Seismic Refraction Survey Report
Former Raytheon Facility
Wayland, Massachusetts

Prepared for
ENVIRONMENTAL RESOURCES
MANAGEMENT, INC.
November 2003

GEOPHYSICAL
APPLICATIONS
INCORPORATED

November 4, 2003

Mr. Jeremy Picard, P.G.
ENVIRONMENTAL RESOURCES MANAGEMENT, INC.
399 Boylston Street, 6th Floor
Boston, MA 02116

Subject: Seismic Refraction Survey Report
Former Raytheon Facility
Wayland, Massachusetts

Dear Mr. Picard:

In accordance with your authorization, Geophysical Applications performed a seismic refraction survey to help ERM characterize subsurface conditions at the above-noted site. The primary objective was to measure bedrock depths along a 2,380-foot seismic traverse.

The geophysical survey method used was seismic refraction profiling, as described below.

METHODS OF INVESTIGATION

Survey Control

ERM selected the approximate location of the seismic refraction traverse prior to data acquisition. Geophysical Applications subsequently flagged and brush cut the traverse, after conferring with the Town's Conservation Commission. The traverse was marked with labeled pin flags at each shot point. These flags were left in place at the survey's conclusion in the event that ERM wishes to have a surveyor locate the traverse.

Vertical survey control entailed ground-surface elevation measurements at seismic shot points and major breaks in topography using a Pentax electronic theodolite. Those measurements were tied to a ground elevation of 123.2 feet, provided by ERM at boring MW-267S.

Seismic Refraction

Refraction data were acquired along 2,380 feet of traverse using an ABEM Terraloc Mark 6 seismograph. Each 24-channel geophone array was 500 feet long, with 20-foot geophone spacings. Interference from wind noise was minimized by using 40-hertz geophones, and high-pass filters set to 12 hertz. Geophones were coupled to the ground surface with spike bases.

Seismic energy was generated with small explosive charges placed at each shot point location. Explosive charges were placed approximately 3 feet below ground surface in pilot holes driven with a steel bar and sledge hammer. An inductive coil around one of the blasting cap wires triggered seismograph recording.

Refraction seismograms were recorded using 0.25-millisecond sampling intervals, with record lengths of 256 milliseconds. Seismograms were reviewed in the field and stored on the ABEM's internal hard drive. Data was also downloaded to floppy diskettes for backup data storage.

Seismic shot points were located at approximately 170-foot intervals along each 24-channel geophone spread. Additional offset shots were placed approximately 150 to 200 feet beyond each

array endpoint, where permitted by site conditions, to help profile bedrock near the endpoints. Up to six shot points were occupied along each geophone array to provide reversed seismic profiles.

Refraction data analysis was performed by picking first-arrival times with Rimrock Geophysics' ASIPIK module, followed by modeling with Rimrock Geophysics' SIPT2 delay-time interpretation software. This software uses a ray-tracing algorithm, in which calculated layer thicknesses beneath each geophone are varied to obtain good agreement between observed and modeled arrival times. The SIPT2-generated computer models were spot-checked using layer depths manually calculated with the crossover-distance technique.

SURVEY LIMITATIONS

Seismic survey depth calculations are estimated to be accurate within ± 10% (or ± 5 feet, whichever is larger) for cross sections presented in this report, unless otherwise stated.

Weathered bedrock or till layers too thin to be detected by seismic profiling may be present along any of the interpreted bedrock surfaces shown on the attached cross sections.

Seismic velocity values shown on the cross sections were calculated over 24-channel geophone arrays, and therefore represent averaged subsurface conditions. Localized low-velocity zones (e.g. bedrock joints or fractures) occur naturally throughout the northeastern United States.

RESULTS

This geophysical survey was designed to characterize generalized subsurface stratigraphy (particularly depths to groundwater and bedrock). The survey traverse was acquired at the approximate location shown on Figure 1.

Seismic refraction survey results are depicted in profile form on Figure 2. This profile shows calculated depths to the various layers detected as well as their compressional seismic velocity values in feet per second (ft/sec).

All seismic traverses disclosed dry, unconsolidated soil or backfill averaging approximately 5 to 10 feet thick. The seismic velocity value calculated for this unsaturated overburden layer is approximately 1,420 ft/sec.

A higher-velocity overburden layer is interpreted above the bedrock. This layer's calculated seismic velocity of approximately 5,000 ft/sec typically represents water-saturated overburden.

The measured bedrock velocities range from 11,200 ft/sec to approximately 15,600 ft/sec. In metamorphic terrain, velocities greater than 13,000 ft/sec generally represent competent bedrock with little to no fractures or weathering. The velocity range of 11,200 to 12,700 ft/sec would represent bedrock with a moderate degree of fractures and/or weathering.

Bedrock depths varied from approximately 90 to 100 feet below ground surface (elevation 20 to 30 feet) between Station 0+00 and Station 4+00. Deeper bedrock was measured between Stations 8+00 to 18+00, with the deepest bedrock detected approximately 165 feet below ground surface (elevation -60 feet) at Station 13+40. The bedrock rises to elevation -20, (approximately 145 feet below ground surface) at the traverse's northern end.

