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January 30, 1998

Butte County Department of Public Works 7 County Center Drive Orville, California 95965

Attention:

Mr. Eric Dugger

Subject:

Subsurface Investigation

1P1/397/179

Neal Road Sanitary Landfill--Module 4

39121-F6:186N:296W

Butte County, California

Transmitted herewith is our report of subsurface investigation performed at the above site in accordance with your request. The original "Log of Test Borings" drawings are being forwarded under separate cover. Please call if you have any questions about this report or subsurface materials and conditions encountered at the site.

We appreciate this opportunity to be of service.

Very truly yours,

TABER CONSULTANTS

Franklin P. Taber

WEN/FPT

Accompanying: Reports (4)

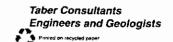


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SUBSURFACE INVESTIGATION Neal Road Sanitary Landfill--Module 4 Butte County, California

1P1/397/179 Location: 39121-F6:186N:296W

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1P1/397179

Introduction

A limited study of subsurface materials and conditions has been completed at the above site in accordance with the agreement between the County of Butte and Taber Consultants. The purpose of this study is to provide an assessment of subsurface earth materials and conditions anticipated to be encountered during excavation of proposed cuts, particularly with respect to "rippability." Limitations of this study are discussed in the attached "General Conditions."

Site/Project Description

Module 4 of the Neal Road Sanitary Landfill is located at the common quarter-corner of Sections 14 and 15, T21N, R2E, between two generally northeast-trending ridges (see Vicinity Map). Along natural slopes, the south face below the northern ridge supports a heavy growth of oak trees and shrub in a long, narrow band just below the ridgeline. Along the north face below the southern ridge a light growth of scattered oak trees is present below the ridgeline. Elsewhere, and particularly along the ridgelines, the area supports only a moderate to heavy growth of wild grass.

The site/project is shown on a preliminary "Module 4 Excavation Plan" (scale 1"=60', dated 11-24-97) by Golder Associates. The area at the base of the existing "Module 4" excavation is shown to slope from elev. 180± on the east to elev. 174± on



the west. Excavation cut slopes are shown extending 40-46±ft below natural ground surface (at/near elev. 220±) at slopes of approximately 2½:1 (horizontal:vertical distance) on the south and 2:1 (H:V) on the north.

The proposed base of new excavation is shown on the above referenced plan at a 2.5% grade sloping from elev. 180± on the east to elev. 158± on the west.

Excavation cut-slopes are shown to be as high as 140±ft at slope 2:1 (horizontal: vertical distance) on the south and at slope 1.75:1 (H:V) on the north. The cut-slopes are shown to include two intermediate benches on the north and three on the south; benches are approximately 25±ft wide. Maximum depth of new cut below the existing base of excavation is indicated to be on order of 16±ft at the southeast corner. Crosssections on the attached "Log of Test Borings" drawings illustrate existing ground profiles and proposed cuts.

Study Procedure

Office study included review of published geologic information. Field work included a limited geologic reconnaissance of the area, six logged and sampled test borings to maximum depth 89±ft (elev. 168±) and nine double-ended refraction seismic profiles.

The borings were advanced with a CME-45 drill rig utilizing combinations of auger and rotary methods with tungsten-carbide bits. Rotary drilling included the use of



air or water as circulating fluid and a down-hole compressed-air driven percussion hammer. Diamond-coring equipment was utilized to advance the borings through hard rock.

Samples of weathered rock materials were recovered from the borings by means of a 2.0-inch OD "standard penetration" sampler advanced with standard 350 ft-lb striking force (ASTM D1586) to provide a field estimate of soils consistency. Samples of hard rock were recovered with the core barrel. The refraction seismic profiles were developed using a sledge-actuated signal-enhancement timer.

