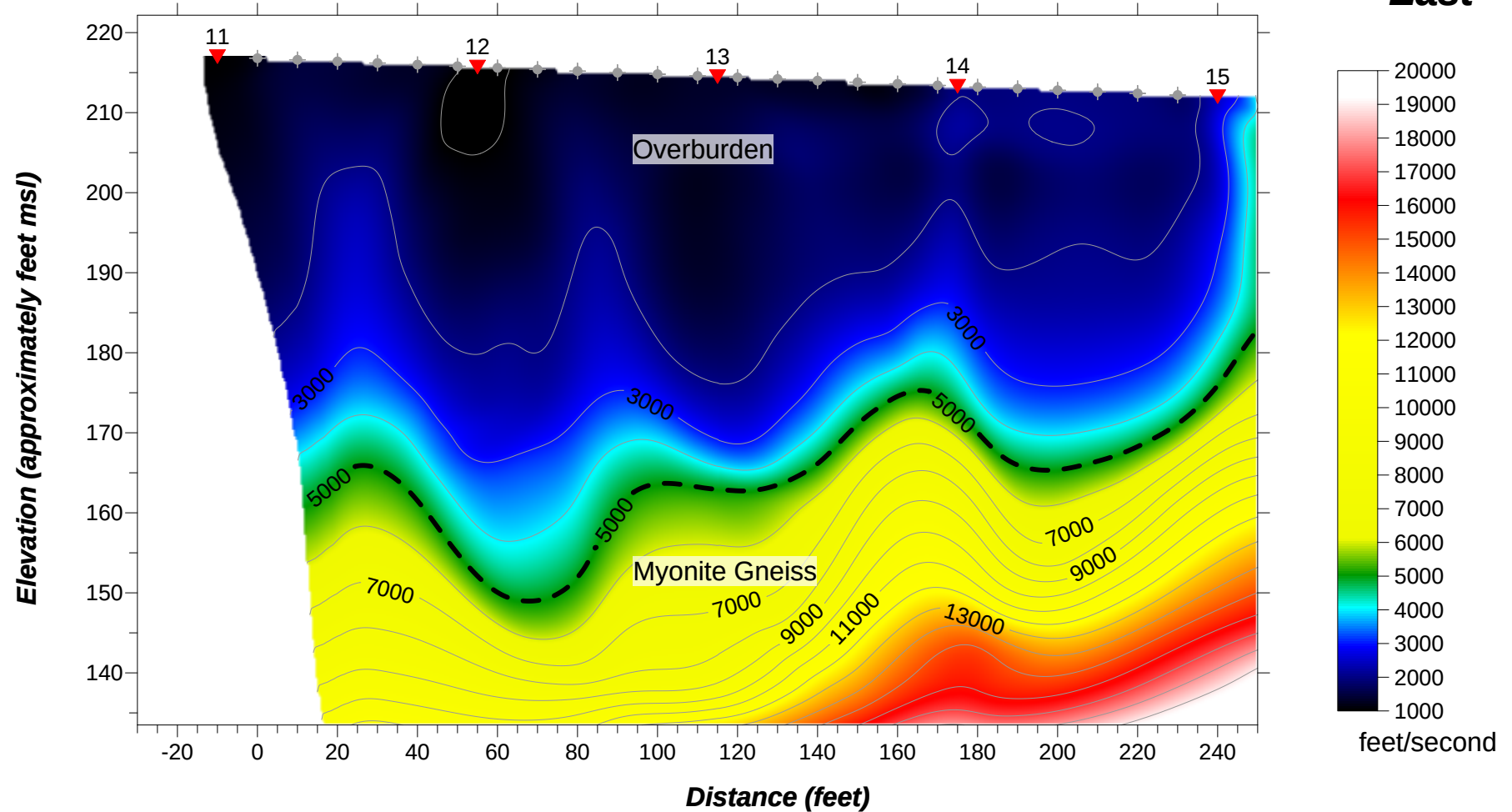
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FIGURE
11

SR Line 11 RMS error 3.2%=2.48ms 20 WET iters. 50Hz Width 4.5% initial GRADIENT.GRD Vers. 3.35