* * * *

We appreciate this opportunity to provide geophysical services, and we welcome questions concerning this report. Please call the undersigned at 508/543-1388 if we may provide additional information that would benefit ERM's project.

Sincerely,
GEOPHYSICAL APPLICATIONS, INC.

E. Rostosky eas
Edward Rostosky
Project Geophysicist

M. Blackey
Mark E. Blackey
Principal and Geophysicist

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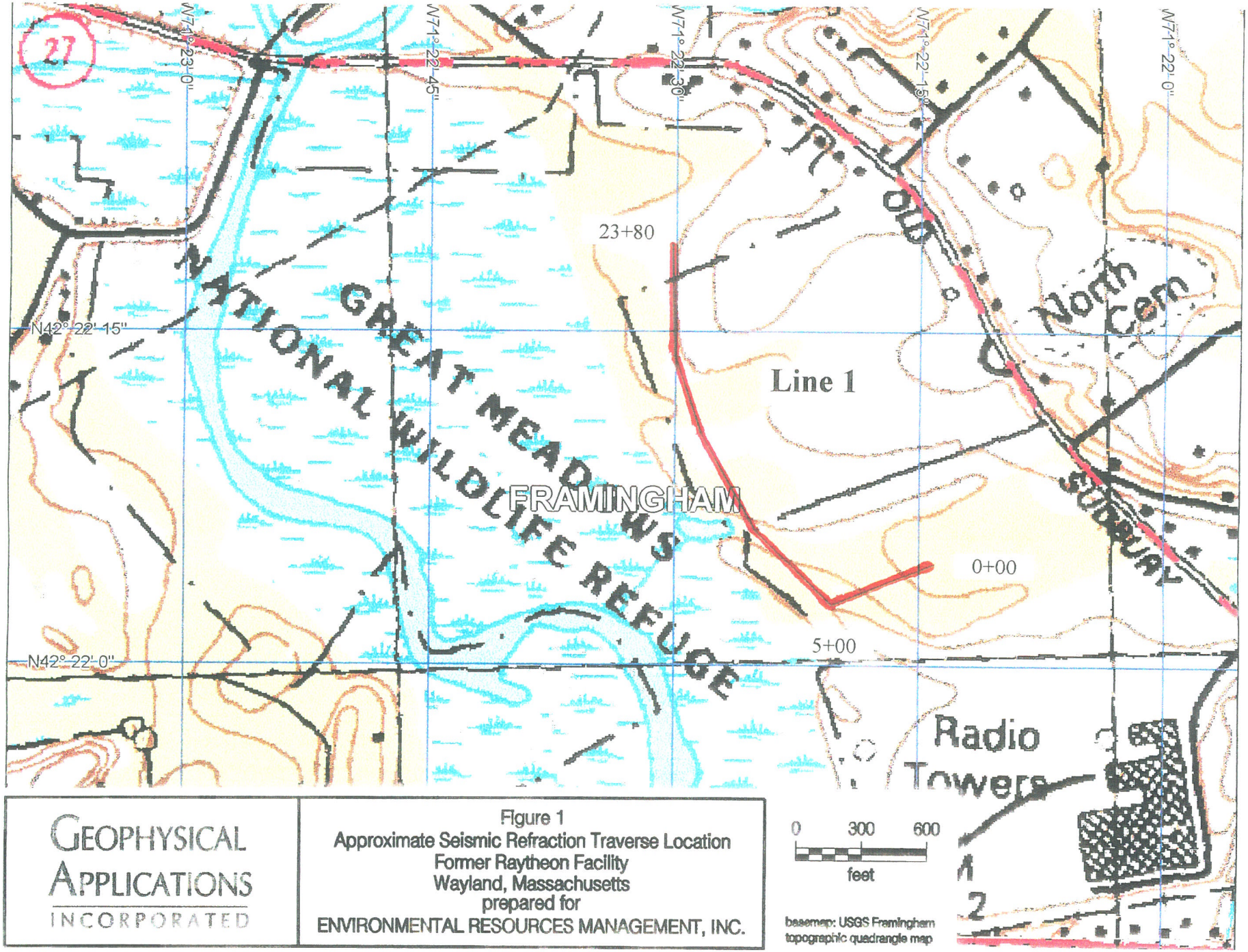