The subsurface materials were field classified and borings logged by an engineer-geologist on the bases of sampler penetration resistance, drill action, examination of cores and samples and inspection of cuttings. Representative portions of drive-sampled earth materials were retained in moisture-proof containers for laboratory testing and reference. Moisture content and dry density tests were performed on selected suitable samples in the laboratory to supplement field evaluation of earth materials parameters/characteristics. All recovered rock cores were retained in core boxes for office examination and reference.

Groundwater observations were made in the borings during drilling and after completion of field operations. All borings completed for this study were backfilled with a lean cement slurry upon completion of drilling operations.

Subsequent to field exploration, the locations and elevations of test borings completed for this study were established by Butte County. Locations, elevations, details of borings and results of tests are shown on the attached "Site Plan" and "Log of



Test Borings" drawings. The refraction seismic profiles are shown on Figure-1. W. Eric Nichols was field engineer-geologist for this study.

Geologic Setting

The project is located in north-central Butte County along the western margin of the foothills bordering the northern Sierra Nevada. The site is mapped (CDMG "Geologic Map of the Chico Quadrangle", 1992) as underlain by Pliocene age volcanic rock of the Tuscan formation which consists of nearly flat-lying strata of interbedded lahar, volcanic conglomerate, volcanic sandstone, siltstone and pumiceous tuff. The uppermost layer of this formation is identified as lahar and was deposited as a fluid over a wide ranging area with pre-existing topographic features that may have included old river/stream channels, valleys, ridgelines, etc. Rock consistent with the published mapping is exposed extensively in existing excavation cut-slopes and along the ridgelines.

Site geologic reconnaissance generally confirms the above mapping. Rock identified with the Tuscan formation is exposed extensively along ridgelines and consists of relatively fresh, hard lahar with discontinuous layers/zones of moderately well cemented sandstone. The lahar forms prominent, 10-15±ft high vertical to near vertical cliff faces where its edges have been eroded. The lahar is observed to be massive, with only a few near-vertical fractures locally identified and irregularly spaced at 15±ft or more, along the top of the northern ridgeline. Where exposed, the base of this unit is typically observed as a sharp, planar contact surface. Large, semi-detached



and/or detached boulders of lahar were observed along the face and at/near the base of these cliffs.

The existing natural slopes and excavation cut slopes below the ridgelines (i.e., below the lahar) typically expose nearly flat-lying layers of moderately well cemented sandstone interbedded with a few thin layers/zones of siltstone. Locally, discontinuous layers/lenses of sandstone were observed to be unconsolidated to very weakly cemented.

No faults are indicated to pass through the immediate project site. The trace of a pre-Quaternary fault is shown about 1,600 ft northeast of the site. The Chico Monocline fault is located approximately one mile east of the site and is mapped as Quaternary in age (i.e. "potentially active", with evidence of surface displacement within the last 1.6 million years, but not considered "active"). The nearest "active" faults (i.e. with evidence of surface displacement with the last 10,000 years) are shown to be the the Big Bend and Cleveland Hill West faults, located about 10 miles and 12 miles east of the site, respectively. These faults are indicated to have respective maximum credible magnitudes of 6.25 and 6.50, with corresponding "peak rock acceleration" of 0.18g and 0.19g (per CDMG OFR 92-1 and Caltrans "California Seismic Hazard Map 1996").

No springs are mapped in the vicinity of the site. During time of field study (December 1997), some areas of minor seepage were observed at scattered locations along the northern slope face.



Earth Materials

Materials encountered in the borings are consistent with the above surface observations and published mapping and are divided into two general units considered significant to excavation work. The upper unit is composed of slightly weathered to unweathered, hard, lahar (volcanic breccia) of variable thickness. The lower unit includes layers of weakly to moderately well cemented sandstone with layers of siltstone.

Upper unit lahar was encountered along the north ridgeline in Boring-1, -2 and -3 from ground surface to 23±ft depth (elev. 286±), 18±ft depth (elev. 299±) and 19±ft depth (elev. 303±), respectively. Along the south ridgeline, lahar was encountered in Boring-4 from ground surface to 10±ft depth (elev. 308±). The lahar typically consists of slightly weathered to unweathered angular and subangular gravel-cobble size clasts of basalt and andesite held in-place by a hard, well cemented matrix of silty sand and locally includes thin layers of well cemented sandstone. Penetration of upper unit lahar required the use of rotary methods with tungsten carbide-tipped bits and diamond coring equipment.