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East



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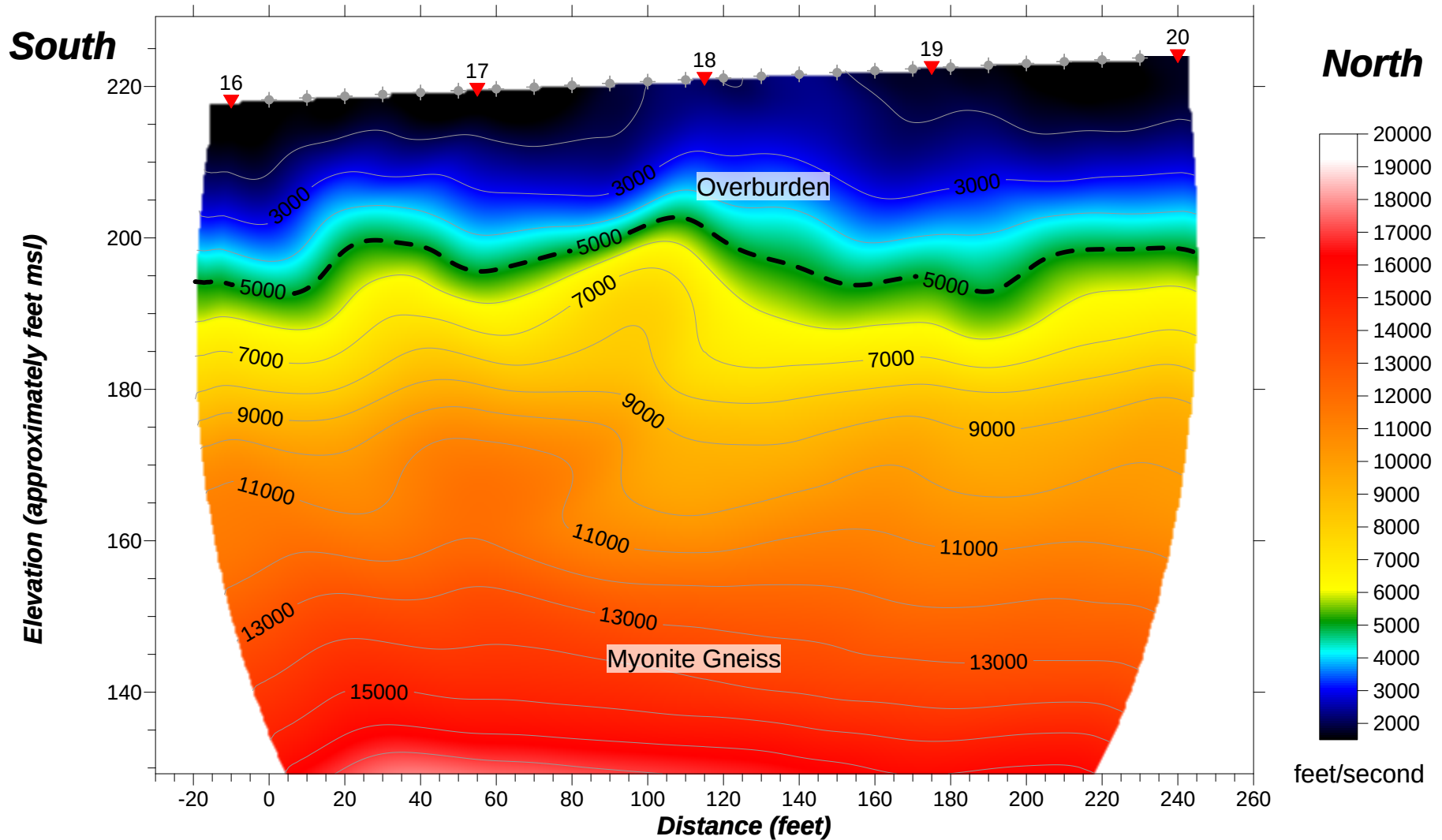
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SR Line 11
Hickory Haven and Samary Forest
Whippoorwill Road
Manakin-Sabot, Virginia