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Figure 1
Approximate Seismic Refraction Traverse Location
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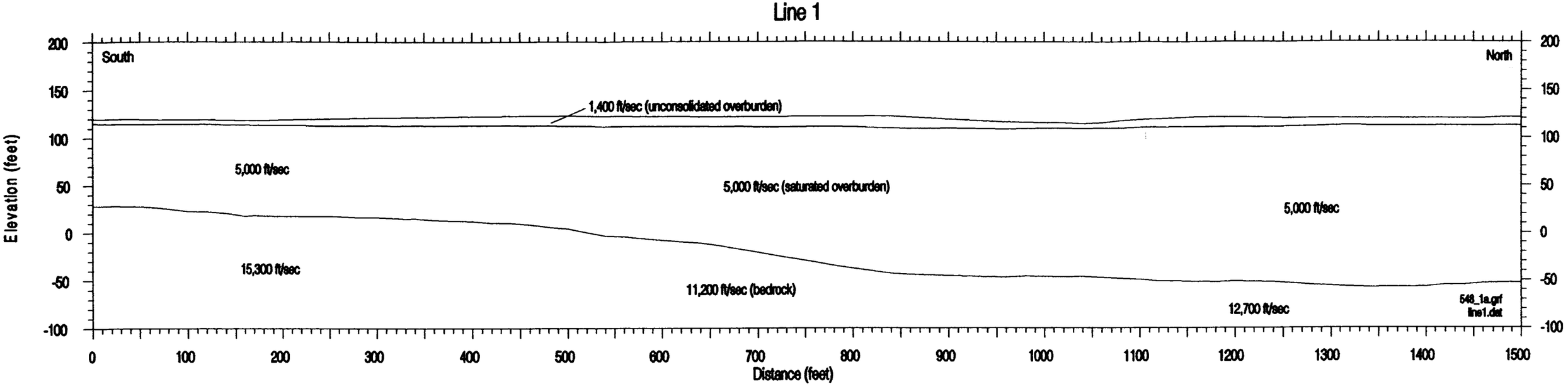

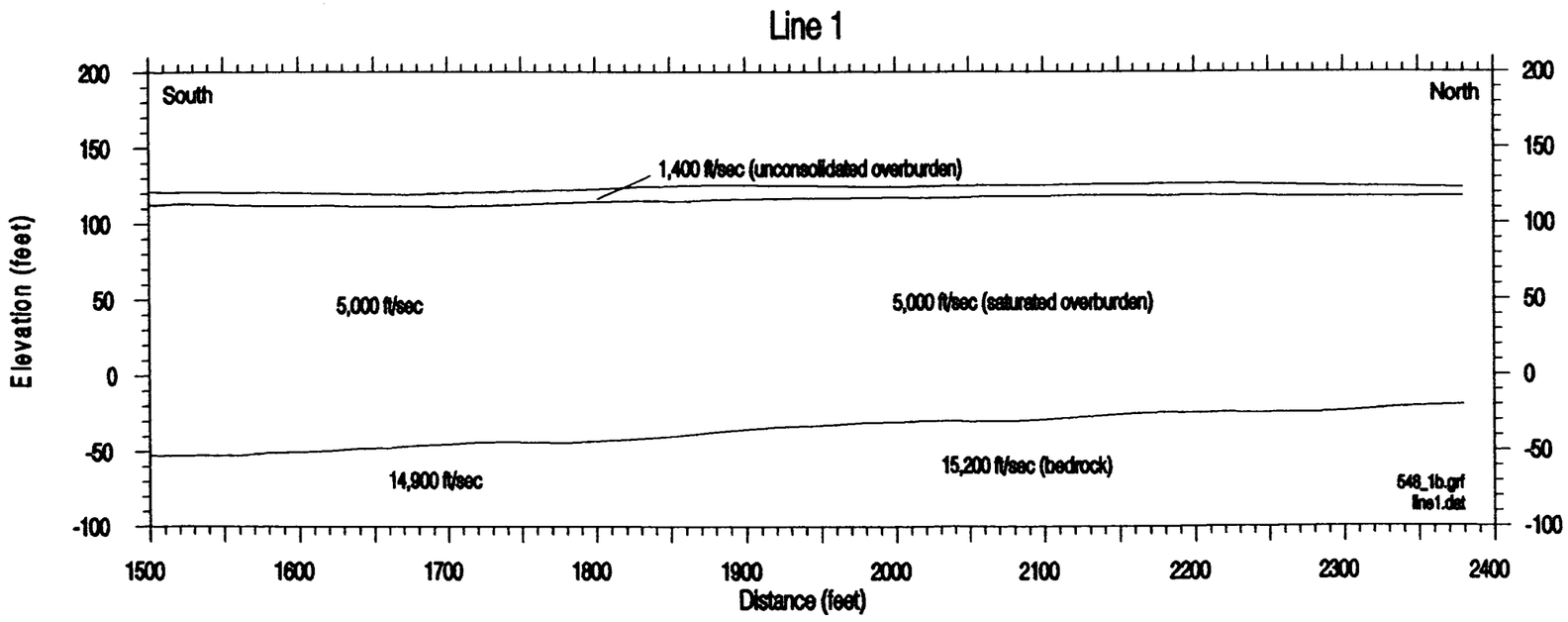

Notes:

1) Seismic velocity values are in units of feet per second (ft/sec)
2) Horizontal scale, 1 inch = 100 feet
   Vertical scale, 1 inch = 100 feet
   Vertical exaggeration 1:1
3) Elevations were referenced to a datum of 123.2 feet
   at ground surface adjacent to MW- 267S

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Figure 2
Line 1 Seismic Refraction Cross Section
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