The lower unit was encountered below the upper unit in Borings-1 through -4 and from ground surface in Borings-5 and -6. This unit is generally described as "very dense" (per soils consistency) weakly to moderately cemented sandstone with rare 1-3 ft thick siltstone layers. Materials of this unit are consistent with weathered sandstone as observed in area outcrops and existing excavation cut-slopes. In Borings-1 through -4, materials of this unit were penetrated utilizing diamond coring



equipment and/or rotary methods with tungsten carbide-tipped bits. In Borings-5 and –6, lower unit materials were penetrated with solid flight auger to full boring depth (45±ft; elev. 168±).

The refraction seismic profiles are consistent with outcrops and confirm the boring data. Velocities of 9,000-14,000±fps are associated with hard, slightly-moderately weathered lahar. Velocities ranging from 3,400±fps to 8,000±fps (typically on order of 6,000±fps) are considered representative of the weathered sandstone unit underlying the lahar.

At time of field study (December 1997), no free groundwater was encountered in any of the borings completed for this project. Perched groundwater and/or saturation of the near-surface soils would not be unexpected during the wet-season. The observed seepage along the northern slope face within the sandstone/siltstone is interpreted to be associated with infiltration of seasonal rainfall and to reflect random occurrences transmitted through fractures and/or local discontinuities within the lower rock unit.

Conclusions/Discussion

In general, the two units identified from this study have significantly different excavation characteristics considered important to the proposed project. The upper unit lahar is indicated (per the "Handbook of Ripping" 7th ed., January 1983) to be "marginally rippable" with a D-9L /D-10 tractor (with multi or single shank ripper) at seismic velocities between 8,500 fps and 11,000 fps and "non-rippable" at seismic velocities greater than 11,000 fps. Sandstone/siltstone with seismic velocities of less



than 9,500 fps are indicated to be "rippable" with "heavy duty" construction equipment as described above.

Based on the above, excavation of the upper unit lahar is anticipated to be typically difficult and no better than "marginally rippable." Boring data and site observation also suggest that initial surface penetration of the lahar will be very difficult with a high probabilty that at least light blasting may be required to improve ripper penetration. Materials generated from blasting/ripping are typically expected to be oversized (i.e., boulder size) and may require consideration regarding disposal.

The approximate surficial limits of the lahar within the proposed excavation limits are shown on the Site Plan. Thickness of the upper unit lahar is estimated from the boring encounters to be on order of 18-23±ft along the northern ridgeline and approximately 10±ft along the southern ridgeline (see cross-sections). No significant variation in thickness of the lahar unit was observed in surface exposures and site observation suggests a relatively planar contact between upper unit lahar and lower unit sandstone. However, buried features such as old channels or ridges may be present/concealed, with associated variations in thickness of the lahar unit.

The lower unit sandstone with seismic velocities typically on order of 6,000±fps is considered to be mostly in the "rippable" range with a D-9L/D-10 tractor. Boring data and site observation indicate that the lower unit is variably cemented and includes local hard zones/layers (i.e. seismic velocities 8,000+fps) to base of proposed excavation. Excavation of these materials is expected to be difficult and might require light blasting to improve ripper penetration at some locations. Materials excavated from this unit are



typically expected to readily break down, however, some large/oversized blocks of hard/resistant rock would not be unexpected and such blocks may require consideration for disposal.

