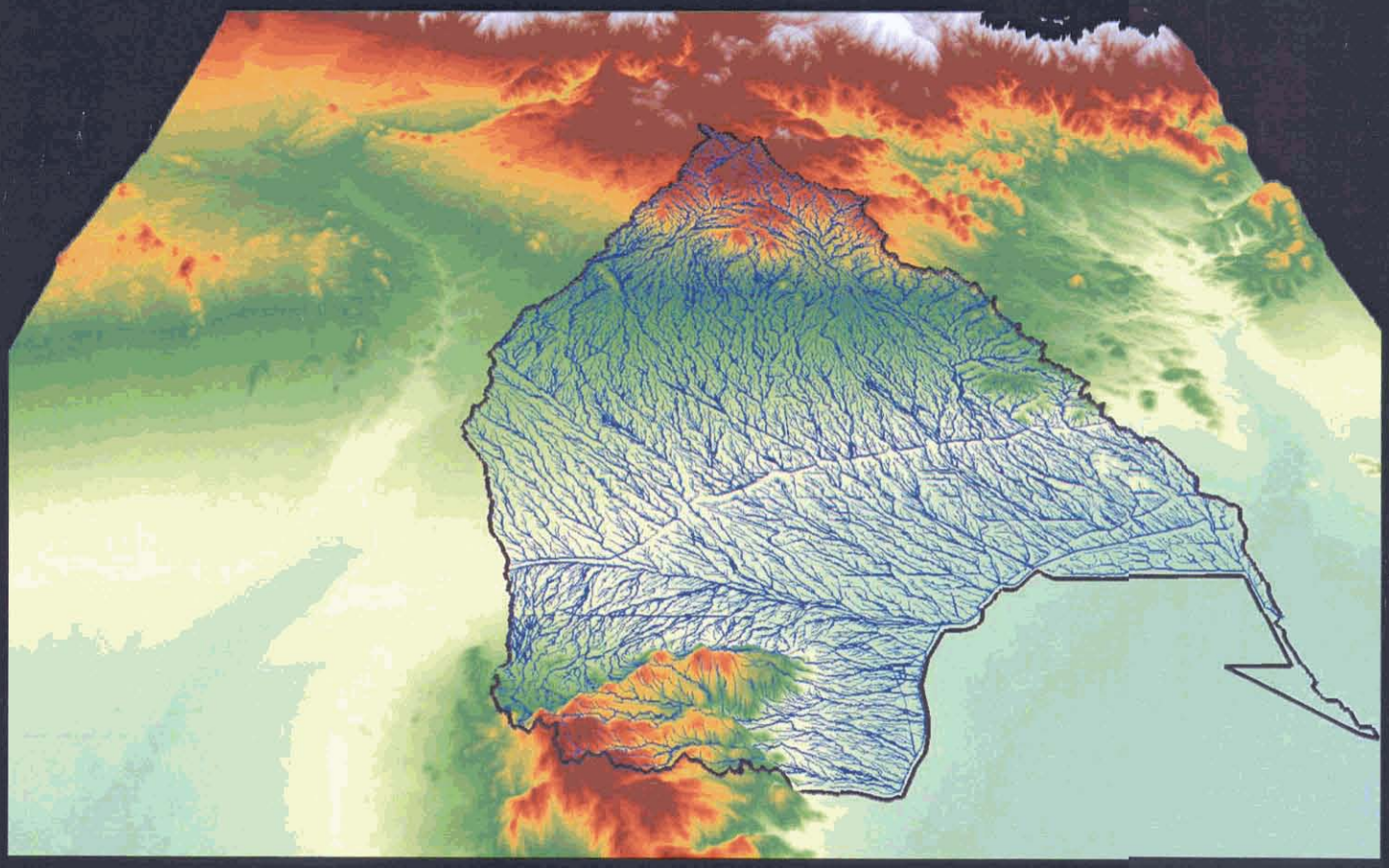
Wittmann Area Drainage Master Plan

Mc Micken Dam Project
Geotechnical Appraisal Report
Volume GA



Prepared for the Flood Control District of Maricopa County

Contract FCD 2004C060

July 2007

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Flood Control District of Maricopa County

WITTMANN AREA DRAINAGE MASTER PLAN

McMicken Dam Project Geotechnical Appraisal Report

VOLUME GA

Contract FCD 2004C060

July 2007

Prepared by: *AMEC Earth & Environmental, Inc.*

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20 July 2007
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Re: McMicken Dam Project
Geotechnical Appraisal Report
Wittmann Area Drainage Master Plan
Contract FCD 2004C060
Maricopa County, Arizona

AMEC Earth & Environmental, Inc. (AMEC) herewith submits a final report summarizing the current geotechnical conditions of the McMicken Dam Project, including its initial construction, modifications, and geotechnical and geological investigations of the embankment and outlet channel. The present study summarizes several field investigations of foundation and embankment soils completed previously by AMEC and others. This knowledge base was then supplemented by additional, but limited, field investigations completed specifically for this evaluation. The results of these investigations are utilized as a basis for the interpretations and recommendations presented in the report.

Should you have any questions concerning the content of this report, please do not hesitate in contacting us.

Respectfully submitted,

AMEC Earth & Environmental, Inc.

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Flood Control District of Maricopa County

WITTMANN AREA DRAINAGE MASTER PLAN
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WITTMANN AREA DRAINAGE MASTER PLAN
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SECTION 1.0 INTRODUCTION

1.1 GENERAL PROJECT DESCRIPTION

This geotechnical report is submitted pursuant to completion of a geotechnical review and appraisal by AMEC Earth & Environmental, Inc. (AMEC) of McMicken Dam and the McMicken Outlet Channel and Outlet Wash (McMicken Dam Project). Presented is a summary of the geotechnical conditions of the McMicken Dam Project, including its initial construction, historic modifications, and geotechnical and geological investigations of the embankment and foundation soils. The report describes the geologic setting, original design and construction, history of cracking, foundation and embankment geotechnical conditions, historic modifications, outlets and penetrations, seismic hazard, and other geotechnically related conditions associated with the McMicken Dam Project. This review was performed for use by Entellus, Inc. (Entellus) and the Flood Control District of Maricopa County (District) in its development and evaluation of rehabilitation or dam replacement alternatives. This study was completed for Entellus as part of the Wittmann Area Drainage Master Plan (ADMP) project, Contract No. FCD 2004C060.

1.2 SCOPE OF WORK

Project details were provided in Exhibit A – Wittmann ADMP Scope of Work with Notice to Proceed given on March 17, 2006. The scope of the appraisal included the following specific elements:

- Collect and evaluate all available data related to the nature and depth of moisture-sensitive, collapsing soils in the shallow geotechnical profile.
- Interpret the geotechnical plan and profile to evaluate the depth of the Holocene soil contact with the underlying, more competent, cemented soils. Within an accuracy dictated by the data, estimate the depth of Holocene soils along the dam alignment.
- Identify and summarize prior investigations of the dam safety issues related to transverse and longitudinal cracking.
- Utilize data collected for this project to identify and clarify other issues related to the integrity of the existing embankment from available data. These issues relate to the condition of the dam and outlet channel embankments, principal and emergency spillways, functionality of the existing central filter drain, and the improperly abandoned embankment penetrations.

At the conclusion of this report, geotechnical design considerations are identified and discussed for incorporation into the alternatives development and evaluation processes.

1.3 SITE DESCRIPTION

1.3.1 McMicken Dam Project

The McMicken Dam Project is located south of U.S. 60, just west of the Beardsley Canal, and extends south to about the extension of Peoria Avenue in central Maricopa County, Arizona (**Figure GA-1.3.1**). The McMicken Dam Project was constructed by the U.S Army Corps of Engineers (USACE) [1] in 1954 and 1955 to provide flood protection to Luke Air Force Base, the Litchfield Park Naval Air Facility, and downstream agricultural areas. Currently, it also provides flood protection to residential and commercial development and critical public facilities such as hospitals, schools, police and fire stations, freeways and other public roadways, railroads, and canals such as the Beardsley Canal. The dam and its appurtenant structures are currently operated and maintained by the District.

1.3.2 McMicken Dam

McMicken Dam is a zoned earthfill structure 9.5 miles in length (including its emergency spillway) that has a maximum height of approximately 34 feet. The crest of the dam has a width of 12 feet and was designed to an elevation of 1361.0 (1362.87)[2] feet. Dam upstream slopes are 2.5:1 (horizontal:vertical) with downstream slopes of 2:1. There is a downstream bench along the dam from approximately dam Station 357+00 to Station 474+50. This bench is the crest of an interim earthfill structure constructed in 1952 under the auspices of the Maricopa County Municipal Water Conservation District No. 1 (MCMWCD). This interim structure was incorporated into McMicken Dam during its original construction in 1954 and 1955. The upstream and downstream shells of the embankment are homogeneous earth with a central filter/drain system along the dam centerline. The slopes of the dam contain numerous erosion features and are generally covered with small desert brush and grasses.

The northern half of the dam crosses a protrusion of an alluvial basin which is situated between the Hieroglyphic Mountains to the north and the White Tank Mountains to the west, and which extends northwestward to the Vulture Mountains. The southern half of the dam subparallels the easternmost exposure of bedrock on the eastern flank of the White Tank Mountains. Trilby Wash and its associated drainages, which are intercepted by McMicken Dam, pass runoff to the Agua Fria River from an extensive watershed containing the southern flanks of the Wickenburg and Hieroglyphic Mountains and the northern flank of the White Tank Mountains. The McMicken Dam Project watershed is estimated to cover an area of approximately 308 square miles. The flood pool for the dam was designed for a capacity of approximately 19,300 acre-feet corresponding to an emergency spillway elevation of 1354.0 (1355.87) feet.

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[1] References are listed at the end of this report.

[2] Elevations shown are based on National Geodetic Vertical Datum 1929 (NGVD29) with elevations in parenthesis shifted +1.87 feet to North American Vertical Datum 1988 (NAVD88) (Entranco, 2004).

The dam includes an emergency spillway, a principal outlet, two operational gated irrigation outlet pipes, and a recently realigned, hardened dam segment at the southern end of the dam. The McMicken Dam emergency spillway is located at the northern most end of the dam, just south of U.S. 60. The emergency spillway is a 2,000-foot long broad-crested weir structure with a top width of 6 feet. The design crest elevation of the emergency spillway was 1354.0 (1555.87) feet. To the north of the emergency spillway section is a short length of dam that pinches out with the adjacent natural grade and is often referred to as the "North Dike".

Constructed as part of the McMicken Fissure Risk Zone Remediation (FRZR) Project the realigned, hardened dam segment was designed to isolate the McMicken Dam flood pool from a known region of high hazard fissure risk located south of historic dam Station 73+00. The remedial modification included the truncation of the existing embankment at Station 75+00 and the construction of a soil-cement dam extension transverse to the current alignment. A detention basin near the original terminus of the McMicken Dam reservoir was constructed south of the area of elevated fissure risk to provide flood protection for the 500-year, 6-hour storm event. Diversion channels were designed to divert runoff away from the fissure risk zones and into the detention basin.

McMicken Dam also has five corrugated metal pipe (CMP) outlet penetrations. Two of the outlets are currently operational, whereas the other three are abandoned. The two operational upstream gated outlets, consisting of 24-inch diameter CMP with trash racks at their inlets, are located at dam Stations 385+14 (corresponding to Station 387+14 on the 1956 as-built plans) and 396+24 (corresponding to Station 398+24 on the 1956 as-built plans). See Section 1.4 for historic Stationing discussion. These pipes were part of the MCMWCD No. 1 interim structure and were extended about 78 feet when McMicken Dam was originally constructed. When the dam was modified in 1984, they were extended an additional 10 feet. The original purpose of these outlets was to release flood water for irrigation purposes. The District no longer operates these outlets for that purpose.

The remaining three outlets were partially abandoned and buried during the construction of the 1956 structure. There was no visible indication of the outlet locations until the outlets were uncovered in 2003 and documented to be located at as-built dam Stations 402+98, 427+17 and 442+80.

The principal outlet for McMicken Dam includes a 20-foot wide outlet channel, a transition section, and a 30-foot wide stilling basin located at about dam Station 474+50. A reinforced concrete bridge spans the outlet, which includes a reinforced concrete breastwall that limits the channel to a height of 11 feet, forming a rectangular orifice. The ungated principal outlet for McMicken Dam discharges into the trapezoidal McMicken Outlet Channel, which runs east-northeasterly towards is confluence with the McMicken Outlet Channel which run southerly to its confluence with the Agua Fria River.

1.3.3 McMicken Outlet Channel

The outlet channel begins at the dam principal outlet structure and extends east-northeasterly for nearly six miles. At approximately outlet channel Station 61+00 the channel passes under three bridge structures, two for U.S. Highway 60, a four lane divided highway, and one for the Atchison, Topeka and Santa Fe (AT&SF) railroad trestle (see **Sheets 4-8**) . The channel continues west for another 5 miles before emptying into the McMicken Outlet Wash, which leads to the Agua Fria River. Overhead 240-KV power transmission lines run along both sides of the outlet channel from approximately outlet channel Station 80+00 to Station 230+00. At Station 230+00 the power lines on the north bank cross over the channel and continue to the southeast. The power lines on the south bank continue to parallel the channel and terminate at a substation just east of the McMicken Outlet Wash.

The outlet channel consists of an excavated channel which varies in slope and width along its length. Channel widths generally vary, being 60 feet between outlet channel Stations 11+91 and 69+16, with a transition to a 100-foot wide channel between Stations 69+16 and 77+16. The southern side of the outlet channel consists of an earthfill levee embankment structure that has a maximum height of approximately 14 feet and is about 6 miles in length. The crest of the levee has a width of 12 feet and was designed with a sloping crest elevation, with the highest elevation at the principal outlet of 1339.5 (1341.37) feet and the lowest elevation at the McMicken Outlet Wash of 1320.0 (1321.87) feet. Levee upstream slopes are 2.5:1 (horizontal: vertical) with downstream slopes of 2:1.

1.3.4 McMicken Outlet Wash

The McMicken Outlet Channel at its eastern terminus discharges into the unimproved McMicken Outlet Wash. The outlet wash is a natural ephemeral wash that has a bottom width ranging from 20 to 40 feet and stretches approximately 2.5 miles southerly to its confluence with the Agua Fria River. The wash is parallel to a service road used for a power line substation for approximately ¾ mile until passing under SR-303L and an 11-barrell box culvert crossing at Williams Road downstream of SR-303L. Further south along its alignment the wash has been channelized from Deer Valley Road to the Agua Fria River as part of the Sun City West development and El Mirage Drain projects. Unimproved portions of the wash are moderately overgrown with Palo Verde trees and desert brush. The channelized portion is trapezoidal with a 180 foot bottom width and 3 foot horizontal to 1 foot vertical side slopes. A large reinforced shotcrete drop structure exists within the channel that allows for a 25 foot change in channel elevation.

1.4 PROJECT STATIONING

Throughout its history McMicken Dam has undergone several changes in its stationing as a result of various activities. The July 1956 as-builts indicate the dam was constructed from Station 35+50 (south end) to Station 537+00 (north side of emergency spillway), with the outlet

channel levee starting at Station 10+00 (centerline of dam at principal outlet) and ending at Station 317+20 (end of levee at east end).

A shift in the stationing occurred during the early 1980s when the dam was raised; however, the shift is undocumented. Later in the 1990s the District added station markers to the crest; however, the means and methods in which the markers were set and numbered also are undocumented. During the search for the abandoned outlets, discussed in Section 9.0, AMEC measured the station markers on the dam crest and discovered that they were inconsistent with the as-built stationing of the dam. The table below details the location of five outlets with both the as-built stationing and the stationing from the dam crest markers. There appears to be an approximate shift of -200 feet; however, the shift is not consistent from location to location.

Dam As-built	Crest Marker (current)	Horizontal Difference (ft)
387+14	385+14	-200
398+24	396+24	-200
405+03	402+98	-205
429+64	427+17	-247
444+61	442+80	-181

As a result of the absence of documentation related to the historic changes in stationing, caution should be exercised when interpreting locations reported in historic studies. A general rule of thumb that may be followed is that most inspections and investigations performed prior to 1990 reference the as-built stationing. Investigations performed after ~2000 are potentially geo-referenced; therefore, they are depicted spatially on maps correctly and utilize the as-built stationing as the reference. However, dam safety inspections and field investigations performed in the last 10 to 15 years may reference the crest monument marker stationing and would therefore be different than the true as-built stationing location by approximately -200 feet. All new activities performed as part of the Wittmann ADMP Project are spatially geo-referenced and correctly depicted on each aerial image.

Activities related to the removal and realignment of the south end of McMicken Dam have also altered the dam stationing. The realigned section has established an independent stationing that begins at its connection with the existing dam at dam Station 75+00. The realigned station increases to the west from realigned dam Station 0+00 (downstream toe of existing dam) to realigned dam Station 14+68. A section of the original dam from dam Station 35+60 to 75+00 was fully removed. Stationing references falling between these are identified as "historic" herein.

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SECTION 2.0 GEOLOGIC SETTING

2.1 GENERAL GEOLOGY

McMicken Dam lies within the western portion of the Salt River Valley, off the eastern flank of the White Tank Mountains. The dam extends beyond the northern end of the White Tank Mountains, intercepting Trilby Wash and flood flows from the extensive contributing watershed. The southern half of the dam is situated on an alluvial fan surface, about two miles east of bedrock exposed at the foot of the White Tank Mountains. Southern portions of the dam are located in the medial position of coalesced alluvial fans of the White Tank Mountains, and from about Bell Road north to the emergency spillway alluvial deposits associated with the Trilby Wash system dominate. The outlet wash is predominately located in the distal portions of coalesced alluvial fans from the Hieroglyphic Mountains to the north. Current depths to groundwater are 400 to 500 feet. **Figure GA-2.1A** depicts the regional geology of the project site.

The western Salt River Valley is a typical component of the Sonoran region of the Basin and Range physiographic province. The Sonoran region contains many broad, deeply founded, alluvium-filled basins, separated by structural highlands composed of competent bedrock. The White Tank Mountains are one of these uplifted highlands, composed of both metamorphic and granitoid bedrock (Reynolds and others, 2002).

Although collaborating data are lacking, the gravity data of both Sweeney and Hill (2001) and Peterson (1968) suggest the presence of a buried bedrock shelf beneath the alluvial fan surface located directly east of the White Tank Mountains. If present, the orientation of the McMicken Dam embankment results in a rapid deepening of basin fill thickness northward and up-station along the alignment. AMEC (2003a) concludes that the depth to bedrock ranges from 75 to 150 feet near the south terminus of McMicken Dam to depths of greater than 1,000 feet below ground surface at dam Station 100+00.

Gravity data of both Sweeney and Hill (2001) and Peterson (1968), well logs (Geological Consultants, 2004), and subsidence patterns evident from InSAR indicate the presence of a buried bedrock ridge or equivalent in the vicinity of the emergency spillway of McMicken Dam. This buried ridge appears to be approximately orientated north-south and centered just to the east of the emergency spillway. Bedrock depths associated with this buried ridge are uncertain, but likely range from 800 to 1,400 feet below the ground surface.

The local surficial geologic units (**Figure GA-2.1B**) in near proximity to McMicken Dam and the outlet channel, as broadly described by Huckleberry (1994), Reynolds and Grubensky (1993), Field and Pearthree (1991), and Demsey (1988) are comprised of an assemblage of unconsolidated Quaternary alluvial fan deposits, and stream deposits associated with the Trilby Wash and Agua Fria River systems. Blissenback (1954) and Harvey (1992) describe alluvial fans as being composed of a complex assemblage of stream channel deposits, sheet flow deposits

from larger floods (which cause avulsion of the small watercourses across the fan surface), and thick debris flow and/or mudflow deposits from large infrequent floods. The fans likely include a minor component of aeolian deposits. Deposits associated with Trilby Wash primarily consist of channel deposits from relatively frequent flow events. Alluvial terrace deposits associated with the Agua Fria River are found to the east of the confluence of the outlet channel and the outlet wash. General descriptions of the surficial units found in the McMicken Dam Project area are presented below and are taken from Huckleberry (1994) and Field and Pearthree (1991).

Young Alluvium in Modern Stream Channels (Qyc) – Within the McMicken Dam study area, this unit is limited to the active channels associated with the Trilby Wash drainage system. Deposits are dominated by clastic sediments of sand and gravel, with some cobbles and rare boulders. The age of unit Qyc is less than 3,000 years before present (ybp).

Young Alluvium (Qy) – Outside the active braided channels, this unit is locally comprised of a limited thickness of silty to clayey sand and sandy silt, overlain by a thin mantle of aeolian silty sand. Little soil development is present and Stage I carbonate cementation development is common in the lower sands, with the upper loess largely uncemented. Moderate to strong rubification (reddening) is common in this unit. Within the ephemeral channels, the upper aeolian deposits are absent, with larger amounts of gravel and cobbles present. Nearer the mountain front, the unit contains coarser sediments, including silt, sand and gravel mixtures. The age of unit Qy ranges from about 10,000 to >3,000 ybp. This unit is widespread throughout the project area with notable deposits in the vicinity of Bell Road, the spillway area, and along the outlet channel.

Younger Middle Alluvium (Qm2) – This unit is locally comprised of moderately cemented (Stage I to II) clayey to silty sands, occasionally interbedded with silty to sandy gravels. These deposits usually display poor soil development and some rubification. The age of unit Qm2 ranges from 10,000 to 150,000 ybp. Qm2 deposits are widespread throughout the project area.

Older Middle Alluvium (Qm1) – This unit consists of a poorly sorted, angular to sub-angular mixture of silt, sand and gravel deposits. The surfaces are moderately dissected on the upper piedmont with 3 to 20 feet of relief above the active channels. Interfluvial areas are generally flat and expansive with poorly preserved bar and swale topography. Desert pavement is moderately to well developed and is found over 50 to 75 percent of the surface. Underlying soils are characterized by weakly developed argillic horizons with Stage II to III calcification. The age of unit Qm1 ranges from 300,000 to 1,000,000 ybp. Qm1 deposits are widespread throughout the study area, with the greatest concentrations occurring to the south of Trilby Wash.

Older Alluvium (Qo) – Unit Qo is composed of early Pleistocene to late Pliocene alluvial fan deposits greater than 1,000,000 years in age. The unit generally consists of poorly sorted subangular gravels containing minor amounts of finer material, ranging in thickness from a thin veneer over bedrock pediments to tens of feet thick. The surfaces of unit Qo are deeply dissected up to 50 feet within interfluvial areas and have well-rounded ridges with intervening swales or

ravines. Soils are generally eroded away, exposing remnants of Stage IV to VI petrocalcic horizons. Unit Qo is found as terrace deposits associated with the Agua Fria River east of the terminus of the outlet channel.

Metamorphic Rocks (Xm) – Unit Xm is composed of metamorphic rock of the White Tank Mountains. Near the McMicken Dam facilities, this unit is only present at Fenne Knoll to the southwest of the southern terminus of the dam.

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SECTION 3.0 PREVIOUS GEOTECHNICAL INVESTIGATIONS

Since McMicken Dam's original construction in the mid 1950s, the dam has been investigated many times to assess its safety. Investigations have primarily focused on the cause of embankment cracking and the impacts of regional land subsidence and associated earth fissuring. Provided in the following sections are condensed summaries of each geotechnical investigation. Unless otherwise stated herein, **Sheets 1** through **8,** included in the map pockets at the end of this report, depict the investigation locations along the McMicken Dam Project boundaries, with select field investigation logs extracted from each investigation and provided in Appendix A. Those agencies or consultants responsible for the historic investigations include:

- USACE
- Sergent, Hauskins & Beckwith Consulting Geotechnical Engineers (SH&B)
- AMEC
- Ricker, Atkinson, McBee and Associates, Inc. (RAM)
- Ninyo & Moore (N&M)

The date provided in each heading below reflects the date of the report in which the field investigation results were published and not necessarily the date of the field investigation. Design and construction history will be discussed in Section 4.0.

3.1 USACE GEOTECHNICAL INVESTIGATION (1954)

In 1952 the USACE conducted a geotechnical investigation along the future alignment of what are now McMicken Dam and McMicken Outlet Channel (**Sheets 1 through 8**). This investigation included 62 borings completed from June to July 1952, and later in October 1953. Borings were documented as being drilled by means of a "power auger" which ranged in size from 12 to 30 inches in diameter. Boring depths ranged from 4 to 40 feet below existing grade. This investigation collected data that was used to improve and enlarge the existing Trilby Wash Dam. Results of this investigation and the subsequent design are documented in USACE (1954).

3.2 USACE GEOTECHNICAL INVESTIGATION (1973)

In July 1972 the USACE conducted a geotechnical investigation to establish a soil profile normal to the dam embankment to investigate embankment cracking. Twelve bucket auger test holes were advanced to depths ranging from 50 to 75 feet between dam Stations 435+00 and 460+00 (**Sheets 1 through 8**). Four lines of three holes each were completed perpendicular to the dam centerline. Results of the investigation are documented in USACE (1973).

3.3 SH&B GEOTECHNICAL INVESTIGATION (1982)

From November 11, 1981 to December 15, 1982, SH&B conducted a geotechnical investigation of McMicken Dam to determine parameters necessary for restoration of two existing dam

breaches, maintenance activities, and to document earth fissuring. The investigation included drilling 75 borings located along nearly the entire length of the dam from Station 67+00 to approximately Station 472+00 (**Sheets 1 through 8**). Borings were advanced with a CME-55 drill rig utilizing a 6 ½ - inch diameter hollow stem auger with depths ranging from 30 to 60 feet. In addition to the borings 36 backhoe test pits were excavated. Test pits were excavated with either an American 35A or Case 580C backhoe. Test pit depths ranged from 5 to 10 feet. Test pits TP-1 through TP-14 were conducted to assess ground fissuring near the dam. Due to their value to the geotechnical engineering investigation of the McMicken Dam Project, test pit locations for TP-1 through TP-14 are not shown on **Sheets 1 through 8**. Results of those test pits have been considered by AMEC in a concurrent study to assess land subsidence and earth fissuring impacts to the McMicken Dam Project area. The results can be found in Volume SE, McMicken Dam Subsidence & Earth Fissure Risk Zoning (AMEC, 2007) and as originally documented by SH&B (1982).

3.4 SH&B GEOTECHNICAL INVESTIGATION (1983)

From October 8 to October 22, 1982, SH&B conducted a geotechnical investigation of McMicken Dam between dam Stations 110+00 and 467+25 (**Sheets 1 through 8**) to investigate upstream borrow sources and to further support the design for the dam restoration. The investigation included excavation of 39 test pits on the upstream side of the dam and 19 downstream test trenches. The average test pit depth was approximately 5.5 feet and the test trenches ranged in depth from 6.5 to 11.5 feet. Both were excavated with a Case 580C backhoe. Results of this investigation are documented in SH&B (1983a).

3.5 AMEC GEOTECHNICAL INVESTIGATION (2003)

In April and May of 2001, AMEC conducted a geotechnical investigation of McMicken Dam to assess the overall condition of the dam as a result of documented transverse and longitudinal cracking. The investigation included 19 borings and 22 test pits between dam Stations 200+00 and 503+13 (**Sheets 1 through 8**). Borings were advanced using a CME-75 with a 6 5/8-inch diameter hollow stem auger and test pits were excavated with John Deere 710D and Case 580L backhoes. Boring depths ranged from 9.5 to 15.5 feet and test pit depths ranged from 3.5 to 8.0 feet. Results of this investigation are documented in AMEC (2003a).

3.6 AMEC EARTH FISSURE INVESTIGATION (2003)

Between November 2001 and mid-February 2002, AMEC conducted an earth fissure investigation to detect and characterize the distribution and nature of earth fissures located in the vicinity of the southernmost, 6-mile portion of McMicken Dam. The investigation included 10 test pits located east of the dam and in the vicinity of historic dam Stations 54+00 to 63+00 (**Sheets 1 through 8**). Test pits were excavated in the projected path or across exposed indications of earth fissuring. Test pits ranged from 24 to 76 feet in length and were excavated to depths ranging from 4.5 to 9 feet utilizing a rubber-tired Case 580C backhoe. The soil profile and the fissures exposed were logged and photographed, with the orientation, persistence and width of the fissures recorded on the test pit logs.

In addition to the test pits, 93 seismic refraction surveys and 7 test trenches were completed to identify the presence or absence of potential fissures in the near vicinity of McMicken Dam. Seismic lines were completed in the area bounded by historic dam Stations 49+00 and 115+00 with the intent of locating subsurface anomalies. Test trenches were positioned to expose the subsurface conditions causing the seismic refraction anomalies, along projected trends of exposed fissures, or where the InSAR interferometry indicated the possibility of adequate horizontal strain necessary to produce fissures. The trenches ranged from 90 to 220 feet in length and averaged about 10 feet in depth. The reader is directed to the AMEC 2003 report for plan view depictions of the seismic refraction and test trench locations. A numerical ground strain model was also developed to predict ground strains at the southern end of the dam. Results of this investigation are documented in AMEC (2003b).

3.7 AMEC FRZR GEOTECHNICAL DESIGN INVESTIGATION (2004)

From December 1, 2003, to April 4, 2004, AMEC conducted a geotechnical investigation to support the McMicken FRZR Project design and to assist in further characterizing the extent and erosional characteristics of earth fissuring. The geotechnical investigation was limited to the south end of the dam from historic dam Stations 45+00 to 80+00 (**Sheets 1 through 8**) and extended from the crest of the dam to as much as 1,500 feet upstream in the area of the proposed footprint of the new dam alignment. The investigation included 13 borings and 36 test pits. Nine borings were advanced with a sonic drill rig and the remaining four with a Burley 4000 drill rig. Boring depths ranged from 35 to 50 feet. The 36 test pits were excavated to depths ranging from three to eight feet by a Case 590 backhoe. Results of the investigation are documented in AMEC (2004).

3.8 RAM GEOTECHNICAL INVESTIGATION (JANUARY 2004)

Between June and August of 2003, RAM performed a geotechnical investigation to assess the need for dam repairs north of the principal outlet structure. Twelve borings and five test trenches were completed between dam Station 477+50 and Station 480+00 (**Sheets 1 through 8**). Borings were advanced with a CME-55 drill rig and ranged in depth from 9.7 to 30 feet. Results of the investigation are reported in RAM (2004a).

3.9 RAM PRINCIPAL OUTLET GEOTECHNICAL INVESTIGATION (APRIL 2004)

In June 2003 RAM performed a geotechnieal investigation to assess the need for principal outlet repairs. Six borings and five test trenches were completed around the principal outlet structure are approximately dam Station 475+00 (**Sheets 1 through 8**). Borings were advanced with a CME-55 drill rig and ranged in depth from 7.5 to 50.8 feet with one boring advanced with a vaeuum truck. Results of the investigation are reported in (2004b).

3.10 N&M PRINCIPAL OUTLET GEOTECHNICAL INVESTIGATION (2005)

In May and June of 2005 N&M completed a geotechnical investigation to further assist in the development of principal outlet rehabilitation alternatives. The investigation included eleven

borings and two test trenches at the principal outlet, approximately Station 475+00 (**Sheets 1 through 8**). Borings were advanced with a CME-75 with a 6 5/8 inch diameter hollow stem auger to depths that ranged from 17 to 49.5 feet. Test trenches were excavated by hand methods to a maximum depth of 3.5 feet. Results of the investigation are documented in N&M (2005a).

3.11 AMEC GEOLOGIC HAZARD AND GEOTECHNICAL INVESTIGATION (2007)

From September to December 2006 a geologic hazard and geotechnical investigation was completed to support the fissure risk zone investigation and geotechnical characterization of the McMicken Dam Project as part of the McMicken Dam alternatives analysis portion of the overall Wittmann ADMP project. The investigation included geophysical surveys followed by the excavation of backhoe test trenches and test pits. Historic geotechnical data compiled and summarized within this report were utilized to identify geotechnical data gaps. AMEC's review indicates limited geotechnical information exists that is associated with the outlet channel, outlet channel levee, and outlet wash. The goal of this investigation was to satisfactorily fill those data gaps by characterizing the geotechnical attributes of the outlet channel levee embankment, outlet channel levee foundation and outlet channel/wash soils. Additional project geologic hazard assessment goals included the search for soil discontinuities related to land subsidence and associated earth fissuring.

The investigation included the excavation of 29 test pits and 375 linear feet of 8-foot deep test trenches. Additionally, several hand-excavated shallow test holes were completed within the levee embankment. Select disturbed bulk soil samples were collected for laboratory testing, which included a suite of physical characterization tests to identify embankment, foundation, and channel soil characteristics. The location of the geophysical surveys, test pits, and test trenches are shown on **Sheets 1 through 8**. A limited discussion related to the test trench investigations is provided herein. For more detailed discussion of the test trench investigation, refer to AMEC (2007). Based on AMEC's current knowledge of the site, it is believed that this investigation sufficiently characterized the geologic hazards and defined the geotechnical profile in sufficient detail for purposes of analyzing project alternatives.

3.11.1 Geophysical Survey

One hundred seismic refraction and shear wave surveys (Lines 1 through 85 and DL-1 through DL-15) were completed by Michael L. Rucker, P.E., with the assistance of several other AMEC personnel. The purpose of these lines was threefold as follows:

(1) To assist in characterizing the subsurface geotechnical profile along the outlet channel levee to support the assessment of existing embankment conditions and to identify the approximate depth of foundation over-excavation required for levee rehabilitation alternatives.

(2) To assist in characterizing the subsurface geotechnical profile along the outlet channel/wash at specific locations for use in assessing the erodibility potential of the channel/wash.

(3) To identify the presence or absence of potential discontinuities associated with land subsidence and earth fissuring in the vicinity of the dam and outlet channel areas.

3.11.1.1 Seismic Refraction and Refraction Microtremor (ReMi) Shear Wave Profiling

Between August and December 2006, eight-five (Lines 1 through 85) 120-foot long combined seismic refraction compression wave (p-wave) and shear wave (s-wave) surveys were completed. A Geometrics S-12 Smartseis signal enhancement seismograph and geophone array consisting of 4.5 Hz geophones at 10-foot spacings were used. A sledgehammer energy source was used to collect p-wave data for seismic refraction analysis. Personnel jumping up and down at the fore-shot of the geophone array were used to generate energy for refraction microtremor (ReMi) analysis for a one-dimensional vertical s-wave profile at the seismic survey line. The seismic refraction data for the present investigation was interpreted to provide information regarding the underlying geotechnical profile, including lateral variations and velocity reversal (a softer horizon underlying a more competent horizon) conditions in the subsurface materials. The results of the refraction seismic surveys are presented in Appendix B, along with brief descriptions of the seismic refraction and ReMi equipment and procedures used. Seismic survey line locations are shown on **Sheets 1 through 8**.

3.11.1.2 Deep ReMi Shear Wave Seismic Surveys

Fifteen deep vertical s-wave profiles adjacent to McMicken Dam (Lines DL-1 through DL-15) were completed. A Geometrics S-12 twelve-channel signal enhancement seismograph with a 240-meter cable and 4.5 Hz vertical geophones were used. A field vehicle driven beyond the geophone array served as the surface wave energy source. The deep ReMi profiles were performed to assist in the understanding of basin sediments to depths of several hundred feet principally for subsidence and earth fissure modeling. Results of the ReMi surveys are included in the AMEC (2007). ReMi survey line locations are shown on **Sheets 1 through 8**.

3.11.1.3 Resistivity Surveys

Five deep resistivity soundings were completed in the McMicken Dam project area by Mr. Rucker and Mark Keyes, P.G. in September 2006. An L-and-R Ultra MiniRes resistivity meter with a 4 point Wenner array configuration was used. Total array length at the 1,000-foot spacing was 3,000 feet. The deep resistivity profiles were performed to assist in the understanding of basin sediments to depths of several hundred feet principally for subsidence and earth fissure modeling. Results of the ReMi surveys are included in the AMEC (2007). Resistivity sounding locations are shown on **Sheets 1 through 8.**

3.11.2 Test Pits and Test Trenches

3.11.2.1 Test Trenches

Six test trenches totaling 375 linear feet were excavated for the purpose of identifying any soil discontinuities and characterizing the general geotechnical conditions. Five of the test trenches

were excavated by means of a Volvo BL-70 rubber tired backhoe mobilized and operated by Wards Tractor Works, Inc. The sixth test trench (TT06-03) was excavated by District Operations & Maintenance (O&M) equipment and operators. The test trench excavations were generally located between the District's existing O&M road and the toes of the dam or levee at approximate dam Stations 145+00, 275+00 and 496+00, and approximate outlet channel Stations 26+00, 180+00 and 275+00. GPS coordinates of all test trenches were collected and utilized to map the test trench locations as depicted on **Sheets 1 through 8**.

Excavation of the test trenches generally occurred in a benched fashion, with the first bench established at a depth of approximately 4 feet, followed by a vertical-walled, 4-foot excavation keyed into the floor of the initial excavation. Ken Fergason, P.G., supervised the excavation program and continuously examined the soils during excavation, visually classified the soils, and prepared test trench logs. Test trench logs are included in Appendix A. Soil samples recovered from the pits were visually inspected, logged and classified using the Unified Soil Classification System (ASTM D2487) and the AMEC Manual of Field Operations.

Once completed, the test trenches were backfilled with moisture-conditioned excavation spoils to a dense, non-yielding condition. Backfill compaction was achieved by multiple passes by the rubber tired backhoe or by means of a vibratory compaction plate backhoe attachment when wheel rolling could not be performed. An AMEC field technician was mobilized for compaction oversight and documentation.

3.11.2.2 Test Pits

Twenty-nine test pits were excavated for the purpose of general geotechnical characterization, primarily along the outlet channel and levee. All 29 of the test pits were excavated using a Volvo DL70 rubber tired backhoe operated by Wards Tractor Works, Inc. Ten test pits were excavated in the channel bottom at an average spacing of 2,000 feet along the outlet channel. Nineteen test pits were excavated along the downstream levee toe at an average spacing of 1,500 feet. GPS coordinates of all test pits were collected and utilized to document the location of the test pits as depicted on **Sheets 1 through 8**.

Excavation of the test pits generally occurred until the backhoe reached refusal, or the equipment's depth of excavation capacity was reached. Excavation depths ranged from 12 to15 feet below ground surface or refusal. Ken Fergason, P.G. and Karen Anglin supervised the excavation program, continuously examined the soils during excavation, visually classified the soils, and prepared test pit logs (Appendix A). Soil samples recovered from the pits were visually inspected, logged and classified using the Unified Soil Classification System (ASTM D2487) and the AMEC Manual of Field Operations. Logs of the test pits are included in Appendix A. Representative bulk samples of the encountered materials were recovered from the test pits for laboratory testing.

Once completed, the test pits along the downstream toe of the levee were backfilled with moisture-conditioned excavation spoils to a dense, non-yielding condition. The 10 test pits within the outlet channel were backfilled with moisture-conditioned and compacted excavation spoils to a minimum dry density of 95 percent standard proctor and moisture content of ±2 percent. An AMEC field technician completed 20 (2 per test pit) nuclear density tests (ASTM D2922) to verify compaction of the outlet channel test pit backfill. Backfill compaction was achieved with a vibratory compaction plate backhoe attachment.

3.11.2.3 Hand Pits

To acquire levee embankment bulk soil samples for soil characterization, eight near-surface shallow hand-excavated test pits (TH06-1 to TH06-5) were completed. The hand pits were excavated using a hand shovel to a maximum depth of two feet. The intent of using hand power was to provide for minimal disturbance to the levee embankment. Except for TH06-2, which was on the upstream slope, the remaining seven hand pits were excavated on the downstream slope. At outlet channel Stations 15+00, 160+00, and 240+00 two hand pits were completed, one just below the crest the second just above the toe. In situ density and moisture contents were completed by nuclear (ASTM D2922) methods at each hand pit. Steve Hargus, E.I.T., completed the excavations, visually classified the soils and prepared hand pit logs (Appendix A). Soil samples recovered from the pits were visually inspected, logged and classified using the Unified Soil Classification System (ASTM D2487) and the AMEC Manual of Field Operations. Logs of the pits are included in Appendix A. Representative bulk samples of the encountered materials were recovered from the hand test pits for laboratory testing. Each pit location was backfilled with hand compacted excavation spoils.

3.11.3 Laboratory Testing

Laboratory testing of selected soil samples recovered from the test trenches and test pits were performed. Tests included moisture content, grain-size analysis and Atterberg limits (plasticity index). A summary of the laboratory test results for the investigation is presented in Appendix C. Results of the moisture content tests are presented on the logs in Appendix A.

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SECTION 4.0 DESIGN AND HISTORIC CONSTRUCTION

As a result of the findings of historic geotechnical investigations, the dam has undergone several modifications over its lifetime. Summarized in the following sections are the significant structural modifications, beginning with the dams original construction in the mid-1950s.

4.1 ORIGINAL DAM CONSTRUCTION (1956)

Construction of McMicken Dam, the outlet channel, and the emergency spillway was authorized by the U.S. Congress in 1953 to provide emergency flood protection for Luke Air Force Base, the Litchfield Park Naval Air Facility and adjacent areas. Planning and design of McMicken Dam was completed by the USACE in 1954 and 1955 (USACE, 1954). Originally termed the Trilby Wash Detention Basin Dam, the homogeneous earthen embankment was constructed between July 1955 and July 1956 of surficial soils borrowed from within its impoundment. Borrow excavation created an upstream low-flow flood channel having a minimum width of 200 feet. The foundation area of the dam was to be stripped and compacted, but the dam did not include a cutoff. As depicted on the as-built plans for the structure (USACE, 1956), and as shown in **Figures GA-4.1A and GA-4.1B**, the crest of the dam was 1361.0 (1362.87) feet, and the crest elevation of the emergency spillway and the Standard Project Flood (SPF) peak outflow water surface elevation were 1354.0 (1355.87) feet, resulting in 7.0 feet of total freeboard.

Construction of McMicken Dam incorporated an existing dam on Trilby Wash that had been constructed in 1952 by the MCMWCD. This homogeneous earthen structure was about four miles long and had a crest elevation of 1352.5 (1354.37) feet. As indicated in **Figure GA-4.1B**, the new dam incorporated those parts of the existing structure located between dam Station 357+00 and the principal outlet at about Station 474+50.

4.2 DAM BREACHING (1977)

As a result of observed and investigated transverse and longitudinal cracking, the USACE (1977a) studied the feasibility of breaching the dam or completing temporary remedial reconstruction to prevent failure. Later that year the USACE (1977b) recommended breaching the dam to "minimize damage to improved property and to eliminate any hazard to human life" as an emergency remedial measure. The recommended design included two breaches towards the north end of the dam. One was a low-flow breach located at dam Station 481+25 and 110 feet in width with 2:1 (horizontal to vertical) side slopes and a concrete sill to prevent headcutting. The low-flow breach invert was one foot higher than the principal outlet invert. A 5-foot diversion levee was to be constructed between the principal outlet and the breach for the purpose of diverting lower flow events through the principal outlet and not through the breach. The diversion was designed to overtop during events greater than the 15-yr storm event (USACE, 1977b), at which time the breach would become operational. Flows exiting this breach were to be carried to the Agua Fria River via the existing McMicken Outlet Channel. The second breach was located at dam Station 320+00 with a base width of 700 feet, 5:1 side slopes, and an invert five feet higher in elevation than the breach at dam Station 481+25.

McMicken Dam was breached in July 1977 at dam Stations 479+39 and 320+00. The low-flow breach with a base width of 110 feet was constructed at dam Station 479+39. The second breach with a base width of 700 feet was constructed at dam Station 320+00.

4.3 DAM RESTORATION AND REHABILITATION (1984)

SH&B completed a geotechnical investigation of McMicken Dam in 1982 (SH&B, 1982). This study investigated the cause or causes of cracking, the possible effects of subsidence and earth fissuring, and changes in embankment geometry. The study also developed alternatives for restoration of the dam. Restoration was undertaken in July 1983 and completed in December 1984. Activities included repair of the two 1977 breach locations, the installation of a central filter/drain to the embankment-foundation interface between historic dam Station 40+00 and dam Station 507+00, construction of 66 associated downstream lateral drains and a downstream cutoff, and a maximum upstream 4-foot crest raise (SH&B, 1983b). Repair of the 1977 breaches at dam Stations 479+39 and 320+00 included removal of the concrete sill at dam Station 479+39 and placement of compacted earthfill. Mitigation for transverse cracking allowed for the reconstruction of the dam within the breach areas to restore the flood protection provided by the dam.

The center filter/drain was extended from elevation 1357.0 (1358.87) feet to about the natural ground elevation, as detailed in **Figures GA-4.1A and GA-4.1B**. The central filter/drain consists of drain rock placed in a 2.5-foot wide trench. The drain rock is fully encapsulated in a geotextile, with the upstream side geotextile acting as a filter and the downstream side geotextile being coated to render it relatively impermeable. Downstream outlet drains were constructed at 66 locations, consisting of drain rock placed in a 2.5-foot wide trench and encapsulated in the coated geotextile. Slotted 12-inch diameter PVC pipe was placed in the bottom of the trench and connected to solid PVC pipe that extended beyond the toe of the embankment. In addition to the center filter/drain, a downstream cutoff was constructed near the downstream toe of the embankment as a continuous trench to a depth that ranged from 4 to 10 feet. The trench included a vertically buried relatively impermeable, coated geotextile.

The dam crest elevation was restored to its original elevation of 1361.0 (1362.87) feet with an upstream compacted earthfill crest raise. The height of the raise generally was less than about four feet, and was required due to regional land subsidence and, to a lesser degree, historic maintenance activities. Construction of the dam raise included use of soil from existing upstream borrow areas, portions of the existing Trilby Wash Dam north of dam Station 358+00, and stockpiled material that was previously excavated from the two breaches. The foundation area upstream of the dam was stripped, scarified and moisture conditioned prior to placement of the upstream fill. The new embankment was bonded to the existing dam by benching with 2.5 feet horizontal by one foot vertical benches as the fill advanced in elevations during placement.

4.4 MCMICKEN FISSURE RISK ZONE REMEDIATION PROJECT (2004-2005)

During the SH&B investigations of the early 1980s, the presence of earth fissures was detected about 600 feet east of historic dam Station 63+50 (SH&B, 1982). The fissures are the result of horizontal strains induced by large-scale ground subsidence caused by consolidation of the alluvial basin sediments upon regional groundwater withdrawal. As part of the District's Phase II Structures Assessment Program, additional studies were conducted by AMEC to further characterize fissuring in the vicinity of the embankment (AMEC, 2003b). The results of these additional studies indicated the presence of earth fissures and/or horizontal strain conditions sufficient for fissure development adjacent to and likely under McMicken Dam from approximate dam Station 56+00 to Station 65+00. A second moderate fissure risk zone extended from approximate dam Station 65+00 to Station 105+00.

Through an alternatives analysis process, an initial list of alternative designs was reduced to one preferred alternative (AMEC, 2003c). As a result of this process it was decided that remediation would only occur to protect the dam from the high hazard fissure risk zone, with additional investigation and extensive monitoring in the moderate hazard fissure risk zone during construction. Isolation was selected as the preferred alternative (AMEC, 2003c). The isolation alternative included realigning the southern reach of the dam to remove that section in the high fissure risk zone. A 500-year, 6-hour return event level of flood protection was maintained for the area downstream of the watershed contributing to the decommissioned section by means of a below-grade detention basin. Mitigation components of the realigned isolation section included a hardened central soil-cement core and upstream apron with a compacted earthen embankment outer shell founded on cemented Pleistocene soils, all capable of spanning and erosion resistant to any future earth fissures.

AMEC led a consulting team in the design of the preferred alternative. The design was completed in 2004 in accordance with Arizona Department of Water Resources (ADWR) requirements. Final design components included a soil-cement dam extension which extends from about dam Station 75+00 westward about 1,500 feet, a 49.9 acre-foot 500-year, 6-hour, detention basin, a diversion channel, and removal of about 3,000 feet of the existing dam embankment south of dam Station 75+00. Other associated project components included an upstream soil cement apron, a downstream HDPE pipe/rock aggregate drain, and a suite of monitoring instrumentation, including conventional and advanced technologies, both proven and prototype. Construction of the McMicken FRZR Project was completed in late 2005.

AMEC also performed post-design and quality assurance services during construction. Monitoring and inspection was performed by AMEC to ensure the adequacy of the foundation and to search for any evidence of earth fissures (AMEC, 2005). Poor quality foundation soils were removed during construction, leaving the new structure founded on the more stable foundation materials.

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SECTION 5.0 HISTORY OF CRACKING

5.1 USACE CRACK STUDY (1973)

The USACE conducted inspections of McMicken Dam in 1964, 1966, 1969 and 1971, finding surficial irregularities at the crest in the form of surface erosion, small holes, and tunnels. As a result of these observations, in March 1972 five backhoe excavations along the crest were completed. Cracks of significant width were observed in 4 of the test pits that extended to depths varying from 6.5 feet to more than 14.5 feet. In June 1972, 40 shallow backhoe test trenches, each 20 feet in length, were excavated on the embankment crest by the USACE. At six locations between about dam Stations 356+75 and 497+20, transverse cracks wider than 1/8 inch and continuously extending to a depth greater than 3 feet were encountered. Areas of extensive cracking were further investigated in July 1972 by advancing bucket auger borings to establish soil profiles. Locations where cracking was observed are shown on **Figure GA-5.1A**. Subsequent to completion of the field studies, the USACE prepared a detailed report of the cracking at McMicken Dam (USACE, 1973). The USACE concluded that the cracking was largely due to regional land subsidence and documented the following other significant conclusions:

- A high frequency of embankment cracking was observed from dam Stations 475+00 to 445+00 and dam Stations 295+00 to 265+00.
- Continuing groundwater decline and surface subsidence will continue to influence the embankment.
- Embankment materials are brittle and highly susceptible to cracking.
- Foundation and embankment materials may be susceptible to collapse upon saturation.
- Treatment to increase the embankment integrity from dam Stations 475+00 to 445+00 and dam Stations 295+00 to 265+00 is required.

5.2 FCDMC CRACK STUDY (1977)

In 1977 the District performed a visual survey of the dam, with all signs of cracking, depressions or rodent holes documented and logged. A report was prepared by the District detailing the study of cracking at McMicken Dam (FCDMC, 1977). The two areas previously noted by the USACE as being compromised by cracks were carefully scrutinized by the District. Nineteen possible cracks were documented between dam Stations 445+00 and 475+00, and eight possible cracks were documented between dam Stations 265+00 and 295+00. In comparison, the 1972 USACE investigation noted 26 and 22 cracks, respectively, in these same areas.

As part of a corrective measure, the area between dam Stations 445+00 and 475+00 was investigated by the District. Procedures included excavating a 6-inch wide by 18-inch deep trench down the center of the dam crest, and then flooding the trench at approximate 20-foot intervals to discover the cracks. Once discovered, a backhoe was used to excavate each crack to

full depth at the crest, with the excavation being extended to the upstream and downstream faces of the dam. After the crack was fully removed by trenching, the transverse trench was backfilled with excavation spoils in 6-inch thick lifts at about optimum moisture content and 95 percent relative compaction.

It became quickly apparent to the District that the cracks were more numerous that originally anticipated. More than 100 cracks were observed in the first area of investigation, and they were more severe than had been expected, being as wide as 3 inches and as deep as 17 feet. Because of the large number of cracks encountered, the large amounts of water required and the time it was taking to obliterate the cracks (about two cracks per day), the District ceased repairing the cracks. The area between dam Stations 265+00 and 295+00, which was scheduled for the same treatment, was neither investigated nor repaired. The locations where cracks were observed are shown on **Figure GA-5.1A**.

The following conclusions were reported in the District's report (FCDMC, 1977):

- There are indications that the cracking is continuous throughout the northernmost two-thirds of the dam (Greenway Rd. to the emergency spillway).
- The large amount of transverse cracking is not totally caused by subsidence and could have one or more contributing causes.
- Emergency corrective actions and any permanent corrective measures are beyond the District's capabilities.

5.3 SH&B STUDY (1982)

In 1982 SH&B completed an investigation of McMicken Dam to identify the cause or causes of cracking, the possible effects of land subsidence and earth fissuring, and changes in embankment geometry (SH&B, 1982). Investigations included trenching of suspected earth fissure locations, detailed ground reconnaissance of the dam, borings at 75 locations, backhoe test pits at 36 locations, and trenching (50 and 100 feet long, 18 inches deep) and flood testing along 21 strategic portions of the dam crest. Borings and test pit locations (TP15 – TP36), with the exception of those excavated to investigate possible earth fissures (TP1 – TP14), are shown on **Sheets 1 through 8**. Observed cracks and holes were logged by SH&B; the locations of these features are shown on **Figure GA-5.1A**.

The test drilling program was performed on the crest of the dam, near the upstream and downstream toes and on the old dam crest. The 75 borings were advanced by hollow-stem auger methods to depths ranging from 8 to 60 feet, with a distance between borings of approximately 1,000 to 2,000 feet. Standard penetration tests were performed with disturbed SPT samples, or undisturbed tube samples obtained at 5-foot increments.

Backhoe test pits included excavation of 36 pits with depths ranging from 4 to 21 feet. Fourteen of the test pits were utilized for fissure investigation purposes, and the remaining 22 test pits were excavated at the dam crest or at the embankment toes. Block samples of undisturbed soils were retrieved from the test pits for consolidation testing.

SH&B concluded that the primary cause of embankment cracking was the result of settlement of a surface layer of collapsing foundations soils. Additional contributions to the cracking were from embankment shrinkage and post construction settlement of the embankment. The occurrence of collapsible foundation soils and the intensity of cracking were more prevalent in the Trilby Wash area. However, SH&B concluded that a thin layer of collapsible soils and isolated cracking is present for the entire length of McMicken Dam. It was further concluded that the potential for future cracking due to collapsible soils was believed to be very low, considering the numerous occurrences of impoundment events. This was believed to be sufficient to produce most, if not all, cracking from collapsing foundation soils (SH&B, 1982). A conservative example was provided with three inches of settlement potentially resulting from the wetting of a 5-foot thick layer of soil that has a collapse potential of 5 percent. If the 3 inches were representative of the differential settlement over a distance of 40 feet, maximum tensile strains of about 2 percent would result, well above the soil cracking threshold of about 0.25 percent.

The SH&B report also included a detailed discussion of the potential for earth fissuring due to groundwater withdrawal. Review of subsidence documentation is not a focus of this report, but rather the principal focus of an additional task of the Wittmann ADMP that AMEC has completed (AMEC, 2007).

5.4 AMEC CRACK STUDY (2001)

In 2001 AMEC completed an investigation of McMicken Dam for the purpose of evaluating longitudinal and transverse cracks on the crest, downstream slope and downstream toe of the dam (AMEC, 2003a). AMEC advanced 19 hollow-stem auger borings and excavated 22 test pits. Locations of the borings and test pits are shown on **Sheets 1 through 8**. Borings were advanced at the dam toes to depths that ranged from 10 to 15 feet. Standard penetration tests were performed with disturbed SPT samples and undisturbed tube samples obtained at increments of 5-foot or less. Test pits were excavated at the dam crest, downstream slope and at select locations along the downstream toe. Test pits ranged from 3.5 to 8 feet deep with an average depth of 4 feet. Grab and bulk samples were retrieved from the test pits for characterization purposes.

Included in the following sections is a summary of the discussion from the AMEC (2003a) report.

5.4.1 Longitudinal Cracks on the Dam Crest

AMEC (2003a) concluded that the longitudinal cracking observed along the crest of dam was due to a combination of causes. The primary causes of cracking were reported to be the result of desiccation exacerbated by erosion. Desiccation is a tensile distress that typically appears on surficial fine-grained soils and is the product of drying accompanied by shrinkage and cracking. AMEC further concluded that moisture contents increased with depth within the embankment and it was evident that drying of the embankment soils had occurred. Locations of the longitudinal cracks did not appear to be coincident with the location of the center filter/drain excavation limits. When investigated the center filter/drain was located along the downstream shoulder. As a result of the dam crest raise in 1984 the dam centerline shifted upstream.

5.4.2 Transverse Cracks on the Downstream Slope

Similar to the longitudinal cracks, AMEC (2003a) concluded that the transverse cracking on the downstream slope of the dam resulted from a combination of causes. The primary causes appear to be desiccation in combination with animal burrowing and runoff erosion. It appeared that significant desiccation of the embankment soils had occurred where more significant cracking was observed. The product of these processes is most evident along the northernmost portion of McMicken Dam where part of the MCMWCD No. 1 structure is still present. Significant erosion was documented in this area. AMEC also reported that the variability in collapse potential could result in differential settlements along the length of the structure, if water were impounded for a sufficient period of time to allow infiltration into the foundation soils. Thus, transverse cracking could occur as a result of collapsing foundation soils.

5.4.3 Longitudinal Cracks along the Downstream Toe

AMEC (2003a) concluded that depressions and longitudinal cracking located along the downstream toe of the dam are the result of loosely backfilled trenches from the construction of the geotextile cutoff in 1984. During excavation of test pits along the toe AMEC documented depressions at or along the downstream side of the filter fabric that was placed on the upstream face of the trench. The depressions were located in relatively low-lying areas that were subject to periodic inundation during and following rainfall events. Water that ponded in these areas likely resulted in settlement of the trench backfill.

5.5 RAM PRINCIPAL OUTLET STUDY (JANUARY 2004)

RAM conducted a geotechnical investigation at McMicken Dam in June 2003. The investigation included dam Stations 478+00 to 480+00. The area investigated was inclusive of the area breached by the USACE in 1977 and reconstructed in 1984. The purpose of the RAM (2004a) investigation was to investigate a void/crack network near the downstream toe at dam Station 478+18, and to assess the existing condition of the reconstructed breach area. The geotechnical investigation involved a detailed ground reconnaissance of the dam, 5 test trenches and 12 test borings. The test trenches were all excavated on the downstream side of the dam and extended

into the dam starting from the toe. The 12 test borings were divided into 3 groups each consisting of 4 borings. The boring groups were located at dam Stations 478+00, 478+75, and 479+50. Each boring group consisted of one boring at the upstream toe, at the crest of the dam, at the downstream toe, and downstream from the dam. Locations of the borings are shown on **Sheets 1 through 8**.

RAM concluded from the investigation that the void/crack network at dam Station 478+18 could act as a discharge point for the center filter drain if the two areas were connected (RAM, 2004a). The RAM report states, "Water entering the void network with sufficient head to daylight above the access ramp on the east side of the dam could result in piping of the dam material downstream of the center filter drain." AMEC understands this statement to mean any water moving through the center filter/drain could be intercepted and could potentially be transported through the void network. This condition could cause material downstream from the central drain to pipe. RAM recommended that the void/crack network be treated with the same priority and manner as other observed cracks within the dam with some additions. RAM recommended daily inspection of the void/crack network when reservoir impoundment levels are higher than elevation 1338.13 (1340.0) feet. RAM also recommended that concentrated surface flows on the downstream face above the access road should be limited. The main source of water on the downstream side is the ditch line between the toe of the dam and the access road. In order to prevent water from making its way into the void/crack network, RAM recommended lining the ditch with gunite, cast–in- place concrete, or asphaltic concrete. In addition to these findings and recommendations, RAM determined that the remaining breach area had a low seepage potential and additional work was not warranted (RAM, 2004a).

5.6 RAM PRINCIPAL OUTLET STUDY (APRIL 2004)

RAM conducted a geotechnical investigation at McMicken Dam in June 2003. The purpose of the investigation was to investigate observed distress at the principal outlet structure. Key areas of interest included the under drainage system, the reinforced concrete outlet walls, and transverse cracking on the crest of the dam. The RAM (2004b) investigation employed the use of detailed ground reconnaissance of the dam, 5 test trenches, 5 test borings and approximately 30 vacuum truck excavations. Locations of the borings and test trenches are shown on **Sheets 1 through 8**. Portions of the investigation were directed toward the distress of the principal outlet whereas the remaining investigation focused on a transverse crack located at dam Station 474+20.

The RAM investigation recognized that the existing center filter/drain did not fully extend to the principal outlet structure. The central filter/drain was documented as ending approximately 28 feet south and 24 feet north of the principal outlet. A transverse crack at the dam crest was observed south of the principal outlet within the area that the central filter/drain was absent. Upon completion of the investigation RAM determined that due to the location, configuration, depth, and size of the transverse crack that the probable cause was the result of longitudinal shrinkage of the compacted embankment fill and not movement of the principal outlet wall

(RAM, 2004b). The RAM report recommended that the structural backfill be grouted in both the north and south sides of the principal outlet using a cementatious or urethane based grout. The grouted zones should extend the full width of the structural backfill. The area extending from the toe of the dam to the Beardsley Canal should be leveled to a uniform elevation of 1335.13 (1337.0) feet. Finally, a surface filter blanket should be installed in the downstream face of the dam on either side of the principal outlet (RAM, 2004b).

5.7 N&M PRINCIPAL OUTLET STUDY (2005)

N&M conducted a geotechnical investigation of the principal outlet which started in April 2005 and continued until June 2005. The purpose of the investigation was to further assess the existing condition of the principal outlet and develop a remedial design (N&M, 2005a). Upon completion of the investigation, 12 potential failure modes (PFMs) were identified. Through a systematic approach N&M (2005b) narrowed the 12 PFMs to 4 credible PFMs as follows:

- Internal erosion through the embankment or transverse cracks near the principal outlet causes a breach.
- Internal erosion along the soil-channel interface of the principal outlet causes a breach.
- The principal outlet walls and/or floors fail due to a defective under-drainage system which leads to an uncontrolled release.
- Overtopping of the dam at the principal outlet leads to uncontrolled release.

Once the 4 credible PFMs were identified, an alternatives development workshop was conducted. N&M and its consulting team formulated 13 possible alternatives to remediate the 4 PFMs. The 13 alternatives were screened through various criteria to determine their feasibility. Criteria included strengths, weaknesses, resolution of the PFMs, optional improvements, level of design effort, resulting major negative consequences, preliminary cost estimates, and expected duration of repair. The results of the alternatives development and analysis performed by the N&M team included the identification of a combination of the following alternatives to satisfactorily address the 4 PFMs:

- Extend the existing center filter/drain to the outlet walls and continuing the filter along the back side of the principal outlet retaining walls (with the option of relocating the existing water-level instrumentation).
- Raise the dam crest and principal outlet bridge deck elevations.
- Apply a water barrier to the Beardsley Canal Siphon.
- Replace the principal outlet stilling basin wall drains and install uplift anchors to the stilling basin floor.
- Abandon the existing drainage system under the stilling basin floor with non-pressurized grout.

5.8 FCDMC PRINCIPAL OUTLET CRACK STUDY (MARCH 2006)

During the February 2006 annual dam safety inspection, District staff documented an upstream transverse crack at approximately dam Station 475+25 (~11 feet south of the principal outlet). The crack was identified by a series of holes and openings 5 feet deep below the crest of the dam and extending down slope approximately 15 feet. Subsequent to the inspection, the District investigated the crack location in March 2006. Using a backhoe the crack was exposed to a depth of 3 feet, cleaned, and photo documented (FCDMC, 2006). The District concluded that the crack was generally hairline except for two areas where the crack width was on the order of 1¼ inch to 1¾ inch wide. It was not apparent whether the open aperture crack was the result of crack flow erosion or widening. Two longitudinal cracks, 15 to 17 feet down slope from the crest, were also observed intersecting the transverse crack. At the conclusion of the investigation the test trench was backfilled with a 1-foot thick layer of ASTM C-33 fine concrete sand and then capped with reconditioned and compacted excavation spoils, restoring the upstream slope to previous lines and grades.

5.9 PRINCIPAL OUTLET INTERIM DAM SAFETY MEASURES (2007)

As a result of the April 2004 RAM investigation which recognized that the existing center filter/drain did not fully extend to the principal outlet structure and conclusions from the March 2006 District principal outlet investigation, the District concluded that the transverse cracking appears to continue and an interim measure is required for mitigation. The District recommended application of an interim dam safety measure to protect the area adjacent to the principal outlet from failure through a transverse crack (FCDMC, 2006). Design and implementation of an interim measure is currently being conducted by AMEC under FCD contract 2004C068, Work Assignment No. 2.

As presently proposed, approximately 6 feet of the upstream dam slope will be removed by excavation for a distance of approximately 125 feet on either side of the principal outlet structure. The excavation will be cut at a 2.5:1 (horizontal to vertical) slope sub-parallel to the existing slope and extended upstream of the existing dam toe to a depth of approximately 2 feet into the underlying Pleistocene soils (±10 feet below existing grade). A 1.5-foot thick granular filter blanket will cover the entire excavation. The granular backfill will be installed to serve as a filter over any underlying embankment cracks, with no need for drainage. A 16-oz non-woven geotextile fabric will be installed above and below the filter to preclude the migration of filter material into any underlying embankment cracks and provide additional incidental filtering capacity upstream of the filter. The filter will then be covered with a 4.5-foot thick, compacted soil layer.

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SECTION 6.0 GEOTECHNICAL PROFILE

6.1 NATIVE DAM FOUNDATION SOILS

Of particular interest to this study is the thickness of Holocene age soils along the dam profile. Holocene soils within this area are commonly described as uncemented, erodible, and/or moisture sensitive (collapsible upon wetting). The Holocene age soils commonly overlie an older Pleistocene age soil that is a moderately to strongly cemented alluvial soil, less susceptible to erosion and collapse. It is also important to note that moisture-sensitive soils may be Pleistocene in age. Therefore, caution is recommended when characterizing foundation soils on geologic age alone. The determination of a soil's ability to support structures should be more focused on the soil properties rather than solely on geologic age.

The native foundation soil conditions along McMicken Dam were assessed on the basis of historic and recent field and laboratory geotechnical investigations. Historic investigations include those completed to support initial design and subsequent dam related modifications. Recent investigations include those conducted by AMEC in accordance with the current project scope of work. Investigations typically included soil borings, test pits, collection of disturbed and undisturbed soil samples for field description and laboratory testing, and geophysical surveys. Abbreviated summaries of all investigation are detailed in Section 3.0.

The native soil profile underlying the McMicken Dam embankment typically includes a shallow, weakly cemented, less dense surface layer of Holocene soils overlying denser, moderately cemented mid to late Pleistocene soils. However, at some isolated locations, coarser sand and gravel deposits extend from near the ground surface to depths of more than 10 feet. The shallow surface soils are predominantly fine grained, consisting of sandy silt and clay, and silty and clayey sand with a trace to some gravel. The soils typically are low in plasticity, with plasticity indices of 2 to 20, and occasionally as high as 30. This layer varies in depth from 1 to 10 feet. The surface soils are predominantly moderately firm to firm. Underlying the surface soils are more dense and more cemented soils composed of medium plasticity silty sand and clayey sand. These soils typically are very firm to hard.

Consolidation/collapse testing of the native soils along the downstream alignment of the dam was completed by AMEC in 2003 (AMEC, 2003a), which indicated the embankment foundation soils have a low to moderate collapse potential upon wetting. Thirty consolidation/collapse tests were completed with all of the samples subjected to inundation at a load of 500 pounds per square foot (psf). The testing indicated a range in collapse potential of 0 to 6 percent for samples having dry densities of 89 to 108 pcf, and in situ moisture contents of 3 to 10 percent. All samples were collected from borings located downstream of the dam and east of the maintenance road.

The McMicken Dam Restoration Study (SH&B, 1982) concluded that the structure is underlain by a deposit of collapsing soils from about dam Stations 250+00 to 500+00. Consolidation/collapse tests were performed on 13 native foundation soil samples as part of that study to estimate the potential collapse. SH&B collected samples from both upstream and downstream locations, and from beneath the dam, between about dam Stations 260+00 and 474+00. The samples were subject to inundation at a load of either 2,000 or 4,000 psf. The testing indicated a range in collapse potential of 0 to 14 percent for samples having dry densities of 89 to 112 pcf, and in situ moisture contents of 5 to 26 percent.

AMEC's 2003 review of the data indicated that the foundation soils have a collapse potential, but that there is no distinct trend in collapse behavior as a function of location relative to the dam. Both upstream and downstream samples exhibit collapse potential when inundated. A few samples with higher in situ moisture contents did not change volume when wetted, most likely because the soil at these locations had previously been wetted and experienced collapse. A similar variability was observed in downstream samples, but the magnitude of collapse generally was less. This may be because the borings, in some cases, were located in areas that may have been wetted in the past as a result of local ponding caused by road grading or other maintenance activities.

AMEC (2003a) concluded that there was a general decrease in collapse potential as a function of depth. However, this trend was skewed by the percent collapse results determined for samples from a depth of about 2 to 4 feet that were wetted at a load of 4,000 psf. These testing loads are significantly higher than the in situ overburden stress at these depths. Mean volume changes due to wetting tested by AMEC were generally constant with depth, whereas the volume change resulting from additional loading tended to decrease with depth. The variability in the foundation soils also is indicated by the penetration resistance profile shown in **Figure GA-6.1A**. First occurrence values greater than 30 of Standard Penetration Test (SPT) N-values for historic investigations are plotted along the dam profile. SPT values greater than 30 typically indicate soils of sufficient integrity to exhibit much less collapse during wetting.

Additional native foundation characteristics of the dam soils were interpreted from the recent AMEC geophysical surveys completed immediately adjacent to the dam embankments upstream and downstream toes. To aid in the earth fissure evaluation and geotechnical characterization 30 refraction seismic surveys were generally completed at 3 locations along the dam alignment. Sixteen lines were completed along the upstream toe and 14 were completed along the downstream toe.

Along the alignment of the dam from dam Stations 122+50 to 155+00, seismic lines 1-6 and 33-38 were completed along the downstream toe. Based on the p-wave velocities, a surficial horizon extends to depths of 0 to 5 feet from existing upstream toe grade. Typical p-wave velocities for this surficial horizon range from 670 to 1,400 f/s. Underlying cemented horizon p-wave velocities typically range from 1,100 to 2,800 f/s from 5 to 15 feet below existing grade.

Below 10 to 15 feet p-wave velocities typically are greater than 2,400 f/s. Velocity reversals under the cemented horizon below a typical depth of about 25 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 25 feet are 1,400 to 2,100 f/s, and below a depth of about 25 feet are 620 to 1,000 f/s.

Along the alignment of the dam from dam Stations 274+00 to 300+00, seismic lines 8-15 were completed along the upstream and downstream toes. Based on the p-wave velocities, a surficial horizon extends to a depth of 0 to 5 feet from existing grade. Typical p-wave velocities for this surficial horizon range from 1,100 to 1,300 f/s. Underlying cemented horizon p-wave velocities typically range from 1,400 to 2,600 f/s from 5 to 15 feet below existing grade. Below 10 to 15 feet p-wave velocities typically are greater than 2,600 f/s. Velocity reversals under the cemented horizon below a typical depth of about 20 to 25 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 20 feet are 880 to 1,500 f/s, and below a depth of about 20 feet are 870 to 1,000 f/s.

Along the alignment of the dam from dam Stations 478+00 to 498+00, seismic lines 29-32, 39-41, and 61-63 were completed along the upstream toe. Based on the p-wave velocities, a surficial horizon extends to a depth of 5 to 10 feet from existing upstream toe grade. Typical p-wave velocities for this surficial horizon range from 1,100 to 1,700 f/s. Underlying cemented horizon p-wave velocities typically range from 1,700 to 3,400 f/s from 5 to 15 feet below existing grade. Below 15 feet p-wave velocities typically are greater than 2,900 f/s. Velocity reversals under the cemented horizon below a typical depth of about 30 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 30 feet are 1,400 to 2,300 f/s, and below a depth of about 30 feet are 800 to 1,000 f/s.

6.1.1 Foundation Preparation

Review of the as-built dam embankment drawings indicates limited removal of existing soils was completed within the footprint of the dam during its construction in 1955 and 1956. Approximately 1 to 2 feet of the existing foundation material was removed by stripping prior to construction of the dam embankment. The existing 1952 interim dam embankment built by the MCMWCD, located between dam Station 357+00 and 474+50, and was incorporated into current McMicken Dam. According to as-built drawings, fill from McMicken Dam was keyed into the existing interim dam embankment by means of 2 foot wide by 1 foot high steps. Documentation of the McMicken Dam foundation preparation was not located. **Figure GA-6.1.1A** depicts the approximate foundation profile after 2 foot of stripping and an elevation datum shift from NGVD29 to NAVD88.

Restoration of the dam crest elevation to as-built elevations in 1984 was accomplished by placement of compacted earthfill on the upstream slope. The upstream restoration earthwork was founded on a prepared upstream toe foundation. Upstream toe preparation included the removal of 2 feet of material, scarification and moisture conditioning of the exposed surface, and re-compaction prior to new fill placement.

6.2 DAM EMBANKMENT SOILS

The discussion included in this section related to the composition of the dam embankment soils is an update to the discussion included in the AMEC (2003a) report. Based on their index properties (grain-size distribution and Atterberg limits) and their location, the dam embankment materials can be subdivided into three general categories. The embankment soils from dam Stations 75+00 to 250+00 consist of low plasticity silty and clayey sand with gravel, and lesser amounts of medium plasticity silt and clay. In-place dry density values vary from 101 to 117 pcf, compared to maximum dry density values (standard Proctor) of 115 to 125 pcf (AMEC, 2003a).

The embankment from dam Stations 250+00 to 500+00 can be divided into two distinct sections, depending on whether the embankment includes the older 1952 interim dam. The existing McMicken dam embankment soils are predominantly sandy clay, sandy silt and clayey sand of low to medium plasticity. In-place dry density values along this section vary from 97 to 128 pcf, compared to maximum dry density values (standard Proctor) of 116 to 124 pcf (AMEC 2003a).

The third section consists of the 1952 interim dam located between dam Stations 357+00 and about 474+50. Based on a very few samples, the soils in this section consist predominantly of low to medium plasticity sandy clay, with silty and clayey sand and gravel. In-place dry density values along this section vary from 92 pcf to 124 pcf (AMEC 2003a).

The moisture content of the near-surface embankment soils sampled and tested between 2001 and 2005 varied from 1 to 11 percent based on laboratory testing. All available moisture content values from historic investigations are plotted in **Figure GA-6.2A** as a function of depth below the dam embankment surface, and are compared to the mean (about 12.5 percent) and standard deviation range (about 10 to 15 percent) of placement values when the embankment was constructed in 1955 and 1956. **Figure GA-6.2A** indicates that the embankment soils have undergone drying since their placement.

Detailed quality control testing data is not available, but summaries of the 963 in-place density and moisture content tests performed on the embankment soils at the time of placement (USACE, 1957) were reviewed by AMEC (2003a). Normal distribution curves were fitted to the data by AMEC to estimate the mean and standard distribution. AMEC (2003a) concluded that the moisture contents at the time of placement ranged from 10 to 15 percent with a mean of 12.9 percent and a standard deviation of 2.7. Additionally AMEC (2003a) reported that the placement moisture contents typically were in the range of about plus or minus 2 percent of optimum moisture content. Mean dry densities at the time of placement were 115.5 pcf with a standard deviation of 6.5 pcf. Finally, relative compaction data had a mean of 96.8 percent and a standard deviation of 3.2 percent. Therefore, AMEC (2003a) concluded that the dam embankment soils generally were placed at a relative compaction of about 94 to 100 percent.

Based on statistical analysis of compaction testing of finer-grained soils used to construct 72 Bureau of Reclamation dams, Hilf (1991) recommended standard deviations of 1.5 percent for quality control of moisture content and 3.0 percent for quality control of relative compaction. The estimated standard deviations for the McMicken Dam quality control data are only slightly larger than these recommended values. From these results AMEC (2003a) concluded that comprehensive, acceptable quality control practices were followed when the dam was constructed, and that a quality, relatively uniform embankment was constructed.

Plasticity index values for fine-grained dam embankment soils and the finer-grained fraction of the coarse-grained embankment soils for all available studies are plotted on a standard plasticity chart in **Figure GA-6.2B**. As shown, plasticity index values range from 1 to 29 with most of the values greater than 1 and less than 20. **Figure GA-6.2B** indicates the embankment soils generally are low to medium in plasticity.

AMEC (2003a) concluded that the dam embankment soils generally were not dispersive, based on testing they performed, but do have erosive characteristics. Of the pinhole dispersion tests conducted on 10 samples, 6 were non-dispersive (classifications ND1 and ND2) and 4 were slightly to moderately dispersive (classification ND3). However, the double hydrometer tests conducted on the same samples indicated 0.0 percent dispersion in all cases. The results of four tests performed on remolded foundation soils as part of the 1982 SHB study also indicated the soils were non-dispersive (classification ND1). Based on these test results, AMEC suggested that the pinhole dispersion test results performed as part of the 2003 study were indicative of the potential erosive characteristics of the soils, not their potential for dispersion (AMEC, 2003a).

Piping resistance categories developed by Sherard (1953) also are shown in **Figure GA-6.2B**. Category 1 soils have the greatest resistance to piping, Category 2 soils have an intermediate resistance to piping and Category 3 soils have the least resistance to piping. Although the resistance to piping also is dependent on grain-size characteristics, **Figure GA-6.2B** indicates that the McMicken Dam embankment soils generally are resistant to piping, with the great majority being Category 1 and 2 soils. Those soils determined to be Category 3 are located randomly throughout the embankment and typically are derived from the more silty or sandy lenses of the native soils.

6.3 NATIVE EMERGENCY SPILLWAY FOUNDATION SOILS

The general geotechnical characteristics of the existing emergency spillway were determined based on existing geotechnical data and limited geophysical surveys. Two refraction seismic surveys were completed to characterize the near surface soils adjacent to the existing emergency spillway weir structure. Investigation locations included seismic survey lines at approximately dam Stations 515+00 and 524+00, and 5 USACE borings, 3 of which are within the existing emergency spillway structure footprint and the others are 1,000 to 1,200 feet downstream within the area where the emergency spillway discharges downstream.

In the vicinity of the existing emergency spillway weir structure, seismic lines 76 and 77 were completed. Based on the p-wave velocities, a surficial horizon extends to a depth of 0 to 4 feet below existing grade. Typical p-wave velocities for these surficial horizons range from 830 to 1,400 foot per second (f/s). Underlying cemented horizon p-wave velocities typically range from 1,700 to 2,500 f/s from a depth of 4 to 16 feet below existing grade. From approximately 15 feet below existing grade p-wave velocities increase to 3,300 f/s. Velocity reversals under the cemented horizon below a typical depth of about 25 to 30 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 25 feet are 1,600 to 1,800 f/s, and below a depth of about 25 feet are 830 to 1,000 f/s.

USACE (1957) exploration borings 52-1, 52-2, 52-47, 52-48, and 52-49 were completed during the initial dam design to depths ranging from 21 to 33 feet. Boring logs indicate a relatively shallow cemented zone from near surface to 14 feet below grade. Soils typically consist of silty sandy gravel, clayey sandy gravel, and sandy clay.

SECTION 7.0 CENTER FILTER/DRAIN

7.1 OVERVIEW

From 1982 to1983, SH&B conducted two geotechnical investigations of McMicken Dam to assess the mechanism causing cracking of the embankment. As a result of its work SH&B recommended that a restoration project be initiated to mitigate several dam safety deficiencies. One of the recommendations was to install a center filter/drain along the entire length of the dam. The constructed center filter/drain extends from elevation 1357.0 (1358.87) feet to about the natural ground elevation, as detailed in **Figure GA-6.1.1.A**. The central filter/drain consists of drain rock aggregate placed in a 2.5-foot wide trench along the approximate dam centerline. The drain rock is encapsulated in a geotextile, with the upstream side geotextile acting as a filter and the downstream side material being coated to render it relatively impermeable. Downstream outlet drains, constructed at 66 locations, consisted of drain rock placed in a 2.5-foot wide trench and encapsulated in the coated geotextile. Slotted 12-inch diameter PVC pipe was placed in the bottom of the trench and connected to solid PVC pipe that extended beyond the toe of the embankment. In addition to the center filter/drain, a downstream cutoff was constructed near the downstream toe of the embankment as a continuous trench to a depth that ranged from 4 to 10 feet. The trench included a vertically buried coated geotextile.

7.2 MATERIALS

7.2.1 Filter/Drain Aggregate

Drain rock materials were utilized in the center filter/drain and outlet drains. The aggregates selected were tested according to ASTM standards during construction to insure that they met project specifications. Completed tests included sieve analysis (ASTM D-2487), soundness (ASTM C-88), specific gravity (ASTM C127-81) and abrasion (ASTM C-535).

The table below summarizes the SH&B design drain rock grain size requirements included in the project specifications. Additionally included in the table is a summary of the drain rock aggregate grains sizes documented as being used in the construction of the center filter/drain.

Sieve Size	Percent Passing (Specifications)	Percent Passing (Approximate In-place)
6 inch	100	100
2 inch	-	100
1-1/2 inch	-	75-100
1 inch	-	25-95
3/4 inch	-	20-75
½ inch	-	5-25
3/8 inch	0-100	0-10
¼ inch	0-70	0-5
No. 4	0-60	0-2
No.8	0-2	0-2
No. 40	0	0

The wide specification range was recommended by SH&B to allow for the maximum use of available material since over 100,000 cubic yards was estimated as being required for construction of the center filter/drain and associated outlets. A coefficient of uniformity (C_U) of 4 was also specified.

7.2.2 Geotextiles

Geotextiles were used in both the center filter/drain and downstream cutoff as a part of the McMicken Dam restoration project. The geotextiles utilized required specific elastic properties in order to protect against future cracking within the dam. In order to analyze these properties, SH&B performed several modified standardized ASTM tests along with a newly devised, project specific test. The reader is directed to the SH&B (1983a) for details of the modified tests.

7.2.2.1 Strength Tests

The standard tests used to evaluate the geotextiles included, grab strength (ASTM D-1682), trapezoidal tear (ASTM D-751), EOS (CW-02215), and puncture (ASTM D-751). While these tests were all standard tests for geotextile fabrics, many of them were slightly modified by SH&B to allow utilization of available testing equipment and to better simulate conditions particular to the McMicken Dam Project.

The newly created, project specific test, was identified by SH&B as the "Pullout Test". In this test a ½ inch thick steel plate box with dimensions of 24 inches by 24 inches and 9 inches in depth was utilized. The test box apparatus housed a sample of geotextile placed between a compacted clay soil and subangular 3/8 inch gravel. This condition simulated the interface of the existing soils dam and the proposed center filter/drain with a geotextile separation. The box allowed for 4 inches of compacted embankment soil to be placed at the bottom overlain by an 18-inch by 12-inch piece of geotextile material. The material was cut and laid out so that it was positioned in the direction of the roll (simulating field installation conditions), with 2 inches of the long end protruding from a ½-inch wide slot. Essentially, a 16-inch by 12-inch piece of geotextile remained in the box. The slot was located 4 inches from the bottom of the steel box (the height of the soil layer), and was 18 inches long. Once the geotextile was in place, 4 inches of uniformly graded 3/8 inch gravel was place on top. The remaining inch in the steel box was filled with a rubber bladder and sealed with a steel plate on top. The bladder was pressurized to 5 psi and 10 psi in order to simulate expected confining pressures within the dam at the mid-depth (12.5 feet) and bottom depth (25 feet), respectively.

The 2-inch piece of geotextile extending out of the box was connected to a manual hand operated tensioning device which measured the load with a direct reading tension load cell. Loads could be measured up to 1,600 pounds in 1 pound increments. As the geotextile was loaded, the strain was measured with a dial gauge. Each test continued until the geotextile either failed or strained 1 inch. The results of SH&B's testing were used in selecting acceptable geotextile for the project.

7.2.2.2 Permeability

In addition to the strength tests performed on the geotextiles, permeability testing was also conducted. If a crack was to occur in the dam, the geotextiles would be exposed to soil borne water. This test was conducted to determine the clogging potential of the center filter/drain and downstream toe cutoff geotextiles.

The geotextiles were cut into approximately 3-inch square samples and placed in a "special constructed constant head permeameter which allowed for gradual addition of known amounts of turbid water" (SH&B, 1983a). Testing procedures included establishing a constant head flow through the geotextile followed by the addition of 50 milliliters of prepared turbid water. Soil particles caught by the geotextile decreased the flow rate during the test. Once the flow rate had become stable this step was repeated with a 400-milliliter and 200-milliliter sample of turbid water. In nearly all of the cases studied the permeability was reduced to near the lower limit of measurement. This reduction "occurred in less than 15 minutes, and usually in 30 seconds to 2 minutes" (SH&B, 1983a).

Upon completion of the testing, SH&B determined that the following geotextiles would be appropriate for the project:

Manufacturer	Geotextile Type
Amoco	Propex 1325 C7305*
Carthage Mills	Polyfilter X
Crown Zellerbach	Fibertex Ten-1
Dominion Textile	Mirafi 140N Mirafi 500X Mirafi MCF500*
DuPont	Typar 3601 Typar T063*
Griffolyn	Transguard 2000

* coated impermeable geotextile

The following specifications were recommended by SH&B and were included in the project contract documentation:

Properties	Center Drain & Toe Cutoff	Coated Center Drain & Outlet
Grab Tensile Strength*	120 pounds minimum machine direction of roll (warp), 90 pounds minimum perpendicular (weft)	130 pounds minimum machine direction of roll (warp), 90 pounds minimum perpendicular (weft)
Trapezoidal Tear*	60 pounds minimum machine direction of roll (warp), 45 pounds minimum perpendicular (weft)	40 pounds minimum machine direction of roll (warp), 40 pounds minimum perpendicular (weft)
Puncture (1" Ball)*	180 pounds minimum	140 pounds minimum
Pullout Test Elongation at 10 psi Overburden Load	1.0 inch minimum	1.0 inch minimum
Permeability	$1x10^{-3}$ cm/s minimum	$1x10^{-7}$ cm/s minimum
Equivalent Opening Size	No larger than U.S. Standard Sieve No. 20	N/A

*Test modified

In 1997, AGRA Earth and Environmental, Inc. (AGRA – predecessor to AMEC) sampled both the upstream permeable and the downstream impermeable geotextile materials from 3 locations (dam Stations 281+00, 462+00 and 60+50). Each sample was divided into multiple specimens in order to conduct laboratory tests. Grab tensile strength (ASTM D4632), puncture resistance (ASTM D4833) and trapezoidal tear strength (ASTM D4533) tests were performed. Except for the permeable sample from dam Station 462+00, 40 specimens were tested for each sample. The permeable sample from 462+00 had 23 total specimens tested. The table below summarizes the averaged values per test sample:

Specimen	Test	SH&B Specification	AGRA Average Test Value
Permeable at Sta. 60+50	Puncture Test	180 lbs.	105 lbs
Impermeable at Sta. 281+00	Trapezoid Tear Strength	40 lbs.	37 lbs.
Permeable at Sta. 281+00	Puncture Test	180 lbs.	123 lbs.
Permeable at Sta. 462+00	Puncture Test	180 lbs.	118 lbs.
Impermeable at Sta. 462+00	Puncture Test	140 lbs.	123 lbs.

The complete AGRA test results are included in Appendix D.

7.2.3 Construction

Construction of the center filter/drain and downstream geotextile cutoff began in November 1983 at the south end of the dam in the vicinity of dam Station 58+00. The first step in the construction process was to install the downstream geotextile cutoff. A backhoe was used to excavate an approximate 3-foot wide, 4 to 10-foot deep trench at the downstream toe of the dam. Once the trench was excavated to design lines and grades crews stretched the impermeable coated geotextile along the trench upstream side wall. As a result of the low density soils along the downstream toe the contractor had to utilize safety belts and a cable system to avoid any trench caving accidents. Six-foot long hooks were use by the contractor to hold the geotextile in place for backfilling. Once the geotextile was properly positioned, a bulldozer backfilled the trench securing the geotextile in place. These steps were repeated until the roll of geotextile ran out and a new roll had to be added by sewing to an adjacent roll. When connecting the two rolls an overlap of at least two feet was utilized. The sewn seam was complete in the field with a "J" seam using two polypropylene thread double locked stitches with five to six stitches per inch. The downstream cutoff construction was completed in December of 1983. While it was not very well documented in the SH&B construction reports, AMEC has interpreted that the downstream cut-off was constructed from historic dam Station 40+00 to dam Station 502+00. Documentation of the methods in which the geotextile cutoff was installed around the two existing and three abandoned outlet conduits is inconclusive. As-built and construction documentation reviewed by AMEC do not fully document the installation at the outlets. However, during the AMEC 2003 investigation the downstream excavations utilized to locate the three abandoned outlet pipes were near coincident with the downstream geotextile cutoff. Review of investigation photos shows the geotextile running past the downstream terminus of the abandoned outlets.

Review of correspondence between AMEC and the District (AMEC, 2001) detailed the methods in which the AMEC 2003 test pit excavations would be backfilled to repair the geotextile cutoff compromised during the investigation. Areas in which the existing geotextile was disturbed were to be replaced with a Beltech Style 304 woven geotextile. Methods included loosely fitting the material against the excavation surface on the embankment side of the test pit and then sewn to connect to the existing geotextile. Although detailed documentation confirming that this method was utilized at all test pit locations was not located, a photograph from a 2001 ADWR supplemental inspection report shows installation of the new geotextile (ADWR, 2001) further supported by communication with AMEC engineers responsible for conducting the investigation.

Upon completion of the downstream cutoff, construction of the center filter/drain and outlet drains was initiated. The initial step was to excavate the dam crest to the top of trench grade by removing approximately two feet of the dam crest. Following removal of the crest a trencher excavated a 2.5-foot wide trench that extended down to the native foundation soils. As the trencher moved along the dam the geotextile envelope was place in the trench. The envelope required the use of both impermeable (coated) and permeable geotextiles sewn together with a minimum 2-foot overlap. The specification called for the downstream (coated) geotextile to be

sewn underneath the upstream geotextile. Once the geotextile was in place, an 18-inch wide conveyor delivered drain rock to the trench for backfill. The drain rock grain size was periodically tested on-site by SH&B representatives to ensure quality assurance control. In the early stages of construction the drain rock was determined to be marginally out of specification at the No. 8 sieve by no more than 3 percent. Adjustments were made by the contractor to remedy the grain size distributions. Over 150 quality assurance sieve analyses were completed to ensure the drain rock met the project specifications. The results of these tests can be found in 15 field reports completed during construction by SH&B (SH&B, 1983b). As-builts were prepared by SH&B shortly after construction. AMEC's review of the as-builts indicates that the central filter/drain extends approximately between historic dam Station 40+00 and dam Station 507+00. However, as discussed in Section 5.6, the RAM April 2004 investigation contradicted the as-builts by discovering that the central filter/drain does not extend fully to either side of the principal outlet.

Historic documentation of the method in which the central filter/drain was installed at each of the existing outlet pipes is not clearly conclusive at all locations. The SH&B as-builts do not document the installation at the two existing and three abandoned outlets, however, the field reports do briefly discuss related activities. At the existing outlet at dam Stations 387+14 and 398+24, SH&B reported that the contractor raised the trencher boom to avoid the outlet pipes (SH&B, 1983b). At the abandoned outlet at dam Station 402+98 SH&B reported that the trencher encountered the pipe at a depth of 27'-9" and brought a small piece of metal to the surface. The contractor immediately raised the trencher boom to 26-ft. to avoid the outlet conduit (SH&B, 1983b). Construction documentation for central filter/drain installation at the other two abandoned outlet pipes (dam Stations 427+17 and 442+60) was not located.

As the project progressed along the length of the dam outlet drains were excavated from the dam center filter/drain trench to the downstream side. Outlet trenches were similar to the center filter/drain in width (2.5 feet) and depth (down to native foundation soils). The outlet consisted of a trench lined with the same impermeable geotextile found on the downstream side of the central filter/drain. The same specified aggregate was used to connect the center filter/drain trench to the downstream outlet drains. At each of the downstream drain outlets a 12-inch diameter PVC drain pipe was installed at or near the bottom of each drain. Starting from the toe of the dam a solid piece of PVC pipe extended 10 feet into the dam embankment where it connected to a 20-foot long, 12-inch diameter, slotted PVC pipe.

Initially a Mirafi 500x permeable geotextile and a Mirafi MCF-500 coated geotextile were selected and installed by the contractor. At some time later an Amoco coated geotextile was utilized. AMEC's review of construction reports is inconclusive regarding the location in which the differing material brands were installed. Historic records do indicate that regardless of the brand all materials meet the required specifications.

The construction techniques were use by two separate crews, one that started on the north end of the dam and one at the south end. However, a dispute between the primary contractor and a subcontractor stopped construction around April 1984. A short delay ensued and a new subcontractor began construction around the middle of May 1984. The new subcontractor installed the central filter/drain with a different technique. Instead of using a trencher for the center filter/drain, a backhoe was used for trenching. In addition, dump trucks delivered drain rock, 10 cubic yards at a time. The dump truck straddled the open excavated trench and dumped the drain material into a chip stone spreader which would funnel drain material into the trench. These techniques were use for the remainder of the construction, which ended in early August 1984.

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SECTION 8.0 ADDITIONAL DAM MODIFICATIONS

8.1 NORTH DIKE REPAIR (2002)

AMEC conducted an inspection, completed a repair design, and preformed construction quality assurance on three breaches north of the McMicken Dam emergency spillway (dam Station 525+00 to 535+00) from June to August of 2002 (AMEC, 2002b & 2002c). The breaches were the result of historic erosion of the up and downstream slopes which eventually head cut sufficiently to breach the dam. The project was completed for the District south of the intersection of Deer Valley Road and Grand Avenue (U.S. Highway 60). Prior to design and construction of the breach repairs, discussions with ADWR were held to identify the repair requirements. It was concluded the dam would be repaired "in kind" in order to match the original slopes, crest width and height. An ADWR application was submitted by the District for these activities.

The breaches were located between dam Station 525+00 and the terminus of the dam at Station 535+00. The primary breach was located at approximately dam Station 530+65 and was nearly 45 feet in length and over 4 feet deep. The second breach consisted of two smaller breaches located at dam Stations 528+60 and 528+95. These two breaches combined to form one prominent breach which extended approximately 60 feet from dam Stations 528+28 to 529+05. In order to restore these sections of the dam the breach sections were over excavated in order to remove roots and affected embankment soil. The areas were then filled with 8-inch thick loose lifts and compacted to match the original dam lines and grades.

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SECTION 9.0 OUTLETS AND PENETRATIONS

9.1 EXISTING OUTLETS

The dam includes two existing 24-inch diameter corrugated metal pipe (CMP) outlets located at dam Stations 385+14 and 398+24. Both outlets were remote video inspected in April 2003 under the direction of AMEC. As a result of the video observations concerns were identified with respect to the outlets' existing integrity related to possible settlement, joint displacement and possible corrosion. The outlets were ordered closed by the District and the operators removed until repairs or replacement could be completed. Details included herein related to the integrity of the existing two outlets are summarized from the AMEC (2003a) report.

9.1.1 Existing Outlet at Dam Station 387+14

Video inspection of the CMP outlet determined a total pipe length of 198.5 feet. Fluctuations in the pipe invert elevation were observed by changes in standing water levels through the length of the pipe. Most of the pipe had some standing water, and the depth of the water was an average of ½ to ¾ inch deep. Gradual increases in the depth of water started at about 148 feet from the upstream end of the pipe. A maximum depth of about 5 to 6 inches was observed between 158 and 186 feet from the upstream end. The depth of water beyond 186 feet decreased to approximately ½ inch.

A careful inspection of joints and bolts at various locations along the length of the pipe was performed. At a distance of 55.2 feet from the downstream end of the pipe, a bulbous mass along a joint was observed. The makeup of the mass could not be discerned but it appeared to be somewhat solid, potentially a type of sealant. When the MCMWCD No. 1 interim structure was incorporated into McMicken Dam an estimated 70 feet of pipe was added to the outlet pipe to the upstream side. The location of the material did not coincide with the location of the original headgate (pipe extension starting point) of the pipe.

9.1.2 Existing Outlet at Dam Station 398+24

Video inspection of the CMP outlet indicated a total pipe length of 192.8 feet. Fluctuations in the pipe invert elevation were apparent with changes in water level within the pipe. Most of the pipe did not have standing water; however, some isolated areas did have standing water varying from ½ to 2 inches in depth.

Careful inspection of joints and bolts at various locations along the length of the pipe was performed. Evidence of corrosion was found from the upstream opening to about 41 feet into the pipe. This area also had the most significant amount of standing water. At 49.2 feet into the pipe from the upstream end a mass was located that appears to have come from the joint. The composition of the mass could not be discerned but it appeared to be somewhat solid.

9.2 ASBESTOS TESTING

Relatively small samples of the two pipe coatings were collected for asbestos testing. The laboratory test results indicate that asbestos was not present within the pipe coatings. However, due to the limited sample size, AMEC recommended that additional sampling and testing be performed when better access to the pipes could be provided (AMEC, 2003a).

9.3 ABANDONED OUTLETS

In 2003 AMEC investigated and reported that three CMP outlets were abandoned when the MCMWCD No. 1 dam structure was incorporated into the construction of McMicken Dam by the USACE in 1956. Details and notes from the as-built drawings for McMicken Dam (USACE, 1956) indicate abandonment of the structures was to include removal and salvage of headgates, frames and wood catwalks. Concrete plugs were then to be placed within the existing 24-inch diameter CMPs on the upstream portion of the pipe with the 24-inch pipe to remain in place.

The locations of the abandoned pipes were previously unknown until the 2003 AMEC investigation. AMEC located all three abandoned structures with the use of as-built drawings, historic aerial photographs, Ground Penetrating Radar (GPR) surveys, and trench excavations. The downstream excavations utilized to locate the pipes were near coincident with the downstream geotextile cutoff installed in the mid-1980s. A videotaped inspection of the three outlets was performed to assess their condition and document their geometry. It is important to note that standing water and moist soil was observed in each of the video inspections. The moisture was the result of a storm event that occurred just after the downstream ends of the pipes were exposed. The excavations used to locate the pipes were inundated during the storm event. Pre-event observations by AMEC indicated that at the time the pipes were first exposed, standing water and moist soil conditions were not observed. Details included herein related to the three abandoned outlets are summarized from the AMEC (2003a) report.

9.3.1 Abandoned Outlet at Dam Station 402+98

The CMP invert was located about five feet below existing grade. The pipe is filled with a considerable amount of sediment or backfill. AMEC was able to clear the opening of the pipe for a distance of about 15 feet back of the downstream opening to allow videotaping. Soil beyond this point was observed to be about six inches deep and very moist to wet. Because of these conditions, the tracked camera could not traverse beyond this point in the pipe. A nest of young snakes was encountered by AMEC during the investigation, indicating a pathway into the pipe from the ground surface possibly existed. No evidence of voids or rodent burrowing was noticed at grade prior to excavation. No open joints or holes were noted when the downstream end of the pipe was videotaped, nor were any areas of corrosion noted.

9.3.2 Abandoned Outlet at Dam Station 427+17

The CMP invert was located at about four feet below existing grade. The pipe was void of significant sediment or backfill beyond the opening. Videotaping of the pipe determined it extends 73 feet into the dam from its downstream end. AMEC (2003a) concluded through the video inspection of the pipe that its condition was very good to excellent. No evidence of corrosion or separated connections was noted. Standing water was encountered near the upstream end of the pipe which is equivalent to the approximate centerline of the dam. A wooden bulkhead was encountered at the upstream end of the pipe. It appeared to be in good condition with little or no degradation noted. The bulkhead appeared to have been grouted.

9.3.3 Abandoned Outlet at Dam Station 442+60

The CMP invert was located at about 4.5 feet below existing grade. The pipe was filled with sediment or backfill to a distance of about 20 feet upstream from the downstream opening. The upper 8 inches of the pipe was observed to be open and accessible. Some visual observations indicated that there had been occurrences of water having traveled on the surface of the sediment or backfill. The pipe was estimated to extend 75 feet into the dam from its downstream end, based on the geometric relationships; however the tracked camera used to videotape the pipe could only traverse about 35 feet into the pipe because of the sediment or backfill. AMEC (2003a) did not report any evidence of significant corrosion or distress where the pipe was videotaped.

The standing water in outlet 427+17, the indications of water flow in outlet 442+60, and the very moist to wet soils in outlet 402+98 were the result of a storm event that occurred just prior to the videotaping of the pipes. The test pits excavated to expose the pipes filled with runoff and the water backed into the pipes. At the time the pipes were first exposed, standing water and wet conditions were not observed.

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SECTION 10.0 TRANSIENT SEEPAGE ANALYSIS

Transient seepage analyses of a typical embankment section were previously completed and reported by AMEC (2003a) to estimate the distance a wetted front would advance into McMicken Dam or the foundation soils supporting the dam during a period of maximum impoundment. Discussions included herein on the transient seepage analysis are summarized from the AMEC (2003a) report. The analysis was completed using the finite element program SEEP/W (Geo-Slope International, Ltd., 1997) and estimated saturated hydraulic conductivity values for the embankment and foundation soils. SEEP/W uses the Green and Corey (1971) procedure for estimating the hydraulic conductivity versus pore-water pressure function.

Analysis was performed for an embankment section that included the remnant historic 1952 interim dam. A typical embankment section not including the interim dam was also analyzed. However, the results were not presented in the 2003 report since results were closely similar to the results of those analyses that included the interim dam. Four materials were assumed to comprise the simplified cross section: the embankment material, the native foundation soils (a two-layer system) and the center filter/drain. The downstream geotextile curtain was not explicitly considered, since it is intended to minimize the potential for soil movement. The impoundment level was assumed by AMEC to be coincident with the top of the center filter/drain, or 4 feet below the crest of the dam. The table below summarizes the saturated vertical hydraulic conductivities (k_y) utilized in the analysis.

Material	Saturated Vertical Hydraulic Conductivity (k_y)	
	(ft/day)	(cm/sec)
Embankment	0.04	1.4×10^{-5}
Foundation 1 (Holocene)	3.0	1.1×10^{-3}
Foundation 2 (Pleistocene)	0.04	1.4×10^{-5}
Central Drain	Very low	Very low

For the base case, the horizontal hydraulic conductivity (k_x) was assumed equal to k_y, but to determine the sensitivity of the wetted front formation to other values, analyses were completed assuming $k_x = 10k_y$ and $k_x = 30k_y$ (hydraulic conductivity ratios of 10 and 30, respectively).

The analyses were extended to 30 days, with the location of the wetted front plotted at 5, 10, 20 and 30 days to determine trends. However, the drawdown time to drain the reservoir impounded by McMicken Dam through its principal outlet is estimated to be 10 days. The analyses conservatively assumed the full impoundment level throughout the 30 days, with no gradual lowering of the reservoir water surface elevation.

The advancement of the wetted front within the embankment and the lower foundation layer typically is less than within the upper foundation layer, as the lower hydraulic conductivity values for these materials would dictate. Results of the 2003 analyses are summarized in the table below where hydraulic conductivity values were changed for sensitivity comparisons. Results below are for a 10-day period.

Material	k_x	Length of Wetting Front Advancement		
		$k_x = 1k_y$	$k_x = 10k_y$	$k_x = 30k_y$
	(cm/sec)	(feet)	(feet)	(feet)
Embankment	$1.4x10^{-5}$	22	25	30
Foundation 1 (Holocene)	$1.1x10^{-3}$			
Foundation 2 (Pleistocene)	$1.4x10^{-5}$			
Central Drain	v. low			
Embankment	$1.4x10^{-5}$	10	20	26
Foundation 1 (Holocene)	$1.1x10^{-4}$			
Foundation 2 (Pleistocene)	$1.4x10^{-5}$			
Central Drain	v. low			
Embankment	$1.4x10^{-4}$	28	41	56
Foundation 1 (Holocene)	$1.1x10^{-2}$			
Foundation 2 (Pleistocene)	$1.4x10^{-4}$			
Central Drain	v. low			

Additional results indicate that if relatively high hydraulic conductivity values are assumed, the wetted front would reach the downstream toe of the embankment section, which includes the 1952 interim dam, within about 25 to 30 days. Additionally, if relatively high hydraulic conductivity values and a large contrast between horizontal and vertical values are assumed, the wetted front would likely reach the downstream toe of the embankment section, which does not include the 1952 interim dam, in about 20 days.

In summary, the results of the analyses generally indicate that a wetted front would not advance to the downstream toe of the dam during the estimated 10-day impoundment period, even if relatively high hydraulic conductivity values are assumed for the materials comprising the embankment and foundation soils. The analyses do not explicitly include the impact of cracking of the embankment soils or the possibility of an earth fissure extending beneath the full cross section, since the two dimensional plane strain finite element model cannot incorporate such features. However, by assigning high hydraulic conductivity values to the various materials, an estimate of the impact of extensive cracking is generally incorporated.

SECTION 11.0 SEISMIC HAZARD

In 2002 the District retained AMEC to perform a county-wide seismic exposure evaluation to establish seismic design parameters for all 22 flood control dams operated and maintained by the District. Discussions included herein on the seismicity related to McMicken Dam are summarized from the AMEC (2002a) report. Both deterministic and probabilistic methods were utilized for development of peak ground accelerations (PGA). The AMEC assessment was based on interpretations and related findings from existing published literature and studies. AMEC did not perform any independent fault analysis on any of the identified faults within the 100 kilometer project study area. Because District dams are founded on stiff soil or rock, the PGA values were developed for stiff soil or rock conditions and based on Maximum Credible Earthquake criteria because of the high hazard classification of most District dams.

The maximum credible earthquake occurrence for McMicken Dam occurs at the Horseshoe Fault, with a magnitude of 7.0 and a resulting peak horizontal bedrock acceleration of 0.05g. The fault is approximately 71 kilometers from McMicken Dam. A PGA of 0.1g was recommended for McMicken Dam by AMEC (2002a).

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SECTION 12.0 MCMICKEN OUTLET CHANNEL

12.1 HISTORIC MAINTENANCE

District O&M records were reviewed dating back to 1999. AMEC's review indicates that the District has performed regular O&M inspection activities and maintenance over the last seven years. Most maintenance activities have been associated with grading and plating of the levee embankment crest to improve all weather access, and the repair of surface erosion gullies and holes, both on the levee slopes and crest. AMEC's experience with similar features on dams in the desert southwest indicates that these surface erosion features may be associated with embankment cracking. Nevertheless, none of these features have been investigated to identify any cause other than surface runoff erosion.

The most significant maintenance activity included the restoration of the levee crest to design elevation west of Grand Avenue. In late 2003 the District surveyed the levee crest to place fill stakes on a ½ mile frequency to facilitate crest restoration. District O&M forces utilized District equipment to plate the levee crest with aggregate base (AB) material. Subsequent evaluation by Kimley-Horn & Associates concluded that the segment of the outlet channel levee east of Grand Avenue had adequate elevation to contain the design storm event, but had sections lacking sufficient freeboard (Kimley-Horn, 2004).

12.2 SITE RECONNAISSANCE

On July 27, 2006, Ralph Weeks, R.G. and Ms. Karen Anglin, both with AMEC, and on April 24, 2007, Brett Howey, P.E. conducted site reconnaissance of the outlet channel and outlet wash for the purpose of visually observing natural and man-made features of the channel, levee and wash. Reconnaissance of outlet channel and outlet wash consisted of driving and walking along the crest of the levee and parallel to the levee crest along the outside of the channel and wash. Stops were made in areas of particular interest and digital photographs were taken of relevant features. Goals of the reconnaissance included preliminary ground truthing of photo lineaments as part of the earth fissure risk zoning project task, observing areas on the levee embankment that showed distress, and to document natural and constructed feature along the channel and wash alignment. Appendix E includes the two reconnaissance reports and associated photographs. Highlighted observations include:

- The outlet channel has a moderate bend in the channel at approximately outlet channel Station 30+00 which is not armored with any embankment or channel erosion protection measures.
- Observed distress included ruts and dips in the levee crest, surface expression of what appeared to be embankment cracks, and increased photo lineament density around approximately outlet channel Station 253+00.
- The outlet channel discharges into the outlet wash through a transition that creates a flow direction change of greater than 90 degrees.

- Four (4) significant structures were identified along the alignment of the outlet wash during the reconnaissances which are discussed in Section 13.1.

12.3 OUTLET CHANNEL GEOTECHNICAL PROFILE

In addition to the AMEC characterization discussed below JE Fuller Hydrology and Geomorphology, Inc. completed an erosion and sedimentation analysis report for the outlet channel and outlet wash which is included in Appendix F of this report.

12.3.1 Native Levee Foundation Soils

The characteristics of the outlet channel levee foundation soils were extrapolated from the recent field and laboratory investigation completed immediately adjacent (downstream) of the levee embankment toe, from geophysical investigations performed along the levee crest and downstream toe, and from historic boring information. Review of the as-built levee embankment drawings indicated limited removal of existing soils was completed within the footprint of the levee (USACE, 1956). Approximately 1 to 2 feet of the existing foundation material was removed prior to construction of the levee embankment. Therefore, it is AMEC's opinion that the subsurface investigation directly downstream of the levee, combined with the geophysical data for areas beneath and downstream of the levee, provides sufficient information regarding the soil characteristics within the native levee foundation for analysis of alternatives. Nineteen backhoe test pits (TP06-1, 4-5, 8, 10, 12-14, 16-18, 20, 22-23, 25-27, and 29-30) were excavated from 5 to 13 feet below existing grade along the downstream toe, 21 refraction seismic surveys were completed along the levee crest, and 11 refraction seismic surveys were completed along the downstream toe by AMEC. Ten borings (2F-5 to 2F-14) ranging in depth from 7.5 to 40 feet, were completed along the outlet channel alignment by the USACE in 1954.

The soils within the outlet channel levee foundation may be sub-divided into three reaches. As indicated by the recent laboratory analyses, summarized in Appendix C, the foundation soils from outlet channel Station 10+00 (principal outlet) to 150+00 primarily consist of sand and gravel with clay, with intermittent zones of sand and clay. The second reach from outlet channel Station 150+00 to 272+00 is composed of an overlying layer of clay and silty sands and an underlying layer of gravel with clay and silt. The third reach from outlet channel Station 272+00 to 307+50 is predominantly sand and clay with some zones of silty gravel to clayey gravel at depth.

Stage cementation of soils within the levee foundation range from uncemented to Stage I from the near surface to a depth of approximately two feet below existing grade. Cementation predominantly increases from Stage I to I+ between depths of 2 and 3 feet. There is an increase in soil cementation from Stage I+ to Stage II to II+ below 3 feet, with a few intermittent zones of Stage I+ soil cementation from 3 to 13 feet. Stage II+ to Stage III cementation is found periodically throughout the levee foundation as shallow as 2 feet below existing grade.

Along the alignment of the outlet channel levee embankment, seismic lines 42-48, 64, 65, 81, and 82 were completed along the downstream toe. Based on the p-wave velocities, a surficial horizon extends to a depth of three to eight feet from existing grade. Typical p-wave velocities for this surficial horizon range from 830 to 1,300 f/s. Underlying cemented horizon p-wave velocities typically range from 1,900 to 5,400 f/s, averaging 2,000 to 3,000 f/s, below 5 to 10 feet. Velocity reversals under the cemented horizon below a typical depth of about 20 to 25 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 25 feet are 1,200 to 1,500 f/s, and below a depth of about 25 feet are 790 to 1,200 f/s.

12.3.2 Levee Embankment Soils

The characteristics of the outlet channel levee embankment soils were determined based on the field and laboratory investigations completed. Eight shallow hand excavated test pits (TH06-1T to TH06-5) where excavated into the levee embankment and 21 refraction seismic surveys were completed on the levee crest. As indicated by the laboratory analyses, summarized in Appendix C, the near surface levee embankment soils are predominantly sandy clay, clayey sand, and silty sand of low to medium plasticity. The embankment fill typically is weakly to moderately cemented, with uncemented and strongly cemented zones. In situ nuclear dry density values along this section vary from 78 to 110 pcf, compared to similar soils maximum dry density values (standard Proctor) in the range of 115 to 125 pcf. The moisture content of the near-surface embankment soils tested varied from 4 to 13 percent based on in situ nuclear gage test methods.

Along the alignment of the outlet channel levee embankment (Stations 20+00 to 307+00) seismic lines 16-26 and 49-58 were completed along the levee crest. Based on the p-wave velocities, most of the existing levee embankment exhibits p-wave velocities ranging from 940 f/s to 1,400 f/s within the upper 10 feet of the embankment. Between approximately outlet channel Stations 175+00 to 260+00 the p-wave velocities increase slightly and range from 1,000 f/s to 2,500 ft/s within the upper 10 feet of the embankment. ReMi shear wave profiles indicate s-wave velocities above a depth of about 10 feet below the existing levee crest are 430 to 730 f/s and average 620 f/s.

12.3.3 Outlet Channel Soils

The characteristics of the outlet channel soils were determined based on the field and laboratory investigations completed. Ten backhoe test pits, TP06-2, 3, 7, 9, 11, 15, 19, 21, 24, and 28, were excavated from 5 to 15 feet below existing grade and 13 refraction seismic surveys were completed. As indicated by the laboratory analyses, summarized in Appendix C, the outlet channel soils are typically sandy clay and silt or clayey silt with a medium plasticity, coarsening to sand and gravel with clay to the east end of the outlet channel. Based on the bulk soil samples collected and tested by AMEC, the percent fines (passing the no. 200 sieve) varies from 7 to 65 percent, and averages 24 percent. The plasticity index varies from 0 (non-plastic) to 29, and

averages 13. Near surface channel soils from 0 to 5 feet below existing channel grade have a D_{50} ranging from 3/8 inch to the no. 200 sieve, with a bimodal distribution of the no. 4 to no. 10 sieve on the coarse end and no. 100 the to no. 200 sieve on the fine end.

Cementation characteristics of the soil profile can be defined by dividing the outlet channel into two reaches. The first reach extends from outlet channel Station 10+00 (principal outlet) to approximately outlet channel Station 165+00. Near channel surface soils to a depth of 4 to 9 feet below the channel bottom exhibit Stage I to II-cementation, below 9 feet cementation increases to Stage II to II+. The second reach extends from approximately outlet channel Station 165+00 to the outlet channels confluence with the outlet wash. Near channel surface soils to a depth of 2 to 10 feet below the channel bottom also exhibit Stage I to II-cementation; however, below 5 feet cementation increases to Stage II to III-with backhoe refusals at 5 to 10 feet below existing channel grade.

Along the alignment of the outlet channel from Station 20+00 to 140+00, seismic lines 66-69 and 72-75 were completed within the channel bottom. Based on the p-wave velocities, a surficial horizon extends to a depth of one to four feet from existing channel grade. Typical p-wave velocities for this surficial horizon range from 710 to 1,300 f/s. Underlying cemented horizon p-wave velocities typically range from 1,200 to 3,600 f/s below 5 feet. Velocity reversals under the cemented horizon below a typical depth of about 25 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 25 feet are 900 to 1,500 f/s, and below a depth of about 25 feet are 940 to 1,100 f/s.

Along the alignment of the outlet channel from Station 260+00 to 297+50, seismic lines 27, 28 and 83 were completed within the channel bottom. Based on the p-wave velocities, a surficial horizon extends to a depth of one to five feet from existing channel grade. Typical p-wave velocities for this surficial horizon range from 830 to 1,300 f/s. Underlying cemented horizon p-wave velocities typically range from 1,400 to 4,500 f/s below 1 to 5 feet. Velocity reversals under the cemented horizon below a typical depth of about 10 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 10 feet are 770 to 2,300 f/s, and below a depth of about 10 feet are 1,200 to 2,100 f/s.

Two seismic lines, 70 and 71, were completed in the outlet channel at the base of the US Highway 60 bridge crossing and AT&SF railroad trestle crossing. Based on the p-wave velocities, a surficial horizon extends to a depth of 0 to 4 feet from existing channel grade. Typical p-wave velocities for this surficial horizon range from 1,000 to 1,300 f/s. Underlying cemented horizon p-wave velocities typically range from 1,400 to 2,400 f/s below 4 feet. No significant velocity reversals under the cemented horizon were indicated in the ReMi shear wave profiles.

SECTION 13.0 MCMICKEN OUTLET WASH

13.1 OUTLET WASH GEOTECHNICAL PROFILE

The general geotechnical and geological characteristic of the outlet wash were determined based on the field reconnaissance and geophysical surveys. Five (5) refraction seismic surveys were completed to characterize the near surface streambed and overbank soils. Investigation locations included the confluence of the McMicken Outlet Channel with the McMicken Outlet Wash, and north and south of the SR-303L roadway crossing.

The McMicken Outlet Channel merges with the outlet wash along a sharp right bend at the end of the outlet channel. The outlet wash is comprised of a natural ephemeral wash with semi-steep banks that range from 2 to 6 feet in height, a bottom channel width of 20 to 40 feet, and an unvegetated low flow channel approximately 10 to 15 feet in width. Directly south of the outlet channel – outlet wash confluence the wash is parallel to a service road used for a power line substation for approximately ¾ mile until passing under SR-303L and an 11-barrell box culvert crossing at Williams Road downstream of SR-303L. Further south along its alignment the wash has been channelized from Deer Valley Road to the Agua Fria River as part of the Sun City West development and El Mirage Drain projects.

Unimproved wash banks are primarily composed of unconsolidated materials, which are densely vegetated with native desert plants. Channel soils within the streambed consist of recent unconsolidated alluvial fan deposits, primarily uncemented sands and gravels, with rare cobbles and boulders. The channelized portion is trapezoidal with a 180 foot bottom width and 3 foot horizontal to 1 foot vertical side slopes.
Four (4) significant structures were identified during the reconnaissances which are discussed below including information gathered from the District.

SR L303 Crossing
Previously visited by AMEC in July 2006, this roadway crossing consists of an 11-bay box culvert. AMEC understands this structure was built by Maricopa County Department of Transportation (MCDOT) and is maintained by the Arizona Department of Transportation (ADOT). The project was permitted through the District's Right-of-Way permitting process and as-builts are on file with the District.

Williams Drive Crossing
This roadway crossing consists of an 11-bay box culvert. AMEC understands this structure was built by MCDOT and designed to pass the 100-year storm event as well as not fail if overtopped during the McMicken Standard Project Flood (SPF) discharge. The project was permitted through the District's Right-of-Way permitting process and as-builts are on file with the District. The structure is maintained by MCDOT and also includes a 12-inch waterline on Williams Drive and a 16-inch waterline on Pinnacle Peak Road.

El Mirage Drain

This structure consists of a 500 foot long, 4-inch thick reinforced concrete lined drop structure. The drop structure has a shallow lower level plunge pool for energy dissipation and a v-shaped low flow channel. The concrete was observed as deteriorating with signs of several historic maintenance repairs. AMEC understands the structure was built as part of the Sun City West development and construction of the El Mirage Drain. The structures are positioned on District property controlled by fee or easement. As-builts and/or engineering records are not available.

Sun City Drain

This structure consists of a 3-bay box culvert and deteriorated energy dissipation structure. AMEC understands this structure was built as part of the Sun City West development and construction of the Sun City Drain. There also is a section of the outlet channel which has been lined with concrete for erosion protection and bank stabilization. The District maintains these structures. As-builts and/or engineering records were not available.

In the vicinity of the outlet channel and outlet wash confluence, seismic lines 78 and 85 were completed within the streambed and the overbank respectively. Based on the p-wave velocities, a surficial horizon extends to a depth of 0 to 4 feet from existing grade within the streambed and 3 to 6 feet below existing grade at the overbank. Typical p-wave velocities for these surficial horizons range from 900 to 1,300 foot per second (f/s) in the streambed and 1,000 to 1,500 f/s at the overbank. Underlying cemented horizon p-wave velocities within the streambed typically range from 2,100 to 2,400 f/s from a depth of 3 to 10 feet below existing grade. P-wave velocities at the overbank cemented zone between 4 to 10 feet below existing grade range from 2,900 to 3,700 f/s. From approximately 10 feet below existing grade p-wave velocities increase to 4,200 to 6,500 f/s. Velocity reversals under the cemented horizon below a typical depth of about 25 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 25 feet are 1,800 to 2,200 f/s, and below a depth of about 25 feet are 960 to 1,300 f/s.

In the area located north of the SR-303L roadway crossing in area near the overhead 240 KV power transmission alignment, seismic lines 79 and 84 were completed within the streambed and the overbank respectively. Based on the p-wave velocities, a surficial horizon extends to a depth of 2 to 3 feet from existing grade within the streambed and 4 to 7 feet below existing grade at the overbank. Typical p-wave velocities for these surficial horizons range from 670 to 1,300 f/s in the streambed and 1,100 to 1,700 f/s at the overbank. Underlying cemented horizon p-wave velocities within the streambed typically range from 3,500 to 3,900 f/s from a depth of 3 to 6 feet below existing grade. P-wave velocities at the overbank cemented zone below 4 feet range from 3,700 to 4,800 f/s. Velocity reversals under the cemented horizon below a typical depth of about 24 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 24 feet are 1,800 to 2,200 f/s, and below a depth of about 24 feet are 1,000 to 1,200 f/s.

At a location south of the SR-303L roadway crossing, seismic line 80 was completed within the outlet wash streambed. Based on the p-wave velocities, a surficial horizon extends to a depth of 2 to 3 feet from existing grade within the streambed. Typical p-wave velocities for this surficial horizon range from 830 to 1,500 f/s. Underlying cemented horizon p-wave velocities within the streambed typically range from 2,900 to 3,400 f/s from a depth of 3 to greater than 10 feet below existing grade. Velocity reversals under the cemented horizon below a typical depth of about 34 feet below existing grade are indicated in the ReMi shear wave profiles. S-wave velocities above a depth of about 34 feet are 1,500 to 2,700 f/s, and below a depth of about 34 feet are 1,000 f/s.

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SECTION 14.0 DISCUSSION

14.1 MCMICKEN DAM

14.1.1 Embankment Cracking

Review of all available data indicates that the McMicken Dam embankment has experienced transverse, and to a lesser extent, longitudinal cracking along its entire length since its original construction. Cracking was first identified in the early 1970s by the USACE and subsequently monitored, studied and mitigated over the next 35 years by the District and various engineering consultants. AMEC's experience with similar flood control dams, as well as our understanding of the McMicken Dam geologic setting and embankment characteristics suggests that no single cause is responsible for the development of embankment cracks within dams in the Desert Southwest. Several mechanisms or combinations of mechanisms exist that likely contribute to cracking of the dam. Often the surficial expression of these feature is exacerbated by localize erosion and rodent activity. The mechanisms that likely contribute to embankment cracking include:

Desiccation – a distress that typically appears on surficial fine-grained soils and is the product of drying accompanied by shrinkage and cracking. The drying of such soils develops tensile stresses within the soil mass until cracks are formed. Longitudinal, but more predominantly transverse, cracking will occur as a result of this mechanism.

Differential Consolidation – a distress of the embankment as a result of differential settlement within the dam foundation. Contributing conditions include the presence of collapse-prone soils within the shallow foundation profile. Both longitudinal and transverse cracking may occur as a result of this mechanism.

Differential Land Subsidence – a distress of the embankment induced by regional land subsidence which creates areas of isolated, tensional embankment strain. Longitudinal, but more predominantly transverse, cracking will occur as a result of this mechanism.

The 1984 dam restoration and rehabilitation project included the installation of a center filter/drain along the entire length of the dam. The center filter/drain extends from elevation 1357.0 (1358.87) feet to about the natural ground elevation. In addition to the center filter/drain a downstream cutoff was constructed near the downstream toe of the embankment as a continuous trench to a depth that ranged from 4 to 10 feet. The installation included a vertically buried coated geotextile. Sections 4.3 and 7.0 herein detailed the design and construction of the central filter/drain and downstream cutoff. AMEC's review of all available data associated with the design, construction, and historic performance indicates that the central filter/drain remains an effective component capable of protecting against seepage erosion through transverse cracks which the central filter/drain directly intercepts. However, as discussed in the following paragraph, a failure mode associated with embankment cracks not intercepted by the existing central filter/drain remains.

As part of the District's Phase I Structures Assessment Program, District consultants have identified and evaluated various failure modes for its inventory of flood control dams and flood retarding structures. In January 2002 the District sponsored a workshop on cracking where various failure modes associated with earth embankments in semi-arid environments were presented and discussed. Of the non-fissure related embankment cracking failure modes identified, one has been recognized by AMEC as applicable to McMicken Dam.

The failure mode includes a scenario where the dam is founded on uncemented, erodible and/or collapsible foundation soils (poor foundation soils). The poor foundation soils overlie a moderately to strongly cemented alluvial soil (good foundation). Flow enters a transverse crack at some height above the embankment-foundation interface along the upstream face of the dam. Seepage along the transverse crack at the embankment-foundation interface causes collapse of the poor foundation soils which allows the more competent embankment to bridge over the collapsed soil, allowing a piping conduit to develop and erosion of the underlying poor foundation soils, leading to failure of the dam. A graphical depiction of this failure mode as prepared by the District (Tetra Tech, 2003) is reproduced as **Figure GA-14.1.1A**.

Although the details of this mechanism are not fully agreed upon by the geotechnical community, it has become apparent to AMEC, the District, and other dam safety engineers working in the desert southwest that the need to protect embankments against failure through embankment cracks is necessary. Therefore, to meet project objectives to provide for a rehabilitation alternative life span of 100 years, AMEC recommends incorporation of design components to protect against failure through embankment cracks. Protection against internal erosion through embankment cracks may be provided by a number of structural applications such as granular central filters, geotextiles, geomembranes, and combinations of naturally occurring and manufactured materials. It should be noted that as a sole line of defense Arizona Administrative Code R12-15-1216(B)(3)(c) does not allow the use of non-naturally occurring, manufactured materials. ADWR would require special variances for their use.

14.1.2 Foundation

Due to the nature of the depositional environment in which McMicken Dam was constructed, the depth of moisture-sensitive and erodible soils (poor foundation) is highly variable. While it is not possible to precisely predict what these depths are, reasonable estimates can be made based on available geotechnical information. Additionally, based in part on observations of the construction of the McMicken Dam FRZR realignment (AMEC, 2005), the presence of poor foundation soils to depths of greater than 20 feet is possible within historic washes where they cross the dam foundation.

Test pit, historic boring, and geophysical data were reviewed and select information plotted in **Figure GA-6.1A** to interpret the existence and extent of poor foundation materials below the existing dam embankment. To estimate the location of good foundation in the geologic profile it is necessary to interpret in-situ material's stage cementation, SPT blow counts, shear wave

velocities, and other related geotechnical information. Comparisons of Stage cementation, shear wave velocities, and poor/good foundation boundaries presented in **Table GA-14.1.2A** were used by AMEC to assist in approximating the depth and extent of poor foundation soils. The variability in the foundation soils also is indicated by the penetration resistance profile shown in **Figure GA-6.1A**. First occurrence values of SPTs greater than 30 for historic investigations are plotted along the dam profile. SPT values greater than 30 typically indicate soils of sufficient integrity to exhibit much less collapse potential during wetting. **Figure GA-6.1A** depicts the approximate interpreted elevation of the poor/good foundation contact.

Both non-earth fissure and earth fissure related poor foundation failure modes identified by the 2002 cracking workshop have been recognized by AMEC as applicable to McMicken Dam:

Non-earth Fissure Poor Foundation Failure Mode – This failure mode includes a scenario where the dam includes a central filter that fully penetrates the dam which is founded on poor foundation soils overlying good foundation soils. Flow enters a transverse crack at the upstream toe where at the embankment-foundation interface. Seepage along the transverse crack at the embankment-foundation interface causes erosion of the underlying poor foundation soils, leading to failure of the dam. A graphical depiction of this failure mode as prepared by the District (Tetra Tech, 2003) is reproduced as **Figure GA-14.1.2A.**

Earth Fissure Poor Foundation Failure Modes – These failure modes include scenarios where the dam is founded on poor foundation soils overlying good foundation soils. In both failure modes downward flow or seepage into an earth fissure creates a gully extending beneath the upstream slope. The first failure mode has flow along the embankment-foundation interface which causes erosion of the underlying poor foundation soils and large deformations of the upstream slope, leading to failure of the dam. The second failure mode is similar to the first with the addition of lateral seepage erosion of the embankment-foundation interface to the downstream toe, leading to failure of the dam. A graphical depiction of both failure modes as prepared by the District (Tetra Tech, 2003) is reproduced in **Figures GA-14.1.2B** and **GA-14.1.2C**.

As a result of the dam being founded on poor foundation soils, AMEC recommends incorporation of design components that extend into good foundation soils to protect against failure through embankment cracks and earth fissures along the embankment-foundation interface. The estimated average depths necessary to reach good foundation soils are summarized in the table below.

Dam Station (from-to)	Average Depth (ft) to Good Foundation at Existing Upstream Dam Toe	Average Depth (ft) to Good Foundation at Dam Centerline from Existing Dam Foundation
75+00 to 165+00	6.0	4.0
165+00 to 205+00	10.0	8.0
205+00 to 310+00	6.0	4.0
310+00 to 345+00	5.0	3.0
345+00 to 425+00	8.0	6.0
425+00 to 470+00	6.0	4.0
470+00 to 500+00	14.0	12.0
500+00 to 540+00	4.0	2.0
Weighted Average	7.0	5.0

Protection against failures from earth fissures may be provided by a number of structural applications such as; soil cement, roller compacted concrete, geomembranes, and other combinations of rigid, erosion resistant materials. As discussed in Section 14.1.1 the use of geosynthetics as a sole line of defense against failure would require a variance from ADWR.

14.1.3 Center Filter/Drain

Samples from three locations (dam Stations 281+00, 462+00 and 60+50) of both the upstream permeable and the downstream impermeable geotextile materials were previously tested in accordance with current ASTM procedures. The intent of the testing was to verify that the in-place geotextiles meet original project specifications. Grab tensile strength tests (ASTM D4632), puncture resistance (ASTM D4833) and trapezoidal tear strength (ASTM D4533) test were performed on multiple specimens from each sample location. However, testing performed by SH&B during the original center filter/drain design was slightly modified to better match anticipated field conditions. Therefore, direct correlations between the design testing and the 1997 ASTM testing are not possible.

A limited number of locations were sampled for the aforementioned conformance testing, one of which was a sample from a section of the dam recently removed during the FRZR project. Extrapolation of the limited available data set is challenging. Should the existing geotextile become punctured or experience a tear, the overall function of the center filter/drain would not be compromised. The intent of the permeable upstream geosynthetic is to preclude the migration of fines into and through the center filter/drain system whereas the function of the impermeable downstream geosynthetic is to keep water within the drain. A puncture within the upstream membrane could have potentially occurred during drain rock placement thus creating a small

pathway for embankment fines to wash into the drain. Additional opening of such a puncture would not seem plausible considering the upstream membrane is confined (sandwiched) against the upstream embankment soils and the drain aggregate. The confinement pressures results from the point contacts applied by each drain aggregate particle. Migration of fines through a puncture would be controlled and disconnected from the downstream embankment.

A similar puncture scenario may exist in the downstream membrane. Like the upstream membrane, the downstream membrane is confined between the drain aggregate and the downstream embankment. A puncture in the downstream membrane could allow leakage from the center filter/drain should the drain develop a phreatic water surface. However, the center filter/drain was designed to act as a drain with periodic downstream outlets responsible for draining seepage water. Development of high heads within the center filter/drain for prolonged periods that would allow for an internal erosion issue to develop does not appear plausible considering the short impoundment duration (days), the coarseness of the existing drain aggregate, and the ability of the drain to relieve heads through the downstream drains.

Tearing of the upstream and downstream geosynthetics is also a concern that requires consideration. The dam through its settlement history does not show any areas of very isolated differential settlement that would impose high stresses on the center filter/drain system. Additionally, should transverse cracks in the dam continue to widen, concentrated stresses may be imposed on the geosynthetics which could be capable of tearing the materials. However, a visual observation of the membranes in contact with the existing embankment, during removal of the south end of the dam for the FRZR project, indicates rootlet growth along this interface. This observation indicates the contact between the membranes and the adjacent embankment soils is questionable, thus significant transference of stresses from the soil to the membranes may not occur.

As discussed in Section 14.1.2 poor foundation soils have been identified beneath the existing dam that require mitigation. Should an upstream alternative be selected to mitigate the poor foundation conditions, the existing integrity and function of the center filter/drain is less important since the upstream alternative would also function as mitigation for transverse cracks. The existing center filter/drain would then be a secondary supporting, component. The redundant system could be realized as an additional risk reduction measure.

Should an alternative be developed that utilizes the full function of the center filter/drain, AMEC recommends additional investigation of the existing condition of the center filter/drain. Collection and laboratory testing of additional representative samples of the existing geosynthetics coupled with additional engineering assessments and a failure modes and effects analysis would assist in decision making efforts.

As documented and previously discussed the central filter/drain does not fully extend to either side of the principal outlet. Implementation of the interim dam safety measures will provide a means to protect the area adjacent to the principal outlet from failure through a transverse crack.

The interim measure has been designed to allow for connection with an upstream alternative, should one be selected to mitigate for poor foundation conditions and embankment cracking.

14.1.4 Outlets and Penetrations

The dam outlet pipes at dam Station 387+14 and dam Station 398+24 have apparent damaged joints that would adversely impact their safe operation and could result in piping of the adjacent soils. The pipes also represent a potential uncontrolled seepage pathway since the pipes do not have any filter diaphragms and historic records would indicate that the center filter/drain does not fully encase the outlets. Evidence of full encapsulation of the outlets by the downstream geotextile cutoff does not appear to exist to support any substantial conclusions. The three abandoned CMP outlets at dam Stations 402+98, 427+17 and 442+60 appear to be in good condition based on the limited video inspections completed. However, the pipes act as open conduits within the dam and do not have filter diaphragms or encapsulation by the center filter/drain to protect against uncontrolled seepage along their length. Because of concerns regarding the two existing and three abandoned outlet pipes, the pipes require safe abandonment or complete removal.

14.2 OUTLET CHANNEL

14.2.1 Levee Embankment Cracking and Integrity

14.2.1.1 Embankment Cracking

The non-fissure related homogeneous embankment cracking failure mode identified by the 2002 cracking workshop has been recognized by AMEC as applicable to the McMicken Outlet Channel levee.

The failure mode includes a scenario where the embankment is a homogenous earthfill structure that becomes compromised by transverse cracks that extend from the upstream face to the downstream face. Flow enters a transverse crack along the upstream face of the embankment and seepage along the transverse crack causes erosion of the poor foundation soils leading to failure of the dam. A graphical depiction of this failure mode as prepared by the District (Tetra Tech, 2003) is reproduced as **Figure GA14.1.2A**.

As a result of the levee embankment being constructed of homogeneous soils, AMEC recommends incorporation of design components that mitigate failure through embankment cracks. Protection against internal erosion through embankment cracks may be provided by a number of structural applications as detailed in Section 14.1.1.

14.2.1.2 Embankment Integrity

The characteristics of the outlet channel levee embankment soils based on the limited hand pit investigation and the geophysical investigation suggests that the integrity of the existing levee embankment soils are questionable. The embankment fill typically is weakly to moderately

cemented with dry density values varying from 78 to 110 pcf, compared to similar soils maximum dry density values (standard Proctor) of 115 to 125 pcf. Historic construction records are not available to assess the level of the construction quality control performed during the original embankment construction. A stretch of the levee embankment between outlet channel Station 175+00 to 260+00 does exhibit physical increases in embankment integrity and, therefore, may be adequate.

As a result of the questionable levee embankment integrity, AMEC recommends consideration of reconstructing the levee embankment. The embankment averages 15 feet in height and will require inclusion of other structural components to mitigate other failure modes. Construction of these other mitigation measures in combination with the relatively low existing structure height may be more cost effectively constructed by full replacement of the existing levee embankment. Alternatives analysis and cost estimates should consider the advantages of embankment reconstruction.

14.2.2 Levee Foundation

The non-fissure related poor foundation embankment cracking failure mode identified by the 2002 cracking workshop has been recognized by AMEC as applicable to the McMicken Outlet Channel levee.

The failure mode includes a scenario where the embankment does not include a central filter that fully penetrates the poor foundation soils overlying good foundation soils. Flow enters a transverse crack at the upstream toe where at the embankment-foundation interface. Seepage along the transverse crack at the embankment-foundation interface causes erosion of the underlying poor foundation soils, leading to failure of the embankment. A graphical depiction of this failure mode as prepared by the District (Tetra Tech, 2003) is reproduced as **Figure GA-14.1.1B**.

Test pit, historic boring data, and geophysical data were reviewed and select information plotted in **Figure GA-14.2.2A** to interpret the existence and extent of poor foundation materials below the existing levee embankment. To estimate the location of good foundation in the geologic profile it is necessary to utilize the in-situ material's stage cementation and shear wave velocity. Comparisons of stage cementation, shear wave velocities, and poor/good foundation boundaries are presented in **Table GA-14.1.2A.** These data were used by AMEC to approximate the depth and extent of poor foundation soils. **Figure GA-14.2.2A** depicts the approximate interpreted elevation of the poor/good foundation contact.

Because the levee embankment is on poor foundation soils, AMEC recommends incorporation of design components that extend into good foundation soils or altogether remove the poor foundation soils beneath the embankment to protect against failure through embankment cracks along the embankment-foundation interface. The average depths necessary to reach good foundation soils are summarized in the table below.

Outlet Channel Station (from-to)	Average Depth (ft) to Good Foundation at Existing Downstream Levee Toe	Average Depth (ft) to Good Foundation at Levee Centerline from Existing Levee Foundation
10+00 to 55+00	8.0	6.0
55+00 to 110+00	13.0	11.0
110+00 to 200+00	9.0	7.0
200+00 to 245+00	5.0	3.0
245+00 to 317+20	8.0	6.0
Weighted Average	6.75	9.50

14.2.3 Channel Scour

To predict scour it is necessary to compare the in-situ materials resistance to scour to the hydraulic energy of the water. The discussions that follow only address the resistance to scour of the in-situ material. Estimated ranges of hydraulic stream power needed to initiate head cutting erosion are summarized in **Table GA-14.2.2A**. Annandale (1995) reviews the determination of stream power as a function of hydraulic flow conditions. For purposes of comparison and correlation, ranges of hydraulic stream power are compared to excavation equipment needed to perform effective excavation as estimated (quantified) by seismic p-wave velocities. Annandale (1995) presents relationships between stream power and initiation of head cutting erosion through an erodibility index based on the Kirsten excavatability index (Kirsten 1982, 1988) for geologic materials.

Review of the p-wave data generated from the thirteen refraction seismic lines performed in the outlet channel and the D_{50} grain size of the samples tested indicates the shallow surface soils appear to be very erodible to a depth of 10 feet within the channel. Below this depth the material becomes slightly more erosion resistant with an erosion threshold of 1.0 kW/m^2 or less.

As a result of the erosion potential, AMEC recommends consideration of incorporating design components that provide bank and channel protection. Measures should be considered should significant increases in channel velocities be required for implementation of an alternative. Bank and channel protection may be provided by a number of common hard and soft structural applications such as: vegetation, rock riprap (grouted and ungrouted), gabions (basket or mattress), check dams, soil cement, and concrete. Toe protection would also be required to prevent undermining of the bank protection measure. Erodible channels should have protection to the maximum estimated depth scour. In addition to bank and channel erosion protection, existing structures, such as the U.S. Highway 60 bridge and AT&SF railroad trestle foundations, should be assessed for erosion stability.

14.3 OUTLET WASH

14.3.1 Channel Scour

As discussed in Section 14.2.3, to predict scour it is necessary to compare the in-situ materials resistance to scour to the hydraulic energy of the water. Using **Table GA-14.2.2A** a review of the p-wave data generated from the five refraction seismic lines performed in the outlet wash streambed and overbank indicates the near-surface soils appear to be very erodible to a depth of three feet within the streambed and to a depth of six feet at the overbank. Below these depths the material becomes more erosion resistant with an erosion threshold of about 5.0 kW/m^2.

As a result of erosion potential of the outlet wash streambed and overbank soils, AMEC recommends consideration of incorporating design components that provide bank and channel protection. Measures should be considered should significant increases in channel velocities be required for implementation of an alternative. Bank and channel protection may be provided by a number of common hard and soft structural applications as detailed in Section 14.2.3. Toe protection would also be required to prevent undermining of the bank protection measure. Erodible channels should have protection to the maximum estimated depth scour. In addition to bank and channel erosion protection, existing structures such as the SR-303L bridge crossing foundations, should be assessed for erosion stability. Realignment of the Outlet Channel-Outlet Wash confluence is also recommended to reduce erodibility potential and to mitigate any local flooding issues that could arise from backwater and/or breakouts.

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TABLES

Table GA-14.1.2A
Approximate Structure Foundation Suitability
Cemented Soils (Caliche)

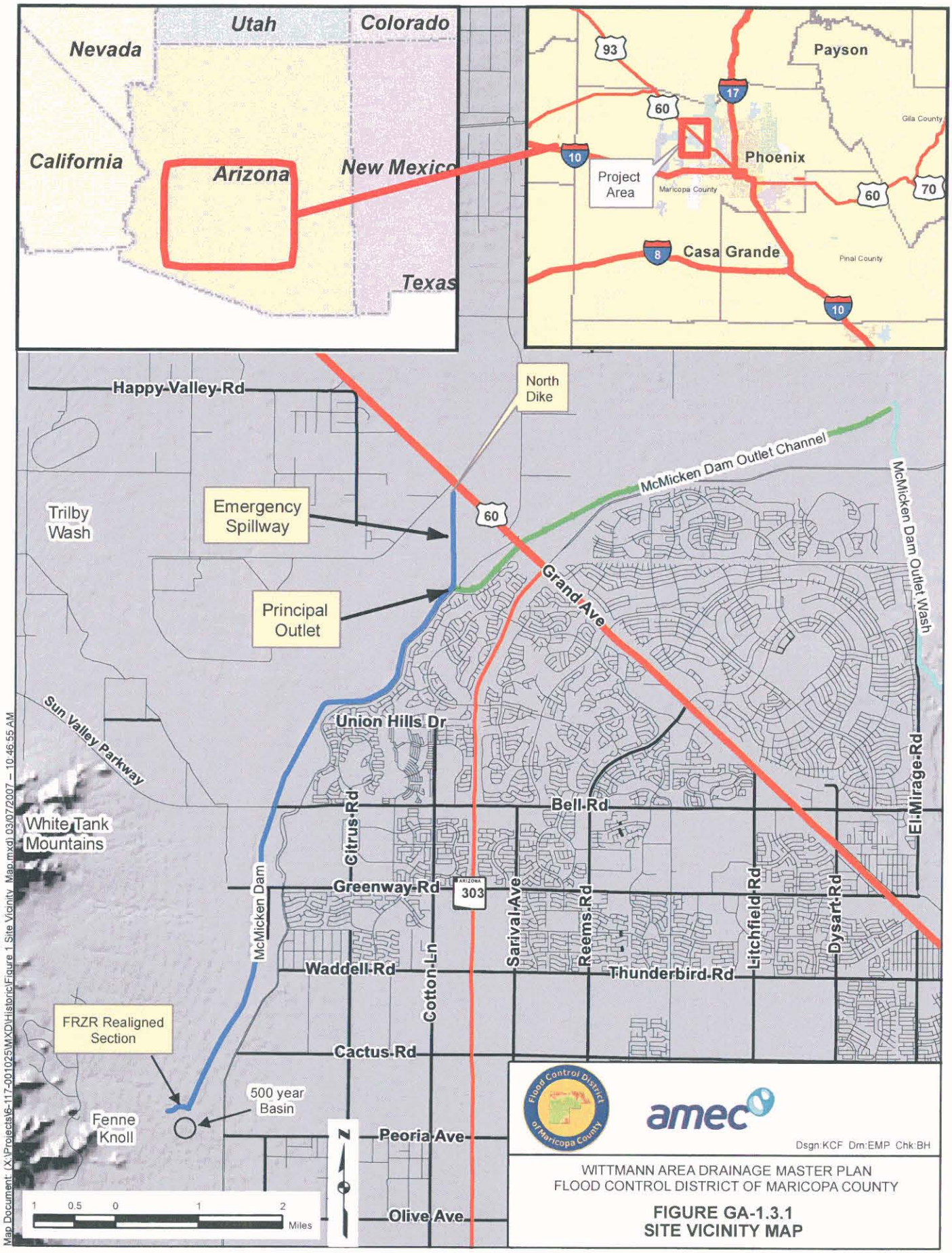
Cementation Stage	S-wave Velocity (ft/s)	Excavation Equipment	Class	Structure Suitability
Stage I	<750	shovel	1	Poor
Stage I+	750	Case 590, Cat 416C	2	
Stage II	1000	Case 590, Cat 416C		
Stage II+	1250	Case 590, Cat 416C		Fair
Stage III	1500	John Deere 710D	3	Good
Stage III+	1750	Cat 325 refused Cat 330BL succeeded		
Stage IV	2000	Cat 330BL refused Cat 345BL succeeded	4	

Table GA-14.2.2A
Approximate Erodibility & Excavatability of Materials
Limestone & Cemented Soils (Caliche)

Seismic Velocity (P-Wave), ft/sec (Rucker and Fergason, 2006)	Trackhoe / Dozer Type & Power (Cat, 1984, 1993)	Erodibility / Excavatability Index (Kirsten, 1982, 1988; NRCS, 2001)	Erosion Threshold Stream Power, kW/m^2 (Annandale, 1995)
<1,500	hand spade	<0.01	very erodible
1,500 - 3,000	hand pick & spade Cat 416C 78 hp	0.01 – 0.099	very erodible - 0.2
3,000 - ~3,500	Cat 325BL 168 hp Cat D6D 136 hp	0.1 – 0.99	0.2 – 1.0
~3,500 - 4,000	Cat 330BL 222 hp Cat D7G 200 hp	1.0 – 9.99	1.0 – 5.0
~4,000 - 5,900	Cat 345BL 321 hp Cat D8L 335 hp	10 - 99	5.0 – 30
5,900 - 7,200	Cat 375 428 hp Cat D9L 460 hp	100 - 999	30 - 200

Notes: Bulldozer and backhoe power ranges are presented by Kirsten (1982, 1988) as a measure of equivalent performance for excavation. All velocities are approximate and represent a typical range. Seismic velocity ranges for backhoes and trackhoes in cemented soils with typical p-wave velocity less than 6,000 f/s are from Rucker and Fergason (2006). See the Caterpillar Performance Handbook (Caterpillar, 1984, 1993 or current edition) for details on use of seismic information for rippability. Different model configurations include variations in weight and horsepower.

FIGURES


Utah
Colorado
Nevada
California
Arizona
New Mexico
Texas
93
60
17
10
Payson
Gila County
Phoenix
Project Area
Maricopa County
60
70
8
Casa Grande
Pinal County
10
Happy Valley Rd
North Dike
McMicken Dam Outlet Channel
McMicken Dam Outlet Wash
Trilby Wash
Emergency Spillway
60
Principal Outlet
Grand Ave
Sun Valley Parkway
Union Hills Dr
Bell Rd
El Mirage Rd
White Tank Mountains
Citrus Rd
Greenway Rd
ARIZONA 303
Sarival Ave
Reems Rd
Litchfield Rd
Dysart Rd
McMicken Dam
Waddell Rd
Cotton Ln
Thunderbird Rd
FRZR Realigned Section
Cactus Rd
500 year Basin
Fenne Knoll
Peoria Ave
Olive Ave
N
1 0.5 0 1 2 Miles
Flood Control District of Maricopa County
amec
Dsgn:KCF Drn:EMP Chk:BH
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-1.3.1
SITE VICINITY MAP
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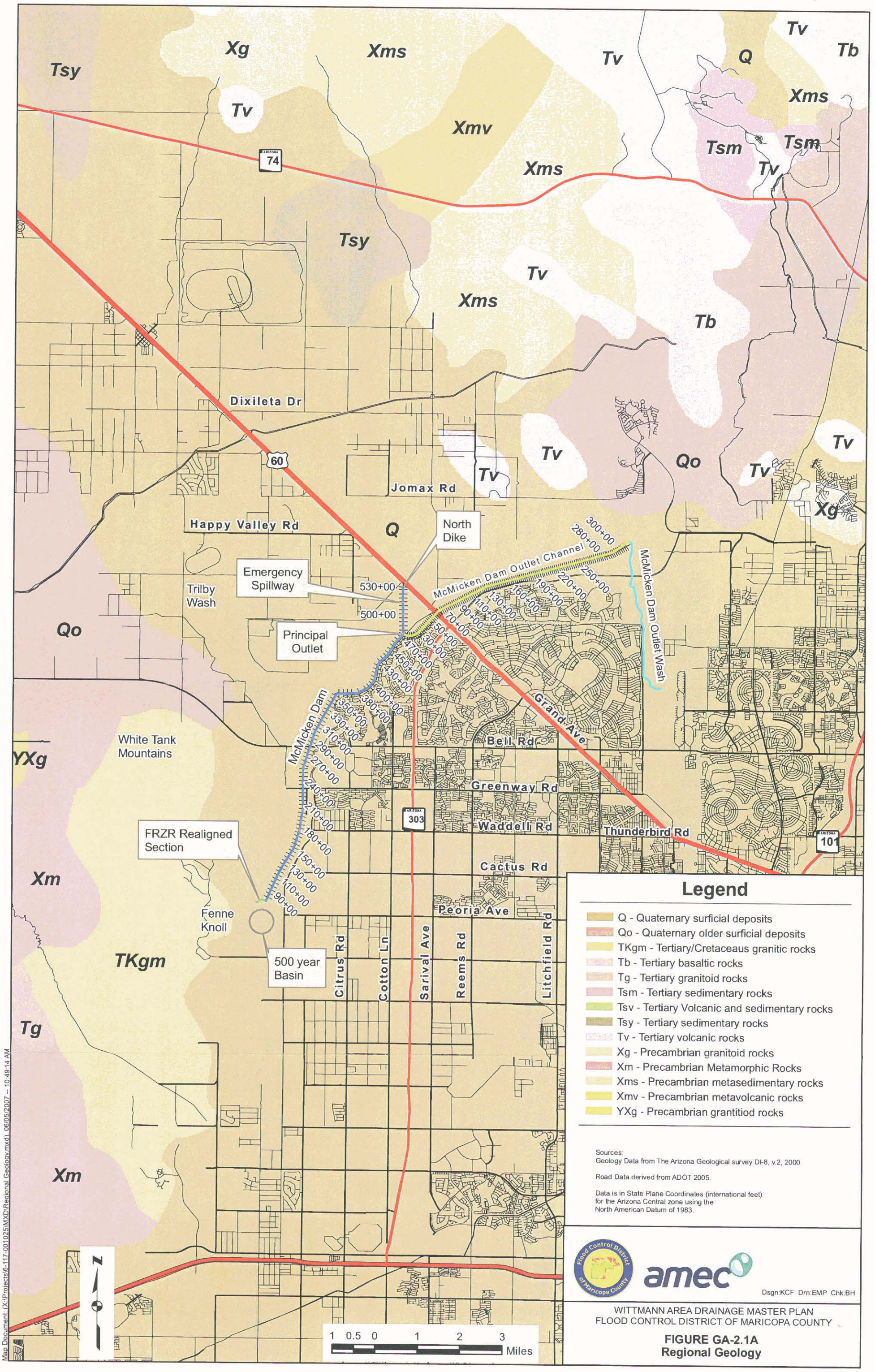
Tsy
Xg
Xms
Tv
Q
Tb
Xmv
Tsm
Xm
YXg
Qo
TKgm
Tg
ARIZONA 74
Dixileta Dr
ARIZONA 60
Jomax Rd
Happy Valley Rd
North Dike
Emergency Spillway
Trilby Wash
Principal Outlet
McMicken Dam Outlet Channel
McMicken Dam Outlet Wash
McMicken Dam
White Tank Mountains
Grand Ave
Bell Rd
Greenway Rd
ARIZONA 303
Waddell Rd
Thunderbird Rd
ARIZONA 101
Cactus Rd
Peoria Ave
FRZR Realigned Section
Fenne Knoll
500 year Basin
Citrus Rd
Cotton Ln
Sarival Ave
Reems Rd
Litchfield Rd
530+00
500+00
1 0.5 0 1 2 3 Miles
Legend
Q - Quaternary surficial deposits
Qo - Quaternary older surficial deposits
TKgm - Tertiary/Cretaceaus granitic rocks
Tb - Tertiary basaltic rocks
Tg - Tertiary granitoid rocks
Tsm - Tertiary sedimentary rocks
Tsv - Tertiary Volcanic and sedimentary rocks
Tsy - Tertiary sedimentary rocks
Tv - Tertiary volcanic rocks
Xg - Precambrian granitoid rocks
Xm - Precambrian Metamorphic Rocks
Xms - Precambrian metasedimentary rocks
Xmv - Precambrian metavolcanic rocks
YXg - Precambrian grantitiod rocks
Sources:
Geology Data from The Arizona Geological survey DI-8, v.2, 2000
Road Data derived from ADOT 2005.
Data is in State Plane Coordinates (international feet) for the Arizona Central zone using the North American Datum of 1983.
Flood Control District of Maricopa County
amec
Dsgn:KCF Drn:EMP Chk:BH
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-2.1A
Regional Geology
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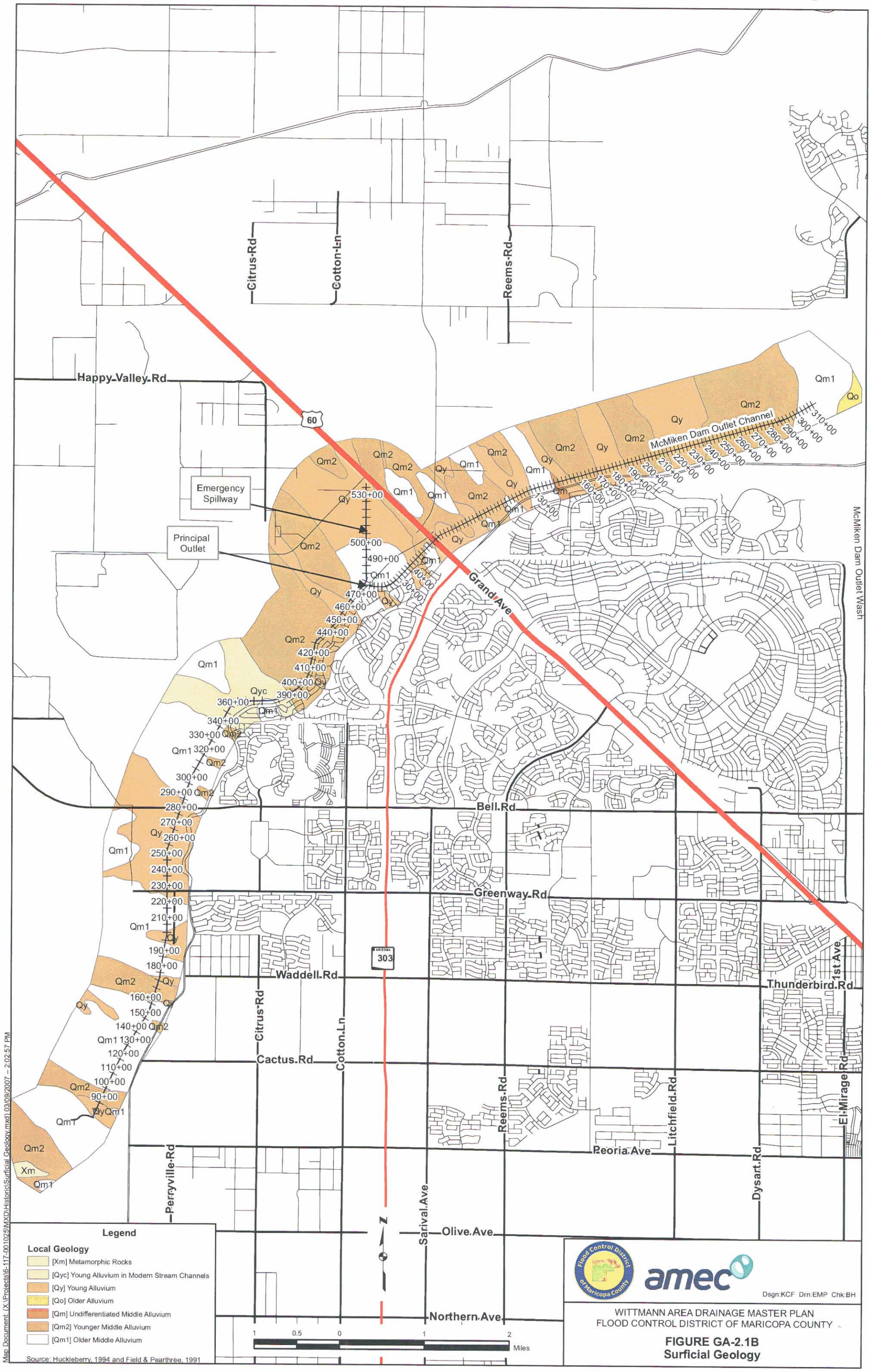
Happy Valley Rd
Citrus Rd
Cotton Ln
Reems Rd
60
Emergency Spillway
Principal Outlet
McMiken Dam Outlet Channel
McMiken Dam Outlet Wash
Grand Ave
Bell Rd
Greenway Rd
Waddell Rd
Thunderbird Rd
1st Ave
Cactus Rd
Peoria Ave
Olive Ave
Northern Ave
Perryville Rd
Litchfield Rd
Dysart Rd
El Mirage Rd
Sarival Ave
303
Qm1
Qm2
Qy
Qyc
Qo
Xm
Legend
Local Geology
[Xm] Metamorphic Rocks
[Qyc] Young Alluvium in Modern Stream Channels
[Qy] Young Alluvium
[Qo] Older Alluvium
[Qm] Undifferentiated Middle Alluvium
[Qm2] Younger Middle Alluvium
[Qm1] Older Middle Alluvium
Source: Huckleberry, 1994 and Field & Pearthree, 1991
Miles
Flood Control District of Maricopa County
amec
Dsgn:KCF Drn:EMP Chk:BH
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-2.1B
Surficial Geology
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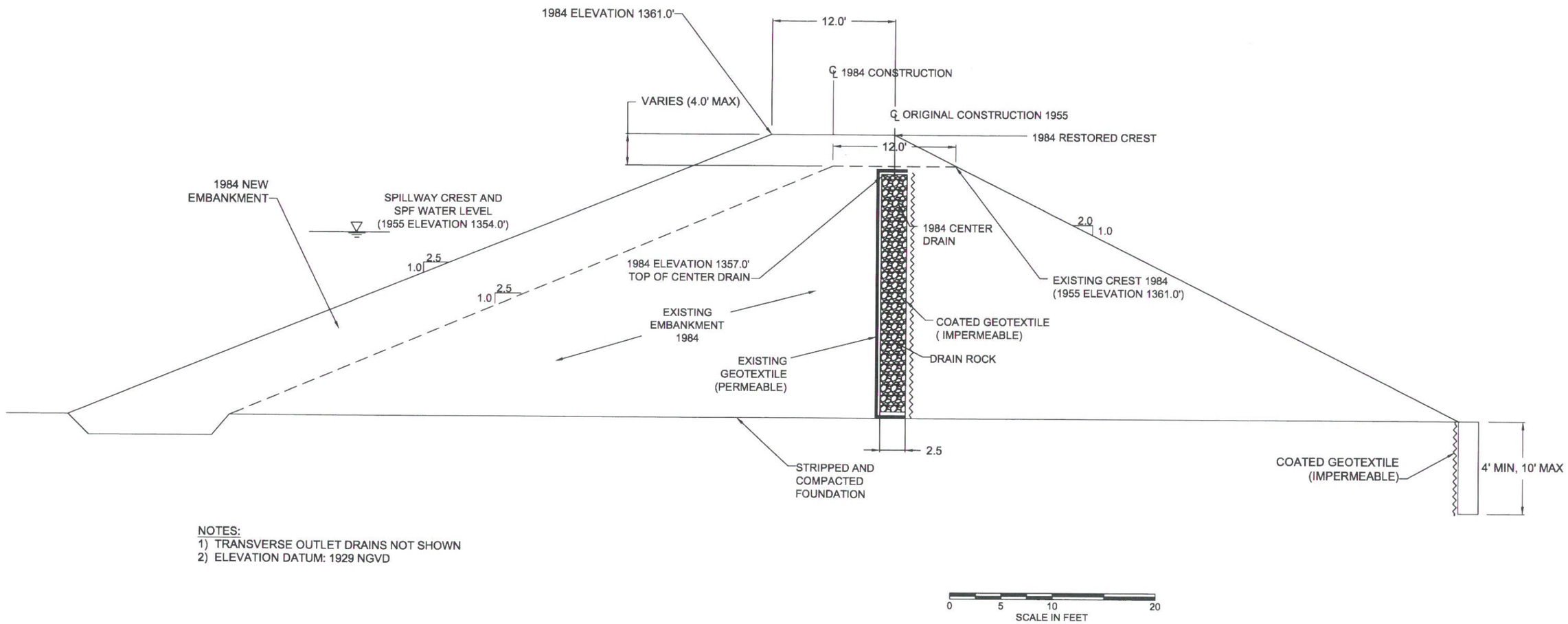
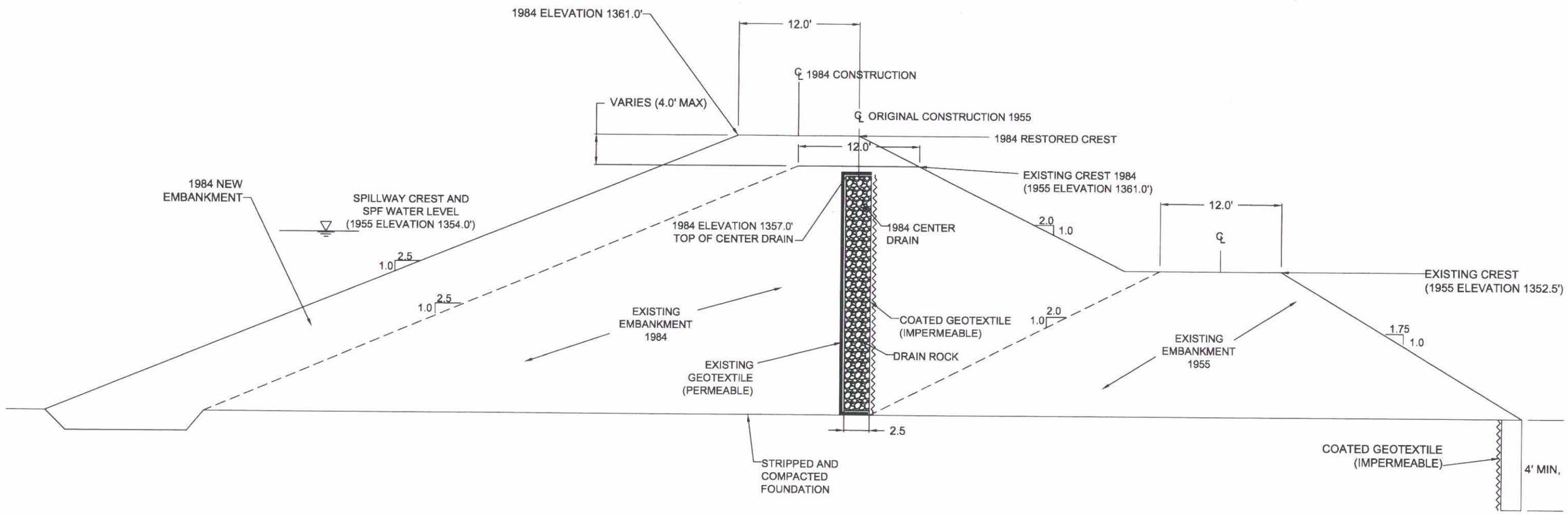


NOTES:
1) TRANSVERSE OUTLET DRAINS NOT SHOWN
2) ELEVATION DATUM: 1929 NGVD

WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE GA-4.1A
TYPICAL EMBANKMENT CROSS SECTION
STA. 75+00 TO 357+00 AND STA. ±474+00 TO ±504+00



NOTES:
1) TRANSVERSE OUTLET DRAINS NOT SHOWN
2) ELEVATION DATUM: 1929 NGVD

0 5 10 20
SCALE IN FEET

amec

WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE GA-4.1B
TYPICAL EMBANKMENT CROSS SECTION
STA. 357+00 TO STA. ±474+00

FIGURE GA-5.1A
McMicken Dam Summary of Cracking

FIGURE GA-6.1A
McMicken Dam Foundation Profile

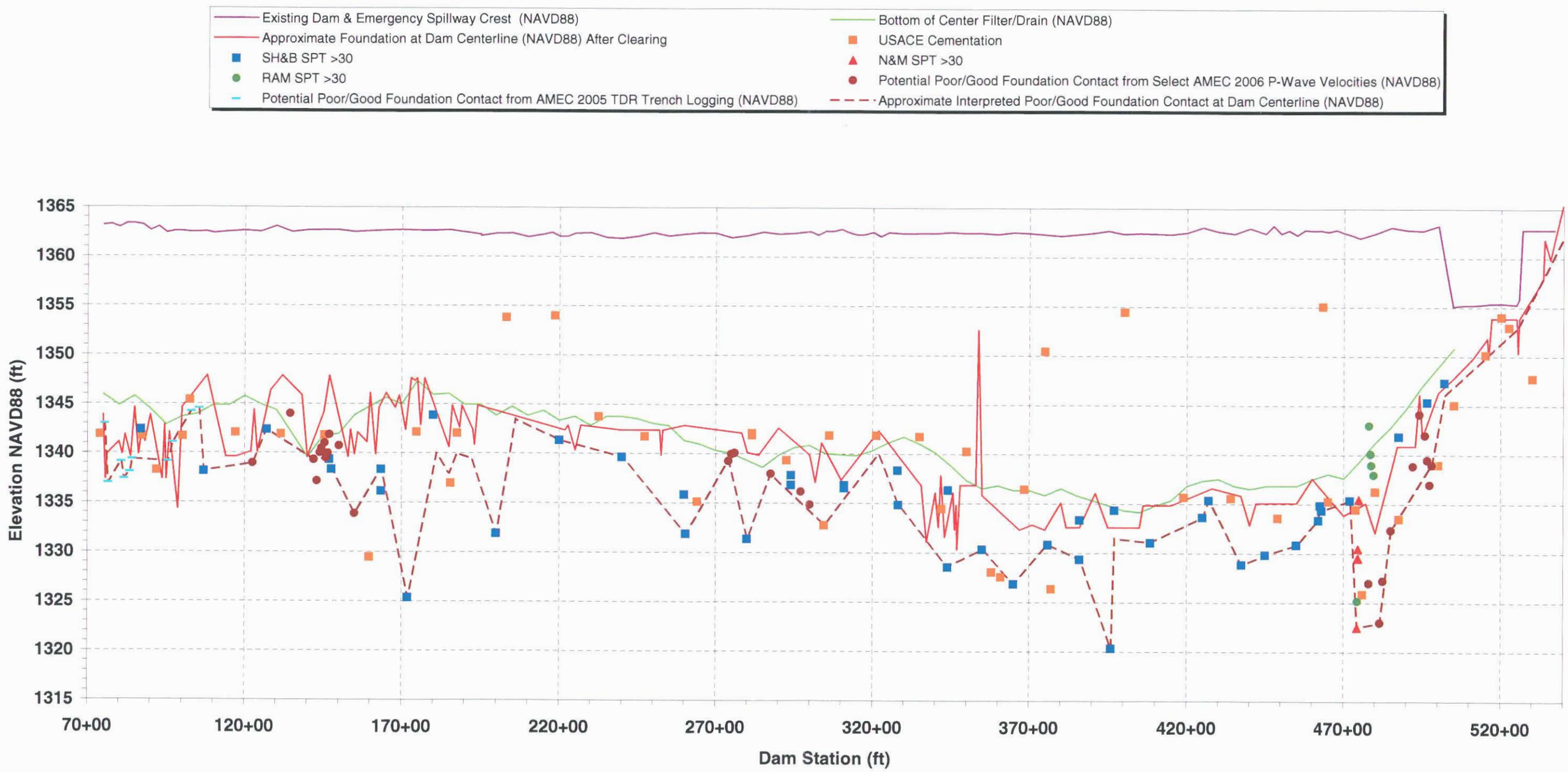


FIGURE GA-6.1.1A
McMicken Dam Center Filter/Drain Profile

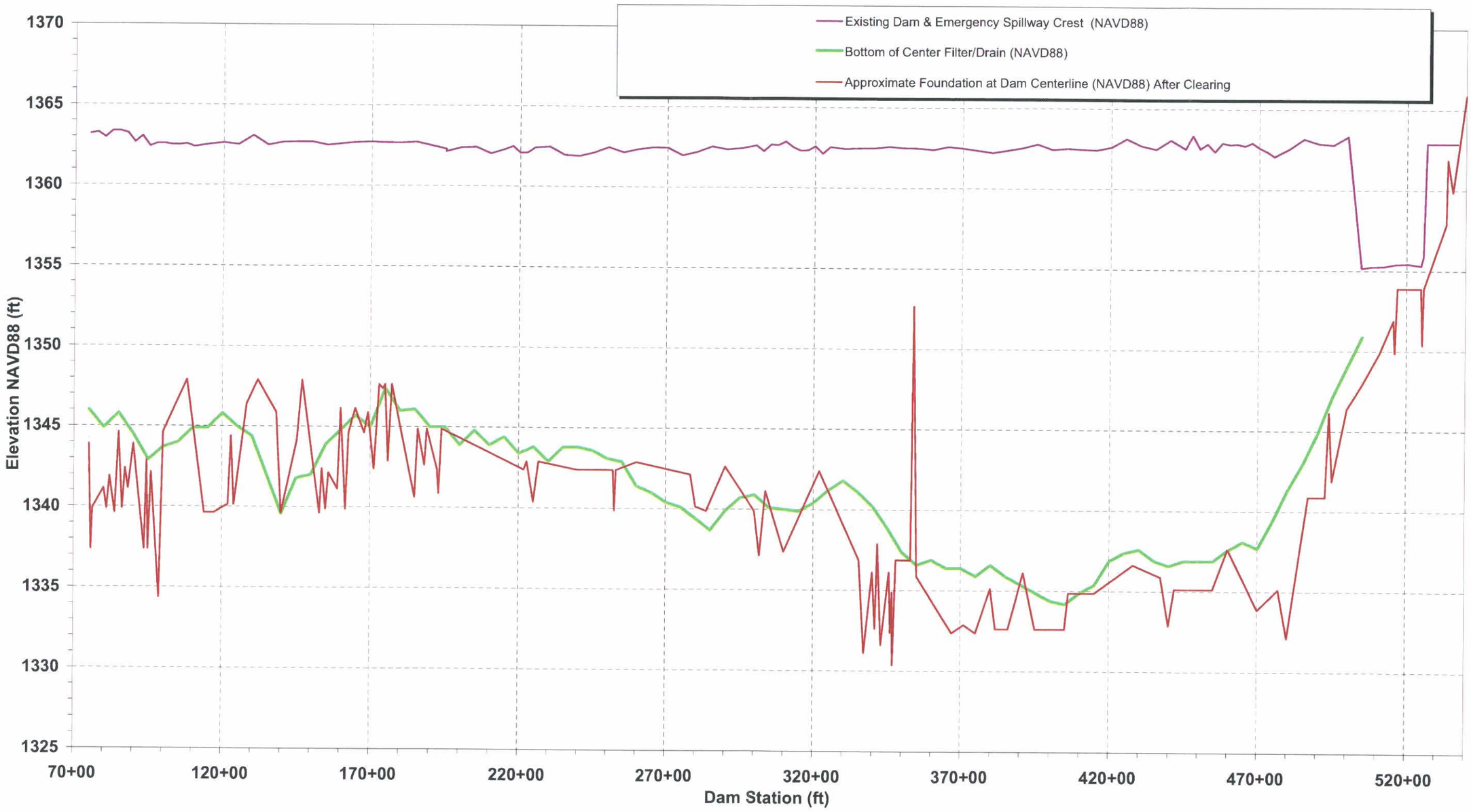


FIGURE GA-6.2A
Summary of McMicken Dam Embankment Moisture Content Data

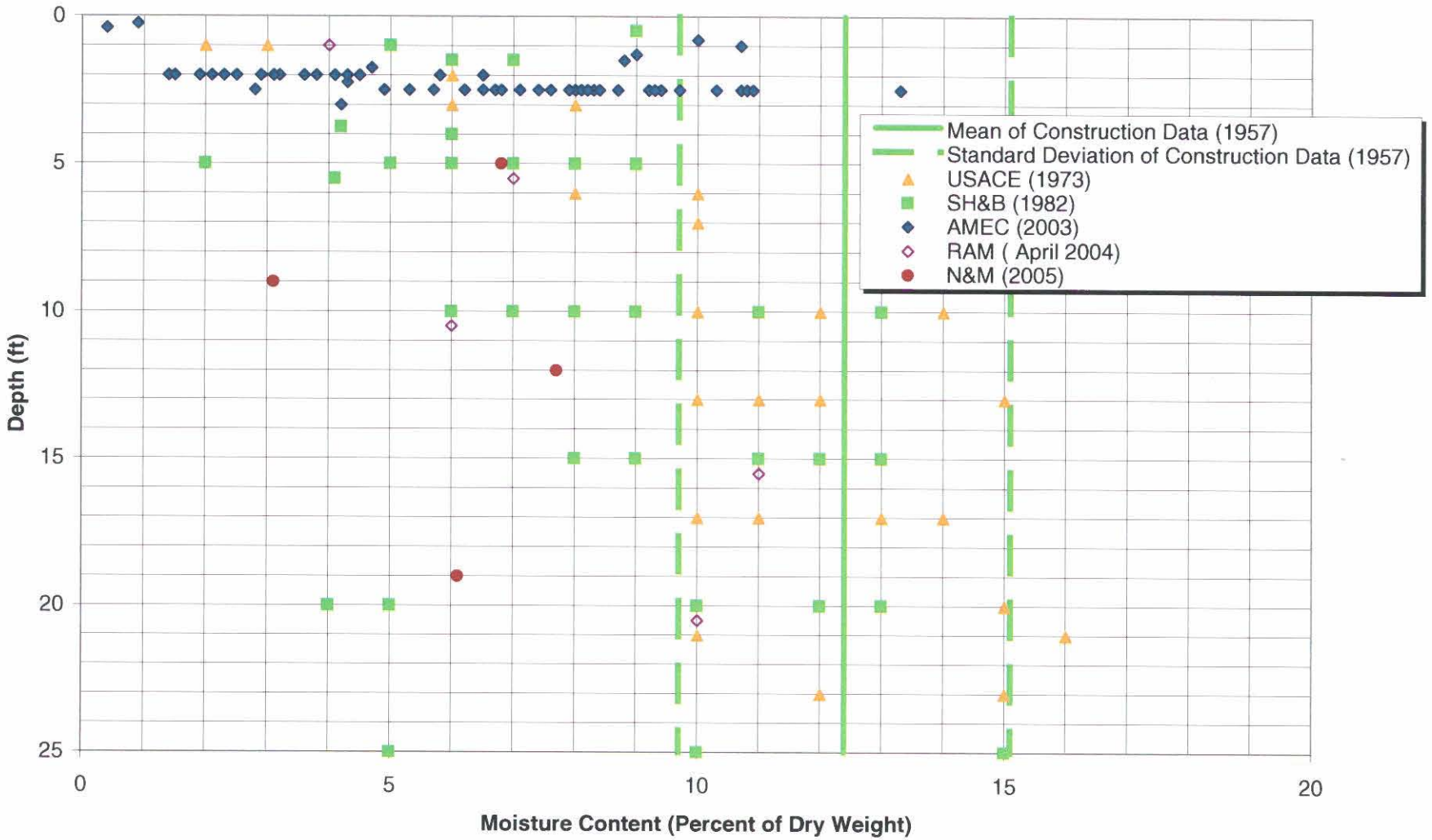


FIGURE GA-6.2B
McMicken Dam Embankment Material Properties

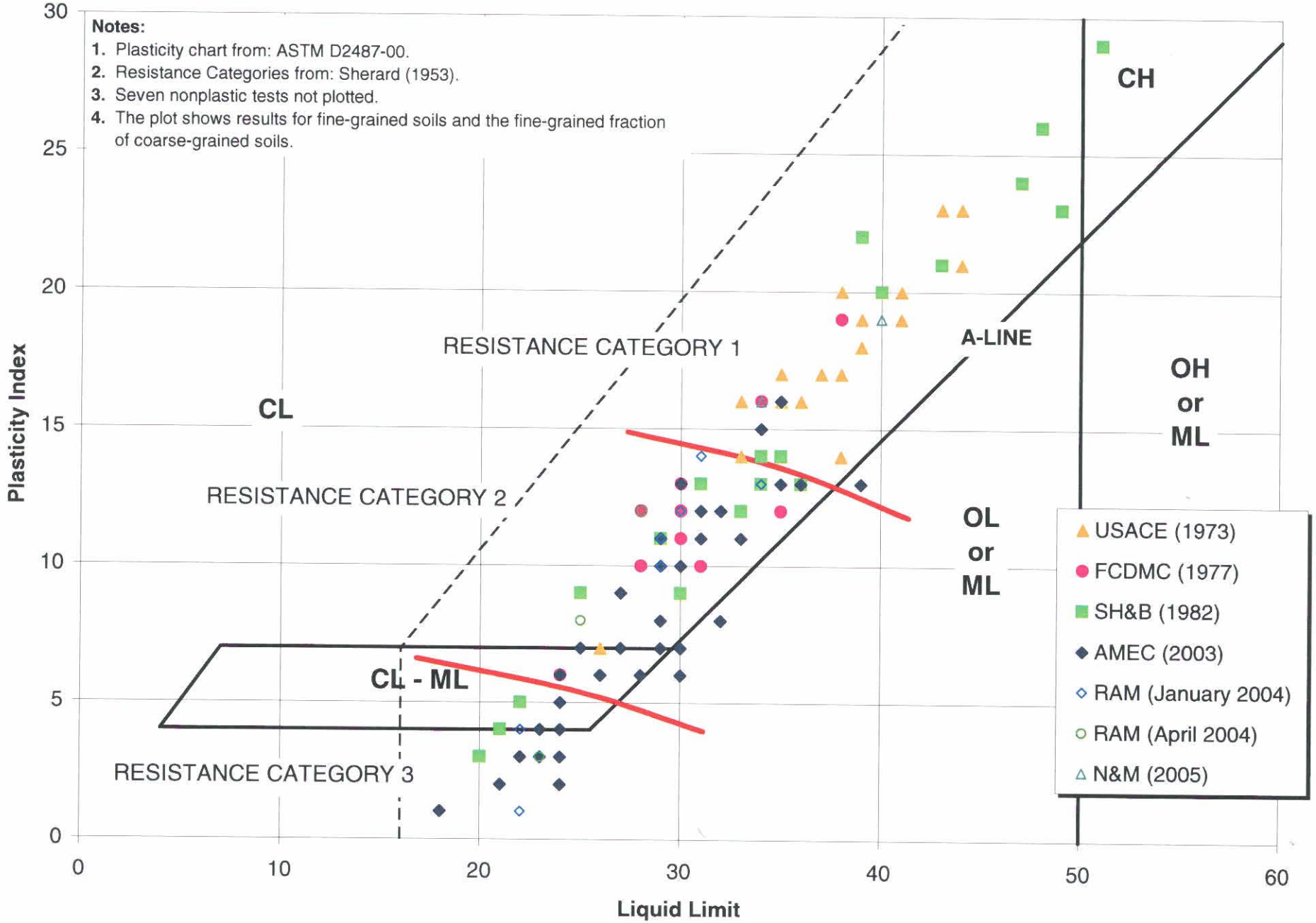


FIGURE GA-14.1.1A
Partially Penetrating Central Filter Failure Mode Cartoon
(from Tetra Tech, 2003)

	CRACK-RELATED FAILURE MODE	**Continuous leak along shrinkage/ settlement cracks through embankment beneath central filter and along embankment-foundation interface**

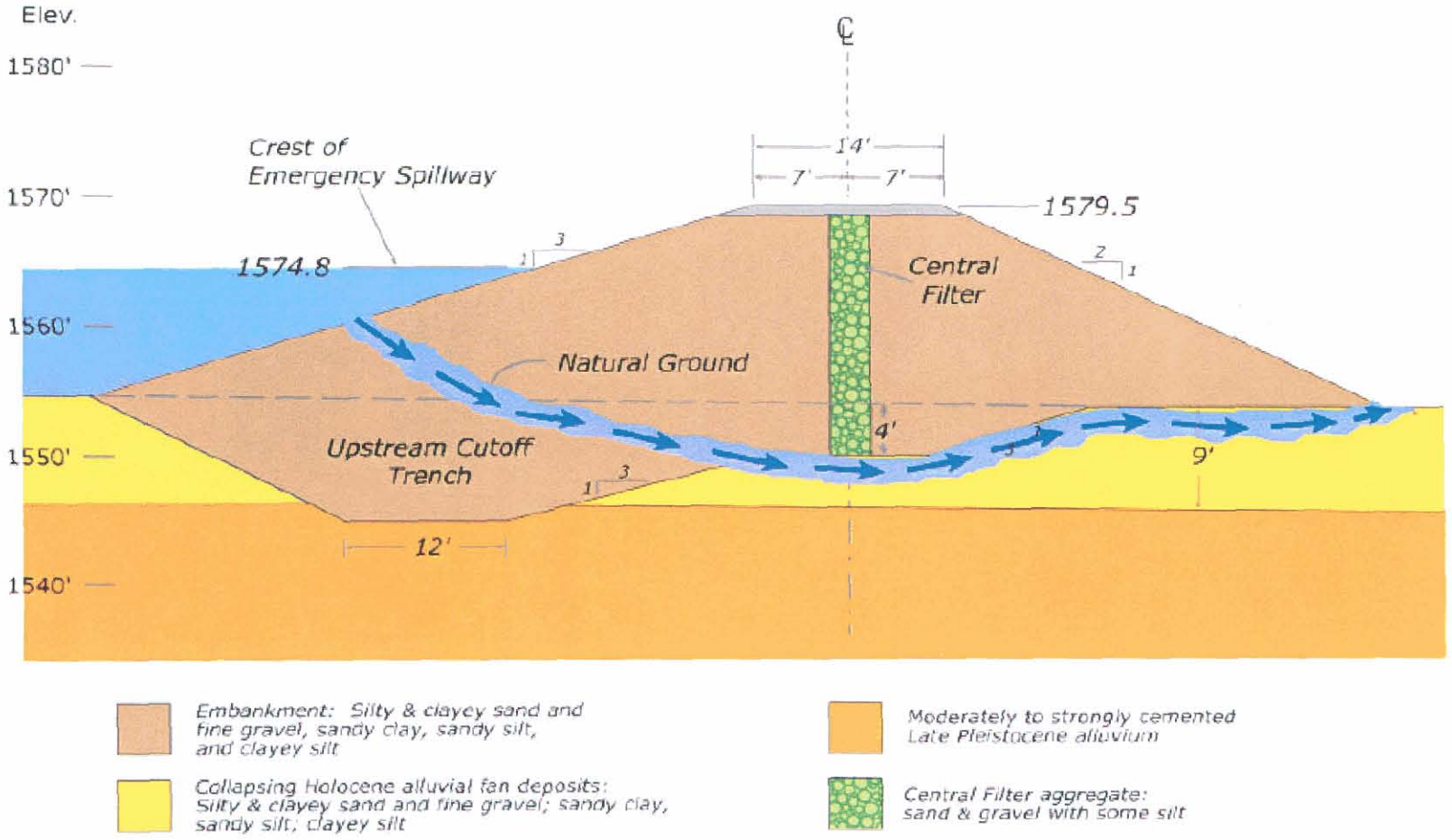


FIGURE GA-14.1.2A
Poor Foundation Conditions Failure Mode Cartoon
(from Tetra Tech, 2003)

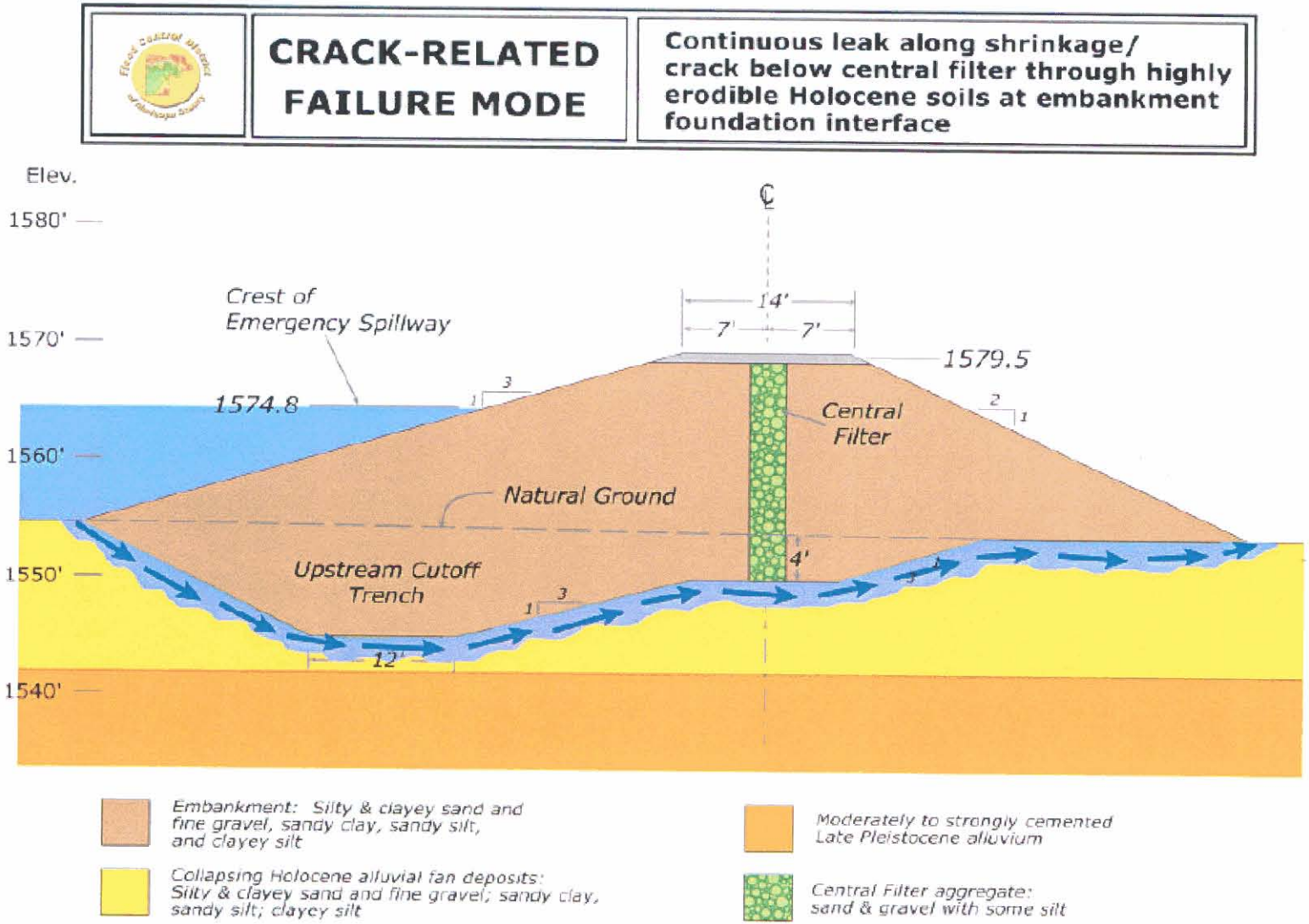


FIGURE GA-14.1.2B
Earth Fissure Failure Mode Cartoon No. 1
(from Tetra Tech, 2003)

	CRACK RELATED FAILURE MODE	**HYDRAULICS OF FLOW: ASSUMPTION A:** ♦ Erosion of Holocene soils by downward seepage into fissure creating gully extending beneath upstream slope ♦ Cracking and large deformations of upstream slope ♦ No seepage through dam

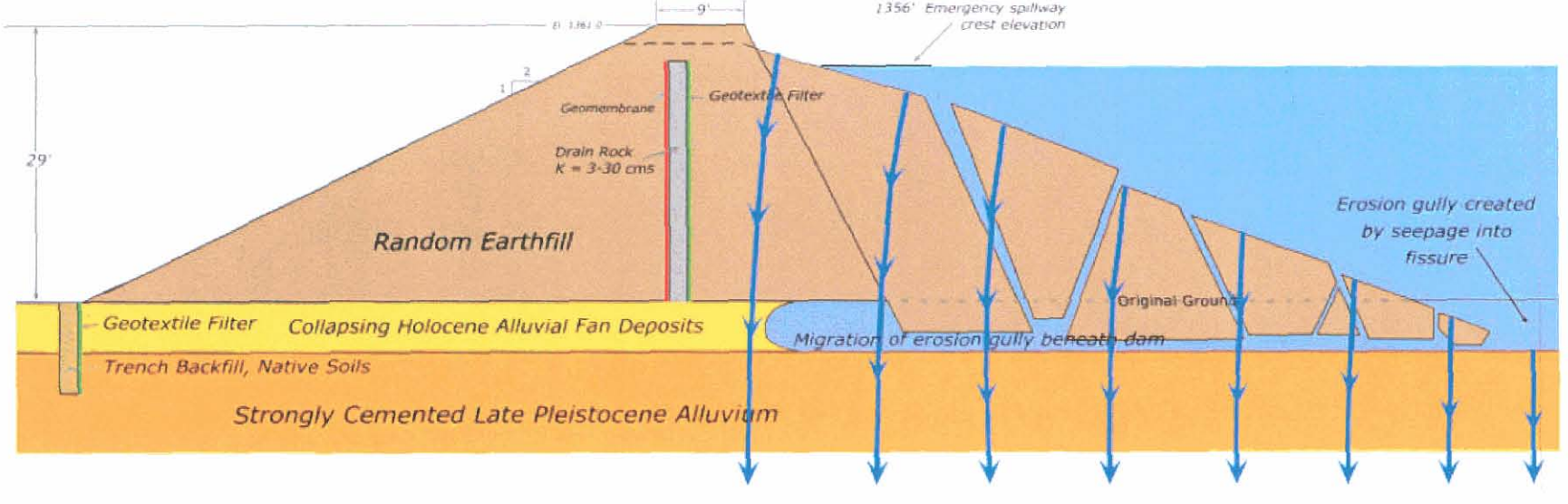


FIGURE GA-14.1.2C
Earth Fissure Failure Mode Cartoon No. 2
(from Tetra Tech, 2003)

	CRACK RELATED FAILURE MODE	**HYDRAULICS OF FLOW: ASSUMPTION A&B:** ♦ Erosion of Holocene soils by downward seepage into fissure creating gully extending beneath upstream slope ♦ Cracking and large deformations of upstream slope ♦ Lateral seepage erosion of embankment - Holocene soil interface to downstream toe

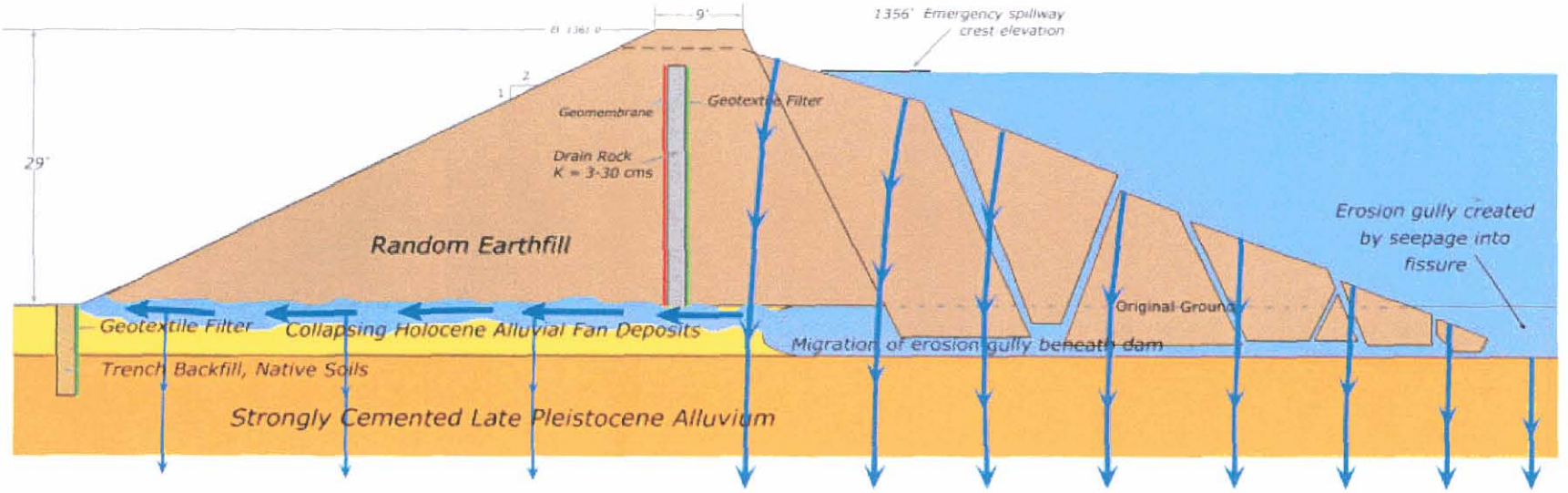


FIGURE GA-14.2.1.1A
Cracked Homogeneous Embankment Failure Mode Cartoon
(from Tetra Tech, 2003)

	CRACK-RELATED FAILURE MODE	**Continuous leak along shrinkage/ settlement cracks passing through homogeneous embankment**

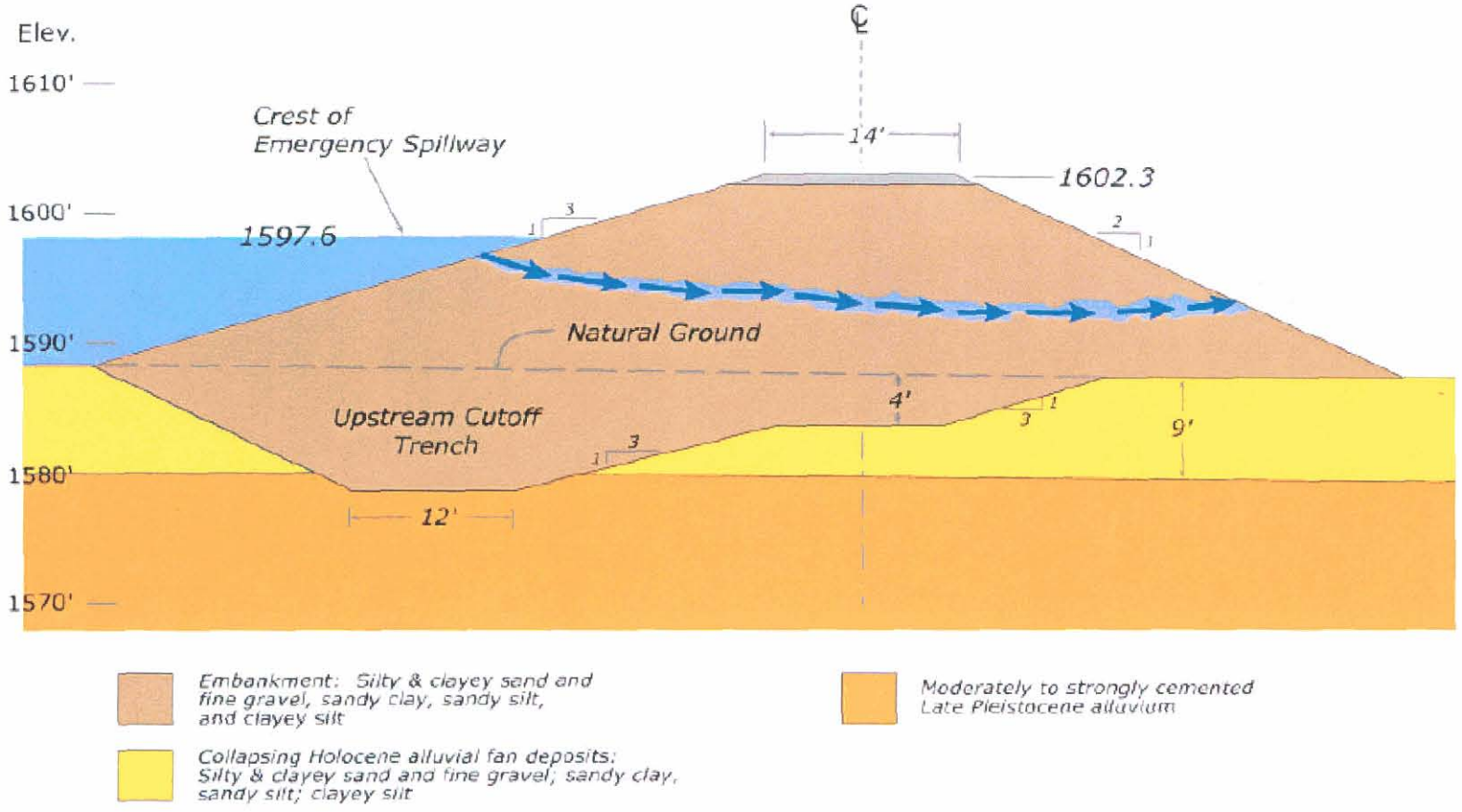
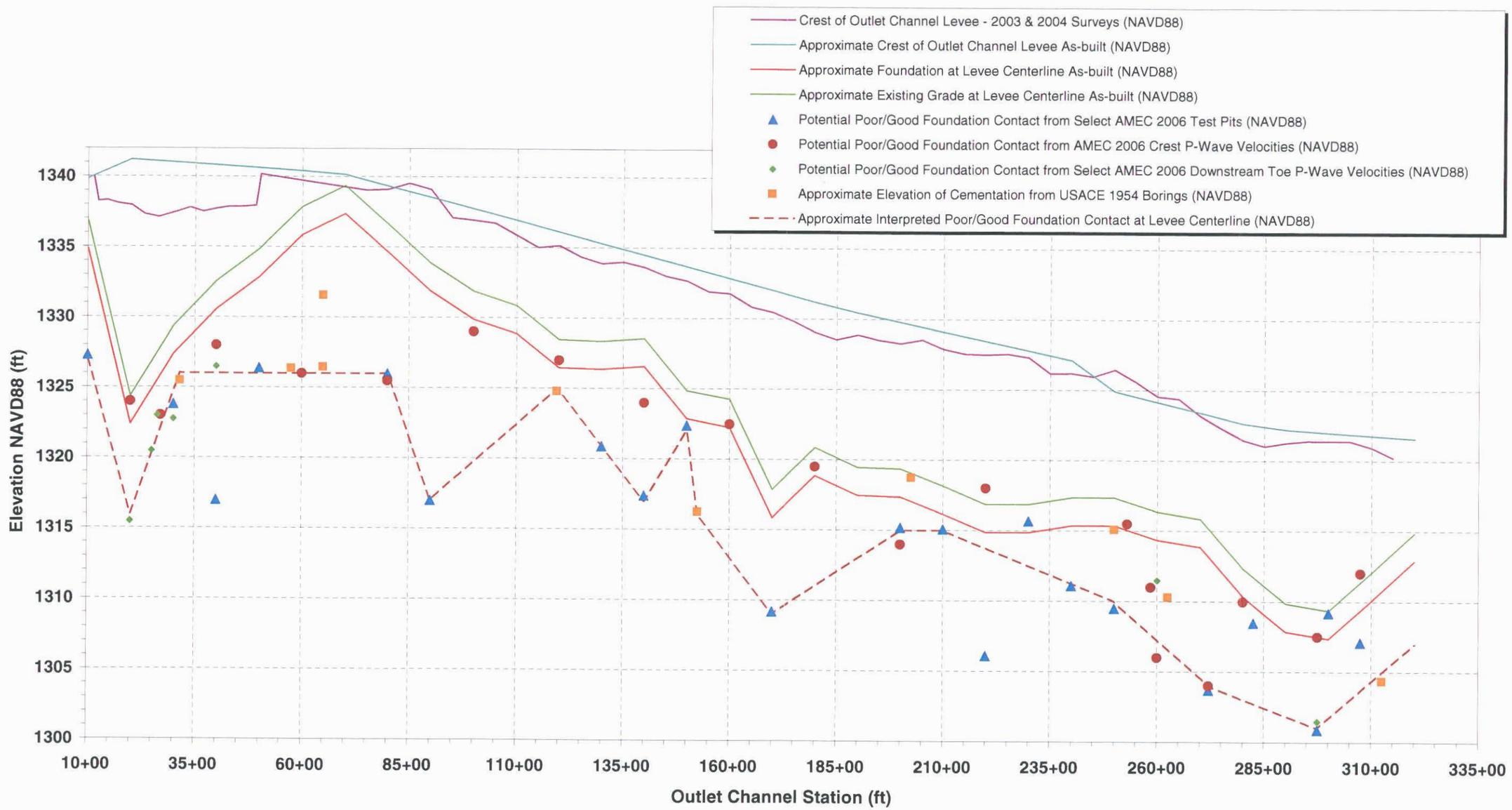
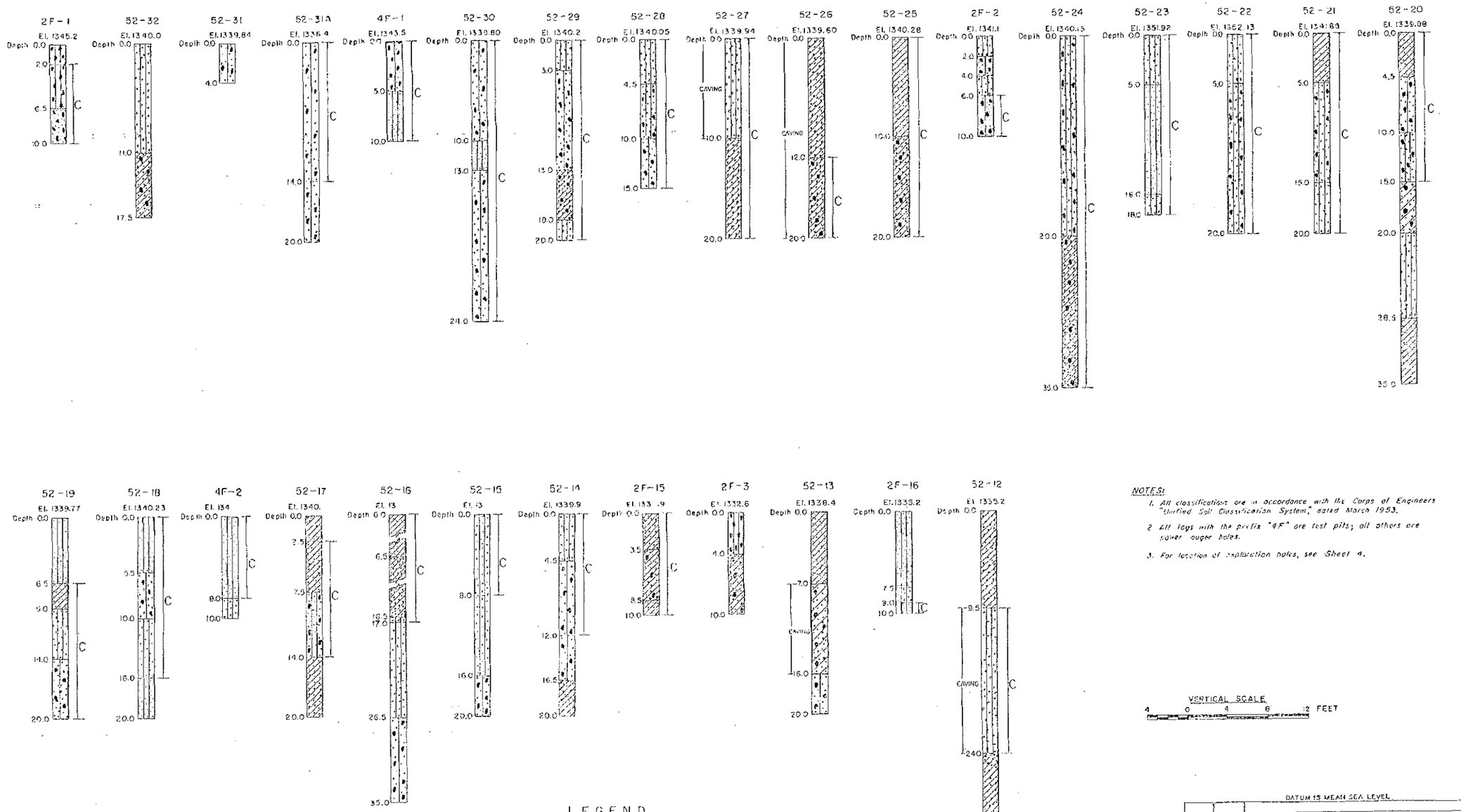


FIGURE GA-14.2.2A
McMicken Outlet Channel Levee Foundation Profile



APPENDIX A – INVESTIGATION LOGS

USACE GEOTECHNICAL INVESTIGATION (1954)



NOTES:

1. All classifications are in accordance with the Corps of Engineers "Unified Soil Classification System," dated March 1953.
2. All logs with the prefix "4F" are test pits; all others are power auger holes.
3. For location of exploration holes, see Sheet 4.

VERTICAL SCALE

4 0 4 8 12 FEET

LEGEND

- Sandy Gravel (GP)
- Silty Sandy Gravel (GM)
- Silty Gravel (GM)
- Silty Gravelly Sand (SM)
- Grav. Silty Sand (SM)
- Silty Sand (SM)
- Clayey Gravelly Sand (SC)
- Gravelly Clayey Sand (SC)
- Clayey Sand (SC)
- Sandy Silt (ML)
- Sandy Clay (CL)

"C" indicates the presence of caliche which is found in varying amounts and degrees of cementation.

RECORD DRAWING-AS CONSTRUCTED
CONT. NO. 4976 REV. ..... DATE 30 July 1964 BY No Change
CONT. NO. ..... REV. ..... DATE ..... BY .....
CONT. NO. ..... REV. ..... DATE ..... BY .....

ORIGINAL FILE NO. 126945
CHANGED 30 July 1964

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DATUM IS MEAN SEA LEVEL

REVISION	DATE	DESCRIPTION	BY	BY

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER

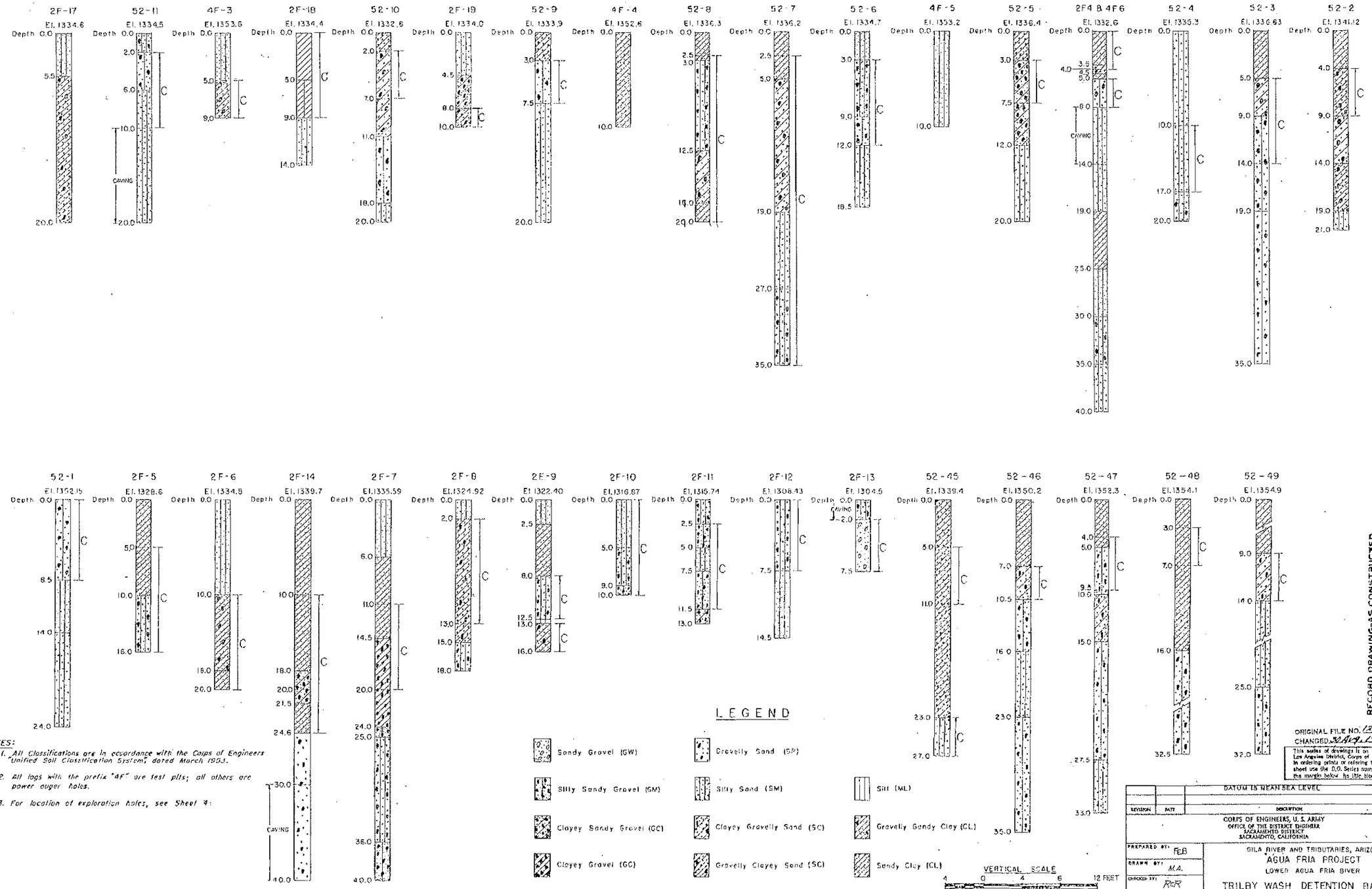
TRILBY WASH DETENTION BASIN
DAM AND APPURTENANCES
LOGS OF EXPLORATION HOLES

DESIGNED BY M.A.
DRAWN BY
CHECKED BY RCB
TRACED BY RB
SUBMITTED BY
CHIEF, DESIGN BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
CONCURRED: CHIEF, DIST. ENGR. SAC'TO DIST.
APPROVED: DISTRICT ENGINEER
COL., CORPS OF ENGRS. DIST. ENGR. L.A. DIST.

O.C.E. DWG NO. 86-02-01
DATE: FEB 14 64
SCALE: 1" = 4' Vert.
SPEC. NO.
FILE NO. SAC'TO. DIST. FILE NO. AF-9-27
SHEETS 1 to 25
SHEET NO. 5

TO ACCOMPANY SPECIFICATIONS ENG-04-353-65-141

FILE NO. (D.O. SERIES) 151/61



NOTES:

1. All Classifications are in accordance with the Corps of Engineers "Unified Soil Classification System" dated March 1953.
2. All logs with the prefix "4F" are test pits; all others are power auger holes.
3. For location of exploration holes, see Sheet 4.

RECORD DRAWING-AS CONSTRUCTED
CONT. NO. 1-5/7-16 REV. DATE 8/4/16 Sheet No Change
CONT. NO. ..... REV. ..... DATE ..... BY .....
CONT. NO. ..... REV. ..... DATE ..... BY .....
CONT. NO. ..... REV. ..... DATE ..... BY .....

ORIGINAL FILE NO. 1269-02
CHANGED 30 Aug. 1968

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DATUM IS MEAN SEA LEVEL

REVISION	DATE	DESCRIPTION	BY	BY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

PREPARED BY: FEB
DRAWN BY: M.A.
CHECKED BY: RCR
SUBMITTED BY: CHIEF, SOILS SECTION
APPROVED: CHIEF, DESIGN BRANCH
CHIEF, ENGINEERING DIVISION

GILA RIVER AND TRIBUTARIES, ARIZONA
AGUA FRIA PROJECT
LOWER AGUA FRIA RIVER

TRILBY WASH DETENTION BASIN
DAM AND APPURTENANCES
LOGS OF EXPLORATION HOLES

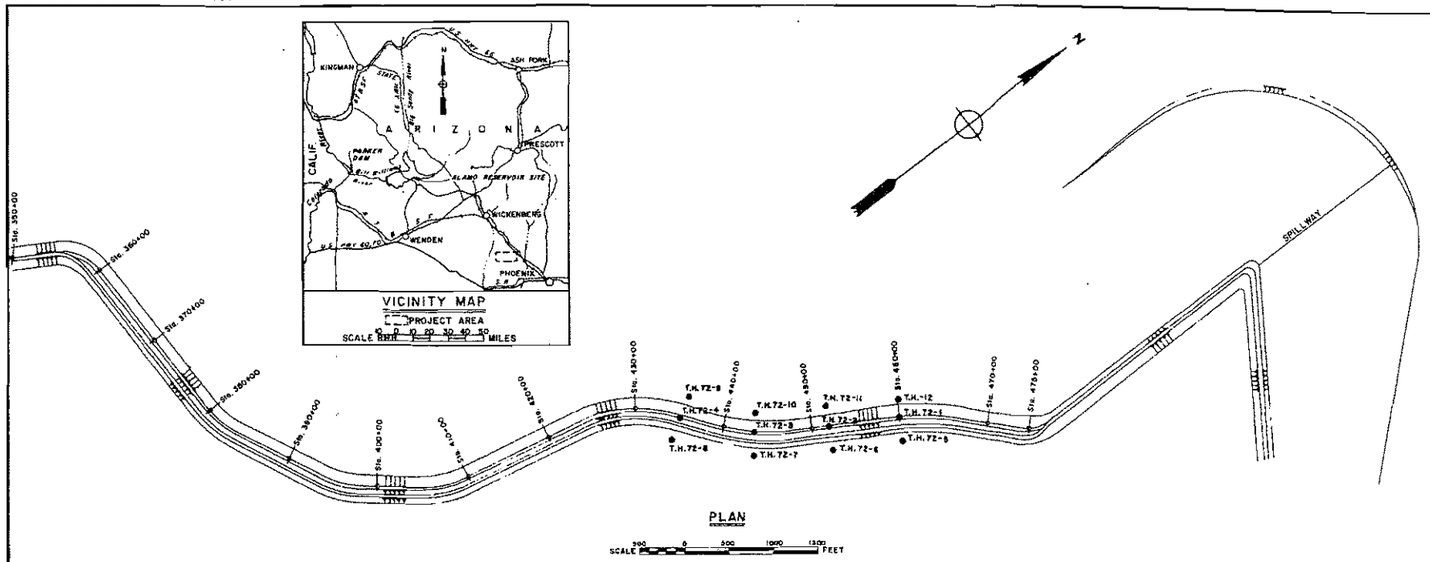
O.C.E. DWG. NO. 86-02-01

APPROVED: SOIL & P.M. BR. DIST. ENGR. SACTO. DIST.
APPROVED: SOIL, DSMP & MSA. DIST. ENGR. L.A. DIST.
DATE: FEB. 17, 1964
SCALE: 1"=4' Vert.
DATE:
FILE NO. SACTO. DIST. FILE NO. AF-9-27
SHEETS 1 to 25
SHEET NO. 6
DSC NO.

TO ACCOMPANY SPECIFICATIONS ENG-04-553-56-141

FILE NO. (DO. SERIES) 151/61

USACE GEOTECHNICAL INVESTIGATION (1973)



UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS More than half of material is larger than no. 200 sieve size.	GRAVELS More than half of coarse fraction is larger than no. 4 sieve size.	Clean gravels	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than no. 4 sieve size.	Clean sands	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly-graded sands, gravelly sands, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than half of material is smaller than no. 200 sieve size.	SILTS AND CLAYS	Low liquid limit	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts, with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
		High liquid limit	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
Highly organic soils			Pt	Peat and other highly organic soils.

NOTES:

1. Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.
2. All sieve sizes on this chart are U. S. Standard.
3. The terms "silt" and "clay" are used respectively to distinguish materials exhibiting lower plasticity from those with higher plasticity. The minus no. 200 sieve material is silt if the liquid limit and plasticity index plot below the "A" line on the plasticity chart (Table VI, Military Standard 619A), and is clay if the liquid limit and plasticity index plot above the "A" line on the chart.
4. For a complete description of the Unified Soil Classification System, see "Military Standard 619A" dated 20 March 1962.

LEGEND

T.H. — LOCATION AND NUMBER OF TEST HOLE (SEE PLATE 10).

M.C. — FIELD MOISTURE CONTENT IN PERCENT OF DRY WEIGHT.

L.L. — LIQUID LIMIT.

P.I. — PLASTICITY INDEX (LIQUID LIMIT MINUS PLASTIC LIMIT).

N.P. — NONPLASTIC

-#4 — PERCENT OF MATERIAL BY WEIGHT PASSING NO. 4 SIEVE.

-200 — PERCENT OF MATERIAL BY WEIGHT PASSING NO. 200 SIEVE.

N — NUMBER OF BLOWS OF A 140-POUND DROP-HAMMER FALLING 30 INCHES REQUIRED TO DRIVE A SAMPLING SPOON ONE FOOT. OUTSIDE DIAMETER OF SPOON IS 2 INCHES; INSIDE DIAMETER IS 1-3/8 INCHES. PROCEDURE IS CALLED STANDARD PENETRATION TEST.

W — DEPTH TO WATER

T.H. 72-1

Depth	Sym.	M.C.	L.L.	P.I.	-#4	-200	N
4.0'	SC	4	38	17	86	40	4
7.0'	CL	10	36	16	90	51	36
11.0'	SC	11	35	15	89	50	27
14.0'	CL	15	28	11	97	65	11
18.0'	SC	11	38	16	79	28	61
21.0'	SC	16	34	23	86	34	35
24.0'	SC	14	37	17	83	40	12
26.0'	ML CL	8	24	6	95	52	23
31.0'	CL	13	36	18	92	64	37
34.0'	SC	17	46	20	93	70	56
37.0'	CL	14	39	19	94	58	50+
41.0'	SM	14	38	18	96	58	62+
45.0'	SW SM	9		NP	100	28	50+
47.0'	SM	5		NP	65	6	58
		6		NP	75	32	50
		8		NP	100	43	1
		7		NP	94	40	1
		6		NP	98	47	1
61.0'		6		NP	91	30	1
65.5'	SW SM	3			93	12	50+
69.0'	SC	16	34	15	100	50	50+
72.0'	SM	7		NP	100	40	50+

EMBANKMENT

- 4.0' CLAYEY SAND, light brown, medium dense, gravel & cobbles to 5" max.
- SANDY CLAY, brown w/white caliche streaks, hard, gravel to 1" max.
- CLAYEY SAND, light brown, caliche streaks, gravel to 2" max.
- SANDY CLAY, brown, caliche streaks, very stiff.
- GRAVELLY CLAYEY SAND, light brown, dense, gravel to 2" max.
- CLAYEY SAND, brown, dense, gravel to 2" max.
- GRAVELLY CLAYEY SAND, brown, medium dense, gravel to 2" max.
- SANDY SILT-SANDY CLAY, brown, dense, gravel to 1" max.
- SANDY CLAY, light brown to tan, some caliche, gravel to 2" max.
- CLAYEY SAND, brown with tan caliche, gravel to 2" max.
- SANDY CLAY, light brown w/dark brown tension, gravel to 1" max.
- SILTY SAND, light brown, cemented, 2-4" cobbles.
- GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 2" max.
- GRAVELLY SILTY SAND, tan, cemented with caliche, gravel & cobbles to 4" max.
- SILTY SAND, light brown w/brown & black streaks, very hard, gravel to 2 1/2" max.
- SAND-SILTY SAND, tan, gravel & cobbles to 4" max., caving.
- CLAYEY SAND, light brown, very hard.
- SILTY SAND, light brown, cemented, very dense.

T.H. 72-2

Depth	Sym.	M.C.	L.L.	P.I.	-#4	-200	N
3.0'	SC	6	35	19	91	45	
	CL	9	35	16	94	56	50
11.0'		12	26	7	98	69	50+
14.0'	SM	10		NP	94	47	50+
18.0'	SC	13	41	22	83	34	50+
21.0'	CL	15	32	16	98	59	77
23.0'	SC	17	33	15	92	47	16
27.0'	ML	8		NP	55	59	16
31.0'	SM	10		NP	81	41	17
33.0'	SW SM	8		NP	78	28	16
35.5'	SW SM	9		NP	65	10	25
38.0'	CL	5	35	15	95	56	39
41.0'	ML	16		NP	100	65	50+
	SM	11		NP	96	47	50+
46.0'		8			92	13	50+
48.5'	SW SM	8			83	7	50+
52.0'	SM	15		NP	94	47	50+
55.0'	SW SM	8		NP	68	8	50+
59.0'	SC	8	38	18	92	36	50+
		7		NP	95	28	50+
66.0'	SM	6		NP	88	13	50+
69.0'	CL	12	36	18	98	56	50+

EMBANKMENT

- 3.0' CLAYEY SAND, light brown, caliche cemented, gravel to 1 1/2" max.
- SANDY CLAY, light brown to brown w/gray streaks, very hard, gravel to 1 1/2" max.
- SILTY SAND, brown, very dense, gravel to 1" max.
- GRAVELLY CLAYEY SAND, brown w/white streaks, dense, gravel to 1" max.
- SANDY CLAY, brown, very stiff.
- CLAYEY SAND, tan & light brown, medium dense, gravel to 2" max.
- SANDY SILT, brown, medium dense, gravel to 1 1/2" max.
- SILTY SAND, brown, medium dense, gravel to 1 1/2" max.
- GRAVELLY SILTY SAND, brown, medium dense, gravel to 2" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, medium dense, gravel & cobbles to 4" max.
- SANDY CLAY, light brown, very stiff, gravel to 1 1/2" max.
- SANDY SILT, tan, very dense, cemented.
- SILTY SAND, tan to brown, very dense, gravel to 2" max.
- SAND-SILTY SAND, light brown, very dense, gravel to 2" max.
- SILTY SAND, tan, cemented, hard to drill, gravel to 3" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 3" max., caving.
- CLAYEY SAND, tan w/white and black streaks, very hard, gravel to 2" max.
- SILTY SAND, light brown, cemented, very dense, gravel & cobbles to 6" max.
- SANDY CLAY, light tan w/brown & white streaks, very hard drilling.

T.H. 72-3

Depth	Sym.	M.C.	L.L.	P.I.	-#4	-200	N
2.0'	SM	2		NP	93	41	
5.0'	ML	6		NP	97	55	50+
10.0'	CL	10	38	17	85	56	50+
		14	35	17	94	67	
14.0'		11	40	20	89	36	39
17.0'	SC	10	44	21	73	35	35
		13	39	19	89	47	26
25.0'		15	43	23	89	45	26
		15	40	18	88	48	31
27.0'	CL	11	37	12	97	67	17
30.0'	ML CL	10	29	6	94	53	18
32.0'	CL	11	35	15	91	51	25
34.0'	SC	9	38	19	65	27	25
36.0'	SM	6		NP	63	13	25
		6		NP	60	16	28
39.0'	SP SM	6		NP	68	8	50
41.0'		12		NP	98	48	50+
		11		NP	97	38	50+
	SM	11		NP	96	49	50+
		12	38	5	94	36	1
58.0'		8		NP	89	20	50+
61.0'		7		NP	79	18	50+
64.0'	SP SM	5		NP	62	9	50+
71.0'	SM	6		NP	90	14	50+
		6		NP	92	15	50+
75.0'	CL	18	36	14	96	53	1

EMBANKMENT

- 2.0' SILTY SAND, tan, dense, gravel to 1/2" max., 1-5" cobble.
- SANDY SILT, brown, dense and cemented, gravel to 2" max.
- SANDY CLAY, brown, very dense & cemented, gravel to 3" max.
- CLAYEY SAND, brown, dense, gravel to 2" max.
- GRAVELLY CLAYEY SAND, tan, medium dense, gravel to 2" max
- CLAYEY SAND, tan, medium dense, gravel to 1" max., several cobbles to 6" max.
- SANDY CLAY, light brown, very stiff.
- SANDY SILT-SANDY CLAY, brown, stiff to very stiff.
- SANDY CLAY, tan w/white caliche streaks, gravel to 2" max.
- CLAYEY GRAVELLY SAND, tan, dense, gravel to 2" max.
- SILTY GRAVELLY SAND, tan, dense, gravel & cobbles to 4" max.
- SILTY SAND, light brown, medium to dense, gravel to 1" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 2" max.
- SILTY SAND, tan to light brown, dense to very dense & highly cemented, gravel to 2" max.,
- dense, gravel to 1 1/2" max.
- SILTY GRAVELLY SAND, light brown & gray, very dense, gravel to 2" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max.
- SILTY SAND, brown, very dense, gravel to 3" max
- SANDY CLAY, tan, very hard, slow drilling.

T.H. 72-4

Depth	Sym.	M.C.	L.L.	P.I.	-#4	-200	N
3.0'	SC	3	35	16	82	36	1
5.0'		8	36	20	89	41	
8.0'	CL	8	33	14	92	61	1
11.0'	SC	10	41	19	85	40	65
15.0'	CL	12	43	23	91	58	1
		14	39	18	85	47	65
22.0'	SC	10	37	17	89	48	26
25.0'	CL	10	38	18	91	58	24
		8	40	17	92	56	28
		12	44	18	94	51	32
30.0'	SW SM	3		NP	69	11	50+
32.0'	SW SM	2		NP	89	11	50+
35.0'							26
36.5'	CL	11	31	12	96	53	19
40.0'	SM	10		NP	98	48	50+
42.0'	SW SM	6		NP	76	12	50+
		10		NP	100	43	50+
48.0'	SM	9		NP	100	46	50+
52.0'	ML	12		NP	100	51	50+
		12		NP	100	36	1
59.0'	SM	9		NP	94	22	1
63.0'	SC	10			88	11	50+
67.0'	SP SM	5			97	8	50+
	SW SM	3			75	6	50+
		3			82	9	50+

EMBANKMENT

- 3.0' GRAVELLY CLAYEY SAND, tan, caliche cemented, gravel to 2" max.
- CLAYEY SAND, brown, slight cementation, gravel to 1" max.
- SANDY CLAY, tan w/white cementation, gravel to 2" max.
- CLAYEY SAND, tan w/white cementation, gravel to 2" max.
- SANDY CLAY, brown, hard, gravel to 2" max.
- CLAYEY SAND, dark brown, slightly cemented, gravel to 3" max.
- SANDY CLAY, brown to tan, cemented zones, gravel to 2" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 2" max
- SAND-SILTY SAND, brown, dense to medium dense, gravel to 2" max., caving.
- SANDY CLAY, brown, very stiff.
- SILTY SAND, brown, cemented, gravel to 1/2" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 1 1/2" max.
- SILTY SAND, tan w/white caliche cementation, gravel to 1" max.
- SANDY SILT, tan, cemented, gravel to 1" max.
- SILTY SAND, light brown, highly cemented, gravel to 2" max.
- SAND-SILTY SAND, brown & gray, very dense, gravel to 2" max.
- GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max

LOGS

VERT. SCALE FEET

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK
DRAWN BY: L.L.W.
CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

LOCATIONS AND LOGS OF TEST HOLES

SUBMITTED BY:
DATE:
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET

D. O. SERIES

PLATE 8

T.H. 72-5

Depth	Class	MC	LL	PI	-4	-200	N	Description
4.0'	SM	3		NP	90	27	9, 5	SILTY SAND, tan, loose, gravel to 3" max.
6.0'	SC	7	35	12	84	44	6, 50	CLAYEY SAND, tan, loose to medium dense, gravel to 1/2" max.
8.0'	SC	6	34	13	81	42	60+	GRAVELLY CLAYEY SAND, tan, caliche cemented, gravel to 3" max.
10.0'	SC	5	35	13	86	29	38, 18	CLAYEY SAND, tan, dense to medium dense, gravel to 2" max. 1-5" cobble
12.5'	ML	9		NP	95	52	18	SANDY SILT, tan, medium dense.
16.0'	CL	12	32	10	100	62	60+, 52	SANDY CLAY, tan, caliche cemented.
	SM	12			100	40	60+, 37	SILTY SAND, brown, dense to medium dense.
	SM	6			100	27	13, 21	
24.0'	SM	7			96	13	18, 30	
27.0'	SW-SM	3			87	9	33, 36	SAND-SILTY SAND, brown & gray, dense, gravel & cobbles to 4" max., caving.
31.0'	SC	10	39	17	100	46	X, X	CLAYEY SAND, tan w/black streaks, very hard drilling.
	SM	10		NP	100	35	60+, 60+	SILTY SAND, tan to brown, highly cemented, a few gravels to 2" max.
	SM	10		NP	100	35	60+, 60+	
41.0'	SM	12		NP	100	40	60+	
	SW-SM	10			84	10	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
47.0'	SW-SM	4			74	9	60+, 60+	
51.0'	SC	27	38	14	95	31	20, 33	CLAYEY SAND, brown, stiff to very hard, gravel to 1 1/2" max., very wet at 47 feet.
54.0'	SW-SM	14			91	12	60+, 60+	SAND-SILTY SAND, brown, very dense, wet, gravel to 2" max.