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FIGURE
12

SR Line 12 RMS error 0.8%=0.37ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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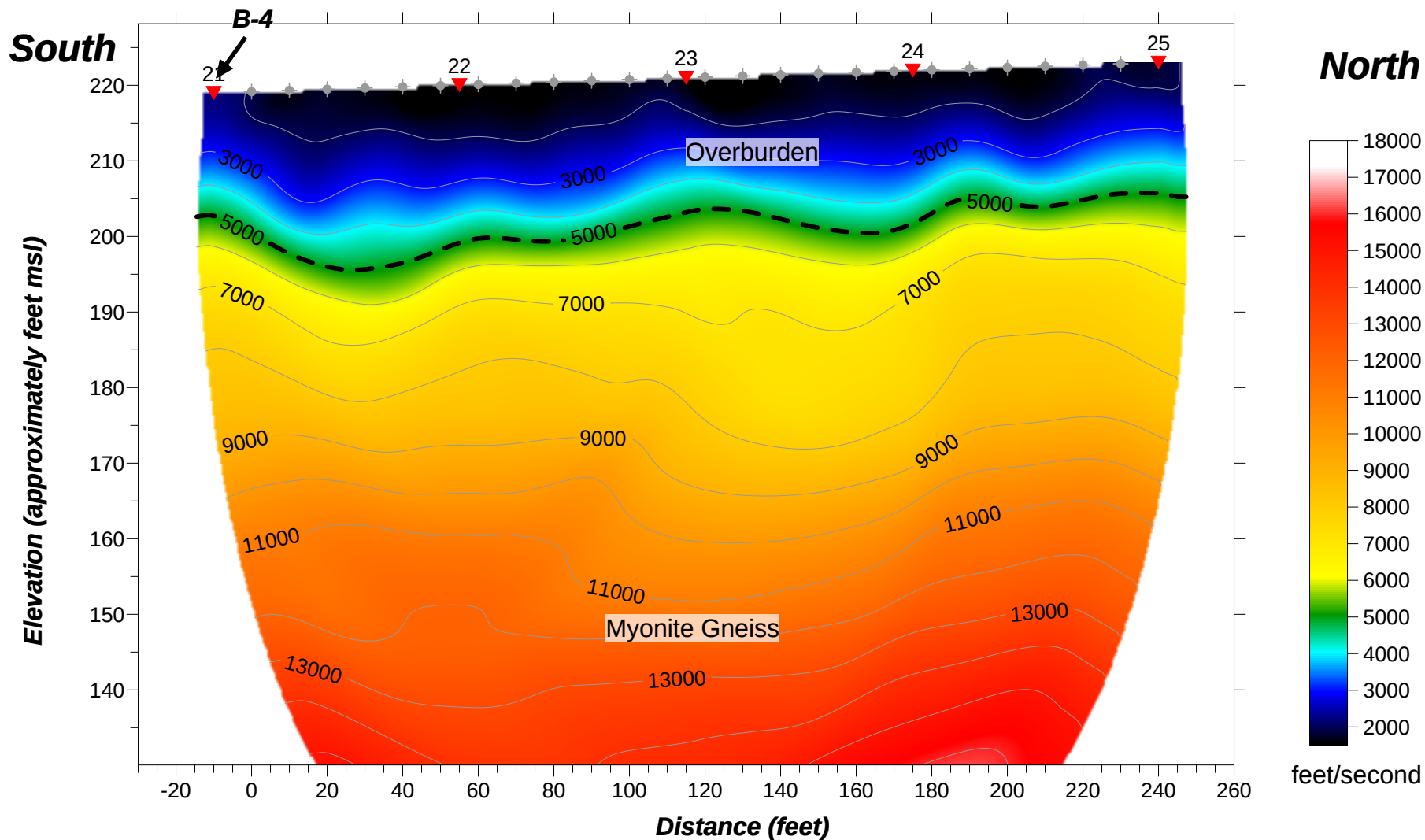
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JOB NO.	19197	DWG. NO./REV. NO.	THHVAF13

SR Line 12
Hickory Haven and Samary Forest
Whippoorwill Road
Manakin-Sabot, Virginia

CLIENT
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FIGURE
13

SR Line 13 RMS error 1.0%=0.40ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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SR Line 13
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FIGURE
14