TABER CONSULTANTS

W. Eric Nichols

F.P. Taber R.C.E. 30920

G.E. 816

January 30, 1998

Attachments:

"General Conditions"

Figure-i

"Vicinity Map"

Figure-1

"Refraction Seismic Profiles" (5 sheets)

"Site Plan"

"Log of Test Borings" (2 sheets)

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1P1/397/179

GENERAL CONDITIONS

The conclusions and recommendations of this study are professional opinion based upon the indicated project criteria and the limited data described herein. It is recognized there is potential for sufficient variation in subsurface conditions that modification of conclusions and recommendations might emerge from further, more detailed study.

This report is intended only for the purpose, site location and project description indicated and assumes design and construction in accordance with latest applicable codes.

As changes in appropriate standards, site conditions and technical knowledge cannot be adequately predicted, review of recommendations by this office for use after a period of two years is a condition of this report.

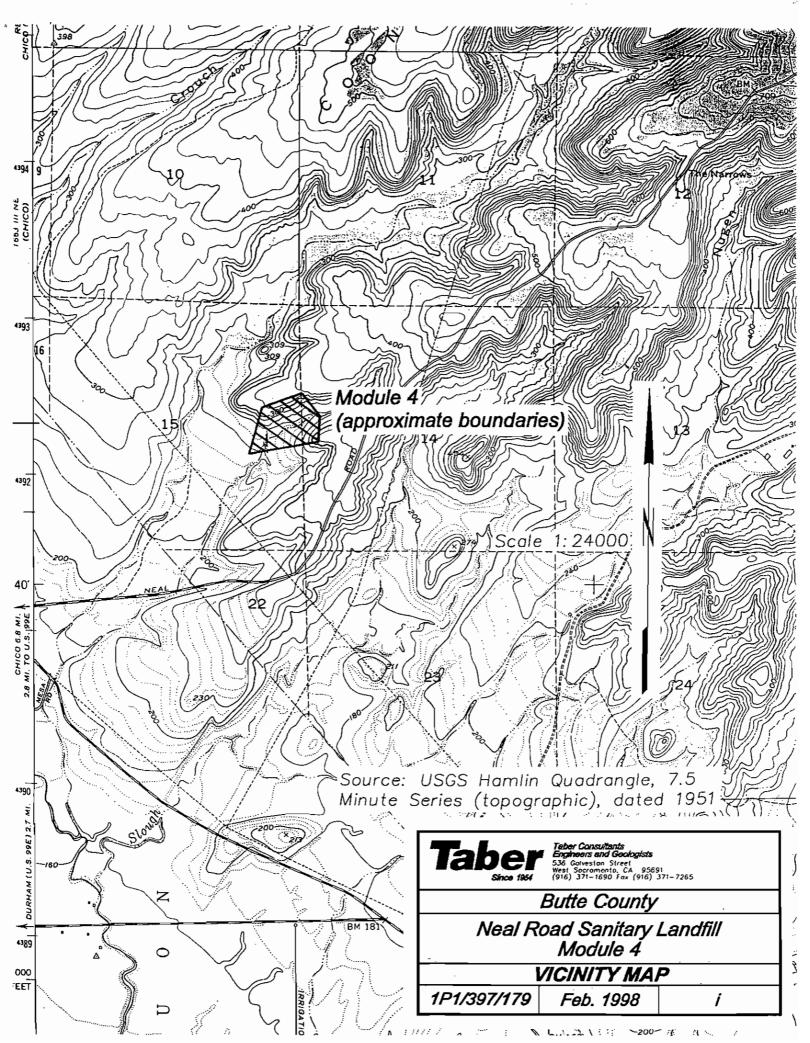
A review by this office of any foundation and/or grading plans and specifications or other work product insofar as they rely upon or implement the content of this report, together with the opportunity to make supplemental recommendations as indicated therefrom is considered an integral part of this study and a condition of recommendations.