T.H. 72-6

Depth	Class	MC	LL	PI	-4	-200	N	Description
	SM	3		NP	84	42	37, 19	GRAVELLY SILTY SAND, tan, dense to medium dense, gravel & cobbles to 4" max.
7.0'	SM	4		NP	79	22	18, 18	
11.0'	SM	4		NP	72	20	25, 29, 24	SILTY GRAVELLY SAND, tan, medium dense, gravel to 3" max.
14.0'	SM	6		NP	88	34	36, 24	SILTY SAND, light brown, dense to medium dense, gravel to 2" max.
16.5'	CL	17	33	13	100	71	39, 58	SANDY CLAY, tan w/white caliche streaks, gravel to 2" max.
18.0'	ML	17		NP	100	62	60+	SANDY SILT, light brown, cemented.
22.0'	SM	9		NP	100	32	60+	SILTY SAND, light brown, very dense & cemented.
25.5'	SW-SM	5		NP	82	9	55, 34, 50	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, dense, gravel to 3" max.
29.0'	SM	12		NP	84	38	60+, 60+	GRAVELLY SILTY SAND, light brown, cemented, gravel to 1" max.
	SM	12	43	16	100	47	X, X, X	SILTY SAND, tan, highly cemented, very hard
	SM	12	36	9	100	45	60+, 60+, 60+	
40.0'	SM	15		NP	95	31	60+, 60+	gravel to 2" max.
42.0'	SM	16		NP	65	15	60	SILTY GRAVELLY SAND, light brown, very dense, gravel to 3" max.
43.5'	SW-SM	20		NP	88	9	58	SAND-SILTY SAND, brown, very dense, very wet.
45.0'	CL	20	38	16	100	55	60+	SANDY CLAY, tan w/white, very hard

T.H. 72-7

Depth	Class	MC	LL	PI	-4	-200	N	Description
	SM	4		NP	90	47	7, 5	SILTY SAND, tan, loose, gravel & cobbles to 5" max.
7.0'	SM	4		NP	90	40	1, 5	
10.0'	CL	5	35	12	89	51	15, 53	SANDY CLAY, tan, cemented, gravel to 1 1/2" max.
11.0'	SC	6	36	14	60	20	60+	CLAYEY GRAVELLY SAND, tan, dense, gravel & cobbles to 6" max.
	SW-SM	4		NP	76	12	22, 32, 36	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel & cobbles to 5" max., caving.
	SW-SM	4		NP	65	11	21	
19.5'	SW-SM	8		NP	76	11	33, 33	
21.0'	SC	6	28	6	89	35	60+	CLAYEY SAND, brown, hard, gravel to 1" max.
25.0'	SM	10		NP	100	35	60+, 60+	SILTY SAND, brown, cemented.
29.0'	CL	17	44	18	97	55	60+, 60+, X	SANDY CLAY, tan w/white streaks, cemented.
	SM	13		NP	91	38	X, 60+	SILTY SAND, tan to brown, cemented, gravel to 2" max.
	SM	8		NP	90	24	60+, 60+	
39.0'	SM	5			92	15	42, 53	
42.0'	SW-SM	4			76	7	60, 58, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 2 1/2" max.
46.0'	SW-SM	5			92	8	58, 60	SAND-SILTY SAND, brown, very dense, gravel & cobbles to 5" max.
49.0'	SW-SM	5			83	10	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max.
51.0'	SW-SM	19			86	12	60+	SAND-SILTY SAND, brown, very dense, wet, gravel & cobbles to 5" max.
54.0'	SC	16	35	15	96	46	60+, 60+	CLAYEY SAND, brown, cemented, moist.

T.H. 72-8

Depth	Class	MC	LL	PI	-4	-200	N	Description
3.0'	SC	2	34	12	85	33	5, 5	CLAYEY SAND, tan, loose, gravel to 1 1/2" max.
5.5'	CL	10	33	11	96	65	9	SANDY CLAY, brown, stiff.
8.5'	SC	8	38	14	86	48	23, 33	CLAYEY SAND, tan, dense, gravel to 1 1/2" max.
11.0'	SC	5	39	20	68	15	56, 25	CLAYEY GRAVELLY SAND, brown, dense to medium dense, gravel to 2 1/2" max.
14.5'	SW-SC	5	42	24	82	12	25, 26	GRAVELLY SAND-CLAYEY GRAVELLY SAND, red-brown, medium dense, gravel to 1 1/2" max.
16.0'	CL	13	29	11	88	56	16, 50	SANDY CLAY, brown, hard, gravel to 2" max.
	SM	11		NP	93	38	56, 60+	SILTY SAND, brown to light brown, very dense, gravel to 2" max.
24.0'	SM	10		NP	92	38	55, 60+, 60+	
29.0'	ML	11		NP	94	56	X, 60+, 60+	SANDY SILT, light brown, cemented, gravel to 1 1/2" max.
31.0'	CL	22	39	18	100	68	60+, 60+	SANDY CLAY, light brown, cemented.
34.0'	ML	15	47	16	100	52	X	SANDY SILT, tan, highly cemented
37.0'	SM	11		NP	85	24	X, X, 60+	SILTY SAND, light brown, very hard, gravel & cobbles to 5" max.
	SW-SM	5		NP	86	11	60+, 60+, 60+	SAND-SILTY SAND, brown, very dense, gravel & cobbles to 6" max., caving.
44.0'	SW-SM	4			96	9	60+	
46.0'	SM	12		NP	92	29	60+	SILTY SAND, brown, cemented, gravel to 2" max.
	SW-SM	7			77	11	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max
52.0'	SW-SM	3			84	9	60+	
54.0'	SM	17		NP	100	27	60+, 60+	SILTY SAND, brown, cemented lenses.

T.H. 72-9

Depth	Class	MC	LL	PI	-4	-200	N	Description
2.0'	ML	8	37	11	93	63	34	SANDY SILT, red-brown, dense, gravel & cobbles to 4" max.
5.0'	SM	10	41	15	92	44	47, 60+	SILTY SAND, tan w/white cementation, gravel to 1/2" max.
8.8'	SW-SM	6		NP	84	10	48, 54	GRAVELLY SAND-SILTY GRAVELLY SAND, red-brown, dense, gravel to 3" max.
11.0'	CL	15 / 10	33 / 35	19 / 15	97 / 80	52 / 52	60+, 60+	SANDY CLAY, brown, very hard, gravel & cobbles to 5" max.
14.0'	SC	16	35	15	88	36	60+, 60+	CLAYEY SAND, light brown, very dense & cemented, gravel to 1/2" max.
17.0'	SC	7	37	16	69	16	60+, X	CLAYEY GRAVELLY SAND, brown, very dense & cemented, gravel & cobbles to 4" max.
	SM	11		NP	100	36	60+, 60+, 60+	SILTY SAND, tan, very dense & cemented.
23.0'	SM	17		NP	100	42	60+	
	ML	14	48	16	100	53	60+, 60+, 60+	SANDY SILT, tan w/brown cementation, hard to drill.
31.0'	ML	14	45	14	100	52	60+, 60+, 60+	
33.0'	SC	10	46	26	91	29	X	CLAYEY SAND, tan, highly cemented, gravel to 1" max.
36.0'	SW-SM	8			71	11	X, X	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel & cobbles to 5" max., caving.
	SW-SM	6			97	6	60+, 60+	SAND-SILTY SAND, very dense, gravel & cobbles to 8" max., caving.
42.0'	SW-SM	3			99	5	60+, 60+	
	SW-SM	7			88	10	60+, 60+	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, very dense, gravel to 3" max.
48.0'	SW-SM	5			80	12	60+, 60+	
50.0'	SM	8		NP	96	37	60+	SILTY SAND, brown, cemented.

T.H. 72-10

Depth	Class	MC	LL	PI	-4	-200	N	Description
	CL	4	26	8	94	52	25, 17	SANDY CLAY, tan, caliche cementation, gravel to 1 1/2" max.
5.0'	CL	7	30	14	96	54	14	
	SC	8	41	19	75	26	36, 52	CLAYEY GRAVELLY SAND, tan, medium to very dense, gravel & cobbles to 6" max
9.0'	SC	6	30	15	61	17	58	
11.0'	SW-SC	5	38	18	73	12	54	GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, very dense, gravel to 3" max.
13.0'	CL	12	34	16	97	52	60+	SANDY CLAY, tan, caliche cemented.
15.0'	SC	12	30	11	93	33	55, 60+	CLAYEY SAND, brown, very dense.
19.0'	ML	14		NP	96	54	60+, 60+	SANDY SILT, light brown, highly cemented & hard to drill
23.0'	CL	14	42	22	100	55	60+, 60+, 60+	SANDY CLAY, light brown, highly cemented, hard to drill.
27.0'	SC	11	42	17	95	45	60+, 60+, 60+	CLAYEY SAND, tan, highly cemented, hard drilling.
	SM	14		NP	100	49	60+, 60+	SILTY SAND, light brown, highly cemented, gravel to 1" max.
32.0'	SM	8		NP	95	16	50	
	SW-SM	4			79	6	48, 56	GRAVELLY SAND-SILTY GRAVELLY SAND, brown to light brown, very dense, gravel to 3" max.
	SW-SM	5			67	8	45, X	
42.0'	SW-SM	5			74	7	60+, X, X	
45.0'	SW-SM	4			86	9	60+, 60+	SAND-SILTY SAND, brown, very dense, gravel to 2" max.
49.0'	SP-SM	5			86	6	60+, 60+	
51.0'	SC	8	31	11	94	32	60+, X	SILTY SAND, brown, very dense, hard to drill.

T.H. 72-11

Depth	Class	MC	LL	PI	-4	-200	N	Description
3.0'	ML	5		NP	86	67	36, 41	SANDY SILT, tan, dense, gravel to 1 1/2" max.
5.0'	SM	5		NP	95	41	30	SILTY SAND, tan, dense, 1-4" cobble.
7.0'	SM	3		NP	78	17	22, 11	SILTY GRAVELLY SAND, light brown, medium dense, gravel to 3" max.
11.0'	SM-SC	4	21	5	77	13	8, 7	SILTY GRAVELLY SAND-CLAYEY GRAVELLY SAND, brown, loose, gravel to 2" max.
14.0'	SP-SM	5	20	2	77	12	15, 35	GRAVELLY SAND-SILTY GRAVELLY SAND, brown, medium to dense, gravel to 3" max.
16.0'	CL	20	30	9	100	60	30	SANDY CLAY, brown, dense.
18.0'	SM	7			95	16	53, 55	SILTY SAND, brown, dense, gravel to 1" max.
22.0'	SW-SM	4			95	10	36, 35, 30	SAND-SILTY SAND, light brown, gravel to 2" max.
	SM	17	37	12	95	42	60+, 60+, 60+	SILTY SAND, light brown, very dense, gravel to 2" max.
28.0'	SM	12		NP	88	35	60+	
30.0'	SC	11	38	14	80	19	X	CLAYEY GRAVELLY SAND, tan, caliche cemented, gravel to 2 1/2" max.
31.5'	SM	9		NP	74	16	X	SILTY GRAVELLY SAND, light brown, dense, gravel & cobbles to 5" max.
35.0'	SM	12		NP	90	27	X, 60+	SILTY SAND, light brown, highly cemented.
37.0'	SC	10	27	8	88	26	60+	CLAYEY SAND, light brown, cemented, gravel to 2 1/2" max.
38.0'	SW-SM	7			96	6	60+	SAND-SILTY SAND, light brown, dense
40.0'	SW-SM	4			70	7	60+	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, very dense, gravel to 3" max.
43.0'	SM	10		NP	100	36	X, X	SILTY SAND, brown, highly cemented, hard drilling.
46.0'	CL	19	36	14	100	68	60+, 60+	SANDY CLAY, brown, very hard drilling.
49.0'	GC	14	31	12	55	24	60+, X	CLAYEY SANDY GRAVEL, brown, very hard, gravels are caliche clods.
51.0'	SC	14	26	7	52	18	X, X	CLAYEY GRAVELLY SAND, brown, cemented, gravels are caliche clods.

T.H. 72-12

Depth	Class	MC	LL	PI	-4	-200	N	Description
2.0'	CL	6	33	13	95	51	60+	SANDY CLAY, brown, cemented, gravel to 1 1/2" max.
4.0'	SC	6	44	12	91	47	92, 60+	CLAYEY SAND, tan, caliche cemented, gravel to 1" max.
7.0'	SC	5	36	15	64	20	X, 60+	CLAYEY GRAVELLY SAND, tan, highly cemented, gravel to 3" max.
11.0'	SC	15	43	18	85	44	60+, 60+	CLAYEY SAND, tan, highly cemented, gravel to 2" max.
13.0'	SM	12		NP	100	46	52	SILTY SAND, light brown, dense.
17.0'	SW-SM	6		NP	83	12	34, 35, 46	GRAVELLY SAND-SILTY GRAVELLY SAND, light brown, dense, gravel to 2 1/2" max., 2-5" cobbles.
20.0'	SW-SM	4		NP	95	7	37, 41	SAND-SILTY SAND, light brown, dense, gravel & cobbles to 5" max.
24.0'	SM	10	39	13	90	46	60+, X, X	SILTY SAND, tan, very hard drilling, cemented.
28.0'	GM	13	42	19	50	20	X, X	SILTY SANDY GRAVEL, light brown, highly cemented. +40 material is cemented particles
32.0'	SC	9	31	9	100	41	X, X, X	CLAYEY SAND, tan, highly cemented.
36.0'	SC	11	33	10	75	33	60+, 60+, 60+	GRAVELLY CLAYEY SAND, brown, highly cemented. +40 material is cemented particles.
38.0'	SM	12			97	22	60+	SILTY SAND, brown, very dense gravel to 2" max.
42.5'	SW-SM	5			90	10	60+, 60+, 60+	SAND-SILTY SAND, light brown, very dense, gravel & cobbles to 4" max.
45.0'	CL	13	34	15	100	52	50, X	SANDY CLAY, tan w/white caliche streaks.
	SC	11	30	10	68	29	X, X	CLAYEY GRAVELLY SAND, brown w/black streaks, highly cemented. +40 is cemented particles.
51.0'	SC	10	33	11	100	49	60+, 60+	CLAYEY SAND, brown w/black streaks, highly cemented.

VERT SCALE 5 0 5 10 15 FEET

NOTES:

1. See Sheet 8 for Locations of Test Holes.
2. See Sheet 8 for General Notes, Legend and Basis For Classification.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

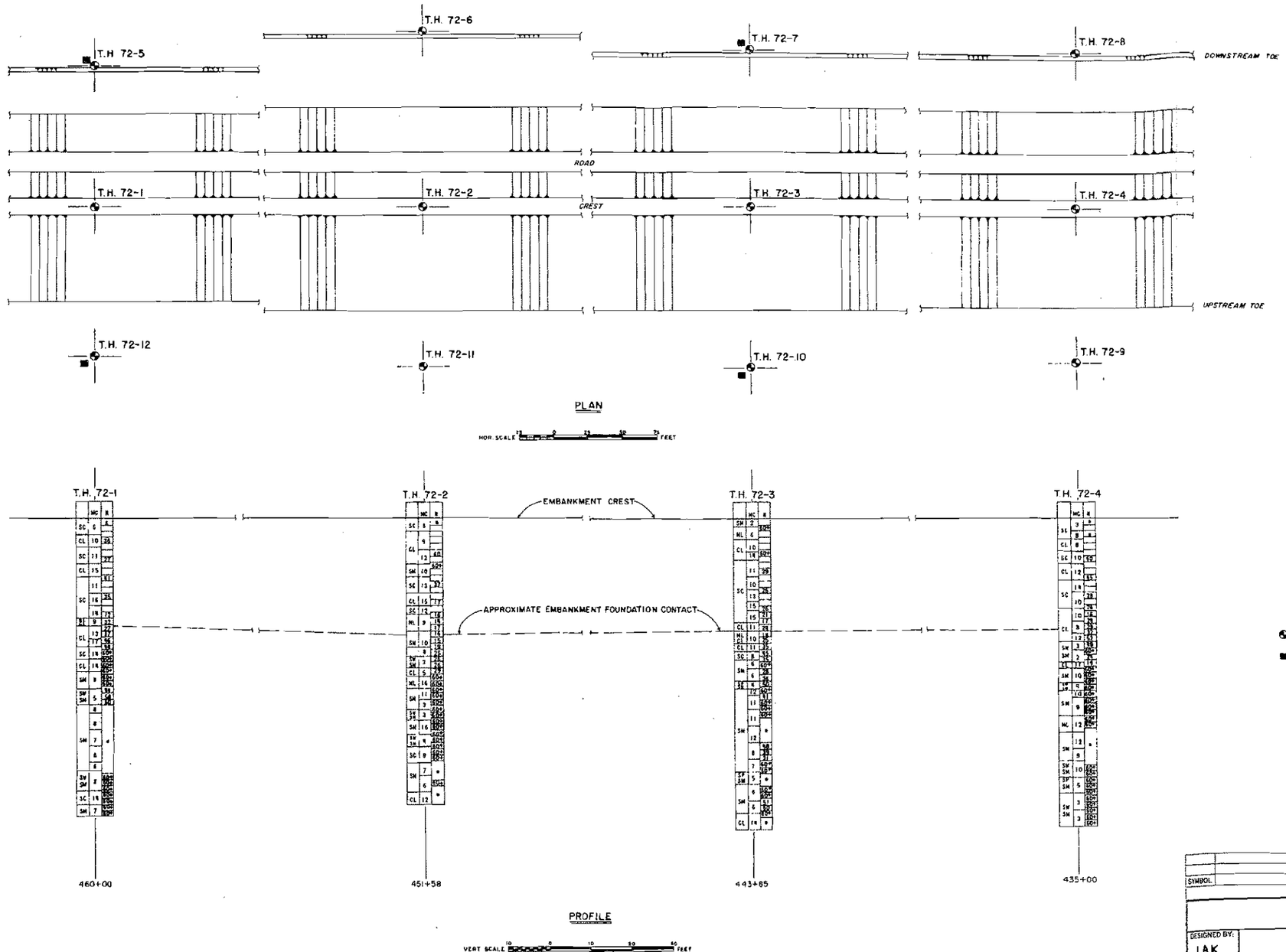
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK
DRAWN BY: L.L.W.
CHECKED BY: mPC

TRILBY WASH DETENTION BASIN

LOGS OF TEST HOLES

SUBMITTED BY:
DATE:
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET



LEGEND

- LOCATION AND NUMBER OF TEST HOLES
- UNDISTURBED SAMPLES

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

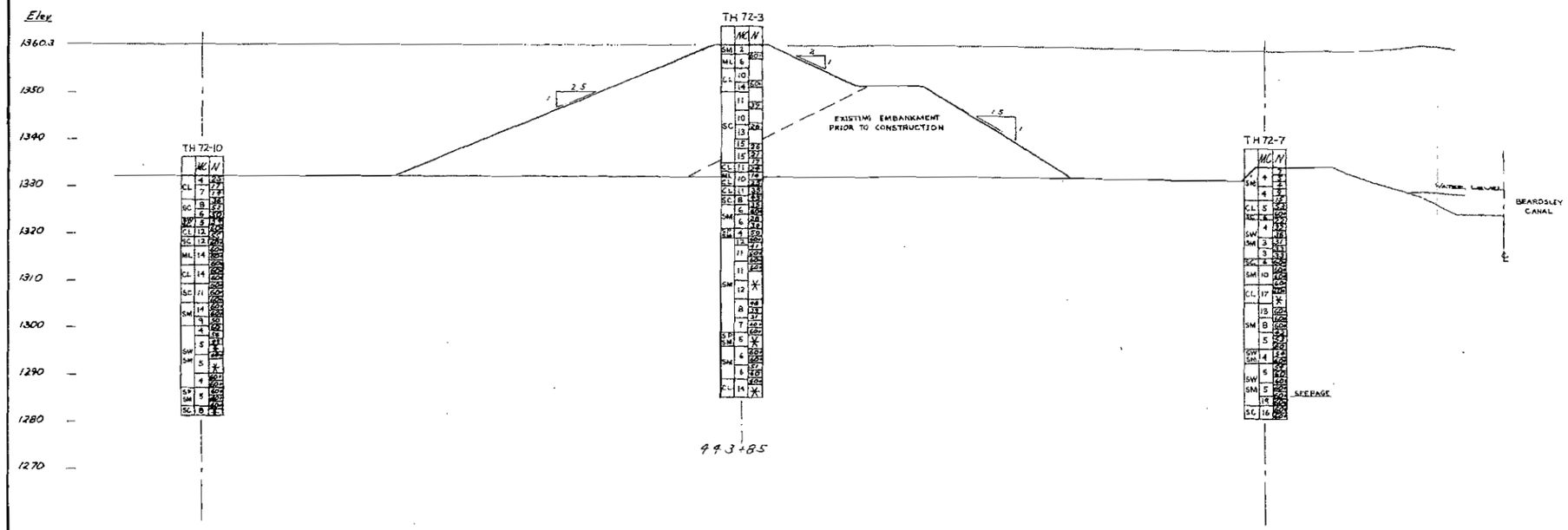
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

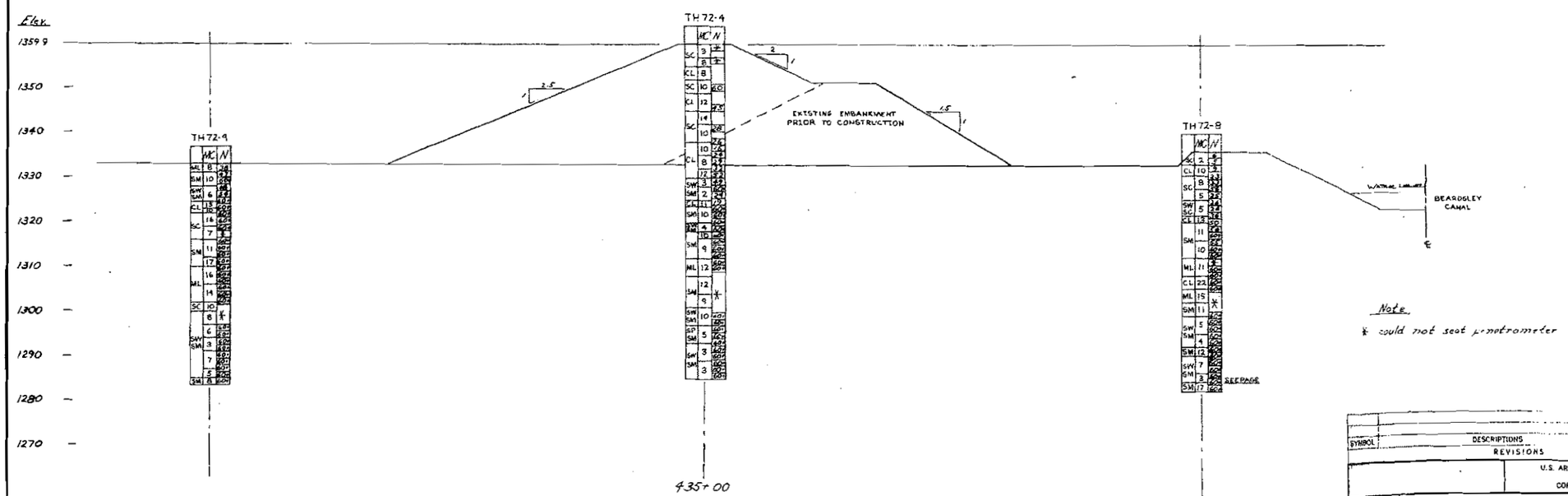
DESIGNED BY: LAK
DRAWN BY: L.L.W.
CHECKED BY: MPC
SUBMITTED BY:
DATE:

TRILBY WASH DETENTION BASIN

SOIL PROFILES

SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO.
SHEET





Note.

* could not seat penetrometer

Scale in Feet

0 2 4 6 8 10 20 30

SYMBOL	DESCRIPTIONS REVISIONS	DATE	APPROVAL

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK
DRAWN BY: LAK
CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

SOIL PROFILES

SUBMITTED BY:

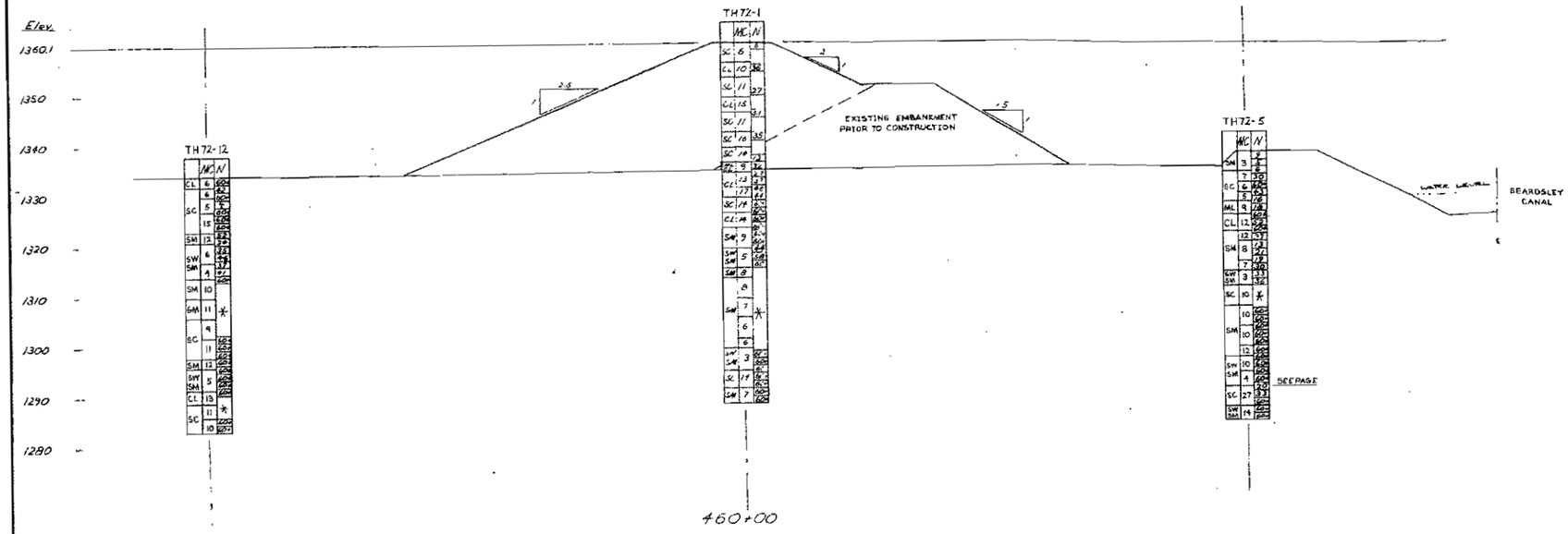
DATE:

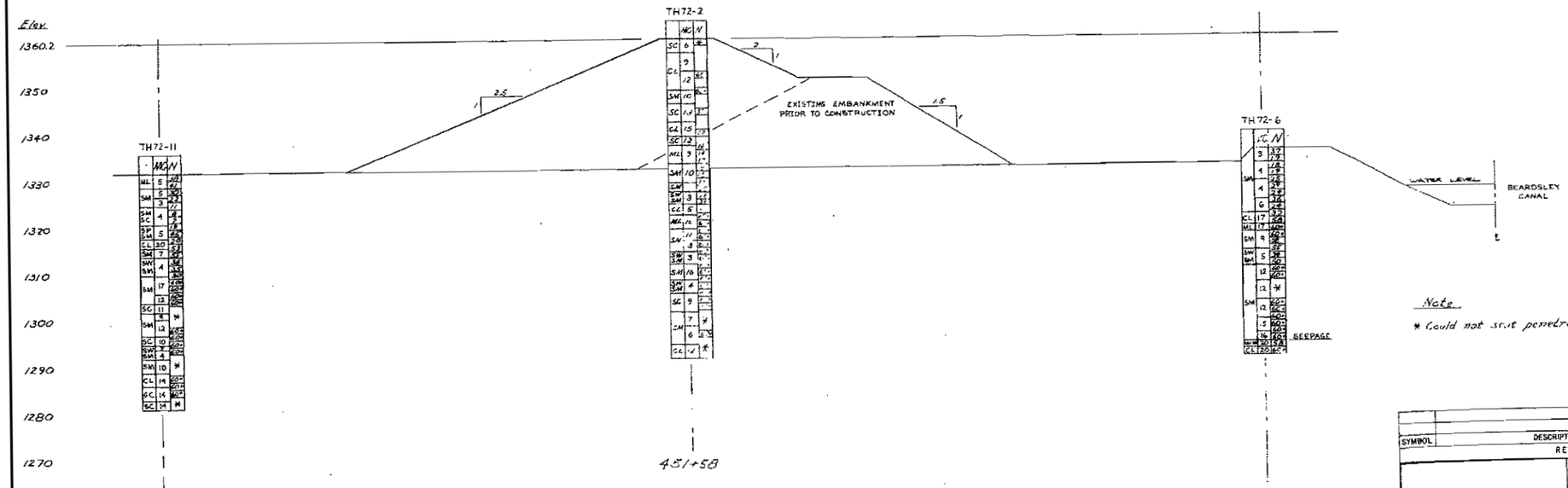
SPEC. NO.

DRAWING NUMBER

DISTRICT FILE NO.

SHEET





Note

* Could not seat penetrometer

Scale in feet

0 2 4 6 8 10 20 30

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY: LAK
DRAWN BY: LAK
CHECKED BY: MPC

TRILBY WASH DETENTION BASIN

SOIL PROFILES

SUBMITTED BY:

DATE:

SPEC. NO.

DRAWING NUMBER

DISTRICT FILE NO.

SHEET

SH&B GEOTECHNICAL INVESTIGATION (1982)

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-14-81

LOG OF TEST BORING NO. 1

location Station 472+00, 18' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	26				slightly moist to dry	SANDY CLAY, considerable silt, some gravel, predominantly well graded, subangular, weakly to moderately cemented, medium plasticity, brown to light brown
			X	S	38				firm to hard	
5			X	S	25			CL		
10			X	S	50/4"				slightly moist very firm	CLAYEY SAND, considerable silt, some fine, subangular gravel, predominantly fine to medium, weakly cemented, medium to low plasticity, brown
15			X	S	46			SC	slightly moist hard	CLAYEY SILT, considerable fine sand, weakly to moderately cemented, low to medium plasticity, tan to light brown
20			X	S	50/2"			ML	slightly moist hard	SANDY, SILTY CLAY, some fine, subangular to subrounded gravel in lenses, moderately cemented, medium plasticity, brown to light brown
25			X	S	50/3"					
30			X	S	50/3"			CL	slightly moist very dense	SAND, considerable silt, predominantly fine to medium, nonplastic, brown
35			X	S	56			SP	slightly moist dense	SILTY SAND, predominantly fine to medium, nonplastic to low plasticity, brown
40			X	S	85				slightly moist hard	SANDY, SILTY CLAY, small amount of fine, subangular gravel, weakly to moderately cemented, medium plasticity, brown
45			X	S	40			SM		
50			X	S	50/5"			CL		Stopped auger at 49'6" Sampler refused at 49'11"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-14-81

LOG OF TEST BORING NO. 2

location Station 462+00, 3' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	65				slightly moist to moist	CLAYEY SAND, some silt, trace of gravel, fine to medium, subangular, weakly cemented, medium plasticity, light brown
			X	S	21				firm to hard	
5			X	S	33			SP-SC		
10			X	U	34	104	15			
15			X	S	30		7	SM-SC	moist firm	SILTY SAND, considerable clay, trace of gravel, predominantly fine to medium, very weakly cemented, low plasticity, brown
20			X	S	50/5"				slightly moist hard	CLAYEY SAND, some silt, predominantly fine, subrounded, weakly cemented, medium plasticity, light brown
25			X	S	50/5"		11	SC		
30			X	S	98					
35										Auger refused at 32'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-14-81

LOG OF TEST BORING NO. 3

location Station 425+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.3'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	32				slightly moist	SILTY CLAY, some to considerable sand, trace of gravel, weakly to moderately cemented, medium plasticity, brown
			X	S	21		8	CL	firm to hard	
5			X	S	72					
									dry	SAND, considerable clay & subrounded to subangular gravel in lenses, predominantly fine to medium, low plasticity, brown to light brown
10			X	S	78		2	SC	very dense	
15			X	S	50/4"				slightly moist to moist	SILTY CLAY, some fine to medium sand, weakly to moderately cemented, medium plasticity, brown
									hard	
20			X	S	83		10	CL		
25			X	S	119					
									slightly moist	CLAYEY SAND, trace of fine, angular to subangular gravel, predominantly fine to medium, occasionally very weakly cemented, low to medium plasticity, brown
30			X	S	39			SC	very firm	
35			X	S	50/4½"					
								CL	slightly moist	SANDY, SILTY CLAY, weakly to moderately cemented, medium plasticity, brown
40			X	S	50/5"				hard	note: some subrounded to angular gravel below 38'
45										Stopped auger at 39'6" Sampler refused at 40'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-15-81

LOG OF TEST BORING NO. 4

location Station 408+50, 20' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1332.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0										FILL
			X	S	35				slightly moist	SILTY CLAY, considerable well graded sand, trace of fine gravel, occasionally weakly cemented, medium plasticity, brown
			X	S	37			CL		
5			X	S	50/5"				very firm	
								CL		
10			X	S	83				slightly moist hard	SANDY CLAY, considerable silt, weakly to moderately cemented, medium plasticity, brown
15			X	S	50/5½"			SC	dry to slightly moist hard	CLAYEY SAND, some silty sand lenses, small amount of fine, subangular gravel, predominantly well graded, occasionally weakly cemented, nonplastic to medium plasticity, brown to reddish-brown
20			X	U	49					
25			X	S	38				slightly moist to moist very firm to hard	SILTY SAND, trace of fine, subrounded gravel, predominantly fine to medium, nonplastic to low plasticity, tan to light brown
30			X	S	85					
35			X	S	40			SM		
40			X	S	50/5½"					note: some predominantly subangular gravel from 38' to 42' & angular to subangular gravel at 50'
45			X	S	63					
50			X	S	50/5½"					Stopped auger at 49'6" Sampler refused at 49'11½"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-15-81

LOG OF TEST BORING NO. 5

location Station 344+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.2'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	25				slightly moist	SILTY CLAY, considerable fine to medium sand, small amount of fine, angular to subangular gravel, medium plasticity, brown
			X	S	22			CL	firm	
5			X	S	25					
									slightly moist	SILTY SAND, considerable clay in lenses & angular to subangular gravel in lenses, predominantly fine to medium, subangular, nonplastic to low plasticity, brown to reddish-brown
			X	S	50/3"			SM	firm to hard	
10										
15			X	S	75				slightly moist to moist	CLAYEY SAND, considerable silt, small amount to considerable gravel in lenses, predominantly fine to medium, subangular, low to medium plasticity, reddish-brown
								SC	hard	
20			X	S	50/5½"					
25			X	S	30				slightly moist	SANDY, SILTY CLAY, small amount of gravel in lenses, very fine sand, weakly to moderately cemented, low to medium plasticity, tan to light brown
									firm to hard	
30			X	S	50/5"					
								CL		note: considerable angular to subangular gravel from 37' to 39'
35			X	S	50/5" (no recovery)					
									slightly moist	SILTY SAND, trace of angular to subangular gravel, predominantly fine to medium, weakly cemented, nonplastic to low plasticity, tan to gray
40			X	S	50/5½"				hard	
45			X	S	71			SM	slightly moist	SILT, some clay & fine sand, low plasticity, brown
									hard	
								ML		Stopped auger at 49'6" Sampler refused at 50'2"
50			X	S	50/2"					

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

B-8

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-15-81

LOG OF TEST BORING NO. 6

Location Station 328+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1338.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	20				slightly moist firm to hard	SILTY CLAY, some fine sand, trace of gravel, weakly cemented, medium to low plasticity, light brown
			X	S	26					
5			X	S	50/6"			CL		
10			X	U	32 (no recovery)					
15			X	S	88				slightly moist very dense	SILTY SAND, considerable angular to subangular gravel, some clay, predominantly fine to medium with considerable well graded lenses, occasionally weakly cemented, nonplastic to low plasticity, brown to reddish-brown note: some sandy silt lenses below 25', tan
20			X	S	71			SM		
25			X	S	56					
30			X	S	145					
35			X	S	50/5" (no recovery)					
40										Stopped auger at 34'6" Sampler refused at 35'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-16-81

LOG OF TEST BORING NO. 7

location Station 311+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	31				slightly moist very firm to hard	SANDY CLAY, considerable silt, weakly cemented, medium plasticity, light brown to reddish-brown
			X	S	42			CL		
5			X	S	77					
10			X	S	29			SC	slightly moist firm to very firm	CLAYEY SAND, considerable silt, some gravel, predominantly fine to medium, weakly cemented, low plasticity, tan to reddish-brown note: considerable subangular gravel below 14'
15			X	S	48					
20			X	S	48				slightly moist to dry very firm to hard	SILTY SAND, some subangular gravel with considerable gravel in lenses, predominantly fine to medium with some well graded lenses, occasionally weakly cemented, non-plastic to low plasticity, tan to light brown
25			X	S	50					
30			X	S	85					
								SM		
35			X	S	59					
40			=	S	50/4"					
45			=	S	50/2"					note: small amount of clay below 45'
50			=	S	50/3"					Stopped auger at 49'6" Sampler refused at 49'9"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-16-81

LOG OF TEST BORING NO. 8

location Station 294+00, 12' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1337.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	11		9		moist	SILTY CLAY, some fine to medium sand, medium plasticity, brown
			X	S	76			CL	moderately firm to hard	note: some gravel weakly to moderately cemented below 3'
5			X	U	100/5½"		7			
10			X	S	50/6"		5	SC	slightly moist hard	CLAYEY SAND, considerable silt, some subangular to subrounded gravel, predominantly fine to medium, some well graded lenses, weakly cemented, medium plasticity, brown to reddish-brown note: occasional sandy or silty clay lenses
15			X	S	84		7			
20			X	S	50/5½"		2			
25			X	S	58		7	SM	very slightly moist to dry very firm to hard	SILTY SAND, some silt in lenses & subrounded to subangular gravel in lenses, predominantly fine, nonplastic to low plasticity, tan to light brown
30			X	S	43		2			
35			X	S	50/6"					
40										Stopped auger at 34'6" Sampler refused at 35'6"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-16-81

LOG OF TEST BORING NO. 9

location Station 280+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1335.3'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	32				slightly moist	SILTY CLAY, some sand & gravel, weakly to moderately cemented below 2½', medium plasticity, brown
			X	S	58			CL	very firm to hard	
5			X	S	93					
									slightly moist to dry	SILTY SAND, some clay & subangular gravel in lenses, predominantly fine to medium, occasionally weakly to moderately cemented, nonplastic to medium plasticity, brown to reddish-brown
10			X	S	21				firm to hard	
15			X	S	31					
20			X	S	50/5"					
25			X	S	72					
								SM		
30			X	S	68					
35			X	S	50/6"					
40			X	S	55					note: gray below 40' note: increase in gravels below 45'
45			X	S	57					
										Stopped auger at 49'6" Sampler refused at 50'4"
50			X	S	50/4"					

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.

B-12

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-16-81

LOG OF TEST BORING NO. 10

location Station 260+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1338.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	15				slightly moist	CLAYEY SILT, some to considerable sand, trace of gravel, medium to low plasticity, light brown
			X	S	9			ML	moderately firm to hard	
5			X	S	59					note: weakly to moderately cemented below 3'
10			X	U	100/9"			CL	slightly moist	SILTY CLAY, some sand, weakly to moderately cemented, medium plasticity, light brown
									hard	
15			X	S	42				slightly moist	CLAYEY SAND, considerable silt, small amount of angular to subangular gravel, predominantly fine to medium, low plasticity, reddish-brown to light brown
								SC	very firm to hard	
20			X	S	50/5"					
25			X	S	50/6"				slightly moist	CLAYEY SILT, small amount of sand, occasional silty sand lenses, weakly to moderately cemented, medium plasticity, light brown
								ML	hard	
30			X	S	50/4"					
									dry	SILTY SAND, small amount of fine, subangular gravel, predominantly fine to medium, nonplastic to low plasticity, light brown
								SM	dense	
35			X	S	44					
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.
U – 3" O.D. 2.42" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-16-81

LOG OF TEST BORING NO. 11

location Station 163+50, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1342.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	12			ML	dry moderately firm	SANDY SILT, some clay & gravel, low plasticity, brown
			X	S	16					
5			X	S	19				dry medium dense to very dense	SILTY SAND & GRAVEL, some clay, occasional thin lenses of clayey silt, weakly to moderately cemented, low to medium plasticity, predominantly fine to medium, angular to subangular, occasionally weakly cemented, nonplastic, light brown note: weakly to moderately cemented from 16½' to 18'
10			X	S	50/5"			SM		
15			X	S	50/2½"					
20										Auger refused at 18'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-17-81

LOG OF TEST BORING NO. 12

location Station 147+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1339.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	12		4	ML	slightly moist	CLAYEY SILT, some sand & gravel, weakly to moderately cemented, low plasticity, brown
			X	S	19		5		moderately firm to firm	
5			X	S	82		6	GM	dry	CLAYEY SILT, small amount of fine sand, weakly cemented, low to medium plasticity, tan to light brown
									hard	
10				S	50/5"		3		dry	SANDY SILT, considerable angular to subangular gravel in lenses, some clay & silty sand lenses, predominantly fine to medium, occasionally weakly cemented, nonplastic to medium plasticity, tan to light brown
									hard	
15				S	50/2½"		7			
20				S	50/2"		4	ML & SM		
25				S	50/4"		4			
30				S	50/3"		6			note: moderately cemented gravels at 30' to 31'
35										Auger refused at 31' on cemented gravels

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-17-81

LOG OF TEST BORING NO. 13

location Station 147+65, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1339.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	27			SC & CL	slightly moist firm to hard	SANDY CLAY, considerable silt, some clayey sand lenses & gravel, weakly to moderately cemented, medium to low plasticity, brown
				S	50/4"					
5				S	100					
10				S	44				dry to slightly moist hard	SANDY, CLAYEY SILT, some lenses of silt, silty sand & silty gravel, angular to subangular, weakly cemented, low plasticity, tan to light brown note: considerable gravel from 11' to 18'
15				S	109					
								ML & SM		
20				S	50/3"					
25				S	50/3½"					
30				S	50/4"					
				A				SM	dry very dense	SILTY SAND, considerable angular gravel, predominantly fine to medium, occasionally weakly cemented, non-plastic, light brown
35				S	50/5"					
40										Stopped auger at 34'6" Sampler refused at 35'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-17-81

LOG OF TEST BORING NO. 14

location Station 163+50, 12' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1343.8'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	50/5"		5	CL	slightly moist	SILTY CLAY, some well graded sand, trace of gravel, weakly to moderately cemented, medium plasticity, brown
			X	S	27		2		hard	
5			X	S	19		1			
									dry	SANDY SILT, considerable gravel, predominantly fine to medium, weakly cemented in places, nonplastic to low plasticity, light brown to brown
									firm to hard	
10			X	S	50/5"		5			
								ML		
15			X	S	50/4"		5			
20			X	S	50/1"		6			
									dry	SILT, occasional thin lenses of silty sand, moderately cemented, low plasticity, tan
25			X	S	50/5"		8		hard	
								ML		
30			X	S	50/4½"		7			
35			X	S	50/4½"		7			
										Stopped auger at 34'6" Sampler refused at 34'10½"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-17-81

LOG OF TEST BORING NO. 15

location Station 260+50, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1339.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	18			SM	slightly moist firm	SILTY SAND, some fine, angular gravel, predominantly well graded, nonplastic to low plasticity, brown
			X	S	16			ML		
5			X	S	16				slightly moist firm	SANDY SILT, small amount of fine, angular gravel, weakly cemented, low plasticity, light brown
								ML		
10			X	U	100/10"	91	9		slightly moist firm to hard	SILT, considerable clay & well graded sand, weakly cemented, medium plasticity, light brown
15			X	S	50/6"					
								SM	slightly moist hard	SILTY SAND, considerable clayey lenses, some subangular gravel, predominantly fine to medium, weakly cemented, low plasticity, light brown to reddish-brown
20			X	S	50/5½"					
25			X	S	50/4½"			CL	slightly moist hard	SILTY CLAY, some fine sand, moderately cemented, medium plasticity, brown
30			X	S	80			CL	dry to slightly moist hard	SANDY CLAY, considerable silt, trace of gravel, moderately cemented, medium plasticity, light brown
35			X	S	50/5" (no recovery)					
40										Stopped auger at 34'6" Sampler refused at 35'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-17-81

LOG OF TEST BORING NO. 16

location Station 280+00, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1338.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	10		7		moist to slightly moist	SILTY CLAY, some fine to medium sand, weakly cemented, medium plasticity, brown
			X	S	23		8	CL	moderately firm to very firm	
5			X	U	48	112	8			
10			X	S	13		4	SM	slightly moist moderately firm to firm	SILTY SAND, considerable clay, some angular to subangular gravel, predominantly fine to medium, weakly cemented, nonplastic to low plasticity, reddish-brown to brown
15			X	S	27		2			
20			X	S	50/6"			ML	slightly moist hard	CLAYEY SILT, some sand, weakly to moderately cemented, low plasticity, light brown
25			X	S	39		3	SW-SM	slightly moist dense	SILTY SAND, trace of gravel, well graded, weakly cemented, nonplastic to low plasticity, brown note: increase in gravel below 27'
30			X	S	36					
35			X	S	34		14	CL	moist very firm	SILTY CLAY, some fine to medium sand, low to medium plasticity, brown to dark brown
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-18-81

LOG OF TEST BORING NO. 17

location Station 294+00, 15' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1339.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	28				moist to slightly moist	SILTY CLAY, some sand, trace of gravel, weakly to moderately cemented, medium plasticity, brown to dark brown
			X	S	52			CL	firm to hard	
5			X	U	99					
10			X	S	30			SM	slightly moist firm to hard	SILTY SAND, some lenses of clayey sand, clayey silt & subangular to subrounded gravel, predominantly fine to medium, occasionally weakly to moderately cemented, low to medium plasticity, brown to reddish-brown
15			X	S	50/4"					
20			X	S	96			CL	slightly moist hard	SILTY CLAY, considerable fine to medium sand, some clayey sand lenses, trace of fine gravel, weakly to moderately cemented, medium plasticity, brown to light brown
25			X	S	65					
30			X	S	49(no recovery)			SM	slightly moist to dry hard to very dense	SILTY SAND, some silt & sandy silt lenses, small amount of angular to subangular gravel, predominantly fine to medium, occasionally weakly cemented, non-plastic to low plasticity, light brown
35			X	S	50/5"					
40										Stopped auger at 34'6" Sampler refused at 35'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-18-81

LOG OF TEST BORING NO. 18

location Station 311+00, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1337.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	31				moist to slightly moist	SILTY CLAY, considerable sand, weakly to moderately cemented, medium plasticity, dark reddish-brown to light brown
			X	S	74			CL	very firm to hard	
5			X	S	45					
10			X	S	50				slightly moist to dry	SILTY SAND, some clayey sand & clayey silt lenses with some subrounded to subangular gravel lenses, predominantly fine to medium, nonplastic to low plasticity, tan to light brown
									hard to firm	
15			X	S	24					
20			X	S	40			SM		note: considerable well graded, angular to subangular sand & gravel below 20'
25			X	S	39					
30			X	S	50/3"					
				S	50/1"					
35										Stopped auger at 34'6" Sampler refused at 34'7"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-18-81

LOG OF TEST BORING NO. 19

location Station 328+00, 17' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1339.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	15			CL	slightly moist	SILTY CLAY, some fine to medium sand, weakly to moderately cemented, medium plasticity, light brown to reddish-brown
			X	S	80		6		firm to hard	
5			X	S	27		3			
10			X	S	18		3		slightly moist firm to hard	SILTY SAND, some clayey sand lenses & subangular gravel in lenses, some well graded lenses, predominantly fine to medium, occasionally weakly cemented, nonplastic to medium plasticity, light brown to tan to reddish-brown
15			X	S	62		4			
20			X	S	27			SM		
25			X	S	36		3			
30			X	S	~~50/5"~~					
35			X	S	50/6"		1			note: considerable gravel below 33'
										Stopped auger at 34'6" Sampler refused at 35'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-18-81

LOG OF TEST BORING NO. 20

location Station 344+00, 5' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1337.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	7			CL	slightly moist	SILTY CLAY, some sand, weakly cemented, medium plasticity, light brown
			X	S	5				soft	
5			X	U	5	103	12	CL	very moist	SILTY CLAY, considerable interbedded lenses of SANDY CLAY & CLAYEY SAND with gravel, medium plasticity, reddish-brown
									soft to moderately firm	
10			X	S	14					
15			X	S	42			SC	moist	CLAYEY SAND, considerable subrounded to subangular gravel in lenses, some silty & sandy clay in lenses, predominantly well graded, occasionally weakly cemented, low to medium plasticity, reddish-brown
									very firm	
20			X	S	37					
25			X	S	13			ML	very moist	CLAYEY SILT, considerable fine to medium sand, occasionally weakly cemented, low plasticity, brown
									moderately firm	
30			X	S	20			SM	moist	SILTY SAND, some clay, predominantly well graded, nonplastic to low plasticity, brown to reddish-brown
									firm to hard	
35			X	S	50/4"					note: considerable gravel in lenses below 32'
										Stopped auger at 34'6" Sampler refused at 34'10"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 12-18-81

LOG OF TEST BORING NO. 21

Location Station 408+50, 15' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	41		7	SM	moist to very moist very firm	SILTY SAND, considerable sand, some gravel in lenses, weakly to moderately cemented, low plasticity, light brown to reddish-brown
			X	S	32					
5			X	S	37		21			
								MH	moist very firm	SILT, some clay, gravel & sandy silt lenses, weakly cemented, medium plasticity, brown to light brown
10			X	S	34					
								SM	moist very firm to hard	SILTY SAND, some clay, small amount of gravel, predominantly fine to medium, nonplastic to low plasticity, light brown to reddish-brown
15			X	S	53		10			
20			X	S	42				slightly moist to moist dense to medium dense	SAND, considerable silt, some silty sand lenses & angular to subangular gravel, predominantly fine to medium with some well graded lenses, nonplastic, brown to light brown
25			X	S	40			SP		
30			X	S	26		3			
35			X	S	31					
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-4-82

LOG OF TEST BORING NO. 22

location Station 425+00, 8' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1335.2'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	14			CL	moist moderately firm to firm	SILTY CLAY, some well graded sand, occasionally weakly cemented, medium plasticity, brown to light brown
			X	S	21		14			
5			X	S	41		8		moist very firm to hard	CLAYEY SAND, considerable gravel in lenses, some clay & sandy clay in lenses, predominantly well graded, angular to subangular, medium plasticity, brown to reddish-brown
								SC		
10			X	S	68		5			
15			X	S	71				moist hard	SILTY CLAY, some fine silty sand in lenses, occasionally weakly cemented, occasional moderately cemented nodules, medium to high plasticity, brown
20			X	U	60	93	26	CH		
25			X	S	104					
30			X	S	39		4	SM	moist very firm to hard	SILTY SAND, some clay, small amount of subangular gravel, predominantly fine to medium, nonplastic to low plasticity, light brown
35			X	S	51					
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-4-82

LOG OF TEST BORING NO. 23

location Station ≈463+00, 8' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1335.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	U	18		8		moist to slightly moist	SILTY SAND & CLAYEY SAND, trace of fine gravel, weakly cemented, medium plasticity, brown
			X	S	39		8	SM-SC	firm to hard	
5			X	S	50/5"					
10			X	S	98		5	CL	slightly moist to dry hard	SILTY CLAY, some fine to medium sand, weakly to moderately cemented, low to medium plasticity, light brown
15			X	S	62					
20			X	S	43		3	SM	slightly moist to dry very firm to hard	SILTY SAND, some clay & subangular gravel, predominantly fine to medium, nonplastic to low plasticity, brown
25				S	50/1"					
30				S	50/3"		6	SC	dry hard	SILT, considerable fine sand, some clay, trace of fine gravel, weakly to moderately cemented, low to medium plasticity, light brown
35				S	50/3"					Stopped auger at 34'6" Sampler refused at 34'9"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-4-82

LOG OF TEST BORING NO. 24

location Station ≈472+00, 5' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.3'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	U	13	108	11	CL	very moist moderately firm	CLAY, considerable silt & fine to medium sand, low to medium plasticity, brown
			X	S	10					
5			X	S	18		13		moist firm to hard	SILTY CLAY, considerable fine sand in lenses, occasionally weakly cemented, medium plasticity, brown
								CL		
10			X	S	51					
15			X	S	148		14		slightly moist to moist hard	CLAYEY SILT, some fine to medium sand & gravel in lenses, weakly cemented, low plasticity, light brown to brown note: trace of gravel below 18'
20			X	S	50/2"		18	ML		
25			X	S	50/3½"		13			
30			X	S	56		8		moist hard	SILTY SAND, small amount of clay & fine gravel, predominantly fine to medium, non-plastic to low plasticity, brown
								SM		
35			X	S	67		5			
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 25

JOB NO. E81-138 DATE 1-4 & 1-5-82

location Station 328+23, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	59				dry to moist	SANDY CLAY, considerable silt, some subangular to subrounded gravel, medium plasticity, brown
								CL	hard to very firm	
5			X	S	104					
10			X	S	38		8		slightly moist to moist	SILTY CLAY with lenses of sandy clay & clayey sand, some gravel, predominantly fine to medium sand, medium plasticity, brown
								CL & SC	very firm to hard	
15			X	S	60					
								CL	slightly moist	SILTY CLAY, some to considerable sand, weakly cemented, medium plasticity, brown to light brown
20			X	S	30				firm	
25			X	S	19		3		slightly moist to dry	CLAYEY SAND, some angular to subangular gravel, well graded, nonplastic to low plasticity, light brown
									firm to hard	
30			X	S	35					
35			X	S	94			SC		
40			X	S	38					
45			X	S	79					
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-4 & 1-5-82

LOG OF TEST BORING NO. 25

location Station 328+23, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	92					note: considerable gravel below 50'
55			X	S	50/3"			SC		
60			X	S	50/3"					Stopped auger at 59'6" Sampler refused at 59'9"

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-5-82

LOG OF TEST BORING NO. 26

location Station 344+15, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	50/5"		9		slightly moist to moist hard	SANDY, SILTY CLAY, some angular to subangular gravel, occasionally weakly cemented, medium plasticity, brown
5				S	66		8	CL		
10				S	54		11			
15				S	21		8	CL	moist firm	SILTY CLAY, some to considerable sand, trace of gravel, medium plasticity, brown to light brown
20				U	24		4	SM	moist firm	SILTY SAND, some clay, sandy silt lenses & subrounded to subangular gravel, predominantly fine to medium, nonplastic to low plasticity, brown
25				S	38		11	CL	very moist very firm	SILTY CLAY, some sand, medium plasticity, dark brown
30				S	19		2	SP	moist medium dense	SAND, some silt, small amount of angular to subangular gravel, predominantly fine to medium, nonplastic, light brown
35				S	29		10	ML	moist firm	CLAYEY SILT, medium plasticity, brown to reddish-brown
40				S	45		3	SM	moist to slightly moist very firm to hard	SILTY SAND, some clay & angular to subangular gravel, predominantly fine to medium, low plasticity to nonplastic, light brown to reddish-brown
45				S	50/3"					
50								ML		

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 26

JOB NO. E81-138 DATE 1-5-82

location Station 344+15, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	54		10	ML	moist hard	CLAYEY SILT, considerable sand, trace of gravel, weakly cemented, medium plasticity, light brown
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-5-82

LOG OF TEST BORING NO. 27

location Station 355+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1359.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	96			CL	slightly moist to moist hard	SILTY, SANDY CLAY, some clayey sand lenses & gravel, medium plasticity, light brown to brown
5			X	S	87					
10			X	S	55		11	CL	moist hard	SILTY CLAY, some sand, small amount of gravel, medium plasticity, dark brown
15			X	S	58		8			
20			X	S	13		5	ML	moist moderately firm	SANDY SILT, some clay & angular to subangular gravel, medium to low plasticity, brown
25			X	U	13	101	5		moist to slightly moist moderately firm	SILTY CLAY, some fine to medium sand, low plasticity, tan to light brown
30			X	S	17		10	CL		
35			X	S	31		7			
40			X	S	50/5"					
45			X	S	82		3	SM	dry to slightly moist hard	SILTY SAND, well graded, nonplastic to low plasticity, light tan
50			X	S	50/4½"					Stopped auger at 49'6" Sampler refused at 50'4½"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 28

JOB NO. E81-138 DATE 1-5 & 1-7-82

location Station 365+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1359.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	85		6		slightly moist to moist hard to very firm	SANDY CLAY, some angular to subangular gravel, some moderate cementation, medium plasticity, brown
5			X	S	39		9			
								CL		
10			X	S	57		7			
15			X	S	25		8		moist very firm	SILTY CLAY, some fine to medium sand, small amount of fine, subangular to subrounded gravel, trace of weak cementation, low plasticity, dark brown
20			X	S	36		12	CL-ML		
25			X	S	38					
30			X	S	39		6	CL-ML	slightly moist very firm	CLAYEY SILT, some sand, predominantly fine, small amount of fine, subangular to subrounded gravel, low plasticity, brown
35				S	50/4½"				moist to slightly moist very firm to hard	SILTY SAND, some clay & fine, angular to subangular gravel, predominantly well graded to predominantly fine, nonplastic to low plasticity, brown to reddish-brown
40			X	S	32		4	SM		
45			X	S	93					
								ML		
50			X	S	50/5"		10			

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 28

JOB NO. E81-138 DATE 1-5 & 1-7-82

location Station 365+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1359.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50									moist to slightly moist	CLAYEY SILT, small amount of sand, moderately cemented, medium to low plasticity, light brown
55				S	50/3"			ML	hard	note: occasional lense of considerable sand
60				S	107		7			
65										Stopped auger at 59'6" Sampler refused at 60'11"

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-7 & 1-8-82

LOG OF TEST BORING NO. 29

location Station 376+00, ¢ of embankment

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.2'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	85		6		slightly moist to moist hard	SILTY, CLAYEY SAND, some angular to sub-angular gravel, occasional lenses of sandy clay or silty sand with angular to subrounded gravel, medium plasticity, brown to dark brown
5			X	S	60		6			
								SC		
10			X	S	101					
15			X	U	52	117	9			
20			X	S	28		13		moist firm to very firm	SILTY CLAY, some fine sand, medium plasticity, brown note: some strongly cemented nodules below 30'
25			X	S	21		15			
								CL		
30			X	S	40					
									moist hard	SILTY SAND, predominantly fine to medium, low plasticity, tan to light brown
35			X	S	51		11	SM		
									moist medium dense to very dense	SAND, considerable silt, predominantly fine to medium, non-plastic, tan to light brown note: small amount of fine, angular to sub-angular gravel below 42'
40			X	S	27		2			
								SP-SM		
45			X	S	94					
										Stopped auger at 49'6" Sampler refused at 50'6"
50			X	S	50/6"		3			

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-11-82

LOG OF TEST BORING NO. 30

location Station 386+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	22			SC	moist firm	CLAYEY SAND, some angular to subangular gravel, predominantly well graded, low plasticity, brown
5			X	S	56				moist hard to very firm	SILTY CLAY, considerable well graded sand in lenses, some angular to subrounded gravel in lenses, occasionally weakly cemented, medium plasticity, brown to reddish-brown to dark brown
10			X	S	55		13			
15			X	S	44			CL		
20			X	S	75					
25			X	S	35				moist firm	CLAYEY SILT, considerable fine to medium sand, low plasticity, light brown to brown
30			X	S	19		10	CL-ML	moist hard to very firm	CLAYEY SAND, considerable silt, some fine, predominantly angular to subangular gravel, predominantly well graded, low plasticity to nonplastic, brown to reddish-brown
35			X	S	50/5"			SC		
40			X	S	48				moist very firm	CLAYEY SILT & SILTY CLAY, medium plasticity, light gray to brown; SILTY SAND, fine, low plasticity, light brown & CLAYEY SAND, fine to medium, low to medium plasticity, brown
45			X	S	48			ML-CL & SC		
50								SP		note: lenticular

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-11-82

LOG OF TEST BORING NO. 30

location Station 386+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	80		3	SP	moist very dense	SAND, some to considerable silt, trace of subrounded gravel, predominantly fine to medium, nonplastic, tan to light brown
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-11-82

LOG OF TEST BORING NO. 31

location Station 397+00, ℄

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	35				slightly moist to moist	SILTY CLAY, some sand, trace of gravel, well graded, trace of weak cementation, medium plasticity, brown
5			X	S	101		9	CL	very firm to hard	
10			X	S	75					
15			X	S	25				moist	CLAYEY SAND, some silt, well graded, subangular to subrounded, low to medium plasticity, brown
20			X	S	40			SC	moderately firm to very firm	
25			X	S	14					
			X	U	31	113	15			
30			X	S	24					
35			X	S	24		11	ML	moist firm	CLAYEY SILT, some sand, predominantly fine, medium plasticity, brown
40			X	S	38			SP	moist dense	SAND, considerable clay, some silt, predominantly fine, non-plastic, brown to orangish-brown
45			X	S	37					
50										Stopped auger at 44'6" Stopped sampler at 46'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-12-82

LOG OF TEST BORING NO. 32

location Station 427+00, ℄, top of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	50/5"		5		slightly moist to moist	SILTY CLAY, considerable well graded sand, some predominantly angular to subangular gravel, occasionally weakly cemented, medium plasticity, brown
5			X	S	50/5½"		8	CL	hard to very firm	
10			X	S	48					
15			X	S	25		12		very moist to moist	SILTY CLAY, considerable fine to medium sand in lenses, some predominantly angular to subangular gravel & silty clay in lenses, occasionally weakly cemented, medium plasticity, light brown
20			X	S	44			CL	firm to very firm	
25			X	S	37		10			
30			X	S	45					
35			X	S	78			SM	moist hard	SILTY SAND, considerable clay, some fine, angular to subangular gravel & sandy silt lenses, predominantly well graded, weakly cemented, medium plasticity, brown
40			X	S	50/5"		18	CL-ML		
45									moist hard	CLAYEY SILT, small amount of fine sand, medium plasticity, brown
										Stopped auger at 39'6" Sampler refused at 40'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

U – 3" O.D. 2.42" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-12-82

LOG OF TEST BORING NO. 33

location Station 462+50

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1359.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	23		7		dry to moist firm to hard	CLAYEY SAND, some silt, trace of gravel, well graded, rounded to subangular, medium plasticity, brown
5			X	S	78		5			
10			X	S	34		9	SC		
15			X	S	43					
20			X	S	46		10			
25			X	S	50/5"				dry to slightly moist hard	CLAYEY SAND, some silt, occasional gravel, well graded, rounded to subangular, some weak to moderate cementation, low to medium plasticity, light brown
30			X	S	50/4"		7	SC		
35			X	S	50/3"				dry to slightly moist very dense	SAND, some silt, predominantly fine, subangular to subrounded, nonplastic, light brown to tan
40			X	S	40		2	SP	dry to slightly moist hard	CLAYEY SILT, some sand, predominantly fine to medium, subangular to subrounded, low plasticity, light tan
45			X	S	50/1"			ML		
50			X	S	50/2"		6			Stopped auger at 49'6" Sampler refused at 49'8"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-13-82

LOG OF TEST BORING NO. 34

location Station 311+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.2'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	37		6	SC	slightly moist very firm to hard	CLAYEY SAND, considerable silt, occasional fine gravel, predominantly fine, subangular, low to medium plasticity, tan
5			X	S	109			SP	slightly moist dense	SAND, some silt, occasional gravel, predominantly fine & some medium, subangular, nonplastic, light brown
10			X	S	45		9	SC	moist very firm to hard	CLAYEY SAND, some silt, predominantly fine to medium, subangular, low to medium plasticity, brown with some light tan mottling
15			X	S	81			SW	slightly moist very dense	SAND, considerable gravel, occasional silt, well graded, subangular to subrounded, nonplastic, light tan
20			X	S	52			SM	slightly moist hard	SILTY SAND, predominantly fine, subangular, low plasticity, light brown
25			X	S	55			SC	moist hard	CLAYEY SAND, some silt, predominantly fine, subrounded to rounded, weakly cemented, medium to high plasticity, brown
30			X	S	50/5"		5	ML	slightly moist hard	SILT, some fine sand, occasional clay, weakly cemented, low plasticity, light brown
35			X	S	50/1½"			SW	slightly moist very dense	SAND, occasional gravel, trace of silt, well graded, subangular to subrounded, nonplastic, light brown note: considerable well graded gravel from 40½' to 44'
40			X	S	107					
45			X	S	80					
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

U – 3" O.D. 2.42" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-13-82

LOG OF TEST BORING NO. 34

location Station 311+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.2'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	93			SW		
										Stopped auger at 49'6" Sampler refused at 50'11½"
55										

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

U – 3" O.D. 2.42" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-13-82

LOG OF TEST BORING NO. 35

location Station 280+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	62				moist hard	SANDY SILT, occasional gravel & lense of some clay, low plasticity, brown note: some granitic gravels are highly weathered to decomposed
5			X	S	50/5½"		8	ML		
10			X	S	51					
15			X	S	80		13	ML-CL SM	moist hard	SILT & CLAY, some sand, occasional gravel, medium plasticity, brown
20			X	S	104			ML	moist hard	SILTY SAND, occasional gravel, predominantly fine, subangular, nonplastic to low plasticity, brown
25			X	S	21		8		moist firm to hard	SANDY SILT, occasional gravel, predominantly fine, low plasticity, brown
30			X	A						
			X	U	27	107	6		slightly moist firm to hard	SILTY SAND, occasional gravel, well graded, subrounded, nonplastic, light brown
35			X	S	19					
40			X	S	248			SM		
45			X	S	42					
50			X							

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-13-82

LOG OF TEST BORING NO. 35

location Station 280+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	40			SM		
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-13-82

LOG OF TEST BORING NO. 36

location Station 240+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.8'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	92		6		slightly moist to moist very firm to hard	SILTY CLAY, some fine to medium sand, low to medium plasticity, light brown with some light tan mottling note: some white angular gravel below 8'
5			X	S	75		7			
10			X	S	30		9	CL		
15			X	S	35					
20			X	S	32				slightly moist hard	SILTY SAND & GRAVEL, well graded, angular to subangular, low plasticity, light tan
25			X	S	50/4½"		5	SM	slightly moist hard	SILTY CLAY, considerable fine sand, occasional gravel, weakly cemented, low to medium plasticity, light brown mottling with light tan note: considerable well graded, angular to subangular sand below 33'
30				S	50/2"			CL		
35				S	50/2"				slightly moist hard	SILTY CLAY, some very fine sand, occasionally weakly cemented, low to medium plasticity, light brown
40				S	50/2½"			CL	slightly moist hard	CLAYEY SAND, some silt, predominantly fine, subrounded, weakly cemented, medium plasticity, brown
45				S	50/1"(no recovery)			SC		
50				S	50/2"					Stopped auger at 49'6" Sampler refused at 49'8"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-14-82

LOG OF TEST BORING NO. 37

location Station 365+00, 15' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1354.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	13		15	CL	moist moderately firm	SILTY CLAY, considerable fine sand, medium plasticity, brown
			X	S	10		12	CL-ML		
5			X	S	10				moist moderately firm	SANDY SILT & CLAY, predominantly fine to medium, low plasticity, brown
10			X	S	72		16	SW & CL	moist dense to hard	SAND, some gravel, well graded, subrounded, nonplastic, brown with lenses of SILTY CLAY, some fine sand, medium plasticity, brown
15			X	S	30			SP	moist medium dense	SAND, occasional gravel & silt, predominantly fine to medium, subrounded, nonplastic, orangish-brown
20			X	S	34		5	SW-SC	moist very firm	SAND, considerable gravel, well graded, subrounded to subangular, nonplastic, brown with lenses of CLAYEY SAND, some gravel, predominantly coarse, subangular to subrounded, medium plasticity, brown
25			X	S	21					
								ML		
30			X	S	44				moist firm to very firm	CLAYEY SILT, considerable sand, predominantly fine, well graded, subrounded, low plasticity, brown
35			X	S	41		10	SM	moist very firm	SILTY SAND, occasional gravel, predominantly fine, subrounded, nonplastic to low plasticity, light brown
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-14-82

LOG OF TEST BORING NO. 38

location Station 386+00, 15' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	9				very moist to moist	SILTY CLAY, some fine sand, medium plasticity, brown
			X	S	8		16	CL	soft to moderately firm	note: light brown below 4'
5			X	S	15		18			
10			X	S	39		6	SW	moist dense	SAND, some gravel & silt, well graded, angular to subangular, nonplastic, orangish-brown
15			X	S	32				moist dense	SAND, some gravel, occasional silt, predominantly fine, subangular, nonplastic, light brown
20			X	S	44		4	SP		
25			X	S	48			SW	moist dense to very dense	SAND, some gravel, well graded, subangular, nonplastic, light brown
30			X	S	79		4			
35			X	S	34			SP	moist dense	SAND, occasional gravel, predominantly fine, subangular, nonplastic, light brown
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 39

JOB NO. E81-138 DATE 1-14-82

location Station 365+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1354.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	9			CL	slightly moist	SILTY CLAY, considerable sand, well graded, low plasticity, light brown
			X	S	16		6	CL	moderately firm	
5			X	S	16		4	SM-SC	slightly moist moderately firm	SILTY CLAY, occasional fine to medium sand, low plasticity, light brown
10			X	S	50/5"			SW	slightly moist moderately firm	SILTY, CLAYEY SAND, some gravel, predominantly fine, well graded, subangular to subrounded, low plasticity, light brown
15			X	S	31		2	SP	slightly moist very dense	SAND, some clay coatings, occasional gravel, well graded, subangular to subrounded, nonplastic to low plasticity, reddish-brown
20			X	S	64			SW		
25			X	S	146			SM	slightly moist dense	SAND, some silt, predominantly fine, subangular, nonplastic, tan
30			X	S	50/2"			ML	slightly moist very dense	SAND, occasional silt, well graded, predominantly fine to medium, subangular, nonplastic, light brown
35			X	S	50/4½"				slightly moist hard	SILTY SAND, occasional gravel, well graded, subangular, weakly cemented, nonplastic to low plasticity, light tan
40									slightly moist hard	CLAYEY SILT, some very fine sand, weakly to moderately cemented, low plasticity, light tan

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-14-82

LOG OF TEST BORING NO. 39

location Station 365+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1354.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
										note: SAND, occasional gravel, predominantly fine, well graded, sub-angular, nonplastic, light brown at 34'6" to 34'9"
										Stopped auger at 34'6" Sampler refused at 35'4½"

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-14-82

LOG OF TEST BORING NO. 40

location Station 386+00, 15' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	37		5	CL	slightly moist very firm	SILTY CLAY, considerable sand, well graded, subrounded, low plasticity, light brown
			X	S	14					
5			X	S	8			CL	slightly moist soft to firm	SILTY CLAY, occasional fine sand, some weak cementation, low to medium plasticity, tan
			X	U	35	82	14			
10			X	S	50/5½"			SM	slightly moist hard	SILTY SAND, some gravel, predominantly fine, well graded, subangular, low plasticity, tan
15			X	S	87		5	SW	slightly moist hard	SAND, considerable gravel, some clay coatings, well graded, subrounded to subangular, nonplastic to low plasticity, reddish-brown
20			X	S	50/5½"					
25			X	S	46				slightly moist dense to very dense	SAND, occasional silt & gravel, predominantly fine, some well graded lenses, subangular, nonplastic, light brown
30			X	S	50/4½"			SP		
35			X	S	70					
40			X	S	41					
45										Stopped auger at 39'6" Stopped sampler at 41'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-15-82

LOG OF TEST BORING NO. 41

location Station 427+00, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	23			SM	slightly moist firm	SILTY SAND, some gravel, predominantly fine, occasionally well graded, subangular, low plasticity, light brown
5			X	S	25					
10			X	S	42			SC	slightly moist to moist firm to very firm	CLAYEY SAND, considerable to occasional gravel, well graded, subangular, medium plasticity, brown
15			X	S	19			ML	slightly moist firm	SANDY SILT, predominantly fine, subangular, low plasticity, light brown
20			X	S	19			ML	slightly moist firm	SILT, occasional fine sand, medium plasticity, light brown mottled with light tan
25			X	S	55				slightly moist very dense	SAND, some gravel & silt, predominantly fine, occasionally well graded, nonplastic, light brown
30			X	S	50/4"					
								SP-SW		
35			X	S	50/5½"					
40			X	S	105					
45			X	S	97			SM	slightly moist hard	SILTY SAND, some gravel, predominantly fine, subangular, low plasticity, light brown
50										Stopped auger at 44'6" Stopped sampler at 46'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-15-82

LOG OF TEST BORING NO. 42

location Station 445+00, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	45				slightly moist	SANDY SILT, occasional fine gravel, predominantly fine, subangular, low plasticity, light brown
								ML	firm to very firm	
5			X	S	22					
10			X	S	28				slightly moist	SAND, considerable clay, some lenses of predominantly fine clayey sand, occasional gravel, well graded, subangular, nonplastic to low plasticity, brown
								SC	firm	
15			X	S	16					
20			X	S	13			CL	slightly moist	SILTY CLAY, occasional sand, predominantly coarse, low plasticity, light brown mottled with light tan
									moderately firm	
25			X	U	42			GW	slightly moist	SAND & GRAVEL, occasional silt, well graded to predominantly fine, subangular, nonplastic, light brown
									dense	
30			X	S	49			SM	slightly moist	SILTY SAND, some gravel, well graded to predominantly fine, subangular, low plasticity, light brown
									very firm	
35			X	S	45			SM	slightly moist	SILTY SAND, occasional gravel, predominantly fine, subangular, low plasticity, light brown
									very firm	
40				S	50/3½"			CL	slightly moist	SANDY CLAY, some silt, predominantly fine, low plasticity, light brown mottled with light tan
									hard	
45			X	S	40			SM	slightly moist	SILTY SAND, occasional gravel, predominantly fine, subangular, nonplastic to low plasticity, light brown
								GW	very firm	
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-15-82

LOG OF TEST BORING NO. 42

location Station 445+00, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	78				slightly moist very dense	SAND & GRAVEL, occasional silt, well graded, subangular, nonplastic, light grayish-brown note: occasional reddish-brown clay below 54'
55			X	S	50/4½"			GW		
60			X	S	76					
65										Stopped auger at 59'6" Stopped sampler at 61'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 43

JOB NO. E81-138 DATE 1-15-82

location Station 462+50, ℄ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1352.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	16				slightly moist firm	SANDY SILT, well graded, subangular, low plasticity, light brown
								ML		
5			X	S	25					
10			X	S	24				slightly moist firm to very firm	SILTY SAND, considerable gravel, occasional sandy clay lense, medium plasticity, brown note: light tan below 15'
								SM		
15			X	S	40					
20			X	S	11				slightly moist medium dense to dense to very dense	SAND, some silt, occasional gravel, predominantly fine, some well graded, nonplastic, light brown
25				U	100/4½"					note: moderately cemented below 23½'
30			X	S	44					note: some gravel below 30'
								SP		
35			X	S	230					note: moderately to weakly cemented, tan below 35½'
40				S	50/1"					
45				S	50/5"					
								SM		
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-15-82

LOG OF TEST BORING NO. 43

location Station 462+50, ℄ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1352.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	92			SM	slightly moist hard	SILTY SAND, occasional gravel, predominantly fine, subangular, occasional weakly cemented nodules, nonplastic, light brown
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 44

location Station 127+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	44				slightly moist very firm to hard	SILTY SAND, some clay, predominantly fine, low to medium plasticity, brown
5			X	S	75					
10			X	S	50/5½"			SM		
15			X	S	41					
20			X	S	50/5"			ML	slightly moist hard	SILT, some fine to medium sand, some weak cementation, low plasticity, light brown
25			X	S	101			SW	slightly moist very dense	SAND, some silt, trace of subangular to subrounded gravel, non-plastic, light brown to light gray
30			X	S	50/5½"			SP	slightly moist very dense	SAND, considerable silt, predominantly fine to medium, non-plastic, light brown
										Stopped auger at 29'6" Sampler refused at 29'11½"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 45

location Station 147+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	25			ML	slightly moist firm	SANDY SILT, trace of gravel & clay, low to medium plasticity, light brown
5			X	S	50/5½"			CL	slightly moist hard	SANDY CLAY, considerable silt, some weak cementation, medium plasticity, light brown
10			X	S	56					
15			X	S	50/4"			SC	moist hard	CLAYEY SAND, trace of angular gravel, predominantly fine, low plasticity, brown
20			X	S	90				slightly moist to moist very firm to hard	SAND, some clay & silt, trace of gravel, predominantly fine, non-plastic, light brown
25			X	S	34			SP		
30			X	S	38					
35			X	S	50/5"					note: considerable angular white gravel below 34'
40										Stopped auger at 34'6" Sampler refused at 35'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 46

location Station 163+50, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	52			SM	slightly moist hard	SILTY SAND, predominantly fine, nonplastic, brown
5			X	S	50/5"			ML	slightly moist hard	SANDY SILT, trace of gravel, predominantly fine, medium plasticity, brown
10			X	S	50			CL	slightly moist to moist very firm	SILTY CLAY, trace of weak to moderate cementation, medium plasticity, brown
15			X	S	50/5"			SW	slightly moist very dense to medium dense	SAND, some silt, trace of gravel, well graded, nonplastic, light brownish-gray
20			X	S	19					
25			X	S	55			CL	slightly moist hard	SANDY CLAY, trace of cemented nodules & gravel, predominantly fine to medium, medium plasticity, light brown
30			X	S	50/5"			SW	slightly moist very dense	SAND, some rounded gravel, trace of clay, well graded, nonplastic to low plasticity, light brown
35										Stopped auger at 29'6" Sampler refused at 30'5"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 47

location Station 180+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	102				slightly moist hard	CLAYEY SAND, considerable silt, trace of gravel, predominantly fine, low plasticity to nonplastic, light brown
5			X	S	57					
10			X	S	50/5½"			SC		
15			X	S	61					
20			X	S	45			CL	slightly moist to moist very firm	SILTY CLAY, trace of sand & weakly to moderately cemented nodules, medium plasticity, brown
25			X	S	61			GW	slightly moist very dense	SANDY GRAVEL, some silt, well graded, subangular to subrounded, nonplastic, light gray
30			X	S	50/5"					Stopped auger at 29'6" Sampler refused at 29'11"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 48

location Station 200+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	35				slightly moist very firm to hard	CLAYEY SAND, some gravel, trace of silt, well graded to predominantly fine, low to medium plasticity, brown
5			X	S	50/5½"		2	SC		
10			X	S	44					
								CL	moist very firm	SILTY CLAY, some sand, trace of angular gravel, trace of weak cementation, medium plasticity, brown
15			X	S	96					
									moist hard to firm	CLAYEY SAND, some silt, trace of gravel, predominantly fine, non-plastic to low plasticity, brown
20			X	S	23			SC		
25			X	S	19					
								SC	slightly moist to moist very dense	SAND, some clay & gravel, well graded, low plasticity, light grayish-brown
30			X	S	120		3			
35										Stopped auger at 29'6" Sampler refused at 30'10"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 49

location Station 220+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	37			ML	slightly moist very firm	SILT, some sand, trace of weak cementation, low plasticity, light brown
5			X	S	50				slightly moist hard	SILTY SAND, considerable clay, predominantly fine to medium, low to medium plasticity, light gray note: trace of gravel below 10'
10			X	S	61			SM		
15			X	S	30					
20			X	S	28			ML	slightly moist very firm to hard	SILT, trace of sand, low plasticity to nonplastic, light brown
25			X	S	50/4½"					
30			X	S	56			SW	slightly moist very dense	SAND, considerable silt, trace of rounded gravel, well graded, nonplastic, light brown
35										Stopped auger at 29'6" Stopped sampler at 31'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 50

location Station 260+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	49				slightly moist to moist very firm	CLAY, considerable sand, predominantly fine, some weak cementation, medium plasticity, brown
5			X	S	40			CL		
10			X	S	37					
15			X	S	45			SC	moist very firm	CLAYEY SAND, trace of gravel, predominantly fine to medium, medium plasticity, brown
20			X	S	14				moist moderately firm to very firm	CLAY, some sand & silt, predominantly fine to medium, medium plasticity, brown
25			X	S	44			CL		
30			X	S	53					
35			X	S	74			SW	slightly moist very dense	SAND, some silt, trace of gravel, well graded, nonplastic, brown
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 51

location Station 294+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	50				slightly moist very firm	CLAY, some sand, some weak to moderate cementation, medium plasticity, brown
5			X	S	39			CL		
10			X	S	52					
15			X	S	25			CL	moist firm	SANDY CLAY, considerable silt, trace of weak cementation, medium plasticity, brown
20			X	S	23					
25			X	S	37				slightly moist dense	SAND, considerable silt, trace of subrounded gravel, well graded with some predominantly fine lenses, nonplastic, light brown to reddish-brown
30			X	S	40			SW		
35			X	S	50/5½"					
40			X	S	50/5½"			SC	slightly moist hard	CLAYEY SAND, predominantly fine, some weak cementation, nonplastic, light brown
45			X	S	43			SP	slightly moist dense	SAND, predominantly fine, nonplastic, light brown
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

LOG OF TEST BORING NO. 51

JOB NO. E81-138 DATE 1-19-82

location Station 294+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1357.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50		• • •	X	S	37			SP		
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-19-82

LOG OF TEST BORING NO. 52

location Station 355+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1334.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	18				slightly moist to moist	SILT, some sand occasionally in lenses, trace of gravel, well graded, low plasticity, brown
			X	S	21			ML	firm	
5			X	S	25					
10			X	S	26			SP	slightly moist medium dense	SAND, considerable silt, predominantly fine, nonplastic, light brown
15			X	S	50/5"			ML	slightly moist hard	SILT, some sand, nonplastic to low plasticity, light brown
20			X	S	28			SP	slightly moist medium dense to very dense	SAND, predominantly fine, nonplastic, light brown
25			X	S	50/4"					
30										Stopped auger at 24'6" Sampler refused at 25'4"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 53

location Station 408+50, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1350.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	20				dry to moist firm to very firm	SILTY CLAY, some fine sand, weakly cemented, medium plasticity, brown to light brown note: small amount of subangular gravel below 5' note: some gravel below 15'
5			X	S	36					
								CL		
10			X	S	25					
15			X	S	37					
20			X	S	50/5½"				slightly moist hard	SILTY SAND, some clay & subangular gravel, predominantly fine to medium, occasionally weakly cemented, low plasticity to nonplastic, tan to light brown
25			X	S	50/5"			SM		
30			X	S	121					
35			X	S	44				slightly moist to dry dense to very dense	SAND, some silt, trace of fine, subangular gravel, predominantly fine to medium, nonplastic, light brown note: some predominantly angular to subangular gravel below 40'
40			X	S	64					
								SP		
45			X	S	50/5"					
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 53

location Station 408+50, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1350.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	76			SP		
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 54

location Station 437+50, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	21			CL	slightly moist firm	SILTY CLAY, some sand, weakly cemented, medium plasticity, light brown
5			X	S	23			CL	slightly moist firm	SANDY CLAY, considerable silt, some subangular to subrounded gravel, medium plasticity, light brown
10			X	S	42			SM	very slightly moist very firm	SILTY SAND & GRAVEL, some clay, predominantly fine to medium sand, predominantly subangular gravel, nonplastic to low plasticity, light brown
15			X	S	17					
20			X	S	36			ML	moist firm to hard	SANDY SILT, some silty sand lenses, silty clay lenses, clay & gravel, occasionally weakly cemented, low to medium plasticity, light brown
25			X	S	75					
30			X	S	50/5"					
35			X	S	50/5½"			SM	moist to slightly moist hard	SILTY SAND, some sandy silt lenses, small amount of gravel, predominantly fine, low plasticity to nonplastic, light brown
40			X	S	78					
45			X	S	50/2⅝"			ML	slightly moist hard	SILT, some clay & fine sand, moderately cemented, medium plasticity, light brown
50			X					SM		

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 54

location Station 437+50, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50			X	S	48			SM	slightly moist very firm	SILTY SAND, predominantly fine, nonplastic, light brown to tan
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 55

location Station 455+00, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6⅜" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	9				slightly moist to moist	SILTY CLAY, some sand, trace of gravel, weakly cemented, medium plasticity, light brown to brown
5			X	S	25				moderately firm to firm	
10			X	S	15			CL		
15			X	U	12	94	11			
20			X	S	20					
25			X	S	32			SC	moist very firm	CLAYEY SAND, considerable silt, some fine, angular to subangular gravel, predominantly well graded, low plasticity, reddish-brown
30			X	S	50/5"			ML	slightly moist hard	CLAYEY SILT, some fine sand, low to medium plasticity, brown
35			X	S	94			SW	slightly moist very dense	SAND, some silt, predominantly well graded, nonplastic, light brown
40			X	S	77				moist hard	SILT, some clay, trace of sand, low plasticity, brown
45			X	S	50/5"			ML		
50								SC		

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 55

location Station 455+00, ℄ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50		%%%	X	S	105			SC	slightly moist hard	CLAYEY SAND, predominantly fine, low to medium plasticity, brown
55										Stopped auger at 49'6" Sampler refused at 50'11"

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 56

location Station 472+00, ¢ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	16				slightly moist firm	SANDY SILT, considerable clay, predominantly fine, low plasticity, brown
								ML		
5			X	S	24					
10			X	S	9				slightly moist moderately firm to very firm	SILTY CLAY, some to considerable sand, predominantly fine, low to medium plasticity, light brown
15			X	U	13	100	8			
								CL		
20			X	S	21					
25			X	S	46					note: considerable gravel, occasionally weakly cemented below 24'
30			X	S	16			SC	slightly moist to moist firm	CLAYEY SAND, predominantly well graded, some weak cementation, medium plasticity, light brown
35			X	S	50/5"				slightly moist hard	SILT, some sand & clay, low plasticity, light brown
40				S	50/2"			ML		
45				S	50/5"					
								SP		
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-20-82

LOG OF TEST BORING NO. 56

location Station 472+00, ℄ of old dike

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1351.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50		• • •	X	S	84			SP	slightly moist very dense	SAND, predominantly fine, nonplastic, light brown to tan
55										Stopped auger at 49'6" Stopped sampler at 51'

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-21-82

LOG OF TEST BORING NO. 57

location Station 172+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	28			ML	slightly moist firm	SANDY SILT, trace of gravel, predominantly fine, low plasticity, light brown
5			X	S	50/5"				moist hard to firm	CLAYEY SAND, predominantly fine, weakly cemented, low plasticity, brown note: some angular gravel below 15'
10			X	S	54					
								SC		
15			X	S	34					
20			X	S	28					
25			X	S	17			CL	moist firm	SANDY CLAY, some silt, medium plasticity, brown
									moist firm	SILT, some clay, trace of sand, low plasticity, light brown to brown
30			X	S	22			ML		
35			X	S	44			SP	slightly moist dense	GRAVELLY SAND, some silt, predominantly fine to medium, angular gravel, nonplastic to low plasticity, light brown
40			X	S	62			SM	slightly moist hard	SILTY SAND, predominantly fine, low plasticity, light brown
45			X	S	50/3"				slightly moist hard	SILT, trace of sand, low plasticity, light brown
								ML		
50			X	S	50/5"					Stopped auger at 49'6" Sampler refused at 49'11"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 58

location Station 67+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	52				slightly moist hard	SILTY SAND, some angular to subrounded gravel, predominantly fine, nonplastic to low plasticity, light brown
5			X	S	50/3"			SM		note: gravel & cobbles cover much of dam
10			X	S	50/5"					note: occasional lense of medium plasticity clayey silt
15			X	S	64			CL	moist hard	SILTY, SANDY CLAY, some gravel, 8" lense of clayey sand, medium plasticity, brown
20			X	S	13			SW	slightly moist medium dense	SAND, considerable silt, trace of gravel, predominantly well graded, nonplastic to low plasticity, light brown
25			X	S	34-(50/0")				slightly moist very dense	SAND, considerable gravel, some silt, well graded, nonplastic, light brown
30			X	S	50/5½"			SW		
35				S	50/0"					Stopped auger at 34'6" Sampler refused at 34'6"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 59

location Station 87+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	18				slightly moist firm to hard	CLAYEY SAND, some silt, predominantly well graded, low to medium plasticity, light brown
5			X	S	72		5	SC		note: trace of gravel, weak cementation below 4'
10			X	S	50/4½"			SM	moist hard	SILTY SAND, some clay & subangular gravel, low plasticity, brown
15			X	S	50/5"		2		slightly moist hard	SILTY GRAVEL & SAND, well graded, subrounded to angular, nonplastic, light brown
20			X	S	50/2"			GM		
25			X	S	50/5½"					
30			X	S	50/4"					
35										Stopped auger at 29'6" Sampler refused at 30'4"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-18-82

LOG OF TEST BORING NO. 60

location Station 107+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.3'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	38				slightly moist very firm to hard	SILT, some sand & sub-angular gravel, trace of clay, low plasticity, light brown note: occasional silty sand lenses below 5'
5			X	S	92					
10			X	S	50/3"			ML		note: considerable gravel & cobbles below 13'
15			X	S	27					
20			X	S	20			SW	slightly moist medium dense	SAND, some subrounded gravel, trace of silt, well graded, nonplastic, light brown to gray
25			X	S	50/5½"			SM	slightly moist hard	SILTY SAND, predominantly fine, nonplastic, light brown
30			X	S	50/5½"			ML	slightly moist hard	SILT, trace of sand, low plasticity, light brown note: trace of gravel at 34⅓'
35			X	S	50/2"					Stopped auger at 34'6" Sampler refused at 34'8"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 61

location Station 397+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	32			SC	slightly moist to moist	CLAYEY SAND, some gravel, predominantly fine, medium plasticity, light brown to brown
			X	S	20				very firm	
5			X	S	34			CL	slightly moist	SILTY CLAY, trace of sand, some weak cementation, medium plasticity, light brown
10			X	S	109				firm to very firm	
									moist	SAND, some clay & silt, some lenses of considerable gravel, predominantly well graded, with some lenses predominantly fine, non-plastic, reddish-brown
15			X	S	36				very dense to medium dense	
20			X	S	72					
								SW		
25			X	S	27					
30			X	S	86					
35			X	S	96					
40										Stopped auger at 34'6" Sampler refused at 35'11½"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 62

location Station 376+00, 10' E of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	51				moist to slightly moist	SANDY CLAY, considerable silt, trace of fine gravel, medium plasticity, brown
			X	S	22			CL	firm to hard	
5			X	S	101					
10			X	S	28			SP	slightly moist medium dense	SAND, trace of silt, predominantly fine, nonplastic, light brown
15			X	S	33				slightly moist dense to very dense	SAND, some silt, trace of clay & subangular gravel, well graded, nonplastic, light brown
20			X	S	36			SW		
25			X	S	67					
30										Stopped auger at 24'6" Stopped sampler at 26'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 63

Location Station 355+00, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1335.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	30			CL	moist firm	SANDY CLAY, some silt, weakly cemented, medium plasticity, brown
			X	S	24					
5			X	S	11			ML	slightly moist moderately firm	SILT, some sand & clay, low plasticity, light brown
10			X	S	50/5"			GP	dry to slightly moist very dense	SAND & GRAVEL, predominantly fine, angular, nonplastic, light gray to white
15			X	S	50/5½"			ML	slightly moist hard	SILT, some clay, low plasticity, light brown
20			X	S	34			SP-SW	slightly moist dense	SILTY SAND, trace of gravel, predominantly fine, well graded, nonplastic, light brown
25			X	S	45					
30										Stopped auger at 24'6" Stopped sampler at 26'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 64

Location Station 376+00, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	12				moist	SANDY CLAY, trace of gravel, predominantly fine, medium plasticity, brown
								CL	moderately firm	
			X	S	15					
5			X	S	20				slightly moist	GRAVELLY SAND, well graded, subangular to angular, nonplastic, light gray to white
								SW	medium dense	
10										Auger refused at 8'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

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SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 65

Location Station 396+00, 10' W of toe

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1333.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	16				moist	SANDY CLAY, medium plasticity, brown
			X	S	13			CL	moderately firm to firm	
5			X	S	19					
10			X	S	16				slightly moist to moist	SAND, occasional clay & gravel, well graded, some lenses predominantly fine, occasional weak cementation, non-plastic, light brown to brown
									medium dense to very dense	
15			X	S	45					
20			X	S	38					
								SW		
25			X	S	44					
30			X	S	43					
35			X	S	56					
40										Stopped auger at 34'6" Stopped sampler at 36'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-22-82

LOG OF TEST BORING NO. 66

location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1338.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	22				slightly moist firm to hard	SILT, some clay & sand, trace of gravel, occasional weak cementation, low plasticity, light brown
5			X	S	50/5"					
10			X	S	22			ML		
15			X	S	50/5½"					
20			X	S	52				slighlty moist very dense	SAND, occasional silt, trace of gravel, well graded, subangular to subrounded, nonplastic, light brown
25			X	S	50/4"			SW		
30			X	S	50/4"			ML	slightly moist hard	SANDY SILT, some clay, low plasticity, light brown
35			X	S	50/5"			SW	slightly moist very dense	SAND, trace of clay & gravel, nonplastic, light brown

Stopped auger at 34'6"
Sampler refused at 34'11"

*Station 15+00, downstream outlet channel dike

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-25-82

LOG OF TEST BORING NO. 67

location Station 502+00, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	50/5"				slightly moist hard	CLAY, considerable sand, occasional silt, trace of gravel, some moderate cementation, medium plasticity, light brown
								CL		
5			X	S	81					
10			X	S	100				slightly moist very firm to hard	CLAYEY SAND, trace of gravel, predominantly fine, some weak cementation, low to medium plasticity, light brown
15			X	S	47			SC		
20			X	S	50/5½"					
25			X	S	50/5"			ML	slightly moist hard	SILT, considerable clay, some sand, some moderate cementation, low to medium plasticity, light brown
30			X	S	70				slightly moist very dense	SAND, trace of sub-rounded gravel, predominantly fine with occasional lense well graded, nonplastic, light brown
35			X	S	50/4½"					
								SP		
40			X	S	50/5¾"					
45			X	S	50/3"					
								SW		
50										

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-25-82

LOG OF TEST BORING NO. 67

location Station 502+00, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
50				S	50/5½"			SW	slightly moist very dense	SAND, some gravel, well graded, subrounded to rounded, nonplastic, light gray
55										Stopped auger at 49'6" Sampler refused at 50'5½"

GROUND WATER

DEPTH	HOUR	DATE

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-25-82

LOG OF TEST BORING NO. 68

location Station 496+50, ¢ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1359.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	95		6		slightly moist to moist hard	SANDY CLAY, some subrounded gravel, some weak cementation, medium plasticity, light brown to brown
5			X	S	96					
10			X	S	50/5¾"		6	CL		
15			X	S	53					
20			X	S	46			ML	slightly moist very firm	SILT, some sand & clay, low plasticity, light brown
25			X	S	24		2		slightly moist medium dense to very dense	SAND, some silt, trace of subrounded gravel, well graded, occasional lense predominantly fine, nonplastic, light brown
30			X	S	60					
35			X	S	50/5½"		2	SW		
40			X	S	102(no recovery)					
45			X	S	61					
50				S	50/2"					Stopped auger at 49'6" Sampler refused at 49'8"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-25-82

LOG OF TEST BORING NO. 69

location Station 487+50, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1360.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	50/5½"				slightly moist to moist	CLAYEY SAND, trace of gravel, nonplastic to low plasticity, light brown to brown
5			X	S	50/5"			SC	hard	
10			X	S	20				moist	CLAY, some sand, medium plasticity, brown
15			X	S	34			CL	firm to hard	
20			X	S	61			SC	moist	CLAYEY SAND, trace of gravel, low plasticity, brown
									hard	
25			X	S	89			ML	slightly moist	SILT, considerable clay, low plasticity, light brown
									hard	
30			X	S	51				slightly moist	SILTY SAND, considerable clay, predominantly fine, low plasticity, light brown
									hard to very firm	
35			X	S	50/5"			SM		
40			X	S	30					
45				S	50/1"					
										Stopped auger at 44'6" Sampler refused at 44'7"

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-25-82

LOG OF TEST BORING NO. 70

Location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1336.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	30		5		slightly moist to moist very firm	SILTY, SANDY CLAY, moderately cemented, medium plastictiy, light brown
5			X	S	44		10	CL		
10			X	S	33					
15			X	S	27			ML-CL	slightly moist firm	SILTY CLAY & CLAYEY SILT, some sand, medium plasticity, light brown
20			X	S	50/5½"					
25			X	S	82			SP	slightly moist very dense	SAND, some clay, predominantly fine, some weak cementation, non-plastic, light brown
30										Stopped auger at 24'6" Stopped sampler at 26' *Station 27+50, downstream outlet channel dike

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-26-82

LOG OF TEST BORING NO. 71

location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1335.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	40				moist to slightly moist	SILTY CLAY, some sand, moderately cemented, medium plasticity, brown to light brown
5			X	S	54				very firm to hard	
								CL		
10			X	S	33					
15			X	S	68					
20			X	S	50/5"			SP	slightly moist to moist very dense	SAND, trace of clay & silt, predominantly fine, nonplastic, reddish-brown
25			X	S	93				slightly moist to moist very dense	SAND, trace of silt & clay, well graded, non-plastic, reddish-brown
								SW		
30			X	S	60					
35			X	S	74			SP	slightly moist very dense	SAND, trace of silt & clay, predominantly fine, nonplastic, reddish-brown
40										Stopped auger at 34'6" Stopped sampler at 36' *Station 40+00, down-stream outlet channel dike

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-26-82

LOG OF TEST BORING NO. 72

location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1337.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	15			SM	slightly moist moderately firm	SILTY SAND, considerable clay, predominantly fine, low to medium plasticity, light brown
5			X	S	88			CL	moist hard to firm	SILTY CLAY, some sand, weak cementation, medium plasticity, brown note: uncemented below 8'
10			X	S	16					
15			X	S	36			SW	moist dense	SAND, trace of clay & gravel, well graded, nonplastic, light brown
20			X	S	50/5"			SM	moist hard	SILTY SAND, some clay, trace of gravel, predominantly fine, low plasticity to nonplastic, reddish-brown to light gray
25			X	S	76					
30										Stopped auger at 24'6" Stopped sampler at 26' *Station 52+50, downstream outlet channel dike

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

B-90

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-26-82

LOG OF TEST BORING NO. 73

location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1338.5'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	28		10		moist moderately firm to very firm	SANDY CLAY, considerable silt, some weak cementation, medium plasticity, dark brown
5			X	S	13			CL		
10			X	S	40		9			note: moderately cemented below 9'
15			X	S	40			SW	slightly moist dense to very dense	SAND, trace of gravel, well graded, some weak cementation, nonplastic, light brown
20			X	S	50/5¾"					
25			X	S	60			CL	moist hard	CLAY, some silt, medium to high plasticity, brown
30				S	50/3"			SW	slightly moist very dense	SAND, some clay, trace of gravel, well graded, nonplastic, light brown
										Auger refused at 30'
										*Station 65+00, downstream outlet channel dike

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample

S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH

CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-26-82

LOG OF TEST BORING NO. 74

Location *See Below

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. ≈1390.0'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	17			SC	slightly moist firm	CLAYEY SAND, considerable silt, predominantly fine, low plasticity, light brown
5			X	S	27				slightly moist to moist firm to hard	CLAYEY SILT & SILTY CLAY, some sand, trace of gravel, some weak cementation, medium plasticity, light brown
10			X	S	50					
15			X	S	24			~~ML-CL~~		
20			X	S	46					
25			X	S	82					
30			X	S	7			SW	slightly moist to moist loose to very dense	SAND, trace of silt & gravel, well graded, nonplastic, brown note: considerable gravel below 34'
35			X	S	50/4"					
40										Stopped auger at 34'6" Sampler refused at 35'4" *3,000' North of South End of Levee, on Crest of Levee

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 1-26-82

LOG OF TEST BORING NO. 75

Location Station 408+50, ℄ of dam

RIG TYPE CME-55

BORING TYPE 6½" Hollow Stem Auger

SURFACE ELEV. 1358.7'

DATUM 1982 A.H.A. Survey

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows per foot 140 lb. 30" free-fall drop hammer	Dry Density Lbs. per cu. ft.	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	39				slightly moist to moist	SILTY CLAY, trace of sand, some moderate cementation, medium plasticity, light brown
								CL	very firm	
5			X	S	47					
									moist	CLAYEY SAND, trace of gravel, predominantly fine, low to medium plasticity, brown
10			X	S	30				very firm to hard	
15			X	S	52			SC		
20			X	S	40					note: considerable angular, white gravel below 19'
									moist	SILTY CLAY, trace of sand, medium plasticity, brown
25			X	S	17				firm to very firm	
								CL		
30			X	S	41					
									moist	SAND & GRAVEL, considerable clay, well graded, subrounded, nonplastic, reddish-brown to tan
35			X	S	42				medium dense to dense	
								SW		
40			X	S	20					
45										Stopped auger at 39'6" Stopped sampler at 41'

GROUND WATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

A – Auger cuttings. B – Block sample
S – 2" O.D. 1.38" I.D. tube sample.

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-10-82

LOG OF TEST PIT NO. TP-15

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1342.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	slightly moist	SILT, some sand & gravel, weakly to moderately cemented, low plasticity, light reddish-brown
5		X	B	7 89	ML	slightly moist to dry	SILT, trace of sand & gravel, moderately cemented, low plasticity, tan with some light tan mottling
		X	D		SM	slightly moist to dry	SILTY SAND, considerable gravel, predominantly fine to medium, subrounded to subangular, moderately cemented, nonplastic to low plasticity, light tan
10							Stopped backhoe at 7'

*Station 457+70, 940' upstream of ℄

DATE 2-10-82

LOG OF TEST PIT NO. TP-16

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1342.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	slightly moist	SILT, occasional sand & gravel, low plasticity, tan
5		X	B	5 104	ML	slightly moist to dry	SILT, occasional sand & gravel, weakly cemented, low plasticity, blocky structure, reddish-brown with white lineations
		X	D		GW	slightly moist	SAND & GRAVEL, trace of cobbles, well graded, subangular to subrounded, nonplastic, light grayish-brown
10							Stopped backhoe at 8'

*Station 473+00, 900' upstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-10-82

LOG OF TEST PIT NO. TP-17

Backhoe Type Case 580C

Location *See Below

Elevation 1333.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	slightly moist	SILT, some sand, trace of gravel, predominantly well graded, subrounded to rounded, low plasticity, tan
5		X	D		ML	slightly moist to dry	SILT, some sand & gravel, weakly to moderately cemented, low plasticity, tan mottled with light tan
		X	D		SW & GW	slightly moist to dry	SAND & GRAVEL, some clay, well graded, subrounded, weakly cemented, nonplastic to low plasticity, reddish-brown
10							Stopped backhoe at 7'3"
							*Station 455+22, 420' downstream of ℄

,E 2-10-82

LOG OF TEST PIT NO. TP-18

Backhoe Type Case 580C

Location *See Below

Elevation 1332.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist	SILT, trace of sand & gravel, low plasticity, light brown
5		X	B	6 / 89	ML	slightly moist to dry	SILT, occasional sand, trace of gravel, moderately cemented, low plasticity, blocky structure, light brown with light tan mottling
10					SW & GW	slightly moist to dry	SAND & GRAVEL, occasional silt, well graded, subrounded to subangular, weakly cemented, nonplastic, light grayish-brown
							Stopped backhoe at 10'
							*Station 474+00, 360' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-10-82

LOG OF TEST PIT NO. TP-19

Backhoe Type Case 580C

Location *See Below

Elevation 1333.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist	SILT, trace of sand & gravel, low plasticity, tan
		X	D		ML	slightly moist to dry	SILT, considerable sand & gravel, predominantly well graded, subrounded to subangular, weakly cemented, low to medium plasticity, blocky structure, tan with light tan mottling
5		X	D		GW	slightly moist to dry	SAND & GRAVEL, some clay, well graded, rounded to subangular, weakly cemented, nonplastic, reddish-brown
							Stopped backhoe at 5'
							*Station 433+20, 350' downstream of ℄

E 2-10-82

LOG OF TEST PIT NO. TP-20

Backhoe Type Case 580C

Location *See Below

Elevation 1331.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist	SILT, occasional sand & gravel, low plasticity, tan
5		X	D		ML	slightly moist to dry	SILT, occasional sand & gravel, weakly to moderately cemented, low plasticity, blocky structure, tan with occasional light tan mottling note: considerable lenses of SAND & GRAVEL, trace of clay, well graded, subrounded, nonplastic, reddish-brown
10							Stopped backhoe at 8'
							*Station 390+72, 460' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
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PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-10-82

LOG OF TEST PIT NO. TP-21

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1336.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist to dry	SILT, trace of sand & gravel, low plasticity, tan note: weakly to moderately cemented at 1½' to 4½'
		X	B				
5					ML	dry	SILT, considerable gravel, some sand, well graded, subrounded, weakly to moderately cemented, low plasticity, light tan
10							Stopped backhoe at 7'

*Station 350+36, 150' downstream of ℄

2-11-82

LOG OF TEST PIT NO. TP-22

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1341.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist to dry	CLAYEY SILT, trace of sand & gravel, low to medium plasticity, tan note: weakly cemented & some tan mottling at 1' to 3'
		X	D				
5					SW & GW	slightly moist to dry	SAND & GRAVEL, considerable silt, well graded, subrounded to subangular, nonplastic to low plasticity, brown
10							Stopped backhoe at 7'

*Station 297+42, 310' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
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PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-11-82

LOG OF TEST PIT NO. TP-23

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1342.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SM	moist	SILTY SAND, predominantly well graded, subrounded to subangular, low plasticity, brown
			D		ML-CL		note: occasional lense of well graded sand, subrounded to subangular, nonplastic, light brown
5					SW & GW	slightly moist	SILTY CLAY, some sand, weakly cemented, medium plasticity, blocky structure, brown
10						slightly moist to dry	SAND & GRAVEL, some clay, well graded, subrounded to subangular, weakly cemented, nonplastic, reddish-brown
							Stopped backhoe at 8'6"
							*Station 301+40, 130' downstream of ℄

E 2-11-82

LOG OF TEST PIT NO. TP-24

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1336.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist	SILT, occasional sand, trace of gravel, low plasticity, tan
			B	6 93			
5					ML	slightly moist to dry	SILT, some sand & gravel, well graded, weakly to moderately cemented, low plasticity, tan with light tan mottling
					GW		
10						slightly moist to dry	SAND & GRAVEL, some cobbles & silt, well graded, rounded to subrounded, weakly cemented, nonplastic, light brown
							Stopped backhoe at 8'
							*Station 284+00, 600' upstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-11-82

LOG OF TEST PIT NO. TP-25

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1341.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist to moist	SILT, some sand, predominantly fine to medium, subangular, low plasticity, brown
		☒	B	7 / 97	ML	slightly moist to dry	SILT, trace of sand & gravel, weakly cemented, low plasticity, tan mottled with light tan
5					SW & GW	slightly moist to dry	SAND & GRAVEL, occasional silt & lenses of well graded sand, well graded, subangular to subrounded, some weak cementation, nonplastic, light brown to reddish-brown
10							Stopped backhoe at 8'
							*Station 292+25, 145' downstream of ℄

E 2-11-82

LOG OF TEST PIT NO. TP-26

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1338.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt. & Density (PCF)	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML-CL	slightly moist	CLAYEY SILT, some sand, predominantly fine, low to medium plasticity, light brown
		☒	B	6 / 111	ML-CL	slightly moist to moist	CLAYEY SILT, some sand, weakly cemented, medium plasticity, blocky structure, brown
5					SW & GW	slightly moist	SAND & GRAVEL, some silt, well graded, subrounded to subangular, weakly cemented, nonplastic, brown with considerable light tan mottling
10							Stopped backhoe at 7'
							*Station 282+05, 120' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-11-82

LOG OF TEST PIT NO. TP-27

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1344.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist to dry	SILT, considerable sand, well graded, subangular to subrounded, low plasticity, tan note: predominantly fine, very soft sand from 3' to 4'
		X	D				
5					SW	slightly moist to dry	SAND & GRAVEL, occasional clay, well graded, subangular, nonplastic, reddish-brown to brown
10							Stopped backhoe at 6' *Station 196+78, 160' downstream of ℄

DATE 2-11-82

LOG OF TEST PIT NO. TP-28

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1340.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	B	5	SM	slightly moist to dry	SANDY SILT, some well graded sand & gravel, predominantly very fine, low plasticity, tan
5		X	B				
					ML-CL	slightly moist to dry	SILTY CLAY, low to medium plasticity, blocky structure, reddish-brown
10					SM	slightly moist to dry	SANDY SILT, trace of gravel, very fine, low plasticity, tan
							Stopped backhoe at 10' *Station 179+30, 165' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-12-82

LOG OF TEST PIT NO. TP-29

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1360.0'

Datum: A.H.A. 1982 Survey

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist	SILT, considerable fine sand, some clay & gravel, weakly to moderately cemented, low plasticity, tan note: gravelly lense at 1'9" to 2'
			B	4			
5					SW	slightly moist to dry	SAND & GRAVEL, considerable silt, well graded, moderately cemented, nonplastic, light brown
10							Stopped backhoe at 5'6"
							*Station 464+00, ¢ of dam

TE 2-12-82

LOG OF TEST PIT NO. TP-30

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1352.0'

Datum: A.H.A. 1982 Survey

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	slightly moist to moist	SILT, occasional fine sand, trace of sand & gravel, occasionally weakly cemented, low plasticity, tan note: SAND & GRAVEL, occasional silt & clay, well graded, subrounded to subangular, nonplastic, brown to reddish-brown at 6" to 18"
			B	6			
5			B				
10							Stopped backhoe at 6'6"
							*Station 464+00, ¢ of old dike

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-12-82

LOG OF TEST PIT NO. TP-31

Backhoe Type Case 580C

Location *See Below

Elevation 1350.0'

Datum A.H.A. 1982 Survey

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	B		SM	slightly moist to moist	SANDY SILT, some gravel, fine, low plasticity, light brown
					GW		
5		X	B	5	SM	slightly moist	SANDY GRAVEL, some silt, well graded, subrounded, low plasticity, grayish-brown
					GW	slightly moist	SANDY SILT, some gravel, fine, low plasticity, light brown
10						slightly moist	SANDY GRAVEL, some silt, well graded, subrounded, low plasticity, light greenish-brown
							Stopped backhoe at 7'
							*Station 370+00, ¢ of old dike

E 2-15-82

LOG OF TEST PIT NO. TP-32

Backhoe Type Case 580C

Location *See Below

Elevation 1358.0'

Datum A.H.A. 1982 Survey

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					CL-ML	slightly moist	CLAY, considerable silt & sand, low plasticity, brown
		X	B	4	GM	slightly moist	SILT, considerable gravel, some clay & sand, well graded, subrounded to subangular, weakly to moderately cemented, low plasticity, light brown
5		X	B				note: trace of cobbles at 5'
10							Stopped backhoe at 7'
							*Station 260+00, ¢ of dam

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-15-82

LOG OF TEST PIT NO. TP-33

Backhoe Type Case 580C

Location *See Below

Elevation 1340.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist to dry	SILTY SAND, considerable gravel, predominantly well graded, subrounded to subangular, trace of weak cementation, low plasticity, tan note: weakly cemented & some light tan clay at 4' to 4'3"
		X	D		SM		
5							
					SW	slightly moist to moist	SAND, occasional clay, predominantly well graded, angular to subangular, nonplastic to low plasticity, white & reddish-brown
10							Stopped backhoe at 9'
							*Station 272+87, 90' downstream of ℄

2-15-82

LOG OF TEST PIT NO. TP-34

Backhoe Type Case 580C

Location *See Below

Elevation 1340.0'

Datum U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	slightly moist	SAND, some gravel & silt, well graded, subangular, nonplastic, brown with white specks
					SM		
					GW	slightly moist	SILTY SAND, occasional gravel, predominantly fine, subrounded to subangular, nonplastic to low plasticity, light brown
5						slightly moist	SAND & GRAVEL, some small cobbles, occasional silt, well graded, subangular to subrounded, nonplastic, light brown & white
							Stopped backhoe at 5'6"
							*Station 141+32, 140' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING SOIL AND FOUNDATION ENGINEERS

PROJECT McMicken Dam Restoration Study

JOB NO. E81-138 DATE 2-15-82

LOG OF TEST PIT NO. TP-35

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1340.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	moist to slightly moist	SILTY SAND, predominantly very fine, nonplastic to low plasticity, brown
					GM	slightly moist to dry	SILTY SAND, GRAVEL & COBBLES, well graded, subangular to subrounded, some weak cementation, nonplastic to low plasticity, tan with some light tan mottling
5							
10							Stopped backhoe at 4'

*Station 119+12, 110' downstream of ℄

DATE 2-15-82

LOG OF TEST PIT NO. TP-36

Backhoe Type: Case 580C

Location: *See Below

Elevation: 1335.0'

Datum: U.S.G.S. Topo Map

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					SM	slightly moist to moist	SILTY SAND, predominantly very fine, nonplastic to low plasticity, light brown
		X	D		GW	slightly moist	SAND, GRAVEL & COBBLES, some silt, well graded, subrounded to subangular, trace of weak cementation, nonplastic, light brown to light tan
5							
10							Stopped backhoe at 6'

*Station 79+22, 168' downstream of ℄

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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SH&B GEOTECHNICAL INVESTIGATION (1983)

TEST DRILLING EQUIPMENT & PROCEDURES

Drilling Equipment Truck-mounted CME-55 drill rigs powered with 4 or 6 cylinder Ford industrial engines are used in advancing test borings. The 4 cylinder and 6 cylinder engines are capable of delivering about 4,350 and 6,500 foot/pounds torque to the drill spindle, respectively. The spindle is advanced with twin hydraulic rams capable of exerting 12,000 pounds downward force. Drilling through soil or softer rock is performed with 6 1/2 O.D., 3 1/4 I.D. hollow stem auger or 4 1/2 inch continuous flight auger. Carbide insert teeth are normally used on the auger bits so they can often penetrate rock or very strongly cemented soils which require blasting or very heavy equipment for excavation. Where refusal is experienced in auger drilling, the holes are sometimes advanced with tricone gear bits and NX rods using water or air as a drilling fluid. Where auger and tricone gear bits cannot be used to advance the hole due to cobbles or caving conditions, the ODEX (overburden drilling with the eccentric method) is used. A percussion down-the-hole hammer underreams the hole and 5 inch steel casing is introduced into the hole during drilling. The drill bit is eccentric and can be removed from the center of the casing to allow sampling of the material below the bit penetration depth.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the samplers in 6 inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2 or 3 inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per foot on the logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587). Where samples of rock are required, they are obtained by NX diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings.

Continuous Penetration Tests Continuous penetration tests are performed by driving a 2" O.D. blunt nosed penetrometer adjacent to or in the bottom of borings. The penetrometer is attached to 1 5/8" O.D. drill rods to provide clearance to minimize side friction so that penetration values are as nearly as possible a measure of end resistance. Penetration values are recorded as the number of blows of a 140 pound 30 inch free fall drop hammer required to advance the penetrometer in one foot increments or less.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487) with appropriate group symbols being shown on the logs.

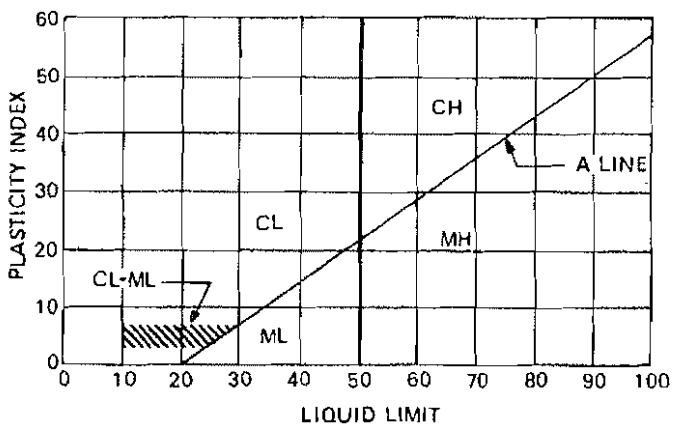
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corp of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
					GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 saive)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (LIMITS PLOT BELOW "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (LIMITS PLOT ABOVE "A" LINE & HATCHED ZONE ON PLASTICITY CHART)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to madium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE: Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with limits plotting in the hatched zone on the plasticity chart to have double symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to ¾ in.
Fine gravel	¾ in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-8-82

LOG OF TEST PIT NO. TP-1

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some fine sand, medium plasticity, brown
			D		CL	very slightly moist	SILTY CLAY, some sand & fine gravel, weakly to moderately lime cemented, medium plasticity, brown
5					SM-SC	very slightly moist	SILTY SAND, considerable clay in lenses, some gravel, predominantly fine to medium grained, cemented, very low plasticity, brown
			D			slightly moist	SAND, occasional lens of gravel, fine grained, cemented, nonplastic, brown
					SP		
10							Stopped backhoe at 10'

LOG OF TEST PIT NO. TP-2

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, low to medium plasticity, brown
			D		CL	very slightly moist	SILTY CLAY, some sand, trace of gravel, weakly lime cemented, low to medium plasticity, brown
5			D		SP-SM	very slightly moist	SAND & SILTY SAND, some gravel, poorly graded, predominantly fine to medium grained, predominantly angular, nonplastic to low plasticity, brown
					CL	very slightly moist	SILTY CLAY, small amount of sand, weakly to moderately lime cemented, medium to low plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

OB NO. E82-111 DATE 10-8-82

LOG OF TEST PIT NO. TP-3

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, trace of sand & gravel, weakly lime cemented, medium plasticity, light brown
			D		CL	slightly moist	SILTY CLAY, considerable sand, small amount of gravel, medium plasticity, brown
5					CL	very slightly moist	SILTY CLAY, small amount of sand & gravel, weakly to moderately lime cemented, medium plasticity, light brown
							Stopped backhoe at 6'6"
10							

E 10-8-82

LOG OF TEST PIT NO. TP-4

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand & fine, angular to subangular gravel, medium plasticity, brown note: very weakly cemented lens from 3' to 4'
5			D		SC	moist to slightly moist	CLAYEY SAND, some fine, angular to subangular gravel, well graded, weakly lime cemented in stringers, medium to high plasticity, dark brown
					CL	slightly moist	SILTY CLAY, some sand & fine gravel, weakly to moderately lime cemented, medium plasticity, light brown
							Stopped backhoe at 9'
10							

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-8-82

LOG OF TEST PIT NO. TP-5

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, considerable well graded sand & fine, angular to subrounded gravel, medium plasticity, brown
			D		SC	slightly moist	CLAYEY SAND, some gravel, weakly lime cemented, medium plasticity, brown note: moderately cemented below 3½'
5			D		SP	very slightly moist	SAND, considerable silt, some fine, angular to subangular gravel, predominantly fine to medium grained, some well graded lenses, nonplastic, light gray to brown
10							Stopped backhoe at 7'6"

DATE 10-8-82

LOG OF TEST PIT NO. TP-6

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, considerable sand, some fine, subangular to subrounded gravel, medium plasticity, brown
			D		CL	very slightly moist	SILTY CLAY, considerable sand & gravel, 6" lens of clayey sand at 3', weakly lime cemented, medium to low plasticity, light brown
5			D		SW	slightly moist	SAND, considerable silt & fine, subangular to subrounded gravel, well graded, weakly cemented, stratified, nonplastic, brown
					GP	slightly moist	SAND & GRAVEL up to 4" in diameter, poorly graded, rounded to subangular, weakly to moderately cemented, nonplastic, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-8-82

LOG OF TEST PIT NO. TP-7

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, small amount of sand & fine gravel, weakly lime cemented below 1½', medium plasticity, brown to light brown
5			D		GM & ML	slightly moist	SILTY SAND & GRAVEL, some clay, silt & gravelly silt lenses, predominantly fine to medium sand, rounded to sub-angular gravel, up to 4" in diameter, weakly lime cemented, low plasticity, brown
10							Stopped backhoe at 9'6"

E 10-8-82

LOG OF TEST PIT NO. TP-8

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, trace of gravel, medium plasticity, brown
5			D		GC	slightly moist	CLAYEY GRAVEL & SAND, some sandy clay lenses, occasional cobbles, predominantly fine to medium grained, sub-angular to subrounded, weakly lime cemented, medium plasticity, dark brown
			D		CL	very slightly moist	SILTY CLAY, small amount of sand, weakly to moderately lime cemented, medium plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-8-82

LOG OF TEST PIT NO. TP-9

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, trace of fine, subangular to subrounded gravel, medium plasticity, brown
			D		CL	very slightly moist	SILTY CLAY, some sand & fine, subangular to subrounded gravel, weakly lime cemented, medium plasticity, light brown
5			D		SC	slightly moist	CLAYEY SAND & GRAVEL, considerable silt, some sandy clay lenses, well graded, angular to subrounded, weakly lime cemented; low to medium plasticity, brown
10							Stopped backhoe at 7'6"

E 10-8-82

LOG OF TEST PIT NO. TP-10

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	moist to slightly moist	CLAY, considerable silt & sand, some fine gravel, medium plasticity, dark brown
			D		GM	very slightly moist	SILTY GRAVEL & SAND, some clay, well graded, angular to subangular, moderately to strongly lime cemented, nonplastic to low plasticity, gray
5							Backhoe refused at 4'6" on very strongly cemented material

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-11-82

LOG OF TEST PIT NO. TP-11

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand & fine, subrounded to angular gravel, weakly cemented below 1½', medium plasticity, brown
			D		SP	very slightly moist	SAND, considerable fine, angular to subangular gravel in lenses, some clay, predominantly fine to medium grained, weakly to moderately lime cemented, low plasticity, light brown
5					SC	slightly moist	CLAYEY SAND & GRAVEL, considerable silt, well graded, angular to subrounded, weakly to moderately cemented, low to medium plasticity, brown
10							Stopped backhoe at 5'6"

E 10-11-82

LOG OF TEST PIT NO. TP-12

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		SC	slightly moist	CLAYEY SAND, some silt & fine, angular to subangular gravel, weakly cemented below 2', medium plasticity, brown
5			D		SM	slightly moist	SILTY SAND, some clay & fine, angular to subangular gravel, well graded, weakly cemented, moderately cemented below 5', stratified, low plasticity, brown
10							Stopped backhoe at 6' in hard material

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-11-82

LOG OF TEST PIT NO. TP-13

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						slightly moist	SILTY CLAY, some sand, small amount of fine, angular to subangular gravel, weakly lime cemented below 1', weakly to moderately lime cemented below 6', low to medium plasticity, brown note: thin lens of considerable gravel at 5'
			D		CL		
5							
10							Stopped backhoe at 8'

LOG OF TEST PIT NO. TP-14

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist	CLAYEY SAND, some fine, angular to subangular gravel, weakly lime cemented below 3', low plasticity, brown
			D		SC		
5						very slightly moist	SILTY SAND, considerable gravel, well graded, angular to subrounded, areas of weak cementation, stratified, non-plastic to low plasticity, brown
			D		SM		
10							Stopped backhoe at 8'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-11-82

LOG OF TEST PIT NO. TP-15

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	very slightly moist	SILTY CLAY, considerable fine to medium grained sand, some fine, angular to subangular gravel, very weakly cemented below 1½', medium to low plasticity, brown
5			D	4	SC	very slightly moist	CLAYEY SAND, considerable gravel, some silt, well graded, angular to subrounded, very weakly cemented, stratified, low plasticity to non-plastic, brown
10							Stopped backhoe at 8'

DATE 10-11-82

LOG OF TEST PIT NO. TP-16

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	very slightly moist	SILTY CLAY, some sand, trace of gravel, very weakly lime cemented below 1½', very weakly stratified, medium plasticity, brown
5			D		SM	very slightly moist	SILTY SAND, some fine, angular to subangular gravel, lens of silty sand & gravel from 6' to 6½', predominantly fine to medium grained, weakly cemented, stratified, non-plastic to low plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-11-82

LOG OF TEST PIT NO. TP-17

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist	SILTY SAND & GRAVEL, some clay, well graded, angular to subrounded, very weakly cemented, stratified, nonplastic to low plasticity, brown to dark brown
			D		SM		
5							
							Stopped backhoe at 7'6"
10							

LOG OF TEST PIT NO. TP-18

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist	SILTY, SANDY CLAY, trace of fine, angular gravel, weakly cemented below 1', weakly to moderately cemented below 3', low to medium plasticity, brown
			D		CL		
5							
							Stopped backhoe at 5'6" on strongly cemented material
10							

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-11-82

LOG OF TEST PIT NO. TP-19

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		ML	very slightly moist	SANDY SILT, trace of clay & gravel, low plasticity, brown
5		X	D	2	SW-SM	very slightly moist	SILTY SAND, considerable angular to subrounded gravel in lenses, well graded, stratified, nonplastic, brown note: occasional thin 2½" sandy silt lenses
							Stopped backhoe at 7'6"
10							

DATE 10-12-82

LOG OF TEST PIT NO. TP-20

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0		X	D		CL	very slightly moist	SILTY CLAY, some sand, small amount of fine, angular to subrounded gravel, weakly lime cemented below 1', medium plasticity, light brown
5		X	D		SW-SM	slightly moist	SAND, some lenses of silty sand & gravel, predominantly well graded, angular to subangular, stratified, nonplastic, light brown
					CL	very slightly moist	SILTY CLAY, some sand & gravel, weakly to moderately lime cemented, medium plasticity, light brown to brown
							Stopped backhoe at 7'6"
10							

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-21

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, considerable sand, some fine gravel, weakly lime cemented below 1', medium plasticity, light brown
5			D	5	SC	slightly moist	CLAYEY SAND, some fine gravel, weakly lime cemented, stratified, medium plasticity, light brown
			D		SM	slightly moist	SILTY SAND, some lenses of clayey sand, silty sand & gravel, predominantly well graded, angular to subangular, stratified, low plasticity, brown
10							Stopped backhoe at 8'

DATE 10-12-82

LOG OF TEST PIT NO. TP-22

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, trace of fine gravel, medium plasticity, brown
5			D		CL	very slightly moist	SILTY CLAY, some sand, small amount of gravel, weakly to moderately lime cemented, medium plasticity, light brown
10							Stopped backhoe at 6'

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-23

Backhoe Type: Case 580C

Location:

Elevation:

Datum:

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, small amount of fine gravel, medium plasticity, light brown
			D		CL	slightly moist	SILTY CLAY, some sand & gravel, weakly to moderately lime cemented, medium plasticity, light brown
5							Stopped backhoe at 5'

E 10-12-82

LOG OF TEST PIT NO. TP-24

Backhoe Type: Case 580C

Location:

Elevation:

Datum:

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand, small amount of fine, angular to subangular gravel, weakly lime cemented below 3', medium to high plasticity, brown
5			D		SC	slightly moist	CLAYEY SAND, considerable fine, angular to subrounded gravel in lenses, predominantly well graded, weakly cemented, stratified, low to medium plasticity, brown
10							Stopped backhoe at 8'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-25

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						moist to slightly moist	SILTY CLAY, some sand, trace of fine gravel, weakly lime cemented below 2', medium plasticity, light brown to brown
			D	8	CL		
5							
			D		SM	slightly moist	SILTY SAND, some clay, predominantly fine to medium grained, stratified, low plasticity, brown
10							Stopped backhoe at 8'

E 10-12-82

LOG OF TEST PIT NO. TP-26

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CH	moist	SILTY CLAY, some sand & fine gravel, medium to high plasticity, dark brown
			D		CL	slightly moist	SILTY CLAY, some sand & fine gravel, weakly lime cemented, medium plasticity, brown
5			D		SM	slightly moist	SILTY SAND, considerable gravel in lenses, some clay, predominantly fine to medium grained, well graded, angular to subangular, stratified, low plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-27

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist	CLAYEY SILT, some sand & fine gravel in thin lenses, low plasticity, light brown
			D	4	ML		
5							
							Stopped backhoe at 8'
10							

10-12-82

LOG OF TEST PIT NO. TP-28

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist	SILTY CLAY, some fine sand & gravel, weakly lime cemented below 1½', medium plasticity, light brown
			D	9	CL		
5						very slightly moist	SILTY SAND, some fine, angular to subangular gravel, predominantly fine to medium grained, weakly cemented, stratified, low plasticity, light brown
			D		SM		
							Stopped backhoe at 7'6"
10							

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-29

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	very slightly moist	SILTY CLAY, some sand & gravel in lenses, low to medium plasticity, light brown
5			D		CL	slightly moist	SILTY CLAY, some sand & fine gravel, weakly lime cemented, medium plasticity, brown
10							Stopped backhoe at 7'6"

10-12-82

LOG OF TEST PIT NO. TP-30

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	6	CL	slightly moist	SILTY, SANDY CLAY, some lenses of silty sand with considerable clay & clayey sand, small amount of fine, angular to subangular gravel, moderate stratification, low to medium plasticity, brown
5					CL	slightly moist	SILTY CLAY, considerable sand, weakly to moderately lime cemented, medium plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-12-82

LOG OF TEST PIT NO. TP-31

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	very slightly moist	SILTY CLAY, considerable sand, some fine, angular to subangular gravel, medium plasticity, light brown
			D		SC	moist	CLAYEY SAND, considerable gravel, well graded, angular to subangular, weakly lime cemented, stratified, medium plasticity, dark brown
5			D		CH	moist	SILTY CLAY, some sand & fine gravel, weakly to moderately lime cemented, medium to high plasticity, dark brown to brown
10							Stopped backhoe at 7'

DATE 10-13-82

LOG OF TEST PIT NO. TP-32

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	4	ML	slightly moist	CLAYEY SILT, some sand & fine, angular to subangular gravel, weakly lime cemented below 2', low plasticity, light brown
			D		CH	moist	SILTY CLAY, some fine sand & well graded sand in pockets, weakly lime cemented, high plasticity, dark brown
			D		CL		
5					CL	slightly moist	SILTY CLAY, some sand & fine gravel, weakly lime cemented, medium plasticity, brown
						slightly moist	SILTY CLAY, considerable angular to subangular gravel, some sand, weakly to moderately lime cemented, moderately stratified, medium plasticity, brown
10							Stopped backhoe at 6'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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JOB NO. E82-111 DATE 10-13-82

LOG OF TEST PIT NO. TP-33

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		GM	very slightly moist	SILTY SAND & GRAVEL, occasional cobbles up to 4" in diameter, well graded, nonplastic to very low plasticity, light brown
5			D	5	CL	slightly moist	SILTY CLAY, some sand & fine to medium gravel, occasional pocket of medium to high plasticity clay & occasional pocket of clayey sand, weakly lime cemented below 5', moderately stratified, low plasticity, brown to light brown
10							Stopped backhoe at 7'6"

DATE 10-13-82

LOG OF TEST PIT NO. TP-34

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		ML	slightly moist	CLAYEY SILT, some sand & fine gravel, low plasticity, brown
			D		GM	very slightly moist	SILTY SAND & GRAVEL, well graded, angular to subangular, moderately stratified, nonplastic to very low plasticity, brown note: test pit walls caved
5			D		CL	slightly moist	SILTY CLAY, small amount of sand & fine gravel, weakly lime cemented, medium plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-13-82

LOG OF TEST PIT NO. TP-35

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0						very slightly moist to slightly moist	SILTY SAND, considerable gravel, well graded, angular to subangular, moderately stratified, nonplastic, brown note: wall caving
			D	1	SW-SM		
5							
			D		ML	very slightly moist	CLAYEY SILT, some fine sand, weakly lime cemented, low plasticity, light brown
10							Stopped backhoe at 9'

E 10-13-82

LOG OF TEST PIT NO. TP-36

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	very slightly moist	SILTY CLAY, some sand & fine, angular gravel, weakly lime cemented below 1', medium plasticity, brown
			D	3	GC	very slightly moist	CLAYEY GRAVEL & SAND, some cobbles up to 1' in diameter, well graded, angular to subangular, weakly lime cemented, moderately stratified, nonplastic to low plasticity, brown
5							
10							Stopped backhoe at 7'

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-13-82

LOG OF TEST PIT NO. TP-37

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D		CL	slightly moist	SILTY CLAY, some sand & fine gravel, weakly lime cemented below 2', medium plasticity, brown
5			D		GM	very slightly moist	SILTY GRAVEL & SAND, some cobbles, well graded, angular to subangular, very weakly lime cemented, moderately stratified, nonplastic, light brown note: decrease in gravel & cobbles below 6'
10							Stopped backhoe at 7'6"

E 10-13-82

LOG OF TEST PIT NO. TP-38

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0					ML	very slightly moist	SANDY SILT, low plasticity, brown
			D	1	GP-GM	very slightly moist	GRAVEL, considerable silt & sand, cobbles to 1½' in diameter, well graded, angular to subangular, stratified, nonplastic, brown note: wall caving
5					GC	slightly moist	CLAYEY SAND & GRAVEL, considerable silt, well graded, angular to subangular, stratified, low plasticity, brown
10							Stopped backhoe at 7'6"

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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PROJECT McMicken Dam Restoration Study

JOB NO. E82-111 DATE 10-13-82

LOG OF TEST PIT NO. TP-39

Backhoe Type Case 580C

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			D	4	CL	slightly moist	SILTY CLAY, considerable sand & gravel, weakly lime cemented below 1½', medium plasticity, brown
5			D		GM	very slightly moist	SILTY GRAVEL & SAND, some cobbles, well graded, angular to subangular, weakly lime cemented, moderately stratified, nonplastic to very low plasticity, light brown
							Stopped backhoe at 6'6"
10							

DATE

LOG OF TEST PIT NO.

Backhoe Type

Location

Elevation

Datum

GROUND WATER

DEPTH	HOUR	DATE

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Per Cent of Dry Wt.	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION

SAMPLE TYPE
B — Undisturbed Block Sample
D — Disturbed Bulk Sample

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McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-1 October 19, 1982

Station 467+25
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 3.0 feet	Silty, sandy clay, firm, very moist, trace of fine, subangular to angular gravel, medium to low plasticity, brown Cementation Properties Very weakly lime cemented
3 - 4.5 feet	Clayey sand, hard, slightly moist, considerable silt & gravel, well graded, angular to subangular, weakly stratified, low to medium plasticity, gray Cementation Properties Moderately to strongly lime cemented, all space between grains has been filled with cement
4.5 - 10.5 feet	Silty sand, firm, slightly moist, some clayey sand in thin lenses, some clean sand in thin lenses, considerable angular to subangular gravel in lenses, well graded, stratified, nonplastic to medium plasticity, light brown to tan Cementation Properties Weakly clay cemented throughout, some extension of lime cemented unit above into this unit

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-2 October 19, 1982

Station 435+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.0 feet

Depth	Description
0 - 3.5 feet	Silty, sandy clay, firm to very firm, slightly moist, considerable gravel, medium plasticity, brown Cementation Properties Very weakly lime cemented
3.5 - 6.5 feet	Silty clay, very firm, slightly moist, some sand & fine gravel, medium plasticity, brown Cementation Properties Weakly to moderately lime cemented throughout with occasional nodules that have been strongly cemented
6.5 - 8.0 feet	Transition zone: clayey sand, firm, slightly moist, considerable fine gravel, well graded, low plasticity, brown Cementation Properties Generally weakly to moderately lime cemented, with a decrease in cementation with depth
8.0 - 11.0 feet	Sand & clayey sand, moderately firm, moist, considerable fine, angular to subangular gravel in lenses, well graded, stratified, nonplastic to low plasticity, brown

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-2 (Cont'd.) October 19, 1982

Station 435+00
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 11.0 feet

Cementation Properties

Weakly clay cemented with occasional thin lenses of lime cementation

8 - 9 feet deep intrusion of moderately to strongly lime cemented unit into weakly clay cemented unit.

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-3 October 19, 1982

Station 390+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.5 feet

Depth	Description
0 - 3.0 feet	Sandy clay, firm to hard, slightly moist, some to considerable gravel, medium to high plasticity, brown Cementation Properties Weakly lime cemented in filaments
3.0 - 4.0 feet	Clayey sand, firm, slightly moist, considerable gravel, well graded, angular to subangular, low plasticity, brown Cementation Properties Weakly lime cemented with occasional soft, weakly cemented nodules
4.0 - 7.5 feet	Silty clay, very firm to hard, moist, some sandy clay in pockets, medium to high plasticity, brown Cementation Properties Occasional thin filaments of lime cementation
7.5 - 9.0 feet	Sandy clay, very firm, moist, low to medium plasticity, brown

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-3 (Cont'd.) October 19, 1982

Station 390+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.5 feet

Cementation Properties

Weakly lime cemented

9.0 - 11.5 feet Clayey sand, firm to moderately firm, moist, considerable silt, considerable gravel in lenses, well graded, angular to subangular, stratified, low to medium plasticity, brown

Cementation Properties

Weakly clay cemented, occasional filaments of lime cementation

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-4 October 19, 1982

Station 345+00
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 11.5 feet

Depth	Description
0 - 5.0 feet	Sandy silt, firm to moderately firm, slightly moist to dry, some clay, small amount of gravel, low plasticity, light brown Cementation Properties Very weakly lime cemented
5.0 - 9.0 feet	Clayey sand, firm, moist, some gravel in lenses, well graded, angular to subangular, low to medium plasticity, reddish-brown Cementation Properties No cementation
9.0 - 10.5 feet	Silty clay, very firm, moist, considerable fine sand, low to medium plasticity, brown Cementation Properties Occasional thin filaments of lime cementation
10.5 - 11.5 feet	Silty sand, firm, moist, some gravel, small amount of clay, predominantly

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-4 (Cont'd.) October 19, 1982

Station 345+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.5 feet

Depth	Description
10.5 - 11.5 feet	fine to medium grained, nonplastic to low plasticity, brown
	Cementation Properties
	No cementation

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-5 October 19, 1982

Station 290+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 6.0 feet	Silty clay, very firm to hard, slightly moist, some sand, small amount of fine gravel, medium plasticity, brown to light brown Cementation Properties Weakly lime cemented throughout, occasional soft to hard cemented nodules, mottled light gray and brown appearance due to cementation
6.0 - 10.5 feet	Silty sand, firm to very firm, moist, considerable gravel below 9 feet, some clay, predominantly fine to medium grained with some well graded lenses, angular to subangular, low plasticity, gray to brown Cementation Properties Weakly clay cemented

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

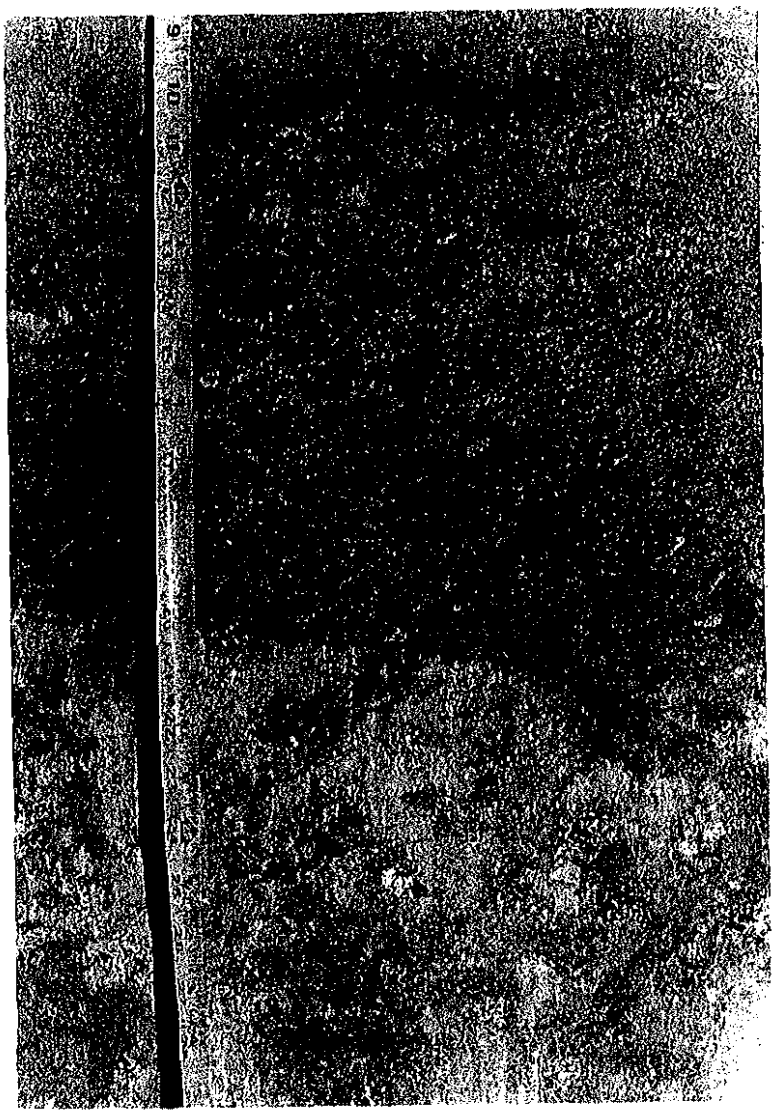
Log of Test Trench TT-6 October 19, 1982

Station 243+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 9.0 feet (refusal)

Depth	Description
0 - 2.0 feet	Silty clay, firm, moist, some sand, medium plasticity, brown Cementation Properties No cementation
2.0 - 3.5 feet	Silty & clayey sand, firm to very firm, slightly moist, small amount of fine gravel, well graded, medium to low plasticity, brown to light brown Cementation Properties Very weakly lime cemented
3.5 - 9.0 feet	Silty clay, very hard, slightly moist, some sand & gravel, medium plasticity, gray Cementation Properties Moderately to strongly lime cemented throughout, similar to soft rock in character



2 - 3 feet deep contact between uncemented soils & underlying cemented soils.

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-7 October 20, 1982

Station 185+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 2.5 feet	Silty sand, firm, slightly moist, some gravel, well graded, angular to subangular, nonplastic to very low plasticity, light brown Cementation Properties No cementation
2.5 - 10.5 feet	Clayey silt, firm to hard, slightly moist, silty clay in thin lenses, occasional pockets of silty sand, low to medium plasticity, light brown Cementation Properties Weakly lime cemented above 7.5 feet, weakly to moderately lime cemented below 7.5 feet, cement filaments are abundant in places and absent in other places

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-8 October 20, 1982

Station 135+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 9.5 feet (refusal)

Depth	Description
0 - 6.0 feet	Silty sand & gravel, loose, slightly moist, well graded, angular to subangular, stratified, nonplastic, light brown, considerable caving within this unit Cementation Properties No cementation
6.0 - 9.5 feet	Silty clay, hard, slightly moist, some sand, low to medium plasticity, brown Cementation Properties Weakly to moderately lime cemented throughout in long, thin filaments and in small, soft nodules

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-9 October 20, 1982

Station 85+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.5 feet

Depth	Description
0 - 11.5 feet	Silty sand & gravel, loose, slightly moist, occasional interbedded lenses of very firm to hard silt & silty clay, some cobbles to 2 feet in diameter, well graded with some poorly graded lenses, angular to subangular, stratified, non-plastic to low plasticity, light brown, considerable caving within the upper 8 feet of this unit Cementation Properties Below 8 feet, the lenses of fine grained material are weakly lime cemented; below 10 feet, the lenses of coarse grained material are also weakly lime cemented

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-10 October 20, 1982

Station 110+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 6.5 feet (refusal)

Depth	Description
0 - 2.5 feet	Clayey, silty sand, firm, slightly moist, some fine gravel, predominantly fine grained, low plasticity, brown Cementation Properties No cementation
2.5 - 3.5 feet	2 inch cap of sandy gravel over a sandy silt, hard to firm, slightly moist, low plasticity, light brown Cementation Properties Sandy gravel cap in moderately lime cementation; sandy silt is weakly lime cemented throughout
3.5 - 5.5 feet	Clayey sand & gravel, hard, slightly moist, well graded, angular to subangular, stratified, low plasticity, light brown Cementation Properties Moderately lime cemented throughout, soils are partially coated and there are thin filaments & small nodules of soft lime cementation

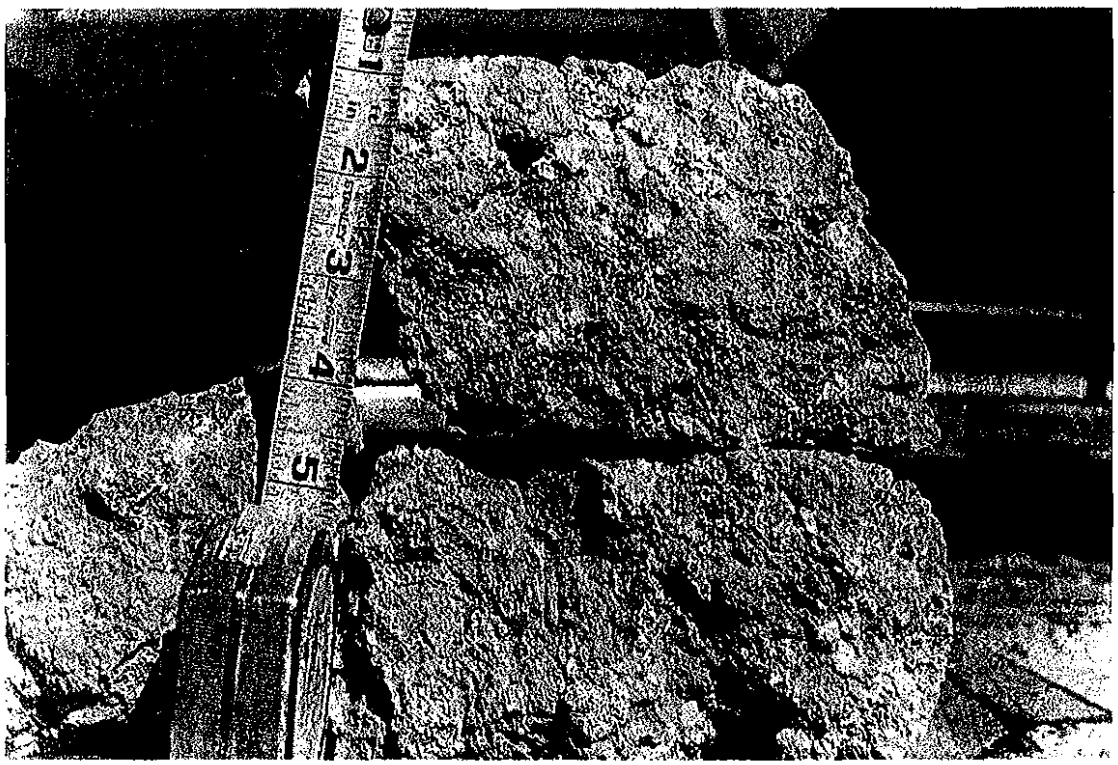
McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-10 (Cont'd.) October 20, 1982

Station 110+00
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 6.5 feet (refusal)

Depth	Description
5.5 - 6.5 feet	Silty clay, hard, slightly moist, medium plasticity, brown Cementation Properties Moderately to highly lime cemented throughout, mottled appearance from small nodules of soft lime cementation



Samples from 6 - 6.5 feet deep. Samples of moderately to strongly lime cemented silty clay. Mottled appearance due to small nodules of soft lime cement.

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-11 October 20, 1982

Station 160+00
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 9.5 feet

Depth	Description
0 - 1.5 feet	Silty sand, moderately firm, dry to slightly moist, some fine gravel, predominantly fine grained, subangular, nonplastic, light brown Cementation Properties No cementation
1.5 - 3.5 feet	Silty clay, firm, slightly moist, some fine sand, trace of fine gravel, medium plasticity, brown Cementation Properties Weakly lime cemented throughout as fine filaments & small vugs; & near vertical fissures as a coating
3.5 - 4.5 feet	Sandy silt, soft, dry, some fine to medium grained sand in thin lenses, nonplastic to low plasticity, tan Cementation Properties No cementation
4.5 - 9.5 feet	Sandy clay, hard, slightly moist, low to medium plasticity, brown

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-11 (Cont'd.) October 20, 1982

Station 160+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 9.5 feet

Cementation Properties

Moderately lime cemented throughout, predominantly as veinlets & thin filaments

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-12 October 20, 1982

Station 210+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 9.5 feet

Depth	Description
0 - 3.5 feet	Silty & clayey sands, moderately firm to firm, slightly moist, some fine, subangular gravel, well graded, nonplastic to low plasticity, brown Cementation Properties No cementation
3.5 - 5.5 feet	Silty sand & gravel, hard, dry, considerable cobbles from 4.5 to 5.5 feet, gap graded, subangular to subrounded, nonplastic, light gray to white Cementation Properties Weakly to moderately lime cemented, cementation occurs in the clayey silt matrix, in areas where matrix is missing, cementation is also missing
5.5 - 9.5 feet	Silty sand & gravel, loose, dry, well graded, subangular, crudly stratified, nonplastic, gray Cementation Properties No cementation from 5.5 to 8.5 feet, weakly lime cemented below 8.5 feet

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-13 October 20, 1982

Station 265+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 4.5 feet	Silty sand, soft to moderately firm, slightly moist, some gravel, 8 inch sandy gravel lens at the base of this unit, predominantly fine grained, well graded, bottom 8 inches crudly stratified, nonplastic to low plasticity, brown Cementation Properties Small amount of lime cementation occurs as a coating on some of the coarse grained material
4.5 - 7.5 feet	Silty clay, very firm to hard, moist, considerable fine sand, medium plasticity, light reddish-brown Cementation Properties Weakly lime cemented by thin filaments & coatings on fracture surfaces
7.5 - 10.5 feet	Clayey sand, hard, slightly moist, some fine, subangular gravel, well graded, medium plasticity, light tan Cementation Properties Moderately lime cemented throughout, mottled appearance due to cementation

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-14 October 20, 1982

Station 315+00
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 10.0 feet

Depth	Description
0 - 1.5 feet	Silty sand, soft, slightly moist, trace of gravel, fine to medium grained, low plasticity to nonplastic, light brown Cementation Properties No cementation
1.5 - 10.0 feet	Clayey sand, moderately firm to hard, slightly moist, some gravel, well graded, stratified, medium plasticity, reddish-brown Cementation Properties From 1.5 to 6 feet, there is weak lime cementation throughout, there are moderately to strongly cemented nodules up to 1.5 inches in diameter above 3 feet, & a stratification of cementation from 3 to 6 feet, from 6 to 7 feet there is no cementation & below 7 feet there is weak lime cementation

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

1.5 - 3 feet moderately to strongly lime cemented nodules in clayey sand.

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-15 October 22, 1982

Station 302+50
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 10.5 feet

Depth	Description
0 - 3.0 feet	Silty clay, firm to very firm, moist, considerable sand, medium plasticity, brown Cementation Properties Weakly lime cemented below 2 feet, predominantly in filaments
3.0 - 6.5 feet	Clayey sand, hard, slightly moist, some fine to medium, subangular gravel, well graded, low plasticity, light brown to gray Cementation Properties Moderately lime cemented throughout
6.5 - 10.5 feet	Silty sand, hard, slightly moist, considerable fine to medium, subangular to subrounded gravel in lenses, predominantly well graded, stratified, nonplastic to low plasticity, reddish-brown Cementation Properties Weakly clay cemented throughout, small amount of lime cementation in veinlets

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-16 October 22, 1982

Station 330+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 5.0 feet	Silty clay, very firm to hard, slightly moist to moist, considerable fine sand, small amount of fine gravel, medium plasticity, brown Cementation Properties Weakly lime cemented below 1 foot, some strongly cemented nodules below 3.5 feet, mottled appearance due to nodules & soft blotches of lime cementation
5.0 - 6.0 feet	Clayey sand, hard, moist, considerable gravel, predominantly fine to medium grained, weakly stratified, low to medium plasticity, light brown Cementation Properties Moderately lime cemented throughout
6.0 - 10.5 feet	Silty sand, loose to hard, moist to slightly moist, considerable gravel in lenses, occasional lenses of clean, loose sands, predominantly well graded, with lenses of predominantly fine & fine to medium grained sand, stratified, nonplastic to low plasticity, light brown

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-16 (Cont'd.) October 22, 1982

Station 330+00
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Cementation Properties

Most of this unit is weakly clay cemented, there is some weak lime cementation between 6 and 8 feet, & there are lenses without any cementation

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-17 October 22, 1982

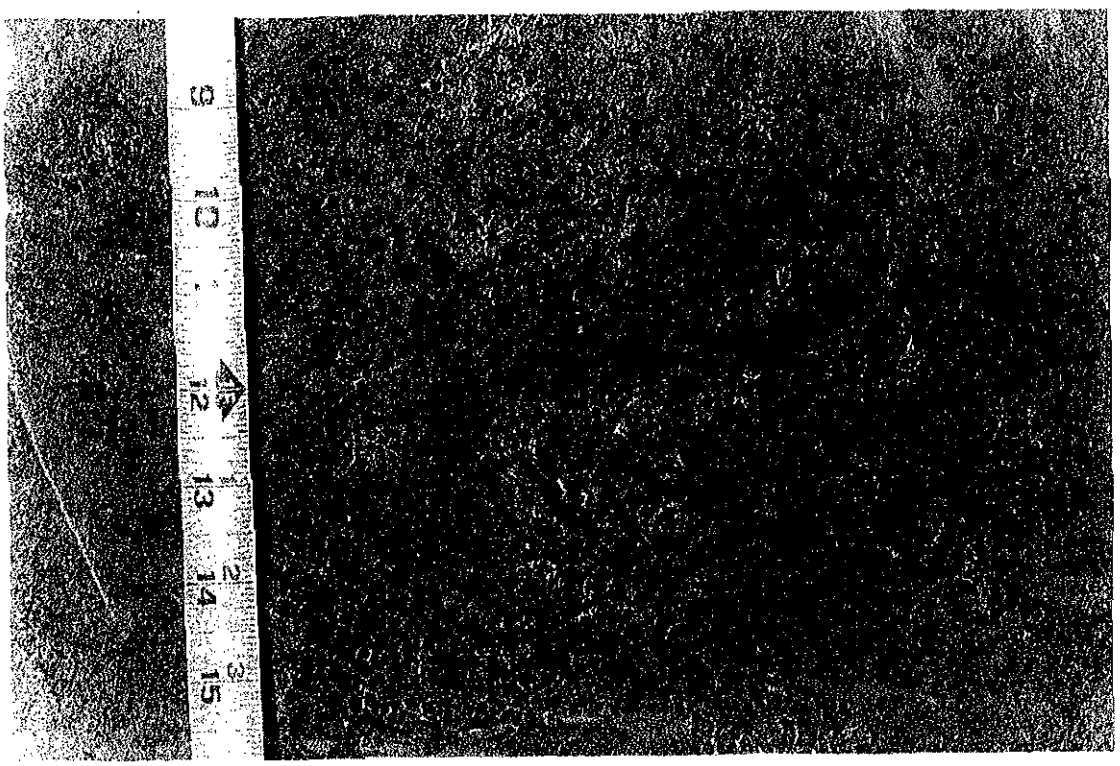
Station 362+85
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 11.0 feet

Depth	Description
0 - 5.5 feet	Silty clay, very firm, slightly moist, some sand, trace of fine gravel, medium plasticity, brown to light brown Cementation Properties Weakly lime cemented from 1 to 3.5 feet, moderately lime cemented below 3.5 feet, all cementation in thin filaments
5.5 - 11.0 feet	Clayey sand, loose to hard, slightly moist, considerable gravel in lenses, occasional lenses of clean sand & silty sand, predominantly well graded, angular to subangular, stratified, nonplastic to low plasticity, reddish-brown Cementation Properties Weakly to moderately clay cemented throughout most of the unit, some weak lime cementation from 5.5 to 7 feet, some uncemented lenses throughout

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111



3 - 4 feet deep. Silty clay with filaments of lime cementation.

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-18 October 22, 1982

Station 375+20
Downstream Toe

Equipment Type: Case 580C Backhoe
Total Depth of Trench: 10.5 feet

Depth	Description
0 - 6.0 feet	Silty clay, firm to hard, slightly moist, considerable sand, some fine gravel, medium to low plasticity, brown to light brown Cementation Properties Weakly lime cemented below 2.5 feet, occasional moderately hard to hard lime cemented nodules
6.0 - 7.5 feet	Clayey sand & gravel, hard, slightly moist, well graded, subangular, weakly stratified, low plasticity to nonplastic, reddish-brown Cementation Properties Moderately lime cemented, some clay cementation also
7.5 - 10.5 feet	Sandy clay, hard, slightly moist, considerable silt, some clayey sand in pockets, weakly stratified, low to medium plasticity, light reddish-brown Cementation Properties Moderately lime cemented throughout, with occasional soft lime nodules giving a mottled appearance

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

Log of Test Trench TT-19 October 22, 1982

Station 412+50
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
0 - 2.0 feet	Sandy clay, firm, slightly moist, considerable lenses of clayey sand, considerable fine, subangular to subrounded gravel, weakly stratified, low plasticity, light brown Cementation Properties No cementation
2.0 - 3.5 feet	Silty clay, very firm, moist, some sand, medium to high plasticity, dark brown Cementation Properties Very weakly lime cemented
3.5 - 8.0 feet	Clayey sand, hard, slightly moist, considerable sandy clay in pockets, some fine to medium, subangular gravel, predominantly fine to medium grained, low to medium plasticity, brown to light brown Cementation Properties Moderately lime cemented throughout, with occasional moderately to strongly cemented nodules giving a mottled appearance

McMicken Dam Restoration Study
Maricopa County, Arizona
SHB Job No. E82-111

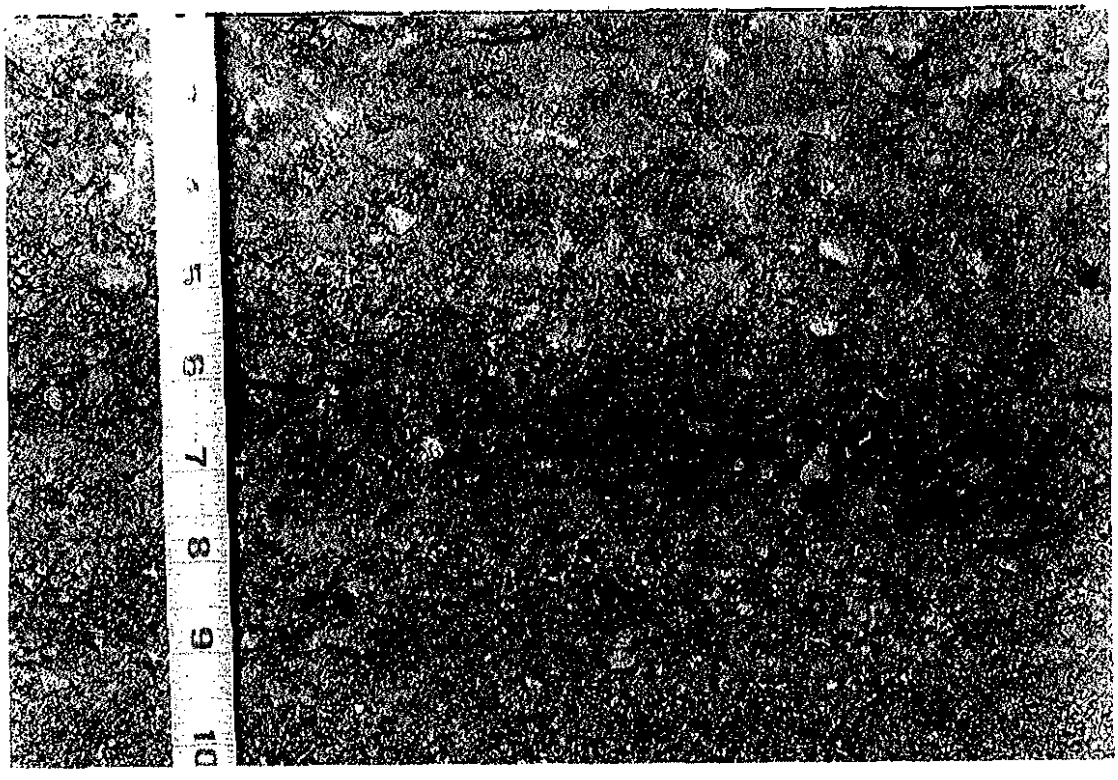
Log of Test Trench TT-19 (Cont'd.) October 22, 1982

Station 412+50
Downstream Toe

Equipment Type: Case 580C Backhoe

Total Depth of Trench: 10.5 feet

Depth	Description
8.0 - 10.5 feet	Clayey sand, medium to loose to hard, slightly moist, considerable silty sand in lenses, some lenses of clean sand, considerable angular to subangular gravel in lenses, well graded, stratified, nonplastic to low plasticity, reddish-brown
	Cementation Properties
	Weakly lime cemented from 8 to 9 feet, primarily as a coating on grains, moderately clay cemented in many lenses, some lenses are uncemented



9 - 10 feet deep. Weakly clay cemented clayey sand, some weakly lime cemented lenses near top of picture.

AMEC GEOTECHNICAL & EARTH FISSURE INVESTIGATIONS (2003)

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 200+00, East of Maintenance road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-6-9			SC-SM	slightly moist moderately firm to firm	**SILTY TO CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, predominantly fine grained, subangular to subrounded, weakly lime cemented, low to medium plasticity, reddish brown
				U	15	110	2			note: some well graded gravel from 5' to 8'6"
										note: decrease in clay content below 8'6"
5				U	30	100	3			
10				U	37	107	3			
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-1

BORING LOG 0117122.GPJ AGRA_PHX.GDT 10/2/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 210+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-8-8			CL	slightly moist firm to moderately firm	**SANDY CLAY**, fine grained sand, weakly lime cemented, low to medium plasticity, reddish brown
				U	42	96	6			
5				U	17 NR					
								SP	slightly moist dense	**SAND**, trace of clay, trace to some predominantly fine grained, subangular to subrounded gravel, predominantly medium to coarse grained, subangular to subrounded, nonplastic, brown
				U	63					
10								SC	slightly moist	**CLAYEY SAND** predominantly fine grained, weakly to moderately lime cemented, low to medium plasticity, reddish brown
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-2

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 220+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-11-11			CL	slightly moist firm to hard	**SANDY CLAY**, trace of fine grained, subangular to subrounded gravel, fine grained sand, low to medium plasticity, reddish brown note: cementation below 4'6"
				U	35	94	5			
5				U	100/10"					
								SC-SM	slightly moist hard	**CLAYEY SAND TO SILTY SAND** predominantly medium to fine grained, moderately to strongly lime cemented, low plasticity, reddish brown to light brown
10				U	100/9"					Stopped Auger at 9'6" Stopped Sampler at 10'3"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-3

RING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 230+00, East of Maintenance Road

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-10-9			SC	slightly moist firm to soft	**CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, predominantly fine grained, low to medium plasticity, reddish brown note: cemented nodules
				U	11	99	4			
								SM	slightly moist hard	**SILTY SAND** predominantly fine grained, low plasticity, light brown
5				U	80 NR					
								SM-ML	slightly moist hard	**SILTY SAND TO SANDY SILT** predominantly fine grained sand, low plasticity, light brown
10				U	100/12"					
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▽			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-4

ING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 240+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-6-6			SC	slightly moist moderately firm to firm	**CLAYEY SAND** predominantly medium to fine grained, weakly lime cemented, low to medium plasticity, reddish brown
				U	50					
								CL	slightly moist firm	**SANDY CLAY**, fine to medium grained, subangular to subrounded sand, weakly lime cemented, low plasticity, brown
5				U	36	89	6			
								SP-SM	slightly moist firm to very firm	**SAND TO SILTY SAND** predominantly fine grained sand, nonplastic to low plasticity, light brown
10				U	68					
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-5

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 250+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-7-8			SC	slightly moist moderately firm	**CLAYEY SAND** predominantly medium to fine grained, weakly lime cemented, low to medium plasticity, reddish brown to brown note: small diameter roots from 0 to 1'
								ML	slightly moist firm to very firm	**SANDY SILT**, trace of clay, predominantly fine grained, weakly to moderately lime cemented, low plasticity, brown to light brown
				U	32	92	6			
5				U	40	96	6			
10				U	42	94	7			
15										Stopped Auger at 9'6" Stopped Sampler at 10'6"
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-6

BORING LOG 0117122.GPJ AGRA_PHX.GDT 10/2/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 260+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	8-18-16			SC	slightly moist very firm to soft	**CLAYEY SAND** predominantly medium to fine grained, low to medium plasticity, reddish brown to brown note: weakly to moderately lime cemented from 1' to 2'6"
				U	10					
5				U	17	100	7			
								CL	slightly moist	**SANDY CLAY**, predominantly fine grained sand, weakly lime cemented, low to medium plasticity, brown to reddish brown
								SC	moderately firm to firm	
				U	40				slightly moist firm	**CLAYEY SAND** predominantly medium to fine grained, weakly lime cemented, low to medium plasticity, brown to reddish brown to brown note: decrease in clay with depth
10										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▽			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-7

BORING LOG 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 292+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	4-8-9			CL	slightly moist firm to very firm	**SANDY CLAY**, predominantly fine grained, low to medium plasticity, reddish brown note: weakly to moderately lime cemented from 2' to 4'6"
				U	72	98	5			
5				U	63			SM	slightly moist very firm	**SILTY SAND**, predominantly medium to fine grained, low plasticity, light brown to brown
								SP		**SAND**, trace of clay, trace to some predominantly fine grained, subrounded to subangular gravel, predominantly medium grained, weakly lime cemented, reddish brown
10				U	39					
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-8

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 302+[illegible], East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-11-13			CL	slightly moist firm	**SANDY CLAY**, predominantly medium to fine grained sand, low to medium plasticity, reddish brown note: weakly to moderately lime cemented below 2'
				U	47	96	5			
				U	67					
5								SP-SC	slightly moist medium dense	**SAND TO CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, predominantly medium grained, low plasticity, brown to reddish brown
								SC	slightly moist firm	**CLAYEY SAND** trace of fine grained gravel, predominantly fine grained, weakly lime cemented, low plasticity, brown
								SP	slightly moist very dense	**SAND & GRAVEL**, trace of clay, predominantly fine grained, subrounded to subangular gravel, predominantly medium to coarse grained, subangular to subrounded sand, nonplastic, brown to reddish brown
				U	78					
10										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-9

_ORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 312+00, East of Maintenance Road

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-8-12			SC	slightly moist firm	**CLAYEY SAND**, trace of fine grained, subangular to subrounded gravel, predominantly fine grained, low to medium plasticity, brown to reddish brown note: predominantly fine grained & weakly lime cemented below 2'6"
				U	39					
5				U	60	107	4			
								SM	slightly moist very firm to hard	**SILTY SAND**, predominantly fine grained, weakly to moderately lime cemented, low plasticity, light brown to brown note: trace of clay below 8'
10				U	100/10 1/2"					
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-10

/ING LOG 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 420+05, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-6-5			SM	slightly moist moderately firm	**SILTY SAND**, predominantly fine grained sand, low plasticity, brown
				U	20	99	6	SC	slightly moist moderately firm	**CLAYEY SAND**, trace of fine grained, subangular to subrounded gravel, predominantly medium to fine grained, low plasticity, brown note: weakly lime cemented below 4' with cemented nodules
5				U	17	95	5	CL	slightly moist moderately firm	**SANDY CLAY**, fine grained sand, weakly cemented, low plasticity, brown
10				U	62			SC	slightly moist very firm	**CLAYEY SAND & GRAVEL**, trace of silt, predominantly fine grained, subangular to subrounded gravel, predominantly fine grained, weakly lime cemented, low plasticity, brown to light brown
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-11

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/3/01

LOCATION Sta. 430+10, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	2-7-15			SC	slightly moist moderately firm to firm	**CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, predominantly medium to fine grained, low to medium plasticity, brown note: small diameter roots from 0 to 1' note: weakly lime cemented below 1'6" note: predominantly fine grained below 3'
				U	16	102	3			
								CL	slightly moist moderately firm	**SANDY CLAY** fine grained sand, weakly cemented, low plasticity, brown
5				U	17	93	5			
								SC	slightly moist firm	**CLAYEY SAND & GRAVEL** predominantly fine grained, subangular to subrounded gravel, well graded sand, weakly lime cemented, low to medium plasticity, reddish brown
10				U	41		3			
										Stopped Auger at 9'6" Stopped Sampler at 10'6"
15										
20										
25										

BORING LOG 01171122.GPJ AGRA_PHX.GDT 10/2/01

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-12

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 440+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	6-6-11			SC	slightly moist	**CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, well graded sand, low to medium plasticity, brown to reddish brown
								SC	firm	
				U	37				slightly moist	**CLAYEY SAND** predominantly fine grained, weakly to moderately lime cemented, low to medium plasticity, reddish brown
									firm to very firm	
5				U	60	97	5			
								SP-SM	slightly moist	**SAND TO SILTY SAND** trace to some predominantly fine grained, subangular to subrounded gravel, predominantly medium grained, subangular to subrounded, low plasticity, light brown
10				U	14		2		loose to medium dense	
								SM	slightly moist	**SILTY SAND** some well graded, subangular to subrounded gravel, predominantly medium to fine grained, weakly lime cemented, low plasticity, light brown
									moderately firm to firm	
								SP	slightly moist	**SAND**, trace of silt, trace of predominantly fine grained, subangular to subrounded gravel, predominantly medium grained, subangular to subrounded, brown
15				U	61				dense	
										Stopped Auger at 14'6" Stopped Sampler at 15'6"
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-13

_ORING LOG 0117122.GPJ AGRA_PHX.GDT 10/2/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 450+00, East of Maintenance Road

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	7-24-16			SC	slightly moist moderately firm to very firm	**CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, well graded, subangular to subrounded, weakly lime cemented, low plasticity, brown to reddish brown note: no gravel, strong cementation, predominantly fine grained below 2' note: predominantly fine grained below 6'
				U	17					
5				U	25	109	3	SM	slightly moist firm	**SILTY SAND** trace of clay, fine to medium grained sand, moderately cemented, low plasticity, brown
10				U	24	106	7	SC	slightly moist firm	**CLAYEY SAND** trace to some fine grained gravel, subangular to subrounded, predominantly medium to coarse grained, low plasticity to nonplastic, brown
								CL	slightly moist moderately firm	**SANDY CLAY**, predominantly fine grained, weakly lime cemented, low to medium plasticity, reddish brown
15				U	65			SC	slightly moist very firm	**CLAYEY SAND** trace of fine grained gravel, subangular to subrounded gravel, predominantly fine grained, low to medium plasticity, reddish brown note: weakly to moderately lime cemented below 14'
										Stopped Auger at 14'6" Stopped Sampler at 15'6"
20										
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-14

BORING LOG 0117122.GPJ AGRA_PHX.GDT 10/2/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 460+10, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	3-5-7			SC-SM	slightly moist moderately firm to soft	**SILTY TO CLAYEY SAND** trace of fine grained gravel, subangular to subrounded gravel, predominantly fine grained, low plasticity, reddish brown note: predominantly fine grained & increase in clay content below 4'
				U	30	108	4			
5				U	11	108	3	SM	slightly moist *moderately firm*	**SILTY SAND** trace of clay, trace of fine grained, subangular to subrounded gravel, predominantly fine grained, low plasticity, reddish brown
								SP-SM		
10				U	60	105	7		*slightly moist* very firm	**SAND TO SILTY SAND** trace to some *predominantly fine grained, subrounded to* subangular gravel, predominantly medium to coarse grained, weakly lime cemented, low plasticity to nonplastic, brown to light brown
15										
20										Stopped Auger at 14'6" Stopped Sampler at 15'6"
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-15

oORING LOG 01171122.GPJ AGRA_PHX.GDT 6/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 473+30, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	9-15-23			SM CL	slightly moist moderately firm	**SILTY SAND**, predominantly medium to fine grained, low plasticity, light brown note: small diameter roots
				U	45			SC-SM	slightly moist moderately firm to firm	**SANDY CLAY**, predominantly fine grained sand, weakly lime cemented, low to medium plasticity, brown to reddish brown
5				U	30	100	5		slightly moist firm	**SILTY TO CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, reddish brown
				U	15	103	10	SM	slightly moist moderately firm	**SILTY SAND**, trace of fine grained, subangular to subrounded gravel, well graded sand, weakly lime cemented, low plasticity, light brown
15				U	50			SP SC	slightly moist medium dense slightly moist very firm	**SAND**, trace of silt, predominantly medium to coarse grained, subangular to subrounded, nonplastic, brown **CLAYEY SAND**, predominantly medium to fine grained, weakly lime cemented, low to medium plasticity, brown to reddish brown
20										Stopped Auger at 14'6" Stopped Sampler at 15'6"
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-16

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 494+00, East of Maintenance Road

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV.

DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				U	27			SC	slightly moist firm	**CLAYEY SAND** trace of fine grained, subangular to subrounded gravel, predominantly medium to fine grained, weakly lime cemented, low to medium plasticity, brown to reddish brown *note: small diameter roots in upper 1'*
				U	27	94	7			
5				U	50			SM	slightly moist hard	**SILTY SAND**, predominantly fine grained, moderately lime cemented, low plasticity, brown to light brown note: cemented nodules
10				U	25			SP	slightly moist medium dense *to dense*	**SAND**, trace of silt, trace to some fine grained, subrounded to subangular gravel, well graded, subrounded to subangular, nonplastic, brown note: filter fabric at 12' note: predominantly medium grained below 14'
15				U	45					
20										Stopped Auger at 14'6" Stopped Sampler at 15'6"
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-18

BORING LOG 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

LOCATION Sta. 503+14, East of Maintenance Road

RIG TYPE CME-75
BORING TYPE 6 5/8" Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Blows Per Foot	Graphical Log	Sample	Sample Type	Blow Count / % Recovery	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				U	17	102	5	SM	slightly moist moderately firm to firm	**SILTY SAND**, trace of clay, trace of fine grained, subrounded to subangular gravel, well graded, weakly lime cemented, low plasticity, brown
				U	35	94	6			
5				U	22	97	5	CL	slightly moist moderately firm	**SANDY CLAY**, predominantly fine grained, weakly lime cemented, low to medium plasticity, brown note: increased cementation below 6'6"
10				U	50/2"			SC	slightly moist hard	**CLAYEY SAND** trace of subrounded to subangular gravel, predominantly medium grained sand, weakly to moderately lime cemented, low plasticity, reddish brown note: strongly cemented at 9'8" note: clay content decreases from 8'6" to 9'
15										Stopped Auger at 9'6" Sampler refused at 9'8"
20										
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample
D - 2.5" O.D. 1.9" I.D. tube sample
C - 2.5" O.D. 2.0" I.D. tube sample

LOG OF TEST BORING NO. B-19

BORING LOG 0171122.GPJ AGRA_PHX.GDT 10/2/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 221+00, Crest
SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose to medium dense	Man-made FILL **SILTY SAND** trace of fine grained, subangular gravel, predominantly medium grained sand, weakly cemented, nonplastic, brown note: surficial cracks up to 7" in length, 1" deep
1			D	4	SC-SM	slightly moist to moist	**SILTY TO CLAYEY SAND** trace of subrounded to subangular, fine grained gravel, fine to medium grained, subangular sand, moderately cemented, medium plasticity, reddish brown note: 1" wide crack infilled with sand to depth of 3', small roots in narrow dessication cracks
2							
3							
4							Stopped Backhoe at 3.5'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C1

JTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 221+50, Crest
SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose to medium dense	Man-made FILL **SILTY SAND** fine to medium grained, subangular sand, weakly cemented, nonplastic, light brown note: no surficial evidence of cracks
					SC-SM		note: small horizontal cracking in upper 10"
1						slightly moist moderately firm	**SILTY TO CLAYEY SAND** predominantly medium grained, subangular sand, trace of coarse grained, subangular gravel, moderately cemented, medium plasticity, brown note: small roots from 2'6" to 3' note: some cracking up to 1" down to 2'6", cracks predominantly horizontal with some random orientation note: cementation increases with depth
2							
3							
4							Stopped Backhoe at 3.8'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C2

...GEOTECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 215+36, Crest

SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	Man-made FILL **SILTY SAND**, trace of fine grained, subrounded to subangular gravel, predominantly fine grained sand, weakly cemented, nonplastic, light brown
					SC	loose to medium dense	
1			D	4		slightly moist firm to very firm	**CLAYEY SAND**, trace of silt, trace of coarse grained, subangular gravel, predominantly fine to medium grained, subangular sand, moderately to strongly cemented with depth, low to medium plasticity, brown note: horizontal crack at 1', occasional vertical crack (up to 0.2"), block cracking in upper 1'6", evidence of wateflow, few cracks below 1'6"
2							
3							
							Stopped Backhoe at 3.3'
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C3

TECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

amec

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 215+86, Crest

SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
∇		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	Man-made FILL **SILTY SAND**, trace of fine grained, subangular gravel, predominantly medium grained, subangular sand, weakly cemented, nonplastic, light brown
					SC-SM	loose to medium dense	
1			D	4		slightly moist firm to very firm	**SILTY TO CLAYEY SAND**, predominantly fine to medium grained, subangular sand, moderately to strongly cemented, medium plasticity, reddish brown note: horizontal cracks in upper 1' (up to 0.1") note: coarse grained gravel, occasional cobble note: cementation increases with depth
2							
3							
4							
							Stopped Backhoe at 4.5'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C4

TECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

amec

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 217+57, Crest

SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose to medium dense	Man-made FILL **SILTY SAND** trace of fine grained, subrounded to subangular gravel, predominantly medium grained, subangular sand, weakly cemented, nonplastic, light brown
1			D	4	SC-SM	slightly moist moderately firm to firm	**SILTY TO CLAYEY SAND** fine to medium grained, subangular sand, moderately cemented, medium plasticity, reddish brown note: surficial cracks include two 1/2" diameter holes, horizontal separation in upper 1' (cracks) note: occasional transverse cracks filled with silty sand to depth of 2'6" note: occasional horizontal cracks down to 2'6" filled with small roots
2							
3							
4							Stopped Backhoe at 3.8'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C5

ECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 217+87, Crest
SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose to medium dense	Man-made FILL **SILTY SAND** trace of subangular gravel, predominantly medium grained, subangular sand, weakly cemented, nonplastic, light brown
1 2 3					SC	slightly moist moderately firm to firm	**SILTY TO CLAYEY SAND** fine to medium grained, subangular sand, moderately cemented, medium plasticity, reddish brown note: horizontal cracks evident at stratum change, random orientation of cracks in lower stratum, many cracks filled with roots note: very dense from 2' to 3'
4 5 6 7 8 9 10							Stopped Backhoe at 3.5'

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C6

JTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 310+75, Crest

SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			G	1	SM	slightly moist soft	Man-made FILL **SILTY SAND**, trace of gravel, fine grained, subangular to subrounded gravel, fine to medium grained, subangular sand, no cementation, nonplastic, brown to gray
			G	11	SM	slightly moist to moist	**SILTY SAND**, trace of clay, trace of gravel, fine grained, subrounded gravel, predominantly medium grained, subangular sand, weakly cemented, low plasticity, brown
1			G	5	SP-SC	soft	note: roots, very small to 2', larger root at 1'4" up to 1/4" to 1" in diameter
2					SC	slightly moist loose	**SAND**, trace of fine grained, trace of clay, subangular to subrounded gravel, predominantly medium grained sand, weakly cemented, low plasticity, light brown
3			G	4		slightly moist moderately firm	**CLAYEY SAND**, trace of gravel, fine grained, subrounded gravel, predominantly fine to medium grained, subangular sand, weakly cemented, low plasticity, light brown
4							Stopped Backhoe at 4'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C7

TECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/17/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 311+25, Crest
SURFACE ELEV. 1364'
DATUM AMEC GPS Survey

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			G	1	SM	slightly moist	Man-made FILL **SILTY SAND**, trace of gravel, fine grained, subangular gravel, predominantly medium grained sand, no cementation, nonplastic, light brown to gray
			G	10	SM		note: horizontal bedding/separation including bottom of layer
1			G	9	SC	moist	**SILTY SAND**, trace of clay, trace of fine grained, subrounded to subangular gravel, predominantly medium grained, subangular sand, weakly cemented, low plasticity, brown
					SM	moderately firm	
2			G	4		moist dense	**CLAYEY SAND**, fine grained sand, weakly cemented, medium plasticity, brown note: 1/4" roots at 1'3"
3						slightly moist medium dense	**SILTY SAND**, trace of gravel, fine grained, subrounded gravel, fine to medium grained sand, weakly cemented, nonplastic, light brown note: small roots from 1'2" to 1'10" note: 1" sandy layer from 1'5" to 1'6"
4							Stopped Backhoe at 3.5'
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-C8

TECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 232+00, E of maintenance Rd.

SURFACE ELEV.

DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SC-SM	slightly moist soft	Surficial Evidence: 84' in length, 5" maximum depth, 3' maximum width, depression is discontinouous, relatively linear **SILTY TO CLAYEY SAND** trace of gravel, fine grained, subrounded gravel, predominantly fine grained sand, weakly lime cemented, medium plasticity, brown note: upper 10" dessicated with cracks, roots up to 1/8", small roots to 2'6", 1/8" voids, evidence of water travel in cracks, increase in cementation after 2'6", increase in gravel below 2'
1			D	3			
2							
3							
4							
5							Stopped Backhoe at 4'4"
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-D1

JTECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 235+00, East of Maintenance Road

SURFACE ELEV.

DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			G	5	CL	slightly moist soft	Surficial Evidence: approximately 65' long, up to 6'6" wide & 11" deep **SANDY CLAY**, trace of silt, predominantly fine grained sand, weakly cemented, medium plasticity, brown note: roots to 1/4", increase in clay below 2'
1							
2							
3			G	9	SC	moist firm	**CLAYEY SAND** fine to medium grained, subangular sand, weakly cemented, reddish brown
4							
5			G	4	SM	slightly moist loose to medium dense	**SILTY SAND**, trace of clay, predominantly medium grained sand, weakly cemented, low plasticity, reddish brown Stopped Backhoe at 5'
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-D2

...OTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 244+00, E of maintenance Rd.

SURFACE ELEV.

DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SC	moist soft to moderately firm	Surficial Evidence: 96' long, up to 3'2" wide, 6" deep, evidence of mechanical grading **CLAYEY SAND** trace of silt, fine to medium grained, subangular sand, weakly cemented, low plasticity, brown note: increase in clay with depth roots up to 1/4" in size to 2'
1			D	5			
2							
3							
4							
5							Stopped Backhoe at 4'6"
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-D3

GTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe
LOCATION Sta. 447+06, downstream slope
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist soft	Surficial Evidence: Appears to be of animal origin **SILTY SAND**, trace of fine grained, subrounded gravel, predominantly fine grained sand, weakly cemented, nonplastic, yellow to brown note: surficial dessication note: small diameter roots
1			D		SC	slightly moist moderately firm	**CLAYEY SAND**, trace of silt, fine to medium grained sand, moderately cemented with depth, low plasticity, brown note: some calcareous clay nodules note: no subsurface evidence of cracking
2							Stopped Backhoe at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S1

JTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe

LOCATION Sta. 449+27, downstream slope

SURFACE ELEV.

DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	Surficial Evidence: 4" to 5" wide crack/hole up to 1' in length
						loose	**SILTY SAND** trace of fine grained, subangular gravel, fine to medium grained sand, weakly cemented, nonplastic, brown
							note: small diameter roots within surficial dessicaton cracks (random orientation)
1			D		SC	slightly moist	**CLAYEY SAND** trace of silt, predominantly fine grained sand, weakly to moderately cementated, low plasticity, brown
						moderately firm	note: trace of fine roots in upper portion of layer
2							note: no subsurface evidence of cracking
							Stopped Backhoe at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S2

GEOTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe
LOCATION Sta. 454+88.3, downstream slope

SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth In Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose	Surficial Evidence: Series of small hole in linear fashion. Probe up to 3'6" without force in some cracks. One large crack/hole about 0.8' long up to 1' in depth **SILTY SAND**, trace of clay, trace of fine grained, subrounded gravel, fine to medium grained sand, weakly cemented, nonplastic, brown note: small diameter roots within surficial dessication cracks (random orientation)
1			D		SC	slightly moist moderately firm	**CLAYEY SAND**, trace of gravel, fine grained, subrounded, fine to medium grained sand, weakly cemented, moderate increases with depth below 1', low to medium plasticity, brown note: significant cracking found, portions of crack up to 0.8" wide at opening, length of crack about 8' with variable depth of probing note: dessication within upper portion of layer Stopped Backhoe at 2'
2							
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S3

:CH_TP 0117122.GPJ AGRA_PHX.GDT 7/25/02

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe
LOCATION Sta. 455+28, downstream slope
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist loose	Surficial Evidence: Hole at surface 0.6' X 2', up to 2.4' deep. Probed hole 2.8' horizontally towards crest. **SILTY SAND**, trace of clay, predominantly fine grained sand, weakly cemented, low plasticity, brown note: small diameter roots within dessication cracks, predominantly horizontal, small horizontal voids at contact with lower layer
1			D				
			D		SM	slightly moist moderately firm	**SILTY SAND**, trace of clay, predominantly fine grained sand, weakly to moderately cemented, low plasticity, brown note: trace of small diameter roots
2					SC	slightly moist moderately firm	**CLAYEY SAND**, trace of silt, predominantly fine grained sand, weakly cemented, low plasticity, brown note: some calcic zones; soft with dessication cracks (random) filled with small voids note: significant cracks encountered determined minimum of 14' in length, maximum depth encountered 4'6"
3							Stopped Backhoe at 2'
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S4

TECH_TP 0117122.GPJ AGRA_PHX.GDT 7/25/02

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 DATE 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe

LOCATION Sta. 474+21, downstream slope

SURFACE ELEV.

DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth In Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	Surficial Evidence: Series of small holes in linear fashion, deepest probe to 3'
			D			soft to moderately firm	**SILTY SAND**, trace of clay, fine to medium grained sand, weakly cemented, low plasticity, brown
1							note: zones of clayey material, weakly cemented, trace of small diameter roots to 2'
							note: significant crack observed up to 19' in length, probed to 4' deep, maximum width 0.3'
2							Stopped Backhoe at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S5

ECH TP 0117122.GPJ AGRA PHX.GDT 7/25/02

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 5/2/01

BACKHOE TYPE CASE 580L, Extendahoe
LOCATION Sta. 493+18, downstream slope
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist soft	**CLAYEY SAND** trace of silt, fine to medium grained sand, weakly to moderately cemented, low plasticity, reddish brown note: dissication cracks with fine roots
1			D				
			D		SP	slightly moist loose	**SAND**, trace of fine grained, subrounded gravel, predominantly medium grained sand, nonplastic, brown to gray note: small diemeter roots
2			D		SC	slightly moist moderately firm	**CLAYEY SAND** trace of silt, predominantly fine grained sand, medium plasticity, reddish brown note: no evidence of subsurface cracking
3							Backhoe refused at 2.8' Stopped Backhoe at 2.8'
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-S6

TECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

amec

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 232+55, Toe Drain
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	moist soft to moderately firm	Surficial Evidence: approximately 36' long, up to 3'4" wide, 7" maximum depth **SILTY SAND** trace of clay, fine to medium grained sand, weakly cemented, medium plasticity, reddish brown note: geotextile filter fabric from 6" to full depth of investigation note: geotextile separates native, undisturbed soils from disturbed backfill; undisturbed soils are towards dam
1							
2							
3							
4							
5							
6							Stopped Backhoe at 6'
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-T1

ECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

amec

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 264+10, Toe Drain

SURFACE ELEV.

DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	moist soft to moderately firm	Surficial Evidence: approximately 72' long, up to 3'10" wide, 6" maximum depth **SILTY SAND**, trace of gravel, fine to coarse grained, subangular gravel, predominantly fine to medium grained sand, weakly cemented, medium plasticity, reddish brown note: geotextile filter fabric from 1' to full depth of investigation note: geotextile separates native, undisturbed soils from disturbed backfill; undisturbed soils are towards dam
1							
2							
3							
4							
5							
6							
7							Stopped Backhoe at 6'6"
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-T2

TECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 272+50, Toe Drain

SURFACE ELEV.

DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	moist soft to moderately firm	Surficial Evidence: approximately 90' long, up to 2'10" wide, up to 2'8" deep **SILTY SAND**, trace of clay, trace of gravel, fine grained, subrounded to subangular gravel, fine to medium grained, subangular sand, weakly cemented, medium plasticity, reddish brown note: geotextile from 6" to fill depth of investigation note: geotextile separates native, undisturbed soils from disturbed backfill; undisturbed soils are towards dam
1							
2							
3							
4							
5							
6							
7							Stopped Backhoe at 7'
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-T3

...JTECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D

LOCATION Sta. 424+50, Toe Drain

SURFACE ELEV.

DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	moist soft to moderately firm	Surficial Evidence: approximately 195' long, up to 4'4" wide, up to 10" deep **SILTY SAND with GRAVEL**, trace of cobbles, fine to coarse grained, subrounded to subangular gravel, predominantly fine grained sand, weakly cemented, nonplastic, brown note: 11" cobble at 3', lenticular deposits of poorly graded sand, predominantly medium grained, subangular sand note: geotextile to full depth of investigation, separates undisturbed soil (towards dam) from trench backfill note: geotextile separates native, undisturbed soils from disturbed backfill; undisturbed soils are towards dam
1							
2							
3							
4							
5							
6							
7							Stopped Backhoe at 7'
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-T4

TECH_TP 01171122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Structures Assessment: McMicken Dam

amec

JOB NO. 0-117-001122 Task 1 **DATE** 4/18/01

BACKHOE TYPE John Deere 710D
LOCATION Sta. 425+50

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	moist soft to moderately firm	Surficial Evidence: approximately 195' long, up to 4'4" wide, up to 10" deep **SILTY SAND**, trace of gravel, fine to medium grained sand, weakly cemented, nonplastic, brown note: geotextile to full depth of investigation, separates undisturbed soil (towards dam) from trench backfill note: geotextile separates native, undisturbed soils from disturbed backfill; undisturbed soils are towards dam
8							Stopped Backhoe at 8'
10							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-T5

ECH_TP 0117122.GPJ AGRA_PHX.GDT 8/30/01

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 11-27-01 & 2-12-02

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			G		SM	dry soft to moderately firm	SILTY SAND , trace of gravel, trace of clay, predominantly fine to medium grained, subrounded gravel, subangular sand, weakly cemented (stage I), low plasticity, light reddish-brown (5YR 6/4)
			G		SC-SM	dry moderately firm	SILTY TO CLAYEY SAND , fine to medium grained sand, moderately to strongly cemented (stage II), medium plasticity, pinkish-gray (5YR 7/2)
5					GP	dry loose	SAND & GRAVEL , occasional cobble, some silt, fine to medium grained sand, subangular to subrounded, fine to coarse grained gravel, subrounded, slightly cemented (stage I), light reddish-brown (5YR 6/4)
10							Stopped Backhoe at 9'

DESCRIPTION OF EARTH FISSURING

ORIENTATION 004 deg AZ True
Concave to West
Vertical

PERSISTENCE Low; not single fissure near surface - array of small cracks, 6 - 8 inch zone; significant infilling

WIDTH 3/8 - 5/8 inch

REMARKS Poorly preserved in all units exposed; considerable infilling in sand & gravel unit; difficult to trace to surface on north side of trench

PHOTO NO. REW-2/13/02-1-1A LOOKING: North

TRENCH DATA

ION	N33.58116 deg W112.48040 deg
ORIENTATION	107 deg AZ
LENGTH	76 ft
AVERAGE DEPTH	9 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-1

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 11/28/01

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	dry soft	SILTY SAND , trace of clay, medium to fine grained sand, weakly cemented (stage I), low plasticity, light brown (7.5YR 6/4)
5					SC-SM	dry hard	SILTY TO CLAYEY SAND , trace of gravel, fine to medium grained sand, moderately to strongly cemented (stage II - III), medium plasticity, pinkish-white (7.5YR 8/2)
					SC-GC	dry hard	CLAYEY SAND & GRAVEL , fine to coarse grained, subangular gravel, well graded, subangular sand, strongly cemented (stage II - III), medium plasticity, pinkish-gray (7.5YR 7/2)
10							Stopped Backhoe at 9'

DESCRIPTION OF EARTH FISSURING

ORIENTATION Curving, concave to west, in south side at 020 deg AZ
Out north side 005 deg AZ, vertical

PERSISTENCE High, presistent throughout lower two units, projects up into top unit

WIDTH 1/2 - 3/4 inch

REMARKS Very prominent in trench, fully open to within 1 foot of surface

PHOTO NO. REW-2/15/02-1-2A LOOKING: North

TRENCH DATA

LOCATION	N33.58092 deg W112.48040 deg
ORIENTATION	110 deg AZ
LENGTH	49 ft
AVERAGE DEPTH	8 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-2

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 11/29/01

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	dry soft	SILTY SAND , some gravel, increase of gravel with depth, predominantly fine grained sand, subangular to subrounded gravel, uncemented to weakly cemented (O-Stage I), massive to crudely bedded, nonplastic, light reddish-brown (2.5YR 7/4)
5					GC/GM	dry	SILTY TO CLAYEY SAND & GRAVEL , trace of cobbles, fine to coarse grained, subangular to subrounded gravel, fine to medium grained, subangular sand, moderately cemented (Stage II), medium plasticity, pinkish-gray (7.5YR 7/2) Stopped Backhoe at 10'
10							

DESCRIPTION OF EARTH FISSURING

ORIENTATION 002 deg AZ (true)
(Slightly concave to west)
Vertical

PERSISTENCE High, presistent in lower two units, infilled
Completely in upper, uncemented unit

WIDTH 1 1/4 - 1 3/8 inch

REMARKS Fully open in lower, cemented unit,
Prominent fissure gully
Just south of trench

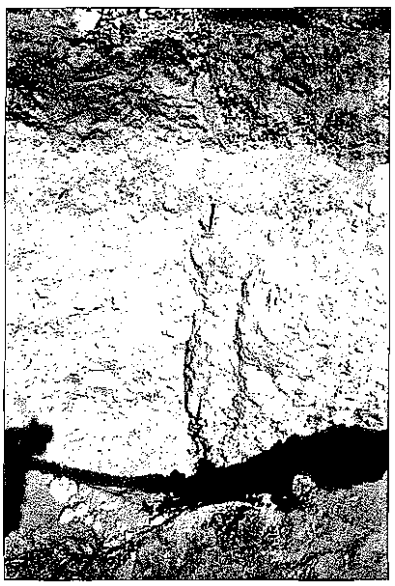


PHOTO NO. REW-2/15/02-1-3A LOOKING: North

TRENCH DATA

TION	N33.58060 deg W112.48048 deg
ORIENTATION	093 deg AZ
LENGTH	51 ft
AVERAGE DEPTH	9 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-3

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 11/29/01

GROUNDWATER

DEPTH	HOUR	DATE
	none	

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1330' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	dry soft	SILTY SAND , some coarse grained gravel, predominantly medium to fine grained gravel, angular to subangular sand, massive, uncemented to very weakly cemented (O-Stage I), nonplastic to very low plasticity, very pale brown (10YR 8/3)
					GP	dry soft	Fine pebble gravel with coarse grained gravel & cobbles, some silt, some medium to fine grained sand, moderately sorted, fine grained, subangular sand & gravel, crudley bedded, Stage II cementation to about 3' below top of unit, (caliche coatings on all cobbles & coarse grained gravel particles, grading to Stage I cementation at depth (slight matirx banding with no coatings, nonplastic, pinkisk-white (7.5YR 8/2)
5							
							Stopped Backhoe at 8'
10							

DESCRIPTION OF EARTH FISSURING

ORIENTATION 005 deg AZ (true)
Plunges 80 to 85 deg to the east

PERSISTENCE High in lower unit, infilled array of small cracks near surface

WIDTH 3/4 - 1 inch

REMARKS No trace of fissure at surface

PHOTO NO. REW-2/15/02-1-4A LOOKING: North

TRENCH DATA

LOCATION	N33.58015 deg W112.48014 deg
ORIENTATION	102 deg AZ
LENGTH	47 ft
AVERAGE DEPTH	8 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-4

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 11-29-01

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1330' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SM	dry soft	SILTY SAND , some fine grained, subangular to subrounded gravel, predominantly medium to fine grained gravel, massive, uncemented to slightly cemented at depth (O-Stage I), nonplastic, light brown (7.5YR 6/3)
5					SC-GC	dry hard	CLAYEY SAND & GRAVEL , occasional cobbles, predominantly medium to coarse grained, subangular sand, predominantly medium to coarse grained, subrounded gravel, crudely bedded, moderately cemented (Stage II), medium plasticity, very pale brown (10YR 7/4)
10							Stopped Backhoe at 9'

DESCRIPTION OF EARTH FISSURING

ORIENTATION 013 deg AZ (true)
Vertical

PERSISTENCE High with opening extending to with 1' of surface

WIDTH 5/8 - 3/4 inch (much of fissure is eroded)

REMARKS Typical sinuous pattern in cemented horizon

PHOTO NO. REW-2/15/02-1-5A LOOKING: North

TRENCH DATA

TION	N33.57996 deg W112.48016 deg
ORIENTATION	117 deg AZ
LENGTH	41 ft
AVERAGE DEPTH	9ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-5

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 1/23/02

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1330' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			G		SM	dry soft	SILTY SAND , some gravel, trace of cobbles, predominantly medium to fine grained sand, medium grained, subangular gravel, massive, uncemented, nonplastic, light brown (7.5YR 6/4)
			G		GM	dry hard	SILTY SAND & GRAVEL , some clay & cobbles, predominantly medium to fine grained, subangular sand, predominantly medium to coarse grained, subrounded gravel, crudely bedded, strongly cemented (Stage II & III), low plasticity, pinkish gray (7.5YR 7/2)
5							
							Stopped Backhoe at 9'
10							

DESCRIPTION OF EARTH FISSURING

ORIENTATION 010 deg AZ (true)
Vertical

PERSISTENCE High - projects to surface infilled but prominent from about 5' to surface, open below

WIDTH 1/2 - 3/4 inch (some erosion)

REMARKS

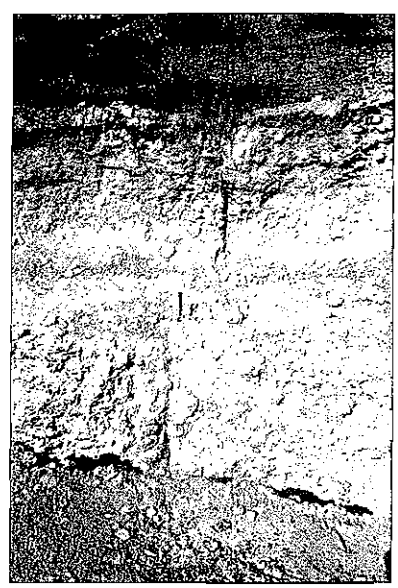


PHOTO NO. REW-2/15/02-1-7A LOOKING: North

TRENCH DATA

LOCATION	N33.57088 deg W112.47966 deg
ORIENTATION	105 deg AZ
LENGTH	41 ft
AVERAGE DEPTH	9ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-6

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 1/23/02

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SC	dry firm	CLAYEY SAND , considerable gravel & trace of cobbles, predominantly medium to fine grained, uncemented, subangular, medium plasticity, reddish brown (5 YR 6/4)
5					GM	dry hard	SILTY SAND & GRAVEL , some subrounded cobbles, trace of subrounded boulders, well graded sand, predominantly medium to coarse grained gravel, subangular to subrounded sand & gravel, weakly to uncemented above 4.5' (Stage I), well cemented below 4.5' (Stage II - II), low plasticity to nonplastic, light brown (1.5' to 4.5'), below 4.5' light gray to tan (10 YR 7/2)
10							Stopped Backhoe at 8'

DESCRIPTION OF EARTH FISSURING

ORIENTATION No fissure(s) detected

PERSISTENCE

WIDTH

REMARKS

PHOTO NO. --- LOOKING: ---

TRENCH DATA

TION	N33.58153 deg W112.48036 deg
ORIENTATION	055 deg AZ
LENGTH	31 ft
AVERAGE DEPTH	8 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-7

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 2/15/02

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					GM	dry loose to moderately firm	SILTY SAND , some cobbles, some clay in upper 2', well graded sand, medium to coarse grained gravel, crudely bedded, cementation begin about 2' below surface, Stage I - II to depth, nonplastic to medium plasticity with upper clays, light brown (7.5YR 6/4)
5							
							Stopped Backhoe at 6'
10							

DESCRIPTION OF EARTH FISSURING

ORIENTATION 353 deg AZ (true)
Some cracks plunge to west steeply

PERSISTENCE Diffuse array of small fissures on both sides of trench

WIDTH 1/8 - 1/16 inch for each small crack

REMARKS Looseness of soil at fissure location is considerable, no definitive signle crack

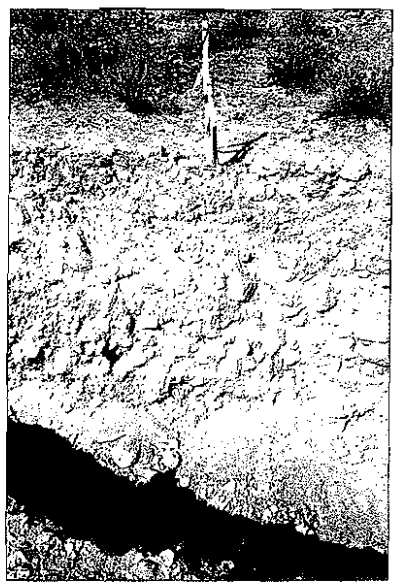


PHOTO NO. REW-2/15/02-1-6A LOOKING: North

TRENCH DATA

LOCATION	N33.58109 deg W112.47962 deg
ORIENTATION	092 deg AZ
LENGTH	38 ft
AVERAGE DEPTH	6ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-9

PROJECT Earth Fissure Investigation
McMicken Dam
Flood Control District of Maricopa County

JOB NO. 0-117-001122 DATE 2/15/02

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

BACKHOE TYPE CASE 580C
SURFACE ELEV. 1340' +/- 5'
DATUM USGS Survey/NAD27/MSL

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist very firm	CLAYEY SAND , considerable subrounded, coarse grained gravel near surface, well graded, crudely bedded, weakly cemented (Stage I), medium plasticity,
5							Stopped Backhoe at 5'
10							

DESCRIPTION OF EARTH FISSURING

ORIENTATION 005 deg AZ (true)
Vertical

PERSISTENCE Poor, not observable on north side of trench

WIDTH 1/32 - 1/16 one small crack

REMARKS Thin, single crack on south wall

PHOTO NO. REW-2/15/02-1-8A LOOKING: North

TRENCH DATA

TION	N33.58158 deg W112.47951 deg
ORIENTATION	110 deg AZ
LENGTH	24 ft
AVERAGE DEPTH	4.5 ft

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
G - Grab sample

LOG OF TEST TRENCH NO. TP-10

AMEC FRZR GEOTECHNICAL DESIGN INVESTIGATION (2004)

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist firm	**SILTY SAND,** trace of gravel, predominantly fine to medium grained sand, weakly lime cemented, Stage I, low plasticity, light brown
					GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,**occasional small diameter boulders, well graded, subrounded, Stage II, low plasticity, light brown
			D		SM	slightly moist hard	**SILTY SAND,** trace to some gravel, rare cobbles, predominantly fine grained sand, weakly to moderately lime cemented, Stage II, low plasticity, light brown
5			D		GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,**occasional small diameter boulder, well graded, subrounded, Stage II, moderately lime cemented, low plasticity, light brown note: Stage II+ below 7'
							Backhoe refused at 8'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-1

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 DATE 12/1/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM/ML	slightly moist moderately firm to hard	**SILTY SAND TO SANDY SILT,** trace of gravel, predominantly fine grained sand, moderately lime cemented below 6" to 1' Stage II, low plasticity, light brown
					SP-SM/ GM	slightly moist hard	**SILTY SAND & GRAVEL,** occasional cobbles & small diameter boulders, well graded, subrounded to subangular, weakly to moderately lime cemented Stage II to II+, nonplastic to low plasticity, light brown
			D	2			
5							
			D				
					SM	slightly moist hard	**SILTY SAND,** trace of gravel, predominantly fine grained sand, weakly to moderately lime cemented, Stage II, low plasticity, light brown
							Stopped Backhoe at 8'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-2

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 DATE 12/1/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SC	moist firm	**CLAYEY SAND,** some gravel, occasional cobble, prdominantly fine to medium grained sand, some calcium carbonate, medium plasticity, dark brown
					GC	moist hard	**CLAYEY SAND, GRAVEL & COBBLES,**considerable silt, occasional small diameter boulder, well graded, subrounded, Stagel+ to II, uncemented, low to medium plasticity, light brown
			D				
					SM/GM	moist hard	**SILTY SAND TO SILTY SAND & GRAVEL,**occasional cobble, rare small diameter boulder, well graded, subrounded, uncemented, Stage II, low plasticity, light brown
5			D				
							Stopped Backhoe at 8'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-3

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	4	SM	slightly moist firm	**SILTY SAND,** some gravel, trace of cobbles, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
			D		SP-SM/ GP-GM	slightly moist very firm	**SILTY SAND & GRAVEL,** occasional cobble, well graded, subrounded, moderately lime cemented, Stage II+, nonplastic to low plasticity, light brown
5			D	2			
							Backhoe refused at 7'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-4

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	3	SM	slightly moist firm	**SILTY SAND,** trace of gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
					SM	slightly moist very firm	**SILTY SAND,** some gravel, rare cobbles & small diameter boulders, well graded, subrounded, weakly lime cemented, Stage I+, low plasticity, light brown
			D	3			note: Stage II to II+, moderately lime cemetned below 4'6"
5							Backhoe refused at 5'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-5

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	2	GC	slightly moist very firm	**CLAYEY SAND & GRAVEL,** some silt, some cobbles, occasional small diameter boulder, well graded, subrounded, some calcium carbonate, low plasticity, light brown note: Stage I below 2'
					GP-GM	slightly moist very firm	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, uncemented, Stage II, nonplastic to low plasticity, light brown
			D	1			
5							
			D				note: Stage II+, moderately lime cemented below 7'
							Stopped Backhoe at 9'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-6

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist very firm	**SILTY SAND,** some to considerable gravel, occasional cobble, well graded, subrounded, Stage I, low plasticity, light reddish-brown
					SP-SM to GP-GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, weakly lime cemented, Stage I+, nonplastic to low plasticity, light brown
			D				
5							note: weakly lime cemented, Stage II to II+ below 5'
			D	1			
							Stopped Backhoe at 9'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-7

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM/ML	slightly moist soft to firm	**SILTY SAND TO SAND SILT,** trace of gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light reddish-brown
			D		GM	slightly moist hard	**SILTY SAND & GRAVEL,** some cobbles, occasional small diameter broulder, well graded, subrounded, weakly to moderately lime cemented, Stage II to II+, low plasticity, light brown
5			D				
							Stopped Backhoe at 8'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-8

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/1/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist firm	**SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine grained sand, some calcium carbonate, low plasticity, light brown
					GM	slightly moist hard	**SILTY SAND & GRAVEL,** some cobble, occasional small diameter boulder, well graded, subrounded, moderately lime cemented, Stage II+, low plasticity, light brown note: strongly lime cemented, Stage III below 3'
			D				Backhoe refused at 3'6"
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-9

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 DATE 12/1/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist to moist	**SILTY SAND,** some gravel, occasional cobble, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
					GM	firm slightly moist hard	**SILTY SAND & GRAVEL,** some cobbles, rare small diameter boulder, well graded, subrounded, uncemented, Stage I+, low plasticity, light brown
			D				note: Stage II to II+ below 3'
5							Backhoe refused at 5'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-10

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist firm	**SILTY SAND,** trace of gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
			D		SM	slightly moist hard	**SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, moderately lime cemented, Stage II to II+, low plasticity, light brown
5			D		GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, moderately lime cemented, Stage II to II+, low plasticity, light brown
							Backhoe refused at 5'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-11

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
∇		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SC	moist firm	**CLAYEY SAND,** considerable silt, some gravel, occasional cobble, well graded, subrounded, some calcium carbonate, low plasticity, brown
			D		GC	moist hard	**CLAYEY SAND, GRAVEL & COBBLES,** considerable silt, occasional small diameter boulder, well graded, subrounded, uncemented, Stage II, low plasticity, light brown
							Backhoe refused at 3'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-12

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SC	slightly moist firm	**CLAYEY SAND,** considerable silt, some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, reddish-brown
					SM	slightly moist hard	**SILTY SAND,** trace of clay, some gravel, occasional cobble, predominantly fine to medium grained sand, weakly lime cemented, Stage I+, low plasticity, light reddish-brown
			D		SM/GM	slightly moist hard	**SILTY SAND TO SILTY SAND, GRAVEL & COBBLES** rare small diameter boulder, predominantly fine to medium grained sand, well graded gravel, subrounded, moderately lime cemented, Stage II+, light brown
5							Backhoe refused at 4'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-13

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	moist very firm	**SILTY SAND,** some gravel, occasional cobble, well graded, subrounded, some calcium carbonate, low plasticity, brown
					GM	moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, Stage I, low plasticity, brown
			D				
5							Backhoe refused at 5'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-14

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		GP-GC/ GP-GM	slightly moist very firm	**CLAYEY SAND, GRAVEL & COBBLES,** rare small diameter boulder, considerable silt, well graded, subrounded, some calcium carbonate, nonplastic to low plasticity, light reddish-brown
							note: grades to silty sand, gravel & cobbles below 2'
			D	2			
5					GP-GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, weakly to moderately lime cemetned, Stage II, nonplastic to low plasticity, light brown
			D	2			
10					GP-GM		**SILTY SAND, GRAVEL & COBBLES,** continued
							Backhoe refused at 12'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-15

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	moist very firm to hard	**SILTY SAND,** trace of clay, some gravel, rare cobble, well graded, some calcium carbonate, low plasticity, brown note: Stagel below 1' note: occasional gravelly lense
5			D		SC	moist hard	**CLAYEY SAND,** some to considerable gravel, occasional cobble, well graded, subrounded, weakly lime cemented, Stage I, low plasticity, reddish-brown
							Backhoe refused at 6'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-16

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	4	SM	slightly moist moderately firm	**SILTY SAND TO SANDY SILT,** trace of gravel, predominantly fine to medium grained sand, some calcium carbonate, nonplastic to low plasticity, light brown note: Stage I below1'
					SM/ML	slightly moist hard	**SAND TO SANDY SILT,** trace of gravel, predominantly fine grained sand, weakly to moderately lime cemented, Stage II, low plasticity, light brown
			D				
					GP-GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, moderately lime cemented, Stage II, nonplastic to low plasticity, light brown
5			D	2			
							Stopped Backhoe at 8'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-17

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		ML	slightly moist firm to very firm	**SANDY SILT,** trace of gravel, weakly lime cemented, Stage II, low plasticity, light brown
					GP-GM/ SP-SM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, weakly to moderately lime cemented, Stage II, nonplastic to low plasticity, light brown
			D	1			
5							
					SM/ML	slightly moist hard	**SILTY SAND TO SANDY SILT,** trace of gravel, predominantly fine grained sand, moderately lime cemented, Stage II, low plasticity, light brown
			D				
							Stopped Backhoe at 9'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-18

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		GP-GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, some calcium carbonate, nonplastic to low plasticity, light brown note: weakly to moderately lime cemented, Stage II below 1'
5			D				
10							Stopped Backhoe at 8'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-19

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	5	SM	slightly moist hard	**SILTY SAND,** trace to some gravel, rare cobble, predominantly fine to medium grained sand, moderately lime cemetned, Stage II, nonplastic to low plasticity, light brown
					GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, moderately to strongly lime cemented, Stage II+, low plasticity, light brown
							Backhoe refsued at 2'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-20

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist to moist very firm	**SILTY SAND,** some to considerable gravel, occasional cobbles & small diameter boulders, predominantly fine to medium grained sand, subrounded, some calcium carbonate, low plasticity, light brown
					GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, Stage II, low plasticity, light brown
			D				
5							Backhoe refused at 5'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-21

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** trace of clay, occasional small diameter boulder, well graded, subrounded, some calcium carbonate, low plasticity, light brown
			D		SC	slightly moist hard	**CLAYEY SAND,** some to considerable gravel, rare cobbles, well graded, subrounded, weakly to moderately lime cemented, Stage I+, low to medium plasticity, reddish-brown
5			D		GC	slightly moist hard	**CLAYEY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, Stage I+, weakly to moderately lime cemented, low to medium plasticity, reddish-brown
10							Stopped Backhoe at 9'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-22

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	3	GP-GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, some calcium carbonate, nonplastic to low plasticity, light brown note: Stage II below 1'
							Backhoe refused at 2'6"
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-23

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SP-SM	slightly moist to moist	**SAND TO SILTY SAND,** some to considerable gravel, occasional cobble, well graded, subrounded, some calcium carbonate, nonplastic to low plasticity, light brown
					GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES** occasional small diameter boulder, well graded, subrounded, Stage II+, moderately lime cemented, low plasticity, light brown
			D				Backhoe refused at 3'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-24

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	moist very firm	**SILTY SAND**, some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown note: weakly lime cemented, Stage II to II+ below 1'
			D				
							Backhoe refused at 3'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-25

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, some calcium carbonate, low plasticity, light brown note: Stage II below 1'
5							Backhoe refused at 4'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-26

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan

SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	3	SM	slightly moist firm	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, some calcium carbonate, nonplastic to low plasticity, light reddish-brown
					GC	slightly moist hard	**CLAYEY SAND, GRAVEL & COBBLES,** rare small diameter boulder, considerable silt, well graded, subrounded, Stage I, low plasticity, light reddish-brown
5			D	4	SM	slightly moist hard	**SILTY SAND,** trace of gravel, predominantly fine grained sand, moderately lime cemented, Stage II+, nonplastic to low plasticity, light brown
					GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulders, well graded, subrounded, moderately lime cemented, Stage II+, low plasticity, light brown
10							Backhoe refused at 8'
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-27

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** trace of clay, occasional small diameter boulder, well graded, subrounded, some calcium carbonate, low plasticity, light brown note: Stage II below 1'
			D		SM	slightly moist hard	**SILTY SAND,** some to considerable gravel, occasional cobble, well graded, subrounded, moderately to strongly lime cemented, Stage II+, low plasticity, light brown
							Backhoe refused at 3'6"
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-28

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SC	slightly moist firm to hard	**CLAYEY SAND,** some silt, some to considerable gravel, rare cobble, predominantly fine to medium grained sand, some calcium carbonate, medium plasticity, light reddish-brown note: Stage II below 1'
5			D	3	GP-GM/ SP-SM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES**occasional small diameter boulder, well graded, subrounded, moderately lime cemented, Stage II+, low plasicity, light brown
			D	2	SP	slightly moist dense	**SAND,** trace of silt, some to considerable gravel, occasional cobble & small diameter boulder, moderately lime cemented, Stage II, nonplastic to low plasticity, light brown
			D		SM	slightly moist hard	**SILTY SAND,** trace of gravel, predominantly fine grained sand, weakly to moderately lime cemented, Stage II, low plasticity, light brown
10							Backhoe refused at 9'6"
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-29

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	4	GP-GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES,** trace of clay, occasional small diameter boulder, well graded, some calcium carbonate, low plasticity, light brown
			D				
							Backhoe refused at 4'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-30

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
∇		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	6	GC	slightly moist firm to hard	**CLAYEY SAND, GRAVEL & COBBLES**,some silt, rare small diameter boulder, well graded, subrounded, some calcium carbonate, low to medium plasticity, light reddish-brown note: Stage I+ below 1'
			D		GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES**,occasional small diameter boulder, well graded, moderately lime cemented, Stage II+, low plasticit6y, light brown
5							
							Backhoe refused at 7'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-31

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist hard	**SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, moderately lime cemented, Stage II, low plasticity, light brown note: Stage II+ below 1'
							Backhoe refused at 2'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-32

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/3/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	3	GP-GC	slightly moist very firm	**CLAYEY SAND & GRAVEL,** occasional cobble, predominantly fine to medium grained sand, some calcium carbonate, low to medium plasticity, light reddish-brown
			D		GM	slightly moist hard	**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, moderately lime cemented, Stage II+, low plasticity, light brown
5							
							Backhoe refused at 6'
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-33

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

amec

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D	4	GP-GM		**SILTY SAND, GRAVEL & COBBLES,** occasional small diameter boulder, well graded, subrounded, Stage II, nonplastic to low plasticity, light brown
			D				
5							Backhoe refused at 5'6"
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-34

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/2/03

BACKHOE TYPE CASE 590 Super M 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		SP-SM	moist medium dense	**SILTY SAND TO SAND**, some to considerable gravel, occasional cobble, rare small diameter boulder, well graded, subrounded, some calcium carbonate, nonplastic to low plasticity, light brown
					GP-GM	slightly moist to moist hard	**SILTY SAND, GRAVEL & COBBLES**, occasional small diameter boulder, well graded, subrounded, Stage II+, nonplastic to low plasticity, light brown
			D	6			
							Backhoe refused at 4'
5							
10							
15							
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-35

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/10/03

BACKHOE TYPE John Deere 710D 24" Bucket
LOCATION See Site Plan
SURFACE ELEV.
DATUM

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	SOIL DESCRIPTION
0			D		CL	slightly moist soft	**SILTY CLAY,** trace of sand, rare gravel, trace to some calcium carbonate, low plasticity, brown
					SM	slightly moist firm	**SILTY SAND,** some gravel, rare cobbles, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
			D				
5					SP-SM/ GP-GM	slightly moist dense	**SAND & GRAVEL TO SILTY SAND & GRAVEL,** occasional cobble, rare small diameter boulder, predominantly fine to medium grained sand, predominantly fine grained gravel, subrounded, trace of calcium carbonate, nonplastic to low plasticity, light brown
			D				
10					SP-SM/ GP-GM		**SAND & GRAVEL TO SILTY SAND & GRAVEL** continued
					SC		**CLAYEY SAND,** some to considerable gravel, occasional cobble, well graded, subrounded, medium plasticity, reddish-brown
15							Stopped Excavation at 14'
20							
25							

SAMPLE TYPE
B - Undisturbed Block Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP-36

APPENDIX B

BORING LOGS

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.9			C				SM	moderately firm	**SILTY SAND,** trace of clay, trace of gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light reddish-brown note: occasional lense of sandy silt
				C				SM		
								SM/ML	firm	**SILTY SAND,** some to considerable gravel, occasional cobble, well graded sand, weakly lime cemented, low plasticity, light grayish-brown
									firm	**SILTY SAND TO SANDY SILT,** predominantly fine grained sand, weakly to moderately lime cemented, low plasticity, light brown
5								SM	very firm	**SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light grayish-brown to light brown
	0.6			C						
								SC	very firm to hard	**CLAYEY SAND,** some gravel, predominantly fine to medium grained sand, weakly lime cemented, low plasticity, light reddish-brown note: occasional gravelly lense
10				C						
				C				GC-GM	very firm	**SILTY SAND,** trace to some clay, trace to some gravel, rare cobble, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown note: occasional gravel lense
15										
	1.1			C						
				C						
20										
				C						
								GM	hard	**SILTY SAND, GRAVEL & COBBLES,** pred fine to medium grained sand, well graded gravel, subrounded to subangular, moderately lime cemented, low plasticity, light grayish-brown
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-1

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	1.0			C				GM	hard	**SILTY SAND, GRAVEL & COBBLES,** continued
								SM	hard	**SILTY SAND,** trace of clay, trace to considerable gravel, rare cobble, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown note: occasional gravel lense typ. <1'
				C						
30										
				C						
35										Stopped Drill at 35'
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-1

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/17/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.5			C				SM	moderately firm to firm	**SILTY SAND,** trace of clay, some gravel, some calcium cerbonate, low plasticity, reddish-brown
				C						
5	0.8			C				SC/GC	very firm to hard	**CLAYEY SAND, GRAVEL & COBBLES,** some silt, occasional small diameter boulder, predominantly fine to medium grained sand, well graded gravel, subrounded to subangular, weakly to moderately lime cemented, low plasticity, light grayish-brown note: occasional lense of silty sand
10				C						
15	0.8			C						
20				C				SM	very firm to hard	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown
25				C				SM/GM	hard	**SILTY SAND, GRAVEL COBBLES,** well graded, subrounded to subangular, weakly to moderately lime cemented, low plasticity, light grayish-brown

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-2

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/17/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.8							SM/GM	hard	**SILTY SAND, GRAVEL COBBLES,** continued note: occasional lense of silty sand
	1.3			C						
30				C						
								SC/CL	hard	**CLAYEY SAND TO SANDY CLAY,** some silt, trace to considerable gravel, rare cobble, well graded, moderately lime cemented, low plasticity, light grayish-brown
				C						
35	2.9			C						
40				C						
				C						
45								ML	hard	**SANDY SILT,** trace of clay, moderately lime cemented, low plasticity, light brown
	0.5			C						
								SC	hard	**CLAYEY SAND,** some gravel, pred fine to medium grained sand, mod lime cemented, low to med plasticity, light reddish-brown Stopped Drill at 50'
50										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-2

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/17/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.3			C				SM	moderately firm	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
				C						
								SM/GM	very firm to hard	**SILTY SAND, GRAVEL & COBBLES,** well graded, subangular to subrounded, weakly to moderately lime cemented, low plasticity, light grayish-brown
5	0.7			C						
				C				SM	very firm	**SILTY SAND,** trace of clay, trace to considerable gravel, rare cobbles, well graded, weakly to moderately lime cemented, low plasticity, light brown note: occasional gravelly lense (typ. <1')
10										
				C						
15	0.7			C						
				C						
20				C						
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-3

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/17/03

LOCATION See Site Plan
RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.7							SM	very firm	**SILTY SAND,** continued
	0.9			C						
				C						
30										
								ML	hard	**SANDY SILT,** trace of clay, moderately lime cemented, low plasticity, light brown
				C						
35										Stopped Drill at 35'
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-3

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.3			C				SC	moderately firm	**CLAYEY SAND,** trace of gravel, some silt, predominantly fine to medium grained sand, trace of calcium carbonate, low plasticity, brown
				C				SM/GM	firm to very firm	**SILTY SAND & GRAVEL,** some cobbles, well graded, subangular to subrounded, weakly to moderately lime cemented, low plasticity, light grayish-brown
5	0.7			C				SM	very firm to hard	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
				C				SP-SM	dense	**SILTY SAND,** some to considerable gravel, rare cobbles, predominantly fine to medium grained sand, weakly lime cemented, nonplastic, light brown
10				C				GM	hard	**SILTY SAND, GRAVEL & COBBLES,** well graded, subangular to subrounded, moderately lime cemented, low plasticity, light gray
15	1.0			C				SM	very firm to hard	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown note: occasional gravel lense
				C						
20				C						
								GM	hard	**SILTY SAND, GRAVEL & COBBLES,** well graded, subangular to subrounded, moderately lime cemented, low plasticity, light gray
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-4

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	1.0							GM	hard	**SILTY SAND, GRAVEL & COBBLES,**continued
	1.4			C				SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown
				C						
30										
				C						
35										
				C						
40										Stopped Drill at 40'
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-4

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.4			C				SC	soft	**CLAYEY SAND,** some gravel, predominantly fine grained sand, some calcium carbonate, low plasticity, brown
								SP-SM	dense	**SILTY SAND,** some to considerable gravel, predominantly fine to medium grained sand, weakly lime cemented, nonplastic to low plasticity, light brown
				C						
5								ML	very firm	**SANDY SILT,** trace of clay, trace of gravel, weakly lime cemented, medium plasticity, light reddish-brown
	0.6			C				SP-SM	dense	**SILTY SAND,** some to considerable gravel, rare cobbles, well graded, weakly lime cemented, nonplastic to low plasticity, light brown
								SM	very firm to hard	**SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, weakly lime cemented, low plasticity, light brown
10				C						
								SP-SM/ SC-SM	dense	**SILTY SAND TO CLAYEY SAND,** considerable gravel, well graded, weakly lime cemented, nonplastic to low plasticity, light grayish-brown
15	0.7			C						
20				C						
				C				SM	very firm to hard	**SILTY SAND,** some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-5

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.7							SM	very firm to hard	**SILTY SAND,** continued
	0.9			C						
								SP-SM	very dense	**SILTY SAND,** considerable gravel, well graded, weakly lime cemented, nonplastic to low plasticity, light brown
				C				CL	very stiff	**SILTY CLAY,** trace of sand, trace of gravel, weak cementation (no calcium carbonate), medium plasticity, light reddish-brown
								SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
30								CL	very stiff	**SILTY CLAY,** trace of sand, trace of gravel, weak cementation (no calcium carbonate), medium plasticity, light reddish-brown
				C				SP-SM	very dense	**SILTY SAND,** considerable gravel, well graded, weakly lime cemented, nonplastic to low plasticity, light brown
								SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
35	0.4			C				CL	very stiff	**SILTY CLAY,** trace of sand, trace of gravel, weak cementation (no calcium carbonate), medium plasticity, light reddish-brown
								SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
								CL	very stiff	**SILTY CLAY,** trace of sand, trace of gravel, weak cementation (no calcium carbonate), medium plasticity, light reddish-brown
40										Stopped Drill at 40'
45										
50										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-5

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.2			C				SM/ML	moderately firm	**SILTY SAND TO SANDY SILT,** trace to some clay, trace of gravel, predominantly fine to medium grained sand, weakly lime cemented, low plasticity, light reddish-brown
				C						
								GM/GC	very firm to hard	**SILTY SAND & GRAVEL,** trace to some clay, some cobbles, well graded, subangular to subrounded, weakly to moderately lime cemented, nonplastic to low plasticity, light grayish-brown note: occasional lense (typ. <1') of SM & SP-SM
5	0.7			C						
10				C						
				C						
15	0.7			C						
				C						
20				C						
								SM	very firm to hard	**SILTY SAND,** trace of clay, some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light brown
25										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-6

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.7							SM	hard	**SILTY SAND,** continued
	1.0			C				SM/GM	hard	**SILTY SAND & GRAVEL,** occasional to some cobbles, well graded, subangular to subrounded, weakly lime cemented, nonplastic to low plasticity, light grayish-brown
				C						
30										
	0.9			C				SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown
35										
				C						
40										Stopped Drill at 40'
45										
50										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-6

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/19/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.5			C				ML	moderately firm	**SANDY SILT,** trace of gravel, weakly to moderately lime cemented, low plasticity, light grayish-brown
								SM/GM	firm to very firm	**SILTY SAND & GRAVEL,** occasional to some cobbles, predominantly fine to medium grained sand, well graded gravel, weakly to moderately lime cemented, low plasticity, light grayish-brown
				C						
5										
								SP-SM	dense	**SILTY SAND,** some gravel, well graded, weakly lime cemented, nonplastic to low plasticity, light reddish-brown note: occasional gravelly lense
	0.7			C						
				C						
10										
								SM	moderately firm to hard	**SILTY SAND,** trace to some gravel, predominantly fine to medium sand, moderately lime cemented, low plasticity, light brown
				C						
								SP-SM/ GP-GM	dense	**SILTY SAND & GRAVEL,** trace of clay, occasional cobble, well graded, subangular to subrounded, weakly to moderately lime cemented, nonplastic to low plasticity, light reddish-brown to light grayish-brown note: occasional lense of clayey sand
15										
	0.4			C						
				C						
20										
				C						
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-7

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/19/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-Inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.7							SM/ML	hard	**SILTY SAND TO SANDY SILT,** trace of clay, trace of gravel, predominantly fine to medium *grained sand, moderately lime cemented, low* plasticity, light brown
	0.7			C						
				C						
								SM	hard	**SILTY SAND,** trace to some clay, trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light grayish-brown *note: occasional gravelly lense (typ. <1')*
30				C						
35										Stopped Drill at 35'
40										
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▽			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-7

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.2			C				SC	moderately firm	**CLAYEY SAND,** some gravel, well graded, weakly lime cemented, low plasticity, light reddish-brown
								SM/GM	very firm	**SILTY SAND & GRAVEL,** occasional cobble, well graded, subangular to subrounded, weakly lime cemented, nonplastic to low plasticity, light grayish-brown
5	0.5			C				SM	very firm	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, weakly lime cemented, low plasticity, light brown
								GP-GM	very firm to hard	**SILTY SAND & GRAVEL,** some cobbles, well graded, subangular to subrounded, weakly to moderately lime cemented, nonplastic to low plasticity, light grayish-brown
10				C						
				C						
15								SM	very firm to hard	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, weakly lime cemented, low plasticity, light brown
	1.0			C						
20				C						
								GM	hard	**SILTY SAND & GRAVEL,** some cobbles, well graded, subangular to subrounded, weakly to moderately lime cemented, nonplastic to low plasticity, light grayish-brown
	0.5			C						
25										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-8

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/18/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.5							SM	hard	**SILTY SAND,** trace of clay, trace to some gravel, predominantly fine to medium grained sand, moderately lime cemented, low plasticity, light brown
	1.0			C						note: occasional gravelly lense
										note: occasional lense of sandy silt
				C						
30										
										Stopped Drill at 33'
35										
40										
45										
50										

GROUNDWATER

DEPTH(ft)	HOUR	DATE
	none	

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-8

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/19/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	0.2			C				SM	moderately firm	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, some calcium carbonate, low plasticity, light brown
				C						
								SM	firm	**SILTY SAND,** some to considerable gravel, occasional cobble, well graded, some calcium carbonate, low plasticity, light brown
5	0.3			C						
				C				SM/SC	very firm to hard	**SILTY SAND TO CLAYEY SAND,** some gravel, rare cobbles, predominantly fine to medium grained sand, weakly to moderately lime cemented, low plasticity, light reddish-brown to light brown note: occasional silty sand & gravel lense
10				C						
15	0.7			C						
20				C						
25				C						

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▽			
▼			

SAMPLE TYPE

A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-9

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

JOB NO. 2-117-001066 **DATE** 12/19/03

LOCATION See Site Plan

RIG TYPE Sonic Drill Rig
BORING TYPE Sonic 4" I.D.
SURFACE ELEV.
DATUM

Depth in Feet	Drill Rate Min/ft.	Graphical Log	Sample	Sample Type	Blow Count Per 6-inches	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
25	0.7							SM	very firm to hard	**SILTY SAND,** continued
	0.8			C						
30				C						
	0.6			C				ML	hard	**SANDY SILT,** trace to some clay, trace of gravel, moderately lime cemented, low plasticity, light brown
35										
				C				GM	hard	**SILTY SAND, GRAVEL & COBBLES,** well graded, subangular to subrounded, moderately lime cemented, low plasticity, light grayish-brown
40										Stopped Drill at 40'
45										
50										

GROUNDWATER

	DEPTH(ft)	HOUR	DATE
▽		none	
▼			
▼			
▼			

SAMPLE TYPE
A - Drill cuttings
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
C - 4" I.D. Sonic sample
NR - No Recovery
PR - Poor Recovery

LOG OF TEST BORING NO. B-9

PROJECT Fissure Risk Zone Remediation
McMicken Dam

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JOB NO. 2-117-001066 DATE 4-4-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load Index Test (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing (Wide - Close) 1 2 3 4 5	DISCONTINUITIES Orientation (Horiz - Vert) H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
4/1 HQ 2.7	0		HQ		95	95		N/A	N/A	N/A	N/A	GC	**CLAYEY SAND, GRAVEL & COBBLES,** well graded, subangular to subrounded, weakly lime cemented, Stage I, low plasticity, brownish-gray
												GW	**SAND & GRAVEL,** considerable silt & cobbles, predominantly fine to medium grained, subangular sand & well graded, subrounded gravel, weakly lime cemented, Stage II+ to III, nonplastic to low plasticity, grayish-brown
1.8	5		HQ		35								
			S		40-50/ 3 1/2"							SM/ SP-SM	**SILTY SAND TO SANDY SILT,** predominantly fine grained sand, weakly to moderately lime cemented, Stage II+, nonplastic to low plasticity, medium brown
2.7			HQ	688	100		103						
	10											GW	**SAND, GRAVEL & COBBLES,** considerable silt, well graded, subangular sand & subrounded gravel & cobbles, weakly lime cemented, Stage II+, nonplastic, brownish-gray
3.4			S		50/ 4 1/2"								
			HQ	220	100		102					SP-SM/ SM	**SILTY SAND TO SANDY SILT,** very fine grained sand, weakly lime cemented, Stage II to II+, nonplastic to low plasticity, medium brown
	15												note: trace to some well graded sand & fine to medium grained gravel
2.8			S		22-50/ 5 1/2"								note: predominantly fine to medium grained, subangular sand below 15.0'
			HQ		100								
	20			75			118					SM	**SILTY SAND & GRAVEL,** considerable cobbles, well graded, subangular to subrounded, weakly lime cemented, Stage II to II+, nonplastic, grayish-brown
													note: low plasticity, fine grained silty sand lens from 20.2' to 21.2'
2.6			S		50/4"								
			HQ		95								
	25												

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-10

PROJECT: Fissure Risk Zone Remediation
McMicken Dam

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JOB NO. 2-117-001066 DATE 4-4-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load Index Test (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	Discontinuities: Spacing (Wide - Close 1 2 3 4 5)	Discontinuities: Orientation (Horiz - Vert H 45 V)	Condition	Bedding and/or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
4/1 HQ	25					95						SM	**SAND & GRAVEL,** continued
													note: sand-sized particles locally predominantly angular to subangular
		X	S		32-50/5"								
3.0			HQ		100								note: some medium plasticity clay from 28.0' to 31.0'
													note: sand decrease of cobbles & very weakly cemented from 28.0' to 33.0'
	30												
													note: low to medium plasticity sandy clay lens from 33.0' to 35.5'
3.4		X	S		50/5"								note: trace to some clay below 40.0'
			HQ		100								
				300			102						
	35												
2.6		X	S		50/ 4 1/2"								
			HQ		45								
2.5	40		HQ		45								
												SC	**CLAYEY SAND,** some gravel, occasional cobble, predominantly fine to medium grained, subangular sand, uncemented, low plasticity, medium brown
		X	S	73	16-50/3"		115						
2.8			HQ										
													note: clayey sand lens from 45.0' to 45.5'
	45												note: predominantly fine grained sandy silt below 49.5'
				30			122						
3.4		X	S		30-50/ 5 1/2"								
			HQ										
	50												Stopped HQ Coring at 50.0'

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-10

PROJECT Fissure Risk Zone Remediation
McMicken Dam

amec

JOB NO. 2-117-001066 DATE 3-31-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load IndexTest (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing Wide - Close (1 2 3 4 5)	Orientation Horiz - Vert (H 45 V)	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/31 HQ 2.8	0		HQ		90	90-100						SM/ ML	**SILTY SAND TO SANDY SILT,** trace of gravel, predominantly fine to medium grained sand, low plasticity, light brown
												GM	**SILTY SAND, GRAVEL & COBBLES,** well graded gravel, predominantly fine to medium grained sand, subangular to subrounded, weakly to moderately lime cemented, Stage II to III, low plasticity, light brown note: moderately lime cemented (Stage II+ to III from 2.5' to 4.1 & 5.5. to 6.0)
1.5	5		HQ		75								
												SP-SC	**CLAYEY SAND, GRAVEL & COBBLES,** trace to some silt, well graded sand & gravel, subangular to subrounded, Stage I, nonplastic to low plasticity, brown
2.4			S		6-18-50/6"								
			HQ		60								
	10												
2.7			S		50/3"							SP-SM/ SM	**SILTY SAND,** trace of clay, some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, weakly lime cemented, Stage II, nonplastic to low plasticity, light brown
			HQ	201	100		128						
	15												
2.5			S		18-26-33								
			HQ		100							GP-GM	**SILTY SAND, GRAVEL & COBBLES,** occasional boulder, trace of clay, well graded sand & gravel, subangular to subrounded, weakly lime cemented, Stage II, nonplastic to low plasticity, light brown
3.1	20		HQ		95								
1.9			S		50/5"								
			HQ		100								
2.9			HQ		100								
	25											SM	**SILTY SAND**

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-11

PROJECT Fissure Risk Zone Remediation
McMicken Dam

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JOB NO. 2-117-001066 DATE 3-31-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load IndexTest (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing (Wide - Close) 1 2 3 4 5	Orientation (Horiz - Vert) H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/31 HQ 2.9	25		HQ		100	100						SM	**SILTY SAND,** trace clay, some gravel, occasional cobble, predominantly fine to medium grained sand, weakly lime cemented, Stage II+ to III, low plasticity, light brown
2.6			S	223	50/5 1/2"		121						
			HQ		95							SP-SM/ SM	**SILTY SAND,** trace to some gravel, occasional cobble, well graded, nonplastic to weakly lime cemented, Stage I+, nonplastic to low plasticity, light brown
	30												
2.8			S		27-20-19								
			HQ		100							SC	**CLAYEY SAND,** trace to some gravel, rare cobble, considerable silt, predominantly fine to medium grained sand, weakly lime cemented, Stage II to II+, medium plasticity, light brown
	35												
22			S		9-19-28								note: occasional gravelly zone
													note: low plasticity sandy silt below 39'
			HQ	171			88						
	40												Stopped HQ Coring at 40.0'
	45												
	50												

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.6" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-11

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

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JOB NO. 2-117-001066 DATE 3-30-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load Index Test (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	Discontinuities: Spacing (Wide - Close) 1 2 3 4 5	Discontinuities: Orientation (Horiz - Vert) H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/30 HQ 1.4	0		HQ		50	90-100						GM	**SILTY SAND & GRAVEL,** some cobbles, well graded gravel, predominantly fine to medium grained sand, weakly lime cemented, nonplastic to low plasticity, light brown
				485			133						note: moderately lime cemented below 3.0' (Stage II+ to III)
1.3	5		HQ	387	30		126					SM	**SILTY SAND,** some gravel, predominantly fine to medium grained sand, weakly lime cemented, Stage II to II+, low plasticity to nonplastic, light brown
												GM	**SILTY SAND, GRAVEL & COBBLES,** well graded gravel, predominantly fine to medium grained sand, moderately lime cemented, Stage II+ to III), nonplastic to low plasticity, light brown
1.8			S		8-6-50/6"							SP-SM	
			HQ		100							GM	**SAND TO SILTY SAND,** occasional to some gravel, predominantly fine to medium grained sand, weakly lime cemented, Stage II, nonplastic, light brown
2.2	10		HQ		70								**SILTY SAND, GRAVEL & COBBLES,** well graded gravel, predominantly fine to medium grained sand, subangular to subrounded, weakly lime cemented, Stage I to I+, nonplastic to low plasticity, light brown
2.9			S		50/5"								
			HQ		60								
1.2			HQ		90								
	15												
1.9			S	30	50/2 1/2"								
			HQ		60								
	20												
1.5			HQ		100								
2.6			S		50/4"								
			HQ		85								
	25												

GROUNDWATER

PTH (ft)	HOUR	DATE
	none	

BORING OPERATION
S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-12

PROJECT Final Geotechnical Investigation Report
Fissure Risk Zone Remediation
McMicken Dam

amec

JOB NO. 2-117-001066 DATE 3-30-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load Index Test (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing Wide - Close 1 2 3 4 5	Orientation Horiz - Vert H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/30 HQ2.6	25					100						GM	**SILTY SAND, GRAVEL & COBBLES,** continued
3.1			S		26-15-14	0-50							
			HQ		50	100							
3.1	30		HQ		50	0							
1.5			S		18-21-14							SC	**CLAYEY SAND,** considerable silt, some gravel, predominantly fine to medium grained sand, low plasticity, brown note: occasional lense of clayey sand, gravel & cobbles
			HQ		50								
	35												
1.7			S		29-22-29								
			HQ		0								
	40												Stopped HQ Coring at 40.0'
	45												
	50												

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-12

PROJECT Fissure Risk Zone Remediation
McMicken Dam

amec

JOB NO. 2-117-001066 DATE 3-30-04

RIG TYPE Burley 4000
LOCATION See Site Plan
ORIENT.
ELEVATION
DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load IndexTest (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing (Wide - Close) 1 2 3 4 5	Orientation (Horiz - Vert) H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/30 HQ 1.5	0		HQ		5	90-100						SM	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, noncemented to weakly lime cemented, Stage II to III, low plasticity, light brown
1.3	5		HQ		0								
												SP-SM	**SAND TO SILTY SAND,** some to considerable gravel, occasional cobble, predominantly fine to medium grained sand, noncemented to weakly lime cemented, nonplastic, light brown
2.2			S		14-26-27								
			HQ		65								
3.0	10		HQ		100							GP-GM	**SILTY SAND, GRAVEL & COBBLES,** occasional boulders, well graded gravel, predominantly fine to medium grained sand, subangular to subrounded, weakly lime cemented, Stage I to I+, low plasticity, light brown
2.7			S		50/5"								
			HQ		100								note: nonplastic to low plasticity sandy silt lens from 13.0' to 14.0'
				82			107						
	15												
3.2			S		50/4 1/2"								
			HQ		100								
2.9	20		HQ		100								
3/31 2.5			S		50/4 1/2"							SM/ML	**SILTY SAND TO SANDY SILT,** trace of clay, trace of gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, Stage II+ to III, low plasticity, light brn
			HQ		100								
				269			94						
				10			110						
	25											SM	**SILTY SAND**

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

BORING OPERATION

S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-13

Fissure Risk Zone Remediation

McMicken Dam

amec

JOB NO. 2-117-001066 **DATE** 3-30-04

RIG TYPE Burley 4000

LOCATION See Site Plan

ORIENT.