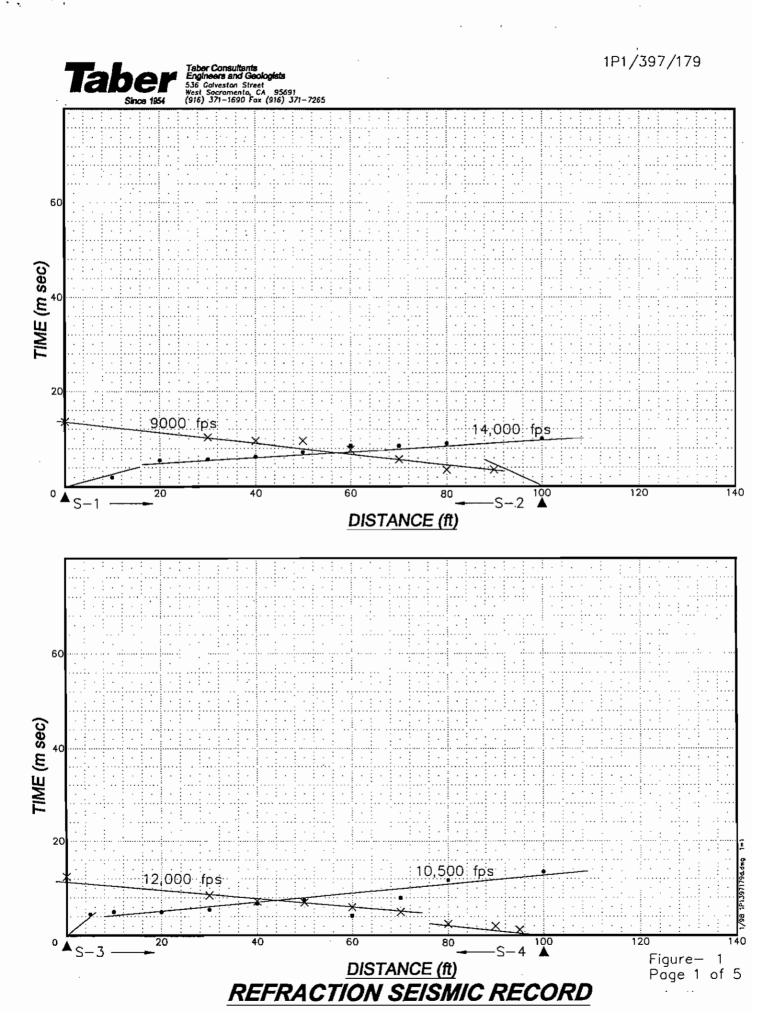
Subsequently defined construction observation procedures and/or agencies are an element of work, which may affect supplementary recommendations.

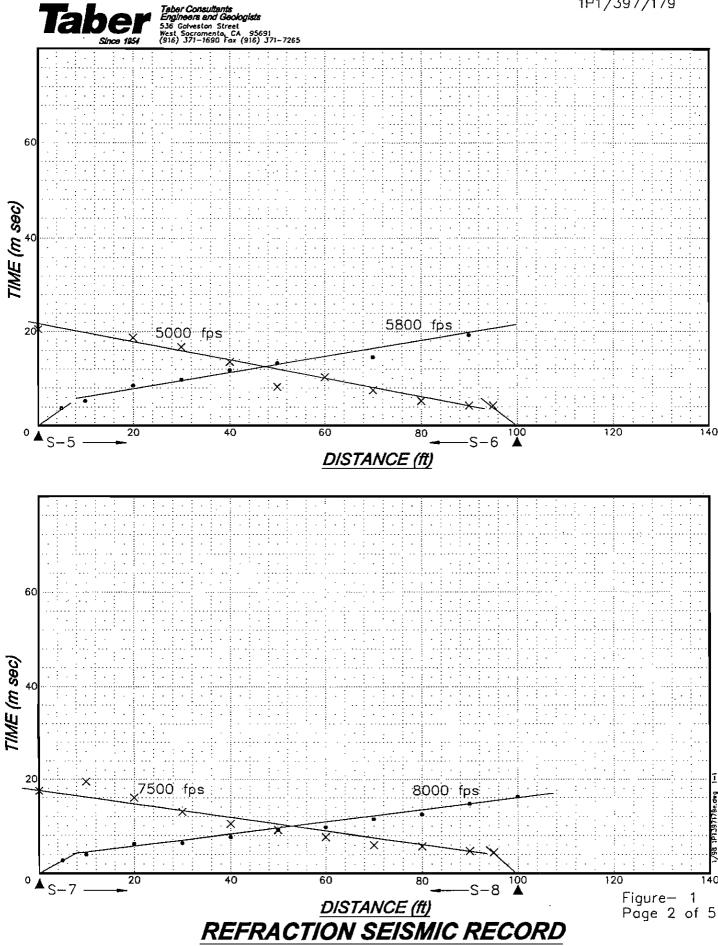
Should there be significant change in the project or should soils conditions different from those described in this report be encountered during construction, this office should be notified for evaluation and supplemental recommendations as necessary or appropriate.