ELEVATION

DATUM

Boring Operation and Drill Rate (min/feet)	Depth in Feet	Sample	Sample Type	Unconfined Compression or Point Load IndexTest (psi)	% Core Recovery/ SPT Blow Counts	% Drilling Fluid Rec.	Dry Density lb/cu. ft.	DISCONTINUITIES Spacing (Wide - Close) 1 2 3 4 5	Orientation (Horiz - Vert) H 45 V	Condition	Bedding and/ or Fabric	Weathering or USCS (Soils)	Rock Type & Remarks
3/31 HQ 2.5	25					100						SM	**SILTY SAND,** some gravel, occasional cobble, trace of clay, predominantly fine grained sand, weakly lime cemented, Stage I+ to II, nonplastic to low plasticity, light brown
												SM	
2.8			S		50/5"								**SILTY SAND,** trace of clay, rare gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, Stage II to III, low plasticity, light brown
			HQ		100							GP-GM	
	30												**SILTY SAND, GRAVEL & COBBLES,** trace of clay, well graded gravel, predominantly fine to medium grained sand, subangular to subrounded, weakly to moderately lime cemented, Stage II to III, nonplastic to low plasticity, light brown
2.8			S		14-31-43								
			HQ		100								
2.4	35												
3.2			S		50/5 1/2"							SM/ML	**SILTY SAND TO SANDY SILT,** some silt, trace of gravel, predominantly fine to medium grained sand, weakly cemented to noncemented, nonplastic to low plasticity, brown
			HQ	318	100		95						
	40												
2.0			S		50/4"							GC	**CLAYEY SAND, GRAVEL & COBBLES,** trace of silt, well graded gravel, predominantly fine to medium grained sand, subangular to subrounded, low plasticity, brown
			HQ		100								
	45												
												SC	**CLAYEY SAND,** trace to some silt, trace of gravel, predominantly fine to medium grained sand, weakly cemented to noncemented, low plasticity, brown
2.7			S		25-41-32								
			HQ		100								
	50												Stopped HQ Coring at 50.0'

GROUNDWATER

DEPTH (ft)	HOUR	DATE
	none	

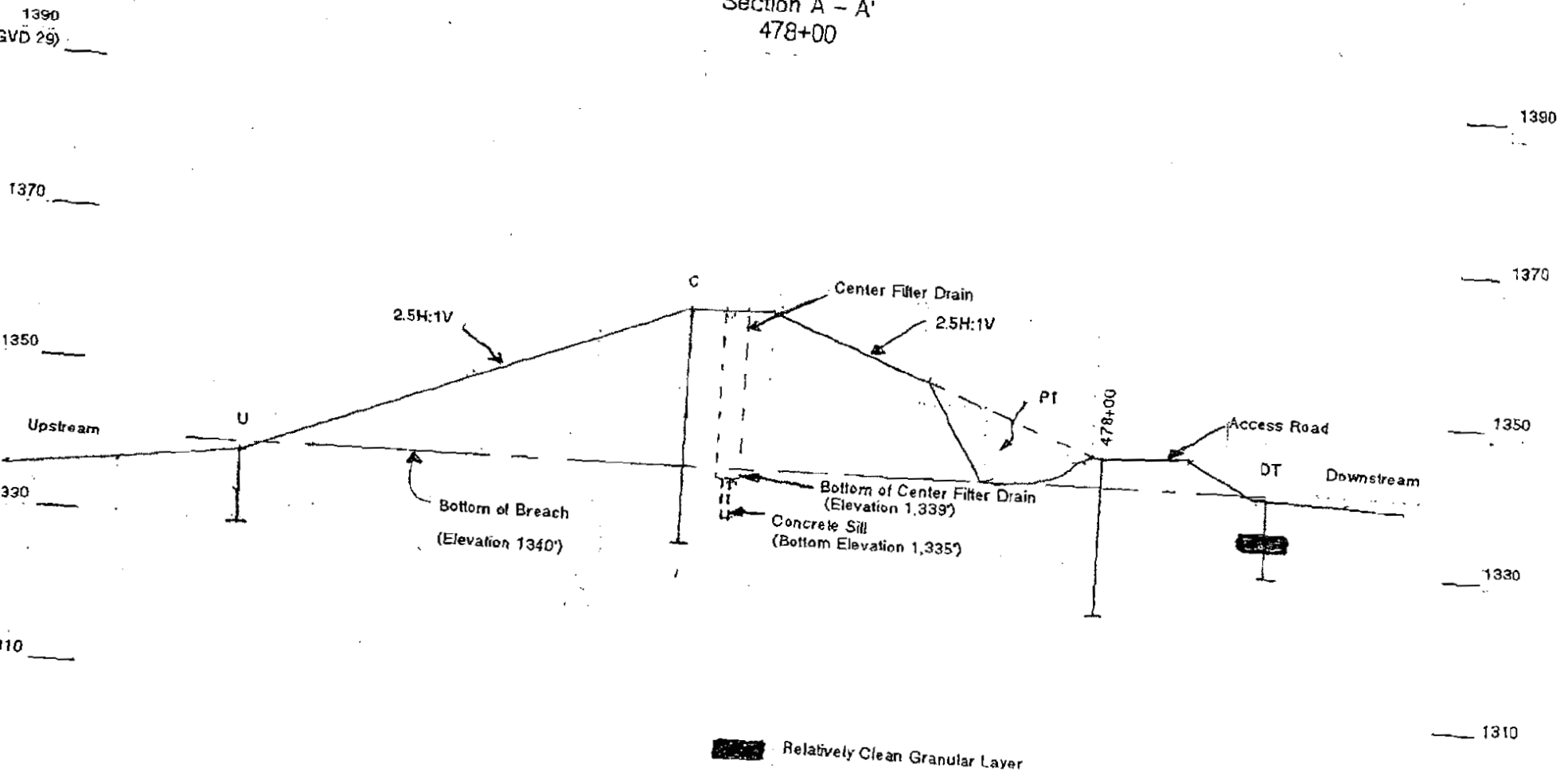
BORING OPERATION

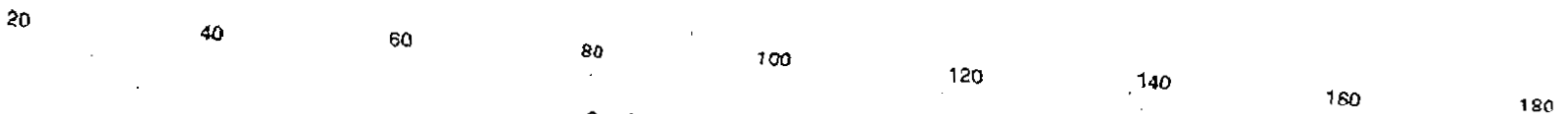
S - 2" O.D. Tube Sample
HQ - 2.8" O.D. Triple-tube Wireline Rock Coring
B - BDBGM Wireline Rock Coring.
BW - BW-44 Rock Coring
BWC - BW Casing
NV - No Value

LOG OF TEST BORING NO. B-13

RAM GEOTECHNICAL INVESTIGATION (JANUARY 2004)

Section A – A'
478+00

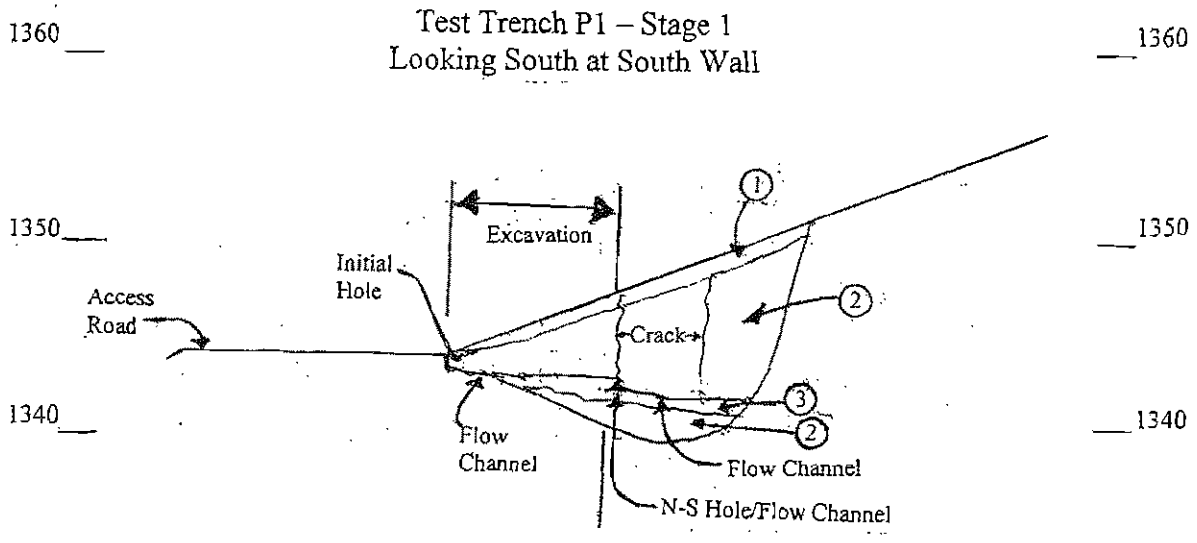




Section A – A' (Scale 1" = 20')

7–17/03
G08912 (Supplement)

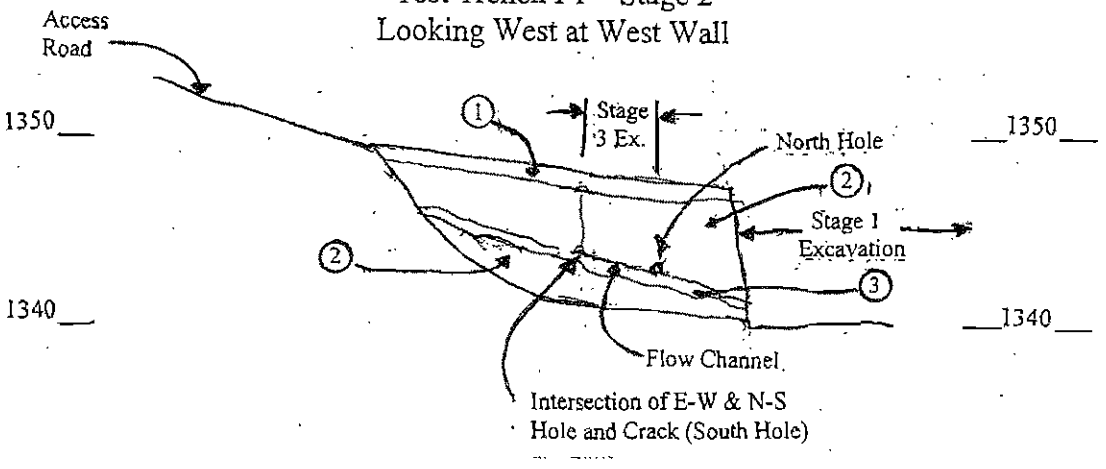
Test Trench P1 – Stage 1
Looking South at South Wall



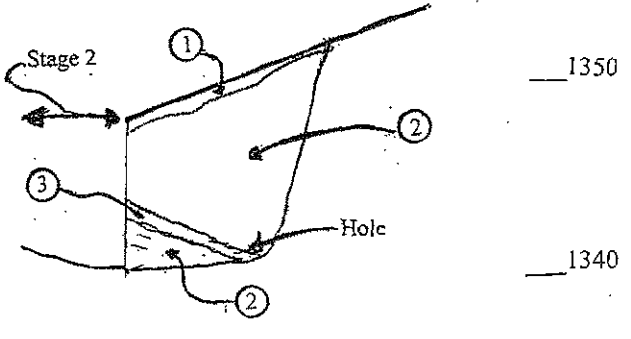
1" = 1'

1. Fill – Sandy Clay, Trace Gravel & Some Roots, Soft to Stiff (CL)
2. Fill – Sandy Clay, Trace Gravel, Very Stiff to Hard (CL)
3. Fill – Silty Sand, Trace Gravel, Dense, Low Plasticity Fines

Test Trench P1 – Stage 2
Looking West at West Wall



Test Trench P1 – Stage 3
Looking South at South Wall



G08912
(Supplement)

TEST BORING LOG

BORING NO. 478+00 U
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+08; Upstream Toe
DRILL EQUIPMENT: CME 55

DATE: 8-20-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1339.25' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		12	R	98	7	CL	Fill: Sandy Clay, Trace Gravel; brown, nearly dry, very stiff, medium plasticity.
		27	R	105	5		
		43	R	100	5		
		39	R	105	5		
5		50/9"	R	117	4		
		50/7"	R	116	3	SC-SM	Clayey Silty Sand, Trace to Some Gravel; brown, nearly dry, very dense, light cementation.
		50/11"	R	109	4		
		33	R	102	5	SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense to very dense, light cementation.
		50/5"	R	109	12		
		50/8"	R	111	8		
10							Stopped at 9.7 feet. No groundwater observed.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+00 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+08; 6' L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 1 OF 2
GROUND ELEV. 1360.67' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense, well compacted, medium plasticity fines.
5							
10							
15							
20							
25		50/6"	R	117	6		
							- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+00 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+08, 6' L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 2 OF 2
GROUND ELEV. 1360.67' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/4"	R	NR		SC	Fill: Clayey Sand, Trace to Some Gravel - continued
		50/8"	R	110	6		
		50/9"	R	119	4	CL/SC	Sandy Clay/Clayey Sand, Trace Gravel; brown, nearly dry, brown, nearly dry, very stiff, very dense, moderate cementation.
		50/5"	R	113	3		
		50/10"	R	115	4	SC-SM	Clayey Silty Sand, Trace to Some Gravel; brown, nearly dry, very dense, light cementation.
30		50/10"	R	105	9		
		50/11"	R	100	6		
						CL	Sandy Clay, Trace of Gravel; brown, slightly damp, very stiff, moderate cementation.
						SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, very dense, light cementation.
35							Stopped at 31 feet. No groundwater observed. NR = No Recovery
40							Note: Second attempt was drilled at Sta. 478+11, 6' R, Elev. 1360.72 on downstream crest to check for filter cloth and gravel. Found nothing to 10'.
45							
50							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+00 **DATE:** 6-18-03 **BY:** DM
PROJECT NAME: Dam Repair **SHEET NO.** 1 **OF** 1
Principal Spillway at McMicken Dam **GROUND ELEV.** 1344.00' (NGVD 29)
LOCATION: Sta. 478+18; R55' (ML) **W.T. ELEV.** None Encountered
DRILL EQUIPMENT: CME 55 **DRILLER:** D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/6"	R	111	5	SC	Fill: Clayey Sand, Some Gravel; brown, nearly dry, dense, medium plasticity fines.
		50/7"	R	108	6		
5		50/6"	R	110	6		
		50/2"	R	NR			
10		50/10"	R	108	4	SC/SM	Clayey to Silty Sand, Some Gravel; brown, nearly dry, dense to medium dense, low plasticity fines.
		39	R	109	3		
15		50/7"	R	104	11	SC	Clayey Sand, Some Gravel; brown, slightly damp, very dense, light cementation, medium plasticity fines, slightly to moderately vesicular.
20		50/10"	R	95	7		
							Stopped drilling at 20.8 feet. No groundwater observed. NR = No Recovery
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

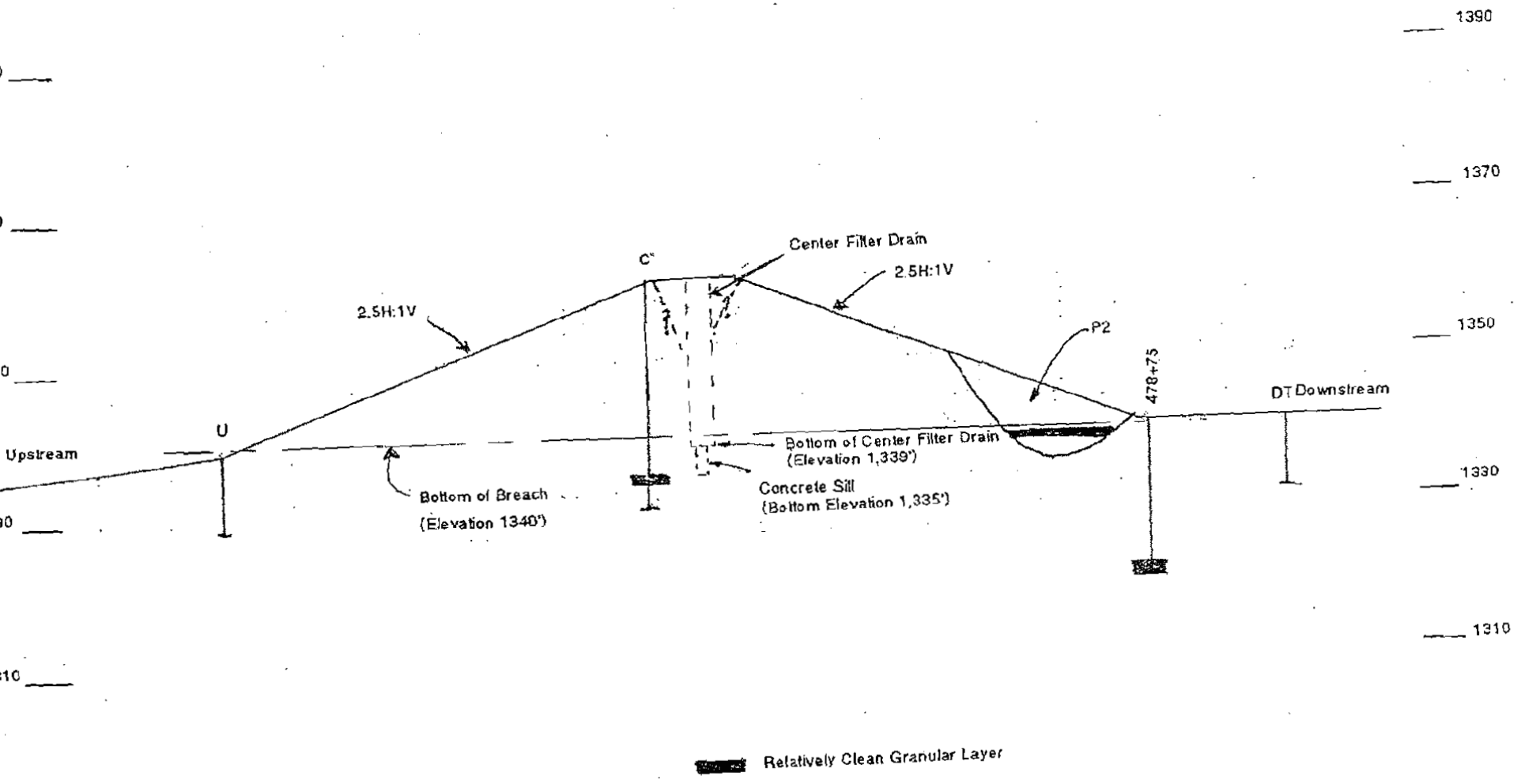
BORING NO. 478+00 DT
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+08; 14' L of Offset Fence Post
DRILL EQUIPMENT: CME 55

DATE: 8-20-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1339.53' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		15	R	111	4	SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, medium dense, well compacted, medium plasticity fines.
		18	R	113	7		
		36	R	109	5	CL	Sandy Clay, Trace of Gravel; brown, slightly damp, stiff to very stiff, moderate cementation.
		43	R	115	5		
5		50/9"	R	112	5		
		37	R	114	4		
		31	R	113	1	SP-SM	Gravelly Sand, Some Silt; brown, nearly dry, medium dense, non-plastic fines.
		21	R	89	4		
		29	R	103	7	ML	Sandy Silt, Trace Gravel; brown, nearly dry, stiff, low plasticity, lightly cemented.
		44	R	117	6		
10						SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense, light cementation.
							Stopped at 10 feet. No groundwater observed.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

Section B – B'
478+75

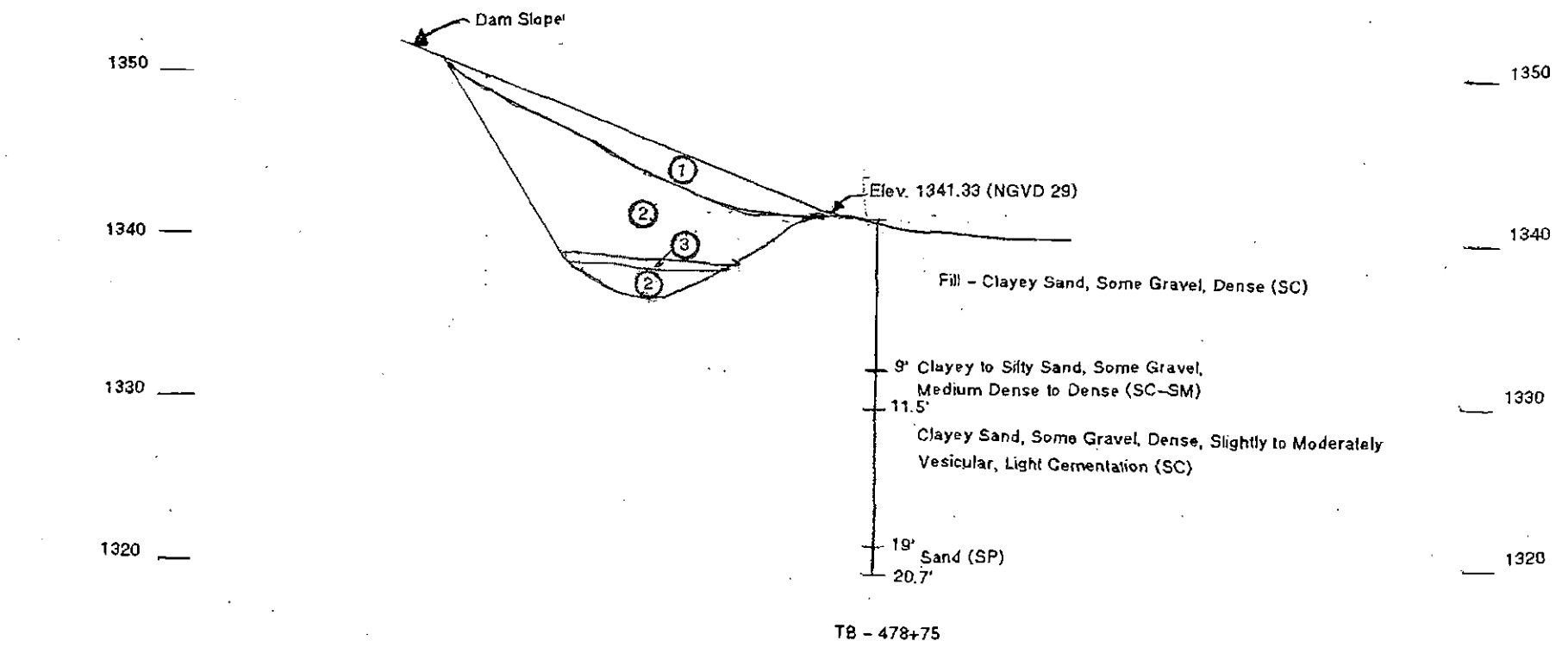


Section B – B' (Scale 1" = 20')

7-17/03
G08912 (Supplement)

A12

Test Trench P2
(Looking North)
Sta. 478+68



Scale 1" = 10'

1. Fill – Clayey Sand, Some Gravel & Roots, Loose to Medium Dense (SC)
2. Fill – Clayey Sand, Some Gravl, Dense (SC)
3. Gravelly Sand, Some Clay, Dense (SC)

G08912
(Supplement)

TEST BORING LOG

BORING NO. 478+75 U
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+68; Upstream Toe
DRILL EQUIPMENT: CME 55

DATE: 8-20-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1340.00' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		19	R	108	2	SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense, well compacted, medium plasticity fines.
		50/11"	R	108	4		
		50	R	117	4		
		50/8"	R	113	4	SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, medium dense to dense, light cementation.
5		38	R	109	4		
		27	R	101	4		
		30	R	111	2		
		29	R	96	4	ML	Sandy Silt, Trace Gravel; brown, nearly dry, stiff, low plasticity, lightly cemented.
		25	R	107	4		
		34	R	105	4	SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense, light cementation.
10							
							Stopped at 10 feet. No groundwater observed.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+75 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+68; 8' 6" L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 1 OF 2
GROUND ELEV. 1360.80' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, dense, well compacted, medium plasticity fines.
5							
10							
15							
20							
25		50/6"	R	118	4		
							- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+75 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+68; 8' 6" L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 2 OF 2
GROUND ELEV. 1360.80' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/6"	R	101	4	SC	Fill: Clayey Sand, Trace to Some Gravel; - continued
		50/8"	R	118	4		
		38	R	118	2	SP-SM	Gravelly Sand, Some Silt; brown, nearly dry, very dense, non-plastic fines.
		50	R	116	3		
		45	R	94	4	SM	Silty Sand, Some Gravel; brown, nearly dry, dense, non-plastic to low plasticity fines.
30		50	R	103	5		
						CL	Sandy Clay, Trace of Gravel; brown, slightly damp, very stiff, moderate cementation.
							Stopped at 30 feet.
							No groundwater observed.
35							Note: First attempt was drilled at Sta. 478+65, 9' R, Elev. 1360.56. Hit filter cloth and washed gravel 7'. Moved to upstream crest.
40							
45							
50							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 478+75
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 478+67.9; R56' (ML)
DRILL EQUIPMENT: CME 55

DATE: 6-18-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1341.33' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		18	R	106	5	SC	Fill: Clayey Sand, Some Gravel; brown, nearly dry, dense to very dense, medium plasticity fines.
		50/4"	R	105	5		
5		50/7"	R	106	5		
		50/6"	R	NR			
10		35	R	118	3	SC/SM	Clayey to Silty Sand, Some Gravel; brown, nearly dry, medium dense to dense, low plasticity fines.
		50/9"	R	100	10	SC	Clayey Sand, Some Gravel; brown, slightly damp, very dense, light cementation, medium plasticity fines, slightly to moderately vesicular.
15		50/9"	R	96	6		
20		50/8"	R	106	4	SP	Sand, Trace Gravel and Silt; brown, nearly dry, very dense, non-plastic.
							Stopped drilling at 20.7 feet. No groundwater observed. NR = No Recovery
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

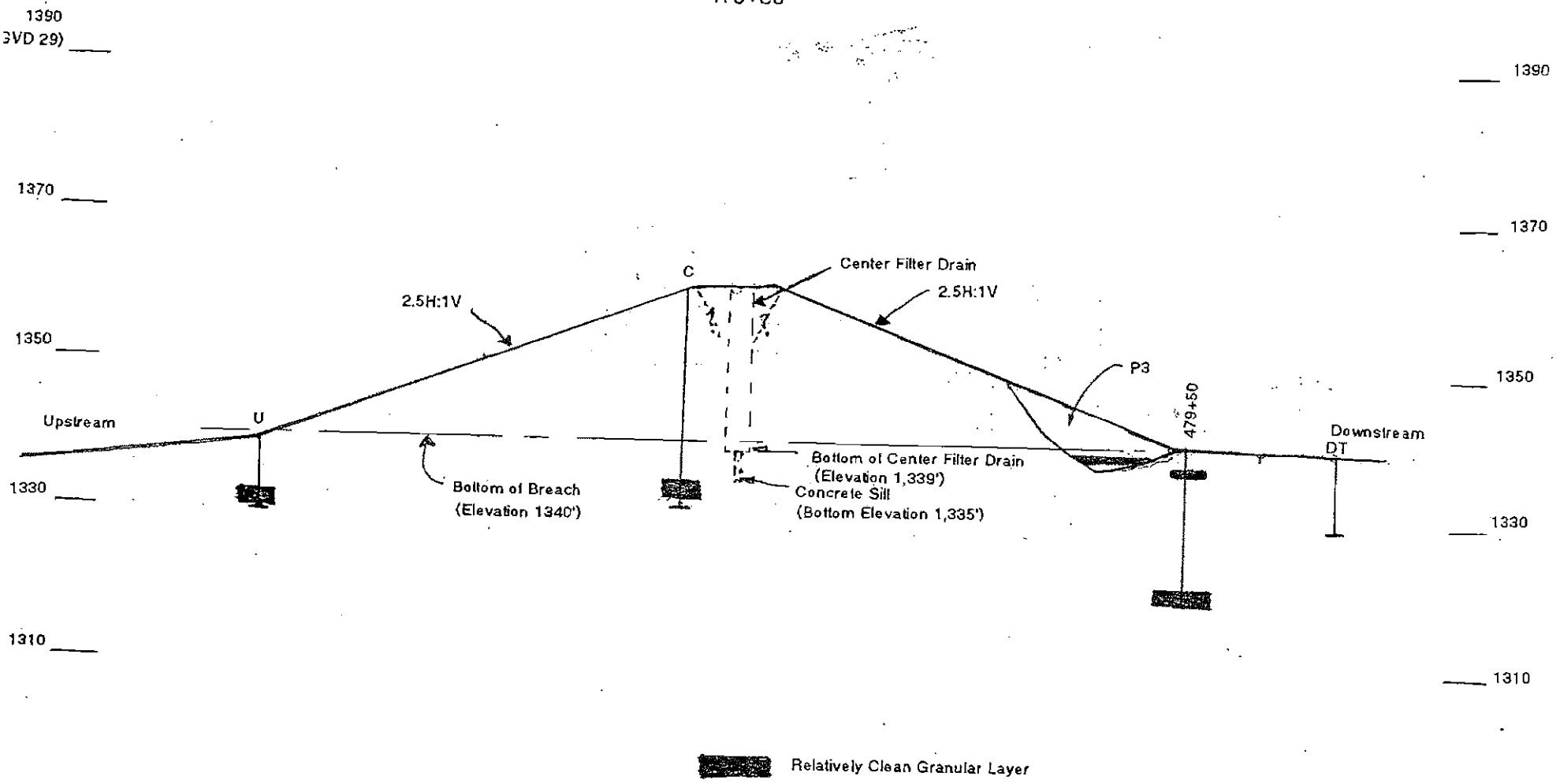
TEST BORING LOG

BORING NO. 478+75 DT | DATE: 8-20-03 | BY: DM
PROJECT NAME: Dam Repair | SHEET NO. 1 OF 1
Principal Spillway at McMicken Dam | GROUND ELEV. 1340.00' (NGVD 29)
LOCATION: Sta. 478+68; 14' L of Offset Fence Post Align. | W.T. ELEV. None Encountered
DRILL EQUIPMENT: CME 55 | DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50	R	119	3	SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, medium dense to dense, well compacted, medium plasticity fines.
		39	R	118	6		
		28	R	110	6		
		26	R	114	6		
5		26	R	105	6	SC-SM	Clayey Silty Sand, Trace to Some Gravel; brown, nearly dry, medium dense to very dense, light cementation.
		50/9"	R	113	6		
		50/9"	R	110	5		
		21	R	119	5		
		22	R	118	4		
10		14	R	94	3		
							Stopped at 10 feet. No groundwater observed.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

Section C – C'
479+50



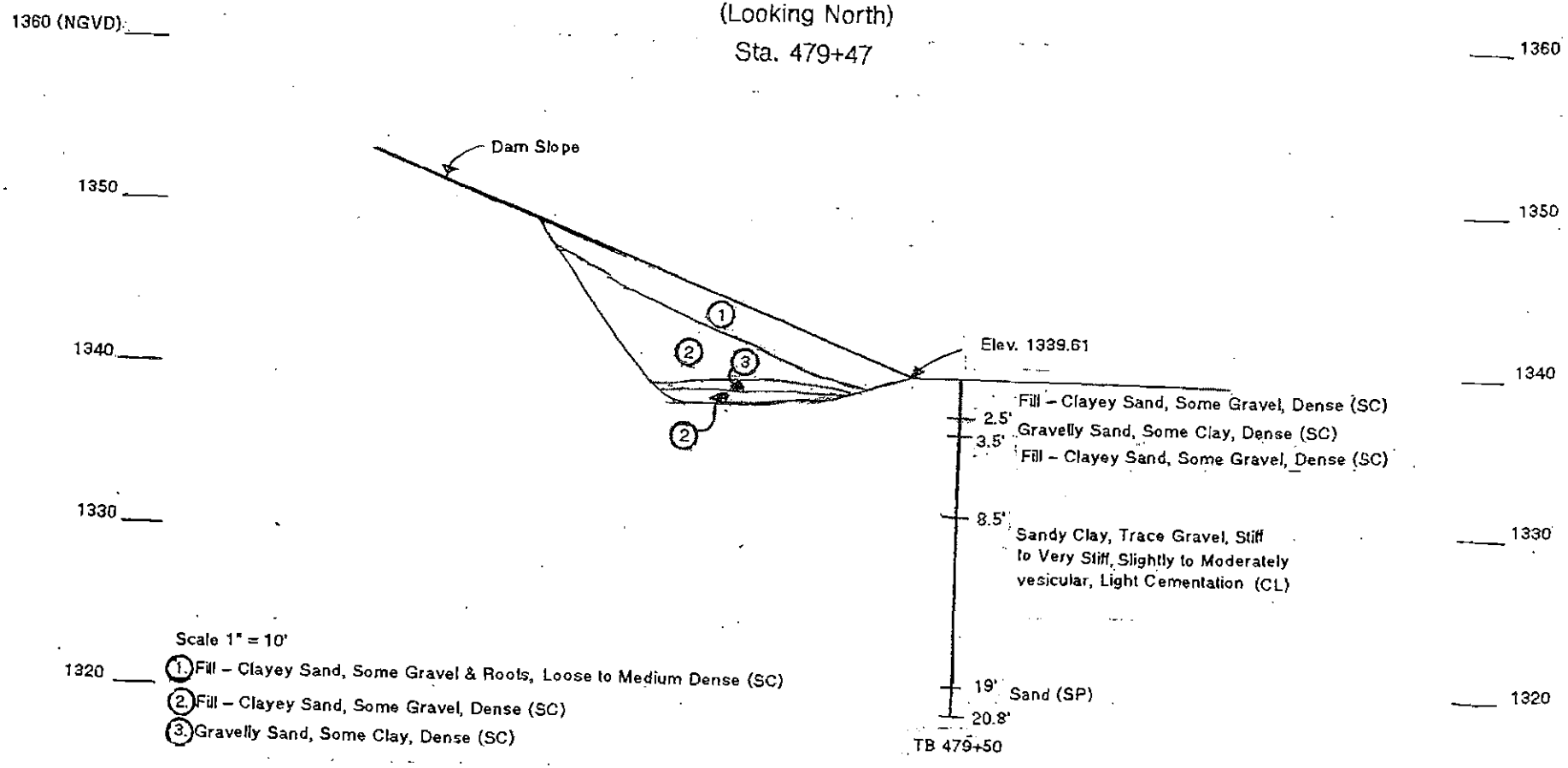
0 20 40 60 80 100 120 140 160 180

Section C – C' (Scale 1" = 20')

A19

7–17/03
G08912 (Supplement)

Test Trench P3
(Looking North)
Sta. 479+47



Scale 1" = 10'

1. Fill – Clayey Sand, Some Gravel & Roots, Loose to Medium Dense (SC)
2. Fill – Clayey Sand, Some Gravel, Dense (SC)
3. Gravelly Sand, Some Clay, Dense (SC)

A20

G08912
(Supplement)

TEST BORING LOG

BORING NO. 479+50 U
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 479+38; Upstream Toe
DRILL EQUIPMENT: CME 55

DATE: 8-20-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1341.12' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		34	R	112	3	CL	Fill: Sandy Clay, Trace Gravel; brown, nearly dry, very stiff, medium plasticity.
		50/10"	R	120	4		
		50/7"	R	109	6		
		38	R	113	4		
5		33	R	111	4	CL	Sandy Clay, Trace of Gravel; brown, slightly damp, stiff, moderate cementation.
		26	R	108	4		
		46	R	107	4		
		18	R	112	2	SP-SM	Gravelly Sand, Some Silt; brown, nearly dry, medium dense, non-plastic fines.
		27	R	108	2		
		50/3"	R	*	9		
10						SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, very dense, light cementation.
							Stopped at 9.3 feet. No groundwater observed.
15							* Sample too disturbed to determine density.
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 479+50 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 479+38; 8' 6" L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 1 OF 2
GROUND ELEV. 1362.80' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		22	R	120	2	SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, medium dense to very dense, well compacted, medium plasticity fines.
5		36	R	116	4		
10		50/8"	R	113	6		
15		50/5"	R	112	5		
20		50/6"	R	123	6		
		50/5"	N		9		
		70/6"	N		5		
		50/4"	N		5		
		50/4"	N		4		
		50	N		4		
25		45	R	110	10	SM	Silty Sand, Some Gravel; brown, nearly dry, dense, non-plastic to low plasticity fines.

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 479+50 C
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 479+38; 8' 6" L
DRILL EQUIPMENT: CME 55

DATE: 8-19-03 BY: DM
SHEET NO. 2 OF 2
GROUND ELEV. 1362.80' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		44	R	107	3	SM	Silty Sand, Some Gravel; - continued
		50/6"	R	97	4	SP	Sand, Some Silt and Gravel; brown, nearly dry,
		40	R	113	1		dense, non-plastic fines.
		50	R	107	10	SC	Clayey Sand, Trace to Some Gravel; brown,
		50/4"	R	NR			nearly dry, very dense, light cementation.
30							
							Stopped at 29.3 feet.
							No groundwater observed.
							NR = No Recovery
							Note: First attemp to drill at
35							Sta. 479+38, 9' R, Elev. 1360.69.
							Hit filter cloth and washed gravel 6'.
							Second attempt to drill at
							Sta. 479+43, 4' R, Elev. 1360.69.
							Hit filter cloth and washed gravel 7' and
							third attempt to drill at Sta. 479+44, 4' L,
							Elev. 1362.00. Hit cloth and washed gravel
40							7'.
45							
50							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 479+50
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 479+47.3; R58' (ML)
DRILL EQUIPMENT: CME 55

DATE: 6-16-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1339.60' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		26	R	114	3	SC	Fill: Clayey Sand, Some Gravel; brown, nearly dry, medium dense, medium plasticity fines.
		37	R	112	5	SC	Gravelly Sand, Some Clay; brown, nearly dry, medium dense, medium plasticity fines.
5		50/8"	R	107	4	SC	Fill: Clayey Sand, Some Gravel; brown, nearly dry, very dense, medium plasticity fines. (old fill ?)
		50/8"	R	114	4		
10		43	R	111	3	CL	Sandy Clay, Trace Gravel; brown, slightly damp, stiff to very stiff, light cementation, medium plasticity, slightly to moderately vesicular.
		35	R	*	7		
15		47	R	97	6		
20		50/10"	R	113	2	SP	Sand, Trace Gravel and Silt; brown, nearly dry, very dense, non-plastic.
							Stopped drilling at 20.8 feet. No groundwater observed.
25							* Sample to disturbed to determine density.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

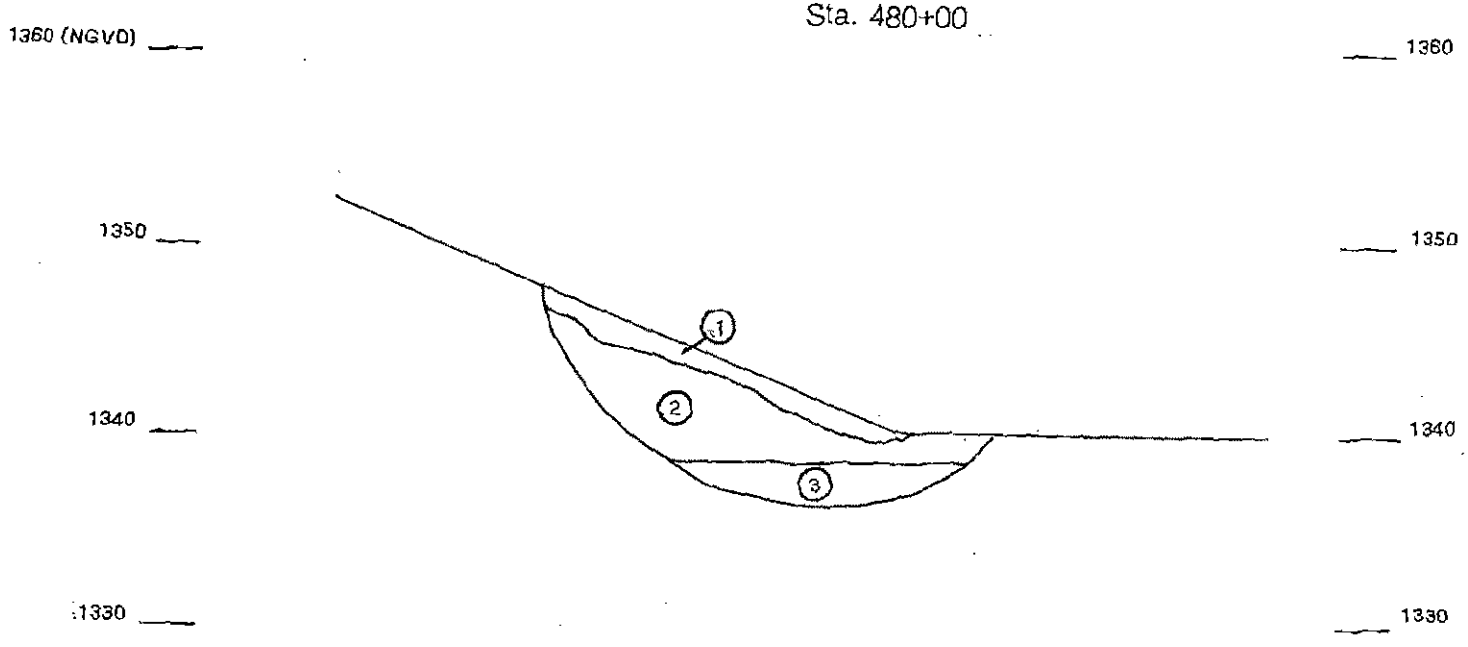
BORING NO. 479+50 DT
PROJECT NAME: Dam Repair
Principal Spillway at McMicken Dam
LOCATION: Sta. 479+38; 14' L of Offset Fence Post Align.
DRILL EQUIPMENT: CME 55

DATE: 8-20-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1340.00' (NGVD 29)
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		27	R	112	4	SC	Fill: Clayey Sand, Trace to Some Gravel; brown, nearly dry, medum dense to dense, well compacted, medium plasticity fines.
		35	R	112	6		
		28	R	112	5		
		9	R	102	7	SC	Clayey Sand, Trace to Some Gravel; brown, nearly dry, loose, light cementation.
5		5	R	99	7		
		5	R	97	7		
		4	R	93	5		
		4	R	94	6		
		9	R	91	10		
		5	R	95	7		
10							
							Stopped at 10 feet. No groundwater observed.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

Test Trench P4
(Looking North)
Sta. 480+00

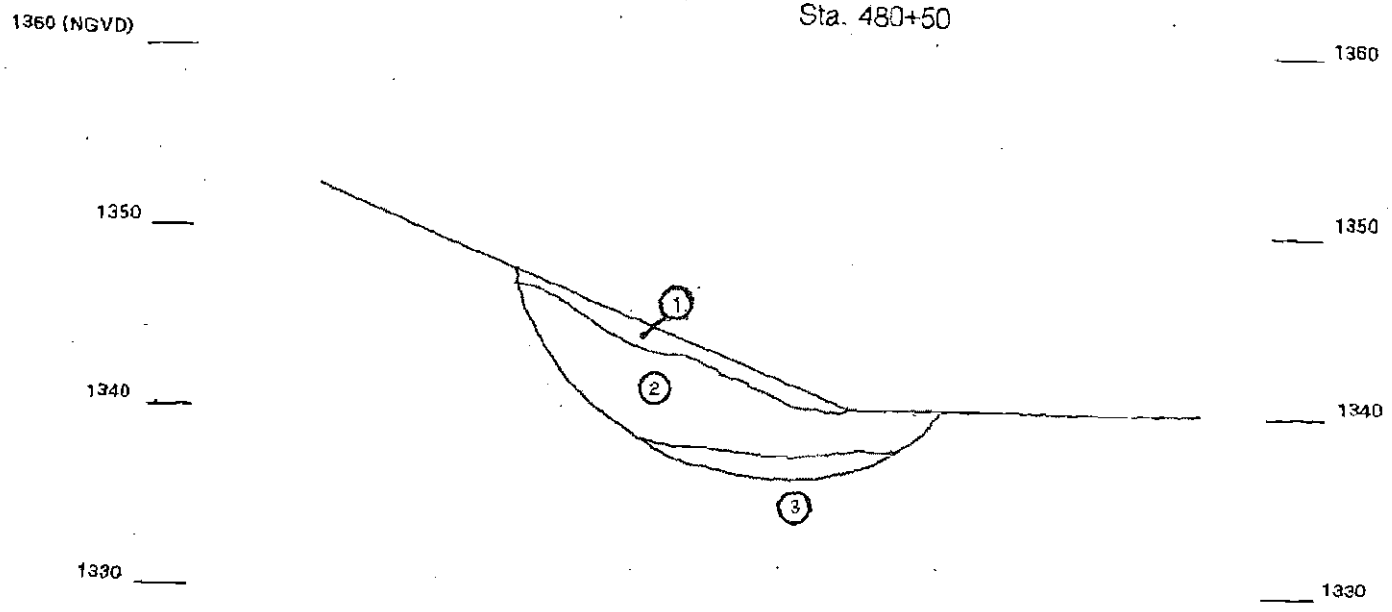


Scale 1" = 10'

1. Fill – Clayey Sand, Some Gravel & Roots, Loose to Medium Dense (SC)
2. Fill – Clayey Sand, Some Gravel, Dense (SC)
3. Silty to Clayey Sand, Some Gravel, Medium Dense (SM–SC)

G08912
(Supplement)

Test Trench P5
(Looking North)
Sta. 480+50



Scale 1" = 10'

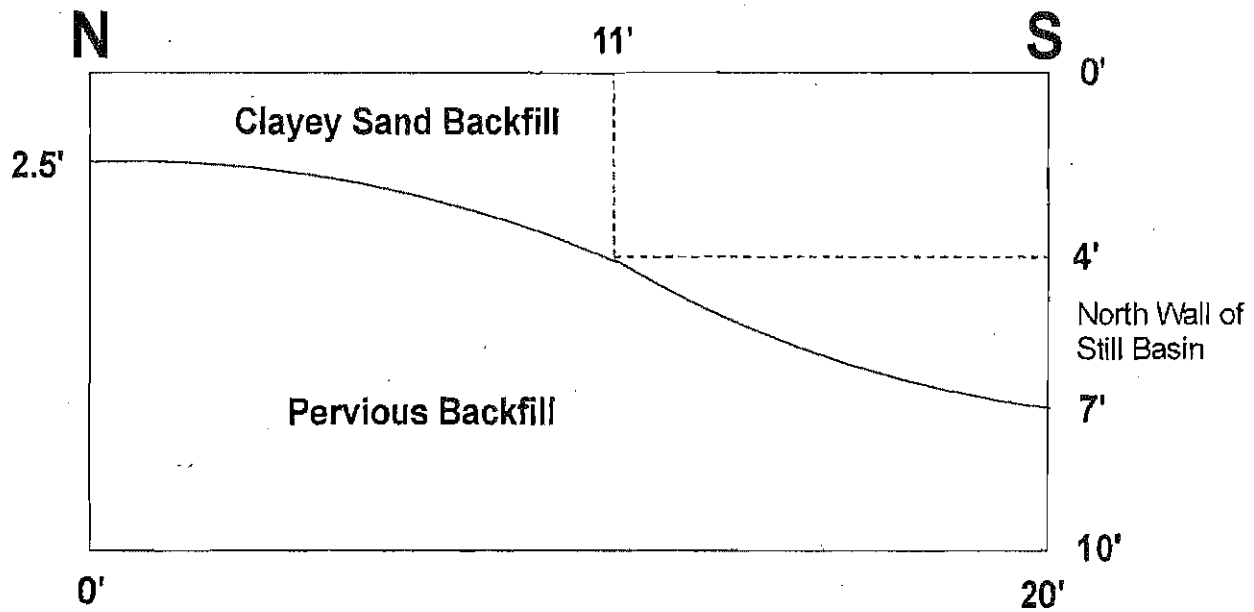
1. Fill – Clayey Sand, Some Gravel & Roots, Loose to Medium Dense (SC)
2. Fill – Clayey Sand, Some Gravel, Dense (SC)
3. Silty to Clayey Sand, Some Gravel, Medium Dense (SM–SC)

G08912
(Supplement)

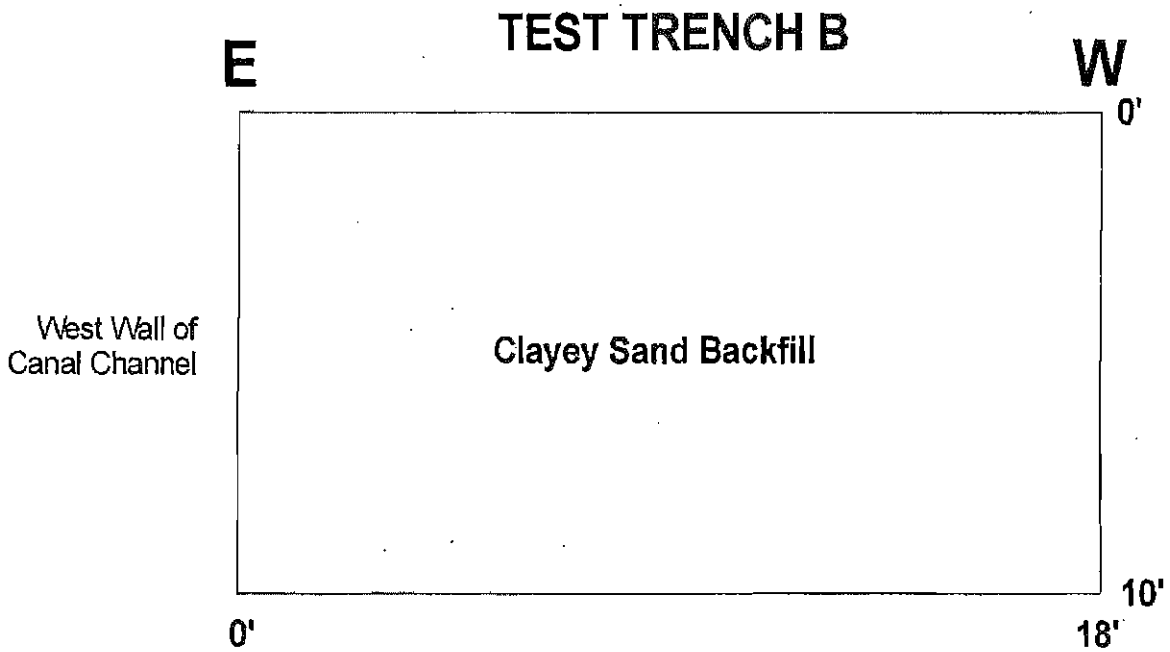
RAM PRINCIPAL OUTLET GEOTECHNICAL INVESTIGATION (APRIL, 2004)

TEST TRENCH CROSS-SECTIONS

TEST TRENCH A



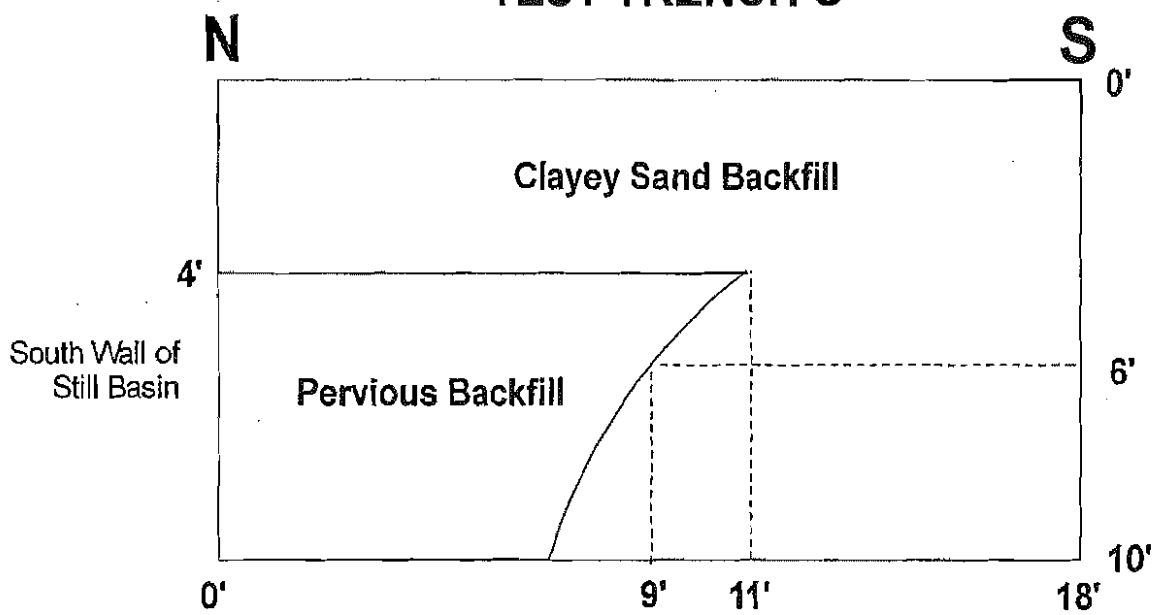
TEST TRENCH B



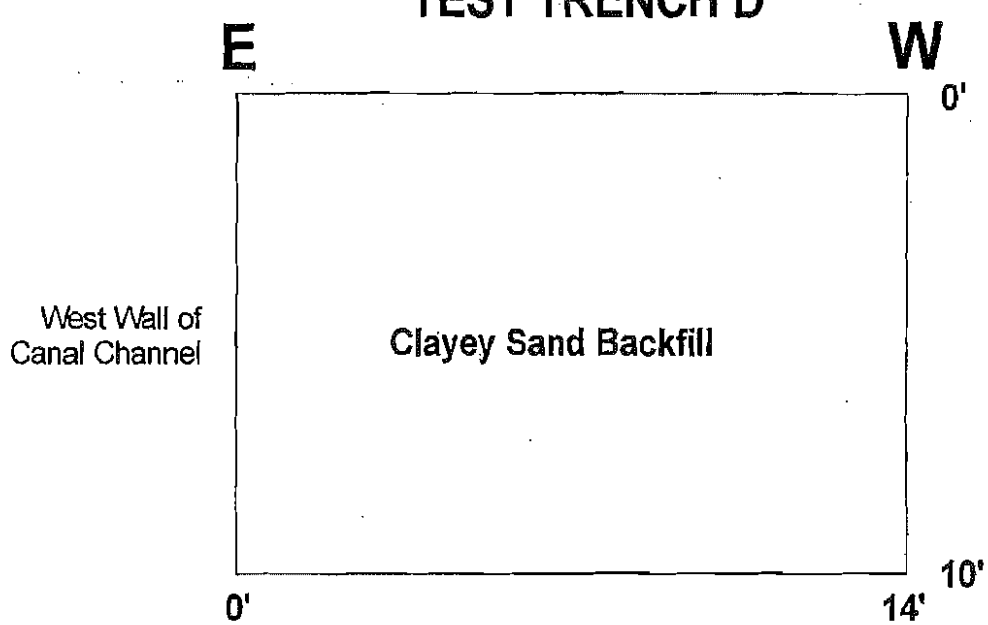
Not To Scale

TEST TRENCH CROSS-SECTIONS

TEST TRENCH C



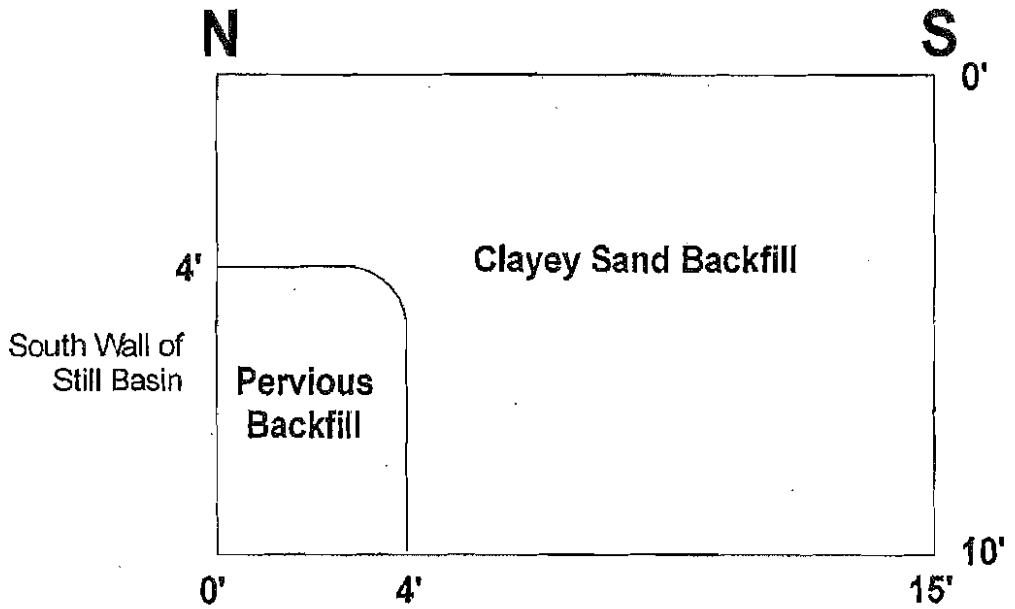
TEST TRENCH D



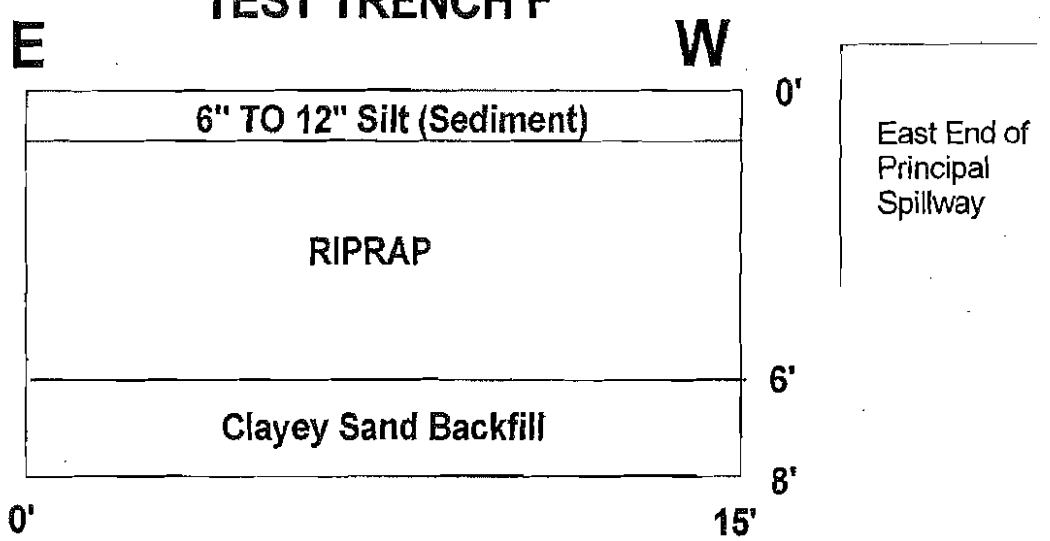
Not To Scale

TEST TRENCH CROSS-SECTIONS

TEST TRENCH E



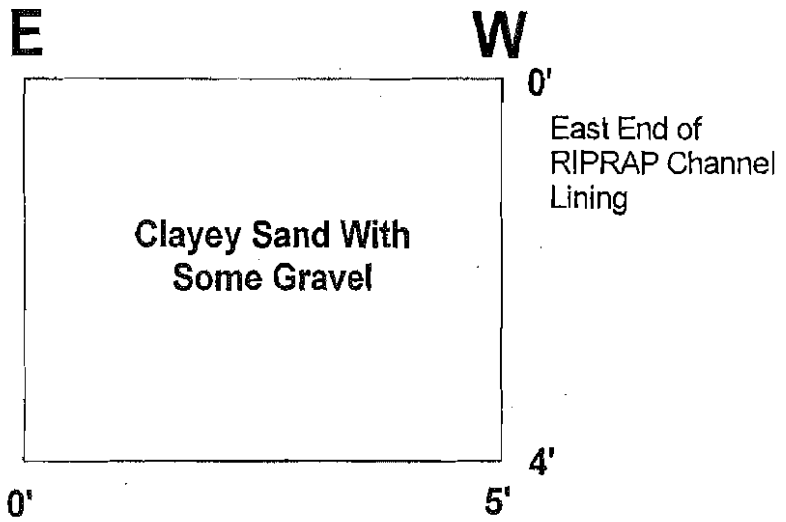
TEST TRENCH F



Not To Scale

TEST TRENCH CROSS-SECTIONS

TEST TRENCH G



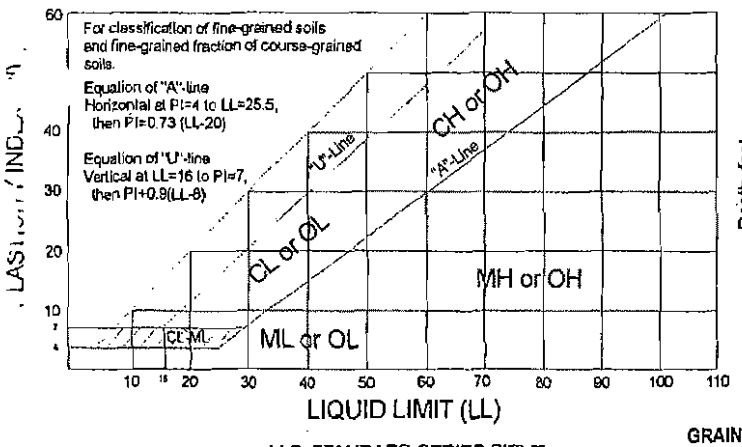
Not To Scale

LEGEND

CLASSIFICATION OF SOILS

ASTM Designation: D2487-83
(Based on Unified Soil Classification System)

			Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests		Soil Classification: Group Symbol	Soil Classification: Name
COARSE-GRAINED SOILS More than 50% retained on No. 200 Sieve	Gravels More than 50% coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines	Cu > 4 and 1 < Cc < 3		GW	Well graded gravel
			Cu<4 and/or 1>Cc>3		GP	Poorly graded gravel
		Gravels with Fines More than 12% fines	Fines classify as ML or MH		GM	Silty gravel
			Fines classify as CL or CH		GC	Clayey gravel
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	Cu > 6 and 1 < Cc < 3		SW	Well-graded sand
			Cu<6 and/or 1>Cc>3		SP	Poorly graded sand
		Sands with Fines More than 12% fines	Fines classify as ML or MH		SM	Silty sand
			Fines classify as CL or CH		SC	Clayey sand
FINE-GRAINED SOILS 50% or more passes the No. 200 Sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI>7 and plots on or above "A" line		CL	Lean clay
			PI<4 or plots below "A" line		ML	Silt
		Organic	Liquid Limit - oven dried / Liquid limit - not dried	<0.75	OL	Organic clay / Organic silt
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line		CH	Fat clay
			PI plots below "A" line		MH	Elastic silt
		Organic	Liquid limit - oven dried / Liquid limit - not dried	<0.75	OH	Organic clay / Organic silt
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor				Pt	Peat



TEST BORING LOG DEFINITIONS

Blows per foot using 140 pound hammer with 30 inch free-fall.

Depth, feet	Blows/Foot: C	Blows/Foot: N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description

C = Continuous Penetration Resistance (2 inch diameter rod)
N = Standard Penetration Resistance (ASTM D1586)
R = Penetration Resistance (3 inch diameter ring line sampler)

GRAIN SIZES

U.S. STANDARD SERIES SIEVE	200	40	10	4	CLEAR SQUARE SIEVE OPENINGS 3/4"	3"	12"
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE →)

DRY — SLIGHTLY DAMP — DAMP — MOIST (Plastic Limit) — VERY MOIST — WET (SATURATED) (Liquid Limit)

CONSISTENCY CORRELATION: CLAYS & SILTS	BLOWS/FOOT*	RELATIVE DENSITY CORRELATION: SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	VERY LOOSE	0-4
SOFT	2-4	LOOSE	4-10
FIRM	4-8	MEDIUM DENSE	10-30
STIFF	8-16	DENSE	30-50
VERY STIFF	16-32	VERY DENSE	OVER 50
HARD	OVER 32		

*Number of blows of 140 lb hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).

TEST BORING LOG

BORING NO. H1
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Joint S3
DRILL EQUIPMENT: Vacuum Truck Excavation

DATE: 6-19-03 BY: DM
SHEET NO. 1 OF 1
GROUND ELEV. 1,355.5'
W.T. ELEV. None Encountered
DRILLER: AZTEC

Depth, feet	*Blows/Foot C	*Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
						SM-SC	Structural Backfill - Silty to Clayey Sand, Trace Gravel; brown, nearly dry, loose, low plasticity fines.
5							
		21	R	97	3		
		40	R	103	4		
		61	R	99	3		
							Stopped at 7.5 feet. Backfill too loose and dry to retain in sampler.
10							No groundwater observed.
							* Sampler driven with 40 pound hand operated slide hammer.
							Vacuum truck used 0 to 4.5 feet continuous drive sampling below.
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. TD1 **DATE:** 6-19-03 **BY:** DM
PROJECT NAME: Principal Spillway at McMicken Dam **SHEET NO.** 1 **OF** 3
GROUND ELEV. 1,360.2'
LOCATION: Dam Crest South of Bridge **W.T. ELEV.** None Encountered
DRILL EQUIPMENT: CME 75 **DRILLER:** D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		46	R	114	4	SC	Structural Backfill - Clayey Sand, Some Gravel; brown, nearly dry to slightly damp, dense at the surface, medium dense to loose below, medium plasticity fines.
5		14	R	114	7		
10		15	R	99	6		
15		9	R	101	11		
20		12	R	107	10		
						SM	Structural Backfill - Silty Sand, Some Gravel; brown, nearly dry to slightly damp, medium dense to loose, low plasticity fines.
25							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. TD1
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Dam Crest South of Bridge
DRILL EQUIPMENT: CME 75

DATE: 6-19-03 **BY:** DM
SHEET NO. 2 **OF** 3
GROUND ELEV. 1,360.2'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		11	R	111	9	SM	Structural Backfill - Silty Sand, Some Gravel; - cont.
30		21	R	111	7	SC	Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, intermittent light to moderate cementation 30 to 45 feet, moderate to heavy cementation below 45 feet.
35		33	R	115	4		
40		26	R	*	2		
45		50/7"	R	112	3		
50							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. TD1
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Dam Crest South of Bridge
DRILL EQUIPMENT: CME 75

DATE: 6-19-03 **BY:** DM
SHEET NO. 3 **OF** 3
GROUND ELEV. 1,360.2'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/9"	R	104	7	SC	Clayey Sand, Some Gravel; - cont.
							Stopped at 50.8 feet.
							No groundwater observed.
55							* Ring sample too disturbed to determine density
60							
65							
70							
75							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 1
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Northwest Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-17-03 **BY:** DM
SHEET NO. 1 **OF** 2
GROUND ELEV. 1,338.6'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		10	R	106	4	SM-SC	Backfill - Silty to Clayey Gravelly Sand; brown, nearly dry, medium dense to loose, low to medium plasticity fines.
5		7	R	112	3		
10		21	R	115	4	SM	Pervious Backfill - Gravelly Silty Sand; brown, nearly dry, medium dense to loose, low plasticity fines.
15		9	R	112	4		
20		6	R	110	9		
25						SC	Clayey sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, intermittent moderate to heavy cementation.

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 1
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Northwest Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-17-03 **BY:** DM
SHEET NO. 2 **OF** 2
GROUND ELEV. 1,338.6'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/9"	R	108	14	SC	Clayey Sand, Some Gravel; - cont.
30		33	R	109	9		
35		41	R	111	10		
40		50/3"	R	NR			
							Stopped at 40.3 feet. No groundwater observed. NR = No Recovery Note: Set slotted pipe tip at 39.3 feet and completed piezometer.
45							
50							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 2
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Northeast Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-17-03 **BY:** DM
SHEET NO. 1 **OF** 3
GROUND ELEV. 1,337.0'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		8	R	112	4	SM	Pervious Backfill - Gravelly Silty Sand; brown, nearly dry, medium dense to loose, low plasticity fines.
5		5	R	108	5		
10		10	R	118	5		
15		9	R	113	8		
20							
		6	R	NR		SM-SC	Backfill - Silty to Clayey Gravelly Sand; brown, nearly dry, medium dense to loose, low to medium plasticity fines.
25							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 2
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Northeast Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-17-03 BY: DM
SHEET NO. 2 OF 3
GROUND ELEV. 1,337.0'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		7	R	112	13	SM-SC	Backfill - Silty to Clayey Gravelly Sand; - cont.
30		42	R	104	6		Concrete Wash/Spoil/Spillage; gray, very hard to soft, low strength.
35						SC	Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, moderate cementation.
		39	R	106	9	SP	Sand, Trace to Some Gravel, Trace Silt; brown, slightly damp to nearly dry, medium dense to dense, no to low plasticity fines.
40		36	R	110	3		
45		50/8"	R	111	9	SC	Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, moderate cementation.
50							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 2
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Northeast Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-17-03 **BY:** DM
SHEET NO. 3 **OF** 3
GROUND ELEV. 1,337.0'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50	R	103	8	SC	Clayey Sand, Some Gravel; - cont.
							Stopped at 51 feet.
							No groundwater observed.
							NR = No Recovery
55							Note: Set porous stone/pipe tip at 49.8 feet, then completed piezometer.
60							
65							
70							
75							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 3
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Southwest Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-18-03 **BY:** DM
SHEET NO. 1 **OF** 2
GROUND ELEV. 1,339.6'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		5	R	111	12	SC	Backfill - Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, loose to medium dense, medium plasticity fines.
5		12	R	123	10		
10		7	R	NR		SM-SC	Backfill - Silty to Clayey Gravelly Sand; brown, nearly dry, medium dense to loose, low to medium plasticity fines.
15		10	R	116	5		
20		38	R	113	4		
25						SC	Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, moderate cementation.

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 3 **DATE:** 6-18-03 **BY:** DM
PROJECT NAME: Principal Spillway at McMicken Dam **SHEET NO.** 2 **OF** 2
GROUND ELEV. 1,339.6'
LOCATION: Southwest Corner of Stilling Basin **W.T. ELEV.** None Encountered
DRILL EQUIPMENT: CME 75 **DRILLER:** D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		44	R	104	13	SC	Clayey Sand, Some Gravel; - cont.
30		36	R	115	11		
35		50/7"	R	113	11		
40		45	R	117	3		
							Stopped at 41 feet. No groundwater observed. NR = No Recovery
45							Note: Set porous stone/pipe tip at 40.5 feet, then completed piezometer.
50							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 4
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Southeast Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-18-03 **BY:** DM
SHEET NO. 1 **OF** 3
GROUND ELEV. 1,338.0'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		8	R	102	3	SM-SC	Backfill - Silty to Clayey Gravelly Sand; brown, nearly dry, medium dense to loose, low to medium plasticity fines.
5		6	R	97	5		
10							
		12	R	119	3	SM	Pervious Backfill - Gravelly Silty Sand; brown, nearly dry, medium dense to loose, low plasticity fines.
15		11	R	109	4		
20							
		6	R	NR		SM-SC	Backfill - Silty to Clayey Gravelly Sand; brown, nearly dry, medium dense to loose, low to medium plasticity fines.
25							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 4 **DATE:** 6-18-03 **BY:** DM
PROJECT NAME: Principal Spillway at McMicken Dam **SHEET NO.** 2 **OF** 3
GROUND ELEV. 1,338.0'
LOCATION: Southeast Corner of Stilling Basin **W.T. ELEV.** None Encountered
DRILL EQUIPMENT: CME 75 **DRILLER:** D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		7	R	117	12	SM-SC	Backfill - Silty to Clayey Gravelly Sand; - cont.
30		7	R	107	13		
35		19	R	107	16	SM	Silty Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense, low plasticity fines.
40		50/9"	R	116	5	SC	Clayey Sand, Some Gravel; brown, slightly damp to nearly dry, medium dense to dense, moderate cementation.
45		50/8"	R	113	6		
50							

- continued -

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

BORING NO. 4
PROJECT NAME: Principal Spillway at McMicken Dam
LOCATION: Southeast Corner of Stilling Basin
DRILL EQUIPMENT: CME 75

DATE: 6-18-03 **BY:** DM
SHEET NO. 3 **OF** 3
GROUND ELEV. 1,338.0'
W.T. ELEV. None Encountered
DRILLER: D & S Drilling

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		50/7"	R	113	7	SC	Clayey Sand, Some Gravel; - cont.
							Stopped at 50.6 feet.
							No groundwater observed.
							NR = No Recovery
55							Note: Set porous stone/pipe tip at 50.0 feet, then completed piezometer. 55
60							60
65							65
70							70
75							75

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

N&M PRINCIPAL OUTLET GEOTECHNICAL INVESTIGATION (2005)

DATE DRILLED 05/23/05 BORING NO. B-1

GROUND ELEVATION ±1,336' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	HOLOCENE ALLUVIUM: Dark yellowish brown (10YR, 4/6), damp, medium dense, clayey fine to coarse SAND with gravel; low to medium plasticity; fine gravel; few silt.
		16	8.9	111			
		30					Pink (7.5YR, 7/4); dense; weak to moderate cementation; strong reaction with HCl.
5							
		70				GP	PLEISTOCENE ALLUVIUM: Pink (7.5YR, 7/3), damp, dense, sandy fine to coarse GRAVEL; trace silt; numerous caliche filaments and nodules (Stage III); strong reaction with HCl; moderate cementation.
		35				SM	Pink (7.5YR, 7/4), damp, very dense, gravelly, silty fine to coarse SAND; trace clay; numerous caliche filaments (Stage III); weak cementation; strong reaction with HCl.
10							
		47					Light brown (7.5YR, 6/4).
		67/11"	4.7	109			Yellowish red (5YR, 4/6); decrease in caliche content; moderate reaction with HCl.
15							
		73					Brown (7.5YR, 5/4).
							Total depth = 17.0 feet. Groundwater not encountered. Grouted on 05/23/05.
20							

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-1

DATE DRILLED 05/23/05 BORING NO. B-2

GROUND ELEVATION ±1,337' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	HOLOCENE ALLUVIUM: Brownish yellow (10YR, 6/6), damp, medium dense, clayey fine to coarse SAND; low to medium plasticity; few silt.
		11					
		29	6.1	104			Yellowish brown (10YR, 5/6); scattered caliche filaments (Stage I); weak cementation.
5							
		22					Strong brown (7.5YR, 5/6); dense.
		43				SC	PLEISTOCENE ALLUVIUM: Light yellowish brown (10YR, 6/4), damp, dense, clayey fine to coarse SAND; low to medium plasticity; few silt; weak to moderate cementation; strong reaction with HCl.
10							
		20				SP	Light gray (10YR, 7/2), damp, medium dense to dense, gravelly fine to coarse SAND; trace silt.
		32	1.6	115			Strong brown (7.5YR, 4/6); medium dense; increase in gravel content.
15							
		66				SM	Light brown (7.5YR, 6/4), damp, very dense, silty fine SAND; low plasticity; scattered caliche filaments; weak cementation; strong reaction with HCl.
		50/5"					Trace fine gravel.
							Total depth = 18.9 feet. Groundwater not encountered. Grouted on 05/23/05.
20							

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-2

DATE DRILLED 05/25/05 BORING NO. B-3

GROUND ELEVATION ±1,335' MSL SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC/BEP LOGGED BY TLC/BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								PORTLAND CEMENT CONCRETE: Approximately 22" thick.
		■	22	8.3	120		SC	FILL: Strong brown (7.5YR, 4/6), damp, medium dense, clayey SAND.
		■	24				SC	HOLOCENE ALLUVIUM: Strong brown (7.5YR, 4/6), damp, medium dense, clayey SAND; caliche nodules and filaments; pinhole-sized pore spaces.
5		■	41	8.9	110		SC	Light brown (7.5YR, 6/4), scattered cemented caliche nodules. Pink (7.5YR, 7/3), damp, medium dense, clayey fine to coarse SAND; scattered caliche nodules and filaments; trace fine gravel; caliche coating on gravel; medium to reaction with HCl.
		■	55	5.4	114		SM	Light brown (7.5YR, 6/4), damp, dense, silty fine to coarse SAND; caliche coating on gravel; moderate to strong reaction with HCl.
		■	39	7.0	108			Medium dense; scattered caliche nodules.
10		■	23				SP	Brown (10YR, 5/3), damp, medium dense, fine SAND.
		■	23	2.0	108			Fine to coarse-grained.
		■	30	6.1	122			
15		■	45				SM	PLEISTOCENE ALLUVIUM: Brown (7.5YR, 5/4), damp, dense, silty fine SAND; strong reaction with HCl; weak to moderate cementation.
		■	48	2.7	115			
		■	84					Very dense; few clay.
20		■	50/6"					

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-3

DATE DRILLED 05/25/05 BORING NO. B-3

GROUND ELEVATION ±1,335' MSL SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC/BEP LOGGED BY TLC/BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	50/6"				SC	PLEISTOCENE ALLUVIUM: (continued)
		■	50/3"					Strong brown (7.5YR, 4/6), damp, medium dense, clayey SAND; caliche nodules and filaments.
								Total depth = 20.8 feet.
								Groundwater not encountered.
								Grouted on 05/25/05.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-4

DATE DRILLED 05/23/05 BORING NO. B-4

GROUND ELEVATION ±1,335' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR/DTM LOGGED BY JSR/DTM REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CONCRETE: Approximately 44" thick.
		51	7.3	110		SM	HOLOCENE ALLUVIUM: Light yellowish brown (10YR, 6/4), damp, dense, silty fine to coarse SAND; low to medium plasticity; trace silt; trace fine gravel; weak cementation; strong reaction with HCl.
5		61					
		42				GP	Very pale brown (10YR, 7/4), damp, dense, silty fine to coarse SAND; trace silt; clay; scattered fine to coarse gravel. Light yellowish brown (10YR, 6/4), medium dense to dense.
		41	5.3	104		SC	Light yellowish brown (10YR, 6/4), damp, dense, clayey fine to medium SAND; trace fine gravel.
10		99/9"				GP	PLEISTOCENE ALLUVIUM: Light yellowish brown (10YR, 6/4), damp, very dense, sandy fine to coarse GRAVEL; trace silt; possible cobbles.
		92/10"				SM	Light yellowish brown (10YR, 6/4), damp, very dense, silty fine to medium SAND; trace fine gravel; weak cementation.
		50/5"				GP	Strong brown (7.5YR, 5/8), damp, very dense, sandy fine to coarse GRAVEL; trace silt.
		50/5" 50/5" 50/2"	9.5	104		SM	Strong brown (7.5YR, 5/6), damp, very dense, silty fine to medium SAND; scattered caliche filaments.
		50/2"					
15		50/5"				SC	Light brown (7.5YR, 6/4), damp, very dense, clayey fine to medium SAND; trace fine gravel.
		50/6"					
		50/5"					
							Total depth = 18.3 feet. Groundwater not encountered. Grouted on 05/23/05.
20							

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-5

DATE DRILLED 05/25/05 BORING NO. B-5

GROUND ELEVATION ±1,334' MSL SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CONCRETE: Approximately 45" thick.
5		25				GC	HOLOCENE ALLUVIUM: Yellowish brown (10YR, 5/4), damp, medium dense, clayey fine to coarse GRAVEL with sand; low plasticity; trace clay; scattered caliche filaments; weak cementation; moderate reaction with HCl.
		37	6.7	110			
		21					
						SC	Dark yellowish brown (10YR, 5/8), damp, medium dense, clayey fine to medium SAND; fine to medium plasticity; low silt; trace fine gravel; scattered caliche nodules.
10		79				GP	Strong brown (7.5YR, 5/6), damp, very dense, sandy fine to coarse GRAVEL; trace silt.
		50/4"					
		57	2.4	112			Trace clay.
		76/11"				GP	PLEISTOCENE ALLUVIUM: Light yellowish brown (10YR, 6/4), damp, very dense, sandy, fine to coarse GRAVEL; trace silt; possible cobbles or boulders.
		50/3"					
15		50/3"				SC	Dark yellowish brown (10YR, 4/6), damp, very dense, clayey fine to coarse SAND; low plasticity; trace clay; few fine gravel; scattered caliche nodules and filaments (Stage III); moderate reaction with HCl.
		60					Light yellowish brown (10YR, 6/4).
		100/8"	7.2	121			Light brown (7.5YR, 6/4); weak cementation.
		50/5"					Strong brown (7.5YR, 5/6).
						SP	Light yellowish brown (10YR, 6/4), damp, very dense, gravelly fine to coarse SAND; trace silt.
20		84				SC	Brown (7.5YR, 6/6), damp, very dense, clayey fine to coarse SAND; high plasticity; trace silt; moderate cementation; strong reaction with HCl.

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-6

DATE DRILLED 05/25/05 BORING NO. B-5

GROUND ELEVATION ±1,334' MSL SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION//INTERPRETATION
20			62 99				SC	Light yellowish brown (10YR, 5/6). PLEISTOCENE ALLUVIUM: (continued) Brown (7.5YR, 5/4), damp, very dense, clayey fine to coarse SAND; high plasticity; trace silt; moderate cementation; strong reaction with HCl.
								Total depth = 22.7 feet. Groundwater not encountered. Grouted on 05/26/05.
25								
30								
35								
40								

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-7

DATE DRILLED 05/26/05 BORING NO. B-6

GROUND ELEVATION ±1,320' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY JSR LOGGED BY JSR REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CONCRETE: Approximately 30" thick.
		92/11"	12.2	110		SM	PLEISTOCENE ALLUVIUM: Dark yellowish brown (10YR, 4/4), damp, very dense, silty fine to coarse SAND; few fine to coarse gravel; scattered caliche filaments and nodules (Stage II); weak cementation; strong reaction with HCl.
		50/5"	12.5	105			Yellowish brown (10YR, 5/4).
5		50/5"					
		50/8"				SC	Yellowish brown (10YR, 5/4), damp, very dense, clayey fine to coarse SAND; low to medium plasticity; few silt; few fine gravel; caliche filaments and nodules (Stage II); scattered organics; weak to moderate cementation.
10							
		50/5"	6.6	116		SP	Strong brown (7.5YR, 5/6), damp, very dense, gravelly fine to coarse SAND; trace silt.
15							Total depth = 14.4 feet. Groundwater not encountered. Grouted on 05/26/05.
20							

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-8

DATE DRILLED 05/25/05 BORING NO. B-7

GROUND ELEVATION ±1,361' MSL SHEET 1 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							CL	FILL: Reddish brown (2.5YR, 4/4), damp, stiff, sandy CLAY with gravel; fine to medium sand; fine gravel; scattered caliche nodules.
			6					
			11	3.1	100		GC	Reddish brown (5YR, 4/4), damp, loose, clayey fine GRAVEL with sand; fine to medium sand; fine gravel; scattered caliche nodules.
5								
			14					Medium dense; increase in clay content.
			20					Medium dense.
10								
			15					
			17	7.7	104			
15								
			26					Dark reddish brown (5YR, 3/4); damp; dense.
			35					Reddish brown (5YR, 5/4); medium dense.
20								

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-9

DATE DRILLED 05/25/05 BORING NO. B-7

GROUND ELEVATION ±1,361' MSL SHEET 2 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							GC	FILL: (continued) Reddish brown (2.5YR, 4/4), damp, stiff, sandy CLAY; scattered caliche nodules.
			35				CL	HOLOCENE ALLUVIUM: Light reddish brown (5YR, 6/4), damp, hard, gravelly CLAY with sand; scattered caliche nodules.
25			19	6.1	99		GM	Reddish brown (5YR, 5/4), damp, medium dense, silty fine GRAVEL with fine sand; scattered caliche filaments and nodules.
			67				CL	Reddish brown (5YR, 5/3), damp, hard, sandy CLAY; scattered caliche nodules.
			42					Scattered pinhole-sized pore spaces.
30			63				CL	PLEISTOCENE ALLUVIUM: Pinkish gray (5YR, 7/2), damp, hard, sandy CLAY; numerous caliche nodules; weak cementation; strong reaction with HCl.
			68					
35							GP	Reddish brown (5YR, 5/3), damp, dense, sandy GRAVEL; caliche coating on gravel; strong reaction with HCl.
			32					Light reddish brown (5YR, 6/4); very dense.
							SM	Pink (7.5YR, 7/3), damp, dense, silty SAND; strong reaction with HCl.
40			75	3.2	111		SP	Strong brown (7.5YR, 5/4), very damp, dense, fine to medium SAND; weak reaction with HCl.

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-10

DATE DRILLED 05/25/05 BORING NO. B-7

GROUND ELEVATION ±1,361' MSL SHEET 3 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40							SC	PLEISTOCENE ALLUVIUM: (continued)
							SM	Pinkish gray (5YR, 7/2), damp, hard, sandy CLAY; numerous caliche nodules; weak cementation; strong reaction with HCl.
			87/9"					Light brown (7.5YR, 6/3), damp, very dense, silty fine to coarse SAND; few fine gravel.
			50/4"	1.8	107			Brown (7.5YR, 5/4); fine-grained; scattered pinhole-sized pore spaces; weak cementation.
45								Total depth = 44.3 feet. Groundwater not encountered. Grouted on 05/25/05.
50								
55								
60								

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BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-11

DATE DRILLED 05/24/05 BORING NO. B-8

GROUND ELEVATION ±1,361' MSL SHEET 1 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							GC	FILL: Strong brown (7.5YR, 4/6), damp, medium dense, clayey fine GRAVEL with fine to coarse sand; scattered caliche nodules; low plasticity fines; few silt.
			18					
			19					
5								
			19	6.8	105			
								Light brown (7.5YR, 6/4); fine to coarse-grained sand.
			76					Brown (7.5YR, 4/4); very dense; increase in clay content.
10								
			65					Strong brown (7.5YR, 4/6); dense; decrease in clay content; scattered cemented caliche nodules.
			34				CL	Strong brown (7.5YR, 4/6), damp, hard, silty CLAY; trace sand; trace gravel; scattered caliche nodules and layers.
15								Light brown (7.5YR, 6/4); numerous caliche nodules; few sand.
			24					Strong brown (7.5YR, 4/6); very stiff; sandy; scattered cemented caliche nodules and specks of caliche.
			20					
20								

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-12

DATE DRILLED 05/24/05 BORING NO. B-8

GROUND ELEVATION ±1,361' MSL SHEET 2 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		20				CL	FILL: (continued) Strong brown (7.5YR, 4/6), damp, very stiff, silty CLAY; trace sand; scattered caliche nodules and specks of caliche.
25		28				SC	Strong brown (7.5YR, 4/6), damp, dense, clayey fine to medium SAND; scattered caliche nodules.
		24	6.2	110		SM	HOLOCENE ALLUVIUM: Strong brown (7.5YR, 4/6), damp, medium dense, silty fine to medium SAND; trace clay and fine gravel; scattered caliche nodules and filaments.
30		24				SC	Brown (7.5YR, 5/4) to strong brown (7.5YR, 4/6), damp, dense, clayey SAND; little silt; scattered caliche nodules, filaments and pinhole-sized pore spaces.
		41				CL	Strong brown (7.5YR, 4/6), damp, hard, sandy CLAY; scattered pinhole-sized pore spaces, caliche filaments and nodules up to 6 inches in diameter; weak to moderate cementation.
35		26				SC	Light brown (7.5YR, 6/4), damp, dense clayey fine to coarse SAND; scattered caliche nodules and filaments; weak cementation.
		40	5.3	109		SM	Light yellowish brown (10YR, 6/4), damp, medium dense silty fine SAND; trace gravel; scattered caliche nodules.
40		67/11"				SM	PLEISTOCENE ALLUVIUM: Pale brown (10YR, 6/3), damp, very dense, fine to medium SAND; no caliche. Scattered caliche filaments; weak to moderate cementation.

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-13

DATE DRILLED 05/24/05 BORING NO. B-8

GROUND ELEVATION ±1,361' MSL SHEET 3 OF 3

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40							SM	PLEISTOCENE ALLUVIUM: Pale brown (10YR, 6/3), damp, very dense, silty fine to medium SAND; scattered caliche filaments; weak to moderate cementation.
		■	50/3"					
		▼	54					Fine to coarse-grained; no cementation or caliche.
45								Yellowish brown (10YR, 5/4); trace clay.
		■	50/6"					Light yellowish brown (10YR, 6/4); scattered caliche filaments and nodules; weak cementation.
		▼	84					Light brown (7.5YR, 6/4); trace clay.
50								Total depth = 49.5 feet. Groundwater not encountered. Grouted on 05/24/05.
55								
60								

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-14

DATE DRILLED 05/25/05 BORING NO. B-9

GROUND ELEVATION ±1,337' MSL SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC/BEP LOGGED BY TLC/BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	FILL: Strong brown (7.5YR, 4/6), damp, medium dense, clayey fine to coarse SAND; few silt; few gravel.
		32					
		6					Loose.
5							
		9	3.8	122			
		8					Medium dense.
10							
		17					
						SP	HOLOCENE ALLUVIUM: Brown (7.5YR, 5/4), damp, medium dense, fine to medium SAND; trace gravel.
		18					
15							
		76	4.3	114		GM	Light reddish brown (5YR, 6/4), damp, very dense, silty fine GRAVEL with sand; fine to coarse sand; few clay.
						SC	Reddish brown (5YR, 5/4), damp, very dense, clayey fine to medium SAND.
						SM	Light brown (7.5YR, 6/4), damp, dense, silty fine to medium SAND.
		25					
20							

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-15

DATE DRILLED 05/25/05 BORING NO. B-9

GROUND ELEVATION ±1,337' MSL SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC/BEP LOGGED BY TLC/BEP REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							SM	HOLOCENE ALLUVIUM: (continued) Light brown (7.5YR, 6/4), very dense, silty fine to medium SAND.
			62				SP	PLEISTOCENE ALLUVIUM: Light brown (7.5YR, 6/3), damp, dense, fine to medium SAND; trace silt; weak cementation; no reaction to HCl.
			40				SC	Brown (7.5YR, 5/4), damp, very dense, clayey fine to medium SAND; scattered caliche nodules and filaments; caliche coating on grains; moderate to strong reaction with HCl.
25			72	10.7	115			
			75/11"					
30								Total depth = 29.4 feet. Groundwater not encountered. Grouted on 05/25/05.
35								
40								

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-16

DATE DRILLED 05/24/05 BORING NO. B-10

GROUND ELEVATION ±1,337' MSL SHEET 1 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	FILL: Strong brown (7.5YR, 4/6), damp, medium dense, silty fine to coarse SAND; trace gravel.
		25					
		6					Loose.
5							
		6					
		3					Very loose to loose; layer of clay approximately 3" thick with scattered caliche filaments and nodules.
10							
		2					Very loose; fine to medium-grained.
		12					Medium dense; damp to moist; increase in clay content.
15						SP	HOLOCENE ALLUVIUM: Yellowish brown (10YR, 5/4), damp, medium dense, fine to coarse SAND.
		14					Pale brown (10YR, 6/3); loose to medium dense; trace silt.
		24					Yellowish brown (10YR, 5/4); dense; medium to coarse-grained.
20							

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-17

DATE DRILLED 05/24/05 BORING NO. B-10

GROUND ELEVATION ±1,337' MSL SHEET 2 OF 2

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							SP	HOLECENE ALLUVIUM: (continued)
							SM	Yellowish brown (10YR, 5/4), damp, dense, fine to coarse SAND.
								PLEISTOCENE ALLUVIUM:
								Strong brown (7.5YR, 4/6), damp, very dense, silty fine to coarse SAND.
			80					
								Fine-grained; scattered caliche filaments and nodules.
			41					Few clay.
25								
			69					Brown (7.5YR, 5/4); dense.
			50/5"					Light brown (7.5YR, 6/4); very dense; weak cementation.
								Total depth = 28.9 feet.
								Groundwater not encountered.
30								Grouted on 05/24/05.
35								
40								

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-18

DATE DRILLED 05/23/05 BORING NO. B-11

GROUND ELEVATION ±1,335' MSL SHEET 1 OF 1

METHOD OF DRILLING CME-75, 6.5" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Automatic Hammer) DROP 30"

SAMPLED BY TLC LOGGED BY TLC REVIEWED BY RDL

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0			10				SC	HOLOCENE ALLUVIUM: Strong brown (7.5YR, 4/6), damp, medium dense, clayey fine to coarse SAND; trace silt; trace fine gravel; scattered caliche filaments; low to medium plasticity.
5			17	12.9	105		GC	Light yellowish brown (10YR, 6/4); damp, medium dense, clayey fine to coarse GRAVEL; low to medium plasticity; few silt.
			31				GP	PLEISTOCENE ALLUVIUM: Reddish yellow (5YR, 6/6), damp, dense, sandy fine to coarse GRAVEL; trace silt.
10			36				SM	Strong brown (7.5YR, 4/6); damp, medium dense, silty fine to coarse SAND; few fine gravel; trace clay.
			11				SP	Dark yellowish brown (10YR, 4/4), damp, medium dense, fine to medium SAND; trace silt.
15			76/9"					Yellowish brown (10YR, 5/4); very dense; trace fine gravel.
			66					
20								Total depth = 17.5 feet. Groundwater not encountered. Backfilled on 05/23/05.

Ninyo & Moore

BORING LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600996001	08/05	A-19

Inyo & Moore

TEST PIT LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

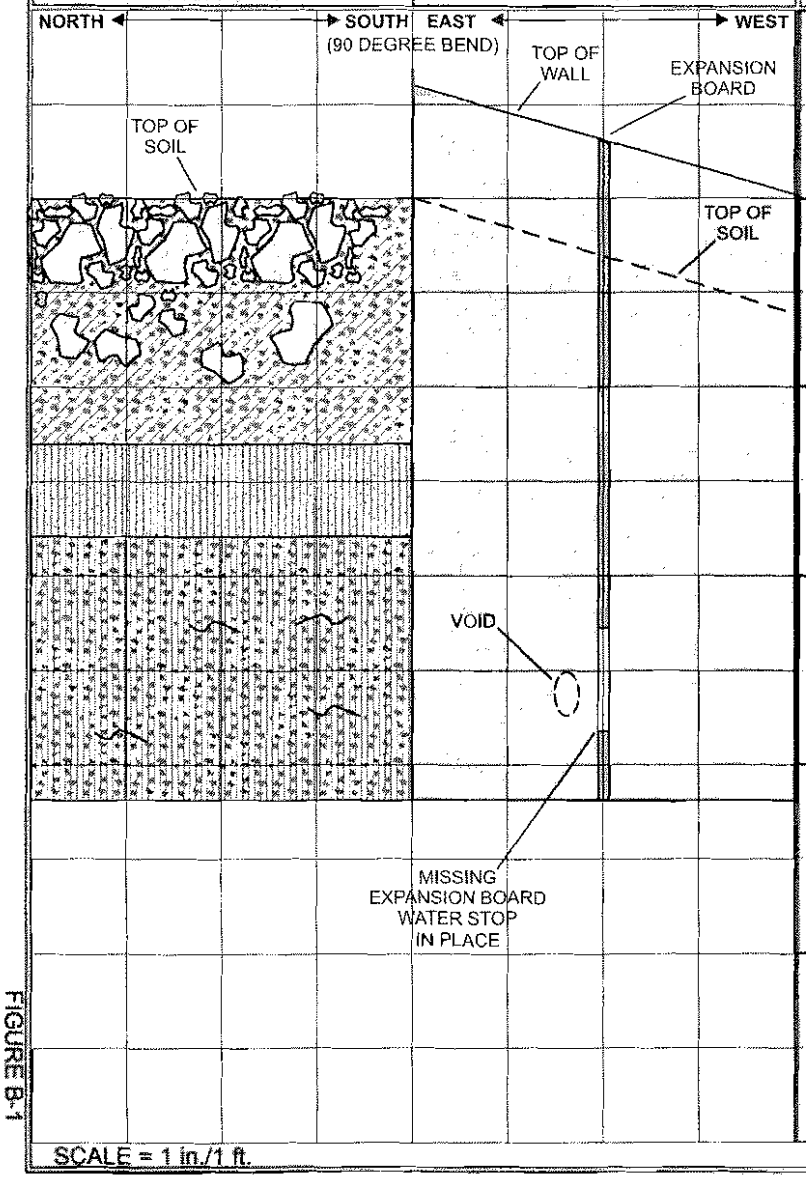
PROJECT NO.	DATE
600996001	08/05

DATE EXCAVATED 06/15/05 TEST PIT NO. TP-1

GROUND ELEVATION ±1,358' MSL LOGGED BY JSR/ATM

METHOD OF EXCAVATION Manual

LOCATION North Side of Spillway, approximately 15' East of Crest



SCALE = 1 in./1 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	SOIL DESCRIPTION
0'							FILL: Rip-Rap Clayey fine GRAVEL with sand infill; moderate vegetation and shallow rootlets.
1'						GC	Reddish brown (2.5YR, 4/4), damp, clayey fine GRAVEL.
						SM	Grayish brown (10 YR, 5/2), damp, silty fine to coarse SAND with gravel; rootlets.
2'						GM	Reddish brown (5YR, 4/4), damp, silty fine GRAVEL with fine to coarse sand; rootlets; few scattered hairline horizontal cracks.
3'							Total Depth = 3.2 feet. Groundwater not encountered. Backfilled with compacted soil on 06/15/05.
4'							
5'							

FIGURE B-1

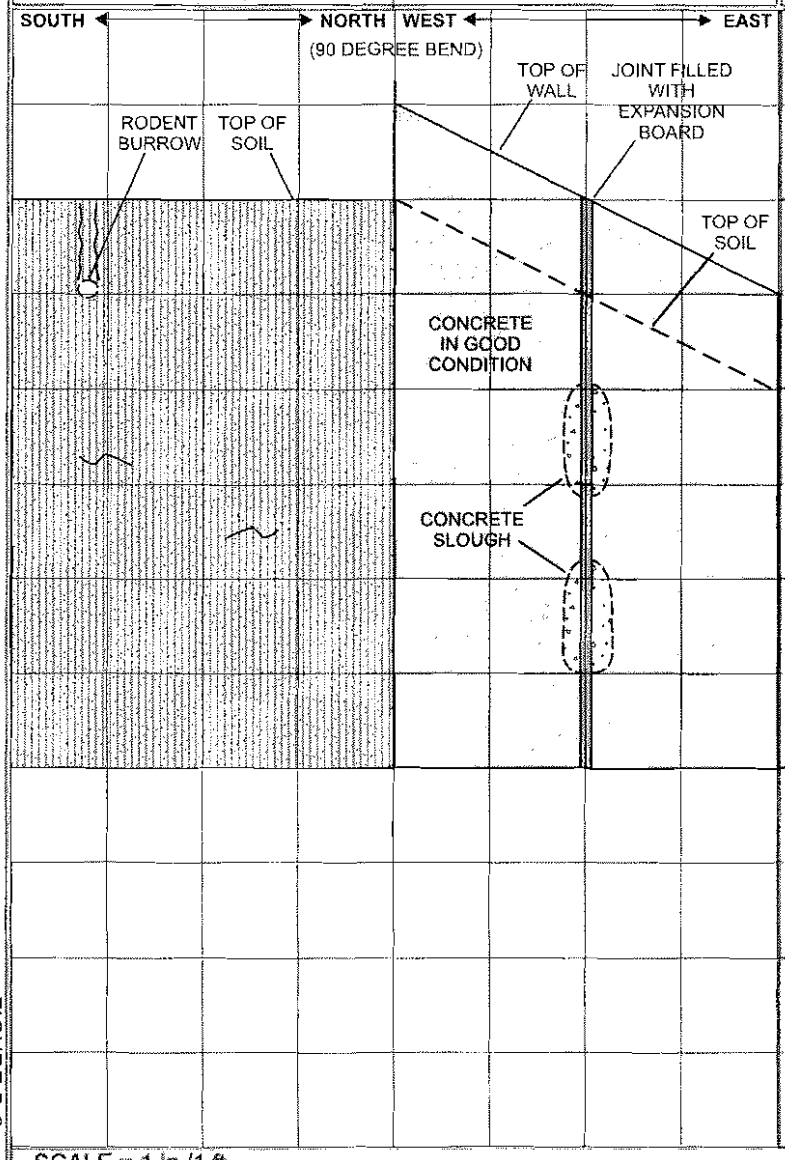
Kinyo & Moore

TEST PIT LOG

MCMICKEN DAM PRINCIPAL SPILLWAY
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE
600996001	08/05

DATE EXCAVATED 06/15/05 TEST PIT NO. TP-2
GROUND ELEVATION ± 1,356' MSL LOGGED BY JSR/ATM
METHOD OF EXCAVATION Manual
LOCATION South Side of Spillway, approximately 17' West of Crest



SCALE = 1 in./1 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	SOIL DESCRIPTION
0'						SM	FILL: Reddish brown (2.5YR, 5/3), damp, silty fine to medium SAND with gravel; trace clay; trace scattered hairline horizontal cracks.
3'							Few clay.
							Total Depth = 3.0 feet. Groundwater not encountered. Backfilled with compacted soil on 06/15/05.

FIGURE B-2

AMEC GEOLOGIC HAZARD AND GEOTECHNICAL INVESTIGATION (2007)

TEST DRILLING EQUIPMENT AND PROCEDURES

Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8-inch O.D., 3 1/4-inch I.D. hollow stem auger or 4 1/2-inch solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Cummins diesel engines capable of delivering about 11.4 kN-m torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 90 kN (20,000 pounds) downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or "river-run" material or harder bedrock, which require other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42-inch diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP-1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9-inch O.D. by 6-inch I.D. or 6 5/8-inch O.D. by 4-inch I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1-foot increments, as noted on the boring logs. Standard penetration tests or 2.42-inch diameter ring samples taken are noted on the boring logs.

Core Boring Rock core samples are retrieved using a CME-75 drill rig, SAITECH GH 3 rig or Burley 2500, 4500 or 4000. The GH 3 is a portable hydraulic core drill. The GH 3 is powered by a Kohler two-cylinder 25-horsepower engine. The hydraulics motor which feeds a two-speed transmission and powers the BW spindle. This unit has a 3-foot stroke and is hand-fed with a 2,000 pound push-pull capability. The GH 3 has the capability of drilling with either B- or N-size core steel using standard or wireline systems. N-size core is the preferred size and it has a nominal O.D. of about 2 inches. The Burley 2500 and 4500 series are portable hydraulic core drills. The 4500 series is capable of a track-mounted or skid-type chassis. The Burley 2500 and 4500 series are powered by 44 and 75 HP power units, respectively, provide up to 2,000 foot-pounds (ft.-lbs.) of torque and in excess of 1,000 revolutions per minute (RPM) of spindle speed. Both rigs are capable of retrieving either N- or H-sized core using wireline systems. The N-size core has a nominal O.D. of about 2 inches and the H-size of about 2.4 inches. The Burley 4000 is a track-mounted core drill.

The CME-75 utilizes a wireline core drilling system that takes N-size cores. Using the NQ wireline system, core is recovered quickly by retrieving the core-laden inner tube through the drill string.

TEST DRILLING EQUIPMENT AND PROCEDURES (Cont.)

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2-inch O.D., 1 3/8-inch I.D. samples are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3-inch O.D. samples lined with 2.42-inch I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samples in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. **Relative Density.** Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50+	Very dense

2. **Relative Consistency.** Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. **Relative Firmness.** Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50+	Hard

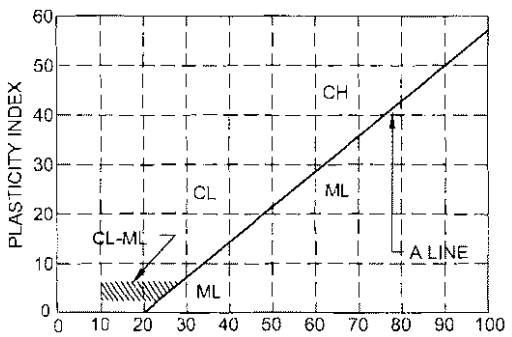
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the United Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see " The Unified Soil Classification System " ASTM Designation: D2487

MAJOR DIVISION				GRAPH SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
					GP	Poorly graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixture.
			Limits plot below "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixture.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot below "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	SILTS OF LOW PLASTICITY (Liquid limit less than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid limit more than 50)			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	CLAYS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	CLAYS OF LOW PLASTICITY (Liquid limit less than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid limit more than 50)			CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.

NOTE: Coarse-grained soils with between 5% to 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 15+00
Upper Downstream Slope
SURFACE ELEV. 1333.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		CL		**SANDY CLAY,** rare fine grained, subangular to subrounded gravel, some fine to medium grained, subangular to subrounded sand, weakly cemented, low to medium plasticity, dark brown
1						ASTM D2292 Nuclear Density at 2.0' Dry Density 96 pcf	
2				6			Stopped Digging at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-1C

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 15+00
Lower Downstream Slope
SURFACE ELEV. 1333.2'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC		**CLAYEY SAND,** trace of fine grained, subangular to subrounded gravel, considerable fine to medium grained, subangular to subrounded sand, weakly to moderately cemented, low to medium plasticity, brown
1						ASTM D2292 Nuclear Density at 2.0' Dry Density 110 pcf	
				6			
2							Stopped Digging at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-1T

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 100+00
Middle Downstream Slope
SURFACE ELEV. 1333.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM	ASTM D2292 Nuclear Density at 1.5' Dry Density 102 pcf	**SILTY SAND WITH GRAVEL,** some fine grained, subangular to subrounded gravel, some fine to medium grained, subangular to subrounded sand, strongly cemented, nonplastic to low plasticity, light brown
1				6			
2							Stopped Digging at 1'6"
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-2

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 160+00
Upper Downstream Slope
SURFACE ELEV. 1327.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM		**SILTY SAND,** trace of fine grained, subangular to subrounded gravel, some medium to coarse grained, subangular to subrounded sand, uncemented, nonplastic to low plasticity, brown
1						ASTM D2292 Nuclear Density at 2.0' Dry Density 108 pcf	
				4			
2							Stopped Digging at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-3C

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 160+00
Lower Downstream Slope
SURFACE ELEV. 1331.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		CL		**SANDY CLAY,** trace of fine grained, subangular to subrounded gravel, some fine to medium grained, subangular to subrounded sand, low plasticity, brown
1							
2				9		ASTM D2292 Nuclear Density at 2.5' Dry Density 93 pcf	
3							Stopped Digging at 2'6"
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-3T

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 240+00
Upper Downstream Slope
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC		**CLAYEY SAND,** trace of fine grained, subangular to subrounded gravel, some fine to medium grained, subangular to subrounded sand, weakly cemented, medium to high plasticity, brown
1						ASTM D2292 Nuclear Density at 2.0' Dry Density 89 pcf	
2				7			Stopped Digging at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-4C

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 240+00
Lower Downstream Slope
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC		**CLAYEY SAND WITH GRAVEL,** some fine grained, subangular to subrounded gravel, some fine to medium grained, subangular to subrounded sand, weakly cemented, low to medium plasticity, brown
1						ASTM D2292 Nuclear Density at 2.0' Dry Density 78 pcf	
				13			
2							Stopped Digging at 2'
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-4T

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 11/22/06

BACKHOE TYPE Hand Dug Test Pit
LOCATION O.C Sta. 300+00
Middle Downstream Slope
SURFACE ELEV. 1315.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC-SM	ASTM D2292 Nuclear Density at 1.5' Dry Density 100 pcf	**CLAYEY SAND,** considerable fine to medium grained, subangular to subrounded sand, strongly cemented, low plasticity, light brown
1				6			
							Stopped Digging at 1'6"
2							
3							
4							
5							
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TH06-5

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/7/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 10+00
Downstream
SURFACE ELEV. 1334.3'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					CL/SC	slightly moist	**SAND & CLAY,** predominantly fine grained, subangular to subrounded, uncemented, medium to high plasticity, reddish-brown
1							
2			D				
3							note: Stage I cementation & trace of fine grained gravel below 3'6"
4							
5					SC	slightly moist	**CLAYEY SAND,** predominantly fine to medium grained sand, Stage I+ cementation, low to medium plasticity, dark reddish-brown
6							
7			D		SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, some to considerable well graded gravel, subangular to subrounded, Stage II to II+ cementation, medium plasticity, tan to white
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-1

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/7/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 10+00
Downstream
SURFACE ELEV. 1334.3'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** continued
							note: Stage II cementation below 10'
11							note: SC zone, predominantly fine to medium grained sand from 11' to 12'
12			D				note: decrease in fines below 12', possible SP/GP
13							Stopped Backhoe at 13'
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-1

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 20+00
Channel
SURFACE ELEV. 1326.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		CL	slightly moist	**SANDY CLAY,** predominantly fine grained sand, Stage I, medium plasticity, reddish-brown
1							
2							
3							
4					CL-SC	slightly moist	**SANDY CLAY TO CLAYEY SAND,** predominantly fine grained sand, Stage I to I+ cementation, medium plasticity, brown
5							
6			D				note: trace of fine grained gravel below 6'
7							
8							
9					SC	slightly moist	**CLAYEY SAND,** trace of silt, predominantly fine grained sand, trace of cobbles up to 3" in diameter, subangular, uncemented to Stage I, low to medium plasticity, reddish-brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-2

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 20+00
Channel
SURFACE ELEV. 1326.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10			D		SC	slightly moist	**CLAYEY SAND,** continued
11							note: predominantly fine to medium grained sand & Stage I cementation below 11'
12							
13							Stopped Backhoe at 13'
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-2

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 30+00
Channel
SURFACE ELEV. 1326.8'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		CL-ML		**SANDY CLAY TO SANDY SILT,** predominantly fine grained sand, Stage I to I+ cementation, medium to high plasticity, brown
1							
2							
3			D		SM		**SILTY SAND,** trace of clay, well graded sand, trace of fine grained gravel, subangular, Stage II to II+ cementation, low plasticity, light brown to tan
4							
5							note: increase in fine grained gravel & brown in color, Stage I to II cementation below 5'
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-3

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 30+00
Channel
SURFACE ELEV. 1326.8'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SM		**SILTY SAND,** continued
11					SM		**SILTY SAND,** predominantly fine grained sand, subangular to subrounded, uncemented, low plasticity, dark brown
12			D				
13							
14							
15							Stopped Backhoe at 15'
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-3

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/7/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 40+00
Downstream
SURFACE ELEV. 1328.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					CL/SC	slightly moist	**SAND & CLAY,** predominantly fine to medium grained sand, Stage I cementation, medium plasticity, reddish-brown
1							
2							
3			D		SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, predominantly well graded gravel, Stage I+ cementation, medium plasticity, light brown to tan
4							
5			D				note: decrease in fines, Stage II cementation & low plasticity below 5'
6							
7							note: possible SW/GW zone from 7'6" to 8'6", Stage I+ to II cementation & low to medium plasticity
8							note: increase in fines, Stage I+ cementation, light brown to tan below 8'6"
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-4

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/7/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 40+00
Downstream
SURFACE ELEV. 1328.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** continued
11			D		SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** predominantly well graded sand, trace to some coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, low to medium plasticity, tan to white
							Backhoe refused at 11'6"
12							
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-4

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/7/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 50+00 Downstream
SURFACE ELEV. 1335.9'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** trace to some fine grained gravel, subangular to subrounded, trace of silt, considerable fine grained sand, Stage I cementation, low to medium plasticity, light brown
1							
2							
3							note: well graded sand & increase in fine grained gravel & medium plasticity below 3'
4							
5					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, well graded gravel, Stage II+ to III cementation, low to medium plasticity, tan to white (possible GC-GW below 6') note: Stage II cementation & reddish-brown to white below 9'
6							
7							
8			D				
9			D				
							Backhoe refused at 9'6"
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-5

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 70+00
Channel
SURFACE ELEV. 1339.6'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, some fine grained gravel, subangular to subrounded, predominantly fine to medium grained sand, Stage I to I+ cementation, low plasticity, light brown to brown
1							
2					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** some fine grained gravel, subangular to subrounded, predominantly well graded sand, subangular to subrounded, uncemented to Stage I, low to medium plasticity, reddish-brown
3							
4			D				
5							note: Stage I cementation below 5'
6							
7							
8							
9					SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** predominantly fine to medium grained sand, trace to some gravel, subangular, rare cobbles up to 3" in diameter, Stage I cementation, low plasticity, reddish-brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-7

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 70+00
Channel
SURFACE ELEV. 1339.6'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** continued
11			D				note: slight decrease in cemenation at 11'
12							
13							Stopped Backhoe at 13'
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-7

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 80+00
Downstream
SURFACE ELEV. 1338.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** predominantly fine to medium grained sand, some coarse grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, brown
1							
2			D		SC/CL	slightly moist	**SAND & CLAY,** predominantly fine grained sand, uncemented to Stage I cementation, medium to high plasticity, light brown to brown
3							
4							note: increase in fine grained sand & Stage I cementation below 4'
5							
6					SC	slightly moist	**CLAYEY SAND,** trace of fine grained gravel, predominantly fine grained sand, Stage I cementation, medium to high plasticity, dark brown
7			D				
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-8

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 80+00
Downstream
SURFACE ELEV. 1338.0'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC	slightly moist	**CLAYEY SAND,** continued
							note: Stage I+ cementation below 10'
11			D				
12							note: Stage I+ to II below 12'
							Stopped Backhoe at 12'6"
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-8

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 90+00
Channel
SURFACE ELEV. 1326.0'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly well graded sand, considerable fine grained gravel, subangular to subrounded, Stage I+ to II cementation, low to medium plasticity, light brown
1							
2			D		SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, considerable predominantly fine grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, brown to reddish-brown
3							
4							
5							note: predominantly fine to medium grained sand, Stage I cementation at 5'
6							
7							
8			D		SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** rare cobbles up to 4" in diameter, predominantly fine grained sand, Stage I+, low to medium plasticity, brown
9					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** trace of cobbles up to 4 1/2" in diameter, predominantly fine to medium grained sand, considerable gravel, subangular to subrounded, Stage II to II+ cementation, low to medium plasticity, light brown to brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-9

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 90+00
Channel
SURFACE ELEV. 1326.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** continued
11			D				
12							Stopped Backhoe at 12'
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-9

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 100+00
Downstream
SURFACE ELEV. 1336.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		GM-GC	slightly moist	**CLAYEY TO SILTY GRAVEL,** predominantly well graded sand & gravel, subangular to subrounded, Stage I to I+ cementation, low plasticity, light brown to brown
1							
2							
3							
4					CL/SC	slightly moist	**SAND & CLAY,** predominantly fine grained, subangular to subrounded, Stage I cementation, medium to high plasticity, brown to reddish-brown
5							
6							
7			D				note: dark reddish-brown color below 7'
8							
9					GC	slightly moist	**CLAYEY GRAVEL,** predominantly well graded sand, predominantly well graded gravel, subangular to subrounded, Stage I cementation, medium to high plasticity, brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-10

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 100+00
Downstream
SURFACE ELEV. 1336.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10			D		GC	slightly moist	**CLAYEY GRAVEL,** continued note: Stage I+ cementation & light brown in color below 10'6"
11							
12							Stopped Backhoe at 12'
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-10

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 110+00
Channel
SURFACE ELEV. 1324.3'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** considerable predominantly coarse grained gravel, predominantly well graded sand, Stage I+ to II cementation, low plasticity, light brown
1							
2			D		CL/SC	slightly moist	**SAND & CLAY,** predominantly fine grained sand, Stage I cementation, medium plasticity, reddish-brown
3							
4							
5							
6			D		SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** considerable predominantly coarse grained gravel, subangular to subrounded, predominantly well graded sand, Stage I cementation, low to medium plasticity, brown to reddish-brown
7							
8							note: CL-SC zones from 8' to 9'
9			D				note: decrease in coarse grained gravel, subangular to subrounded below 9'
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-11

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 110+00
Channel
SURFACE ELEV. 1324.3'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** continued
11							
12							Stopped Backhoe at 12'
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-11

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 120+00
Downstream
SURFACE ELEV. 1331.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** considerable predominantly fine to medium grained sand, considerable predominantly fine grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, light brown
1			D				
2							
3							
4							note: predominantly well graded gravel, subangular to subrounded, light brown to tan below 4'
5			D				
6							note. Stage I+ cementation below 6'
7							
8					SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly fine grained sand, considerable predominantly well graded gravel, subangular to subrounded, Stage I+ cementation, low to medium plasticity, light brown to tan
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-12

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 120+00
Downstream
SURFACE ELEV. 1331.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** continued note: Stage I cementation & well graded sand below 10'
11							
12			D				
13							Stopped Backhoe at 13'
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-12

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 130+00
Downstream
SURFACE ELEV. 1327.9'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					GC	slightly moist	**GRAVEL WITH CLAY,** trace of silt, predominantly well graded sand, predominantly coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, medium plasticity, light brown to tan
1							
2			D				
3							
4							
5					SC	slightly moist	**CLAYEY SAND WITH GRAVEL,** predominantly fine grained sand, some coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, medium to high plasticity, light brown to tan
6							
7			D		GC	slightly moist	**CLAYEY GRAVEL,** predominantly well graded sand, predominantly coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, medium to high plasticity, light brown to tan (white blocky areas)
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-13

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 130+00
Downstream
SURFACE ELEV. 1327.9'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10			D		GC	slightly moist	**CLAYEY GRAVEL,** continued
11							
12							Stopped Backhoe at 12'
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-13

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 140+00
Downstream
SURFACE ELEV. 1328.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC	slightly moist	**CLAYEY SAND,** trace of silt, predominantly fine grained sand, uncemented, medium plasticity, light brown to tan
1							
2							note: increase in medium to coarse grained sand, fine grained gravel & Stage I cementation below 2'
3							
4			D		SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly fine grained sand, considerable predominantly coarse grained gravel, subangular to subrounded, Stage I to I+ cemenation, medium to high plasticity, light brown to tan
5							
6							
7							
8					GC	slightly moist	**CLAYEY GRAVEL,** predominantly well graded sand, considerable predominantly coarse grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, light brown to tan
9							
10							note: uncemented to Stage I cementation & reddish-brown at 10'

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-14

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 140+00
Downstream
SURFACE ELEV. 1328.4'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					GC	slightly moist	**CLAYEY GRAVEL,** continued
11							note: Stage I+ to II cementation & light brown to tan below 11'
12			D				
13							Stopped Backhoe at 13'
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-14

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 150+00
Channel
SURFACE ELEV. 1322.4
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, considerable coarse grained gravel, subangular to subrounded, predominantly well graded sand, uncemented Stage I, low to medium plasticity, light brown to brown
1							
2							note: decrease in coarse grained gravel at 2'
3							
4							
5			D		CL	slightly moist	**SANDY CLAY,** trace of silt, predominantly fine grained sand, uncemented Stage I to I+, medium to high plasticity, brown to reddish-brown
6							
7							
8			D		SM	slightly moist	**SILTY SAND WITH GRAVEL,** trace of clay, trace to some coarse grained gravel, subangular to subrounded, predominantly fine grained sand, Stage I+ to II cementation, medium plasticity, light brown to brown
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-15

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 150+00
Channel
SURFACE ELEV. 1322.4
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SM	slightly moist	**SILTY SAND WITH GRAVEL,** continued
11							
							Stopped Backhoe at 11'6"
12							
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-15

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 160+00
Downstream
SURFACE ELEV. 1323.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC-SM	slightly moist	**SILTY TO CLAYEY SAND,** predominantly fine grained sand, trace of fine grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, brown to light brown
1							
2							note: Stage I to I+ below 2'
3							
4			D		GC-GM	slightly moist	**GRAVEL WITH SILT & CLAY,** predominantly coarse grained gravel, subangular to subrounded, considerable predominantly well graded sand, Stage I to I+ cementation, medium plasticity, light brown
5							
6			D		SC	slightly moist	**CLAYEY SAND,** trace of coarse grained gravel, subangular to subrounded, predominantly well graded sand, Stage I to I+ cementation, medium plasticity, light brown
7							
8							
9					GC	slightly moist	**CLAYEY GRAVEL,** predominantly well graded sand, predominantly coarse grained gravel, subangular to subrounded, Stage I+ cementation, light brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-16

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 160+00
Downstream
SURFACE ELEV. 1323.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					GC	slightly moist	**CLAYEY GRAVEL,** continued
11							
12			D				
							Stopped Backhoe at 12'6"
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-16

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 170+00
Downstream
SURFACE ELEV. 1318.2'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					CL/SC	slightly moist	**SAND & CLAY,** predominantly fine grained sand, uncemented to Stage I, medium to high plasticity, reddish-brown
1							
2			D				note: increase in fine grained sand & Stage I cementation & dark reddish-brown below 2'
3							
4			D		SC	slightly moist	**CLAYEY SAND,** trace of coarse grained gravel, trace of silt, predominantly fine grained sand, Stage I+ cementation, medium plasticity, light brown
5							
6							
7					SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly well graded sand, considerable predominantly coarse grained gravel, Stage I cementation, low plasticity, brown
8							
9			D				note: Stage II to II+ cementation & brown to tan below 9'
10							Backhoe refused at 10'

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-17

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 190+00
Downstream
SURFACE ELEV. 1319.1'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					CL/SC	slightly moist	**SAND & CLAY,** predominantly fine grained sand, uncemented, medium to high plasticity, reddish-brown
1			D				
2							note: Stage I to I+ cementation & brown in color below 2'
3							
4							
5							
6			D				note: trace to some coarse grained gravel, subangular to subrounded below 6'
7							
8							note: Stage I+ cementation below 8' (blocky appearance to samples)
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-18

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/6/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 190+00
Downstream
SURFACE ELEV. 1319.1'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					CL/SC	slightly moist	**SAND & CLAY,** continued
11			D				
12							Stopped Backhoe at 12'
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-18

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 200+00
Channel
SURFACE ELEV. 1317.2'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist	**SILTY SAND WITH GRAVEL,** trace of clay, trace to some coarse grained gravel, subangular to subrounded, predominantly fine grained sand, Stage I+ to II cementation, medium to high plasticity, light brown
1							
2			D		SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, considerable coarse grained gravel, subangular to subrounded, predominantly fine grained sand, Stage II to II+ cementation, low to medium plasticity, light brown to tan
3					GM	slightly moist	**GRAVEL & SAND WITH SILT,** rare cobbles up to 3" in diameter, trace of clay, considerable predominantly coarse grained gravel, subangular to subrounded, predominantly well graded sand, subangular to subrounded, Stage II+ to III cementation, low to medium plasticity, tan to white
4			D				
5							
6							Backhoe refused at 5'6"
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-19

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 210+00
Downstream
SURFACE ELEV. 1317.1'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM-GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of cobbles up to 2 1/2" in diameter, trace of clay, predominantly well graded sand, considerable coarse grained gravel, subangular to subrounded, Stage I to I+ cementation, light brown
1							
2					GM-GC	slightly moist	**GRAVEL WITH SILT & CLAY,** trace of cobbles up to 3" in diameter, predominantly well graded sand, predominantly coarse grained gravel, subangular to subrounded, Stage II+ to III cementation, low plasticity, tan to white
3							
4			D				
5							Backhoe refused at 5'
6							
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-20

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/4/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 220+00
Channel
SURFACE ELEV. 1316.1'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	**SILTY SAND WITH GRAVEL,** trace of clay, trace to some fine grained gravel, subangular to subrounded, Stage I cementation, medium plasticity, light brown
1							
2			D		GM-SP	slightly moist	**GRAVEL WITH SAND & SILT,** trace of clay, predominantly well graded sand, predominantly coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, low to medium plasticity, light brown to tan note: increase in clay & decrease in cementation (Stage I)
3							
4							
5							
6			D		SM-GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly fine grained sand, considerable predominantly fine grained gravel, subangular to subrounded, Stage I+ to II cementation, low to medium plasticity, light brown note: predominantly fine grained gravel below 7'
7							
8					SM	slightly moist	**SILTY SAND WITH GRAVEL,** trace of clay, trace of coarse grained gravel, predominantly fine grained, Stage I+ to II cementation, low plasticity, light brown
9			D				
10							Backhoe refused at 10'

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-21

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 230+00
Downstream
SURFACE ELEV. 1319.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC-SM	slightly moist	**SILTY TO CLAYEY SAND,** predominantly fine grained sand, uncemented to Stage I, medium plasticity, light brown
1							
2			D		CL	slightly moist	**SANDY CLAY,** predominantly fine grained sand, Stage I cementation, medium to high plasticity, reddish-brown
3							
4					SC/GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, considerable fine grained gravel, Stage II+ to III cementation, medium to high plasticity, tan to white
5			D				
6							
7							
8			D				
							Backhoe refused at 8'6"
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-22

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/1/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 240+00
Downstream
SURFACE ELEV. 1319.6'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SM	slightly moist	**SILTY SAND,** trace of gravel, predominantly fine grained sand, Stage I, low plasticity to nonplastic, light brown
1							
					SC	slightly moist	**CLAYEY SAND,** predominantly fine to medium grained sand, weakly cemented (Stage I to I+), medium to high plasticity, reddish-brown
2							
3							
4			D				note: trace to some gravel below 4'
5							
6							
7					GC	slightly moist	**CLAYEY SAND & GRAVEL,** trace of silt, well graded sand & gravel, subrounded to rounded, weakly lime cemented (Stage II), low plasticity, brown note: occasional lense of GP-GP
8							note: Stage II+ to III below 8'6"
9			D				
10							Backhoe refused at 10'

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-23

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 250+00
Channel
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly well graded sand, considerable predominantly coarse grained gravel, Stage I cementation, low to medium plasticity, brown to reddish-brown note: Stage I+ cementation below 1'6"
1			D				
2							
3					SM-SC	slightly moist	**SILTY TO CLAYEY SAND WITH GRAVEL,** trace of clay, some coarse grained gravel, subangular to subrounded, predominantly well graded sand, Stage I to I+ cementation, low to medium plasticity, brown to reddish-brown
4							
5							
6			D				note: predominantly fine grained sand below 6'
7							
8							note: Stage I to I+ cementation below 8' & increase in medium to coarse grained sand, subangular to subrounded
9			D		SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly well graded sand, considerable predominantly coarse grained gravel, Stage I+ to II cementation, low to medium plasticity, brown to light brown
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-24

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 250+00
Channel
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SM/GM		**SAND & GRAVEL WITH SILT,** continued
							Backhoe refused at 10'6"
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-24

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/1/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 260+00
Downstream
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SM	slightly moist	**SILTY SAND,** trace of gravel, predominantly fine grained sand, uncemented (Stage I), low plasticity to nonplastic, light brown
1			D				
2							
3							
4					GM	slightly moist	**SILTY SAND & GRAVEL,** occasional cobble, well graded sand & gravel, subrounded, weakly lime cemented (Stage I), nonplastic, light brown note: occasional lense of GP-GM
5			D				
6					SM	slightly moist	**SILTY SAND & GRAVEL,** predominantly fine to medium grained sand, predominantly fine grained gravel, weakly lime cemented (Stage II), low plasticity, light brown note: interbedded with 2' to 3' thick lenses of GP-GM, occasional cobble, uncemented, nonplastic, brown
7							
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-25

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/1/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 260+00
Downstream
SURFACE ELEV. 1320.0'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10					SM	slightly moist	**SILTY SAND & GRAVEL,** continued
11							Stopped Backhoe at 11'
12							
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-25

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/1/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 272+00
Downstream
SURFACE ELEV. 1311.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					CL	slightly moist	**SANDY CLAY,** some silt, predominantly fine grained sand, medium to high plasticity, light reddish-brown note: occasional zone of SC
1							
					CL	slightly moist	**SANDY CLAY,** trace of silt, predominantly fine grained sand, weakly lime cemented (Stage I to I+), medium to high plasticity, reddish-brown
2			D				
3							
4					SM	slightly moist	**SILTY SAND,** trace to some gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented (Stage II+), low plasticity, light brown note: occasional gravelly zone & occasional zone SP-SM/GP-GM
5							
6			D				
7							
8					SM	slightly moist	**SILTY SAND,** trace of gravel, predominantly fine grained sand, weakly lime cemented (Stage II to II+), low plasticity to nonplastic, light brown note: sand coarsens with depth, increase in gravel (Stage I to I+)
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-26

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/1/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 272+00
Downstream
SURFACE ELEV. 1311.7'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
10			D		SM	slightly moist	**SILTY SAND**, continued
11							Stopped Backhoe at 11'
12							
13							
14							
15							
16							
17							
18							
19							
20							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-26

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 282+50
Downstream
SURFACE ELEV. 1314.5'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist	**CLAYEY SAND,** trace of fine grained gravel, predominantly fine grained sand, Stage I to I+ cementation, reddish-brown
1							
2			D		SC-CL	slightly moist	**SAND & CLAY,** predominantly fine grained sand, Stage I+ to II cementation, medium to high plasticity, light brown to tan
3							
4							
5							
6					SC-GC	slightly moist	**SAND & GRAVEL WITH CLAY,** predominantly well graded sand, considerable coarse grained gravel, Stage II+ to III cementation, low to medium plasticity, tan to white
7			D				
							Backhoe refused at 7'6"
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-27

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 297+50
Channel
SURFACE ELEV. 1309.9'
DATUM NAVD 88

GROUNDWATER

DEPTH	HOUR	DATE
	none	

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0			D		SC	slightly moist	**CLAYEY SAND,** predominantly fine grained, sand, Stage I to I+ cementation, medium to high plasticity, brown to reddish-brown
1							note: uncemented to Stage I cementation & reddish-brown at 1'
2							
3					SC	slightly moist	**SANDY CLAY WITH GRAVEL,** trace of silt, predominantly well graded sand, subangular to subrounded, considerable coarse grained gravel, subangular to subrounded, Stage I+ to II cementation, medium plasticity, light brown to tan
4			D				
5							note: decrease in cemetation (Stage I) & fine to medium grained sand below 5'
6							
7			D				
8							
9							note: increase in cementation (Stage II) below 9'
10							Stopped Backhoe at 9'6"

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-28

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 DATE 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 300+00
Downstream
SURFACE ELEV. 1311.2'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC-CL	slightly moist	**SAND & CLAY,** predominantly fine grained sand, trace of coarse grained gravel, Stage I to I+ cementation, medium plasticity, brown to reddish-brown
1							
2			D		SM/GM	slightly moist	**SAND & GRAVEL WITH SILT,** trace of clay, predominantly well graded sand, considerable coarse grained gravel, Stage II to III cementation, low plasticity, tan to white
3							
4							note: increase in fines (clay) at 4'
5							
6			D				
7							Backhoe refused at 7'
8							
9							
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-29

PROJECT Wittmann ADMP

JOB NO. 6-117-001025 **DATE** 12/5/06

BACKHOE TYPE Volvo BL70
LOCATION Sta. 307+50
Downstream
SURFACE ELEV. 1311.1'
DATUM NAVD 88

GROUNDWATER

	DEPTH	HOUR	DATE
▽		none	
▼			

Depth in Feet	Graphical Log	Sample	Sample Type	Moisture Content Percent of Dry Weight	Unified Soil Classification or Rock Unit	REMARKS	SOIL DESCRIPTION
0					SC	slightly moist	**CLAYEY SAND,** trace of coarse grained gravel, subangular to subrounded, predominantly fine grained sand, uncemented to Stage I, low to medium plasticity, light brown to brown
1			D				
2					SC-CL	slightly moist	**CLAYEY SAND TO SANDY CLAY,** predominantly fine grained sand, Stage I to I+ cementation, medium to high plasticity, reddish-brown
3			D				
4							note: Stage II cementation, tan in color below 4'
5							
6							
7							
8							note: increase in coarse grained gravel & Stage I+ to II cementation below 8'6"
9							
							Backhoe refused at 9'6"
10							

SAMPLE TYPE
B - Undisturbed Bulk Sample
D - Disturbed Bulk Sample
U - 3" O.D. 2.42" I.D. tube sample
A - Drill Cuttings
G - Grab sample

LOG OF TEST PIT NO. TP06-30

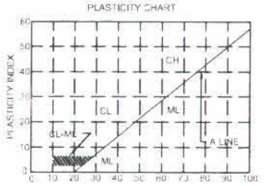
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the United Soil Classification System on the trench logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see " The Unified Soil Classification System " ASTM Designation: D2487

MAJOR DIVISION				GRAPH SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)			GW	Well graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
					GP	Poorly graded gravels, gravel-sized mixtures or sand-gravel-cobble mixture.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixture.
			Limits plot below "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixture.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot below "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	SILTS OF LOW PLASTICITY (Liquid limit less than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid limit more than 50)			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	CLAYS LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART	CLAYS OF LOW PLASTICITY (Liquid limit less than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid limit more than 50)			CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.

NOTE: Coarse-grained soils with between 5% to 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve

STAGES OF CARBONATE MORPHOLOGY

Stage	Gravelly Parent Material	Nongravelly Parent Material
I	Thin discontinuous clast coatings; some filaments; matrix can be calcareous next to stones; about 4% calcium carbonate	Few filaments or coatings on sand grains; <10% calcium carbonate
I +	Many or all clast coatings are thin and continuous	Filaments are common
II	Continuous clast coatings; local cementation of few to several clasts; matrix is loose and calcareous, enough to give somewhat whitened appearance	Few to common nodules; matrix between nodules is slightly whitened by carbonate (15% - 50% by area), and the latter occurs in veinlets and as filaments; some matix can be noncalcareous; about 10 %- 15% calcium carbonate in whole sample, 15% - 75% in nodules
II +	Continuous clast coatings; local cementation of few to several clasts; matrix is loose and calcareous, enough to give somewhat whitened appearance; carbonate in matrix is more pervasive	Common nodules; 50% - 90% of matrix is whitened; about 15% calcium carbonate in whole sample

Continuity of fabric high in carbonate

Stage	Gravelly Parent Material	Nongravelly Parent Material
III	Horizon has 50% - 90% K fabric with carbonate forming an essentially continuous medium; color mostly white; carbonate-rich layers more common in upper part; about 20% to 25% calcium carbonate	Many nodules, and carbonate coats so many grains that over 90% of horizon is white; carbonate-rich layers more common in upper part; about 20% calcium carbonate
III +	Most clasts have thick carbonate coats; matrix particles continuously coated with carbonate or pores plugged by carbonate; cementation more or less continuous; >40% calcium carbonate	Most grains coated with carbonate; most pores plugged; >40% calcium carbonate

Partly or entirely cemented

Stage	Gravelly Parent Material
IV	Upper part of K horizon is nearly pure cemented carbonate (75 - 90% calcium carbonate) and has a weak platy structure due to the weakly expressed laminar depositional layers of carbonate; the rest of the horizon is plugged with carbonate (50 - 75% calcium carbonate)
V	Laminar layer and platy structure are strongly expressed; incipient brecciation and pisolith (thin, multiple layers of carbonate surrounding particles) formation
VI	Brecciation and recementation, as well as pisoliths, are common

Modified from Birkeland (1999) with original compilations from Gile and others (1981) and Machette (1985)

DESCRIPTION OF MASTER SOIL HORIZONS AND SUBHORIZONS

O horizon - Surface accumulations of mainly organic material; may or may not be, or has been, saturated with water. Subdivided on the degree of decomposition as measured by the fiber content after the material is rubbed between the fingers.

Oi horizon - Least decomposed organic materials; rubbed fiber content is greater than 40% by volume.

Oe horizon - Intermediate degree of decomposition; rubbed fiber content is between 17% and 40% by volume.

Oa horizon - Most decomposed organic materials; rubbed fiber content is less than 17% by volume.

A horizon - Accumulation of humified organic matter mixed with mineral fraction; the latter is dominant. Occurs at the surface or below an O horizon; Ap is used for those horizons disturbed by cultivation.

E horizon - Usually underlies an O or A horizon, and can be used for eluvial horizons within or between parts of the B horizon (e.g., common above fragipan, x). Characterized by less organic matter and/or fewer sesquioxides (compounds of iron and aluminum) and/or less clay than the underlying horizon. Many are marked by a concentration of sand and silt. Horizon is light colored due mainly to the color of the primary mineral grains because secondary coatings on the grains are absent, relative to the underlying horizon, color value will be higher or chrome will be lower.

B horizon - Underlies an O, A, or E horizon, and shows little or no evidence of the original sediment or rock structure. Several kinds of B horizons are recognized, some based on the kinds of materials illuviated into them, others on residual concentrations of materials. Subdivisions are:

BH horizon - Illuvial accumulation of amorphous organic matter-sesquioxide complexes that either coat grains or form sufficient coatings and pore fillings to cement the horizon.
Bhs horizon - Illuvial accumulation of amorphous organic matter-sesquioxide complexes, and sesquioxide component is significant; both color value and chroma are three or less.
Bk horizon - Illuvial accumulation of alkaline earth carbonates, mainly calcium carbonate; the properties do not meet those for the K horizon.
Bt horizon - Illuvial concentrations primarily of silt. Used when silt cap development reaches stages 5 and 6.
Bo horizon - Residual concentration of sesquioxides, the most soluble materials having been removed.
Bq horizon - Accumulation of secondary silica.
Bs horizon - Illuvial accumulation of amorphous organic matter-sesquioxide complexes if both value and chroma are greater than three.
Bt horizon - Accumulation of silicate clay that either formed in situ or is illuvial (clay translocated either within the horizon or into the horizon); hence it will have more clay than the assumed parent material and/or the overlying horizon. Illuvial clay can be recognized as grain coatings, bridges between grains, coatings on ped or grain surfaces or in pores, or thin, single or multiple near-horizontal discreet accumulation layers of pedogenic origin (clay bands or lamellae). In places, subsequent pedogenesis can destroy evidence of illuviation.
Bw horizon - Development of color (redder hue or higher chroma relative to C) or structure, or both, with little or no apparent illuvial accumulation or material.
By horizon - Accumulation of secondary gypsum.
Bz horizon - Accumulation of salts more soluble than gypsum.

K horizon - A subsurface horizon so impregnated with carbonate that its morphology is determined by the carbonate. Authigenic carbonate coats or engulfs nearly all primary grains in a continuous medium. The uppermost part of a strongly developed horizon is laminated, brecciated, and/or pisolithic. The cemented horizon corresponds to some caliches and calcretes.

C horizon - A subsurface horizon, excluding R, like or unlike material from which the soil formed, or is presumed to have formed. Lacks properties of A and B horizons, but includes materials in various stages of weathering.

Cox and Cu horizons - In many unconsolidated deposits, the C horizon consists of oxidized material overlying seemingly unweathered C. The oxidized C does not meet the requirements of the Bw horizon. In stratigraphy, it is important to differentiate between these two kinds of C horizons. Here Cox is used for oxidized C horizons and Cu for unweathered C horizons.

Cr horizon - In soils formed on bedrock, there commonly will be a zone of weathered rock between the soil and the underlying rock. If it can be shown that the weathered rock has formed in place, and has not been transported, it is designated as Cr. Such material is the saprolite; in situ formation is demonstrated by preservation or original rock features, such as grain-to-grain texture, layering, or dikes. If such material has been moved, however, the original structural features of the rock are lost, and the transported material may be the C horizon for the overlying soil. Those Cr horizons with translocated clay, as shown by clay films, are termed Crt.

R horizon - Consolidated bedrock underlying soil.

SELECTED SUBORDINATE DEPARTURES

Lower-case letters follow the master horizon designation. Those that are mainly specific to a particular master horizon are given above. Some can be found in a variety of horizons; they are listed below.

b - Buried soil horizon with major features formed prior to burial. May be deeply buried and not affected by subsequent pedogenesis; if shallow, they can be part of a younger soil profile.

c - Concretions or nodules cemented by accumulations of iron, aluminum, manganeses, or titanium.

f - Horizon cemented by permanent ice. Seasonally frozen horizons are not included, nor is dry permafrost material (material that lacks ice but is colder than 0°)

g - Horizon in which gleying is a dominant process, that is either iron has been removed during soil formation or saturation with stagnant water has preserved a reduced state. Common to these soils are neutral color, with or without mottling. Most have chroma of two or less and many have redox concentrations. Strong gleying is indicated by chromas of one or less, and hues bluer than 10Y. Much of the above color is due to the color of reduced iron, or the color of uncoated grains from which iron pigment has been removed. Bg is used for horizons with pedogenic features in addition to gleying is the only pedogenic feature, the horizon is designated Cg.

j - Used in combination with other horizon designation (Btj, Ej) to denote incipient development of the particular feature or property. A rule for some designations would be to use it for those horizons that do not meet criteria for diagnostic horizons (e.g., Ej for an eluvial horizon that does not meet the criteria of the albic horizon).

k - Accumulation of alkaline earth carbonates, commonly calcium carbonate.

m - Horizon that is more than 90% cemented. Denote the cementing material (Km, carbonate; qm, silica; Kqm, carbonate and silica; etc.).

n - Accumulation of exchangeable sodium.

ss - Presence of slickensides.

v - Has two uses. (1) Plinthite, iron-rich, humus-poor, reddish material that hardens irreversibly when dried. (2) If A horizons in arid environments have a vesicular structure (round voids), they are designated Av.

x - Subsurface horizon characterized commonly by a bulk density greater than that of the adjacent horizons, firmness and brittleness, and very coarse prismatic structure with bleached vertical faces (fragipan character). An E horizon nomenclature designations are identical, and both are pedogenic, a prime is applied to the lower E horizon. In this example, the profile would be A/E/Bt/E'/Bx/Cox.

y - Accumulation of gypsum.

z - Accumulation of salts more soluble than gypsum (e.g. NaCl).

From Soil Survey Division Staff (1993), with modification after Birkeland (1999).

TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY, CONSISTENCY OR FIRMNESS OF SOILS

The terminology used on the trench logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand-gravel mixtures.

N	Relative Density
0 - 4	Very loose
5 - 10	loose
11 - 30	Medium dense
31 - 50	Dense
50+	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

N	Relative Consistency	Remarks
0 - 2	Very soft	Easily penetrated several inches with fist.
3 - 4	Soft	Easily penetrated several inches with thumb.
5 - 8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9 - 15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16 - 30	Very stiff	Readily indented with thumbnail.
30+	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

N	Relative Firmness
0 - 4	Very soft
5 - 8	soft
9 - 15	Moderately firm
16 - 30	firm
31 - 50	Very firm
50+	Hard

SOIL COLOR DESIGNATIONS

Descriptions of soil color are based on the Year-2000 revised Munsell Soil Color Charts published by GretagMacbeth. The determination of soil color is accomplished by direct comparison of the soil sample with an series of color charts that each depict a constant hue, and the array of color variations of both value (lightness) and chroma (strength) of that hue. Hue indicates the color's relationship to the true colors of yellow, green, blue and purple. The Mussell system employs both a name for the selected color and an alpha-numeric notation. These notations denote the hue, value and chroma of the selected color. For example, a notation of 5YR 6/3 denotes a hue in the middle of the yellow-red spectrum (scale runs from 0 to10, yellow to red) with a value of 6 (the higher the number the lighter), and a chroma of 3 (medium strength). The description of a 5YR 6/3 soil is light reddish brown.

JOB NO.	6-117-001025
DESIGN:	KCF
DRAWN:	GWH
DATE:	2/2007
SCALE:	N.T.S.

KEY TO TRENCH LOGS

TRENCH INVESTIGATION
WITTMANN ADMP

amec

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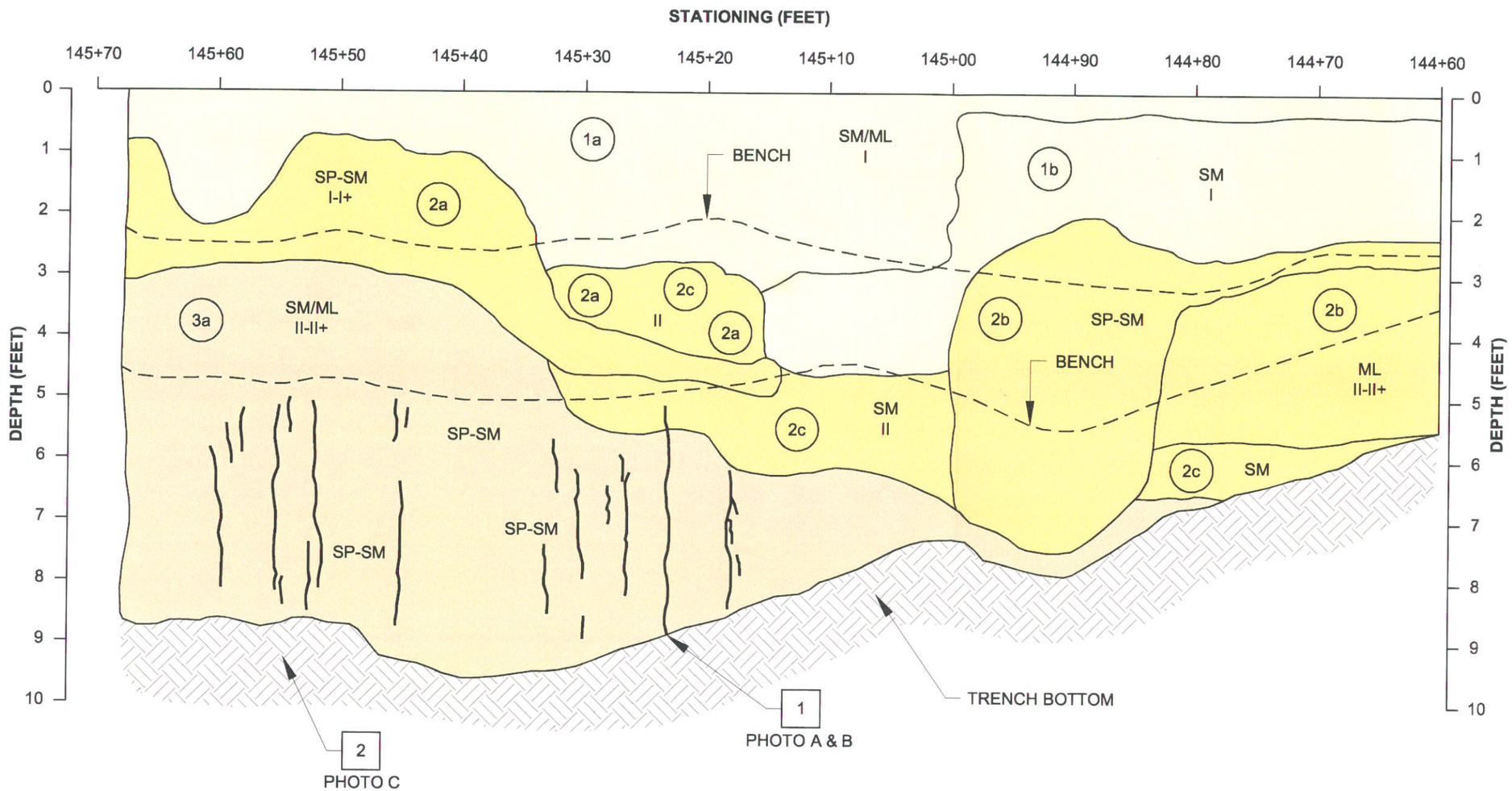

PHOTO - A

PHOTO - B

PHOTO - C

1a - (SM/ML) Silty sand to sandy silt, trace of gravel, predominantly fine to medium grained sand, Stage I, nonplastic to low plasticity, light brown

1b - (SM) Silty sand, some to considerable gravel, rare cobbles, well graded sand, Stage I, nonplastic to low plasticity, light brown

note: occasional zones of SP-SM/GP-GM

2a - (SP-SM) Sand & gravel with silt, well graded sand, predominantly fine grained gravel subangular to subrounded, typical I - I+, nonplastic, brown

note: occasional lenses near top with Stage III - III+ (cementation - not continuous)

2b - (ML) Sandy silt, predominantly fine grained sand, weakly to moderately lime cemented, Stage II - II+, nonplastic, light brown

note: slightly prismatic soil structure

2c - (SM) Silty sand, trace to some fine grained gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, Stage II+, low plasticity to nonplastic, light brown

3a - (SM/ML) Silty sand to sandy soil, trace to some fine grained gravel, predominantly fine to medium grained sand, weakly to moderately lime cemented, Stage II+, low plasticity to nonplastic, light brown

note: occasional lenses of SP-SM (Stage II+-III)

NOTE:

1 - Soil discontinuity continuing across bottom of trench to other side, no aperture - tight, Photo A & B

2 - Soil discontinuities, no aperture, only one present on trench bottom, occasional present both sides of trench, generally not, occaisonal rootlets, Photo C

KEY

	EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE	SM (I,II)	USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY
	ALLUVIAL UNIT - 2 PLEISTOCENE		CONTACT
	ALLUVIAL UNIT - 3 PLEISTOCENE		TEST TRENCH BENCH
			SOIL DISCONTINUITY

JOB NO. 6-117-001025	TRENCH LOG		amec
DESIGN: KCF			
DRAWN: GWH			
DATE: 12/2006	TRENCH INVESTIGATION WITTMANN ADMP	FIGURE TT06-1	
SCALE: AS SHOWN			

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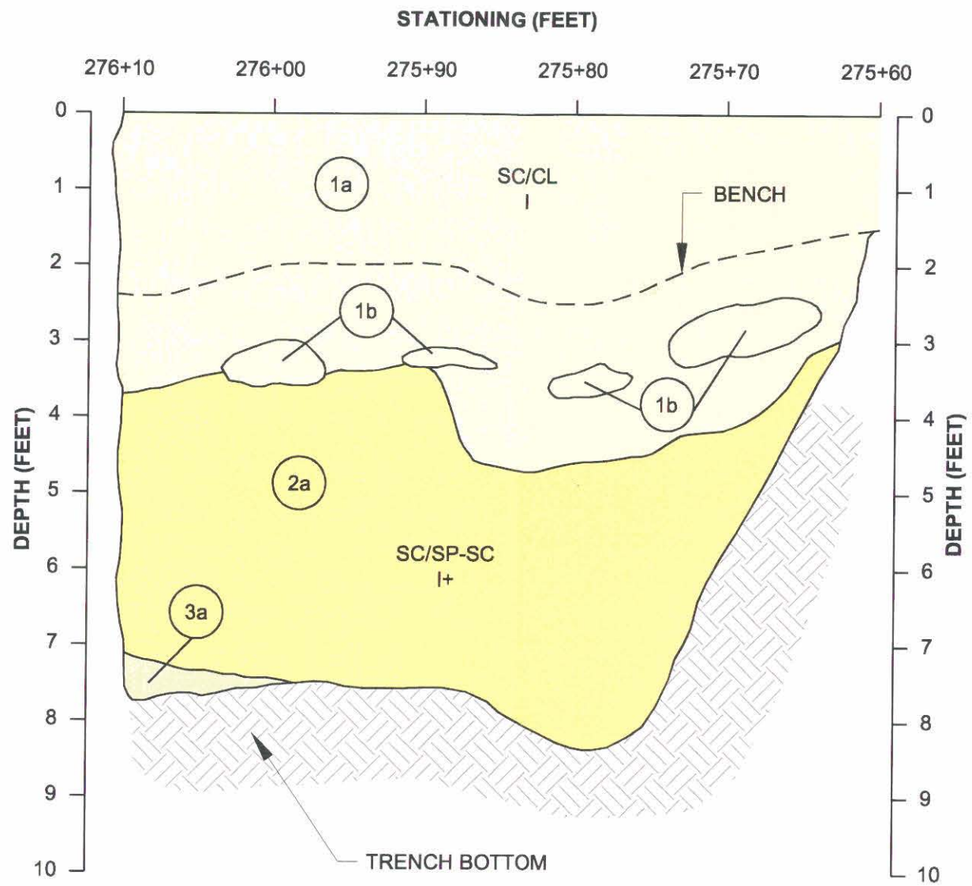

1a - (SC/CL) Sandy clay to clayey sand, some silt, predominantly fine to medium grained sand, Stage I, low to medium plasticity, light reddish-brown

note: slightly prismatic soil structure

1b - (SC) Clayey sand, trace to some gravel, well graded, Stage I, low plasticity, light reddish-brown

2a - (SC/SP-SC) Clayey sand to sand with clay, some to considerable gravel, well graded sand, predominantly fine grained gravel, subangular to subrounded, weakly cemented (Stage I+), nonplastic to low plasticity, light reddish-brown

3a - (SM) Silty sand, trace of clay, trace to some gravel, predominantly medium to fine grained sand, moderately lime cemented (Stage II+ - III), low plasticity to nonplastic, light grayish-brown

KEY

	EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE	SM (I,II)	USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY
	ALLUVIAL UNIT - 2 PLEISTOCENE		CONTACT
	ALLUVIAL UNIT - 3 PLEISTOCENE		TEST TRENCH BENCH
			SOIL DISCONTINUITY

JOB NO. 6-117-001025	TRENCH LOG		amec
DESIGN: KCF			
DRAWN: GWH			
DATE: 12/2006	TRENCH INVESTIGATION WITTMANN ADMP	FIGURE TT06-2	
SCALE: AS SHOWN			

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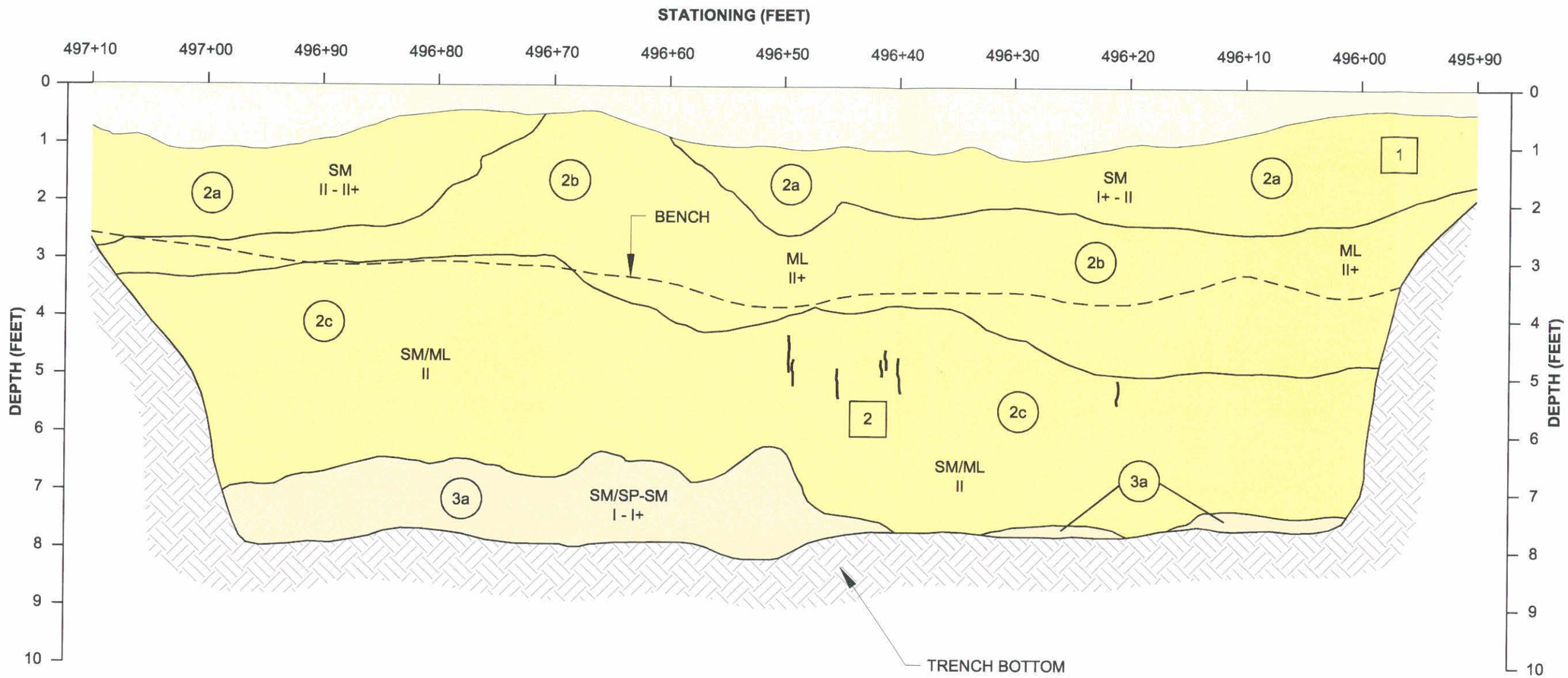

1a - (SC/SM) Silty to clayey sand, trace to some gravel,predominantly medium to fine grained sand, Stage I, low plasticity, light brown to light reddish-brown

note: occasional gravelly pockets/lenses of SP-SC/SP-SM

2a - (SM) Silty sand, trace to some gravel, trace of clay, well graded sand to predominantly fine to medium grained, weakly lime cemented (Stage I+ - II+), low plasticity, light brown to mottled brown with light gray

note: occasional lense of ML

2b - (ML) Sandy silt, rare gravel, trace of clay, predominantly fine to medium grained sand, weakly lime cemented (Stage II+), low plasticity, mottled light gray with light brown

note: occasional lense of SM crumbly/friable structure

2c - (SM/ML) Silty sand to sandy silt, trace of gravel, predominantly fine to medium grained sand, weakly lime cemented (Stage II), nonplastic to low plasticity, light brown

3a - (SM/SP-SM) Silty sand to sand with silt, trace to some gravel, well graded sand with lenses of predominantly fine to medium grained sand, uncemented to weakly lime cemented (Stage I), nonplastic, light brown

NOTE:

1 - Thin lense of Stage II+ cementation

2 - Soil discontinuities due to local prismatic soil structure, no aperture, trace of rootlets typical <1' length

KEY

EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE

ALLUVIAL UNIT - 2 PLEISTOCENE

ALLUVIAL UNIT - 3 PLEISTOCENE

SM (I,II) USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY

CONTACT

TEST TRENCH BENCH

SOIL DISCONTINUITY

JOB NO.	6-117-001025
DESIGN:	KCF
DRAWN:	GWH
DATE:	12/2006
SCALE:	AS SHOWN

TRENCH LOG

TRENCH INVESTIGATION
WITTMANN ADMP

FIGURE
TT06-3

amec

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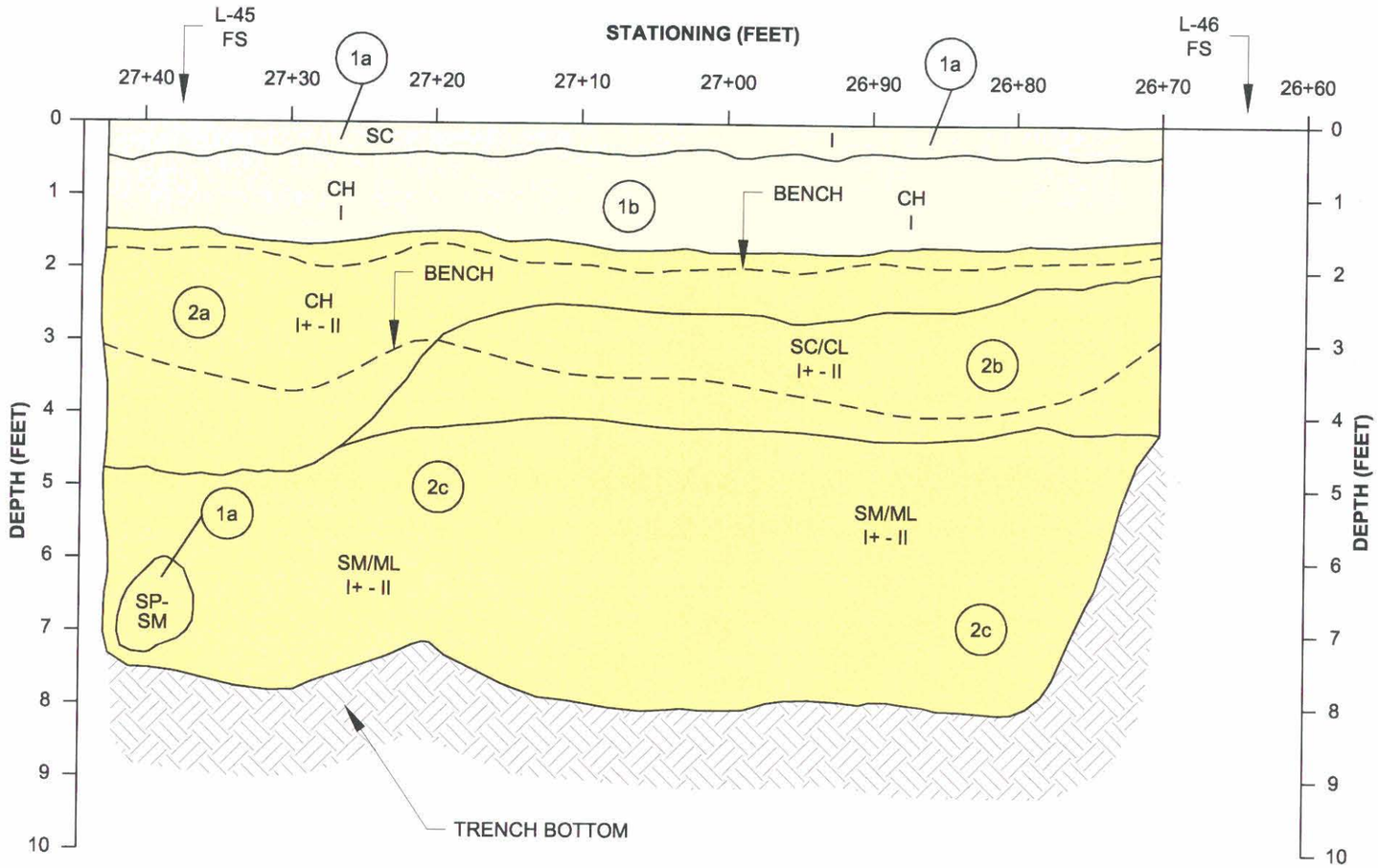

1a - (SC) Clayey sand, predominantly fine to medium grained sand, Stage I, medium plasticity, light brown

1b - (CH) Sandy clay, predominantly fine grained sand, weakly to moderately lime cemented (Stage I), high plasticity, reddish-brown

note: prismatic to blocky soil structure

2a - (CH) Sandy clay, predominantly fine grained sand, weakly to moderately lime cemented (Stage I+ - II), high plasticity, reddish-brown to mottled

note: prismatic to blocky soil structure

2b - (SC/CL) Clayey sand to sandy clay, some silt, trace of gravel, predominantly fine to medium grained sand, weakly lime cemented (Stage I+ - II), low to medium plasticity, light reddish-brown

2c - (SM/ML) Silty sand to sandy silt, trace of gravel, predominantly fine to medium grained sand, weakly lime cemented (Stage I+ - II), low plasticity, light brown

note: occasional clayey zone

note: occasional gravelly zone, SP-SM

KEY

	EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE	SM (I,II)	USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY
	ALLUVIAL UNIT - 2 PLEISTOCENE		CONTACT
	ALLUVIAL UNIT - 3 PLEISTOCENE		TEST TRENCH BENCH
			SOIL DISCONTINUITY

JOB NO.	6-117-001025
DESIGN:	KCF
DRAWN:	GWH
DATE:	12/2006
SCALE:	AS SHOWN

TRENCH LOG

TRENCH INVESTIGATION
WITTMANN ADMP

FIGURE
TT06-4

amec

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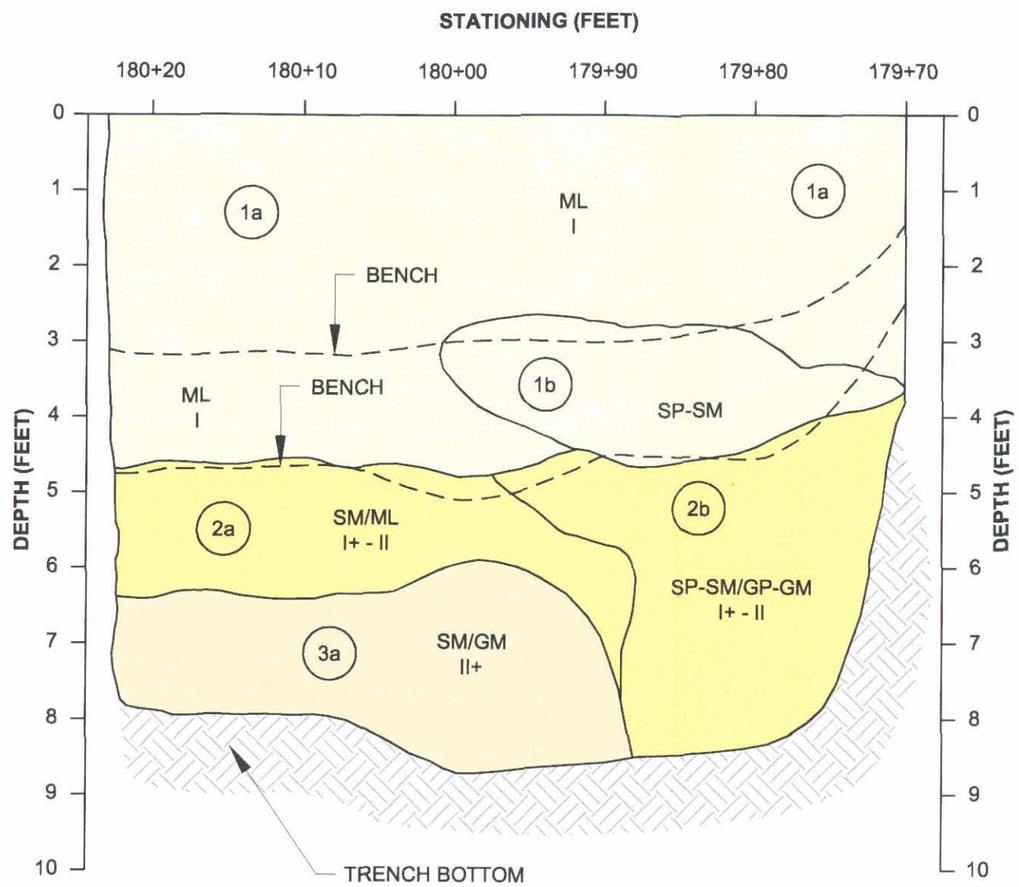

1a - (ML) Sandy silt, trace of clay, predominantly fine grained sand, Stage I, nonplastic to low plasticity, light brown

note: occasional sandy/gravelly lense

1b - (SP-SM) Sand with silt, some gravel, well graded sand, nonplastic, brown

note: occasional lense of silty sand

2a - (SM/ML) Sandy silt to silty sand, trace of clay, predominantly fine to medium grained sand, weakly lime cemented (Stage I+ - II), nonplastic to low plasticity, light brown

2b - (SP-SM/GP-GM) Sand & gravel with silt, rare cobble, well graded sand, predominantly fine grained gravel, subangular to subrounded, weakly cemented (Stage I+ - II), nonplastic, brown

3a - (SM/GM) Silty sand & gravel, well graded sand, predominantly fine grained gravel, subangular to subrounded, weakly to moderately lime cemented (Stage II+), nonplastic to low plasticity, light grayish-brown

KEY

	EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE	SM (I,II)	USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY
	ALLUVIAL UNIT - 2 PLEISTOCENE		CONTACT
	ALLUVIAL UNIT - 3 PLEISTOCENE		TEST TRENCH BENCH
			SOIL DISCONTINUITY

JOB NO.	6-117-001025
DESIGN:	KCF
DRAWN:	GWH
DATE:	12/2006
SCALE:	AS SHOWN

TRENCH LOG

TRENCH INVESTIGATION
WITTMANN ADMP

FIGURE
TT06-5

amec

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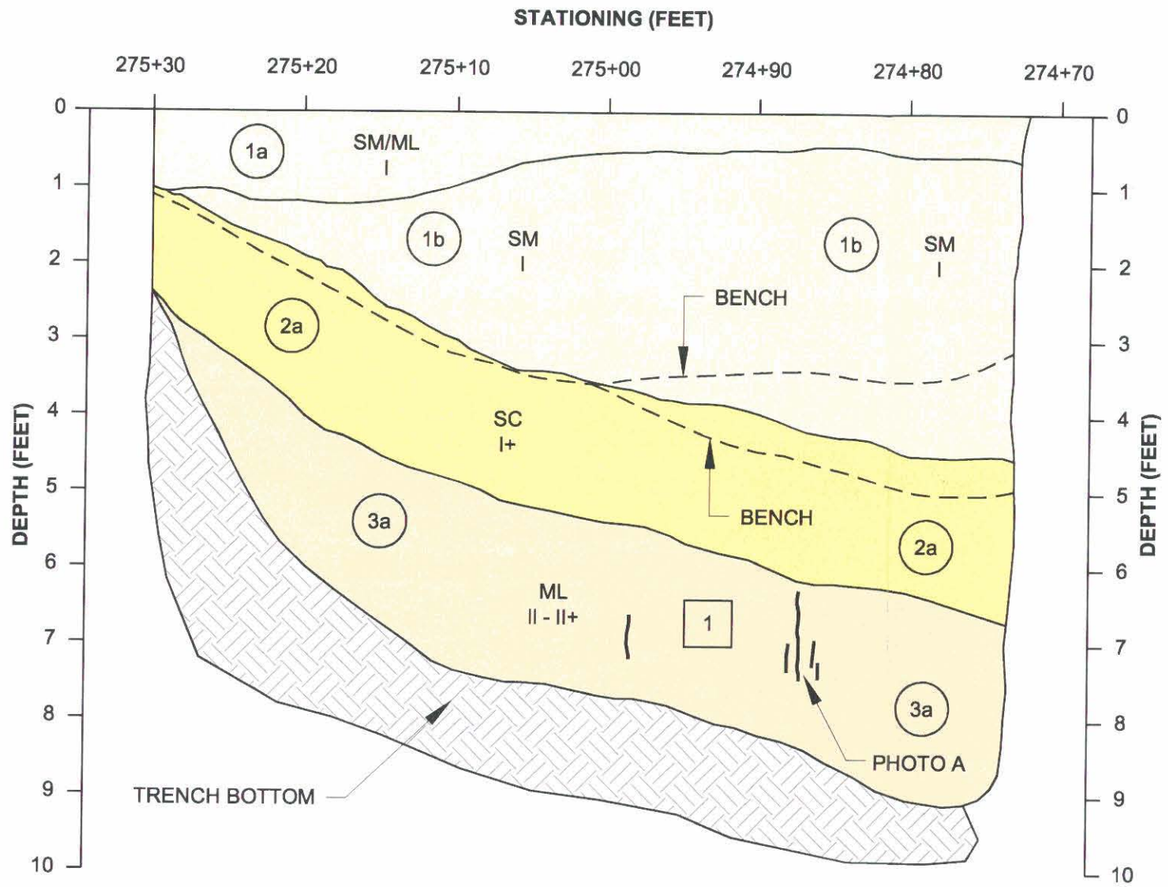

PHOTO - A

1a - (SM/ML) Silty sand to sandy silt, rare gravel, trace of clay, predominantly fine grained sand, Stage I, nonplastic to low plasticity, light brown

1b - (SM) Silty sand, trace to some gravel, rare cobble, well graded sand, Stage I, nonplastic to low plasticity, light brown

note: occasional lense SP-SM/GP-GM

2a - (SC) Clayey sand, trace of gravel, well graded sand, weakly to moderately cemented (Stage I+), medium to high plasticity, reddish-brown

note: slightly blocky

3a - (ML) Sandy silt, predominantly fine grained sand, weakly to moderately cemented (Stage II - II+), nonplastic to low plasticity, light brown

NOTE:

1 - Soil discontinuities, no aperture, trace of rootlets, not continuous

KEY

	EOLIAN/ALLUVIAL UNIT - 1 HOLOCENE	SM (I,II)	USCS SOIL CLASSIFICATION WITH STAGE OF CARBONATE MORPHOLOGY
	ALLUVIAL UNIT - 2 PLEISTOCENE		CONTACT
	ALLUVIAL UNIT - 3 PLEISTOCENE		TEST TRENCH BENCH
			SOIL DISCONTINUITY

JOB NO.	6-117-001025
DESIGN:	KCF
DRAWN:	GWH
DATE:	12/2006
SCALE:	AS SHOWN

TRENCH LOG

TRENCH INVESTIGATION
WITTMANN ADMP

FIGURE
TT06-6

amec

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APPENDIX B – REFRACTION SEISMIC SURVEY

REFRACTION SEISMIC EQUIPMENT & PROCEDURES

Refraction seismic surveys are performed in general conformance with the guidelines presented in ASTM D5777-95 Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation for refraction surveys using compression waves (p-waves). ASTM D5777 does not address shear wave (s-wave) surveys; standard practice is followed for refraction surveys using s-waves. In some investigations, such as seeking and tracing earth fissures or other significant discontinuities (Rucker and Keaton, 1998), non-standard procedures and analyses, such as signal amplitude analysis, are used as part of the investigation process.

Seismic Equipment - Refraction seismic surveys are performed using a Geometrics ES-1225 or Smartseis signal enhancement seismograph. These instruments have the capability to simultaneously record 12 channels of geophone data and produce hard copies of that data. The Smartseis also has the capability of digitally storing geophone data. Signal enhancement capability permits the use of a sledgehammer as the seismic energy source. A timing sensor is attached to the hammer, and for p-waves, a metal plate is set securely on the ground surface and struck. Generating horizontally polarized s-waves typically involves setting the plate against the end of a wooden plank or railroad tie oriented perpendicular to the axis of the geophone array and striking with a horizontal motion of the sledgehammer. A truck is usually driven onto the plank or tie to effectively couple the plank or tie to the ground.

Because of the signal enhancement capability, signals from several or many strikes can be added together to increase the total signal available relative to noise to obtain the seismic record. Although explosives can also be used as a p-wave seismic energy source, a sledgehammer does not require licenses or permits, or involve special limitations, regulations and liabilities. Explosive energy sources may be needed for long geophone arrays. Geophone cables with 12 geophone takeouts at 10-foot, 20-foot or 20-meter spacings are presently used. Vertical geophones are used to obtain p-wave data and horizontal geophones are used to obtain s-wave data. The seismograph system is extremely portable. In areas where vehicular access is not possible, the equipment can be mobilized by various means, including backpacking, packhorse, helicopter and canoe.

Field Procedures - The field operations are directed by our experienced engineer or geologist, who operates the equipment, prepares the records and examines the data in the field. Refraction seismic lines are generally laid out using the standard spacings on the geophone cables. A maximum depth of investigation of about 75 to 100 feet may be possible using a 300-foot array. For shorter lines with improved near-surface resolution, 10-foot spacings between geophones with a 120-foot array have a maximum depth of investigation of about 30 to 40 feet. Other geophone spacings can also be used. To improve the resolution of near-surface interfaces, energy source positions generally are set at 12.5 feet from the ends of a 25-foot spacing geophone array or at 5 feet from the ends of a 10-foot geophone spacing array. Several shots locations are utilized along the length of an array. When three shots are obtained, there is a foreshot and a backshot at the array ends and a midshot at the array center. The midshot is usually placed midway between the two centermost geophones. When five shots are obtained, the additional shotpoints are located midway between the foreshot-midshot and the midshot-backshot. These multiple shot points permit interpretation of near-surface interfaces at various locations along the array as well as near the endpoints for variable subsurface profiles, and permits more refined overall interpretations of shallow and mid-depth subsurface velocities and interfaces. In cases when both enhanced depth of investigation and improved shallow resolution are needed, multiple 12-geophone arrays are completed end to end and combined into longer composite 24- or more geophone arrays with greater depths of investigation. Additional energy shotpoints are then, at a minimum, performed at the midpoint and far endpoint of each adjacent 12-geophone array to provide seismic energy travel path coverage over the extended array.

REFRACTION SEISMIC EQUIPMENT & PROCEDURES (Cont.)

P-wave data are recorded for general exploration work. S-wave data are also recorded when dynamic subsurface material properties are desired. An s-wave arrival is verified by obtained two sets of horizontal data that are 180 degrees out of phase. The phase reversal is obtained by either reversing the horizontal geophone orientation or reversing the hammer impact direction. Hard copy printouts of all field data are made and inspected as the information is collected. Field notes, including line number and orientation, topographic variations and other notes as appropriate are made on the hard copy printout. Locations and other notes are made on site maps and in notebooks as appropriate. Initial first arrival picks are made in the field and array endpoint arrival times are checked for immediate data adequacy verification as part of the quality control process.

Interpretation - Although preliminary or quality control initial refraction seismic data interpretations may sometimes be performed in the field, full interpretations are completed in the office. At the present time, two interpretation methods are being used; the intercept time method (ITM) and an optimization software routine based on finite difference optimization software. ITM breaks an interpretation into several distinct layers. It is simple, can be performed with a calculator, and can provide excellent interpretations of near surface layer depths and velocities. Optimization provides a continuously variable velocity interpretation through a discrete grid. Interpretations using optimization also indicate zones where interpretation has occurred, thus providing quality control on the depths to which the interpretation can be relied upon. However, the discrete grid used by optimization results in a low resolution near surface interpretation. The combination of both ITM and, when appropriate, optimization methods provides two separate interpretations with complimentary strengths and cross-checking capability. These interpretation methods are applied as appropriate to a particular project.

Refraction seismic data interpretation using the intercept time method is detailed by Mooney (1973). A personal computer spreadsheet is used to perform the necessary calculations to obtain depths and layer velocities, and print out time-distance plots and depth interpretations. This method is used for interpretations of up to three layers. It is considered that more than three layers cannot be effectively interpreted using twelve geophone data points. Interpretations are then completed manually to produce a final interpreted geologic profile and layer depths.

Refraction seismic data interpretation using optimization is performed using the SeisOpt2D software package by Optim, L.L.C., 1999, of Reno, Nevada. Energy source and geophone receiver locations and elevations, and first arrival times are entered into the software package, and first arrival travel times are optimized through a process of repeated (typically 10,000 to 100,000) iterations. Multiple seismic lines combined end to end into a longer composite line can be effectively interpreted using this software. Model grid dimensions and element sizes are selected, with larger grids containing smaller elements providing greater potential resolution. However, very large grids containing small elements may become unstable, and several runs may need to be made to obtain stable, robust interpretations. Once a robust interpretation has been obtained, the resulting seismic velocity profile is printed out with varying colors indicating the interpreted velocities.

References:

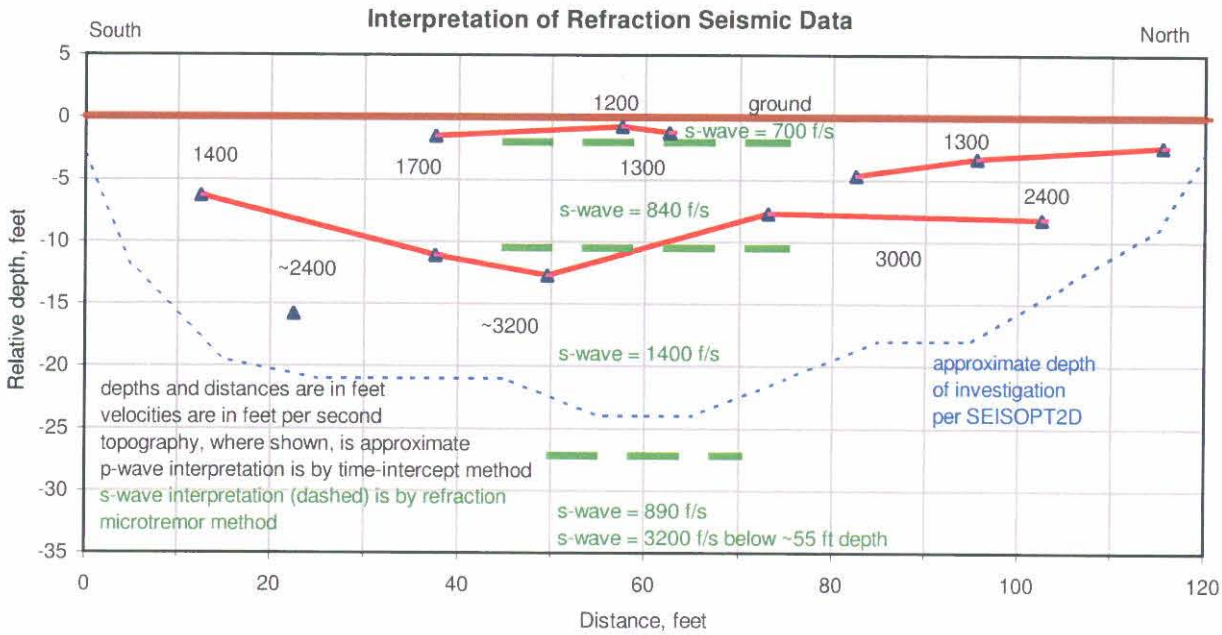
Mooney, H.M., 1973, Engineering Seismology Using Refraction Methods, Bison Instruments, Inc., Minneapolis, Minnesota.

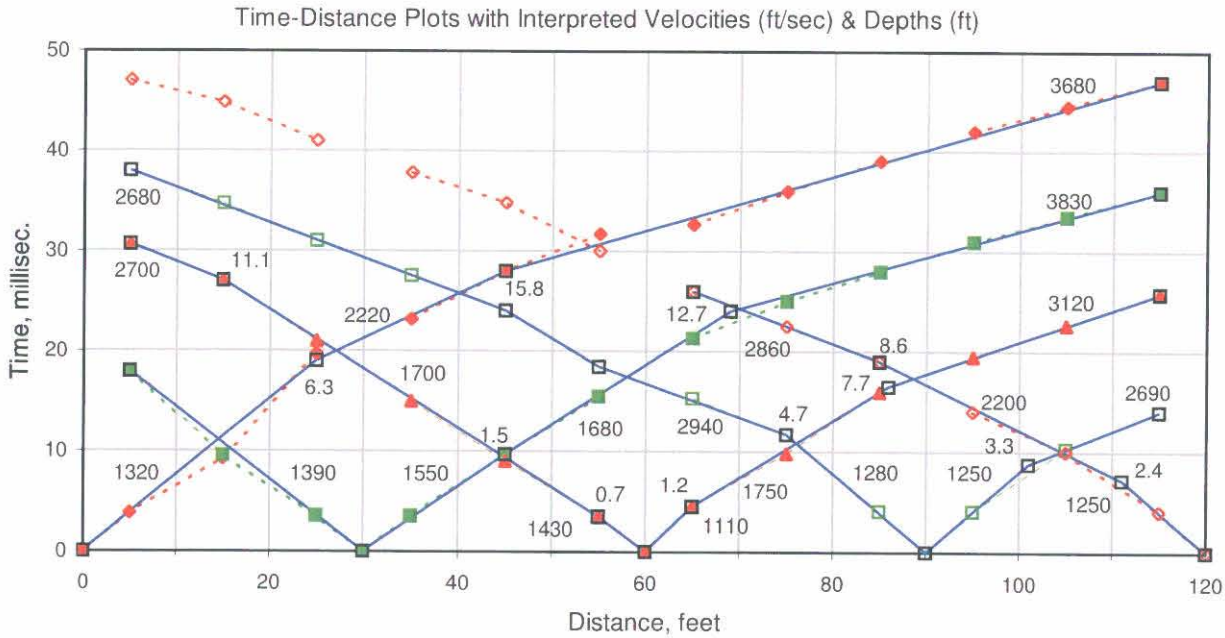
Rucker, M.L. and Keaton, J.R., 1998, Tracing an earth Fissure Using Seismic-Refraction Methods with Physical Verification, in Land Subsidence Case Studies and Current Research: Proceedings of the Dr. Joseph F. Poland Symposium on Land Subsidence, Edited by Borchers, J.W., Special Publication No. 8, Association of Engineering Geologists, Star Publishing Company, Belmont, California, p. 207-216.

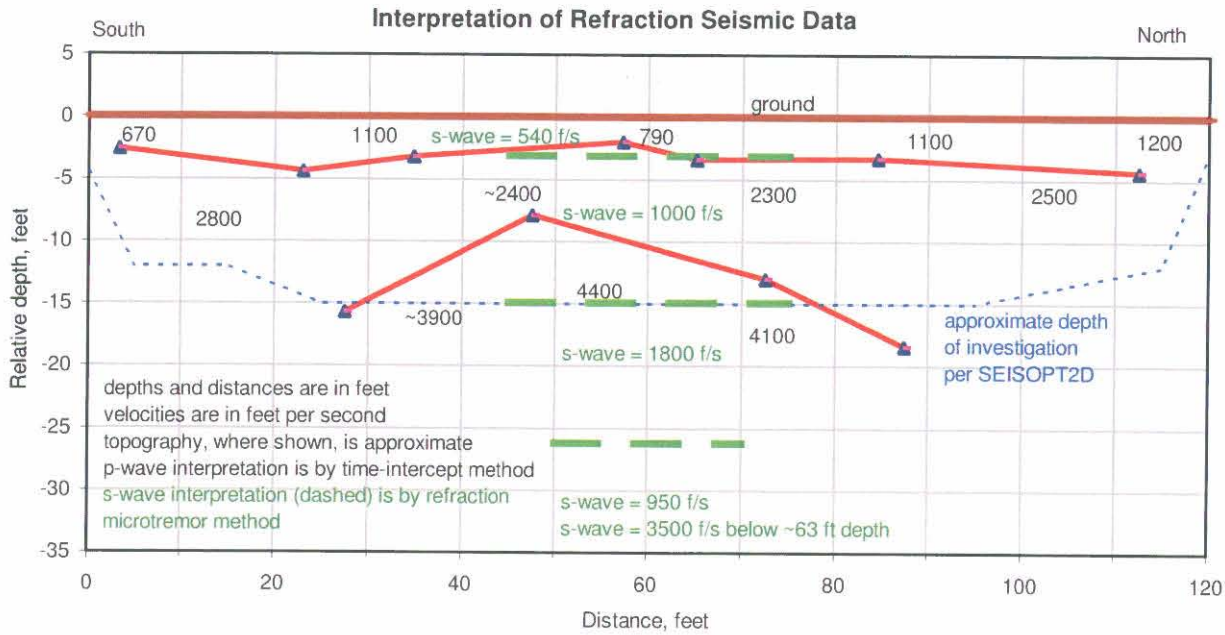
Refraction Seismic Interpretation

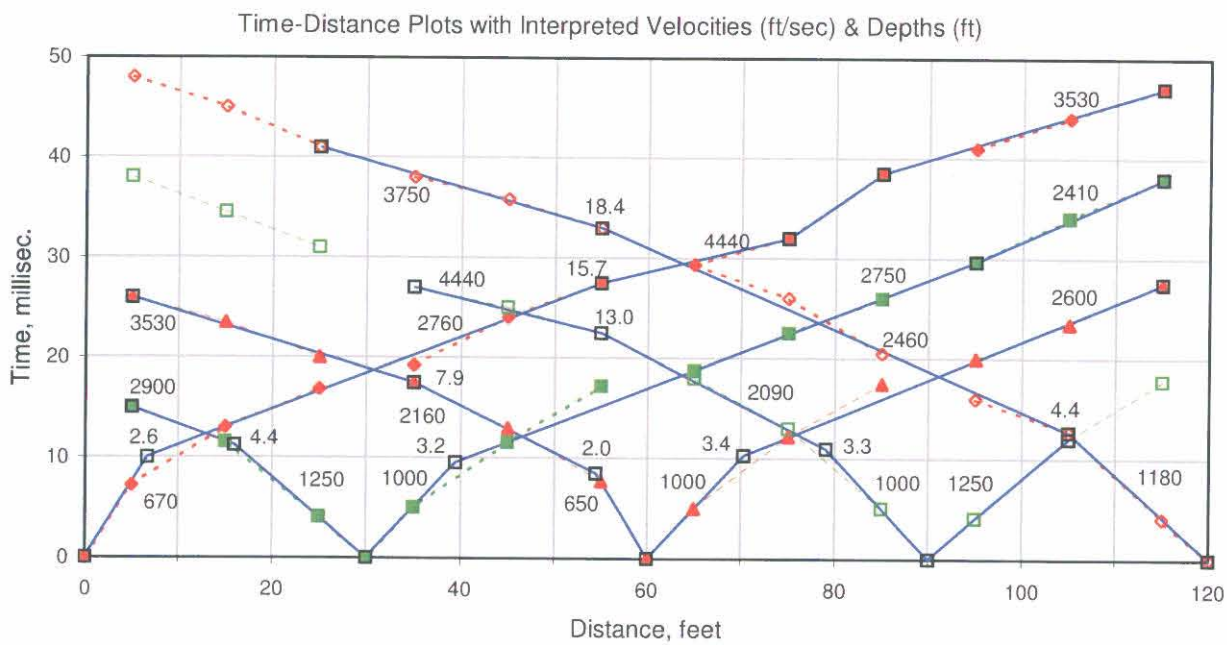
Line 1

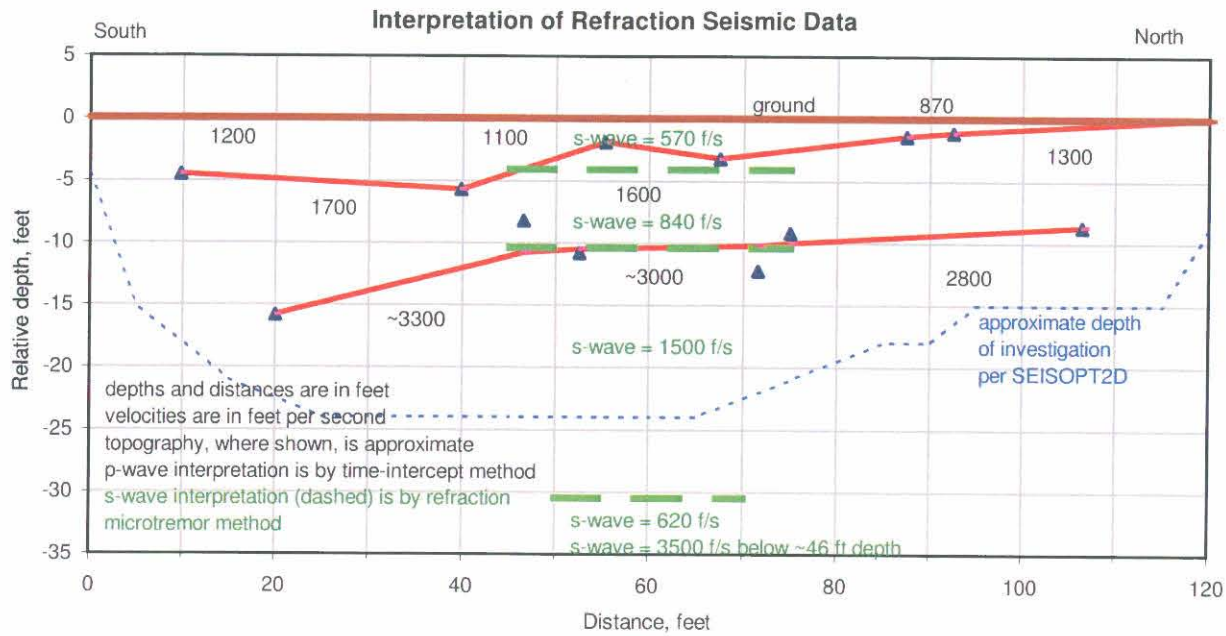
AMEC Job No. 6-117-001025

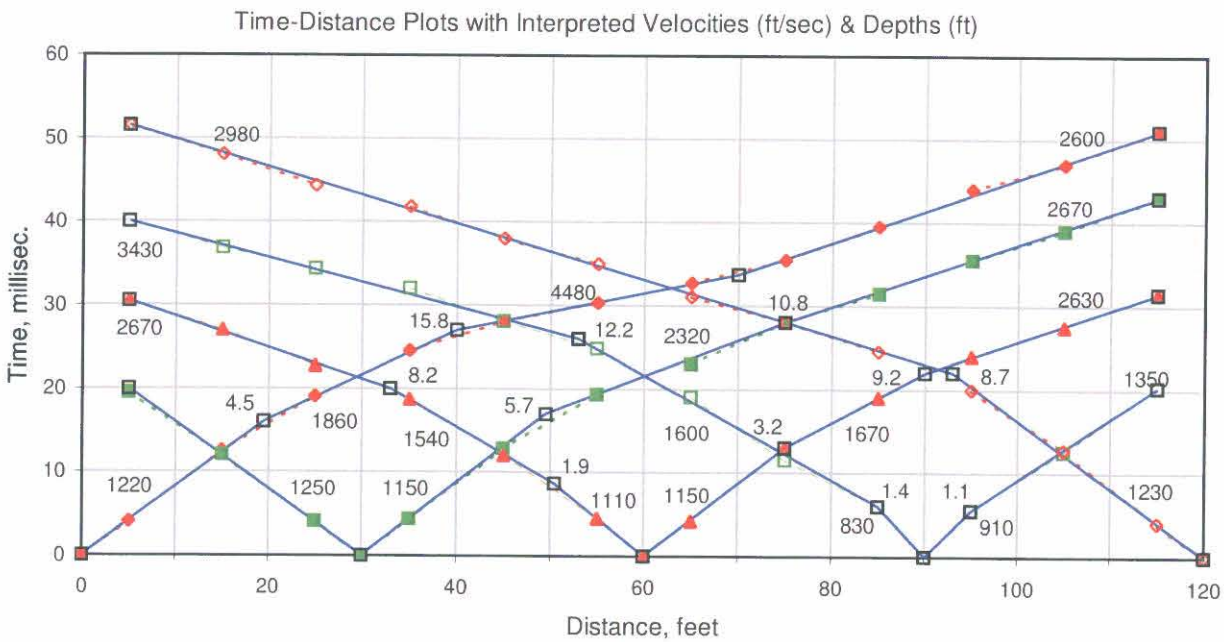


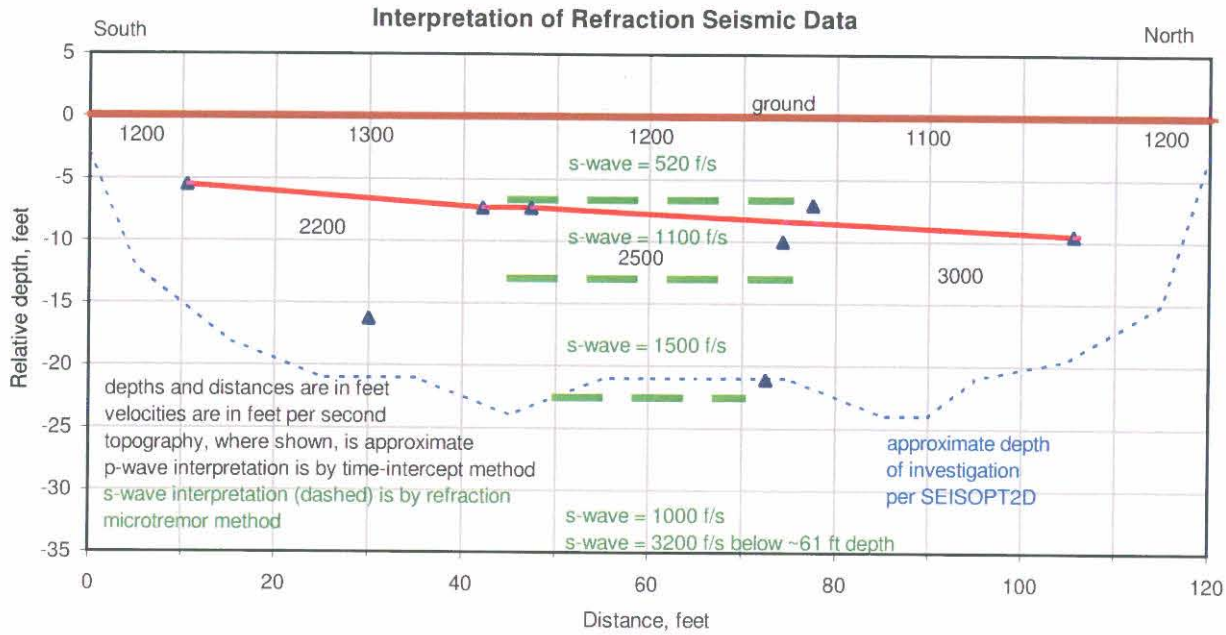


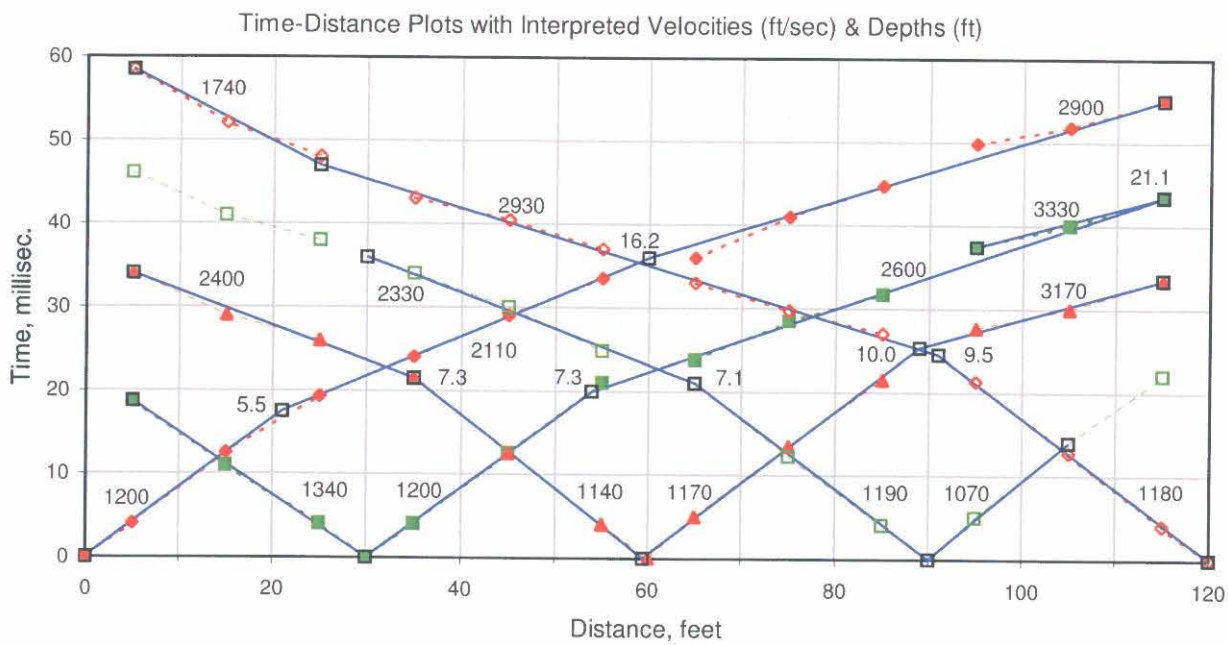

Interpretation of Refraction Seismic Data
South
North
ground
670
1100
s-wave = 540 f/s
790
1100
1200
2800
~2400
s-wave = 1000 f/s
2300
2500
~3900
4400
4100
s-wave = 1800 f/s
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 950 f/s
s-wave = 3500 f/s below ~63 ft depth
Relative depth, feet
Distance, feet

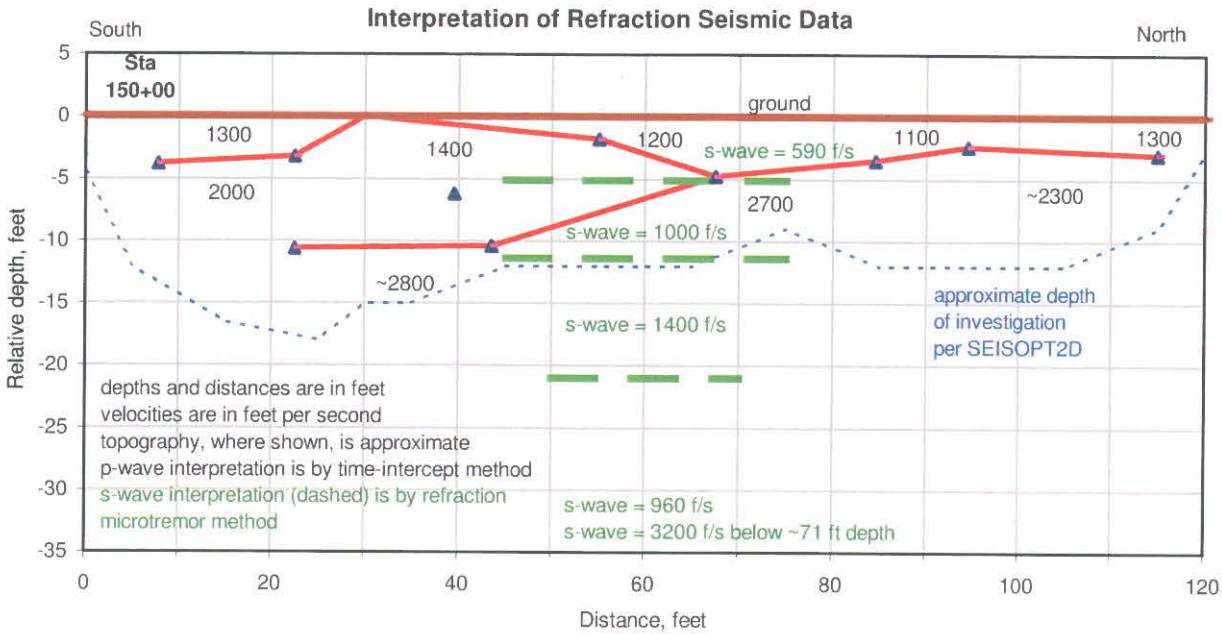

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3530
3750
18.4
4440
2410
4440
15.7
2750
3530
2760
13.0
2600
2460
2900
7.9
2090
2160
4.4
2.6
4.4
3.2
2.0
3.4
3.3
670
1250
1000
650
1000
1000
1250
1180
Time, millisec.
Distance, feet

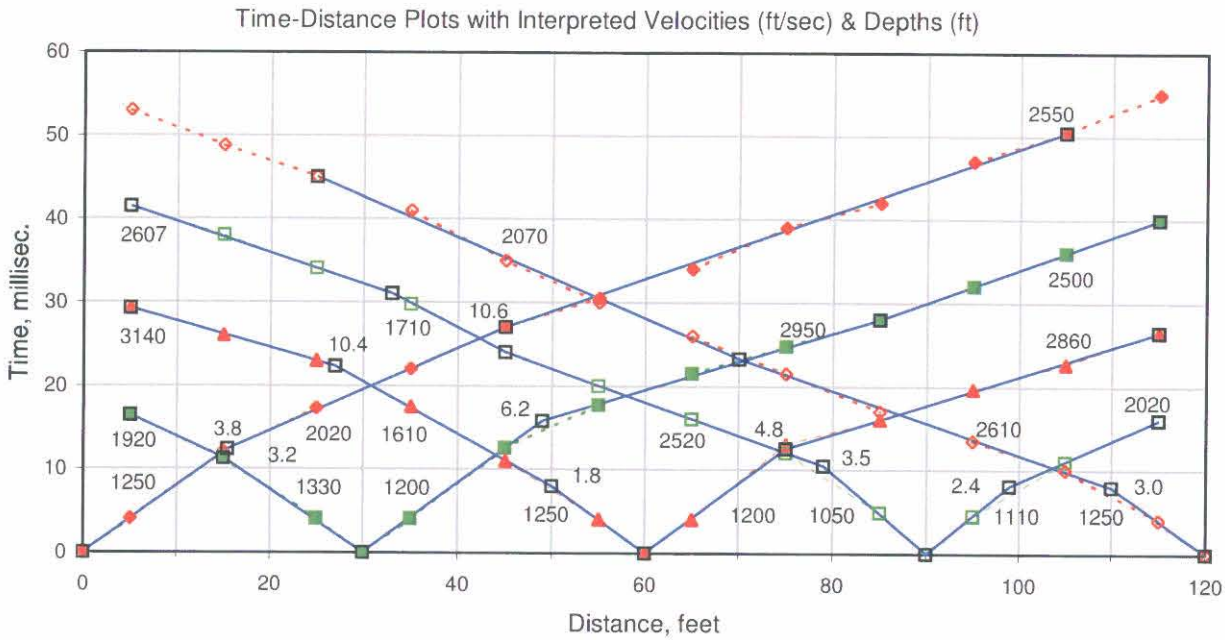

Interpretation of Refraction Seismic Data
South
North
ground
870
1200
1100
s-wave = 570 f/s
1300
1700
1600
s-wave = 840 f/s
~3000
2800
~3300
s-wave = 1500 f/s
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 620 f/s
s-wave = 3500 f/s below ~46 ft depth
Relative depth, feet
Distance, feet

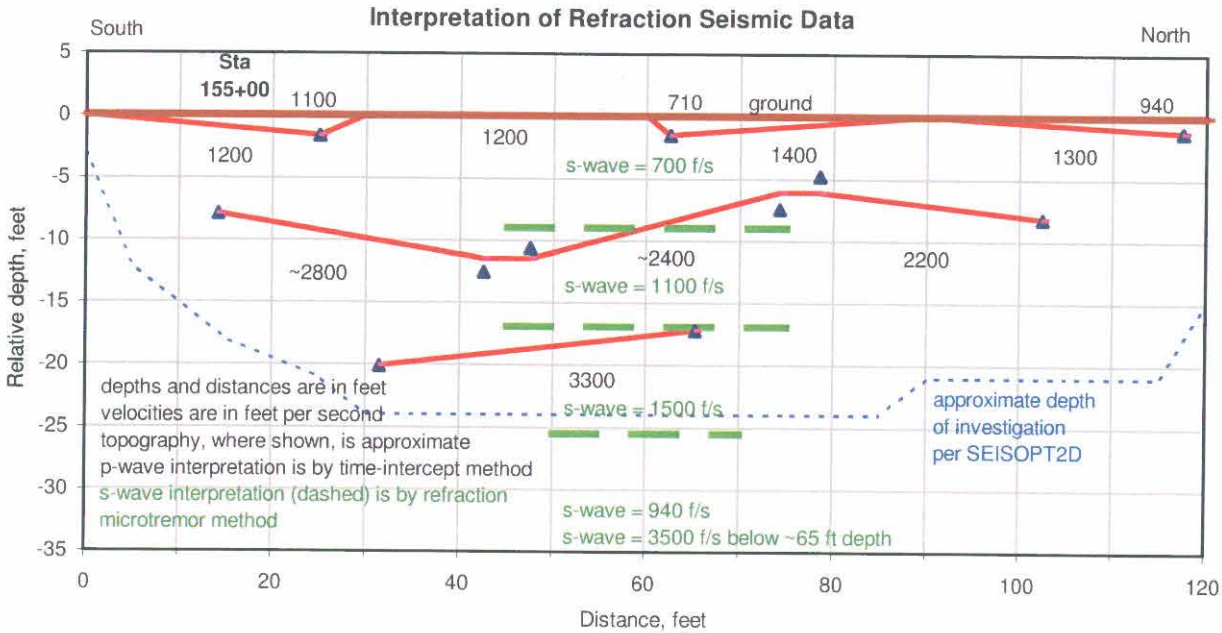

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2980
2600
3430
2670
4480
10.8
2670
15.8
12.2
2320
2630
8.2
9.2
8.7
1350
4.5
1860
5.7
1540
1600
3.2
1670
1.9
1220
1250
1150
1110
1150
1.4
1.1
1230
830
910
Time, millisec.
Distance, feet

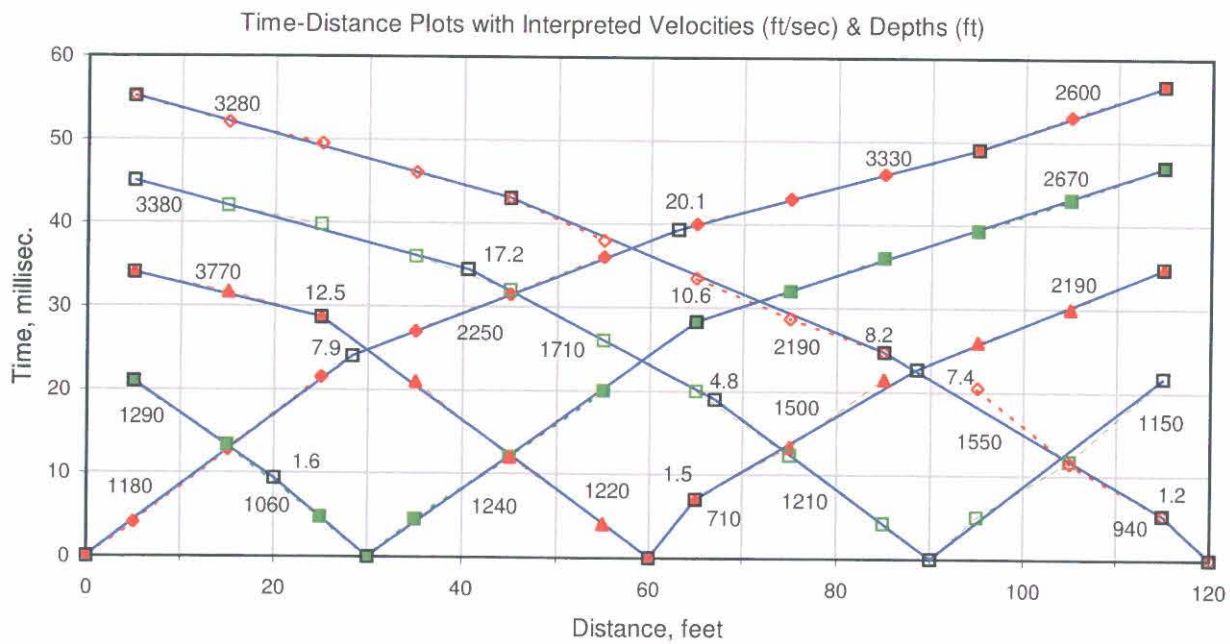

Interpretation of Refraction Seismic Data
South
North
ground
1200
1300
1200
1100
1200
s-wave = 520 f/s
2200
s-wave = 1100 f/s
2500
3000
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
s-wave = 3200 f/s below ~61 ft depth
Relative depth, feet
Distance, feet

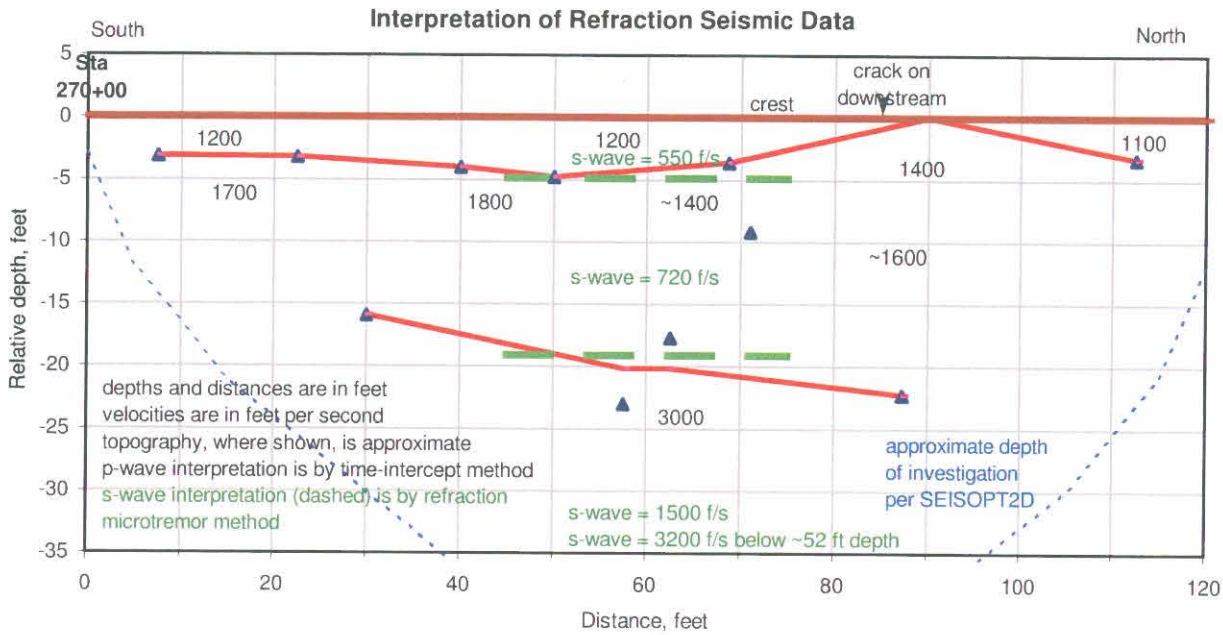

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
1740
2900
21.1
2930
3330
16.2
2400
2330
2600
3170
2110
10.0
9.5
7.3
7.3
7.1
5.5
1200
1340
1200
1140
1170
1190
1070
1180
Time, millisec.
Distance, feet

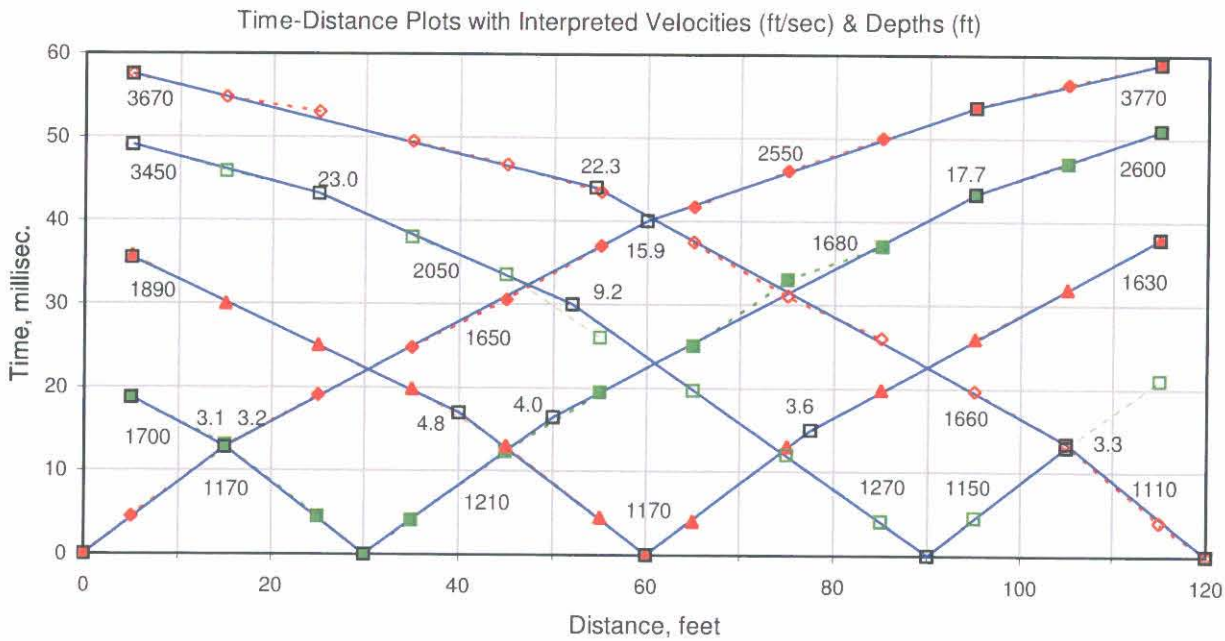

Interpretation of Refraction Seismic Data
South
North
Sta
150+00
ground
1300
1400
1200
1100
1300
s-wave = 590 f/s
2000
2700
~2300
s-wave = 1000 f/s
~2800
s-wave = 1400 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 960 f/s
s-wave = 3200 f/s below ~71 ft depth
Relative depth, feet
Distance, feet

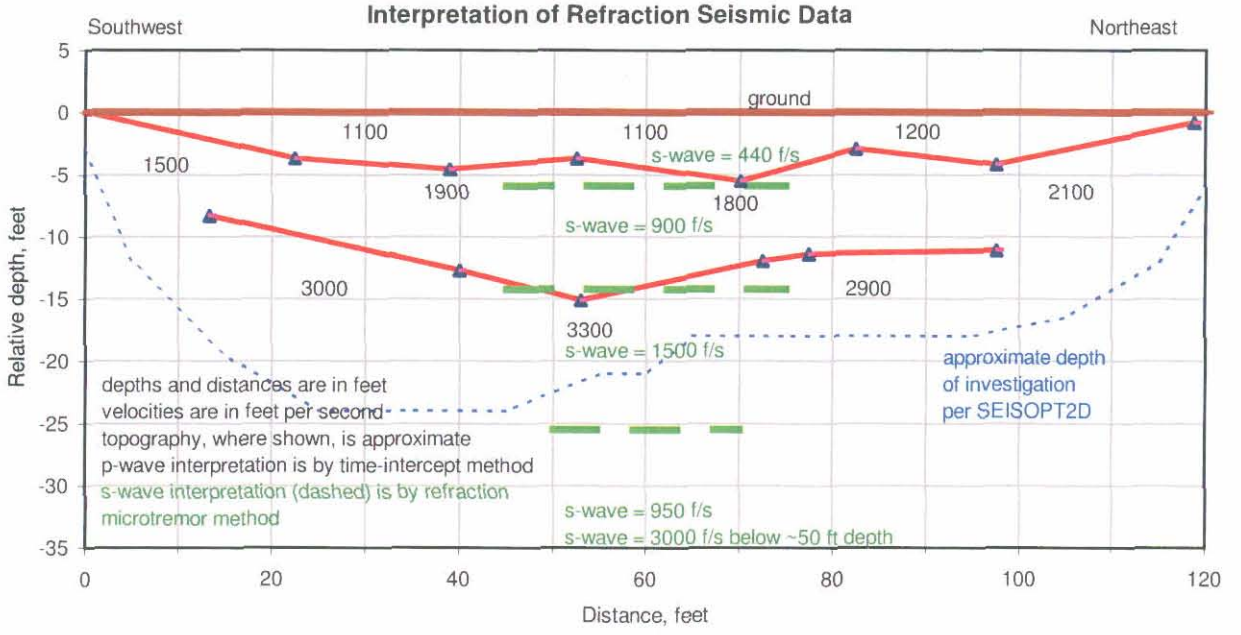

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2550
2607
2070
2500
3140
1710
10.6
2950
2860
10.4
6.2
2020
1920
3.8
2020
1610
2520
4.8
2610
3.2
3.5
1250
1330
1200
1.8
2.4
3.0
1250
1200
1050
1110
1250
Time, millisec.
Distance, feet

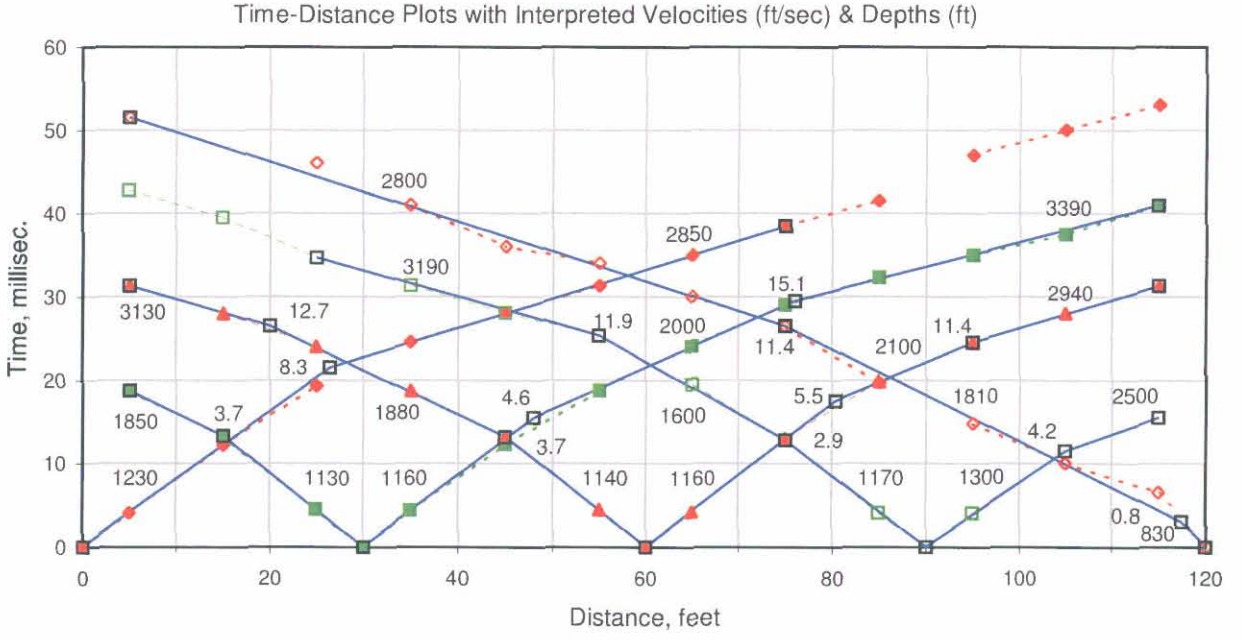

Interpretation of Refraction Seismic Data
South
North
Sta 155+00
1100
710
ground
940
1200
1200
1400
1300
s-wave = 700 f/s
~2800
~2400
2200
s-wave = 1100 f/s
3300
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 940 f/s
s-wave = 3500 f/s below ~65 ft depth
Relative depth, feet
Distance, feet

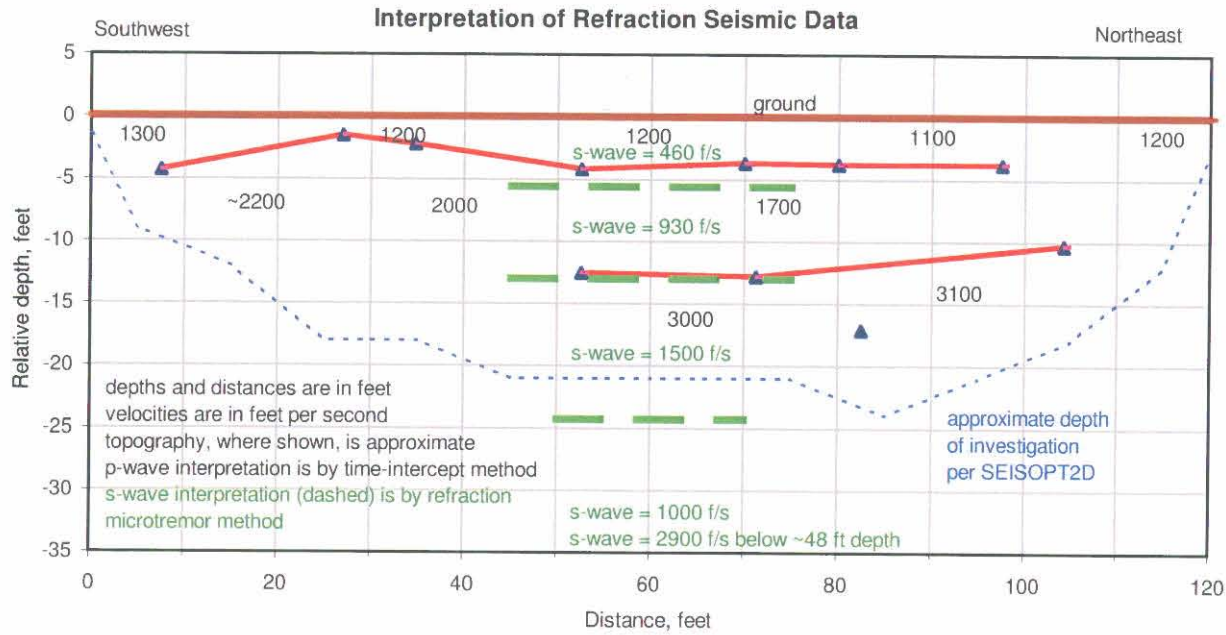

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3280
2600
3330
3380
2670
20.1
17.2
3770
12.5
10.6
2190
2250
7.9
1710
2190
8.2
4.8
7.4
1290
1500
1150
1550
1.6
1.5
1180
1060
1240
1220
710
1210
1.2
940
Time, millisec.
Distance, feet

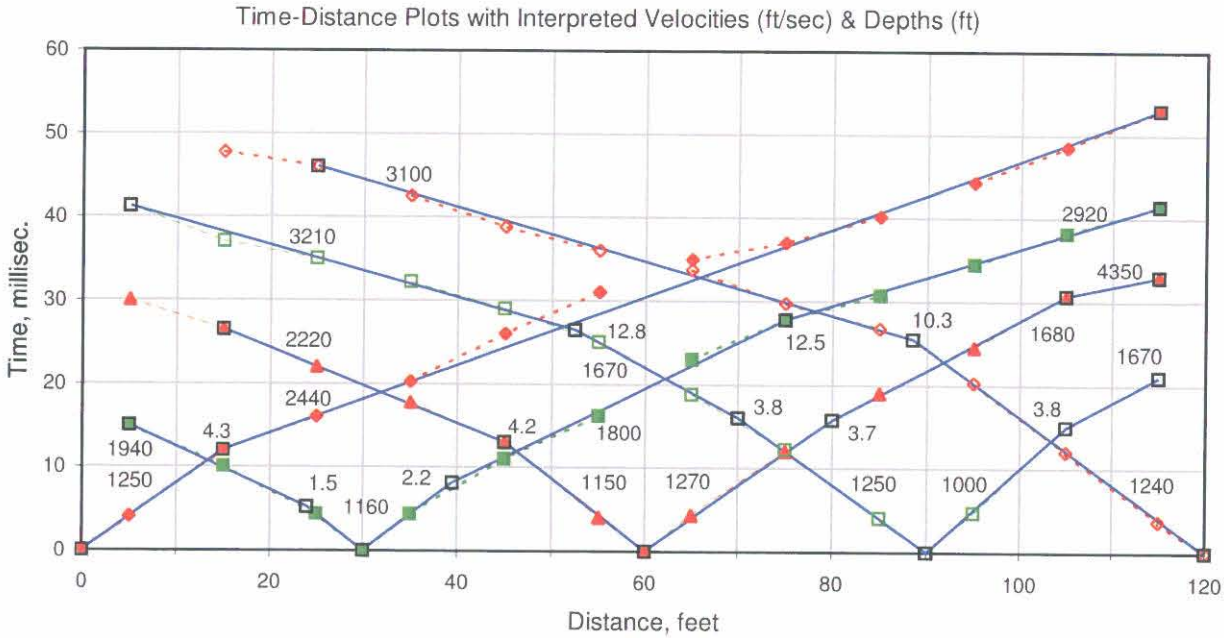

Interpretation of Refraction Seismic Data
South
North
Sta 270+00
crest
crack on downstream
1200
1200
s-wave = 550 f/s
1400
1100
1700
1800
~1400
~1600
s-wave = 720 f/s
3000
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1500 f/s
s-wave = 3200 f/s below ~52 ft depth
Relative depth, feet
Distance, feet

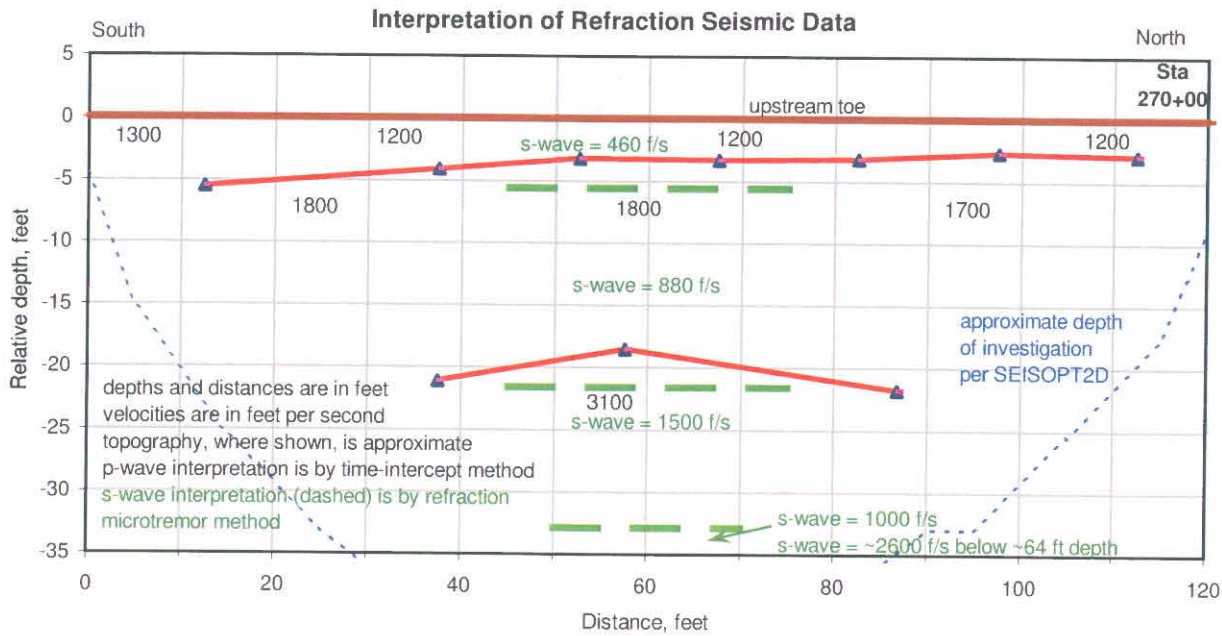

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3670
3770
3450
23.0
22.3
2550
17.7
2600
2050
15.9
1680
1890
9.2
1630
1650
1700
3.1
3.2
4.8
4.0
3.6
1660
3.3
1170
1210
1170
1270
1150
1110
Time, millisec.
Distance, feet

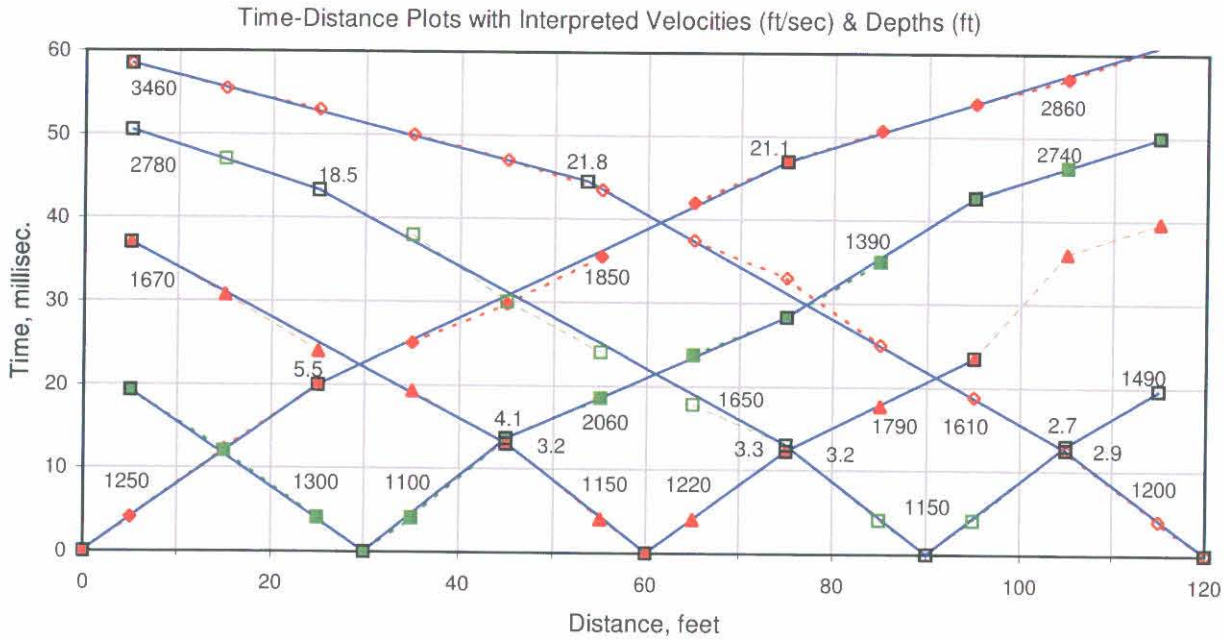

Interpretation of Refraction Seismic Data
Southwest
Northeast
ground
1500
1100
1100
1200
1900
1800
2100
s-wave = 440 f/s
s-wave = 900 f/s
3000
2900
3300
s-wave = 1500 f/s
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 950 f/s
s-wave = 3000 f/s below ~50 ft depth
Relative depth, feet
Distance, feet

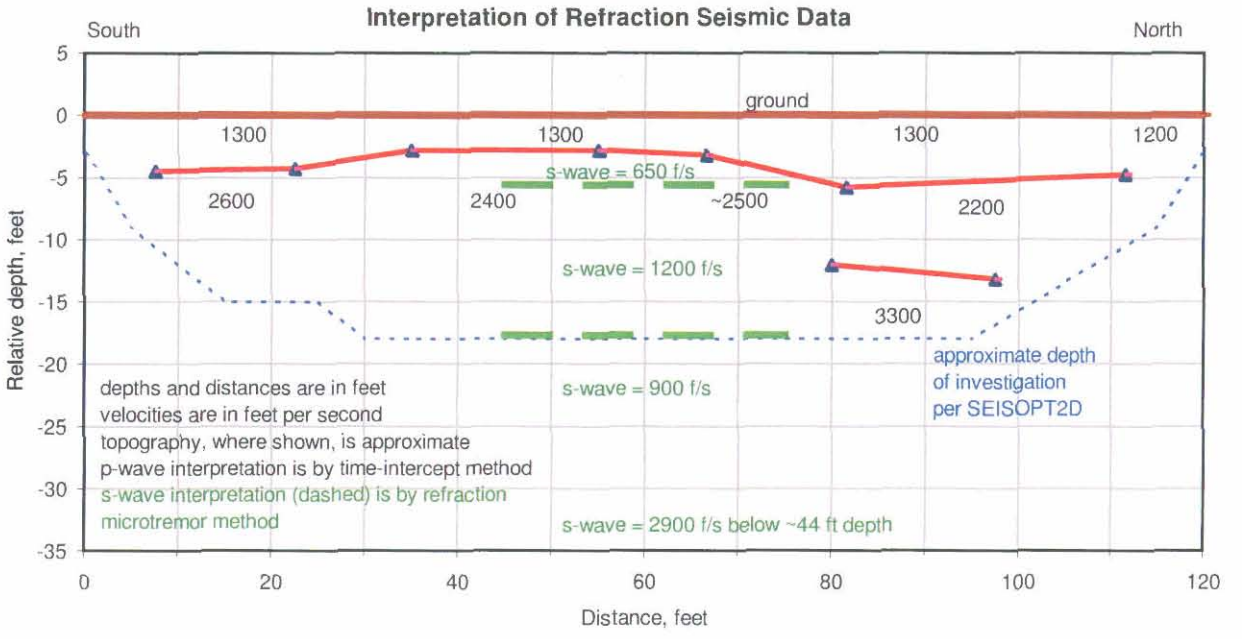

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2800
3190
2850
3390
3130
12.7
11.9
2000
15.1
11.4
2940
8.3
2100
11.4
1850
3.7
1880
4.6
1600
5.5
1810
2500
3.7
2.9
4.2
1230
1130
1160
1140
1160
1170
1300
0.8
830
Time, millisec.
Distance, feet

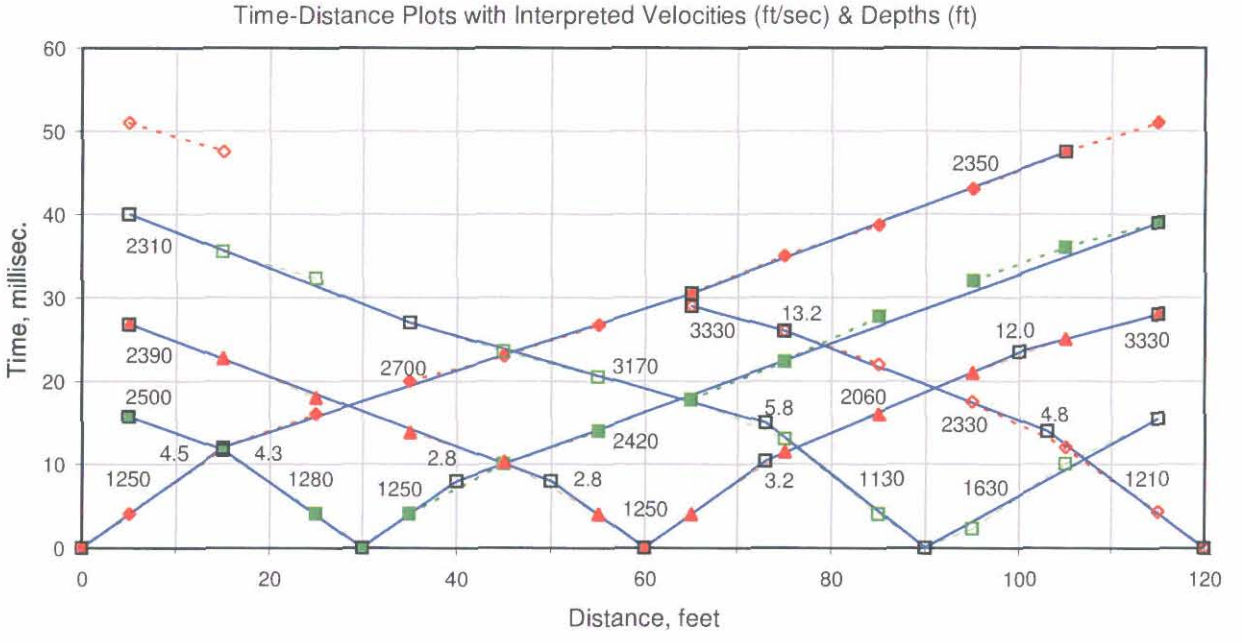

Interpretation of Refraction Seismic Data
Southwest
Northeast
ground
1300
1200
1200
1100
1200
s-wave = 460 f/s
~2200
2000
1700
s-wave = 930 f/s
3100
3000
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
s-wave = 2900 f/s below ~48 ft depth
Relative depth, feet
Distance, feet

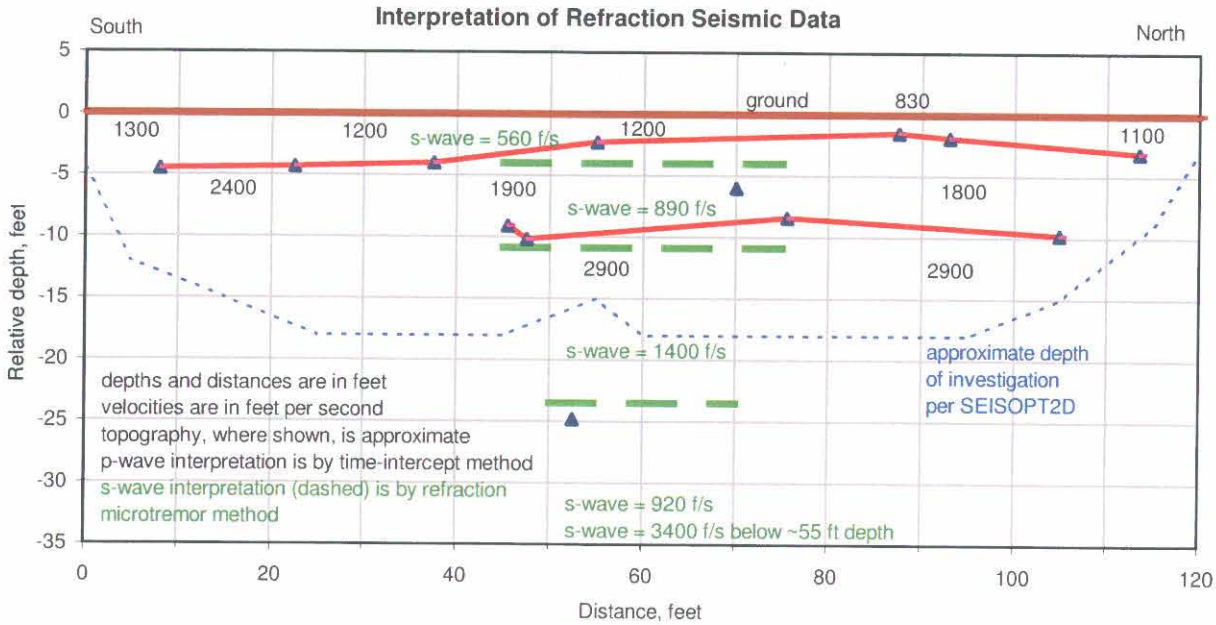

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3100
3210
2920
4350
2220
12.8
10.3
12.5
1680
1670
1670
2440
3.8
3.8
4.3
4.2
3.7
1940
1800
1250
1.5
2.2
1150
1270
1250
1000
1240
1160
Time, millisec.
Distance, feet

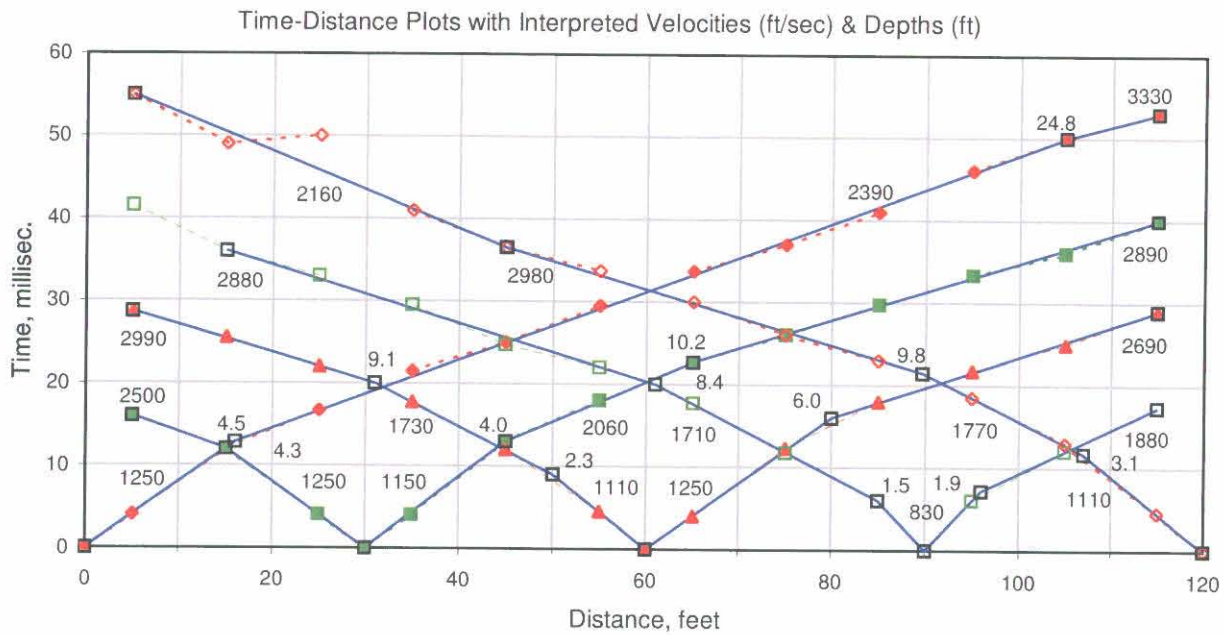

Interpretation of Refraction Seismic Data
South
North
Sta 270+00
upstream toe
1300
1200
s-wave = 460 f/s
1200
1200
1800
1800
1700
s-wave = 880 f/s
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
3100
s-wave = 1500 f/s
s-wave = 1000 f/s
s-wave = ~2600 f/s below ~64 ft depth
Relative depth, feet
Distance, feet

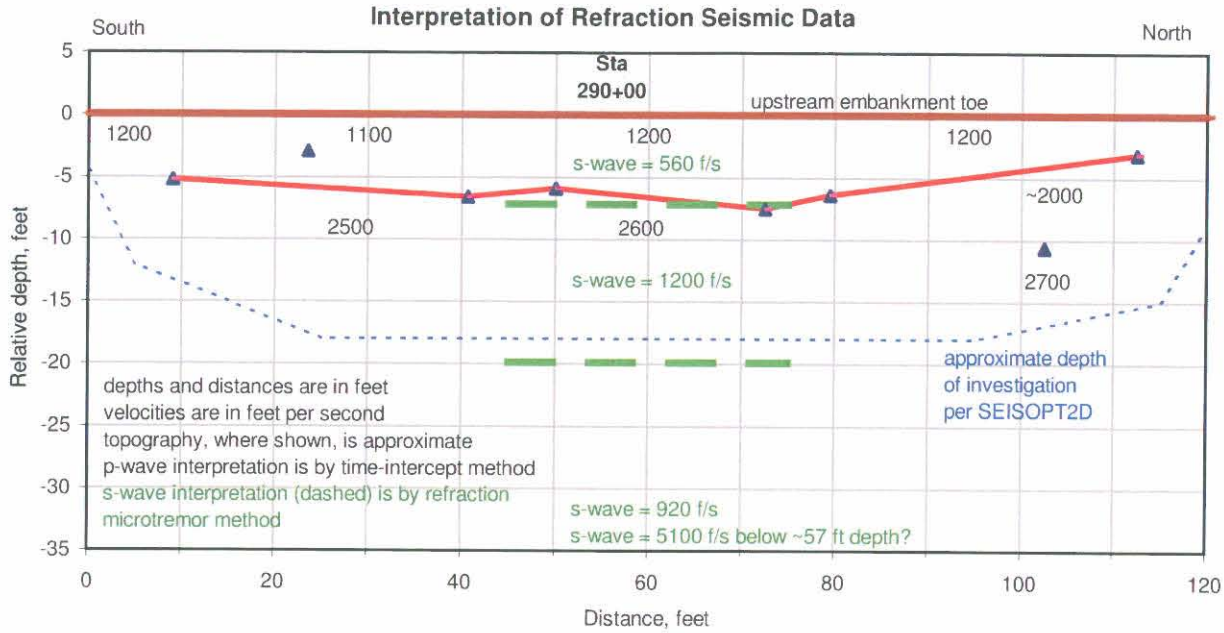

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3460
2780
18.5
21.8
21.1
2860
2740
1390
1670
1850
5.5
1650
1490
4.1
2060
3.2
3.3
3.2
1790
1610
2.7
2.9
1250
1300
1100
1150
1220
1150
1200
Time, millisec.
Distance, feet

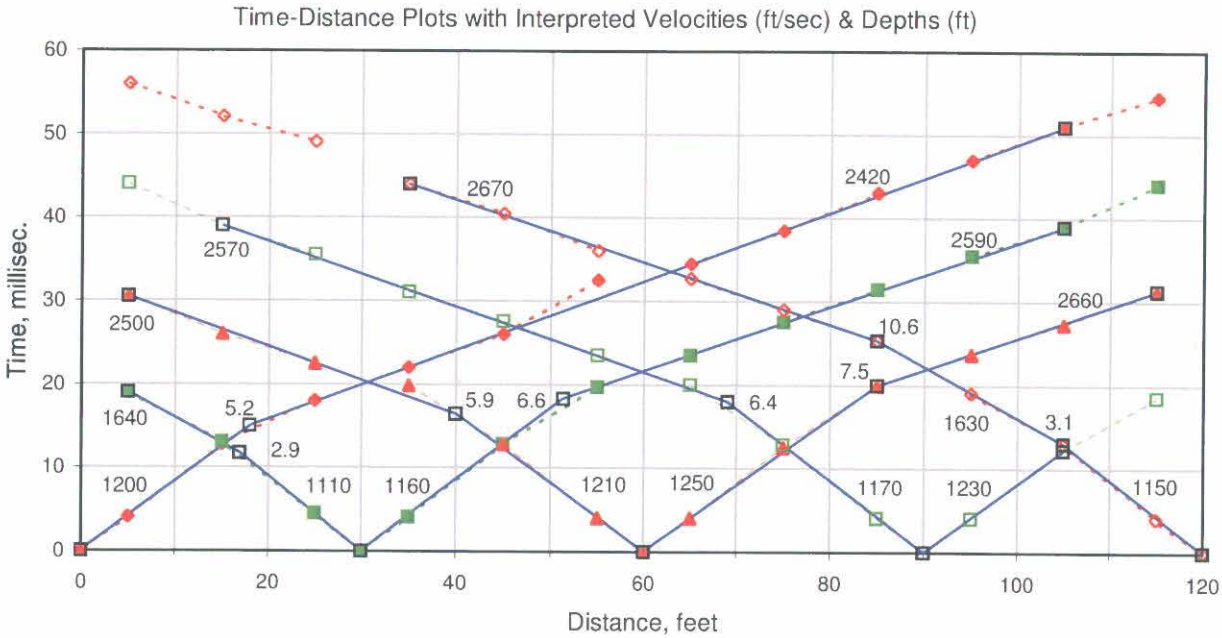

Interpretation of Refraction Seismic Data
South
North
ground
1300
1300
1300
1200
2600
2400
~2500
2200
3300
s-wave = 650 f/s
s-wave = 1200 f/s
s-wave = 900 f/s
s-wave = 2900 f/s below ~44 ft depth
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet

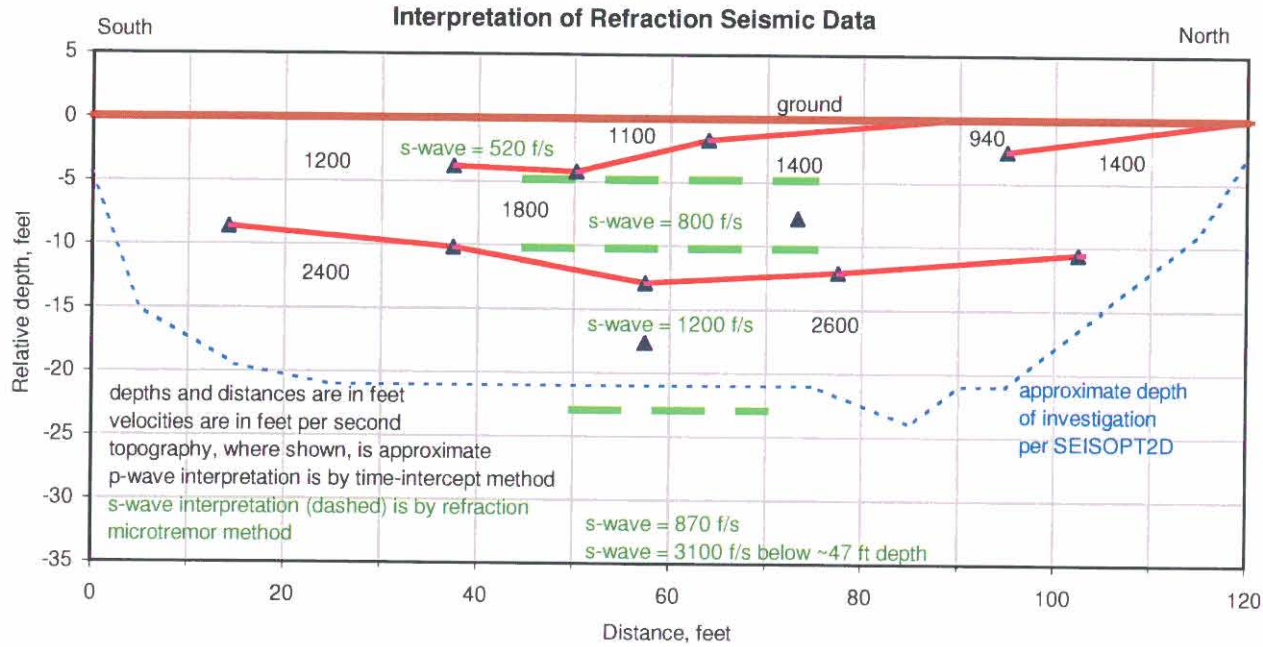

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
2350
2310
2390
2500
3330
13.2
12.0
3330
2700
3170
2060
5.8
4.8
2330
4.5
4.3
2.8
2420
1250
1280
1250
2.8
3.2
1130
1630
1210
1250

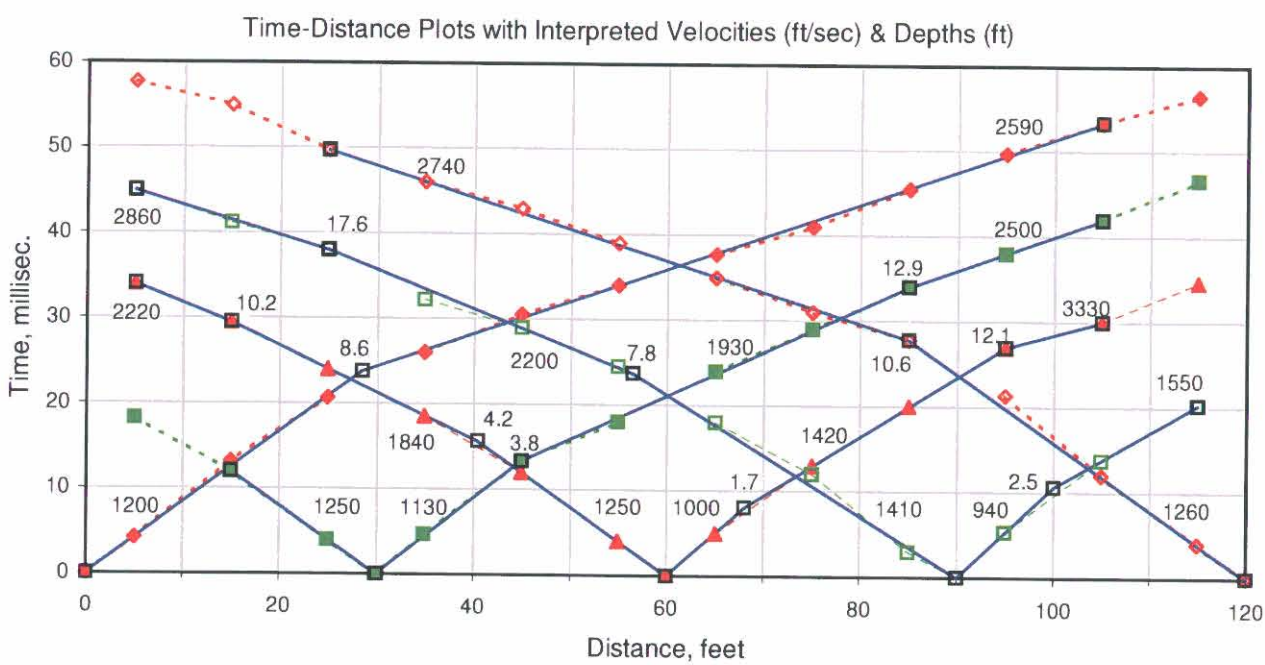

Interpretation of Refraction Seismic Data
South
North
ground
830
1300
1200
s-wave = 560 f/s
1200
1100
2400
1900
1800
s-wave = 890 f/s
2900
2900
s-wave = 1400 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 920 f/s
s-wave = 3400 f/s below ~55 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
3330
24.8
2160
2390
2890
2880
2980
2990
9.1
10.2
9.8
2690
2500
8.4
6.0
4.5
1730
4.0
2060
1710
1770
1880
4.3
2.3
3.1
1250
1250
1150
1110
1250
1.5
1.9
830
1110


Interpretation of Refraction Seismic Data
South
North
Sta
290+00
upstream embankment toe
1200
1100
1200
1200
s-wave = 560 f/s
~2000
2500
2600
2700
s-wave = 1200 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 920 f/s
s-wave = 5100 f/s below ~57 ft depth?
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2670
2420
2570
2590
2500
2660
10.6
7.5
5.2
5.9
6.6
6.4
1640
2.9
1630
3.1
1200
1110
1160
1210
1250
1170
1230
1150
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
South
North
ground
1200
s-wave = 520 f/s
1100
1400
940
1400
1800
s-wave = 800 f/s
2400
s-wave = 1200 f/s
2600
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 870 f/s
s-wave = 3100 f/s below ~47 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2590
2740
2860
17.6
2500
12.9
2220
10.2
3330
8.6
2200
7.8
1930
12.1
10.6
1550
4.2
1840
3.8
1420
1.7
2.5
1200
1250
1130
1250
1000
1410
940
1260
Time, millisec.
Distance, feet

Refraction Seismic Interpretation

Line 15

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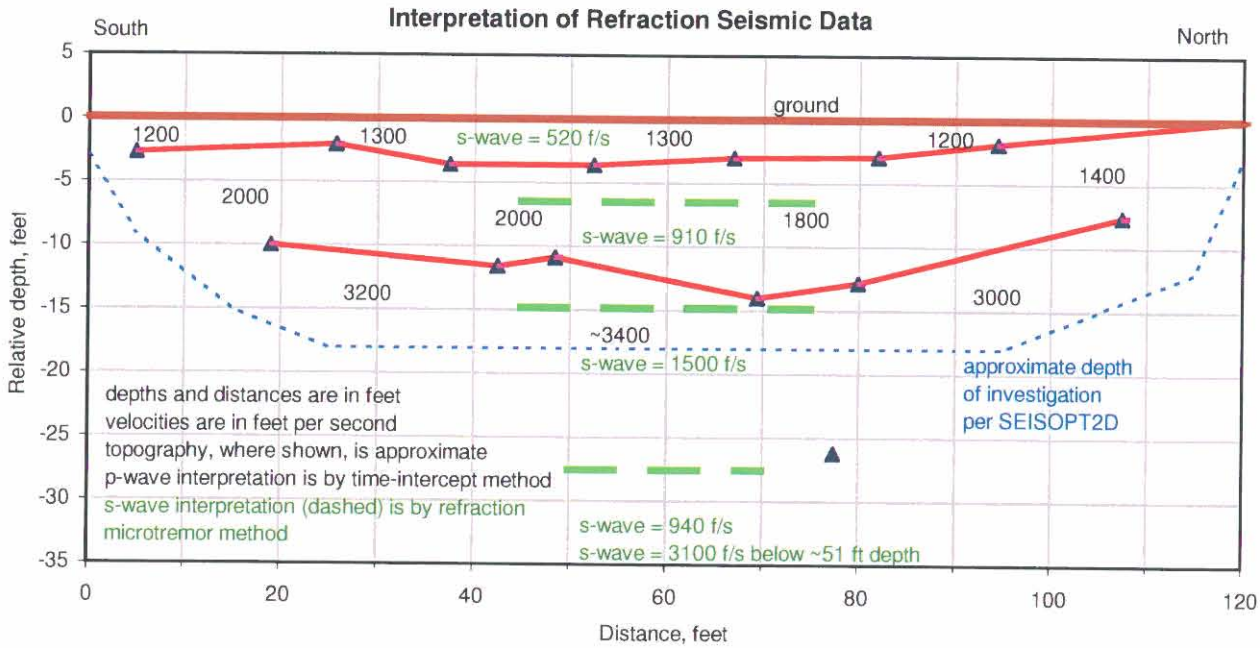
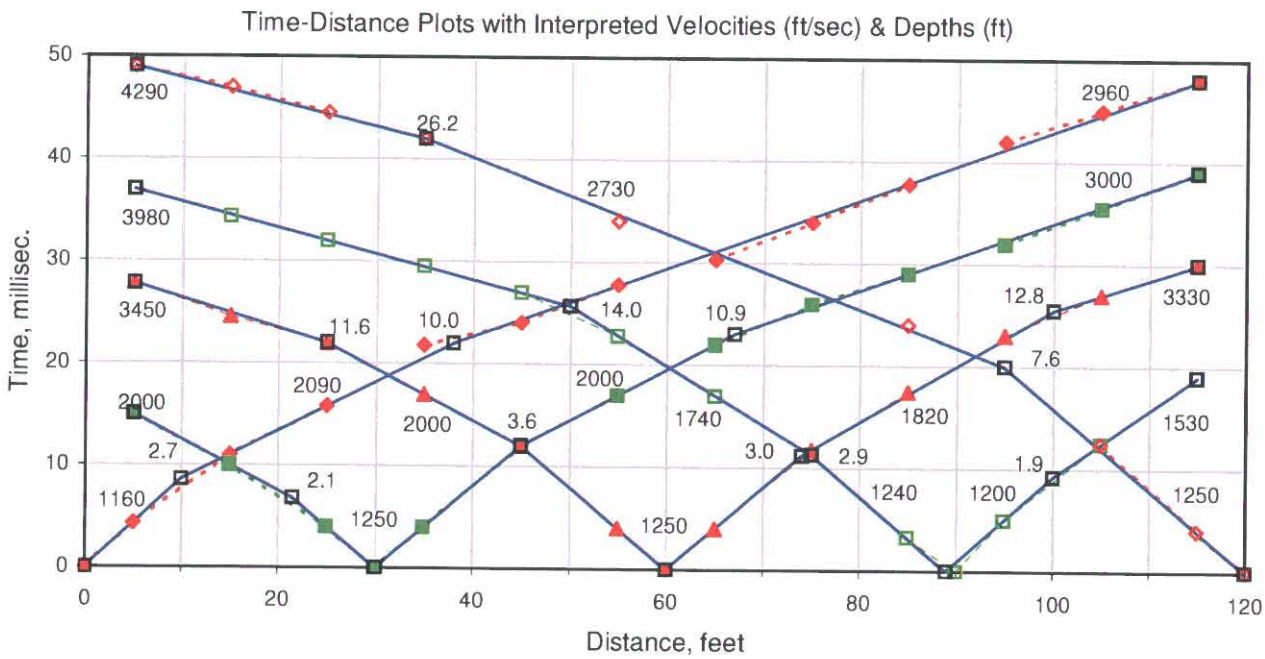
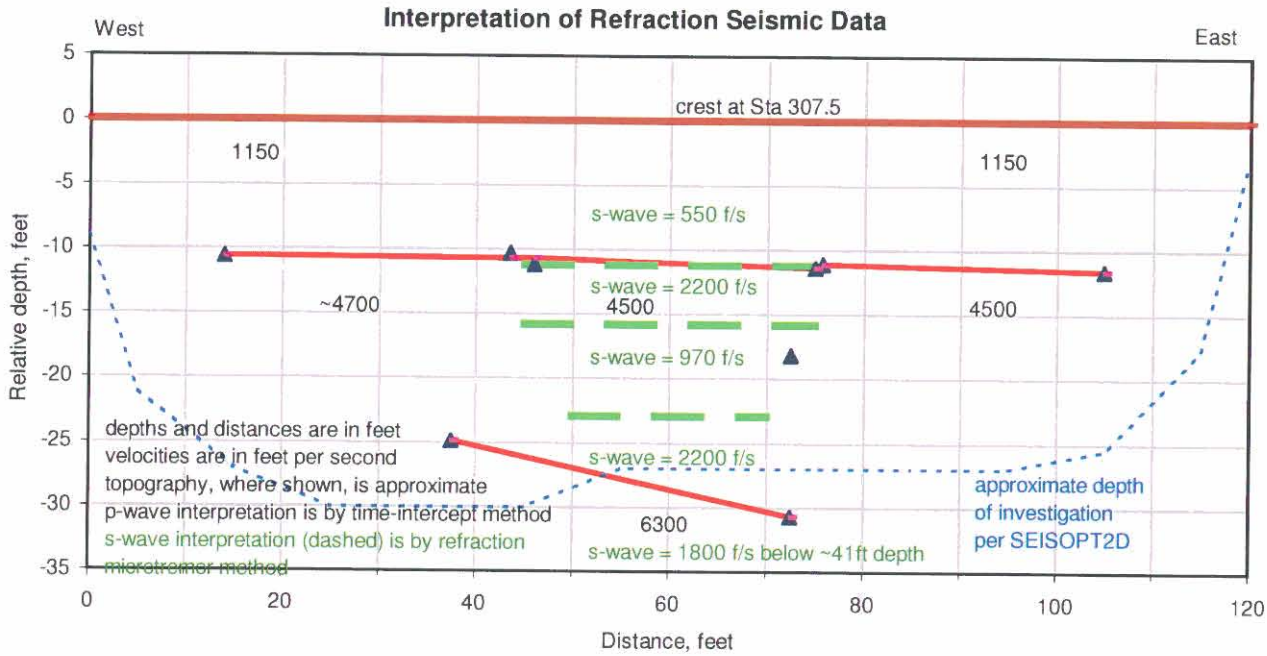
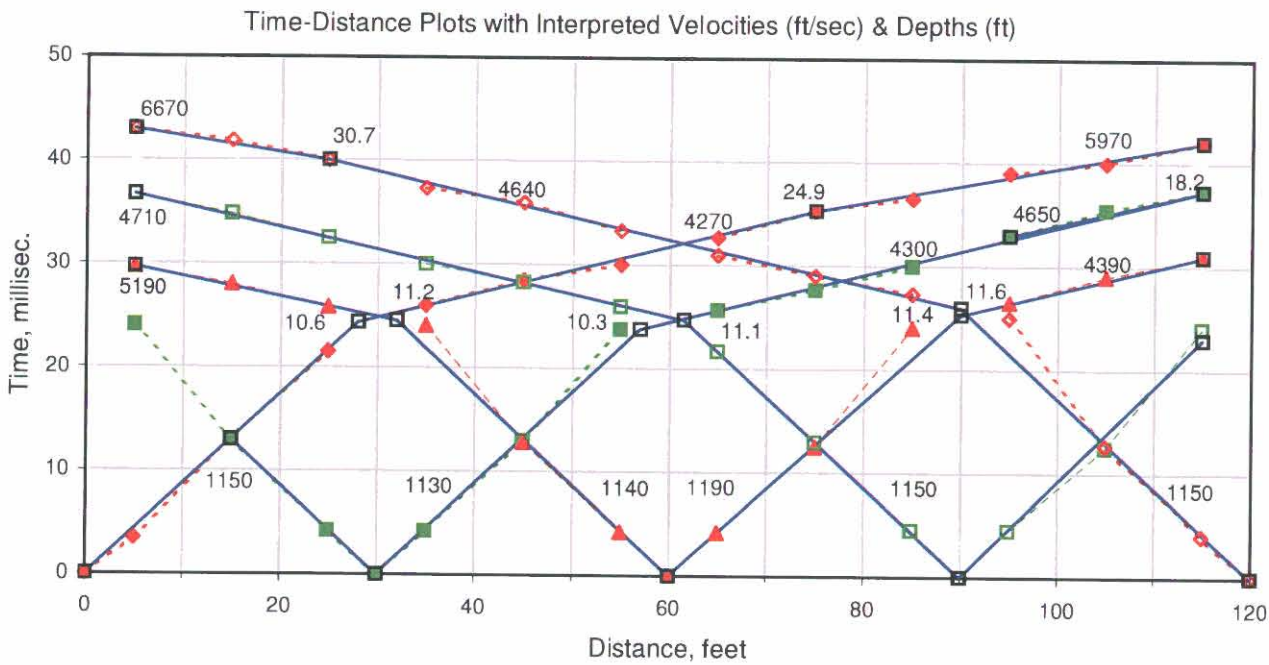
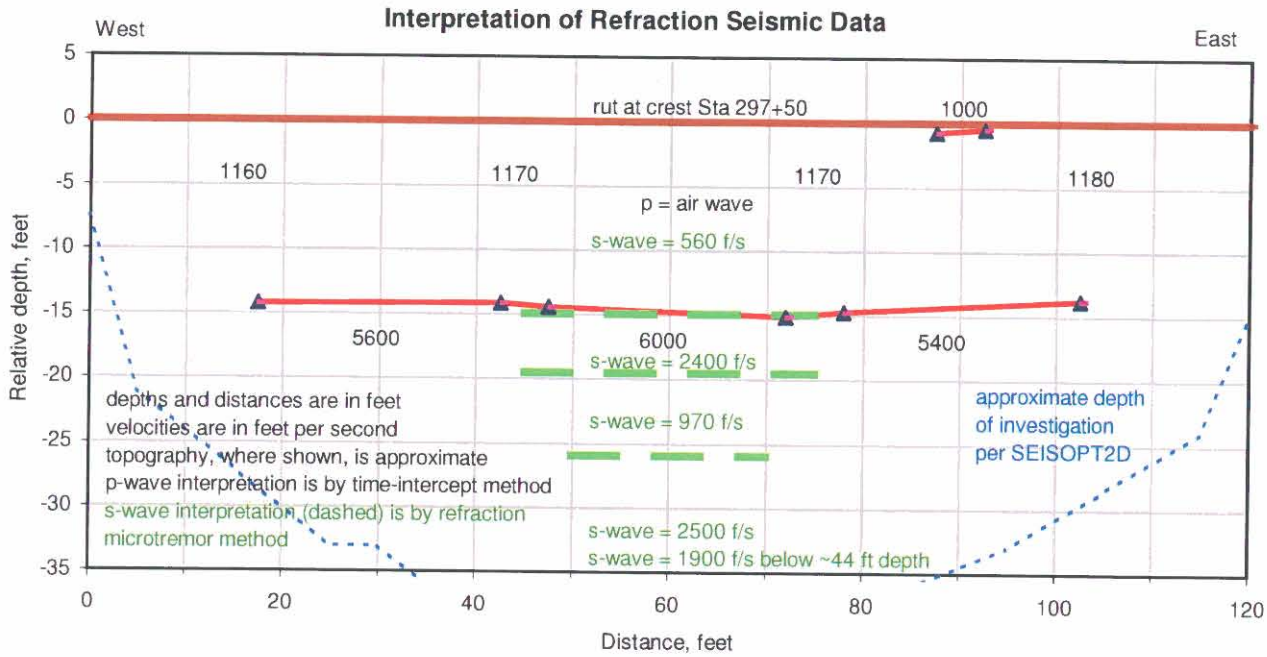
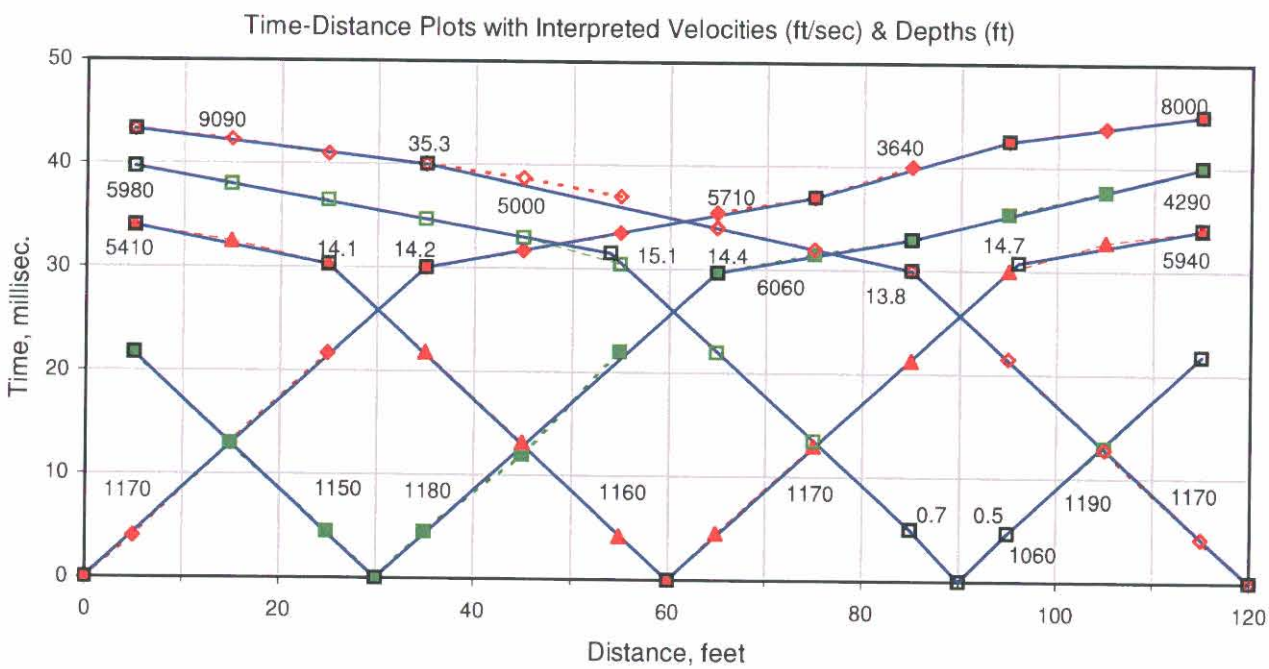


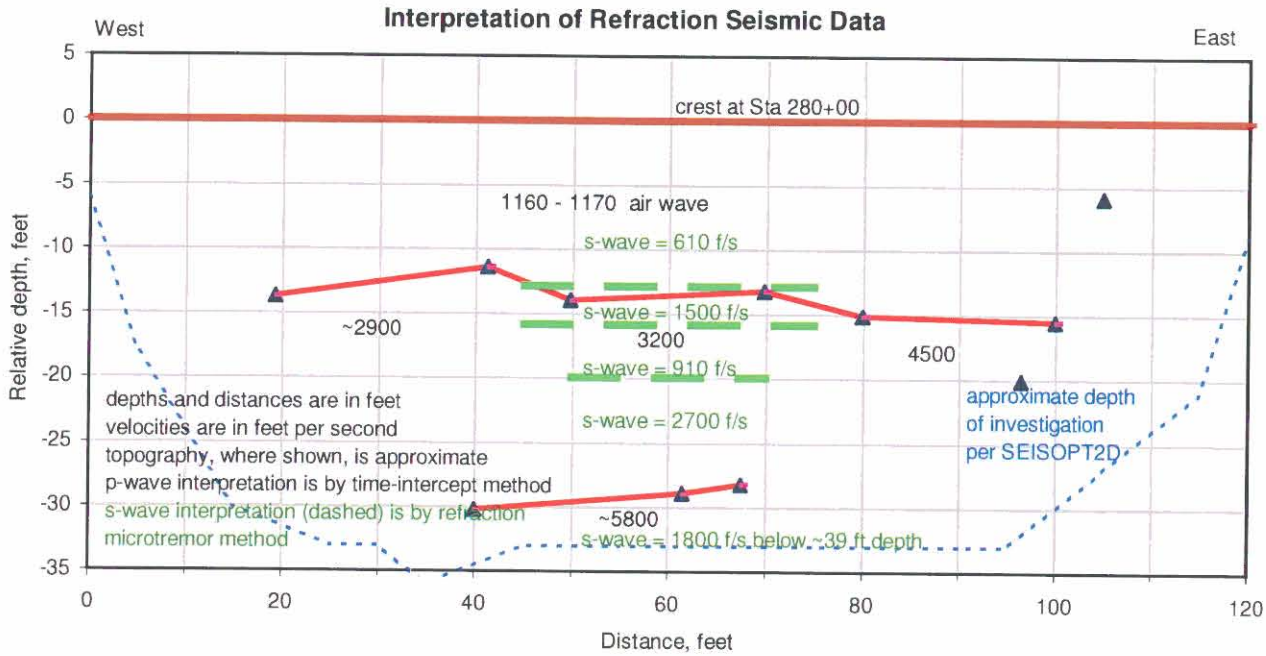


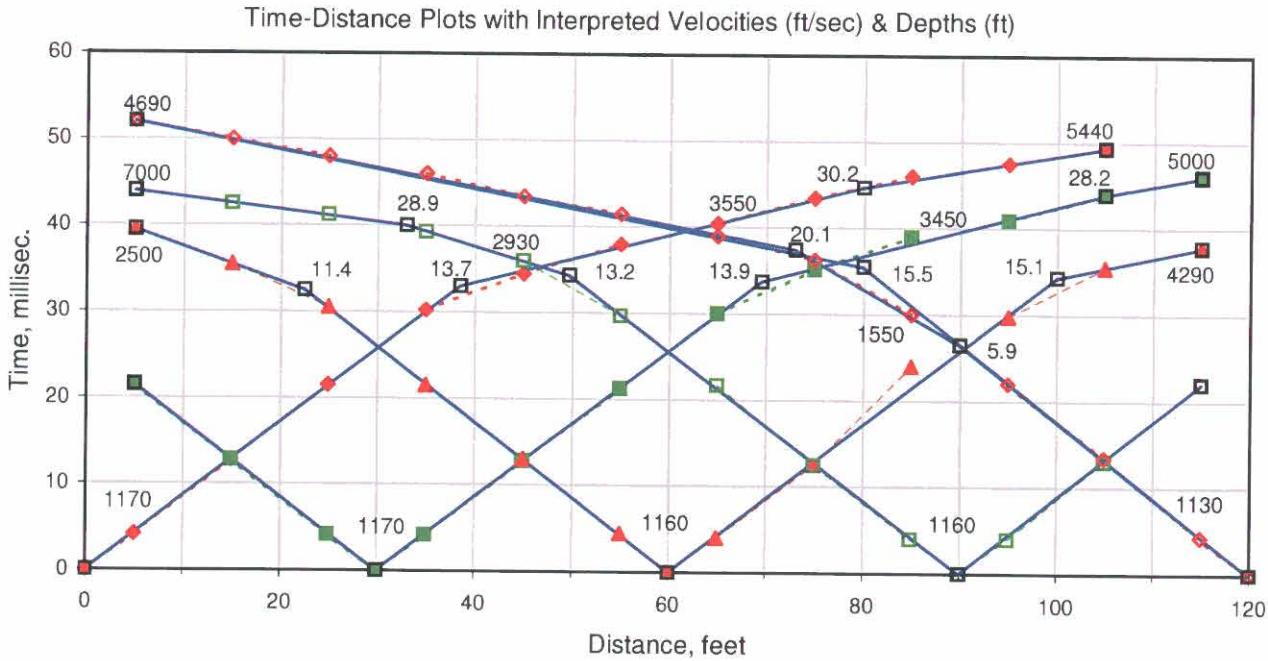

Interpretation of Refraction Seismic Data
West
East
crest at Sta 307.5
1150
1150
s-wave = 550 f/s
s-wave = 2200 f/s
~4700
4500
4500
s-wave = 970 f/s
s-wave = 2200 f/s
6300
s-wave = 1800 f/s below ~41ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
6670
30.7
4640
24.9
5970
18.2
4710
4270
4650
4300
4390
5190
11.2
10.6
10.3
11.1
11.4
11.6
1150
1130
1140
1190
1150
1150
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
West
East
rut at crest Sta 297+50
1000
1160
1170
1170
1180
p = air wave
s-wave = 560 f/s
5600
6000
5400
s-wave = 2400 f/s
s-wave = 970 f/s
s-wave = 2500 f/s
s-wave = 1900 f/s below ~44 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
9090
35.3
3640
8000
5980
5000
5710
4290
5410
14.1
14.2
15.1
14.4
14.7
5940
6060
13.8
1170
1150
1180
1160
1170
0.7
0.5
1190
1170
1060
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
West
East
crest at Sta 280+00
1160 - 1170 air wave
s-wave = 610 f/s
s-wave = 1500 f/s
~2900
3200
4500
s-wave = 910 f/s
s-wave = 2700 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
~5800
s-wave = 1800 f/s below ~39 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4690
7000
2500
28.9
11.4
13.7
2930
13.2
3550
30.2
13.9
20.1
3450
15.5
5440
28.2
15.1
5000
4290
1550
5.9
1170
1170
1160
1160
1130
Time, millisec.
Distance, feet

Refraction Seismic Interpretation

Line 19

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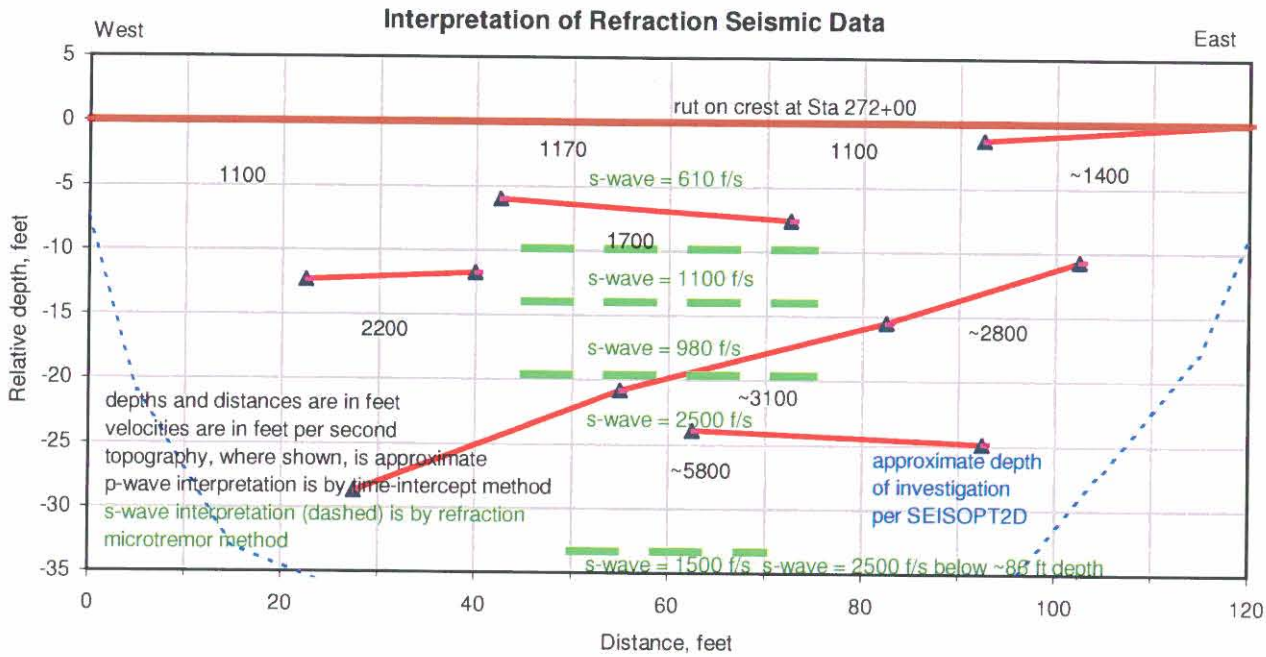
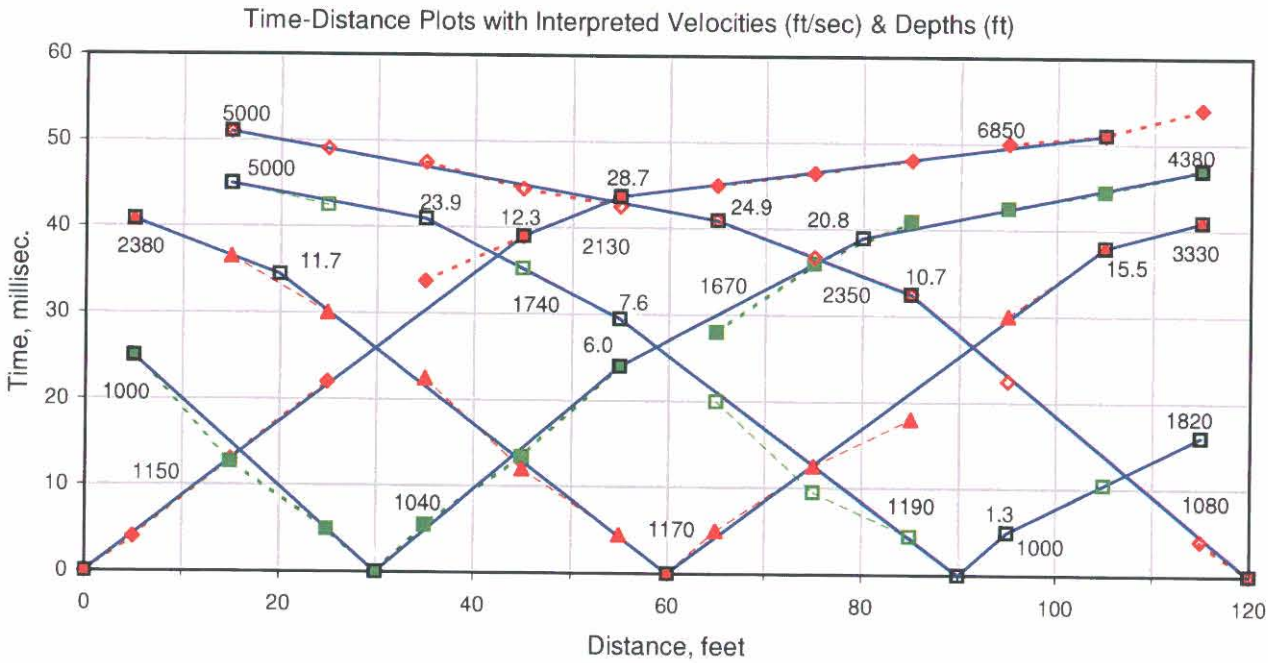
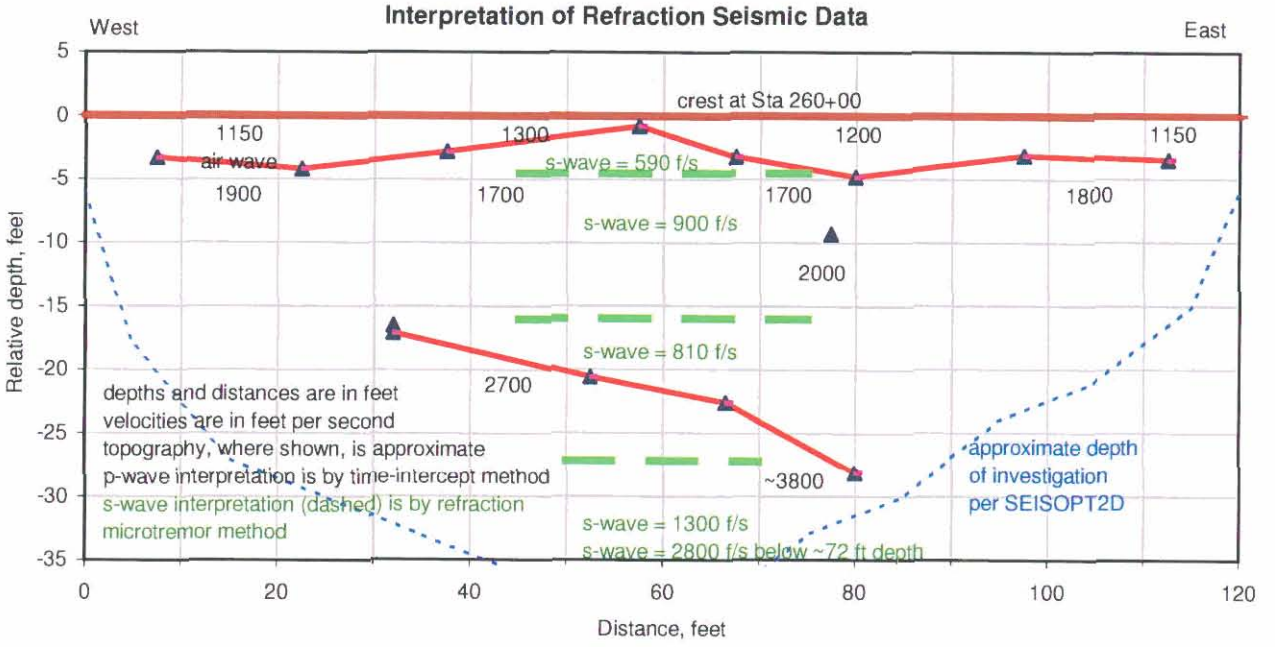
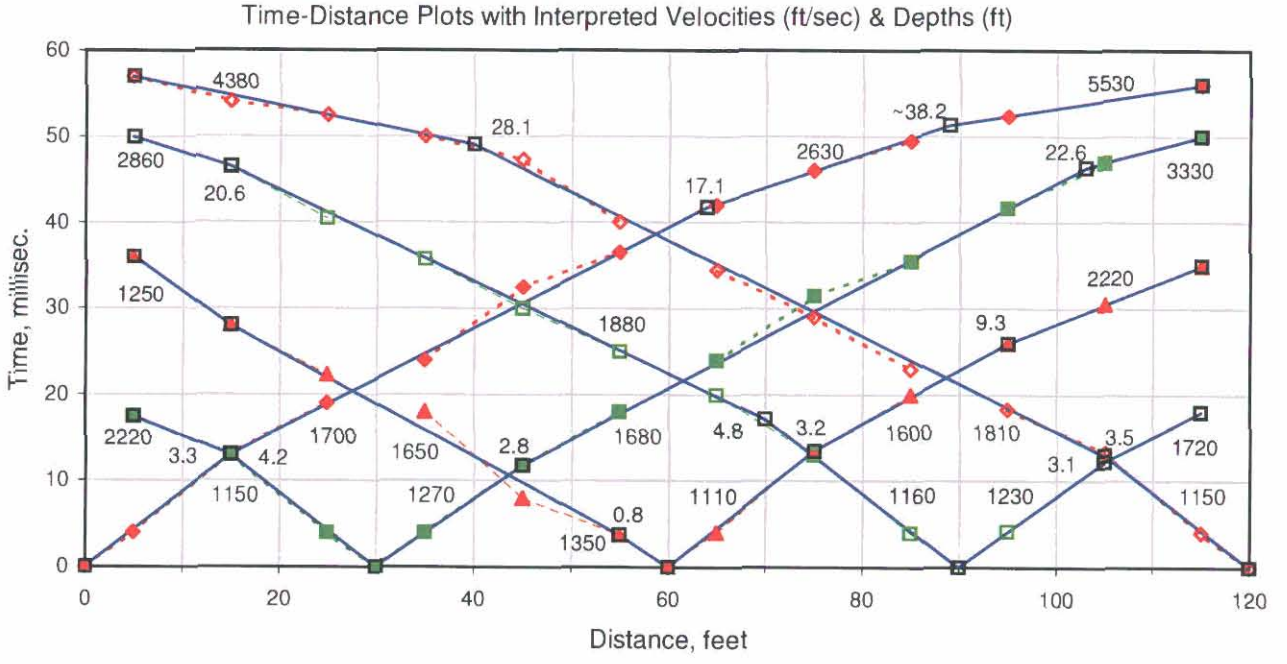




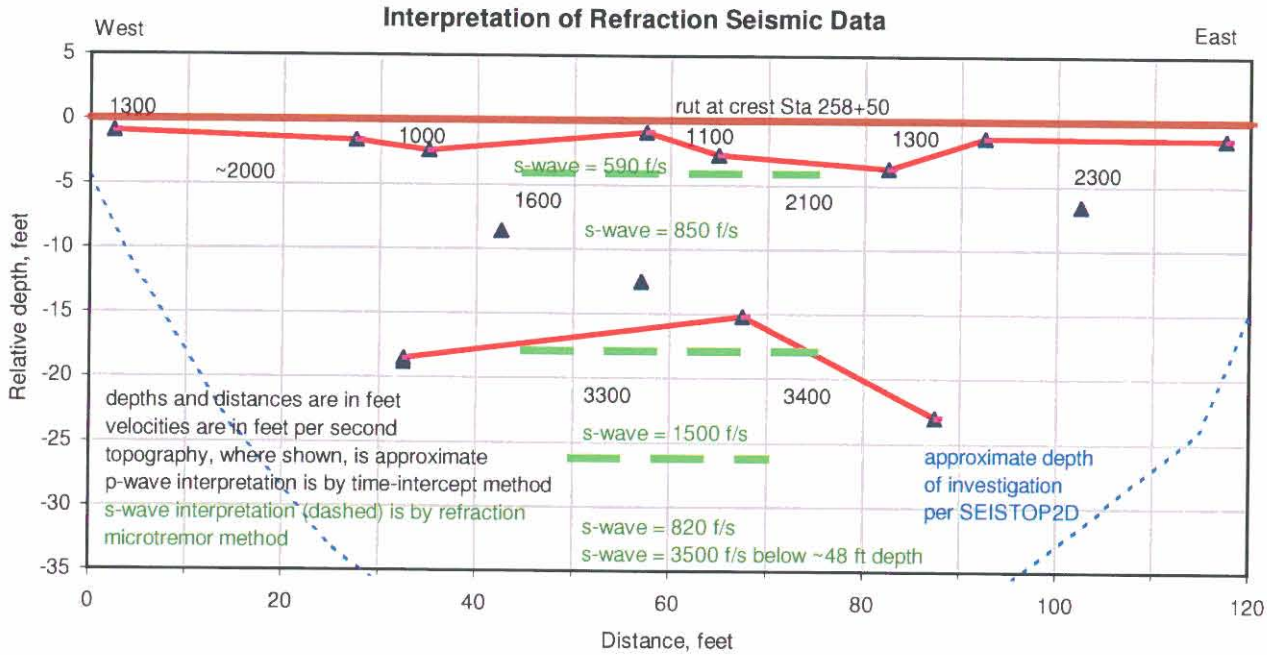

Interpretation of Refraction Seismic Data
West
East
crest at Sta 260+00
1150
air wave
1300
1200
1150
1900
1700
1700
1800
s-wave = 590 f/s
s-wave = 900 f/s
2000
s-wave = 810 f/s
2700
~3800
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1300 f/s
s-wave = 2800 f/s below ~72 ft depth
Relative depth, feet
Distance, feet

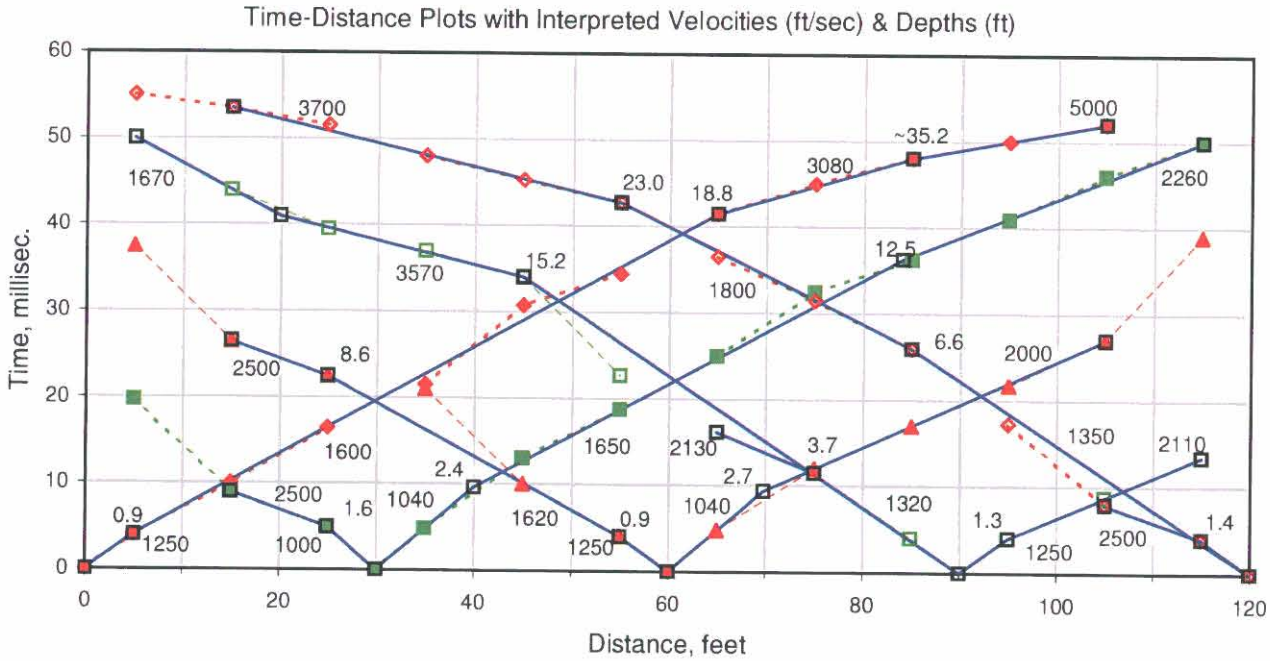

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4380
28.1
~38.2
5530
2860
20.6
2630
22.6
3330
17.1
1250
1880
9.3
2220
2220
3.3
4.2
1700
1650
2.8
1680
4.8
3.2
1600
1810
3.5
1720
3.1
1150
1270
0.8
1350
1110
1160
1230
1150
Time, millisec.
Distance, feet

Refraction Seismic Interpretation

Line 21

AMEC Job No. 6-117-001025

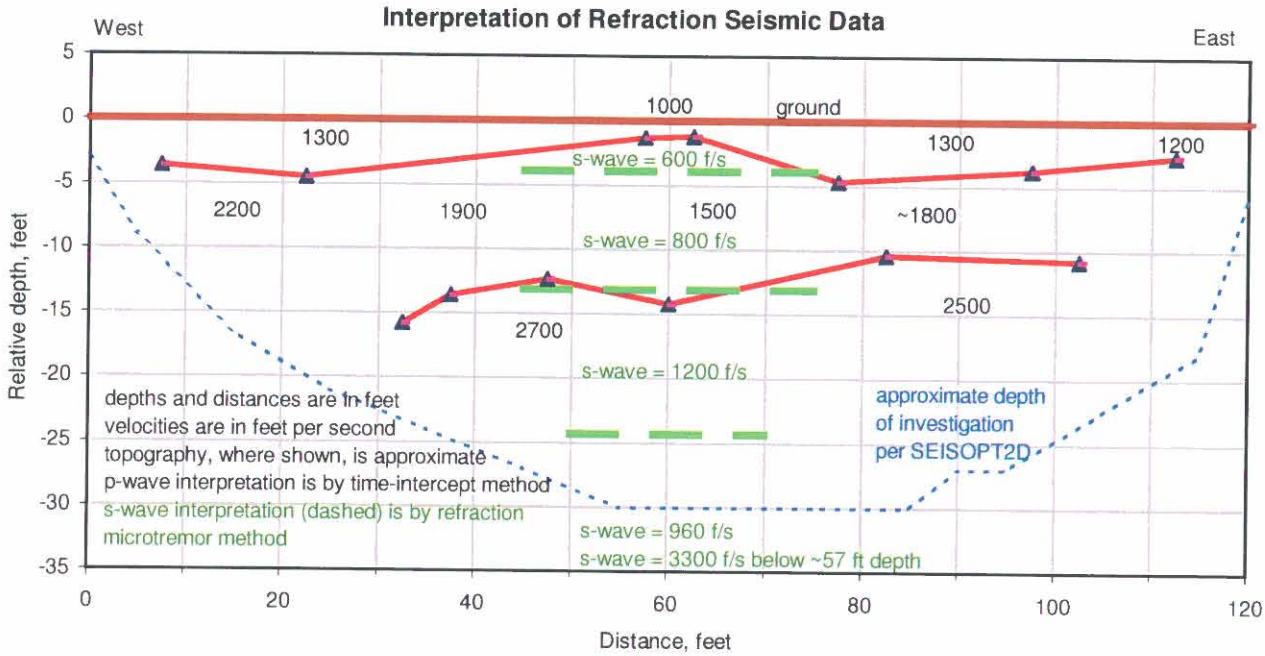


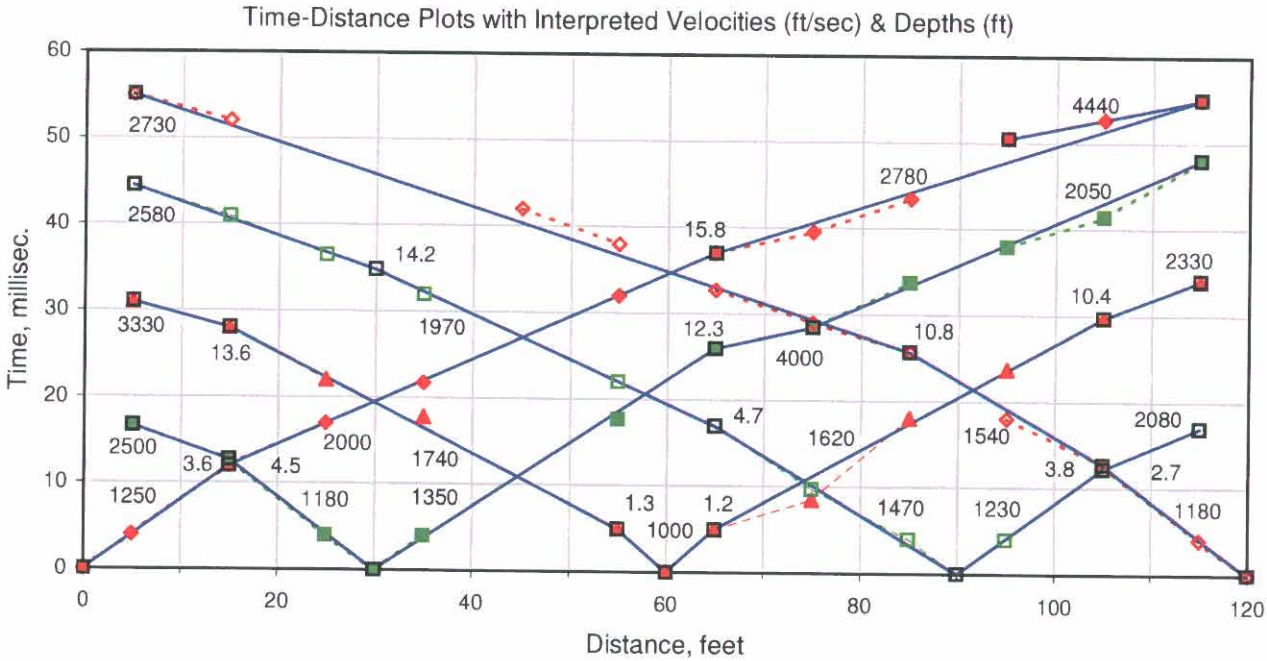


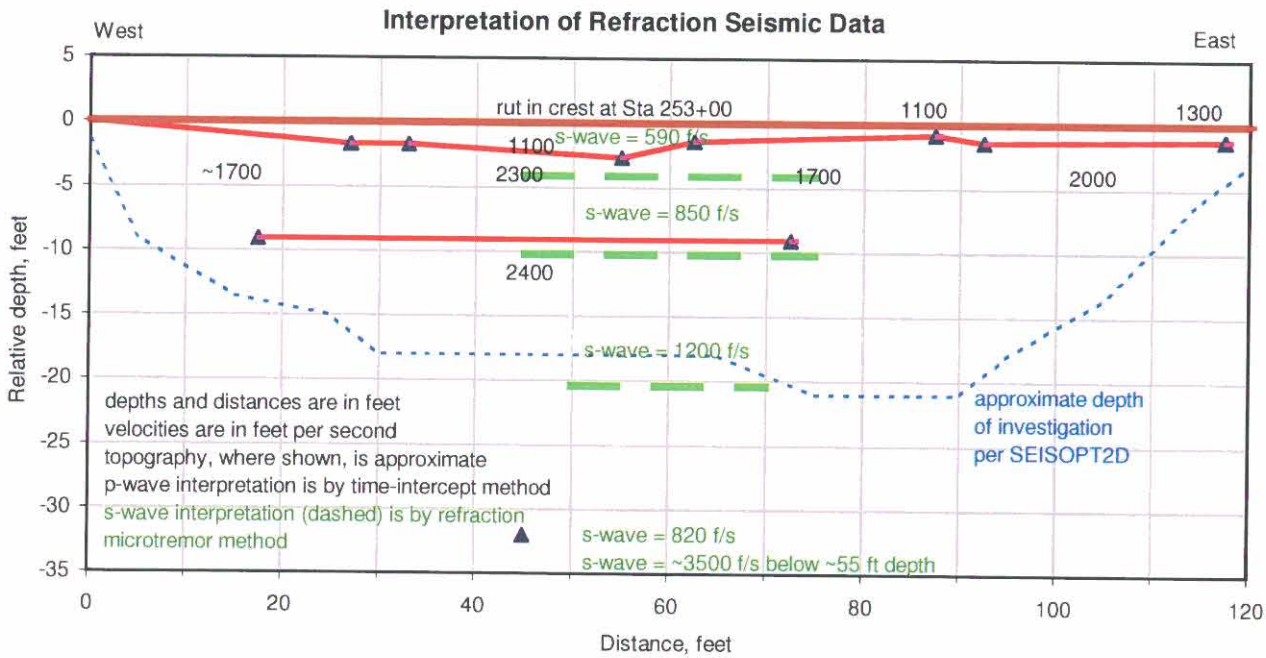
Refraction Seismic Interpretation

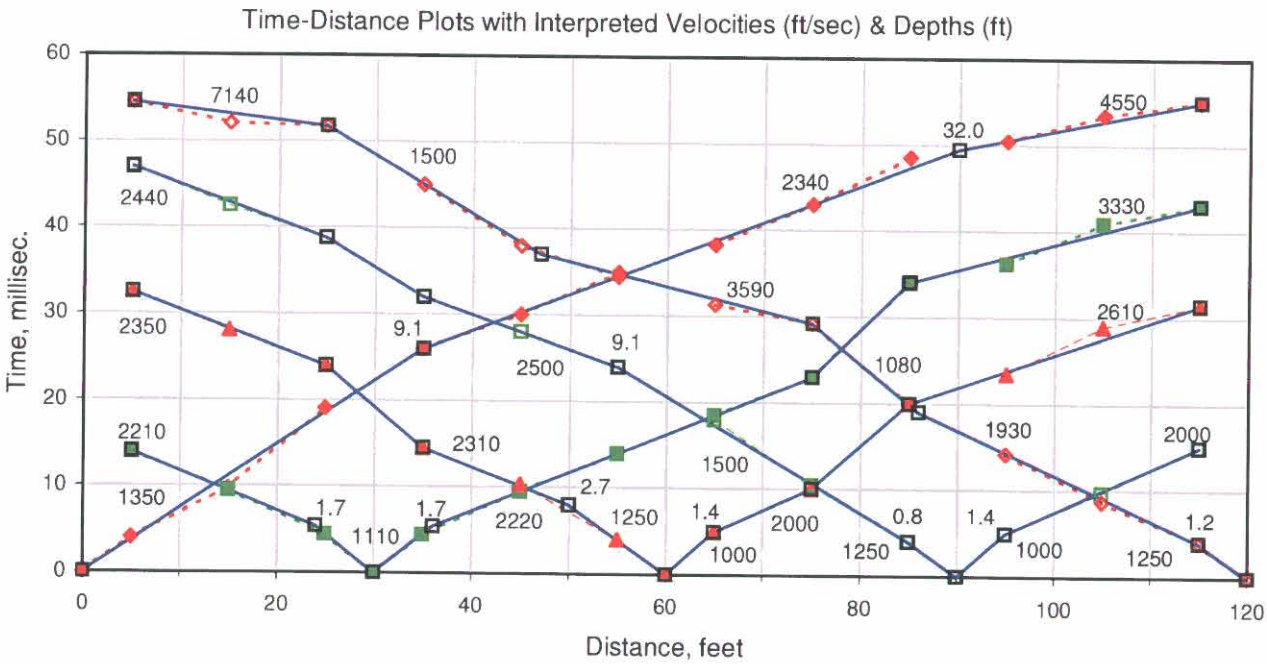
Line 22

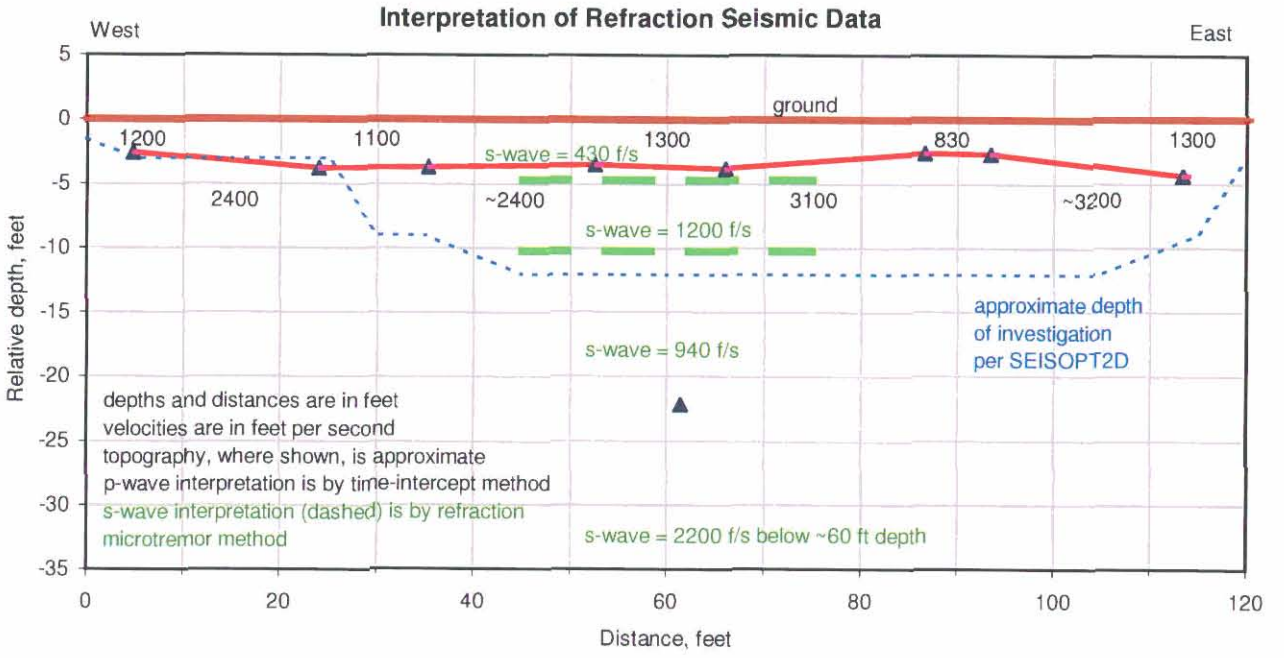
AMEC Job No. 6-117-001025

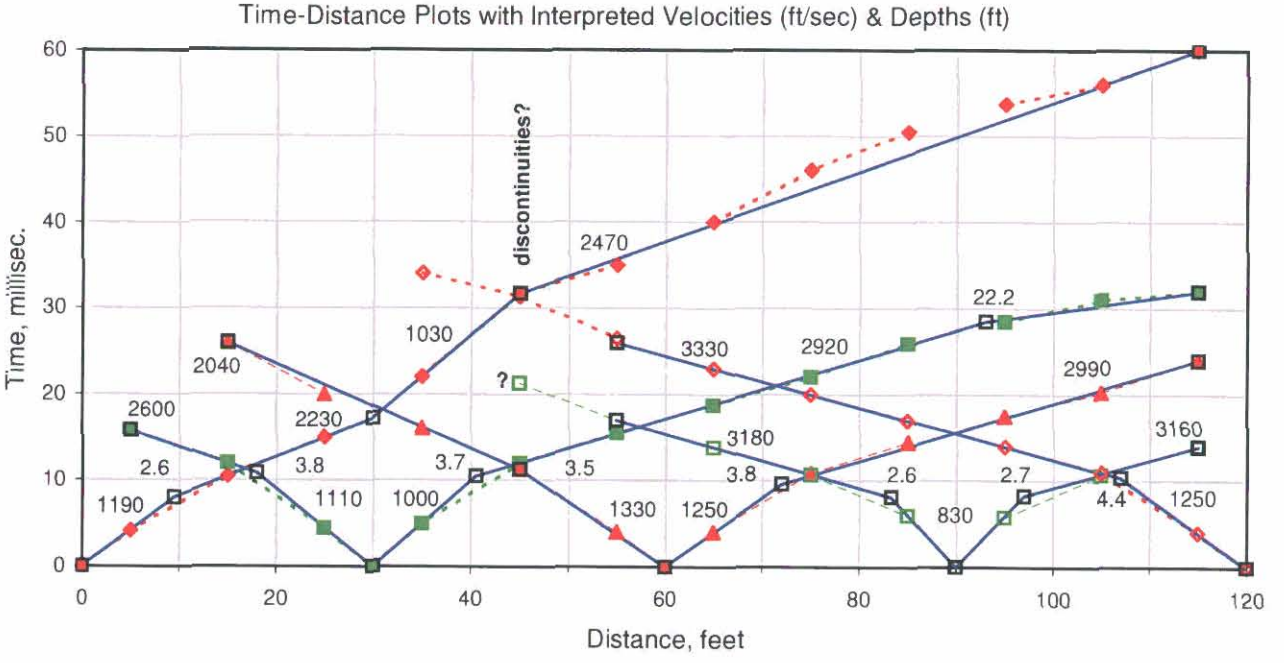


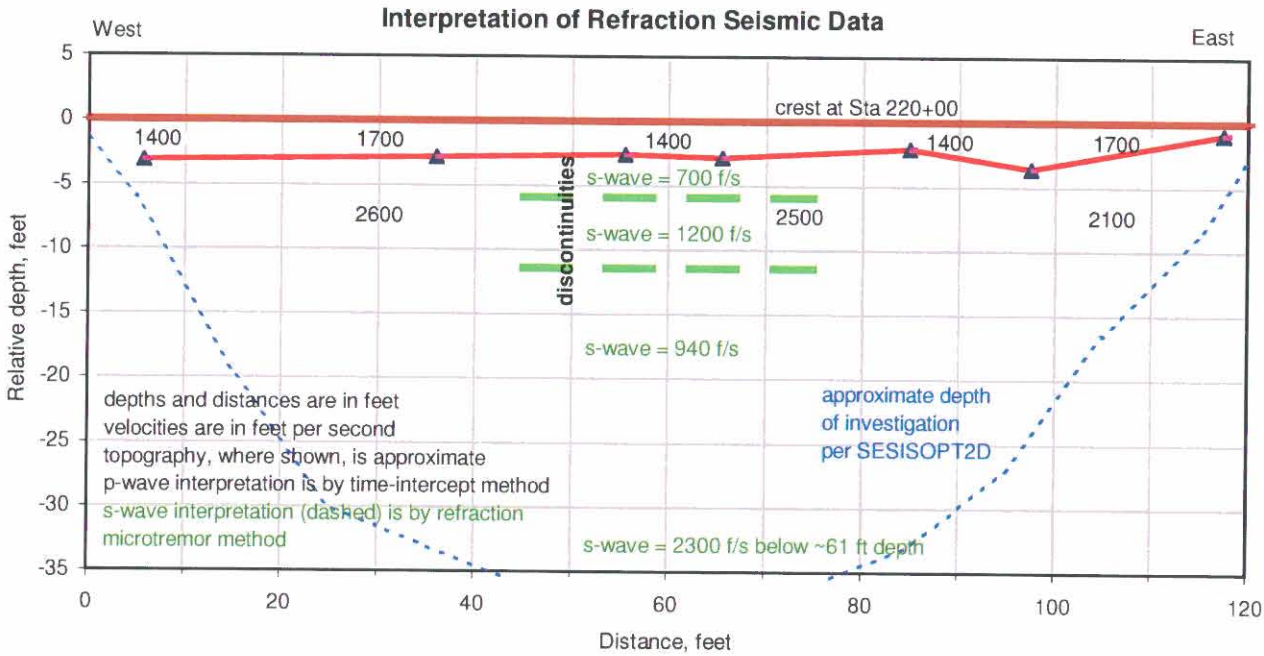


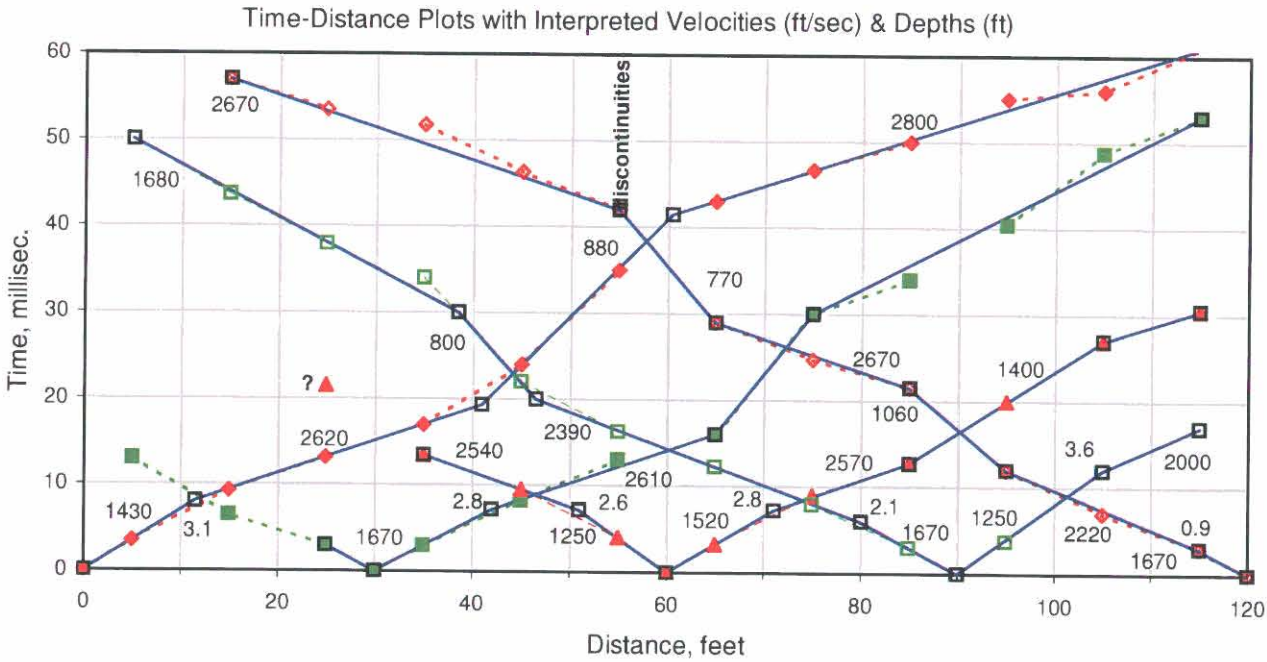

Interpretation of Refraction Seismic Data
West
East
rut in crest at Sta 253+00
1100
1300
1100
s-wave = 590 f/s
~1700
2300
1700
2000
s-wave = 850 f/s
2400
s-wave = 1200 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 820 f/s
s-wave = ~3500 f/s below ~55 ft depth
Relative depth, feet
Distance, feet

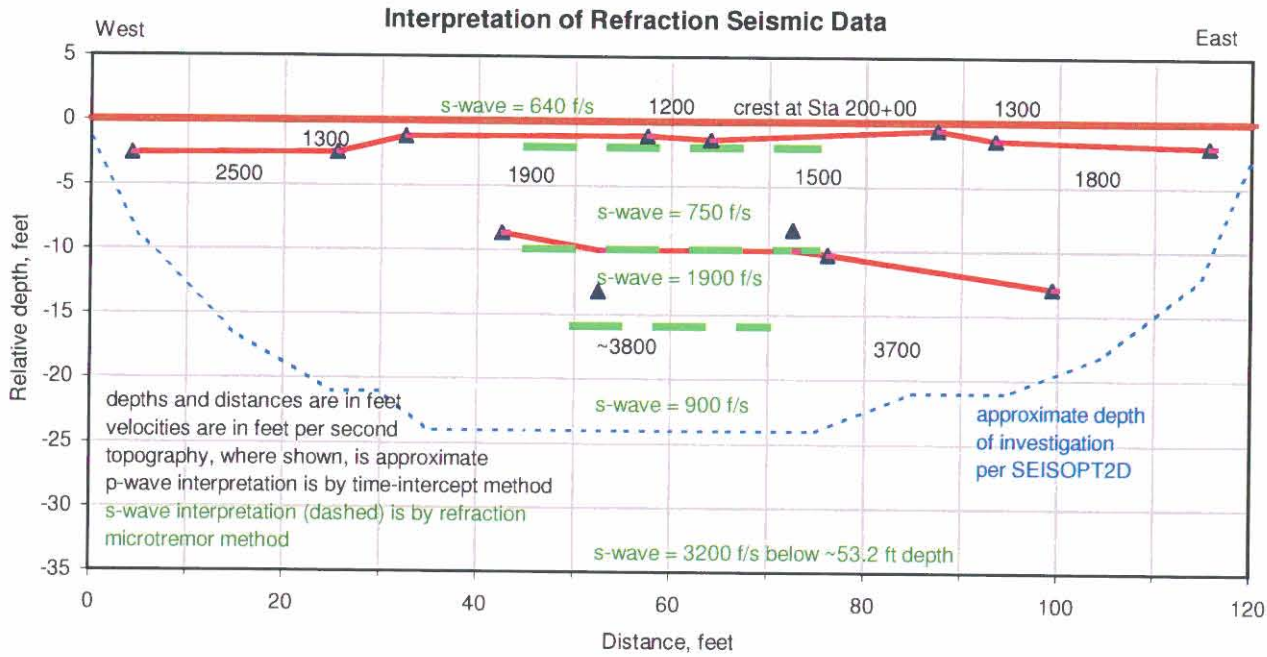

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
7140
1500
2440
2340
32.0
4550
3330
3590
2350
9.1
2500
9.1
1080
2610
2210
2310
1930
2000
1500
1350
1.7
1110
1.7
2220
2.7
1250
1.4
1000
2000
1250
0.8
1.4
1000
1250
1.2
Time, millisec.
Distance, feet

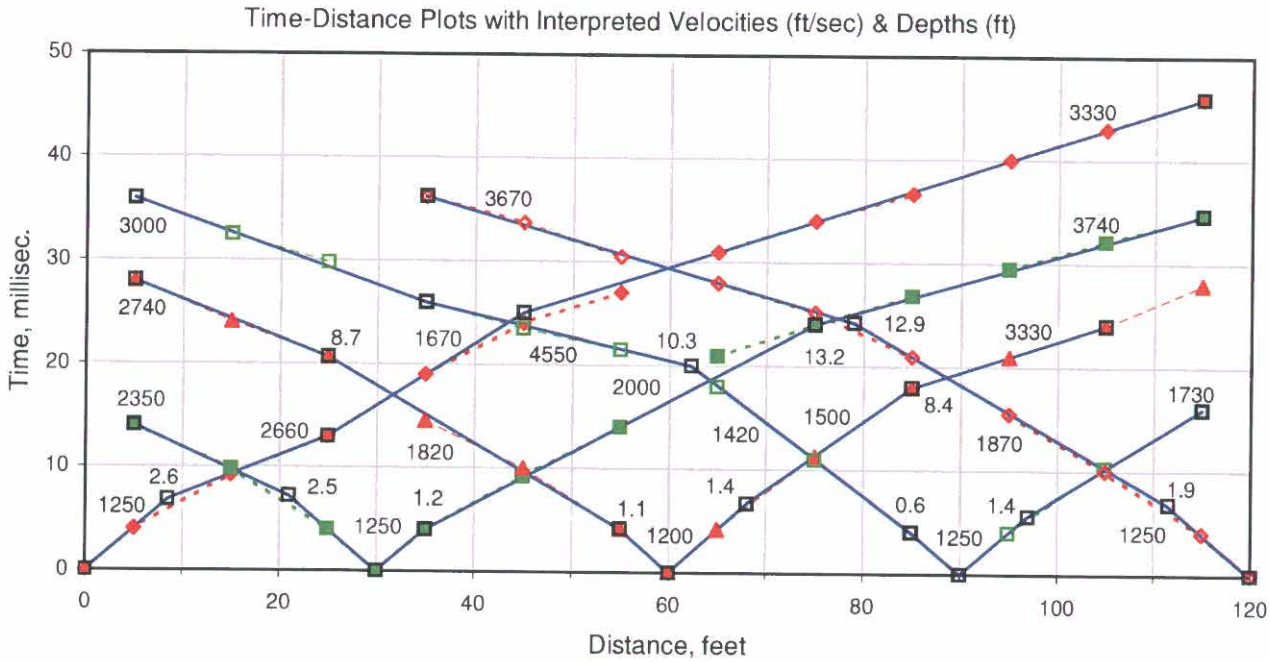

Interpretation of Refraction Seismic Data
West
East
ground
1200
1100
1300
830
1300
2400
~2400
3100
~3200
s-wave = 430 f/s
s-wave = 1200 f/s
s-wave = 940 f/s
s-wave = 2200 f/s below ~60 ft depth
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet

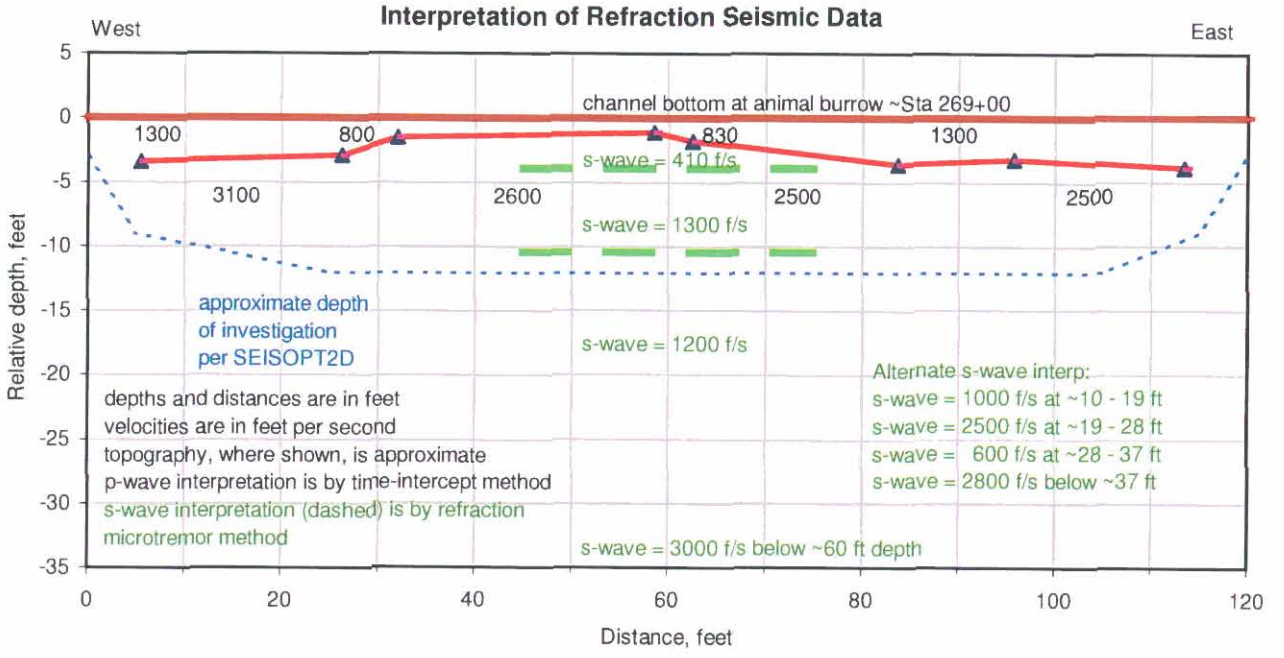

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
discontinuities?
2470
1030
2040
2600
2230
3330
2920
22.2
2990
3160
3180
?
2.6
3.8
3.7
3.5
3.8
2.6
2.7
4.4
1190
1110
1000
1330
1250
830
1250
Time, millisec.
Distance, feet

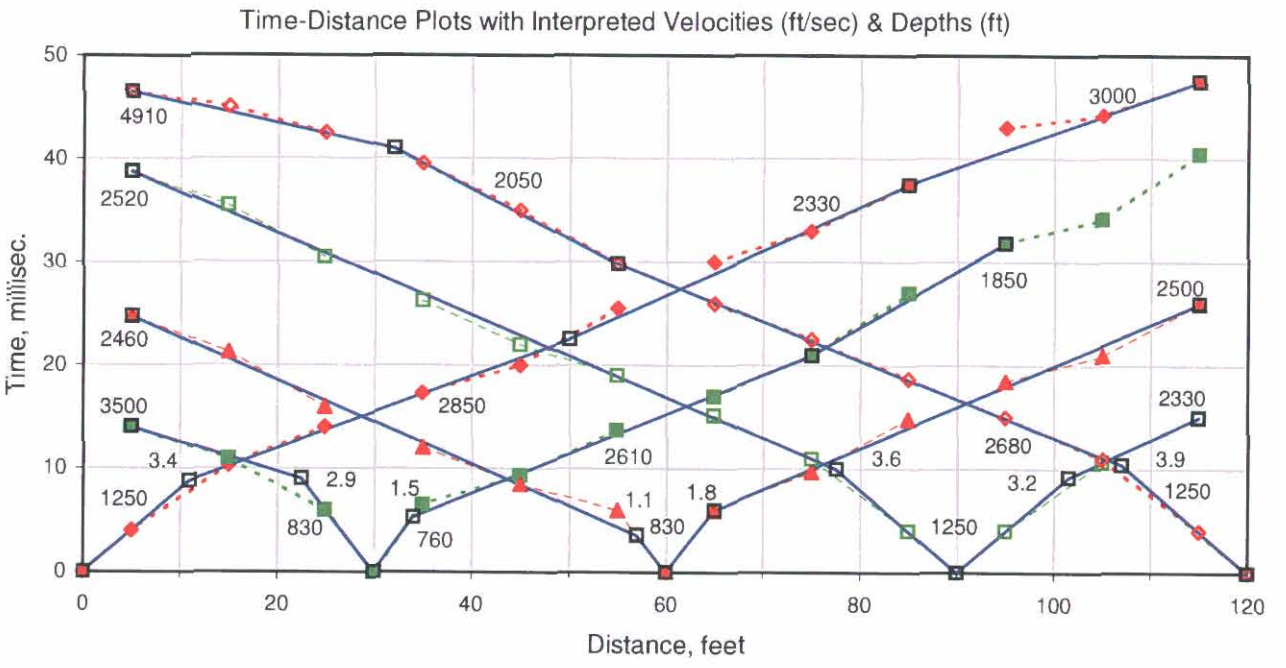

Interpretation of Refraction Seismic Data
West
East
crest at Sta 220+00
1400
1700
1400
1400
1700
2600
2500
2100
discontinuities
s-wave = 700 f/s
s-wave = 1200 f/s
s-wave = 940 f/s
s-wave = 2300 f/s below ~61 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SESISOPT2D
Relative depth, feet
Distance, feet

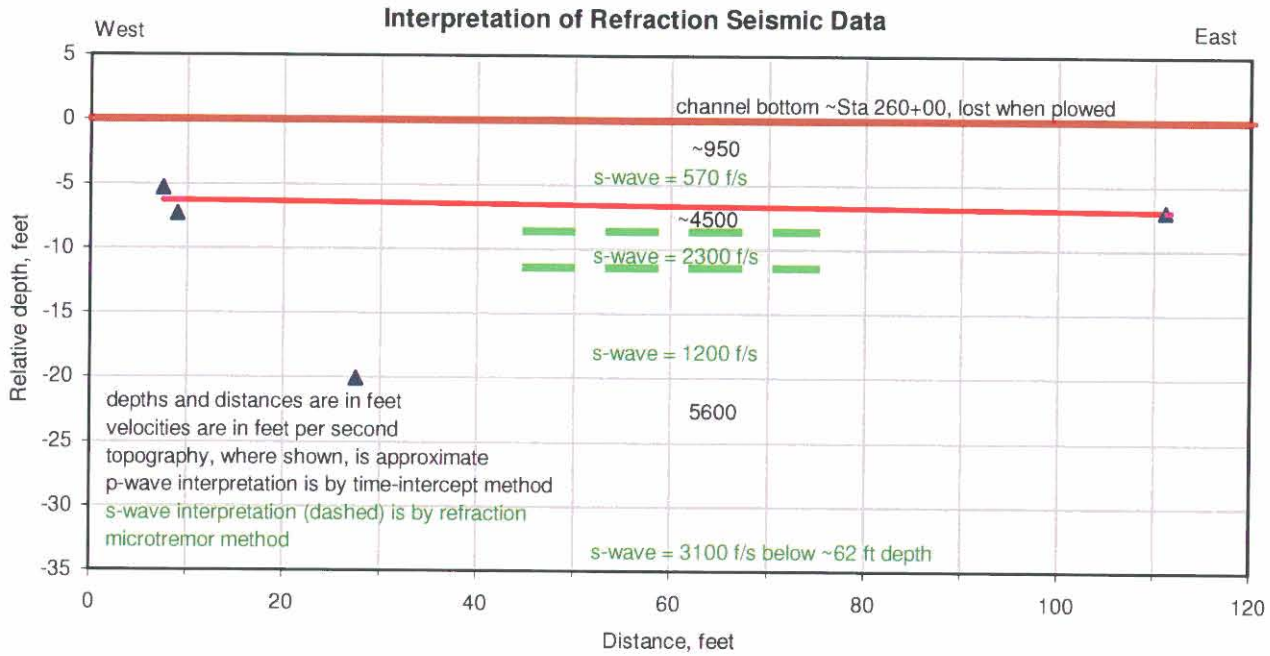

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
discontinuities
2670
1680
880
770
2800
800
2670
1400
1060
?
2620
2540
2390
2610
2570
3.6
2000
1430
3.1
1670
2.8
2.6
1250
1520
2.8
2.1
1670
1250
2220
0.9
1670

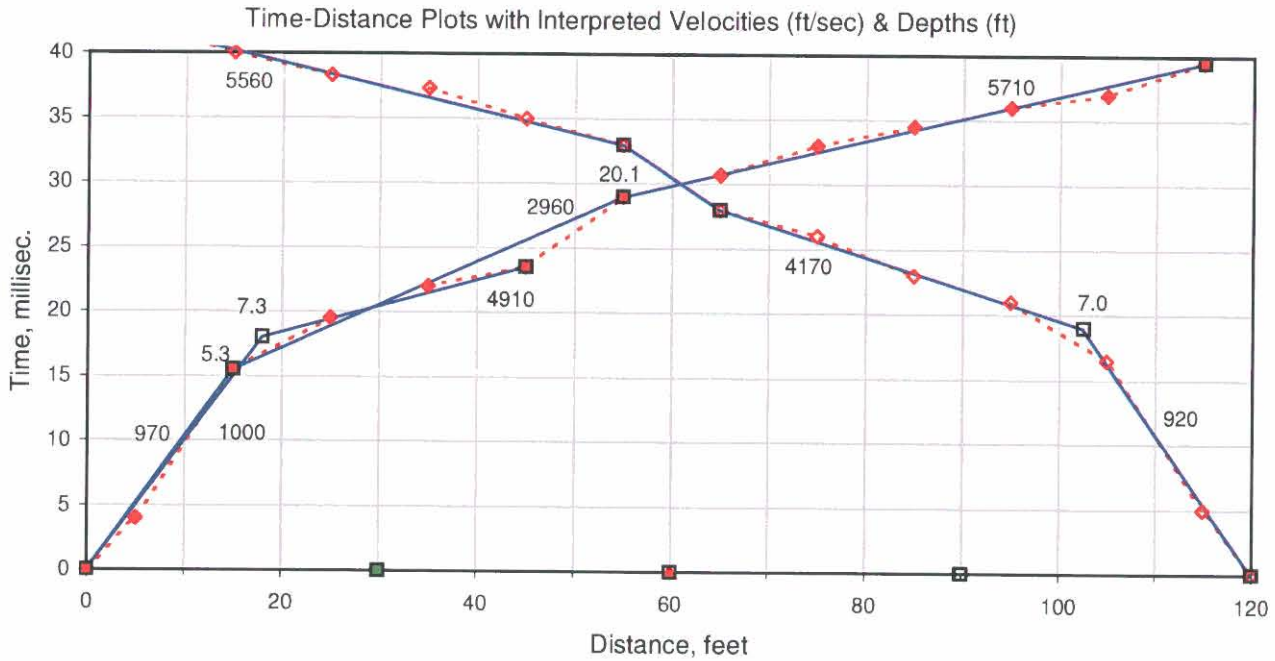

Interpretation of Refraction Seismic Data
West
East
s-wave = 640 f/s
1200
crest at Sta 200+00
1300
1300
2500
1900
1500
1800
s-wave = 750 f/s
s-wave = 1900 f/s
~3800
3700
s-wave = 900 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 3200 f/s below ~53.2 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3330
3670
3000
3740
2740
8.7
1670
4550
10.3
12.9
3330
13.2
2350
2000
8.4
1730
2660
1500
1420
1870
1820
2.6
2.5
1.2
1.4
1.9
1250
1250
1.1
1200
0.6
1250
1.4
1250
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
West
East
channel bottom at animal burrow ~Sta 269+00
1300
800
830
1300
3100
2600
2500
2500
s-wave = 410 f/s
s-wave = 1300 f/s
s-wave = 1200 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
Alternate s-wave interp:
s-wave = 1000 f/s at ~10 - 19 ft
s-wave = 2500 f/s at ~19 - 28 ft
s-wave = 600 f/s at ~28 - 37 ft
s-wave = 2800 f/s below ~37 ft
s-wave = 3000 f/s below ~60 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4910
2520
2460
3500
1250
3.4
830
2.9
1.5
760
2850
2610
1.1
830
1.8
2050
2330
1250
3.6
2680
3.2
1850
3000
2500
2330
3.9
1250
Time, millisec.
Distance, feet

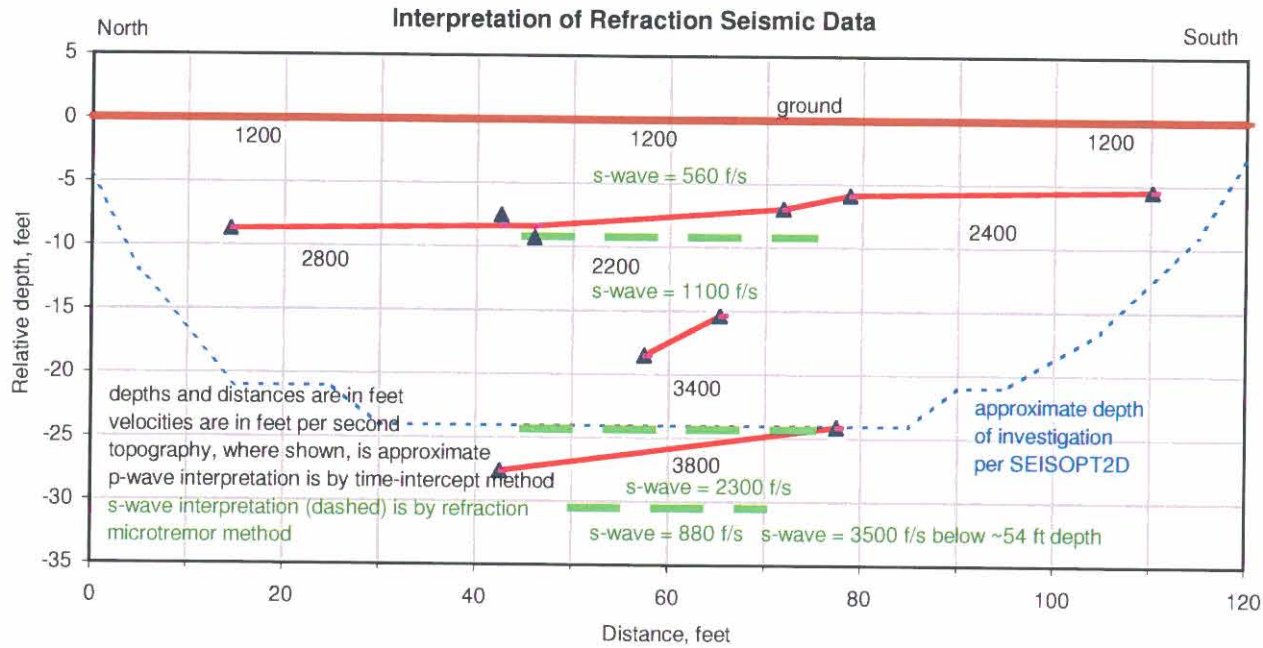

Interpretation of Refraction Seismic Data
West
East
channel bottom ~Sta 260+00, lost when plowed
~950
s-wave = 570 f/s
~4500
s-wave = 2300 f/s
s-wave = 1200 f/s
5600
s-wave = 3100 f/s below ~62 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet

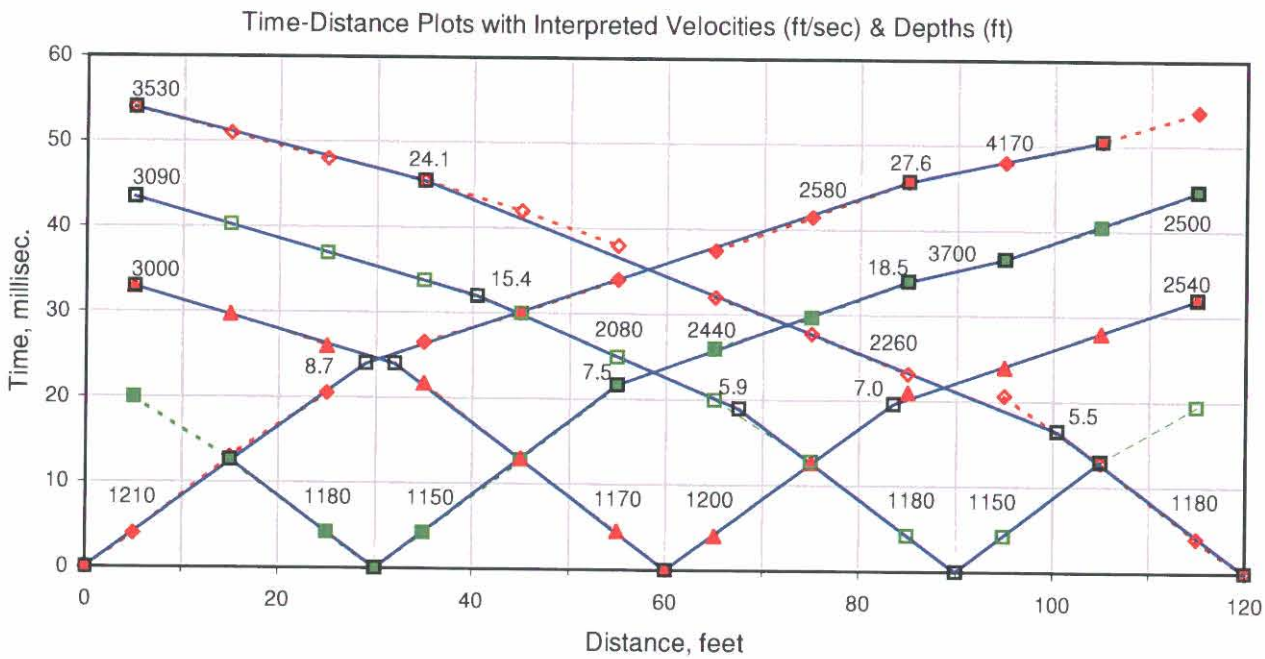

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
5560
5710
20.1
2960
4170
7.3
4910
7.0
5.3
970
1000
920
Time, millisec.
Distance, feet

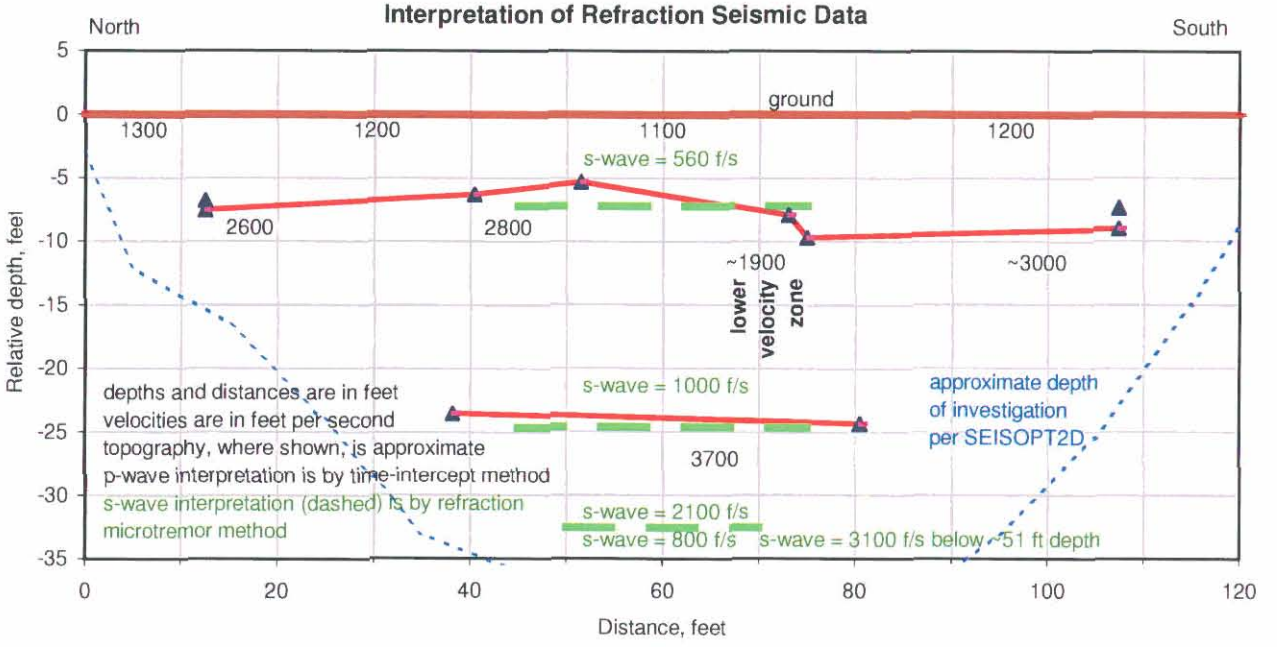
Refraction Seismic Interpretation

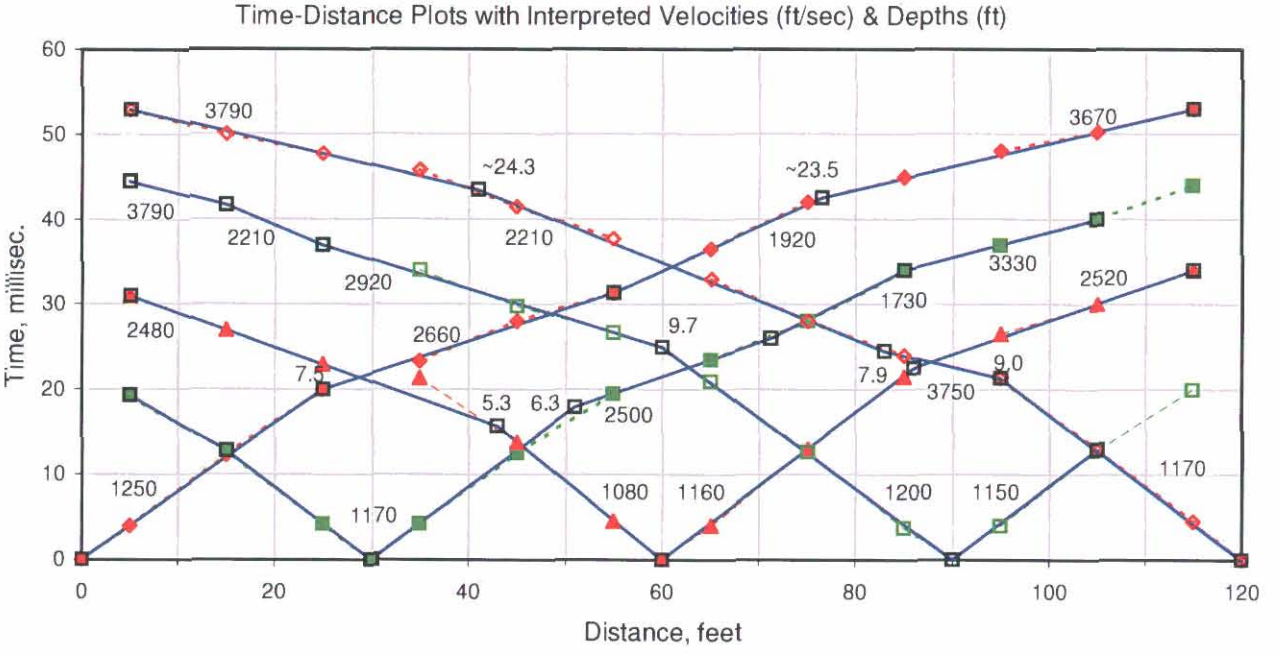
Line 29

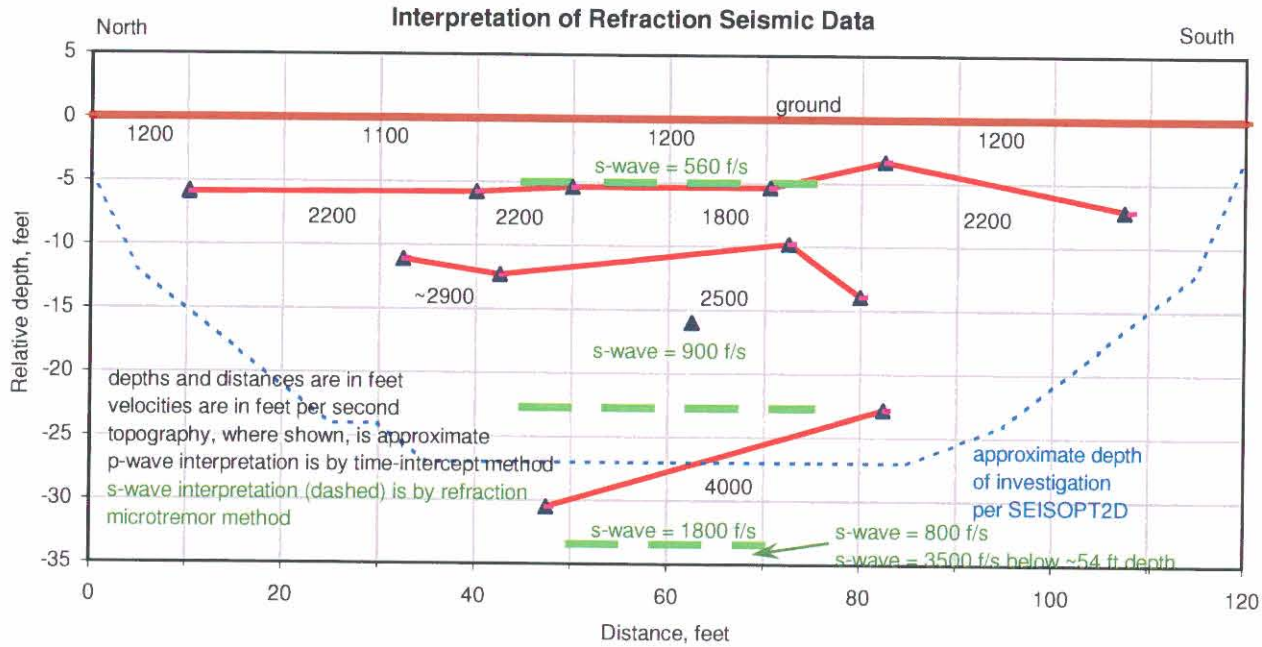
AMEC Job No. 6-117-001025

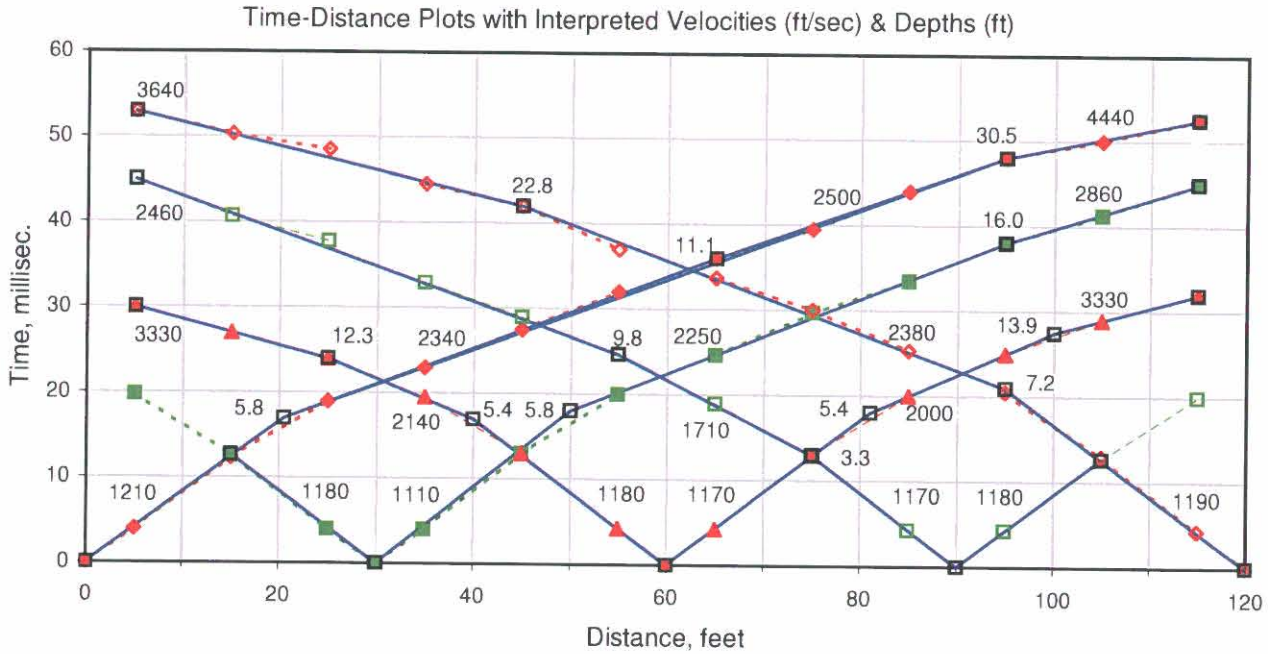


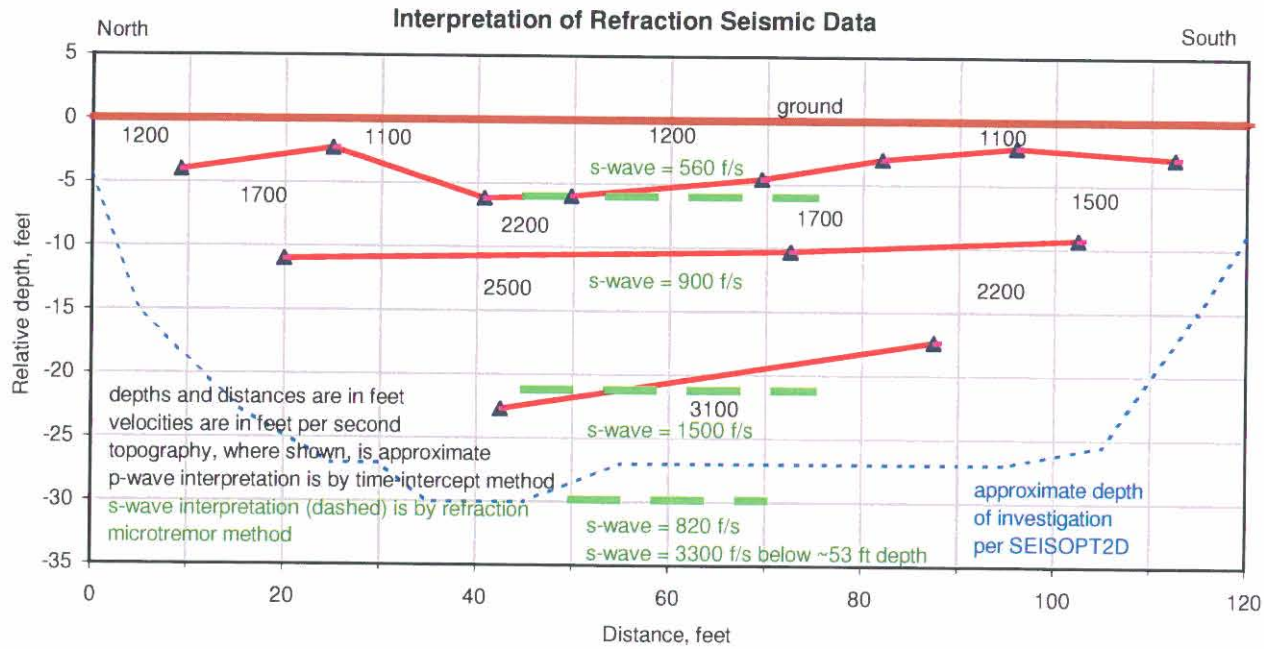


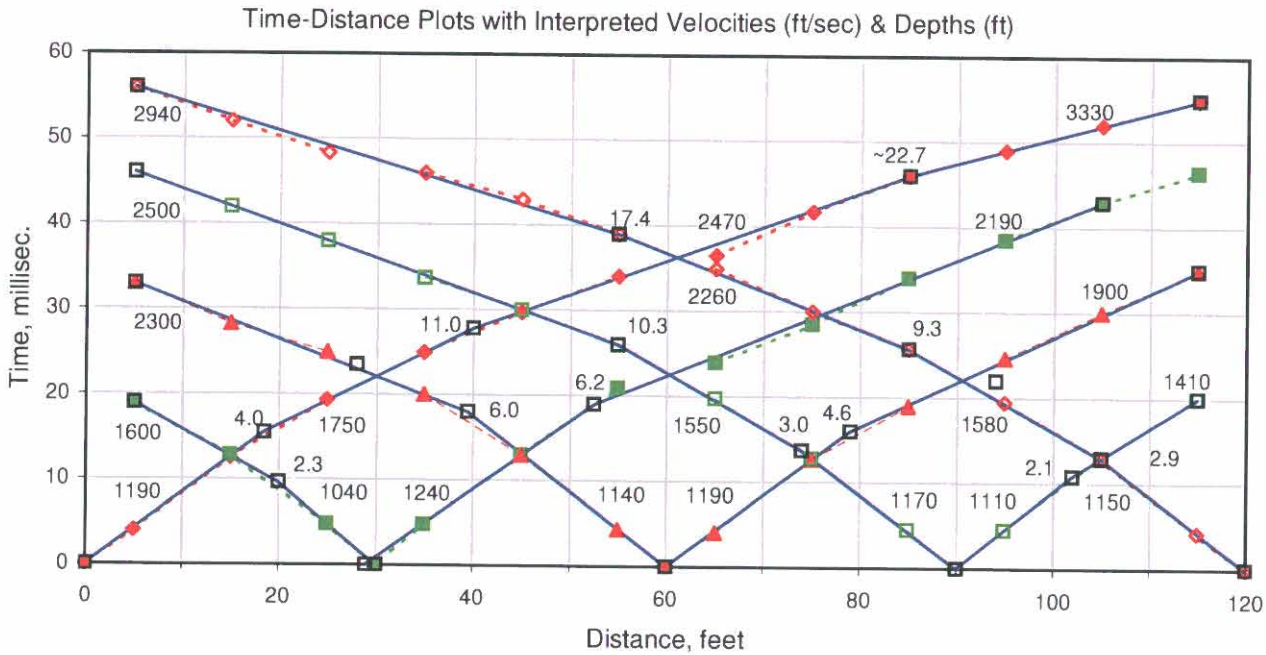

Interpretation of Refraction Seismic Data
North
South
ground
1300
1200
1100
1200
s-wave = 560 f/s
2600
2800
~1900
~3000
lower velocity zone
s-wave = 1000 f/s
3700
s-wave = 2100 f/s
s-wave = 800 f/s
s-wave = 3100 f/s below ~51 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

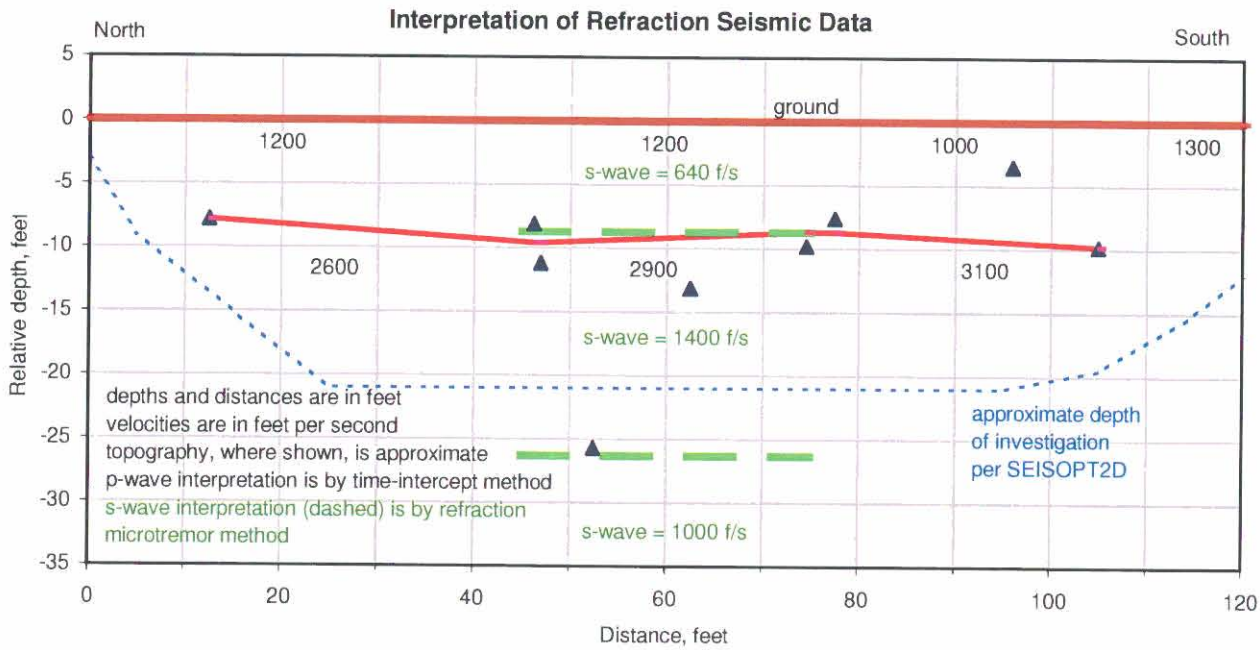

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3790
~24.3
~23.5
3670
3790
2210
2210
1920
2920
3330
2520
2480
2660
9.7
1730
7.5
7.9
9.0
5.3
6.3
2500
3750
1250
1170
1080
1160
1200
1150
1170
Time, millisec.
Distance, feet

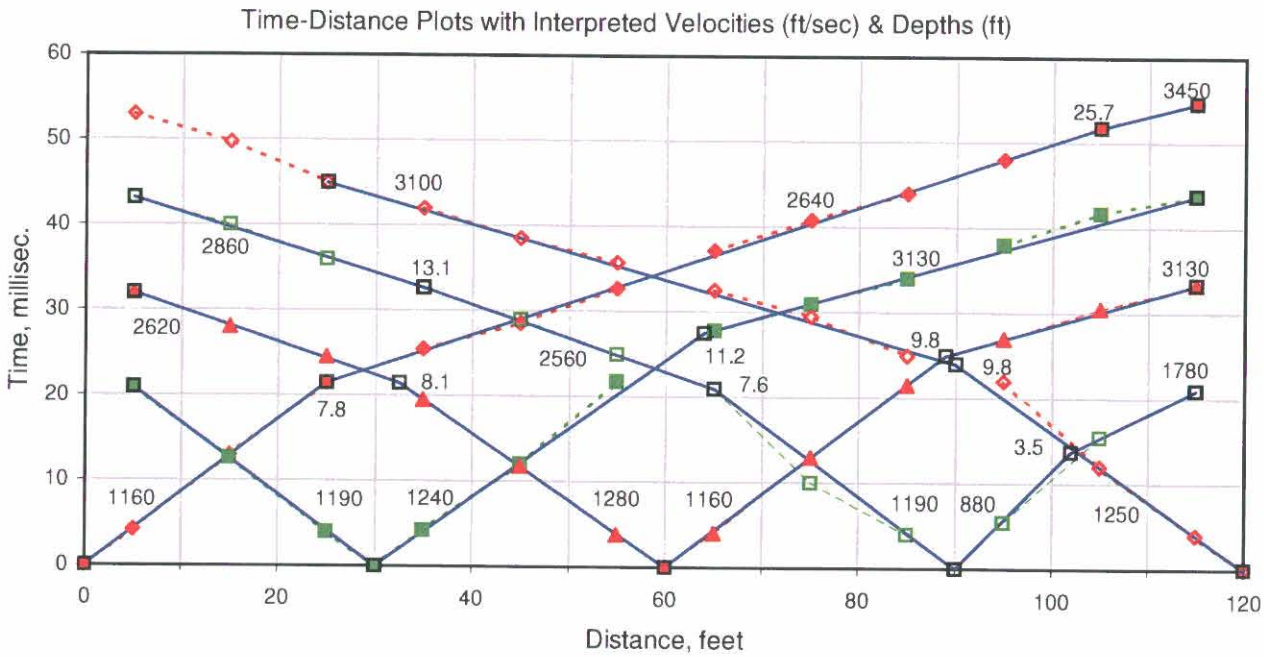

Interpretation of Refraction Seismic Data
North
South
ground
1200
1100
1200
1200
s-wave = 560 f/s
2200
2200
1800
2200
~2900
2500
s-wave = 900 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
4000
approximate depth of investigation per SEISOPT2D
s-wave = 1800 f/s
s-wave = 800 f/s
s-wave = 3500 f/s below ~54 ft depth
Relative depth, feet
Distance, feet

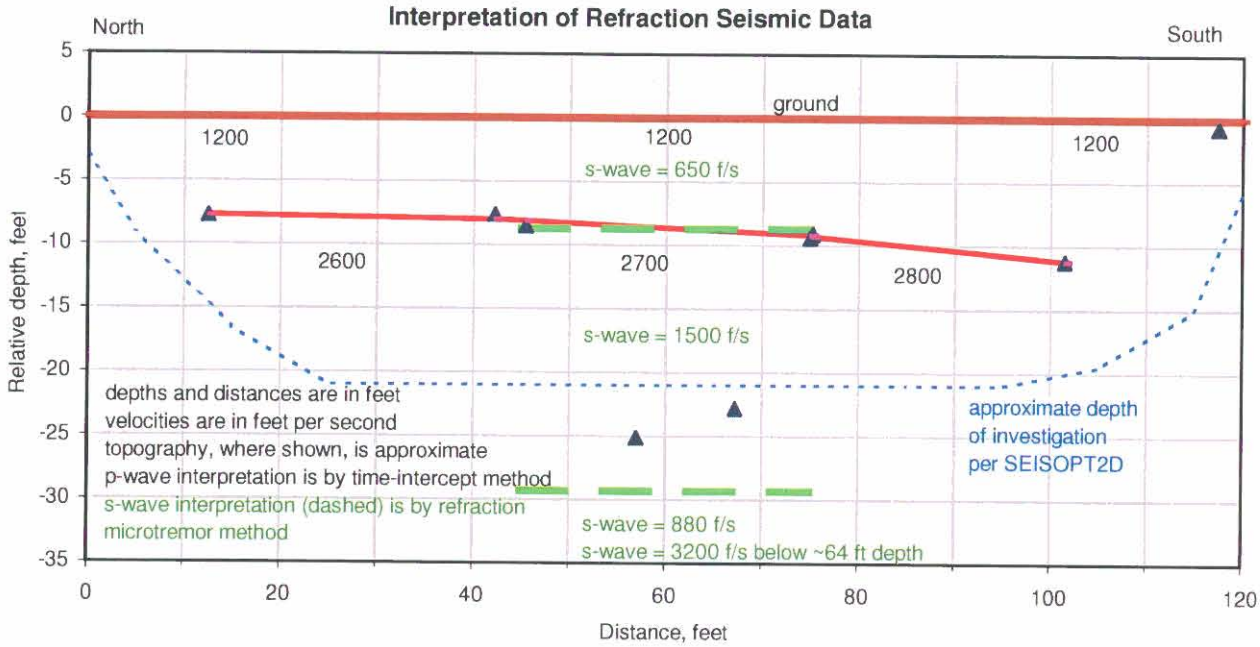

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3640
4440
30.5
22.8
2500
2860
2460
16.0
11.1
3330
3330
12.3
2340
9.8
2250
2380
13.9
7.2
5.8
2140
5.4
5.8
1710
5.4
2000
3.3
1210
1180
1110
1180
1170
1170
1180
1190
Time, millisec.
Distance, feet

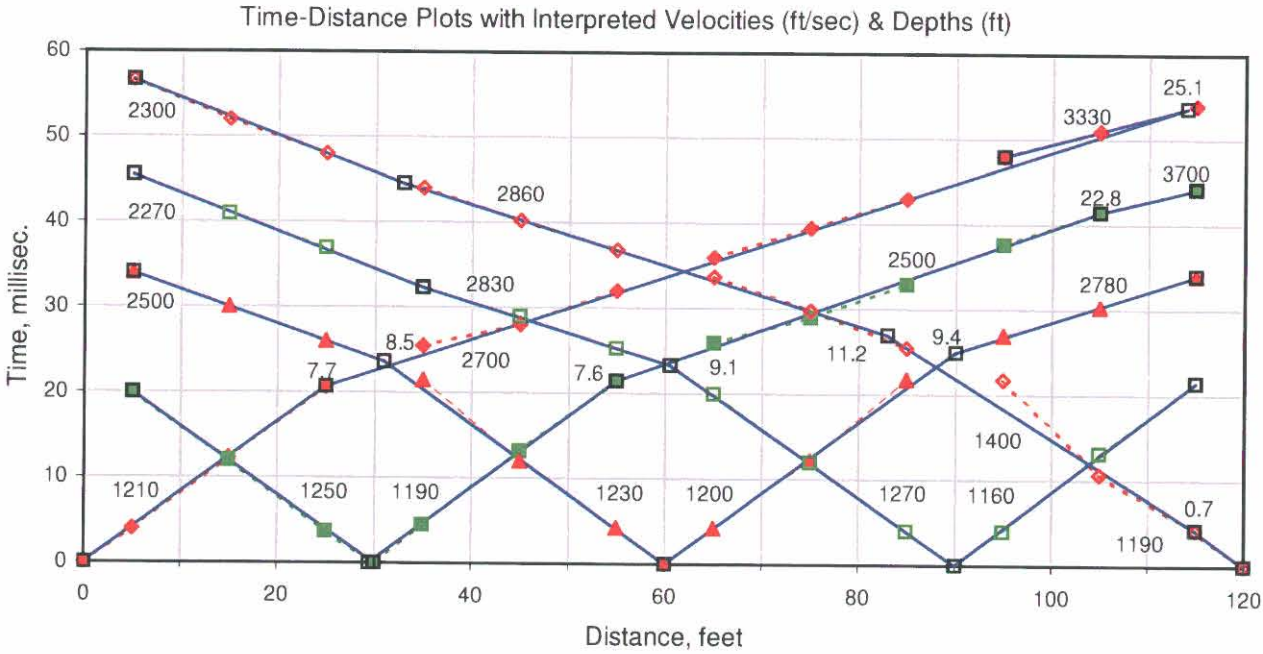

Interpretation of Refraction Seismic Data
North
South
ground
1200
1100
1200
1100
1700
2200
1700
1500
2500
2200
3100
s-wave = 560 f/s
s-wave = 900 f/s
s-wave = 1500 f/s
s-wave = 820 f/s
s-wave = 3300 f/s below ~53 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

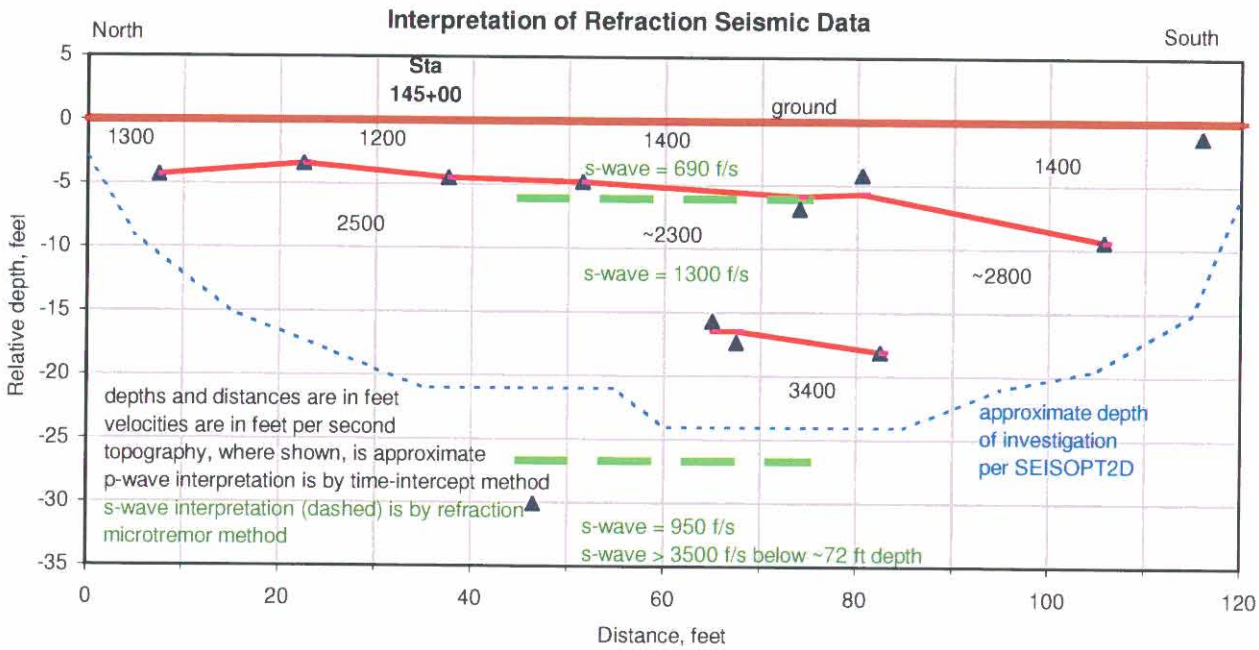

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2940
2500
2300
1600
1190
4.0
1750
2.3
1040
1240
11.0
6.0
17.4
10.3
6.2
1140
2470
2260
1550
1190
3.0
4.6
~22.7
9.3
1170
3330
2190
1580
1110
1900
2.1
1410
2.9
1150
Time, millisec.
Distance, feet

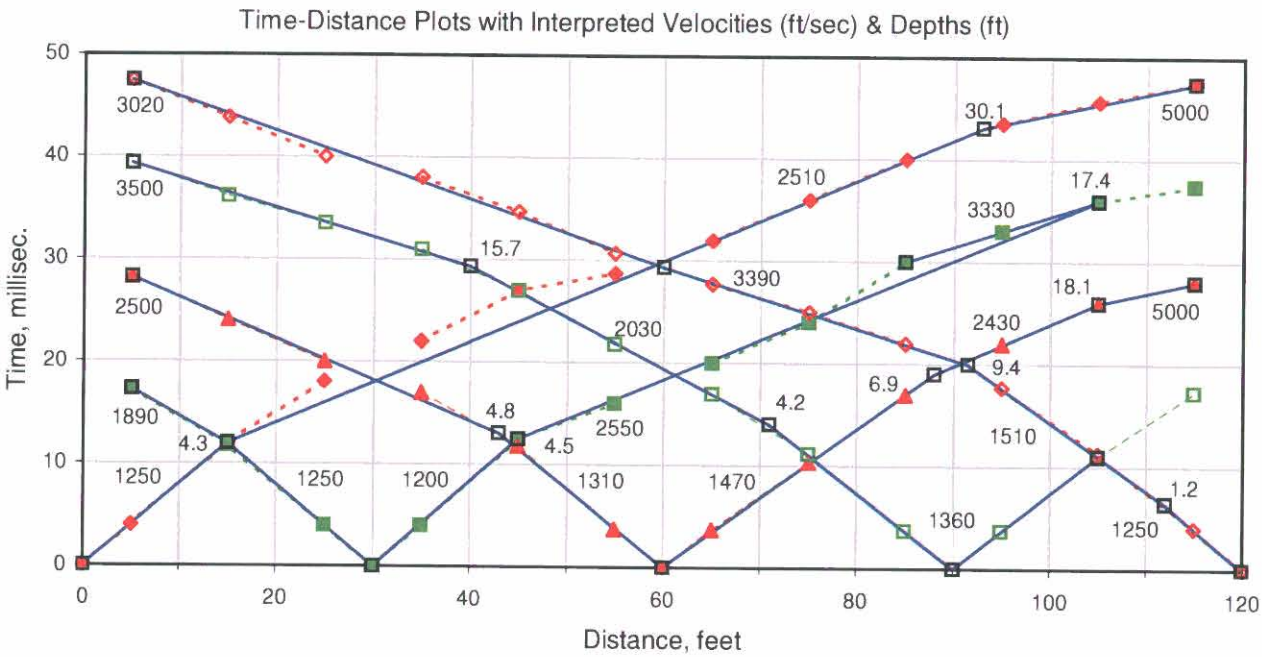

Interpretation of Refraction Seismic Data
North
South
ground
1200
1200
1000
1300
s-wave = 640 f/s
2600
2900
3100
s-wave = 1400 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 1000 f/s
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

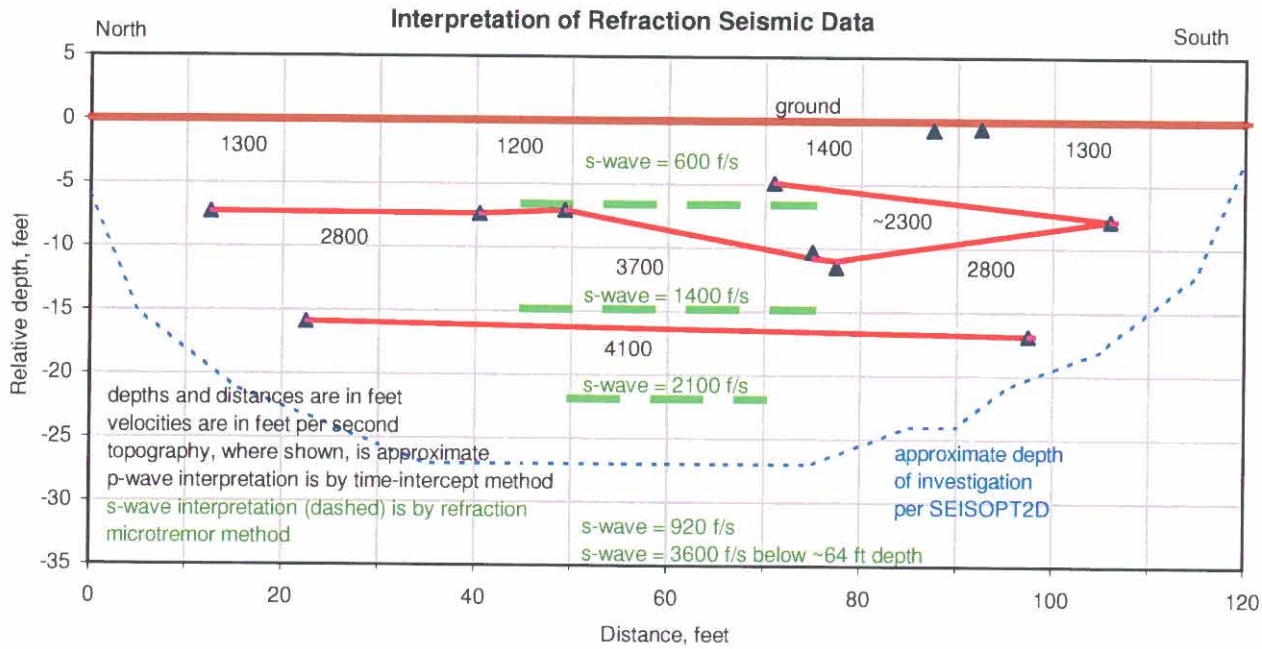

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3450
25.7
3100
2640
2860
13.1
3130
3130
2620
2560
11.2
9.8
9.8
8.1
7.6
1780
7.8
3.5
1160
1190
1240
1280
1160
1190
880
1250
Time, millisec.
Distance, feet

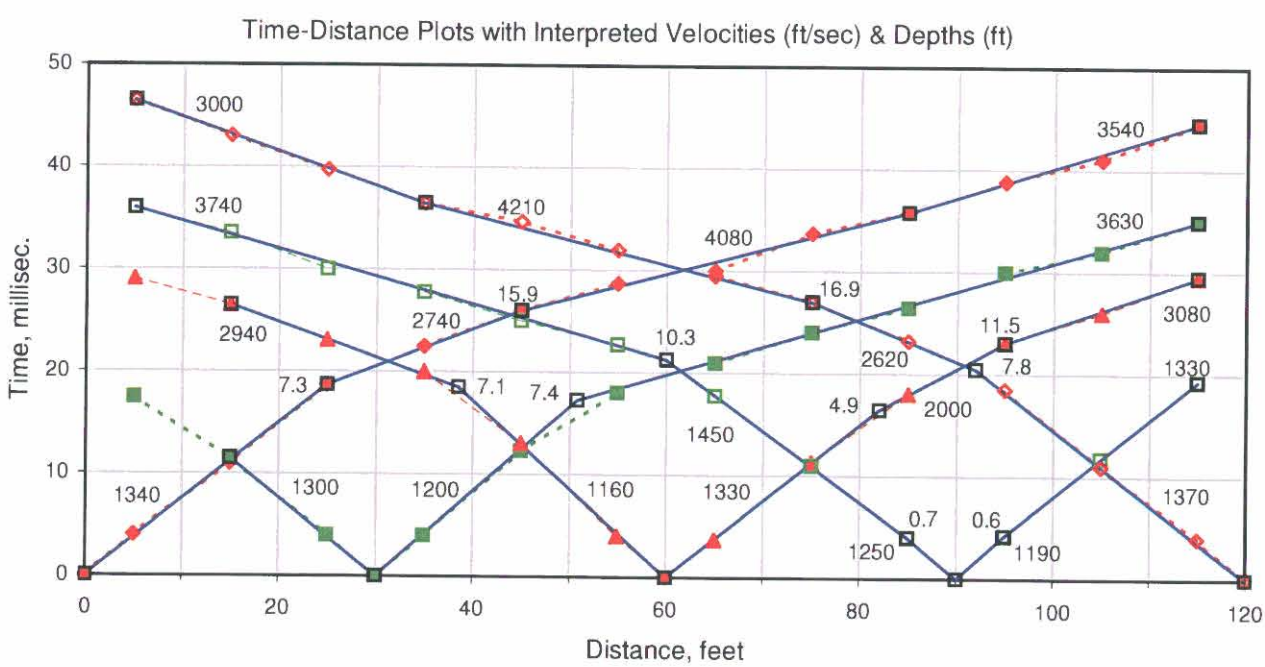

Interpretation of Refraction Seismic Data
North
South
ground
1200
1200
1200
s-wave = 650 f/s
2600
2700
2800
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 880 f/s
s-wave = 3200 f/s below ~64 ft depth
Relative depth, feet
Distance, feet

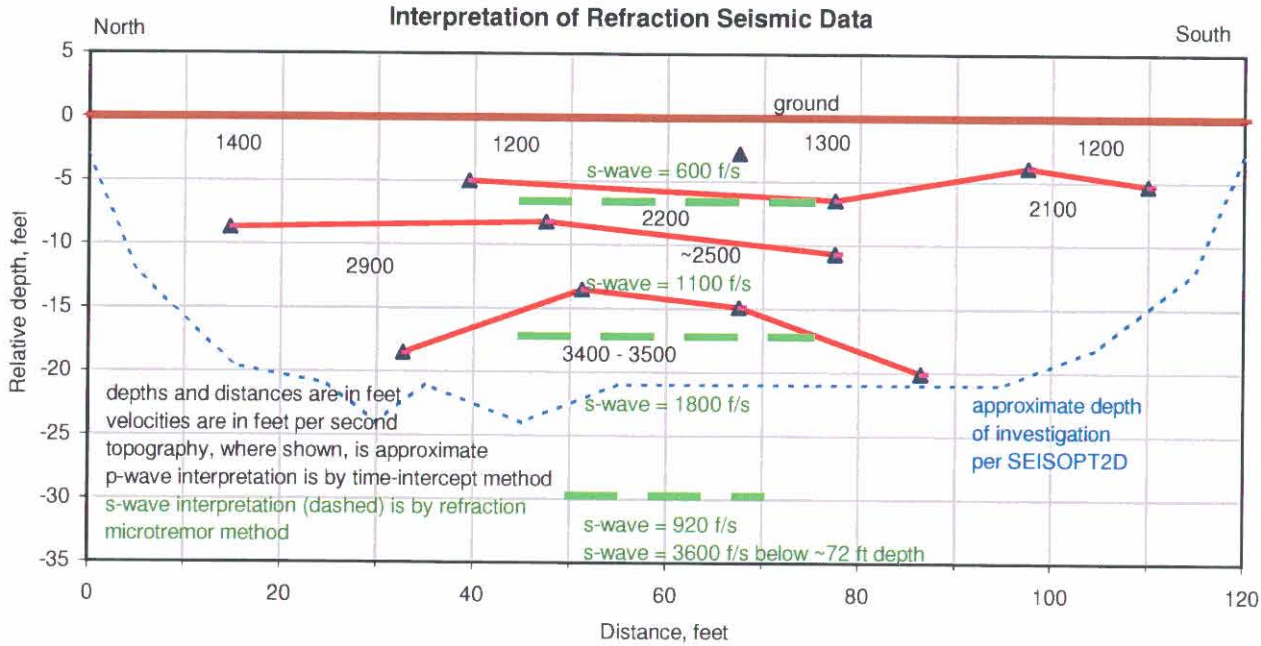

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2300
2270
2500
2860
2830
2700
2500
3330
3700
2780
25.1
22.8
8.5
7.7
7.6
9.1
11.2
9.4
1210
1250
1190
1230
1200
1270
1160
1400
1190
0.7
Time, millisec.
Distance, feet

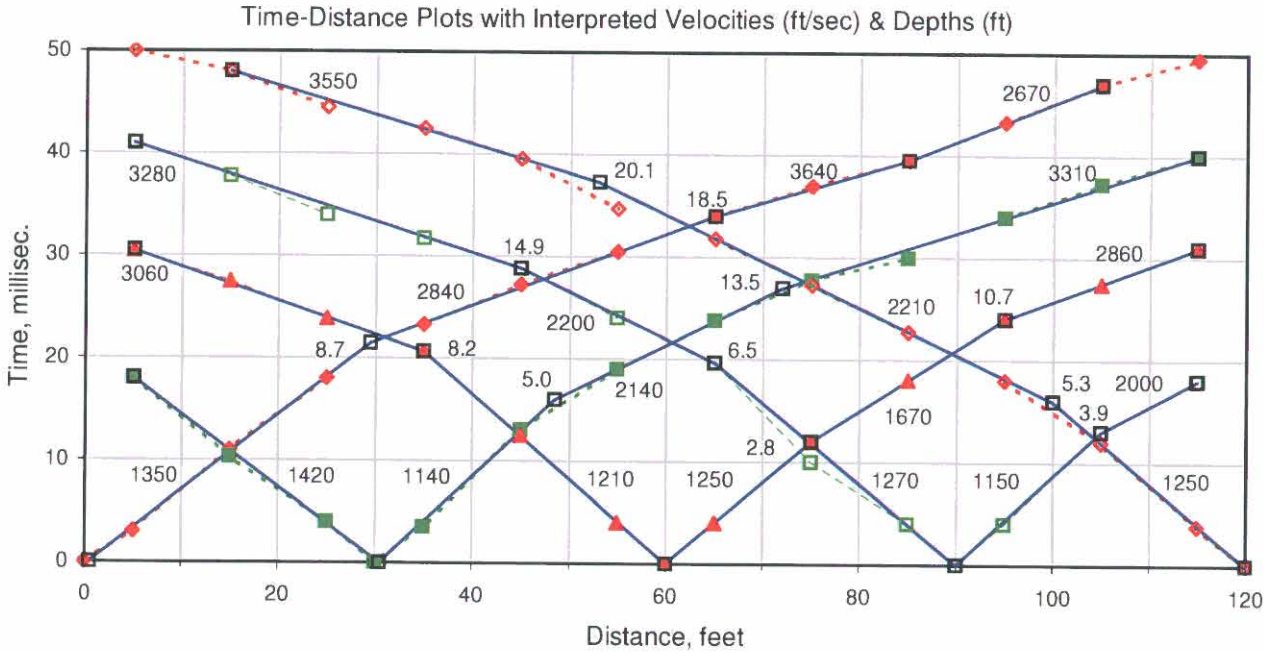

Interpretation of Refraction Seismic Data
North
South
Sta
145+00
ground
1300
1200
1400
1400
s-wave = 690 f/s
2500
~2300
s-wave = 1300 f/s
~2800
3400
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 950 f/s
s-wave > 3500 f/s below ~72 ft depth
Relative depth, feet
Distance, feet

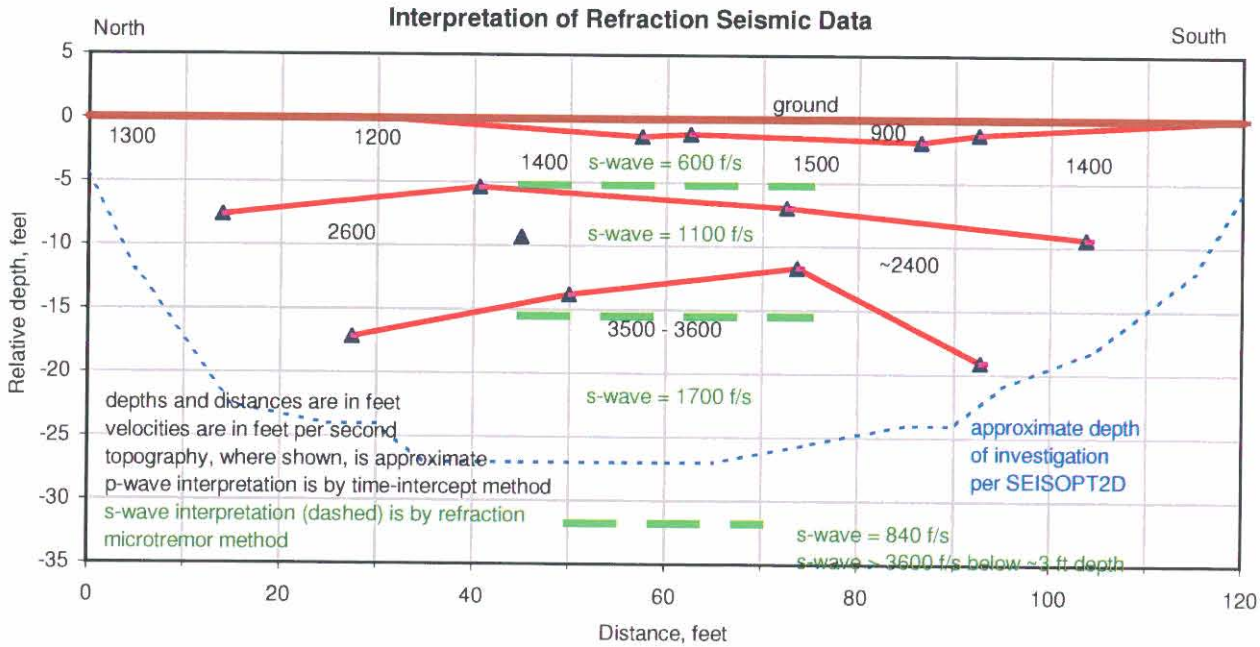

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3020
3500
2500
1890
1250
4.3
1250
1200
15.7
4.8
4.5
2030
2550
1310
3390
2510
4.2
1470
30.1
5000
3330
6.9
1360
17.4
2430
9.4
1510
18.1
5000
1.2
1250
Time, millisec.
Distance, feet

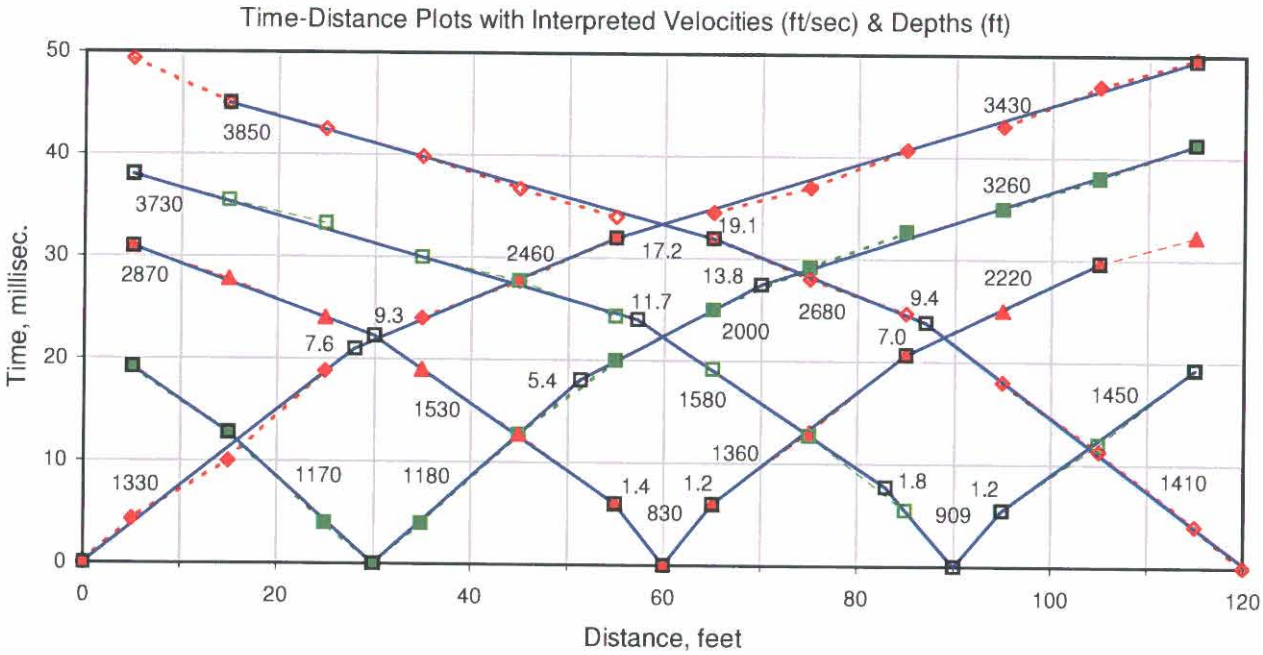

Interpretation of Refraction Seismic Data
North
South
ground
1300
1200
1400
1300
s-wave = 600 f/s
2800
~2300
3700
2800
s-wave = 1400 f/s
4100
s-wave = 2100 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 920 f/s
s-wave = 3600 f/s below ~64 ft depth
Relative depth, feet
Distance, feet

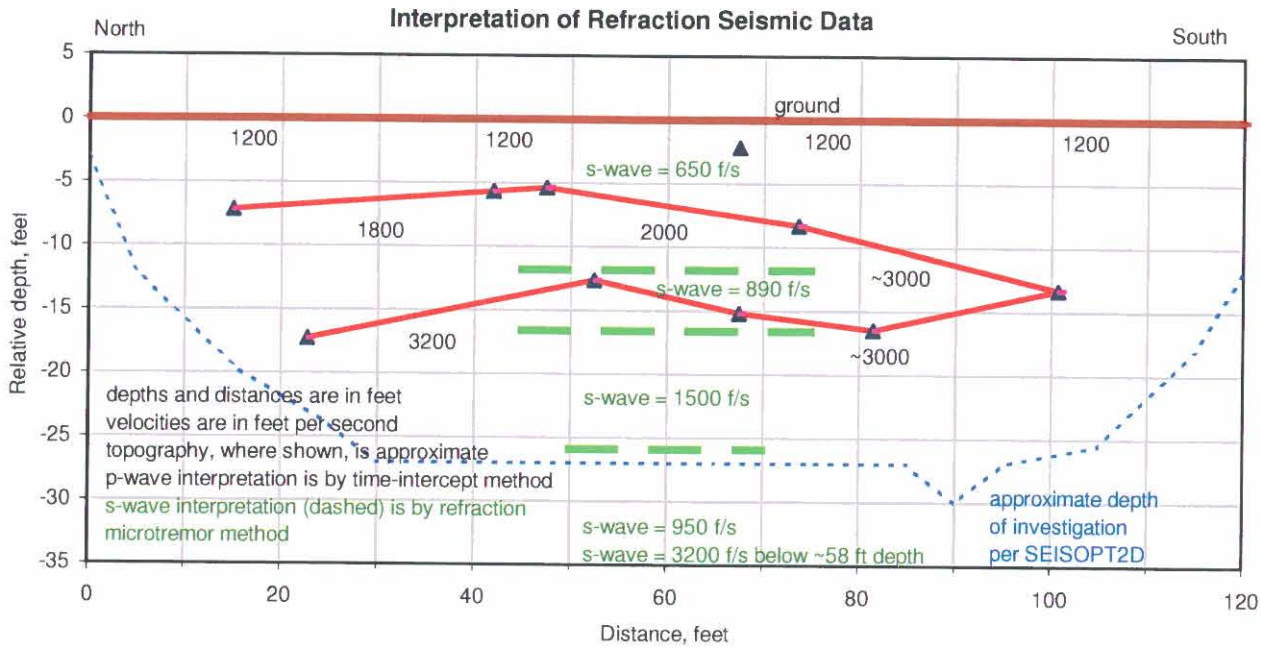

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3000
3540
3740
4210
4080
3630
15.9
16.9
2940
2740
10.3
11.5
3080
2620
7.8
1330
7.3
7.1
7.4
4.9
2000
1450
1340
1300
1200
1160
1330
0.7
0.6
1370
1250
1190
Time, millisec.
Distance, feet

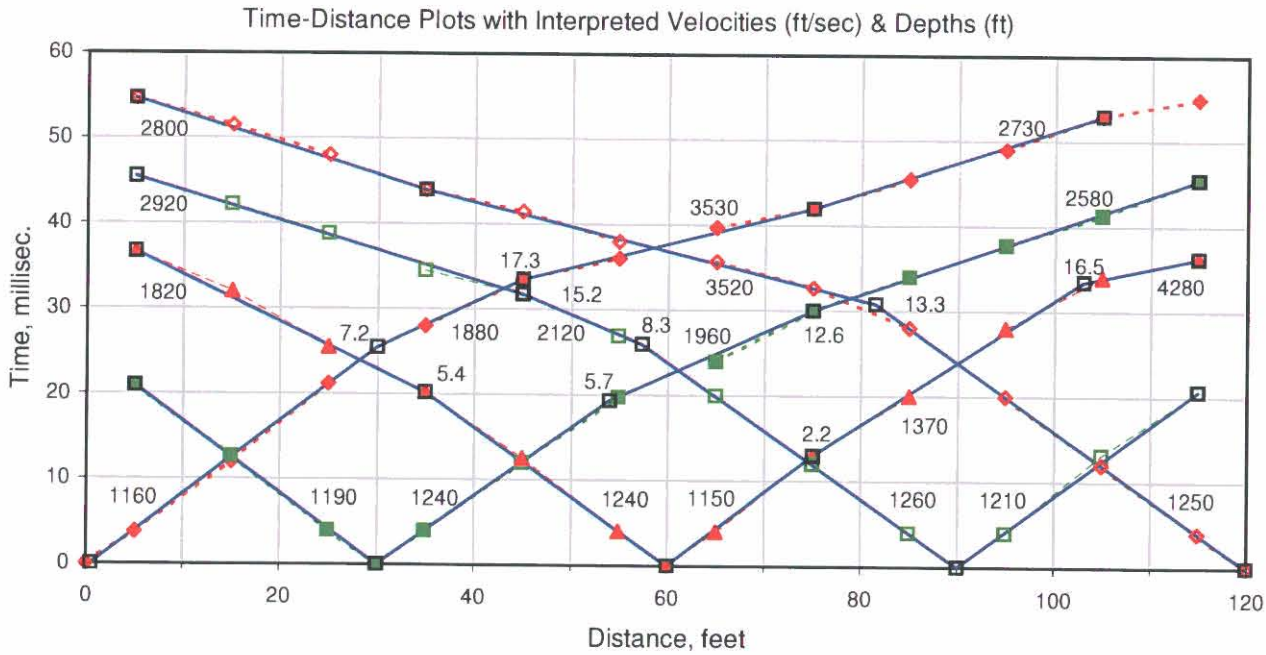

Interpretation of Refraction Seismic Data
North
South
ground
1400
1200
1300
1200
s-wave = 600 f/s
2200
2100
2900
~2500
s-wave = 1100 f/s
3400 - 3500
s-wave = 1800 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 920 f/s
s-wave = 3600 f/s below ~72 ft depth
Relative depth, feet
Distance, feet

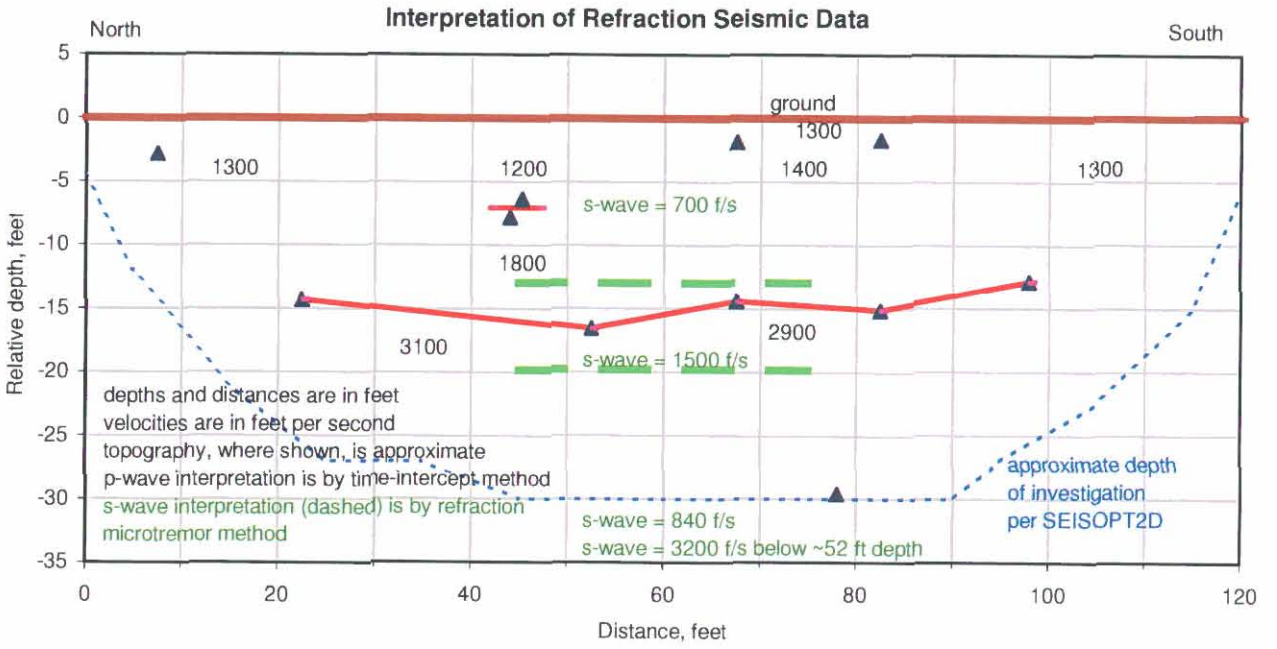

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3550
2670
3280
20.1
3640
3310
18.5
14.9
3060
2860
2840
13.5
2210
10.7
2200
8.7
8.2
6.5
5.0
2140
5.3
2000
3.9
1670
2.8
1350
1420
1140
1210
1250
1270
1150
1250
Time, millisec.
Distance, feet

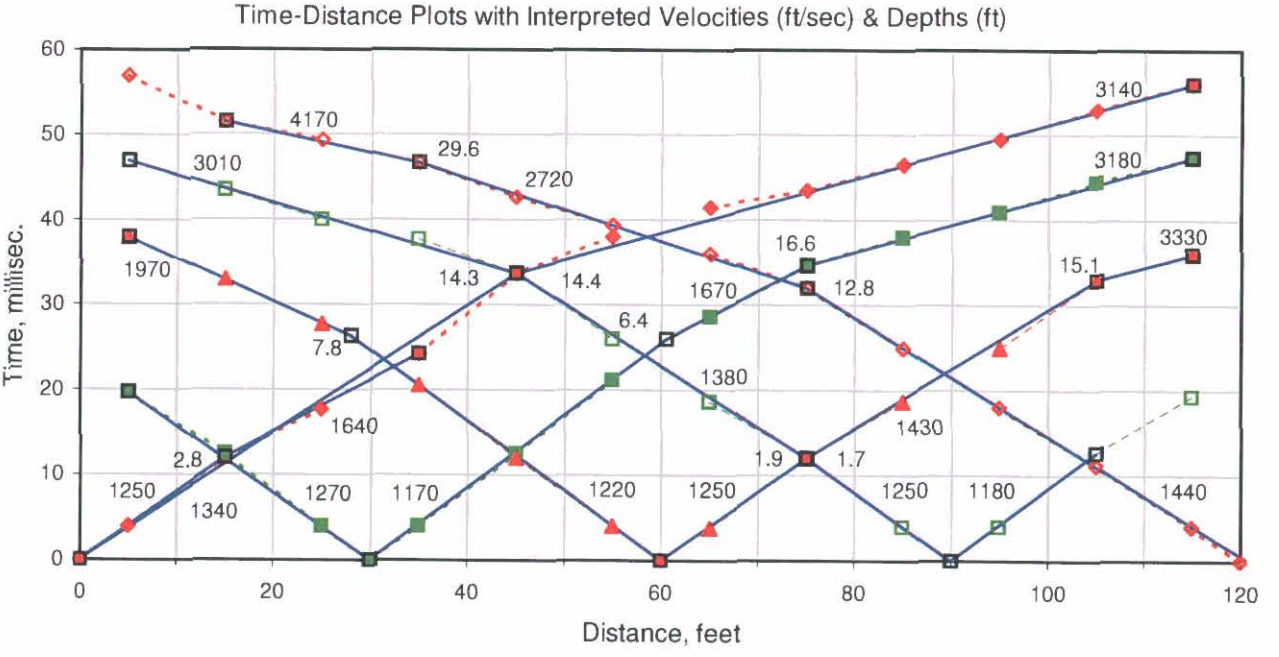

Interpretation of Refraction Seismic Data
North
South
ground
1300
1200
900
1400
s-wave = 600 f/s
1500
1400
2600
s-wave = 1100 f/s
~2400
3500 - 3600
s-wave = 1700 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 840 f/s
s-wave > 3600 f/s below ~3 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3850
3730
2870
1330
1170
1180
1530
7.6
9.3
2460
5.4
17.2
11.7
1.4
830
1580
19.1
13.8
2000
1.2
1360
2680
9.4
7.0
1.8
909
1.2
2220
3260
3430
1450
1410
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
North
South
ground
1200
1200
1200
1200
s-wave = 650 f/s
1800
2000
~3000
s-wave = 890 f/s
3200
~3000
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 950 f/s
s-wave = 3200 f/s below ~58 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2800
2920
1820
2730
3530
2580
17.3
15.2
3520
16.5
4280
13.3
7.2
1880
2120
8.3
1960
12.6
5.4
5.7
2.2
1370
1160
1190
1240
1240
1150
1260
1210
1250
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
North
South
ground
1300
1200
1400
1300
1300
s-wave = 700 f/s
1800
3100
2900
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 840 f/s
s-wave = 3200 f/s below ~52 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4170
29.6
2720
3010
3140
3180
3330
1970
14.3
14.4
16.6
12.8
1670
15.1
6.4
7.8
1380
1640
1430
2.8
1.9
1.7
1250
1340
1270
1170
1220
1250
1250
1180
1440
Time, millisec.
Distance, feet

Refraction Seismic Interpretation

Line 41

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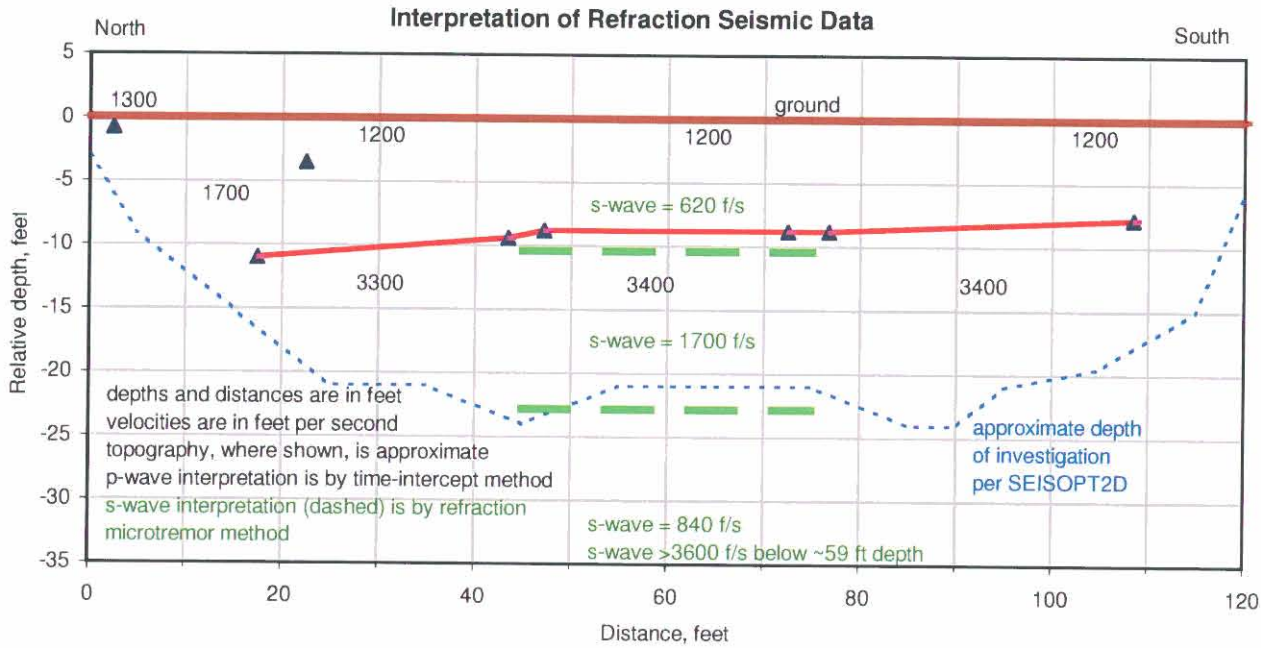
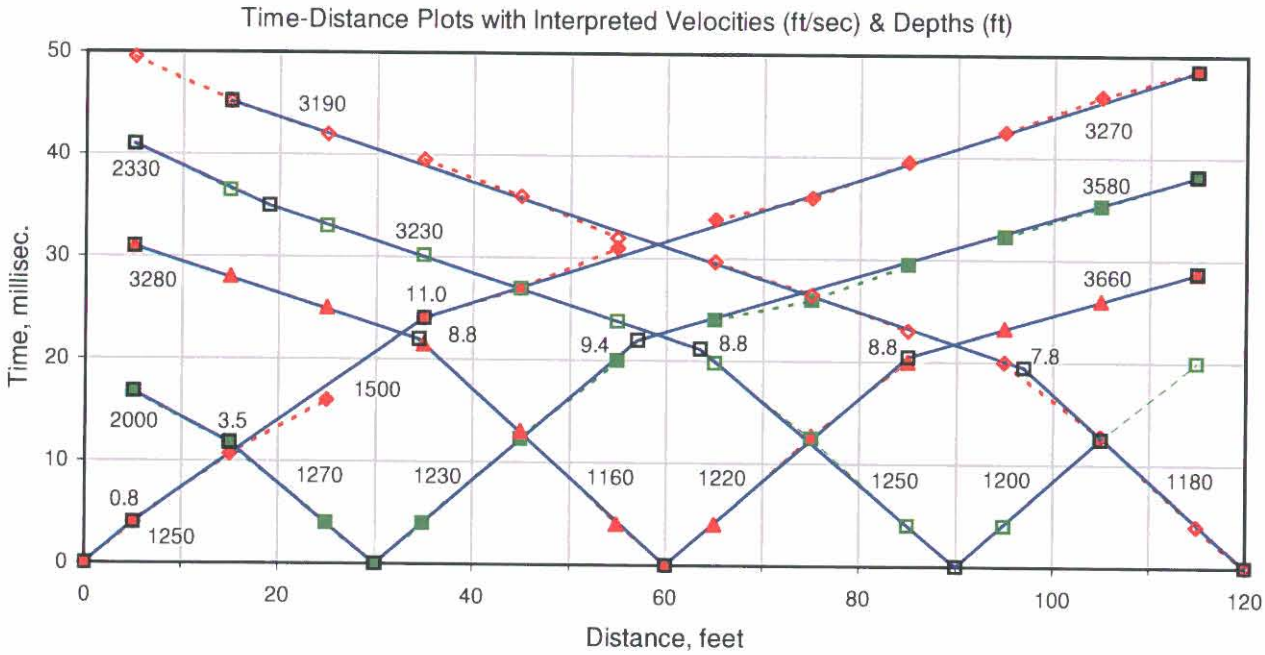
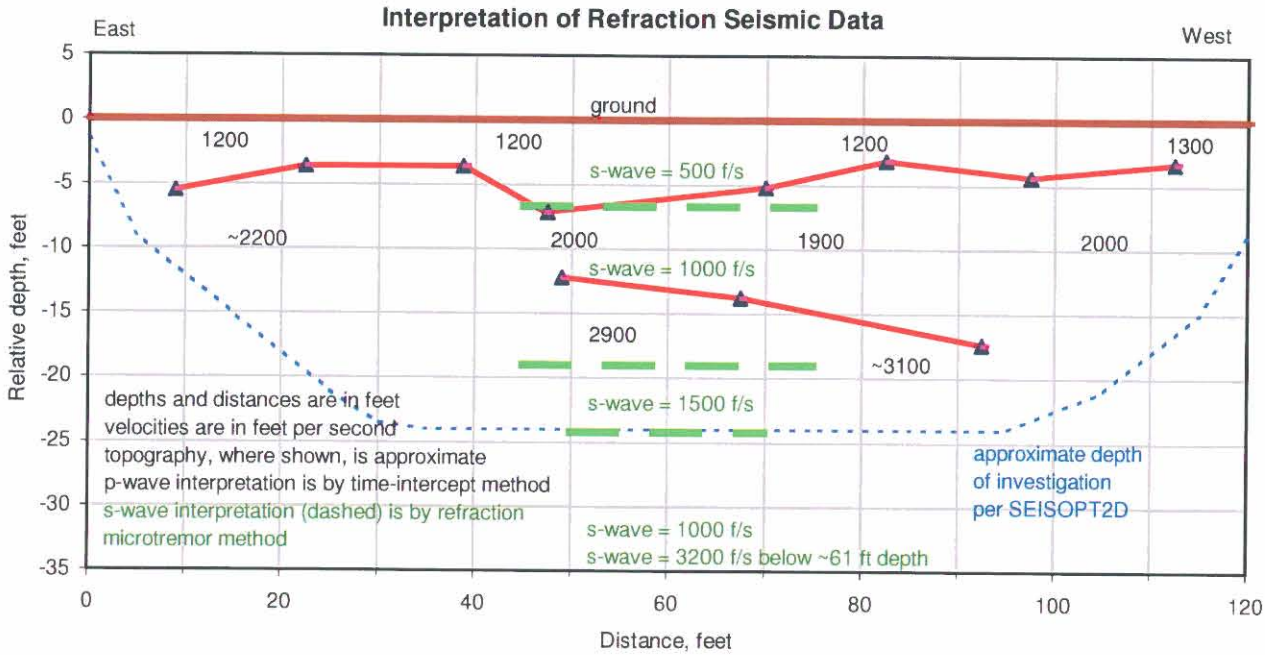
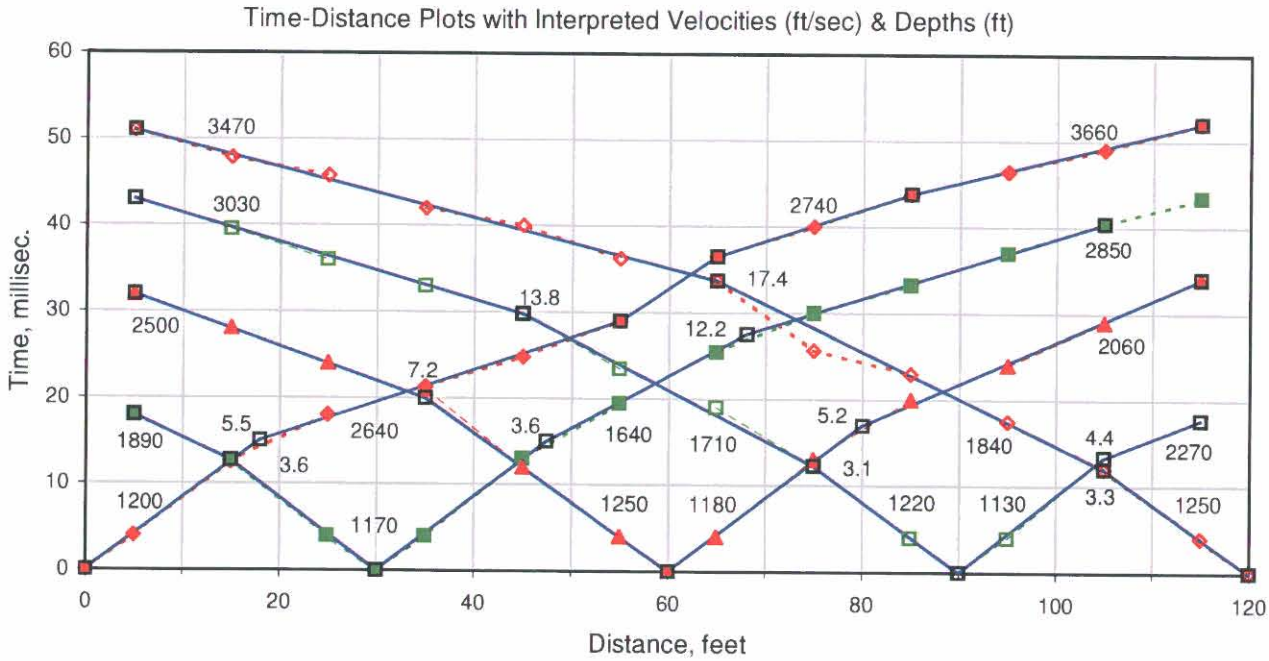
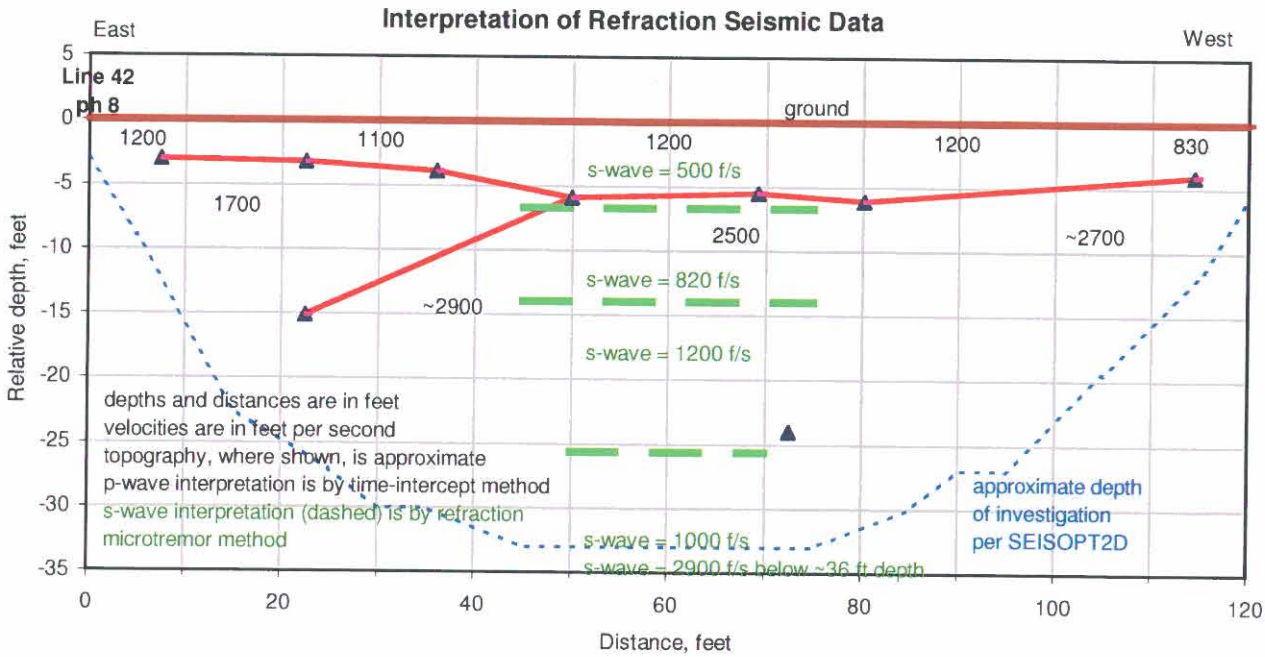
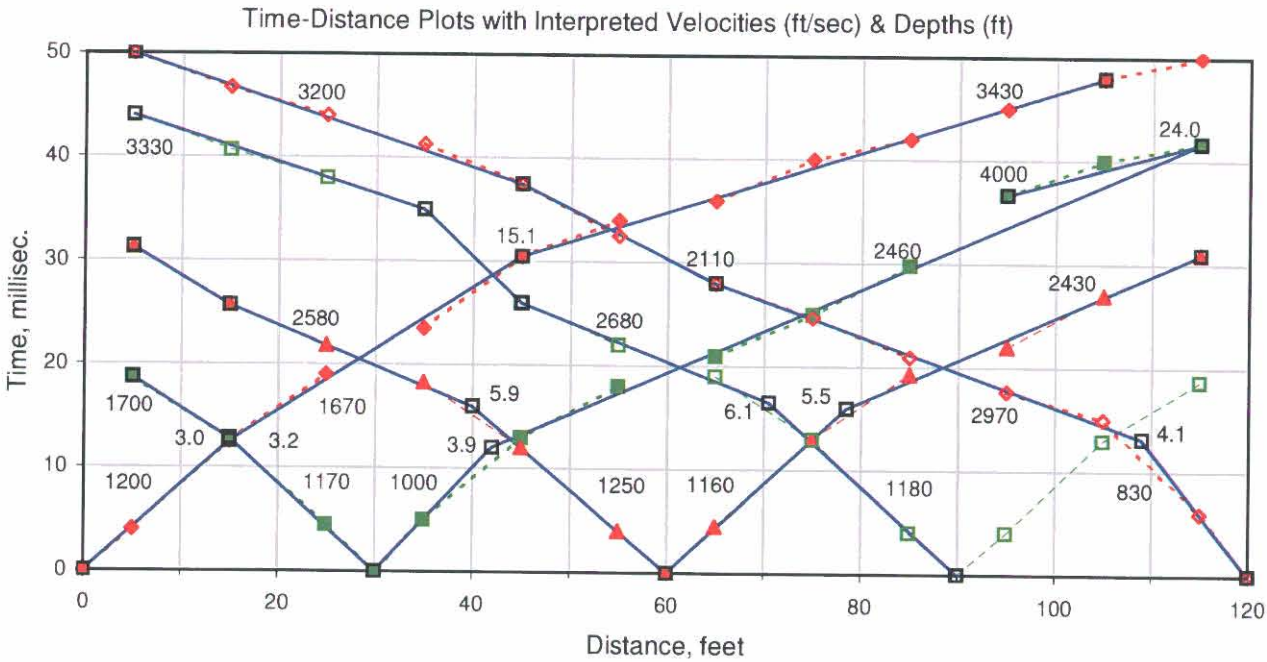


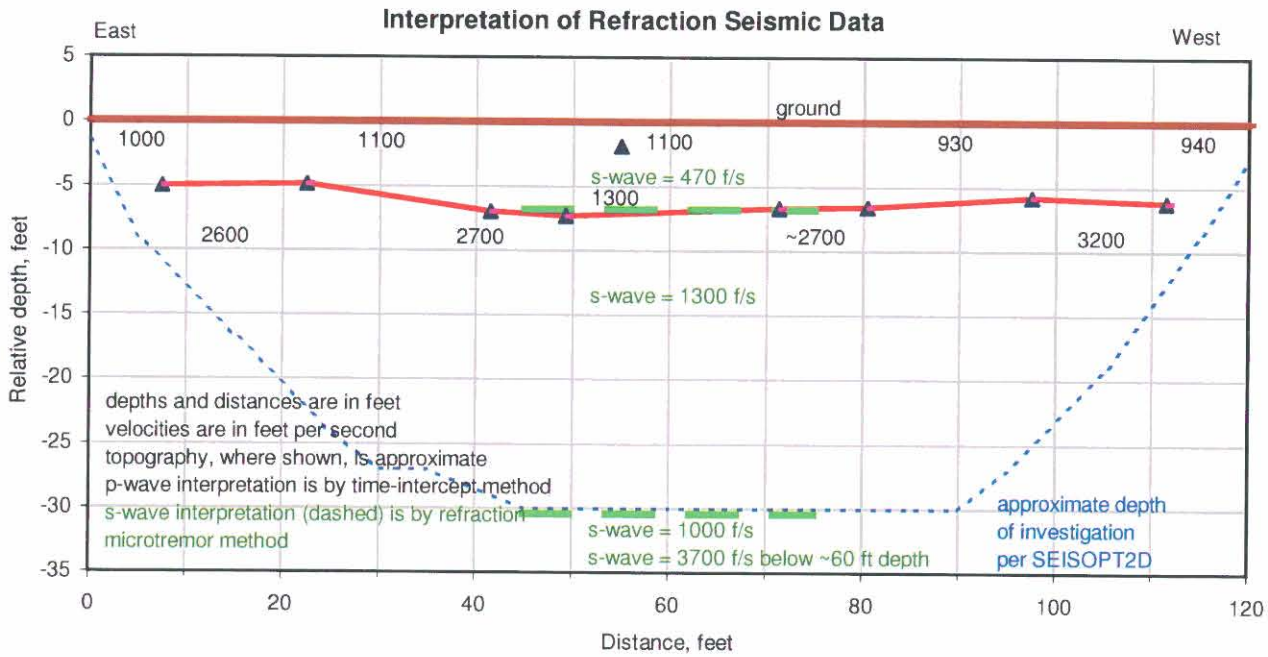


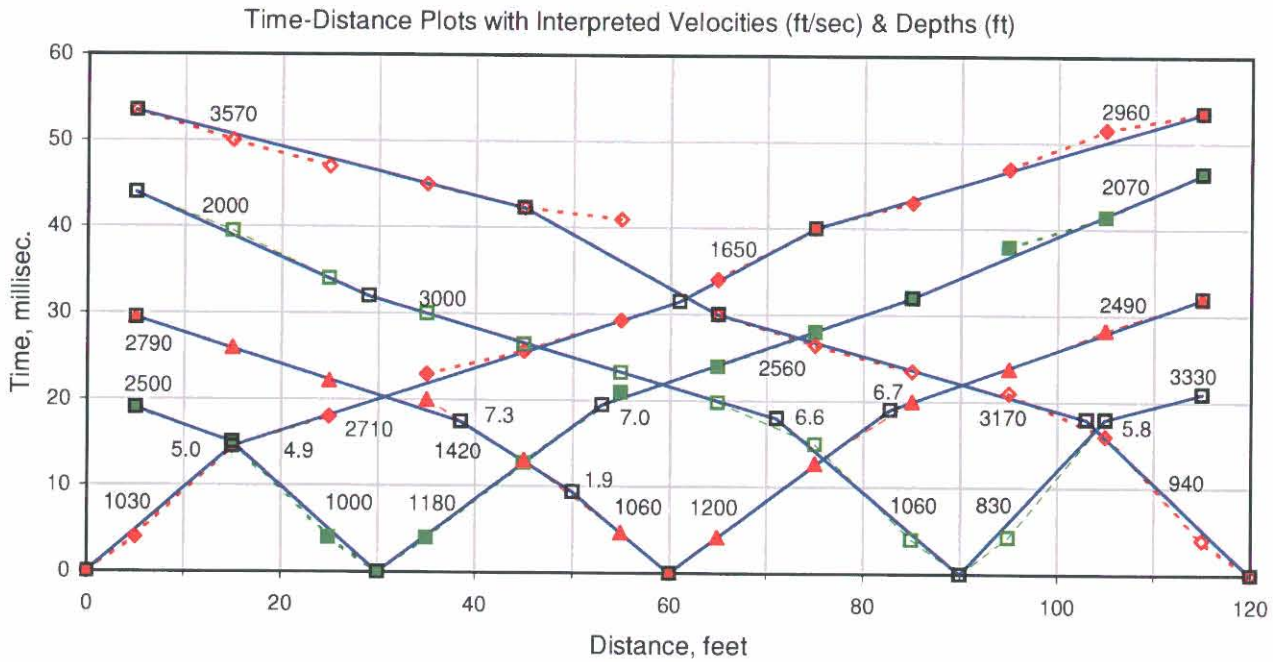

Interpretation of Refraction Seismic Data
East
West
ground
1200
1200
1200
1300
s-wave = 500 f/s
~2200
2000
1900
2000
s-wave = 1000 f/s
2900
~3100
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
s-wave = 3200 f/s below ~61 ft depth
Relative depth, feet
Distance, feet

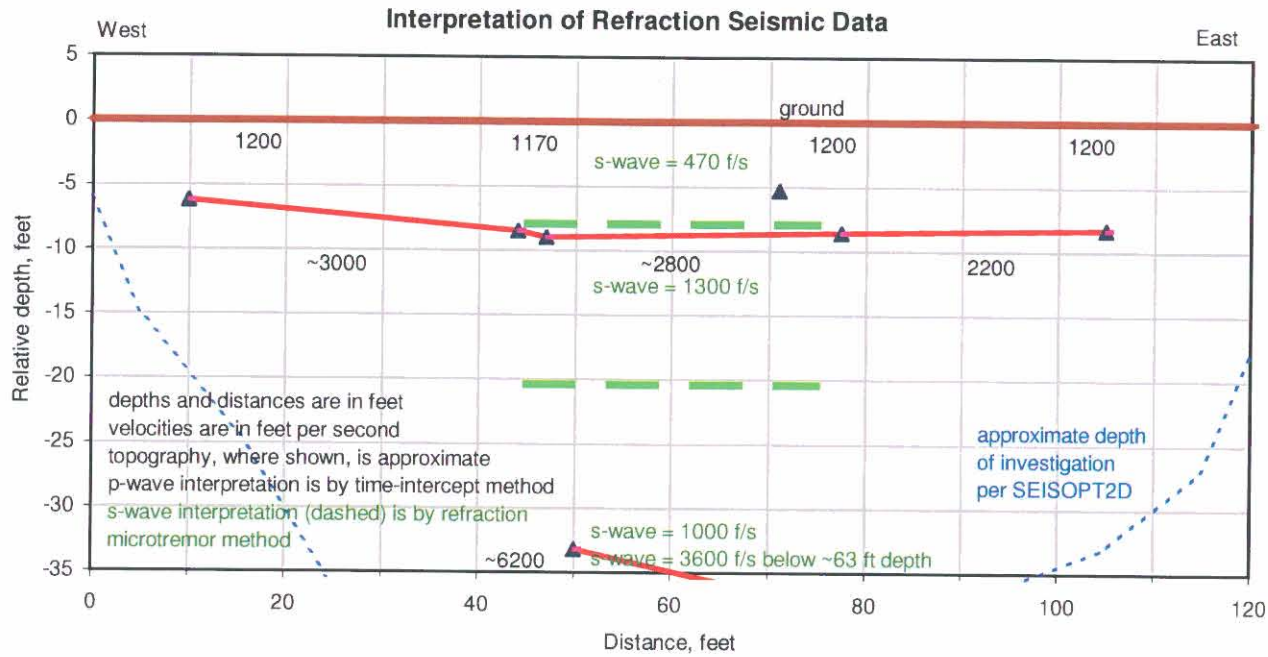

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3470
3660
3030
2740
2850
2500
13.8
17.4
12.2
2060
7.2
1890
5.5
2640
3.6
1640
1710
5.2
1840
4.4
2270
3.6
3.1
1200
1170
1250
1180
1220
1130
3.3
1250
Time, millisec.
Distance, feet

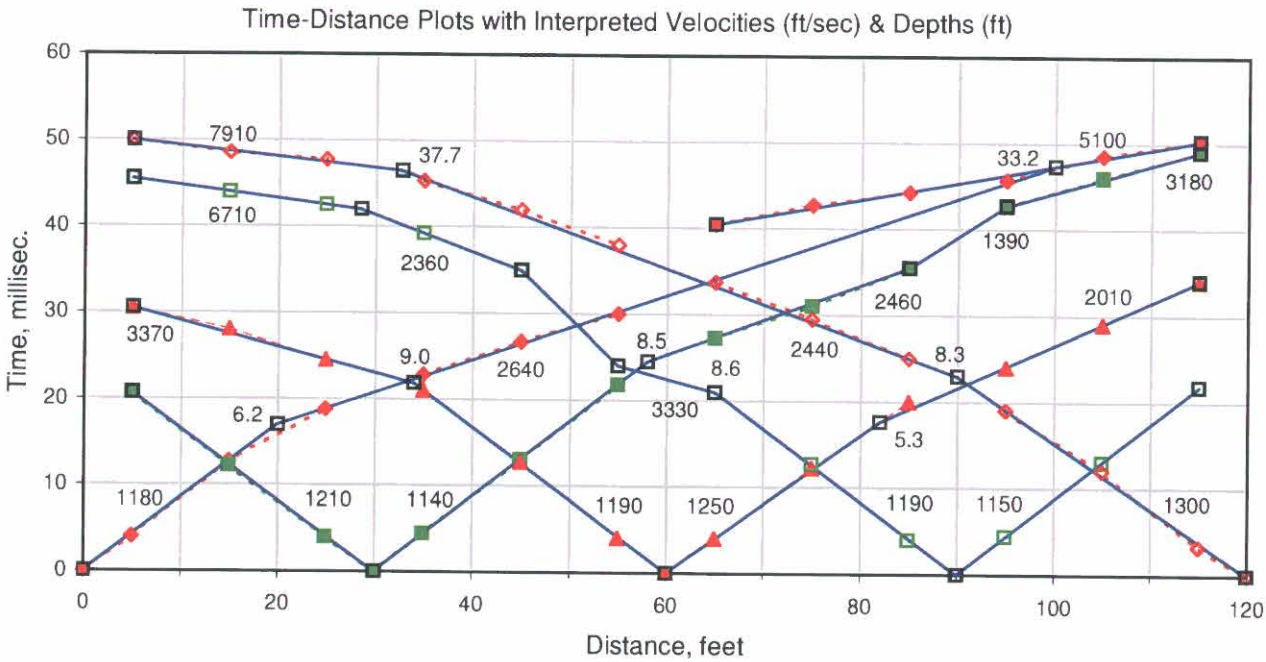

Interpretation of Refraction Seismic Data
East
West
Line 42
ph 8
ground
1200
1100
1200
1200
830
1700
s-wave = 500 f/s
2500
~2700
~2900
s-wave = 820 f/s
s-wave = 1200 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 1000 f/s
s-wave = 2900 f/s below ~36 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

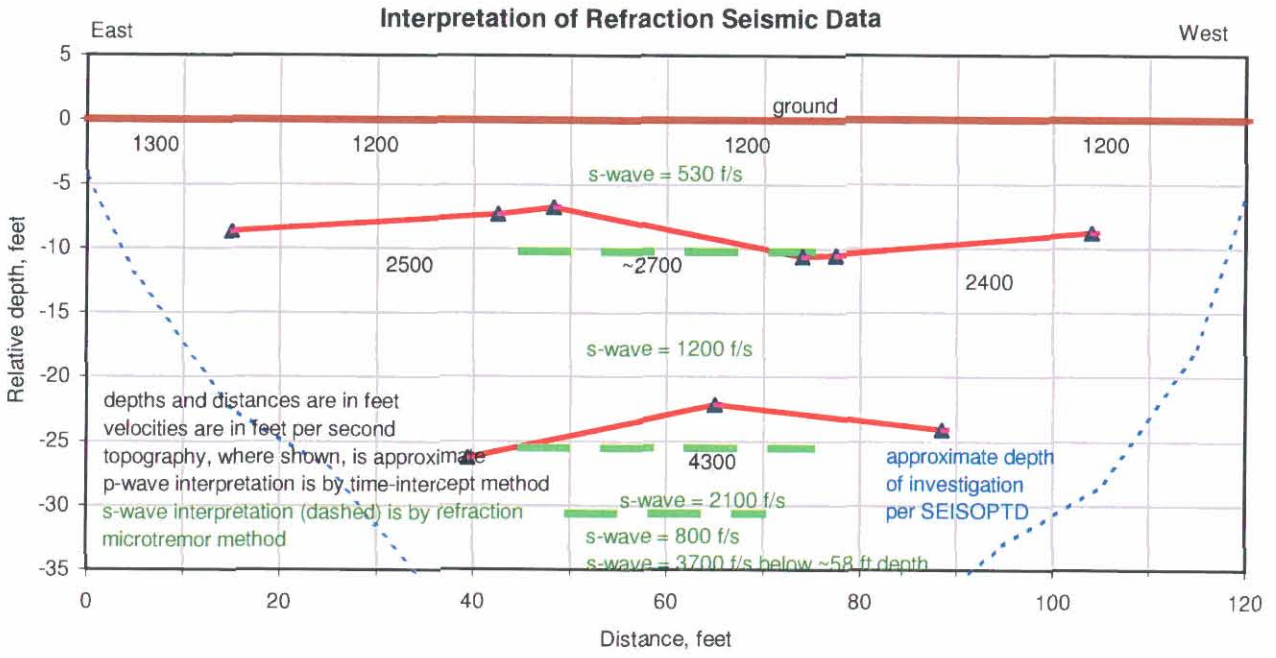

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3200
3330
3430
24.0
4000
15.1
2110
2460
2430
2580
2680
1700
1670
5.9
6.1
5.5
2970
3.0
3.2
3.9
4.1
1200
1170
1000
1250
1160
1180
830
Time, millisec.
Distance, feet

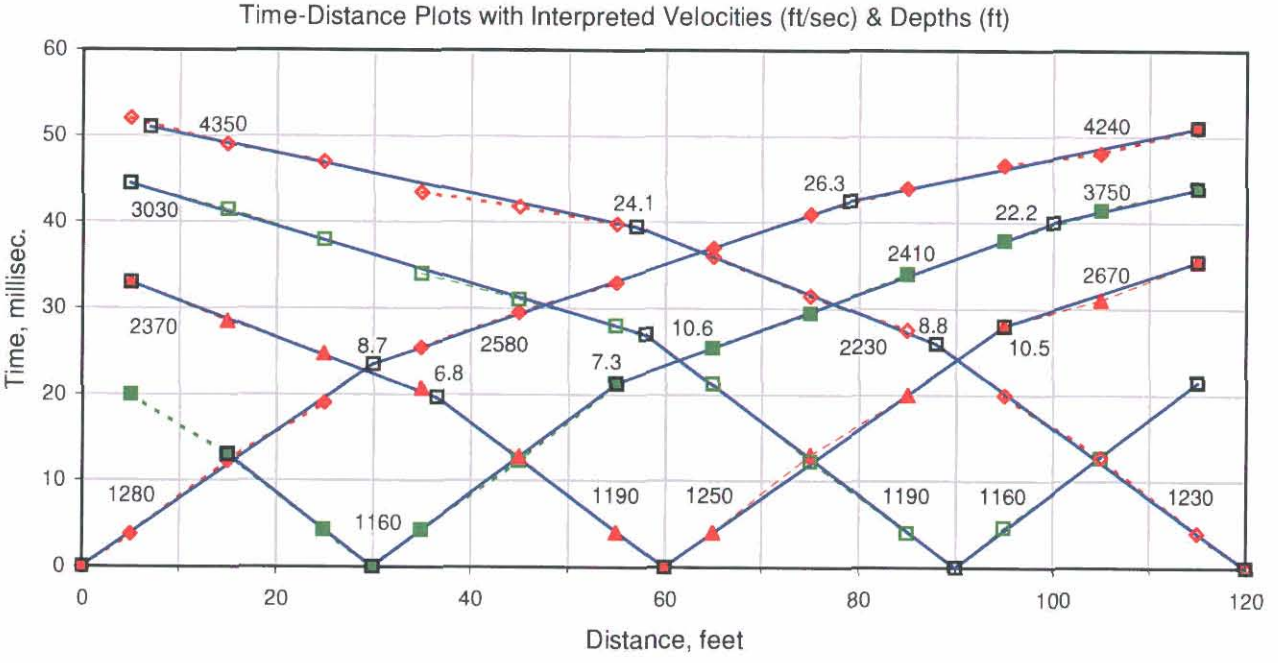

Interpretation of Refraction Seismic Data
East
West
ground
1000
1100
1100
930
940
s-wave = 470 f/s
1300
2600
2700
~2700
3200
s-wave = 1300 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 1000 f/s
s-wave = 3700 f/s below ~60 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

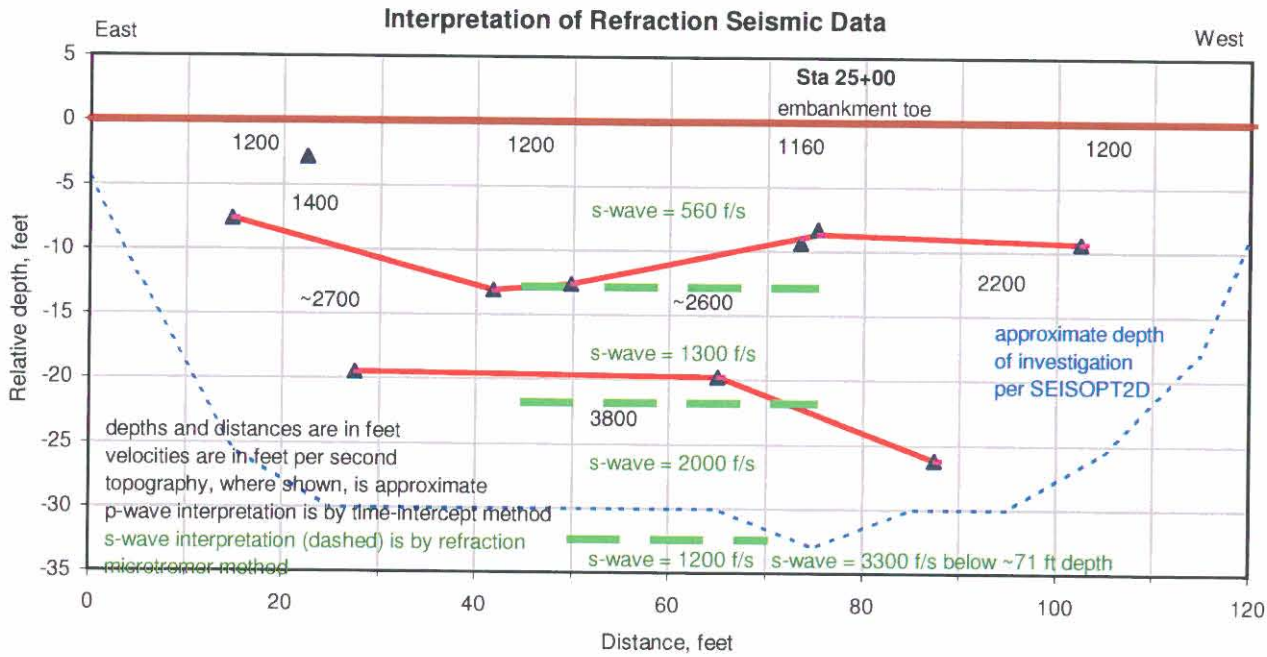

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3570
2000
3000
2790
2500
1030
5.0
4.9
1000
2710
1180
7.3
1420
1.9
7.0
1060
1200
1650
2560
6.6
1060
6.7
830
3170
2960
2070
2490
5.8
3330
940
Time, millisec.
Distance, feet

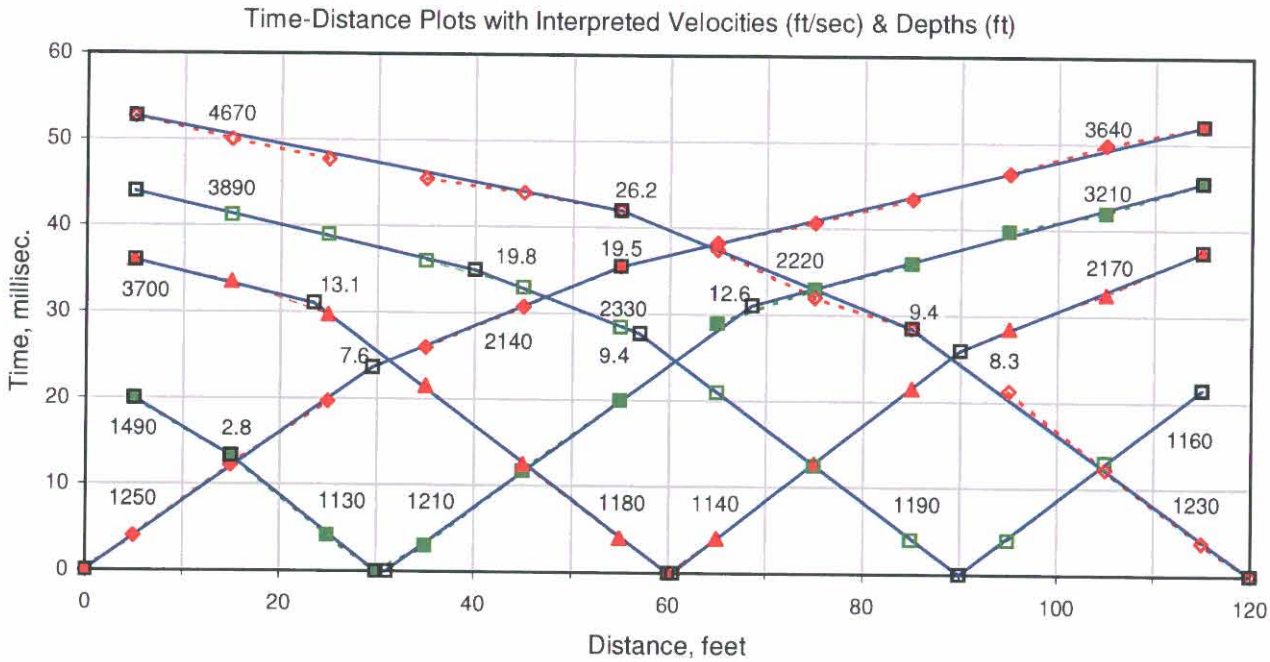

Interpretation of Refraction Seismic Data
West
East
ground
1200
1170
1200
1200
s-wave = 470 f/s
~3000
~2800
2200
s-wave = 1300 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
~6200
s-wave = 3600 f/s below ~63 ft depth
Relative depth, feet
Distance, feet

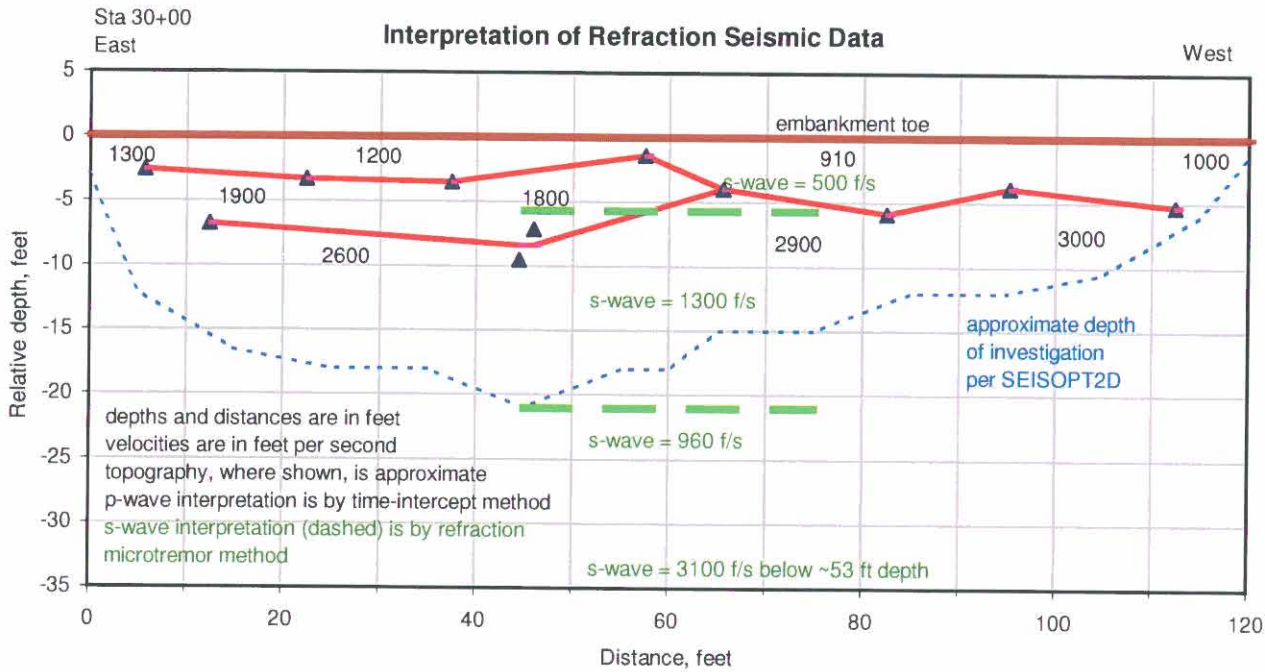

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
7910
37.7
33.2
5100
6710
3180
2360
1390
2460
2010
3370
9.0
2640
8.5
8.6
2440
8.3
6.2
3330
5.3
1180
1210
1140
1190
1250
1190
1150
1300
Time, millisec.
Distance, feet