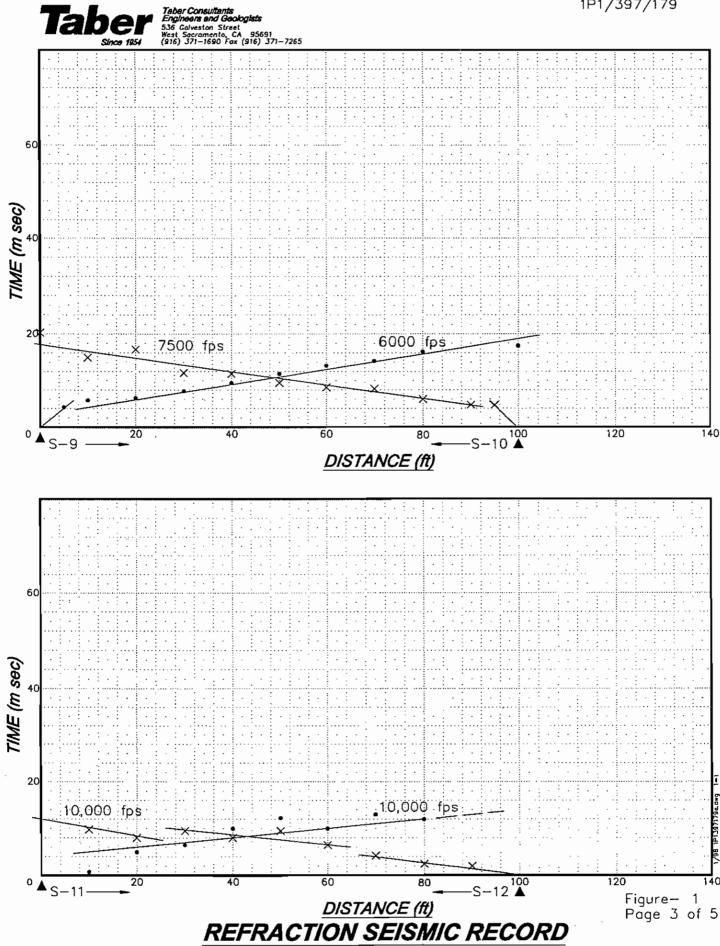
Opinions and recommendations apply to current site conditions and those reasonably foreseeable for the described development -- which includes appropriate operation and maintenance thereof. They cannot apply to site changes occurring, made, or induced, of which this office is not aware and has not had opportunity to evaluate.