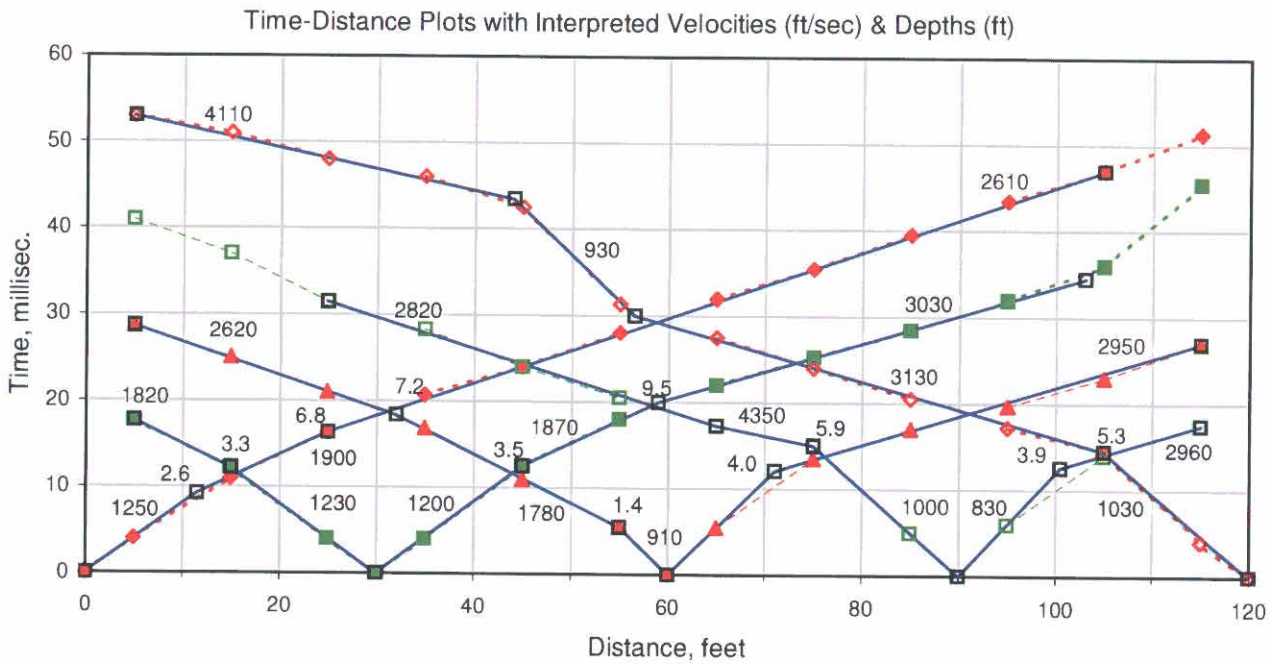

Interpretation of Refraction Seismic Data
East
West
ground
1300
1200
1200
1200
s-wave = 530 f/s
2500
~2700
2400
s-wave = 1200 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
4300
s-wave = 2100 f/s
s-wave = 800 f/s
s-wave = 3700 f/s below ~58 ft depth
approximate depth of investigation per SEISOPTD
Relative depth, feet
Distance, feet

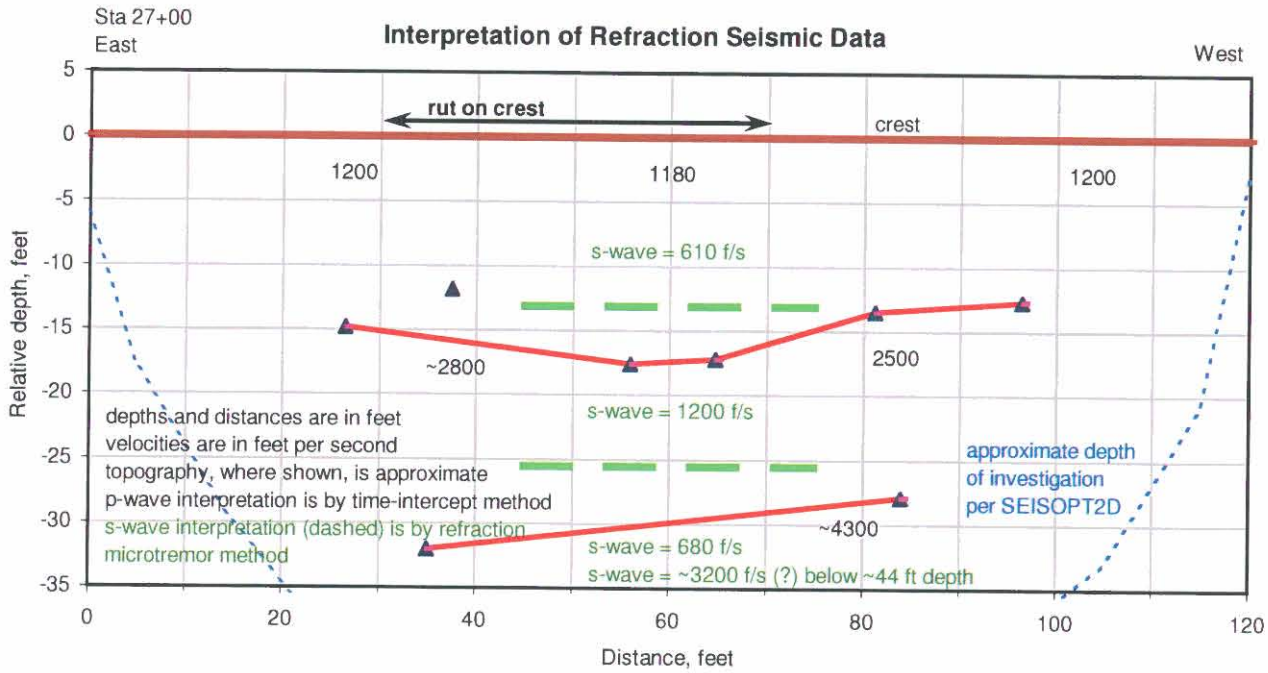

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4350
3030
2370
1280
8.7
6.8
1160
2580
24.1
10.6
7.3
1190
1250
26.3
2230
8.8
1190
2410
22.2
10.5
1160
4240
3750
2670
1230
Time, millisec.
Distance, feet

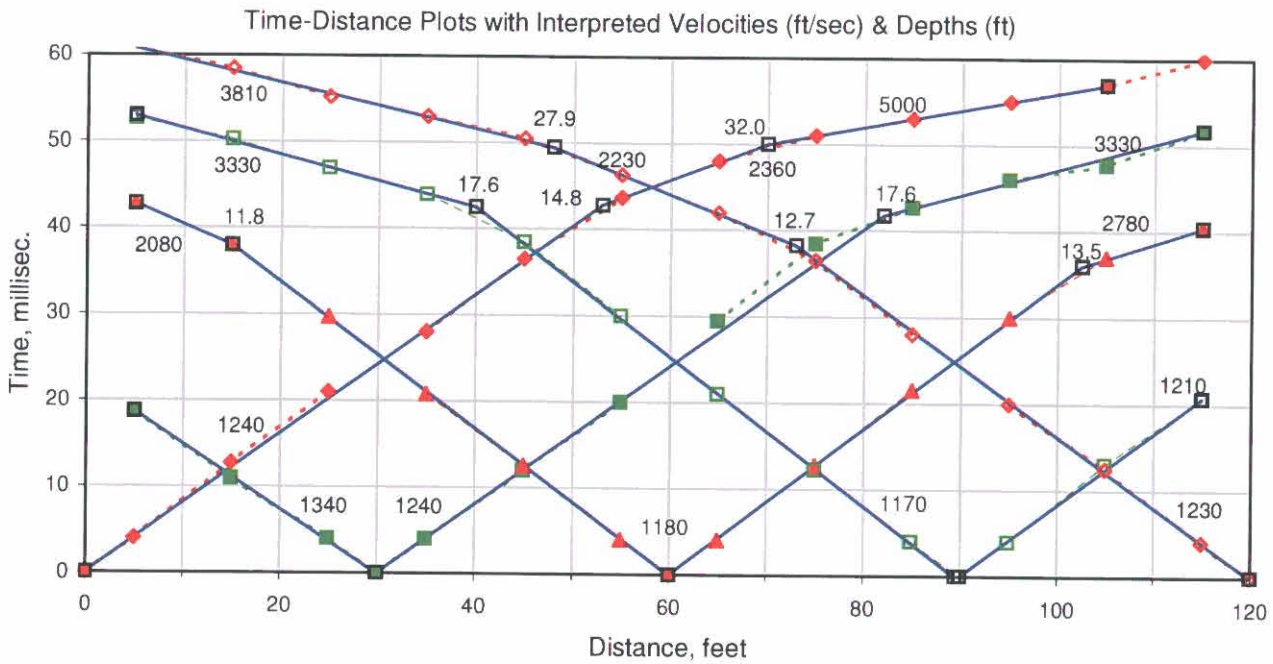

Interpretation of Refraction Seismic Data
East
West
Sta 25+00
embankment toe
1200
1200
1160
1200
1400
s-wave = 560 f/s
~2700
~2600
2200
s-wave = 1300 f/s
approximate depth
of investigation
per SEISOPT2D
3800
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 2000 f/s
s-wave = 1200 f/s
s-wave = 3300 f/s below ~71 ft depth
Relative depth, feet
Distance, feet

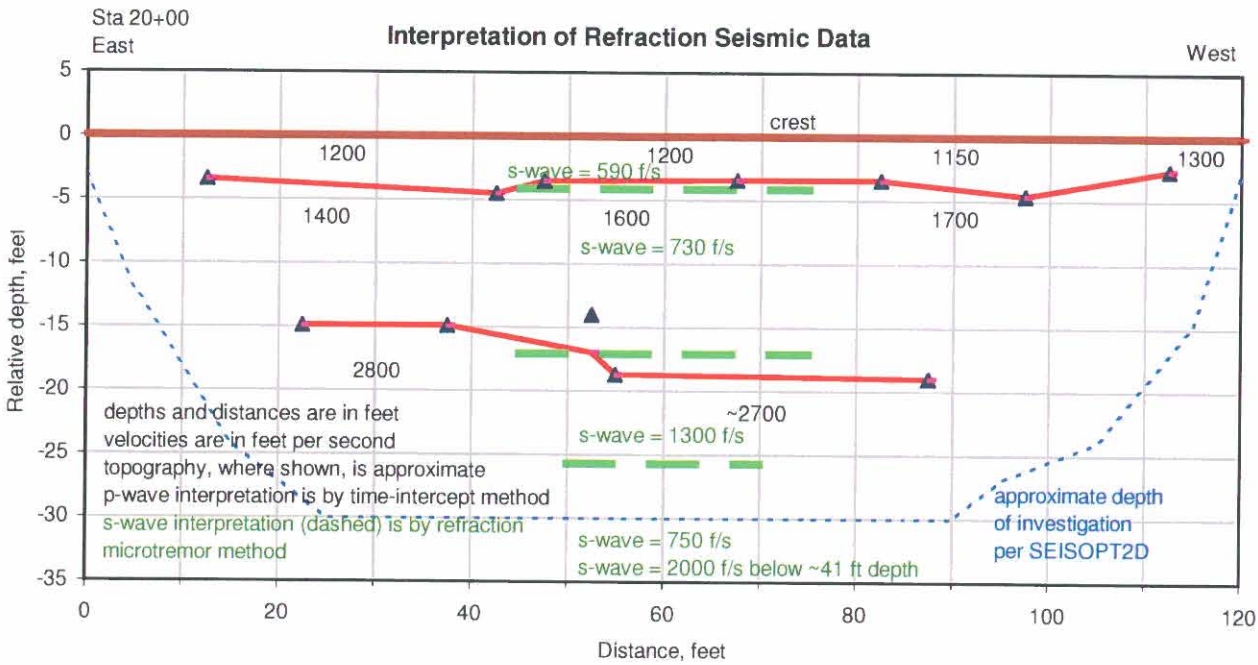

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4670
3640
3890
26.2
3210
19.8
19.5
2220
3700
13.1
2170
12.6
2330
9.4
2140
7.6
9.4
8.3
1490
2.8
1160
1250
1130
1210
1180
1140
1190
1230
Time, millisec.
Distance, feet

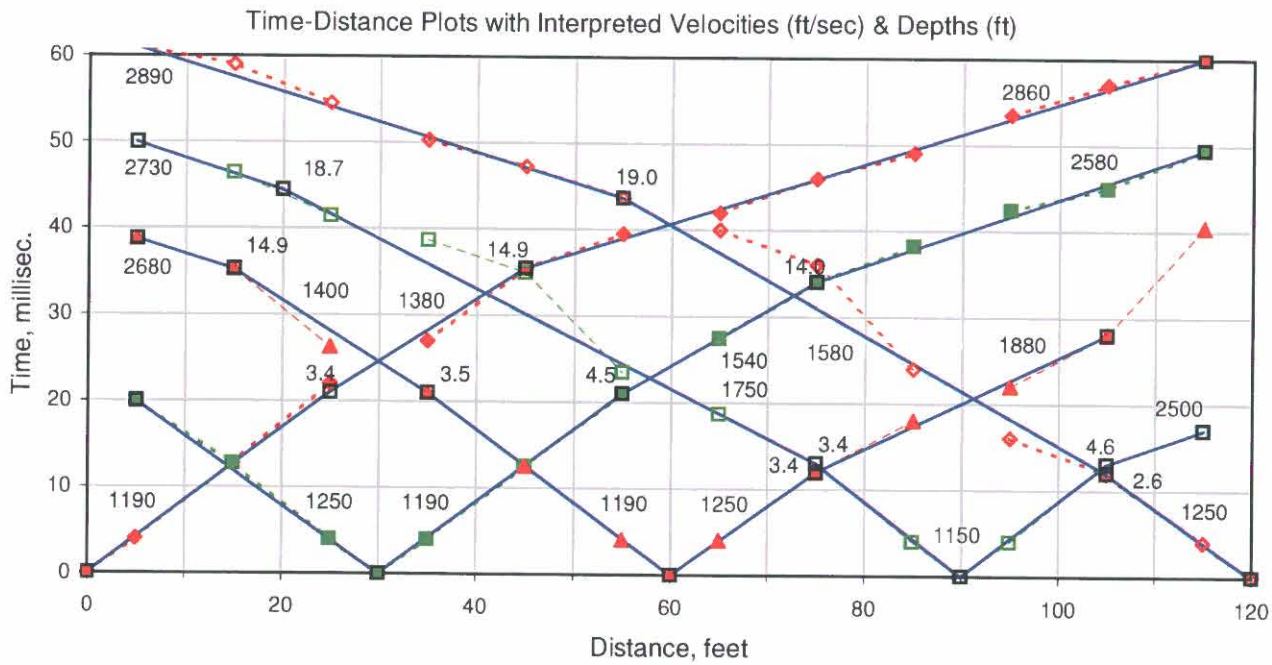

Sta 30+00
East
Interpretation of Refraction Seismic Data
West
embankment toe
1300
1200
910
1000
1900
1800
p-wave = 500 f/s
2600
2900
3000
s-wave = 1300 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 960 f/s
s-wave = 3100 f/s below ~53 ft depth
Relative depth, feet
Distance, feet

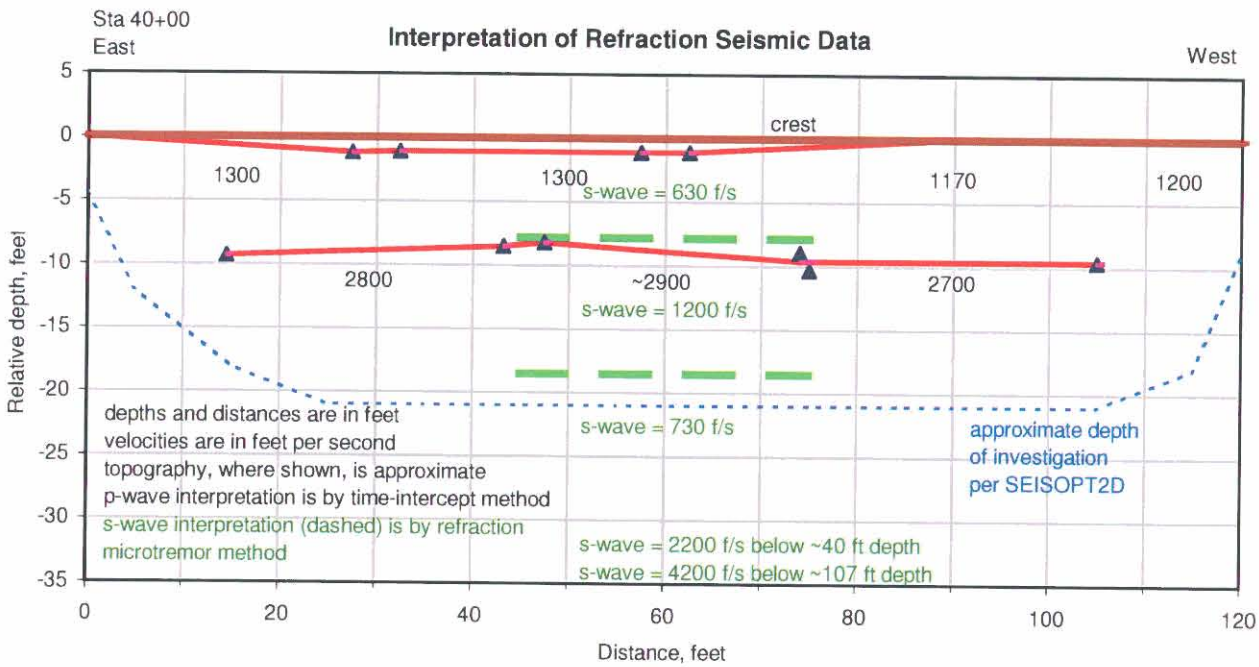

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4110
930
2610
2820
3030
2620
2950
7.2
9.5
3130
1820
6.8
4350
5.9
1870
3.3
1900
3.5
5.3
2960
2.6
4.0
3.9
1250
1230
1200
1780
1.4
910
1000
830
1030
Time, millisec.
Distance, feet

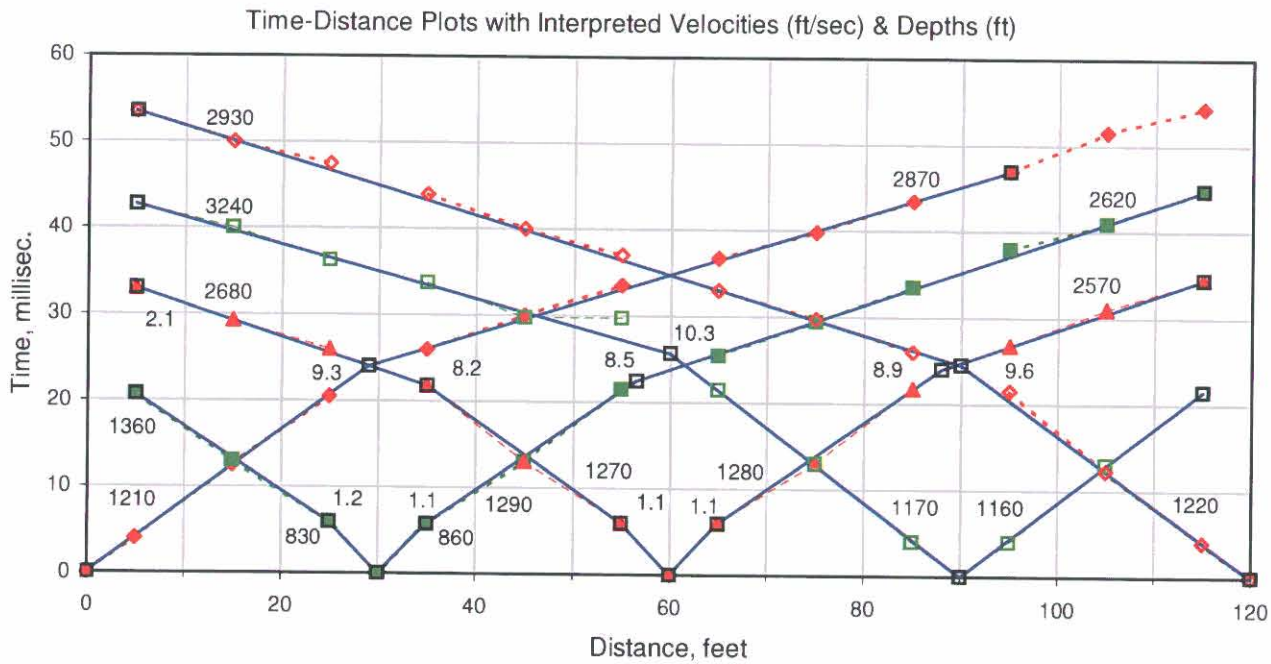

Sta 27+00
East
Interpretation of Refraction Seismic Data
West
rut on crest
crest
1200
1180
1200
s-wave = 610 f/s
~2800
2500
s-wave = 1200 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
~4300
s-wave = 680 f/s
s-wave = ~3200 f/s (?) below ~44 ft depth
Relative depth, feet
Distance, feet

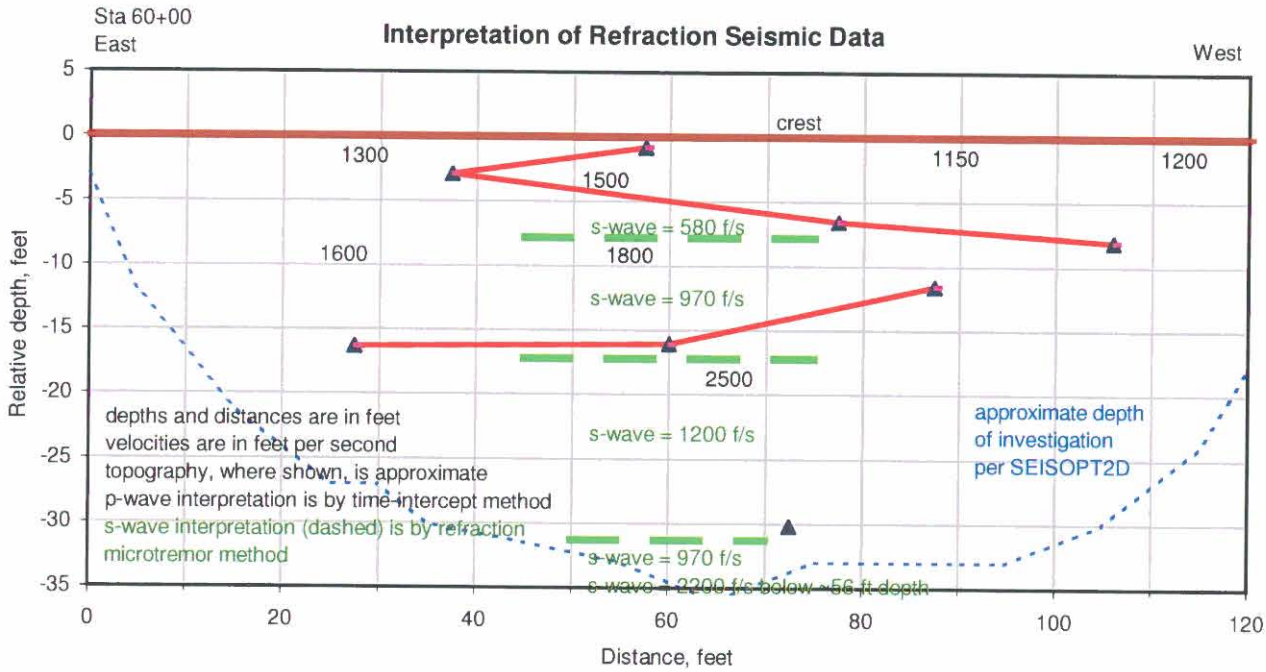

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3810
27.9
32.0
5000
3330
2230
2360
3330
17.6
14.8
17.6
11.8
12.7
2780
2080
13.5
1210
1240
1340
1240
1180
1170
1230
Time, millisec.
Distance, feet

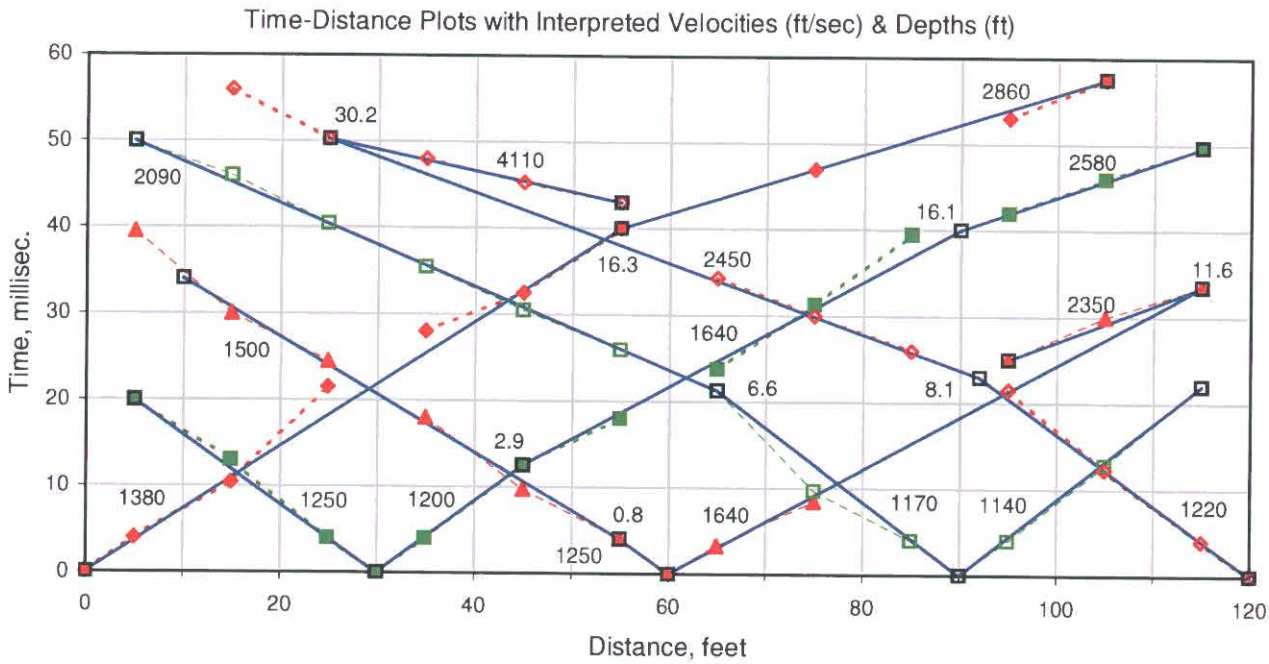

Sta 20+00
East
Interpretation of Refraction Seismic Data
West
crest
1200
1200
1150
1300
s-wave = 590 f/s
1400
1600
1700
s-wave = 730 f/s
2800
~2700
s-wave = 1300 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 750 f/s
s-wave = 2000 f/s below ~41 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

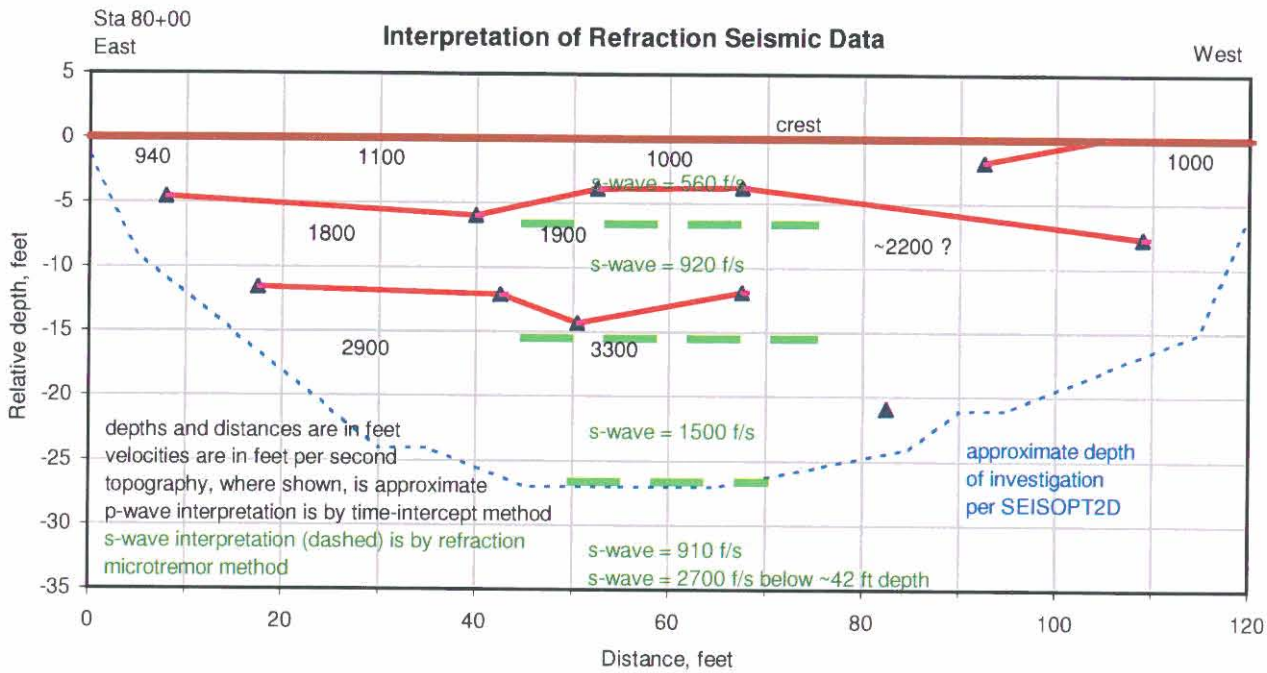

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2890
2860
2730
18.7
19.0
2580
14.9
14.9
2680
1400
1380
1540
1580
1880
3.4
3.5
4.5
1750
2500
3.4
3.4
4.6
2.6
1190
1250
1190
1190
1250
1150
1250
Time, millisec.
Distance, feet

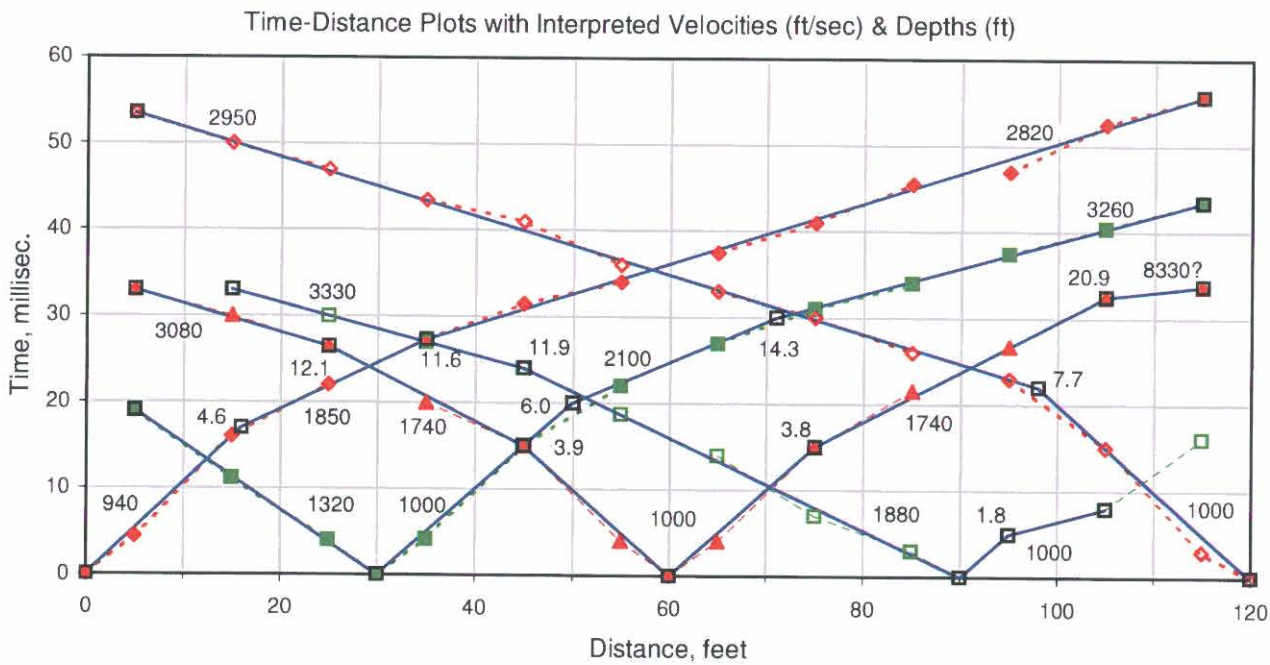

Sta 40+00
East
Interpretation of Refraction Seismic Data
West
crest
1300
1300
s-wave = 630 f/s
1170
1200
2800
~2900
2700
s-wave = 1200 f/s
s-wave = 730 f/s
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 2200 f/s below ~40 ft depth
s-wave = 4200 f/s below ~107 ft depth
Relative depth, feet
Distance, feet

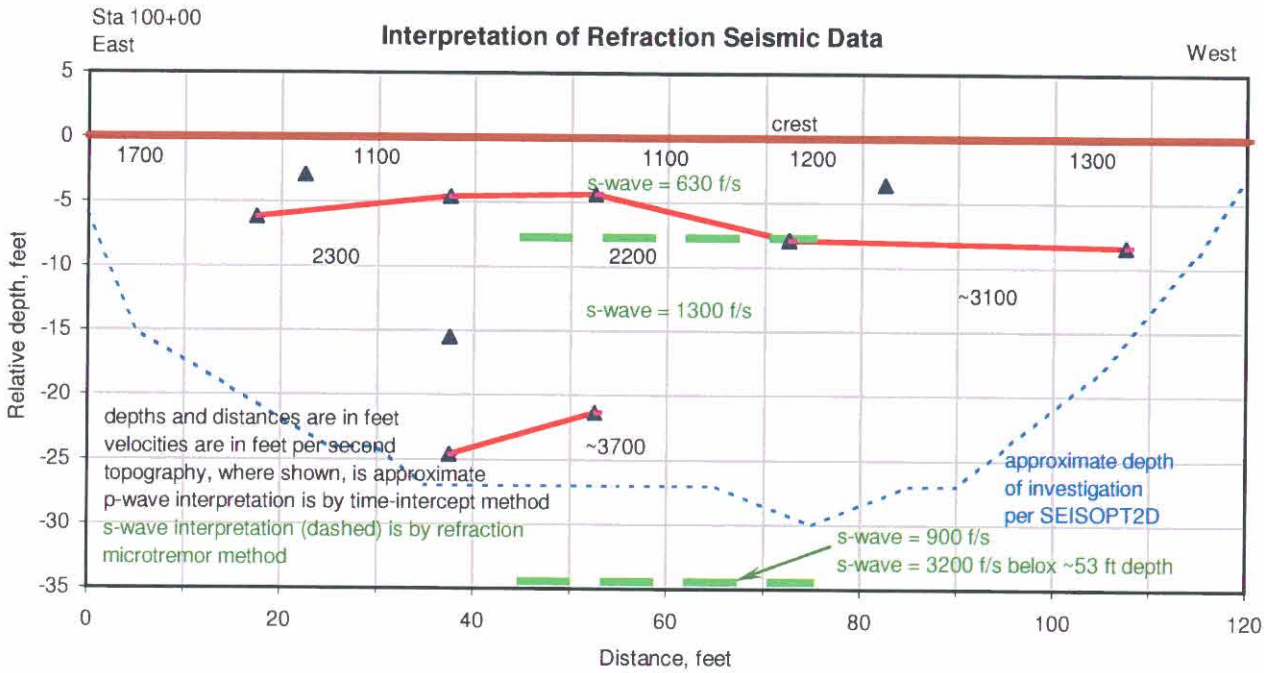

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2930
3240
2680
2.1
1360
1210
9.3
830
1.2
8.2
1.1
860
1290
8.5
1270
1.1
10.3
1.1
1280
2870
8.9
1170
1160
2620
9.6
2570
1220
Time, millisec.
Distance, feet

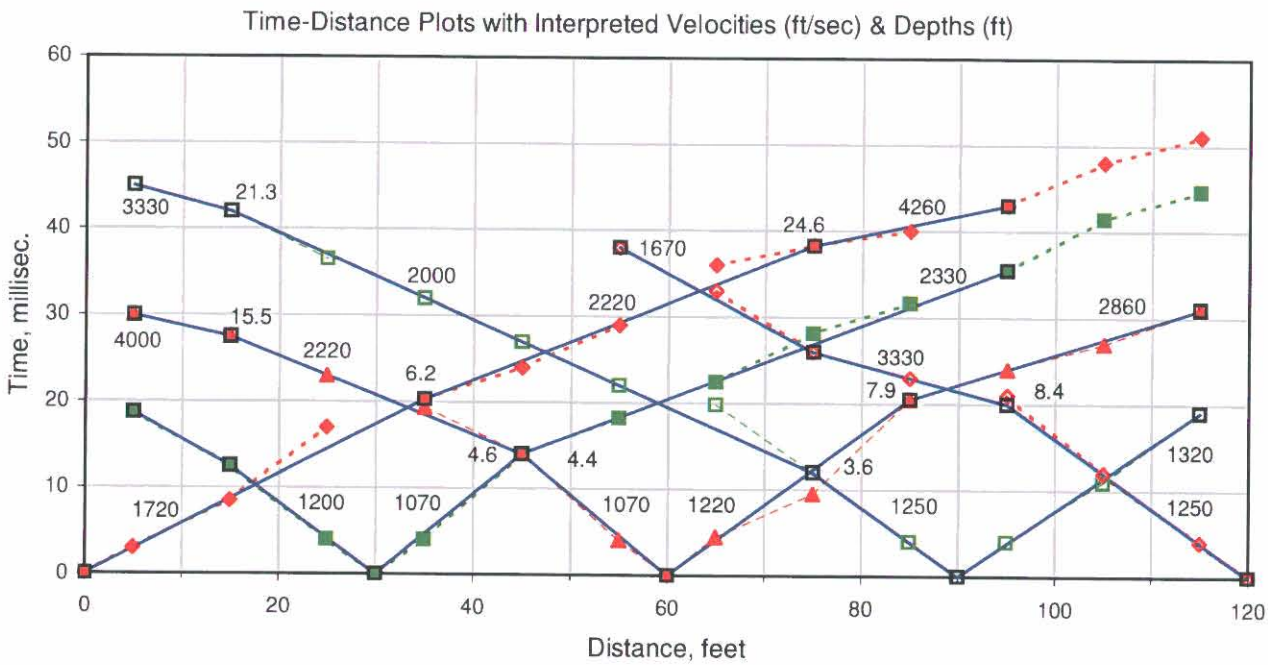

Sta 60+00
East
Interpretation of Refraction Seismic Data
West
crest
1300
1500
1150
1200
1600
1800
2500
s-wave = 580 f/s
s-wave = 970 f/s
s-wave = 1200 f/s
s-wave = 970 f/s
s-wave = 2200 f/s below ~56 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

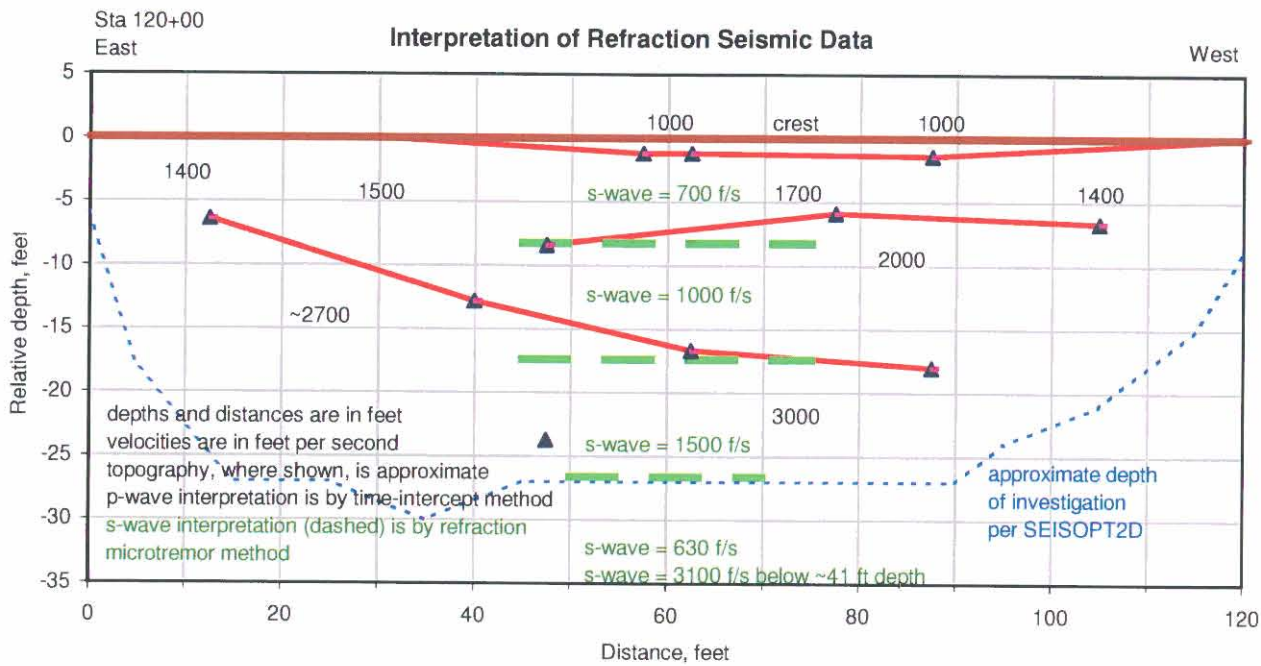

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
30.2
4110
2860
2090
2580
16.1
16.3
2450
11.6
2350
1500
1640
6.6
8.1
2.9
1380
1250
1200
0.8
1640
1170
1140
1220
1250
Time, millisec.
Distance, feet

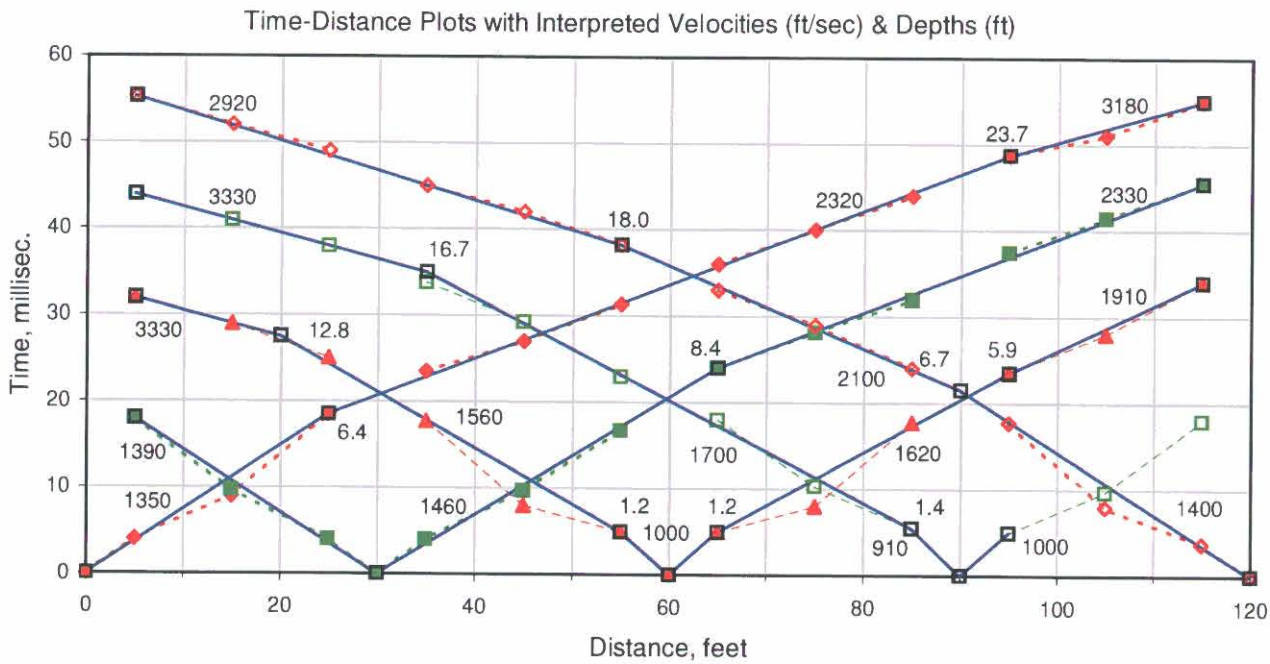

Sta 80+00
East
Interpretation of Refraction Seismic Data
West
crest
940
1100
1000
1000
s-wave = 560 f/s
1800
1900
~2200 ?
s-wave = 920 f/s
2900
3300
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 910 f/s
s-wave = 2700 f/s below ~42 ft depth
Relative depth, feet
Distance, feet

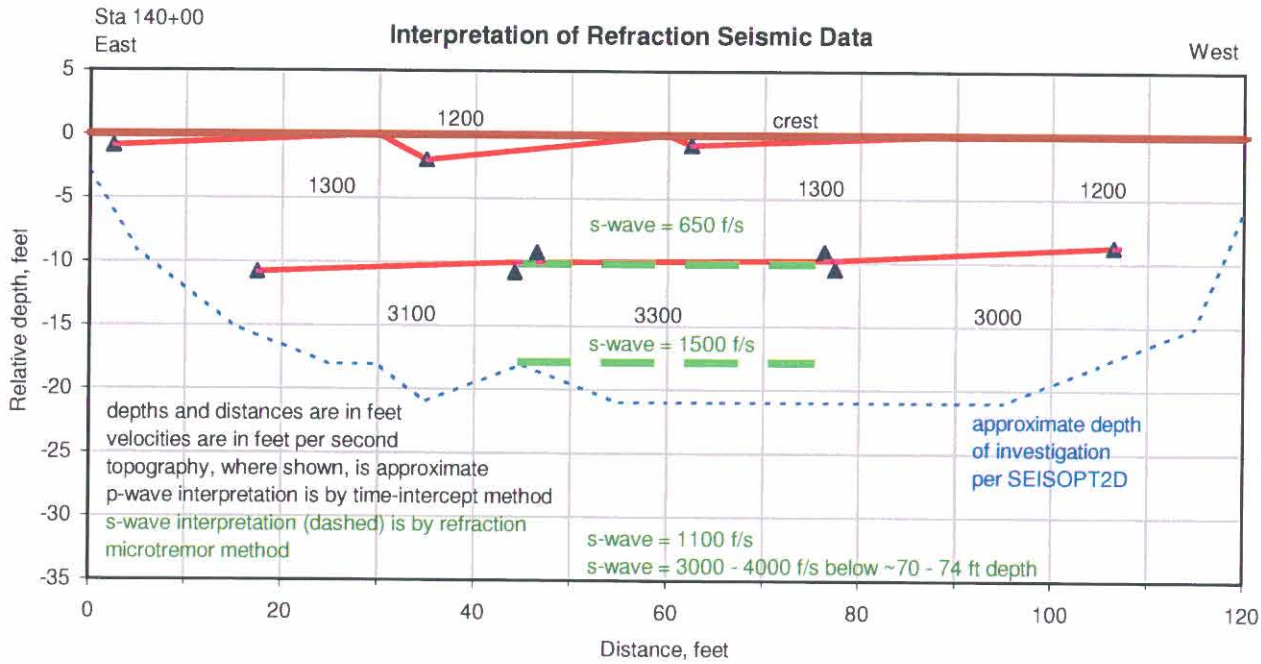

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2950
2820
3260
3330
3080
20.9
8330?
12.1
11.6
11.9
2100
14.3
7.7
4.6
1850
1740
6.0
3.9
3.8
1740
940
1320
1000
1000
1880
1.8
1000
1000
Time, millisec.
Distance, feet

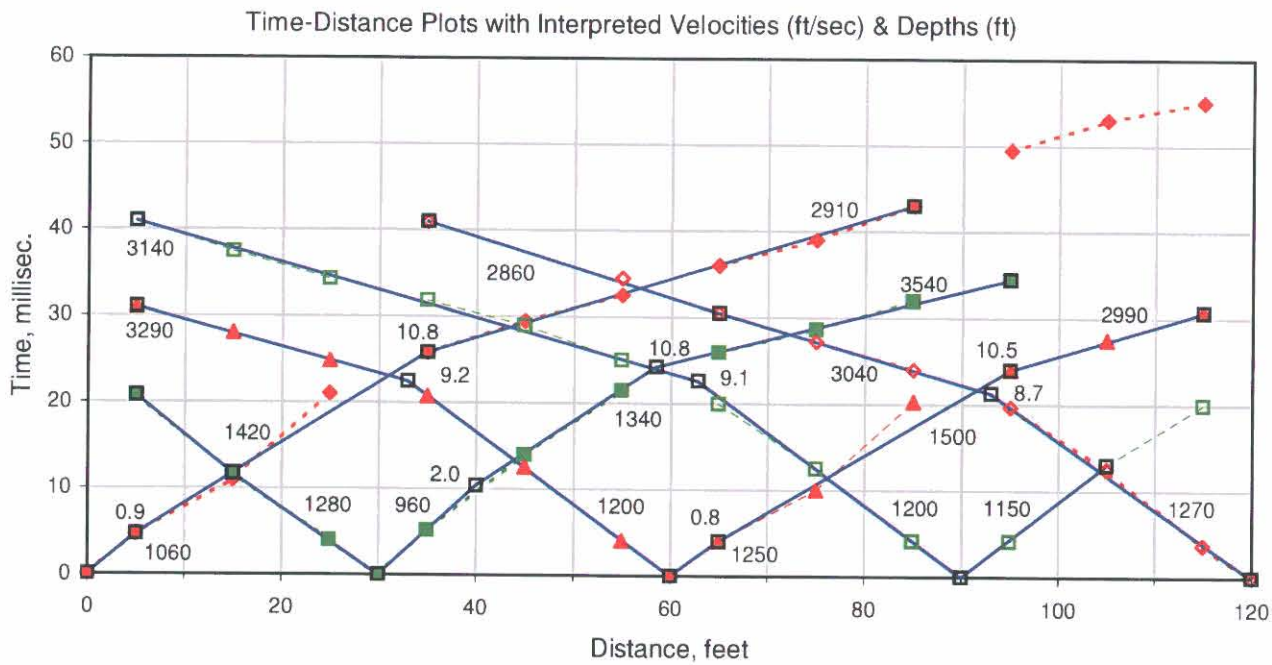

Sta 100+00
East
Interpretation of Refraction Seismic Data
West
crest
1700
1100
1100
1200
1300
s-wave = 630 f/s
2300
2200
~3100
s-wave = 1300 f/s
~3700
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 900 f/s
s-wave = 3200 f/s belox ~53 ft depth
Relative depth, feet
Distance, feet

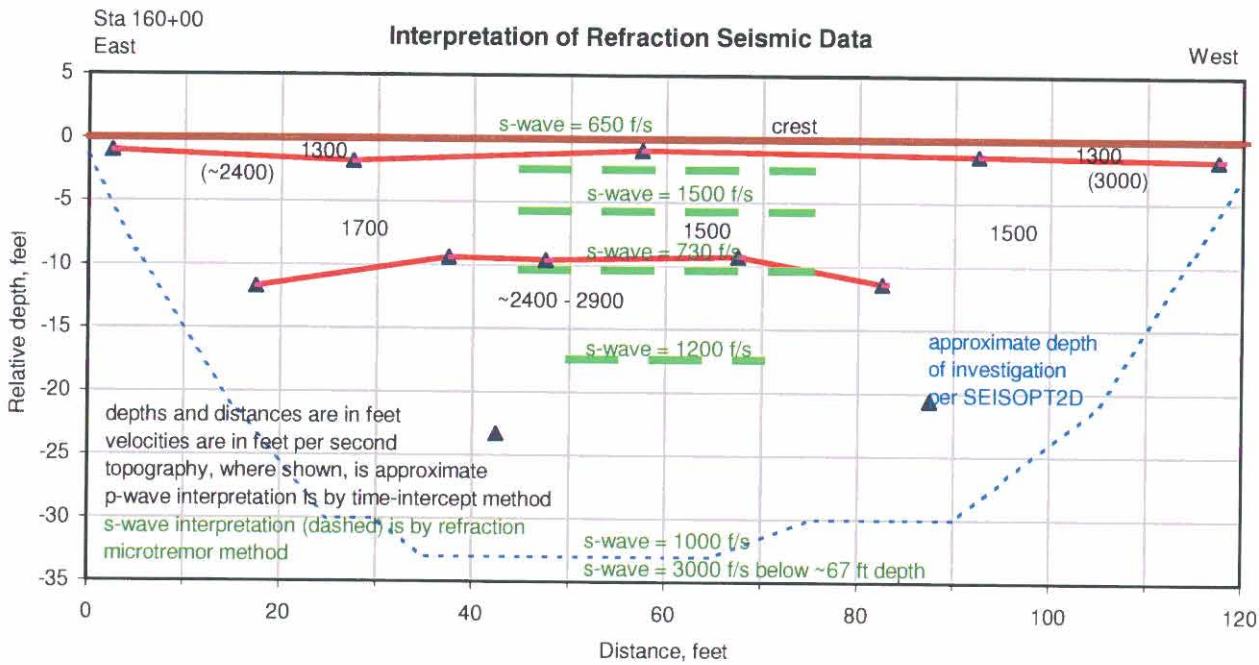

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3330
21.3
2000
1670
24.6
4260
2330
2860
4000
15.5
2220
2220
6.2
3330
7.9
8.4
1320
1720
1200
1070
4.6
4.4
1070
1220
3.6
1250
1250
Time, millisec.
Distance, feet

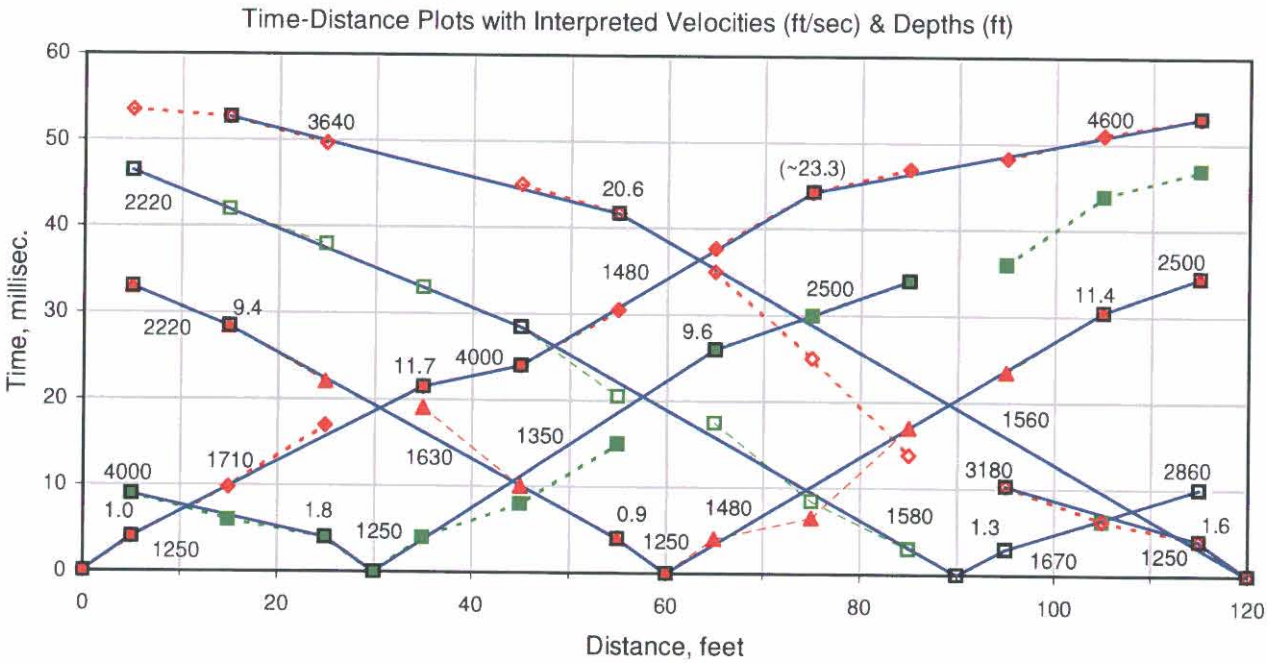

Sta 120+00
East
Interpretation of Refraction Seismic Data
West
1000
crest
1000
1400
1500
s-wave = 700 f/s
1700
1400
2000
s-wave = 1000 f/s
~2700
3000
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 630 f/s
s-wave = 3100 f/s below ~41 ft depth
Relative depth, feet
Distance, feet

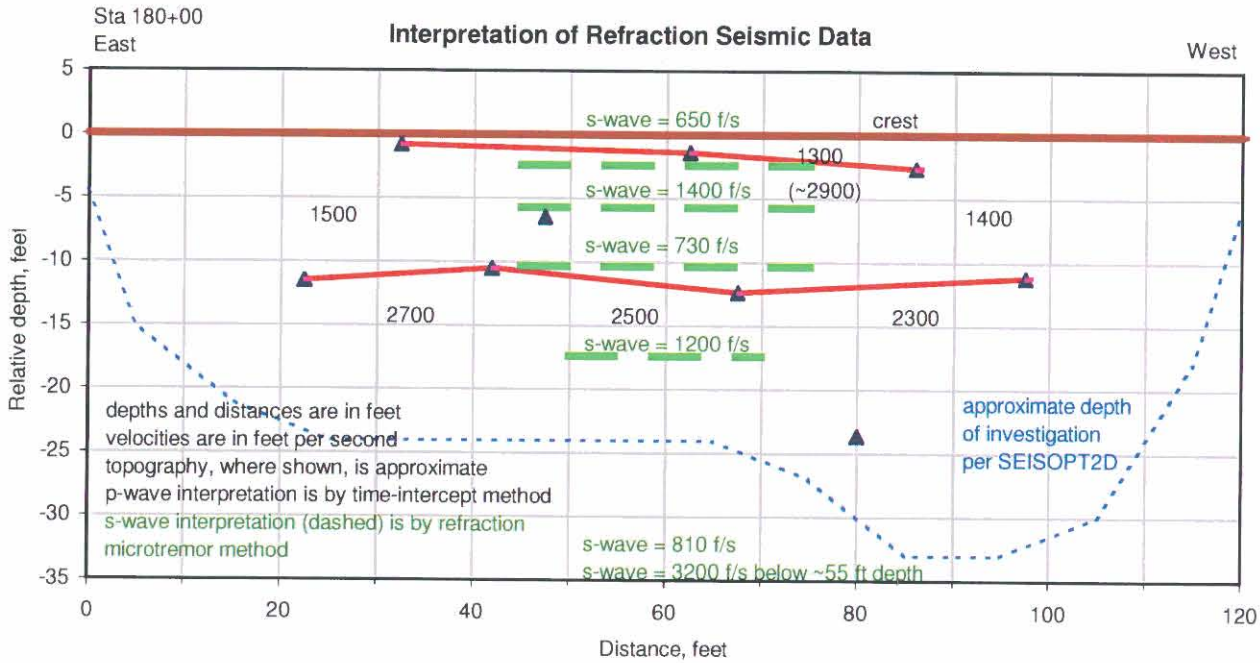

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2920
3180
23.7
3330
2320
2330
18.0
16.7
1910
3330
12.8
8.4
6.7
5.9
2100
1560
6.4
1390
1700
1620
1350
1460
1.2
1.2
1.4
1400
1000
910
1000
Time, millisec.
Distance, feet

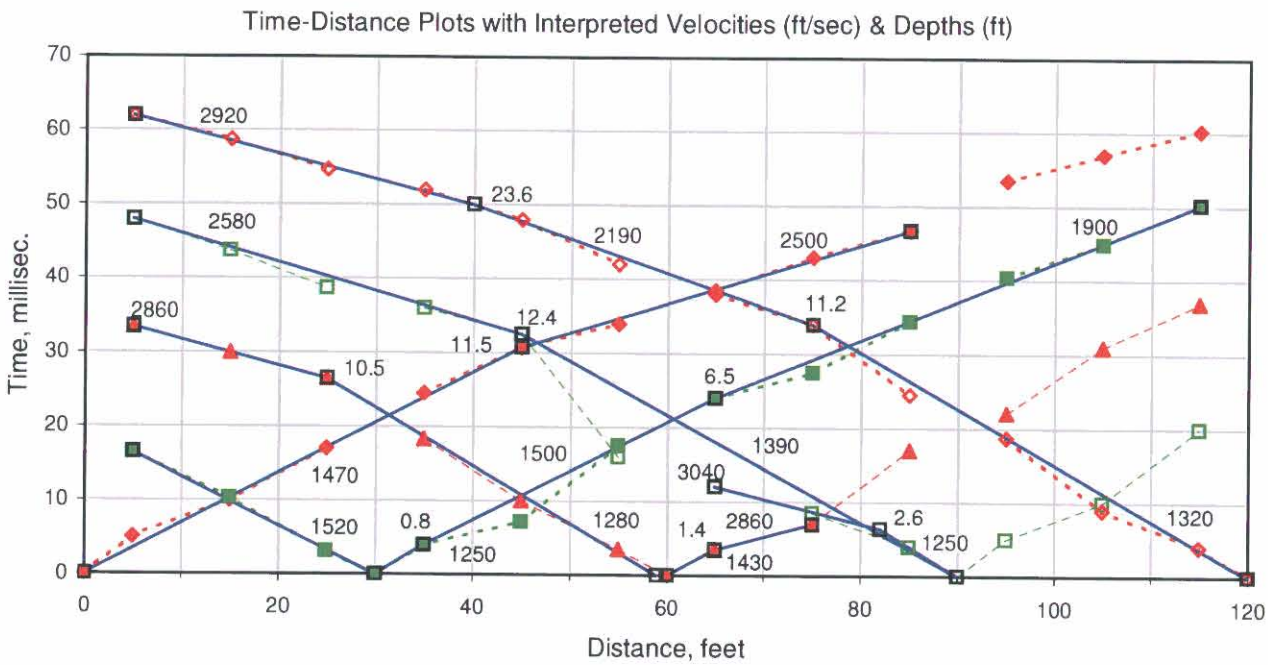

Sta 140+00
East
Interpretation of Refraction Seismic Data
West
1200
crest
1300
1300
1200
s-wave = 650 f/s
3100
3300
3000
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1100 f/s
s-wave = 3000 - 4000 f/s below ~70 - 74 ft depth
Relative depth, feet
Distance, feet

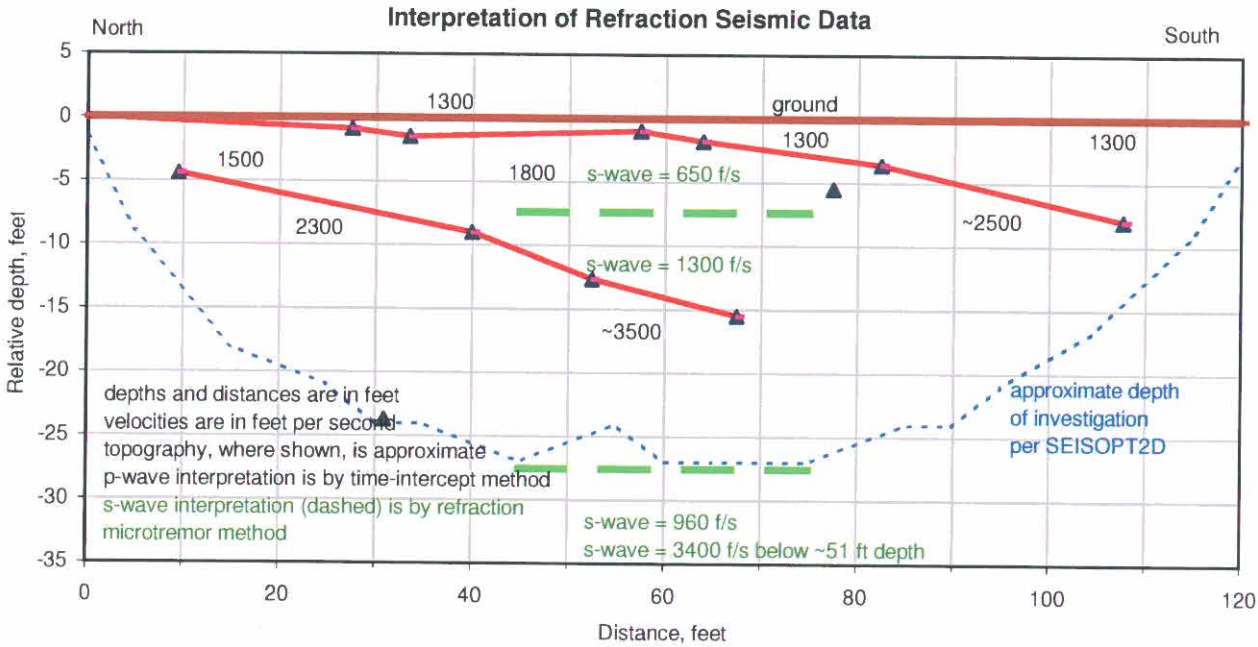

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
3140
3290
2860
2910
3540
2990
10.8
9.2
10.8
9.1
3040
10.5
8.7
1420
1340
1500
2.0
0.9
1060
1280
960
1200
0.8
1250
1200
1150
1270

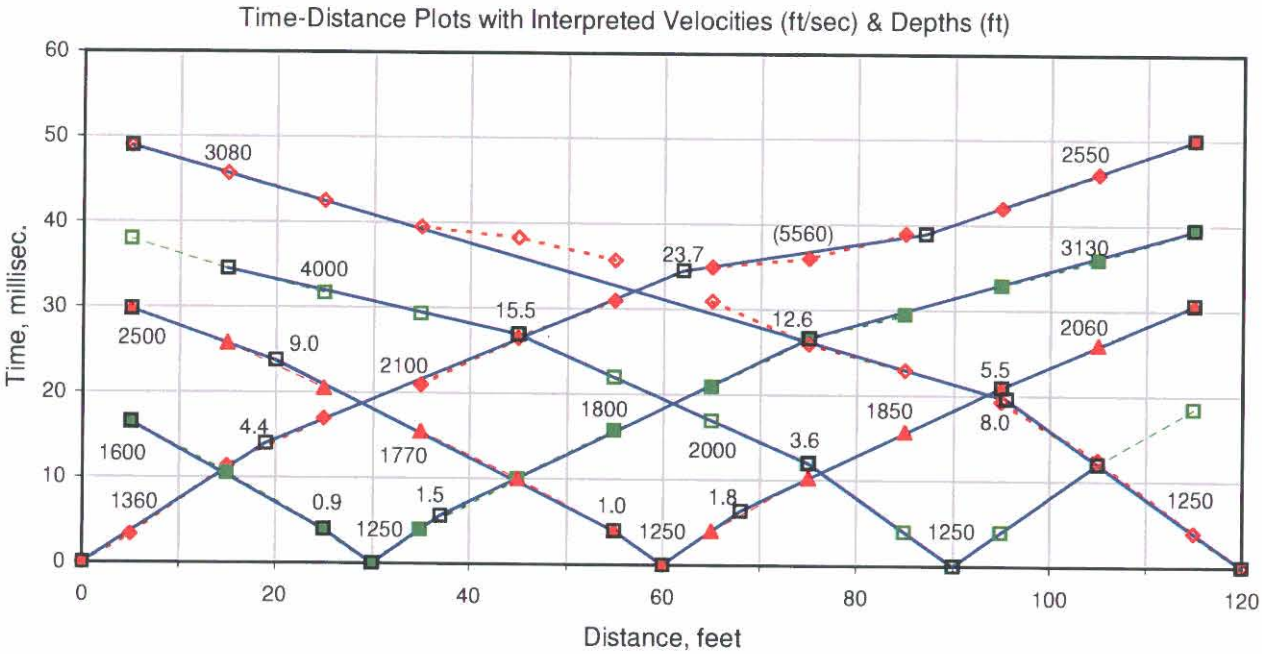

Sta 160+00
East
Interpretation of Refraction Seismic Data
West
s-wave = 650 f/s
crest
1300
(~2400)
1300
(3000)
s-wave = 1500 f/s
1700
1500
1500
s-wave = 730 f/s
~2400 - 2900
s-wave = 1200 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 1000 f/s
s-wave = 3000 f/s below ~67 ft depth
Relative depth, feet
Distance, feet

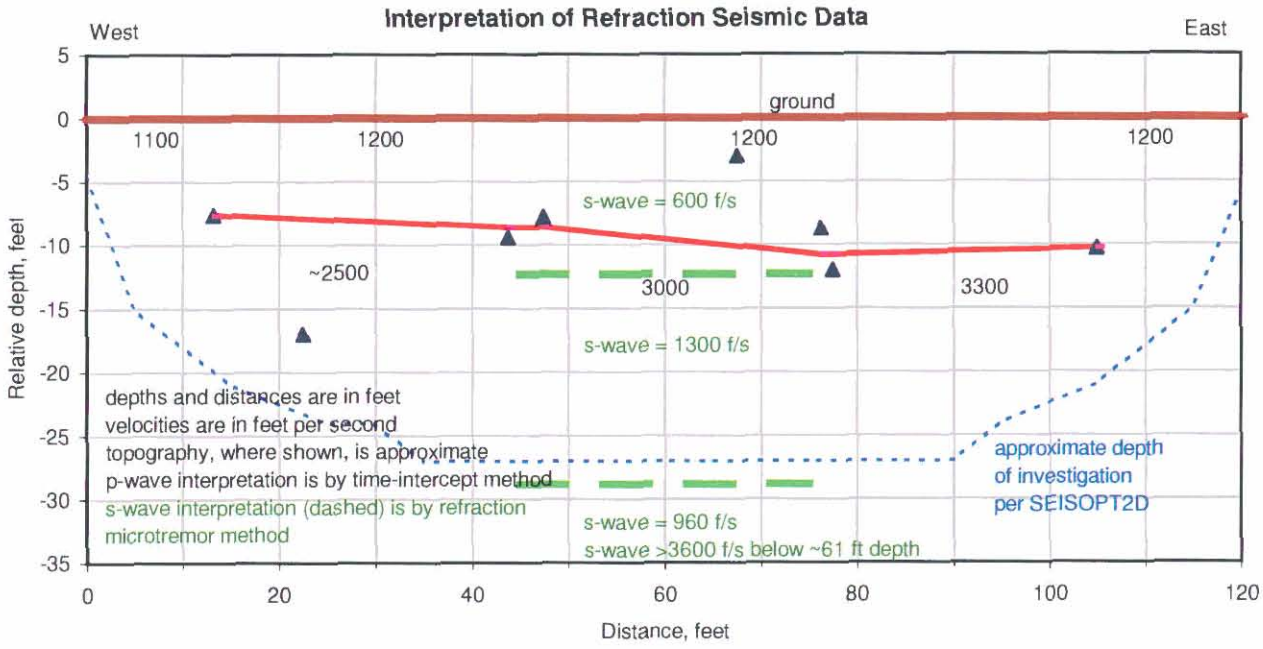

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3640
4600
(~23.3)
20.6
2220
1480
2500
2500
9.4
11.4
2220
9.6
11.7
4000
1560
1350
1710
1630
4000
3180
2860
1.0
1.8
0.9
1480
1580
1.3
1.6
1250
1250
1250
1670
1250
Time, millisec.
Distance, feet

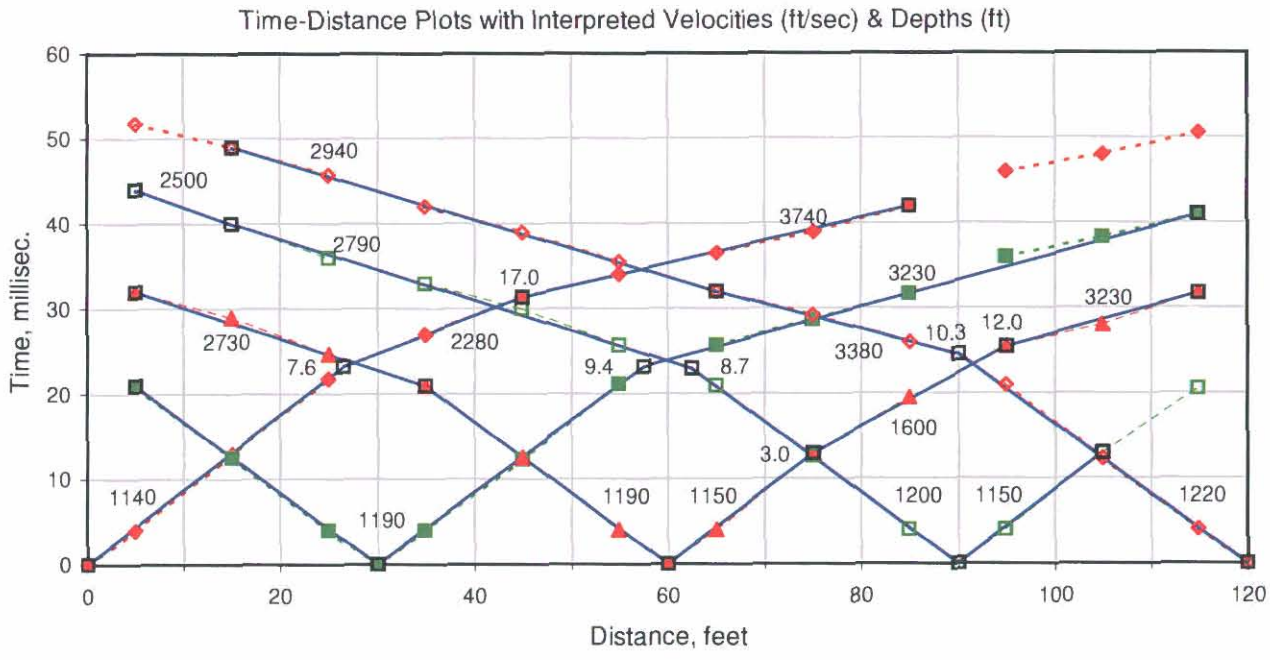

Sta 180+00
East
Interpretation of Refraction Seismic Data
West
s-wave = 650 f/s
crest
1300
s-wave = 1400 f/s
(~2900)
1500
1400
s-wave = 730 f/s
2700
2500
2300
s-wave = 1200 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 810 f/s
s-wave = 3200 f/s below ~55 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2920
23.6
2190
2500
1900
2580
2860
12.4
11.5
11.2
10.5
6.5
1470
1500
1390
3040
1520
0.8
1280
1.4
2860
2.6
1250
1320
1250
1430
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
North
South
ground
1300
1300
1300
1500
1800
s-wave = 650 f/s
2300
~2500
s-wave = 1300 f/s
~3500
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 960 f/s
s-wave = 3400 f/s below ~51 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3080
2550
(5560)
23.7
4000
3130
15.5
12.6
2500
9.0
2100
2060
5.5
1800
1850
8.0
4.4
1600
1770
2000
3.6
1360
0.9
1.5
1.0
1.8
1250
1250
1250
1250
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
West
East
ground
1100
1200
1200
1200
s-wave = 600 f/s
~2500
3000
3300
s-wave = 1300 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 960 f/s
s-wave >3600 f/s below ~61 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2940
2500
2790
3740
17.0
3230
3230
2730
2280
7.6
9.4
8.7
3380
10.3
12.0
1600
3.0
1140
1190
1190
1150
1200
1150
1220
Time, millisec.
Distance, feet

Refraction Seismic Interpretation

Line 61

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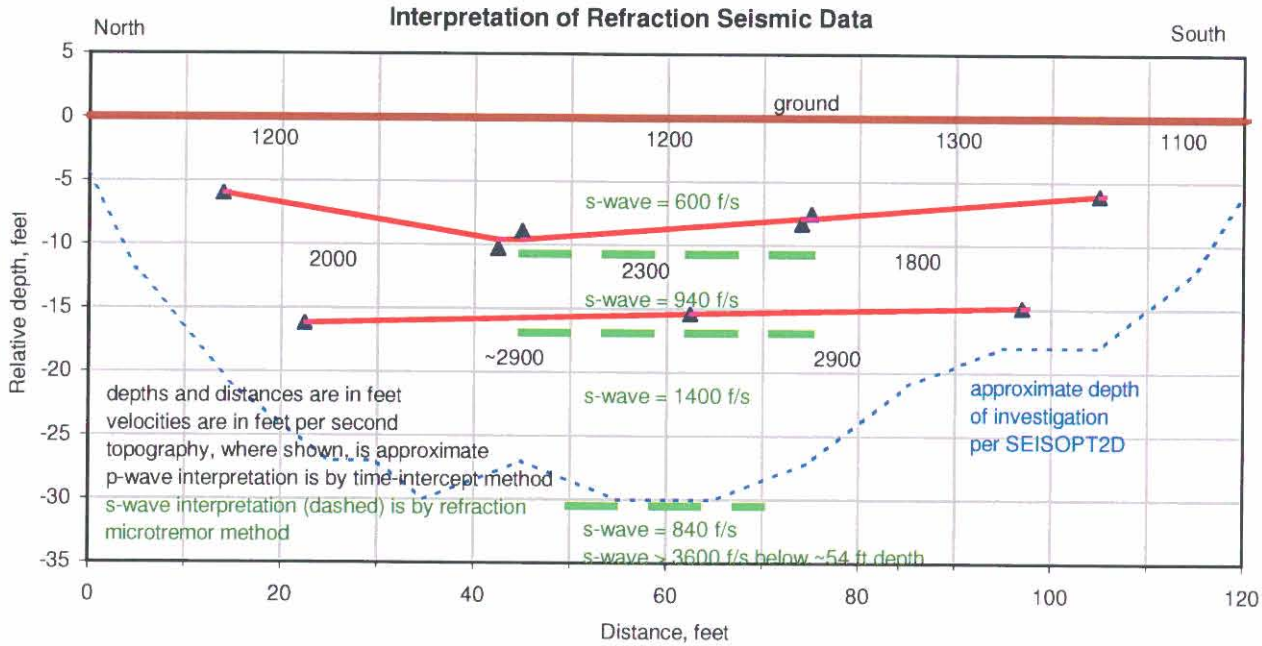
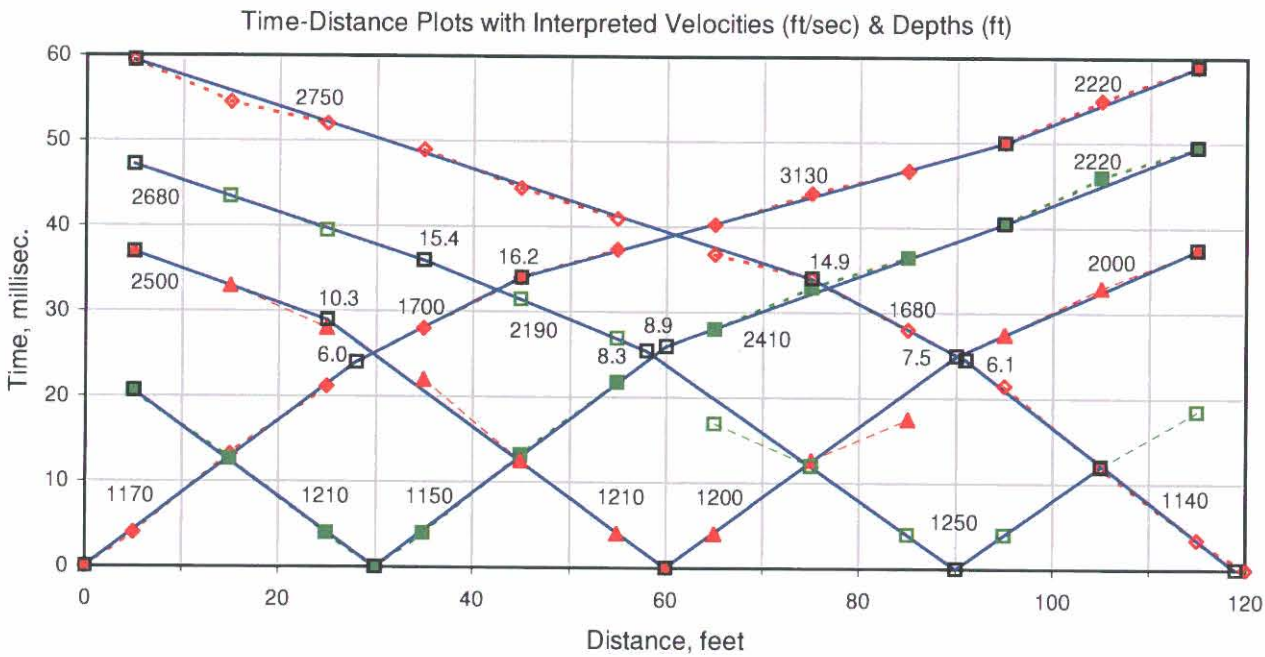
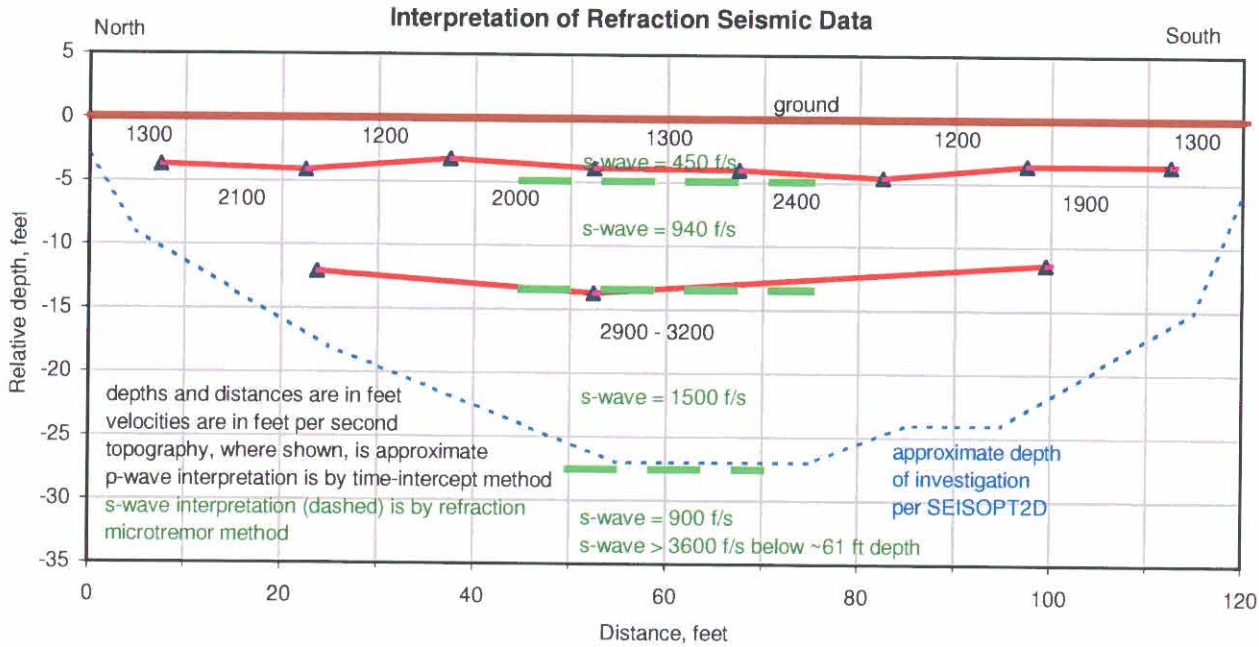
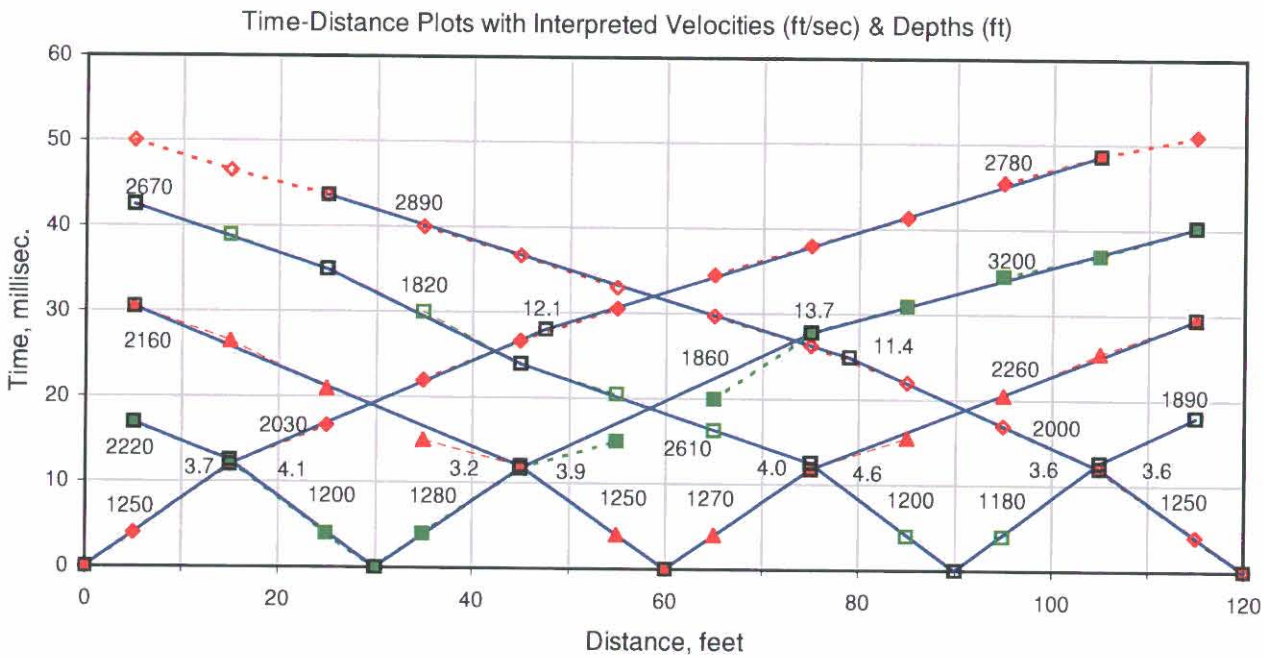
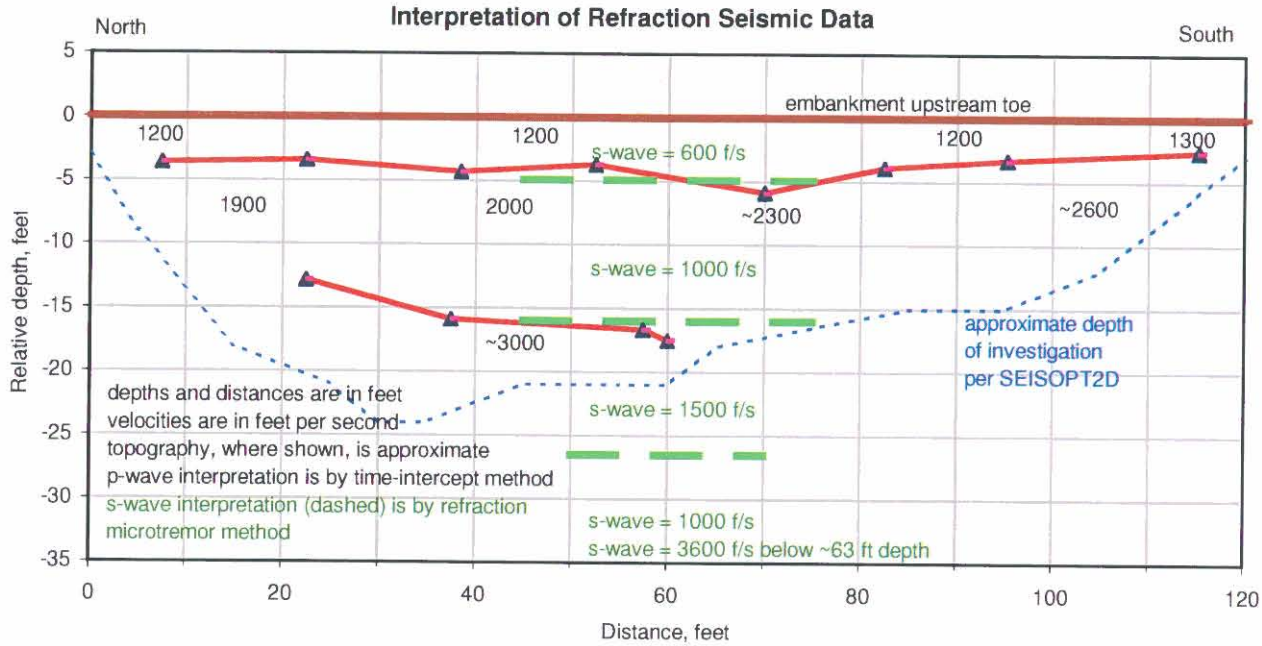
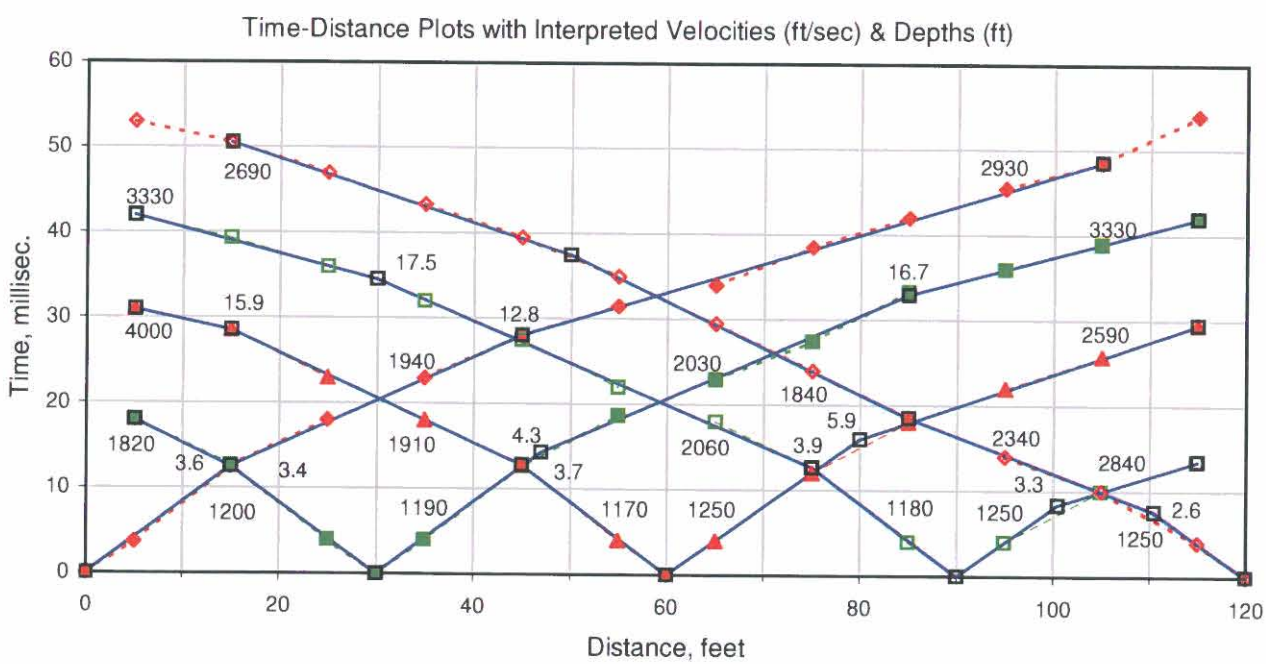


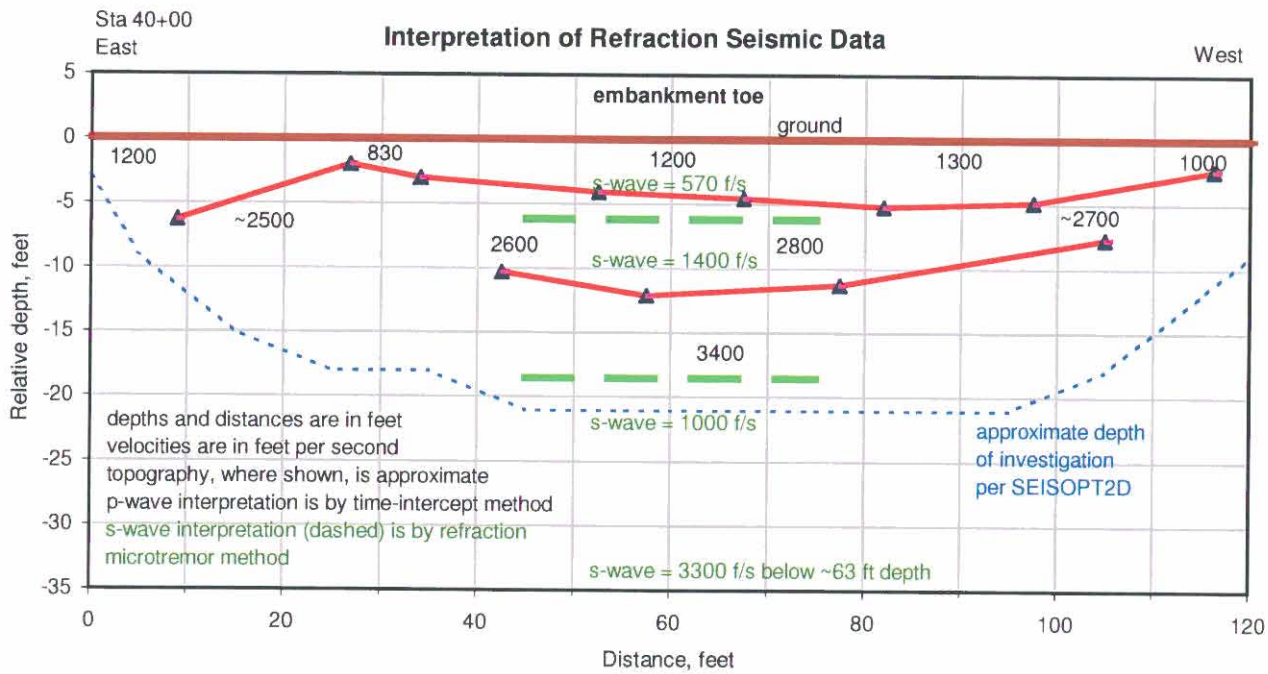


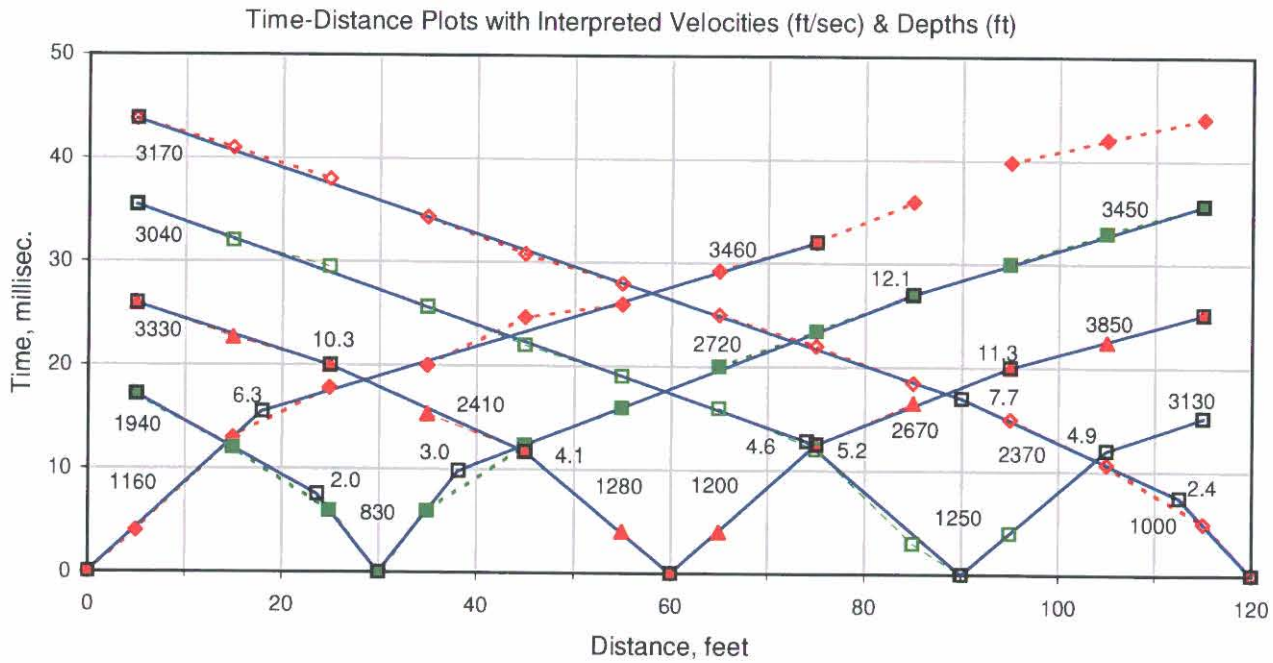

Interpretation of Refraction Seismic Data
North
South
ground
1300
1200
1300
1200
1300
2100
2000
2400
1900
s-wave = 450 f/s
s-wave = 940 f/s
2900 - 3200
s-wave = 1500 f/s
s-wave = 900 f/s
s-wave > 3600 f/s below ~61 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

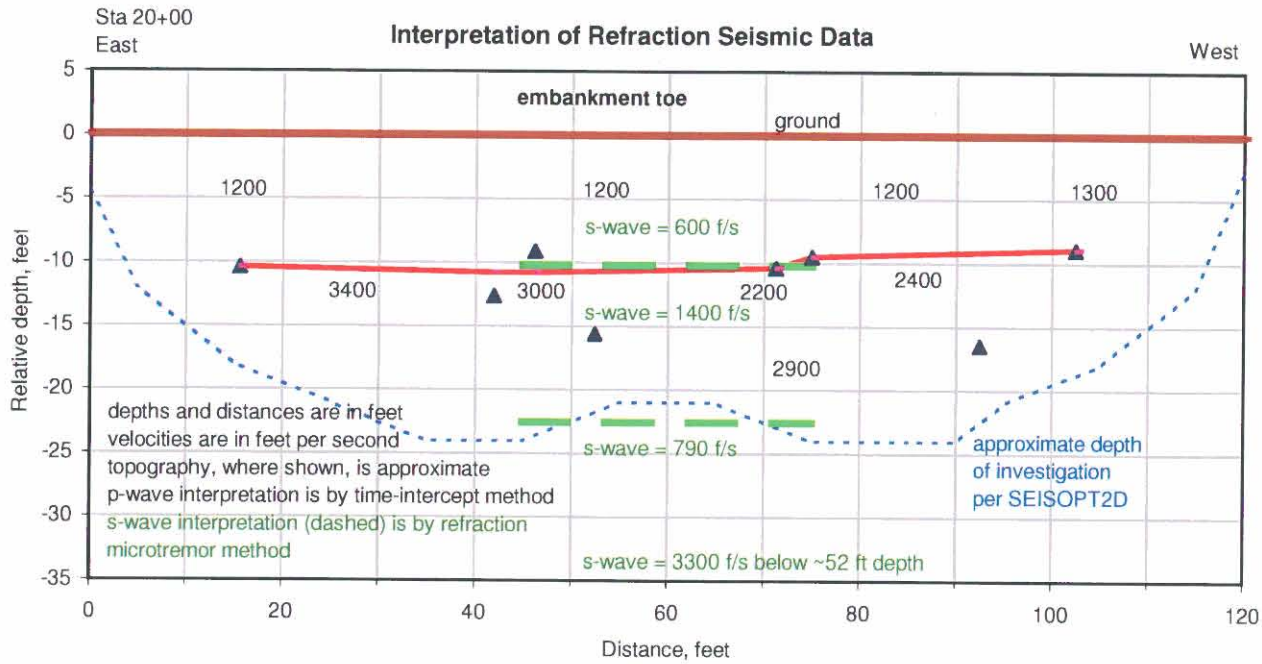

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
2670
2890
2780
1820
3200
12.1
13.7
2160
11.4
1860
2260
1890
2030
2000
2220
2610
3.7
4.1
3.2
3.9
4.0
4.6
3.6
3.6
1250
1200
1280
1250
1270
1200
1180
1250

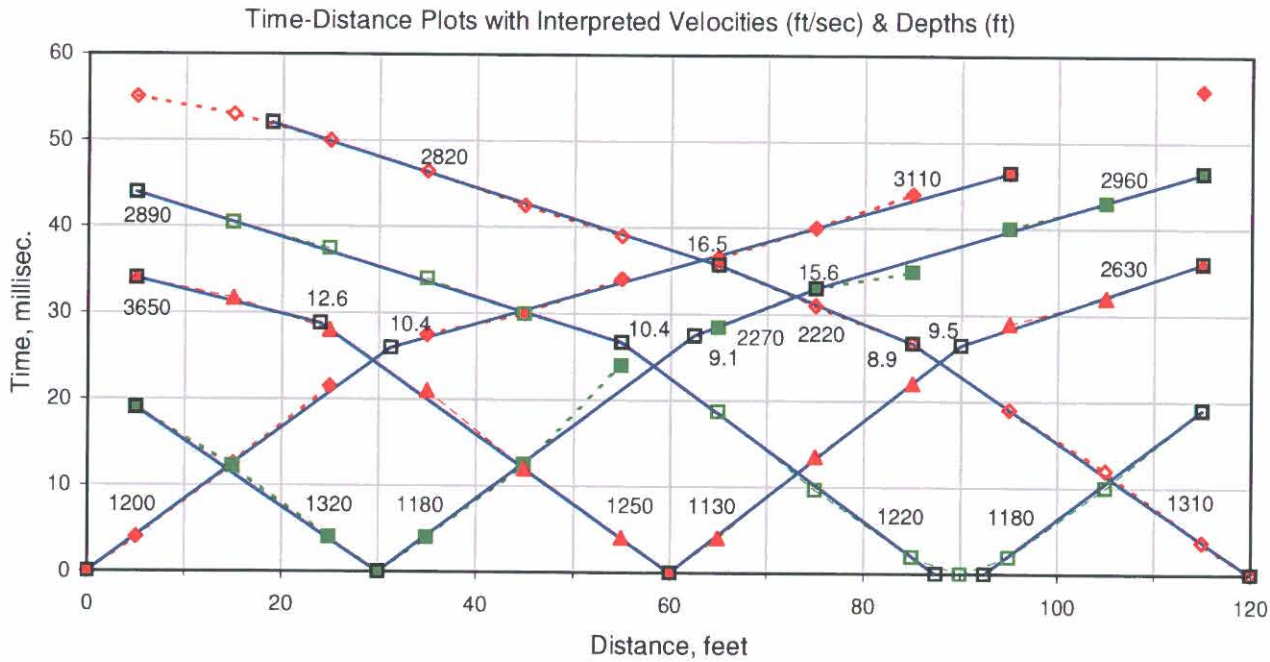

Interpretation of Refraction Seismic Data
North
South
embankment upstream toe
1200
1200
1200
1300
1900
2000
~2300
~2600
~3000
s-wave = 600 f/s
s-wave = 1000 f/s
s-wave = 1500 f/s
s-wave = 1000 f/s
s-wave = 3600 f/s below ~63 ft depth
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet

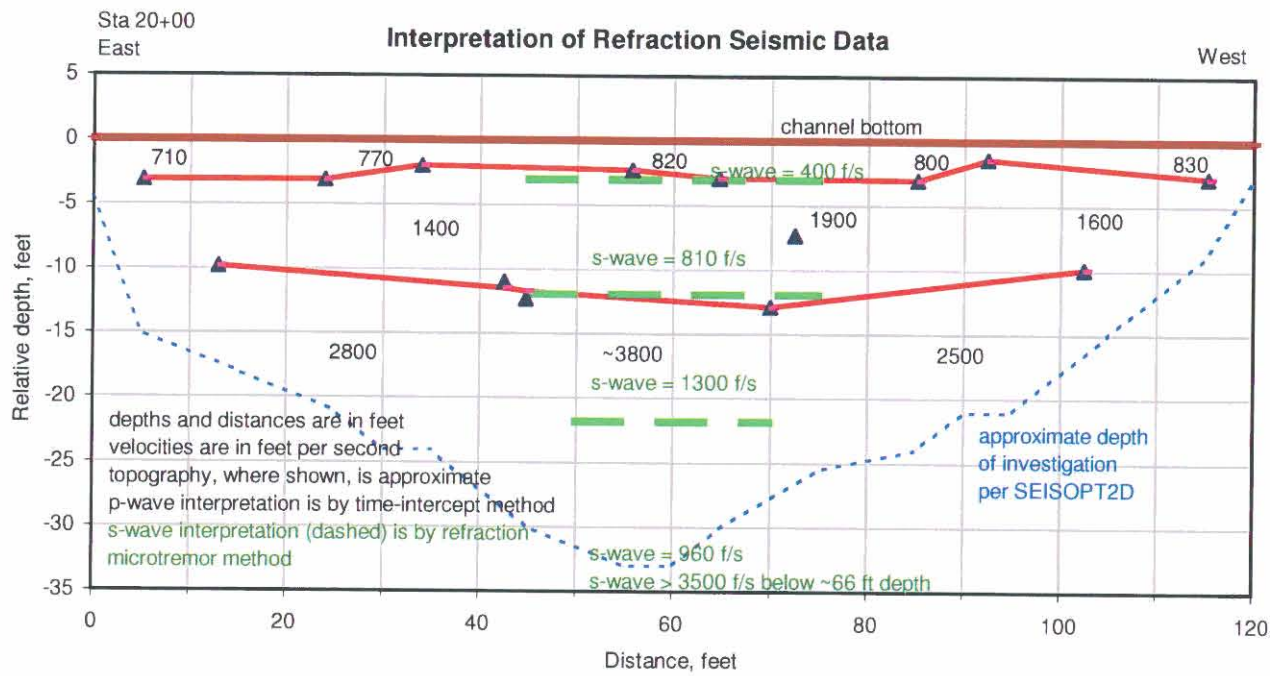

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
2690
3330
4000
1820
3.6
1200
15.9
17.5
1940
3.4
1910
12.8
4.3
1190
3.7
1170
2030
2060
1250
1840
3.9
5.9
1180
16.7
2930
2340
1250
3.3
3330
2590
2840
2.6
1250

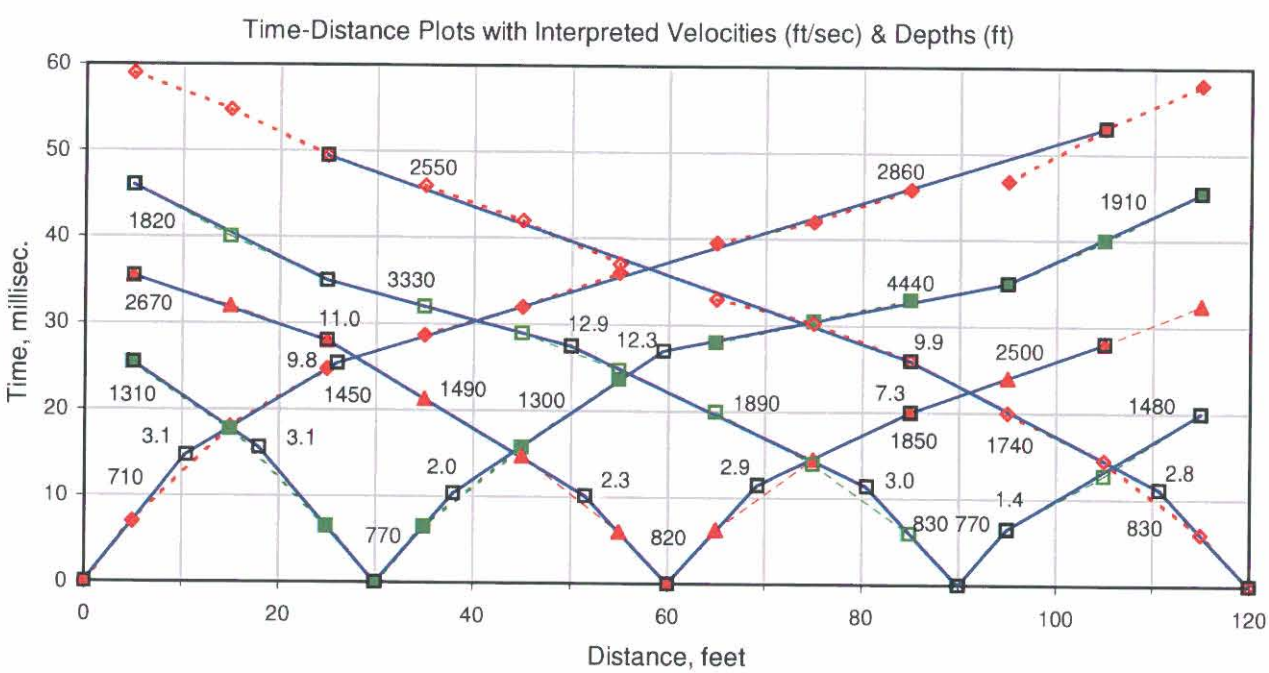

Sta 40+00
East
Interpretation of Refraction Seismic Data
West
embankment toe
ground
1200
830
1200
1300
1000
~2500
~2700
2600
2800
s-wave = 570 f/s
s-wave = 1400 f/s
3400
s-wave = 1000 f/s
s-wave = 3300 f/s below ~63 ft depth
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet

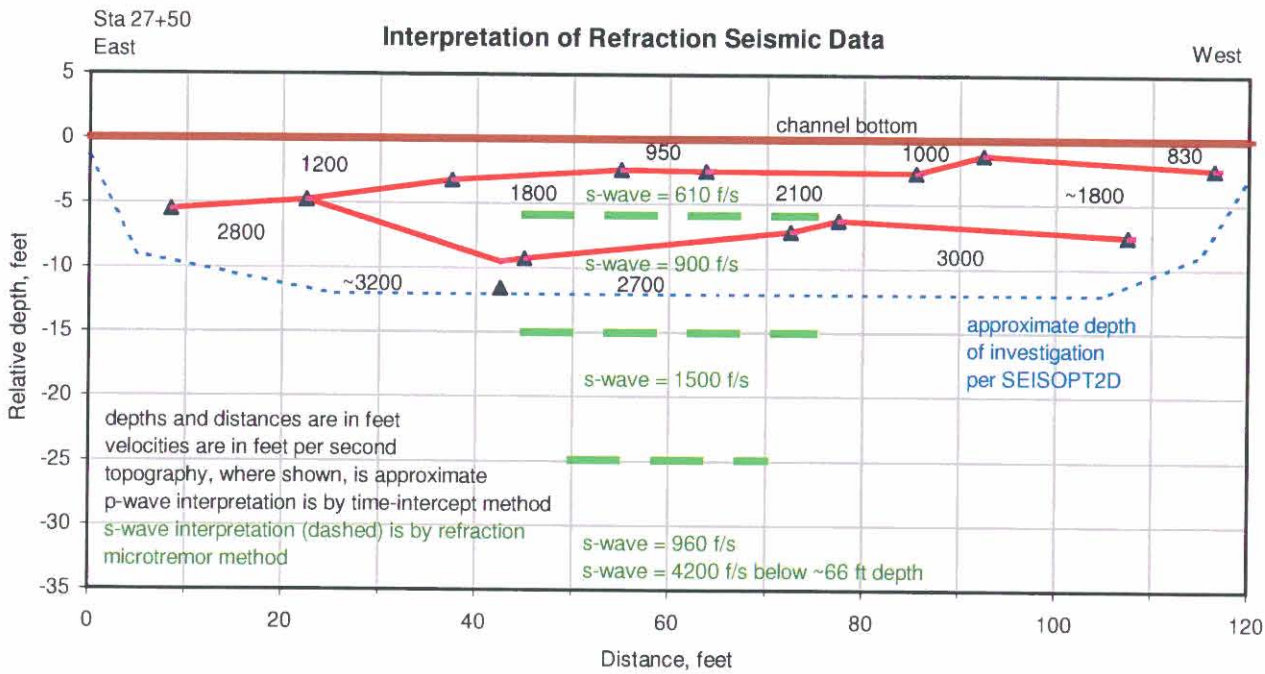

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3170
3040
3330
1940
1160
10.3
6.3
2.0
830
3.0
2410
4.1
1280
3460
2720
1200
4.6
5.2
12.1
2670
1250
11.3
7.7
2370
3450
3850
4.9
3130
2.4
1000
Time, millisec.
Distance, feet

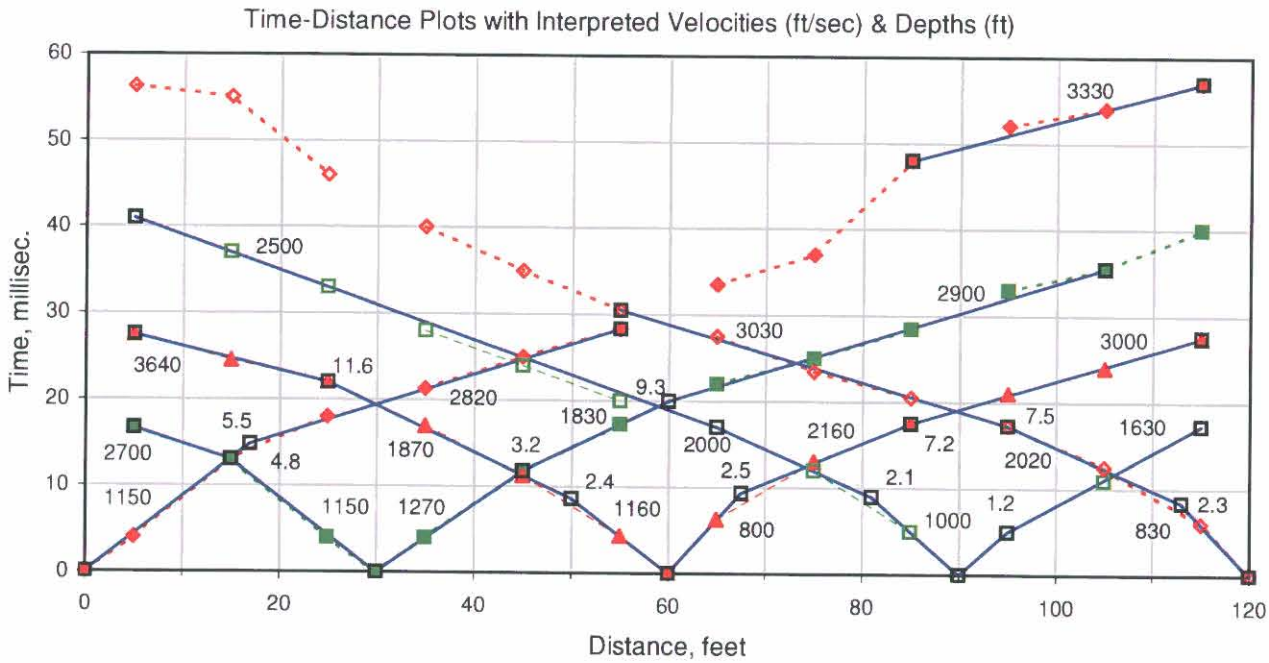

Sta 20+00
East
Interpretation of Refraction Seismic Data
West
embankment toe
ground
1200
1200
1200
1300
s-wave = 600 f/s
3400
3000
2200
2400
s-wave = 1400 f/s
2900
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 790 f/s
approximate depth of investigation per SEISOPT2D
s-wave = 3300 f/s below ~52 ft depth
Relative depth, feet
Distance, feet

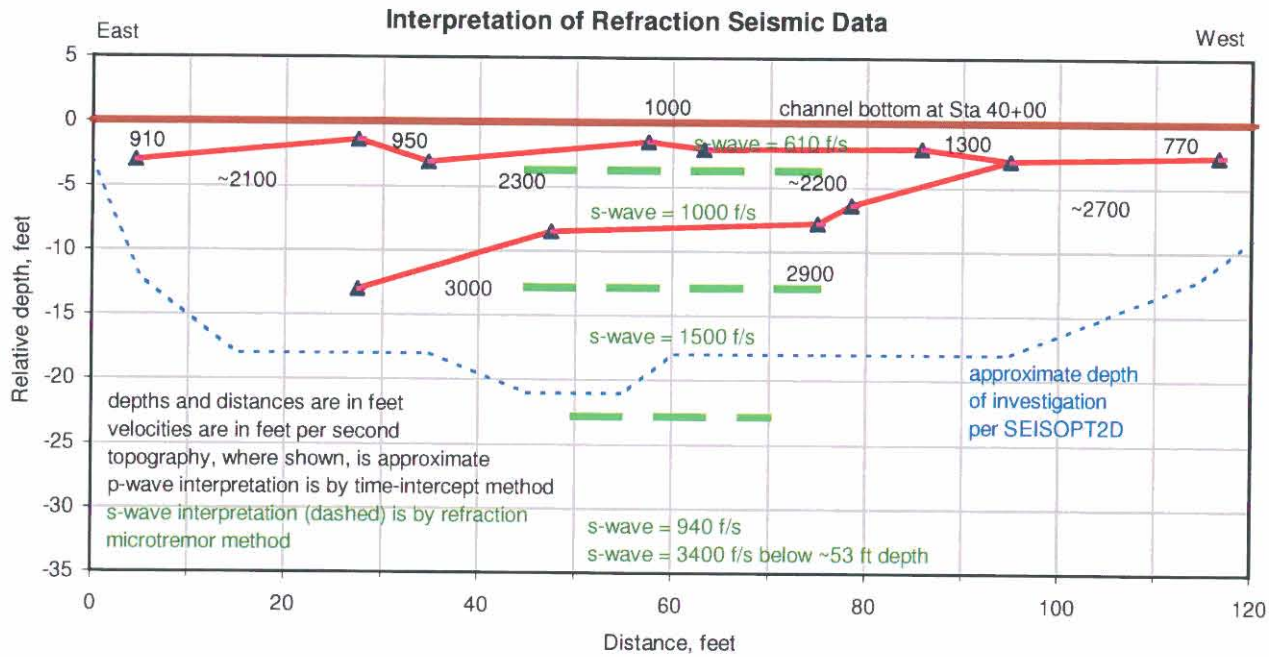

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
2820
3110
2960
2890
16.5
15.6
2630
3650
12.6
10.4
10.4
2270
2220
9.5
9.1
8.9
1200
1320
1180
1250
1130
1220
1180
1310
Time, millisec.
Distance, feet

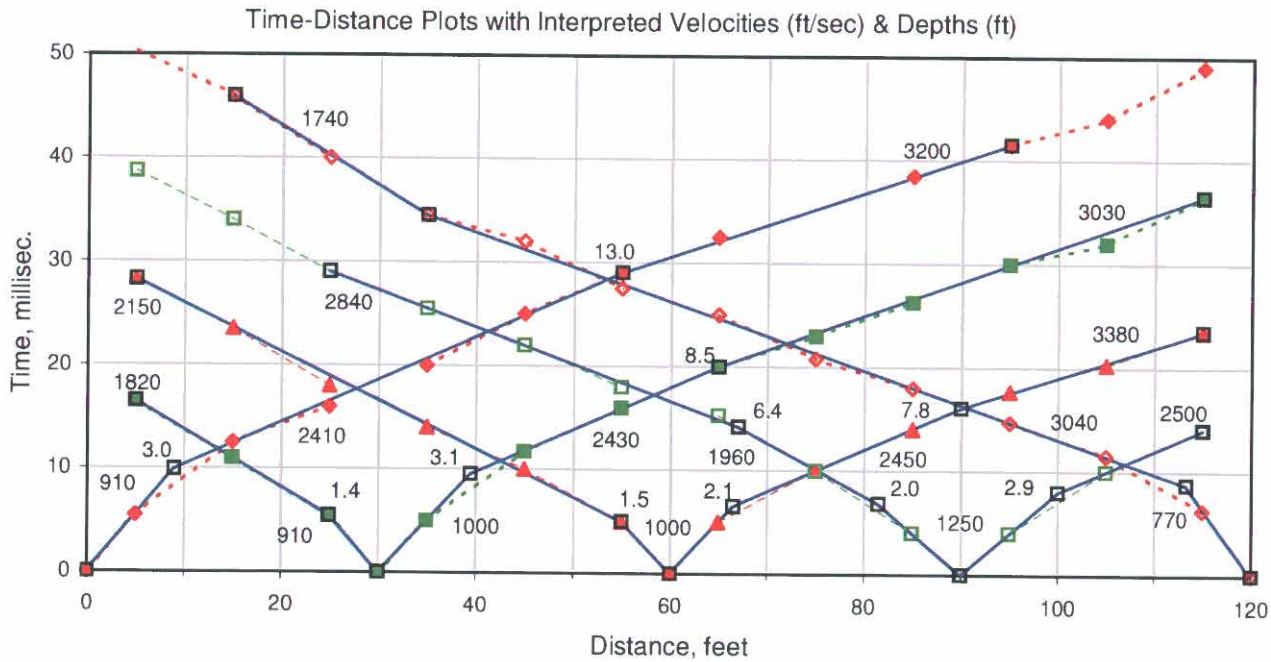

Sta 20+00
East
Interpretation of Refraction Seismic Data
West
channel bottom
710
770
820
800
830
s-wave = 400 f/s
1400
1900
1600
s-wave = 810 f/s
2800
~3800
2500
s-wave = 1300 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 960 f/s
s-wave > 3500 f/s below ~66 ft depth
Relative depth, feet
Distance, feet

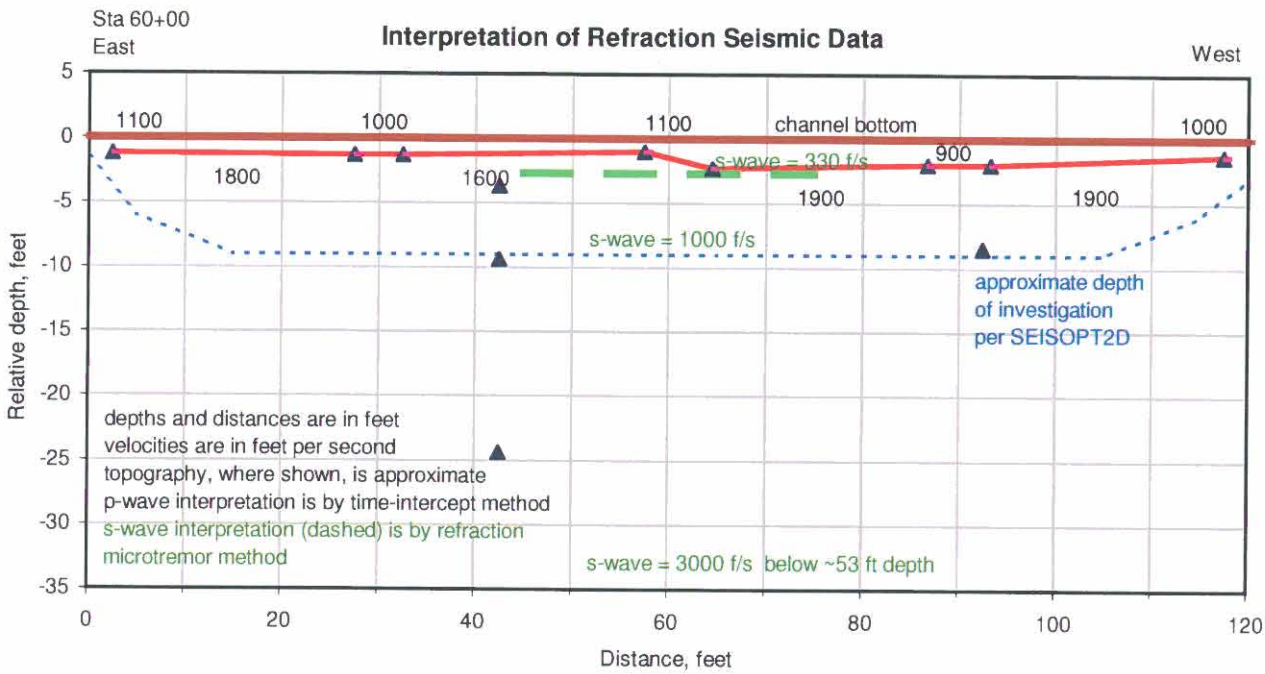

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet

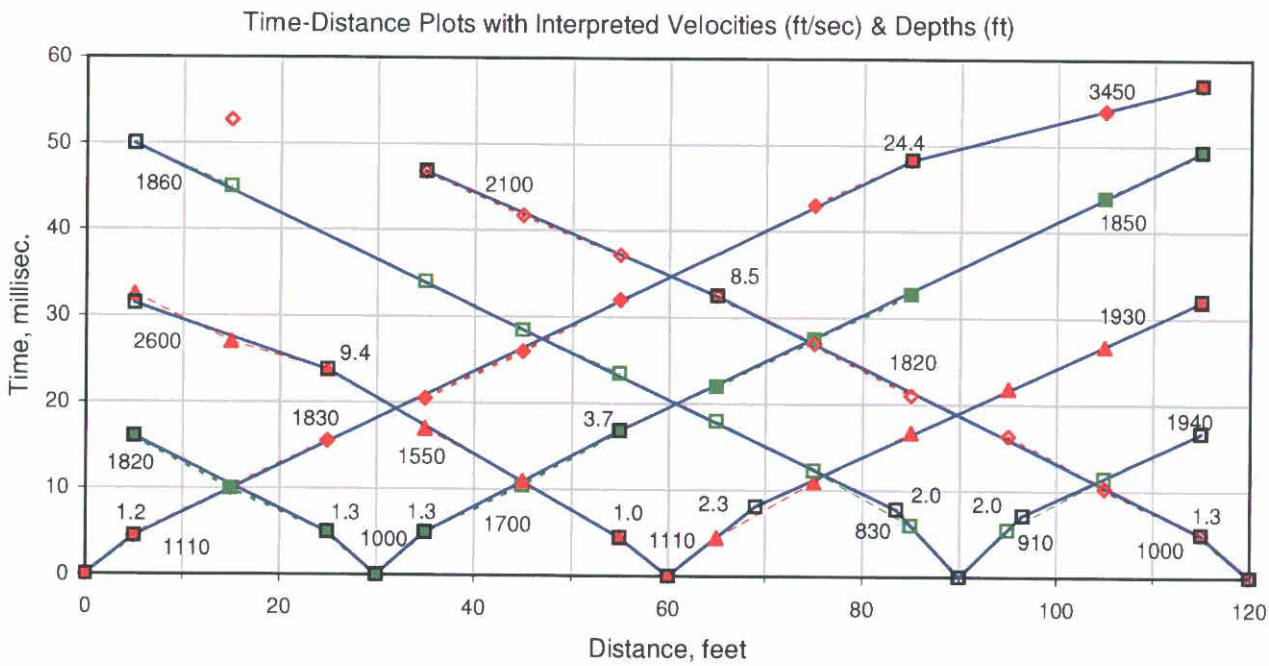

Sta 27+50
East
Interpretation of Refraction Seismic Data
West
channel bottom
1200
950
1000
830
1800
s-wave = 610 f/s
2100
~1800
2800
s-wave = 900 f/s
3000
~3200
2700
approximate depth
of investigation
per SEISOPT2D
s-wave = 1500 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 960 f/s
s-wave = 4200 f/s below ~66 ft depth
Relative depth, feet
Distance, feet

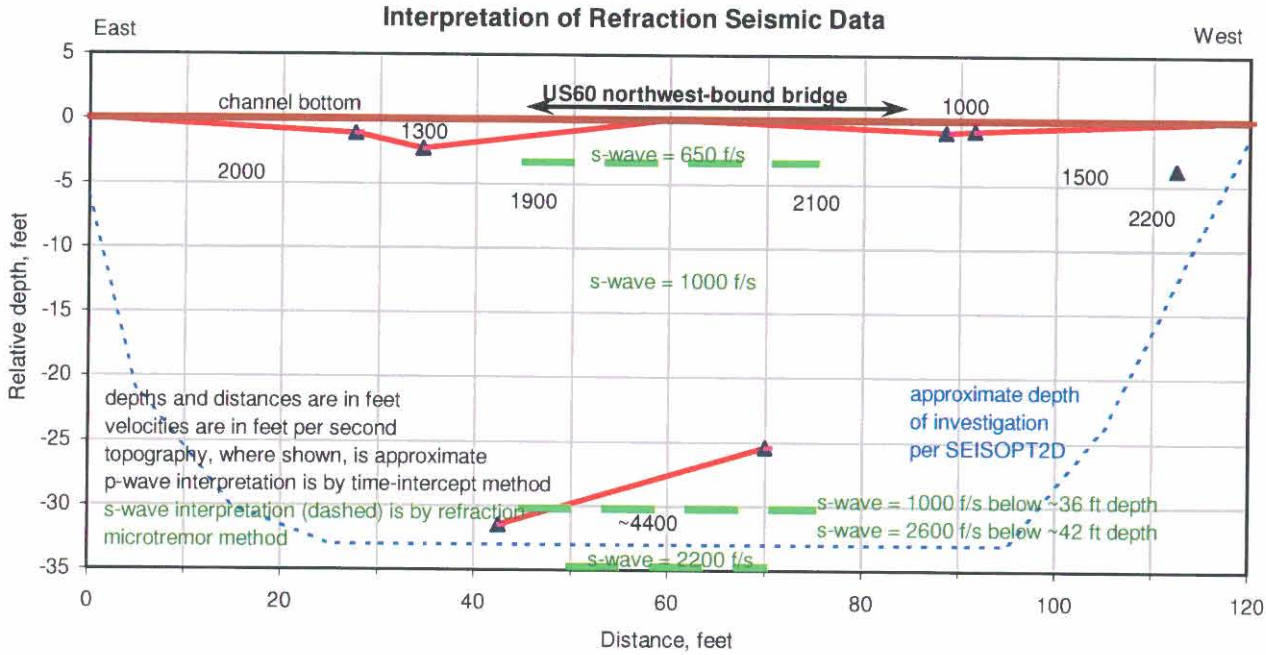

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3330
2500
2900
3030
3640
11.6
3000
9.3
2820
1830
5.5
7.5
2160
1630
2700
4.8
1870
3.2
2000
7.2
2020
2.5
2.1
2.4
1150
1150
1270
1160
800
1000
1.2
2.3
830
Time, millisec.
Distance, feet

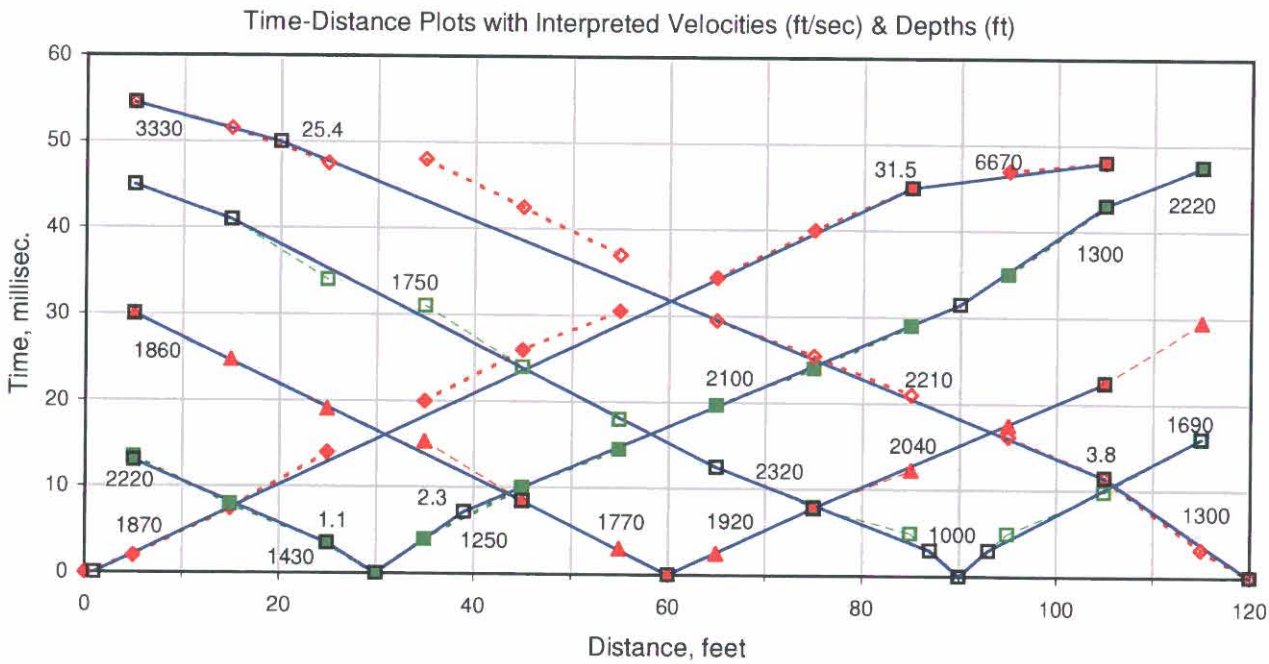

Interpretation of Refraction Seismic Data
East
West
channel bottom at Sta 40+00
910
950
1000
1300
770
~2100
2300
~2200
~2700
3000
2900
s-wave = 610 f/s
s-wave = 1000 f/s
s-wave = 1500 f/s
s-wave = 940 f/s
s-wave = 3400 f/s below ~53 ft depth
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
1740
3200
3030
13.0
2150
2840
3380
8.5
1820
6.4
7.8
3040
2500
2410
2430
3.0
3.1
1960
2450
910
1.4
1.5
2.1
2.0
2.9
910
1000
1000
1250
770
Time, millisec.
Distance, feet


Sta 60+00
East
Interpretation of Refraction Seismic Data
West
1100
1000
1100
channel bottom
1000
1800
1600
s-wave = 330 f/s
900
1900
1900
s-wave = 1000 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 3000 f/s below ~53 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet

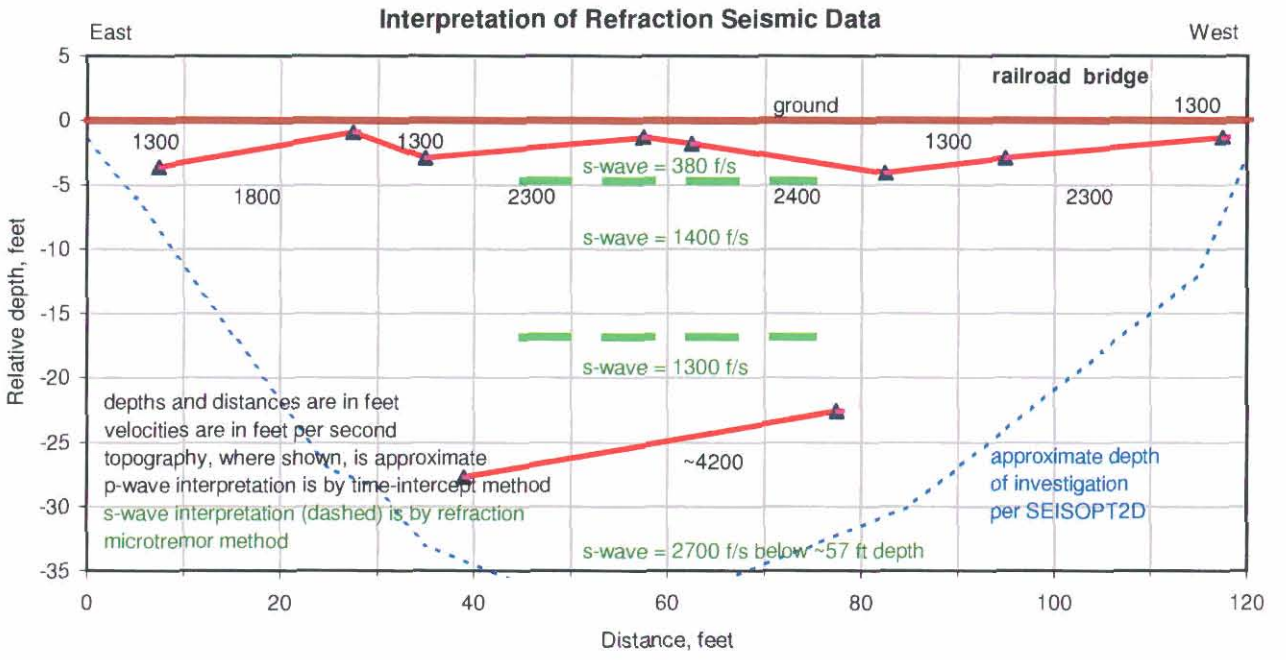

Interpretation of Refraction Seismic Data
East
West
channel bottom
US60 northwest-bound bridge
1300
1000
2000
1900
2100
1500
2200
s-wave = 650 f/s
s-wave = 1000 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
~4400
s-wave = 1000 f/s below ~36 ft depth
s-wave = 2600 f/s below ~42 ft depth
s-wave = 2200 f/s
Relative depth, feet
Distance, feet

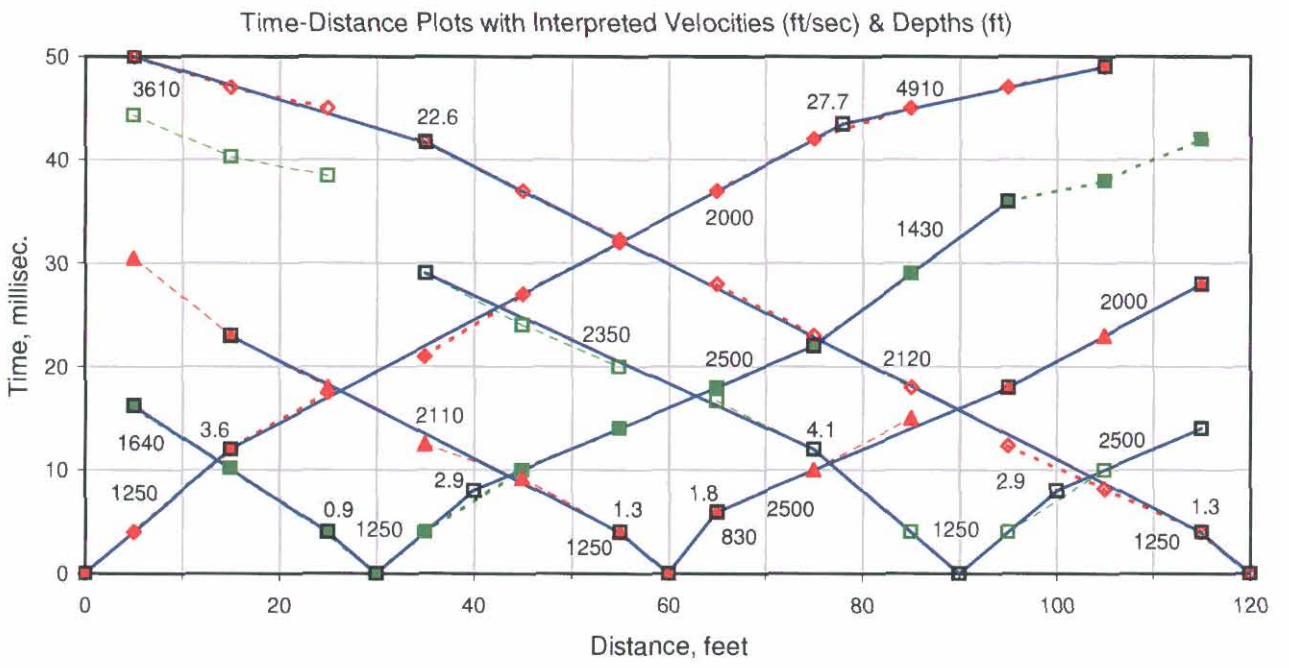

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3330
25.4
31.5
6670
2220
1300
1750
1860
2100
2210
1690
2040
3.8
2220
2320
2.3
1.1
1870
1430
1250
1770
1920
1000
1300
Time, millisec.
Distance, feet

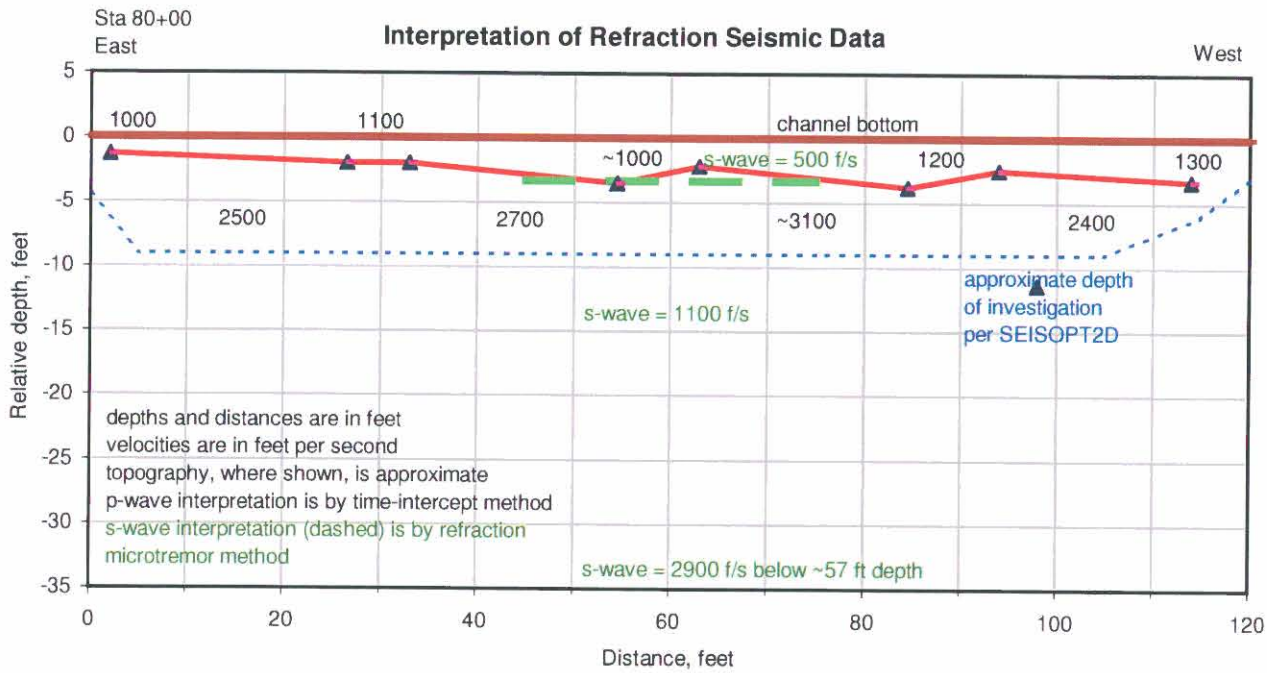
Refraction Seismic Interpretation

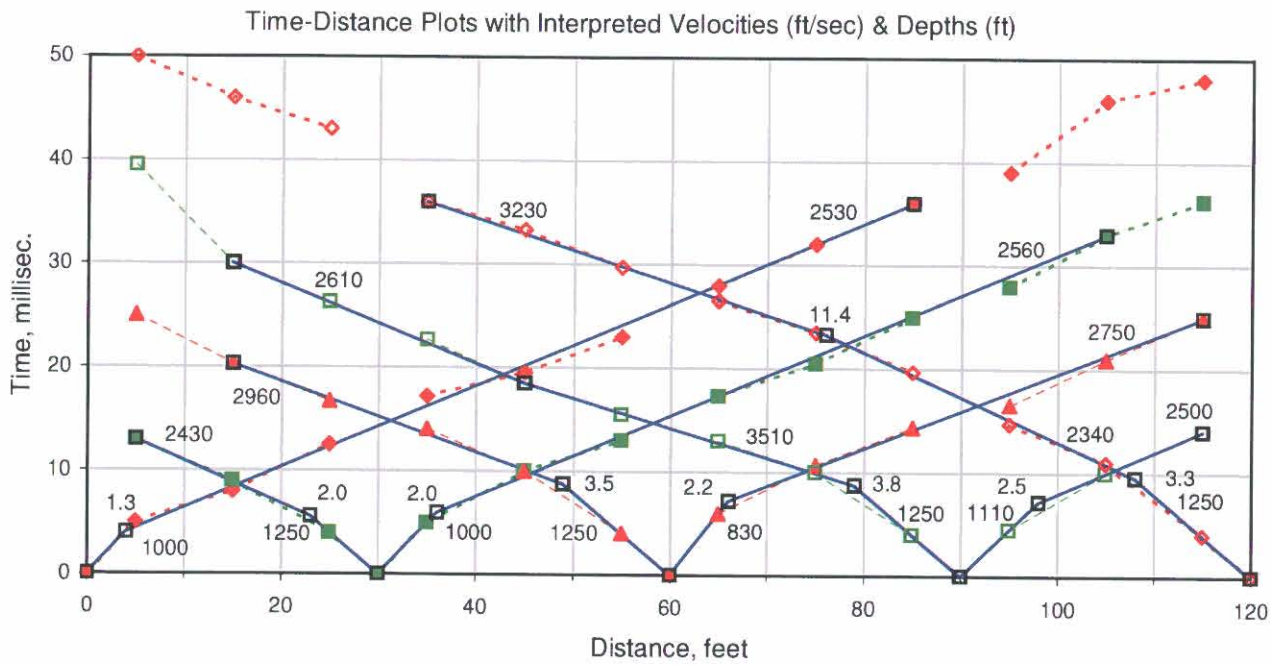
Line 71

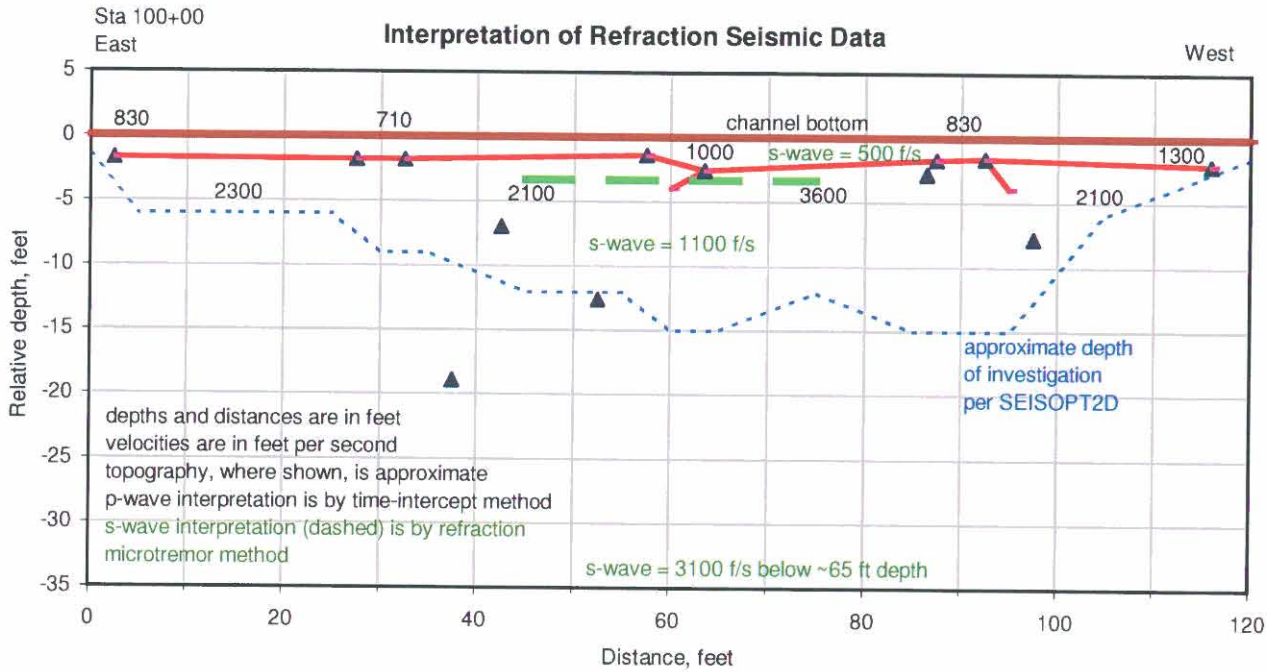
AMEC Job No. 6-117-001025

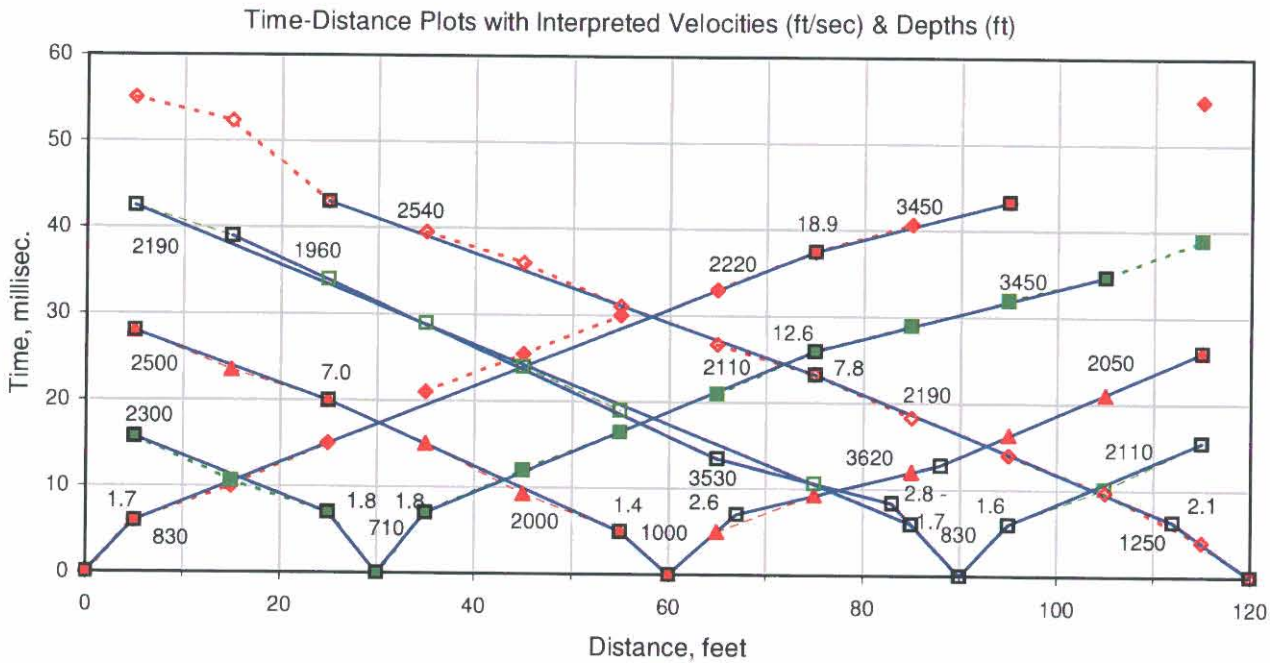


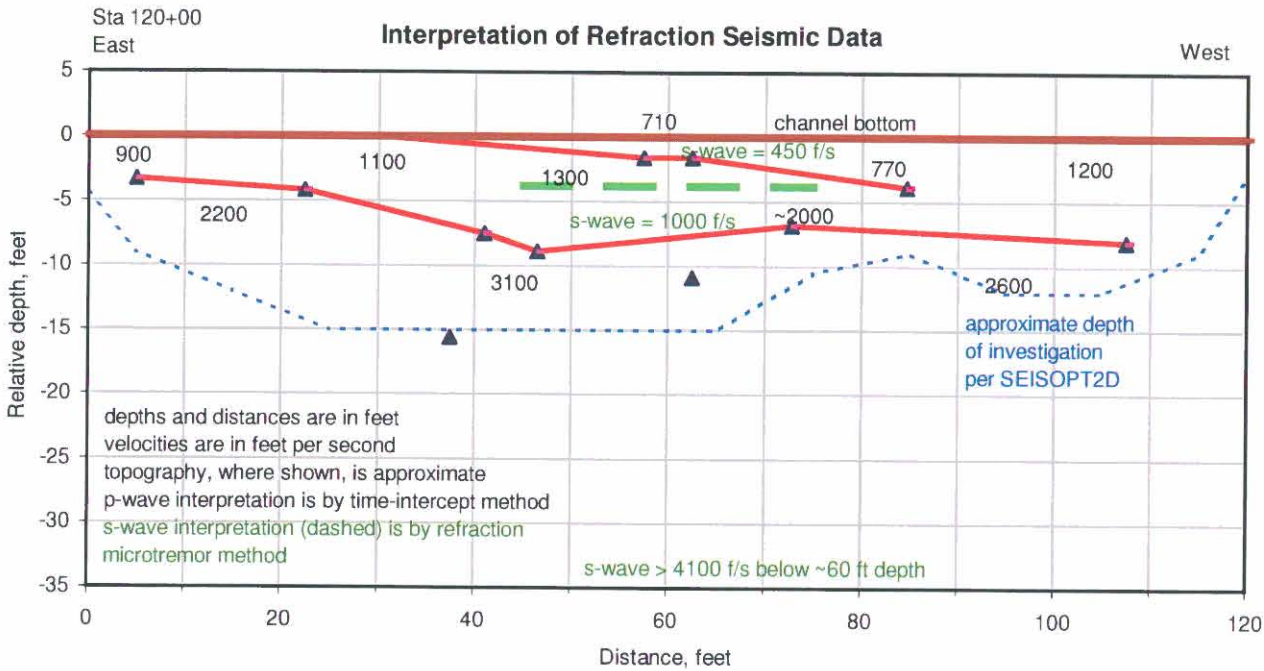


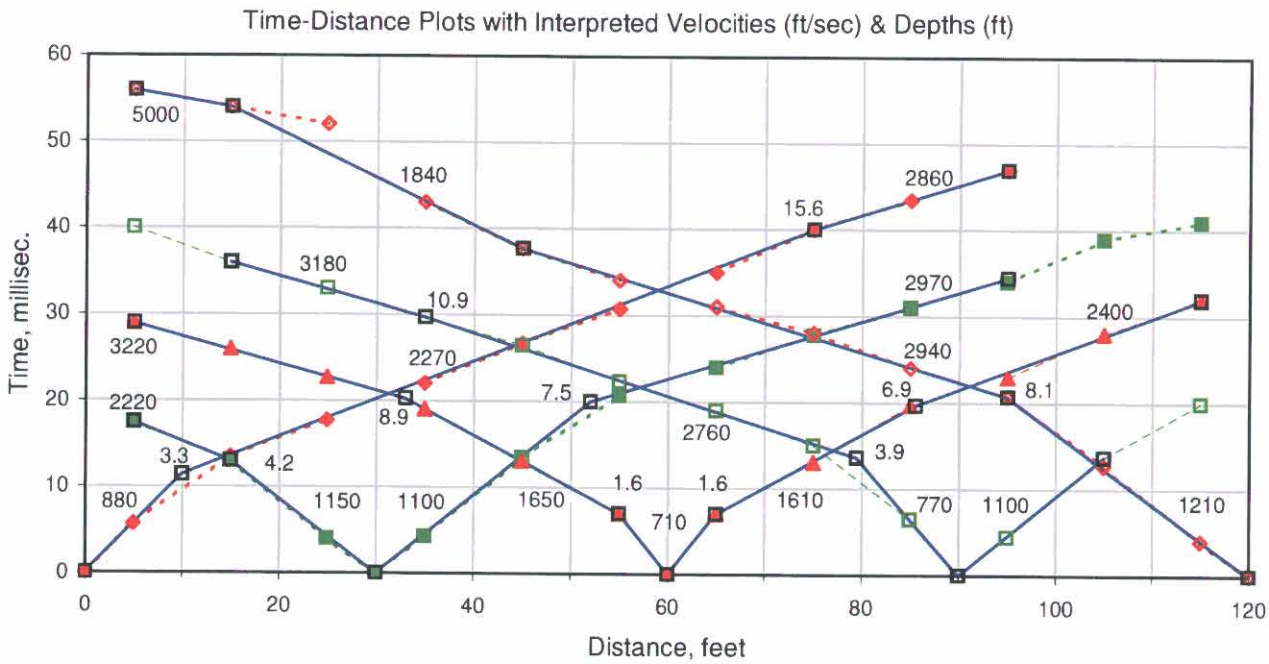

Sta 80+00
East
Interpretation of Refraction Seismic Data
West
1000
1100
channel bottom
~1000
s-wave = 500 f/s
1200
1300
2500
2700
~3100
2400
approximate depth
of investigation
per SEISOPT2D
s-wave = 1100 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 2900 f/s below ~57 ft depth
Relative depth, feet
Distance, feet

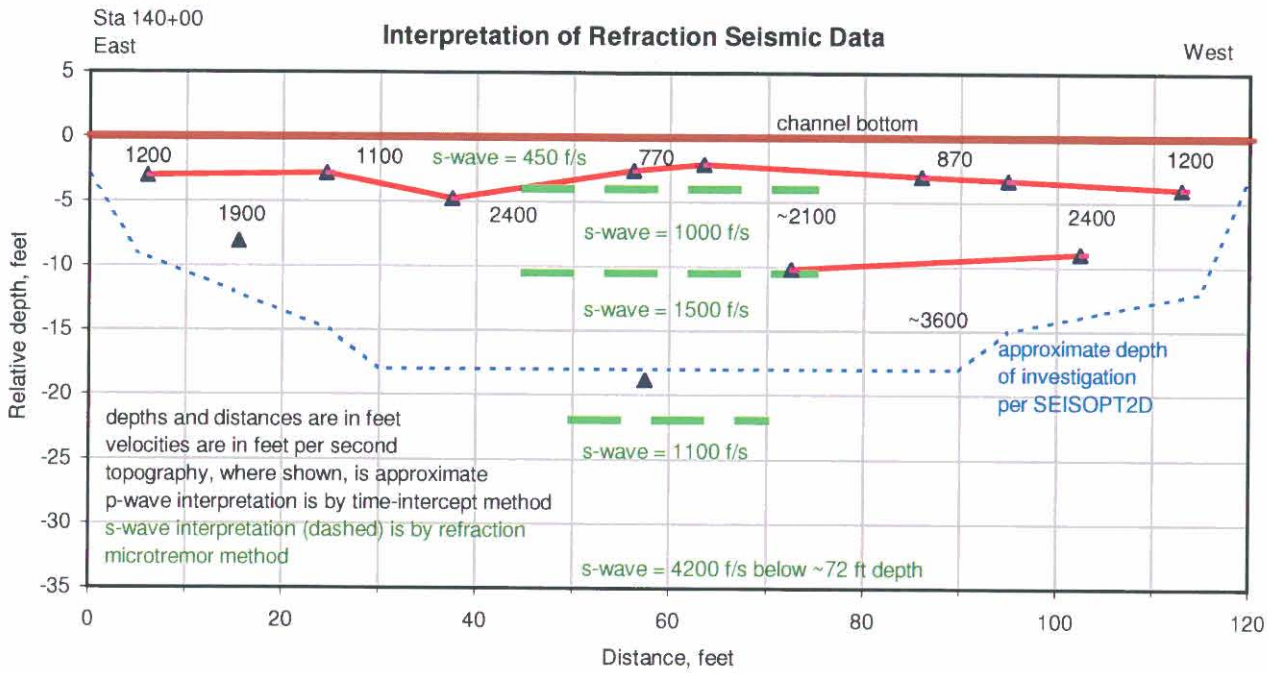

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3230
2530
2560
2610
11.4
2750
2960
2430
3510
2340
2500
1.3
2.0
2.0
3.5
2.2
3.8
2.5
3.3
1000
1250
1000
1250
830
1250
1110
1250
Time, millisec.
Distance, feet

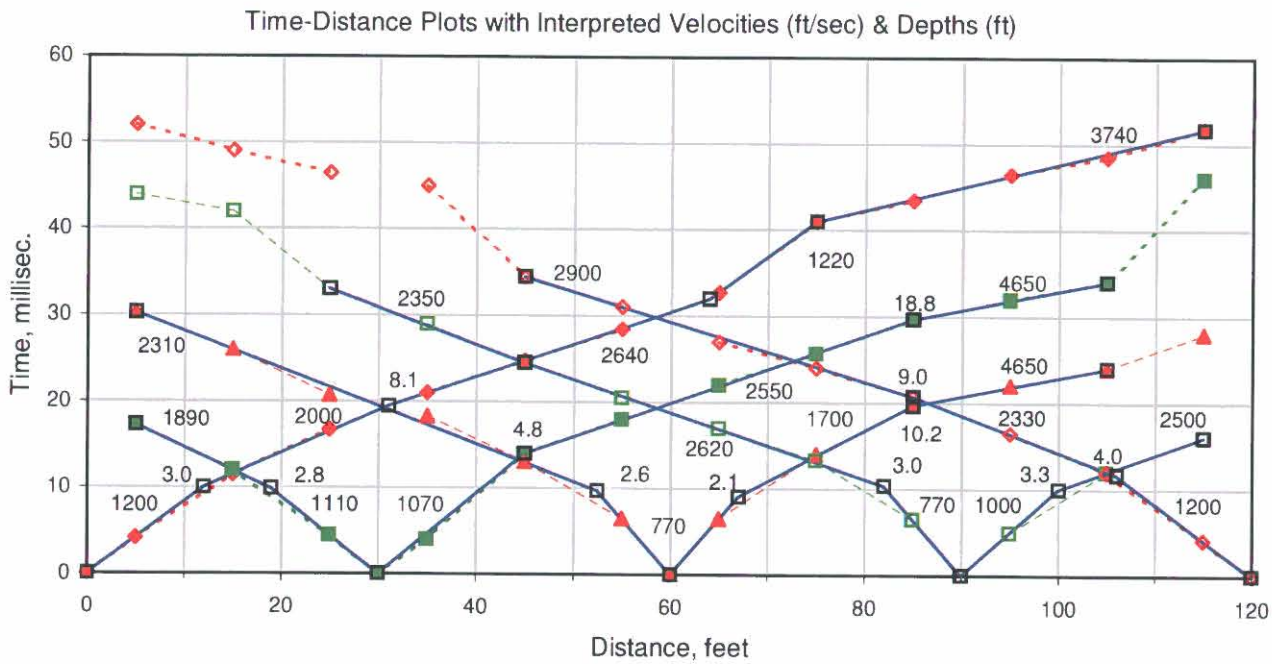

Sta 100+00
East
Interpretation of Refraction Seismic Data
West
830
710
channel bottom
830
1000
s-wave = 500 f/s
1300
2300
2100
3600
2100
s-wave = 1100 f/s
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 3100 f/s below ~65 ft depth
Relative depth, feet
Distance, feet

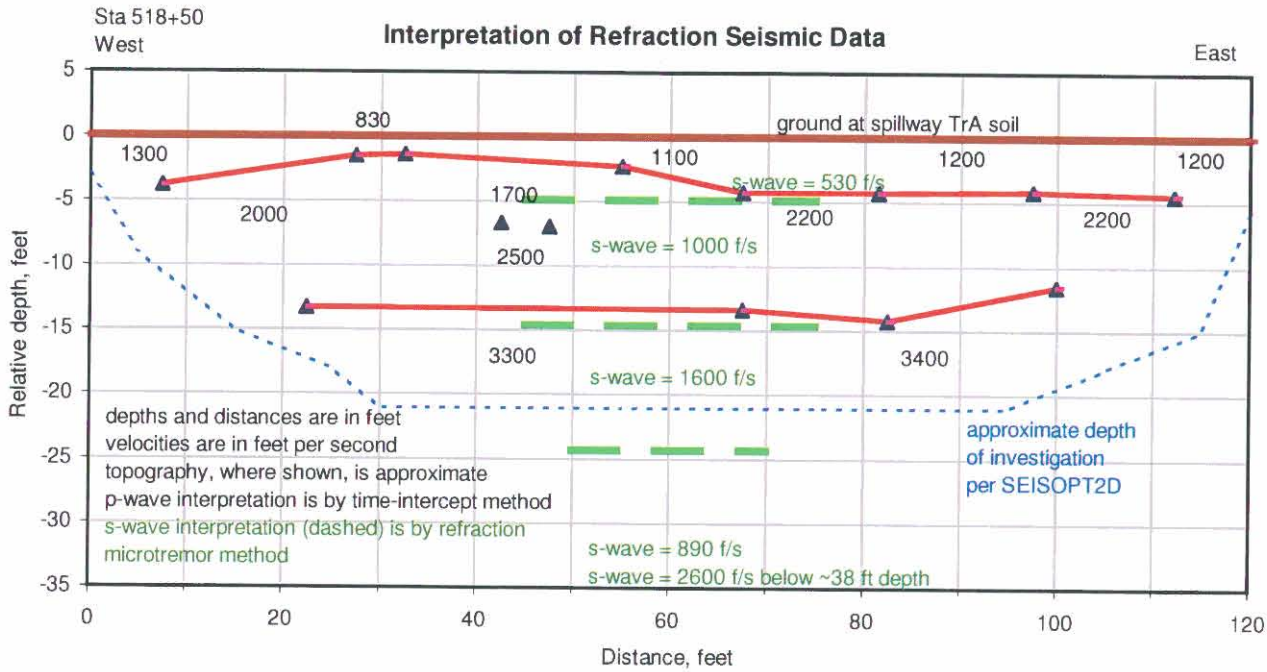

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet

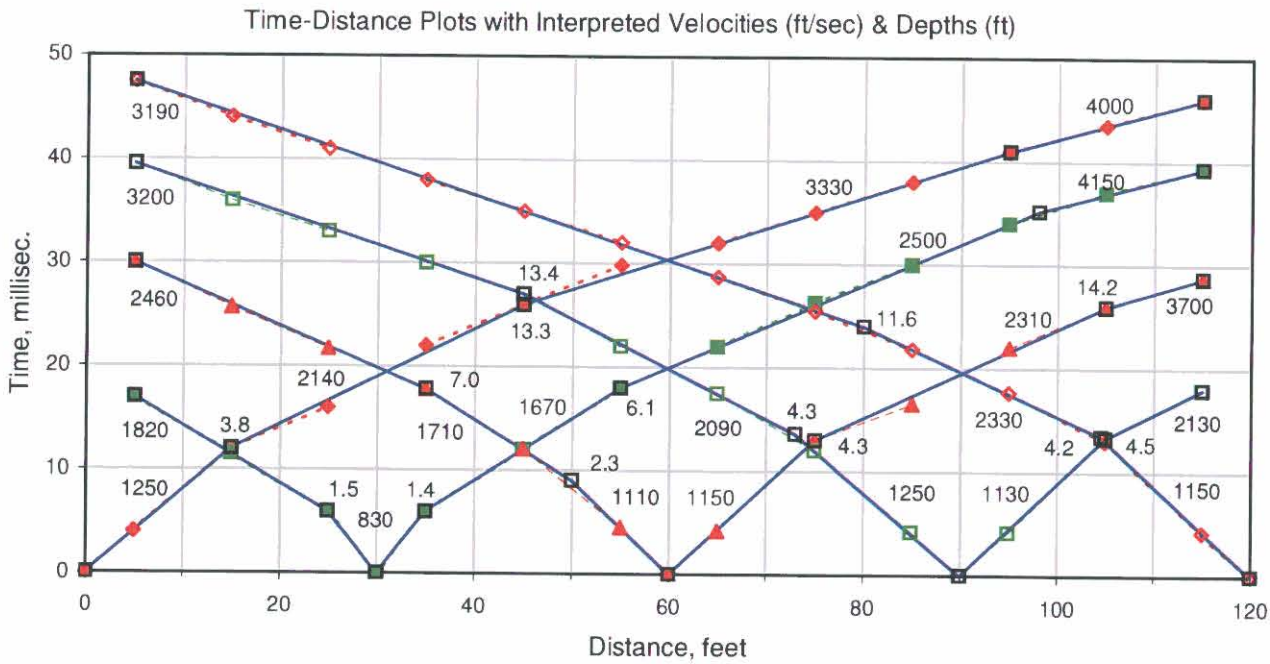

Sta 120+00
East
Interpretation of Refraction Seismic Data
West
channel bottom
s-wave = 450 f/s
s-wave = 1000 f/s
~2000
900
1100
1300
710
770
1200
2200
3100
2600
approximate depth
of investigation
per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave > 4100 f/s below ~60 ft depth
Relative depth, feet
Distance, feet

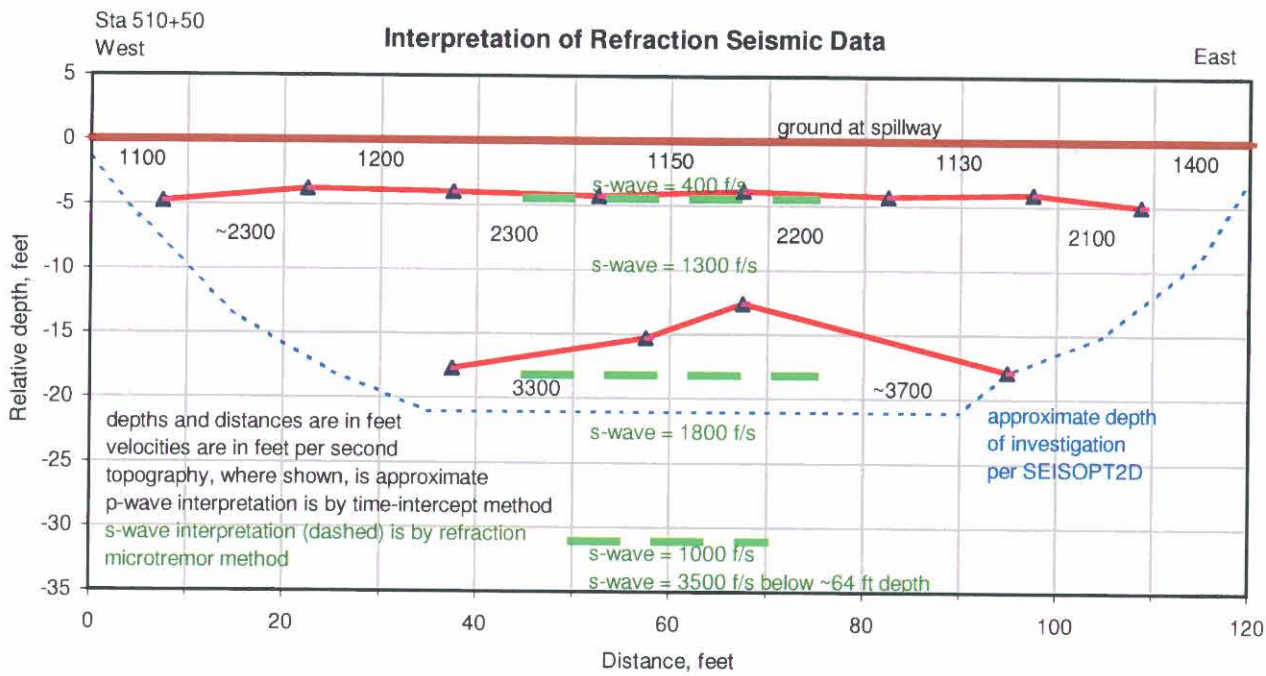

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
5000
1840
2860
15.6
3180
10.9
2970
2400
3220
2270
2940
2220
8.9
7.5
6.9
8.1
2760
3.3
4.2
3.9
880
1150
1100
1650
1.6
1.6
1610
770
1100
1210
710
Time, millisec.
Distance, feet

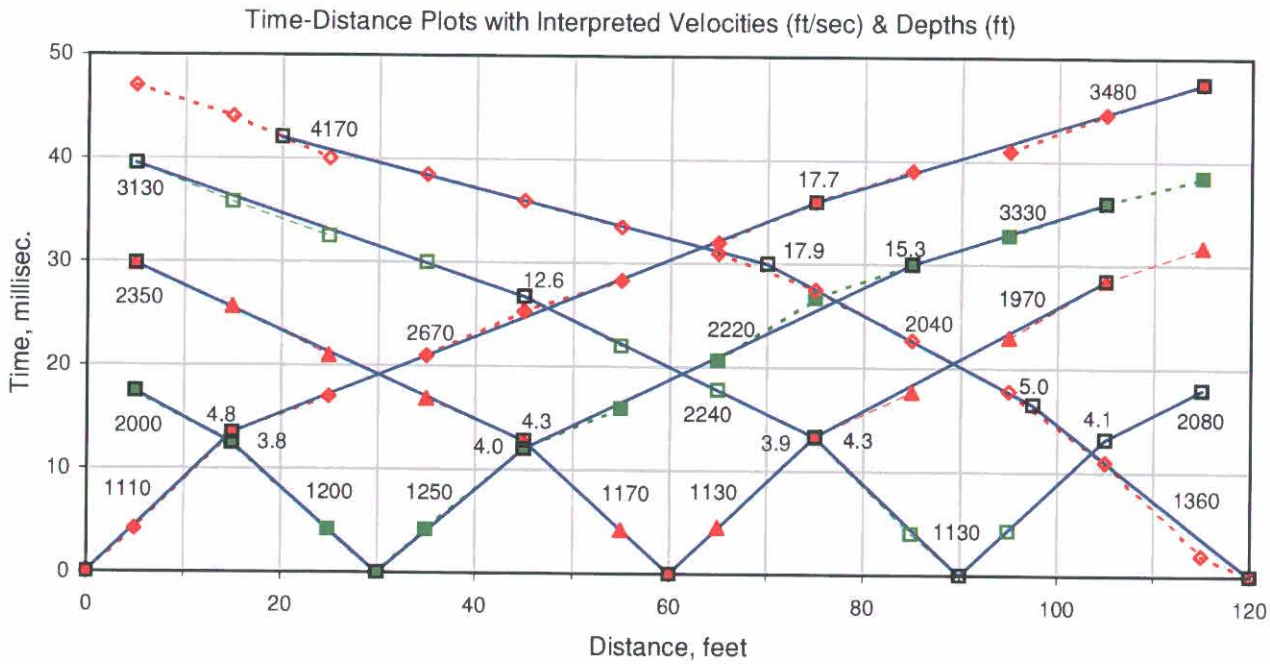

Sta 140+00
East
Interpretation of Refraction Seismic Data
West
channel bottom
1200
1100
s-wave = 450 f/s
770
870
1200
1900
2400
~2100
2400
s-wave = 1000 f/s
s-wave = 1500 f/s
~3600
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 1100 f/s
s-wave = 4200 f/s below ~72 ft depth
Relative depth, feet
Distance, feet

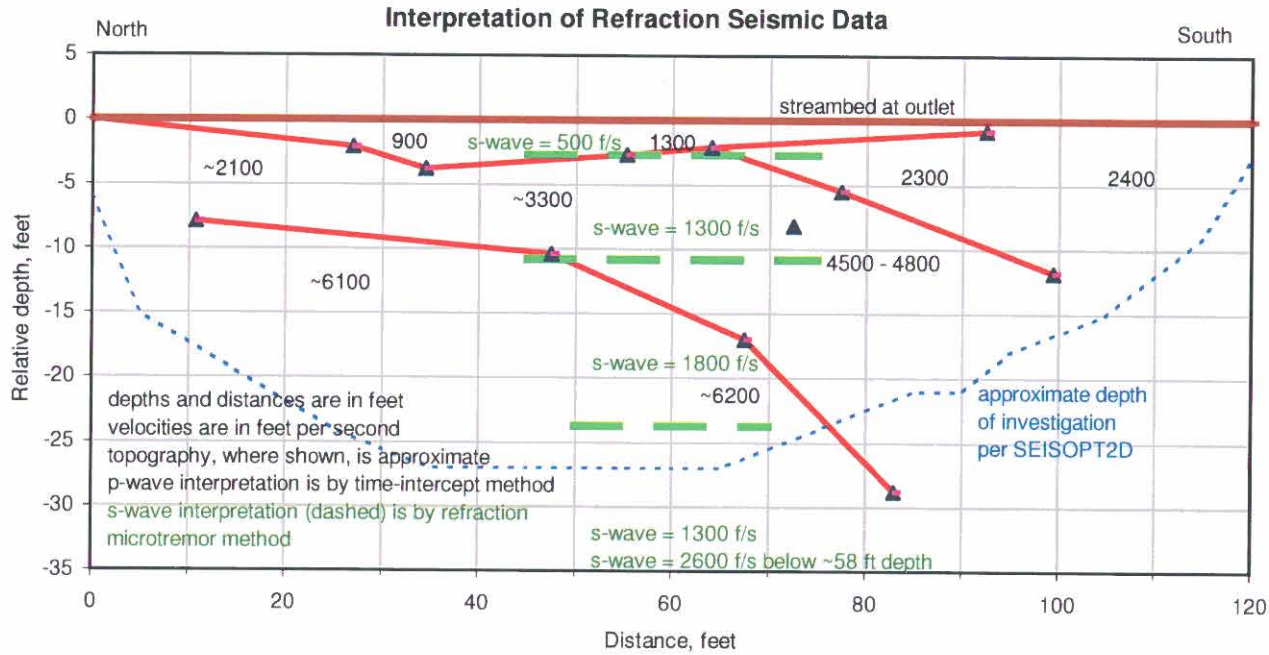

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet

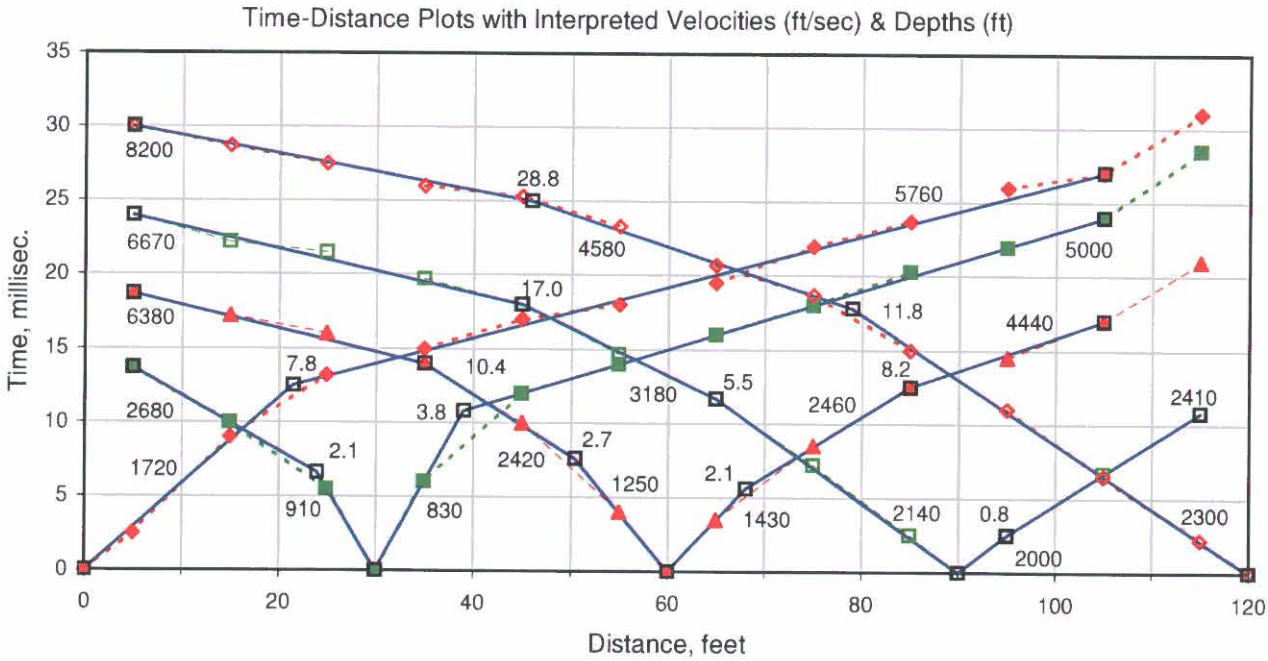

Sta 518+50
West
Interpretation of Refraction Seismic Data
East
ground at spillway TrA soil
1300
830
1100
1200
1200
2000
1700
2500
2200
2200
s-wave = 530 f/s
s-wave = 1000 f/s
3300
3400
s-wave = 1600 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 890 f/s
s-wave = 2600 f/s below ~38 ft depth
Relative depth, feet
Distance, feet

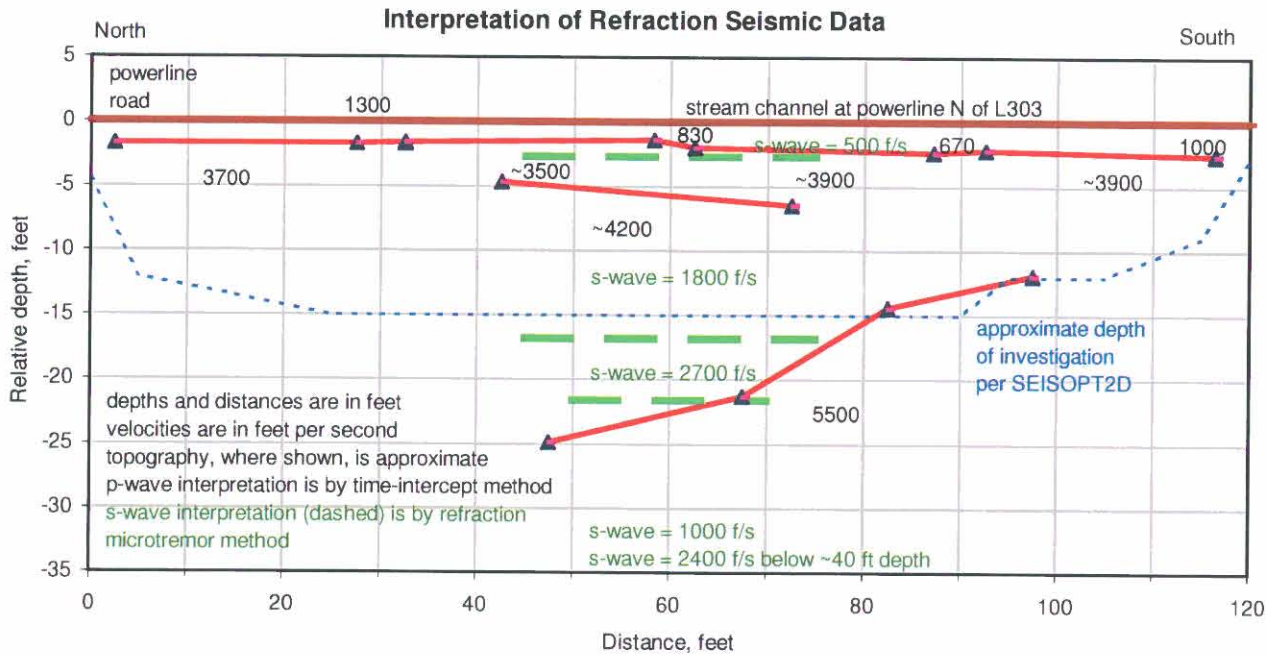

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
3190
3200
2460
1820
1250
3.8
1.5
830
2140
7.0
1.4
1710
13.4
13.3
1670
2.3
1110
6.1
1150
3330
2090
4.3
4.3
11.6
2500
1250
2310
1130
4000
4150
14.2
3700
2330
4.2
4.5
2130
1150
Time, millisec.
Distance, feet

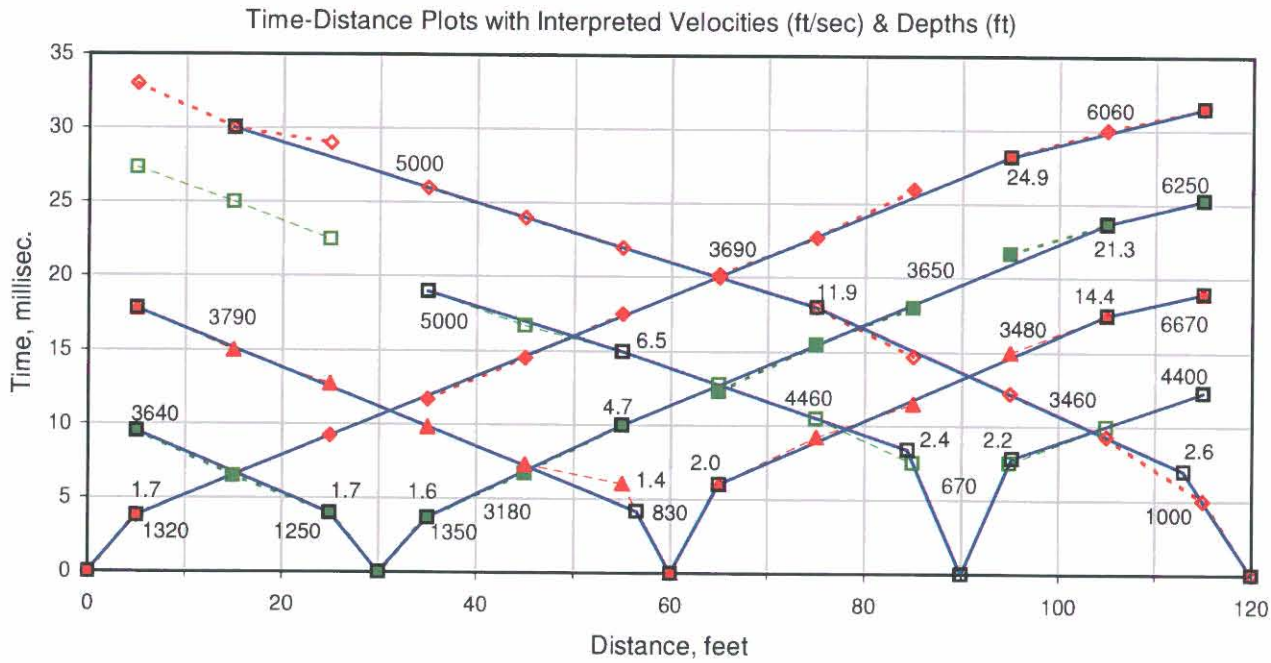

Sta 510+50
West
Interpretation of Refraction Seismic Data
East
ground at spillway
1100
1200
1150
1130
1400
s-wave = 400 f/s
~2300
2300
2200
2100
s-wave = 1300 f/s
3300
~3700
s-wave = 1800 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
s-wave = 3500 f/s below ~64 ft depth
Relative depth, feet
Distance, feet

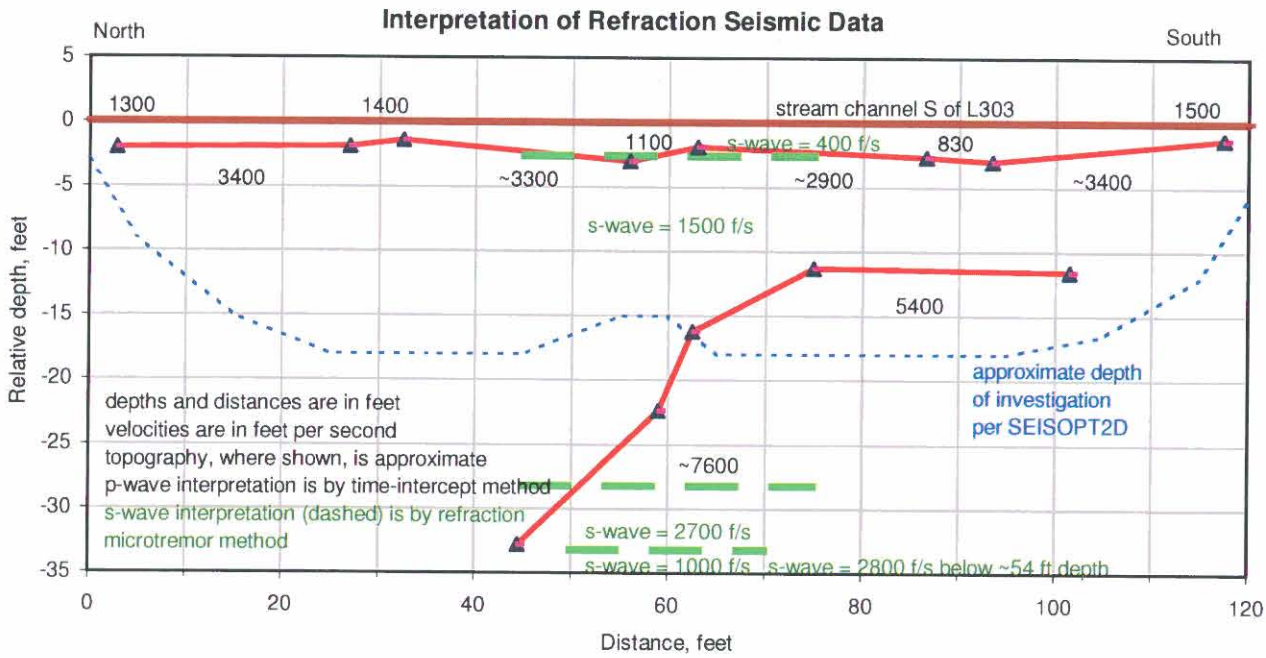

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet

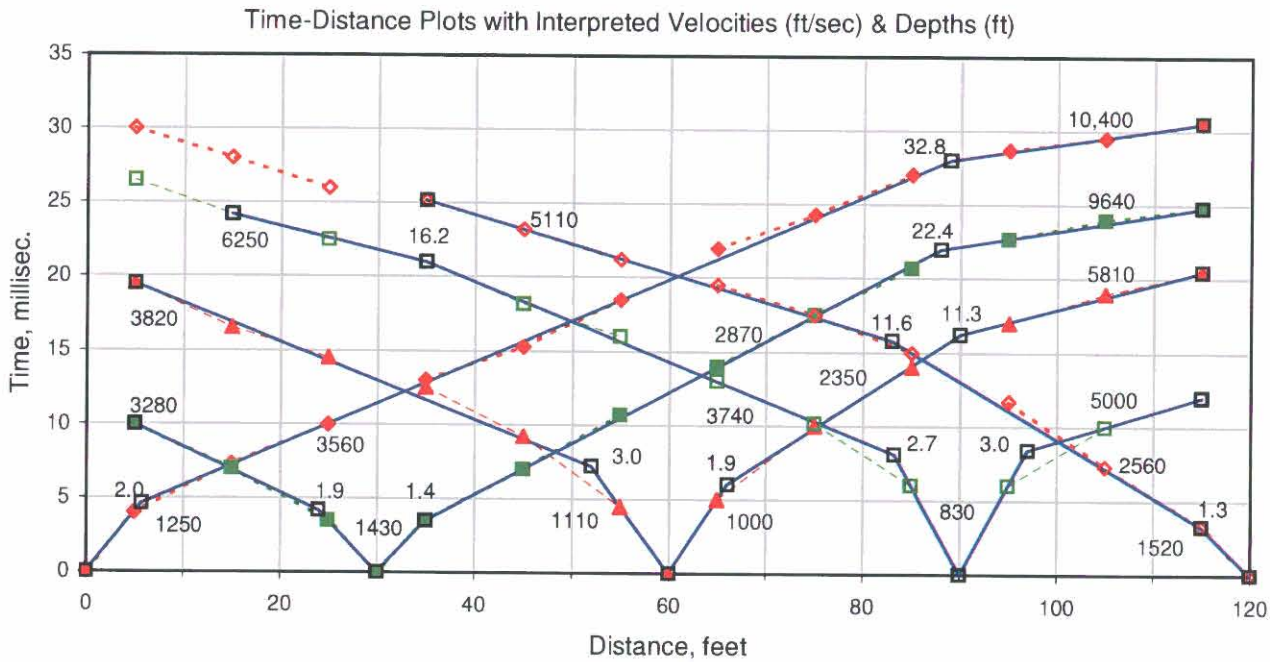

Interpretation of Refraction Seismic Data
North
South
streambed at outlet
900
s-wave = 500 f/s
1300
~2100
~3300
2300
2400
s-wave = 1300 f/s
4500 - 4800
~6100
s-wave = 1800 f/s
~6200
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1300 f/s
s-wave = 2600 f/s below ~58 ft depth
Relative depth, feet
Distance, feet

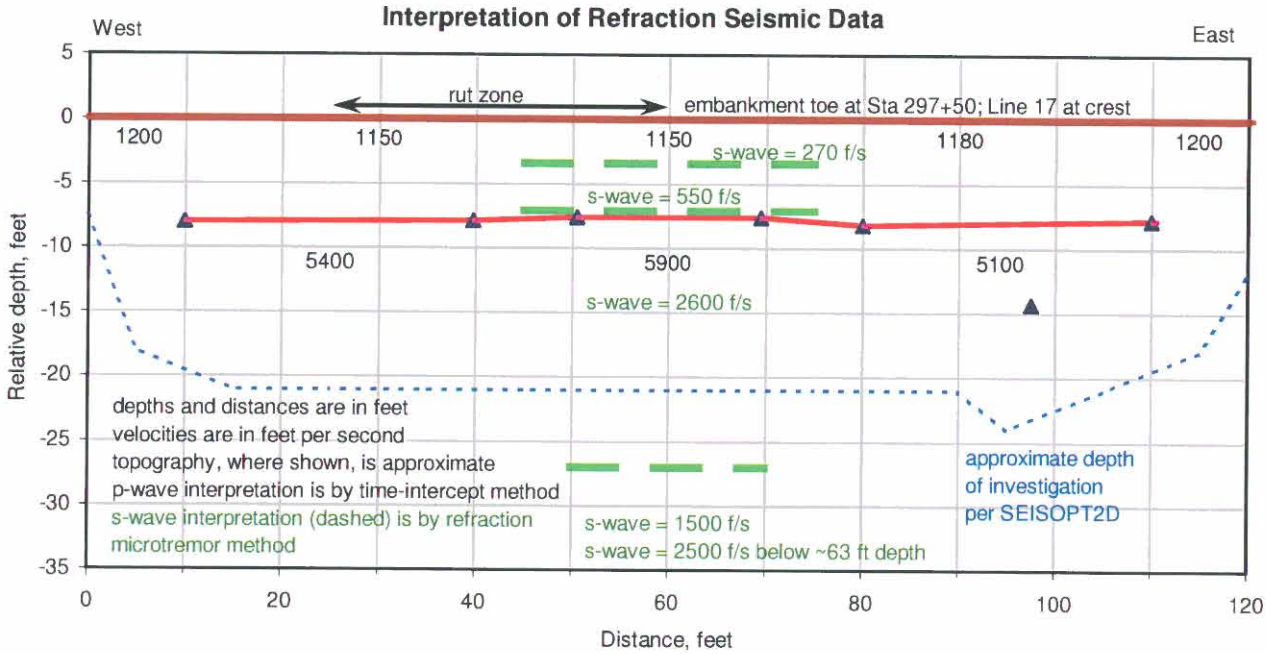

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
8200
28.8
4580
5760
6670
5000
17.0
6380
11.8
4440
7.8
10.4
8.2
3180
5.5
2460
2410
2680
3.8
2.1
2420
2.7
1250
2.1
1720
910
830
1430
2140
0.8
2300
2000
Time, millisec.
Distance, feet

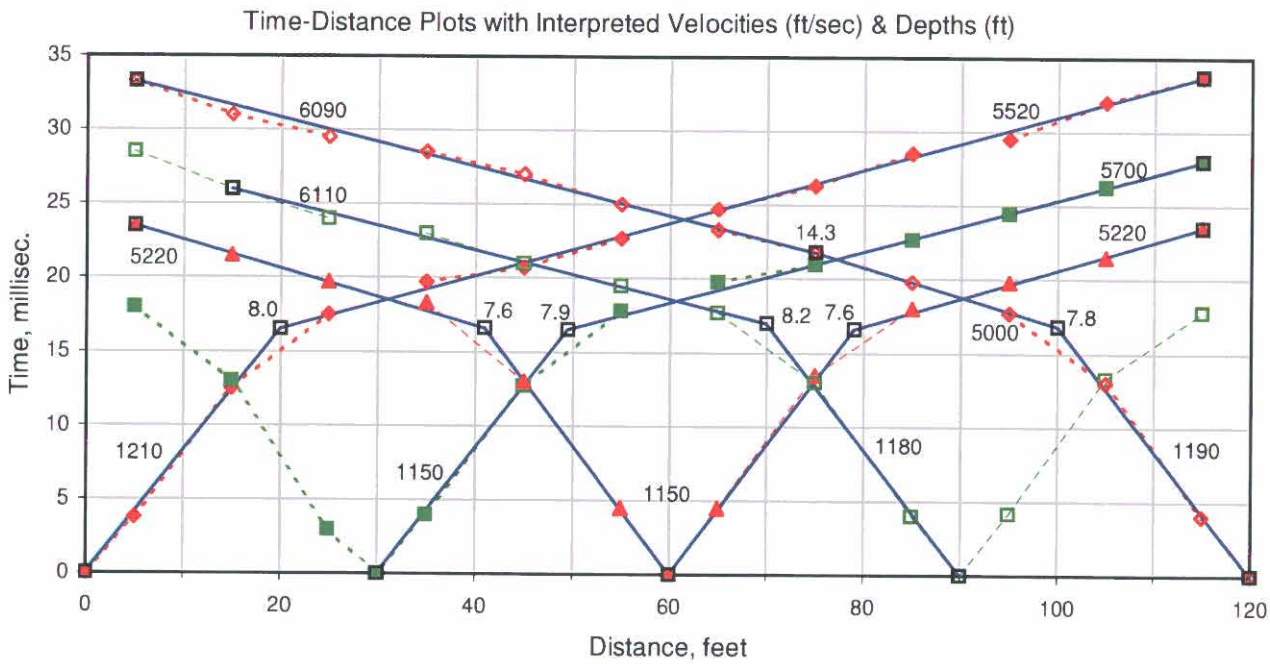

Interpretation of Refraction Seismic Data
North
South
powerline
road
1300
stream channel at powerline N of L303
830
s-wave = 500 f/s
670
1000
3700
~3500
~3900
~3900
~4200
s-wave = 1800 f/s
approximate depth
of investigation
per SEISOPT2D
s-wave = 2700 f/s
5500
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
s-wave = 1000 f/s
s-wave = 2400 f/s below ~40 ft depth
Relative depth, feet
Distance, feet

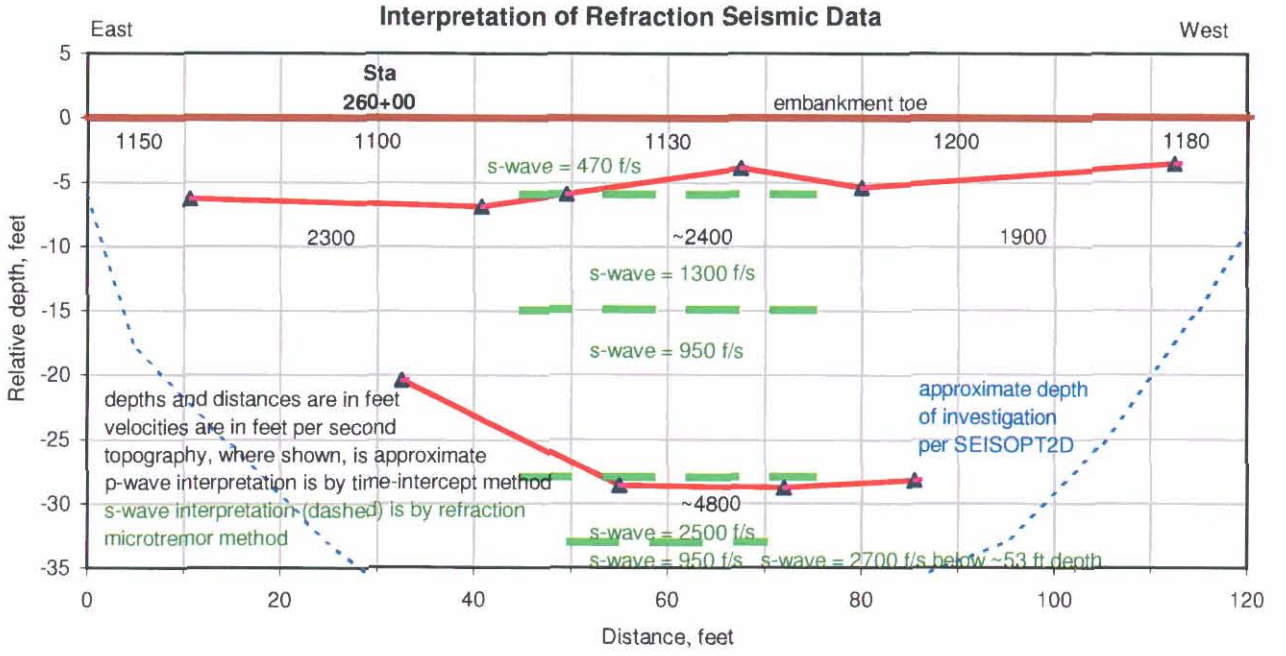

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
6060
24.9
6250
5000
3690
21.3
3650
11.9
14.4
3790
5000
6.5
3480
6670
4400
3640
4.7
4460
3460
2.4
2.2
2.6
2.0
1.7
1.7
1.6
1.4
670
1320
1250
1350
3180
830
1000

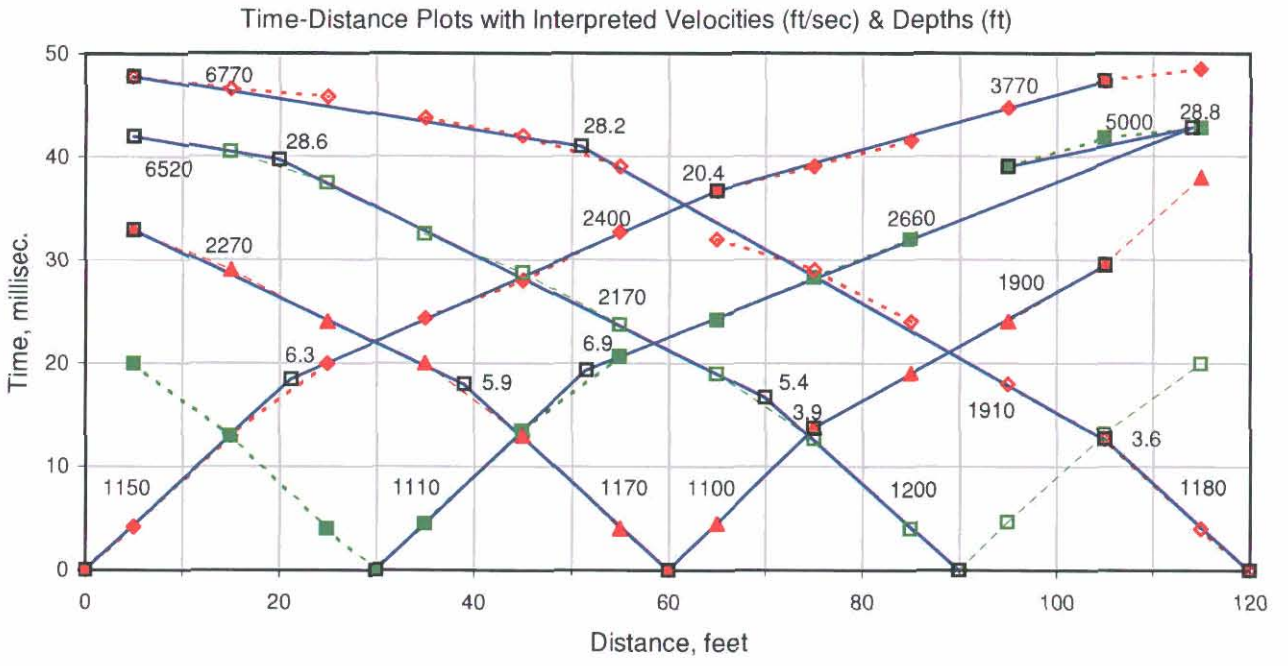

Interpretation of Refraction Seismic Data
North
South
stream channel S of L303
1300
1400
1100
830
1500
3400
~3300
~2900
~3400
s-wave = 400 f/s
s-wave = 1500 f/s
5400
~7600
s-wave = 2700 f/s
s-wave = 1000 f/s
s-wave = 2800 f/s below ~54 ft depth
approximate depth of investigation per SEISOPT2D
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
Relative depth, feet
Distance, feet

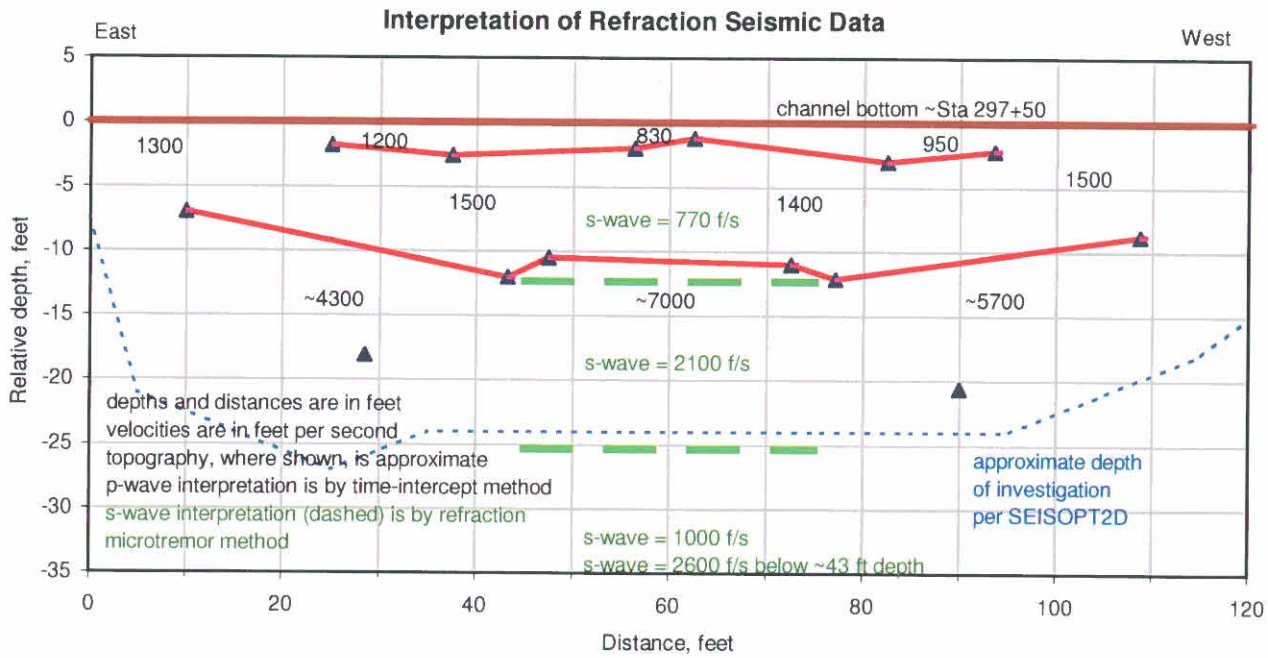

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
Time, millisec.
Distance, feet
10,400
32.8
9640
22.4
5810
11.6
11.3
5110
6250
16.2
3820
2870
2350
3280
3740
5000
3560
3.0
1.9
2.7
3.0
2560
2.0
1.9
1.4
1250
1430
1110
1000
830
1.3
1520

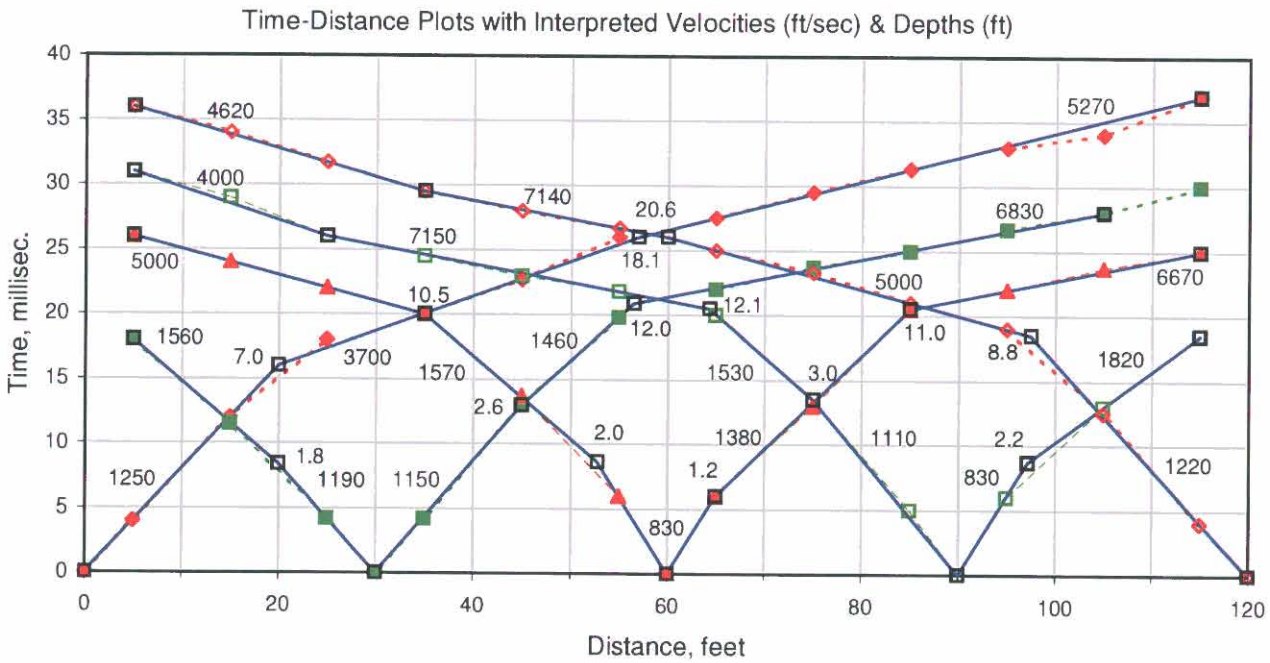

Interpretation of Refraction Seismic Data
West
East
rut zone
embankment toe at Sta 297+50; Line 17 at crest
1200
1150
1150
1180
1200
s-wave = 270 f/s
s-wave = 550 f/s
5400
5900
5100
s-wave = 2600 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
s-wave = 1500 f/s
s-wave = 2500 f/s below ~63 ft depth
approximate depth of investigation per SEISOPT2D
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
6090
6110
5220
5520
5700
5220
5000
14.3
8.0
7.6
7.9
8.2
7.6
7.8
1210
1150
1150
1180
1190
Time, millisec.
Distance, feet


Interpretation of Refraction Seismic Data
East
West
Sta
260+00
embankment toe
1150
1100
1130
1200
1180
s-wave = 470 f/s
2300
~2400
1900
s-wave = 1300 f/s
s-wave = 950 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction
microtremor method
approximate depth
of investigation
per SEISOPT2D
~4800
s-wave = 2500 f/s
s-wave = 950 f/s
s-wave = 2700 f/s below ~53 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
6770
28.2
3770
5000
28.8
28.6
6520
20.4
2400
2660
2270
2170
1900
6.3
6.9
5.9
5.4
3.9
1910
3.6
1150
1110
1170
1100
1200
1180
Time, millisec.
Distance, feet

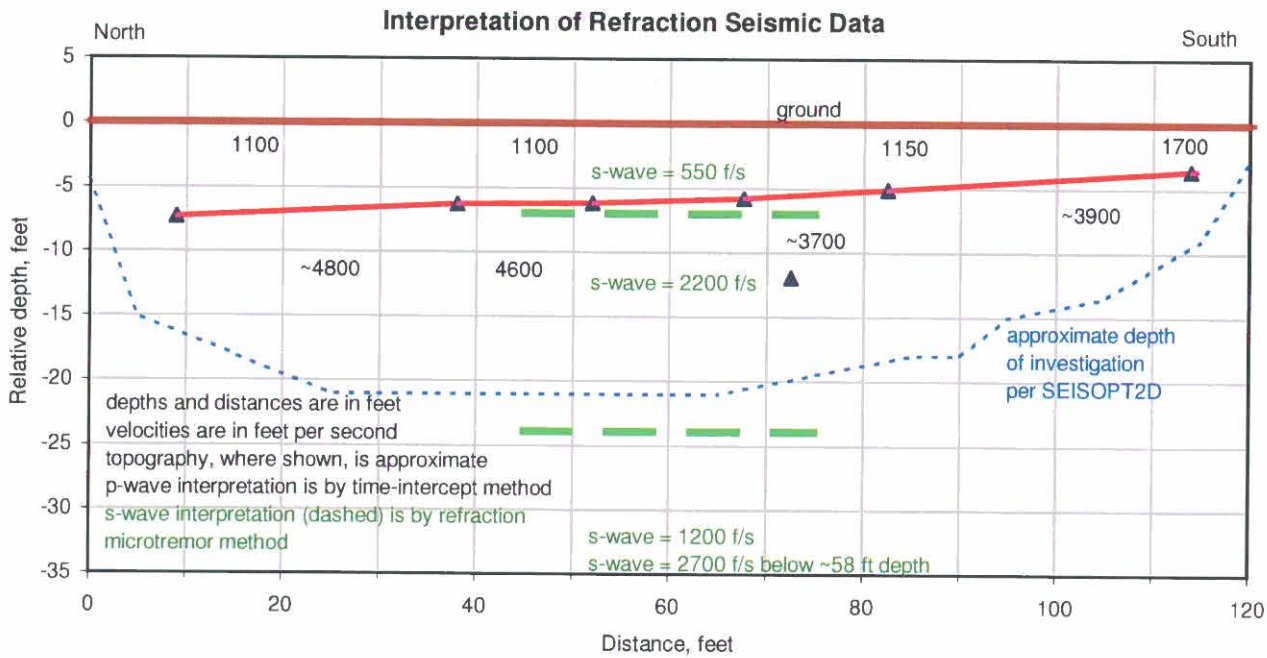

Interpretation of Refraction Seismic Data
East
West
channel bottom ~Sta 297+50
1300
1200
830
950
1500
1500
1400
s-wave = 770 f/s
~4300
~7000
~5700
s-wave = 2100 f/s
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 1000 f/s
s-wave = 2600 f/s below ~43 ft depth
Relative depth, feet
Distance, feet

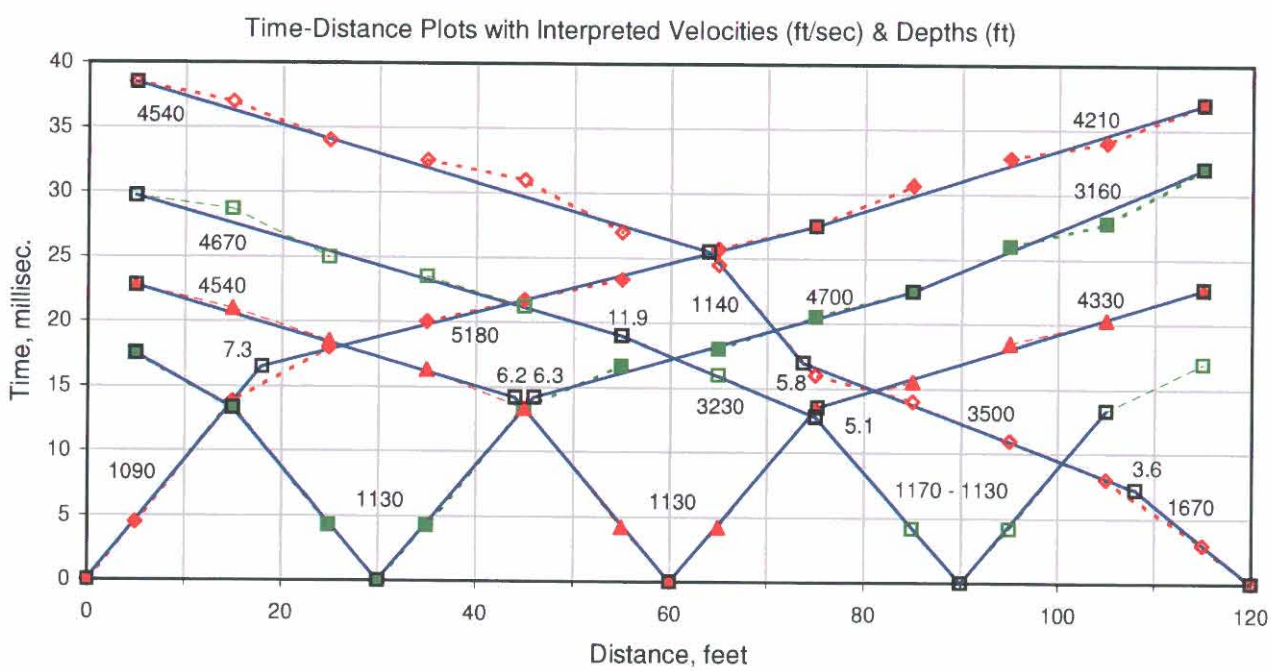

Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
4620
4000
5000
7140
7150
20.6
18.1
10.5
12.1
12.0
5270
6830
5000
6670
11.0
8.8
1560
7.0
3700
1570
1460
1530
3.0
1820
2.6
2.0
1380
1110
2.2
1.8
1.2
830
1250
1190
1150
830
1220
Time, millisec.
Distance, feet

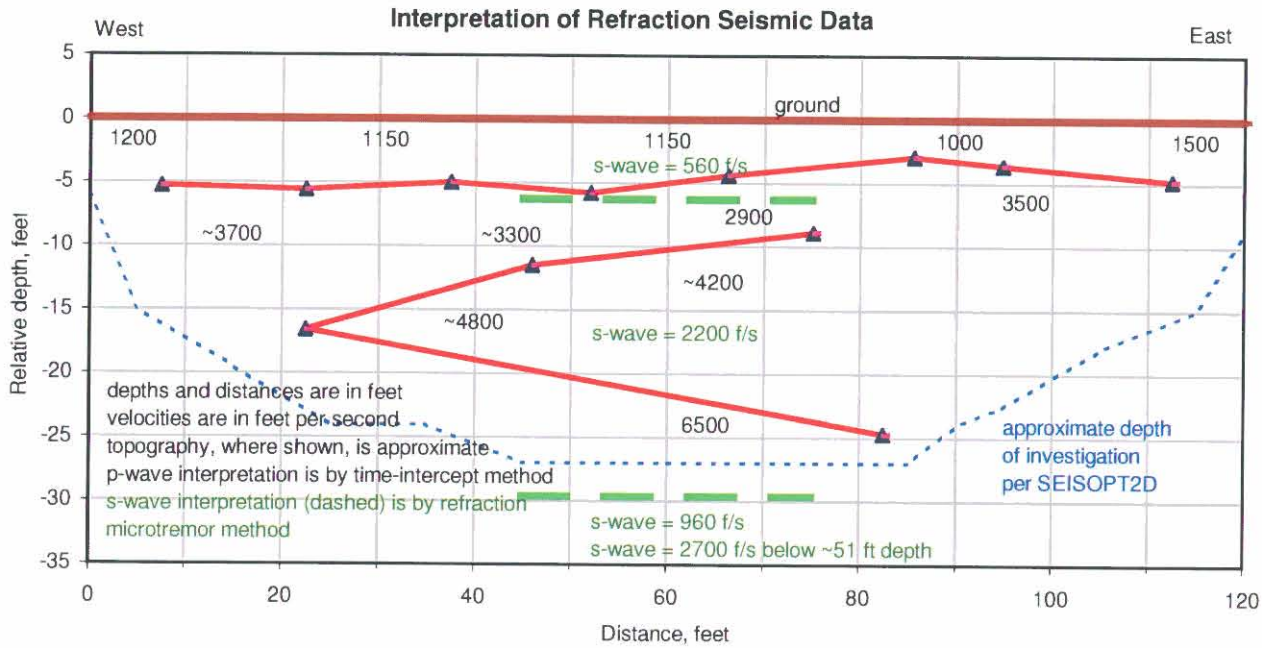
Refraction Seismic Interpretation

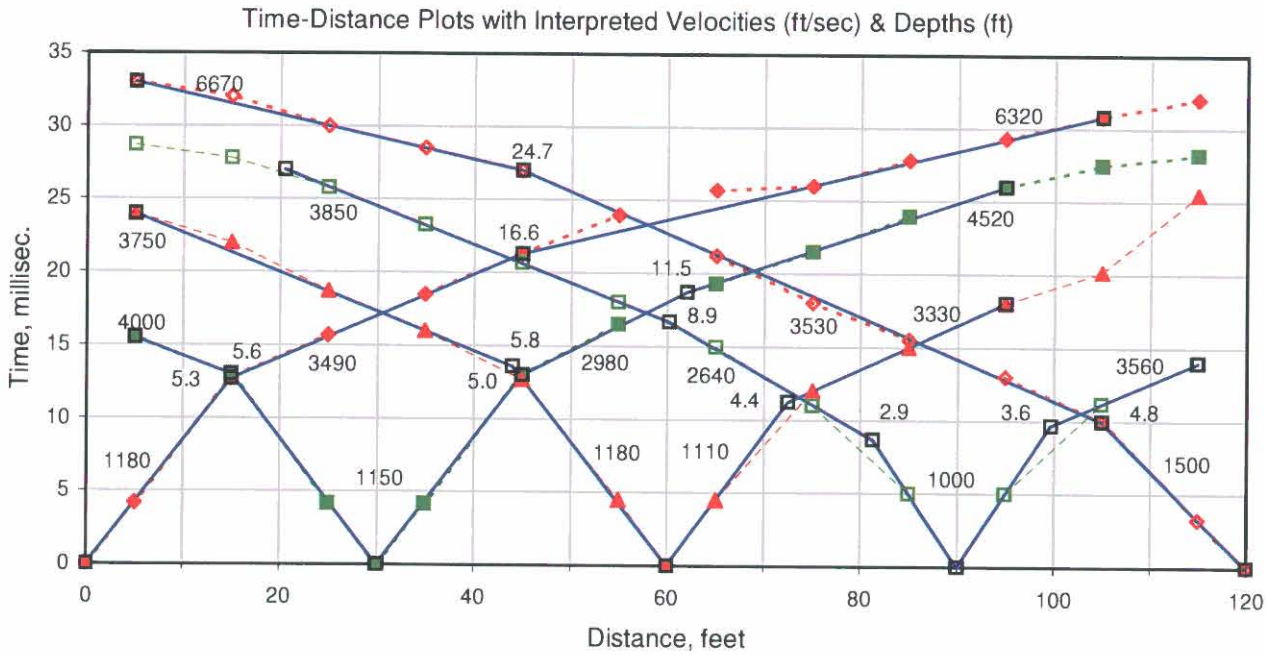
Line 84

AMEC Job No. 6-117-001025






Interpretation of Refraction Seismic Data
West
East
ground
1200
1150
1150
1000
1500
s-wave = 560 f/s
~3700
~3300
2900
3500
~4200
~4800
s-wave = 2200 f/s
6500
depths and distances are in feet
velocities are in feet per second
topography, where shown, is approximate
p-wave interpretation is by time-intercept method
s-wave interpretation (dashed) is by refraction microtremor method
approximate depth of investigation per SEISOPT2D
s-wave = 960 f/s
s-wave = 2700 f/s below ~51 ft depth
Relative depth, feet
Distance, feet


Time-Distance Plots with Interpreted Velocities (ft/sec) & Depths (ft)
6670
24.7
6320
3850
3750
16.6
4520
11.5
4000
8.9
3530
3330
5.6
5.8
3490
2980
2640
3560
5.3
5.0
4.4
2.9
3.6
4.8
1180
1150
1180
1110
1000
1500
Time, millisec.
Distance, feet

REFRACTION MICROTREMOR (ReMi) SHEAR WAVE EQUIPMENT AND PROCEDURES

Refraction microtemor or ReMi surveys are performed in general accordance with the method described by Louie (2001) to develop vertical one-dimensional shear wave (s-wave) velocity profiles. The same equipment used for ReMi is also used for refraction seismic. When appropriate, both p-wave and s-wave data can be collected with the same physical seismic line setup.

ReMi Seismic Equipment - ReMi surveys are performed using a Geometrics S-12 Smartseis signal enhancement seismograph. This instrument has the capability to digitally record and store up to 12 channels of geophone data in SEG2 format. Up to 16,384 samples can be acquired for each geophone channel at sample intervals as long as 0.25, 0.5, 1 and 2 milliseconds. Sampling events to collect ReMi field data may typically last 6, 12 or 24 seconds. Geophone cables with 12 geophone takeouts at 10-foot or 20-meter spacings are presently used. Vertical geophones with resonant frequencies of 28 Hz and 4.5 Hz are used to obtain surface wave data for s-wave vertical profile analysis. High frequency geophones are used for shorter arrays with shallower depths of investigation, and low frequency geophones are used for longer arrays with greater depths of investigation. Broad band ambient site noise may be used as a surface wave energy source. Controlled surface wave energy sources include jogging alongside shorter geophone arrays and driving a field vehicle alongside longer geophone arrays. The seismograph system is extremely portable. In areas where vehicular access is not possible, the equipment can be mobilized by various means, including backpacking, packhorse, helicopter and canoe.

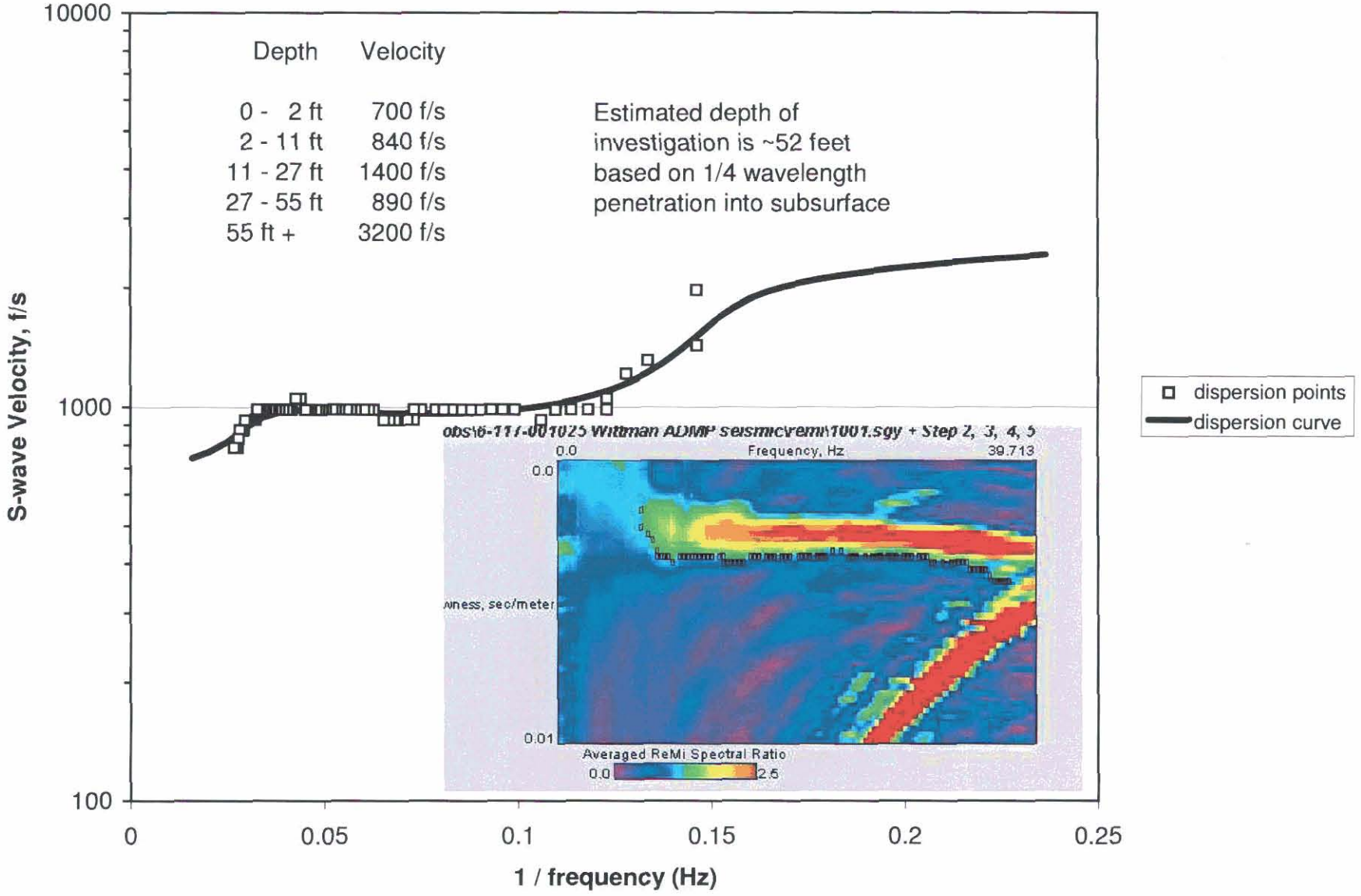
ReMi Field Procedures - The field operations are directed by our experienced engineer or geologist, who operates the equipment, prepares the records and examines the data in the field. ReMi seismic lines are generally laid out using the standard spacings on the geophone cables. A depth of investigation of about 100 meters or more may be possible using a 240 meter array. For shorter lines with improved near-surface resolution, 10-foot spacings between geophones with a 120-foot array have a depth of investigation of about 30 to 40 feet or more. Other geophone spacings can also be used.

Data collection consists of the system sampling the ambient or generated surface waves (a sampling event) at the geophone array for several to many seconds. Typical sampling times and intervals for a sampling event may be 6 seconds at 0.5 milliseconds, 12 seconds at 1 millisecond and 24 seconds at 2 milliseconds for array lengths of 60 feet, 120 feet and 240 meters, respectively. Several sampling events are collected at each ReMi setup. For shorter arrays where ReMi with surface wave energy generated by jogging is conducted in concert with seismic refraction data collection, four sampling events may typically be recorded. For longer arrays where urban ambient noise or a field vehicle generates the surface wave energy, six to ten sampling events may be recorded. Field notes, including line number and orientation, topographic variations and other notes as appropriate are made on hard copy of traces. Locations and other notes are made on site maps and in notebooks as appropriate. Sample data files may be transferred by 3.5-inch floppy to the laptop computer and preliminary interpretations made for immediate data adequacy verification as part of the quality control process.

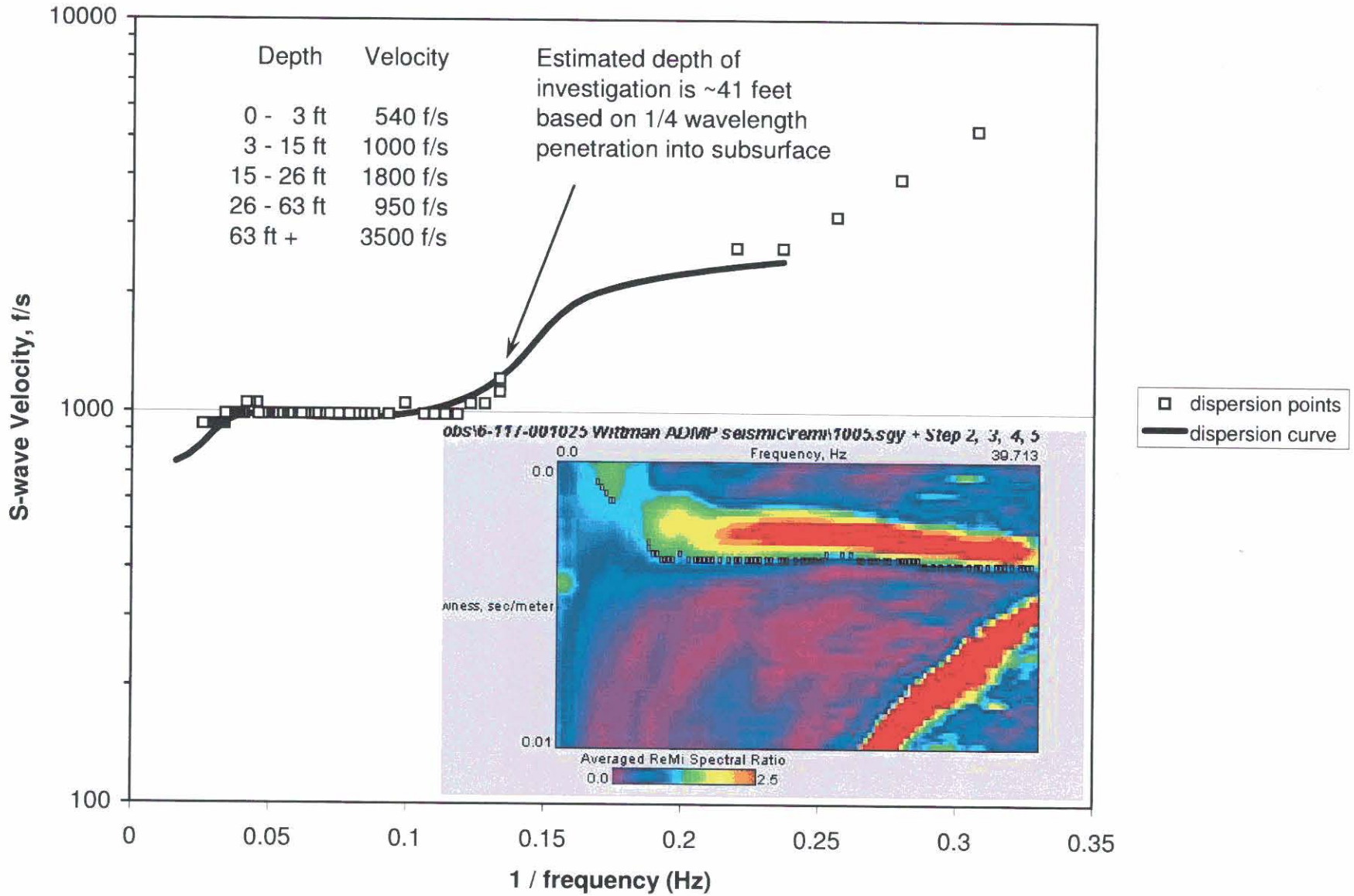
Interpretation - Although preliminary or quality control initial ReMi seismic data interpretations may sometimes be performed in the field, full interpretations are completed in the office. Data files, typically about 580kb each in size, are transferred from the seismograph to the laptop computer using 3.5-inch floppy disks. Interpretation is performed using the SeisOpt ReMi Version 3.0 (2004) software package by Optim, L.L.C., of Reno, Nevada. The software consists of two modules. The ReMiVsSpect module is used to convert the SEG2 files into a spectral energy shear wave frequency versus shear wave velocity presentation for a ReMi seismic setup. The interpreter then selects a dispersion curve consisting of the lower bound of the spectral energy shear wave velocity versus frequency trend, and that dispersion curve is saved to disk. Tracing the lower bound (slowest) of the shear wave velocity at each frequency selects the ambient energy propagating parallel to the geophone array, since energy propagating incident to the array will appear to have a faster propagating velocity. The second module, ReMiDisper, is then invoked. The interpreter models a dispersion curve with multiple layers and s-wave velocities to match the selected dispersion curve from the field data. An interpreted vertical s-wave profile is obtained through this process. It must be understood that this type of interpretation may not result in a unique solution.

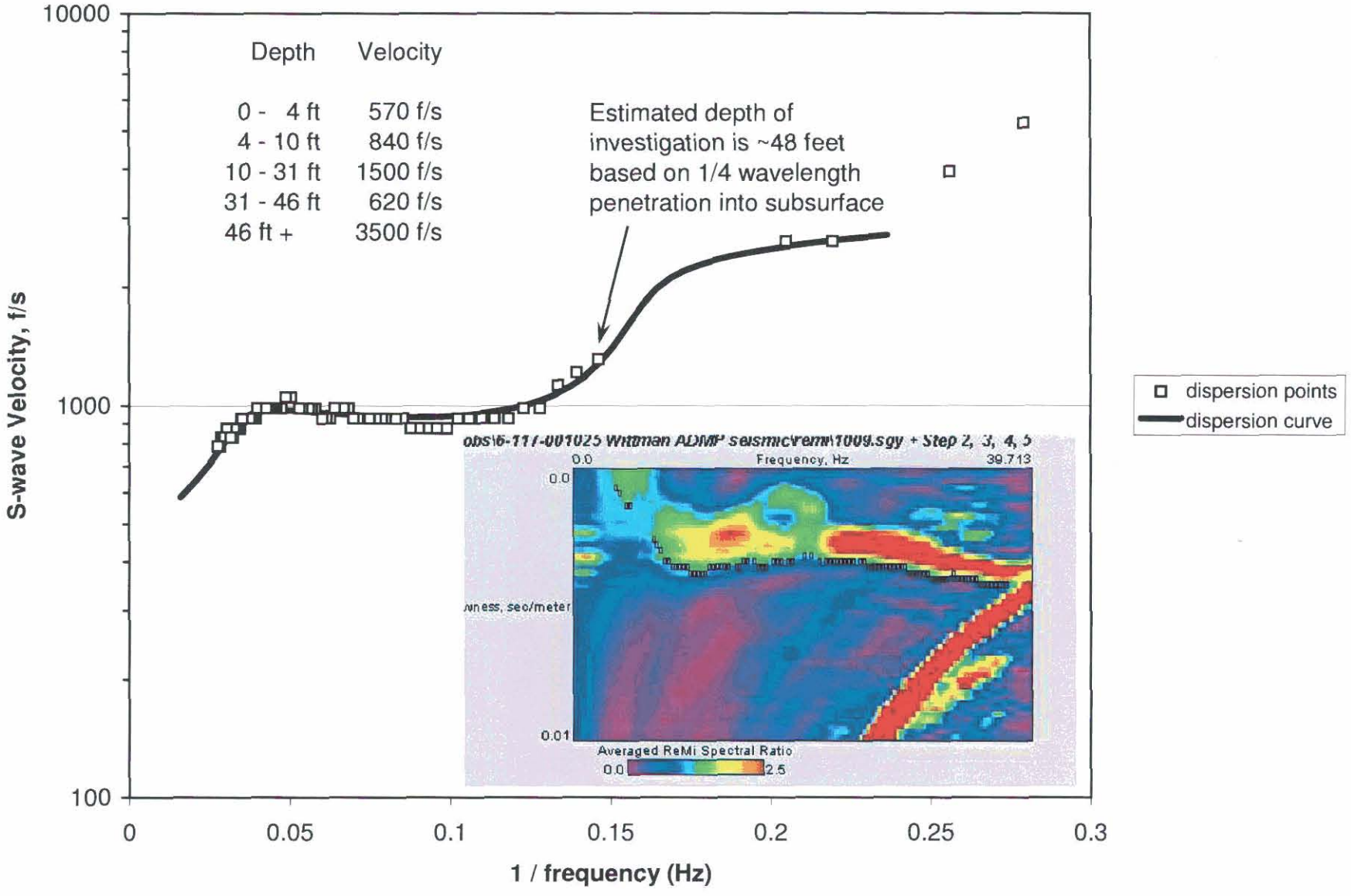
Louie, J.L., 2001, Faster, Better: Shear-wave velocity to 100 meters depth from refraction microtremor arrays, Bulletin of the Seismological Society of America, Vol. 91, 347-364.

Refraction Microtremor S-wave Interpretation **Line 1** AMEC Job No. 6-117-001025

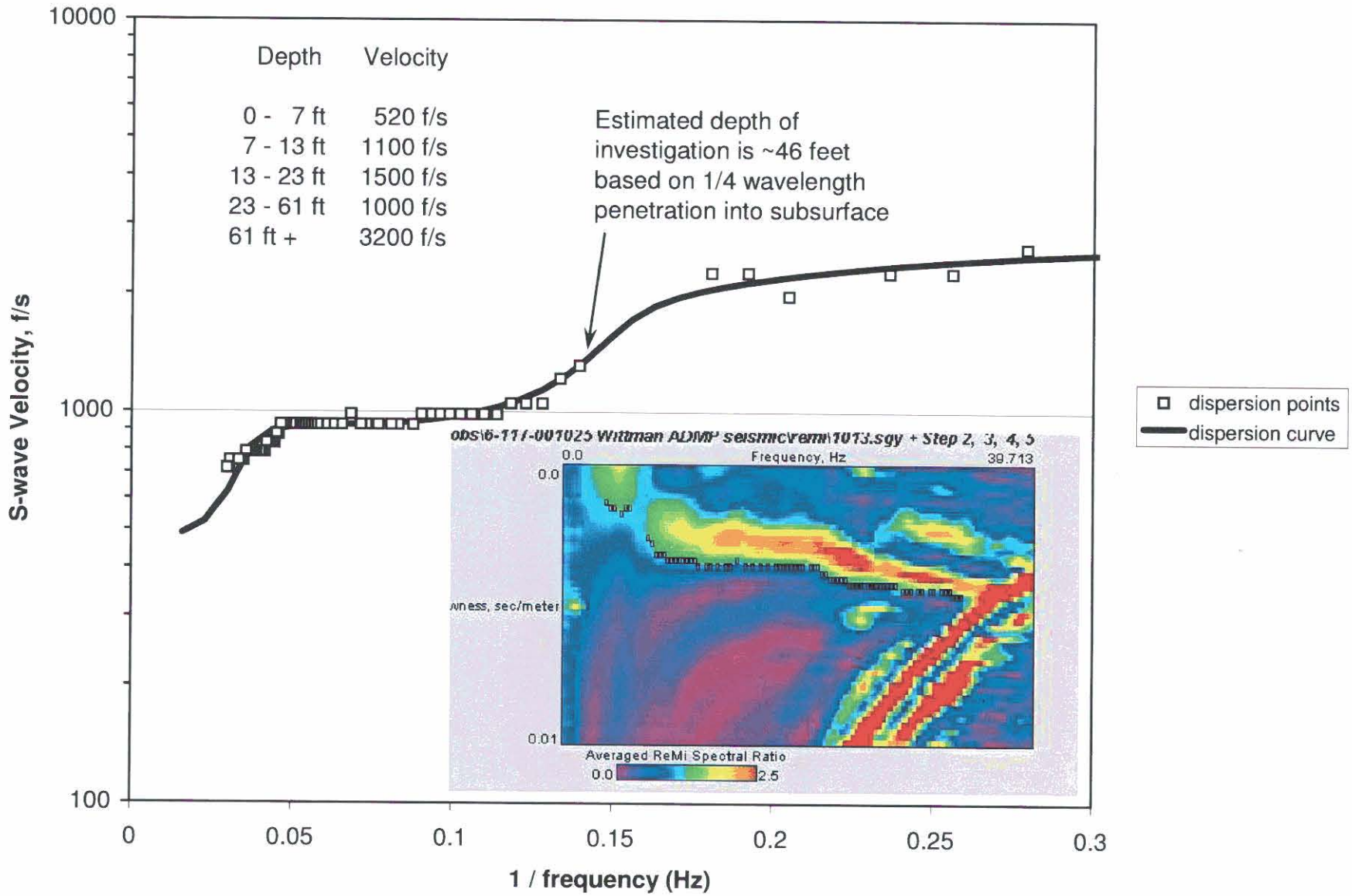


Refraction Microtremor S-wave Interpretation **Line 2** AMEC Job No. 6-117-001025

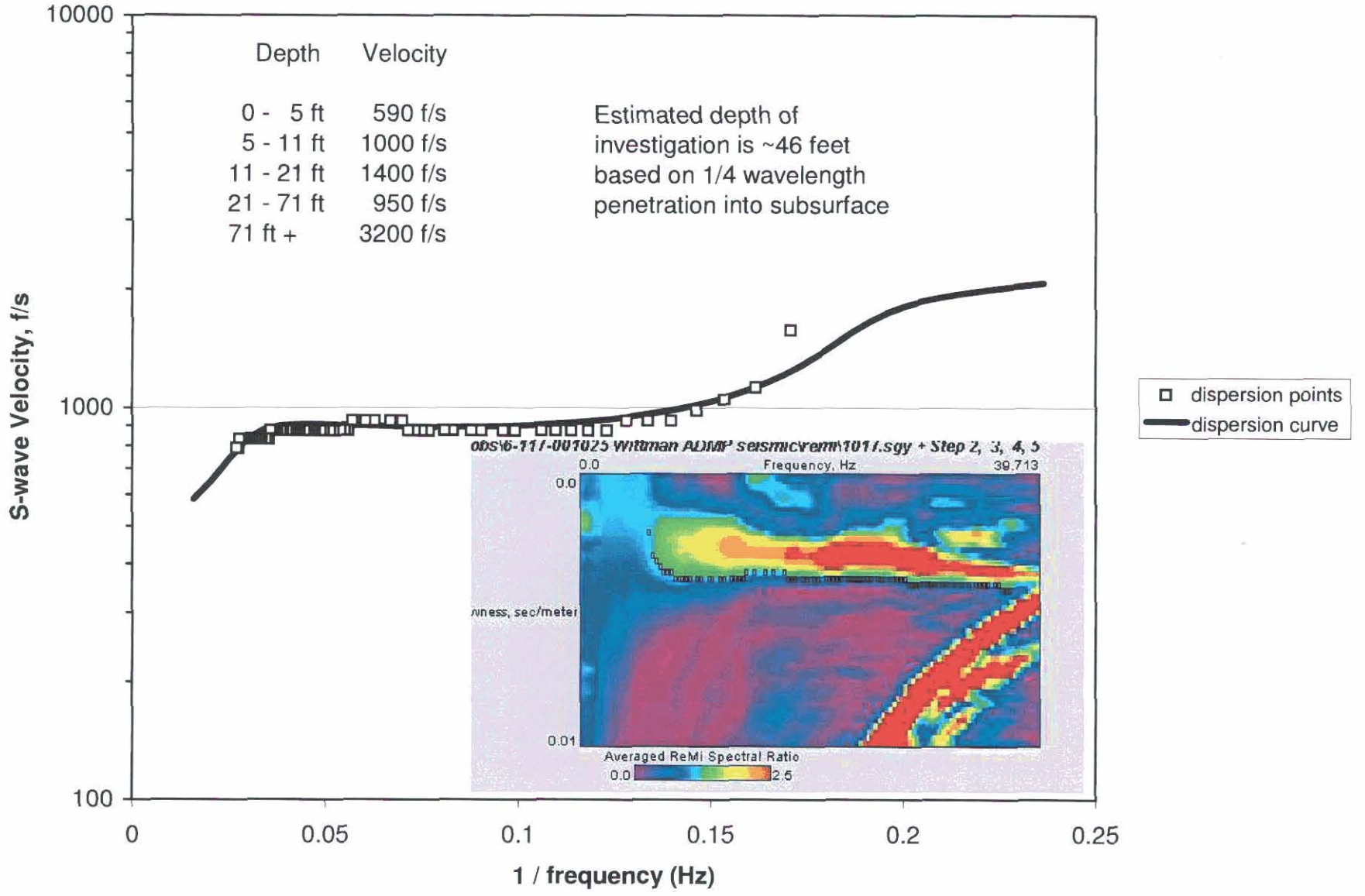


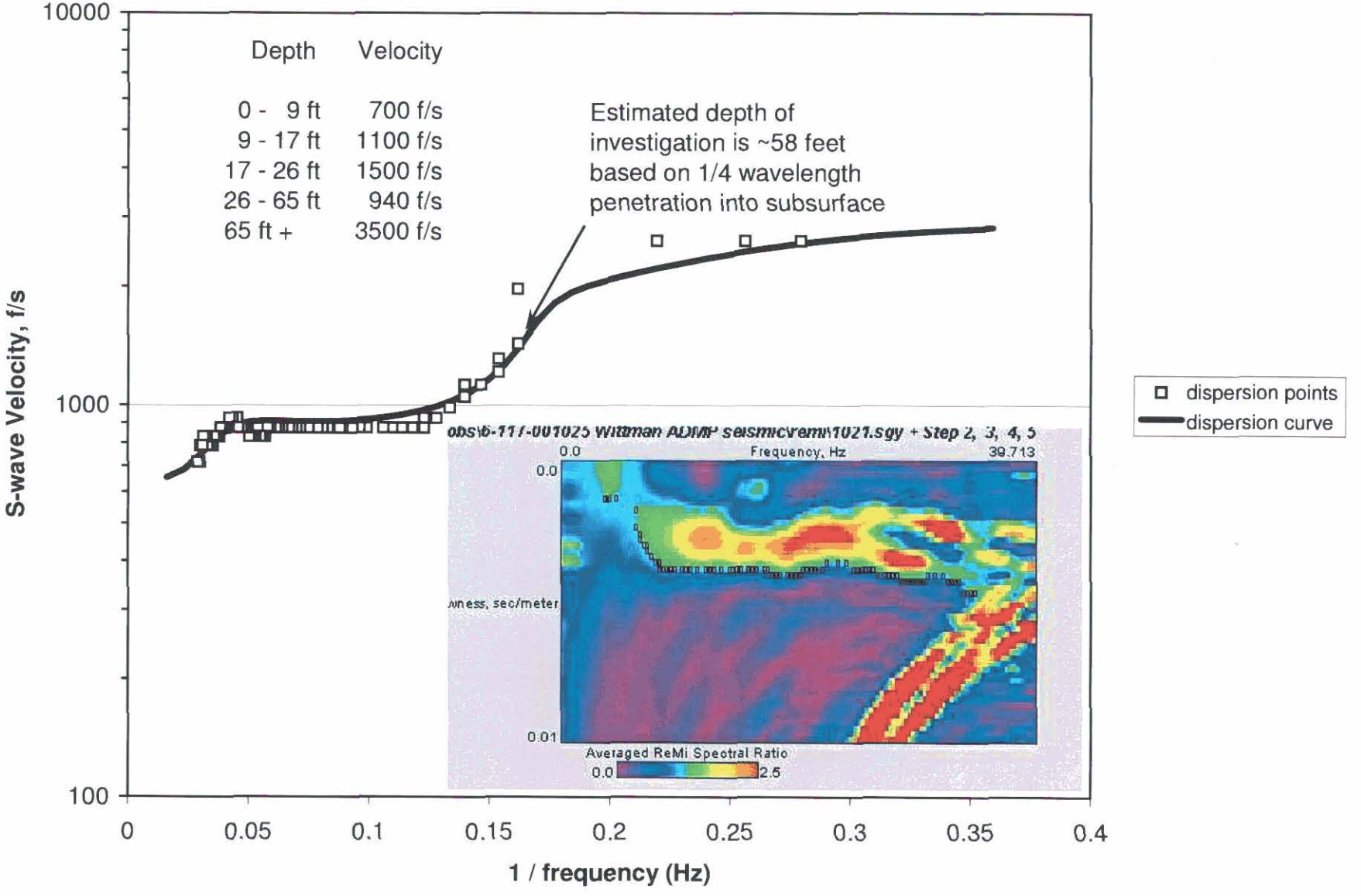

10000
1000
100
S-wave Velocity, f/s
0
0.05
0.1
0.15
0.2
0.25
0.3
1 / frequency (Hz)
Depth Velocity
0 - 4 ft 570 f/s
4 - 10 ft 840 f/s
10 - 31 ft 1500 f/s
31 - 46 ft 620 f/s
46 ft + 3500 f/s
Estimated depth of investigation is ~48 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 4** AMEC Job No. 6-117-001025

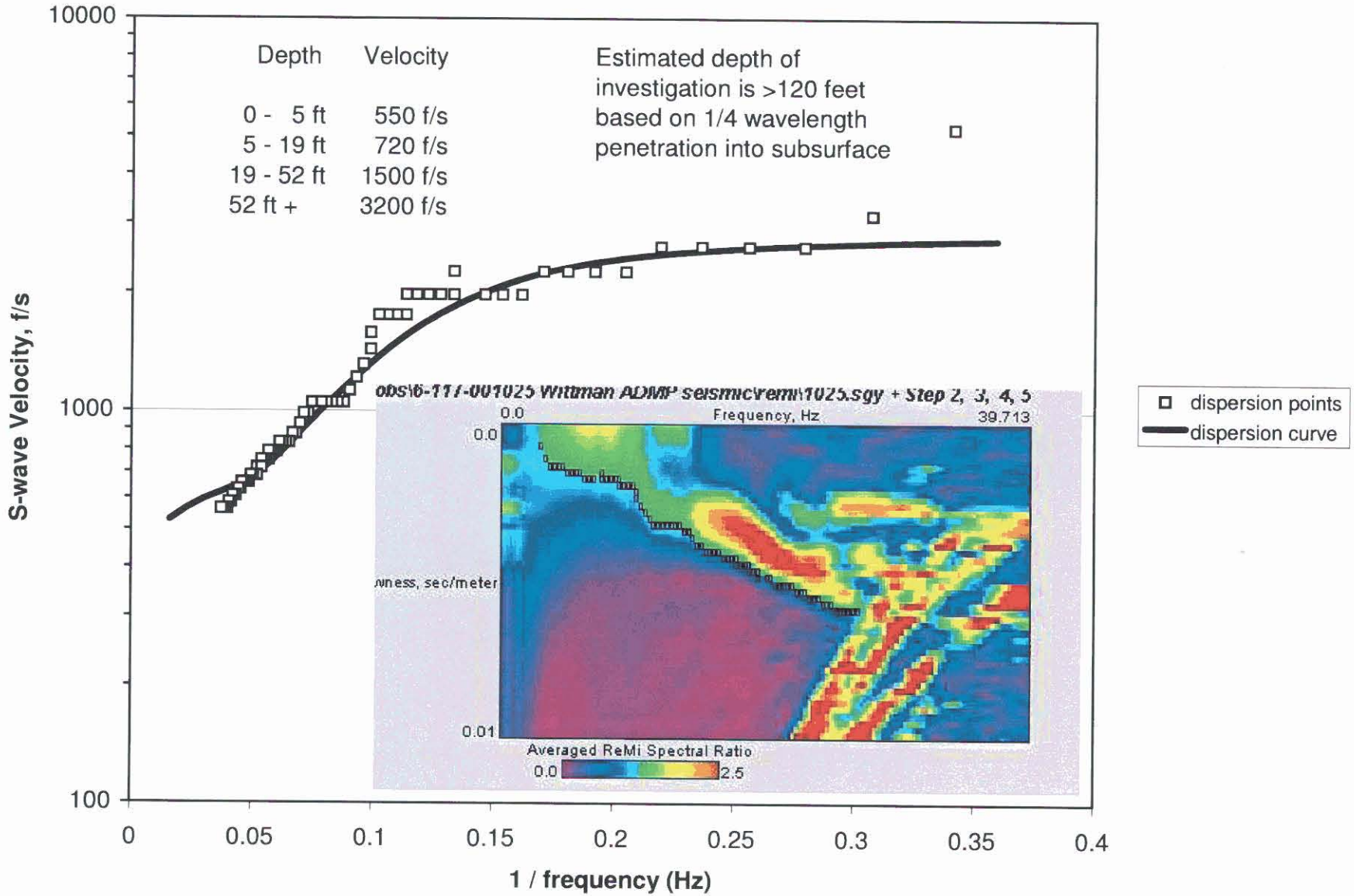


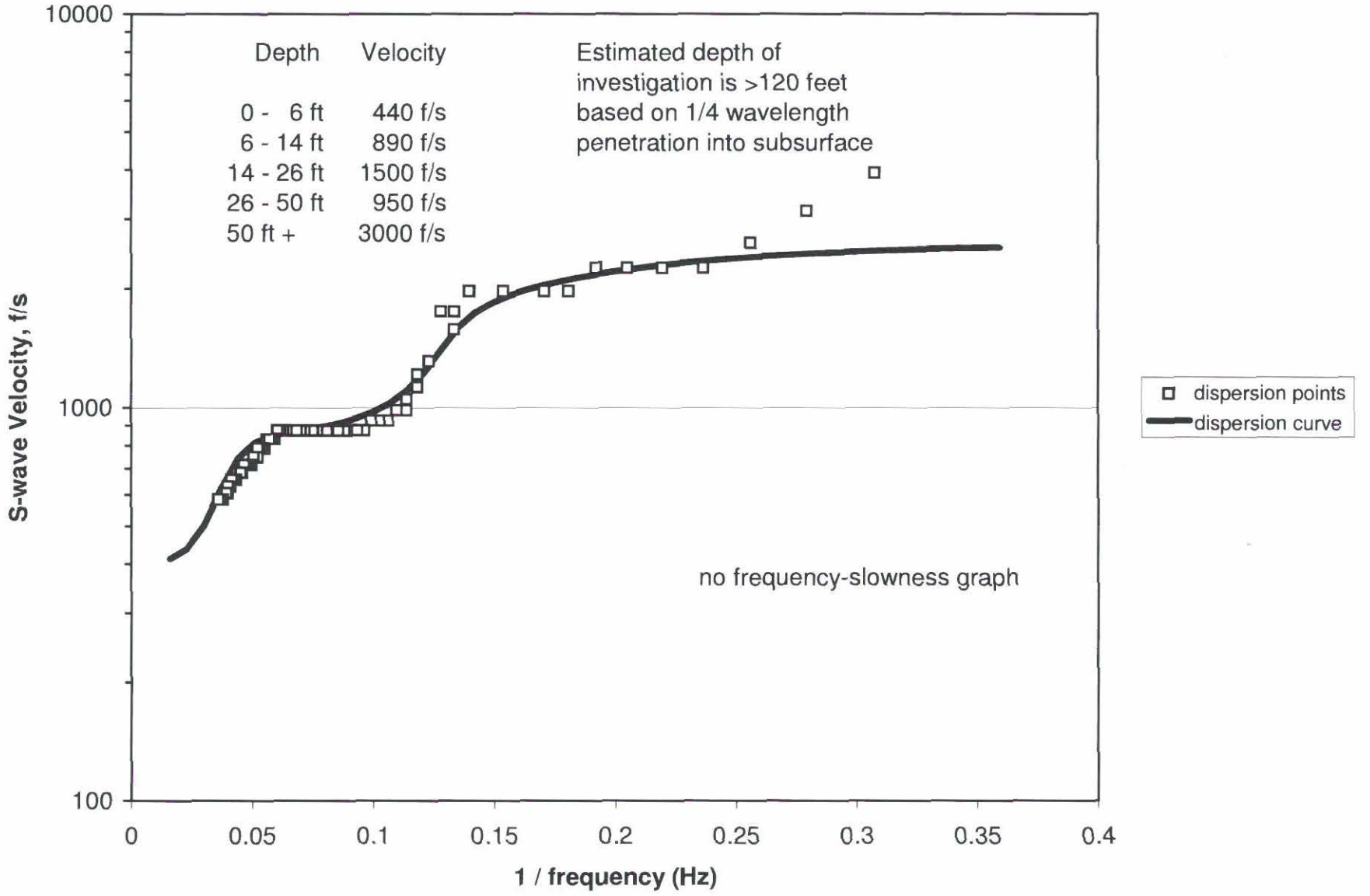
Refraction Microtremor S-wave Interpretation **Line 5** AMEC Job No. 6-117-001025



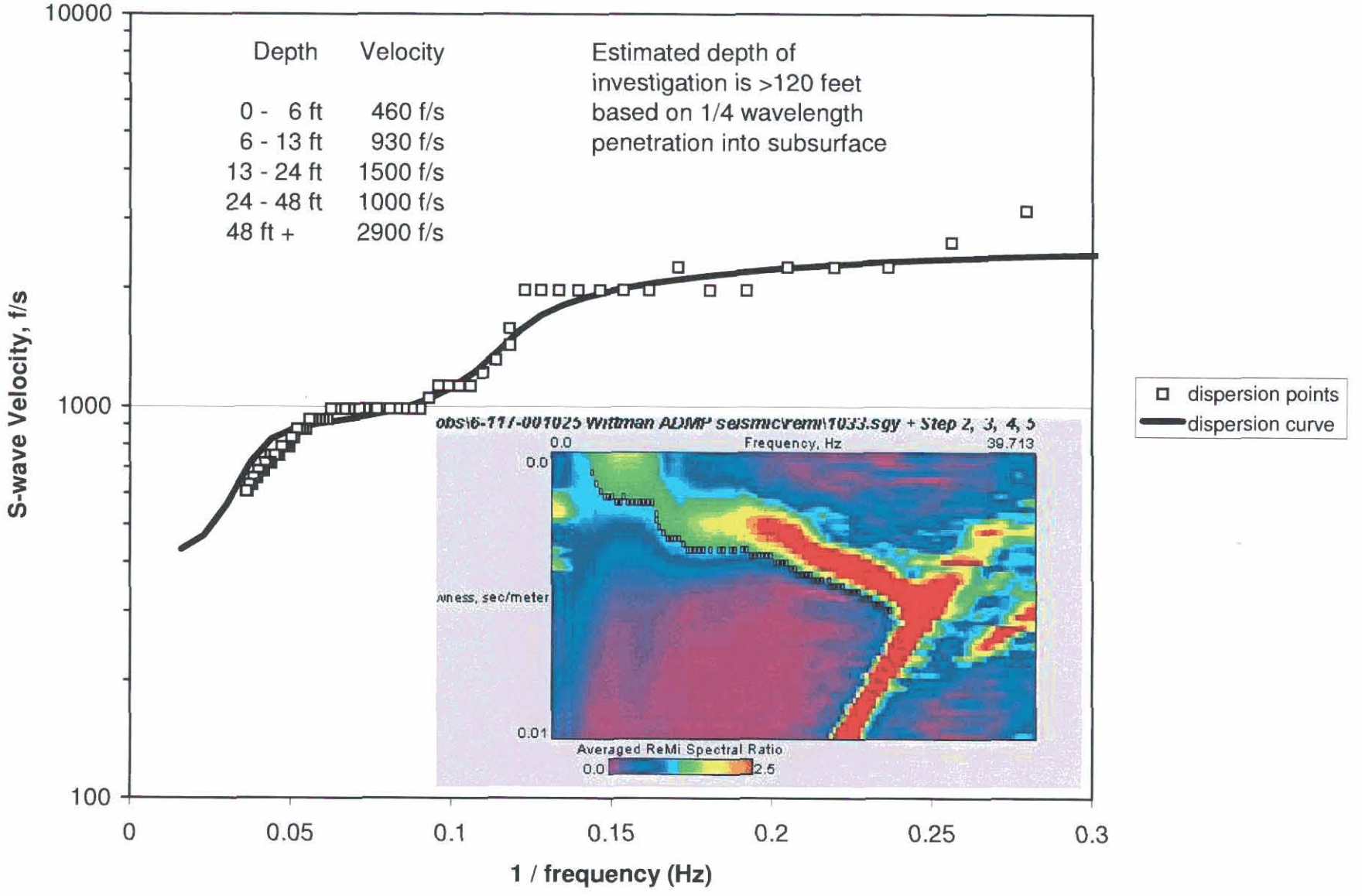

Depth Velocity
0 - 9 ft 700 f/s
9 - 17 ft 1100 f/s
17 - 26 ft 1500 f/s
26 - 65 ft 940 f/s
65 ft + 3500 f/s
Estimated depth of investigation is ~58 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 7** AMEC Job No. 6-117-001025

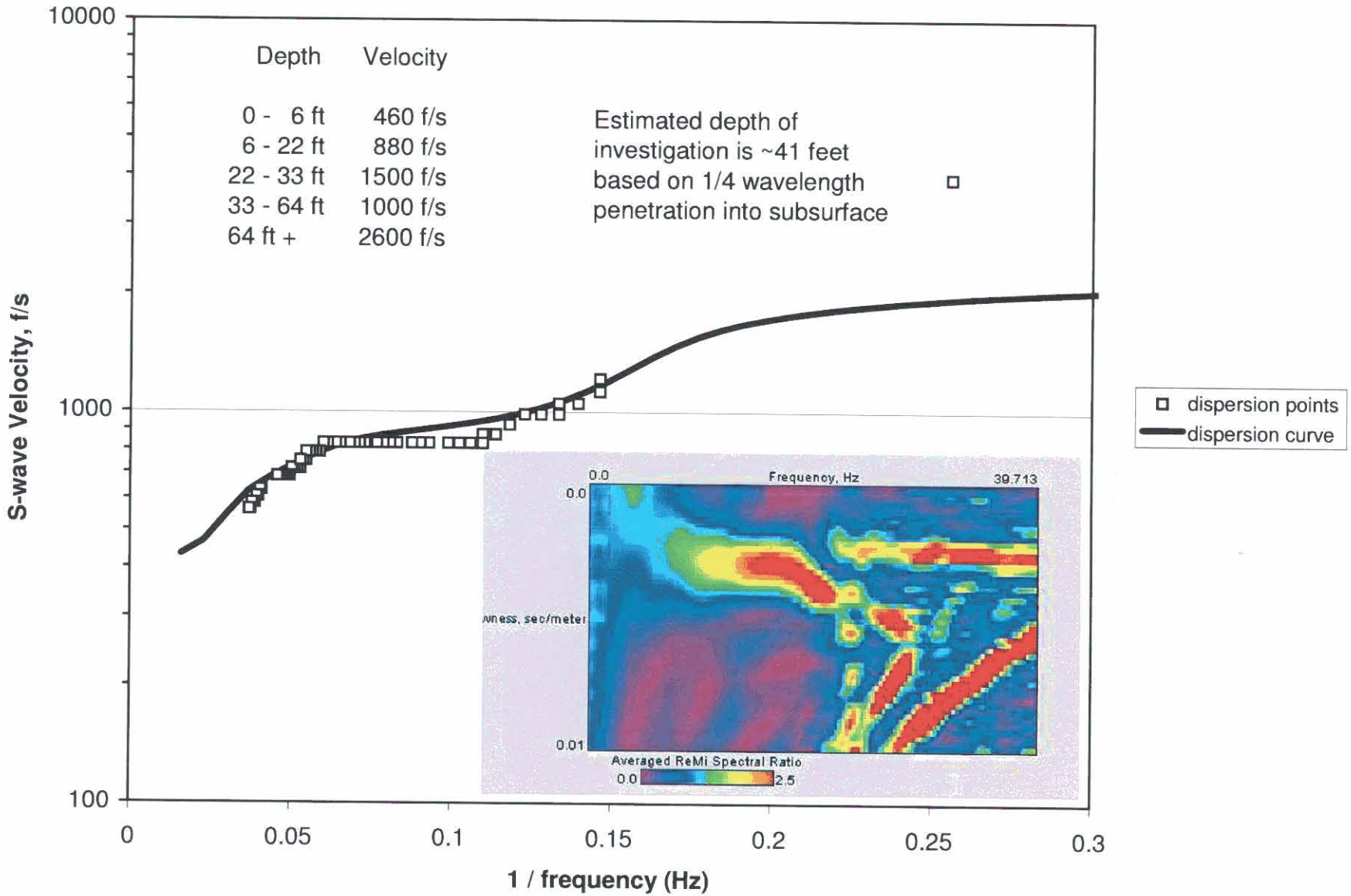



Depth Velocity
0 - 6 ft 440 f/s
6 - 14 ft 890 f/s
14 - 26 ft 1500 f/s
26 - 50 ft 950 f/s
50 ft + 3000 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
no frequency-slowness graph
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)

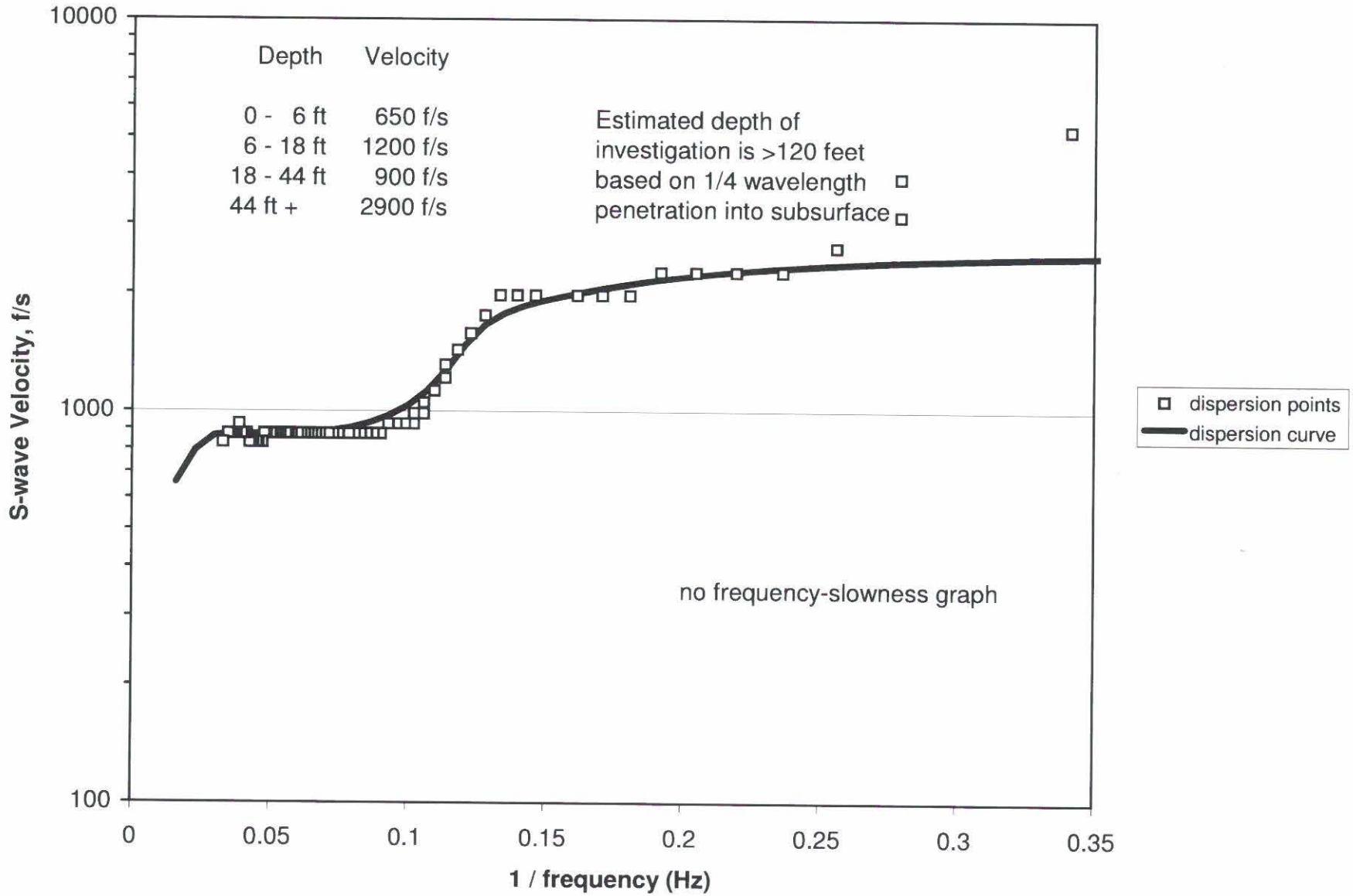
Refraction Microtremor S-wave Interpretation **Line 9** AMEC Job No. 6-117-001025



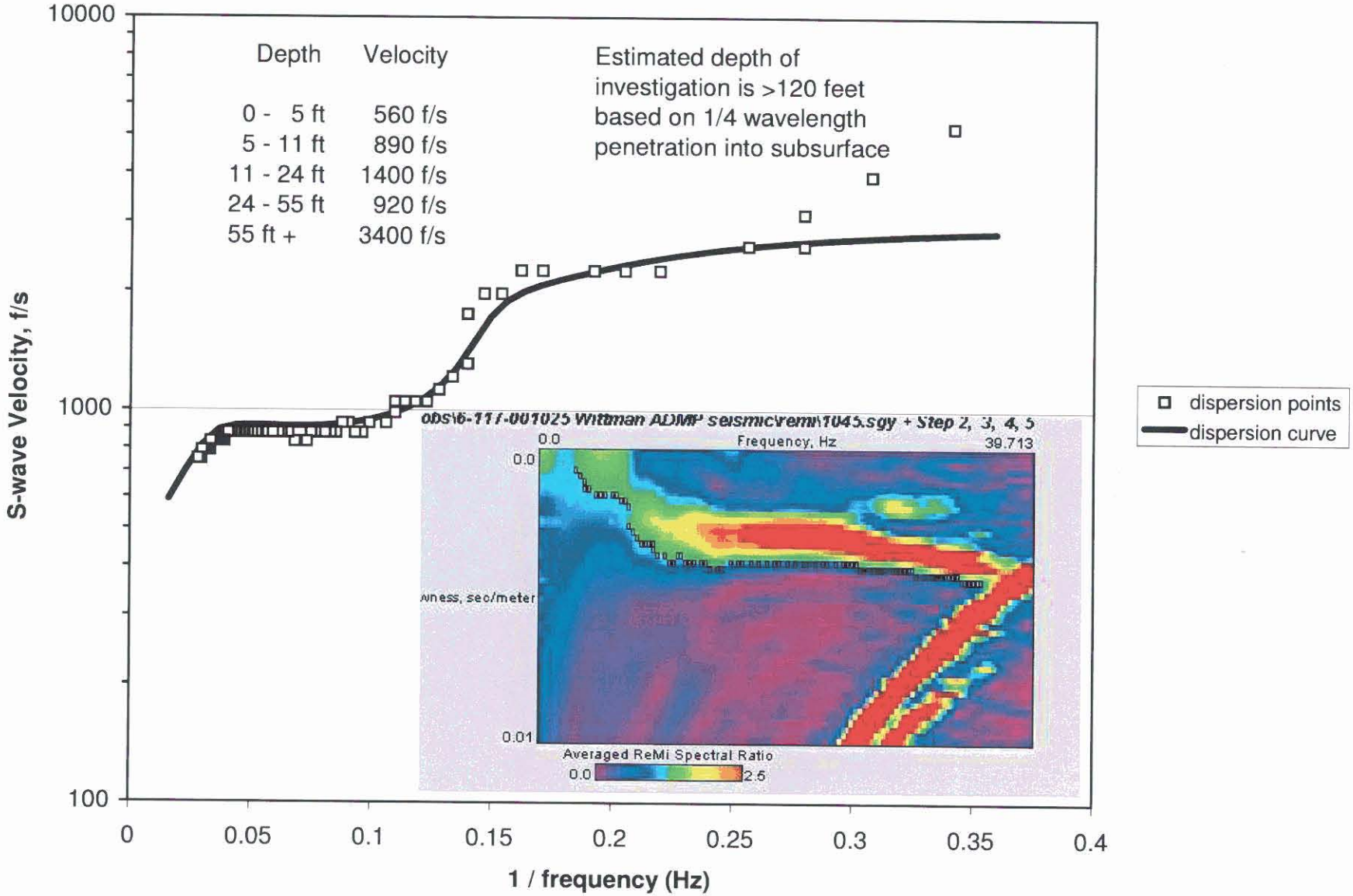
Refraction Microtremor S-wave Interpretation **Line 10** AMEC Job No. 6-117-001025



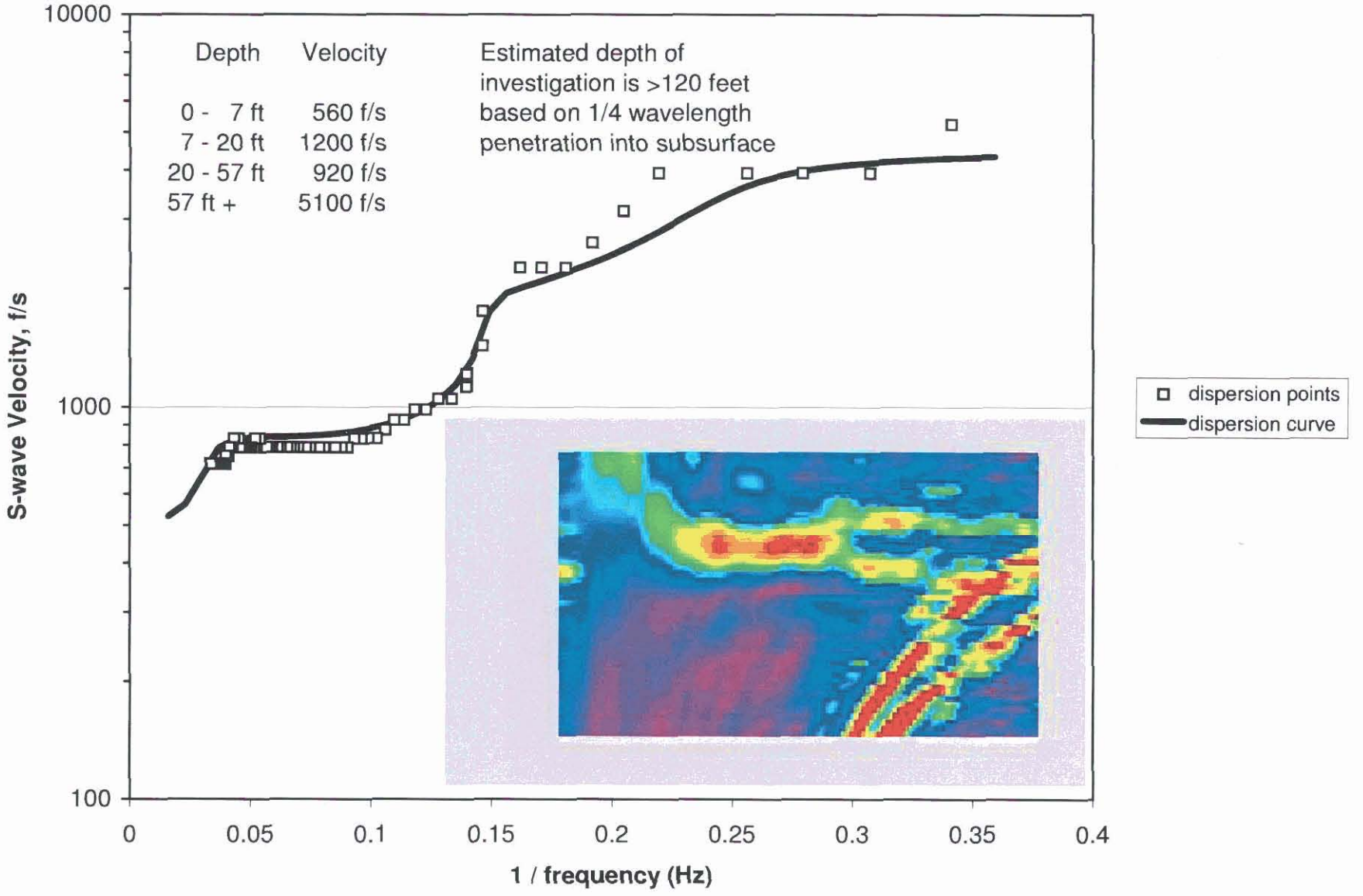
Refraction Microtremor S-wave Interpretation **Line 11** AMEC Job No. 6-117-001025

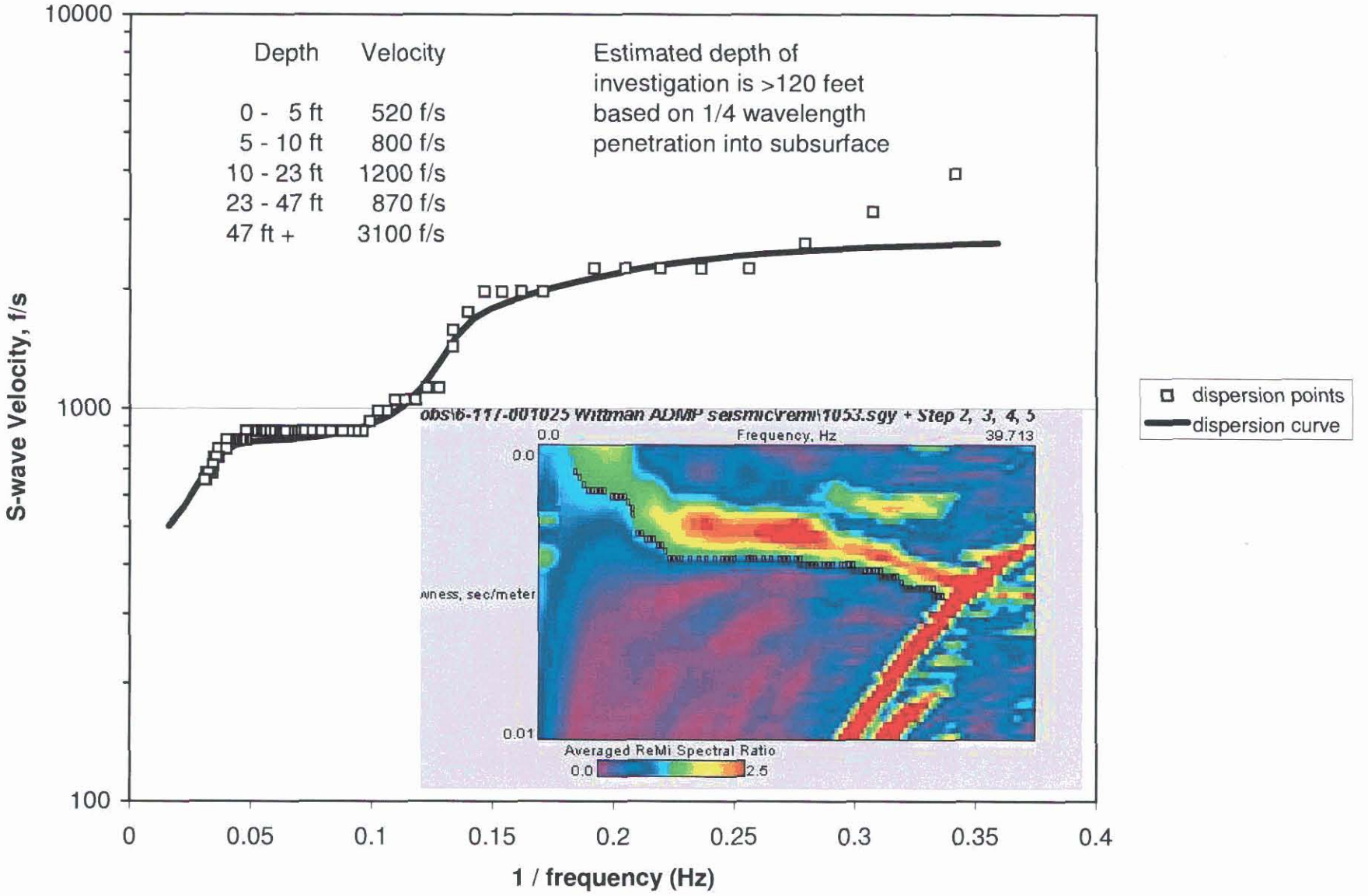


Refraction Microtremor S-wave Interpretation **Line 12** AMEC Job No. 6-117-001025

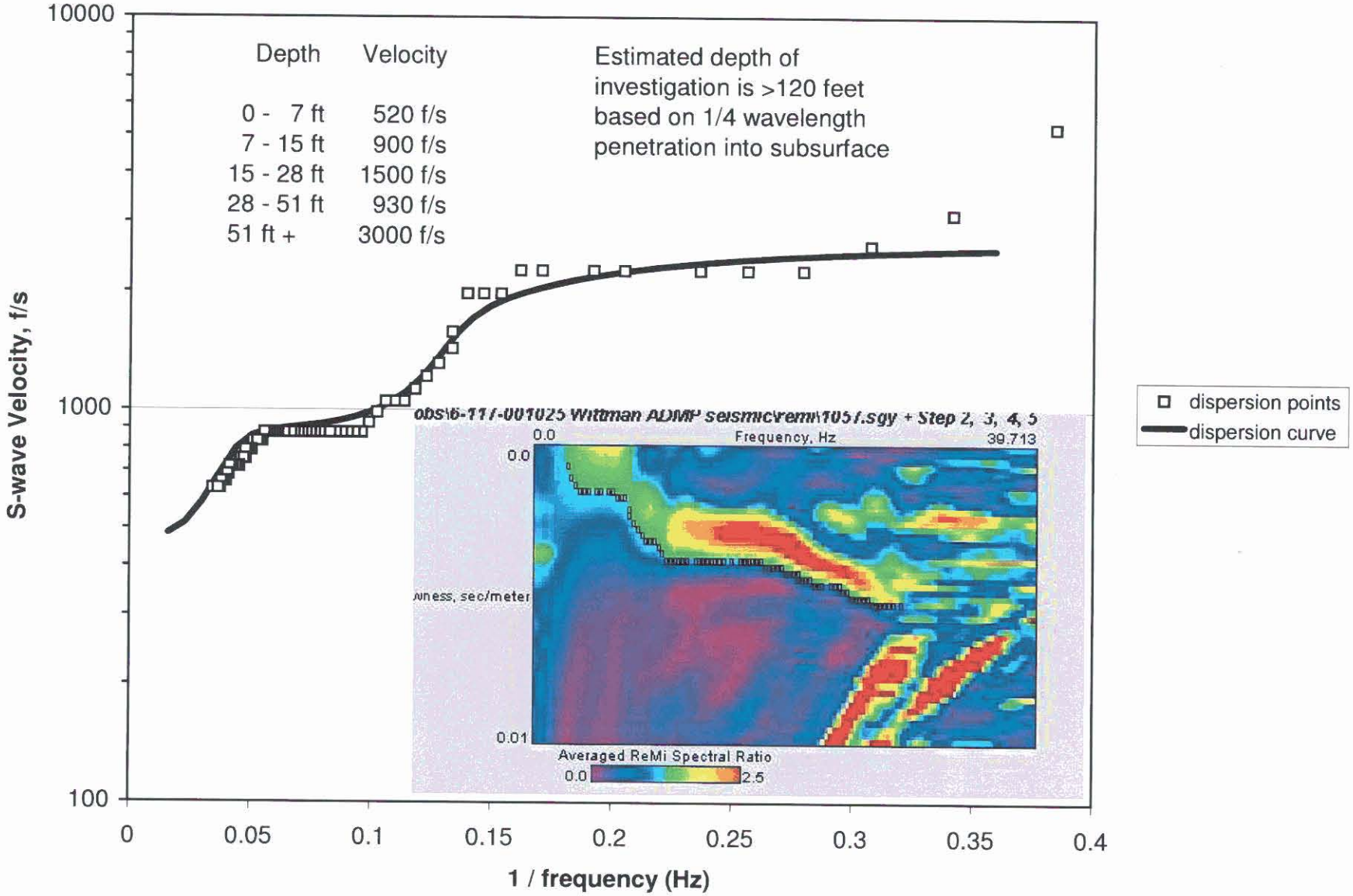


Refraction Microtremor S-wave Interpretation **Line 13** AMEC Job No. 6-117-001025

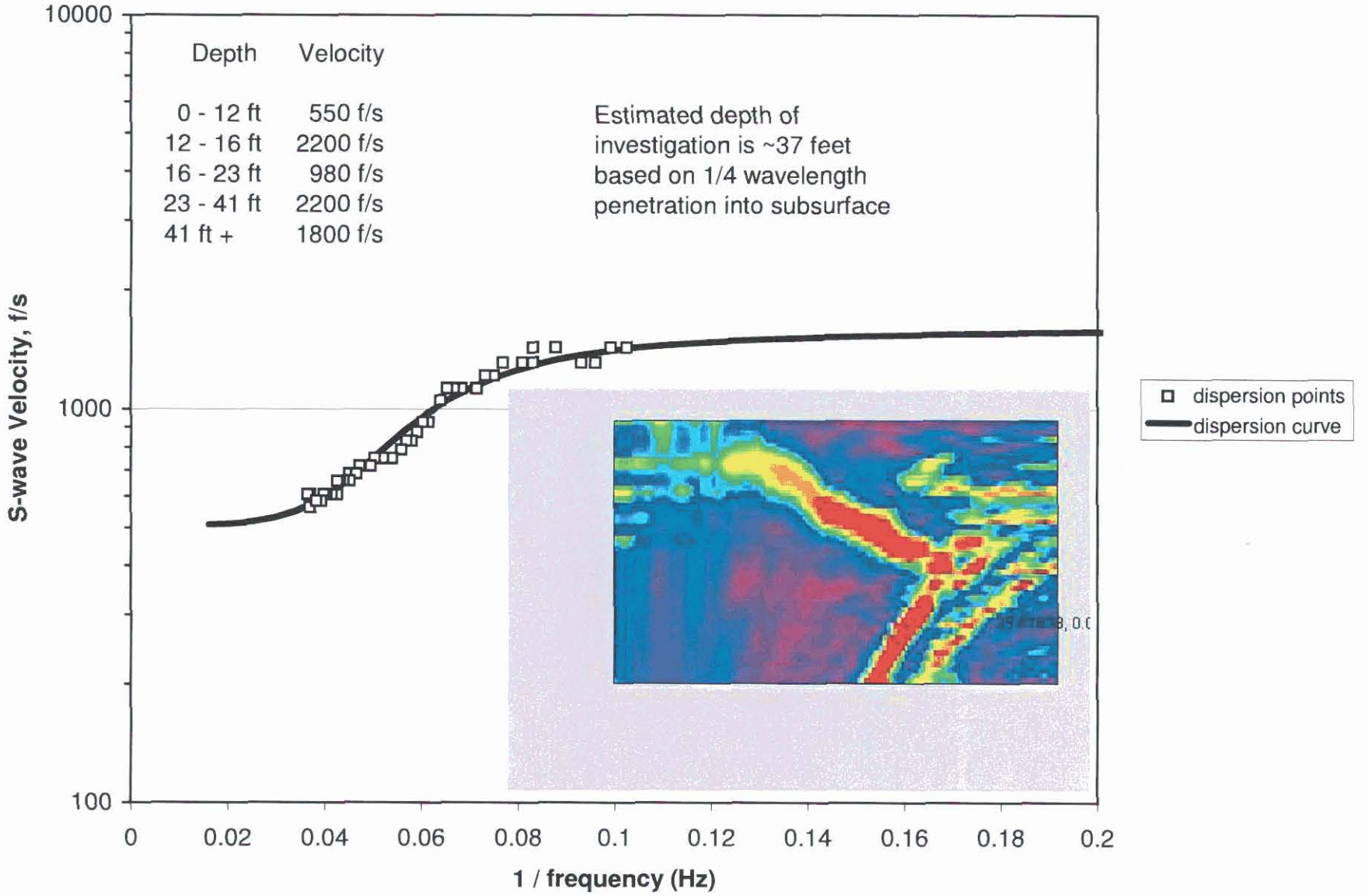


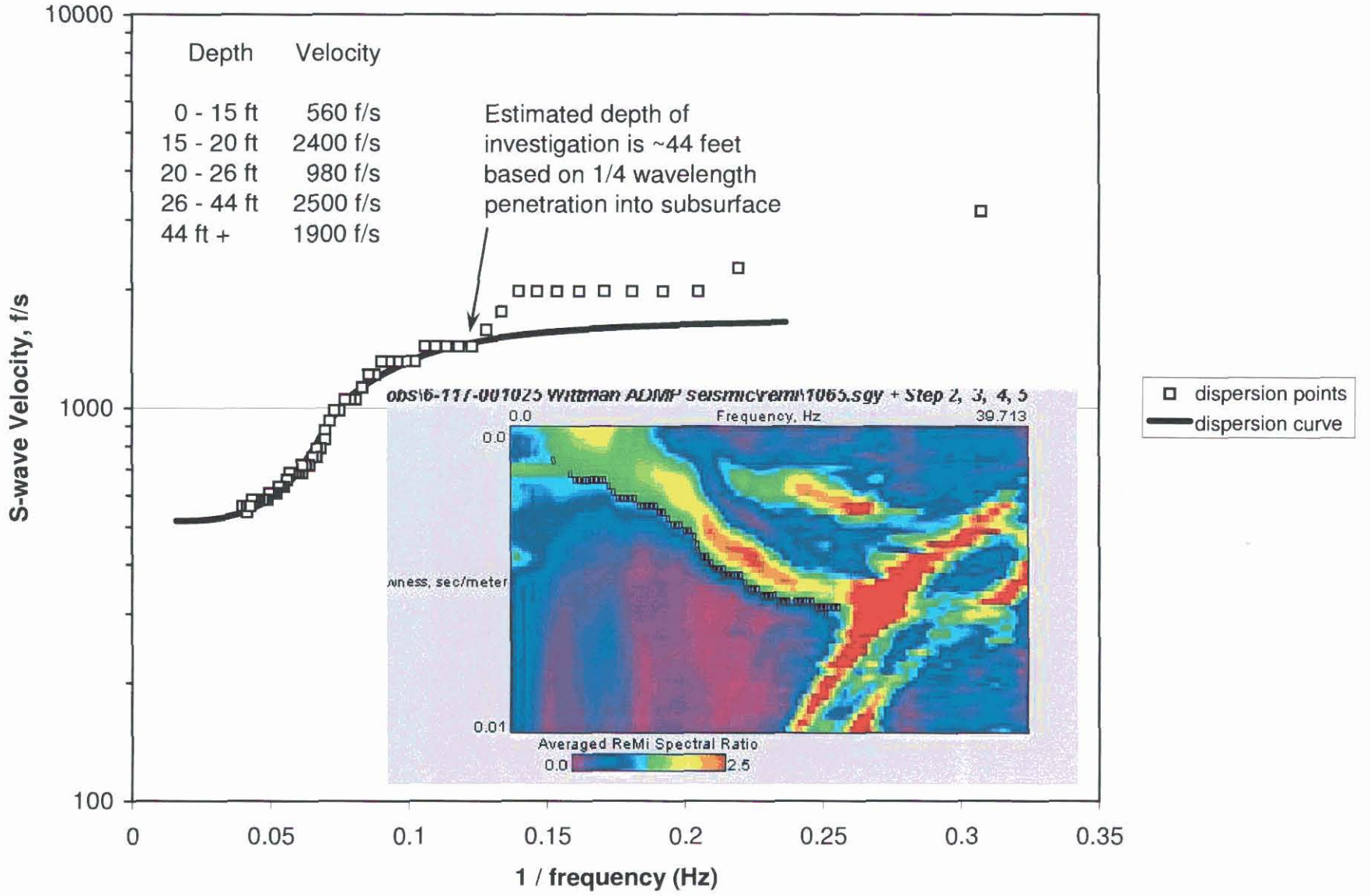

Depth Velocity
0 - 5 ft 520 f/s
5 - 10 ft 800 f/s
10 - 23 ft 1200 f/s
23 - 47 ft 870 f/s
47 ft + 3100 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 15** AMEC Job No. 6-117-001025



Refraction Microtremor S-wave Interpretation **Line 16** AMEC Job No. 6-117-001025

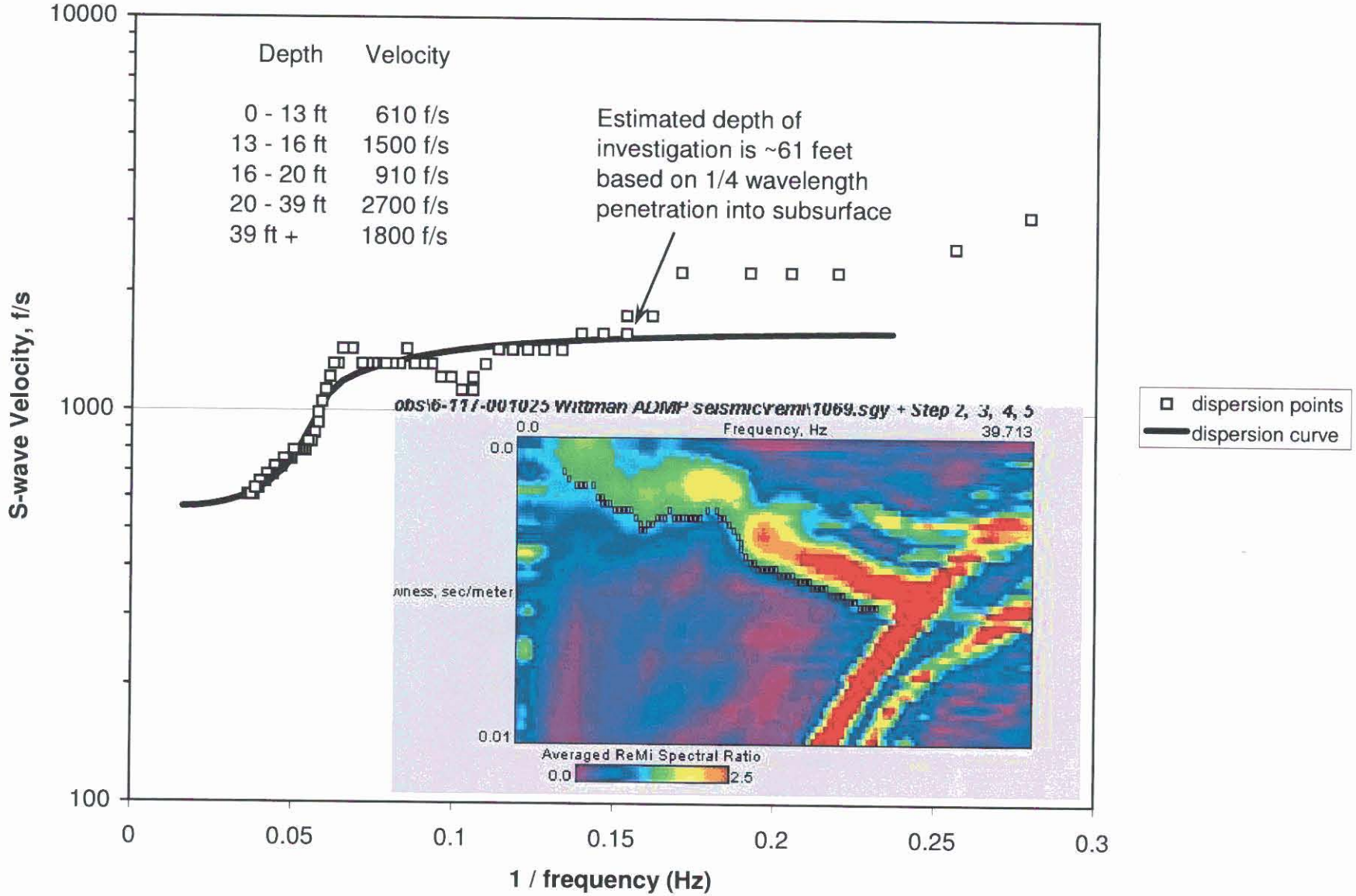


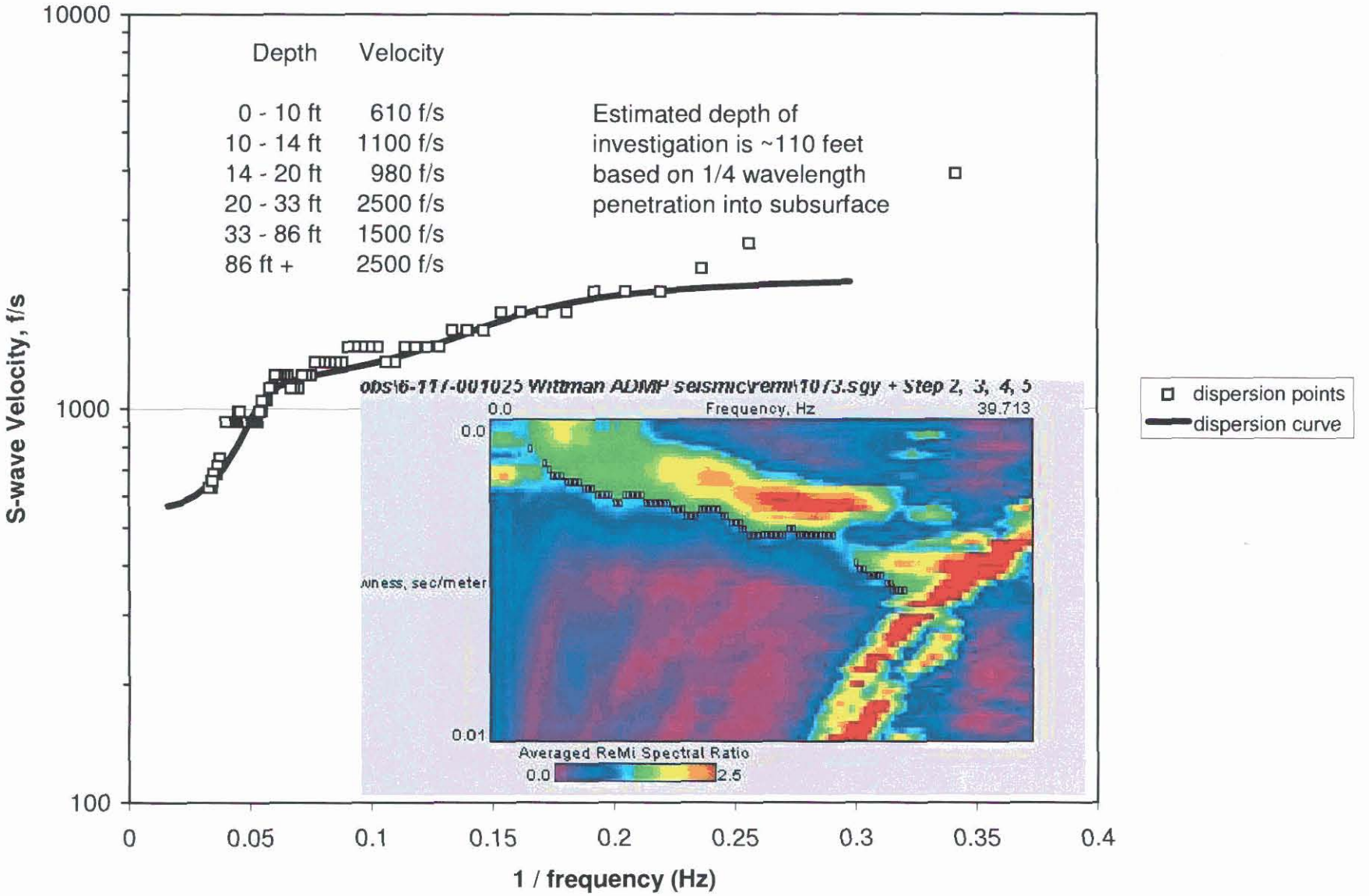

Depth Velocity
0 - 15 ft 560 f/s
15 - 20 ft 2400 f/s
20 - 26 ft 980 f/s
26 - 44 ft 2500 f/s
44 ft + 1900 f/s
Estimated depth of investigation is ~44 feet based on 1/4 wavelength penetration into subsurface
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 / frequency (Hz)
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation

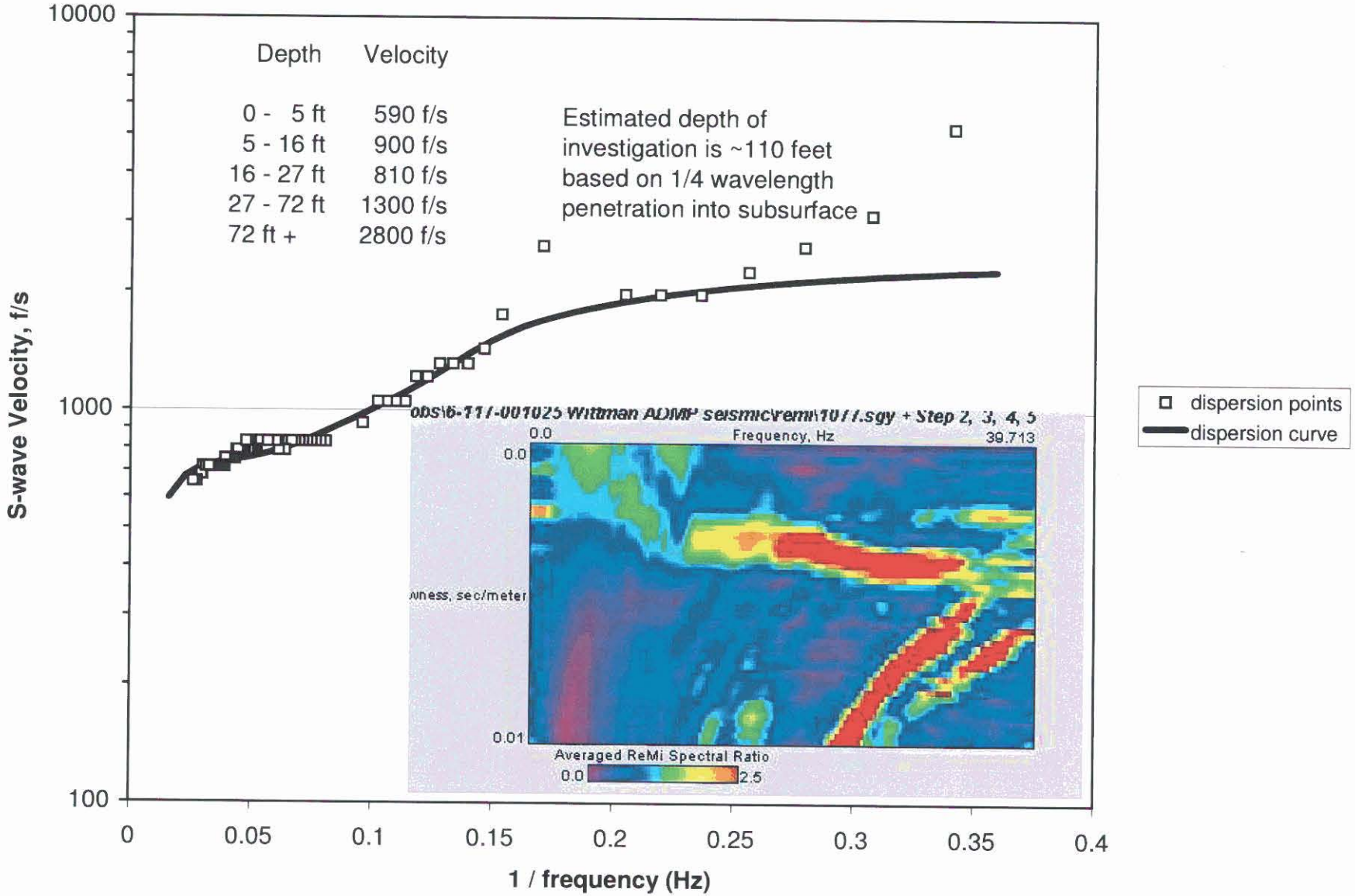
Line 18

AMEC Job No. 6-117-001025

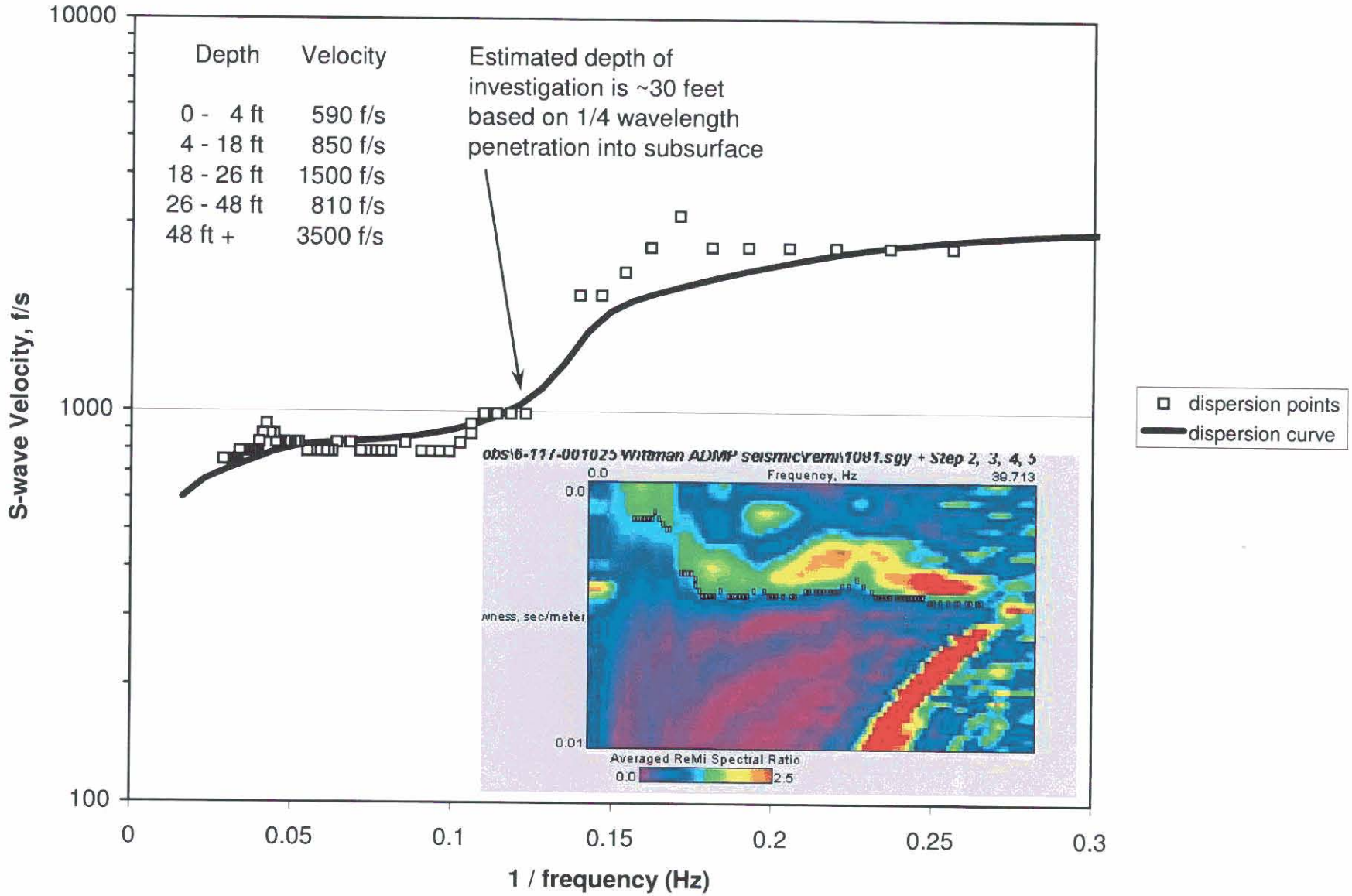



Depth Velocity
0 - 10 ft 610 f/s
10 - 14 ft 1100 f/s
14 - 20 ft 980 f/s
20 - 33 ft 2500 f/s
33 - 86 ft 1500 f/s
86 ft + 2500 f/s
Estimated depth of investigation is ~110 feet based on 1/4 wavelength penetration into subsurface
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)

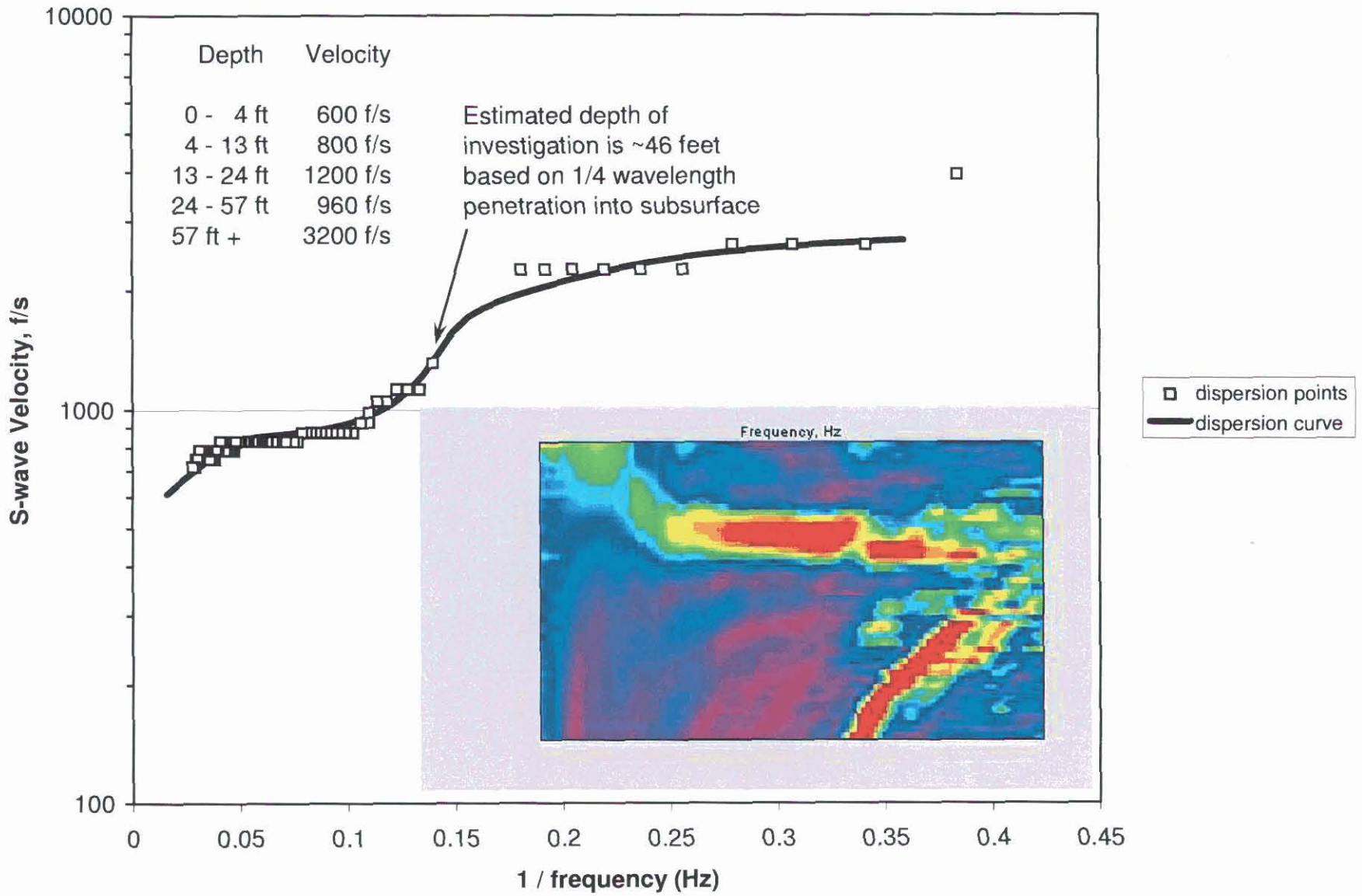
Refraction Microtremor S-wave Interpretation **Line 20** AMEC Job No. 6-117-001025



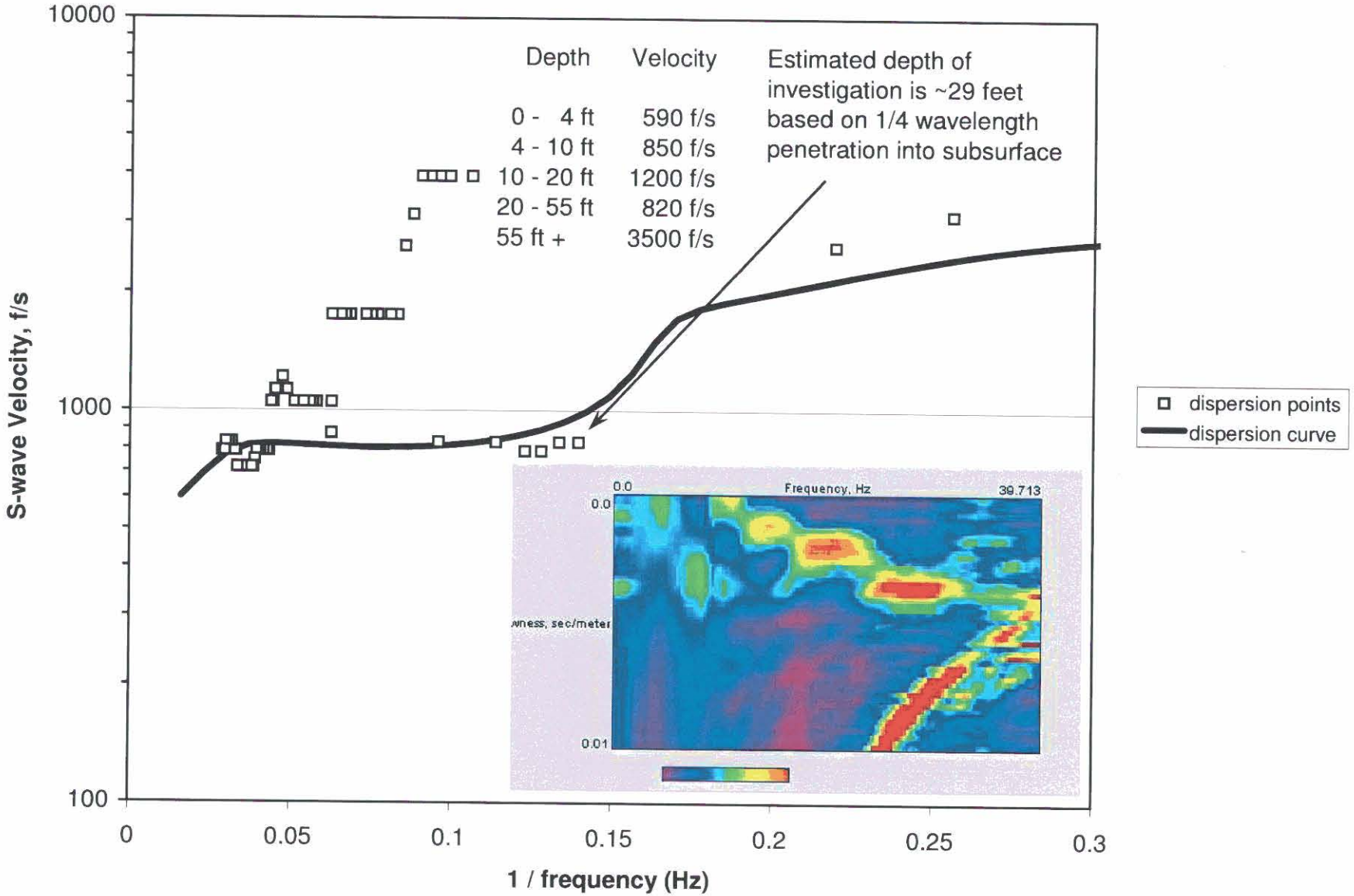
Refraction Microtremor S-wave Interpretation **Line 21** AMEC Job No. 6-117-001025



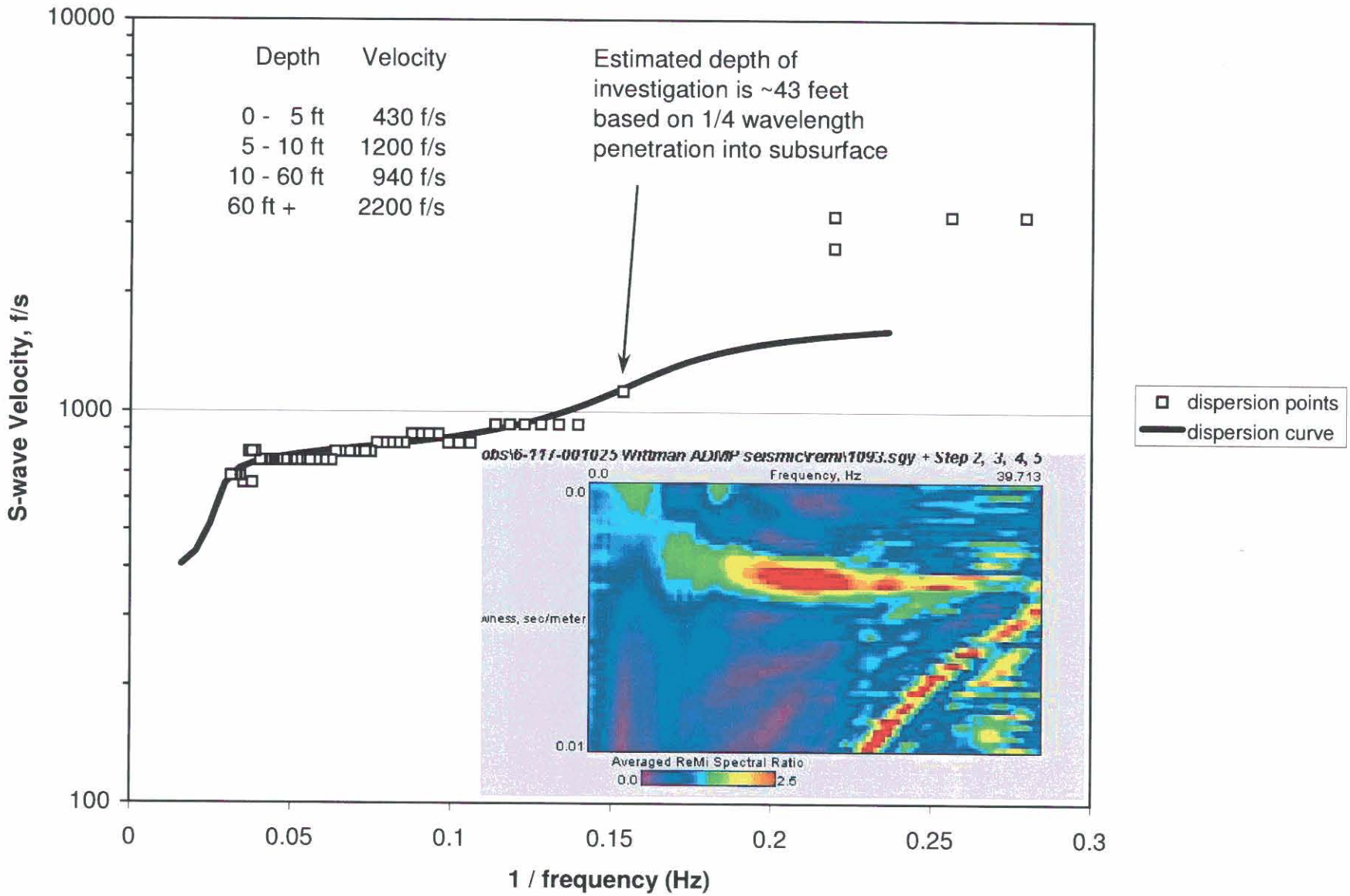
Refraction Microtremor S-wave Interpretation **Line 22** AMEC Job No. 6-117-001025

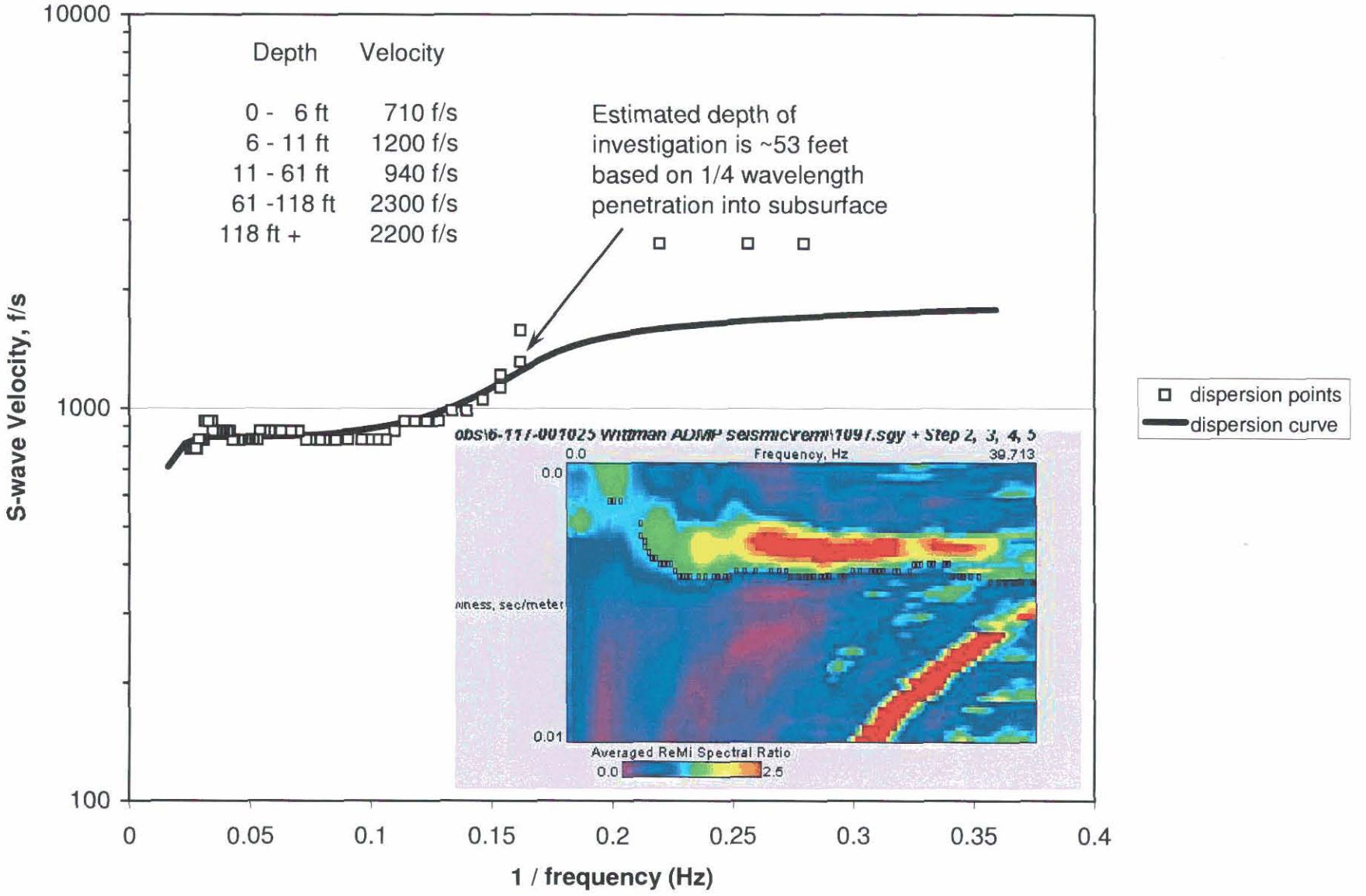


Refraction Microtremor S-wave Interpretation **Line 23** AMEC Job No. 6-117-001025

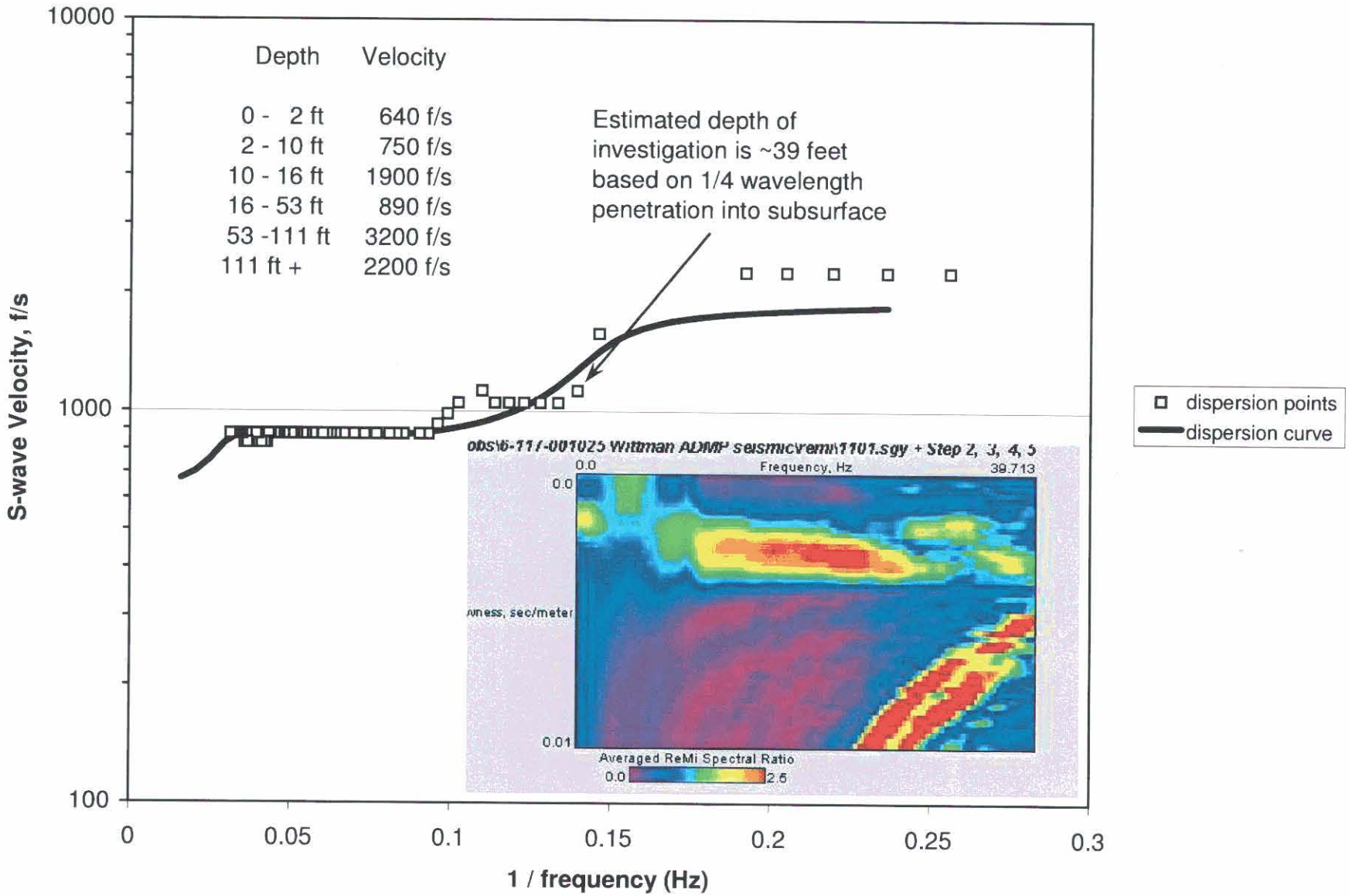


Refraction Microtremor S-wave Interpretation **Line 24** AMEC Job No. 6-117-001025

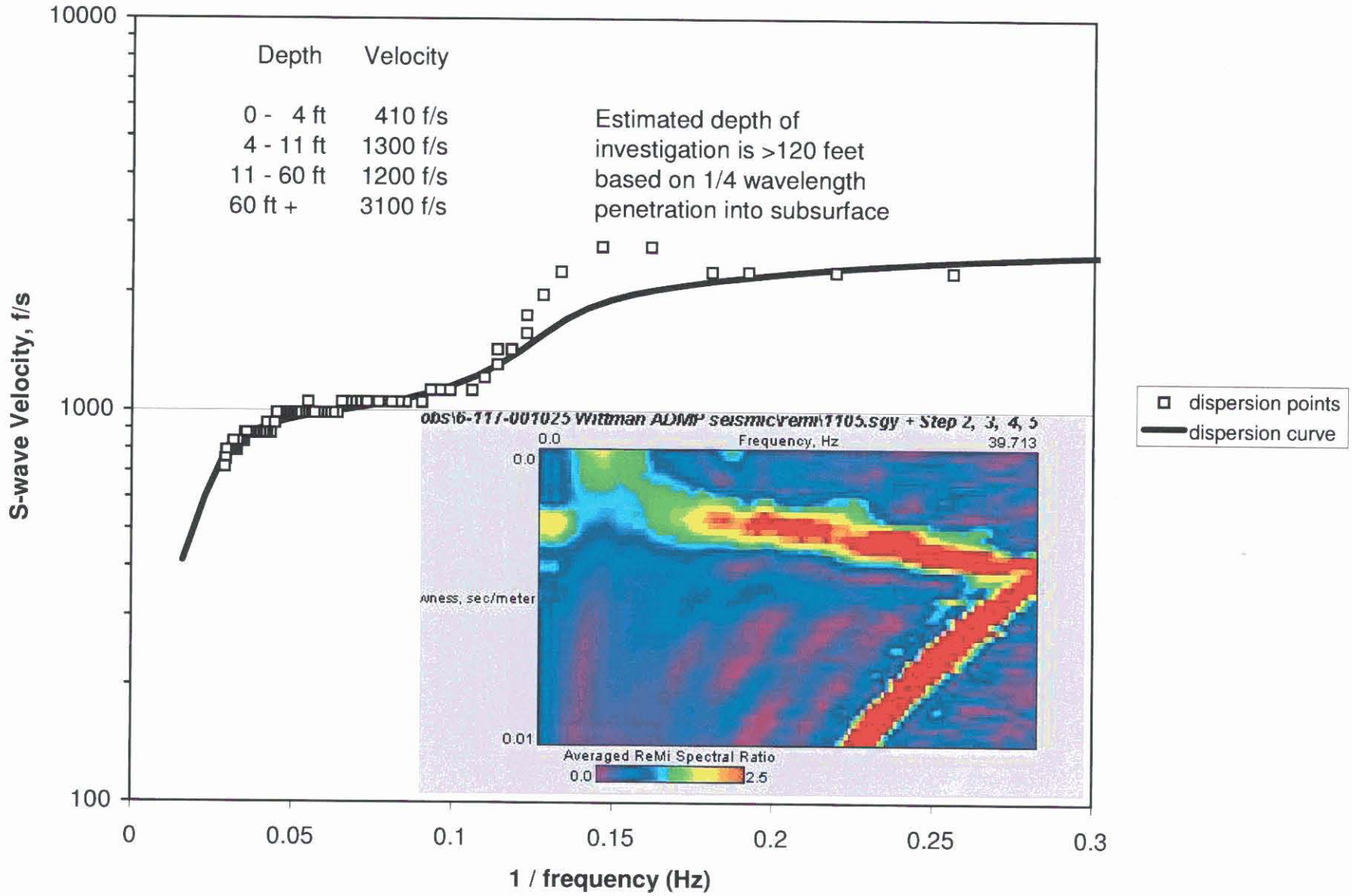



Depth Velocity
0 - 6 ft 710 f/s
6 - 11 ft 1200 f/s
11 - 61 ft 940 f/s
61 -118 ft 2300 f/s
118 ft + 2200 f/s
Estimated depth of investigation is ~53 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

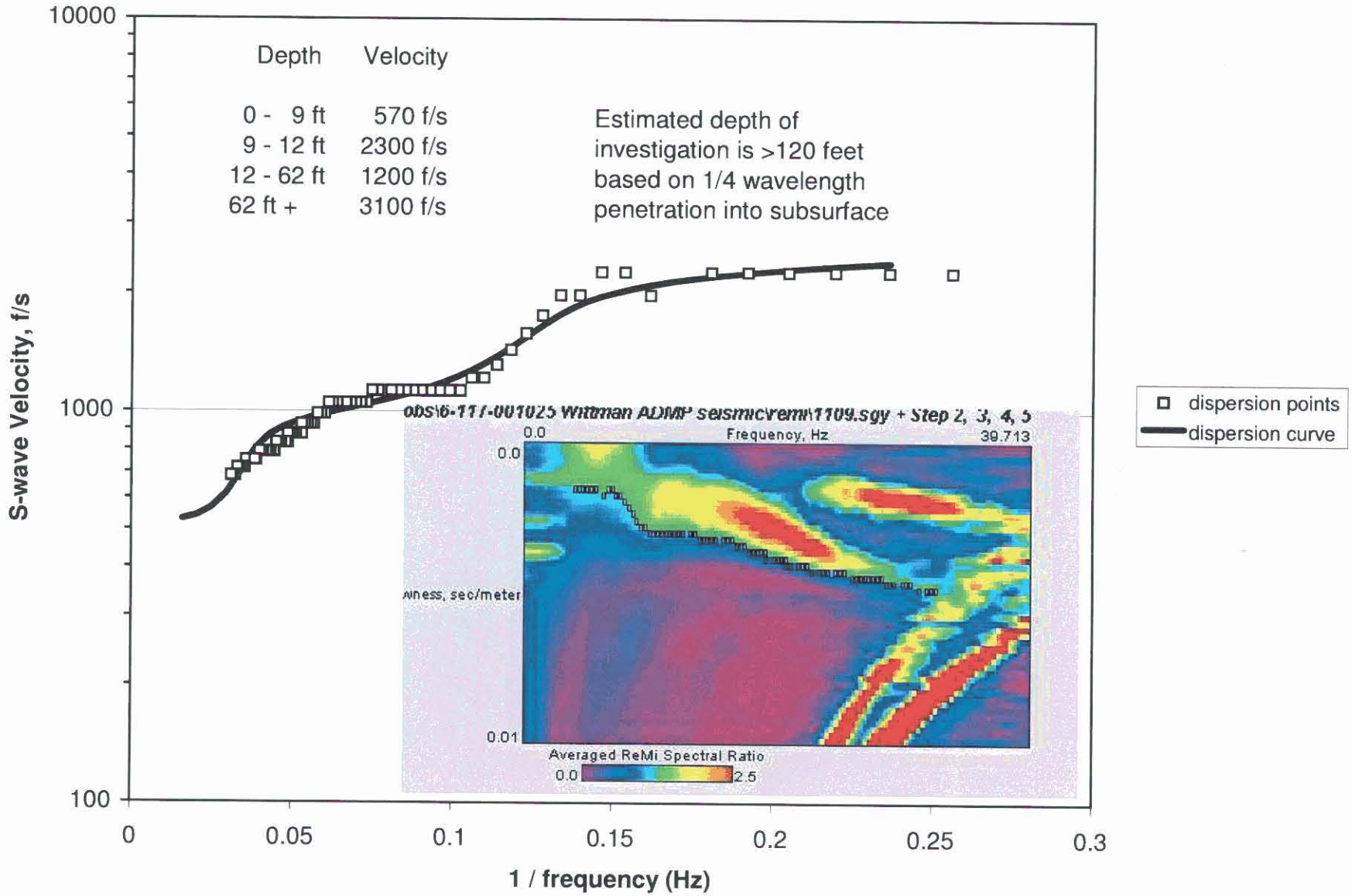
Refraction Microtremor S-wave Interpretation **Line 26** AMEC Job No. 6-117-001025

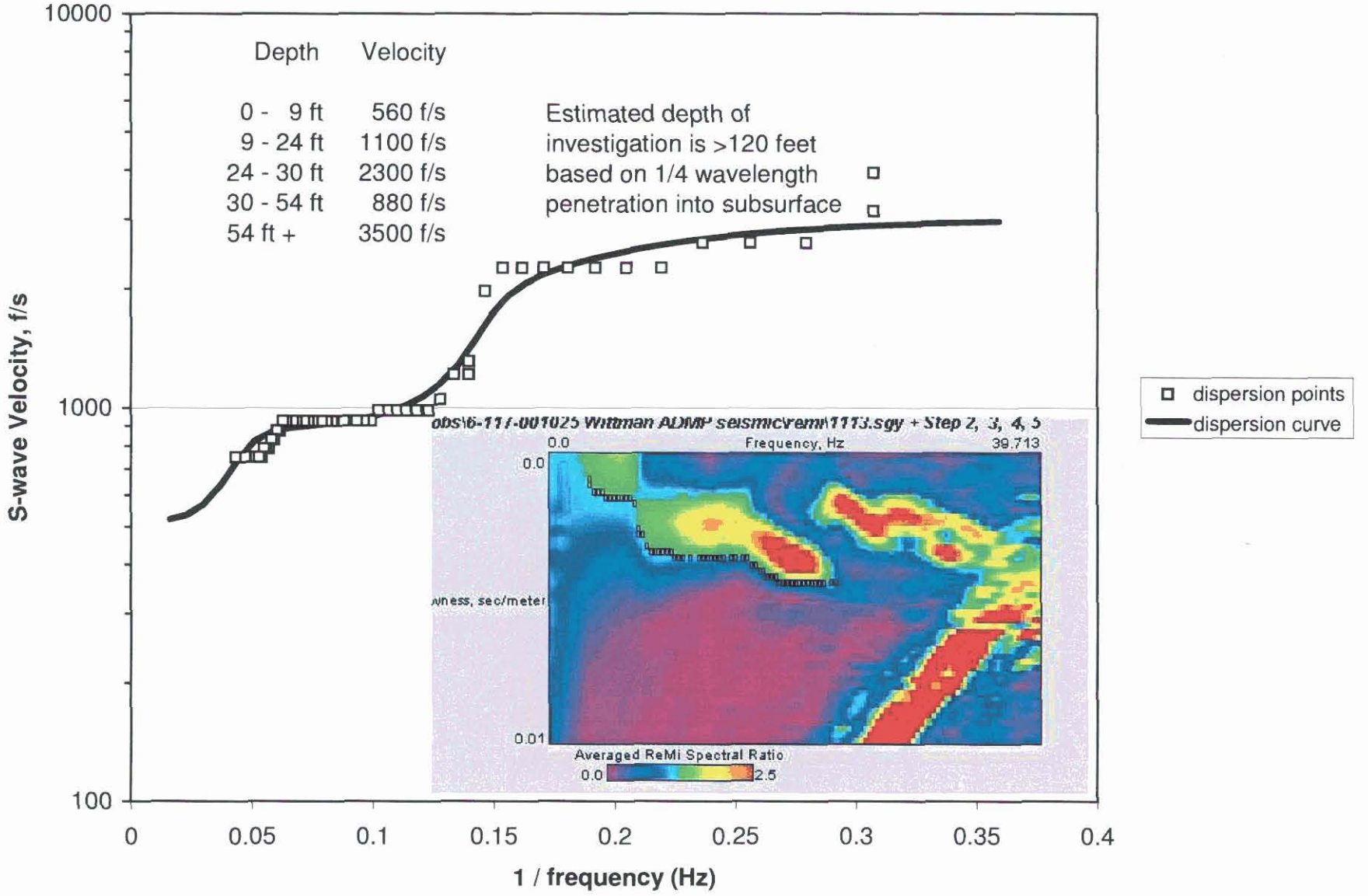


Refraction Microtremor S-wave Interpretation **Line 27** AMEC Job No. 6-117-001025

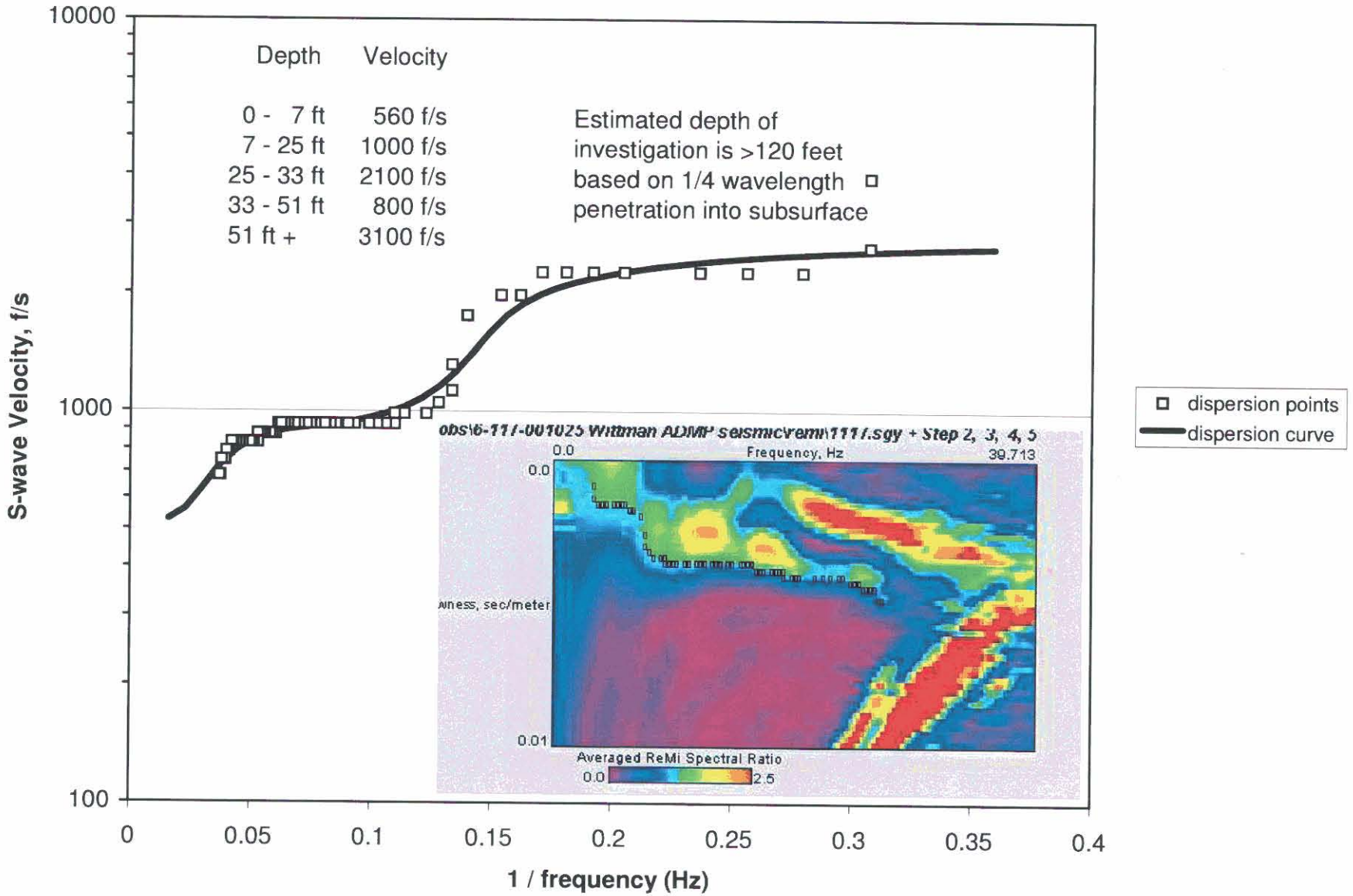


Refraction Microtremor S-wave Interpretation **Line 28** AMEC Job No. 6-117-001025

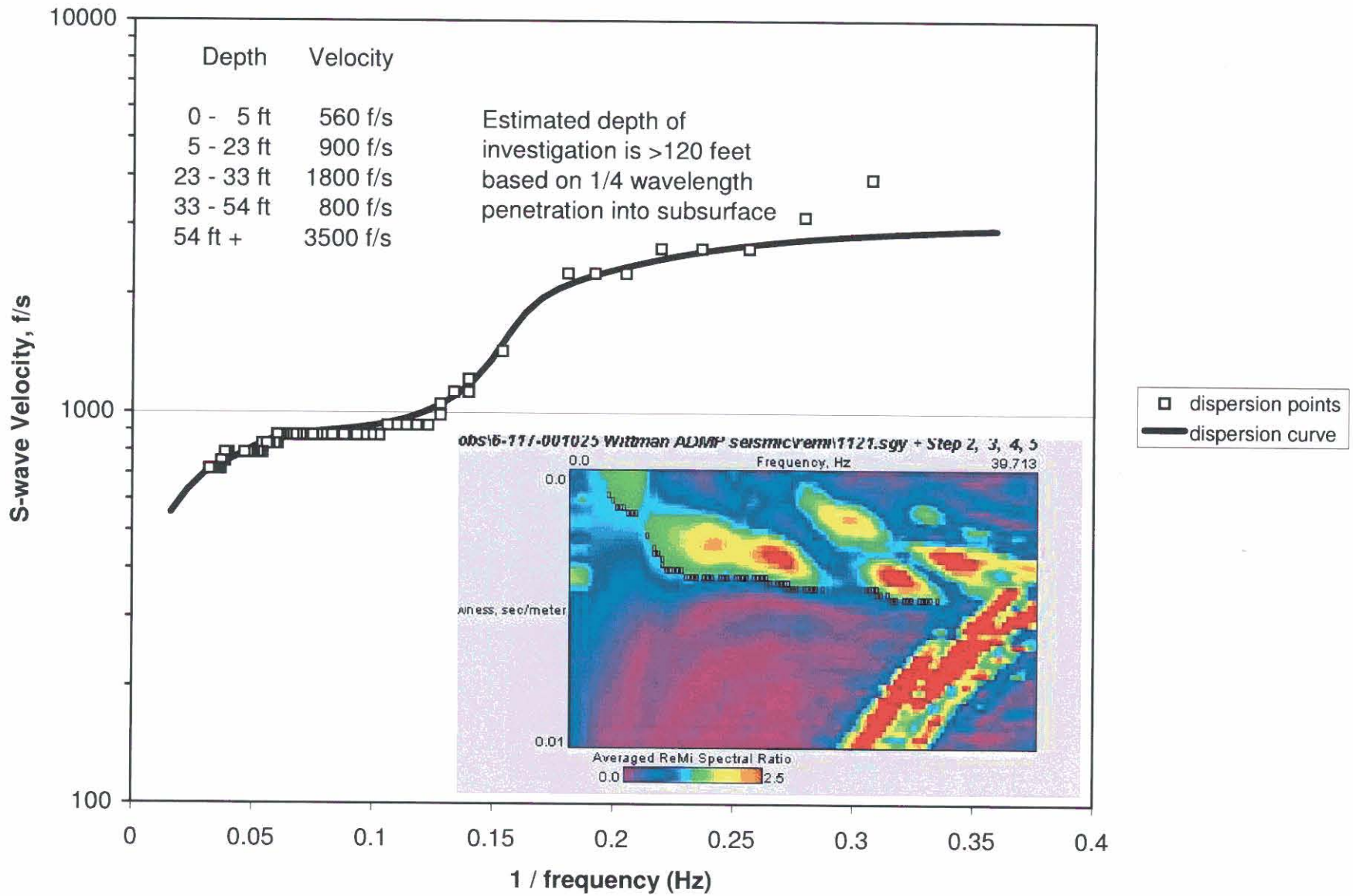


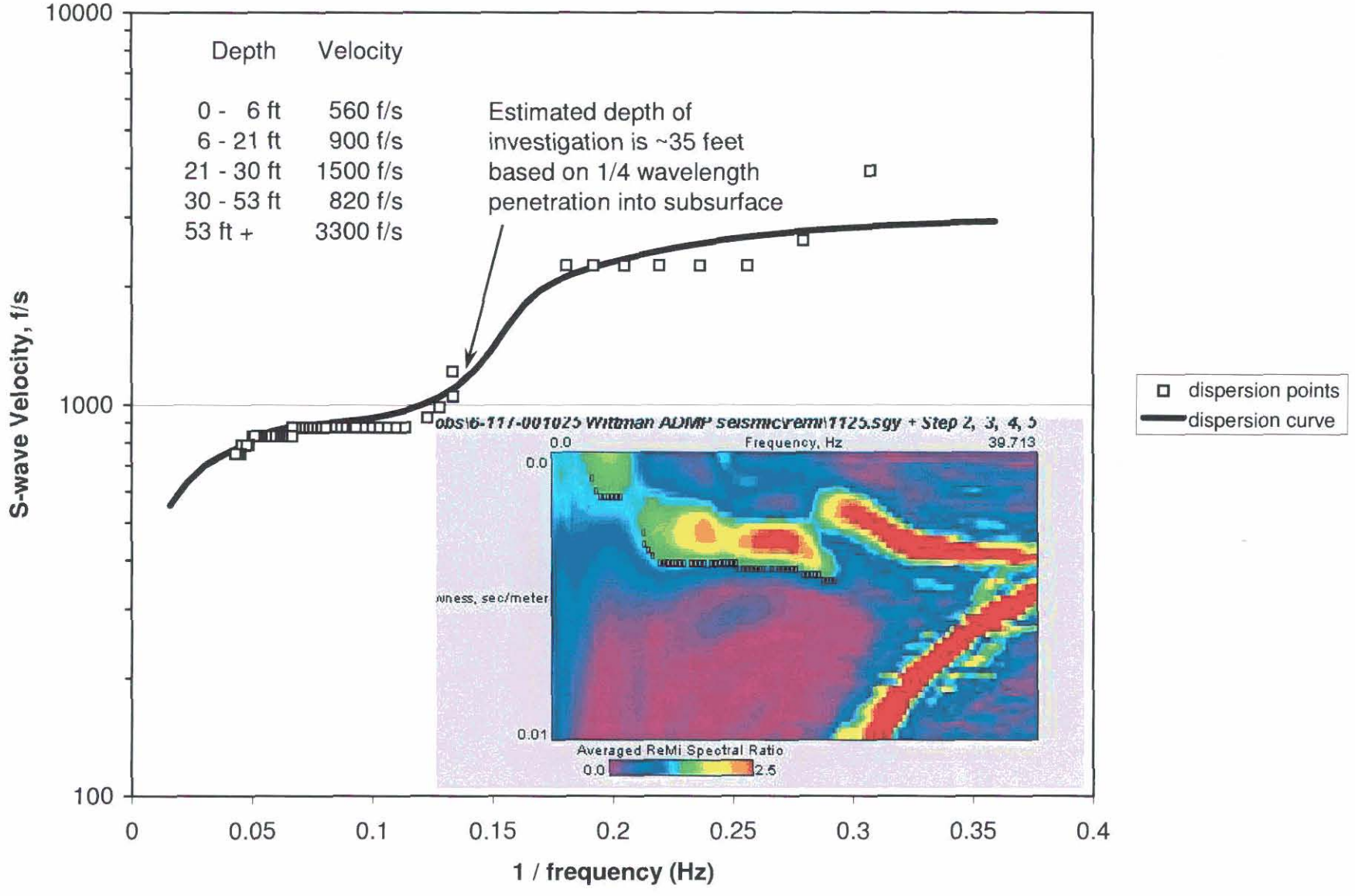

Depth Velocity
0 - 9 ft 560 f/s
9 - 24 ft 1100 f/s
24 - 30 ft 2300 f/s
30 - 54 ft 880 f/s
54 ft + 3500 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

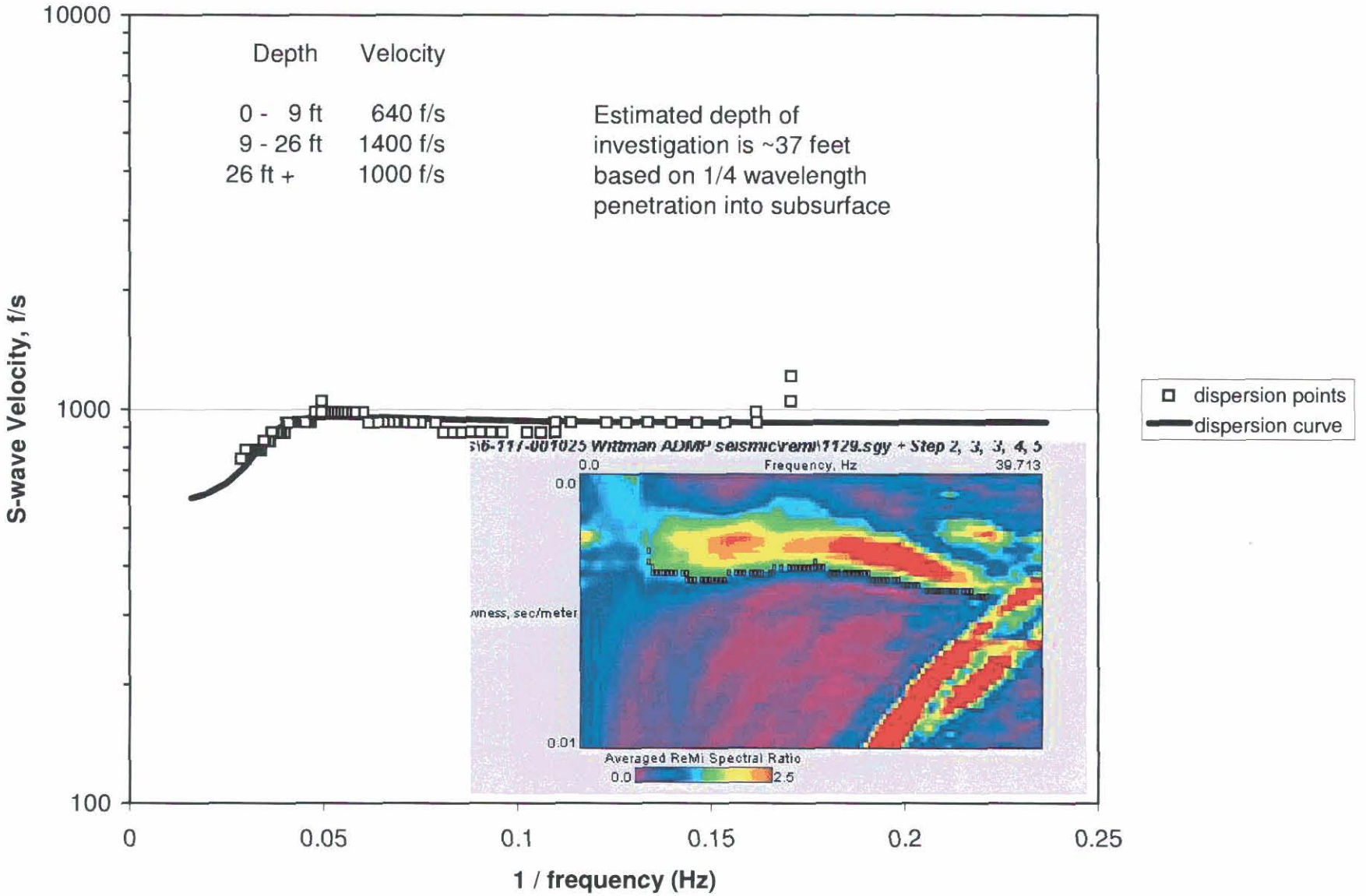
Refraction Microtremor S-wave Interpretation **Line 30** AMEC Job No. 6-117-001025



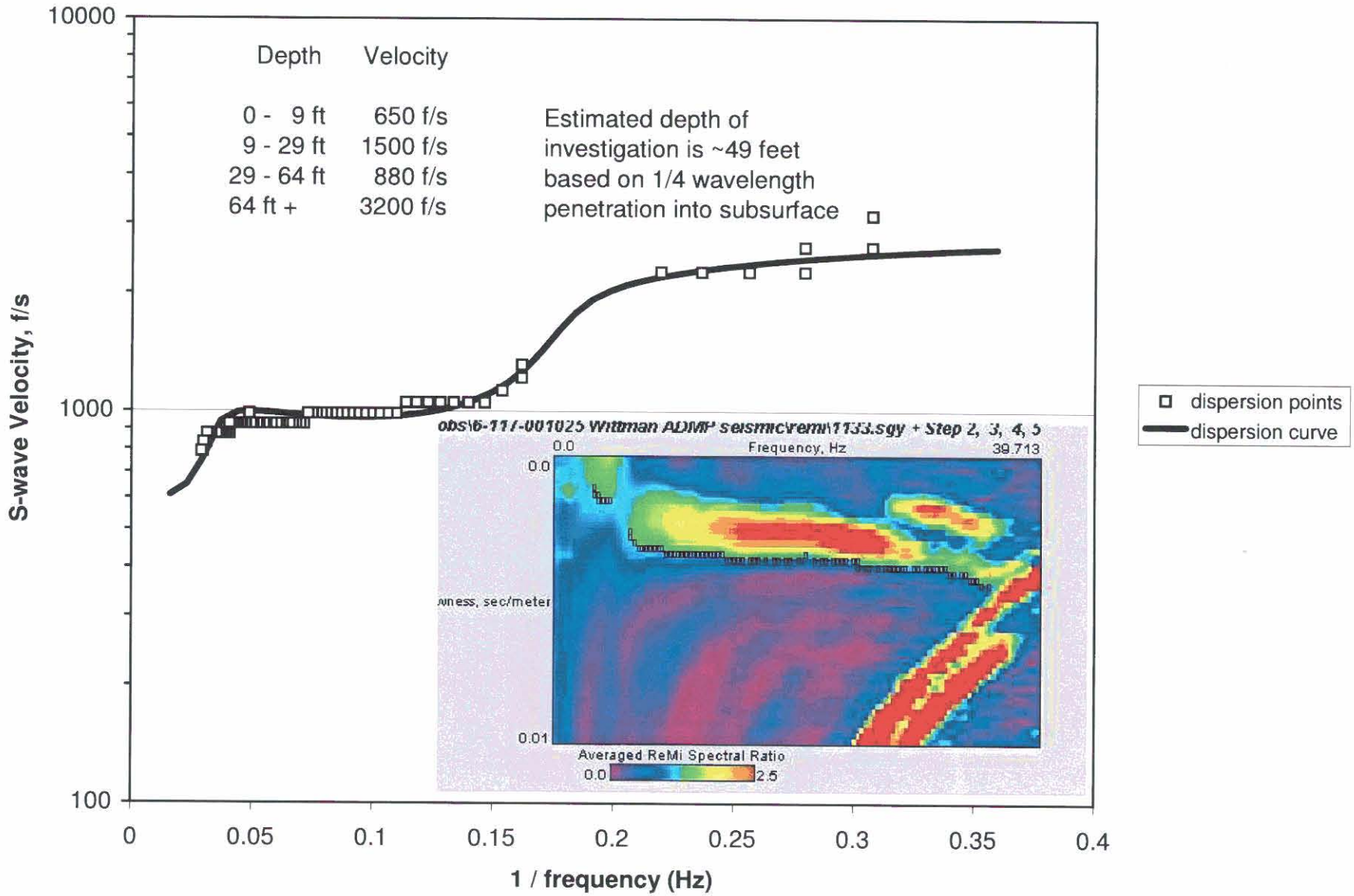
Refraction Microtremor S-wave Interpretation **Line 31** AMEC Job No. 6-117-001025



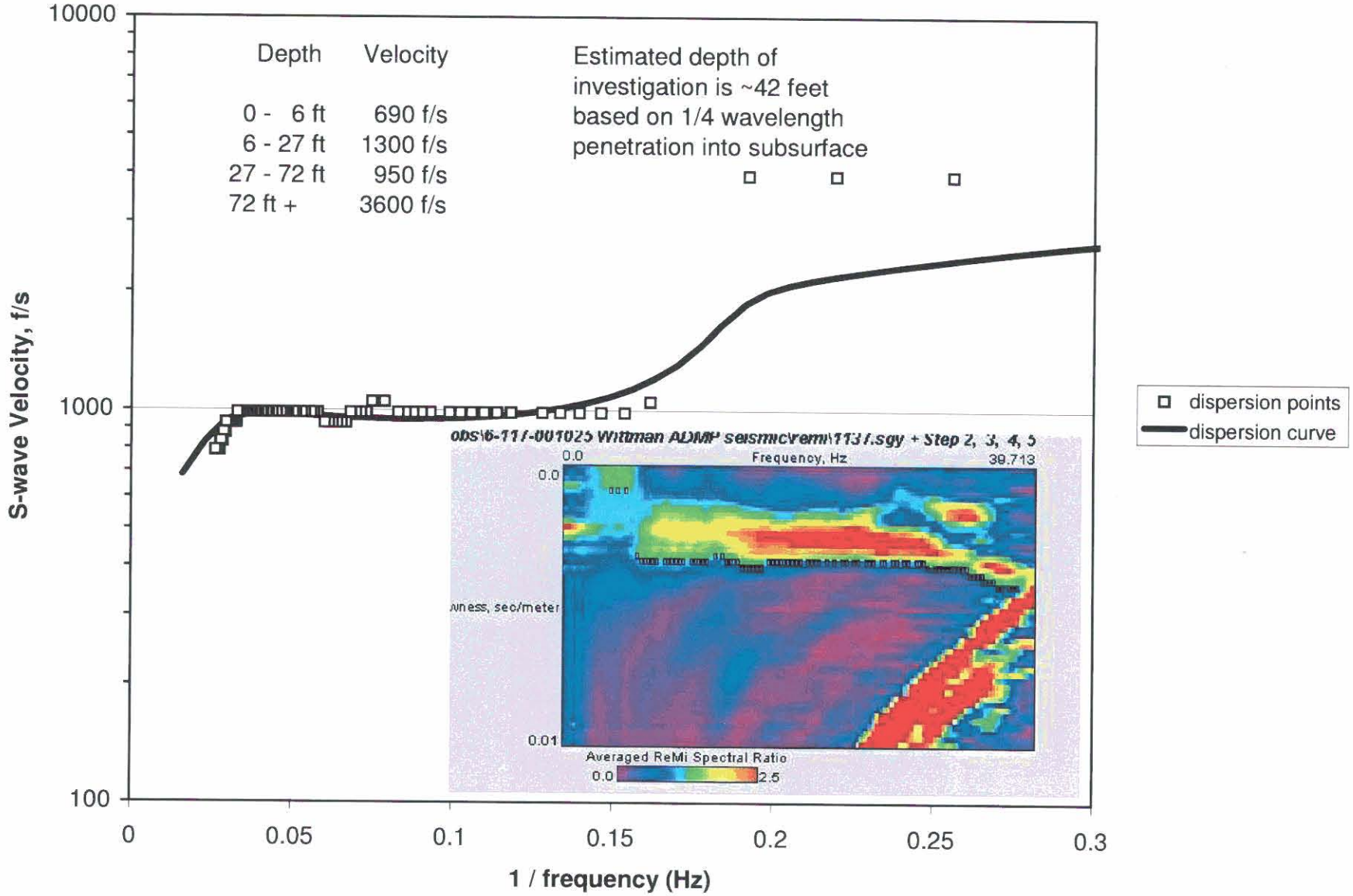

Depth Velocity
0 - 6 ft 560 f/s
6 - 21 ft 900 f/s
21 - 30 ft 1500 f/s
30 - 53 ft 820 f/s
53 ft + 3300 f/s
Estimated depth of investigation is ~35 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5


10000
1000
100
S-wave Velocity, f/s
0
0.05
0.1
0.15
0.2
0.25
1 / frequency (Hz)
Depth Velocity
0 - 9 ft 640 f/s
9 - 26 ft 1400 f/s
26 ft + 1000 f/s
Estimated depth of investigation is ~37 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

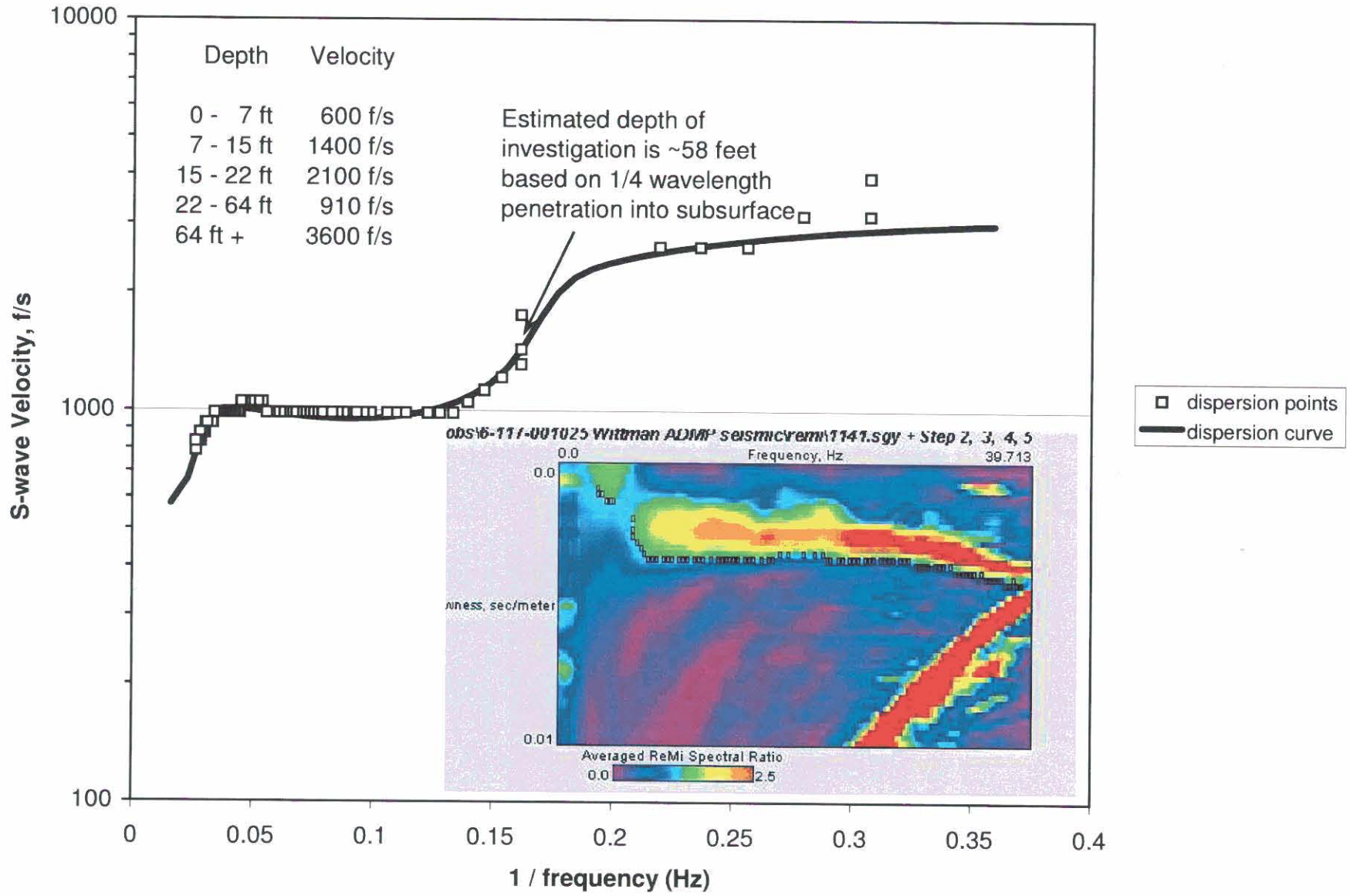
Refraction Microtremor S-wave Interpretation **Line 34** AMEC Job No. 6-117-001025

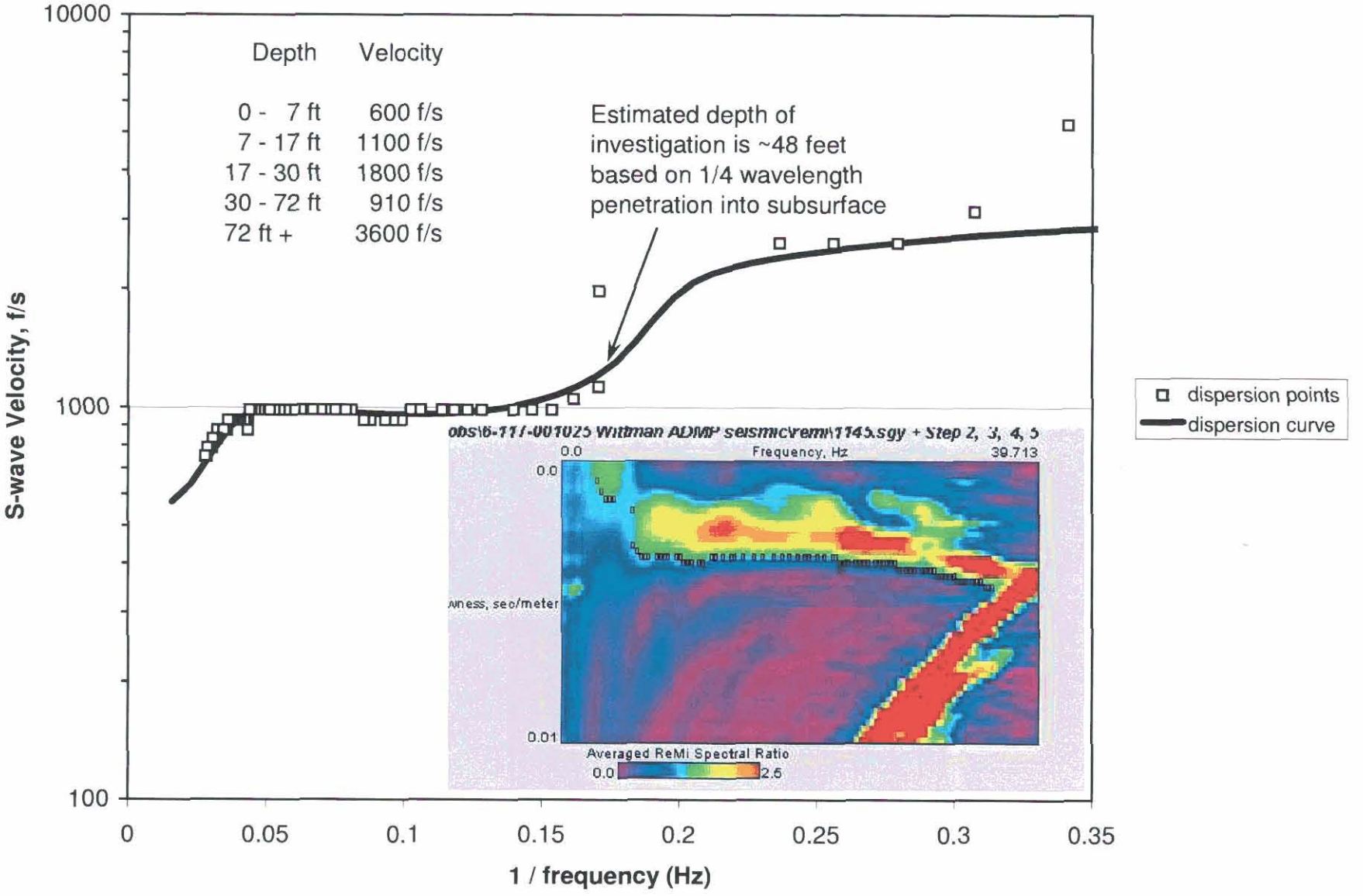


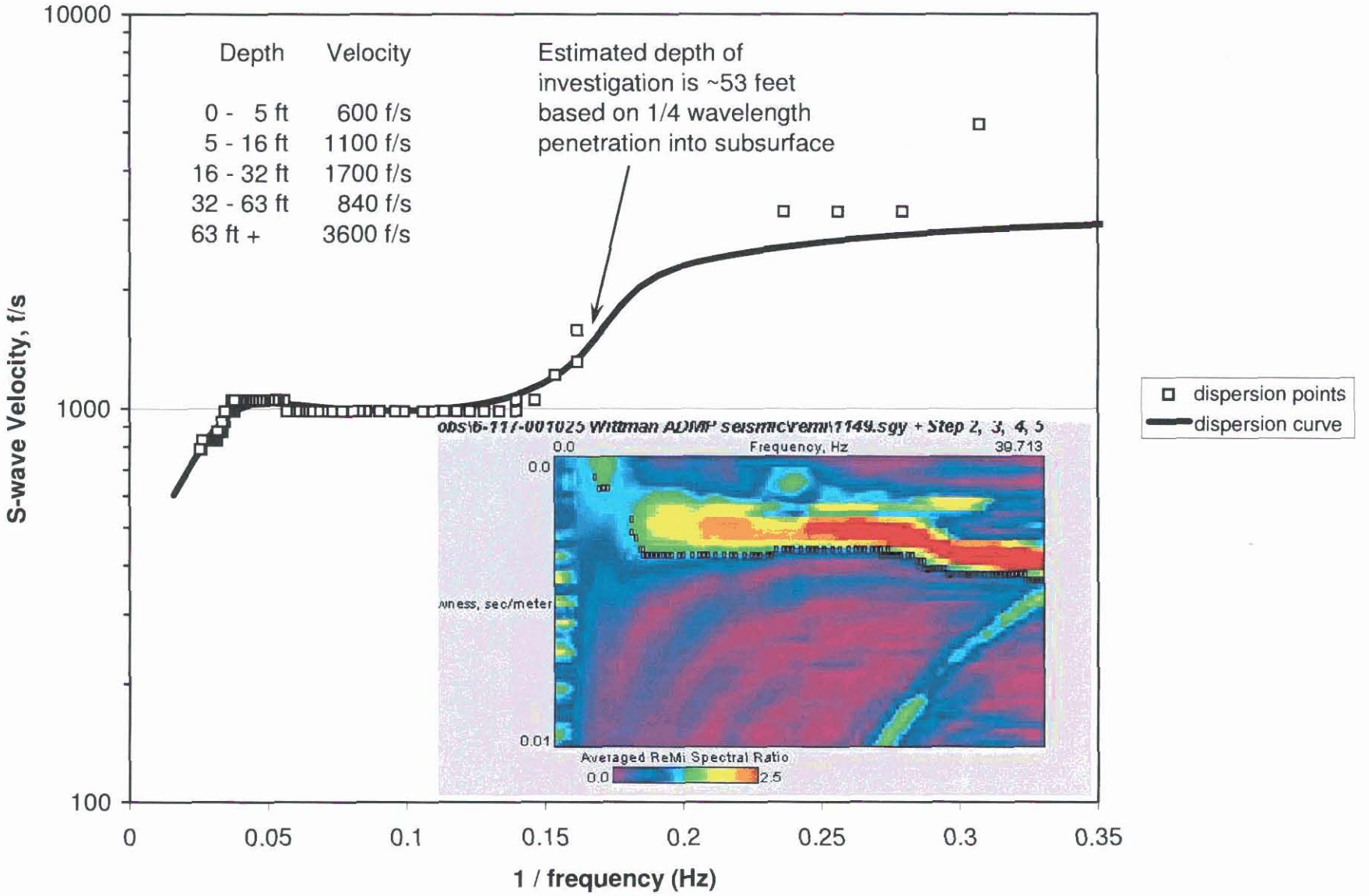
Refraction Microtremor S-wave Interpretation **Line 35** AMEC Job No. 6-117-001025



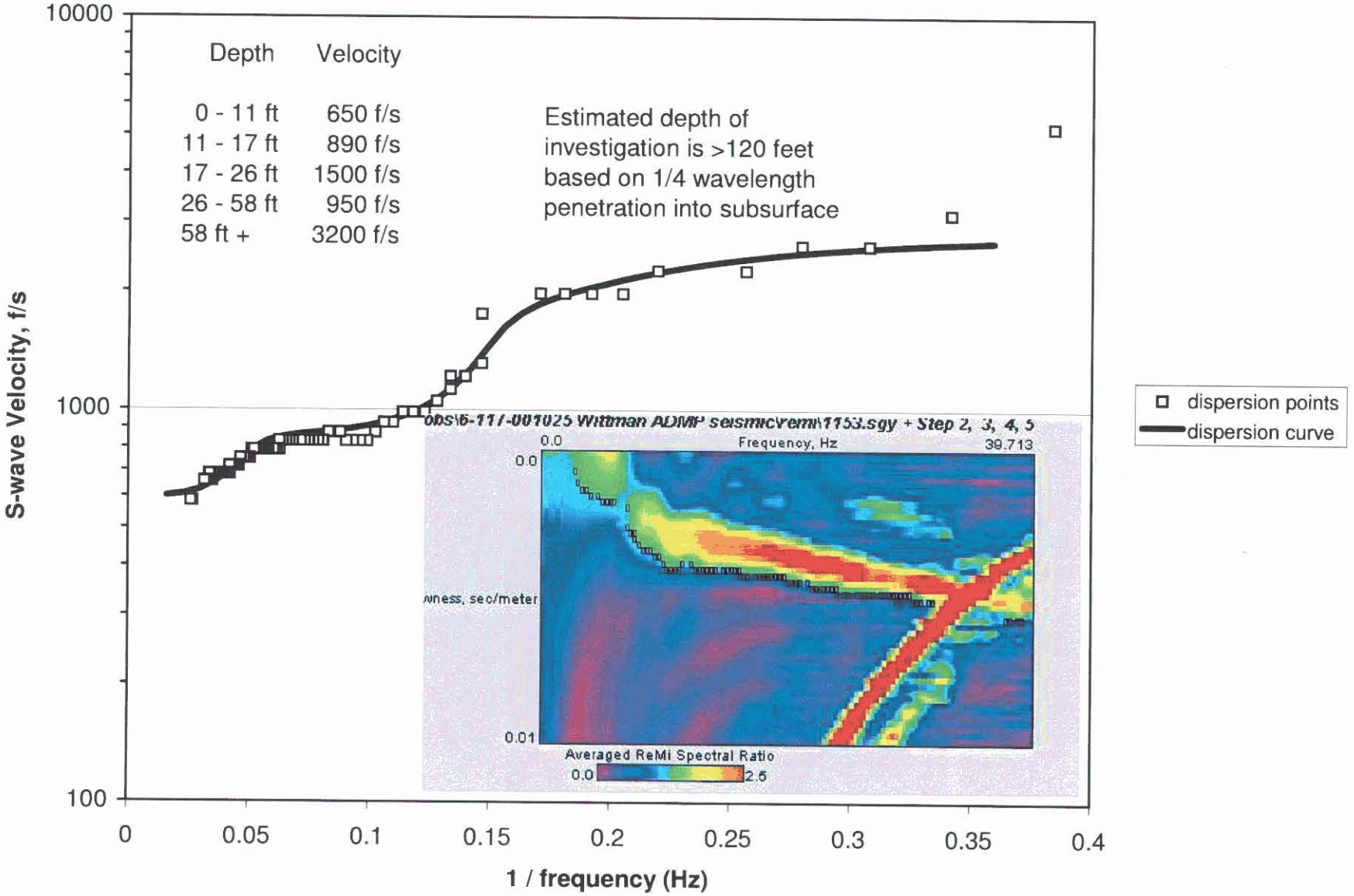
Refraction Microtremor S-wave Interpretation **Line 36** AMEC Job No. 6-117-001025

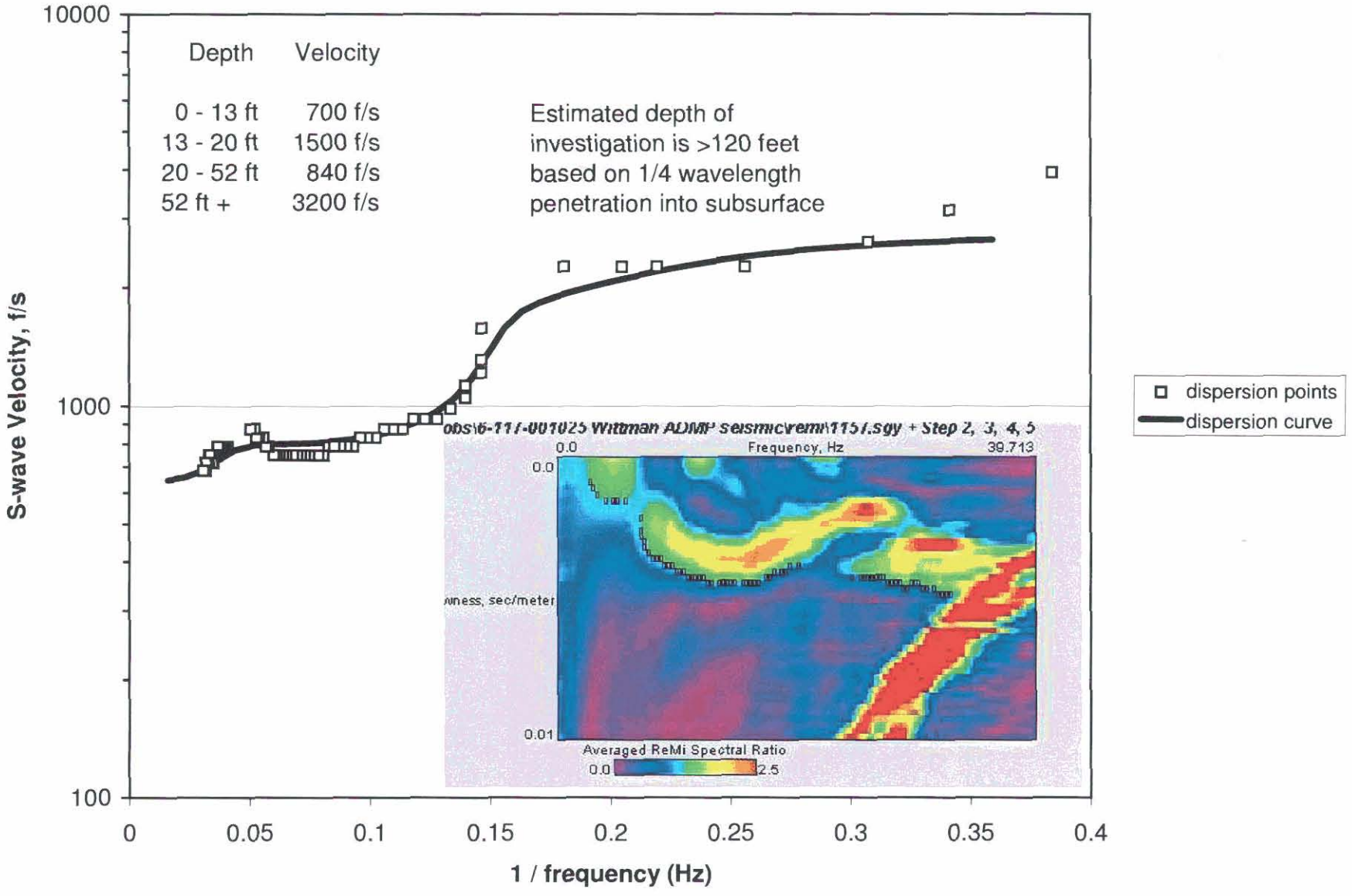



Depth Velocity
0 - 7 ft 600 f/s
7 - 17 ft 1100 f/s
17 - 30 ft 1800 f/s
30 - 72 ft 910 f/s
72 ft + 3600 f/s
Estimated depth of investigation is ~48 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

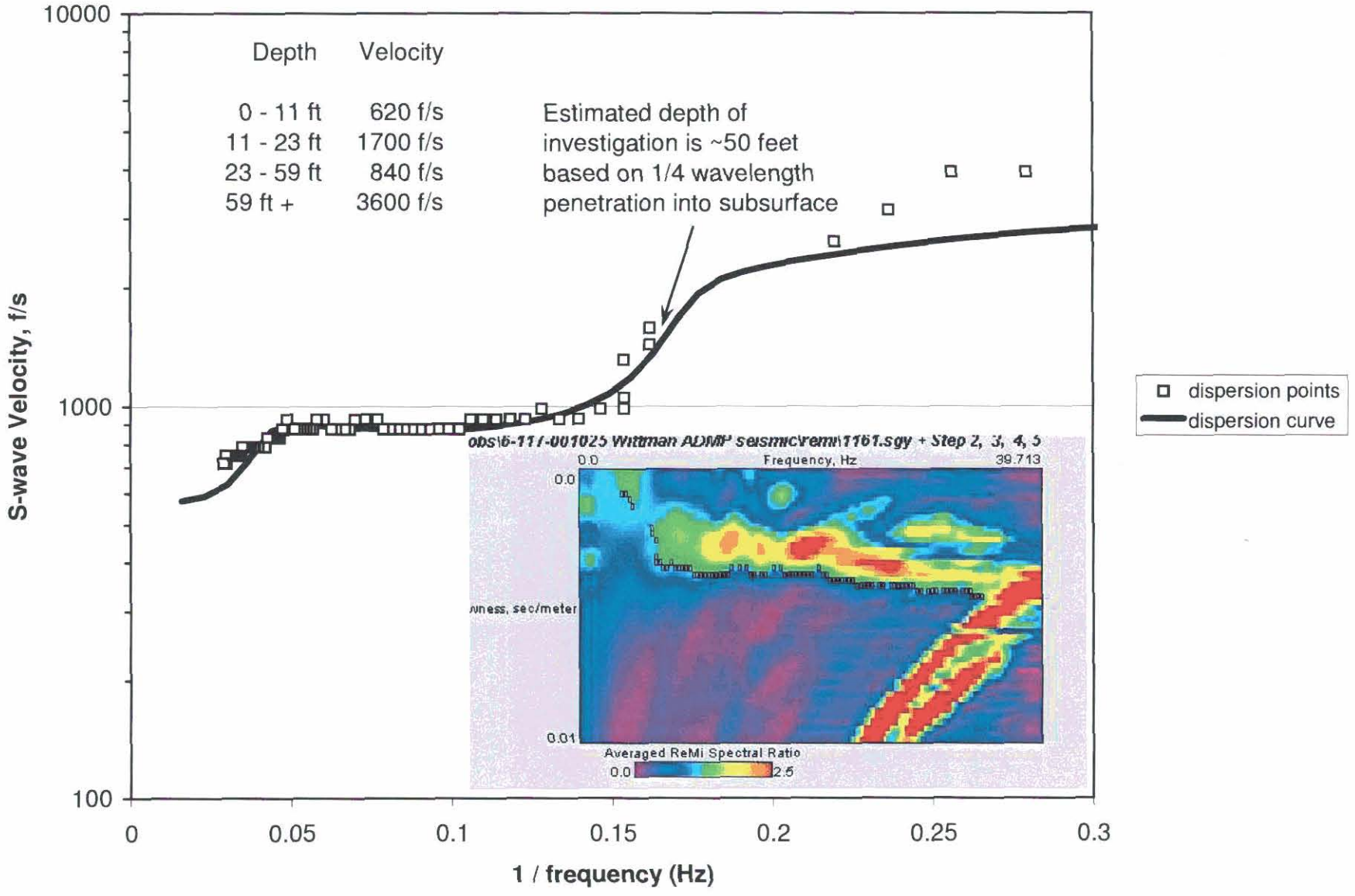

Depth Velocity
0 - 5 ft 600 f/s
5 - 16 ft 1100 f/s
16 - 32 ft 1700 f/s
32 - 63 ft 840 f/s
63 ft + 3600 f/s
Estimated depth of investigation is ~53 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

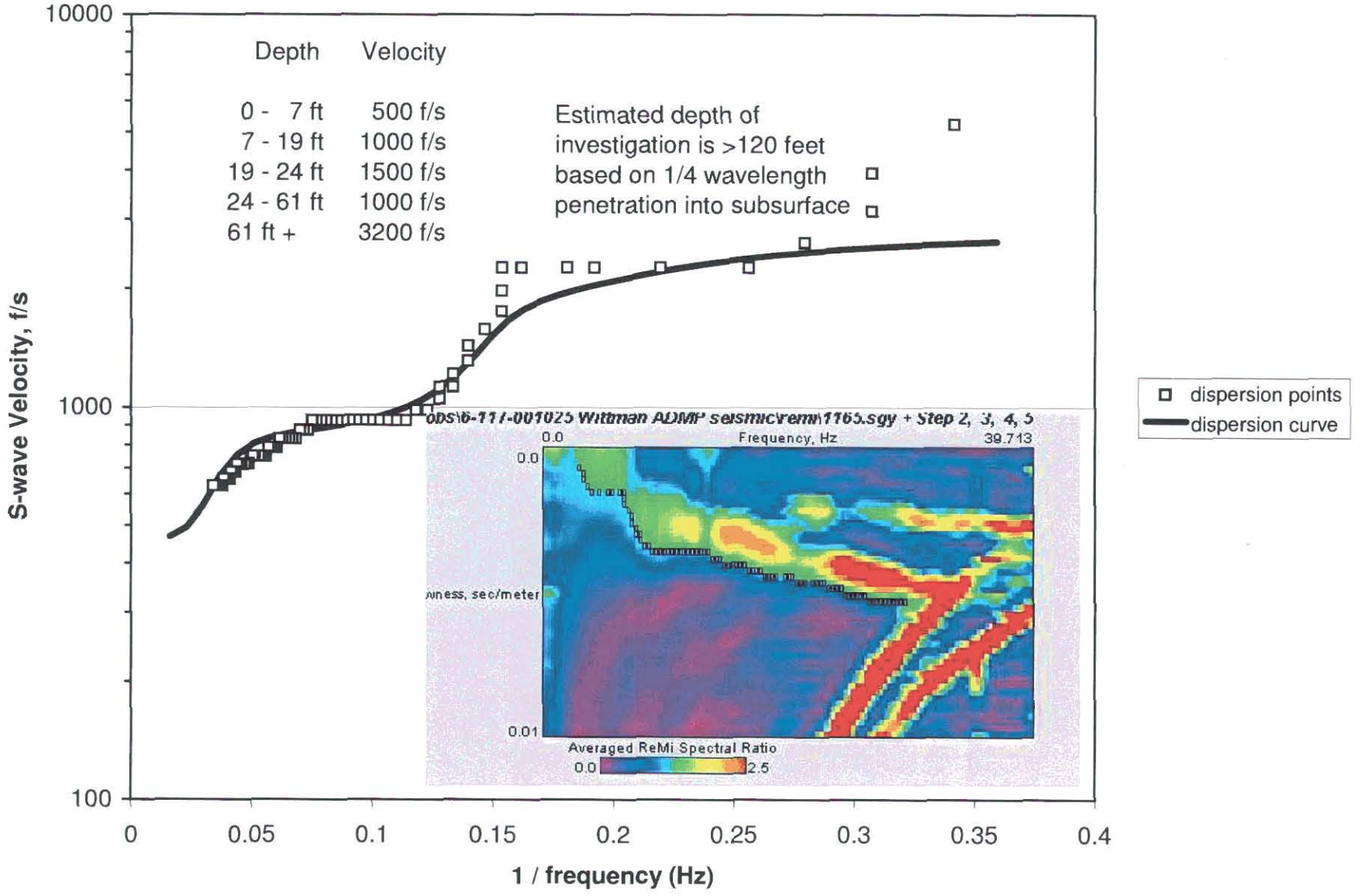
Refraction Microtremor S-wave Interpretation **Line 39** AMEC Job No. 6-117-001025



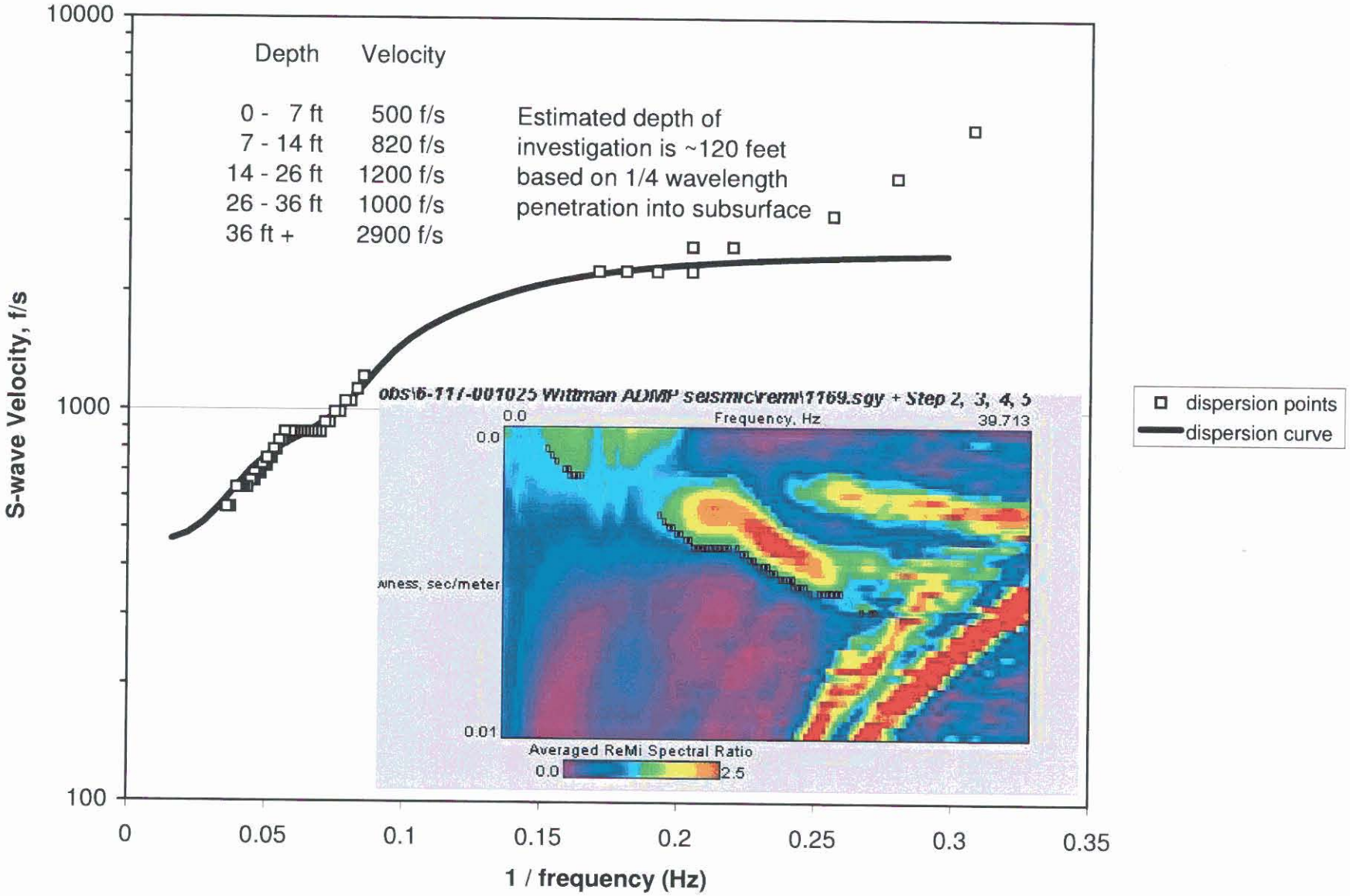

10000
1000
100
S-wave Velocity, f/s
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Depth Velocity
0 - 13 ft 700 f/s
13 - 20 ft 1500 f/s
20 - 52 ft 840 f/s
52 ft + 3200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

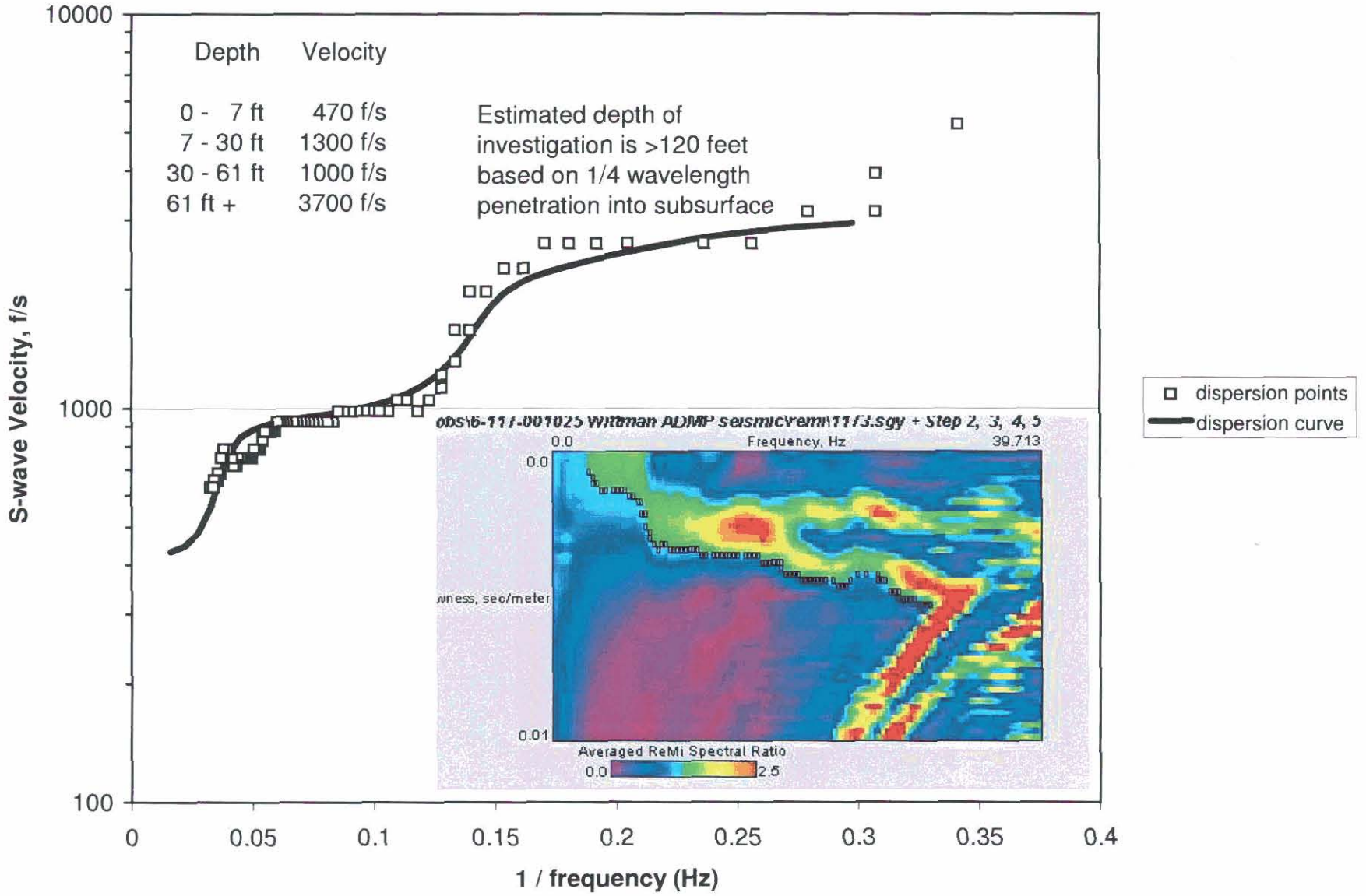
Refraction Microtremor S-wave Interpretation **Line 41** AMEC Job No. 6-117-001025



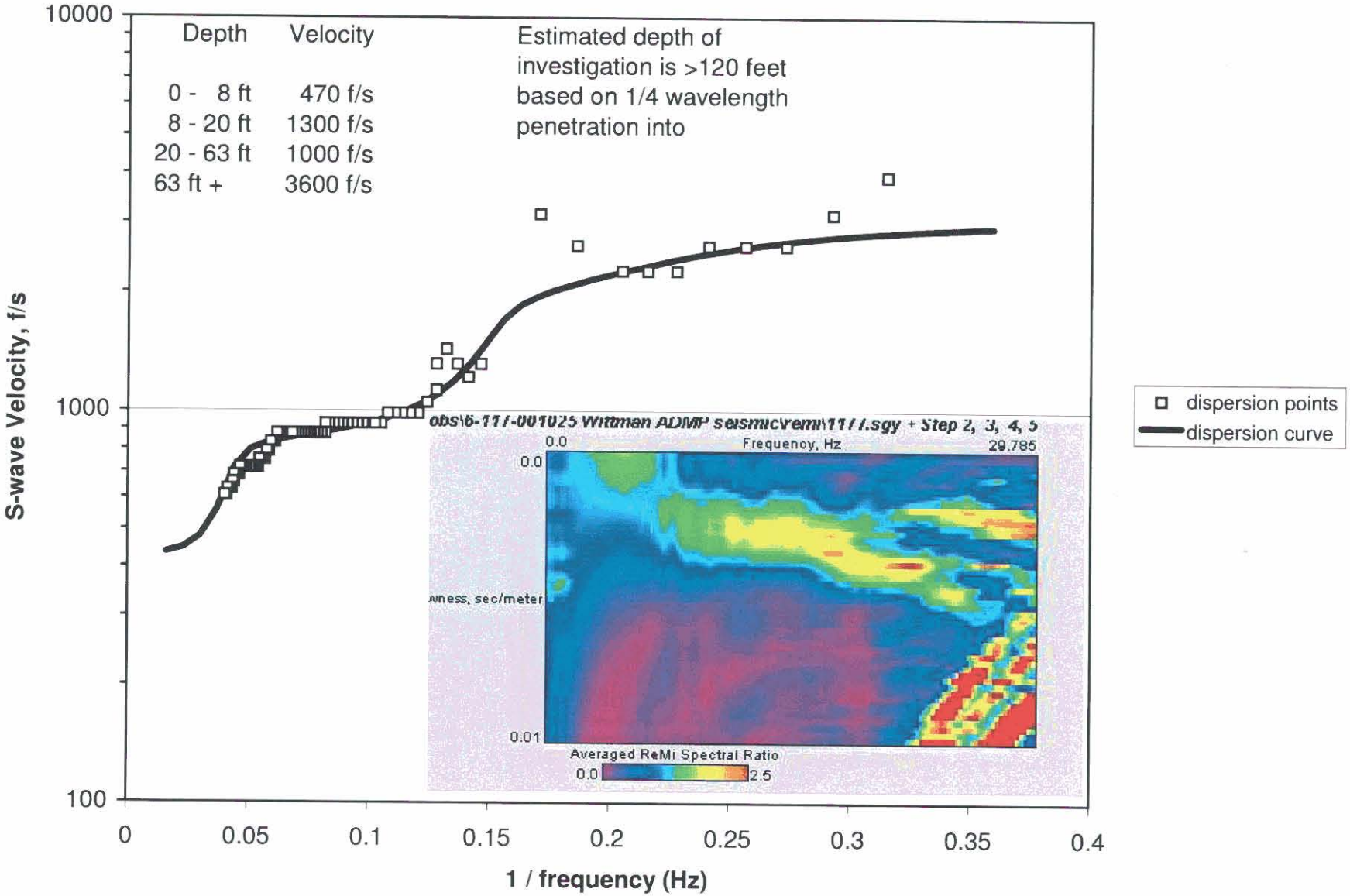

Depth Velocity
0 - 7 ft 500 f/s
7 - 19 ft 1000 f/s
19 - 24 ft 1500 f/s
24 - 61 ft 1000 f/s
61 ft + 3200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 43** AMEC Job No. 6-117-001025

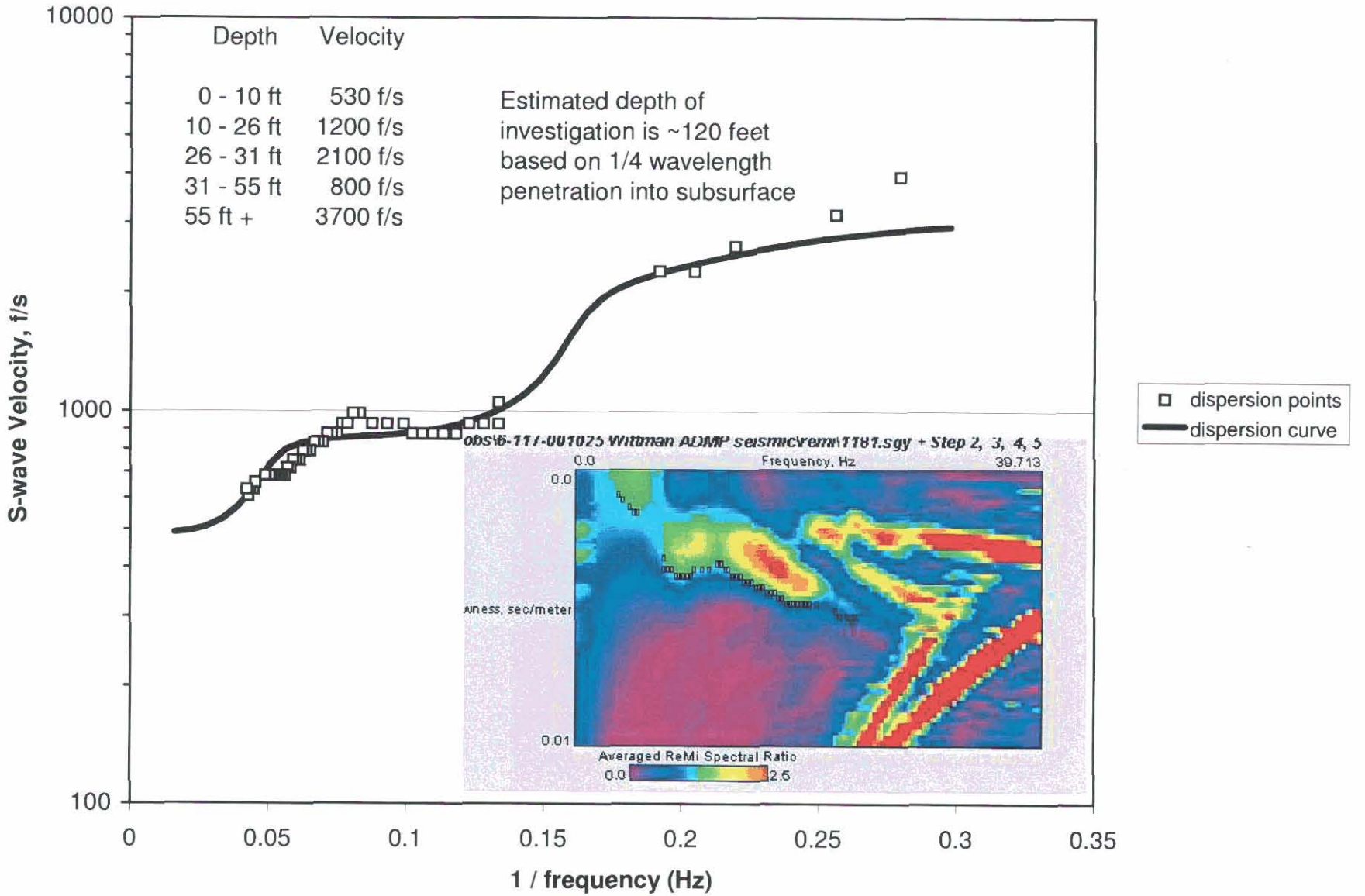


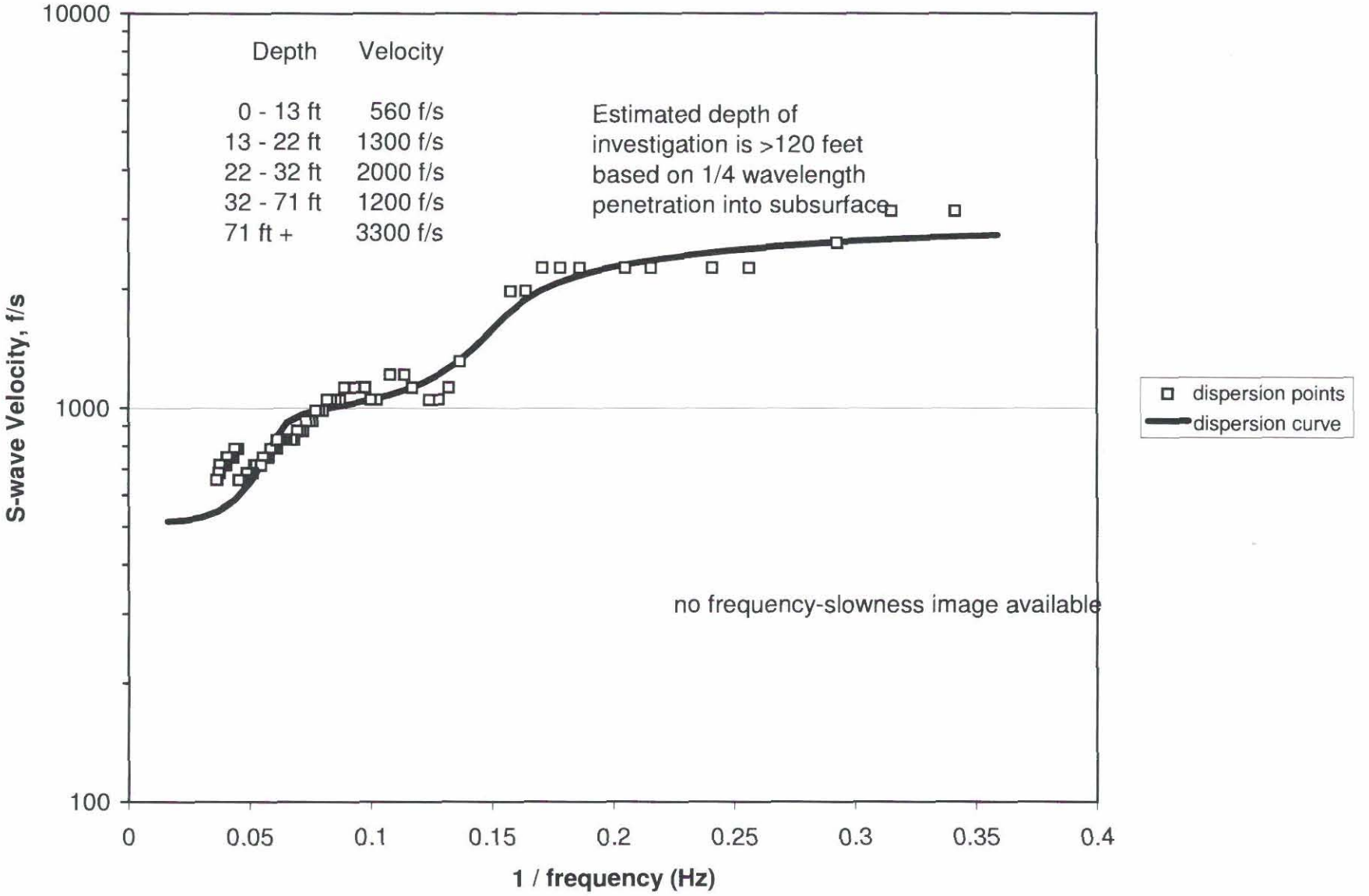

Depth Velocity
0 - 7 ft 470 f/s
7 - 30 ft 1300 f/s
30 - 61 ft 1000 f/s
61 ft + 3700 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 45** AMEC Job No. 6-117-001025

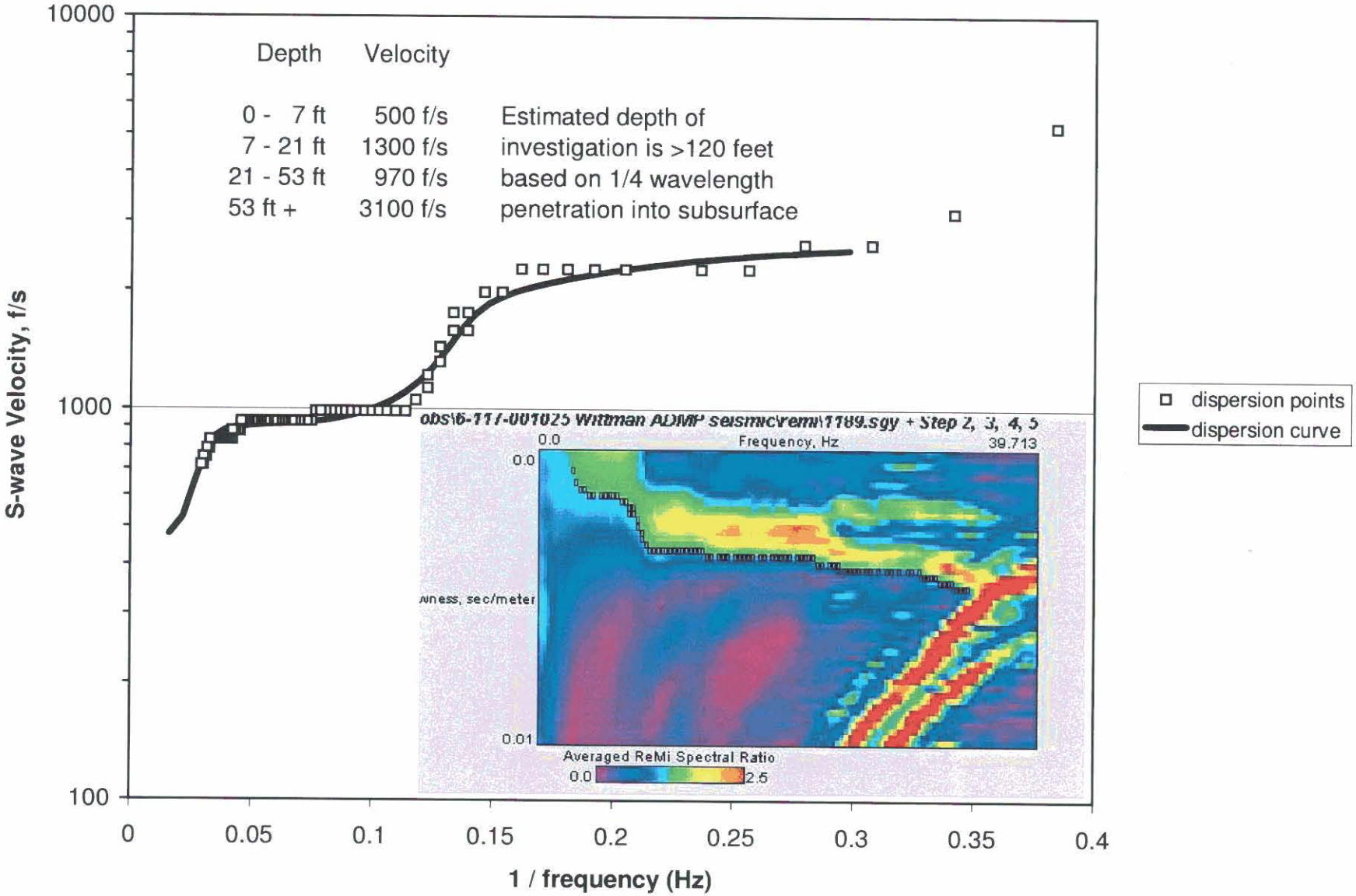


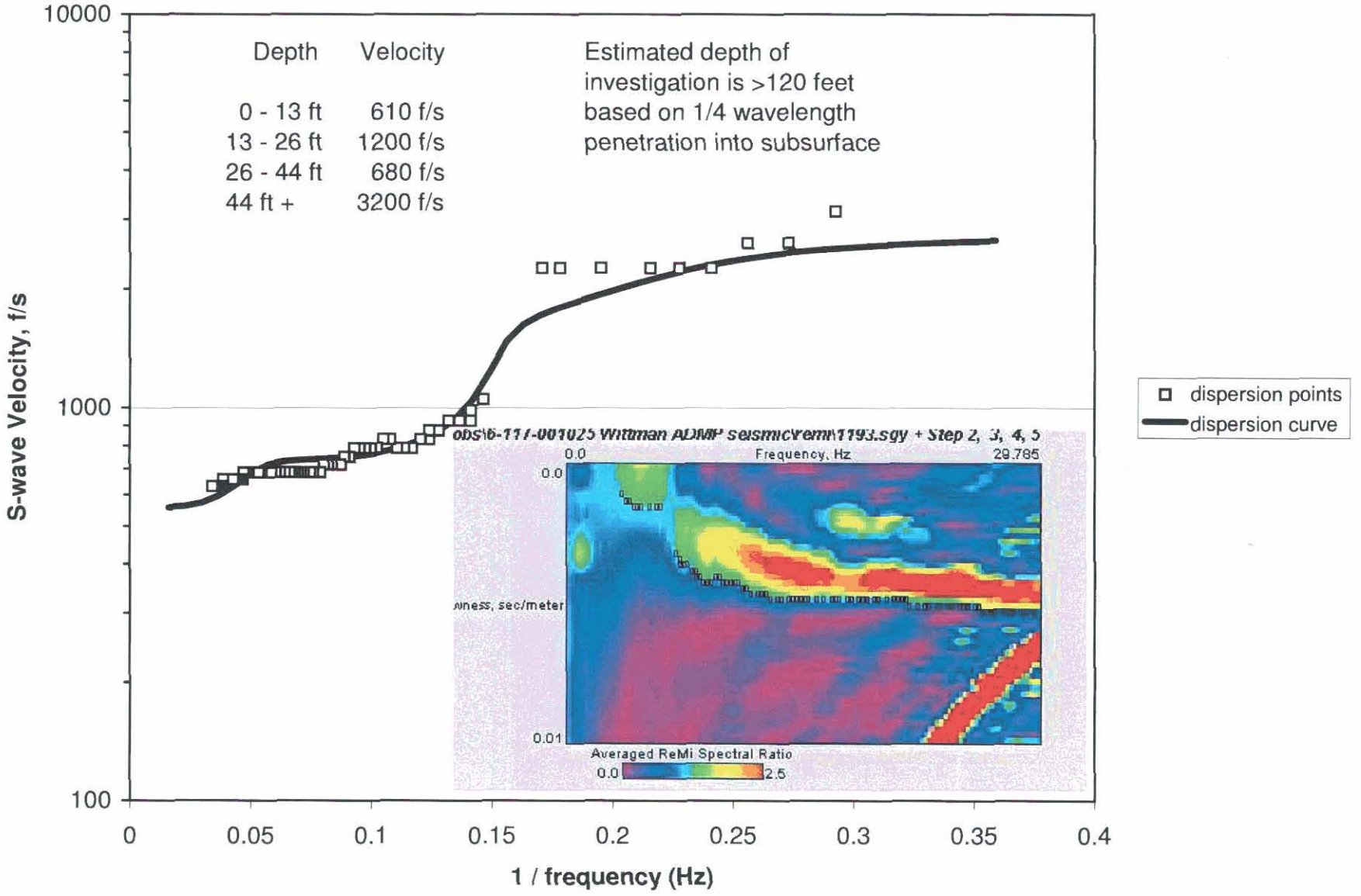
Refraction Microtremor S-wave Interpretation **Line 46** AMEC Job No. 6-117-001025



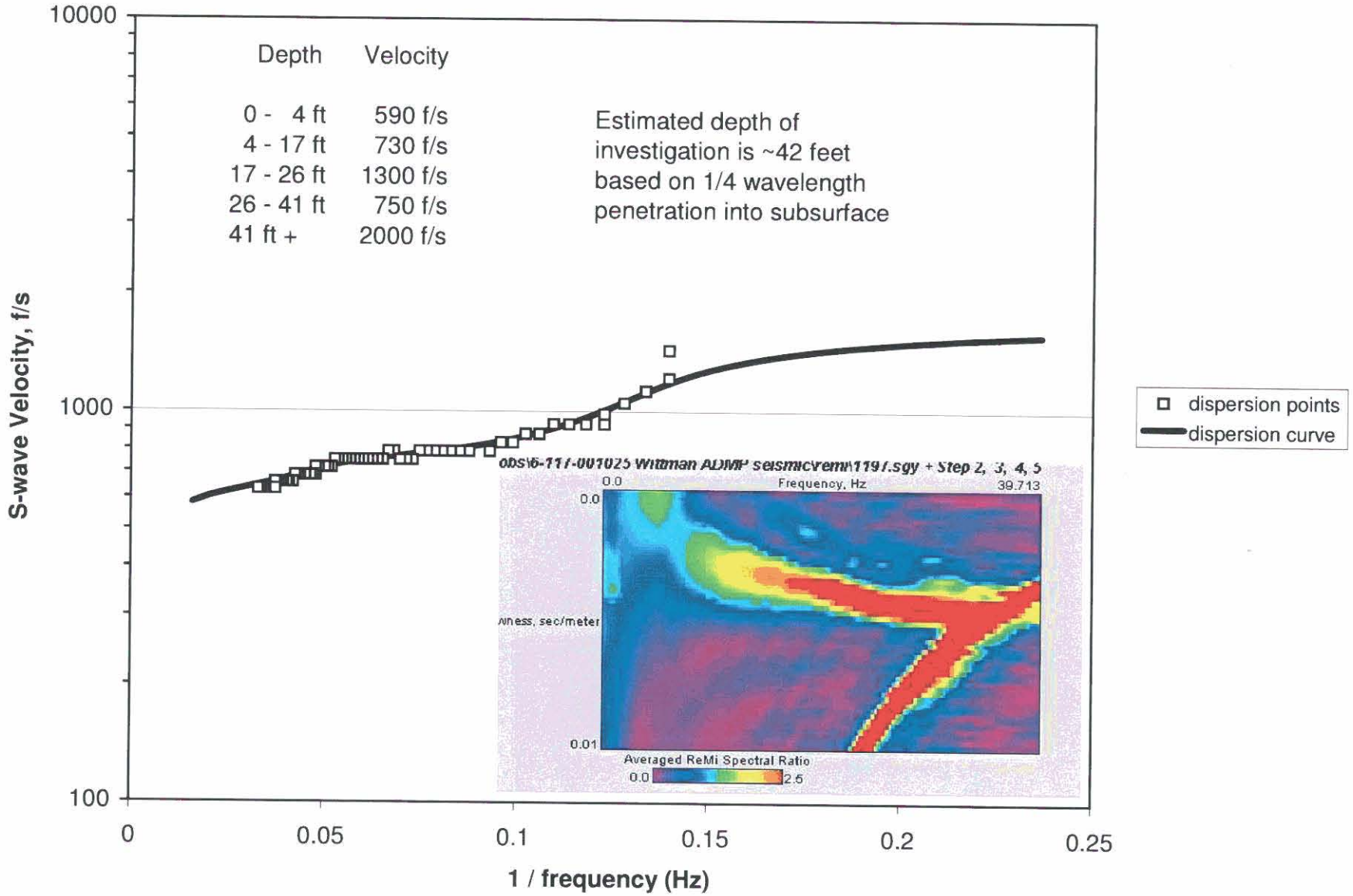

Depth Velocity
0 - 13 ft 560 f/s
13 - 22 ft 1300 f/s
22 - 32 ft 2000 f/s
32 - 71 ft 1200 f/s
71 ft + 3300 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
no frequency-slowness image available
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)

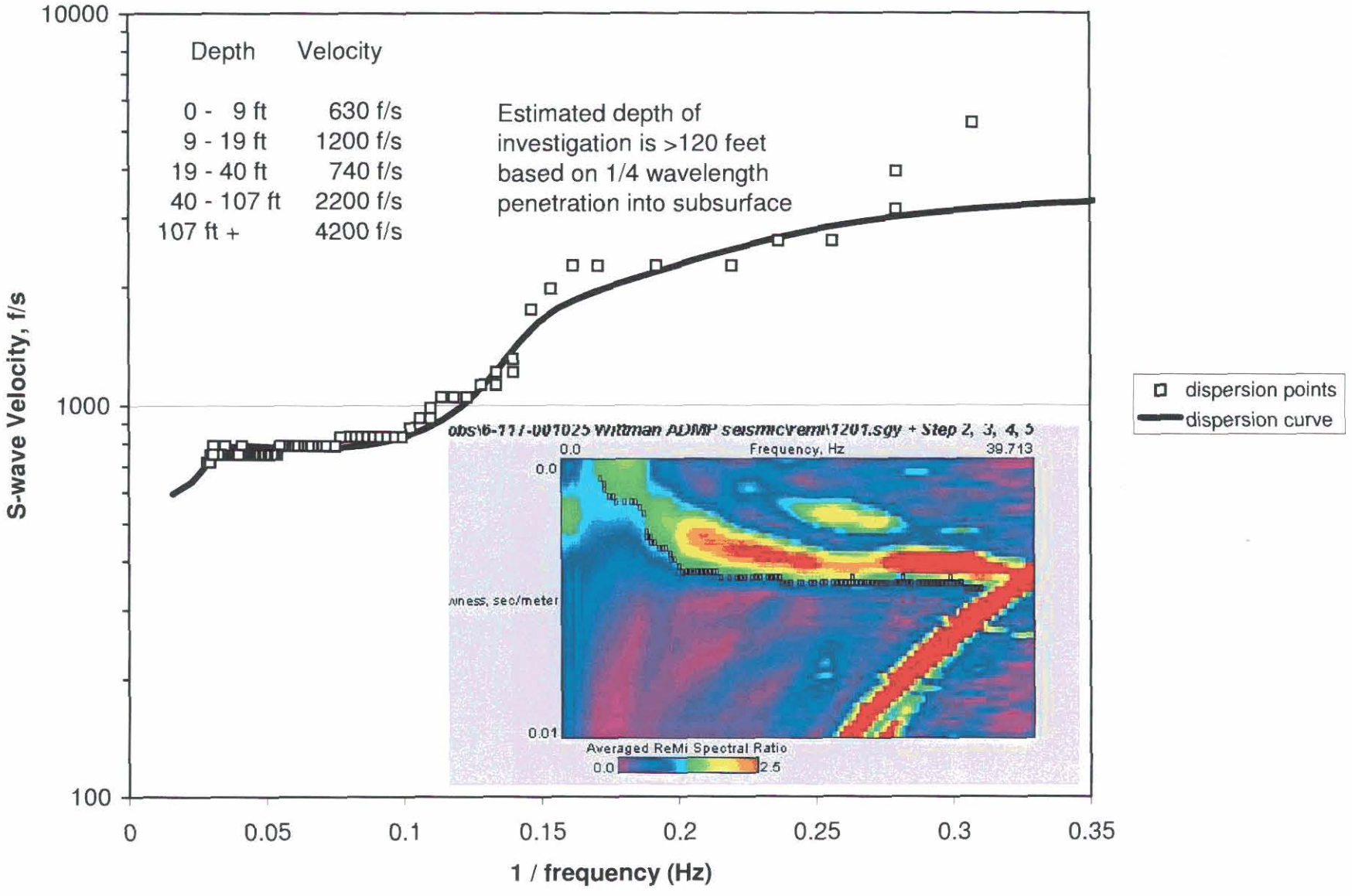
Refraction Microtremor S-wave Interpretation **Line 48** AMEC Job No. 6-117-001025

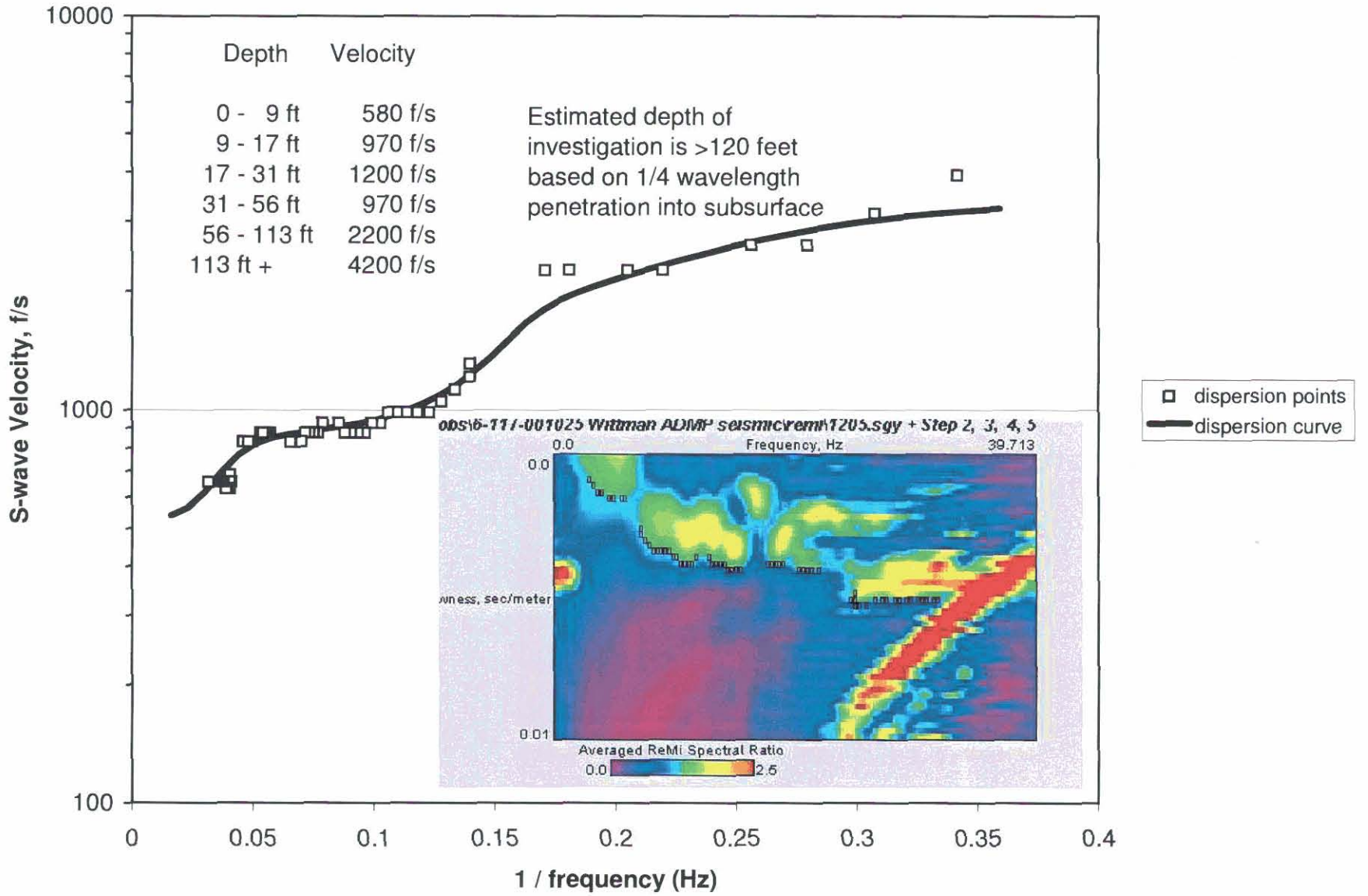



Depth Velocity
0 - 13 ft 610 f/s
13 - 26 ft 1200 f/s
26 - 44 ft 680 f/s
44 ft + 3200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
29.785
0.01
Averaged ReMi Spectral Ratio
2.5

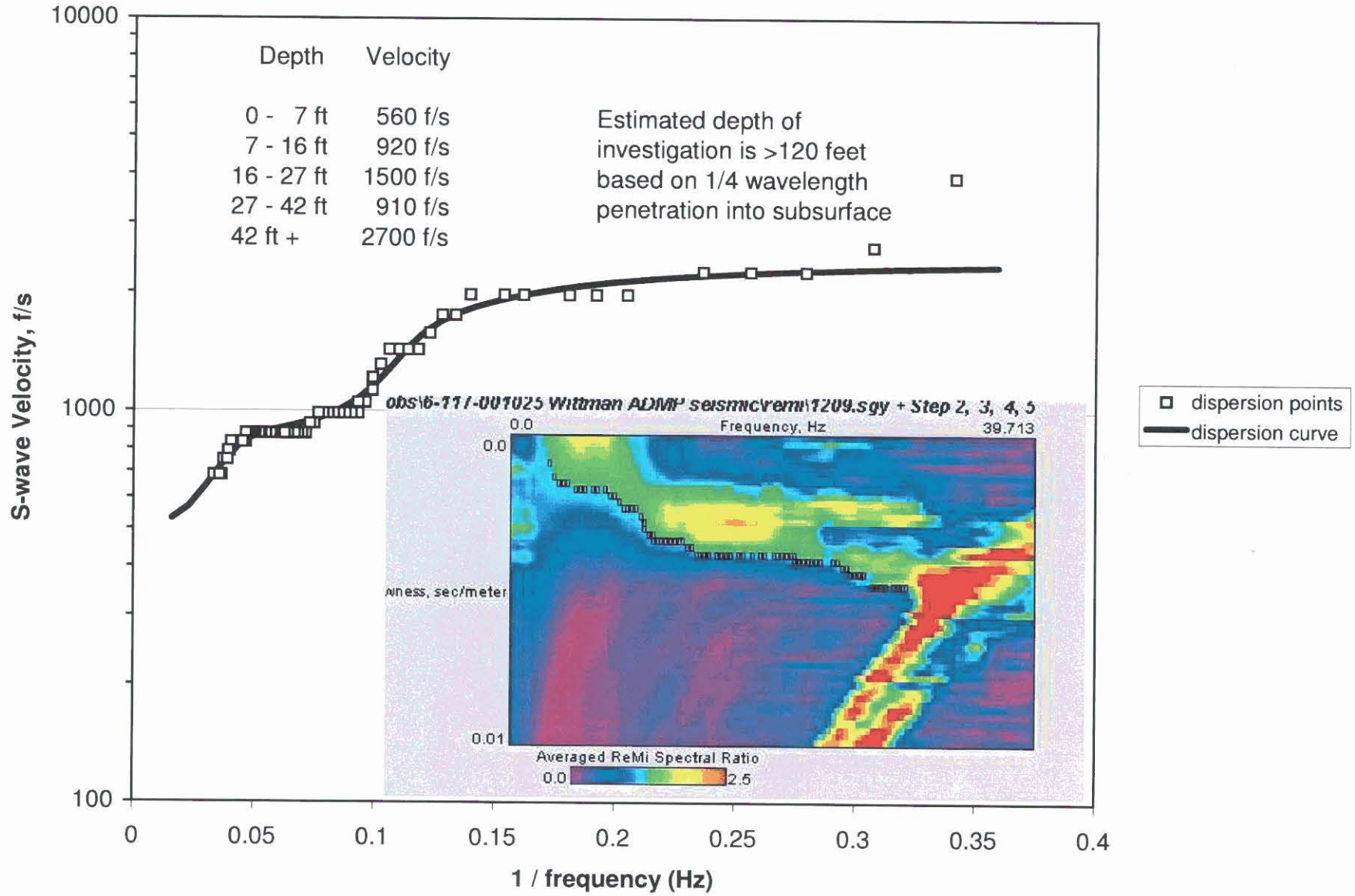
Refraction Microtremor S-wave Interpretation **Line 50** AMEC Job No. 6-117-001025

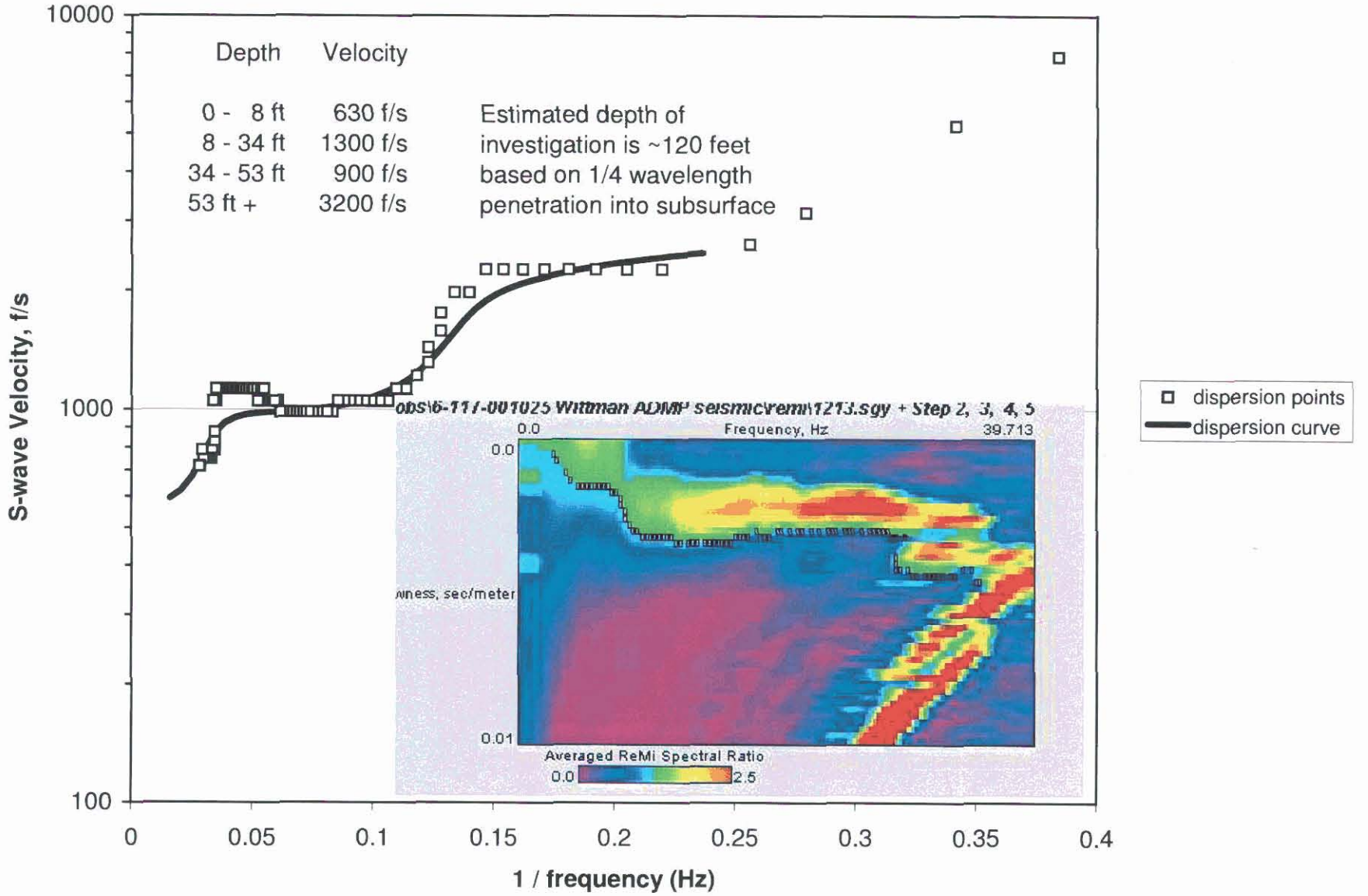



Depth Velocity
0 - 9 ft 630 f/s
9 - 19 ft 1200 f/s
19 - 40 ft 740 f/s
40 - 107 ft 2200 f/s
107 ft + 4200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

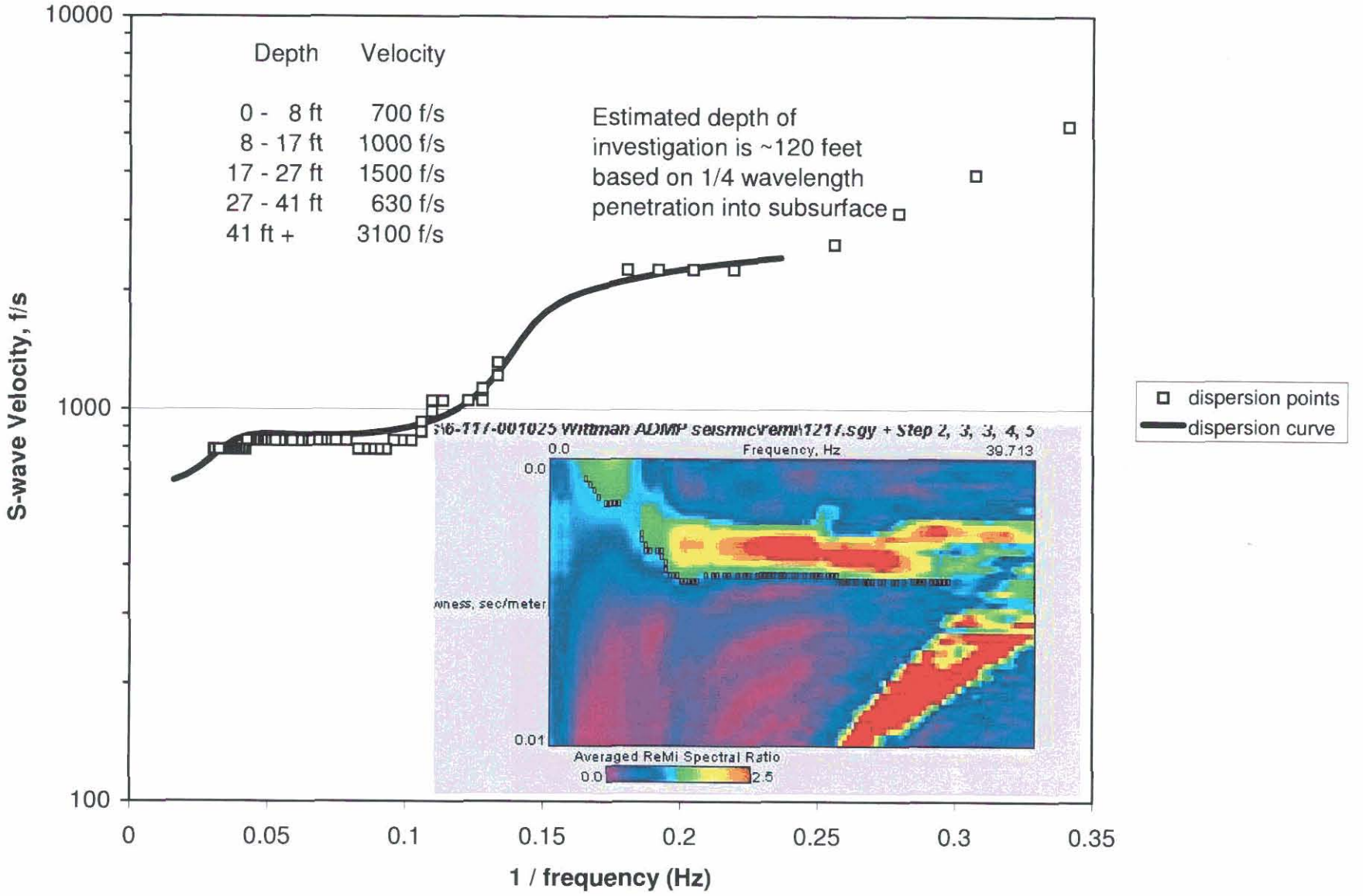

Depth Velocity
0 - 9 ft 580 f/s
9 - 17 ft 970 f/s
17 - 31 ft 1200 f/s
31 - 56 ft 970 f/s
56 - 113 ft 2200 f/s
113 ft + 4200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
39.713
0.0
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 53** AMEC Job No. 6-117-001025

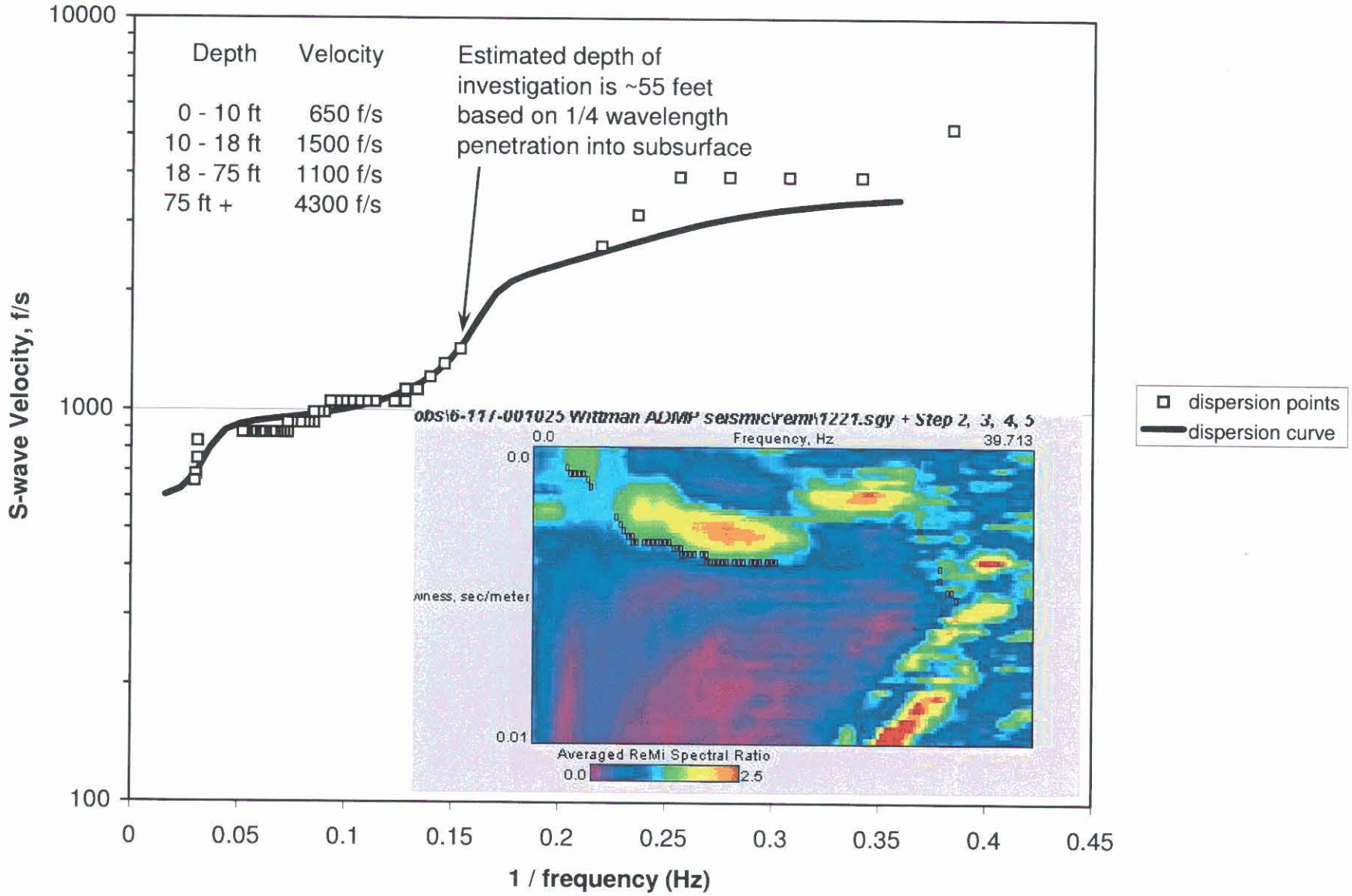



Depth Velocity
0 - 8 ft 630 f/s
8 - 34 ft 1300 f/s
34 - 53 ft 900 f/s
53 ft + 3200 f/s
Estimated depth of investigation is ~120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
Averaged ReMi Spectral Ratio
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4

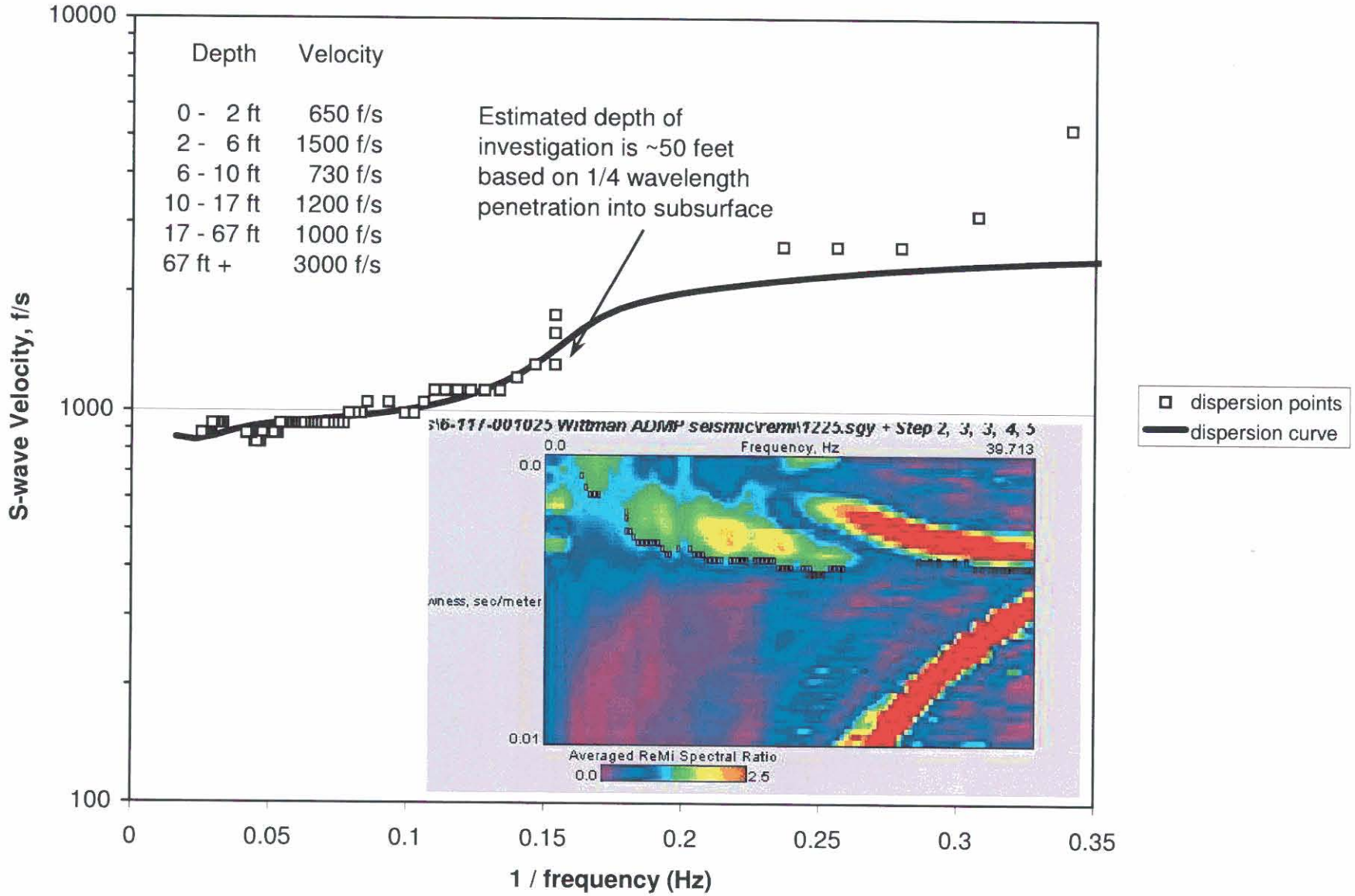
Refraction Microtremor S-wave Interpretation **Line 55** AMEC Job No. 6-117-001025

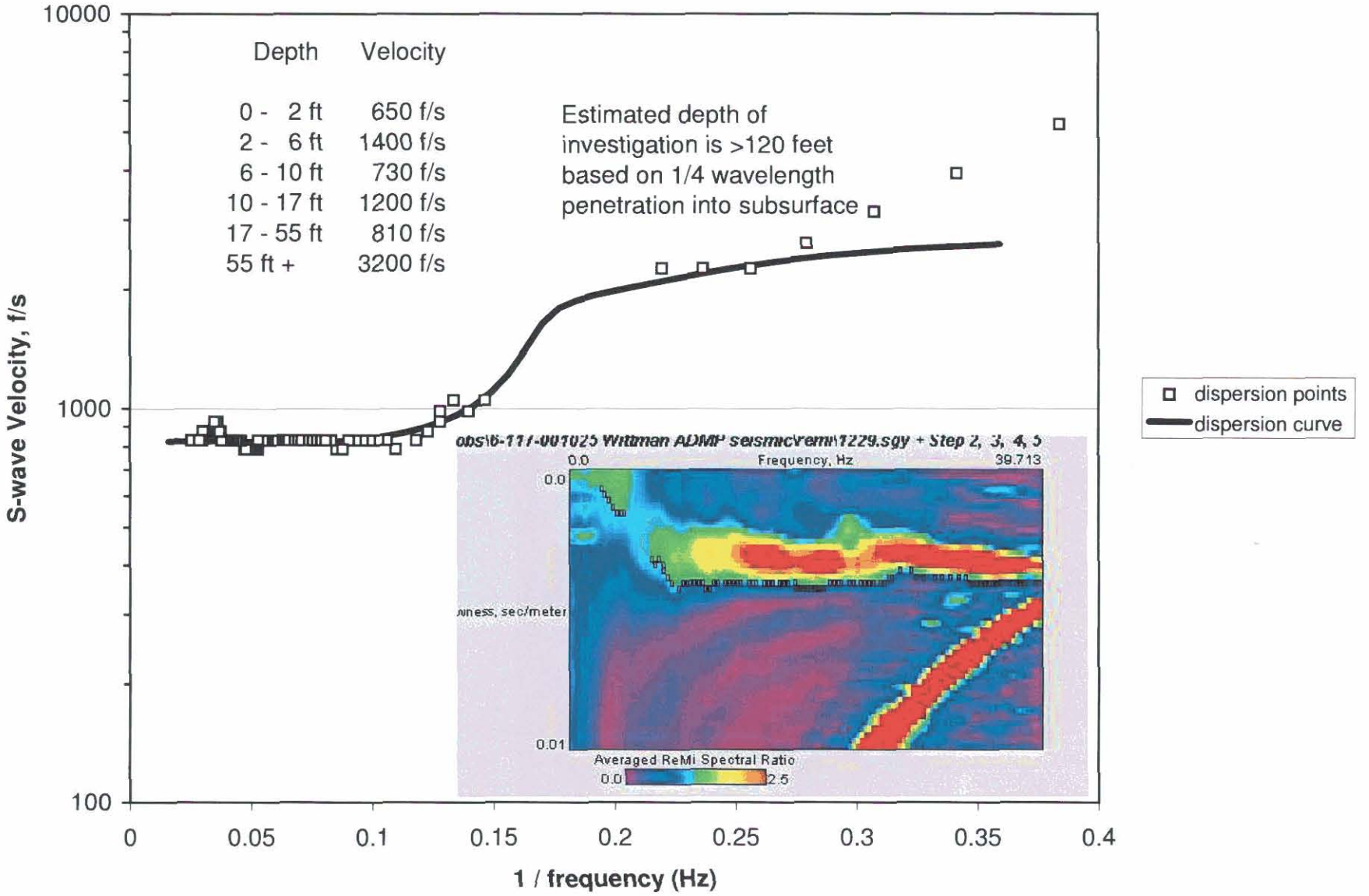


Refraction Microtremor S-wave Interpretation **Line 56** AMEC Job No. 6-117-001025

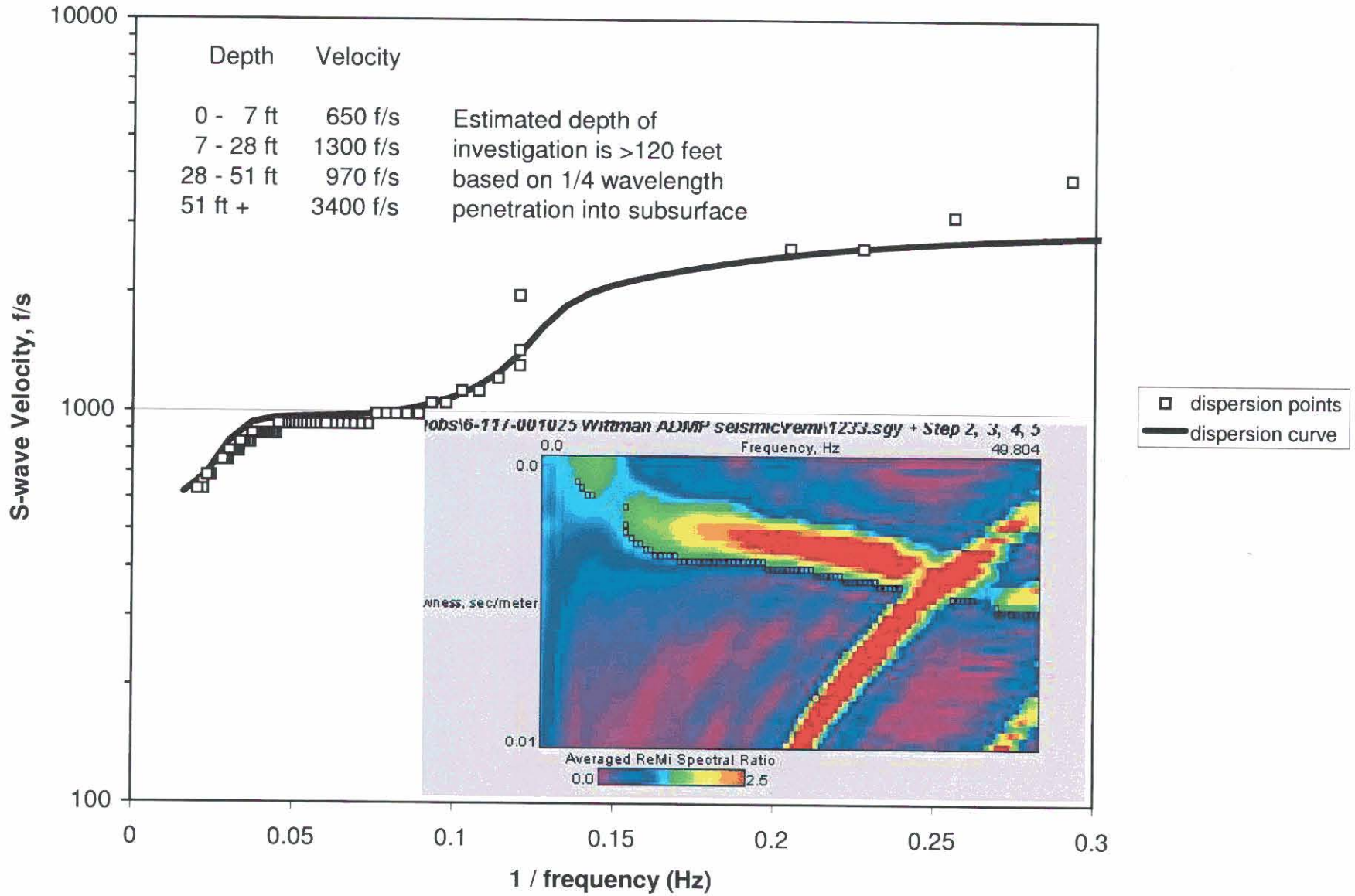


Refraction Microtremor S-wave Interpretation **Line 57** AMEC Job No. 6-117-001025