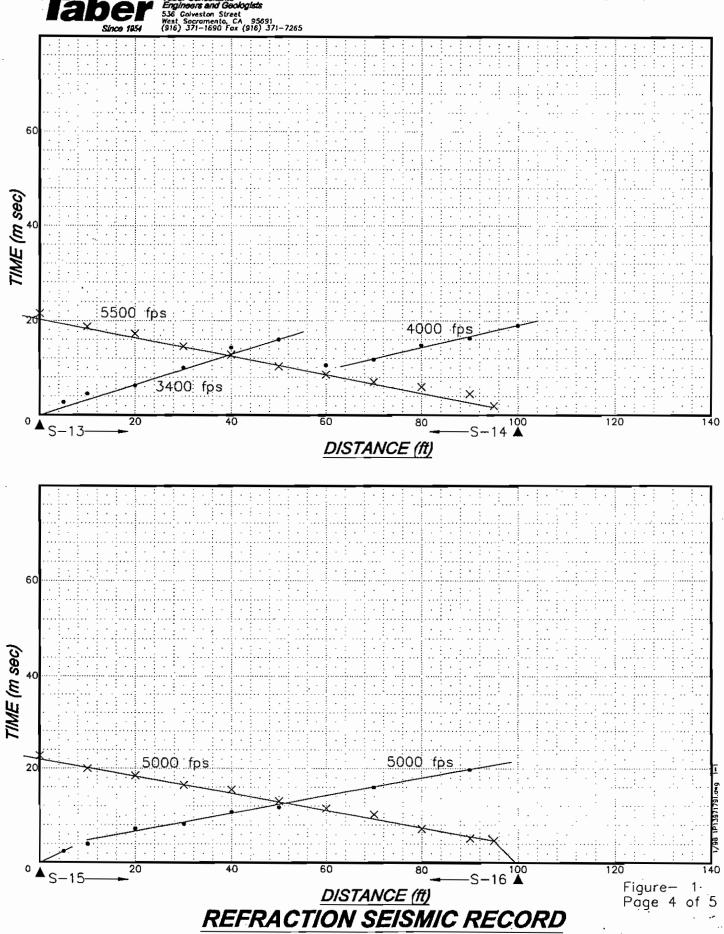
The scope of this study specifically excluded sampling and/or testing for, or evaluation of the occurrence and distribution of, hazardous substances. No opinion is intended regarding the presence or distribution of any hazardous substances at this or nearby sites.

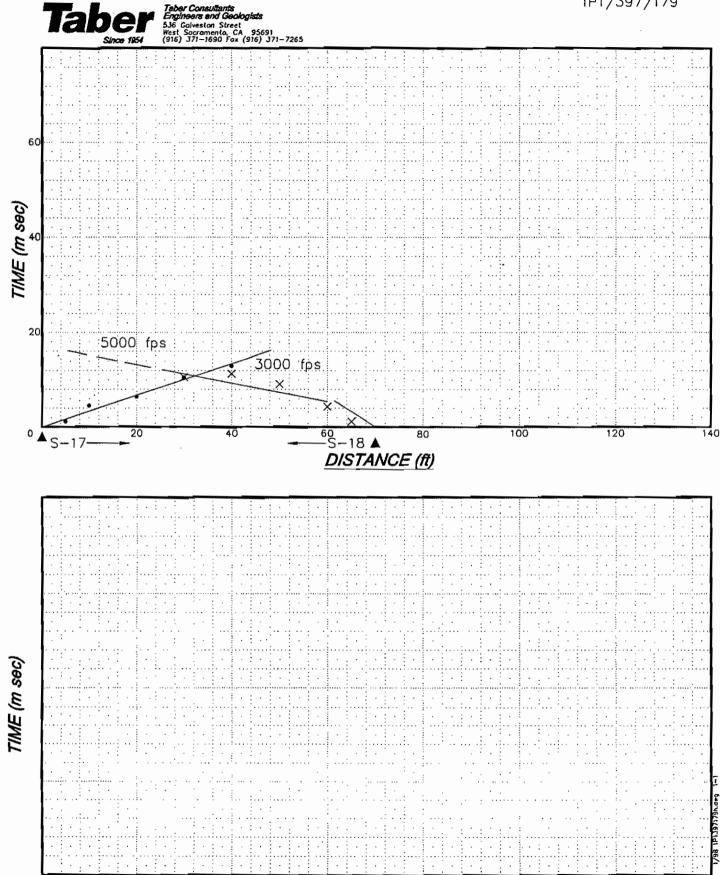












Figure— 1 Page 5 of 5