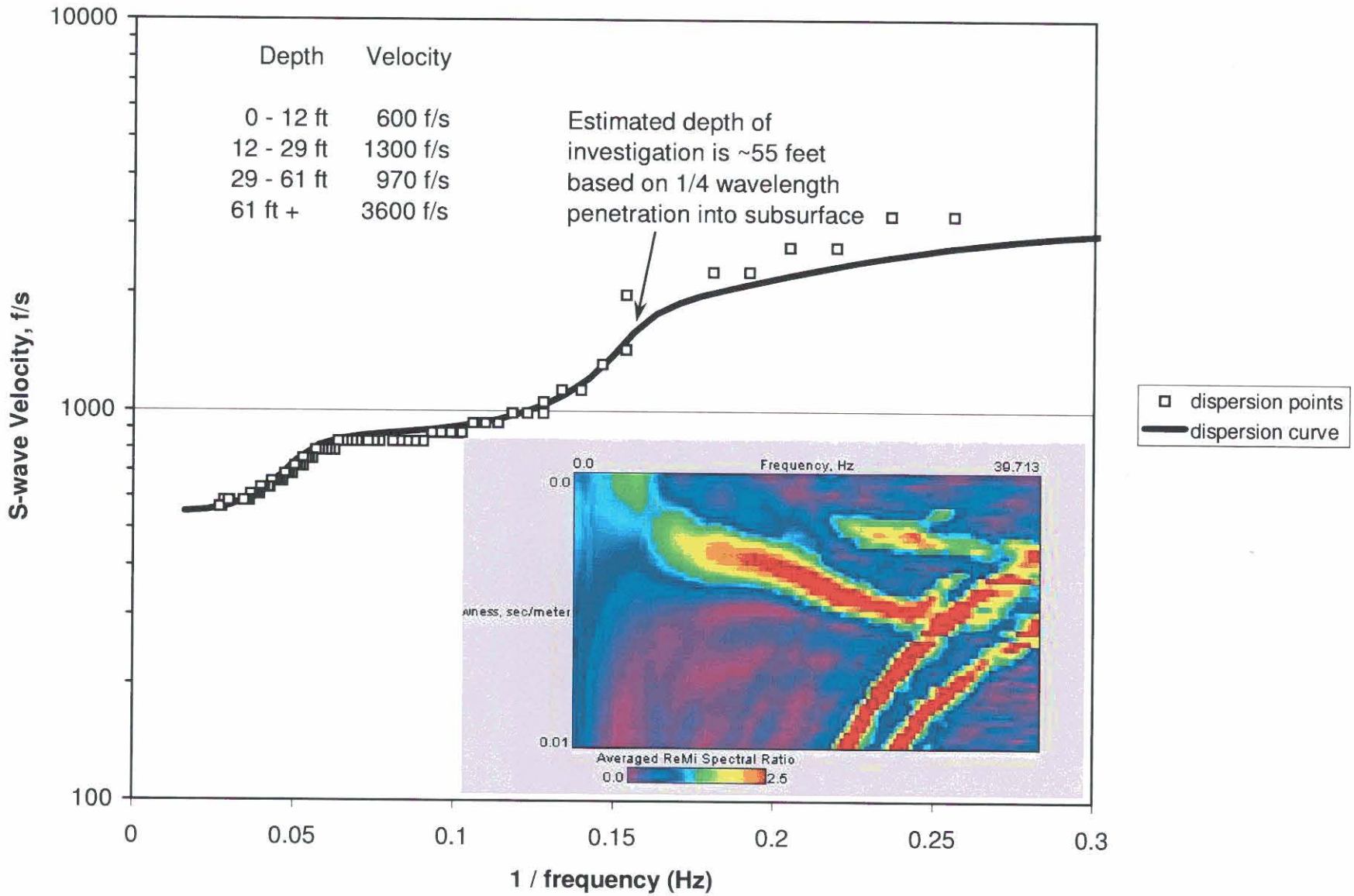



Depth Velocity
0 - 2 ft 650 f/s
2 - 6 ft 1400 f/s
6 - 10 ft 730 f/s
10 - 17 ft 1200 f/s
17 - 55 ft 810 f/s
55 ft + 3200 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

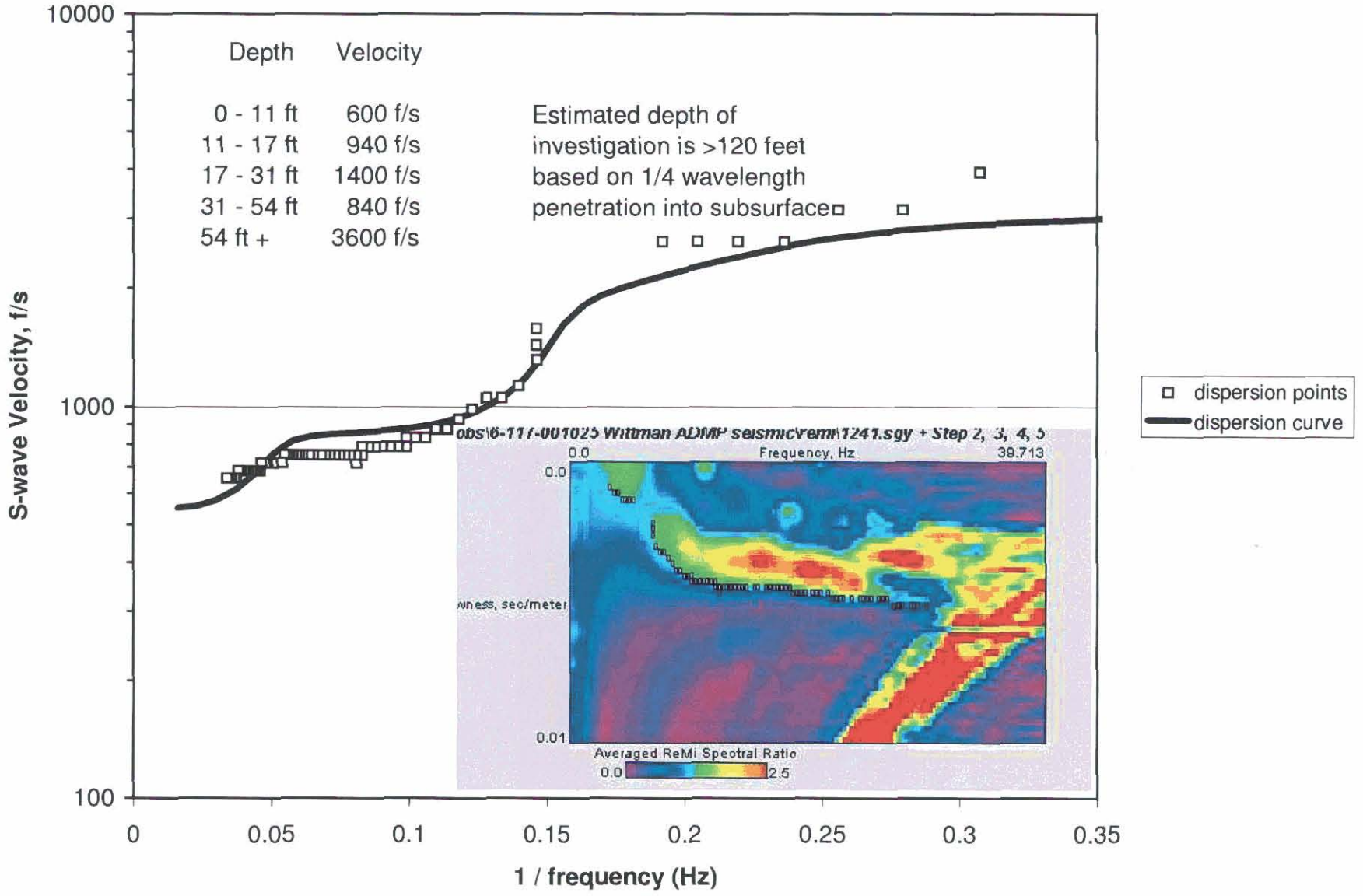
Refraction Microtremor S-wave Interpretation **Line 59** AMEC Job No. 6-117-001025



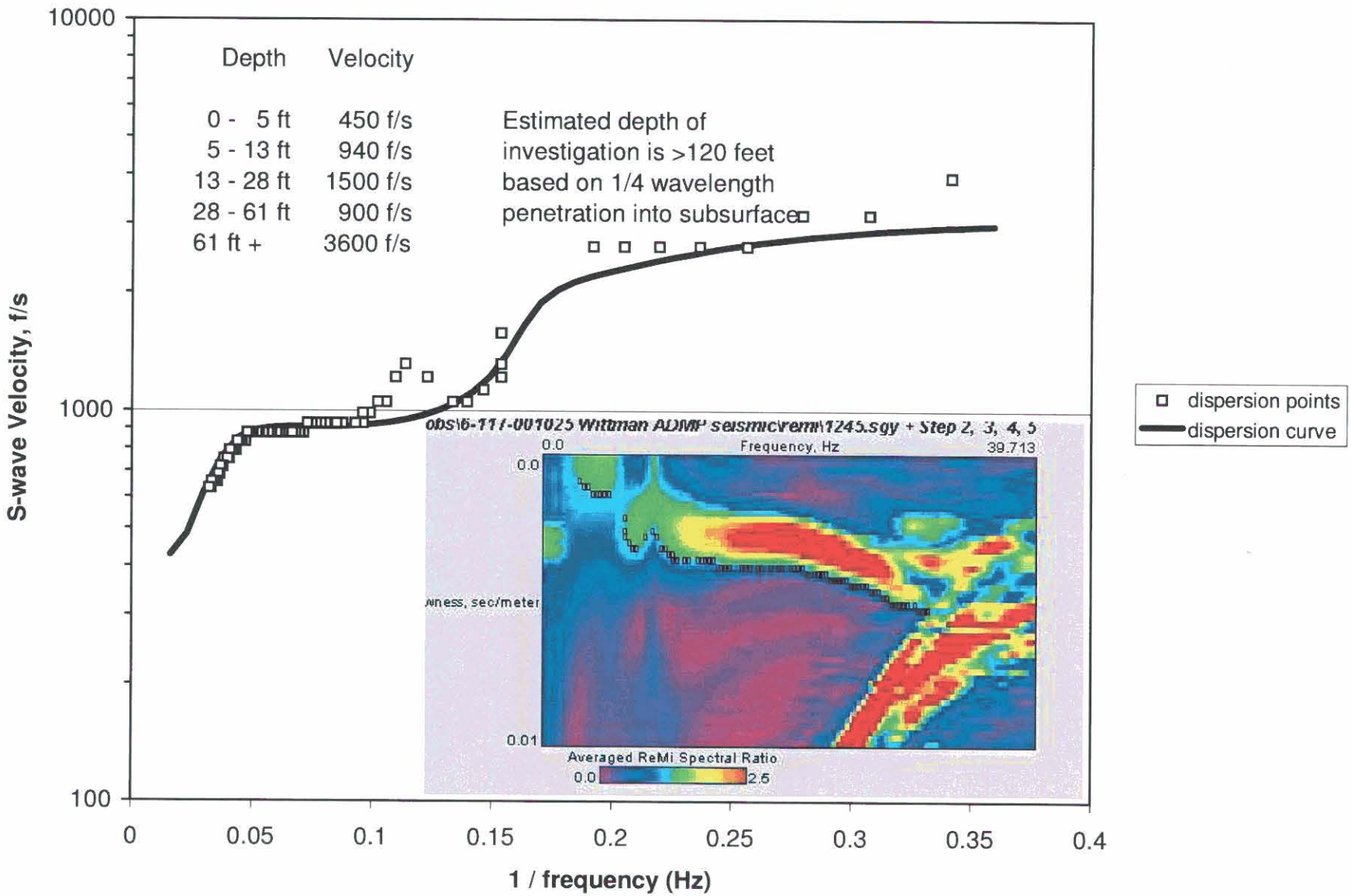
Refraction Microtremor S-wave Interpretation **Line 60** AMEC Job No. 6-117-001025



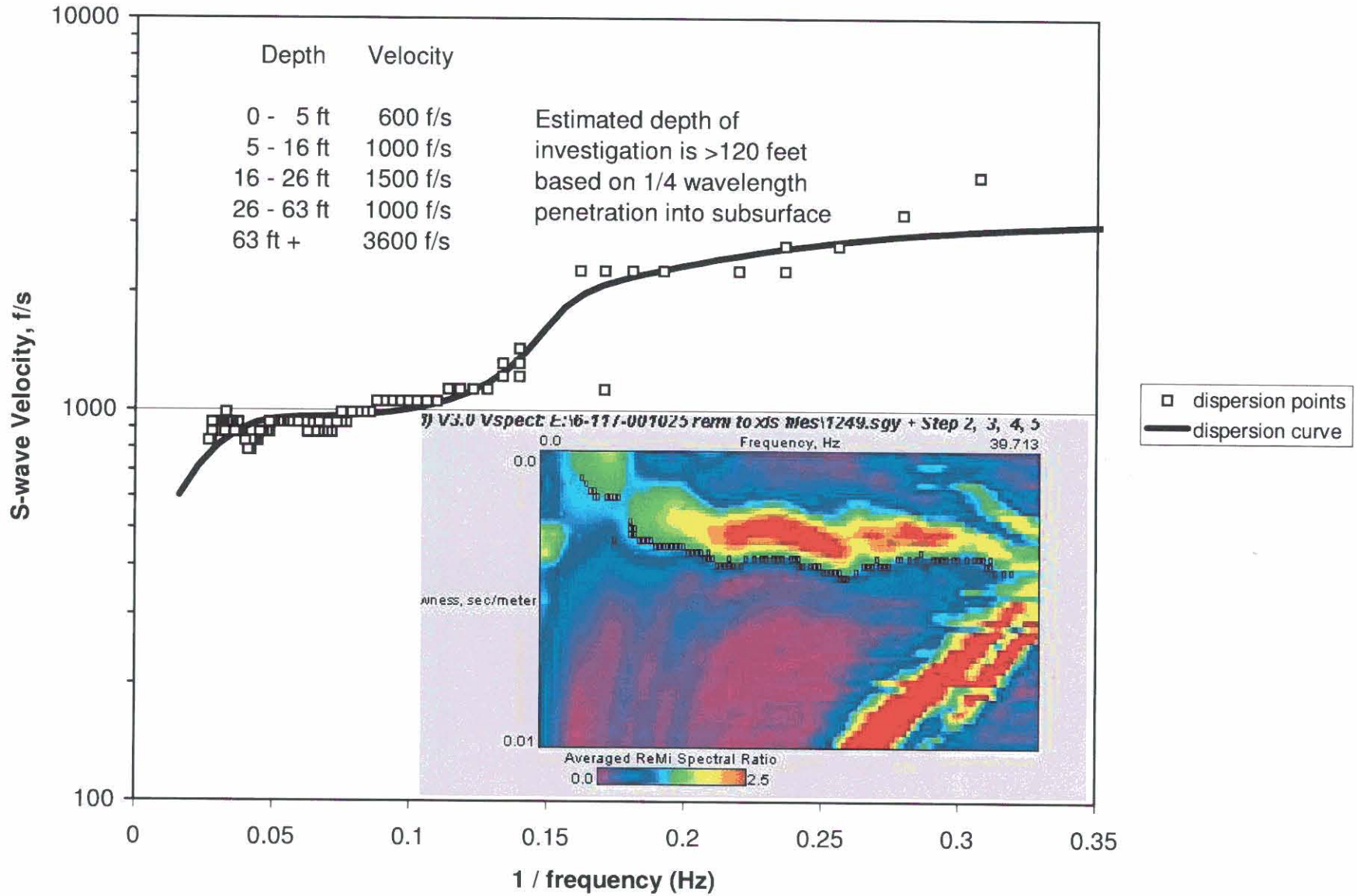
Refraction Microtremor S-wave Interpretation **Line 61** AMEC Job No. 6-117-001025

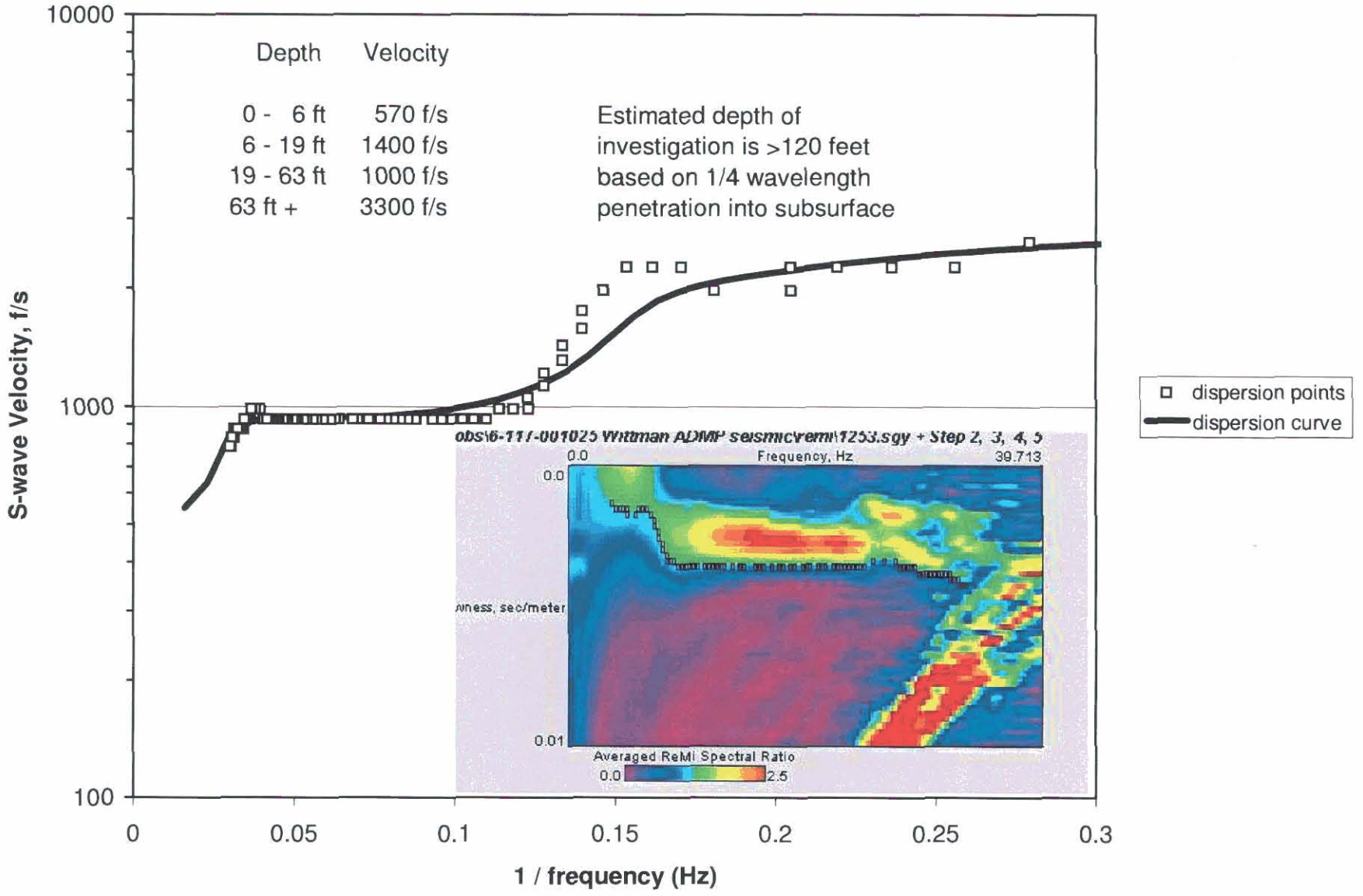


Refraction Microtremor S-wave Interpretation **Line 62** AMEC Job No. 6-117-001025

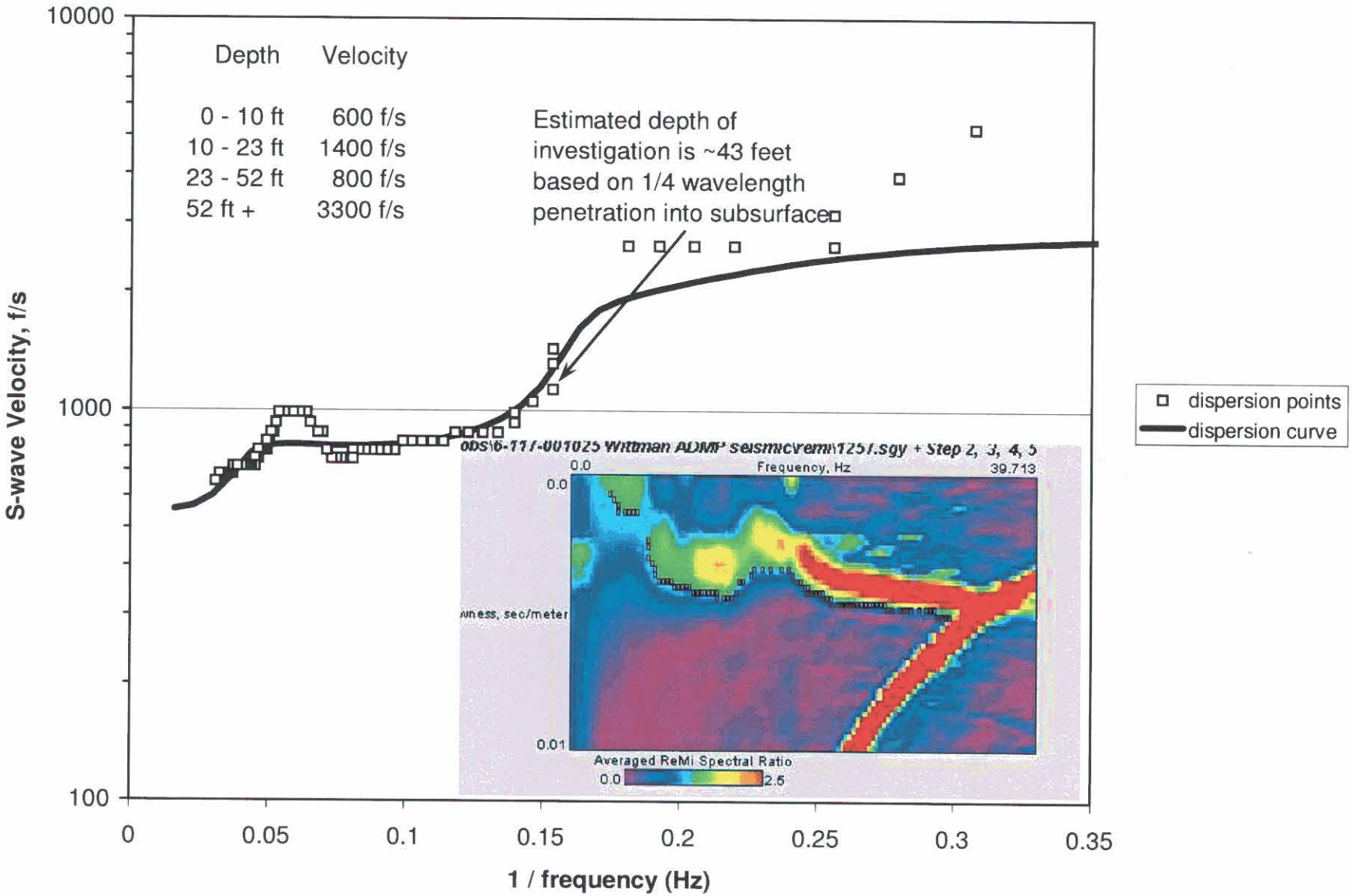


Refraction Microtremor S-wave Interpretation **Line 63** AMEC Job No. 6-117-001025

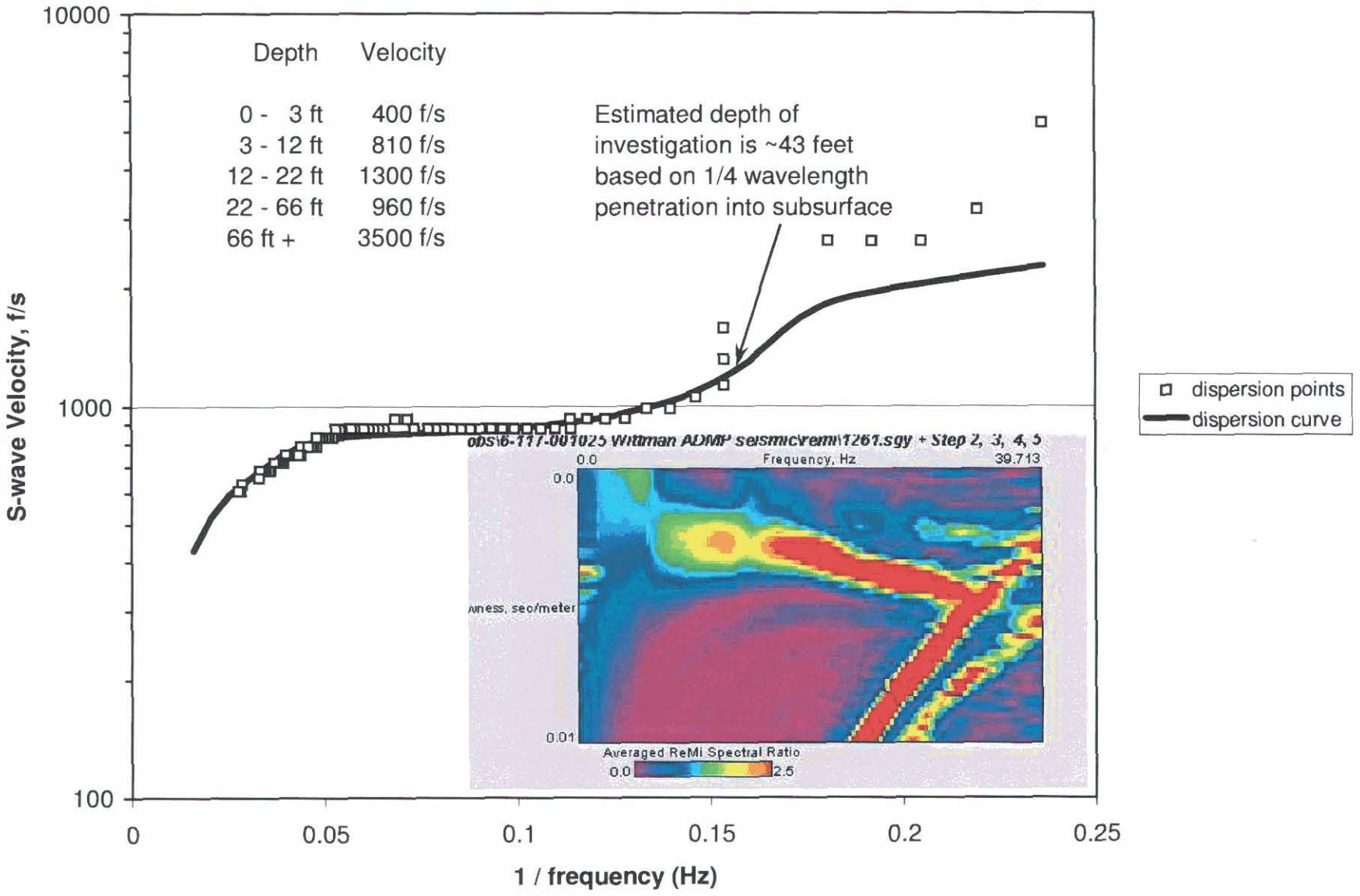



Depth Velocity
0 - 6 ft 570 f/s
6 - 19 ft 1400 f/s
19 - 63 ft 1000 f/s
63 ft + 3300 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
1 / frequency (Hz)

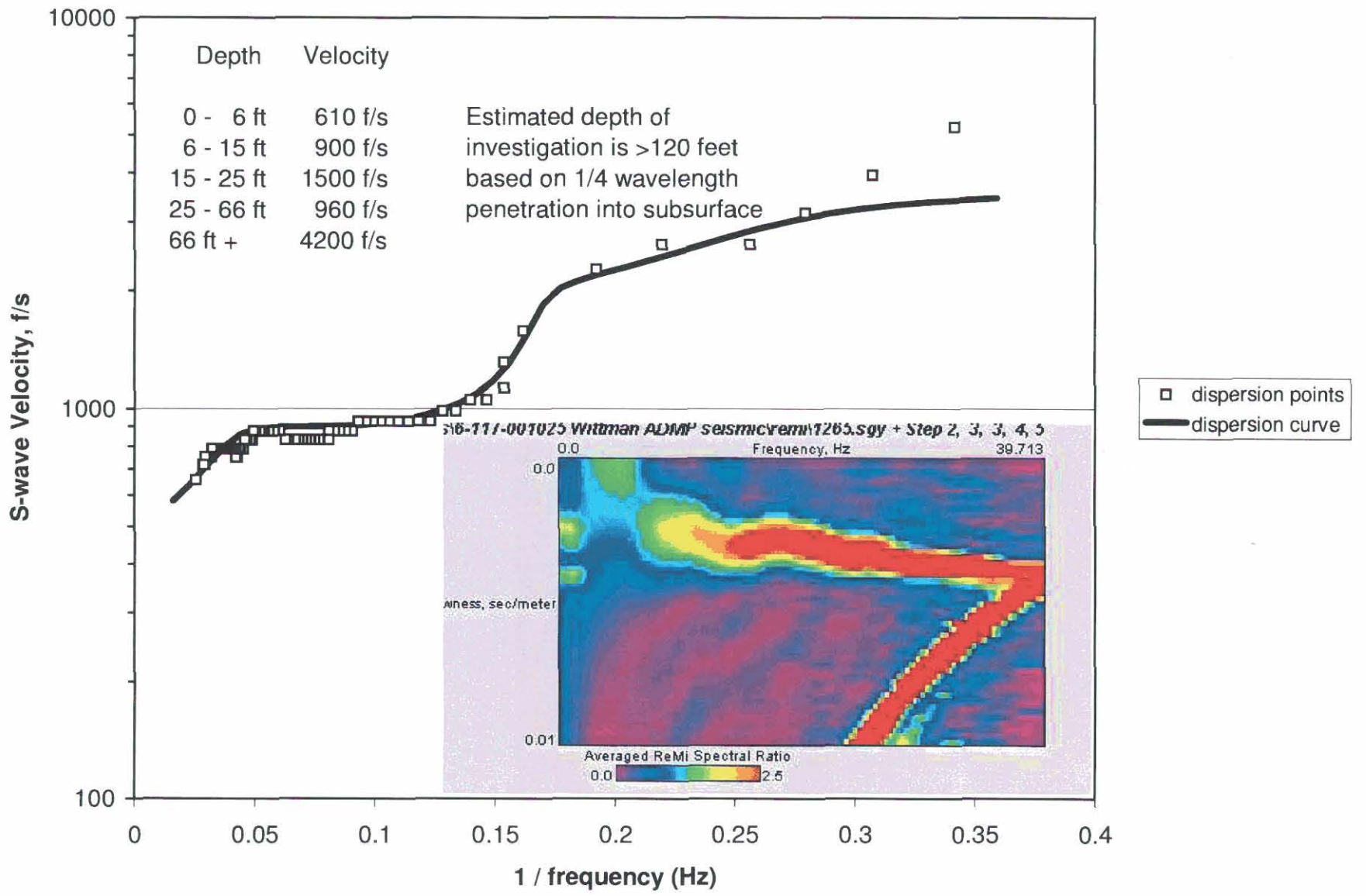
Refraction Microtremor S-wave Interpretation **Line 65** AMEC Job No. 6-117-001025



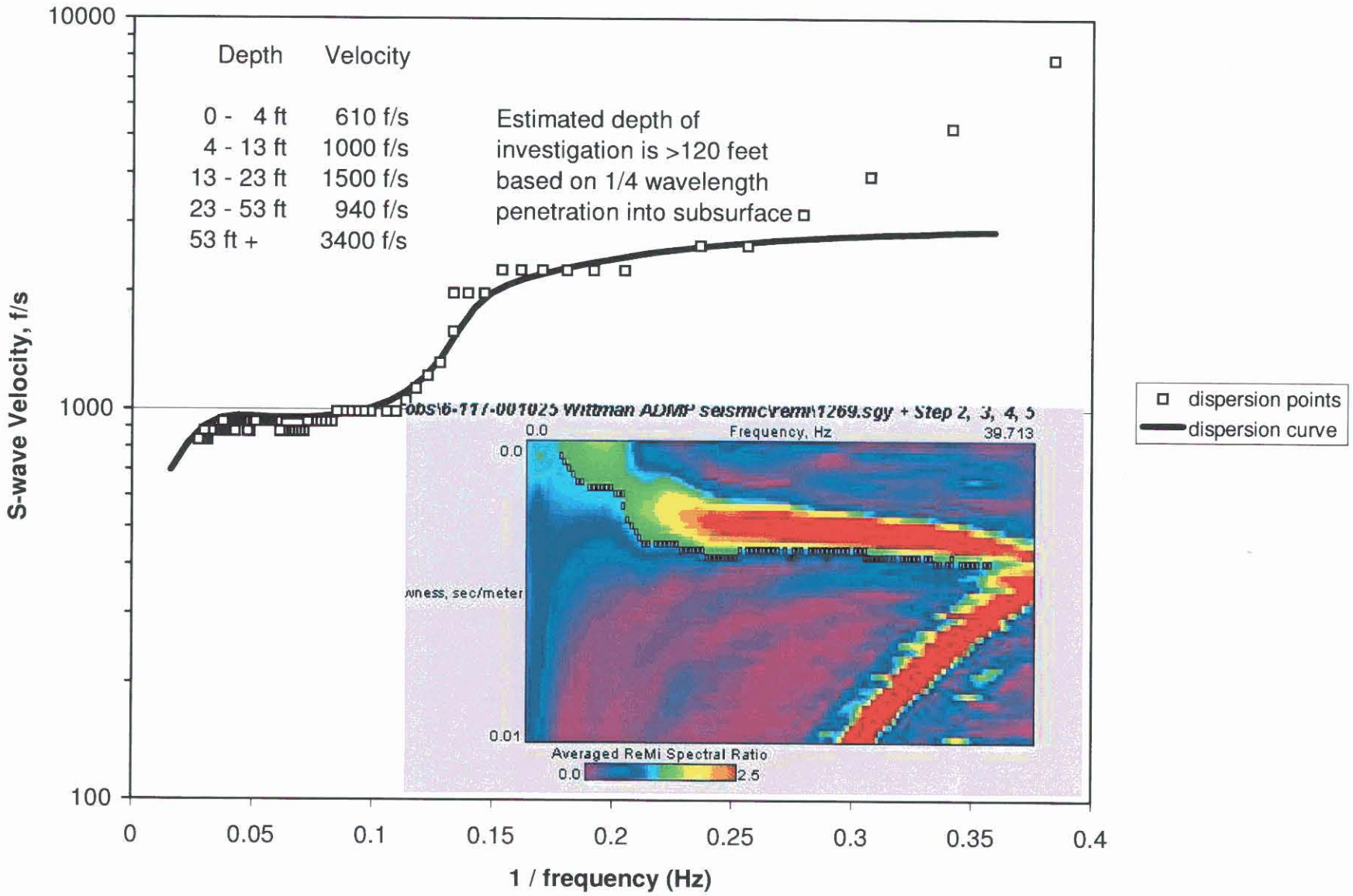
Refraction Microtremor S-wave Interpretation **Line 66** AMEC Job No. 6-117-001025



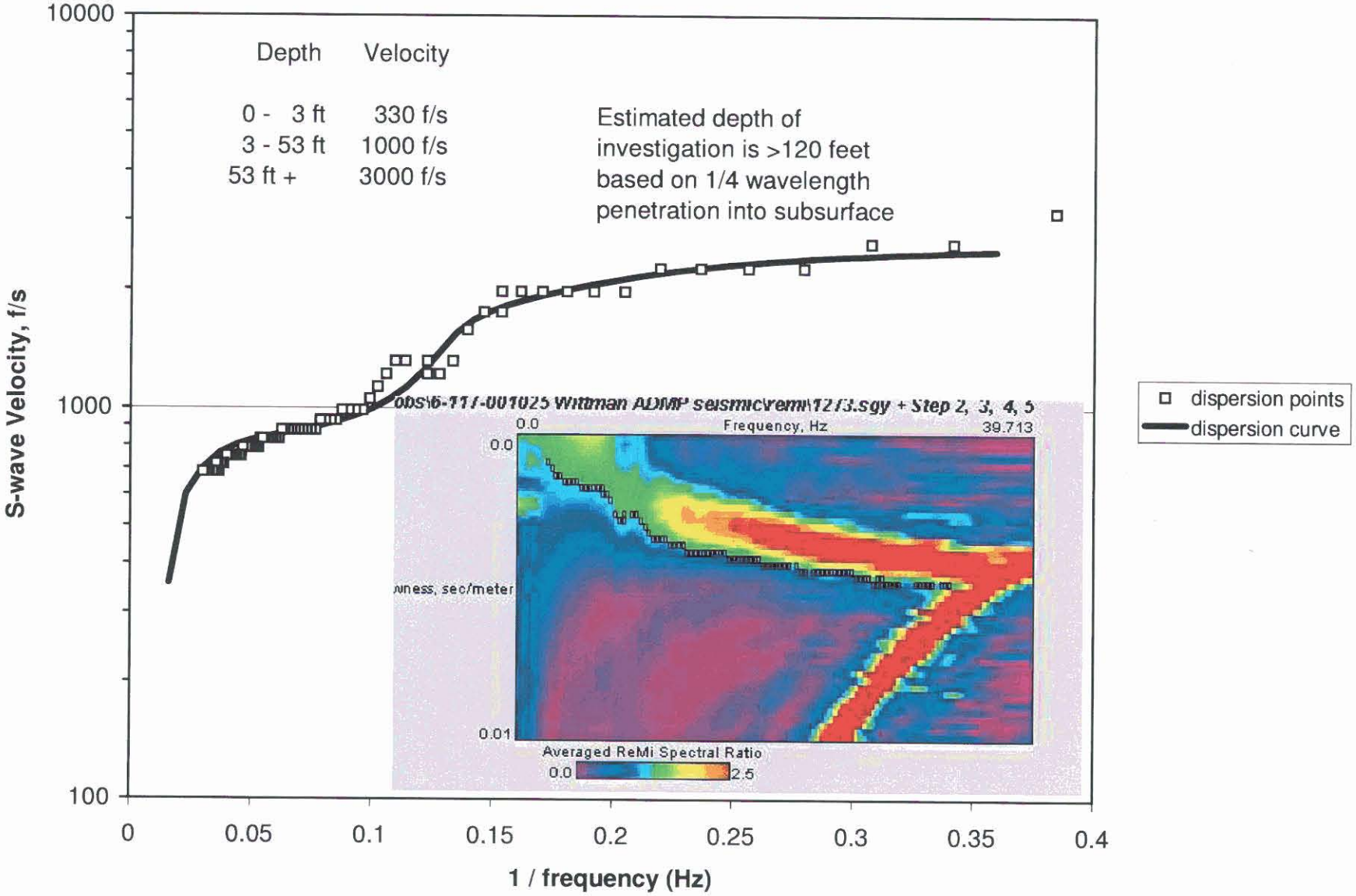
Refraction Microtremor S-wave Interpretation **Line 67** AMEC Job No. 6-117-001025

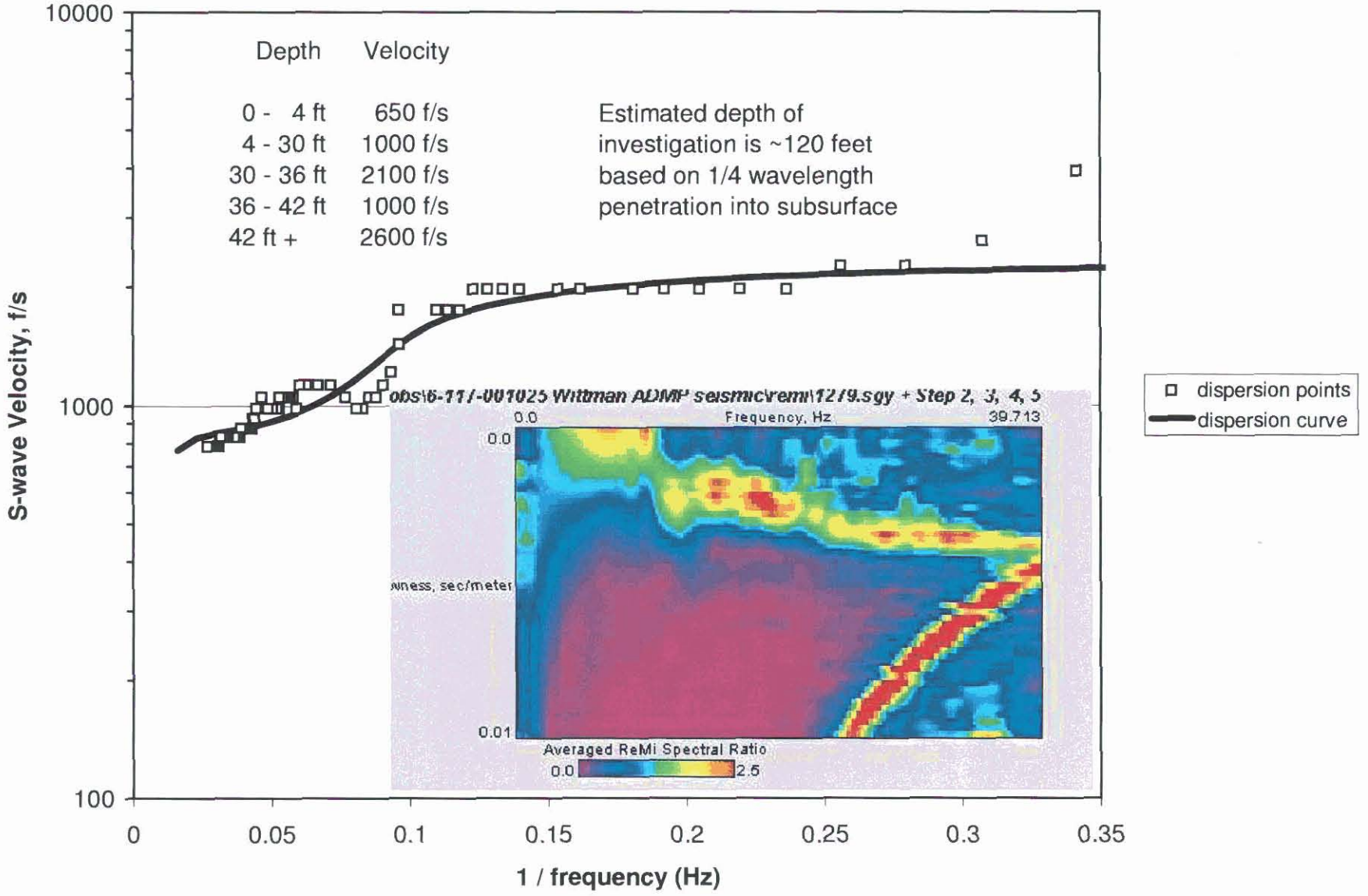


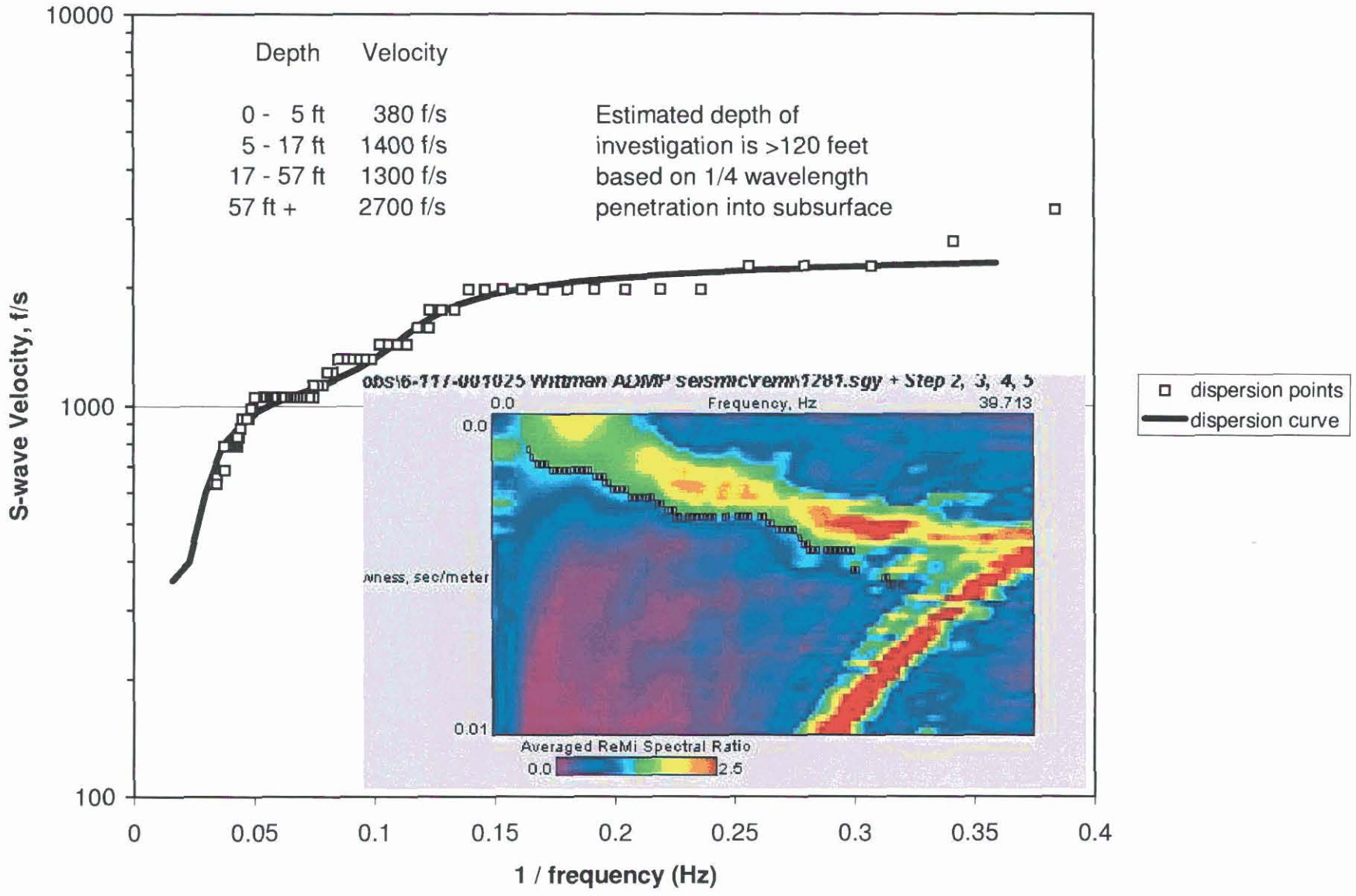
Refraction Microtremor S-wave Interpretation **Line 68** AMEC Job No. 6-117-001025



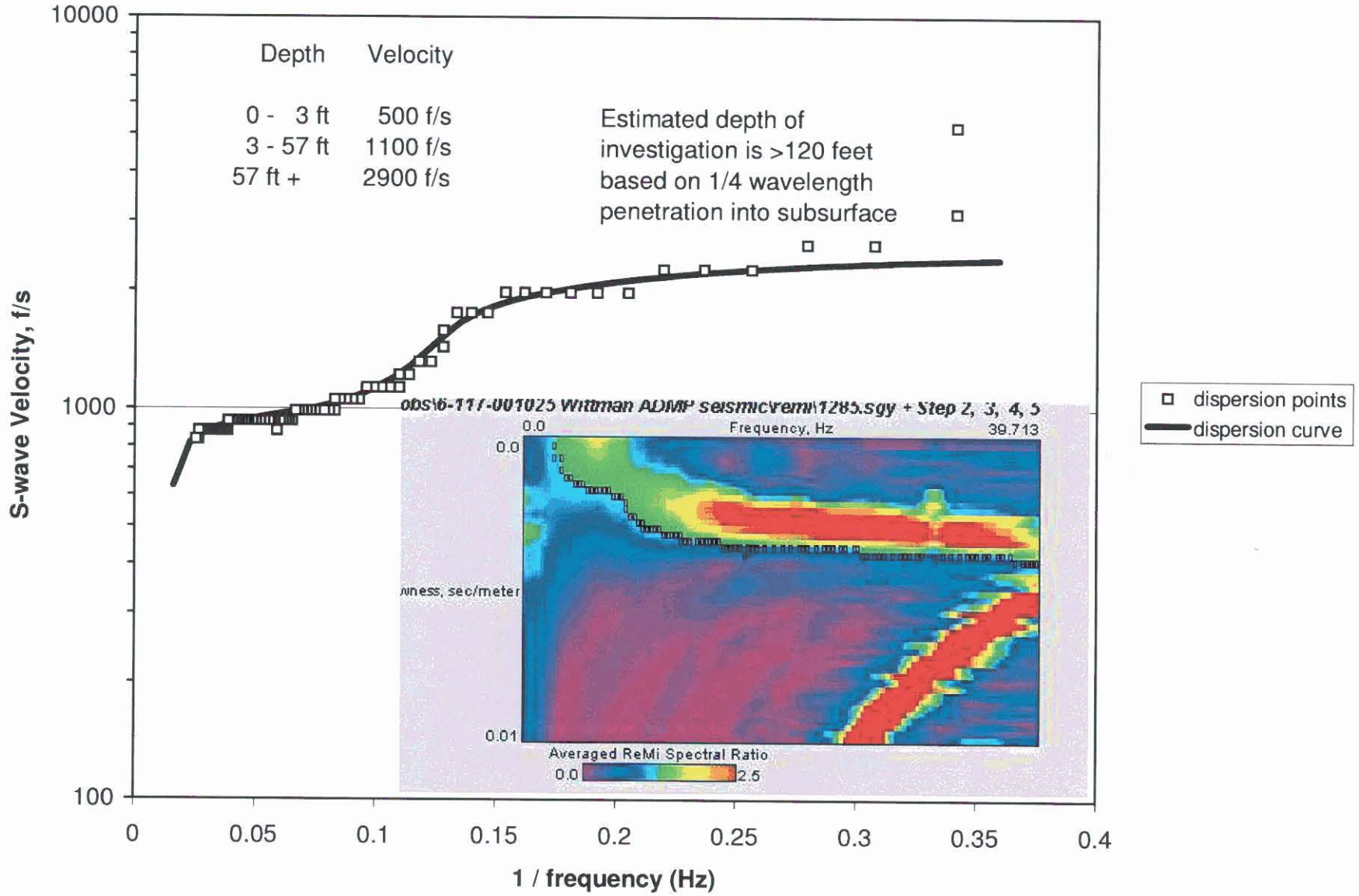
Refraction Microtremor S-wave Interpretation **Line 69** AMEC Job No. 6-117-001025



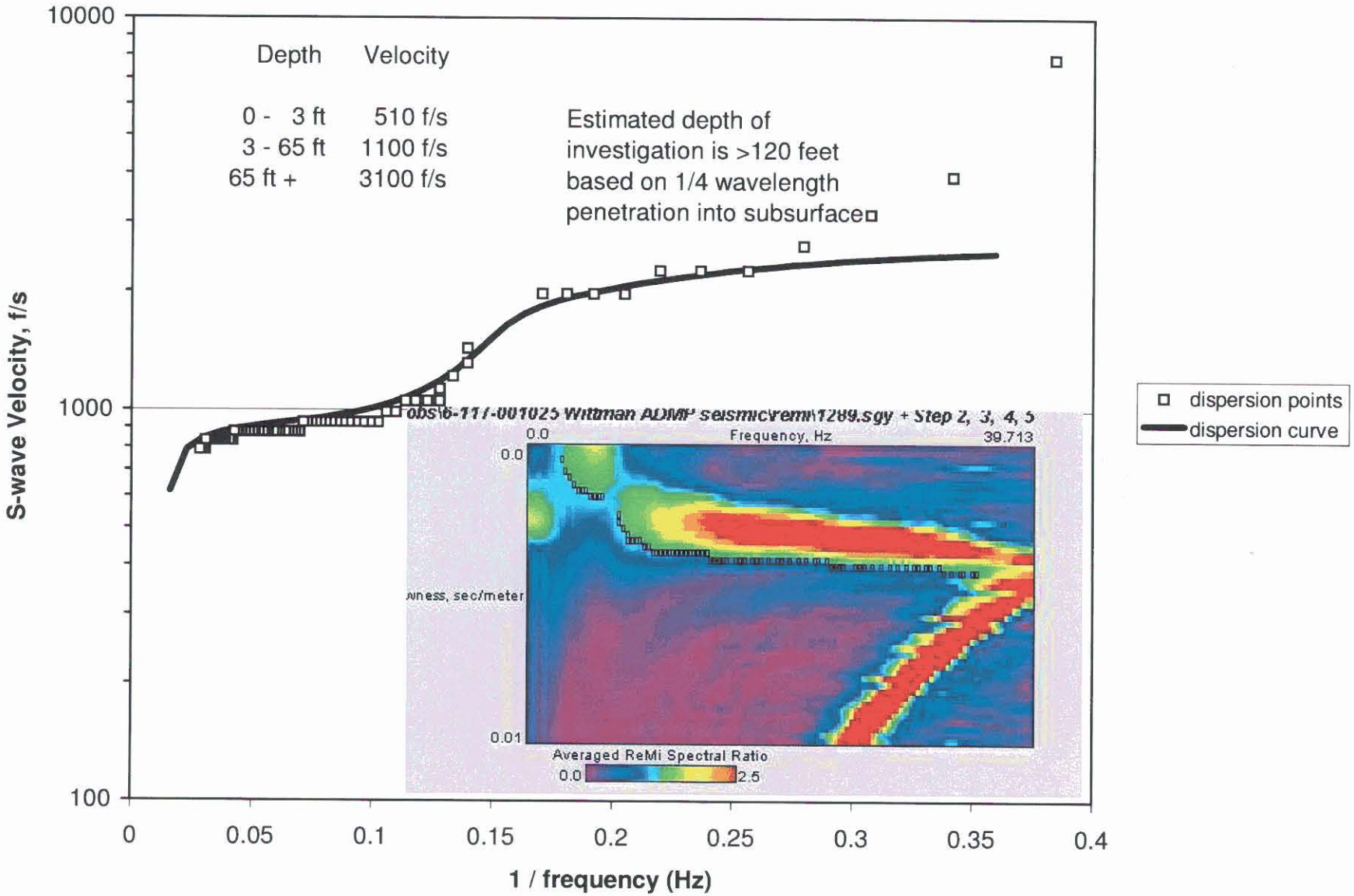

Depth Velocity
0 - 4 ft 650 f/s
4 - 30 ft 1000 f/s
30 - 36 ft 2100 f/s
36 - 42 ft 1000 f/s
42 ft + 2600 f/s
Estimated depth of investigation is ~120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 / frequency (Hz)


Depth Velocity
0 - 5 ft 380 f/s
5 - 17 ft 1400 f/s
17 - 57 ft 1300 f/s
57 ft + 2700 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5
dispersion points
dispersion curve

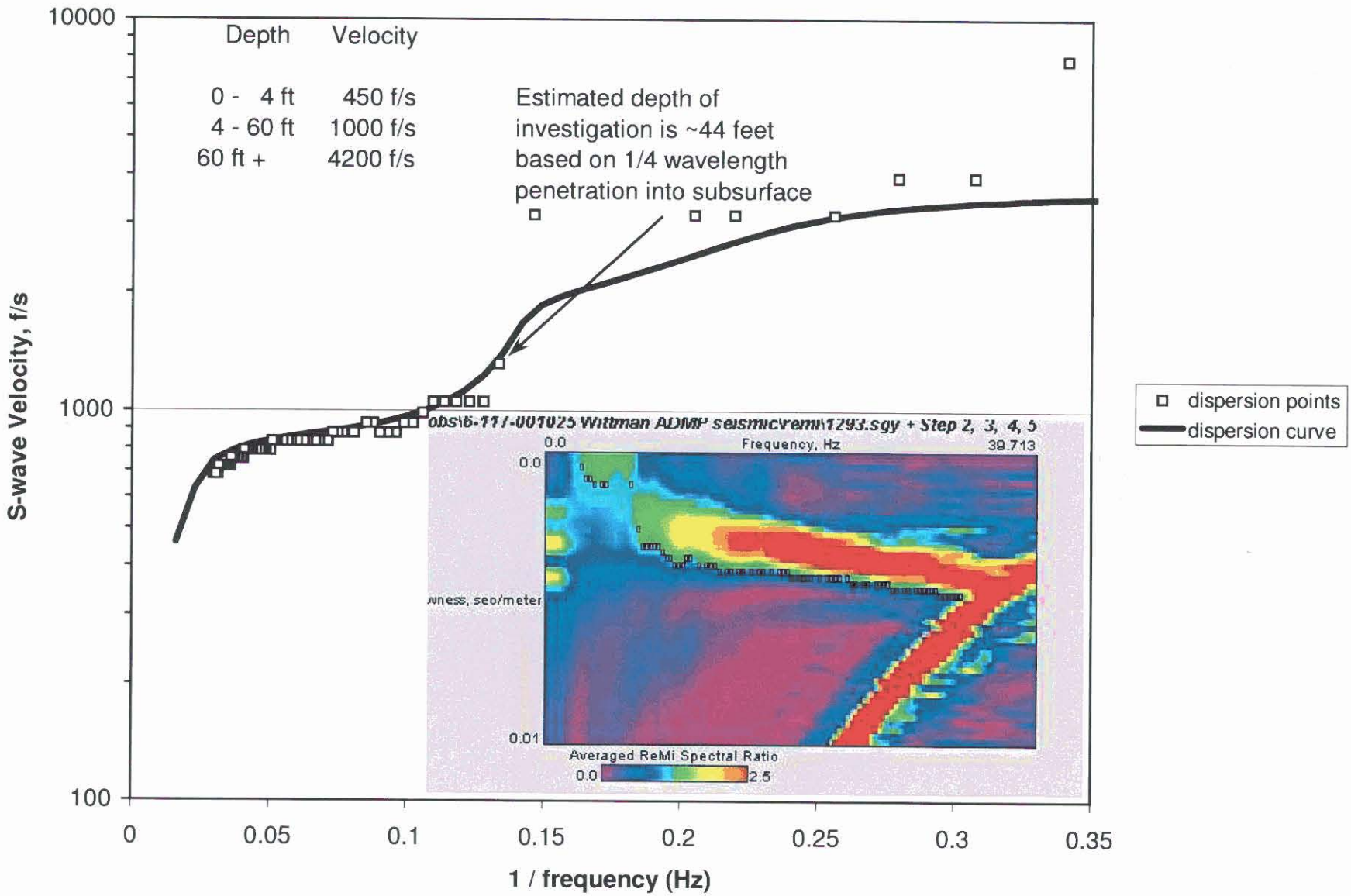
Refraction Microtremor S-wave Interpretation **Line 72** AMEC Job No. 6-117-001025

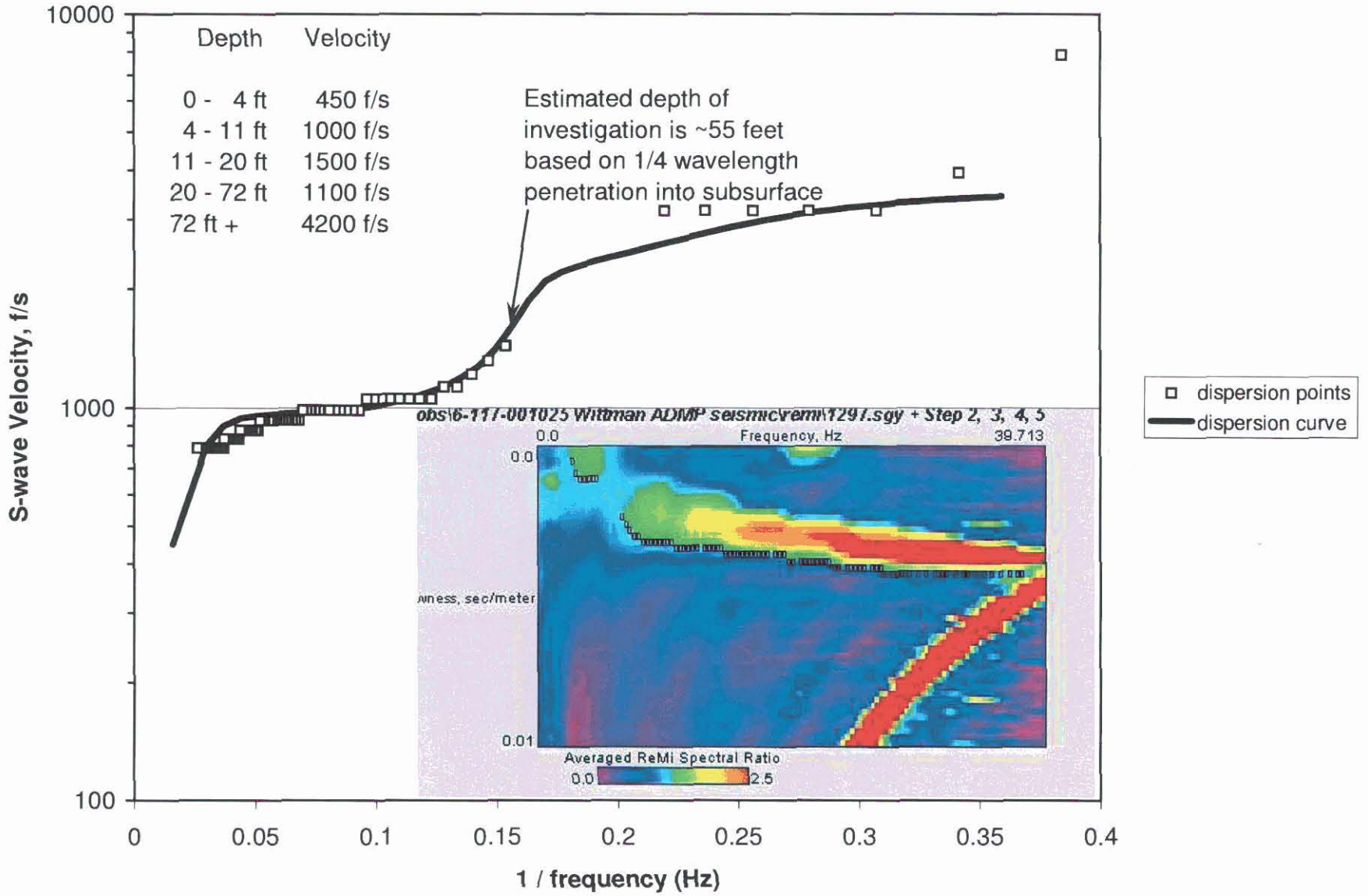


Refraction Microtremor S-wave Interpretation **Line 73** AMEC Job No. 6-117-001025

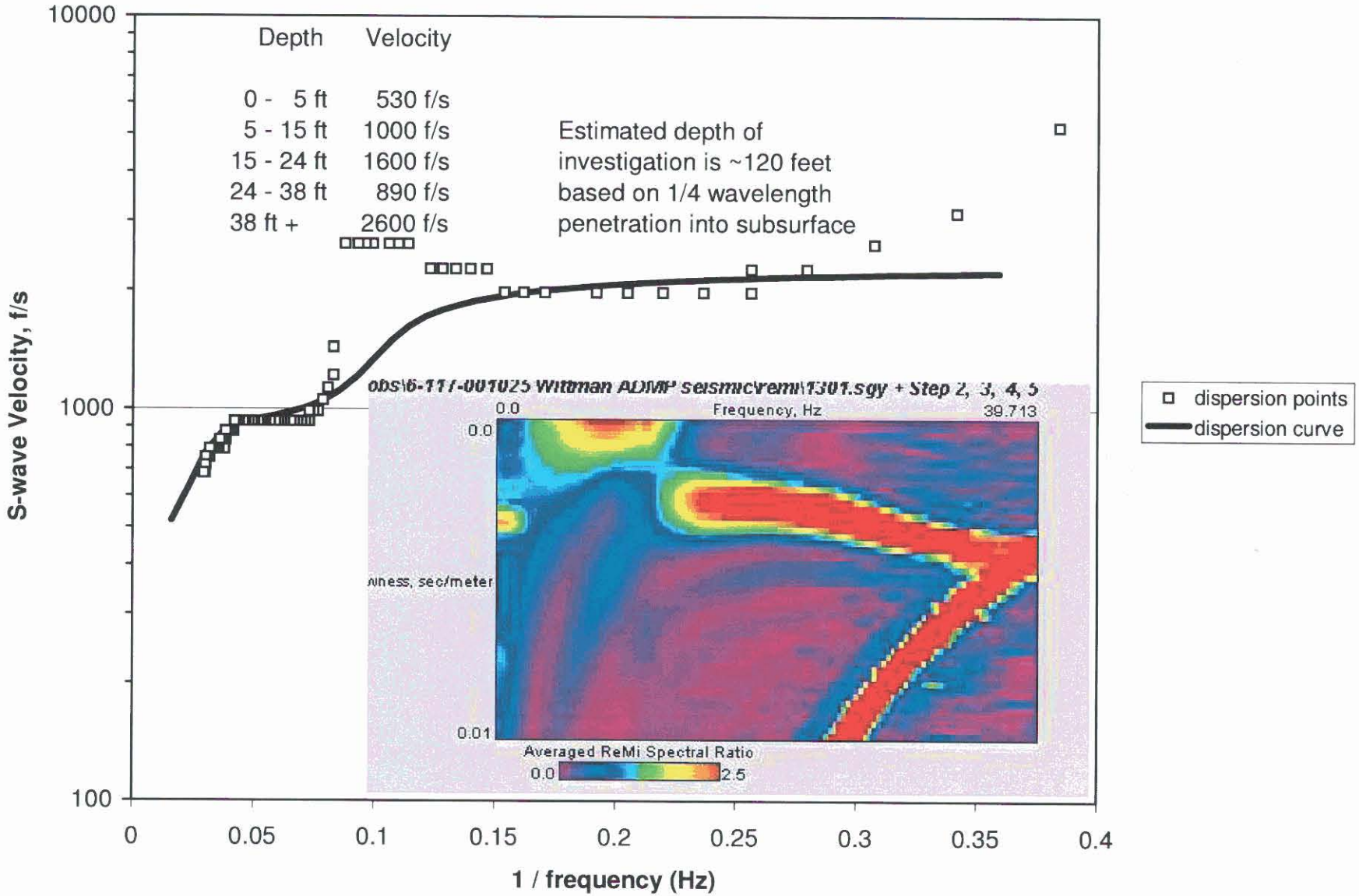


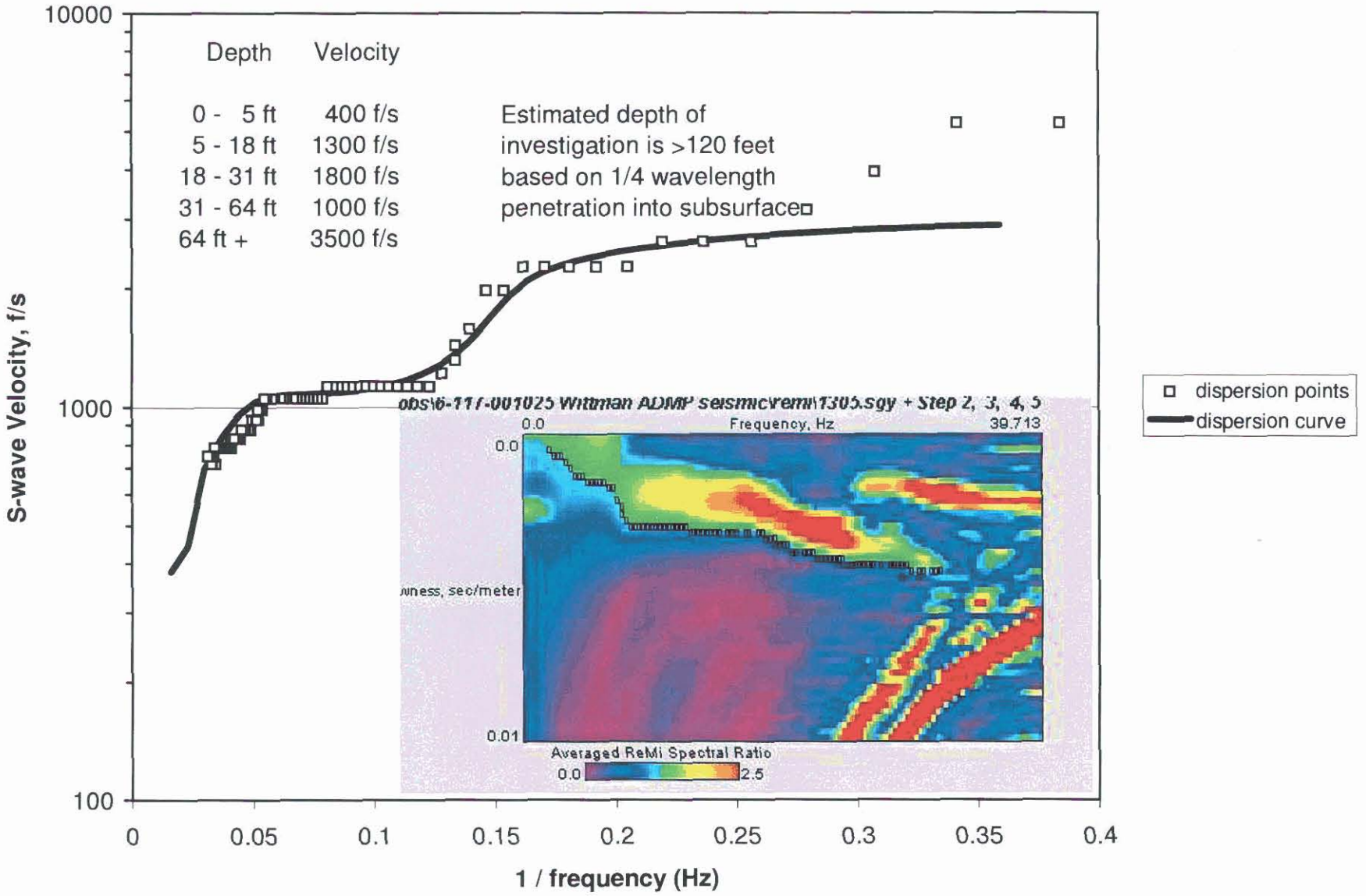
Refraction Microtremor S-wave Interpretation **Line 74** AMEC Job No. 6-117-001025

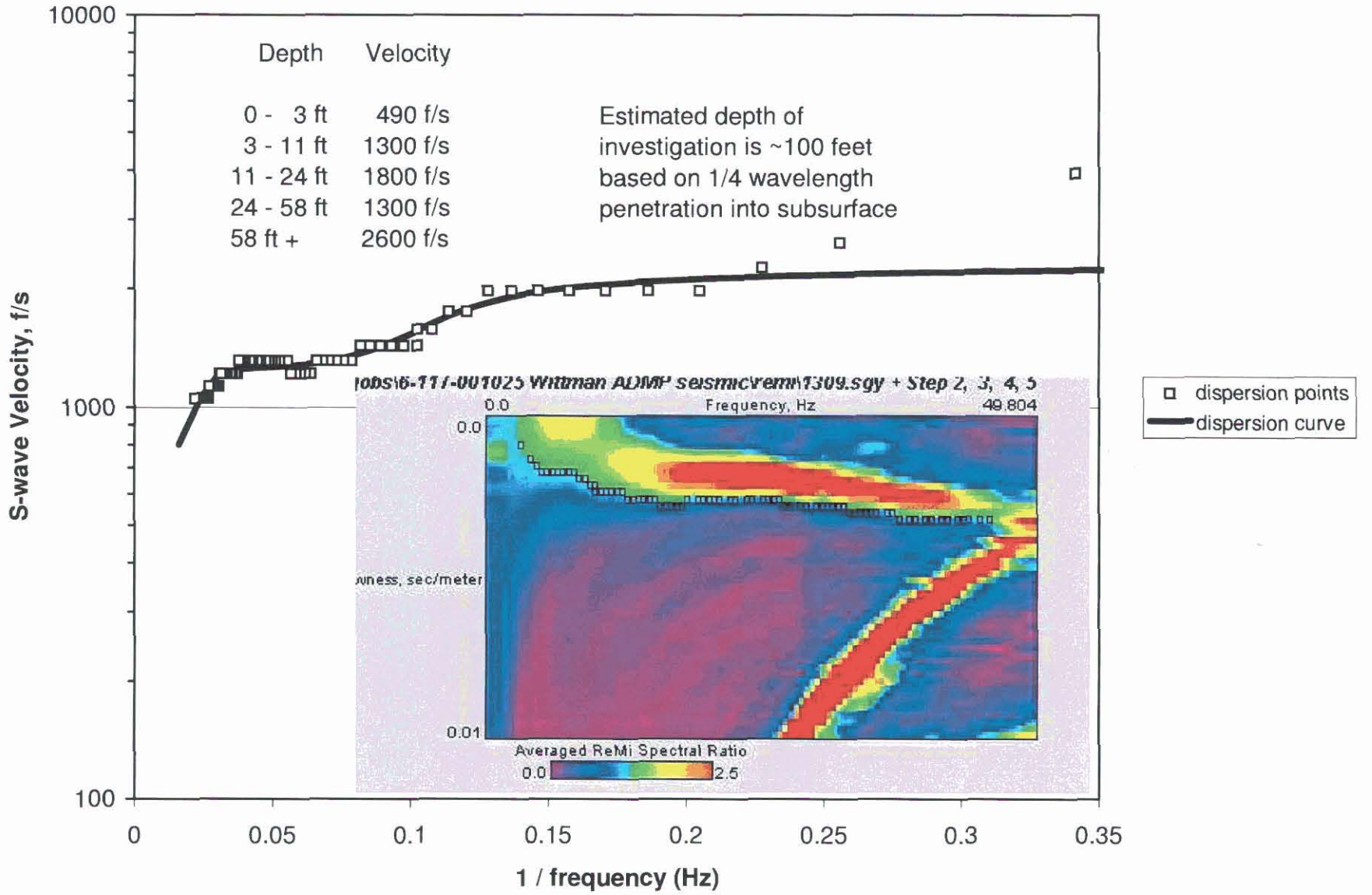


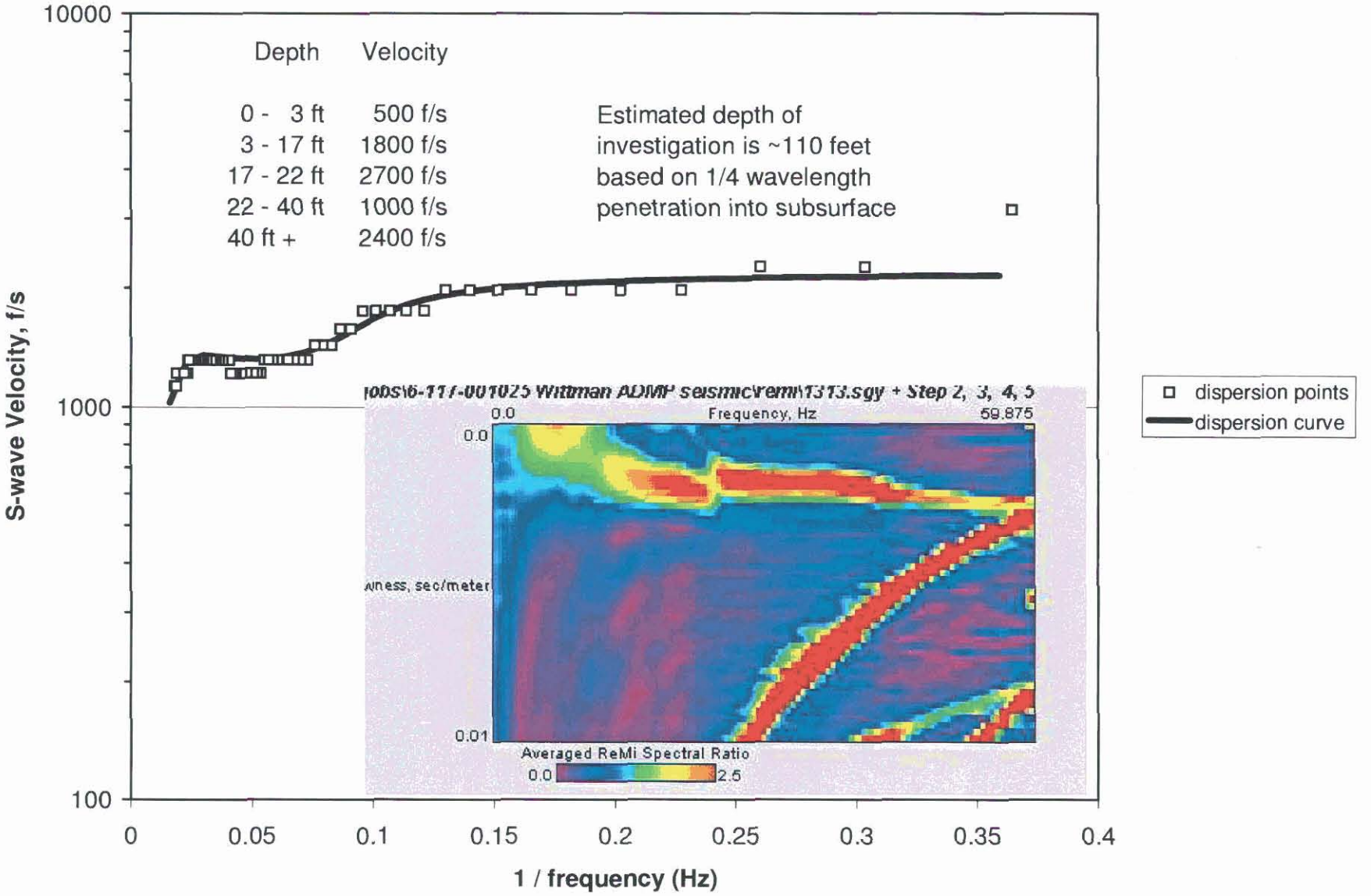

Depth Velocity
0 - 4 ft 450 f/s
4 - 11 ft 1000 f/s
11 - 20 ft 1500 f/s
20 - 72 ft 1100 f/s
72 ft + 4200 f/s
Estimated depth of investigation is ~55 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

Refraction Microtremor S-wave Interpretation **Line 76** AMEC Job No. 6-117-001025

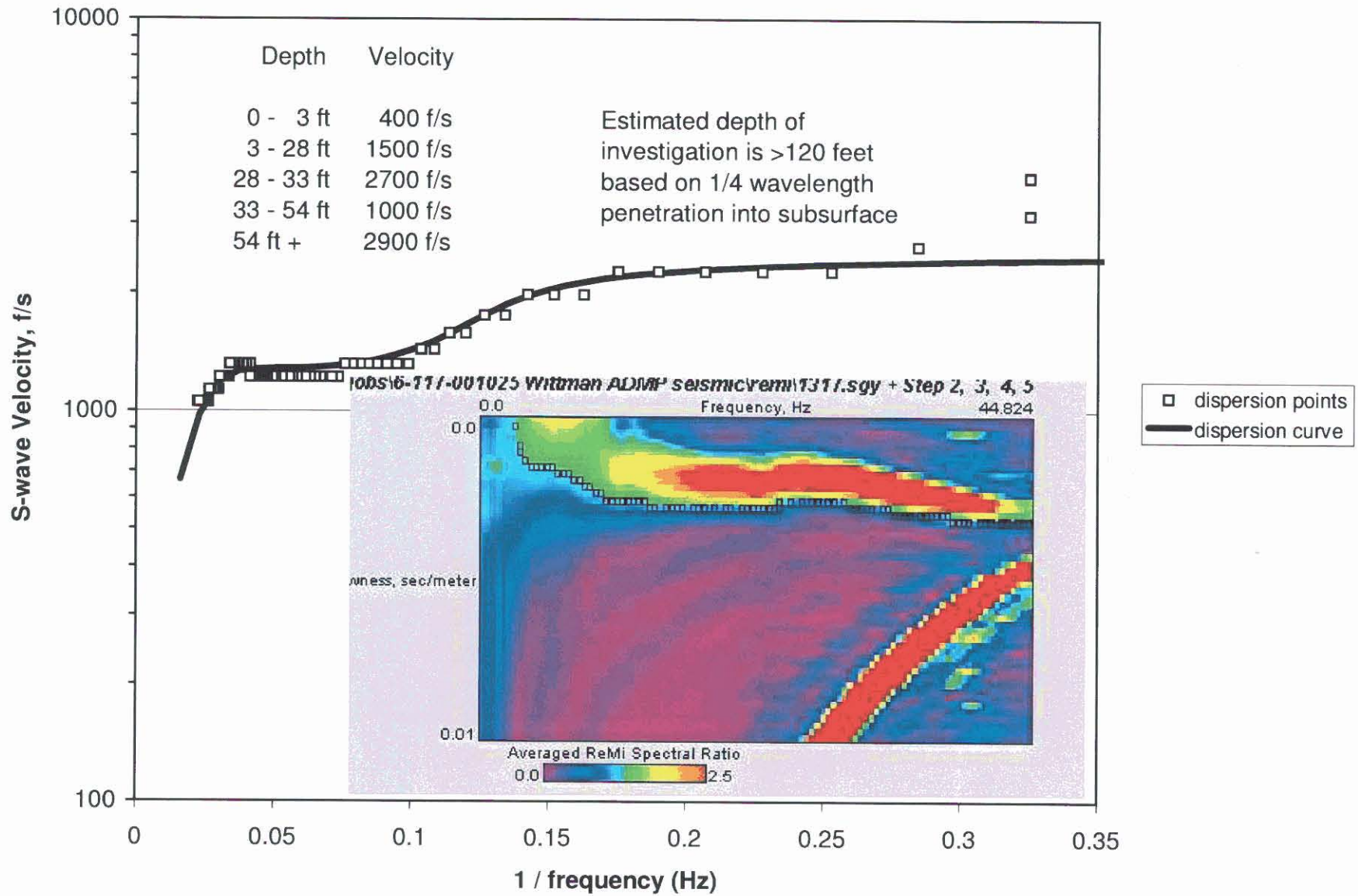



Depth Velocity
0 - 5 ft 400 f/s
5 - 18 ft 1300 f/s
18 - 31 ft 1800 f/s
31 - 64 ft 1000 f/s
64 ft + 3500 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5

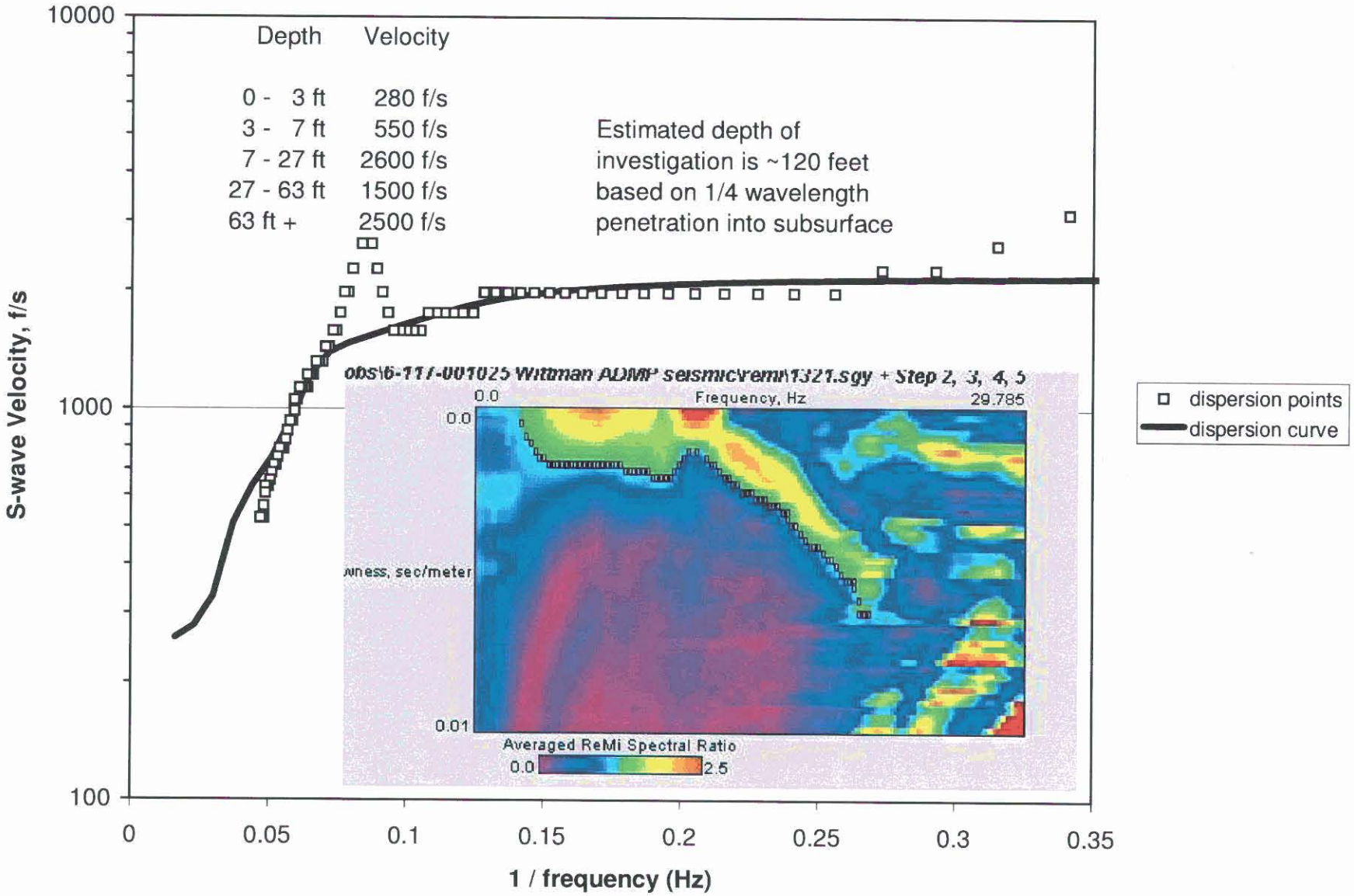

Depth Velocity
0 - 3 ft 490 f/s
3 - 11 ft 1300 f/s
11 - 24 ft 1800 f/s
24 - 58 ft 1300 f/s
58 ft + 2600 f/s
Estimated depth of investigation is ~100 feet based on 1/4 wavelength penetration into subsurface
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 / frequency (Hz)
Frequency, Hz
0.0
49.804
0.01
Averaged ReMi Spectral Ratio
2.5
dispersion points
dispersion curve

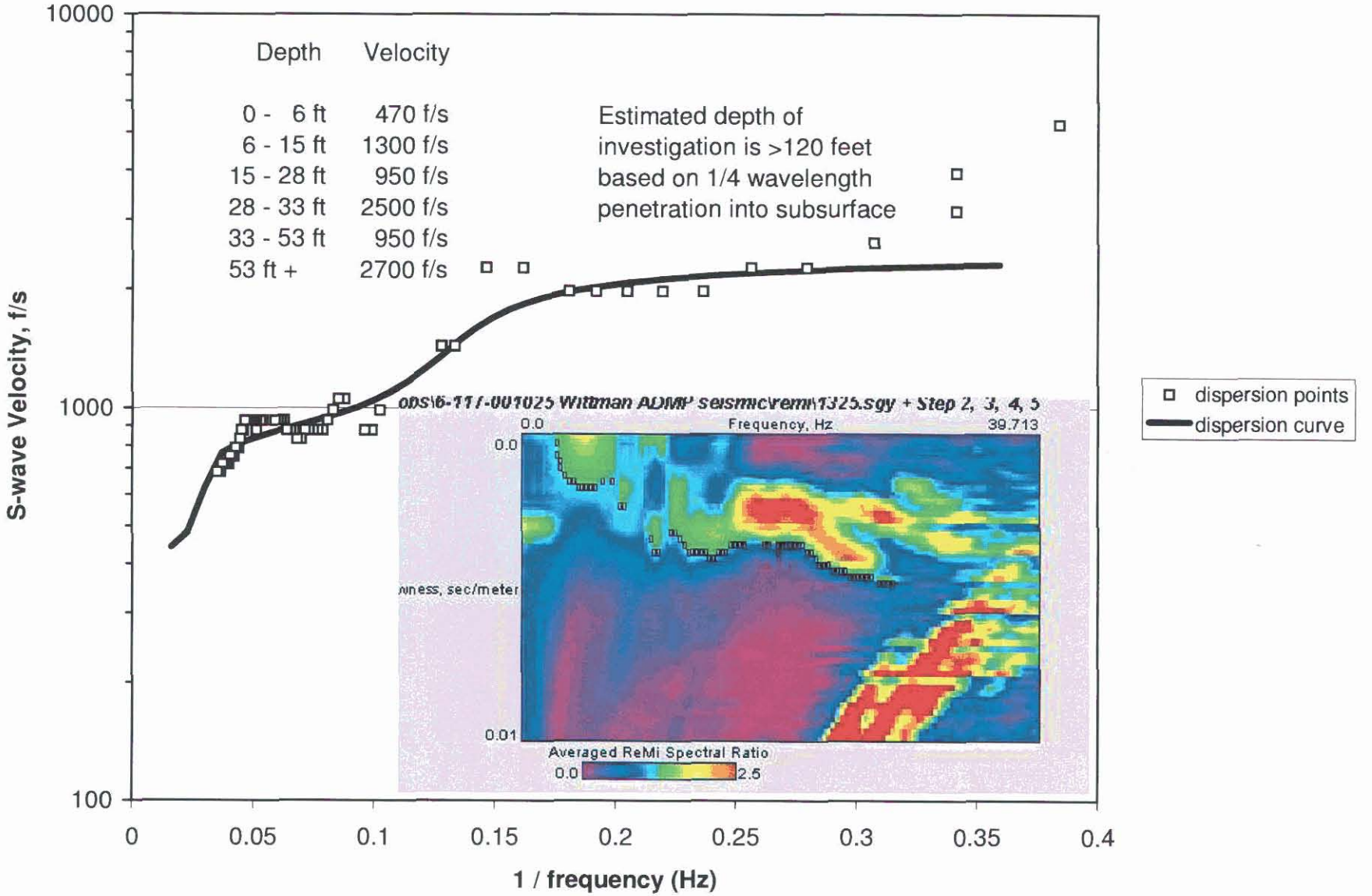

Depth Velocity
0 - 3 ft 500 f/s
3 - 17 ft 1800 f/s
17 - 22 ft 2700 f/s
22 - 40 ft 1000 f/s
40 ft + 2400 f/s
Estimated depth of investigation is ~110 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
59.875
0.01
Averaged ReMi Spectral Ratio
2.5
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
1 / frequency (Hz)

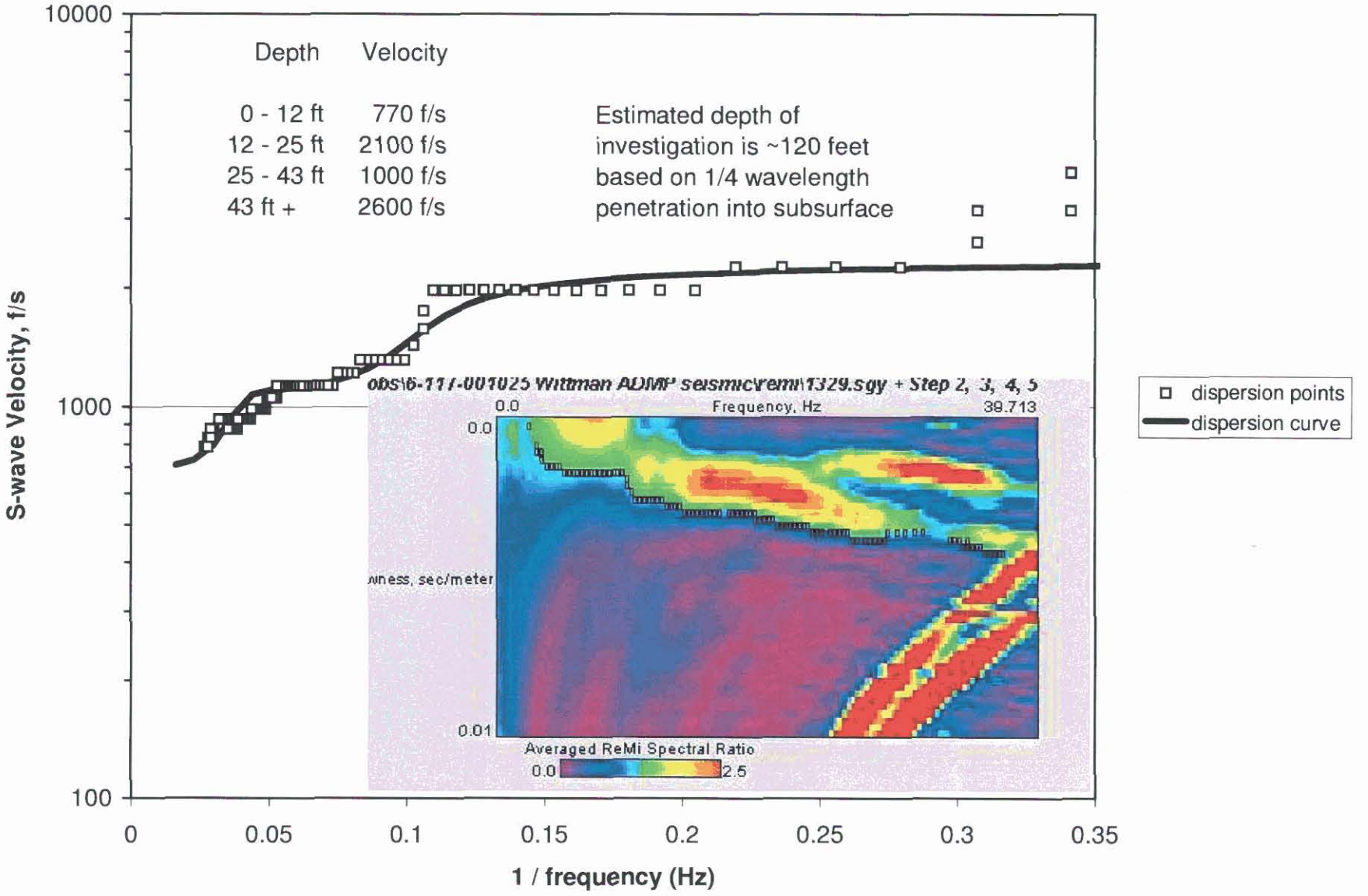
Refraction Microtremor S-wave Interpretation **Line 80** AMEC Job No. 6-117-001025



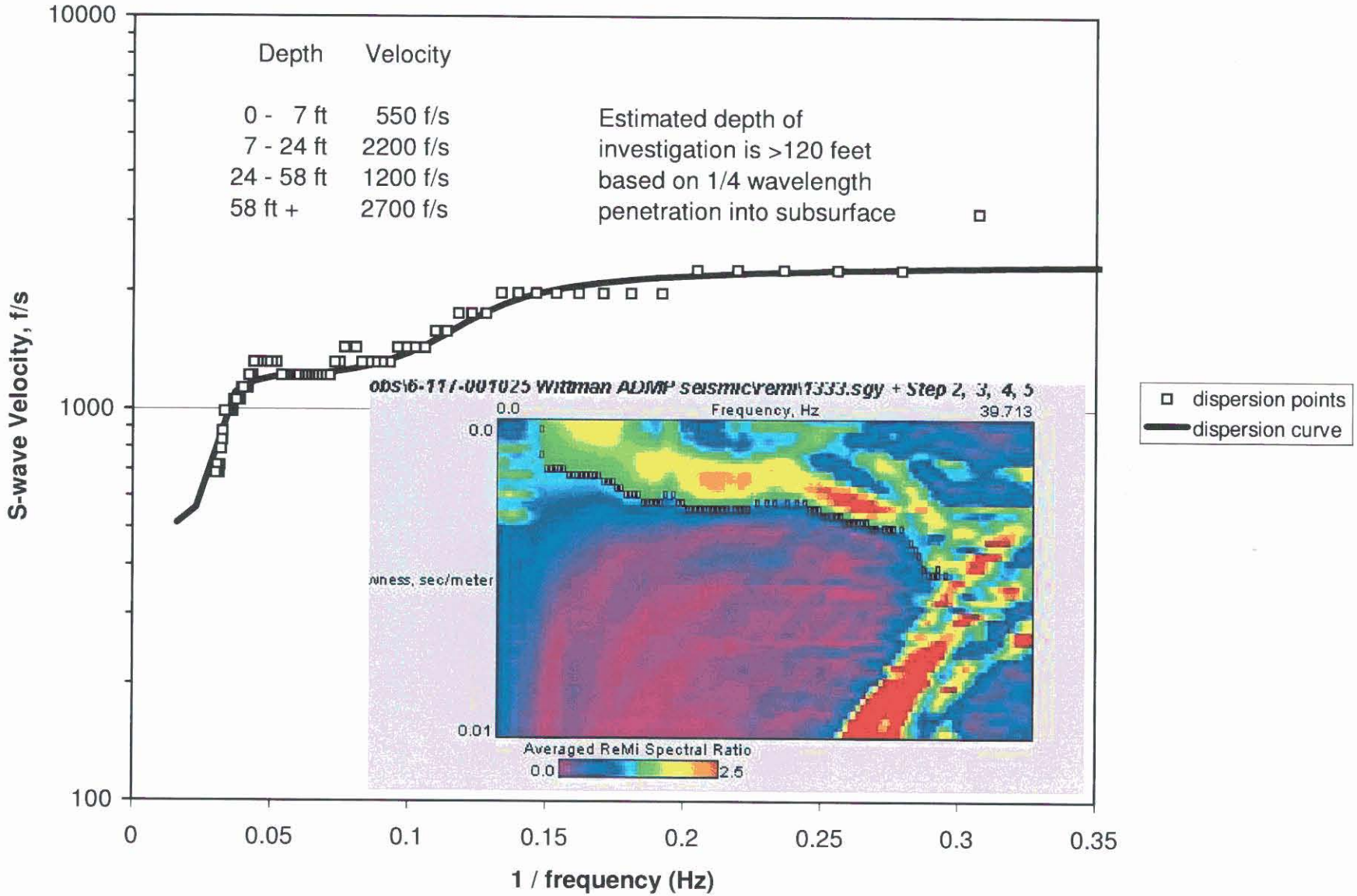
Refraction Microtremor S-wave Interpretation **Line 81** AMEC Job No. 6-117-001025



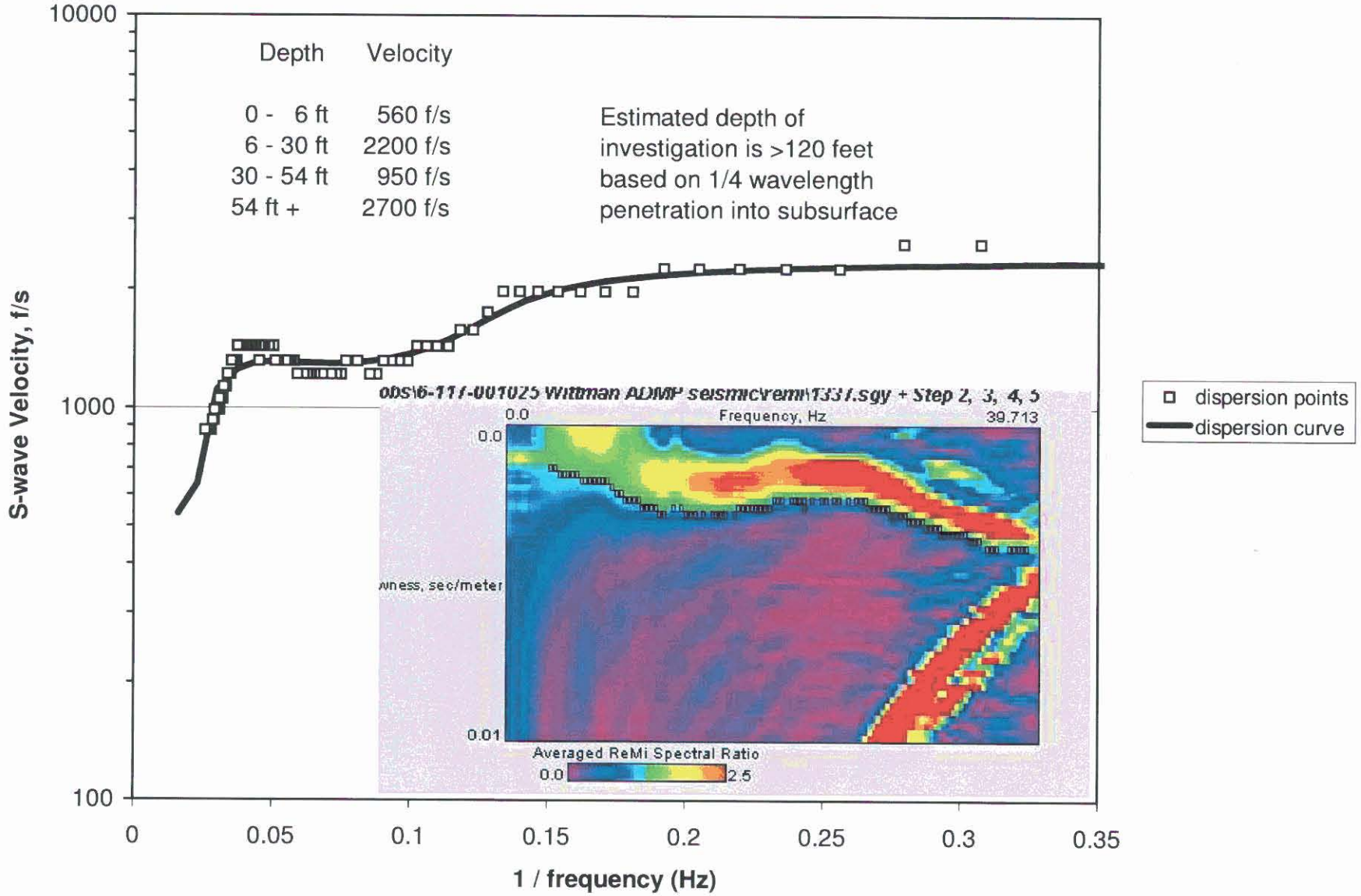

Depth Velocity
0 - 6 ft 470 f/s
6 - 15 ft 1300 f/s
15 - 28 ft 950 f/s
28 - 33 ft 2500 f/s
33 - 53 ft 950 f/s
53 ft + 2700 f/s
Estimated depth of investigation is >120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5


Depth Velocity
0 - 12 ft 770 f/s
12 - 25 ft 2100 f/s
25 - 43 ft 1000 f/s
43 ft + 2600 f/s
Estimated depth of investigation is ~120 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
Frequency, Hz
0.0
39.713
0.01
Averaged ReMi Spectral Ratio
2.5
S-wave Velocity, f/s
10000
1000
100
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
1 / frequency (Hz)

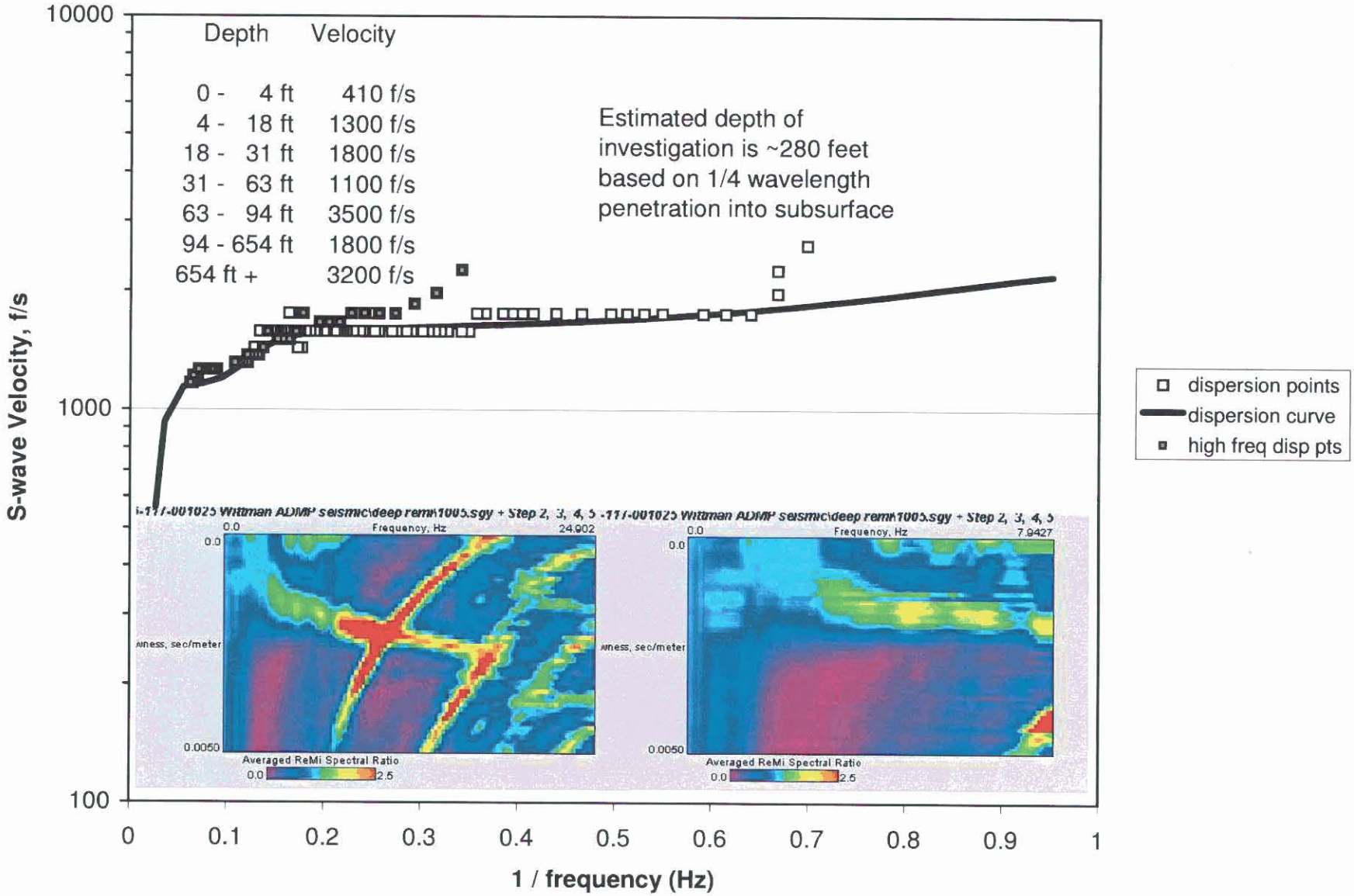
Refraction Microtremor S-wave Interpretation **Line 84** AMEC Job No. 6-117-001025



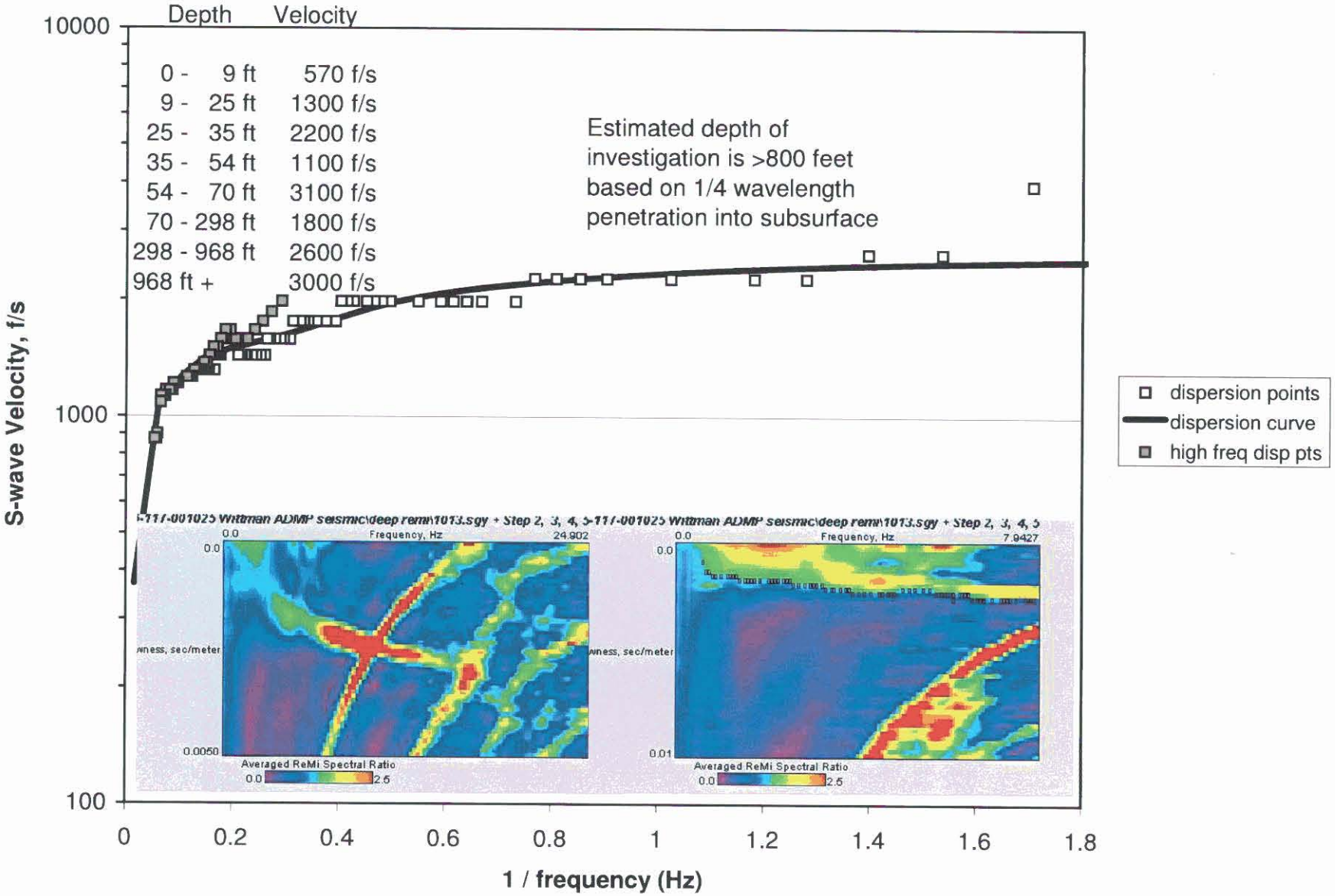
Refraction Microtremor S-wave Interpretation **Line 85** AMEC Job No. 6-117-001025



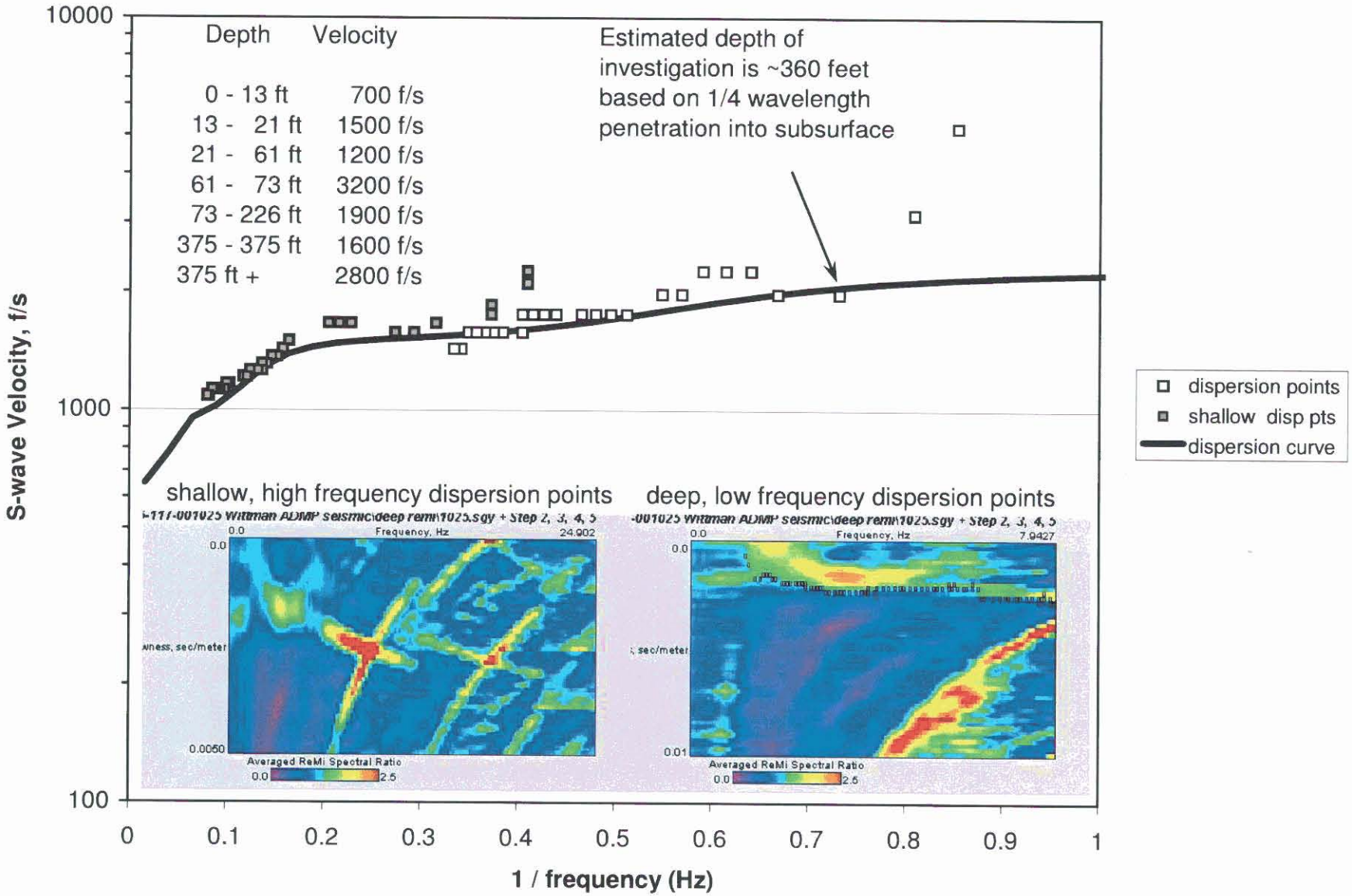
Refraction Microtremor S-wave Interpretation **Deep Remi DL-1** AMEC Job No. 6-117-001025



Refraction Microtremor S-wave Interpretation **Deep Remi DL-2** AMEC Job No. 6-117-001025



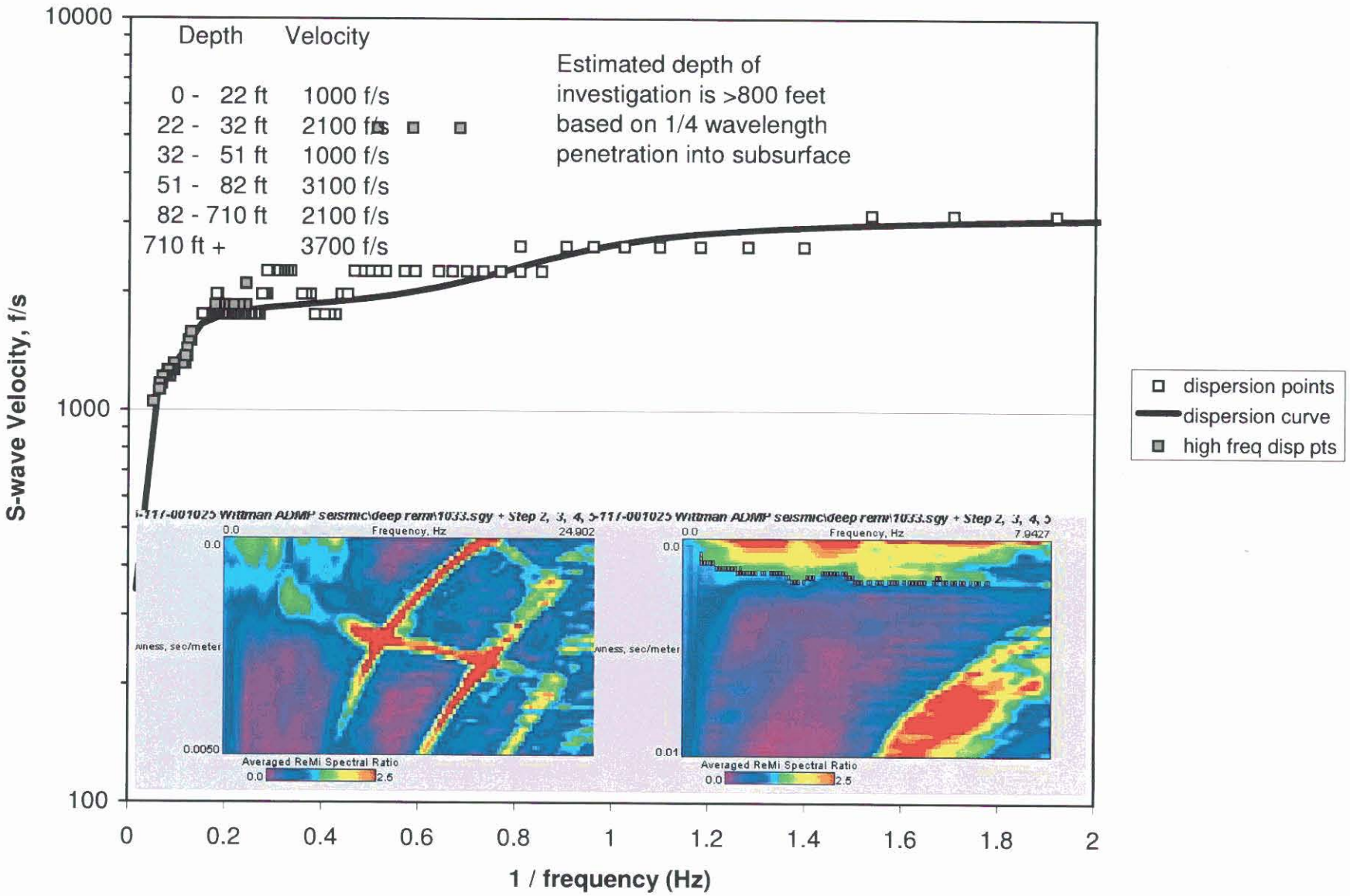
Refraction Microtremor S-wave Interpretation **Deep Remi DL-3** AMEC Job No. 6-117-001025



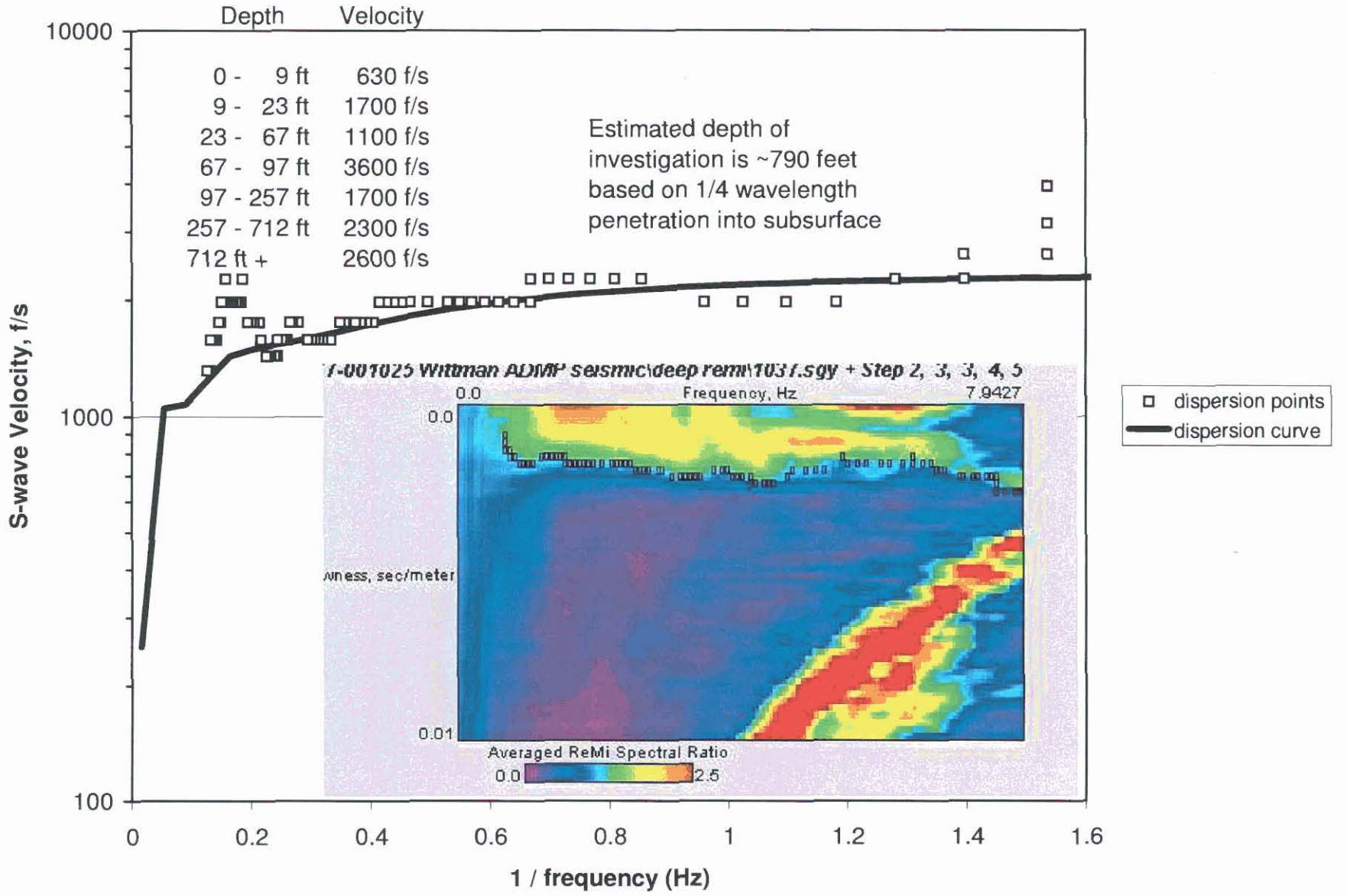
Refraction Microtremor S-wave Interpretation

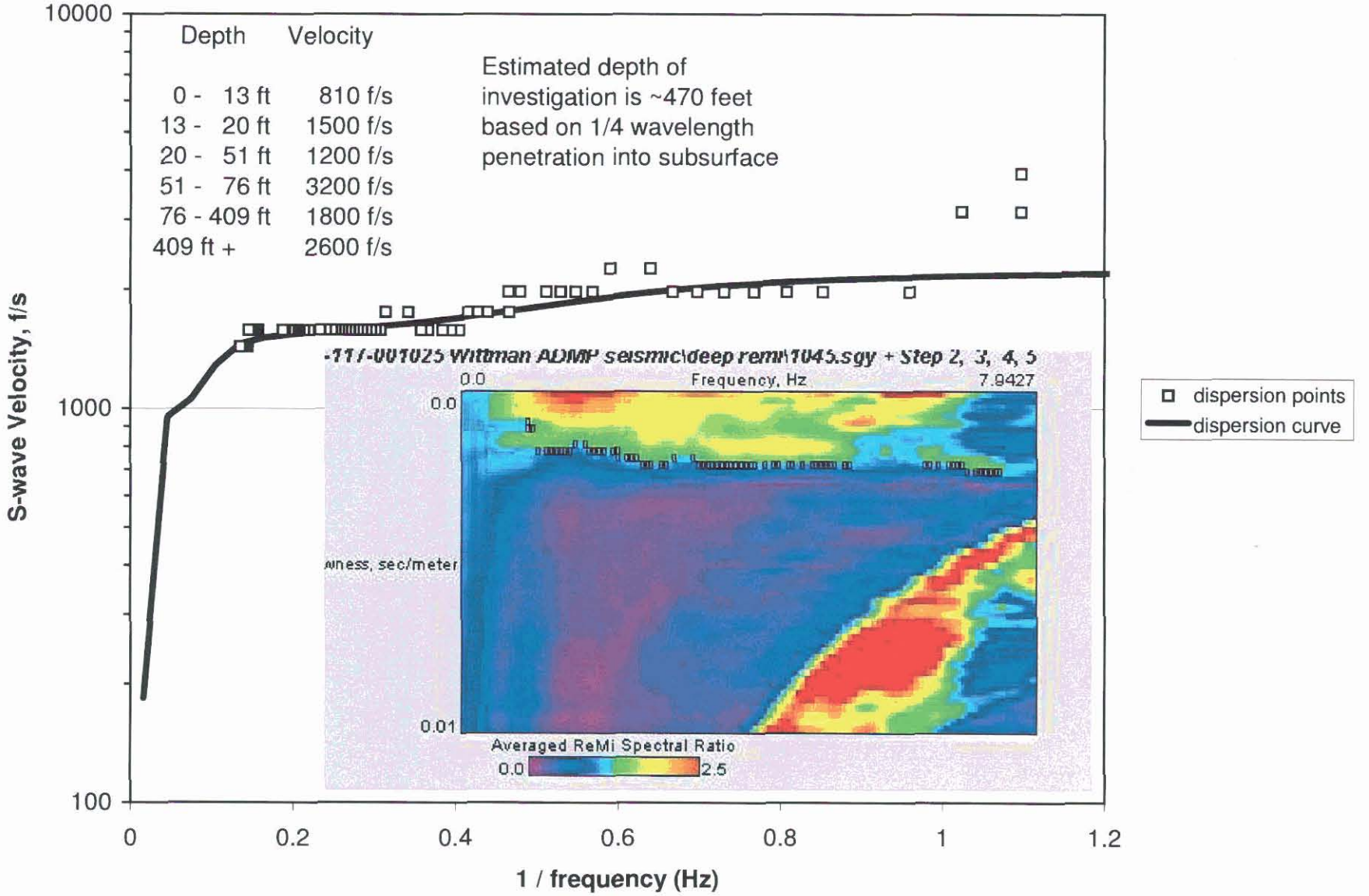
Deep Remi DL-4

AMEC Job No. 6-117-001025

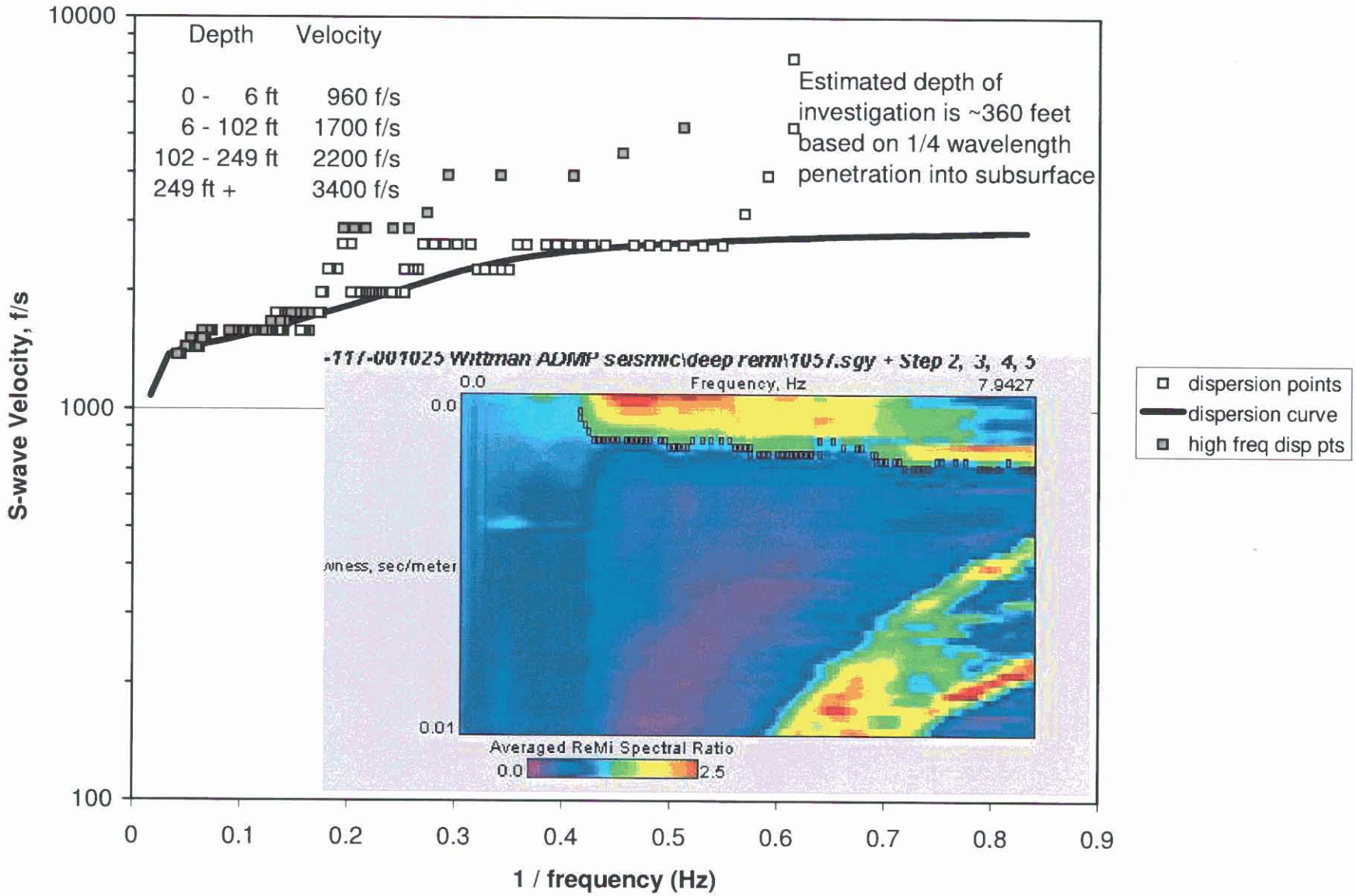


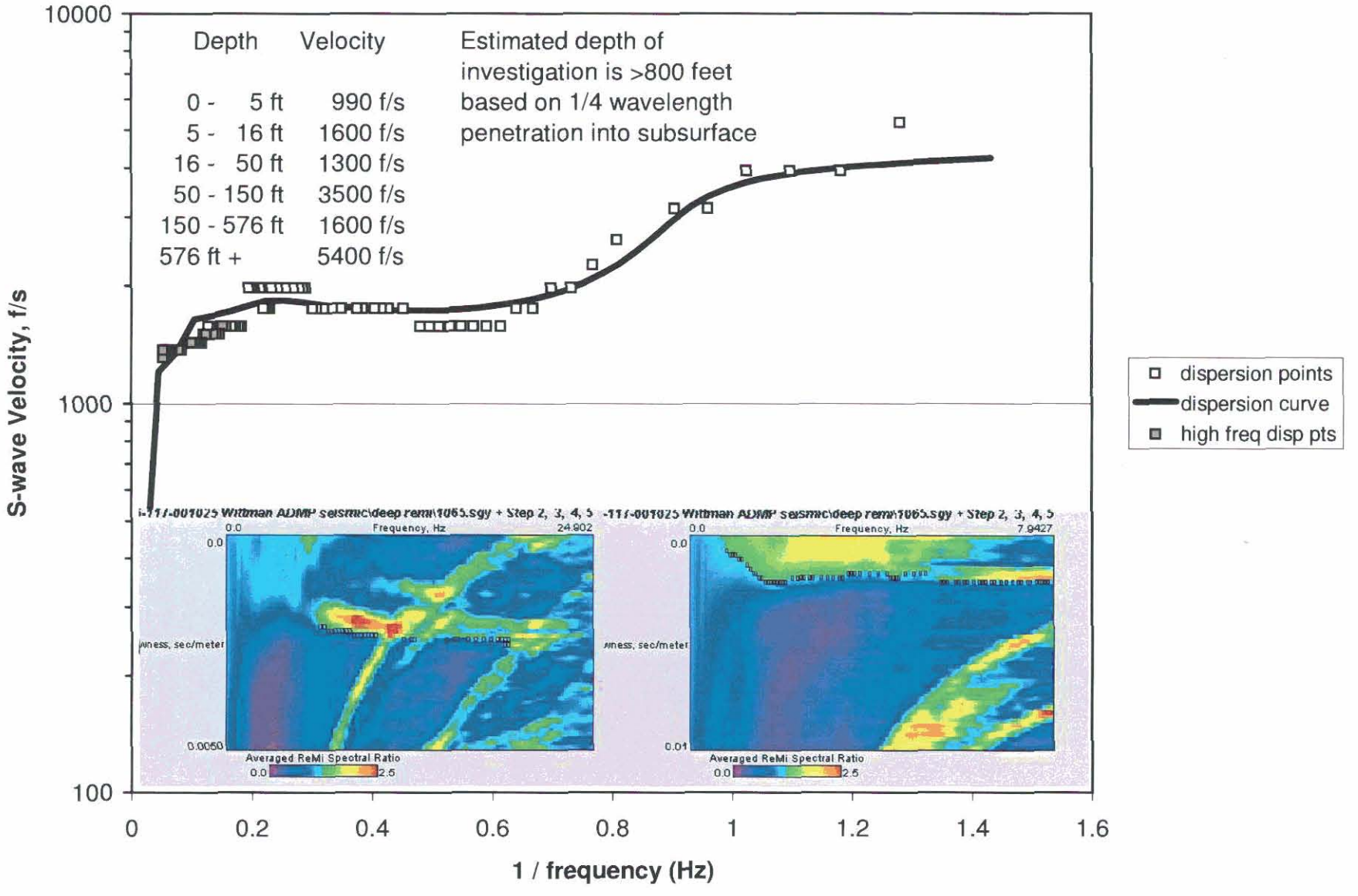
Refraction Microtremor S-wave Interpretation **Deep Remi DL-5** AMEC Job No. 6-117-001025



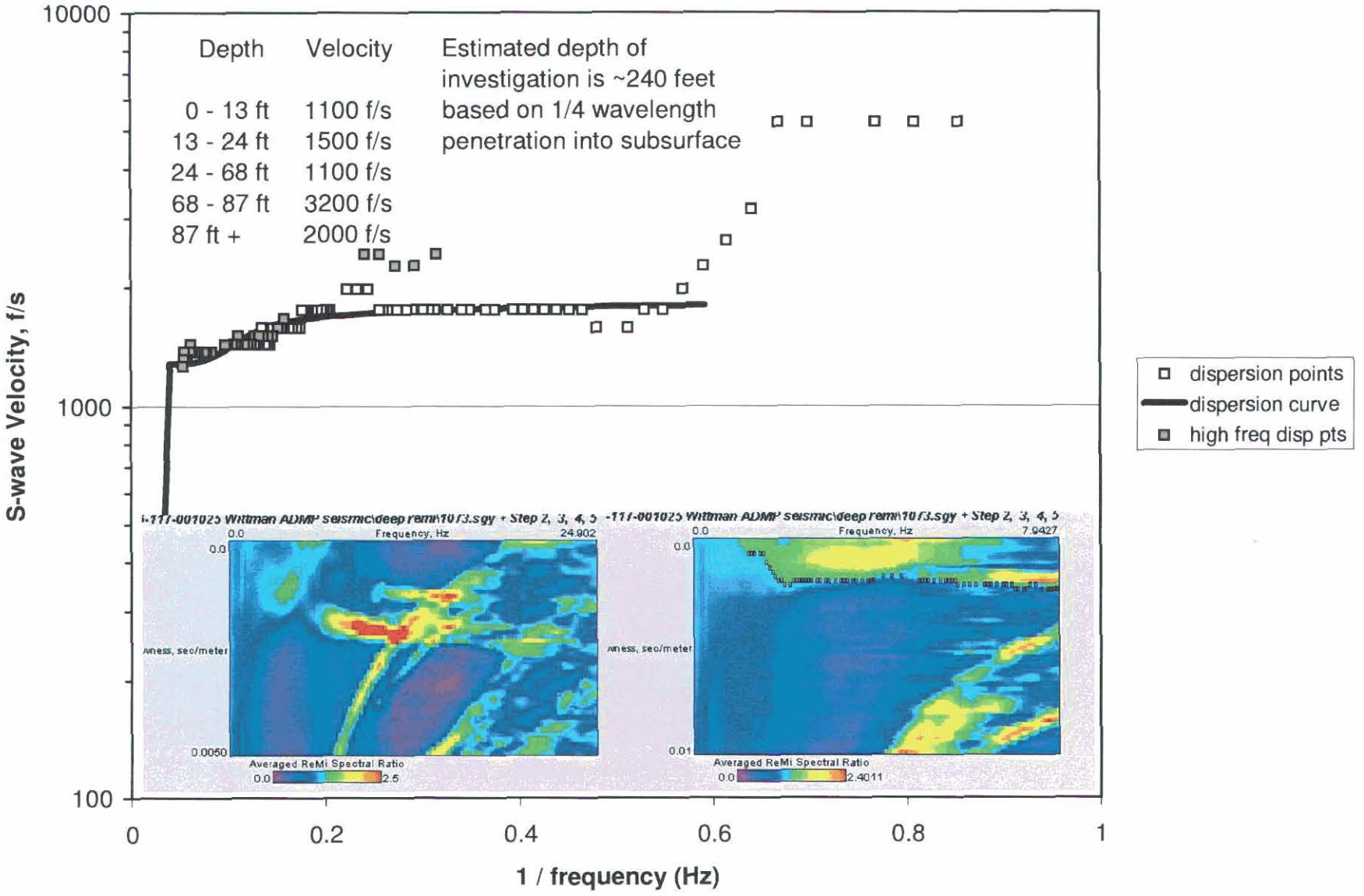

Depth Velocity
0 - 13 ft 810 f/s
13 - 20 ft 1500 f/s
20 - 51 ft 1200 f/s
51 - 76 ft 3200 f/s
76 - 409 ft 1800 f/s
409 ft + 2600 f/s
Estimated depth of investigation is ~470 feet based on 1/4 wavelength penetration into subsurface
-117-001025 Wittman ADMP seismic\deep remi\1045.sgy + Step 2, 3, 4, 5
Frequency, Hz
0.0
7.9427
0.01
Averaged ReMi Spectral Ratio
2.5
dispersion points
dispersion curve
S-wave Velocity, f/s
10000
1000
100
0
0.2
0.4
0.6
0.8
1
1.2
1 / frequency (Hz)

Refraction Microtremor S-wave Interpretation **Deep Remi DL-7** AMEC Job No. 6-117-001025

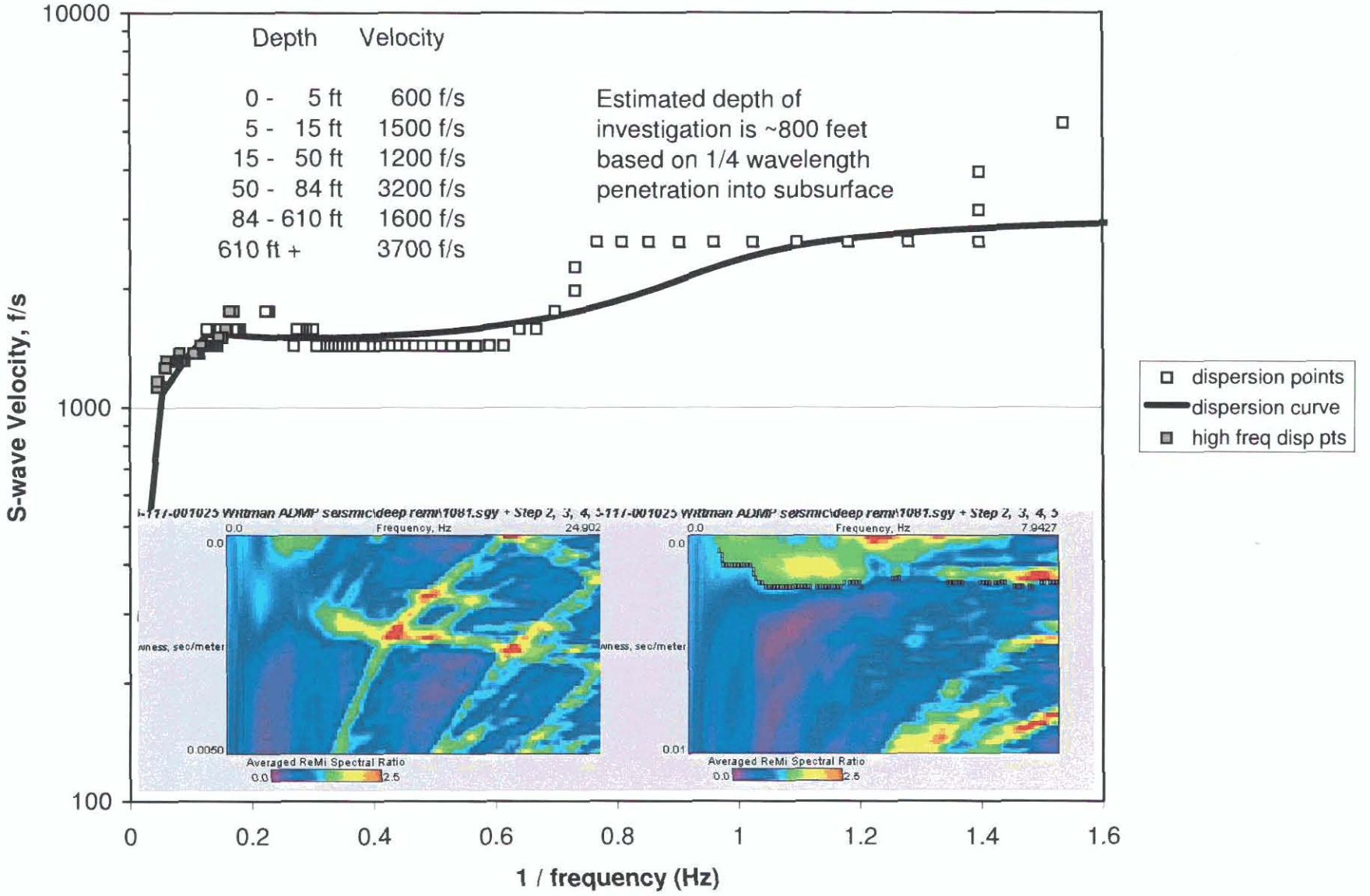



Depth Velocity
0 - 5 ft 990 f/s
5 - 16 ft 1600 f/s
16 - 50 ft 1300 f/s
50 - 150 ft 3500 f/s
150 - 576 ft 1600 f/s
576 ft + 5400 f/s
Estimated depth of investigation is >800 feet based on 1/4 wavelength penetration into subsurface
dispersion points
dispersion curve
high freq disp pts
S-wave Velocity, f/s
1 / frequency (Hz)
10000
1000
100
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Frequency, Hz
24.902
7.9427
Averaged ReMi Spectral Ratio
0.0
2.5

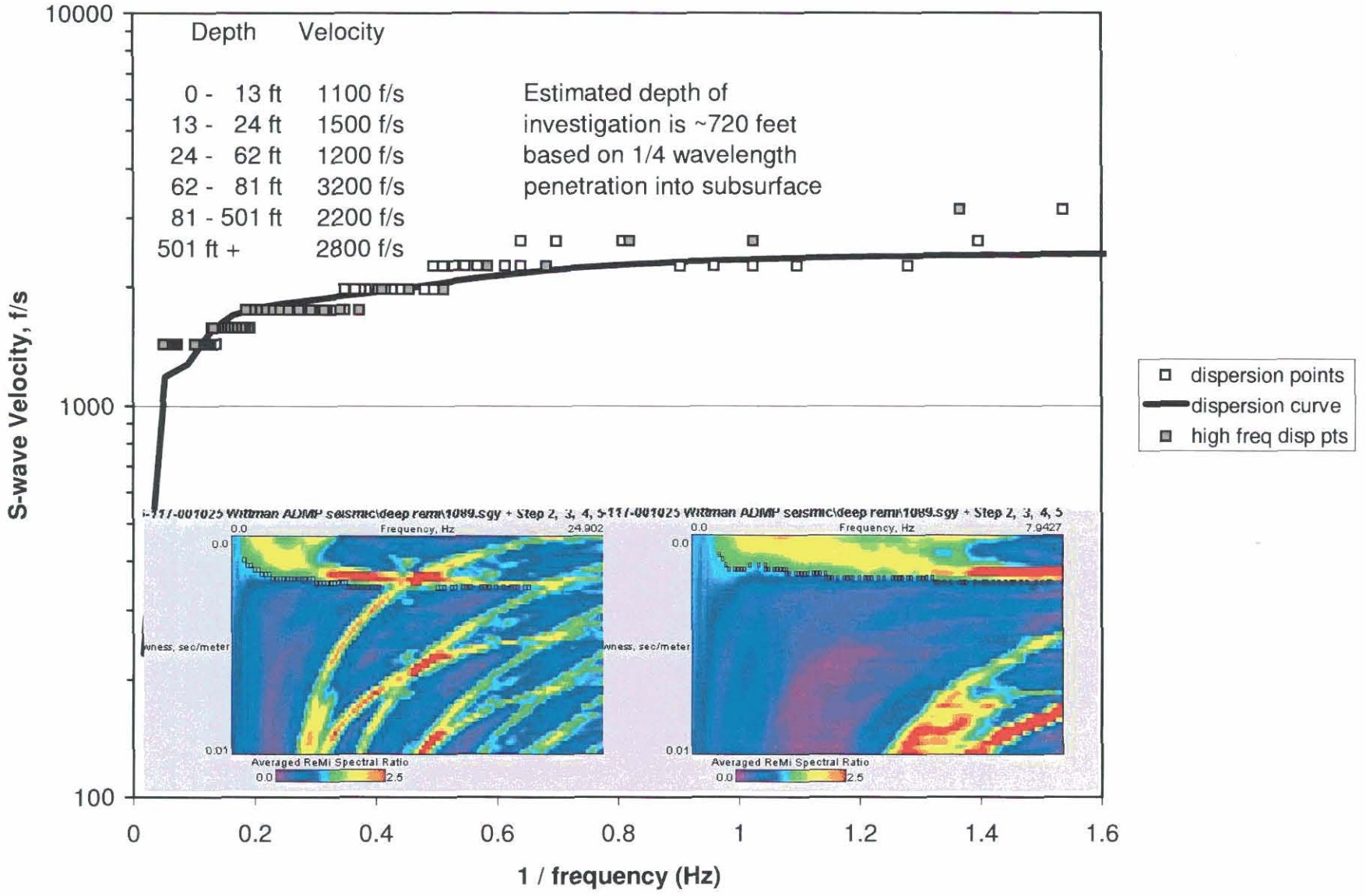
Refraction Microtremor S-wave Interpretation **Deep Remi DL-9** AMEC Job No. 6-117-001025

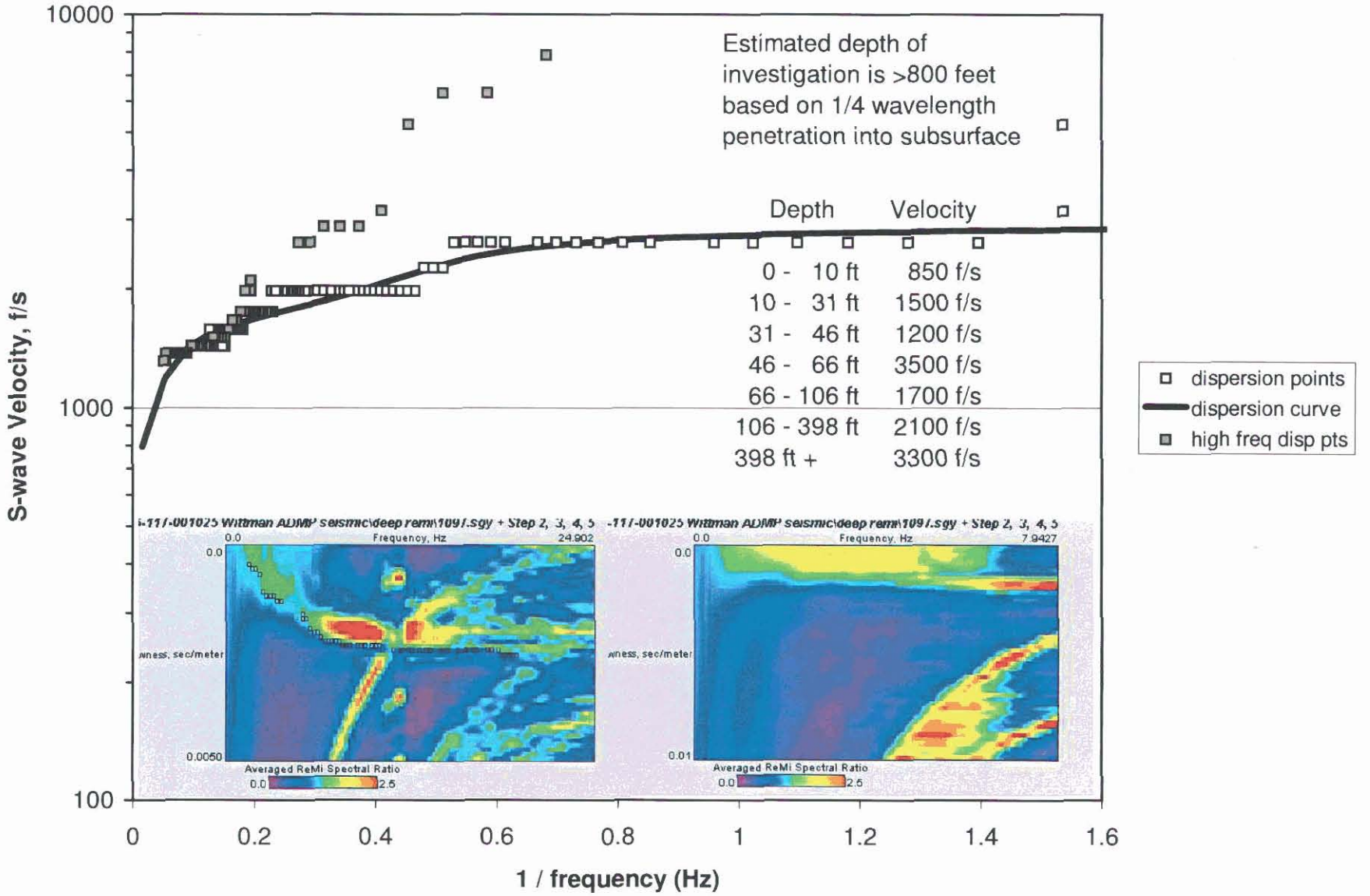


Refraction Microtremor S-wave Interpretation **Deep Remi DL-10** AMEC Job No. 6-117-001025

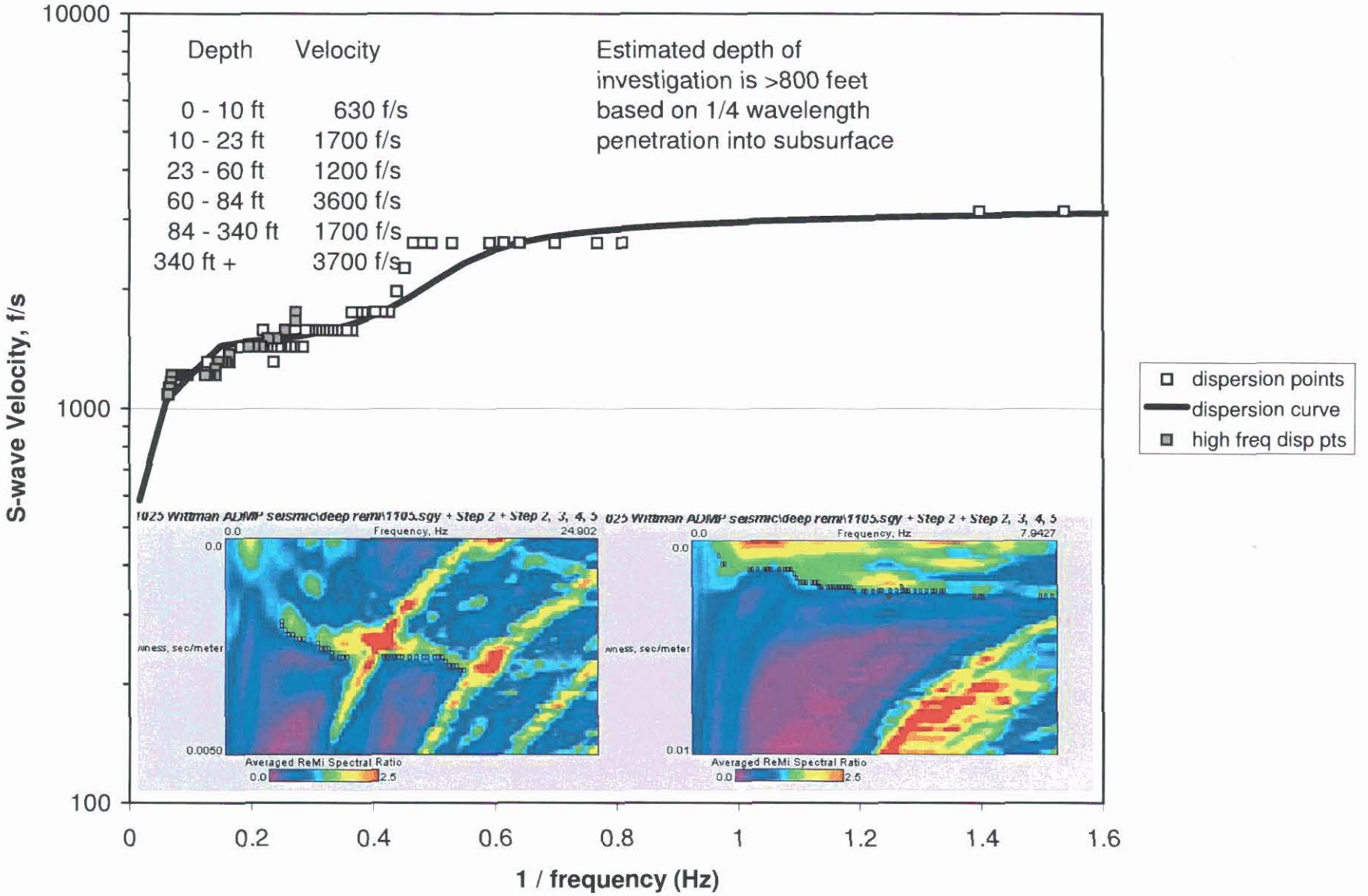


Refraction Microtremor S-wave Interpretation **Deep Remi DL-11** AMEC Job No. 6-117-001025

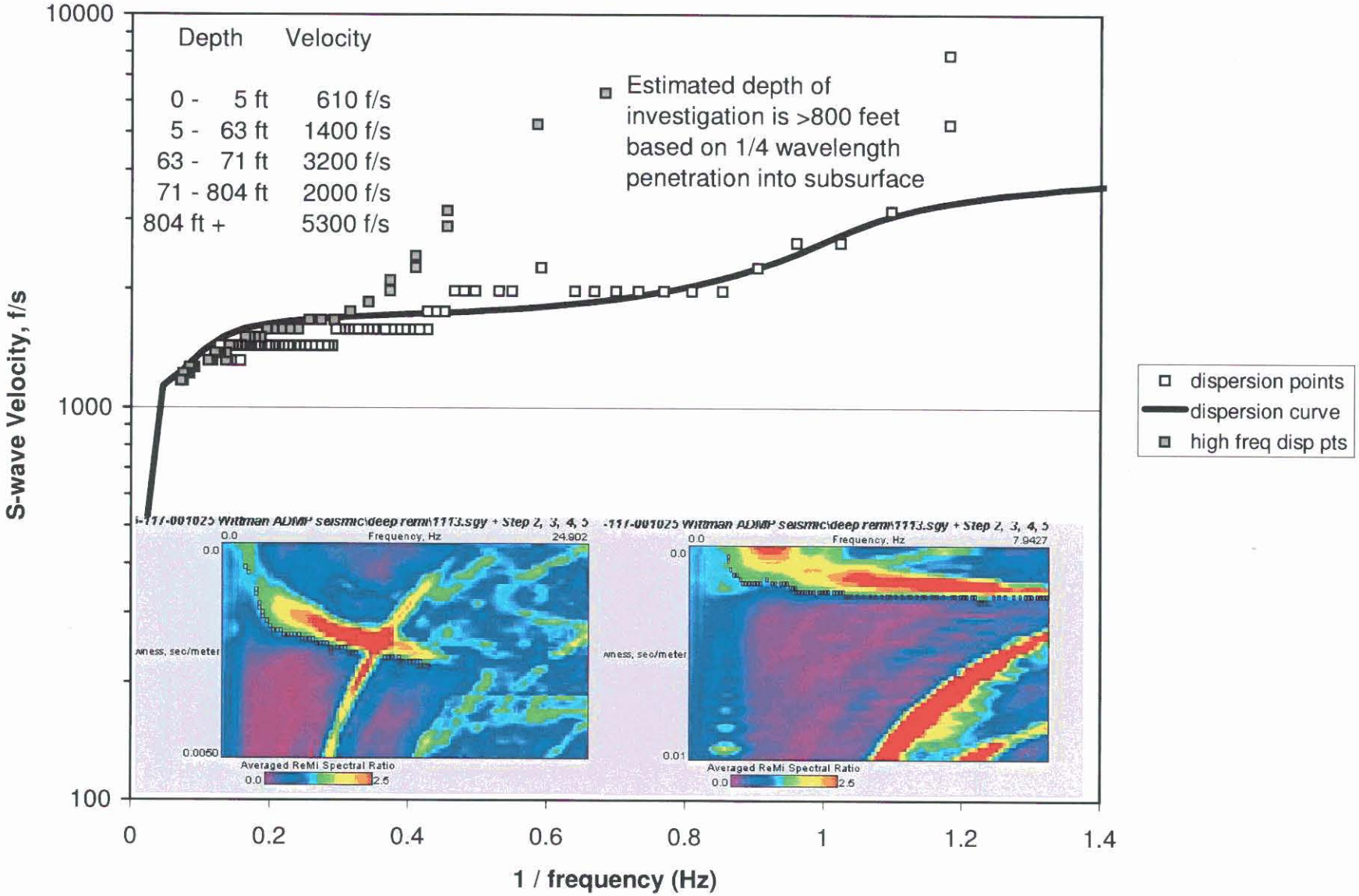



10000
1000
100
S-wave Velocity, f/s
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1 / frequency (Hz)
Estimated depth of investigation is >800 feet based on 1/4 wavelength penetration into subsurface
Depth Velocity
0 - 10 ft 850 f/s
10 - 31 ft 1500 f/s
31 - 46 ft 1200 f/s
46 - 66 ft 3500 f/s
66 - 106 ft 1700 f/s
106 - 398 ft 2100 f/s
398 ft + 3300 f/s
dispersion points
dispersion curve
high freq disp pts
Frequency, Hz
24.902
7.9427
Averaged ReMi Spectral Ratio
0.0
2.5

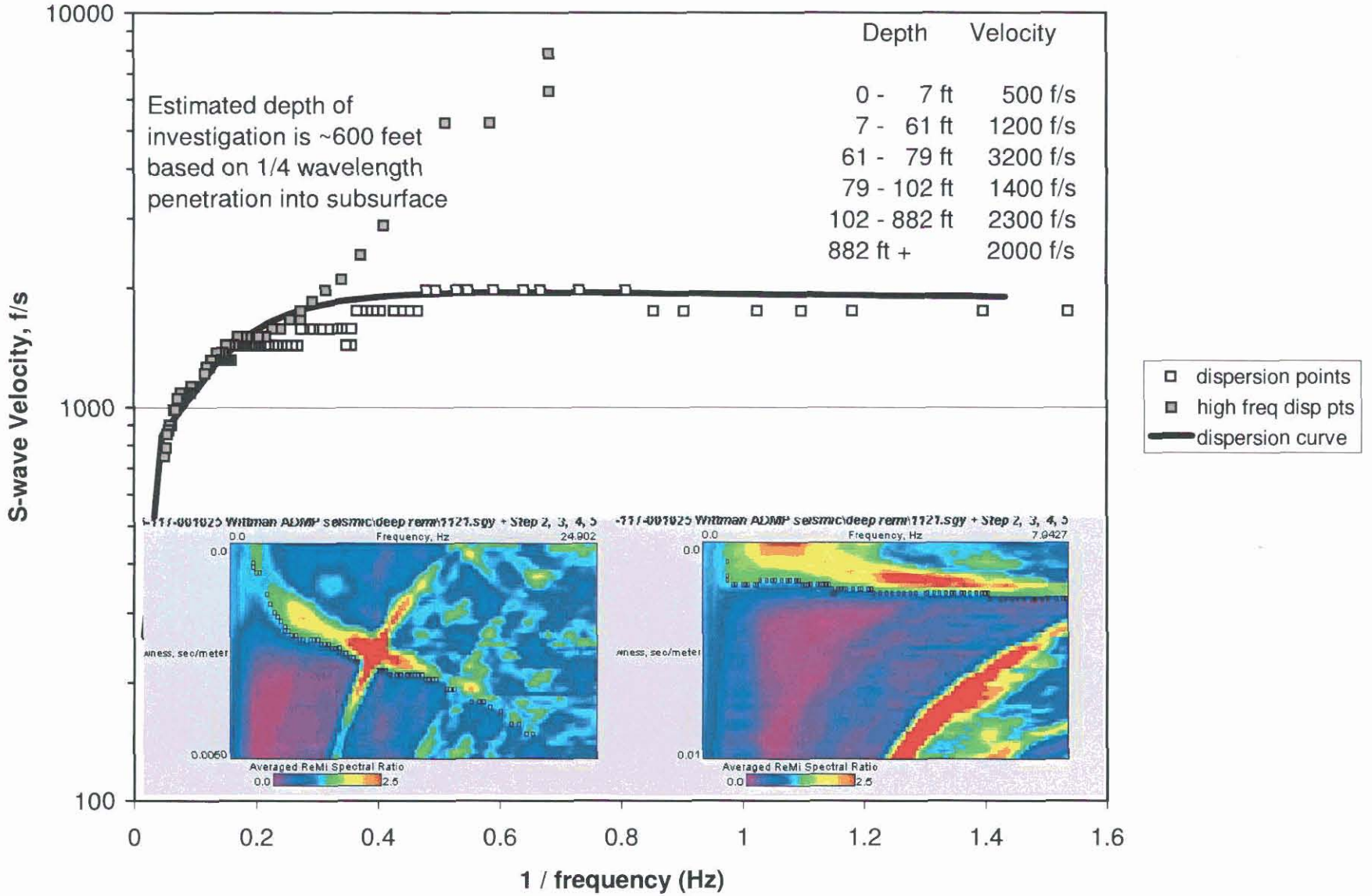
Refraction Microtremor S-wave Interpretation **Deep Remi DL-13** AMEC Job No. 6-117-001025



Refraction Microtremor S-wave Interpretation **Deep Remi DL-14** AMEC Job No. 6-117-001025



Refraction Microtremor S-wave Interpretation **Deep Remi DL-15** AMEC Job No. 6-117-001025



APPENDIX C – AMEC 2007 LABORATORY TEST RESULTS

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:		**WORK ORDER NO:**	1
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**
PERCENT PASSING BY WEIGHT																							
TH06-1T	SC	39	21	46	54	62	66	69	75	80	81	86	89	94	96	98	98	98	100	100	100	100	1
TH06-1C	CL	31	14	51	60	67	70	73	80	85	87	91	93	96	98	99	100	100	100	100	100	100	2
TH06-2	SM	22	3	33	46	57	60	62	66	70	71	81	85	92	95	98	99	100	100	100	100	100	3
TH06-3T	CL	30	12	54	66	75	78	80	84	86	87	91	93	96	97	99	100	100	100	100	100	100	4
TH06-3C	SM	22	2	37	53	63	66	69	74	79	80	87	89	93	95	98	99	100	100	100	100	100	5
TH06-4T	SC	36	16	38	48	55	58	60	65	68	69	75	78	84	88	92	94	95	97	100	100	100	6
TH06-4C	SC	73	47	34	45	55	59	63	69	74	76	83	87	94	96	98	100	100	100	100	100	100	7
TH06-5	SC-SM	21	5	34	48	63	70	76	85	90	92	97	98	99	99	100	100	100	100	100	100	100	8

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/2006

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP06-03 @ 1.0-2.0'	SM	NV	NP	35	48	62	69	76	88	93	94	97	97	98	98	99	99	99	99	100	100	100	9
TP06-03 @ 3.0-4.0'	CL	37	19	71	80	85	88	90	94	96	96	98	98	99	99	100	100	100	100	100	100	100	10
TP06-29 @ 2.0-3.0'	SP-SM	46	13	9.1	13	17	19	22	30	40	44	64	67	75	81	87	91	94	99	100	100	100	11
TP06-29 @ 6.0-7.0'	SM	65	32	18	25	29	32	35	44	53	57	85	89	93	94	96	96	96	97	100	100	100	12
TP06-28 @ 0.0-1.0'	SC	25	9	50	65	77	82	86	92	95	96	98	99	100	100	100	100	100	100	100	100	100	13
TP06-28 @ 4.0-5.0'	GC	37	13	27	31	34	36	38	43	50	52	60	63	67	71	76	86	91	92	100	100	100	14
TP06-28 @ 7.0-8.0'	SM	45	18	47	56	61	64	69	80	88	90	97	98	98	99	100	100	100	100	100	100	100	15
TP06-27 @ 2.0-3.0'	CL	36	16	51	64	74	78	81	87	90	91	95	96	98	99	100	100	100	100	100	100	100	16
TP06-27 @ 7.0-7.5'	SC	35	11	18	25	33	38	43	54	67	72	89	92	96	97	99	100	100	100	100	100	100	17
TP06-26 @ 2.0-3.0'	CL	36	20	51	65	77	81	84	87	88	89	90	92	93	95	96	96	98	100	100	100	100	18

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP06-26 @ 10.0-11.0'	SC	35	13	29	42	52	55	58	62	67	69	78	82	89	93	97	99	100	100	100	100	100	20
TP06-25 @ 1.0-2.0'	SM	NV	NP	41	62	79	84	88	92	95	95	99	100	100	100	100	100	100	100	100	100	100	21
TP06-24 @ 1.0-2.0'	SP-SM	25	2	8.4	12	18	24	32	43	52	55	70	76	86	91	97	99	99	100	100	100	100	23
TP06-24 @ 6.0-7.0'	SM	37	12	29	42	51	55	58	65	72	74	90	92	95	97	99	99	100	100	100	100	100	24
TP06-24 @ 9.0-10.0'	SC	37	15	28	39	47	51	55	63	70	72	81	87	95	98	100	100	100	100	100	100	100	25
TP06-23 @ 0.0-1.0'	SM	NV	NP	31	43	56	61	66	72	77	78	83	86	90	92	96	99	100	100	100	100	100	26
TP06-23 @ 5.0-6.0'	CL	30	15	56	70	82	85	88	92	94	95	98	98	99	100	100	100	100	100	100	100	100	27

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**

PERCENT PASSING BY WEIGHT

TP06-22 @ 2.0-3.0'	CL	42	21	60	74	81	84	87	90	92	93	96	98	99	99	100	100	100	100	100	100	100	100	29
TP06-21 @ 2.0-3.0'	SC	36	15	15	21	27	30	34	43	51	55	71	77	85	90	94	97	98	100	100	100	100	100	32
TP06-21 @ 6.0-7.7'	SP-SC	29	7	12	18	29	36	41	49	55	58	72	79	89	93	97	99	99	100	100	100	100	100	33
TP06-21 @ 9.0-10.0'	SP-SC	33	12	12	19	30	35	40	48	55	58	70	76	86	92	96	98	100	100	100	100	100	100	34
TP06-20 @ 0.0-1.0'	SM	NV	NP	12	17	22	25	27	32	40	43	59	64	75	84	92	97	100	100	100	100	100	100	35
TP06-20 @ 4.0-5.0'	SP-SM	NV	NP	6.6	10	15	18	20	25	33	36	55	59	70	77	83	90	92	95	97	100	100	100	36
TP06-19 @ 0.0-1.0'	SC	32	14	38	49	56	58	60	64	68	69	77	83	92	96	98	100	100	100	100	100	100	100	37
TP06-19 @ 2.0-3.0	GC	32	14	15	22	28	32	35	41	46	48	57	62	72	78	86	92	95	95	100	100	100	100	38

AASHTO R18

REVIEWED BY CMK

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**

PERCENT PASSING BY WEIGHT

TP06-19 @ 4.0-5.0'	GP-GM	37	12	7.3	10	13	15	16	21	26	28	39	44	55	62	77	84	96	96	100	100	100	39
TP06-18 @ 1.0-2.0'	CL	25	8	56	69	81	85	88	93	96	97	99	99	99	99	99	100	100	100	100	100	100	40
TP06-18 @ 6.0-7.0'	CL	38	14	65	75	80	81	82	84	85	85	89	93	97	98	99	100	100	100	100	100	100	41
TP06-17 @ 2.0-3.0'	CL	38	19	61	75	84	87	90	94	96	97	99	100	100	100	100	100	100	100	100	100	100	43
TP06-17 @ 4.0-5.0'	SC	33	12	48	63	71	73	75	78	81	82	87	89	93	95	97	98	100	100	100	100	100	44
TP06-16 @ 6.0-7.0'	CL	36	15	53	64	71	73	76	79	83	84	88	90	94	97	99	100	100	100	100	100	100	47
TP06-15 @ 0.0-1.0'	SP-SM	NV	NP	7.7	13	23	28	33	41	47	50	65	73	83	90	95	97	98	100	100	100	100	49
TP06-15 @ 5.0-6.0'	CL-ML	23	7	57	73	85	88	90	92	93	93	95	96	98	98	99	100	100	100	100	100	100	50
TP06-15 @ 8.0-10.0'	SC	30	12	36	50	62	66	68	73	76	77	83	87	92	94	96	98	98	100	100	100	100	51

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	**USCS**	**LL**	**PI**	**#200**	**#100**	**#50**	**#40**	**#30**	**#16**	**#10**	**#8**	**#4**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1 1/4"**	**1 1/2"**	**2"**	**3"**	**6"**	**Lab #**
													PERCENT PASSING BY WEIGHT										
TP06-14 @ 0.0-1.0'	CL-ML	21	5	50	69	81	84	87	91	95	95	98	99	99	100	100	100	100	100	100	100	100	52
TP06-14 @ 4.0-5.0'	SM	20	2	40	52	62	65	70	77	82	84	90	92	95	96	97	99	100	100	100	100	100	53
TP06-14 @ 12.0-13.0'	SP-SC	25	5	11	16	22	25	28	33	41	43	61	69	81	89	97	99	100	100	100	100	100	54
TP06-13 @ 2.0-3.0'	SC-SM	24	6	32	43	53	57	60	65	69	71	79	82	87	90	92	95	97	97	100	100	100	55
TP06-13 @ 7.0-8.0'	SC	39	20	41	71	63	67	70	76	80	81	88	91	95	97	99	100	100	100	100	100	100	56
TP06-12 @ 1.0-2.0'	SC	33	14	39	48	55	57	60	65	69	71	79	83	89	92	96	98	100	100	100	100	100	58
TP06-12 @ 5.0-6.0'	SC	36	17	44	61	74	76	79	82	86	87	93	95	97	98	100	100	100	100	100	100	100	59
TP06-11 @ 2.0-3.0'	CL	39	16	65	80	86	88	89	92	93	94	95	97	99	99	100	100	100	100	100	100	100	61
TP06-11 @ 6.0-7.0'	SP-SC	49	29	8.6	10	12	13	16	26	38	41	56	63	75	82	92	95	100	100	100	100	100	62

AASHTO R18

REVIEWED BY CY

PROJECT:	Wiltmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP06-11 @ 10.0-11.0'	SC	30	10	20	29	38	44	51	62	72	74	86	89	93	95	98	100	100	100	100	100	100	63
TP06-10 @ 0.0-1.0'	SC	29	10	22	29	36	40	43	50	57	60	73	78	87	91	95	97	99	100	100	100	100	64
TP06-10 @ 7.0-8.0'	CL	30	14	64	76	83	85	86	89	91	92	95	97	98	99	100	100	100	100	100	100	100	65
TP06-09 @ 2.0-3.0'	GP-GC	39	22	7.6	10	13	15	18	26	33	36	50	57	69	77	87	92	97	98	100	100	100	67
TP06-09 @ 8.0-9.0'	SC	34	13	20	26	34	41	49	64	72	75	87	90	96	98	100	100	100	100	100	100	100	68
TP06-09 @ 11.0-12.0'	SP-SM	NV	NP	12	17	28	38	49	66	74	76	83	85	90	93	96	98	100	100	100	100	100	69
TP06-08 @ 2.0-3.0'	SM	22	3	47	69	85	89	91	96	95	96	98	98	99	99	99	100	100	100	100	100	100	70
TP06-08 @ 7.0-8.0'	SC	46	24	42	54	65	69	73	79	82	84	90	93	96	98	99	100	100	100	100	100	100	71
TP06-07 @ 0.0-1.0'	SP-SC	31	13	8.2	12	19	22	26	32	40	42	56	62	73	82	93	97	98	98	100	100	100	73
TP06-07 @ 4.0-6.0'	SC	45	25	35	41	51	58	64	73	77	78	82	85	90	93	97	99	100	100	100	100	100	74

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP06-07 @ 11.0-12.0'	SP-SC	26	8	8.1	11	20	27	38	60	72	75	84	86	91	93	96	98	100	100	100	100	100	75
TP06-05 @ 0.0-1.0'	SM	21	3	27	42	55	59	61	67	72	74	83	86	91	94	96	98	98	99	99	100	100	76
TP06-05 @ 8.0-9.0'	GP	NV	NP	4.9	7	9	11	12	19	27	32	52	60	73	80	87	91	93	94	94	100	100	77
TP06-04 @ 3.0-4.0'	SC	28	10	22	30	40	43	47	53	60	62	72	77	85	90	97	100	100	100	100	100	100	79
TP06-04 @ 5.0-6.0'	SP	26	6	4.9	8	15	20	25	33	41	44	59	65	76	84	91	96	99	100	100	100	100	80
TP06-03 @ 0.0-1.0'	SC	35	16	43	55	66	71	76	82	87	88	93	95	98	99	100	100	100	100	100	100	100	82
TP06-03 @ 3.0-4.0'	SM	33	9	21	29	38	42	46	53	62	65	80	86	95	99	100	100	100	100	100	100	100	83
TP06-03 @ 12.0-13.0'	SM	NV	NP	15	23	49	67	77	87	90	90	94	95	98	99	100	100	100	100	100	100	100	84
TP06-02 @ 0.0-2.0'	SC	30	13	40	50	61	67	72	81	87	89	93	95	98	99	100	100	100	100	100	100	100	85
TP06-02 @ 6.0-8.0'	SC	36	13	29	38	51	56	60	68	73	75	83	86	91	95	98	100	100	100	100	100	100	86

AASHTO R18

REVIEWED BY

PROJECT:	Wittmann ADMP McMicken Dam	**JOB NO:**	6-117-001025 PH 1
LOCATION:	Arizona	**WORK ORDER NO:**	2
SAMPLE SOURCE:	SEE BELOW	**DATE ASSIGNED:**	11/28/06

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

				Silt or	SAND								GRAVEL									COBBLES	
				Clay	Fine			Medium			Coarse		Fine				Coarse						
Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	6"	Lab #

PERCENT PASSING BY WEIGHT

TP06-02 @ 10.0-12.0'	SP-SM	NV	NP	8.8	15	30	40	50	62	69	72	81	85	91	94	98	99	100	100	100	100	100	87
TP06-01 @ 2.0-3.0'	SC	27	10	48	73	88	92	94	97	97	98	98	99	100	100	100	100	100	100	100	100	100	88
TP06-01 @ 7.0-8.0'	SC	36	14	30	42	51	55	59	66	72	75	87	90	95	97	99	100	100	100	100	100	100	89
TP06-01 @ 12.0-13.0'	SP-SM	NV	NP	11	19	35	46	57	71	77	79	87	89	93	95	97	99	100	100	100	100	100	90

AASHTO R18

REVIEWED BY

APPENDIX D – AGRA GEOSYNTHETIC LABORATORY TEST RESULTS

AGRA
Earth & Environmental

AGRA Earth &
Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
Tel (602) 272-6848
Fax (602) 272-7239

6 January 1998
AEE Job No. 7-119-000155
Report No. 2

JAN 0 8 1998

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

1 WFR

Attention: Mr. Warren Rosebraugh

Gentlemen:

RE: McMICKEN DAM (FCD 96-13 ASSIGNMENT #6)
BELL ROAD & COTTON LANE
SURPRISE, ARIZONA

Transmitted herewith are results of testing performed on six geotextile samples submitted to Precision Geosynthetic Laboratories.

Should any questions arise concerning this report, please do not hesitate to call.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Alf Wold

Alf Wold, E.I.T.
Field Supervisor

skn/155-r2

Precision Geosynthetic Laboratories

December 12, 1997

Mr. Alf Wold
AGRA EARTH & ENVIRONMENTAL
3232 West Virginia Ave.
Phoenix, Arizona 85009

Dear Mr. Wold: **RE:** MCMICKEN DAM / 7-119-000155

Thank you for consulting Precision Geosynthetic Laboratories for your material testing needs.

Enclosed is the laboratory report for the testing of six (6) geotextile samples received December 9, 1997.

It should be noted that the test specimen and test sample used for this report were believed to be representative of the material produced under the designation herein stated. However, these results are indicative of only the specimen that were actually tested. The testing herein is based upon accepted industry practice as well as the test method listed. Precision Geosynthetic Laboratories neither accepts responsibility for nor makes claims to the final use and purpose of the material.

By accepting the data and results represented on this report, Client agrees to limit the liability of Precision Geosynthetic Laboratories from Client and all other parties for claims arising out of the use of this data to the cost for the respective test(s) represented in this report, and Client agrees to indemnify and hold harmless Precision Geosynthetic Laboratories from and against all liability in excess of the aforementioned limit.

It is specifically requested that this document is considered proprietary information and should not be disclosed outside your organization in whole or in part without express consent of the author or the reviewer.

If you have any questions or if we may be of further service, please do not hesitate to call at 800-522-4599.

Sincerely,

PRECISION GEOSYNTHETIC LABORATORIES

Cora B. Cueja
Quality Assurance

R. Belanger
Ronald E. Belanger
Technical Director

Enclosure: (Job No. 971305)

1742 West Katella, Suite #4, Orange, CA 92867 • (714) 744-4599 FAX (714) 744-0357

Precision Geosynthetic Laboratories

December 12, 1997

VERIFICATION OF MATERIAL PROPERTIES
Geotextile
MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL
(Reference: PGL Job No. 971305)

MATERIAL DESCRIPTION: geotextile

No. of MATERIALS: (6)

ORIGIN OF MATERIAL: AGRA EARTH & ENVIRONMENTAL / Phoenix, Arizona

DATE RECEIVED: December 9, 1997

SHIPPER: UPS.

SAMPLE IDENTIFICATIONS:

SAMPLE ID	PRECISION CONTROL NUMBER
Imperm @ Sta. 281+00	C #25973
Perm @ Sta. 281+00	C #25974
Perm @ Sta. 462+00	C #25975
Imperm @ Sta. 462+00	C #25976
Perm @ Sta. 60+50	C #25977
Imperm @ Sta. 60+50	C #25978

TESTS REQUIRED:

DESCRIPTION	TEST METHOD	FCD Spec (1983)
Grab Tensile and Elongation	ASTM D4632	ASTM D 1682
Puncture Resistance	ASTM D4833	ASTM D 751
Trapezoid Tear Resistance	ASTM D4533	ASTM D 751

TEST CONDITIONS: The samples were conditioned for a minimum one hour in the laboratory at 23 ± 2°C (73.1 ± 3.6°F) and at 60 ± 10% relative humidity prior to test.

TEST RESULTS:

The test results is summarized in Tables 1 through 6. The units in which the data are reported are included on the tables.

PRECISION GEOSYNTHETIC LABORATORIES

Cora B. Queja
Quality Assurance

Ronald E. Belanger
Technical Director

1742 West Katella, Suite #4, Orange, CA 92867 • (714) 744-4599 FAX (714) 744-0357

TABLE 1.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97
Client Sample ID : Imperm @ Sta. 281+00

Date Reported : 12/12/97
PGL Job No. : 971305
PGL Control No. : 25973

METHOD	DESCRIPTION	SPECIMENS 1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Proj. Specs.
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	232	242	237	251	246						242	7	130
	TD	239	258	250	265	269						256	12	90
	Elongation at Peak (percent)													
	MD	18	16	15	14	14						15	2	
	TD	16	17	17	19	17						17	1	
ASTM D4833	Puncture Resistance* (lbs)													
		137	143	148	140	141	152	145	144	141	157	145	6	140
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	44	26	36	31	48						37	9	40
	TD	88	84	126	89	118						101	19	40

MD - MACHINE DIRECTION
TD - TRANSVERSE DIRECTION
** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPL*

Precision Geosynthetic Laboratories

TABLE 2.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97

Client Sample ID : Perm @ Sta. 281+00

Date Reported : 12/12/97

PGL Job No. : 971305

PGL Control No. : 25974

METHOD	DESCRIPTION	SPECIMENS 1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Proj. Specs.
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	222	222	217	215	199						215	9	120
	TD	197	197	193	197	205						198	4	90
	Elongation at Peak (percent)													
	MD	80	73	78	74	87						78	6	
	TD	21	20	16	19	17						18	2	
ASTM D4833	Puncture Resistance* (lbs)													
		120	130	115	121	134	124	116	116	130	122	123	7	180
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	193	200	200	175	215						197	15	60
	TD	115	115	142	115	98						117	16	45

MD - MACHINE DIRECTION

TD - TRANSVERSE DIRECTION

** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPLE*

Precision Geosynthetic Laboratories

TABLE 3.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97

Client Sample ID : Perm @ Sta. 462+00

Date Reported : 12/12/97

PGL Job No. : 971305

PGL Control No. : 25975

		SPECIMENS												Proj.
		1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Specs.
METHOD	**DESCRIPTION**													
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	197	186	217								200	16	120
	TD	176	169	197								181	15	90
	Elongation at Peak (percent)													
	MD	14	66	81								54	35	
	TD	13	12	75								34	36	
ASTM D4833	Puncture Resistance* (lbs)													
		117	124	102	120	128						118	10	180
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	190	147	185								174	24	60
	TD	127	153	157								146	16	45

MD - MACHINE DIRECTION

TD - TRANSVERSE DIRECTION

** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPLE*

Precision Geosynthetic Laboratories

TABLE 4.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97

Client Sample ID : Imperm @ Sta. 462+00

Date Reported : 12/12/97

PGL Job No. : 971305

PGL Control No. : 25976

METHOD	DESCRIPTION	SPECIMENS 1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Proj. Specs.
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	226	230	230	217	240						229	8	130
	TD	304	243	305	286	233						274	34	96
	Elongation at Peak (percent)													
	MD	19	20	22	17	19						19	2	
	TD	14	12	15	14	16						14	1	
ASTM D4833	Puncture Resistance* (lbs)													
		128	119	144	138	120	112	123	115	114	113	123	11	140
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	58	52	67	45	48						54	9	40
	TD	76	77	90	76	95						83	9	40

MD - MACHINE DIRECTION

TD - TRANSVERSE DIRECTION

** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPLE*

Precision Geosynthetic Laboratories

TABLE 5.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97

Client Sample ID : Perm @ Sta. 60+50

Date Reported : 12/12/97

PGL Job No. : 971305

PGL Control No. : 25977

		SPECIMENS												Proj.
		1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Specs.
METHOD	**DESCRIPTION**													
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	174	230	174	181	253						202	37	120
	TD	197	203	196	167	186						190	14	90
	Elongation at Peak (percent)													
	MD	78	83	71	59	85						75	10	
	TD	75	74	18	19	77						52	31	
ASTM D4833	Puncture Resistance* (lbs)													
		93	106	104	119	120	96	109	113	94	91	105	11	180
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	160	145	175	140	166						157	15	60
	TD	105	111	155	167	130						134	27	45

MD - MACHINE DIRECTION

TD - TRANSVERSE DIRECTION

** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPLE*

Precision Geosynthetic Laboratories

TABLE 6.

MATERIAL PROPERTIES

Geotextile

MCMICKEN DAM / 7-119-000155

FOR: AGRA EARTH & ENVIRONMENTAL

Date Received : 12/9/97

Client Sample ID : Imperm @ Sta. 60+50

Date Reported : 12/12/97

PGL Job No. : 971305

PGL Control No. : 25978

METHOD	DESCRIPTION	SPECIMENS 1	2	3	4	5	6	7	8	9	10	Avg.	Std. Dev.	Proj. Specs.
ASTM D4632	Grab Tensile*													
	Tensile Strength (lbs)													
	MD	246	252	226	281	260						253	20	130
	TD	271	298	287	289	304						290	13	90
	Elongation at Peak (percent)													
	MD	16	25	19	14	20						19	4	
	TD	17	16	16	17	16						16	1	
ASTM D4833	Puncture Resistance* (lbs)													
		125	127	130	138	127	157	160	152	156	157	143	15	190
ASTM D4533	Trapezoid Tear Strength* (lbs)													
	MD	50	50	56	51	55						52	3	40
	TD	78	71	102	88	79						84	12	40

MD - MACHINE DIRECTION

TD - TRANSVERSE DIRECTION

** - TESTED LESS THAN REQUIRED NUMBER OF ASTM REPLICATES, LIMITED SAMPLES*

Precision Geosynthetic Laboratories

GEOTEXTILE SPECIFICATIONS

Polypropylene or Polyester Based Geotextiles

Properties	Pervious ~~Upstream Center~~ Drain & Downstream Toe Cutoff Geotextile	Impervious ~~Coated Center~~ Drain & Outlet Geotextile
Grab Tensile Strength ASTM D1682* (lbs.)	120 Minimum Machine Direction of Roll (warp), 90 Minimum Perpendicular (weft)	130 Minimum Machine Direction of Roll (warp), 90 Minimum Perpendicular (weft)
Trapezoidal Tear ASTM D751* (lbs.)	60 Minimum Machine Direction of Roll (warp), 45 Minimum Perpendicular (weft)	40 Minimum Machine Direction of Roll (warp), 40 Minimum Perpendicular (weft)
Puncture (1" ball) ASTM D751* (lbs.)	180 Minimum	140 Minimum
Equivalent Opening Size (U.S.) COE-CW 02215	No Larger than U.S. Standard Sieve No. 20	NA
Pullout Test Elongation at 10 PSI Overburden Load (inches)	1.0 Minimum	1.0 Minimum
Permeability (cm/sec)	$1x10^{-3}$ Minimum	$1x10^{-7}$ Maximum

*Modified as described in Design Report.

APPENDIX E – OUTLET CHANNEL RECONNAISSANCE REPORT

Memo

To	**File**	File no	**6-117-001025**
From	**Karen Anglin**	cc	
Tel	**480-940-2320 ext. 165**		
Fax	**480-785-0970**		
Date	**July 27, 2006**		

Subject **McMicken Project**
Outlet Channel & Outlet Wash Site Reconnaissance Report
Wittmann Area Drainage Master Plan
Contract FCD 2004C060
Maricopa County, Arizona

Reconnaissance of the McMicken outlet channel and outlet wash consisted of driving along the crest of the levee embankment and parallel to the levee along the channel alignment. Stops were made in areas of particular interest and digital photographs were taken of observed and relevant features.

Stop 1: Principal outlet structure

- Observed recent structural repair work near walls of the principal outlet where cracks once existed between principal outlet walls and earthen dam
- Examined the principal outlet structure walls; observations appeared consistent with previously observed inward movement and offset of walls
- Photos taken from crest of dam looking downstream out over the outlet channel
- Observed some wash areas near beginning of outlet channel that have been covered with rip rap

Stop 2, 3, and 4: Areas of depression in levee embankment crest

- Detected dips and ruts near outlet channel Station 253+00 along levee crest and noted surface cracks on the slope of the levee
- Photos taken of dips and ruts at outlet channel Station 253+00
- Observed recent operation and maintenance repair work along levee crest and sides of levee at outlet channel Station 253+00 as well as Stations 258+50, 272+00 and 297+50.
- Detected higher lineament activity from high resolution photos near outlet channel Stations 253+00 and 258+50
- Observed strong linear features in large drainages in surrounding areas near levee crest repair areas
- Observed odd direction of large drainage near outlet channel Station 264+00
- At outlet channel Station 297+50, observed ATV tracks near area of repair work

AMEC Earth & Environmental, Inc.
1405 West Auto Drive
Tempe, Arizona 85284-1016
Tel +1 (480) 940-2320
Fax +1 (480) 785-0970 www.amec.com

- At outlet channel Station 297+50, observed odd linear feature that does not appears to be a drainage as depicted in high resolution photos
- Initial prep work in placing seismic lines considered areas near these stations where depression were observed, different geologic units along the outlet channel, and in even spacing along the outlet channel.

Stop 5: Confluence of outlet channel and outlet wash

- Outlet channel merges along a sharp right bend with outlet wash
- Observed massive non-native conglomerates placed along cut bank where outlet channel and outlet wash merge
- Photos taken of outlet channel, outlet wash, and non-native conglomerates

Stop 6: Intersection of US 60 and outlet wash channel

- Observed depression in road of US 60 at crossing of outlet wash
- Observed two developing residential areas on opposite side of US 60
- Photos taken on either side of US 60 of outlet wash and broad flat land separating the two residential areas

Stop 7: Principal outlet structure outlet channel

- Photos taken of principal outlet channel facing conduit walls

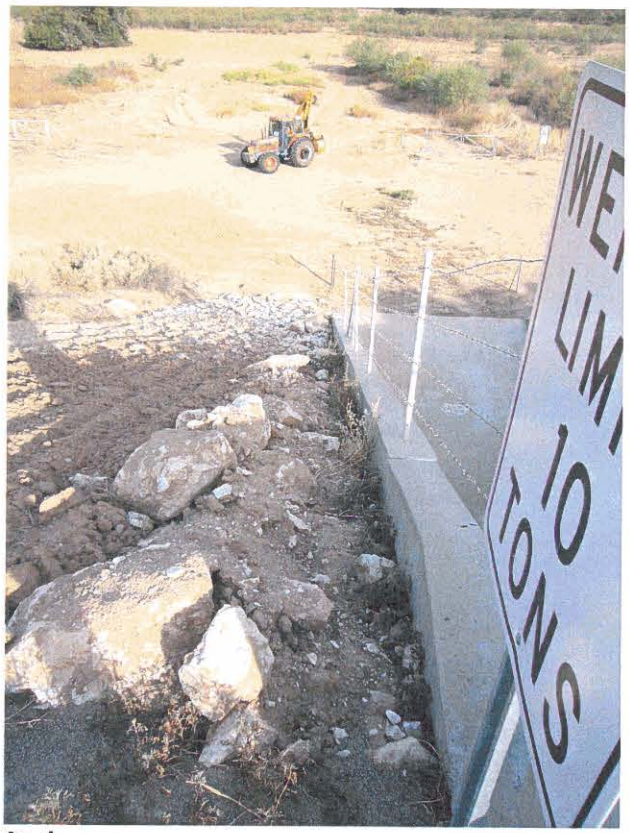


Photo 1
Principal outlet structure wall – right side, upstream.

Photo 2
Principal outlet structure wall – left side, upstream.

Photo 3
Principal outlet structure outlet channel – looking downstream.

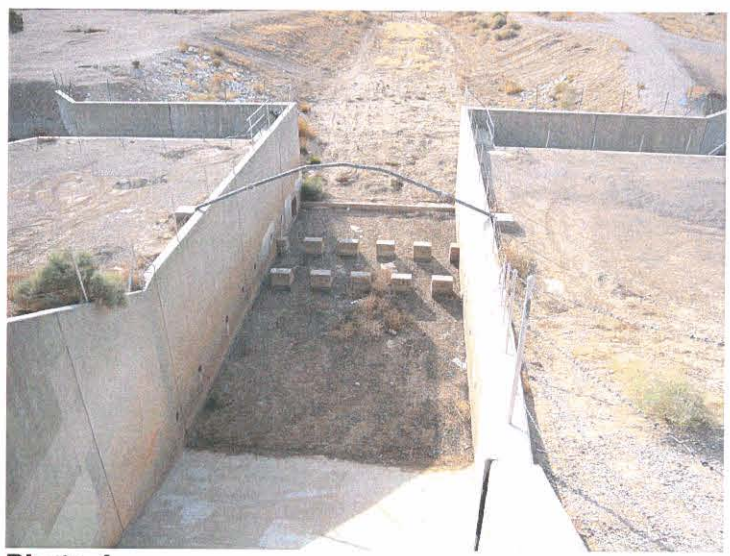


Photo 4
Principal outlet structure energey dissapation structure – looking downstream.

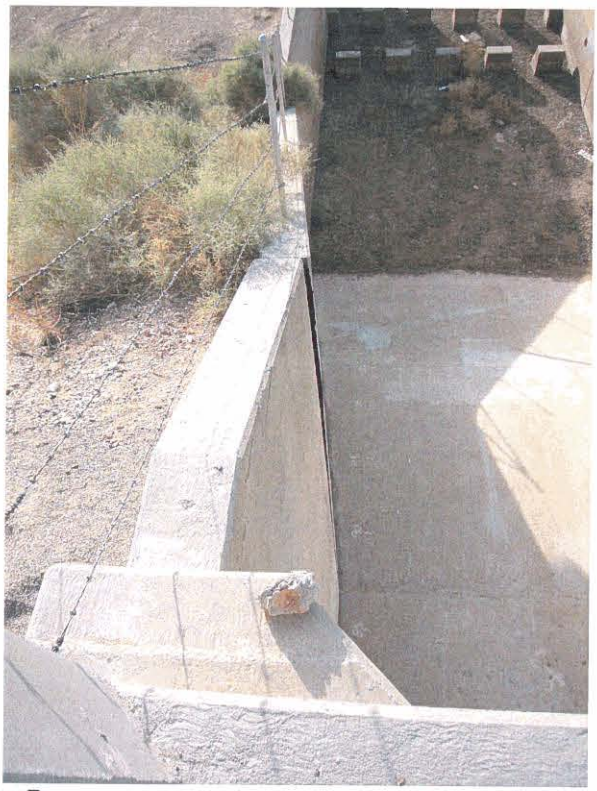


Photo 5
Principal outlet structure wall – left side, downstream.

Photo 6
Principal outlet structure wall – right side, downstream.

Photo 7
O&M access road just east of Atchison & Santa Fe railroad trestle crossing of outlet channel – looking downstream.

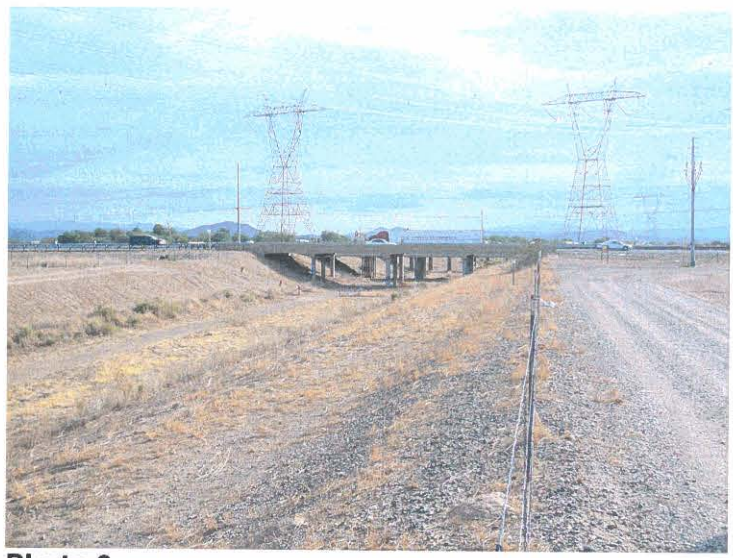


Photo 8
Overview of U.S. Highway 60 crossing of outlet channel – looking downstream.

Photo 9
Overview of Atchison & Santa Fe railroad trestle crossing of outlet channel – looking upstream.

Photo 10
Overview of outlet channel directly downstream of principal outlet structure – photo from levee crest, looking downstream.

Photo 11
Recent O&M repair activities on levee slopes.

Photo 12
Typical dip and rutting activity on levee crest at approximately outlet channel Station 253+00.

Photo 13
Typical dip and rutting activity on levee crest at approximately outlet channel Station 253+00.

Photo 14
Typical rutting activity on levee crest at approximately outlet channel Station 297+50.

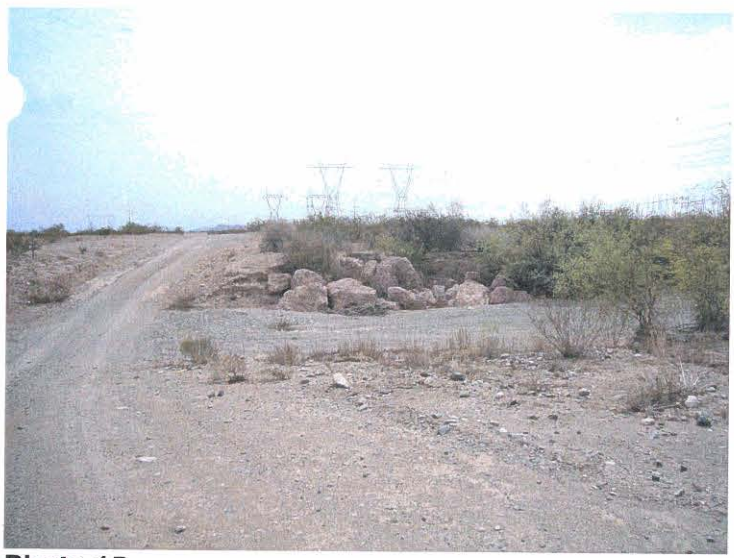


Photo 15
Confluence of outlet channel and outlet wash – outlet wash flow is left to right, photo looking east.

Photo 16
Confluence of outlet channel and outlet wash – outlet channel flow is towards camera position, photo looking west, upstream into outlet channel.

Photo 17
Confluence of outlet channel and outlet wash – outlet channel flow is away from camera position, photo looking south, downstream into outlet wash.

Photo 18
Outlet wash channel north of overhead 240 KV power transmission line crossing – photo looking south.

Photo 19
U.S. Highway 60 crossing of outlet wash.

Photo 20
U.S. Highway 60 crossing of outlet wash – photo looking southerly, downstream.

Photo 21
Overview of principal outlet structure – photo from downstream side of dam, looking upstream.

Photo 22
Overview of outlet channel directly downstream of principal outlet structure – photo from channel, looking downstream.

Memo

To	**File**	File no	**6-117-001025**
From	**Brett A. Howey, P.E.**	cc	
Tel	**480-940-2320 ext. 116**		
Fax	**480-785-0970**		
Date	**April 24, 2007**		

Subject **McMicken Dam Project**
Outlet Wash Site Reconnaissance Report
Wittmann Area Drainage Master Plan
Contract FCD 2004C060
Maricopa County, Arizona

Reconnaissance of the lower McMicken Outlet Wash consisted of a walking and driving inspection along the outlet channel alignment south of the SR L303 roadway crossing. Stops were made in areas of interest and digital photographs were taken of observed and relevant features. Site observations were discussed with District staff for collection of additional information, both institutional knowledge and published documentation.

Four (4) significant structures were identified during the reconnaissances which are discussed below including the information gathered from the District.

SR L303 Crossing

Previously visited by AMEC in July 2006, this roadway crossing consists of an 11-bay box culvert. AMEC understands this structure was built by Maricopa County Department of Transportation (MCDOT) and is maintained by the Arizona Department of Transportation (ADOT). The project was permitted through the District's Right-of-Way permitting process and as-builts are on file with the District.

Williams Drive Crossing

This roadway crossing consists of an 11-bay box culvert. AMEC understands this structure was built by MCDOT and designed to pass the 100-year storm event as well as not fail if overtopped during the McMicken Standard Project Flood (SPF) discharge. The project was permitted through the District's Right-of-Way permitting process and as-builts are on file with the District. The structure is maintained by MCDOT and also includes a 12-inch waterline on Williams Drive and a 16-inch waterline on Pinnacle Peak Road.

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Tempe, Arizona 85284-1016
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Fax +1 (480) 785-0970 www.amec.com

El Mirage Drain

This structure consists of a 500 foot long, 4-inch thick reinforced concrete lined drop structure. The drop structure has a shallow lower level plunge pool for energy dissipation and a v-shaped low flow channel. The concrete was observed as deteriorating with signs of several historic maintenance repairs. AMEC understands the structure was built as part of the Sun City West development and construction of the El Mirage Drain. The structures are positioned on District property controlled by fee or easement. As-builts and/or engineering records are not available.

Sun City Drain

This structure consists of a 3-bay box culvert and deteriorated energy dissipation structure. AMEC understands this structure was built as part of the Sun City West development and construction of the Sun City Drain. There also is a section of the outlet channel which has been lined with concrete for erosion protection and bank stabilization. The District maintains these structures. As-builts and/or engineering records were not available.

Aerial 1: SR L303 crossing over McMicken Outlet Wash

Aerial 2: Williams Drive crossing over McMicken Outlet Wash

Aerial 3: Concrete lined drop structure within McMicken Outlet Wash paralleling El Mirage Road.

Aerial 4: Sun City West Drain (photo top left) and its confluence with the McMicken Outlet Wash. Also shown is concrete channel lining erosion protection.

Photo 1
Eleven bay box culvert at Williams Drive – photo looking southwest.

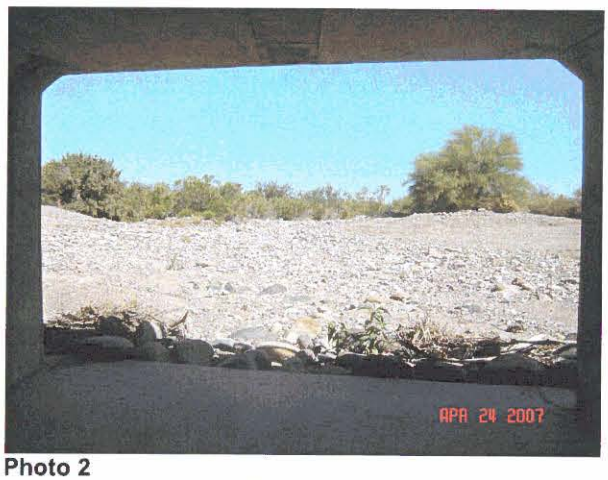

Photo 2
Channel upstream of 11 bay box culverts – photo looking upstream (north) from center bay.

Photo 3
Defined outlet wash channel that parallels El Mirage Road.

Photo 4
Overview of concrete lined drop structure – photo looking downstream (south) from crest of structure.

Photo 5
Typical deterioration of drop structure concrete lining.

Photo 6
Overview of concrete lined drop structure – photo looking upstream (north) from downstream invert of structure.

Photo 7
Confluence of drop structure and downstream natural channel – photo looking upstream (north).

Photo 8
Outlet channel downstream of drop structure – photo looking downstream (south).

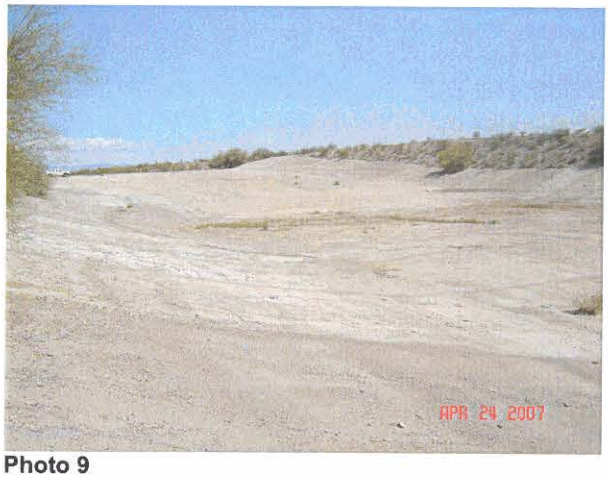

Photo 9
Overview of drop structure plunge pool – photo from right abutment looking upstream (north).

Photo 10
Three bay box culvert which outlets Sun City Drain from beneath El Mirage Road – photo looking west.

Photo 11
Three bay box culvert which outlets Sun City Drain from beneath El Mirage Road – photo looking west.

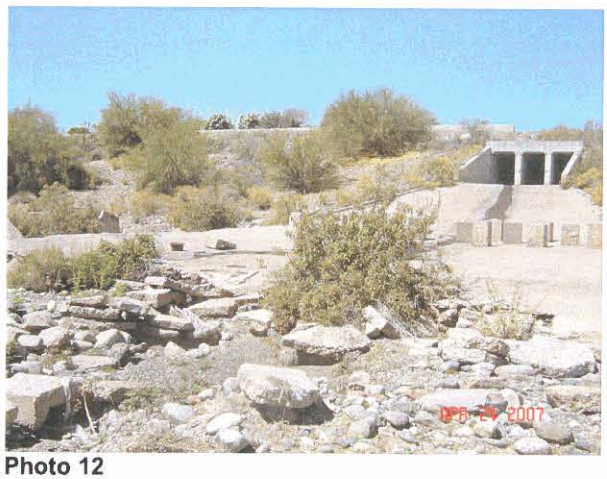

Photo 12
Overview of confluence of Sun City Drain and outlet wash – photo looking southwest.

Photo 13
Photo of outlet wash looking directly downstream from Sun City Drain confluence. In photo background is the section of the wash banks armored with concrete for erosion protection – photo looking downstream (south).

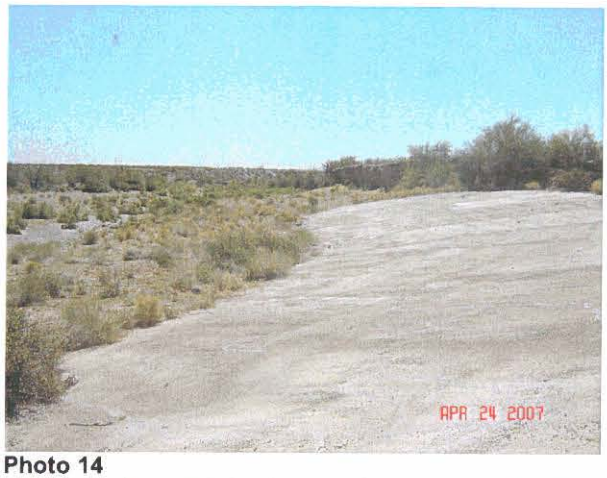

Photo 14
Overview of concrete bank protection – photo looking east towards confluence with Agua Fria River.

APPENDIX F – JE FULLER EROSION AND SEDIMENTATION REPORT

WITTMANN AREA DRAINAGE
MASTER PLAN

McMicken Dam Outlet Channel Erosion and Sedimentation Analysis

VOLUME GA

Contract FCD 2004C060

July 2007

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WITTMANN AREA DRAINAGE MASTER PLAN
CONTRACT FCD 2004C060

MCMICKEN DAM OUTLET CHANNEL EROSION AND SEDIMENTATION ANALYSIS
VOLUME GA

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SECTION GA-1:INTRODUCTION

JE Fuller/ Hydrology & Geomorphology, Inc. (JEF) conducted an erosion and sedimentation analysis on the McMicken Dam Outlet Channel as part of the Wittman Area Drainage Master Plan (Wittman ADMP). The purpose for this analysis is to establish the existing conditions of the McMicken Dam Outlet Channel and Wash and to identify and evaluate historical changes to the system. This report outlines the methodologies used for the analysis and summarizes the findings.

1.1 STUDY LOCATION

The McMicken Dam Outlet Channel and the McMicken Dam Outlet Channel Wash, herein referred to as the McMicken Outlet Channel and McMicken Outlet Wash, are located in western Maricopa County, Arizona north of the Town of Surprise along a portion of the Loop 303 bend as shown in Figure GA-1.1. The study reach is approximately 10 miles long, and begins at the McMicken Dam outlet works and ends at the confluence with the Agua Fria River.

1.2 SCOPE OF SERVICES

The methodology to be used for the erosion and sedimentation analysis of the McMicken Dam McMicken Outlet Channel and McMicken Outlet Wash is defined in the ADMP Scope of Services Task 2.8.2 as follows:

> The CONSULTANT shall evaluate the McMicken Outlet Channel potential for sediment build up or erosion. The evaluation will be based on hydraulic and hydrologic data provided by the DISTRICT (or prepared separately for other authorized ADMPU tasks, i.e., no new hydraulic or hydrologic data will be prepared by the CONSULTANT under this task). The evaluation will consider the limiting stable slope by using Meyer-Peter and Muller beginning transport equation documented in "Computing Degradation and Local Scour" by Bureau of Reclamation, 1984. The evaluation will also consider the dynamic equilibrium slope by using the iterative method documented in "Design Manual for Engineering Analysis of Fluvial Systems" by ADWR, 1985. The evaluation will also consider field observation, comparison of readily available historical and recent topographic mapping, flow/flood history, and measurement of channel change using a historical and recent aerial photograph.

Each element of the Scope of Services is described in the following sections:

- 2.0 Hydrology
- 3.0 Hydraulic Model
- 4.0 Erosion/Sedimentation Analysis
- 5.0 Subsidence
- 6.0 Conclusions
- 7.0 References

1.3 STUDY REACH DESCRIPTION

The Outlet Channel is an excavated trapezoidal channel for most of the length beginning at the principal spillway of the dam as shown in Figure GA-1.3.A. The width of the excavated channel bottom ranges from 45 feet near the dam spillway to more than 90 feet in the lower reach of the excavated channel. The channel's right bank is a constructed embankment or levee which extends up to 13 feet above the natural grade in some locations. The side slope of the channel and the levee is approximately 2 feet horizontal to 1 foot vertical. The channel is regularly maintained by the Flood Control District of Maricopa County (District) and therefore has little vegetation along the channel bottom and right embankment. In some places, the left bank is vegetated by Mesquite, native shrubs, and grasses.

Major structures over the Outlet Channel include the northbound and southbound lanes of Grand Avenue (SR 60) that bridge the channel, as shown in Figure GA-1.3.B. The Burlington Northern and Santa Fe (BNSF) railroad also bridges the Outlet Channel northeast of Grand Avenue, as shown in Figure GA-1.3.C. Numerous washes enter the channel from the northwest, some of which have been hardened with grouted river rock spillways, as shown in Figure GA-1.3.D.

The McMicken Outlet Channel drains into the McMicken Outlet Wash, which then flows south where it joins the Agua Fria River. The McMicken Outlet Wash is named the CAP 16 East upstream of the confluence according to the FEMA FIRM panel. The McMicken Outlet Wash is a natural sand-bedded ephemeral wash from the McMicken Outlet Channel confluence to Deer Valley Road, and has a bottom width ranging from a 20 to 40 feet. The McMicken Outlet Wash has a bridge crossing at SR Loop 303 and an 11-barrel box culvert crossing at the newly constructed Williams Road downstream of SR Loop 303. The McMicken Outlet Wash was channelized from Deer Valley Road to the Agua Fria River during construction of the Sun City West development and as part of the El Mirage Drain project.

The channelized portion of the McMicken Outlet Wash is trapezoidal with a bottom width of approximately 180 feet and 3 feet horizontal to 1 foot vertical side slopes. A large concrete drop structure exists within the McMicken Outlet Wash approximately 3,000 feet downstream of Deer Valley Road and facilitates a drop in the channel bed of almost 25 feet. The El Mirage Drain enters the McMicken Outlet Wash approximately 3,500 feet upstream of the confluence with the Agua Fria River. The McMicken Outlet Wash enters the Agua Fria River at an un-altered (natural) confluence between the Beardsley and Union Hills Road alignments.

1.4 BACKGROUND

The Outlet Channel was constructed as part of the Trilby Wash Detention Basin Dam in 1956 by the Unites States Army Corps of Engineers (USACE), which was later named the McMicken Dam. The dam and McMicken Outlet Channel are currently maintained by the District. The McMicken Outlet Channel levee was restored to the original design elevation by plating the crest with aggregate base material in 2003.

The McMicken Outlet Wash has been modified as listed below:

- 1956 – Addition of previously non-tributary watersheds diverted via the McMicken Outlet Channel
- 1978-1979 – Channelization from Deer Valley Road to approximately 1800 feet upstream of the Agua Fria River as part of the Sun City West development
- Diversion of the El Mirage drain that is now conveyed to the McMicken Outlet Wash.
- 2002 – Construction of SR Loop 303 Bridge over McMicken Outlet Wash
- 2005-2006 – Construction of Williams Drive box culverts over McMicken Outlet Wash

Two other modifications that affect the hydrology and sediment transport characteristics of the McMicken Outlet Channel and Wash include the construction of the Central Arizona Project (CAP) canal in the 1980s and the Beardsley Canal in the 1920s. Both canals are aligned predominantly east-west creating a division of the contributing watershed. Some of the tributaries are completely cutoff while others pass through one or both of the canals via over chutes or siphons. Some alteration of the natural hydrology and sediment supply occurs at the CAP and the Beardsley Canal crossings that may impact sedimentation and erosion in the McMicken Outlet Channel and Wash.

SECTION GA-2:HYDROLOGY

JEF obtained hydrologic data from the Wittman Area Drainage Master Study Update (ADMSU) Hydrology Addendum (Reference 1). The hydrologic analysis performed for the ADMSU included existing and future conditions for the 100-Year return interval for a 6- and 24-hour storm duration. Figure GA-2 shows the HEC-1 hydrologic model sub-basins and concentration points along the McMicken Outlet Channel and Wash.

JEF computed peak discharge rates for the 2- and 10-year recurrence interval events for use in the erosion/sediment analyses using the 10% and 35% ratios outlined in the District's Draft Drainage Design Manual (Reference 2), respectively. The discharges used are summarized in Table GA-2.A.

The District maintains two stream flow gages along the McMicken Outlet Channel. The first is located at the outlet works (Gage 5448), the second is located near Grand Avenue and 163rd Avenue (Gage 5438), as shown in Figure GA-2. Gage 5448 has been in operation since February 1988. Gage 5438 has been in operation since May 1992. Table GA-2.B lists the recorded peak flow rates and flow duration for the events since the beginning of the gage data. The data available for Gage ID 5448 is suspect between June 1997 through May 2006 due to the mis-location of the pressure transducer in the stilling well. Furthermore, a new rating curve was introduced at some point in the early 1990s introducing a possible inconsistency with the data reported. Therefore, the discharge data reported in Table GA-2.B depicts data taken from Gage 5438 since the beginning of its operation. Data prior to May 1992 was taken from Gage 5448. All data were obtained or computed from reports on the District's ALERT website (Reference 3).

The highest recorded discharge from the dam is 658 cfs on September 4th, 1990. This discharge is estimated to be less than a 5-year recurrence interval. Therefore, the McMicken Outlet Channel has not experienced anything close to a design event since gaging began in 1988. JEF is unaware of any large outflows prior to 1988.

SECTION GA-3:HYDRAULIC MODEL

JEF obtained three hydraulic models for the McMicken Outlet Channel and Wash for use in this analysis. The three models were brought together in one comprehensive model that covers the entire drainage path from the McMicken Dam outlet works to the Agua Fria River. Each model is discussed separately below.

3.1 EFFECTIVE FIS MODEL

The effective Flood Insurance Study (FIS) model was obtained from the District for the McMicken Outlet Wash and covers a portion of the McMicken Outlet Channel approximately 3,200 feet upstream of the confluence. This model is in HEC-2 format and was developed using 1986 vintage 2-foot contour interval mapping based on the National Geodetic Vertical Datum of 1929 (NGVD 29). This model was developed by the WLB Group, Inc (Reference 4). The effective model was developed after the construction of the McMicken Outlet Wash channel improvements extending from Deer Valley Road to approximately 2,800 feet upstream of the confluence with the Agua Fria River. The effective floodplain for remainder of the McMicken Outlet Channel is Zone A. Therefore, there is no effective FIS hydraulic model for rest of the channel upstream to the dam.

3.2 EAP MODEL

Kimley-Horn and Associates, Inc. developed a HEC-RAS model for most of the McMicken Outlet Channel for an Emergency Action Plan Update in June 2004 (Reference 5). This model extends from the downstream end of the McMicken Outlet Channel just upstream of the McMicken Outlet Wash confluence to a point approximately 600 feet downstream of Grand Avenue. The geometry for this model was developed using cross section data field surveyed in March 2004. Supplemental geometry was taken from USGS Quadrangle maps to extend the left overbank far enough to contain the water surface profile. The surveyed cross sections were based on the North American Vertical Datum of 1988 (NAVD 88). USGS cross section data were converted to NAVD 88 by adding 1.936 feet to the NGVD 29 elevations.

3.3 BAKER MODEL

Michael Baker, Jr., Inc. developed a HEC-RAS model for the McMicken Outlet Channel for an overtopping analysis done in June 2003 (Reference 6). This model extends from the dam outlet works to approximately 2,500 feet downstream of Grand Avenue. The geometry for this model was developed using cross section data field surveyed by the District in April 2003 and 2-foot contour interval mapping flown on June 9, 2000. Both data sources were based on the NAVD 88 datum.

The three models were combined to develop one hydraulic model in HEC-RAS Version 3.1.3 by adding the geometry data from the Effective FIS model and the EAP model to the Baker model. The geometry for the Effective FIS Model was converted to NAVD 88 using the conversion sited in Kimley Horn Emergency Action Plan Update (NAVD 88 Elev. = NGVD 29

Elev. + 1.94). The cross section data from the most recent study were used in areas of overlap and reach lengths were adjusted accordingly. The river stationing was left as in the original model with one exception. The seven most downstream Baker model cross sections were renamed to allow a continuous descending numbering scheme when merged with the EAP model as shown in Table GA-3.3.A. The cross section layout for the model is shown in Exhibit GA-3.3 in the Appendix.

The model was run using the 2-, 10-, and 100-year discharges listed in Section 2.0. Summary 10-year hydraulic model output is listed in Table GA-3.3.B. The 10-year velocity, maximum channel depth, and top width along the McMicken Outlet Channel and Wash are profiled in Figures GA-3.3.A, GA-3.3.B, and GA-3.3.C respectively. The 10-year discharge is often used as an approximation of the dominant discharge or bankfull discharge and is often used for sediment transport or equilibrium slope analyses.

It can be seen that velocities in the McMicken Outlet Channel are very low in the range of 2 to 3 feet per second (fps). The corresponding energy grade slope is very gradual with a low average Froude number over the McMicken Outlet Channel reaches. The velocities pick up to the 4 to 8 fps range in the McMicken Outlet Wash with a much steeper energy grade slope and higher Froude number. These general hydraulic conditions are expected given the nature of the gradually sloped McMicken Outlet Channel with only 22 feet of fall over nearly 6 miles of the channel. The higher velocities in the McMicken Outlet Wash are expected given the steeper slope of the natural watercourse.

SECTION GA-4:EROSION/SEDIMENTATION ANALYSIS

JEF performed several tasks to evaluate the sedimentation processes occurring within the McMicken Outlet Channel and Wash.

4.1 FIELD RECONNAISSANCE

Field reconnaissance was conducted along the study reach on March 27, 2007, to identify existing conditions within the McMicken Outlet Channel and Wash. No significant evidence of aggradation or degradation was observed within the McMicken Outlet Channel. The McMicken Outlet Wash appears to have experienced net degradation, particularly in the channelized reach.

4.2 LONGITUDINAL PROFILE COMPARISON

The Comparison of historical profiles with modern profiles can be used to document where degradation and aggradation have occurred, and where future adjustments of channel geometry are most likely to occur.

A longitudinal profile of the McMicken Outlet Channel and Wash were plotted to compare the channel elevation versus distance along the channel bed over time. A review of the profile was used to identify slope irregularities, over-steepened or flat reaches, headcuts, areas of natural grade control, and historical changes in bed elevation. Furthermore, the review of the longitudinal profile was conducted to determine indications of the vertical or lateral stability of the McMicken Outlet Channel and Wash.

Figures GA-4.2.A and GA-4.2.B show the results of the longitudinal profile analysis comparison for the following data sets:

- 1954 McMicken Dam and McMicken Outlet Channel As-Constructed plans (Reference 7)
- 1986 Effective FIS Model (developed using 2' contour interval mapping) and 4' contour interval mapping
- 2004 EAP HEC-RAS Model (developed using FCDMC surveyed cross sections)
- 2000 and 2003 Baker HEC-RAS Model (developed using FCDMC surveyed cross sections and 2' contour interval mapping)

The 1954 and 1986 data sets were on the NGVD 29 datum and were adjusted to NAVD 88 as discussed in Section 3.1. Tributary confluences with the McMicken Outlet Channel and Wash are also plotted in Figures GA-4.2.A and GA-4.2.B, the naming of which are associated with the HEC-1 operations discussed in Section 2.0.

Given the very gradual slopes of the McMicken Outlet Channel (0.000185 to 0.001 feet/feet), it is expected that the channel would tend to experience net deposition (aggradation). Although

the 1986 profile is higher than the original channel profile for the upstream half of the McMicken Outlet Channel, the downstream half is lower by almost a foot. The latest profile data from 2000 and later depicts general lowering throughout the entire channel from approximately 0.25 feet in the upstream reach to over 2 feet in the downstream reach near the confluence with the McMicken Outlet Wash.

It can be seen that the current (2000 and later) channel slope is disrupted at nearly every tributary inflow point for the most recent channel profiles. This is indicative of sediment deposits at the confluences as floodwaters from the steeper tributaries enter the wider and gradually sloped channel causing a velocity decrease and deposition. Sediment deposition is only visible at the confluence with tributary reaches PI635 and RWI621 in the 1986 data set, but is much more apparent than the current profile.

The McMicken Outlet Wash profile has also lowered according to the 1986 and 1954 profiles. Some sections indicate a lowering of as much as 6 feet. A comparison to the current condition was not made as no current detailed topographic data were available for this study. The McMicken Outlet Wash has an average slope of approximately 0.005 feet/feet, not necessarily steep for natural washes in the southwest, but much steeper than the McMicken Outlet Channel. Therefore, the observed degradation could be attributed to increased flow volume getting to the channel as discussed in Section 1.4, a reduction in sediment supply caused by deposition upstream of the Beardsley Canal and the CAP, as well as deposition at the tributary confluences with the McMicken Outlet Channel.

4.3 BANK LOCATION COMPARISON

JEF obtained historical aerial photography taken in 1949, 1967, and 1980 to compare with the current orthophotography for the study reach. The aerial photographs used for this comparison are summarized in Table GA-4.3.

The historical aerial photographs from each year of available coverage were digitized and semi-rectified to match the current orthophotography for the study area. The bank positions were then digitized for each year of coverage as shown in Figures GA-4.3.A and GA-4.3.B. The bank locations for the McMicken Outlet Channel were not included in this comparison because the channel is man made, is regularly maintained, and is believed to have experienced only a few moderate discharges events since it was constructed as discussed in Section 2.0.

Two locations were identified where significant lateral channel change has occurred. The first location is about 1,500 feet downstream of the SR Loop 303 crossing as shown in Figure GA-4.3.A. Bank retreat occurred on the outside bend as the McMicken Outlet Wash bends left (east). Further widening was observed just downstream of the second bend right (south). The mean widening of this reach from 1949 to present is approximately 40 feet with a maximum widening of 90 in the first bend.

The second location occurs about 1,500 feet upstream of the SR Loop 303, as shown in Figure GA-4.3.B. The widening has formed a flow split and multiple flow paths through an elevated portion of the channel. The maximum widening of this reach from 1949 to present is approximately 60 feet.

As stated previously, the McMicken Outlet Wash was channelized in 1978-1979 and straightened as can be seen by the bank locations in Figure GA-4.3.B. The constructed channel is much wider than the previous channel and was likely designed to fully contain the floodplain and/or design outflows from McMicken Dam. The elimination of the large bend previously aligned in the Sun City West development was likely one of the main reasons that a drop structure was required within the straightened channel to make up the elevation gradient in the historic alignment.

The location of the low flow channel of the McMicken Outlet Wash as it enters the Agua Fria River has changed significantly over time. This change is apparent even between the 1949 and 1967 aerial photographs and is more than likely a natural process since the reach is essentially a delta that is affected by a change in gradient as the McMicken Outlet Wash enters the Agua Fria River. Changes in the flow and channel configuration in the Agua Fria River also have an affect on the confluence.

Stereo pair aerial photography was available for the 1949 and 1980 data sets and were reviewed using an optical stereo scope. A somewhat recent channel incision was observed along the McMicken Outlet Wash indicating that some level of degradation had occurred prior to the construction of the McMicken Outlet Channel. A relic low flow channel was observed in the low floodplain in one location indicating a previous avulsion. The maturity of trees and shrubs along the 1949 channel banks indicates the avulsion must have occurred prior to 1949.

4.4 MAINTENANCE ACTIVITIES

The District performs regular inspections and maintenance of the McMicken Outlet Channel and levee. Regular maintenance of the levee primarily consists of grading and plating the levee crest to maintain the all-weather access road. Regular maintenance within the channel consists of disking the channel to prevent the growth of trees and shrubs.

According to District Operations and Maintenance (O&M) personnel (Reference 8), the removal of sediment deposited in the channel at the outlet works has been required on occasion and has been used for minor repairs to the north bank of the McMicken Outlet Channel between the outlet works to Grand Avenue. Repairs of rills from erosion on the south slope of the levee are regularly performed. A one mile segment of the McMicken Outlet Channel from Grand Avenue east is subject to regular gopher damage. In addition, the flanking of several concrete spillways has been attributed to gopher burrows, according to O&M personnel.

4.5 GEOTECHNICAL TESTING

The grain size distribution for the bed, bars, or lower banks of the McMicken Outlet Channel and Wash are required to perform the erosion/sedimentation analysis for the study reach. JEF obtained the results of soil sampling and sieve analyses for the McMicken Outlet Channel and Wash from three sources as described below:

1. AMEC 2007: Numerous geotechnical explorations along the dam and McMicken Outlet Channel (Reference 9)

2. Western Technologies 2006: 4 geotechnical borings in the McMicken Outlet Wash at the proposed North El Mirage Road Bridge (Reference 10)
3. Western Technologies 2007: 5 geotechnical borings in the McMicken Outlet Wash at the proposed South El Mirage Road Bridge (Reference 11)

The AMEC explorations consisted of a comprehensive set of borings and test pits along the bed, levee, and the southern toe of the levee of the McMicken Outlet Channel. Sieve analyses were performed on soil samples for each boring near the surface and various depths below. Sieve analyses were also performed on test pit samples that were generally taken somewhere between 0 and 5 feet deep. JEF compiled the shallow sieve analyses within the channel bed to identify trends, clusters, and identify outlier samples to be excluded. This evaluation resulted in two noticeably different grain size distribution clusters within the McMicken Outlet Channel, as can be seen in Figure GA-4.5.A. The individual grain size distributions were averaged for the two reaches for use in the analysis. The upper and lower channel distributions are divided at the tributary RPI621 confluence, where the channel slope increases.

The Western Technologies explorations were performed for the planned bridges for the El Mirage Road re-alignment along the east side of the McMicken Outlet Wash. The explorations consisted of a borings within the McMicken Outlet Wash bed and overbanks. Sieve analyses were performed on soil samples for each boring near the surface and various depths below. The shallow sieve analyses for the bed samples for both the proposed north and south bridges all had very similar grain sized distributions. Therefore individual grain size distributions were averaged and will be used to represent the bed material for the entire McMicken Outlet Wash as shown in Figure GA-4.5.B. Figure GA-4.5.C shows the location of the individual exploration sites used for the erosion/sedimentation analysis.

JEF also reviewed the Natural Resources Conservation Service (NRCS) soil groups of the McMicken Outlet Channel, Wash, and tributaries. The predominant soils include:

- Mohall-Tremant (MTB)
- Estrella (Es)
- Mohall-Laveen (MV)
- Gilman-Antho (GM)
- Vecont (Ve)
- Antho-Carrizo (AGB)

The Soil Survey for the area (Reference 12) reports a sieve analysis for representative soil samples of each soil group limited to a number 4, 10, 40, and 200 sieve. The grain size distribution for the soil groups applicable to the McMicken Outlet Channel and Wash are plotted on Figures GA-4.5.A and GA-4.5.B. These distributions are much finer than the site specific explorations performed by AMEC and Western Technologies and likely represent soils transported as suspended load in the McMicken Outlet Channel and Wash. Therefore, none of the NRCS grain size distributions were used for this study.

The three average sediment distributions for the McMicken Outlet Channel and Wash were used to determine $D_{15.9}$, D_{50}, $D_{84.1}$, D_{90}. D_{50} and D_{90} are required for use in the Meyer-Peter, Muller stable slope computation and $D_{15.9}$, D_{50}, and $D_{84.1}$ are required for the dynamic equilibrium slope computations. The average grain size distribution in the upper McMicken Outlet Channel is the finest sediment of the three reaches with over 40 percent of the sediment passing the smallest sieve, number 200 with an opening of 0.074 millimeters (mm). The distribution was extrapolated using an "S" shaped curve to estimate $D_{15.9}$ as shown in Figure GA-4.5.A.

Table GA-4.5 summarizes the percent finer particle sizes for each average sediment grain size distribution.

4.6 MEYER-PETER, MULLER EQUILIBRIUM SLOPE

Equilibrium slope is defined as the slope at which the channel bed is neither aggrading or degrading and at which the sediment inflow equals the sediment outflow. It could be interpreted as the slope the channel would evolve into, provided continuous flows for a long period of time, and provides an idea as to what the long-term channel slope could become. In other words, over time, the natural trend is for the channel to transform its slope from the existing towards the equilibrium slope as a response to flow events.

The Meyer-Peter Muller (MPM) equation is published in a Bureau of Reclamation manual (Reference 14) for computing scour and channel degradation downstream of dams or other structures that interrupt the natural sediment supply to the downstream channel. The MPM equation is commonly used by the District for equilibrium slope analyses and was required for this study. The MPM is a zero bed sediment discharge (clear water) equation and represents the minimum slope that would occur if the sediment supply was eliminated from a watercourse.

The MPM equation is based on the incipient motion theory, or the point of initiation of sediment transport, for zero sediment inflow.

$$S_L = K_{mpm} (Q/Q_{bf}) (n_s/D_{90}^{1/6})^{3/2} D / d$$

Where:

S_L = Stable slope (ft/ft)

K_{mpm} = 0.19 inch-pound units

Q/Q_{bf} = Ratio of total flow to flow over the channel

Q_{bf} = Dominant discharge (cfs)

n_s = Manning's n for the stream bed

D_{90} = Bed sediment diameter for which 90 percent is smaller (mm)

D = Mean sediment diameter or D_{50} (mm)

d = Channel depth (ft)

The dominant discharge is based on the mean annual flood, the "channel-forming," or "bankfull" discharge. On many perennial alluvial streams, particularly in humid climates, the mean annual flood and the channel-forming and bankfull discharges are nearly equivalent. However, on many ephemeral streams and channels in the southwest where flow events are

rare, the channel-forming discharge is often difficult to determine. To account for the discrepancies in what flow rate is appropriate for equilibrium slope analyses, and to assess the trend of expected slope adjustments during floods, the 2- and 10-year peaks were used in the equilibrium slope equations to assess the expected slope adjustment over a range of discharges. The 2-year event approximates the mean annual flood calculated on a probability-weighted basis. The 10-year event better approximates bankfull conditions in the study reach. The 100-year discharge was also run for comparison and is often run for conservative long-term degradation estimates. The 2-, 10-, and 100-year discharges used are summarized in Table GA-2.A.

Hydraulic data required for the MPM equation were derived from the HEC-RAS hydraulic model discussed in Section 3.0. Manning's n values were taken directly from the HEC-RAS model. Separate D_{50} and D_{90} values were used for the Upper McMicken Outlet Channel, Lower McMicken Outlet Channel, and for the McMicken Outlet Wash as discussed in Section 4.5 and listed in Table GA-4.5.

The McMicken Outlet Channel and Wash were divided into reaches at tributary inflow points as shown in Figure GA-4.6. The McMicken Outlet Wash was also divided at the drop structure in the channelized section of the wash south of Deer Valley Road. The reach names are simply the furthest upstream HEC-RAS cross section number to the furthest downstream HEC-RAS cross section number within the reach. The MPM equilibrium slope was computed at each HEC-RAS cross section. The resulting equilibrium slopes at each section were averaged by reach to determine the general trend along the channel for that reach.

The long-term degradation (or aggradation) was predicted by comparing the equilibrium slope and existing channel slopes for each reach. If the predicted equilibrium slope is less than the existing channel slope, long-term degradation is expected. Conversely, if the predicted equilibrium slope is greater than the existing channel slope, long-term aggradation is expected. Table GA-4.6 summarizes the results of this analysis. Detailed calculations are included in the Appendix.

Where long-term degradation occurs, lateral instability usually occurs as a by-product due to undercutting the channel banks. Where long-term aggradation occurs, lateral instability occurs due to increased braiding and avulsions. While the magnitude of long-term degradation or aggradation cannot be reliably predicted using the equilibrium slope equation, the strength of the trend in either direction probably can be gauged. The strongest trends are predicted where the difference between the average equilibrium slope and the existing channel slope is greatest.

Every reach for the 2-, 10-, and 100-Year discharge has a predicted equilibrium slope less than the existing channel slope resulting in a prediction of degradation. This is consistent with the trend observed in the historic profile comparison. However, the MPM results represent minimum slopes for the specific condition of clear-water discharges. As stated previously, several tributaries enter the McMicken Outlet Channel and supply the channel with sediment.

Discharges from McMicken Dam also contribute some level of sediment although likely fine sediment suspended in the outflow. The sediment load of each tributary has some level of alteration from the Beardsley Canal, CAP or both. Each tributary crossing a canal is conveyed by either an over-chute, culvert, or siphon causing varying degrees of sediment deposition on

the upstream side. Although the McMicken Outlet Channel and Wash are certainly not in a clear water condition, the system is not necessarily natural either. Therefore, the equilibrium slopes computed using the MPM equation at a minimum, can provide a useful baseline for assessing the impacts if the system is modified in some way.

4.7 DYNAMIC EQUILIBRIUM SLOPE METHOD

Dynamic equilibrium slope calculations were performed using the procedures outlined in the Arizona Department of Water Resources (ADWR) manual (Reference 14) as required by the District for this study. According to this approach, the equilibrium slope is defined as the slope which causes the channel's sediment transport capacity to equal the incoming sediment supply. Steeper channels with high velocities will result in net erosion. Gradually sloped channels with lower velocities will result in net deposition.

The sediment transport capacity was used to estimate the rate of sediment transport. The Zeller-Fullerton equation from the ADWR Manual was used to compute sediment transport capacity for the same channel reaches described in Section 4.6. The Zeller-Fullerton Equation is a total bed-material discharge equation, and is formulated as follows:

$$Q_s = 0.0064\, n^{1.77}\, V^{4.32}\, G^{0.45}\, Y_h^{-0.30}\, D_{50}^{-0.61}$$

Where: Q_s = sediment discharge rate (cfs)

n = Manning's roughness coefficient, channel

V = mean channel velocity (ft/s)

G = gradation coefficient

Y_h = hydraulic depth, channel (ft)

D_{50} = median bed sediment size (mm)

and $$G = 0.5*(D_{84.1}/D_{50} + D_{50}/D_{15.9})$$

The hydraulics calculations for the McMicken Outlet Channel, Wash, and tributaries were performed using the normal depth approach. Channel cross sections were obtained from the HEC-RAS geometry file for the McMicken Outlet Channel and Wash. Channel cross sections for the tributary reaches were taken from the routing reach geometry coded in the HEC-1 hydrology model discussed in Section 2.0 with a few exceptions. PI635 is a modeled subbasin that contributes directly to the McMicken Outlet Channel within the HEC-1 model. Therefore a representative cross section was developed using the 2002 2 foot contour interval topographic mapping (Reference 15) developed for the Wittmann ADMP. Another cross section was taken at tributary RPI603 as the routing reach did not adequately match the channel geometry near the confluence with the McMicken Outlet Channel. Several cross sections were used along CAP 16 East (RPD704) and were taken from the effective HEC-2 model for the wash, the locations of which are shown on Exhibit A in the Appendix.

Manning's n values were also obtained from the HEC-RAS, HEC-1, and effective HEC-2 for the CAP 16 East. Some of the n values in the HEC-1 routing reaches were adjusted to more accurately depict the roughness within the reach near the confluence with the McMicken Outlet Channel. The gradation coefficient (G) and mean bed sediment size (D_{50}) were based on the sieve analysis results discussed in Section 4.5 and summarized in Table GA-4.5. The gradation coefficient and mean bed sediment size for tributary reaches were taken from either the upper McMicken Outlet Channel, lower McMicken Outlet Channel, or McMicken Outlet Wash they are tributary to.

The gradation coefficients computed for the three reaches range from 9.6 to 19.4. The range of sediment sample grain size distributions used in the development of the Zeller-Fullerton equation had gradation coefficients in the range of 2 to 5 according to the ADWR Manual. There is no clear guidance in the ADWR manual regarding the accuracy of the methodology relative to the gradation coefficient.

The first tributary sediment inflow modeled is reach RW1502, upstream of the McMicken Dam outlet works. In general, the majority of a watercourse's bed load would be deposited on the upstream side of a dam and only a portion of the suspended load would be conveyed downstream. Typically, long-term scour occurs immediately downstream of the dam outlet. However, the impoundment area behind the McMicken Dam outlet works is only 3 to 4 feet lower than the crest of the outlet, which may allow more of the total sediment load to be transported than for a typical dam/outlet design. Furthermore, sediment deposition downstream of the outlet works has occurred somewhat regularly, as explained in Section 4.4. In any event, some fraction of the total sediment load is delivered to the Outlet Channel and is probably more than the capacity of the Outlet Channel reach downstream (Reach 79.29 to 47.82). A detailed analysis of the sediment transport through the outlet works was not part of this analysis. Therefore, the sediment transported through the outlet works to the beginning of the McMicken Outlet Channel was assumed to equal the sediment capacity of the reach upstream of the outlet works.

The normal depth calculations were performed at each cross section to obtain hydraulic parameters such as velocity and flow depth. Reach-averaged values of these parameters were then obtained for each of the reaches to be used to estimate the sediment transport capacity of each reach. The sediment transport capacity values were used to compute the equilibrium slope for live bed reaches based on the sediment transport continuity approach outlined in the ADWR Manual. The sediment transport capacity was computed for each of the reaches. The sediment transport capacity was then used as sediment inflow for the next downstream reach for use in the equilibrium slope analysis. The modeling procedure is outlined in the following steps:

1. The sediment inflow into a given reach is the sum of the sediment transport capacities of upstream reaches. The sediment inflow for CAP 16 East (RPD704) was computed using the upstream-most cross-section of that reach.
2. An initial estimate of the equilibrium slope is made for each reach. The average existing slope was typically used to provide a starting point and used to compute normal depth hydraulics for every cross section within the reach.
3. Using the reach averaged hydraulics from the initial equilibrium slope estimate, a first iteration of the long-term sediment transport capacity is computed using the Zeller-Fullerton equation.

4. The long-term sediment transport capacity computed is compared to the total sediment inflow in the reach.
5. Based on the comparison, the equilibrium slope is adjusted and the analysis repeats steps 2 through 4 in an iterative fashion until adequate convergence of the equilibrium slope value was obtained. The equilibrium slope adjustment at each step was performed using a bisection algorithm.

The long-term degradation (or aggradation) was predicted by comparing the equilibrium slope and the average existing channel slopes for each reach as discussed in Section 4.6. Table GA-4.7 summarizes the results of the dynamic equilibrium slope analysis. The detailed final iteration calculations and results are included in the Appendix.

The results of this analysis predict aggradation in the McMicken Outlet Channel as would be expected with the gradually sloped bed profile, tributary inflows, field observations and historic maintenance activities. The McMicken Outlet Wash is predicted to degrade overall with possible aggradation in the reach upstream of the existing drop structure. The dynamic equilibrium slope results contradict the results of the MPM equation as expected, but give a better estimate of the regime of the watercourse given the comprehensive sediment transport analysis procedures within the method. It should be noted that this method assumes that sediment input into each reach is assumed to be the sediment transport capacity of upstream reaches and although there is capacity, there may not be sufficient sediment to satisfy the capacity. As stated previously, tributaries to the McMicken Outlet Channel and Wash have been modified and may or may not deliver sediment equal to the sediment transport capacity.

The aggradation predicted in the McMicken Outlet Channel does not match the previous channel degradation identified in the historic profile. However, the general degradation predicted in the McMicken Outlet Wash is consistent with the degradation observed between 1954 and 1986.

SECTION GA-5:SUBSIDENCE

JEF reviewed the draft Subsidence and Earth Fissure report of the study conducted by AMEC (Reference 16). The subsidence study was a comprehensive investigation including the following elements:

- previous subsidence studies
- groundwater declines measured in ADWR well water level database
- historical and recent survey data
- geophysical surveys
- geotechnical explorations
- and along the dam, developed a subsidence model of past and future subsidence

Historic and current survey elevation data sets from National Geodetic Survey (NGS) monuments crest were reviewed to estimate general subsidence rates. Subsidence rates at the eastern end of the McMicken Outlet Channel since 2000 were close to 0.0 ft/year and about 0.02 ft/year along McMicken Dam at the Bell Road alignment.

Subsidence models were developed at 4 locations along the McMicken Dam and appurtenances using coupled flow and deformation models with surveyed ground and dam crest elevation data from 1955 to 2006 for input. Calibration of the models was performed using Repeat-Pass Synthetic Aperture Radar Interferometry (InSAR) data from 2002 to 2005. Insufficient survey data were available along the McMicken Outlet Channel. Therefore, the subsidence model was developed using the InSAR data alone.

Subsidence profiles were developed from the model for a time period between 1947 and 1982, 2006, 2056, and 2106. The model estimates subsidence between 1947 to 2006 of 3.6 feet at the outlet works and as much as 4.7 feet along the McMicken Outlet Channel approximately 2,000 feet downstream of Grand Avenue. Subsidence near the downstream end of channel is nearly zero.

The subsidence profiles predicted from the models were superimposed on the 1986 and 2000-2004 profiles presented in Section 4.2 as shown on Figure GA-5. Assuming this level of subsidence occurred, a significant amount of aggradation has occurred in the upper channel since 1956. It should be reiterated that the subsidence model is based on limited InSAR data and is not an accurate depiction of actual subsidence along the McMicken Outlet Channel. However, the model provides a general order of magnitude of subsidence and helps explain why the channel appears to have degraded since 1956 when the bed slope is so gradual and no signs of degradation have ever been observed or expected.

SECTION GA-6:CONCLUSIONS

Based on the analytical components of this study, it can be concluded that the McMicken Outlet Channel is likely to aggrade over time given the current conditions of the watershed. The McMicken Outlet Wash is in a degradational condition as a result of increased flows caused by the construction of the McMicken Outlet Channel and alterations to the sediment supply of the natural tributaries caused by the construction of the CAP and the Beardsley Canal. Course grained sediment loads (bed loads) from tributaries to the McMicken Outlet Channel will likely be deposited near their confluences with the McMicken Outlet Channel and will not be transported to the McMicken Outlet Wash.

Future development within the watershed of both the McMicken Outlet Channel and Wash will have the affect of reducing the sediment supply contributing to the watercourses and consequently, reducing the aggradation potential and/or increasing the degradation potential.

Two bridge crossings are proposed for the re-alignment of El Mirage Road as discussed earlier. The current bridge proposals will span the McMicken Outlet Wash main channel and immediate overbanks and supported by piers driven into the channel. The bridge crossings will have a limited affect on the sediment transport within the wash but are not expected to significantly affect the system overall. Impact analyses for any channelization associated with the bridges are being performed by the bridge designers and were not available for inclusion in this report. We would anticipate that increased erosion potential will occur with any channelization, but that the effect would be focused within the bridge reach.

SECTION GA-7:REFERENCES

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13. Pemberton, E.L. and Lara, J.M. Bureau of Reclamation Engineering and Research Center, January 1984, Computing Degradation and Local Scour.
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Table GA-2.A. Peak Discharge Estimate Summary			
HEC-1 Operation	**Q (100-Year)**	**Q (10-Year)**	**Q (2-Year)**
SPPILL	2908	1018	291
PI635	622	218	62
CPI635	2908	1018	291
RPI621	1177	412	118
CPI633	3906	1367	391
RPI603	2239	784	224
CPI600	4434	1552	443
RPD726	2405	842	241
CPD720	5843	2045	584
RD716	584	204	58
C700*	6286	2200	629
RPD704	2930	1026	293
CPD700	7038	2463	704
AF802	425	149	43
C802*	7038	2463	704
RAF807	2496	874	250
CAF810	7163	2507	716

Table GA-2.B. Summary of Recorded Flow Events in the McMicken Outlet Channel							
Gage ID	**Date of Peak**	**Duration (Hours)**	**Peak Discharge (cfs)**	**Gage ID**	**Date of Peak**	**Duration (Hours)**	**Peak Discharge (cfs)**
5438	9/2/2006	33.5	78	5438	8/15/2003	4.2	53
5438	3/21/2006	7.2	13	5438	2/14/2003	26.6	48
5438	8/9/2005	18.6	121	5438	9/7/2002	7.7	159
5438	8/2/2005	21	25	5438	9/7/2002	19.3	180
5438	7/30/2005	72	74	5438	7/24/2002	6.2	80
5438	2/24/2005	6	5	5438	9/20/1999	10.4	76
5438	2/9/2005	148	12	5438	7/15/1999	24.6	98
5438	1/29/2005	0.6	7	5438	2/17/1998	48.7	53
5438	1/25/2005	4	8	5438	7/14/1996	10.7	53
5438	1/4/2005	18	6	5438	1/11/1993	22.4	59
5438	12/4/2005	48	6	5438	9/20/1992	35.8	52
5438	11/30/2004	31.7	25	5438	7/30/1992	0.2	98
5438	4/2/2004	18.6	132	5448	10/1/1990	127.2	318
5438	10/10/2003	15.3	92	5448	9/4/1990	51.4	658
5438	9/4/2003	8	74	5448	8/15/1989	2.6	43
5438	8/27/2003	73.6	213	5448	8/21/1988	272.1	457

Table GA-3.3.A. Model River Station Revisions	
Original Baker Model River Station	**Revised Model River Station**
12.54	14.30125
12	14.3012
10	14.3010
8	14.3008
6	14.3006
4	14.3004
2	14.3002

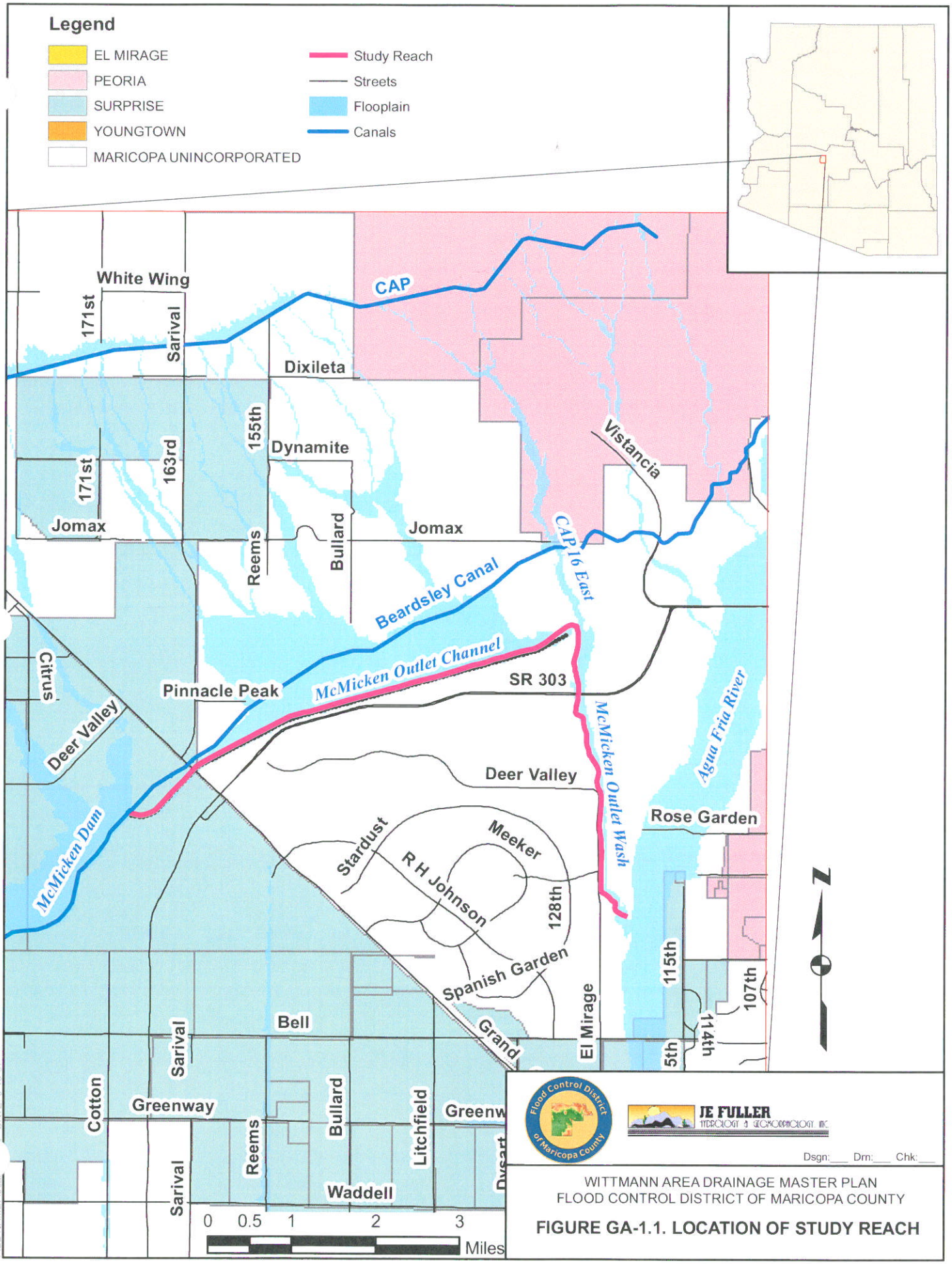
Table GA-3.3.B. Hydraulic Model Summary Output (averaged by reach) for the 10-Year Discharge Event						
Reach	**Hydr Depth Chnl (ft)**	**E.G. Slope (ft/ft)**	**Vel Chnl (fps)**	**Flow Area (sf)**	**Top Width (ft)**	**Froude # Chnl**
79.29 to 47.82	4.8	0.0004	2.2	460	119.7	0.18
44.39 to 13.728	3.9	0.0008	2.8	364	94.3	0.25
13.487 to 12.463	3.4	0.0008	2.8	515	191.7	0.26
12.102 to11.825	3.7	0.0007	2.6	717	301.5	0.24
11.555 to 11.270	3.7	0.0009	3.1	674	217.0	0.28
10.992 to 3.945	3.8	0.0013	3.3	937	362.9	0.30
3.879 to 3.354	5.0	0.0051	6.0	573	317.4	0.47
3.247 to 1.949	4.4	0.0067	6.0	562	275.3	0.52
1.858 to 1.307	2.7	0.0048	4.8	531	196.4	0.52
1.169 to 0.000	2.0	0.0100	5.3	648	373.6	0.73

Table GA-4.3. Historical Aerial Photography		
Date	**Source**	**Media Type**
02-20-49	National Archives	9 x 9 paper prints, B&W, scale 1:20000
10-09-67	Landiscor Aerial	9 x 9 paper prints, B&W, scale 1:40000
12-15-80	Landiscor Aerial	9 x 9 paper prints, B&W, scale 1:40000
11-2004	FCDMC	Orthophotography, Color, 0.80-foot/pixel resolution

Table GA-4.5. Percent Finer Particle Sizes by Reach				
Reach	**$D_{15.9}$ (mm)**	**D_{50} (mm)**	**$D_{84.1}$ (mm)**	**D_{90} (mm)**
Upper Outlet Channel	0.005	0.12	1.4	3.0
Lower Outlet Channel	0.15	2.2	10	13
Outlet Channel Wash	0.14	3.2	51	76.2

	Table GA-4.6. Meyer-Peter, Muller Equilibrium Slope Analysis Results					
	Sediment Reach	**Channel Slope (ft/ft)**	**2-Year Eq. Slope (ft/ft)**	**10-Year Eq. Slope (ft/ft)**	**100-Year Eq. Slope (ft/ft)**	**Condition (10-year)**
Outlet Channel	79.29 to 47.82	0.00029	0.000039 D	0.000024 D	0.000015 D	Degrade
	44.39 to 13.728	0.00064	0.000054 D	0.000029 D	0.000018 D	Degrade
	13.487 to 12.463	0.00082	0.000753 D	0.000424 D	0.000286 D	Degrade
	12.102 to11.825	0.00065	0.000648 =	0.000403 D	0.000294 D	Degrade
	11.555 to 11.270	0.00099	0.000608 D	0.000381 D	0.000252 D	Degrade
	10.992 to 3.945	0.00139	0.000660 D	0.000406 D	0.000277 D	Degrade
Outlet Channel Wash	3.879 to 3.354	0.00501	0.000831 D	0.000518 D	0.000573 D	Degrade
	3.247 to 1.949	0.00525	0.001022 D	0.000659 D	0.000607 D	Degrade
	1.858 to 1.307	0.01200	0.001249 D	0.000618 D	0.000351 D	Degrade
	1.169 to 0.000	0.00575	0.001225 D	0.000929 D	0.000560 D	Degrade

	Table GA-4.7. Dynamic Equilibrium Slope Analysis Results					
	Sediment Reach	**Channel Slope (ft/ft)**	**2-Year Eq. Slope (ft/ft)**	**10-Year Eq. Slope (ft/ft)**	**100-Year Eq. Slope (ft/ft)**	**Condition (10-Year)**
Outlet Channel	79.29 to 47.82	0.00029	0.00651 A	0.00187 A	0.00223 A	Aggrade
	44.39 to 13.728	0.00043	0.00155 A	0.00142 A	0.00130 A	Aggrade
	13.487 to 12.463	0.00075	0.00334 A	0.00266 A	0.00278 A	Aggrade
	12.102 to11.825	0.00093	0.00328 A	0.00281 A	0.00486 A	Aggrade
	11.555 to 11.270	0.00098	0.00253 A	0.00180 A	0.00201 A	Aggrade
	10.992 to 3.945	0.00152	0.00168 A	0.00185 A	0.00168 A	Aggrade
Outlet Channel Wash	3.879 to 3.354	0.00521	0.00254 D	0.00370 D	0.00348 D	Degrade
	3.247 to 1.949	0.00529	0.00523 D	0.00610 A	0.00515 D	Aggrade
	1.858 to 1.307	0.00440	0.00773 A	0.00503 A	0.00441 =	Aggrade
	1.169 to 0.000	0.00586	0.00555 D	0.00435 D	0.00396 D	Degrade


Legend
EL MIRAGE
PEORIA
SURPRISE
YOUNGTOWN
MARICOPA UNINCORPORATED
Study Reach
Streets
Flooplain
Canals
White Wing
171st
Sarival
CAP
Dixileta
155th
Dynamite
163rd
171st
Jomax
Reems
Bullard
Jomax
Vistancia
CAP 16 East
Beardsley Canal
McMicken Outlet Channel
Citrus
Pinnacle Peak
SR 303
Deer Valley
McMicken Outlet Wash
Agua Fria River
Deer Valley
McMicken Dam
Rose Garden
Stardust
Meeker
R H Johnson
128th
Spanish Garden
115th
107th
El Mirage
Bell
Grand
114th
5th
Sarival
Cotton
Greenway
Bullard
Litchfield
Greenw
Reems
Sarival
Waddell
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Miles
N
Flood Control District of Maricopa County
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.
Dsgn:___ Drn:___ Chk:___
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-1.1. LOCATION OF STUDY REACH
DATE: 6-15-07
FILENAME: fig-ga

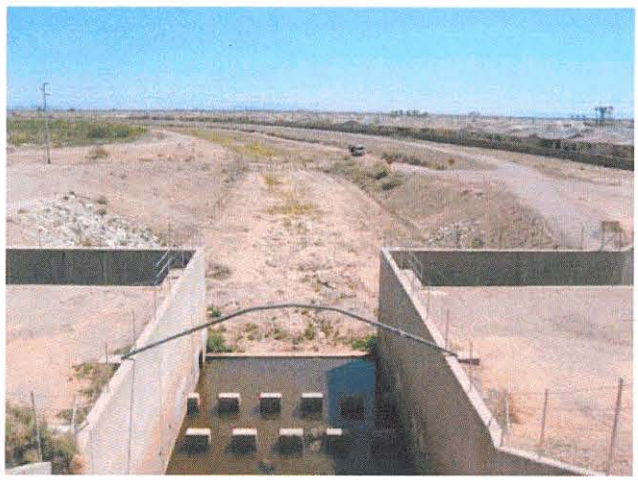


Figure GA-1.3.A: McMicken Outlet Channel at Principal Spillway.

Figure GA-1.3.B: McMicken Outlet Channel at Grand Avenue Bridges

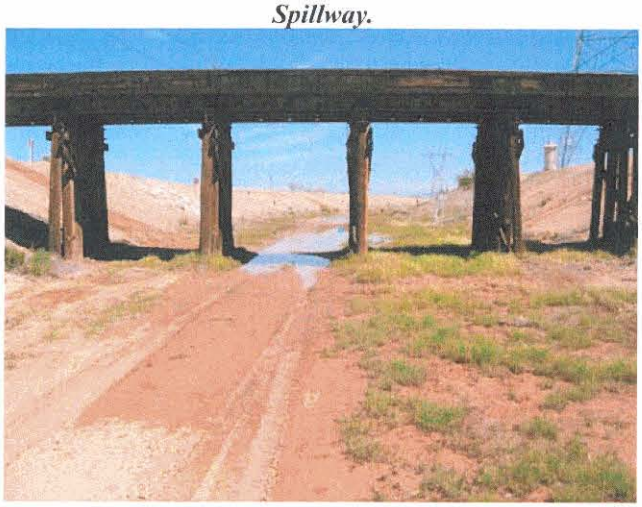


Figure GA-1.3.C: McMicken Outlet Channel at ATSF Railroad Bridge

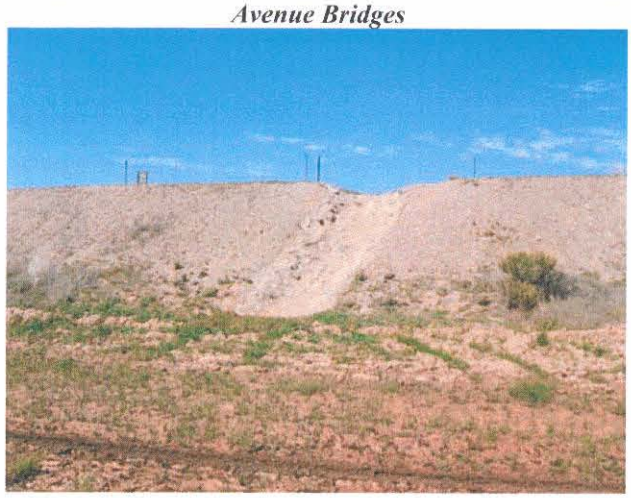
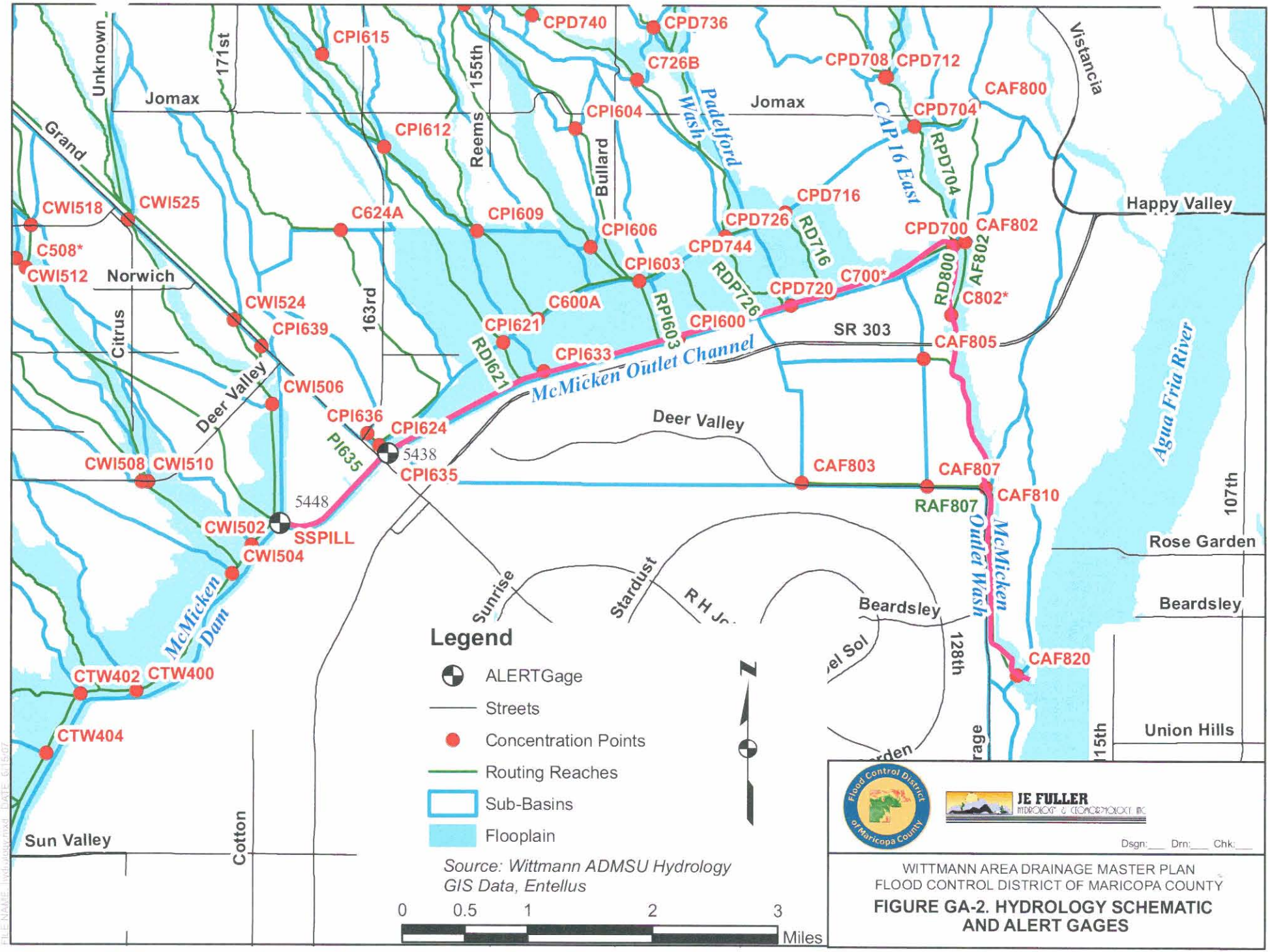


Figure GA-1.3.D: Typical Tributary to McMicken Outlet Channel with Grouted Rock Spillway


Unknown
171st
Jomax
Grand
CPI615
CPD740
CPD736
C726B
155th
Reems
Bullard
CPI604
CPI612
Padelford Wash
Jomax
CPD708
CPD712
CAF800
CPD704
CAP 16 East
RPD704
Vistancia
CWI518
CWI525
C624A
CPI609
CPI606
CPD716
CPD726
RD716
CPD700
CAF802
Happy Valley
C508*
CWI512
Norwich
CPD744
CPI603
RDP726
CPD720
C700*
RD800
AF802
C802*
CWI524
CPI639
163rd
C600A
RPI603
CPI600
CPI621
RD621
CPI633
SR 303
CAF805
Citrus
Deer Valley
CWI506
McMicken Outlet Channel
Agua Fria River
CPI636
CPI624
PI635
5438
Deer Valley
CWI508
CWI510
CPI635
CAF803
CAF807
CAF810
RAF807
5448
CWI502
SSPILL
CWI504
McMicken Outlet Wash
107th
Rose Garden
McMicken Dam
Sunrise
Stardust
R H Jr
Beardsley
Beardsley
128th
CAF820
CTW402
CTW400
CTW404
Union Hills
Sun Valley
Cotton
Legend
ALERTGage
Streets
Concentration Points
Routing Reaches
Sub-Basins
Flooplain
Source: Wittmann ADMSU Hydrology GIS Data, Entellus
0
0.5
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2
3
Miles
N
Flood Control District of Maricopa County
JE FULLER
Dsgn:___ Drn:___ Chk:___
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-2. HYDROLOGY SCHEMATIC AND ALERT GAGES

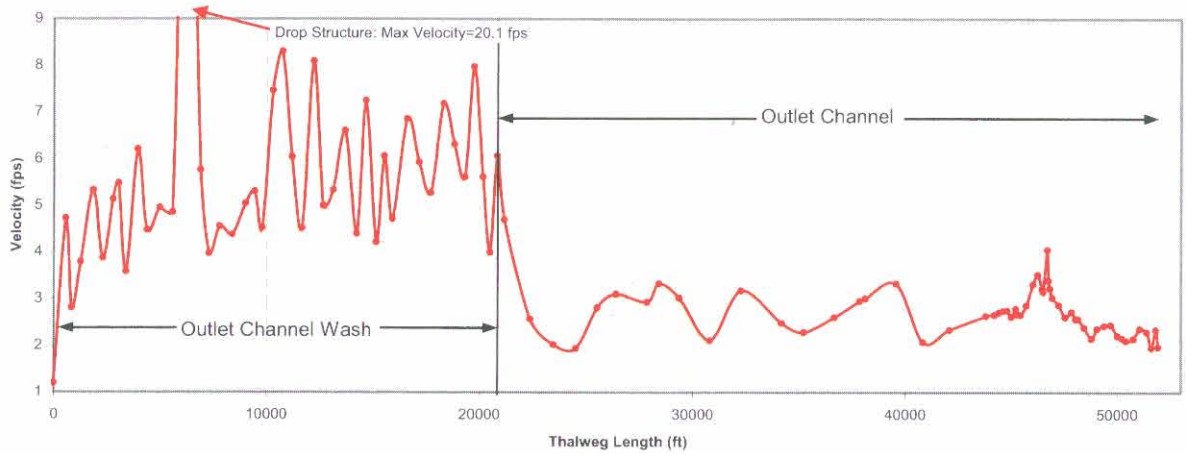

Figure GA-3.3.A. 10-Year Channel Velocity

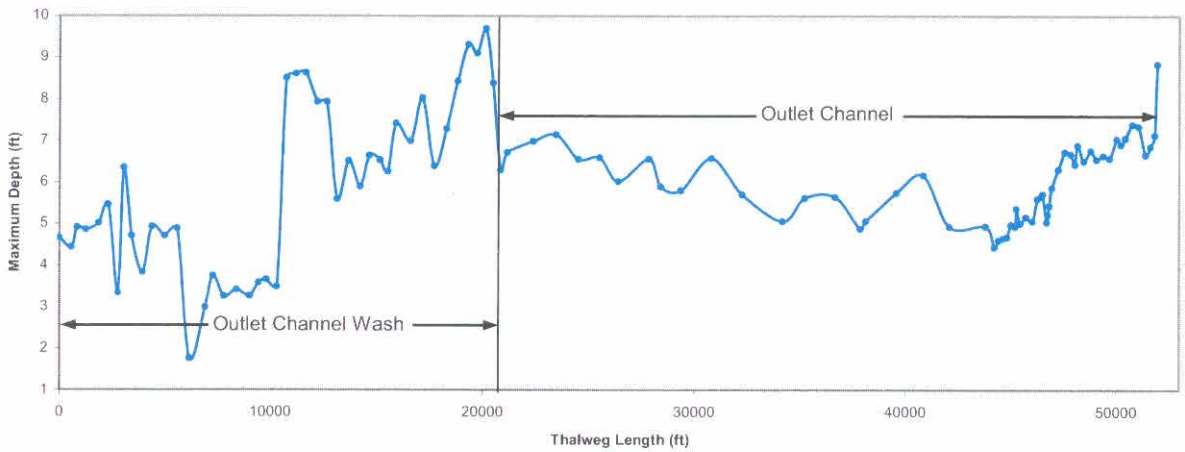

Figure GA-3.3.B. 10-Year Maximum Channel Depth

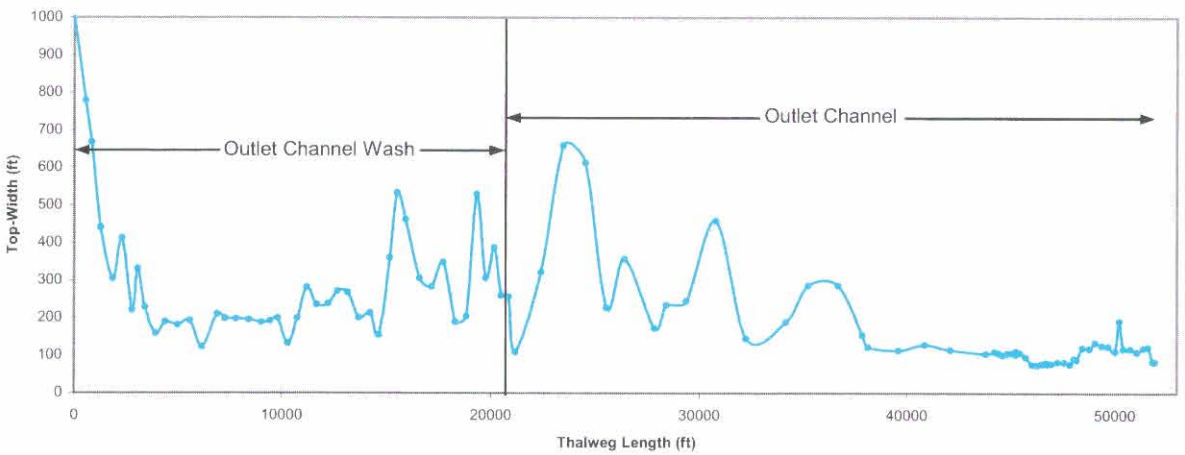

Figure GA-3.3.C. 10-Year Top Width

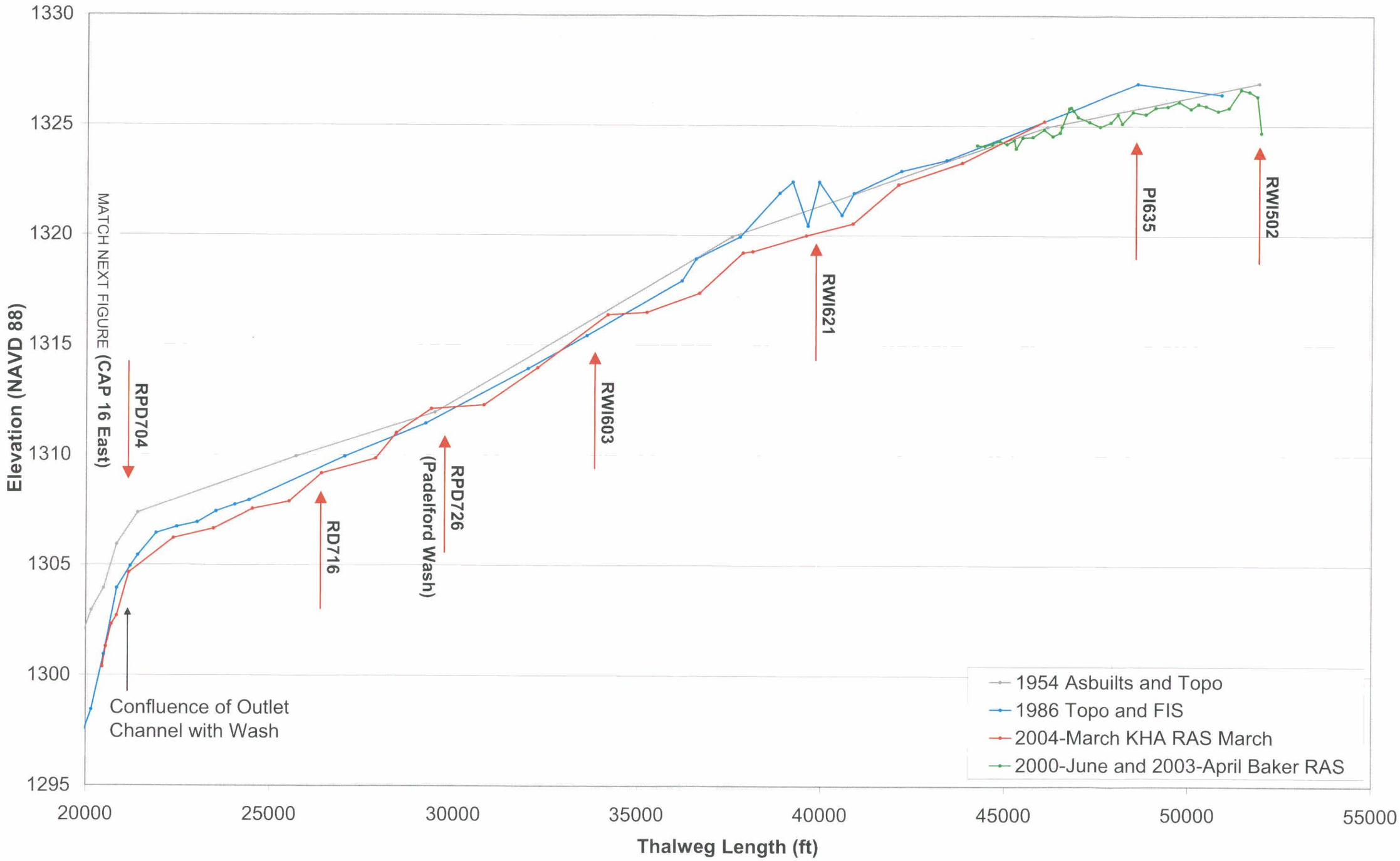

Figure GA-4.2.A. McMicken Outlet Channel Profile Comparison

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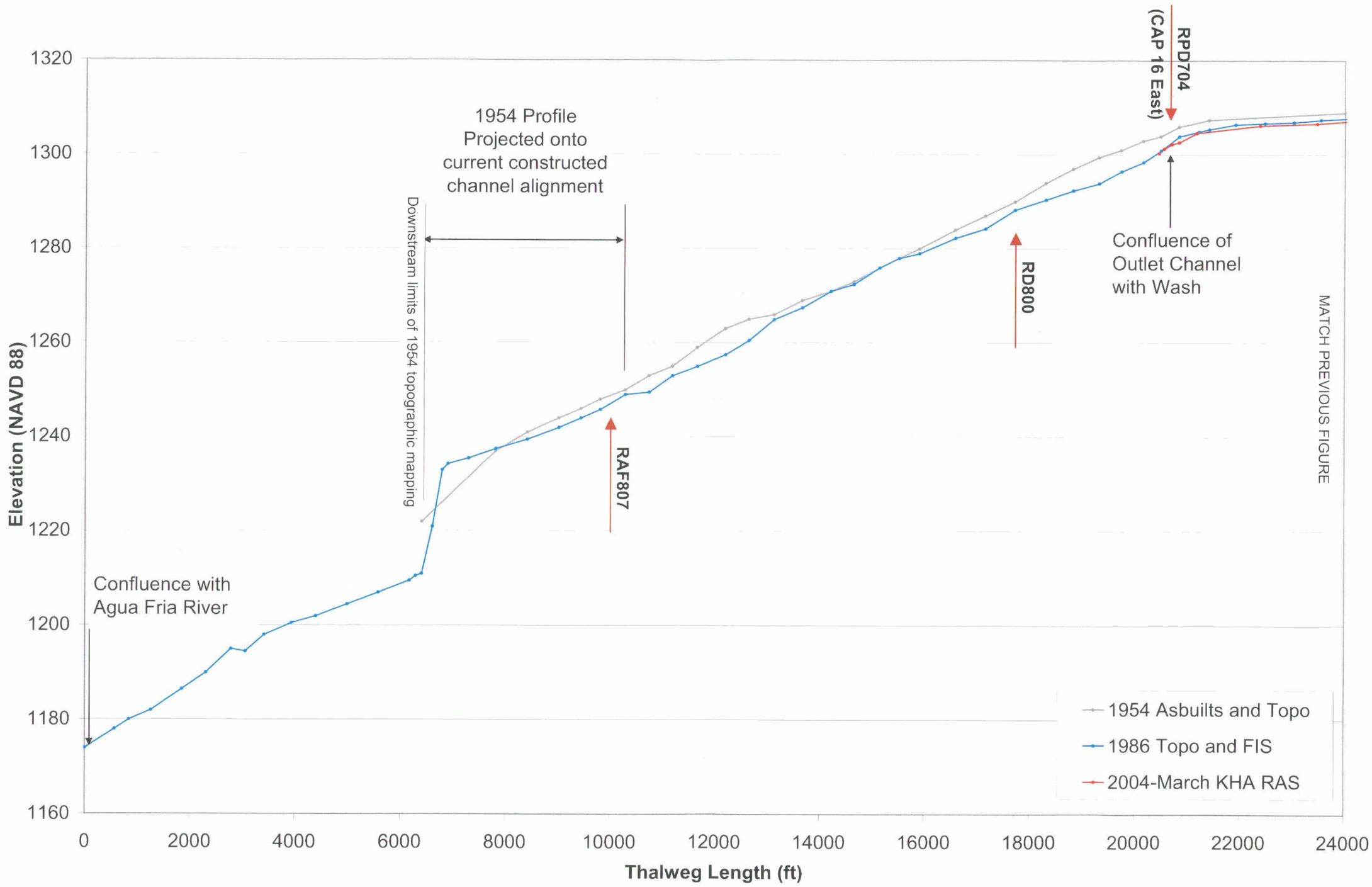

Figure GA-4.2.B. McMicken Outlet Channel Wash Profile Comparison

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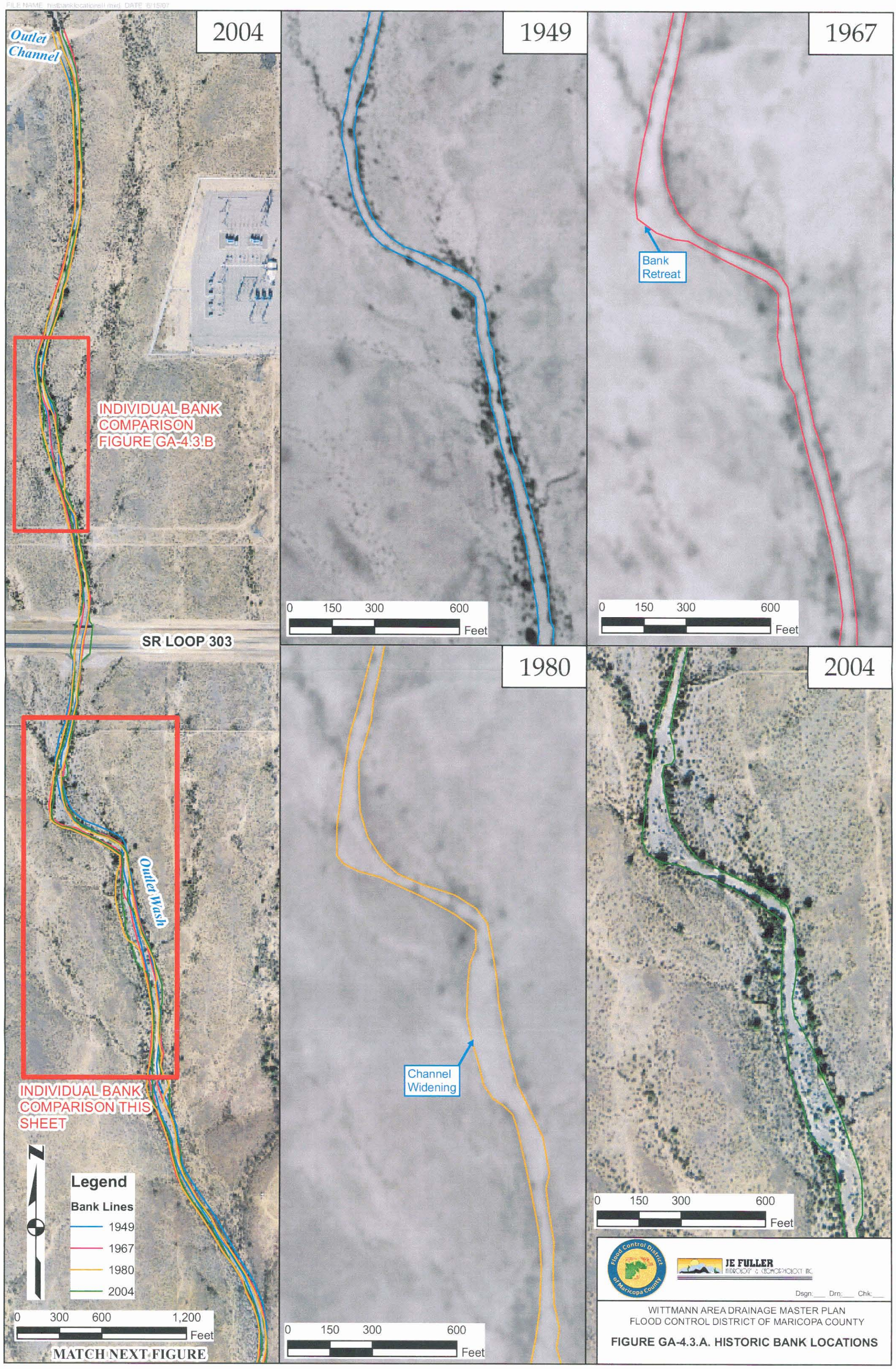
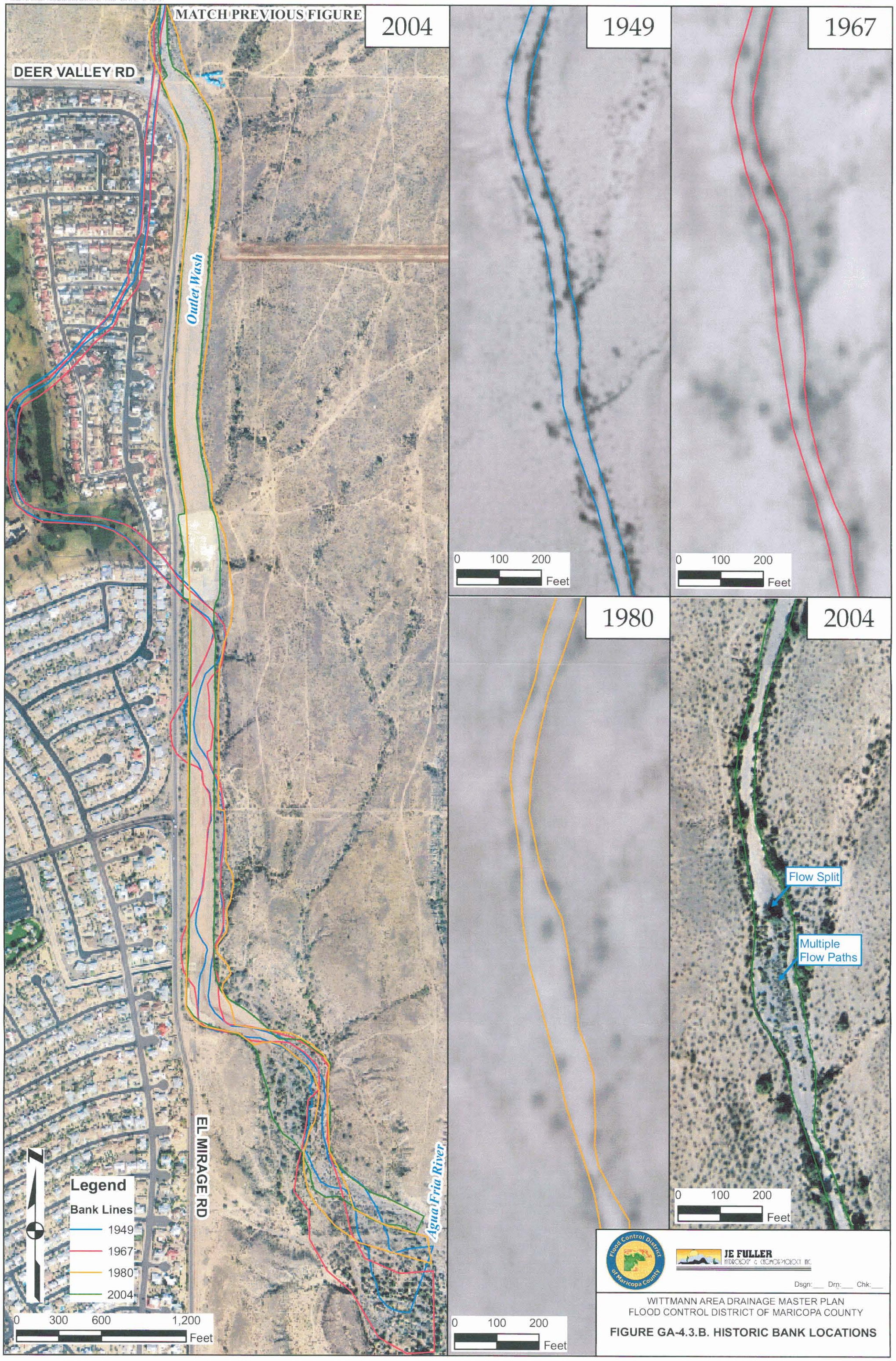
FILE NAME: histbanklocationsII.mxd, DATE: 6/15/07



WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FIGURE GA-4.3.A. HISTORIC BANK LOCATIONS

FILE NAME: hstbanklocations.mxd DATE: 6/15/07



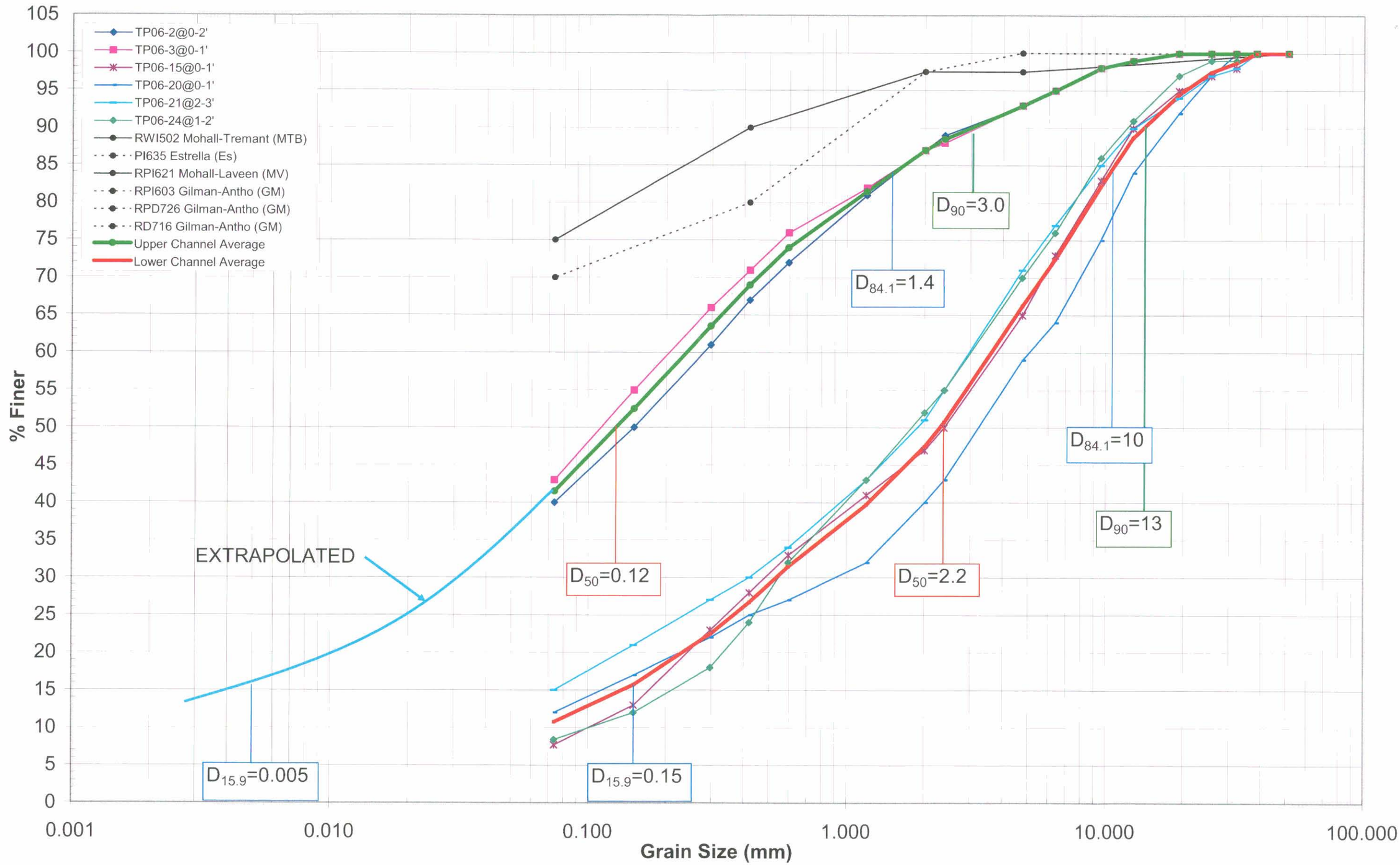


Figure GA-4.5.A. McMicken Outlet Channel Grain Size Distribution

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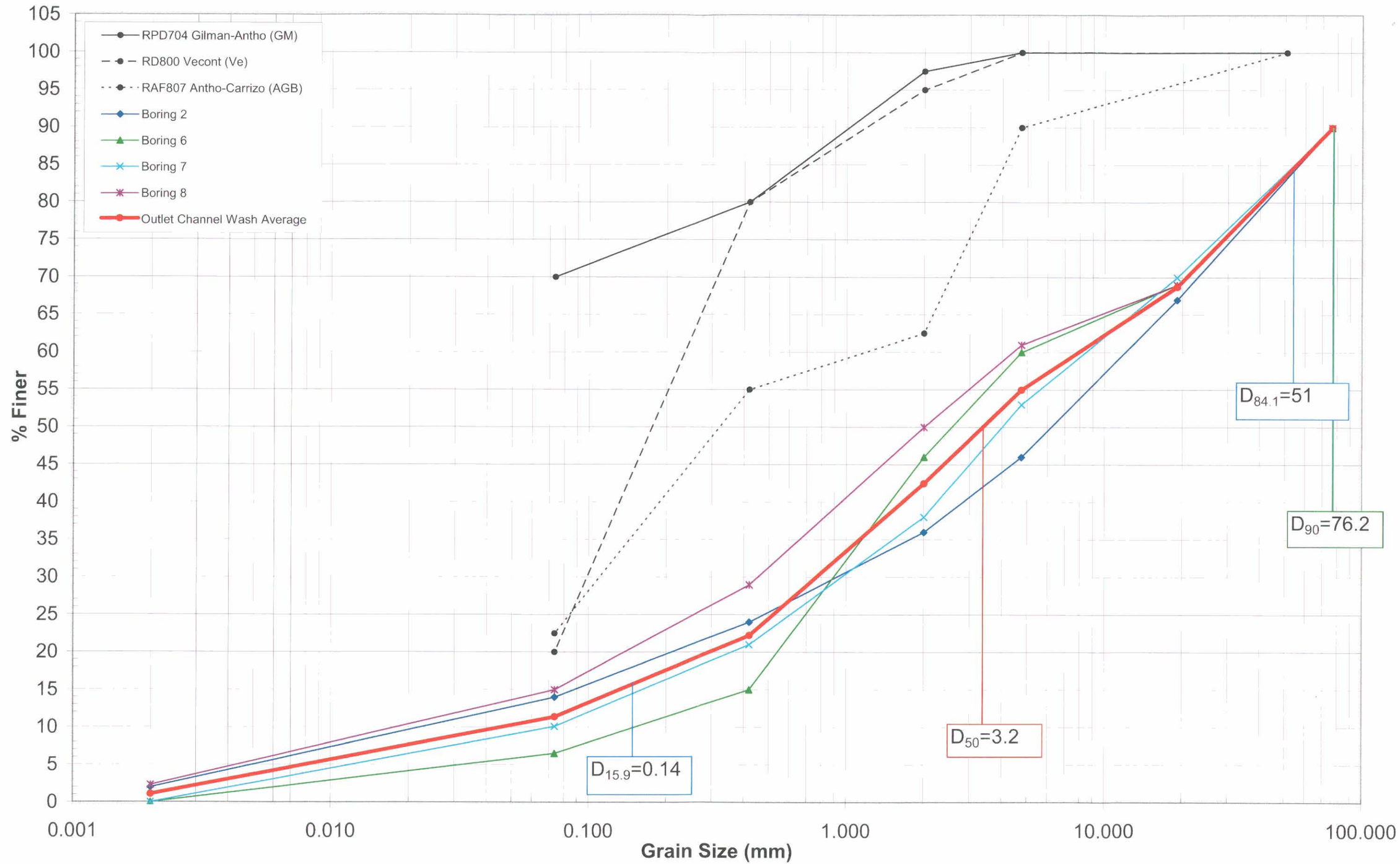

Figure GA-4.5.B. McMicken Outlet Wash Grain Size Distribution

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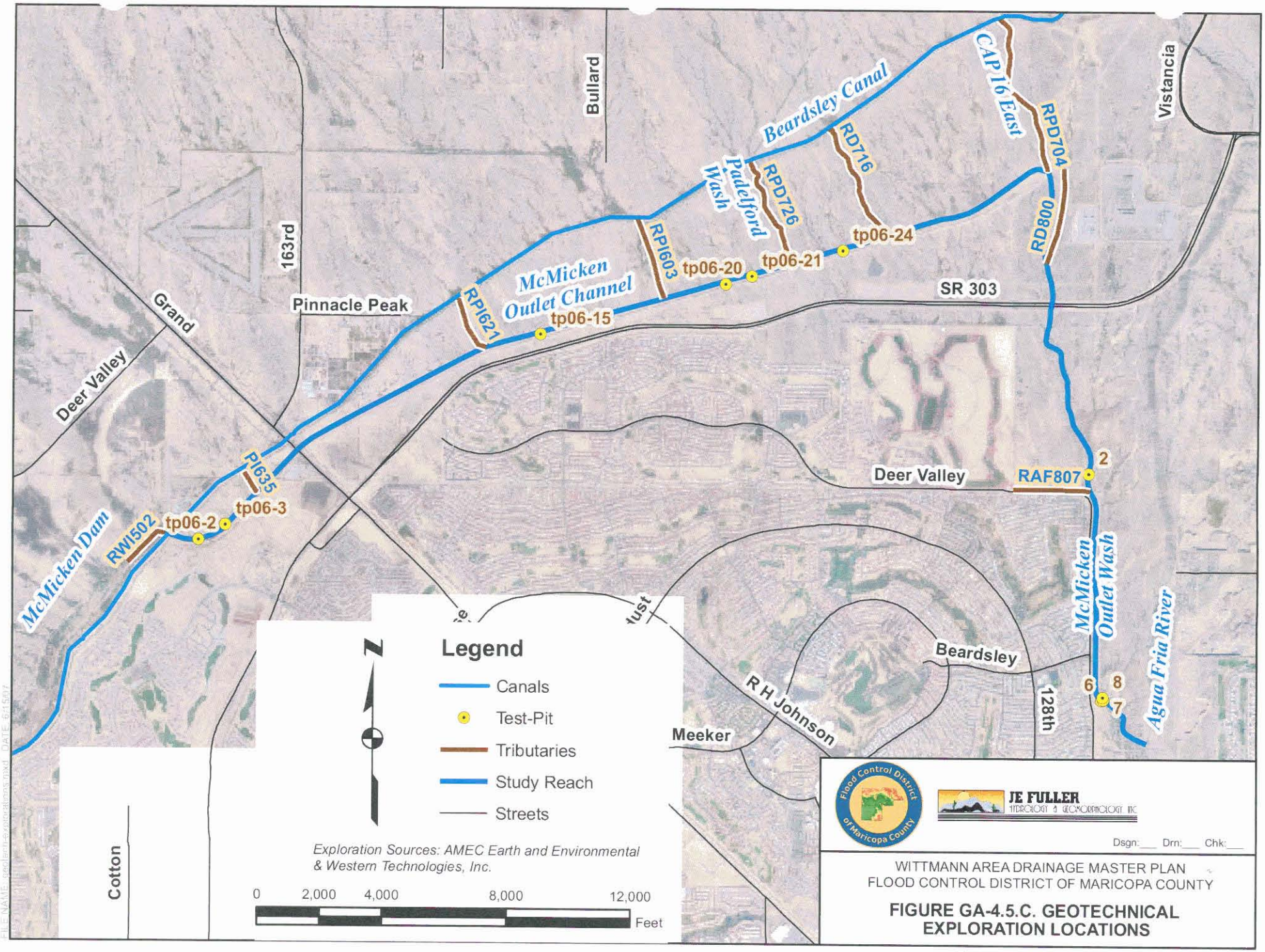
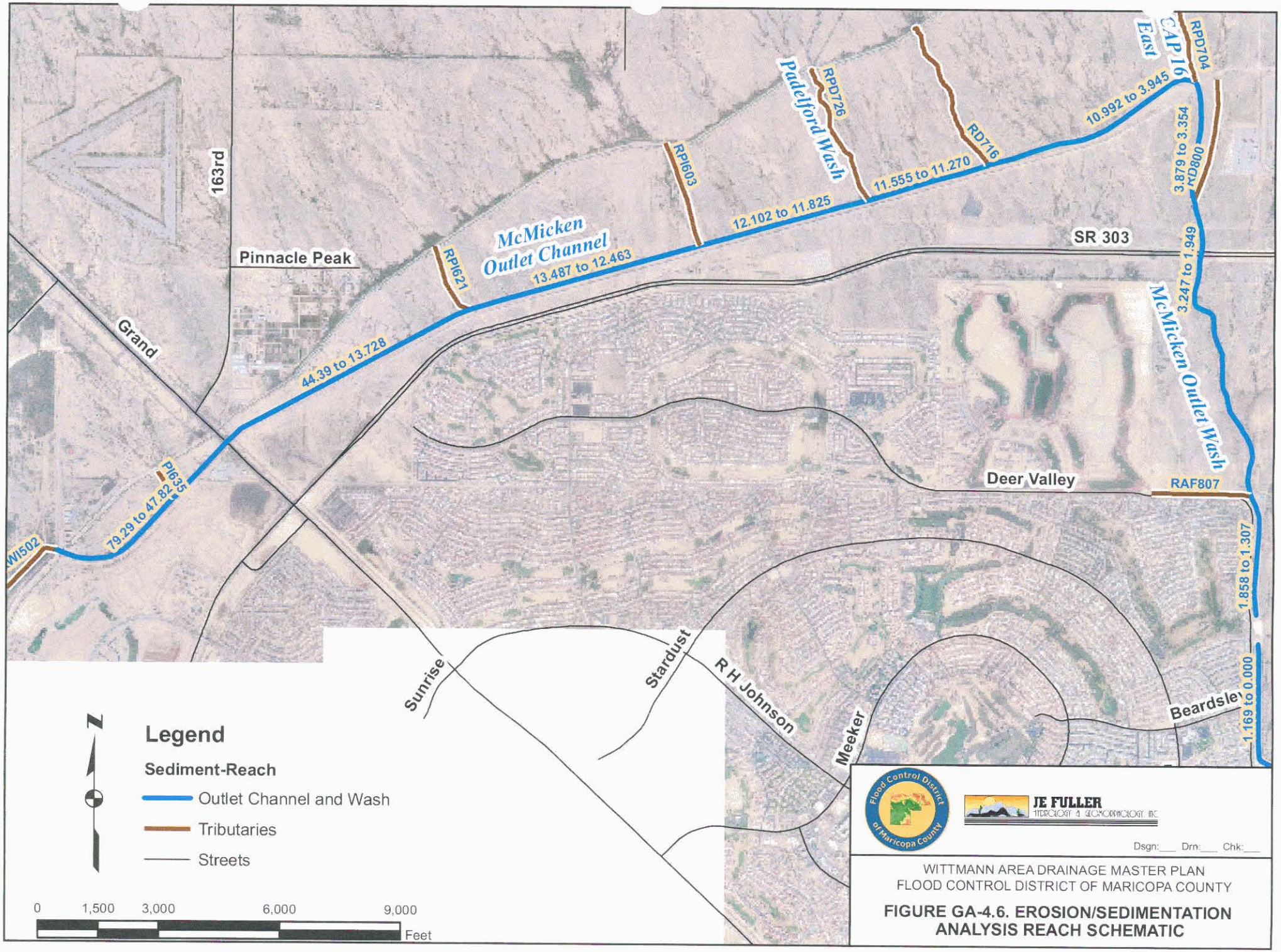

Legend
Canals
Test-Pit
Tributaries
Study Reach
Streets
Exploration Sources: AMEC Earth and Environmental & Western Technologies, Inc.
0
2,000
4,000
8,000
12,000
Feet
N
Bullard
Vistancia
Beardsley Canal
CAP 16 East
RPD704
RD716
Padelford Wash
RPD726
RD800
tp06-24
tp06-21
tp06-20
RPI603
McMicken Outlet Channel
tp06-15
RPI621
SR 303
163rd
Pinnacle Peak
Grand
Deer Valley
PI635
tp06-3
tp06-2
RWI502
McMicken Dam
Deer Valley
RAF807
2
McMicken Outlet Wash
Agua Fria River
Beardsley
R H Johnson
Meeker
128th
6
8
7
Cotton
Flood Control District of Maricopa County
JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC
Dsgn:___ Drn:___ Chk:___
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FIGURE GA-4.5.C. GEOTECHNICAL EXPLORATION LOCATIONS

FILE NAME: sed-eros-s Mxd DATE: 6/15/07



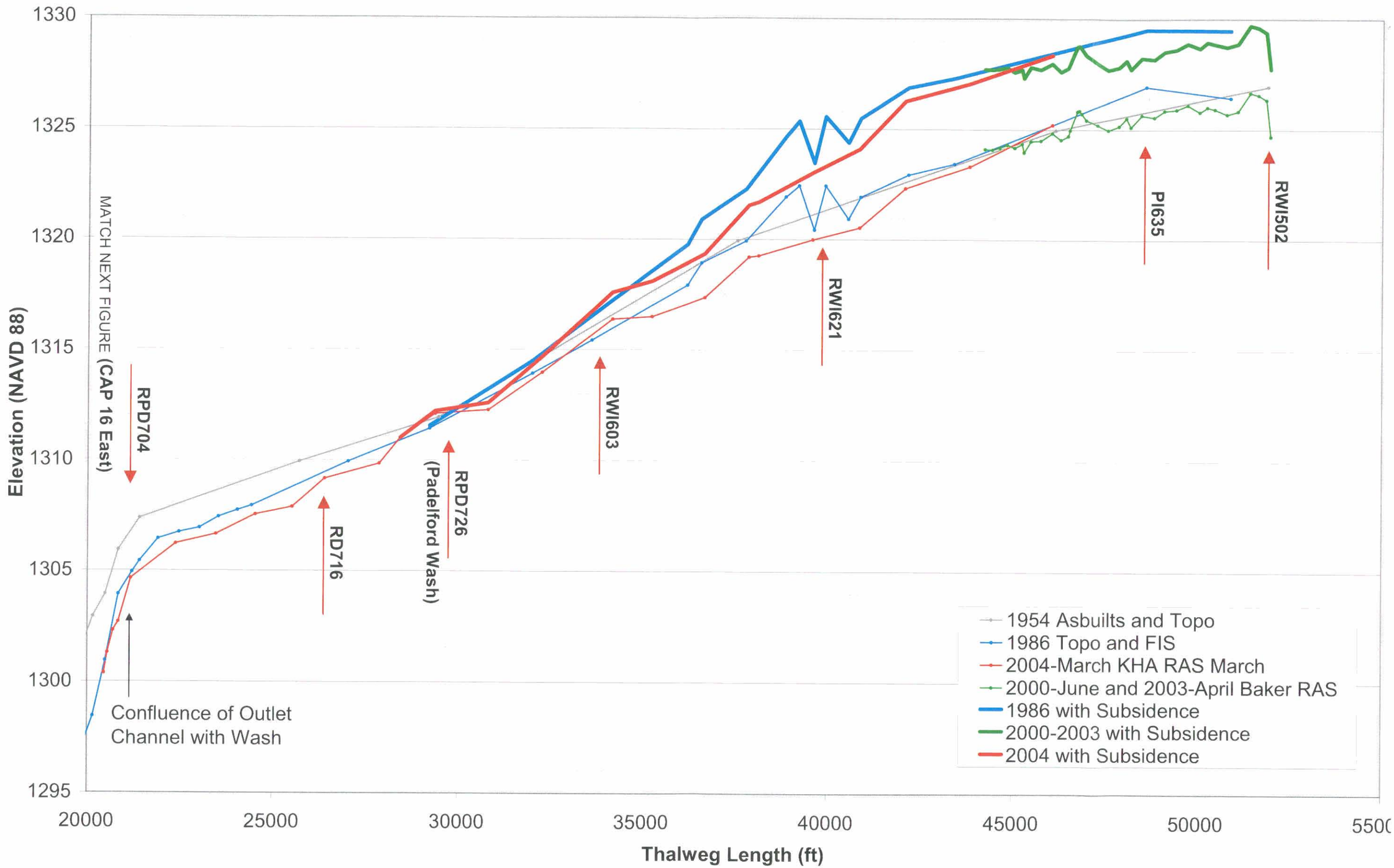


Figure GA-5. McMicken Outlet Channel Profile Comparison with Subsidence Estimates added to profile elevation

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APPENDIX A. EQUILIBRIUM SLOPE CALCULATIONS

A.1. Meyer-Peter, Muller Equilibrium Slope Calculations

A.2. ADWR 1985 Dynamic Equilibrium Slope Calculations

A.1. Meyer-Peter, Muller Equilibrium Slope Calculations

Meyer-Peter, Muller Equilibrium Slope Calculations: 2-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q2

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
79.29 to 47.82	Downstream	79.29	Q2	291	291	0.035	4.23	1324.7	111.78	1330.49	0.000087	1.02	286.23	67.62	0.09	0.12	3	0.000027			
	Downstream	78.17	Q2	291	291	0.035	3.1	1326.35	214.63	1330.46	0.000248	1.41	206.98	66.77	0.14	0.12	3	0.000037			
	Downstream	76.05	Q2	291	291	0.035	2.62	1326.57	226.62	1330.41	0.000269	1.32	220.99	84.45	0.14	0.12	3	0.000043			
	Downstream	73.75	Q2	291	291	0.035	2.81	1326.67	334.1	1330.33	0.000325	1.51	192.8	68.67	0.16	0.12	3	0.000040			
	Downstream	70.42	Q2	291	291	0.035	3.11	1325.84	294.95	1330.24	0.000246	1.41	206.97	66.5	0.14	0.12	3	0.000036			
	Downstream	67.46	Q2	291	291	0.035	3.04	1325.7	330.25	1330.17	0.000227	1.33	218.53	77.59	0.13	0.12	3	0.000037			
	Downstream	64.16	Q2	291	291	0.035	2.93	1325.93	206.79	1330.1	0.000234	1.32	220.57	82.8	0.14	0.12	3	0.000039			
	Downstream	62.09	Q2	291	291	0.035	2.87	1326.02	202.96	1330.04	0.000263	1.38	210.68	155.34	0.14	0.12	3	0.000040			
	Downstream	60.05	Q2	291	291	0.035	2.91	1325.8	326.24	1329.99	0.000255	1.37	212.29	77.13	0.14	0.12	3	0.000039			
	Downstream	56.8	Q2	291	291	0.035	2.8	1326.12	301.37	1329.89	0.000329	1.52	191.91	68.56	0.16	0.12	3	0.000041			
	Downstream	53.79	Q2	291	291	0.035	2.58	1325.91	325.77	1329.78	0.000379	1.55	188.24	72.87	0.17	0.12	3	0.000044			
	Downstream	50.53	Q2	291	291	0.035	2.74	1325.86	270.93	1329.67	0.000313	1.46	199.47	98.86	0.16	0.12	3	0.000041			
	Downstream	47.82	Q2	291	291	0.035	2.66	1325.56	343.33	1329.6	0.000252	1.29	226.45	99.8	0.14	0.12	3	0.000043	0.000039	0.00029	Degrade
44.39 to 13.728	Downstream	44.39	Q2	291	291	0.035	2.87	1325.66	295.79	1329.5	0.000291	1.45	200.96	78.27	0.15	0.12	3	0.000040			
	Downstream	41.43	Q2	291	291	0.035	2.68	1325.13	115.87	1329.4	0.000355	1.53	189.68	70.7	0.17	0.12	3	0.000042			
	Downstream	40.27	Q2	291	291	0.035	2.47	1325.53	198.69	1329.35	0.000432	1.61	181.28	73.27	0.18	0.12	3	0.000046			
	Downstream	38.29	Q2	291	291	0.035	3.1	1325.17	289.87	1329.29	0.000277	1.48	196.19	63.22	0.15	0.12	3	0.000037			
	Downstream	35.4	Q2	291	291	0.035	2.99	1324.99	291.84	1329.21	0.000269	1.43	203.15	67.88	0.15	0.12	3	0.000038			
	Downstream	32.45	Q2	291	291	0.035	2.54	1325.21	308.88	1329.1	0.000459	1.68	173.32	68.36	0.19	0.12	3	0.000045			
	Downstream	29.38	Q2	291	291	0.035	2.64	1325.43	124.78	1328.96	0.000452	1.71	170.49	64.69	0.19	0.12	3	0.000043			
	Downstream	28.13	Q2	291	291	0.035	2.37	1325.73	64.58	1328.88	0.000642	1.9	153.43	64.74	0.22	0.12	3	0.000048			
	Downstream	27.48	Q2	291	291	0.035	2.21	1325.86	2	1328.82	0.000832	2.06	141.38	64.1	0.24	0.12	3	0.000051			
	Downstream	26.94	Q2	291	291	0.035	1.34	1325.83	195.79	1328.51	0.005015	3.65	79.77	59.45	0.55	0.12	3	0.000085			
	Downstream	24.99	Q2	291	291	0.035	2.37	1324.98	5	1328.35	0.000622	1.87	155.82	65.73	0.21	0.12	3	0.000048			
	Downstream	24.5	Q2	291	291	0.035	2.33	1324.72	200.07	1328.08	0.000661	1.9	153.03	65.76	0.22	0.12	3	0.000049			
	Downstream	22.48	Q2	291	291	0.035	2.14	1324.55	233	1327.91	0.000928	2.14	136.29	63.61	0.26	0.12	3	0.000053			
	Downstream	20.15	Q2	291	291	0.035	2.25	1324.85	305	1327.73	0.000711	1.93	151.06	67.07	0.23	0.12	3	0.000050			
	Downstream	17.1	Q2	291	291	0.035	1.92	1324.51	275	1327.51	0.000761	1.8	161.24	83.79	0.23	0.12	3	0.000059			
	Downstream	14.35	Q2	291	291	0.035	1.99	1324.48	181	1327.32	0.000662	1.72	169.41	85.31	0.21	0.12	3	0.000057			
	Downstream	14.30125	Q2	291	291	0.035	1.81	1323.98	54	1327.18	0.000846	1.83	159.26	88.02	0.24	0.12	3	0.000063			
	Downstream	14.3012	Q2	291	291	0.035	1.89	1324.36	200	1327.14	0.000787	1.81	160.44	84.92	0.23	0.12	3	0.000060			
	Downstream	14.301	Q2	291	291	0.035	1.84	1324.18	200	1326.99	0.000702	1.69	172.58	93.68	0.22	0.12	3	0.000062			
	Downstream	14.3008	Q2	291	291	0.035	1.74	1324.32	200	1326.83	0.0009	1.84	158.3	90.9	0.25	0.12	3	0.000065			
	Downstream	14.3006	Q2	291	291	0.035	1.96	1324.19	200	1326.68	0.000675	1.72	169.31	86.54	0.22	0.12	3	0.000058			
	Downstream	14.3004	Q2	291	291	0.035	1.75	1324.09	200	1326.52	0.000858	1.8	161.51	92.17	0.24	0.12	3	0.000065			
	Downstream	14.3002	Q2	291	291	0.035	1.62	1324.11	405	1326.33	0.001037	1.88	155.06	95.96	0.26	0.12	3	0.000070			
	Downstream	14.289	Q2	291	291	0.035	1.91	1323.32	1727	1325.99	0.000692	1.72	169.65	88.62	0.22	0.12	3	0.000059			
	Downstream	13.962	Q2	291	291	0.035	1.86	1322.33	1236	1324.87	0.000615	1.59	183.59	98.86	0.2	0.12	3	0.000061			
	Downstream	13.728	Q2	291	291	0.035	2.14	1320.55	1268	1324.3	0.000365	1.34	216.38	100.88	0.16	0.12	3	0.000053	0.000054	0.00064	Degrade
13.487 to 12.463	Downstream	13.487	Q2	391	391	0.035	1.96	1320	1460	1323.42	0.001156	2.25	173.67	88.56	0.28	2.2	13	0.000735			
	Downstream	13.211	Q2	391	391	0.035	2.07	1319.27	265	1322.09	0.000754	1.89	207.25	100.1	0.23	2.2	13	0.000696			
	Downstream	13.161	Q2	391	391	0.035	1.96	1319.21	1191	1321.87	0.000886	1.97	198.24	101.24	0.25	2.2	13	0.000735			
	Downstream	12.935	Q2	391	391	0.035	1.91	1317.38	1429	1320.86	0.000832	1.88	207.95	108.99	0.24	2.2	13	0.000755			
	Downstream	12.665	Q2	391	391	0.035	1.98	1316.5	1062	1319.94	0.00052	1.52	256.89	129.89	0.19	2.2	13	0.000728			
	Downstream	12.463	Q2	391	391	0.035	1.66	1316.39	1906	1319.14	0.001106	1.97	198.14	119.65	0.27	2.2	13	0.000868	0.000753	0.00082	Degrade
12.102 to11.825	Downstream	12.102	Q2	443	443	0.035	2.11	1313.98	1466	1317.17	0.000966	2.17	204.49	96.75	0.26	2.2	13	0.000683			
	Downstream	11.825	Q2	443	443	0.035	2.35	1312.28	1425	1316.28	0.000431	1.55	285.04	121.25	0.18	2.2	13	0.000613	0.000648	0.00065	Degrade
11.555 to 11.270	Downstream	11.555	Q2	584	584	0.035	2.18	1312.1	943	1315.3	0.000976	2.23	262.07	120.1	0.27	2.2	13	0.000661			
	Downstream	11.376	Q2	584	584	0.035	2.09	1311.01	563	1314.09	0.001619	2.79	209.66	100.34	0.34	2.2	13	0.000690			
	Downstream	11.27	Q2	584	584	0.035	2.74	1309.85	1464	1313.69	0.000474	1.79	325.66	118.95	0.19	2.2	13	0.000526	0.000608	0.00099	Degrade
10.992 to 3.945	Downstream	10.992	Q2	629	629	0.035	2.21	1309.17	877	1312.71	0.000922	2.18	287.96	130.28	0.26	2.2	13	0.000652			
	Downstream	10.826	Q2	629	621.81	0.035	2.32	1307.89	999	1312.07	0.000609	1.84	351.98	158.13	0.21	2.2	13	0.000628			
	Downstream	10.637	Q2	629	626.97	0.035	2.17	1307.55	1060	1311.63	0.000362	1.35	476.71	264.41	0.16	2.2	13	0.000666			
	Downstream	10.436	Q2	629	628.8	0.035	2.11	1306.65	1089	1311.16	0.000511	1.58	402.04	259.3	0.19	2.2	13	0.000683			
	Downstream	10.23	Q2	629	629	0.035	2.43	1306.22	1213	1310.33	0.001049	2.48	253.89	104.34	0.28	2.2	13	0.000593			

Meyer-Peter, Muller Equilibrium Slope Calculations: 2-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q2

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
	Downstream	10	Q2	629	629	0.035	2.53	1304.65	341	1308.92	0.001239	2.76	227.72	89.94	0.31	2.2	13	0.000570			
	Downstream	3.945	Q2	629	629	0.035	1.74	1303.94	350	1307.93	0.005467	4.53	138.93	79.66	0.6	2.2	13	0.000828	0.000660	0.00139	Degrade
3.879 to 3.354	Downstream	3.879	Q2	704	704	0.05	2.16	1300.94	330	1306.34	0.004373	3.27	215.47	99.58	0.39	3.2	76.2	0.001065			
	Downstream	3.816	Q2	704	704	0.05	3.29	1298.44	420	1305.01	0.003397	3.76	187.13	56.95	0.37	3.2	76.2	0.000699			
	Downstream	3.737	Q2	704	704	0.05	3.23	1296.44	425	1302.9	0.006442	5.06	139.15	43.07	0.5	3.2	76.2	0.000712			
	Downstream	3.656	Q2	704	704	0.05	2.99	1293.94	490	1300.01	0.00717	5.1	138.08	46.12	0.52	3.2	76.2	0.000769			
	Downstream	3.563	Q2	704	704	0.05	3.5	1292.44	520	1297.86	0.003235	3.82	184.19	52.56	0.36	3.2	76.2	0.000657			
	Downstream	3.465	Q2	704	704	0.05	2.49	1290.44	585	1295.42	0.006762	4.45	158.04	63.43	0.5	3.2	76.2	0.000924			
	Downstream	3.354	Q2	704	704	0.05	2.33	1288.24	565	1291.79	0.005848	3.97	177.29	76.22	0.46	3.2	76.2	0.000987	0.000831	0.00501	Degrade
3.247 to 1.949	Downstream	3.247	Q2	704	704	0.05	3.26	1284.24	565	1289.24	0.00362	3.87	181.97	55.79	0.38	3.2	76.2	0.000706			
	Downstream	3.14	Q2	704	704	0.05	3.12	1282.24	680	1287.4	0.003038	3.46	203.52	65.31	0.35	3.2	76.2	0.000737			
	Downstream	3.011	Q2	704	630.36	0.05	3.02	1278.94	393	1284.66	0.005252	4.43	236.97	309.49	0.45	3.2	76.2	0.000851			
	Downstream	2.937	Q2	704	637.15	0.05	2.23	1277.94	370	1282.17	0.007643	4.41	183.84	112.35	0.52	3.2	76.2	0.001140			
	Downstream	2.867	Q2	704	704	0.05	1.9	1275.94	490	1279.98	0.004845	3.16	223.06	117.48	0.4	3.2	76.2	0.001211			
	Downstream	2.774	Q2	704	704	0.05	2.34	1272.44	440	1277.12	0.006495	4.19	167.84	71.8	0.48	3.2	76.2	0.000983			
	Downstream	2.691	Q2	704	704	0.05	1.66	1270.94	540	1274.47	0.00591	3.19	220.7	132.97	0.44	3.2	76.2	0.001386			
	Downstream	2.588	Q2	704	704	0.05	2.78	1267.44	540	1271.82	0.003977	3.68	191.39	68.83	0.39	3.2	76.2	0.000828			
	Downstream	2.486	Q2	704	704	0.05	1.49	1264.94	480	1268.58	0.00991	3.85	182.76	122.52	0.56	3.2	76.2	0.001544			
	Downstream	2.395	Q2	704	704	0.05	2.53	1260.44	450	1265.68	0.004132	3.53	199.6	78.84	0.39	3.2	76.2	0.000909			
	Downstream	2.31	Q2	704	704	0.05	2.77	1257.44	540	1263.02	0.007445	4.97	141.54	51.19	0.53	3.2	76.2	0.000831			
	Downstream	2.208	Q2	704	614.82	0.05	3.24	1254.94	475	1260.89	0.002734	3.36	270.51	155.79	0.33	3.2	76.2	0.000813			
	Downstream	2.118	Q2	704	704	0.05	2.59	1252.94	440	1258.4	0.009184	5.3	132.94	51.24	0.58	3.2	76.2	0.000888			
	Downstream	2.034	Q2	704	704	0.05	3.46	1249.44	450	1255.27	0.005754	5	140.7	40.67	0.47	3.2	76.2	0.000665			
	Downstream	1.949	Q2	704	704	0.05	1.25	1248.94	480	1250.93	0.019721	4.84	145.48	116.27	0.76	3.2	76.2	0.001841	0.001022	0.00525	Degrade
1.858 to 1.307	Downstream	1.858	Q2	716	716	0.04	1.43	1245.74	370	1247.85	0.003436	2.76	259.8	182.21	0.41	3.2	76.2	0.001151			
	Downstream	1.788	Q2	716	716	0.04	1.22	1243.94	425	1246.17	0.00583	3.23	221.37	181.68	0.52	3.2	76.2	0.001349			
	Downstream	1.708	Q2	716	716	0.04	1.28	1241.94	605	1243.59	0.006207	3.45	207.69	162.15	0.54	3.2	76.2	0.001286			
	Downstream	1.593	Q2	716	716	0.04	1.54	1239.44	603	1241.28	0.002683	2.56	279.54	181.69	0.36	3.2	76.2	0.001069			
	Downstream	1.479	Q2	716	716	0.04	1.23	1237.44	516	1238.96	0.005615	3.2	223.7	181.21	0.51	3.2	76.2	0.001338			
	Downstream	1.381	Q2	716	716	0.04	1.76	1235.44	392	1237.54	0.001743	2.25	317.69	180.98	0.3	3.2	76.2	0.000935			
	Downstream	1.307	Q2	716	716	0.04	1.02	1234.24	113	1236.12	0.008606	3.49	205.19	201.32	0.61	3.2	76.2	0.001614	0.001249	0.01200	Degrade
1.169 to 0.000	Downstream	1.169	Q2	716	716	0.02	0.53	1209.44	585	1210.27	0.092344	14.8	48.38	91.11	3.58	3.2	76.2	0.001098			
	Downstream	1.058	Q2	716	716	0.04	1.51	1206.94	591	1210.11	0.004233	3.18	225.26	149.21	0.46	3.2	76.2	0.001090			
	Downstream	0.946	Q2	716	716	0.04	1.48	1204.44	600	1207.39	0.004916	3.38	211.61	142.79	0.49	3.2	76.2	0.001112			
	Downstream	0.833	Q2	716	716	0.04	1.64	1201.94	457	1205.01	0.003373	3	238.76	145.57	0.41	3.2	76.2	0.001004			
	Downstream	0.746	Q2	716	716	0.04	1.4	1200.44	521	1202.74	0.007109	3.93	182.42	129.89	0.58	3.2	76.2	0.001176			
	Downstream	0.647	Q2	716	716	0.04	1.5	1197.94	360	1200.55	0.002987	2.66	269.66	180.16	0.38	3.2	76.2	0.001098			
	Downstream	0.579	Q2	716	716	0.04	2.13	1194.44	273	1198.48	0.008167	5.52	129.76	60.89	0.67	3.2	76.2	0.000773			
	Downstream	0.527	Q2	716	716	0.04	1.26	1194.94	480	1196.75	0.006217	3.41	209.7	166.46	0.54	3.2	76.2	0.001307			
	Downstream	0.437	Q2	716	716	0.04	1.69	1189.94	459	1193.72	0.006022	4.06	176.15	104.25	0.55	3.2	76.2	0.000974			
	Downstream	0.35	Q2	716	716	0.04	1.32	1186.44	590	1189.7	0.012665	4.99	143.36	108.95	0.77	3.2	76.2	0.001247			
	Downstream	0.238	Q2	716	716	0.04	1.16	1181.94	418	1185.47	0.004928	2.88	248.71	213.94	0.47	3.2	76.2	0.001419			
	Downstream	0.159	Q2	716	716	0.04	1.2	1179.94	274	1183.85	0.003236	2.38	301.17	251.5	0.38	3.2	76.2	0.001372			
	Downstream	0.107	Q2	716	716	0.04	0.75	1177.94	564	1181.57	0.02689	5	143.15	191.53	1.02	3.2	76.2	0.002195			
	Downstream	0	Q2	716	716	0.04	1.28	1173.94		1177.18	0.0004	0.87	819.07	641.78	0.14	3.2	76.2	0.001286	0.001225	0.00575	Degrade

Meyer-Peter, Muller Equilibrium Slope Calculations: 10-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q10

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
79.29 to 47.82	Downstream	79.29	Q10	1018	1018	0.035	6.21	1324.7	111.78	1333.54	0.000198	1.97	515.81	83.01	0.14	0.12	3	0.000018			
	Downstream	78.17	Q10	1018	1018	0.035	5.18	1326.35	214.63	1333.48	0.000351	2.34	434.85	83.94	0.18	0.12	3	0.000022			
	Downstream	76.05	Q10	1018	1018	0.035	4.52	1326.57	226.62	1333.43	0.000287	1.95	520.73	121.73	0.16	0.12	3	0.000025			
	Downstream	73.75	Q10	1018	1018	0.035	4.06	1326.67	334.1	1333.33	0.000459	2.29	444.68	119.18	0.2	0.12	3	0.000028			
	Downstream	70.42	Q10	1018	1018	0.035	5.03	1325.84	294.95	1333.18	0.00037	2.36	431.17	108.93	0.19	0.12	3	0.000023			
	Downstream	67.46	Q10	1018	1018	0.035	4.76	1325.7	330.25	1333.09	0.000325	2.14	475.08	116.99	0.17	0.12	3	0.000024			
	Downstream	64.16	Q10	1018	1018	0.035	4.73	1325.93	206.79	1332.99	0.000314	2.1	485.21	117.37	0.17	0.12	3	0.000024			
	Downstream	62.09	Q10	1018	1018	0.035	4.61	1326.02	202.96	1332.92	0.000344	2.16	471.48	191.28	0.18	0.12	3	0.000025			
	Downstream	60.05	Q10	1018	1018	0.035	4.76	1325.8	326.24	1332.84	0.000346	2.21	460.72	110.95	0.18	0.12	3	0.000024			
	Downstream	56.8	Q10	1018	1018	0.035	4.36	1326.12	301.37	1332.69	0.000473	2.44	417.67	124.66	0.21	0.12	3	0.000026			
	Downstream	53.79	Q10	1018	1018	0.035	4.31	1325.91	325.77	1332.55	0.000472	2.42	421.5	126	0.21	0.12	3	0.000026			
	Downstream	50.53	Q10	1018	1018	0.035	4.48	1325.86	270.93	1332.41	0.000428	2.36	432	133.72	0.2	0.12	3	0.000025			
	Downstream	47.82	Q10	1018	1018	0.035	4.89	1325.56	343.33	1332.32	0.000316	2.15	474.11	118.23	0.17	0.12	3	0.000023	0.000024	0.00029	Degrade
44.39 to 13.728	Downstream	44.39	Q10	1018	1018	0.035	4.46	1325.66	295.79	1332.17	0.000443	2.39	425.21	120.34	0.2	0.12	3	0.000025			
	Downstream	41.43	Q10	1018	1018	0.035	4.56	1325.13	115.87	1332.02	0.000497	2.57	396.09	88.19	0.21	0.12	3	0.000025			
	Downstream	40.27	Q10	1018	1018	0.035	4.33	1325.53	198.69	1331.96	0.00053	2.57	395.98	91.37	0.22	0.12	3	0.000026			
	Downstream	38.29	Q10	1018	1018	0.035	4.89	1325.17	289.87	1331.84	0.000511	2.72	374.86	76.62	0.22	0.12	3	0.000023			
	Downstream	35.4	Q10	1018	1018	0.035	4.76	1324.99	291.84	1331.71	0.000487	2.61	390.04	81.97	0.21	0.12	3	0.000024			
	Downstream	32.45	Q10	1018	1018	0.035	4.33	1325.21	308.88	1331.52	0.000662	2.87	355.25	82.01	0.24	0.12	3	0.000026			
	Downstream	29.38	Q10	1018	1018	0.035	4.33	1325.43	124.78	1331.29	0.000742	3.03	336.43	77.79	0.26	0.12	3	0.000026			
	Downstream	28.13	Q10	1018	1018	0.035	4.06	1325.73	64.58	1331.16	0.00091	3.22	316.31	77.83	0.28	0.12	3	0.000028			
	Downstream	27.48	Q10	1018	1018	0.035	3.93	1325.86	2	1331.08	0.001057	3.39	300.05	76.31	0.3	0.12	3	0.000029			
	Downstream	26.94	Q10	1018	1018	0.035	3.12	1325.83	195.79	1330.87	0.002026	4.05	251.44	80.6	0.4	0.12	3	0.000036			
	Downstream	24.99	Q10	1018	1018	0.035	4.17	1324.98	5	1330.69	0.000843	3.15	323.49	77.59	0.27	0.12	3	0.000027			
	Downstream	24.5	Q10	1018	1018	0.035	4.12	1324.72	200.07	1330.38	0.000892	3.21	316.77	76.8	0.28	0.12	3	0.000028			
	Downstream	22.48	Q10	1018	1018	0.035	3.91	1324.55	233	1330.15	0.001139	3.51	290.34	74.27	0.31	0.12	3	0.000029			
	Downstream	20.15	Q10	1018	1018	0.035	4.04	1324.85	305	1329.91	0.000981	3.31	307.18	75.99	0.29	0.12	3	0.000028			
	Downstream	17.1	Q10	1018	1018	0.035	3.71	1324.51	275	1329.67	0.000807	2.86	355.42	95.89	0.26	0.12	3	0.000031			
	Downstream	14.35	Q10	1018	1018	0.035	3.57	1324.48	181	1329.48	0.000731	2.66	382.34	107.1	0.25	0.12	3	0.000032			
	Downstream	14.30125	Q10	1018	1018	0.035	3.44	1323.98	54	1329.34	0.000772	2.67	380.86	110.6	0.25	0.12	3	0.000033			
	Downstream	14.3012	Q10	1018	1018	0.035	3.56	1324.36	200	1329.29	0.000806	2.79	365.14	102.67	0.26	0.12	3	0.000032			
	Downstream	14.301	Q10	1018	1018	0.035	3.63	1324.18	200	1329.15	0.00069	2.62	388.86	107.09	0.24	0.12	3	0.000031			
	Downstream	14.3008	Q10	1018	1018	0.035	3.52	1324.32	200	1328.99	0.000794	2.75	369.87	104.95	0.26	0.12	3	0.000032			
	Downstream	14.3006	Q10	1018	1018	0.035	3.67	1324.19	200	1328.83	0.000745	2.74	371.9	101.24	0.25	0.12	3	0.000031			
	Downstream	14.3004	Q10	1018	1018	0.035	3.54	1324.09	200	1328.68	0.000763	2.71	376.28	106.23	0.25	0.12	3	0.000032			
	Downstream	14.3002	Q10	1018	1018	0.035	3.48	1324.11	405	1328.54	0.000754	2.66	382.73	109.89	0.25	0.12	3	0.000033			
	Downstream	14.289	Q10	1018	1018	0.035	3.71	1323.32	1727	1328.25	0.000677	2.63	387.67	104.61	0.24	0.12	3	0.000031			
	Downstream	13.962	Q10	1018	1018	0.035	3.82	1322.33	1236	1327.25	0.000511	2.33	437.49	114.56	0.21	0.12	3	0.000030			
	Downstream	13.728	Q10	1018	1018	0.035	3.83	1320.55	1268	1326.71	0.000401	2.07	491.6	128.2	0.19	0.12	3	0.000030	0.000029	0.00064	Degrade
13.487 to 12.463	Downstream	13.487	Q10	1367	1367	0.035	3.63	1320	1460	1325.74	0.001109	3.32	411.86	113.33	0.31	2.2	13	0.000397			
	Downstream	13.211	Q10	1367	1367	0.035	3.73	1319.27	265	1324.33	0.00087	3	456.3	122.19	0.27	2.2	13	0.000386			
	Downstream	13.161	Q10	1367	1366.95	0.035	3.19	1319.21	1191	1324.08	0.001033	2.95	464.37	154.1	0.29	2.2	13	0.000452			
	Downstream	12.935	Q10	1367	1345.53	0.035	3.16	1317.38	1429	1323.02	0.000813	2.6	575.15	286.12	0.26	2.2	13	0.000463			
	Downstream	12.665	Q10	1367	1359.94	0.035	3.6	1316.5	1062	1322.11	0.00053	2.28	628.95	285.77	0.21	2.2	13	0.000402			
	Downstream	12.463	Q10	1367	1365.47	0.035	3.26	1316.39	1906	1321.44	0.000712	2.48	555.62	188.84	0.24	2.2	13	0.000443	0.000424	0.00082	Degrade
12.102 to11.825	Downstream	12.102	Q10	1552	1552	0.035	3.38	1313.98	1466	1319.68	0.00111	3.17	488.84	144.54	0.3	2.2	13	0.000426			
	Downstream	11.825	Q10	1552	1453.81	0.035	4.06	1312.28	1425	1318.85	0.000383	2.11	945.89	458.44	0.18	2.2	13	0.000379	0.000403	0.00065	Degrade
11.555 to 11.270	Downstream	11.555	Q10	2045	2037.71	0.035	3.55	1312.1	943	1317.9	0.000938	3.02	696.4	244.67	0.28	2.2	13	0.000407			
	Downstream	11.376	Q10	2045	2041.8	0.035	3.54	1311.01	563	1316.9	0.001141	3.32	627.47	234.56	0.31	2.2	13	0.000408			
	Downstream	11.27	Q10	2045	2045	0.035	4.07	1309.85	1464	1316.41	0.000747	2.93	698.66	171.84	0.26	2.2	13	0.000354	0.000381	0.00099	Degrade
10.992 to 3.945	Downstream	10.992	Q10	2200	2136.01	0.035	3.76	1309.17	877	1315.18	0.000915	3.1	813.79	356.78	0.28	2.2	13	0.000395			
	Downstream	10.826	Q10	2200	2141.9	0.035	3.8	1307.89	999	1314.48	0.00074	2.81	821.11	226.4	0.25	2.2	13	0.000390			
	Downstream	10.637	Q10	2200	1958.63	0.035	4.5	1307.55	1060	1314.1	0.000281	1.94	1553.45	612.99	0.16	2.2	13	0.000360			
	Downstream	10.436	Q10	2200	1826.78	0.035	4.62	1306.65	1089	1313.79	0.000295	2.02	1650.85	659.19	0.17	2.2	13	0.000376			
	Downstream	10.23	Q10	2200	2200	0.035	2.66	1306.22	1213	1313.2	0.001	2.57	855.14	320.97	0.28	2.2	13	0.000542			

Meyer-Peter, Muller Equilibrium Slope Calculations: 10-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q10

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
	Downstream	10	Q10	2200	2200	0.035	4.34	1304.65	341	1311.36	0.001751	4.69	469.38	108.21	0.4	2.2	13	0.000332			
	Downstream	3.945	Q10	2200	2184.07	0.035	3.26	1303.94	350	1310.23	0.004255	6.06	394.72	255.45	0.59	2.2	13	0.000445	0.000406	0.00139	Degrade
3.879 to 3.354	Downstream	3.879	Q10	2463	2393.51	0.05	4.29	1300.94	330	1309.32	0.002609	3.99	682.62	259.22	0.34	3.2	76.2	0.000552			
	Downstream	3.816	Q10	2463	2167.67	0.05	5.94	1298.44	420	1308.13	0.003432	5.61	622.6	387.28	0.41	3.2	76.2	0.000440			
	Downstream	3.737	Q10	2463	2132.33	0.05	5.35	1296.44	425	1305.54	0.008155	7.97	453.25	306.1	0.61	3.2	76.2	0.000497			
	Downstream	3.656	Q10	2463	2020.89	0.05	4.62	1293.94	490	1303.25	0.004805	5.61	708.38	528.61	0.46	3.2	76.2	0.000607			
	Downstream	3.563	Q10	2463	2227.61	0.05	6.08	1292.44	520	1300.86	0.004255	6.31	510.44	203.11	0.45	3.2	76.2	0.000418			
	Downstream	3.465	Q10	2463	2277.47	0.05	4.53	1290.44	585	1297.72	0.007909	7.18	423.42	189.12	0.59	3.2	76.2	0.000549			
	Downstream	3.354	Q10	2463	2242.21	0.05	4.48	1288.24	565	1294.62	0.00431	5.27	611.14	348.34	0.44	3.2	76.2	0.000564	0.000518	0.00501	Degrade
3.247 to 1.949	Downstream	3.247	Q10	2463	2145.61	0.05	6.03	1284.24	565	1292.26	0.003764	5.93	594.29	282.65	0.43	3.2	76.2	0.000438			
	Downstream	3.14	Q10	2463	2263.49	0.05	4.72	1282.24	680	1289.23	0.006868	6.85	481.96	304.8	0.56	3.2	76.2	0.000530			
	Downstream	3.011	Q10	2463	1076.33	0.05	4.31	1278.94	393	1286.35	0.003712	4.71	943.78	461.22	0.4	3.2	76.2	0.001222			
	Downstream	2.937	Q10	2463	1673.39	0.05	4.25	1277.94	370	1284.19	0.006116	6.06	697.2	531.96	0.52	3.2	76.2	0.000797			
	Downstream	2.867	Q10	2463	2423.25	0.05	3.67	1275.94	490	1282.47	0.003583	4.21	641.53	360.51	0.39	3.2	76.2	0.000637			
	Downstream	2.774	Q10	2463	2409.16	0.05	3.63	1272.44	440	1279.08	0.010794	7.25	367.97	154.15	0.67	3.2	76.2	0.000648			
	Downstream	2.691	Q10	2463	2440.64	0.05	3.81	1270.94	540	1276.83	0.003715	4.39	585.34	212.98	0.4	3.2	76.2	0.000609			
	Downstream	2.588	Q10	2463	2247.82	0.05	4.87	1267.44	540	1273.95	0.006076	6.6	470.58	199.92	0.53	3.2	76.2	0.000518			
	Downstream	2.486	Q10	2463	2402.87	0.05	3.11	1264.94	480	1270.53	0.007125	5.33	506.61	267.8	0.53	3.2	76.2	0.000758			
	Downstream	2.395	Q10	2463	2110.67	0.05	5.1	1260.44	450	1268.37	0.003253	4.99	667	270.62	0.39	3.2	76.2	0.000526			
	Downstream	2.31	Q10	2463	2249.62	0.05	4.64	1257.44	540	1265.37	0.009868	8.09	404.86	237.21	0.66	3.2	76.2	0.000543			
	Downstream	2.208	Q10	2463	1549.94	0.05	5.63	1254.94	475	1263.56	0.002366	4.51	777.98	234.77	0.34	3.2	76.2	0.000649			
	Downstream	2.118	Q10	2463	2144.11	0.05	4.32	1252.94	440	1261.54	0.006024	6.04	550.39	280.91	0.51	3.2	76.2	0.000612			
	Downstream	2.034	Q10	2463	2164.73	0.05	5.41	1249.44	450	1257.94	0.008805	8.3	410.61	198.11	0.63	3.2	76.2	0.000484			
	Downstream	1.949	Q10	2463	2463	0.05	2.51	1248.94	480	1252.42	0.018618	7.46	330.15	131.72	0.83	3.2	76.2	0.000917	0.000659	0.00525	Degrade
1.858 to 1.307	Downstream	1.858	Q10	2507	2507	0.04	2.8	1245.74	370	1249.39	0.003752	4.52	555.25	198.08	0.48	3.2	76.2	0.000588			
	Downstream	1.788	Q10	2507	2507	0.04	2.47	1243.94	425	1247.52	0.006103	5.3	473.4	191.58	0.59	3.2	76.2	0.000667			
	Downstream	1.708	Q10	2507	2507	0.04	2.66	1241.94	605	1245.2	0.005011	5.04	497.72	187.02	0.54	3.2	76.2	0.000619			
	Downstream	1.593	Q10	2507	2507	0.04	2.96	1239.44	603	1242.85	0.003277	4.37	573.85	194.15	0.45	3.2	76.2	0.000556			
	Downstream	1.479	Q10	2507	2507	0.04	2.8	1237.44	516	1240.69	0.003821	4.55	550.82	196.79	0.48	3.2	76.2	0.000588			
	Downstream	1.381	Q10	2507	2507	0.04	3.19	1235.44	392	1239.19	0.002444	3.97	630.94	197.53	0.39	3.2	76.2	0.000516			
	Downstream	1.307	Q10	2507	2507	0.04	2.07	1234.24	113	1237.23	0.009116	5.76	435.09	209.71	0.7	3.2	76.2	0.000795	0.000618	0.01200	Degrade
1.169 to 0.000	Downstream	1.169	Q10	2507	2507	0.02	1.2	1209.44	585	1211.19	0.041811	17.14	146.23	121.89	2.76	3.2	76.2	0.000485			
	Downstream	1.058	Q10	2507	2507	0.04	2.69	1206.94	591	1211.82	0.004552	4.85	517.26	192	0.52	3.2	76.2	0.000612			
	Downstream	0.946	Q10	2507	2507	0.04	2.82	1204.44	600	1209.14	0.004486	4.95	506.17	179.81	0.52	3.2	76.2	0.000584			
	Downstream	0.833	Q10	2507	2507	0.04	2.97	1201.94	457	1206.86	0.003397	4.47	561.38	189.13	0.46	3.2	76.2	0.000554			
	Downstream	0.746	Q10	2507	2507	0.04	2.56	1200.44	521	1204.27	0.008016	6.21	403.88	158.02	0.68	3.2	76.2	0.000643			
	Downstream	0.647	Q10	2507	2507	0.04	3.07	1197.94	360	1202.64	0.00208	3.58	701.04	228.24	0.36	3.2	76.2	0.000536			
	Downstream	0.579	Q10	2507	2507	0.04	1.38	1194.44	273	1200.79	0.014155	5.48	457.57	330.41	0.82	3.2	76.2	0.001193			
	Downstream	0.527	Q10	2507	2507	0.04	2.22	1194.94	480	1198.28	0.006613	5.13	488.48	220.15	0.61	3.2	76.2	0.000742			
	Downstream	0.437	Q10	2507	2507	0.04	1.57	1189.94	459	1195.39	0.005964	3.87	648.51	412.99	0.54	3.2	76.2	0.001049			
	Downstream	0.35	Q10	2507	2507	0.04	1.54	1186.44	590	1191.45	0.011599	5.33	470.16	304.48	0.76	3.2	76.2	0.001069			
	Downstream	0.238	Q10	2507	2507	0.04	1.5	1181.94	418	1186.79	0.006073	3.79	660.79	439.72	0.55	3.2	76.2	0.001098			
	Downstream	0.159	Q10	2507	2507	0.04	1.34	1179.94	274	1184.85	0.003895	2.81	892.18	667.62	0.43	3.2	76.2	0.001229			
	Downstream	0.107	Q10	2507	2507	0.04	0.68	1177.94	564	1182.37	0.026962	4.72	530.9	778.26	1.01	3.2	76.2	0.002421			
	Downstream	0	Q10	2507	2507	0.04	2.07	1173.94		1178.59	0.0004	1.2	2081.13	1007.42	0.15	3.2	76.2	0.000795	0.000929	0.00575	Degrade

Meyer-Peter, Muller Equilibrium Slope Calculations: 100-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q100

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
79.29 to 47.82	Downstream	79.29	Q100	2908	2908	0.035	8.66	1324.7	111.78	1337.63	0.000347	3.24	897.29	113.03	0.19	0.12	3	0.000013			
	Downstream	78.17	Q100	2908	2908	0.035	7.46	1326.35	214.63	1337.55	0.000493	3.53	824.8	168.29	0.23	0.12	3	0.000015			
	Downstream	76.05	Q100	2908	2908	0.035	6.37	1326.57	226.62	1337.53	0.000297	2.49	1165.91	208.78	0.17	0.12	3	0.000018			
	Downstream	73.75	Q100	2908	2908	0.035	6.98	1326.67	334.1	1337.4	0.000405	3.08	945.62	155.29	0.21	0.12	3	0.000016			
	Downstream	70.42	Q100	2908	2908	0.035	7.18	1325.84	294.95	1337.22	0.000472	3.37	861.77	153.79	0.22	0.12	3	0.000016			
	Downstream	67.46	Q100	2908	2908	0.035	7.42	1325.7	330.25	1337.11	0.000389	3.14	926.9	152.19	0.2	0.12	3	0.000015			
	Downstream	64.16	Q100	2908	2908	0.035	7.37	1325.93	206.79	1336.99	0.000375	3.07	947.83	153.31	0.2	0.12	3	0.000015			
	Downstream	62.09	Q100	2908	2908	0.035	7.3	1326.02	202.96	1336.9	0.000395	3.13	928.97	226.27	0.2	0.12	3	0.000016			
	Downstream	60.05	Q100	2908	2908	0.035	7.45	1325.8	326.24	1336.81	0.000422	3.27	888.9	148.55	0.21	0.12	3	0.000015			
	Downstream	56.8	Q100	2908	2908	0.035	7.08	1326.12	301.37	1336.63	0.000505	3.46	840.16	164.67	0.23	0.12	3	0.000016			
	Downstream	53.79	Q100	2908	2908	0.035	7.24	1325.91	325.77	1336.49	0.000488	3.45	843.8	158.98	0.23	0.12	3	0.000016			
	Downstream	50.53	Q100	2908	2908	0.035	7.4	1325.86	270.93	1336.33	0.000475	3.44	845.31	173.22	0.22	0.12	3	0.000015			
	Downstream	47.82	Q100	2908	2908	0.035	7.79	1325.56	343.33	1336.22	0.000405	3.29	884.6	144.67	0.21	0.12	3	0.000015	0.000015	0.00029	Degrade
44.39 to 13.728	Downstream	44.39	Q100	2908	2908	0.035	7.14	1325.66	295.79	1336.05	0.000504	3.48	836.61	168.62	0.23	0.12	3	0.000016			
	Downstream	41.43	Q100	2908	2908	0.035	6.76	1325.13	115.87	1335.85	0.000614	3.69	787.65	151.06	0.25	0.12	3	0.000017			
	Downstream	40.27	Q100	2908	2908	0.035	6.75	1325.53	198.69	1335.79	0.000597	3.65	796.41	117.92	0.25	0.12	3	0.000017			
	Downstream	38.29	Q100	2908	2908	0.035	7.2	1325.17	289.87	1335.59	0.000725	4.16	698.58	97.01	0.27	0.12	3	0.000016			
	Downstream	35.4	Q100	2908	2908	0.035	7.08	1324.99	291.84	1335.4	0.000671	3.97	731.73	103.34	0.26	0.12	3	0.000016			
	Downstream	32.45	Q100	2908	2908	0.035	6.74	1325.21	308.88	1335.16	0.000801	4.21	691.1	102.54	0.29	0.12	3	0.000017			
	Downstream	29.38	Q100	2908	2908	0.035	6.64	1325.43	124.78	1334.85	0.000927	4.48	649.6	97.83	0.31	0.12	3	0.000017			
	Downstream	28.13	Q100	2908	2908	0.035	6.4	1325.73	64.58	1334.71	0.001038	4.63	628.09	98.13	0.32	0.12	3	0.000018			
	Downstream	27.48	Q100	2908	2908	0.035	6.32	1325.86	2	1334.6	0.00115	4.83	602.6	95.35	0.34	0.12	3	0.000018			
	Downstream	26.94	Q100	2908	2908	0.035	5.7	1325.83	195.79	1334.42	0.001445	5.08	572.72	100.48	0.37	0.12	3	0.000020			
	Downstream	24.99	Q100	2908	2908	0.035	6.59	1324.98	5	1334.23	0.000998	4.62	629.67	95.53	0.32	0.12	3	0.000017			
	Downstream	24.5	Q100	2908	2908	0.035	6.55	1324.72	200.07	1333.86	0.001064	4.75	612.71	93.51	0.33	0.12	3	0.000017			
	Downstream	22.48	Q100	2908	2908	0.035	6.32	1324.55	233	1333.57	0.00128	5.08	572.27	90.58	0.36	0.12	3	0.000018			
	Downstream	20.15	Q100	2908	2908	0.035	6.54	1324.85	305	1333.3	0.001174	4.95	587.47	89.81	0.34	0.12	3	0.000017			
	Downstream	17.1	Q100	2908	2908	0.035	6.22	1324.51	275	1333.08	0.000825	4.07	714.98	114.97	0.29	0.12	3	0.000018			
	Downstream	14.35	Q100	2908	2908	0.035	6.11	1324.48	181	1332.91	0.000693	3.69	787.61	129	0.26	0.12	3	0.000019			
	Downstream	14.30125	Q100	2908	2908	0.035	6.11	1323.98	54	1332.79	0.000678	3.65	796.53	130.42	0.26	0.12	3	0.000019			
	Downstream	14.3012	Q100	2908	2908	0.035	6.09	1324.36	200	1332.72	0.000758	3.85	754.84	123.99	0.28	0.12	3	0.000019			
	Downstream	14.301	Q100	2908	2908	0.035	6.25	1324.18	200	1332.6	0.000664	3.67	792.39	126.8	0.26	0.12	3	0.000018			
	Downstream	14.3008	Q100	2908	2908	0.035	6.06	1324.32	200	1332.45	0.000729	3.77	771.75	127.38	0.27	0.12	3	0.000019			
	Downstream	14.3006	Q100	2908	2908	0.035	6.12	1324.19	200	1332.29	0.000737	3.81	762.88	124.71	0.27	0.12	3	0.000019			
	Downstream	14.3004	Q100	2908	2908	0.035	6.09	1324.09	200	1332.16	0.000701	3.71	784.53	128.79	0.26	0.12	3	0.000019			
	Downstream	14.3002	Q100	2908	2908	0.035	6.13	1324.11	405	1332.03	0.000662	3.62	803.74	131.1	0.26	0.12	3	0.000019			
	Downstream	14.289	Q100	2908	2908	0.035	6.17	1323.32	1727	1331.76	0.000665	3.64	798.46	129.49	0.26	0.12	3	0.000018			
	Downstream	13.962	Q100	2908	2908	0.035	5.13	1322.33	1236	1330.61	0.000695	3.3	880.78	171.63	0.26	0.12	3	0.000022			
	Downstream	13.728	Q100	2908	2695.41	0.035	5.77	1320.55	1268	1330.04	0.000374	2.63	1326.61	311.71	0.19	0.12	3	0.000021	0.000018	0.00064	Degrade
13.487 to 12.463	Downstream	13.487	Q100	3906	3906	0.035	5.78	1320	1460	1328.89	0.001262	4.82	811.07	140.25	0.35	2.2	13	0.000249			
	Downstream	13.211	Q100	3906	3906	0.035	4.77	1319.27	265	1326.88	0.001528	4.67	835.51	175.07	0.38	2.2	13	0.000302			
	Downstream	13.161	Q100	3906	3709.54	0.035	5.14	1319.21	1191	1326.58	0.001143	4.26	1121.01	387.39	0.33	2.2	13	0.000295			
	Downstream	12.935	Q100	3906	3343.84	0.035	5.55	1317.38	1429	1325.59	0.00071	3.53	1583.55	497.45	0.26	2.2	13	0.000303			
	Downstream	12.665	Q100	3906	3365.74	0.035	6.02	1316.5	1062	1324.73	0.000537	3.24	1792.35	600.42	0.23	2.2	13	0.000278			
	Downstream	12.463	Q100	3906	3455.93	0.035	5.7	1316.39	1906	1324.08	0.000649	3.44	1639.12	597.12	0.25	2.2	13	0.000286	0.000286	0.00082	Degrade
12.102 to11.825	Downstream	12.102	Q100	4434	4024.79	0.035	5.39	1313.98	1466	1322.4	0.001059	4.23	1448.31	557.46	0.32	2.2	13	0.000295			
	Downstream	11.825	Q100	4434	3259.88	0.035	6.69	1312.28	1425	1321.71	0.000335	2.75	2893.1	901.8	0.19	2.2	13	0.000293	0.000294	0.00065	Degrade
11.555 to 11.270	Downstream	11.555	Q100	5843	5208.24	0.035	6.19	1312.1	943	1320.75	0.00088	4.23	1981.85	682.54	0.3	2.2	13	0.000261			
	Downstream	11.376	Q100	5843	5057.66	0.035	6.13	1311.01	563	1319.89	0.000937	4.33	2007.1	676.49	0.31	2.2	13	0.000272			
	Downstream	11.27	Q100	5843	5495.08	0.035	6.59	1309.85	1464	1319.33	0.000912	4.46	1664.21	493.04	0.31	2.2	13	0.000233	0.000252	0.00099	Degrade
10.992 to 3.945	Downstream	10.992	Q100	6286	5150.26	0.035	6.52	1309.17	877	1318.14	0.00079	4.15	2350.95	682.28	0.29	2.2	13	0.000270			
	Downstream	10.826	Q100	6286	5745.34	0.035	6.52	1307.89	999	1317.4	0.000816	4.22	2020.43	627.2	0.29	2.2	13	0.000242			
	Downstream	10.637	Q100	6286	4586.71	0.035	7.26	1307.55	1060	1317.06	0.000293	2.72	4006.31	1041.23	0.18	2.2	13	0.000272			
	Downstream	10.436	Q100	6286	4147.33	0.035	7.36	1306.65	1089	1316.75	0.000301	2.77	4214.71	1072.46	0.18	2.2	13	0.000297			
	Downstream	10.23	Q100	6286	6248.07	0.035	5.49	1306.22	1213	1316.18	0.000669	3.4	1928.17	478.61	0.26	2.2	13	0.000264			

Meyer-Peter, Muller Equilibrium Slope Calculations: 100-Year Discharge

HEC-RAS Plan: Plan1 River: McMicken Outlet Reach: Downstream Profile: Q100

Sed. Reach	Reach	River Sta	Profile	Q Total	Q Channel	Mann Wtd Chnl	Hydr Depth C	Min Ch El	Length Chnl	W.S. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	D_{50}	D_{90}	MPM	MPM	Chan	Deg/Agg
				(cfs)	(cfs)		(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(mm)	(mm)	S_L	Rch Avg S_L	slope	
	Downstream	10	Q100	6286	6055.1	0.035	5.91	1304.65	341	1313.71	0.003512	8.14	949.55	373.91	0.59	2.2	13	0.000253			
	Downstream	3.945	Q100	6286	4948.62	0.035	5.42	1303.94	350	1312.71	0.003406	7.6	1480.72	597.55	0.58	2.2	13	0.000338	0.000277	0.00139	Degrade
3.879 to 3.354	Downstream	3.879	Q100	7038	6003.15	0.05	6.3	1300.94	330	1311.32	0.004568	6.81	1353.72	480.62	0.48	3.2	76.2	0.000428			
	Downstream	3.816	Q100	7038	3598.38	0.05	7.97	1298.44	420	1310.16	0.003557	6.95	2285.86	1051.82	0.43	3.2	76.2	0.000565			
	Downstream	3.737	Q100	7038	3669.17	0.05	6.93	1296.44	425	1307.12	0.010189	10.59	1523.59	863.21	0.71	3.2	76.2	0.000637			
	Downstream	3.656	Q100	7038	2872.26	0.05	7.35	1293.94	490	1305.98	0.002068	5.01	2769.32	875.69	0.33	3.2	76.2	0.000767			
	Downstream	3.563	Q100	7038	5125.2	0.05	7.98	1292.44	520	1302.76	0.009126	11.08	1050.76	359.65	0.69	3.2	76.2	0.000396			
	Downstream	3.465	Q100	7038	3589	0.05	6.53	1290.44	585	1299.72	0.005818	7.85	1836.8	789.15	0.54	3.2	76.2	0.000691			
	Downstream	3.354	Q100	7038	4215.04	0.05	7.26	1288.24	565	1297.4	0.003055	6.11	1986.87	639.45	0.4	3.2	76.2	0.000529	0.000573	0.00501	Degrade
3.247 to 1.949	Downstream	3.247	Q100	7038	4735.2	0.05	7.68	1284.24	565	1293.91	0.008187	10.28	1312.93	612.86	0.65	3.2	76.2	0.000445			
	Downstream	3.14	Q100	7038	3135.42	0.05	6.47	1282.24	680	1290.99	0.004593	6.92	2048.21	795.2	0.48	3.2	76.2	0.000798			
	Downstream	3.011	Q100	7038	2132.27	0.05	6.15	1278.94	393	1288.2	0.004435	6.54	1927.32	633.05	0.46	3.2	76.2	0.001235			
	Downstream	2.937	Q100	7038	2842.72	0.05	6.32	1277.94	370	1286.26	0.0047	6.92	1901.84	633.26	0.49	3.2	76.2	0.000901			
	Downstream	2.867	Q100	7038	5265.17	0.05	5.86	1275.94	490	1284.66	0.00355	5.73	1874.89	712	0.42	3.2	76.2	0.000525			
	Downstream	2.774	Q100	7038	5096.37	0.05	6.03	1272.44	440	1281.7	0.007939	8.72	1363.23	618.62	0.63	3.2	76.2	0.000527			
	Downstream	2.691	Q100	7038	6040.39	0.05	6.64	1270.94	540	1279.66	0.003562	6.23	1474.49	407.06	0.43	3.2	76.2	0.000404			
	Downstream	2.588	Q100	7038	4965.08	0.05	7.02	1267.44	540	1276.1	0.008751	10.11	1167.26	446.2	0.67	3.2	76.2	0.000465			
	Downstream	2.486	Q100	7038	5417.45	0.05	5.69	1264.94	480	1273.11	0.004836	6.57	1479.49	447.2	0.49	3.2	76.2	0.000525			
	Downstream	2.395	Q100	7038	4709.48	0.05	7.44	1260.44	450	1270.72	0.004596	7.63	1426.01	370.18	0.49	3.2	76.2	0.000462			
	Downstream	2.31	Q100	7038	3886.3	0.05	7.74	1257.44	540	1268.47	0.005337	8.37	1435.47	380.7	0.53	3.2	76.2	0.000538			
	Downstream	2.208	Q100	7038	3663.99	0.05	8.28	1254.94	475	1266.21	0.003652	7.25	1556.91	443.16	0.44	3.2	76.2	0.000534			
	Downstream	2.118	Q100	7038	4136.44	0.05	5.95	1252.94	440	1264.17	0.005203	6.96	1540.12	436.24	0.5	3.2	76.2	0.000658			
	Downstream	2.034	Q100	7038	4139.14	0.05	7.58	1249.44	450	1260.94	0.00815	9.96	1071.84	242.31	0.64	3.2	76.2	0.000516			
	Downstream	1.949	Q100	7038	7038	0.05	4	1248.94	480	1254.78	0.019534	10.43	674.85	168.54	0.92	3.2	76.2	0.000575	0.000607	0.00525	Degrade
1.858 to 1.307	Downstream	1.858	Q100	7163	7163	0.04	4.84	1245.74	370	1251.83	0.004035	6.73	1064.67	220.01	0.54	3.2	76.2	0.000340			
	Downstream	1.788	Q100	7163	7163	0.04	4.5	1243.94	425	1249.85	0.005712	7.63	939.18	208.65	0.63	3.2	76.2	0.000366			
	Downstream	1.708	Q100	7163	7163	0.04	4.84	1241.94	605	1247.75	0.004597	7.18	998.03	206.03	0.57	3.2	76.2	0.000340			
	Downstream	1.593	Q100	7163	7163	0.04	5.14	1239.44	603	1245.45	0.00346	6.48	1104.91	214.82	0.5	3.2	76.2	0.000320			
	Downstream	1.479	Q100	7163	7153.98	0.04	5.12	1237.44	516	1243.35	0.003487	6.5	1109.06	226.15	0.51	3.2	76.2	0.000322			
	Downstream	1.381	Q100	7163	7163	0.04	5.19	1235.44	392	1241.69	0.003125	6.2	1154.88	222.48	0.48	3.2	76.2	0.000317			
	Downstream	1.307	Q100	7163	7149.27	0.04	3.67	1234.24	113	1238.89	0.010592	9.07	797	233.89	0.84	3.2	76.2	0.000449	0.000351	0.01200	Degrade
1.169 to 0.000	Downstream	1.169	Q100	7163	7163	0.02	2.32	1209.44	585	1212.71	0.022793	19.64	364.64	157.06	2.27	3.2	76.2	0.000251			
	Downstream	1.058	Q100	7163	7163	0.04	4.88	1206.94	591	1214.34	0.004282	6.97	1028.38	210.92	0.56	3.2	76.2	0.000337			
	Downstream	0.946	Q100	7163	7163	0.04	4.96	1204.44	600	1211.77	0.00433	7.09	1010.25	203.48	0.56	3.2	76.2	0.000332			
	Downstream	0.833	Q100	7163	7163	0.04	5.15	1201.94	457	1209.51	0.003514	6.55	1094.38	212.57	0.51	3.2	76.2	0.000320			
	Downstream	0.746	Q100	7163	7163	0.04	4.76	1200.44	521	1207.01	0.006143	8.21	872.74	183.43	0.66	3.2	76.2	0.000346			
	Downstream	0.647	Q100	7163	7163	0.04	3.47	1197.94	360	1204.62	0.004618	5.78	1240.13	357.64	0.55	3.2	76.2	0.000474			
	Downstream	0.579	Q100	7163	7163	0.04	2.57	1194.44	273	1202.6	0.006962	5.8	1235.5	481.44	0.64	3.2	76.2	0.000641			
	Downstream	0.527	Q100	7163	7163	0.04	2.43	1194.94	480	1200.25	0.009428	6.52	1099.22	452	0.74	3.2	76.2	0.000677			
	Downstream	0.437	Q100	7163	7163	0.04	2.75	1189.94	459	1196.78	0.006077	5.67	1263.53	458.97	0.6	3.2	76.2	0.000599			
	Downstream	0.35	Q100	7163	7085.66	0.04	2.67	1186.44	590	1192.97	0.00989	7.09	1045.43	459.37	0.77	3.2	76.2	0.000623			
	Downstream	0.238	Q100	7163	7163	0.04	1.92	1181.94	418	1188.27	0.007304	4.91	1459.59	758.48	0.62	3.2	76.2	0.000857			
	Downstream	0.159	Q100	7163	7163	0.04	2.33	1179.94	274	1185.9	0.004698	4.48	1600.63	685.83	0.52	3.2	76.2	0.000707			
	Downstream	0.107	Q100	7163	7163	0.04	1.32	1177.94	564	1183.04	0.022582	6.71	1066.93	807.66	1.03	3.2	76.2	0.001247			
	Downstream	0	Q100	7163	7163	0.04	3.84	1173.94		1180.41	0.0004	1.82	3931.7	1023.52	0.16	3.2	76.2	0.000429	0.000560	0.00575	Degrade

A.2. ADWR 1985 Dynamic Equilibrium Slope Calculations

ADWR 1985 Dynamic Equilibrium Slope Calculations 2-Year

Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
U/S Limit	RWI502	1	291	0.035	0.0026	63.2	99.6	63.7	4.0	1.6	4.0	1.6	63.2	0.12	17.833	5.0				60.1	74.0	60.5	3.9	1.2	3.9	1.2	60.1				
	79.29_to_47.82	79.29	291	0.035	0.00029	60.0	189.6	61.3	1.5	3.1				0.12	17.833					48.7	68.1	49.1	4.3	1.4							
	79.29_to_47.82	78.17	291	0.035	0.00029	65.9	196.5	67.0	1.5	2.9				0.12	17.833					54.0	70.9	54.3	4.1	1.3							
	79.29_to_47.82	76.05	291	0.035	0.00029	83.8	215.6	84.4	1.3	2.6				0.12	17.833					66.0	76.8	66.2	3.8	1.2							
	79.29_to_47.82	73.75	291	0.035	0.00029	69.6	200.6	70.5	1.5	2.8				0.12	17.833					52.2	70.0	52.6	4.2	1.3							
	79.29_to_47.82	70.42	291	0.035	0.00029	65.4	195.8	66.4	1.5	3.0				0.12	17.833					51.2	69.5	51.6	4.2	1.3							
	79.29_to_47.82	67.46	291	0.035	0.00029	69.5	200.4	70.3	1.5	2.8				0.12	17.833					50.3	69.0	50.6	4.2	1.4							
	79.29_to_47.82	64.16	291	0.035	0.00029	73.3	204.6	74.1	1.4	2.8				0.12	17.833					54.1	71.0	54.4	4.1	1.3							
	79.29_to_47.82	62.09	291	0.035	0.00029	72.6	203.8	73.4	1.4	2.8				0.12	17.833					54.1	71.0	54.4	4.1	1.3							
	79.29_to_47.82	60.05	291	0.035	0.00029	71.8	203.0	72.6	1.4	2.8				0.12	17.833					54.3	71.0	54.5	4.1	1.3							
	79.29_to_47.82	56.8	291	0.035	0.00029	69.4	200.4	70.3	1.5	2.8				0.12	17.833					54.8	71.3	55.1	4.1	1.3							
	79.29_to_47.82	53.79	291	0.035	0.00029	74.4	205.8	75.2	1.4	2.7				0.12	17.833					61.8	74.8	62.0	3.9	1.2							
	79.29_to_47.82	50.53	291	0.035	0.00029	73.2	204.6	74.1	1.4	2.8				0.12	17.833					61.7	74.7	61.9	3.9	1.2							
1	79.29_to_47.82	47.82	291	0.035	0.00029	84.4	216.3	85.1	1.3	2.5	1.4	2.8	71.8	0.12	17.833	0.1	5.0		5.0	56.5	72.2	56.8	4.0	1.3	4.1	1.3	55.4	5.0	0.0065	0.00029	Aggrade
U/S Limit	PI635	1	62	0.07	0.009	24.7	28.3	25.0	2.2	1.1	2.2	1.1	24.7	0.12	17.833	0.5				30.9	52.6	31.6	1.2	1.7							
	44.39_to_13.728	44.39	291	0.035	0.00037	68.4	185.3	69.2	1.6	2.7				0.12	17.833					59.7	113.7	60.3	2.6	1.9							
	44.39_to_13.728	41.43	291	0.035	0.00037	70.5	187.5	71.3	1.6	2.6				0.12	17.833					64.0	116.8	64.4	2.5	1.8							
	44.39_to_13.728	40.27	291	0.035	0.00037	74.2	191.3	74.9	1.5	2.6				0.12	17.833					67.1	119.0	67.5	2.4	1.8							
	44.39_to_13.728	38.29	291	0.035	0.00037	61.7	178.3	62.8	1.6	2.8				0.12	17.833					55.7	110.7	56.4	2.6	2.0							
	44.39_to_13.728	35.4	291	0.035	0.00037	66.2	183.0	67.1	1.6	2.7				0.12	17.833					60.0	113.9	60.5	2.6	1.9							
	44.39_to_13.728	32.45	291	0.035	0.00037	69.4	186.5	70.3	1.6	2.7				0.12	17.833					63.5	116.5	64.0	2.5	1.8							
	44.39_to_13.728	29.38	291	0.035	0.00037	65.7	182.6	66.7	1.6	2.7				0.12	17.833					59.5	113.6	60.1	2.6	1.9							
	44.39_to_13.728	28.13	291	0.035	0.00037	67.4	184.4	68.4	1.6	2.7				0.12	17.833					61.2	114.9	61.8	2.5	1.9							
	44.39_to_13.728	27.48	291	0.035	0.00037	67.7	184.7	68.7	1.6	2.7				0.12	17.833					61.9	115.4	62.5	2.5	1.8							
	44.39_to_13.728	26.94	291	0.035	0.00037	76.5	193.5	77.1	1.5	2.5				0.12	17.833					69.8	120.8	70.2	2.4	1.7							
	44.39_to_13.728	24.99	291	0.035	0.00037	67.9	185.0	68.9	1.6	2.7				0.12	17.833					62.6	115.8	63.1	2.5	1.8							
	44.39_to_13.728	24.5	291	0.035	0.00037	68.1	185.1	69.0	1.6	2.7				0.12	17.833					63.0	116.2	63.6	2.5	1.8							
	44.39_to_13.728	22.48	291	0.035	0.00037	67.1	184.1	68.0	1.6	2.7				0.12	17.833					62.0	115.4	62.6	2.5	1.8							
	44.39_to_13.728	20.15	291	0.035	0.00037	69.2	186.6	70.5	1.6	2.6				0.12	17.833					65.0	117.7	65.7	2.5	1.8							
	44.39_to_13.728	17.1	291	0.035	0.00037	86.6	203.3	87.2	1.4	2.3				0.12	17.833					81.6	128.6	81.9	2.3	1.6							
	44.39_to_13.728	14.35	291	0.035	0.00037	93.1	209.2	93.7	1.4	2.2				0.12	17.833					75.7	124.8	76.1	2.3	1.6							
	44.39_to_13.728	14.30125	291	0.035	0.00037	99.7	214.9	100.2	1.4	2.1				0.12	17.833					80.7	128.0	81.1	2.3	1.6							
	44.39_to_13.728	14.3012	291	0.035	0.00037	91.5	207.7	92.1	1.4	2.3				0.12	17.833					80.0	127.6	80.4	2.3	1.6							
	44.39_to_13.728	14.301	291	0.035	0.00037	96.4	212.0	96.9	1.4	2.2				0.12	17.833					85.5	131.0	85.8	2.2	1.5							
	44.39_to_13.728	14.3008	291	0.035	0.00037	94.6	210.5	95.2	1.4	2.2				0.12	17.833					89.1	133.2	89.4	2.2	1.5							
	44.39_to_13.728	14.3006	291	0.035	0.00037	89.4	205.9	90.0	1.4	2.3				0.12	17.833					83.3	129.7	83.8	2.2	1.5							
	44.39_to_13.728	14.3004	291	0.035	0.00037	95.6	211.4	96.2	1.4	2.2				0.12	17.833					88.8	133.0	89.2	2.2	1.5							
	44.39_to_13.728	14.3002	291	0.035	0.00037	99.9	215.2	100.6	1.4	2.1				0.12	17.833					92.3	135.1	92.8	2.2	1.5							
	44.39_to_13.728	14.289	291	0.035	0.00083	87.8	159.5	88.3	1.8	1.8				0.12	17.833					82.0	128.9	82.4	2.3	1.6							
	44.39_to_13.728	13.962	291	0.035	0.00093	96.4	160.0	96.9	1.8	1.7				0.12	17.833					90.5	134.0	90.9	2.2	1.5							
2	44.39_to_13.728	13.728	291	0.035	0.00093	87.2	153.9	87.6	1.9	1.8	1.5	2.4	79.9	0.12	17.833	0.1	0.5	0.1	0.6	80.8	128.1	81.2	2.3	1.6	2.4	1.7	72.5	0.6	0.0015	0.00043	Aggrade
U/S Limit	RPI621	1	118	0.035	0.0079	47.0	36.8	47.1	3.2	0.8	3.2	0.8	47.0	2.2	9.6061	0.2				55.2	50.8	55.3	2.3	0.9	2.3	0.9	55.2	0.1			
	13.487_to_12.463	13.487	391	0.035	0.00047	99.4	238.0	100.1	1.6	2.4				2.2	9.6061					76.0	118.6	76.5	3.3	1.6							
	13.487_to_12.463	13.211	391	0.035	0.00046	103.8	243.8	104.4	1.6	2.3				2.2	9.6061					84.6	123.7	85.0	3.2	1.5							
	13.487_to_12.463	13.161	391	0.035	0.0013	96.2	172.9	96.6	2.3	1.8				2.2	9.6061					85.7	124.3	86.0	3.1	1.4							
	13.487_to_12.463	12.935	391	0.035	0.00103	104.8	191.4	105.1	2.0	1.8				2.2	9.6061					85.5	124.1	85.7	3.2	1.4							
	13.487_to_12.463	12.665	391	0.035	0.0004	137.1	284.1	137.6	1.4	2.1				2.2	9.6061					92.2	128.0	92.5	3.1	1.4							
3	13.487_to_12.463	12.463	391	0.035	0.00085	125.1	218.0	125.4	1.8	1.7	1.8	2.0	111.0	2.2	9.6061	0.0	0.2	0.1	0.3	99.0	131.6	99.2	3.0	1.3	3.1	1.4	87.2	0.3	0.0033	0.00075	Aggrade
U/S Limit	RPI603	1	224	0.05	0.008	76.0	81.4	77.5	2.8	1.0	2.8	1.0	76.0	2.2	9.6061	0.3				94.4	115.8	95.9	1.9	1.2	1.9	1.2	94.4	0.1			
	12.102_to_11.825	12.102	443	0.035	0.00122	95.0	189.0	95.4	2.3	2.0				2.2	9.6061					88.7	136.6	89.0	3.2	1.5							
4	12.102_to_11.825	11.825	443	0.035	0.00065	112.1	243.7	112.5	1.8	2.2	2.1	2.1	103.5	2.2	9.6061	0.1	0.3	0.0	0.4	97.7	141.9	98.0	3.1	1.4	3.2	1.5	93.2	0.4	0.0033	0.00093	Aggrade
U/S Limit	RPD726	1	241	0.035	0.0044	45.6	66.8	46.2	3.6	1.4	3.6	1.4	45.6	2.2	9.6061	0.3				50.6	82.2	51.3	2.9	1.6	2.9	1.6	50.6	0.1			
	11.555_to_11.270	11.555	584	0.035	0.00054	129.8	323.1	130.1	1.8	2.5				2.2	9.6061					107.1	187.8	107.3	3.1	1.8							
	11.555_to_11.270	11.376	584	0.035	0.00149	101.4	215.3	101.7	2.7	2.1				2.2	9.6061					94.5	178.7	94.8	3.3	1.9							
5	11.555_to_11.270	11.27	584	0.035	0.00091	113.7	262.5	114.9	2.2	2.3	2.2	2.3	114.9	2.2	9.6061	0.1	0.3	0.1	0.4	105.3	187.1	106.3	3.1	1.8	3.2	1.8	102.3	0.4	0.0025	0.00098	Aggrade
U/S Limit	RD716	1	58	0.035	0.0091	23.3	17.5	23.7	3.3	0.7	3.3	0.7	23.3	2.2	9.6061	0.1				32.0	33.0	32.5	1.8	1.0	1.8	1.0	32.0	0.0			
	10.992_to_3.945	10.992	629	0.035	0.00084	136.2	301.8	137.2	2.1	2.2				2.2	9.6061					123.4	235.4	124.0	2.7	1.9							
	10.992_to_3.945	10.826	629	0.035	0.00086	153.1	312.7	153.4	2.0	2.0				2.2	9.6061					144.7	250.5	145.0	2.5	1.7							
	10.992_to_3.945	10.637	629	0.035	0.0006	221.5	403.8	221.8	1.6	1.8				2.2	9.6061					165.3	264.2	165.5	2.4	1.6							
	10.992_to_3.945	10.436	629	0.035	0.00062	321.9	465.2	322.5	1.4	1.4				2.2	9.6061					167.1	265.5	167.5	2.4	1.6							
	10.992_to_3.945	10.23	629	0.035	0.00087	105.6	269.5	106.2	2.3	2.5				2.2	9.6061					101.5	217.7	102.0	2.9	2.1							
	10.992_to_3.945	10	629	0.035	0.00147	88.9	215.1	89.5	2.9	2.4				2.2	9.6061					88.1	205.9	88.7	3.1	2.3							
6	10.992_to_3.945	3.945	629	0.035	0.00537	79.9	139.6	80.4	4.5	1.7	2.4	2.0	158.1	2.2	9.6061	0.2	0.1	0.1	0.2	91.7	209.2	92.4	3.0	2.3	2.7	1.9	125.9	0.2	0.0017	0.00152	Aggrade
U/S Limit	RPD704	0.829	293	0.05	0.00486	74.9	109.7	75.2	2.7	1.5	2.7	1.5	74.9	3.2	19.397	0.3				75.2	110.6	75.5	2.6	1.5	2.6	1.5	75.2	0.3			
	RPD704	0.673	293	0.05	0.00461	149.2	146.6	149.4	2.0	1.0				3.2	19.397					148.3	145.0	148.5	2.0	1.0							
	RPD704	0.541	293	0.05	0.00461	75.5	111.8	75.8	2.6	1.5				3.2	19.397					75.2	110.6	75.5	2.6	1.5							
	RPD704	0.345	293	0.05	0.0056	96.8	116.4	97.0	2.5	1.2				3.2	19.397					98.8	123.3	98.9	2.4	1.2							

ADWR 1985 Dynamic Equilibrium Slope Calculations 2-Year

Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
	RPD704	0.169	293	0.05	0.00632	135.6	128.4	135.7	2.3	0.9				3.2	19.397					143.1	142.9	143.2	2.1	1.0							
7	RPD704	0	293	0.05	0.00618	42.8	82.0	43.5	3.6	1.9	2.6	1.3	95.8	3.2	19.397	0.3	0.3		0.3	43.9	89.7	44.6	3.3	2.0	2.5	1.4	97.4	0.3	0.0047	0.00536	Degrade
	3.879_to_3.354	3.879	704	0.035	0.00809	77.2	130.5	78.1	5.4	1.7				3.2	19.397					95.9	201.4	96.9	3.5	2.1							
	3.879_to_3.354	3.816	704	0.05	0.006	51.1	150.9	52.5	4.7	2.9				3.2	19.397					60.1	208.2	61.7	3.4	3.4							
	3.879_to_3.354	3.737	704	0.06	0.00533	47.7	171.0	49.9	4.1	3.4				3.2	19.397					224.2	390.8	226.5	1.8	1.7							
	3.879_to_3.354	3.656	704	0.06	0.00437	65.9	205.2	67.9	3.4	3.0				3.2	19.397					394.3	488.9	396.5	1.4	1.2							
	3.879_to_3.354	3.563	704	0.05	0.00347	52.0	179.4	53.6	3.9	3.3				3.2	19.397					72.0	223.6	73.7	3.1	3.0							
	3.879_to_3.354	3.465	704	0.05	0.0038	87.5	213.1	88.3	3.3	2.4				3.2	19.397					129.1	280.6	130.0	2.5	2.2							
8	3.879_to_3.354	3.354	704	0.05	0.00539	76.7	181.9	77.3	3.9	2.4	4.1	2.7	65.5	3.2	19.397	1.3	0.3	0.2	0.5	82.6	234.8	83.3	3.0	2.8	2.7	2.3	151.2	0.5	0.0025	0.00521	Degrade
U/S Limit	RD800	1	43	0.035	0.0059	22.6	16.4	22.9	2.6	0.7	2.6	0.7	22.6	3.2	19.397	0.1				23.1	17.2	23.5	2.5	0.7	2.5	0.7	23.1	0.0			
	3.247_to_1.949	3.247	704	0.05	0.00531	53.2	158.9	54.5	4.4	2.9				3.2	19.397					53.3	159.7	54.6	4.4	2.9							
	3.247_to_1.949	3.14	704	0.05	0.00426	62.1	179.9	63.0	3.9	2.9				3.2	19.397					60.2	167.1	61.1	4.2	2.7							
	3.247_to_1.949	3.011	704	0.06	0.00401	417.1	435.8	418.4	1.6	1.0				3.2	19.397					415.5	401.8	416.8	1.8	1.0							
	3.247_to_1.949	2.937	704	0.06	0.00393	222.4	341.3	223.9	2.1	1.5				3.2	19.397					199.7	300.2	201.1	2.3	1.5							
	3.247_to_1.949	2.867	704	0.05	0.0064	112.0	201.0	112.9	3.5	1.8				3.2	19.397					116.3	216.8	117.1	3.2	1.9							
	3.247_to_1.949	2.774	704	0.05	0.00538	74.3	179.8	75.0	3.9	2.4				3.2	19.397					74.7	181.7	75.4	3.9	2.4							
	3.247_to_1.949	2.691	704	0.05	0.0051	133.6	230.7	134.5	3.1	1.7				3.2	19.397					133.5	229.0	134.3	3.1	1.7							
	3.247_to_1.949	2.588	704	0.05	0.00556	65.8	169.7	66.5	4.1	2.6				3.2	19.397					66.3	173.4	67.0	4.1	2.6							
	3.247_to_1.949	2.486	704	0.05	0.00686	125.6	205.8	126.1	3.4	1.6				3.2	19.397					128.1	225.1	128.6	3.1	1.7							
	3.247_to_1.949	2.395	704	0.05	0.00806	69.3	154.9	70.0	4.5	2.2				3.2	19.397					75.3	182.4	76.0	3.9	2.4							
	3.247_to_1.949	2.31	704	0.05	0.00556	54.2	157.8	55.4	4.5	2.8				3.2	19.397					54.8	161.5	56.1	4.4	2.9							
	3.247_to_1.949	2.208	704	0.05	0.00443	153.7	254.6	154.8	2.8	1.6				3.2	19.397					151.9	241.3	153.0	2.9	1.6							
	3.247_to_1.949	2.118	704	0.05	0.00601	58.2	158.5	59.5	4.4	2.7				3.2	19.397					60.6	167.9	61.8	4.2	2.7							
	3.247_to_1.949	2.034	704	0.05	0.00449	42.1	153.5	44.1	4.6	3.5				3.2	19.397					41.2	145.4	43.1	4.8	3.4							
9	3.247_to_1.949	1.949	704	0.05	0.00398	124.5	241.4	125.0	2.9	1.9	3.6	2.2	117.9	3.2	19.397	1.4	0.1	1.3	1.3	122.8	221.2	123.2	3.2	1.8	3.6	2.2	116.9	1.3	0.0052	0.00529	Degrade
U/S Limit	RAF807	1	250	0.035	0.004	54.1	75.1	54.6	3.3	1.4	3.3	1.4	54.1	3.2	19.397	0.3				52.5	60.8	52.9	4.1	1.2	4.1	1.2	52.5	0.7			
	1.858_to_1.307	1.858	716	0.04	0.00588	175.1	217.2	175.3	3.3	1.2				3.2	19.397					171.8	198.6	172.1	3.6	1.2							
	1.858_to_1.307	1.788	716	0.04	0.00478	182.2	234.9	182.3	3.0	1.3				3.2	19.397					180.9	202.7	181.0	3.5	1.1							
	1.858_to_1.307	1.708	716	0.04	0.00437	169.2	234.3	169.5	3.1	1.4				3.2	19.397					157.9	192.0	158.2	3.7	1.2							
	1.858_to_1.307	1.593	716	0.04	0.00373	180.5	252.2	180.8	2.8	1.4				3.2	19.397					178.2	201.6	178.5	3.6	1.1							
	1.858_to_1.307	1.479	716	0.04	0.00357	182.8	256.7	183.1	2.8	1.4				3.2	19.397					180.1	202.4	180.3	3.5	1.1							
	1.858_to_1.307	1.381	716	0.04	0.00352	177.5	254.7	177.7	2.8	1.4				3.2	19.397					174.3	199.8	174.5	3.6	1.1							
10	1.858_to_1.307	1.307	716	0.04	0.00495	202.7	242.5	202.8	3.0	1.2	3.0	1.3	181.4	3.2	19.397	0.7	0.3	1.4	1.7	201.6	211.6	201.6	3.4	1.0	3.6	1.1	177.8	1.7	0.0077	0.00440	Aggrade
	1.169_to_0.000	1.169	716	0.02	0.005	116.8	127.9	116.8	5.6	1.1				3.2	19.397					115.5	123.4	115.5	5.8	1.1							
	1.169_to_0.000	1.058	716	0.04	0.00425	149.1	224.5	149.2	3.2	1.5				3.2	19.397					145.8	205.4	146.0	3.5	1.4							
	1.169_to_0.000	0.946	716	0.04	0.0042	146.9	224.0	147.0	3.2	1.5				3.2	19.397					139.4	201.7	139.6	3.5	1.4							
	1.169_to_0.000	0.833	716	0.04	0.00378	142.9	228.6	143.0	3.1	1.6				3.2	19.397					134.8	199.0	134.9	3.6	1.5							
	1.169_to_0.000	0.746	716	0.04	0.00409	135.6	218.7	135.8	3.3	1.6				3.2	19.397					132.3	197.6	132.5	3.6	1.5							
	1.169_to_0.000	0.647	716	0.04	0.00681	171.1	205.9	171.2	3.5	1.2				3.2	19.397					173.1	220.0	173.2	3.3	1.3							
	1.169_to_0.000	0.579	716	0.04	0.00474	67.1	158.5	67.8	4.5	2.3				3.2	19.397					65.2	149.5	65.9	4.8	2.3							
	1.169_to_0.000	0.527	716	0.04	0.00598	166.6	211.9	166.8	3.4	1.3				3.2	19.397					166.9	216.8	167.1	3.3	1.3							
	1.169_to_0.000	0.437	716	0.04	0.00905	80.3	140.3	81.1	5.1	1.7				3.2	19.397					108.1	182.8	109.1	3.9	1.7							
	1.169_to_0.000	0.35	716	0.04	0.00763	159.9	194.2	160.9	3.7	1.2				3.2	19.397					164.5	216.0	165.5	3.3	1.3							
	1.169_to_0.000	0.238	716	0.04	0.00645	201.8	223.8	202.2	3.2	1.1				3.2	19.397					208.3	237.0	208.8	3.0	1.1							
	1.169_to_0.000	0.159	716	0.04	0.00578	208.4	234.4	209.2	3.1	1.1				3.2	19.397					211.3	238.5	212.1	3.0	1.1							
	1.169_to_0.000	0.107	716	0.04	0.00716	695.3	355.6	696.3	2.0	0.5				3.2	19.397					710.9	387.2	712.0	1.8	0.5							
11	1.169_to_0.000	0	716	0.04	0.00709	243.7	234.4	243.8	3.1	1.0	3.6	1.3	191.8	3.2	19.397	1.7	0.3	1.4	1.7	260.3	259.0	260.5	2.8	1.0	3.5	1.3	195.5	1.7	0.0056	0.00586	Degrade

ADWR 1985 Dynamic Equilibrium Slope Calculations 10-Year

Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
U/S Limit	RWI502	1	1018	0.035	0.0026	77.0	228.9	78.1	4.0	2.9	4.0	2.9	77.0	0.12	17.833	5.0				168.5	344.9	169.8	3.0	2.0	3.0	2.0	168.5				
	79.29_to_47.82	79.29	1018	0.035	0.00029	77.6	429.4	80.2	2.4	5.4				0.12	17.833					63.7	235.3	65.3	4.3	3.6							
	79.29_to_47.82	78.17	1018	0.035	0.00029	84.5	443.0	86.7	2.3	5.1				0.12	17.833					69.8	243.6	71.1	4.2	3.4							
	79.29_to_47.82	76.05	1018	0.035	0.00029	111.0	491.1	112.2	2.1	4.4				0.12	17.833					89.6	268.0	90.3	3.8	3.0							
	79.29_to_47.82	73.75	1018	0.035	0.00029	112.9	495.6	114.8	2.1	4.3				0.12	17.833					75.2	250.4	76.2	4.1	3.3							
	79.29_to_47.82	70.42	1018	0.035	0.00029	88.3	450.3	90.3	2.3	5.0				0.12	17.833					70.0	243.7	71.2	4.2	3.4							
	79.29_to_47.82	67.46	1018	0.035	0.00029	99.6	471.3	101.2	2.2	4.7				0.12	17.833					75.6	250.9	76.6	4.1	3.3							
	79.29_to_47.82	64.16	1018	0.035	0.00029	102.0	475.6	103.5	2.1	4.6				0.12	17.833					81.6	258.4	82.4	3.9	3.1							
	79.29_to_47.82	62.09	1018	0.035	0.00029	102.5	476.6	104.1	2.1	4.6				0.12	17.833					82.3	259.3	83.2	3.9	3.1							
	79.29_to_47.82	60.05	1018	0.035	0.00029	97.2	466.9	98.9	2.2	4.7				0.12	17.833					79.6	256.0	80.6	4.0	3.2							
	79.29_to_47.82	56.8	1018	0.035	0.00029	98.9	470.4	100.7	2.2	4.7				0.12	17.833					74.2	249.2	75.3	4.1	3.3							
	79.29_to_47.82	53.79	1018	0.035	0.00029	100.6	473.6	102.4	2.1	4.6				0.12	17.833					78.5	254.6	79.5	4.0	3.2							
	79.29_to_47.82	50.53	1018	0.035	0.00029	98.2	469.6	100.3	2.2	4.7				0.12	17.833					77.0	253.0	78.2	4.0	3.2							
1	79.29_to_47.82	47.82	1018	0.035	0.00029	96.5	466.1	98.4	2.2	4.7	2.2	4.7	97.7	0.12	17.833	0.4	5.0		5.0	87.2	265.3	88.1	3.8	3.0	4.0	3.2	77.3	5.1	0.0019	0.00029	Aggrade
U/S Limit	PI635	1	218	0.07	0.009	39.5	72.7	40.2	3.0	1.8	3.0	1.8	39.5	0.12	17.833	2.9				60.0	149.6	61.2	1.5	2.4							
	44.39_to_13.728	44.39	1018	0.035	0.00037	97.9	468.4	99.7	2.2	4.7				0.12	17.833					80.5	279.1	81.6	3.6	3.4							
	44.39_to_13.728	41.43	1018	0.035	0.00037	91.1	455.4	92.9	2.2	4.9				0.12	17.833					77.9	275.5	79.0	3.7	3.5							
	44.39_to_13.728	40.27	1018	0.035	0.00037	96.5	465.7	98.2	2.2	4.7				0.12	17.833					82.2	281.3	83.3	3.6	3.4							
	44.39_to_13.728	38.29	1018	0.035	0.00037	80.7	435.7	83.1	2.3	5.2				0.12	17.833					68.5	262.6	70.1	3.9	3.7							
	44.39_to_13.728	35.4	1018	0.035	0.00037	85.7	445.3	87.8	2.3	5.1				0.12	17.833					73.2	269.1	74.5	3.8	3.6							
	44.39_to_13.728	32.45	1018	0.035	0.00037	88.3	450.4	90.3	2.3	5.0				0.12	17.833					76.2	273.3	77.4	3.7	3.5							
	44.39_to_13.728	29.38	1018	0.035	0.00037	85.2	444.5	87.4	2.3	5.1				0.12	17.833					72.7	268.6	74.1	3.8	3.6							
	44.39_to_13.728	28.13	1018	0.035	0.00037	87.0	447.8	89.1	2.3	5.0				0.12	17.833					74.4	270.9	75.8	3.8	3.6							
	44.39_to_13.728	27.48	1018	0.035	0.00037	86.0	446.2	88.3	2.3	5.1				0.12	17.833					74.2	270.7	75.6	3.8	3.6							
	44.39_to_13.728	26.94	1018	0.035	0.00037	94.1	461.1	95.8	2.2	4.8				0.12	17.833					82.7	282.0	83.8	3.6	3.4							
	44.39_to_13.728	24.99	1018	0.035	0.00037	85.1	444.4	87.4	2.3	5.1				0.12	17.833					74.0	270.5	75.5	3.8	3.6							
	44.39_to_13.728	24.5	1018	0.035	0.00037	84.3	442.9	86.7	2.3	5.1				0.12	17.833					73.8	270.2	75.3	3.8	3.6							
	44.39_to_13.728	22.48	1018	0.035	0.00037	83.4	441.0	85.7	2.3	5.1				0.12	17.833					72.9	268.8	74.3	3.8	3.6							
	44.39_to_13.728	20.15	1018	0.035	0.00037	82.9	441.2	85.8	2.3	5.1				0.12	17.833					74.0	271.1	75.9	3.8	3.6							
	44.39_to_13.728	17.1	1018	0.035	0.00037	102.8	477.3	104.4	2.1	4.6				0.12	17.833					92.3	294.4	93.3	3.5	3.2							
	44.39_to_13.728	14.35	1018	0.035	0.00037	113.7	496.3	115.1	2.1	4.3				0.12	17.833					102.5	306.8	103.4	3.3	3.0							
	44.39_to_13.728	14.30125	1018	0.035	0.00037	116.7	501.4	118.1	2.0	4.2				0.12	17.833					107.0	312.0	107.8	3.3	2.9							
	44.39_to_13.728	14.3012	1018	0.035	0.00037	109.9	489.7	111.4	2.1	4.4				0.12	17.833					98.8	302.3	99.7	3.4	3.0							
	44.39_to_13.728	14.301	1018	0.035	0.00037	112.6	494.2	113.9	2.1	4.3				0.12	17.833					102.3	306.4	103.1	3.3	3.0							
	44.39_to_13.728	14.3008	1018	0.035	0.00037	112.4	493.9	113.8	2.1	4.3				0.12	17.833					100.9	304.8	101.7	3.3	3.0							
	44.39_to_13.728	14.3006	1018	0.035	0.00037	108.7	487.7	110.2	2.1	4.4				0.12	17.833					96.2	299.3	97.2	3.4	3.1							
	44.39_to_13.728	14.3004	1018	0.035	0.00037	113.3	495.6	114.7	2.1	4.3				0.12	17.833					101.8	306.0	102.7	3.3	3.0							
	44.39_to_13.728	14.3002	1018	0.035	0.00037	106.5	322.3	107.5	3.2	3.0				0.12	17.833					105.8	310.8	106.8	3.3	2.9							
	44.39_to_13.728	14.289	1018	0.035	0.00083	102.8	360.8	103.8	2.8	3.5				0.12	17.833					98.6	302.2	99.5	3.4	3.0							
	44.39_to_13.728	13.962	1018	0.035	0.00093	109.9	358.2	111.0	2.8	3.2				0.12	17.833					107.1	312.3	108.1	3.3	2.9							
2	44.39_to_13.728	13.728	1018	0.035	0.00093	116.6	366.8	117.4	2.8	3.1	2.3	4.5	98.2	0.12	17.833	0.5	2.9	0.4	3.3	111.7	317.2	112.4	3.2	2.8	3.5	3.3	87.8	3.3	0.0014	0.00043	Aggrade
U/S Limit	RPI621	1	412	0.035	0.0079	172.7	131.0	172.9	3.1	0.8	3.1	0.8	172.7	2.2	9.6061	0.8				218.1	199.5	218.3	2.1	0.9	2.1	0.9	218.1	0.1			
	13.487_to_12.463	13.487	1367	0.035	0.00047	123.4	550.9	124.8	2.5	4.4				2.2	9.6061					105.1	306.9	106.0	4.5	2.9							
	13.487_to_12.463	13.211	1367	0.035	0.00046	139.0	581.6	140.3	2.4	4.1				2.2	9.6061					110.0	312.3	110.8	4.4	2.8							
	13.487_to_12.463	13.161	1367	0.035	0.0013	138.1	423.6	138.8	3.2	3.1				2.2	9.6061					117.5	320.4	118.1	4.3	2.7							
	13.487_to_12.463	12.935	1367	0.035	0.00103	297.5	615.6	298.1	2.2	2.1				2.2	9.6061					147.6	350.7	148.0	3.9	2.4							
	13.487_to_12.463	12.665	1367	0.035	0.0004	386.3	910.9	387.4	1.5	2.4				2.2	9.6061					154.8	357.5	155.4	3.8	2.3							
3	13.487_to_12.463	12.463	1367	0.035	0.00085	186.1	541.7	186.7	2.5	2.9	2.4	3.2	211.7	2.2	9.6061	0.2	0.8	0.5	1.3	159.1	361.2	159.4	3.8	2.3	4.1	2.6	132.4	1.3	0.0027	0.00075	Aggrade
U/S Limit	RPI603	1	784	0.05	0.008	217.2	252.1	218.2	3.1	1.2	3.1	1.2	217.2	2.2	9.6061	1.5				103.0	268.7	107.2	2.9	2.5	2.9	2.5	103.0	0.4			
	12.102_to_11.825	12.102	1552	0.035	0.00122	138.0	465.9	138.8	3.3	3.4				2.2	9.6061					110.2	331.2	110.8	4.7	3.0							
4	12.102_to_11.825	11.825	1552	0.035	0.00065	440.3	893.2	441.1	1.7	2.0	2.5	2.7	289.1	2.2	9.6061	0.3	1.5	0.2	1.7	148.8	373.1	149.3	4.2	2.5	4.4	2.7	129.5	1.7	0.0028	0.00093	Aggrade
U/S Limit	RPD726	1	842	0.035	0.0044	230.3	269.4	231.3	3.1	1.2	3.1	1.2	230.3	2.2	9.6061	0.9				310.5	397.1	311.6	2.1	1.3	2.1	1.3	310.5	0.2			
	11.555_to_11.270	11.555	2045	0.035	0.00054	419.2	1094.9	419.9	1.9	2.6				2.2	9.6061					215.1	583.6	215.5	3.5	2.7							
	11.555_to_11.270	11.376	2045	0.035	0.00149	170.8	562.8	171.5	3.6	3.3				2.2	9.6061					169.1	530.4	169.7	3.9	3.1							
5	11.555_to_11.270	11.27	2045	0.035	0.00091	158.0	636.2	160.4	3.2	4.0	2.9	3.3	249.3	2.2	9.6061	0.5	0.9	0.3	1.2	131.1	481.2	133.1	4.2	3.6	3.9	3.1	171.7	1.2	0.0018	0.00098	Aggrade
U/S Limit	RD716	1	204	0.035	0.0091	37.4	44.9	37.9	4.5	1.2	4.5	1.2	37.4	2.2	9.6061	0.7				50.4	81.6	51.1	2.5	1.6	2.5	1.6	50.4	0.1			
	10.992_to_3.945	10.992	2200	0.035	0.00084	408.0	991.8	410.4	2.2	2.4				2.2	9.6061					319.3	709.2	321.4	3.1	2.2							
	10.992_to_3.945	10.826	2200	0.035	0.00086	224.6	773.0	225.3	2.8	3.4				2.2	9.6061					199.5	586.6	200.0	3.8	2.9							
	10.992_to_3.945	10.637	2200	0.035	0.0006	525.7	1209.4	526.3	1.8	2.3				2.2	9.6061					383.4	761.3	383.8	2.9	2.0							
	10.992_to_3.945	10.436	2200	0.035	0.00062	564.1	1234.1	565.1	1.8	2.2				2.2	9.6061					446.9	809.7	447.8	2.7	1.8							
	10.992_to_3.945	10.23	2200	0.035	0.00087	321.7	891.4	323.2	2.5	2.8				2.2	9.6061					318.2	707.5	319.5	3.1	2.2							
	10.992_to_3.945	10	2200	0.035	0.00147	110.2	497.8	111.6	4.4	4.5				2.2	9.6061					107.6	459.9	108.9	4.8	4.2							
6	10.992_to_3.945	3.945	2200	0.035	0.00537	114.0	341.3	114.9	6.4	3.0	3.1	2.9	324.0	2.2	9.6061	1.0	0.7	0.5	1.2	507.2	851.9	508.3	2.6	1.7	3.3	2.4	326.0	1.2	0.0018	0.00152	Aggrade
U/S Limit	RPD704	0.829	1026	0.05	0.00486	109.9	271.3	110.5	3.8	2.5	3.8	2.5	109.9	3.2	19.397	1.6				108.3	262.7	108.9	3.9	2.4	3.9	2.4	108.3	1.8			
	RPD704	0.673	1026	0.05	0.00461	245.1	379.3	245.4	2.7	1.5				3.2	19.397					238.5	359.6	238.8	2.9	1.5							
	RPD704	0.541	1026	0.05	0.00461	110.9	276.6	111.5	3.7	2.5				3.2	19.397					108.3	262.7	108.9	3.9	2.4							
	RPD704	0.345	1026	0.05	0.0056	136.2	283.0	136.5	3.6	2.1				3.2	19.397					137.3	288.5	137.6	3.6	2.1							

ADWR 1985 Dynamic Equilibrium Slope Calculations 10-Year

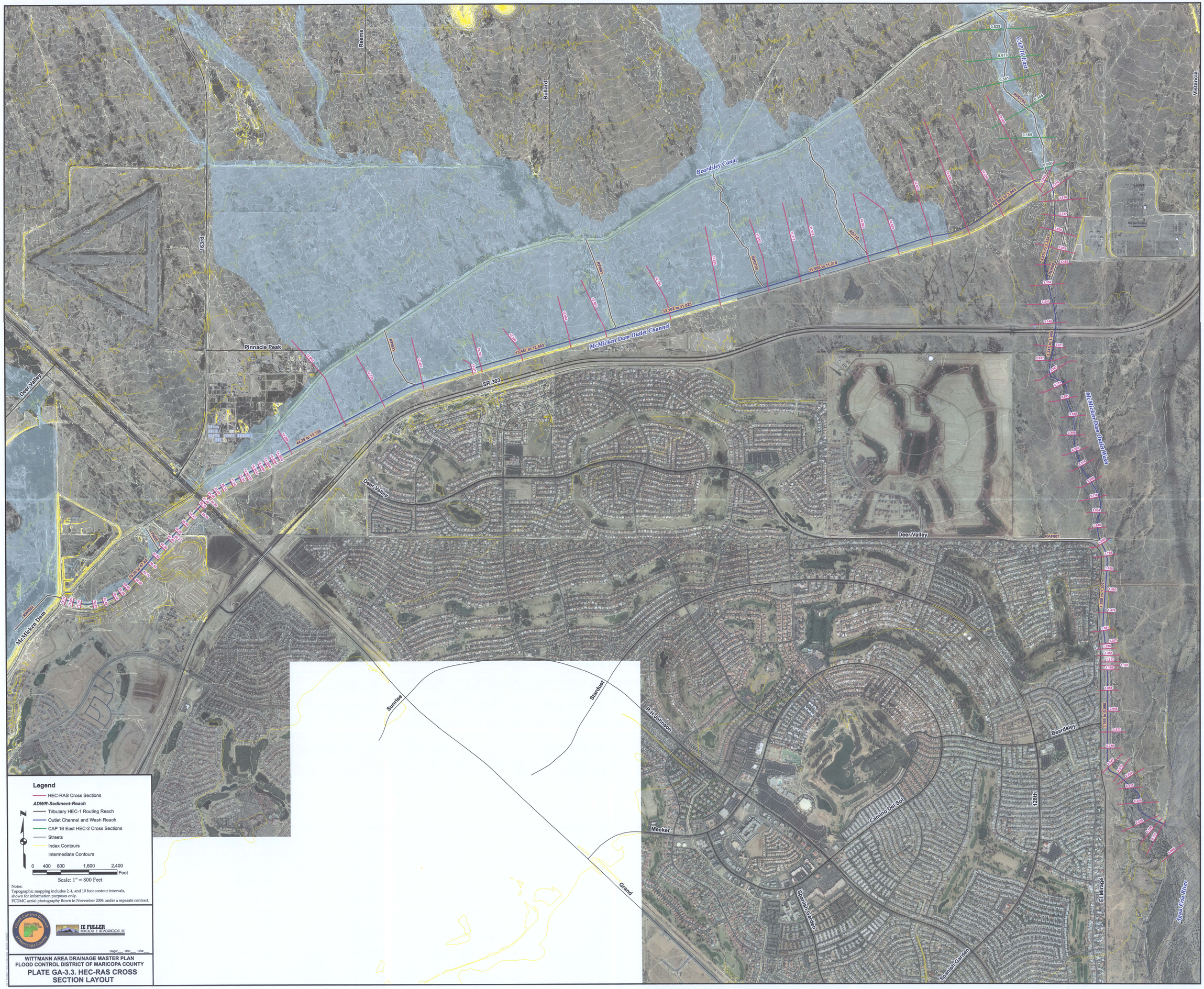
Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
	RPD704	0.169	1026	0.05	0.00632	216.4	328.2	216.5	3.1	1.5				3.2	19.397					221.4	349.0	221.5	2.9	1.6							
7	RPD704	0	1026	0.05	0.00618	184.4	310.8	185.8	3.3	1.7	3.4	2.0	167.1	3.2	19.397	1.6	1.6		1.6	199.4	335.5	200.8	3.1	1.7	3.4	1.9	168.9	1.6	0.0053	0.00536	Degrade
	3.879_to_3.354	3.879	2463	0.035	0.00809	126.7	336.9	127.7	7.3	2.6				3.2	19.397					188.1	498.6	189.2	4.9	2.6							
	3.879_to_3.354	3.816	2463	0.05	0.006	349.5	684.2	351.3	3.6	1.9				3.2	19.397					428.3	857.8	430.1	2.9	2.0							
	3.879_to_3.354	3.737	2463	0.06	0.00533	567.4	959.9	569.8	2.6	1.7				3.2	19.397					692.8	1159.5	695.2	2.1	1.7							
	3.879_to_3.354	3.656	2463	0.06	0.00437	714.0	1116.0	716.2	2.2	1.6				3.2	19.397					727.5	1182.3	729.7	2.1	1.6							
	3.879_to_3.354	3.563	2463	0.05	0.00347	290.4	749.7	292.5	3.3	2.6				3.2	19.397					283.7	728.5	285.8	3.4	2.5							
	3.879_to_3.354	3.465	2463	0.05	0.0038	597.3	970.8	598.2	2.5	1.6				3.2	19.397					605.8	984.4	606.7	2.5	1.6							
8	3.879_to_3.354	3.354	2463	0.05	0.00539	407.1	750.2	408.1	3.3	1.8	3.5	2.0	436.0	3.2	19.397	5.0	1.6	1.0	2.5	475.4	893.6	476.4	2.8	1.9	3.0	2.0	485.9	2.5	0.0037	0.00521	Degrade
U/S Limit	RD800	1	149	0.035	0.0059	36.1	41.7	36.5	3.6	1.1	3.6	1.1	36.1	3.2	19.397	0.3				35.8	41.2	36.3	3.6	1.1	3.6	1.1	35.8	0.3			
	3.247_to_1.949	3.247	2463	0.05	0.00531	339.5	701.5	341.2	3.5	2.1				3.2	19.397					315.2	653.3	316.9	3.8	2.1							
	3.247_to_1.949	3.14	2463	0.05	0.00426	506.3	878.6	507.5	2.8	1.7				3.2	19.397					455.7	756.2	456.9	3.3	1.7							
	3.247_to_1.949	3.011	2463	0.06	0.00401	464.4	964.5	465.8	2.6	2.1				3.2	19.397					444.2	835.3	445.6	2.9	1.9							
	3.247_to_1.949	2.937	2463	0.06	0.00393	563.0	1047.6	564.6	2.4	1.9				3.2	19.397					551.1	910.4	552.7	2.7	1.6							
	3.247_to_1.949	2.867	2463	0.05	0.0064	156.3	486.9	157.4	5.1	3.1				3.2	19.397					164.6	504.1	165.7	4.9	3.0							
	3.247_to_1.949	2.774	2463	0.05	0.00538	466.7	792.8	467.7	3.1	1.7				3.2	19.397					455.1	755.7	456.0	3.3	1.7							
	3.247_to_1.949	2.691	2463	0.05	0.0051	215.2	591.7	216.4	4.2	2.7				3.2	19.397					196.7	541.1	197.8	4.6	2.7							
	3.247_to_1.949	2.588	2463	0.05	0.00556	282.2	642.2	283.1	3.8	2.3				3.2	19.397					270.3	613.8	271.2	4.0	2.3							
	3.247_to_1.949	2.486	2463	0.05	0.00686	307.4	623.6	308.1	3.9	2.0				3.2	19.397					316.9	653.9	317.6	3.8	2.1							
	3.247_to_1.949	2.395	2463	0.05	0.00806	246.7	544.3	247.6	4.5	2.2				3.2	19.397					259.3	603.7	260.1	4.1	2.3							
	3.247_to_1.949	2.31	2463	0.05	0.00556	318.8	674.8	320.3	3.7	2.1				3.2	19.397					317.0	654.5	318.4	3.8	2.1							
	3.247_to_1.949	2.208	2463	0.05	0.00443	207.4	608.4	208.8	4.0	2.9				3.2	19.397					195.2	539.7	196.6	4.6	2.7							
	3.247_to_1.949	2.118	2463	0.05	0.00601	365.6	696.1	367.3	3.5	1.9				3.2	19.397					365.4	692.9	367.1	3.6	1.9							
	3.247_to_1.949	2.034	2463	0.05	0.00449	212.7	613.7	215.6	4.0	2.8				3.2	19.397					208.7	555.7	211.4	4.4	2.6							
9	3.247_to_1.949	1.949	2463	0.05	0.00398	148.8	550.3	149.8	4.5	3.7	3.7	2.3	320.1	3.2	19.397	4.2	0.3	5.0	5.3	142.7	475.9	143.6	5.2	3.3	3.9	2.3	310.5	5.3	0.0061	0.00529	Aggrade
U/S Limit	RAF807	1	874	0.035	0.004	63.8	170.4	64.8	5.1	2.6	5.1	2.6	63.8	3.2	19.397	1.8				62.6	157.8	63.6	5.5	2.5	5.5	2.5	62.6	2.5			
	1.858_to_1.307	1.858	2507	0.04	0.00588	194.7	481.0	195.2	5.2	2.5				3.2	19.397					195.8	505.3	196.3	5.0	2.6							
	1.858_to_1.307	1.788	2507	0.04	0.00478	193.0	510.1	193.5	4.9	2.6				3.2	19.397					192.7	502.0	193.2	5.0	2.6							
	1.858_to_1.307	1.708	2507	0.04	0.00437	187.9	518.7	188.6	4.8	2.8				3.2	19.397					187.0	496.3	187.7	5.1	2.6							
	1.858_to_1.307	1.593	2507	0.04	0.00373	193.2	550.2	193.9	4.6	2.8				3.2	19.397					191.1	500.5	191.8	5.0	2.6							
	1.858_to_1.307	1.479	2507	0.04	0.00357	197.3	561.6	197.9	4.5	2.8				3.2	19.397					194.6	504.1	195.2	5.0	2.6							
	1.858_to_1.307	1.381	2507	0.04	0.00352	193.9	560.2	194.5	4.5	2.9				3.2	19.397					190.8	500.1	191.4	5.0	2.6							
10	1.858_to_1.307	1.307	2507	0.04	0.00495	212.9	525.0	213.4	4.8	2.5	4.7	2.7	196.1	3.2	19.397	4.9	1.8	4.2	6.0	212.8	522.3	213.3	4.8	2.4	5.0	2.6	195.0	6.0	0.0050	0.00440	Aggrade
	1.169_to_0.000	1.169	2507	0.02	0.005	151.7	301.4	151.9	8.3	2.0				3.2	19.397					152.9	315.3	153.1	8.0	2.1							
	1.169_to_0.000	1.058	2507	0.04	0.00425	193.5	528.7	193.9	4.7	2.7				3.2	19.397					192.9	524.5	193.3	4.8	2.7							
	1.169_to_0.000	0.946	2507	0.04	0.0042	180.3	516.1	180.7	4.9	2.9				3.2	19.397					180.0	510.3	180.4	4.9	2.8							
	1.169_to_0.000	0.833	2507	0.04	0.00378	188.2	541.5	188.6	4.6	2.9				3.2	19.397					187.1	518.1	187.4	4.8	2.8							
	1.169_to_0.000	0.746	2507	0.04	0.00409	163.6	500.4	164.1	5.0	3.0				3.2	19.397					163.0	490.5	163.5	5.1	3.0							
	1.169_to_0.000	0.647	2507	0.04	0.00681	206.2	470.7	206.4	5.3	2.3				3.2	19.397					215.2	547.8	215.5	4.6	2.5							
	1.169_to_0.000	0.579	2507	0.04	0.00474	409.5	691.1	410.7	3.6	1.7				3.2	19.397					415.0	712.9	416.2	3.5	1.7							
	1.169_to_0.000	0.527	2507	0.04	0.00598	222.6	504.9	223.0	5.0	2.3				3.2	19.397					231.2	563.9	231.6	4.4	2.4							
	1.169_to_0.000	0.437	2507	0.04	0.00905	404.8	566.7	406.3	4.4	1.4				3.2	19.397					419.7	716.4	421.4	3.5	1.7							
	1.169_to_0.000	0.35	2507	0.04	0.00763	323.4	545.3	324.5	4.6	1.7				3.2	19.397					362.3	675.3	363.5	3.7	1.9							
	1.169_to_0.000	0.238	2507	0.04	0.00645	431.8	643.3	432.5	3.9	1.5				3.2	19.397					471.0	749.5	471.8	3.3	1.6							
	1.169_to_0.000	0.159	2507	0.04	0.00578	664.9	790.0	665.9	3.2	1.2				3.2	19.397					666.8	861.3	667.8	2.9	1.3							
	1.169_to_0.000	0.107	2507	0.04	0.00716	804.7	799.6	806.0	3.1	1.0				3.2	19.397					806.2	929.2	807.4	2.7	1.2							
11	1.169_to_0.000	0	2507	0.04	0.00709	518.7	672.4	519.0	3.7	1.3	4.6	2.0	347.4	3.2	19.397	8.3	1.8	4.2	6.0	678.0	866.7	678.3	2.9	1.3	4.2	2.1	367.2	6.0	0.0043	0.00586	Degrade

ADWR 1985 Dynamic Equilibrium Slope Calculations 100-Year

Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
U/S Limit	RWI502	1	2908	0.035	0.0026	388.3	817.5	389.7	4.0	2.1	4.0	2.1	388.3	0.12	17.833	28.0				406.0	871.8	407.4	3.3	2.1	3.3	2.1	406.0				
	79.29_to_47.82	79.29	2908	0.035	0.00029	106.6	958.5	111.4	3.0	8.6				0.12	17.833					79.5	459.7	82.3	6.3	5.6							
	79.29_to_47.82	78.17	2908	0.035	0.00029	123.2	1010.3	127.0	2.9	8.0				0.12	17.833					86.6	474.2	88.9	6.1	5.3							
	79.29_to_47.82	76.05	2908	0.035	0.00029	183.4	1175.3	185.4	2.5	6.3				0.12	17.833					117.1	531.6	118.3	5.5	4.5							
	79.29_to_47.82	73.75	2908	0.035	0.00029	140.6	1062.1	144.0	2.7	7.4				0.12	17.833					114.8	528.8	116.7	5.5	4.5							
	79.29_to_47.82	70.42	2908	0.035	0.00029	128.2	1025.1	131.8	2.8	7.8				0.12	17.833					100.0	501.1	102.1	5.8	4.9							
	79.29_to_47.82	67.46	2908	0.035	0.00029	130.0	1029.6	133.2	2.8	7.7				0.12	17.833					101.6	503.6	103.3	5.8	4.9							
	79.29_to_47.82	64.16	2908	0.035	0.00029	133.2	1038.7	136.2	2.8	7.6				0.12	17.833					104.1	508.1	105.7	5.7	4.8							
	79.29_to_47.82	62.09	2908	0.035	0.00029	132.7	1037.4	135.7	2.8	7.6				0.12	17.833					104.5	509.0	106.1	5.7	4.8							
	79.29_to_47.82	60.05	2908	0.035	0.00029	125.3	1015.6	128.7	2.9	7.9				0.12	17.833					99.0	498.7	100.8	5.8	4.9							
	79.29_to_47.82	56.8	2908	0.035	0.00029	127.4	1022.2	130.8	2.8	7.8				0.12	17.833					100.8	502.3	102.7	5.8	4.9							
	79.29_to_47.82	53.79	2908	0.035	0.00029	123.1	1010.0	126.9	2.9	8.0				0.12	17.833					102.1	505.1	104.1	5.8	4.9							
	79.29_to_47.82	50.53	2908	0.035	0.00029	120.2	1001.7	124.4	2.9	8.1				0.12	17.833					99.7	500.8	101.9	5.8	4.9							
1	79.29_to_47.82	47.82	2908	0.035	0.00029	117.6	993.0	121.7	2.9	8.2	2.8	7.8	130.1	0.12	17.833	1.4	28.0		28.0	97.9	496.9	99.9	5.9	5.0	5.8	4.9	100.6	28.1	0.0022	0.00029	Aggrade
U/S Limit	PI635	1	622	0.07	0.009	60.0	161.8	61.6	3.8	2.6	3.8	2.6	60.0	0.12	17.833	11.6				60.0	297.5	66.2	2.1	4.5							
	44.39_to_13.728	44.39	2908	0.035	0.00037	122.3	935.7	125.5	3.1	7.5				0.12	17.833					105.3	601.3	107.5	4.8	5.6							
	44.39_to_13.728	41.43	2908	0.035	0.00037	122.4	938.2	126.4	3.1	7.4				0.12	17.833					103.5	597.5	105.8	4.9	5.6							
	44.39_to_13.728	40.27	2908	0.035	0.00037	126.5	947.5	129.5	3.1	7.3				0.12	17.833					105.9	602.4	108.0	4.8	5.6							
	44.39_to_13.728	38.29	2908	0.035	0.00037	118.3	926.5	122.5	3.1	7.6				0.12	17.833					88.6	564.2	91.7	5.2	6.2							
	44.39_to_13.728	35.4	2908	0.035	0.00037	118.6	926.4	122.4	3.1	7.6				0.12	17.833					93.9	575.9	96.5	5.0	6.0							
	44.39_to_13.728	32.45	2908	0.035	0.00037	120.9	933.3	124.7	3.1	7.5				0.12	17.833					96.3	581.4	98.8	5.0	5.9							
	44.39_to_13.728	29.38	2908	0.035	0.00037	113.6	911.0	117.4	3.2	7.8				0.12	17.833					93.5	575.1	96.2	5.1	6.0							
	44.39_to_13.728	28.13	2908	0.035	0.00037	113.4	909.9	117.1	3.2	7.8				0.12	17.833					95.2	579.0	97.8	5.0	5.9							
	44.39_to_13.728	27.48	2908	0.035	0.00037	111.1	903.4	115.0	3.2	7.9				0.12	17.833					93.8	576.1	96.6	5.0	6.0							
	44.39_to_13.728	26.94	2908	0.035	0.00037	118.5	924.4	121.8	3.1	7.6				0.12	17.833					101.6	593.0	103.8	4.9	5.7							
	44.39_to_13.728	24.99	2908	0.035	0.00037	108.8	896.6	112.8	3.2	7.9				0.12	17.833					92.5	573.0	95.3	5.1	6.0							
	44.39_to_13.728	24.5	2908	0.035	0.00037	106.9	890.9	111.1	3.3	8.0				0.12	17.833					91.3	570.4	94.2	5.1	6.1							
	44.39_to_13.728	22.48	2908	0.035	0.00037	105.9	888.0	110.1	3.3	8.1				0.12	17.833					90.4	568.1	93.3	5.1	6.1							
	44.39_to_13.728	20.15	2908	0.035	0.00037	111.3	908.3	116.5	3.2	7.8				0.12	17.833					88.8	566.2	92.5	5.1	6.1							
	44.39_to_13.728	17.1	2908	0.035	0.00037	125.7	945.4	128.8	3.1	7.3				0.12	17.833					109.8	611.0	111.9	4.8	5.5							
	44.39_to_13.728	14.35	2908	0.035	0.00037	138.2	979.7	140.8	3.0	7.0				0.12	17.833					121.2	634.6	123.0	4.6	5.2							
	44.39_to_13.728	14.30125	2908	0.035	0.00037	138.3	980.3	141.0	3.0	7.0				0.12	17.833					123.3	638.9	125.1	4.6	5.1							
	44.39_to_13.728	14.3012	2908	0.035	0.00037	134.3	969.0	137.0	3.0	7.1				0.12	17.833					117.4	626.8	119.3	4.6	5.3							
	44.39_to_13.728	14.301	2908	0.035	0.00037	134.6	969.7	137.2	3.0	7.1				0.12	17.833					119.3	630.6	121.1	4.6	5.2							
	44.39_to_13.728	14.3008	2908	0.035	0.00037	137.5	977.7	140.1	3.0	7.0				0.12	17.833					120.1	632.2	121.9	4.6	5.2							
	44.39_to_13.728	14.3006	2908	0.035	0.00037	168.9	1060.4	171.6	2.7	6.2				0.12	17.833					117.0	626.0	118.9	4.6	5.3							
	44.39_to_13.728	14.3004	2908	0.035	0.00037	154.7	1024.4	157.4	2.8	6.5				0.12	17.833					121.0	634.1	122.8	4.6	5.2							
	44.39_to_13.728	14.3002	2908	0.035	0.00037	161.9	1044.5	165.3	2.8	6.3				0.12	17.833					123.2	638.9	125.1	4.6	5.1							
	44.39_to_13.728	14.289	2908	0.035	0.00083	126.0	736.4	128.0	3.9	5.8				0.12	17.833					120.0	632.0	121.8	4.6	5.2							
	44.39_to_13.728	13.962	2908	0.035	0.00093	141.1	744.3	143.1	3.9	5.2				0.12	17.833					125.9	644.3	127.8	4.5	5.0							
2	44.39_to_13.728	13.728	2908	0.035	0.00093	292.0	992.9	293.2	2.9	3.4	3.1	7.1	133.5	0.12	17.833	2.3	11.6	1.4	13.0	278.7	881.7	279.9	3.3	3.2	4.8	5.5	113.0	13.1	0.0013	0.00043	Aggrade
U/S Limit	RPI621	1	1177	0.035	0.0079	270.4	294.2	270.6	4.0	1.1	4.0	1.1	270.4	2.2	9.6061	3.1				336.0	439.0	336.2	2.7	1.3	2.7	1.3	336.0	0.6			
	13.487_to_12.463	13.487	3906	0.035	0.00047	533.1	1852.2	535.6	2.1	3.5				2.2	9.6061					127.8	615.2	129.3	6.3	4.8							
	13.487_to_12.463	13.211	3906	0.035	0.00046	382.4	1634.3	384.6	2.4	4.2				2.2	9.6061					158.3	669.4	159.7	5.8	4.2							
	13.487_to_12.463	13.161	3906	0.035	0.0013	424.0	1244.5	425.2	3.1	2.9				2.2	9.6061					293.1	854.6	294.1	4.6	2.9							
	13.487_to_12.463	12.935	3906	0.035	0.00103	462.4	1378.9	463.4	2.8	3.0				2.2	9.6061					377.7	945.2	378.4	4.1	2.5							
	13.487_to_12.463	12.665	3906	0.035	0.0004	663.0	2122.2	664.5	1.8	3.2				2.2	9.6061					404.9	972.2	406.0	4.0	2.4							
3	13.487_to_12.463	12.463	3906	0.035	0.00085	591.2	1613.9	592.2	2.4	2.7	2.5	3.3	509.4	2.2	9.6061	0.5	3.1	2.3	5.4	416.7	983.1	417.4	4.0	2.4	4.8	3.2	296.4	5.4	0.0028	0.00075	Aggrade
U/S Limit	RPI603	1	2239	0.05	0.008	103.0	371.4	109.2	6.0	3.4	6.0	3.4	103.0	2.2	9.6061	9.1				103.0	433.2	110.4	5.2	3.9	5.2	3.9	103.0	4.5			
	12.102_to_11.825	12.102	4434	0.035	0.00122	576.8	1547.5	578.1	2.9	2.7				2.2	9.6061					381.3	866.2	382.3	5.1	2.3							
4	12.102_to_11.825	11.825	4434	0.035	0.00065	747.6	2072.2	748.8	2.1	2.8	2.5	2.7	662.2	2.2	9.6061	0.7	9.1	0.5	9.6	451.9	926.7	452.7	4.8	2.0	5.0	2.2	416.6	9.6	0.0049	0.00093	Aggrade
U/S Limit	RPD726	1	2405	0.035	0.0044	441.9	655.8	443.1	3.7	1.5	3.7	1.5	441.9	2.2	9.6061	3.1				548.2	903.5	549.4	2.7	1.6	2.7	1.6	548.2	0.9			
	11.555_to_11.270	11.555	5843	0.035	0.00054	839.9	2714.0	841.1	2.2	3.2				2.2	9.6061					574.9	1568.2	575.8	3.7	2.7							
	11.555_to_11.270	11.376	5843	0.035	0.00149	662.9	1816.3	664.5	3.2	2.7				2.2	9.6061					581.5	1575.9	582.9	3.7	2.7							
5	11.555_to_11.270	11.27	5843	0.035	0.00091	553.4	1964.8	556.5	3.0	3.5	2.8	3.2	685.4	2.2	9.6061	1.2	3.1	0.7	3.9	434.3	1404.7	437.3	4.2	3.2	3.9	2.9	530.2	3.8	0.0020	0.00098	Aggrade
U/S Limit	RD716	1	584	0.035	0.0091	55.5	98.8	56.2	5.9	1.8	5.9	1.8	55.5	2.2	9.6061	2.9				251.3	299.1	252.3	2.0	1.2	2.0	1.2	251.3	0.1			
	10.992_to_3.945	10.992	6286	0.035	0.00084	668.7	2267.4	671.6	2.8	3.4				2.2	9.6061					573.9	1732.0	576.6	3.6	3.0							
	10.992_to_3.945	10.826	6286	0.035	0.00086	679.6	2259.1	681.0	2.8	3.3				2.2	9.6061					549.0	1699.9	550.2	3.7	3.1							
	10.992_to_3.945	10.637	6286	0.035	0.0006	849.5	2751.0	850.5	2.3	3.2				2.2	9.6061					679.3	1850.3	680.1	3.4	2.7							
	10.992_to_3.945	10.436	6286	0.035	0.00062	859.7	2742.2	861.2	2.3	3.2				2.2	9.6061					705.9	1879.3	707.1	3.3	2.7							
	10.992_to_3.945	10.23	6286	0.035	0.00087	518.7	2025.8	520.9	3.1	3.9				2.2	9.6061					351.1	1423.5	353.1	4.4	4.0							
	10.992_to_3.945	10	6286	0.035	0.00147	266.6	1330.7	269.9	4.7	4.9				2.2	9.6061					265.6	1276.0	268.6	4.9	4.8							
6	10.992_to_3.945	3.945	6286	0.035	0.00537	609.1	1249.6	610.2	5.0	2.0	3.3	3.4	636.0	2.2	9.6061	2.2	2.9	1.2	4.1	963.5	2127.9	964.6	3.0	2.2	3.8	3.2	584.0	3.7	0.0017	0.00152	Aggrade
U/S Limit	RPD704	0.829	2930	0.05	0.00486	399.8	852.5	400.6	3.4	2.1	3.4	2.1	399.8	3.2	19.397	3.9				400.6	862.7	401.4	3.4	2.1	3.4	2.1	400.6	3.7			
	RPD704	0.673	2930	0.05	0.00461	366.5	836.2	367.0	3.5	2.3				3.2	19.397					365.4	831.3	365.9	3.5	2.3							
	RPD704	0.541	2930	0.05	0.00461	320.7	793.2	321.6	3.7	2.5				3.2	19.397					319.4	788.1	320.2	3.7	2.5							
	RPD704	0.345	2930	0.05	0.0056	425.6	837.4	426.1	3.5	2.0				3.2	19.397					493.8	937.6	494.3	3.1	1.9							

ADWR 1985 Dynamic Equilibrium Slope Calculations 100-Year

Reach	River	Cutline ID	Discharge (cfs)	Mannings n	Existing Slope (ft/ft)	Flow Width (ft)	Wetted Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/s)	Hydraulic Depth (ft)	Average Velocity (ft/s)	Average Depth (ft)	Average Width (ft)	D50 (mm)	G	Existing Sediment Transport Capacity (cfs)	Sediment Inflow #1 (cfs)	Sediment Inflow #2 (cfs)	Total Sediment Inflow (cfs)	Long-term Flow Width (ft)	Long-term Wetted Area (sq ft)	Long-term Wetted Perimeter (ft)	Long-term Velocity (ft/s)	Long-term Hydraulic Depth	Long-term Average Velocity (ft/s)	Long-term Average Depth (ft)	Long-term Average Width (ft)	Equilibrium Sediment Transport Capacity (cfs)	Equilibrium Slope (ft/ft)	Existing Average Slope (ft/ft)	Aggrade or Degrade?
	RPD704	0.169	2930	0.05	0.00632	292.0	694.5	292.2	4.2	2.4				3.2	19.397					306.0	774.2	306.2	3.8	2.5							
7	RPD704	0	2930	0.05	0.00618	376.8	775.2	378.2	3.8	2.0	3.7	2.2	363.6	3.2	19.397	4.8	3.9		3.9	403.9	866.0	405.3	3.4	2.1	3.5	2.2	381.5	3.9	0.0047	0.00536	Degrade
	3.879_to_3.354	3.879	7038	0.035	0.00809	319.8	914.7	321.0	7.7	2.8				3.2	19.397					551.8	1464.3	553.0	4.8	2.6							
	3.879_to_3.354	3.816	7038	0.05	0.006	1059.7	1999.3	1061.6	3.5	1.9				3.2	19.397					1088.8	2379.9	1090.7	3.0	2.2							
	3.879_to_3.354	3.737	7038	0.06	0.00533	1013.0	2270.9	1015.5	3.1	2.2				3.2	19.397					1042.9	2610.3	1045.3	2.7	2.5							
	3.879_to_3.354	3.656	7038	0.06	0.00437	828.6	2223.6	830.8	3.2	2.7				3.2	19.397					844.4	2399.3	846.7	2.9	2.8							
	3.879_to_3.354	3.563	7038	0.05	0.00347	1028.4	2329.5	1030.6	3.0	2.3				3.2	19.397					1028.2	2326.4	1030.4	3.0	2.3							
	3.879_to_3.354	3.465	7038	0.05	0.0038	903.4	2150.4	904.4	3.3	2.4				3.2	19.397					910.5	2215.1	911.5	3.2	2.4							
8	3.879_to_3.354	3.354	7038	0.05	0.00539	627.0	1673.5	628.0	4.2	2.7	4.0	2.4	825.7	3.2	19.397	15.0	4.8	2.2	7.0	672.6	1962.8	673.7	3.6	2.9	3.3	2.5	877.0	7.0	0.0035	0.00521	Degrade
U/S Limit	RD800	1	425	0.035	0.0059	53.4	91.6	54.1	4.6	1.7	4.6	1.7	53.4	3.2	19.397	1.1				54.8	96.4	55.5	4.4	1.7	4.4	1.7	54.8	0.9			
	3.247_to_1.949	3.247	7038	0.05	0.00531	686.1	1743.4	687.8	4.0	2.5				3.2	19.397					689.0	1762.8	690.8	4.0	2.6							
	3.247_to_1.949	3.14	7038	0.05	0.00426	843.6	2022.6	844.8	3.5	2.4				3.2	19.397					809.0	1878.9	810.2	3.7	2.3							
	3.247_to_1.949	3.011	7038	0.06	0.00401	647.5	2067.8	649.1	3.4	3.2				3.2	19.397					629.9	1897.1	631.4	3.7	3.0							
	3.247_to_1.949	2.937	7038	0.06	0.00393	647.6	2079.9	649.3	3.4	3.2				3.2	19.397					633.2	1901.3	634.9	3.7	3.0							
	3.247_to_1.949	2.867	7038	0.05	0.0064	697.2	1658.9	698.4	4.2	2.4				3.2	19.397					725.2	1798.6	726.4	3.9	2.5							
	3.247_to_1.949	2.774	7038	0.05	0.00538	668.4	1718.5	669.7	4.1	2.6				3.2	19.397					670.3	1743.0	671.6	4.0	2.6							
	3.247_to_1.949	2.691	7038	0.05	0.0051	398.4	1420.0	399.7	5.0	3.6				3.2	19.397					397.6	1415.1	398.9	5.0	3.5							
	3.247_to_1.949	2.588	7038	0.05	0.00556	526.1	1546.2	527.1	4.6	2.9				3.2	19.397					535.1	1592.7	536.1	4.4	3.0							
	3.247_to_1.949	2.486	7038	0.05	0.00686	436.4	1346.6	437.1	5.2	3.1				3.2	19.397					447.5	1482.7	448.2	4.7	3.3							
	3.247_to_1.949	2.395	7038	0.05	0.00806	347.1	1171.1	348.0	6.0	3.4				3.2	19.397					365.0	1367.1	365.9	5.1	3.7							
	3.247_to_1.949	2.31	7038	0.05	0.00556	375.2	1352.0	376.9	5.2	3.6				3.2	19.397					377.5	1386.7	379.1	5.1	3.7							
	3.247_to_1.949	2.208	7038	0.05	0.00443	308.3	1338.0	310.0	5.3	4.3				3.2	19.397					299.8	1265.1	301.4	5.6	4.2							
	3.247_to_1.949	2.118	7038	0.05	0.00601	405.4	1362.0	407.2	5.2	3.3				3.2	19.397					409.3	1432.4	411.2	4.9	3.5							
	3.247_to_1.949	2.034	7038	0.05	0.00449	251.9	1233.3	255.5	5.7	4.8				3.2	19.397					248.7	1177.9	252.1	6.0	4.7							
9	3.247_to_1.949	1.949	7038	0.05	0.00398	240.0	1251.0	241.6	5.6	5.2	4.7	3.4	498.6	3.2	19.397	16.4	1.1	15.0	16.1	227.1	1132.6	228.6	6.2	5.0	4.7	3.4	497.6	16.1	0.0051	0.00529	Degrade
U/S Limit	RAF807	1	2496	0.035	0.004	91.9	370.5	93.6	6.7	4.0	6.7	4.0	91.9	3.2	19.397	7.3				88.3	354.3	90.0	7.0	3.9	7.0	3.9	88.3	8.5			
	1.858_to_1.307	1.858	7163	0.04	0.00588	214.9	940.1	215.9	7.6	4.4				3.2	19.397					218.7	1032.8	219.8	6.9	4.7							
	1.858_to_1.307	1.788	7163	0.04	0.00478	210.5	992.7	211.7	7.2	4.7				3.2	19.397					211.4	1019.2	212.6	7.0	4.8							
	1.858_to_1.307	1.708	7163	0.04	0.00437	206.6	1012.8	208.0	7.1	4.9				3.2	19.397					206.5	1010.0	207.9	7.1	4.9							
	1.858_to_1.307	1.593	7163	0.04	0.00373	213.8	1076.8	215.1	6.7	5.0				3.2	19.397					211.6	1019.7	212.9	7.0	4.8							
	1.858_to_1.307	1.479	7163	0.04	0.00357	226.5	1115.0	227.6	6.4	4.9				3.2	19.397					222.1	1039.1	223.2	6.9	4.7							
	1.858_to_1.307	1.381	7163	0.04	0.00352	220.4	1107.8	221.6	6.5	5.0				3.2	19.397					216.8	1029.1	217.9	7.0	4.7							
10	1.858_to_1.307	1.307	7163	0.04	0.00495	255.3	1060.2	256.1	6.8	4.1	6.9	4.7	221.1	3.2	19.397	23.2	7.3	16.4	23.7	257.3	1101.4	258.2	6.5	4.3	6.9	4.7	220.6	23.7	0.0044	0.00440	Aggrade
	1.169_to_0.000	1.169	7163	0.02	0.005	174.5	598.9	175.1	12.0	3.4				3.2	19.397					176.8	645.7	177.4	11.1	3.6							
	1.169_to_0.000	1.058	7163	0.04	0.00425	210.9	1028.9	212.0	7.0	4.9				3.2	19.397					211.7	1052.7	212.8	6.8	4.9							
	1.169_to_0.000	0.946	7163	0.04	0.0042	203.9	1018.7	204.9	7.0	5.0				3.2	19.397					204.7	1038.6	205.8	6.9	5.0							
	1.169_to_0.000	0.833	7163	0.04	0.00378	211.4	1066.1	212.3	6.7	5.0				3.2	19.397					210.7	1050.4	211.7	6.8	5.0							
	1.169_to_0.000	0.746	7163	0.04	0.00409	189.6	997.8	190.7	7.2	5.2				3.2	19.397					190.2	1008.7	191.3	7.1	5.3							
	1.169_to_0.000	0.647	7163	0.04	0.00681	248.0	951.8	248.5	7.5	3.8				3.2	19.397					372.7	1318.1	373.4	5.4	3.5							
	1.169_to_0.000	0.579	7163	0.04	0.00474	489.6	1393.8	491.3	5.1	2.8				3.2	19.397					493.8	1476.1	495.5	4.9	3.0							
	1.169_to_0.000	0.527	7163	0.04	0.00598	518.3	1329.0	519.0	5.4	2.6				3.2	19.397					554.9	1545.4	555.7	4.6	2.8							
	1.169_to_0.000	0.437	7163	0.04	0.00905	457.7	1117.9	459.9	6.4	2.4				3.2	19.397					460.5	1436.6	463.0	5.0	3.1							
	1.169_to_0.000	0.35	7163	0.04	0.00763	497.9	1216.5	499.6	5.9	2.4				3.2	19.397					574.1	1567.8	576.1	4.6	2.7							
	1.169_to_0.000	0.238	7163	0.04	0.00645	760.9	1514.6	761.9	4.7	2.0				3.2	19.397					771.8	1763.4	772.9	4.1	2.3							
	1.169_to_0.000	0.159	7163	0.04	0.00578	683.3	1499.4	684.4	4.8	2.2				3.2	19.397					687.4	1683.7	688.6	4.3	2.4							
	1.169_to_0.000	0.107	7163	0.04	0.00716	812.4	1507.1	813.9	4.8	1.9				3.2	19.397					815.8	1803.2	817.3	4.0	2.2							
11	1.169_to_0.000	0	7163	0.04	0.00709	1003.6	1643.8	1004.1	4.4	1.6	6.3	3.2	461.6	3.2	19.397	38.1	7.3	16.4	23.7	1006.4	1960.2	1006.9	3.7	1.9	5.7	3.4	480.8	23.7	0.0040	0.00586	Degrade


Legend
HEC-RAS Cross Sections
ADWR-Sediment-Reach
Tributary HEC-1 Routing Reach
Outlet Channel and Wash Reach
CAP 16 East HEC-2 Cross Sections
Streets
Index Contours
Intermediate Contours
0 400 800 1,600 2,400
Feet
Scale: 1" = 800 Feet
Notes:
Topographic mapping includes 2, 4, and 10 foot contour intervals, shown for information purposes only.
FCDMC aerial photography flown in November 2004 under a separate contract.
Flood Control District of Maricopa County
JE FULLER
Dsgn:___ Drn:___ Chk:___
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
PLATE GA-3.3. HEC-RAS CROSS SECTION LAYOUT
Reems
Bullard
Vistancia
163rd
Pinnacle Peak
Deer Valley
Beardsley Canal
McMicken Dam Outlet Channel
McMicken Dam Outlet Wash
SR 303
CAP 16 East
McMicken Dam
Sunrise
Stardust
R.H.Johnson
Meeker
Grand
Camino Del Sol
128th
Beardsley
Spanish Garden
El Mirage
Agua Fria River

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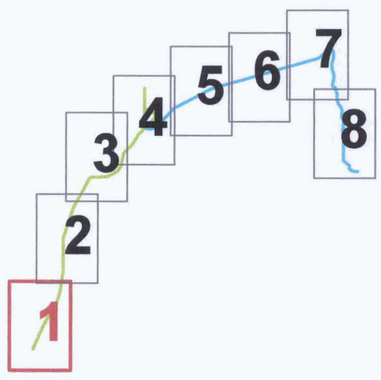
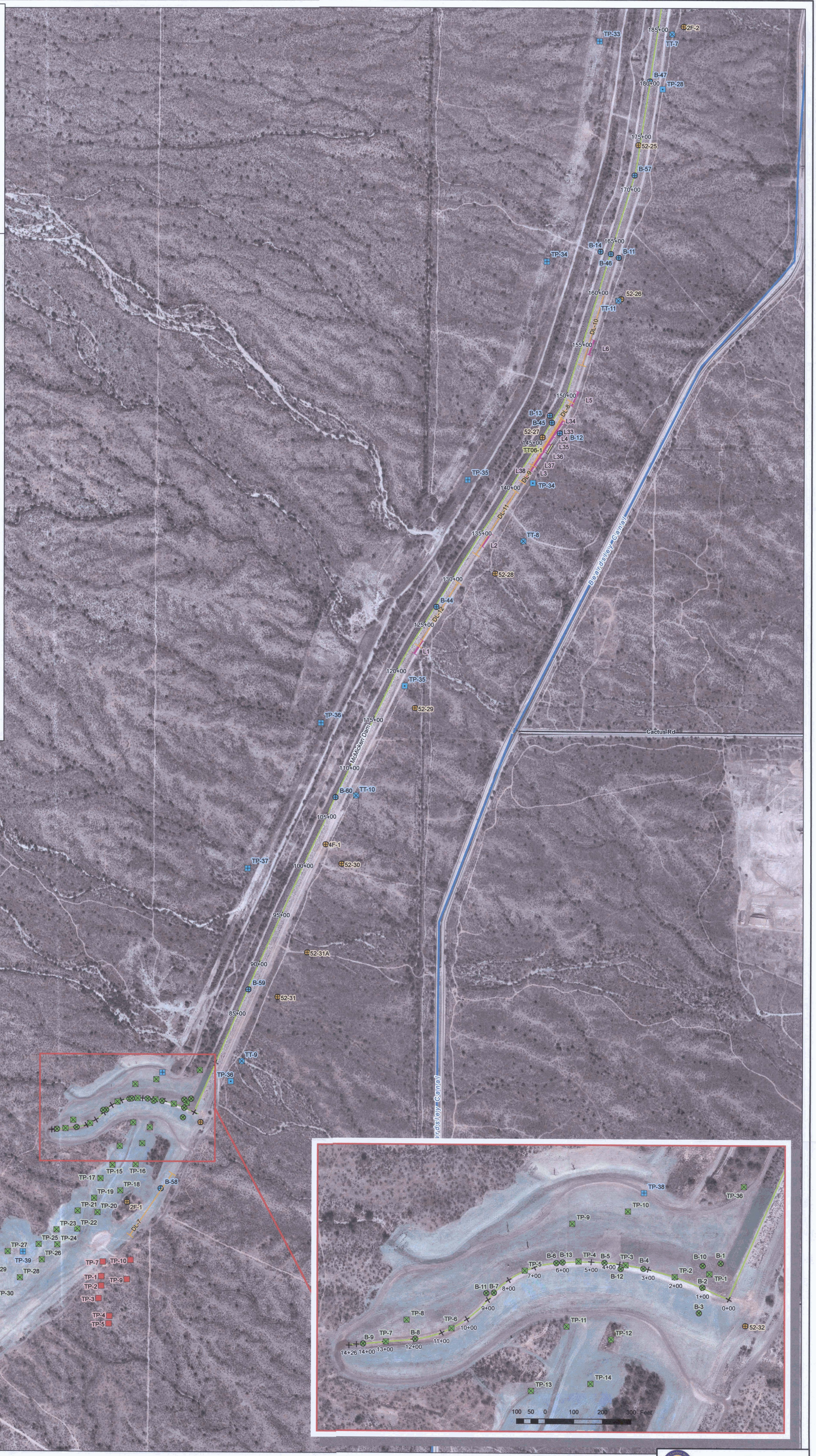


Legend

- Resistivity Line (AMEC 2007)
- Remi Line (AMEC 2007)
- Test Trenches (AMEC 2007)
- Seismic Lines (AMEC 2007)
- Test Holes (AMEC 2007)
- Test Pits (AMEC 2007)
- Boring Location (N&M 2005)
- Test Pit (N&M 2005)
- Boring Location (RAM 04-2004)
- Test Trench Location (RAM 01-2004)
- Test Trench Location (RAM 04-2004)
- Boring Location (RAM 01-2004)
- Boring Location (AMEC 2004)
- Test Pit Location (AMEC 2004)
- Boring Location (AMEC 2003)
- Test Pit Location (AMEC 2003)
- Test Trench (AMEC 2003)
- Test Trench Location (SH&B 1983)
- Test Pit Location (SH&B 1983)
- Boring Location (SH&B 1982)
- Test Pit Location (SH&B 1982)
- Boring Location (USACE 1973)
- Boring Location (USACE 1954)



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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HISTORICAL GEOTECHNICAL INVESTIGATIONS

Sheet 1 of 8

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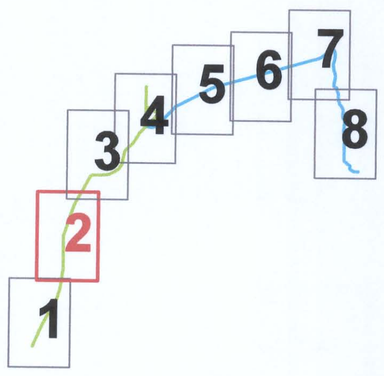

Legend

- Resistivity Line (AMEC 2007)
- Remi Line (AMEC 2007)
- Test Trenches (AMEC 2007)
- Seismic Lines (AMEC 2007)
- Test Holes (AMEC 2007)
- Test Pits (AMEC 2007)
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- Test Pit (N&M 2005)
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- Test Trench Location (RAM 01-2004)
- Test Trench Location (RAM 04-2004)
- Boring Location (RAM 01-2004)
- Boring Location (AMEC 2004)
- Test Pit Location (AMEC 2004)
- Boring Location (AMEC 2003)
- Test Pit Location (AMEC 2003)
- Test Trench (AMEC 2003)
- Test Trench Location (SH&B 1983)
- Test Pit Location (SH&B 1983)
- Boring Location (SH&B 1982)
- Test Pit Location (SH&B 1982)
- Boring Location (USACE 1973)
- Boring Location (USACE 1954)

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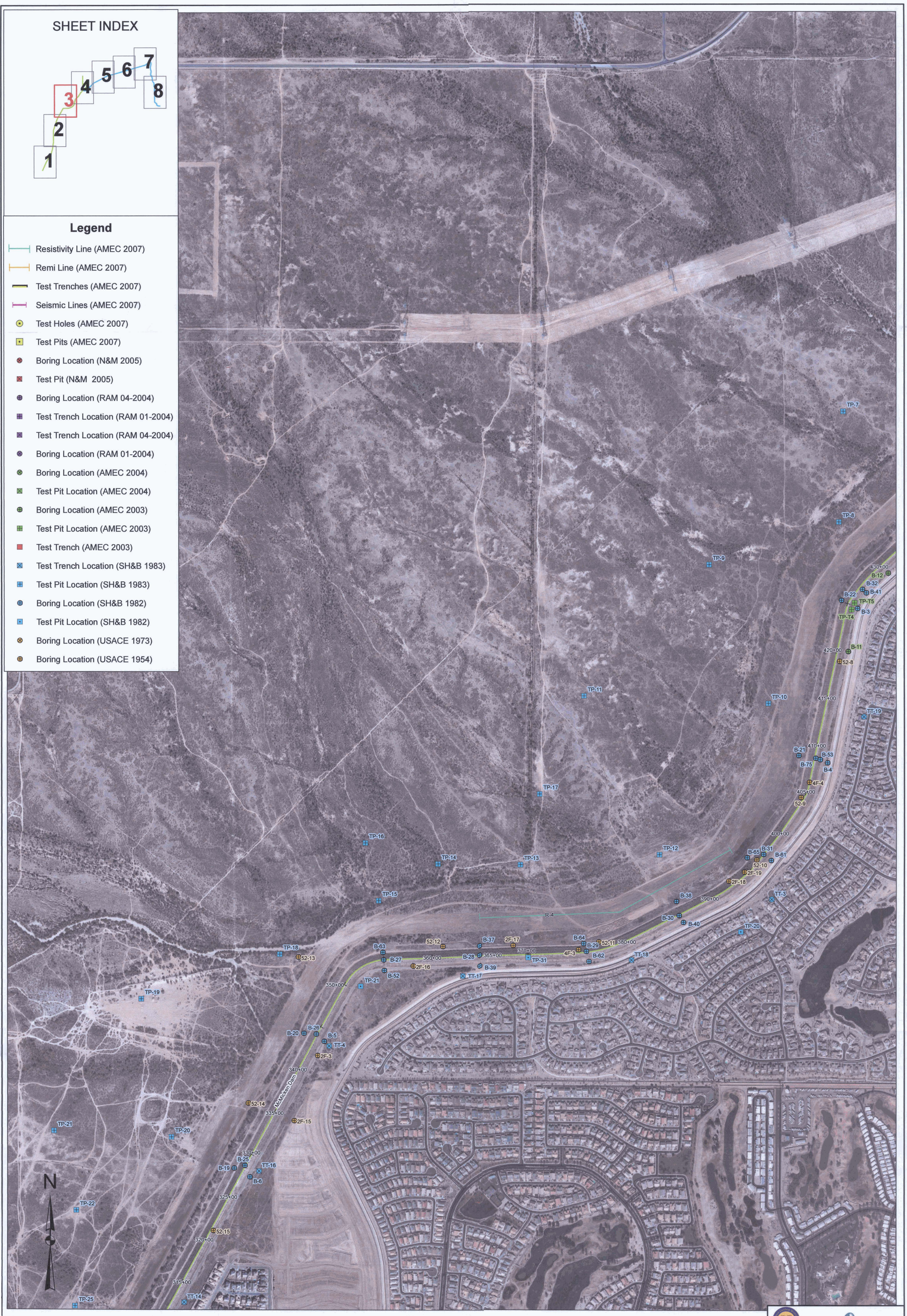
WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HISTORICAL GEOTECHNICAL INVESTIGATIONS

Sheet 2 of 8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Legend
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Test Holes (AMEC 2007)
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Boring Location (N&M 2005)
Test Pit (N&M 2005)
Boring Location (RAM 04-2004)
Test Trench Location (RAM 01-2004)
Test Trench Location (RAM 04-2004)
Boring Location (RAM 01-2004)
Boring Location (AMEC 2004)
Test Pit Location (AMEC 2004)
Boring Location (AMEC 2003)
Test Pit Location (AMEC 2003)
Test Trench (AMEC 2003)
Test Trench Location (SH&B 1983)
Test Pit Location (SH&B 1983)
Boring Location (SH&B 1982)
Test Pit Location (SH&B 1982)
Boring Location (USACE 1973)
Boring Location (USACE 1954)
TP-7
TP-8
TP-9
TP-10
TP-11
TP-12
TP-13
TP-14
TP-15
TP-16
TP-17
TP-18
TP-19
TP-20
TP-21
TP-22
TP-25
TP-31
TP-T4
TP-T5
TT-3
TT-4
TT-14
TT-16
TT-17
TT-18
TT-19
R-4
McMicken Dam
430+00
420+00
415+00
410+00
405+00
400+00
390+00
380+00
370+00
365+00
360+00
350+00
340+00
335+00
330+00
325+00
320+00
315+00
B-12
B-32
B-41
B-22
B-3
B-11
52-8
B-21
B-53
B-75
B-4
4F-4
52-9
B-31
B-65
B-61
52-10
2F-19
2F-18
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B-40
B-64
B-29
52-11
B-62
4F-3
52-12
B-37
2F-17
B-63
B-27
B-28
2F-16
B-39
B-52
52-13
B-20
B-26
B-5
2F-3
52-14
2F-15
B-25
B-19
B-6
52-15
N
400 200 0 400 800 Feet
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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
HISTORICAL GEOTECHNICAL INVESTIGATIONS
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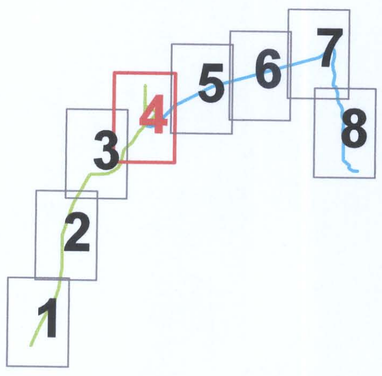

Legend

- Resistivity Line (AMEC 2007)
- Remi Line (AMEC 2007)
- Test Trenches (AMEC 2007)
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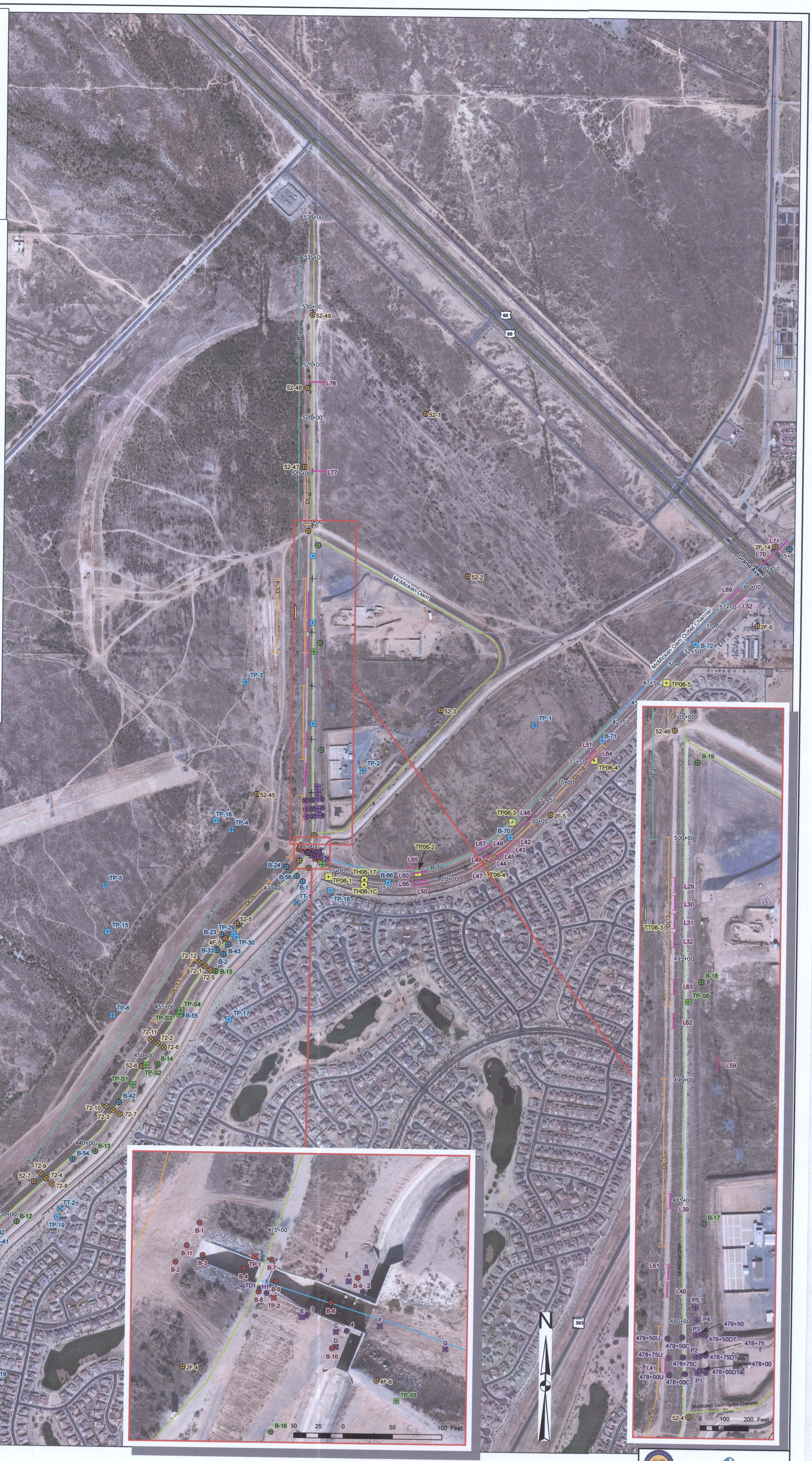

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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

HISTORICAL GEOTECHNICAL INVESTIGATIONS

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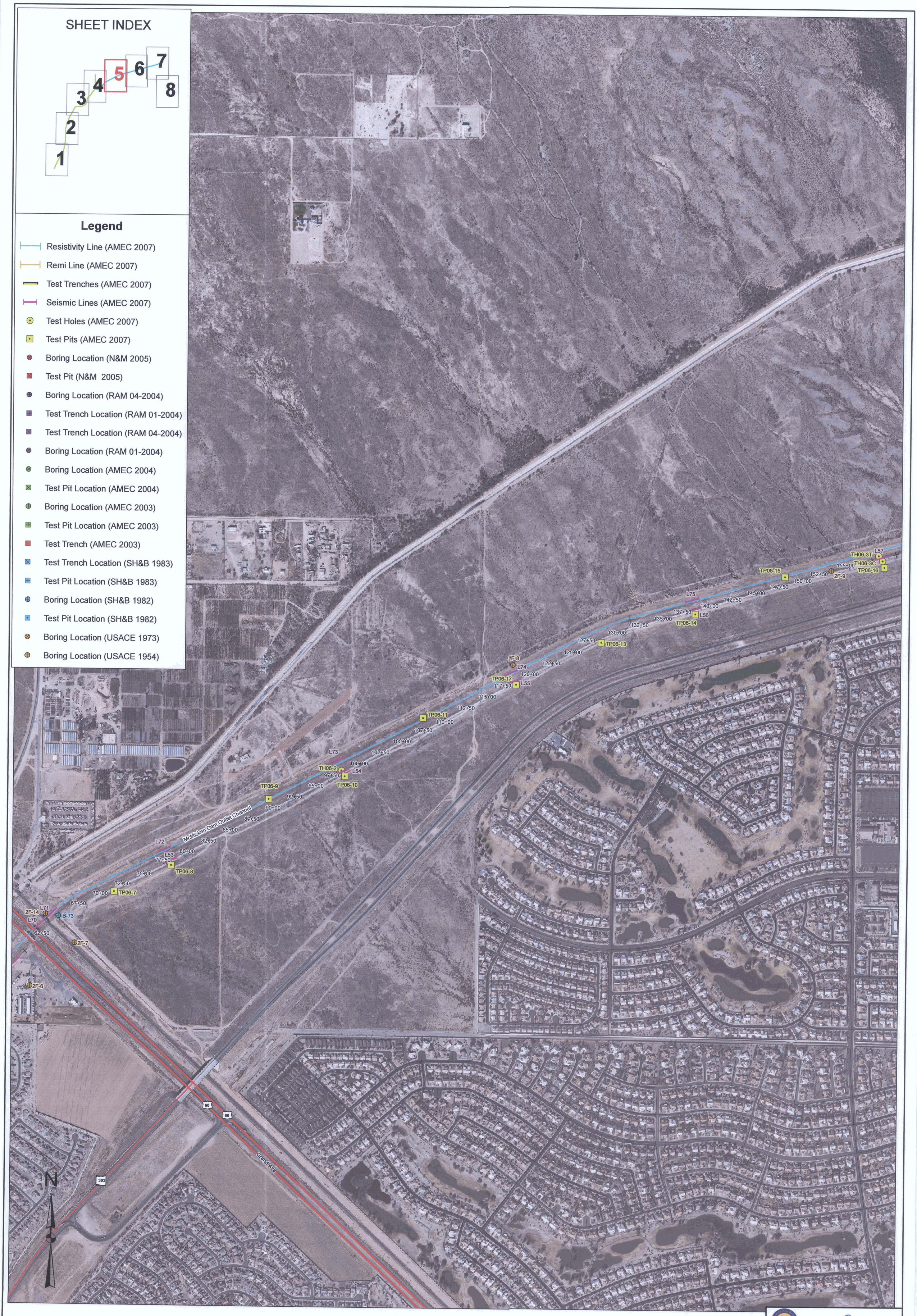

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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Boring Location (SH&B 1982)
Test Pit Location (SH&B 1982)
Boring Location (USACE 1973)
Boring Location (USACE 1954)
McMicken Dam Outlet Channel
TP06-17
TP06-18
TP06-19
TP06-20
TP06-21
TP06-22
TP06-23
TP06-24
TT06-5
TH06-4T
TH06-4C
L58
L26
L25
L24
L23
2F-10
2F-11
162+50
165+00
167+50
170+00
172+50
175+00
177+50
180+00
182+50
185+00
190+00
192+50
195+00
197+50
200+00
202+50
205+00
207+50
210+00
212+50
215+00
217+50
220+00
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247+50
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WITTMANN AREA DRAINAGE MASTER PLAN
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Test Pit Location (SH&B 1983)
Boring Location (SH&B 1982)
Test Pit Location (SH&B 1982)
Boring Location (USACE 1973)
Boring Location (USACE 1954)
McMicken Dam Outlet Channel
McMicken Dam Outlet Wash
L78
L85
2F-13
312+50
310+00
307+50
TP06-30
305+00
L16
302+50
L83
300+00
TP06-28
TH06-5
TP06-29
L17
297+50
L12
L13
295+00
L81
292+50
290+00
287+50
285+00
L18
280+00
282+50
TP06-27
2F-12
277+50
L27
272+50
275+00
L19
TT06-6
TP06-26
267+50
270+00
L28
265+00
TP06-25
262+50
L20
L21
L22
L82
TP06-24
L23
252+50
255+00
250+00
247+50
2F-11
L79
L84
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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
HISTORICAL GEOTECHNICAL INVESTIGATIONS
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Test Pit Location (SH&B 1982)
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Test Pit Location (AMEC 2003)
Test Trench Location (SH&B 1983)
Test Pit Location (SH&B 1983)
Boring Location (USACE 1973)
Boring Location (USACE 1954)
NOTE: Geologic and/or geotechnical investigations have not been conducted in this mapped area.
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McMicken Dam Outlet Wash
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WITTMANN AREA DRAINAGE MASTER PLAN
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
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