SPEEDIE
AND ASSOCIATES

GEOTECHNICAL/ENVIRONMENTAL/MATERIAL ENGINEERS
11029 N. 24th AVE., SUITE 805 • PHOENIX, ARIZONA 85029 • (602) 997-6391

1980 20th ANNIVERSARY 2000 SPEEDIE AND ASSOCIATES

REPORT ON GEOTECHNICAL INVESTIGATION

Scott

DESIGNATION: Elliot Road Basins

LOCATION: Elliot & Ellsworth Roads
Mesa, Arizona

SPEEDIE AND ASSOCIATES
GEOTECHNICAL / ENVIRONMENTAL / MATERIALS ENGINEERS

11029 N. 24th AVE., SUITE 805 • PHOENIX, ARIZONA 85029 • (602) 997-6391 • FAX (602) 943-5508

HENRIETTA SPEEDIE, C.E.O.
JAMES A. SPEEDIE, P.E.
GREGG A. CREASER, P.E.
BRETT P. CREASER, P.E.
DONALD L. CORNELISON, P.E.
STEVEN A. GRIESS, P.E.
PRABHAKAR (PETER) RUPAL, P.E.

REPORT ON GEOTECHNICAL INVESTIGATION

Scott

DESIGNATION: Elliot Road Basins

LOCATION: Elliot & Ellsworth Roads
Mesa, Arizona

CLIENT: Wood, Patel & Associates

PROJECT NO: 990509SA

DATE: January 6, 2000

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30524
PRABHAKAR
RUPAL
Date Signed 1-6-00
ARIZONA, U.S.A.

SPEEDIE AND ASSOCIATES
GEOTECHNICAL / ENVIRONMENTAL / MATERIALS ENGINEERS
3731 E. WOOD STREET • PHOENIX, ARIZONA 85040 • (602) 997-6391 • FAX (602) 943-5508

HENRIETTA SPEEDIE, C.E.O.
JAMES A. SPEEDIE, P.E.
GREGG A. CREASER, P.E.
BRETT P. CREASER, P.E.
DONALD L. CORNELISON, P.E.
STEVEN A. GRIESS, P.E.
PRABHAKAR (PETER) RUPAL, P.E.

June 8, 2000

Mr. James Taillon
Wood, Patel & Associates
2051 W. Northern Avenue
Suite 100
Phoenix, AZ 85021

RE: **Addendum No. 1**
Project No. 990509SA
Elliot Road Basins
Elliot & Ellsworth Roads
Mesa, AZ

Dear Mr. Taillon :

It is understood that the main concrete channel at Ellsworth Road is about 4 feet high. During the 100 year storm, excess water would spill over a weir into an adjacent channel with a 12 foot high (retaining) wall. Water will continuously flow through this channel during rainfall events to a positive outlet.

Accordingly, it is our opinion that properly filtered weepholes may be included as part of the channel (retaining) wall design and construction.

A well-graded granular import should be specified for backfill of the channel (retaining) wall. The native clays may be used in the upper 2 feet of retaining wall backfill to act as a surface seal to limit infiltration of water. Grading should promote runoff away from the channel (retaining) wall backfill zone. Irrigated landscaping should not be located within the wall backfill zone.

This addendum should be attached to the original report and made a part thereof.

Respectfully Submitted,
SPEEDIE & ASSOCIATES, INC.

Prabhakar (Peter) Rupal, P.E.

Registered Professional Engineer (Civil)
CERTIFICATE NO. 30524
PRABHAKAR RUPAL
Date Signed 6.9.
ARIZONA, U.S.A.

TABLE OF CONTENTS

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30524
PRABHAKAR
RUPAL
Date Signed 1-6-00
ARIZONA, U.S.A.

SPEEDIE AND ASSOCIATES
GEOTECHNICAL / ENVIRONMENTAL / MATERIAL ENGINEERS
11029 N. 24th AVE., SUITE 805 • PHOENIX, ARIZONA 85029

1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of the proposed Elliot Road Basins at Elliot Road and Ellsworth Road in Mesa, Arizona.

Preliminary information calls for the construction of three large storm water retention basins and associated infra-structure (pipelines, weirs and channels) that will be formed by a combination of shallow excavation and embankment. The intent is to size basins so that they will not come under the jurisdiction of ADWR as 'small dams'. It is anticipated that the basins will be about 12 feet deep with side slopes of 5:1 or 6:1 (horizontal:vertical). They will be incorporated into a City of Mesa park for recreational uses such as turf soccer play fields, a small parking lot and small restrooms. Cast-in-place storm drain pipe will replace the existing drainage channel on the south side of Elliot Road and east side of Ellsworth Road. The only channels (earth-lined) proposed will occur on the west side of Ellsworth Road and Crismon Road. Channel side slopes will be on the order of 4:1. Channel depth is expected to be about 4 feet deep along Crismon Road and 13 feet deep at Ellsworth Road. In addition there will also be several drop structures.

2.0 GENERAL SITE AND SOIL CONDITIONS

2.1 Site Conditions

The subject site extends along Ellsworth Road, from 2,000 feet south of Elliot Road northward to Elliot Road, east on Elliot Road to about 2,800 feet east of Crismon Road. Channel improvements to an existing earthen channel are proposed along the east side of Ellsworth Road and south side of Elliot Road (GM Proving Grounds). The basins are located on the north side of Elliot Road, just east and west of Crismon Road in what is currently undeveloped desert land.

2.2 Geological Conditions

The site is located within an area that has undergone considerable subsidence due to groundwater removal. Total subsidence of several feet has been recorded in the valley. Recent investigations have indicated that the rate of subsidence is decreasing due to reduced groundwater withdrawal as a result of urbanization and subsequent lowered agricultural demand for groundwater. Fissure gullies form over subsurface irregularities such as soil-rock contacts which cause tensional stresses and differential subsidence. Where such anomalies are not present, subsidence tends to be uniform over a wide area, this having no effect on surficial structures. It is not known if subsidence at this site has stopped, if it is continuing, or at what rate it may be occurring. Subsidence is a basin wide phenomenon that would result in differential elevation changes over long distances that typically would not affect the type of buildings proposed for this site. There could be a negative effect on long flatly sloped channels if the trend of basin tilt goes against the channel flow direction.

A field reconnaissance and study of aerial photographs did not reveal any apparent suspect features within in the study area.

2.3 General Subsurface Conditions

Subsoil conditions consist of interbedded composites of clays, silts and sands with subordinate amounts of gravel and with varying degrees of calcareous cementation to depths of up to 21 feet below existing grade. Boring B-3, drilled in the existing channel revealed 2 feet of silty fine sand over 2 inches of concrete. Borings B-25 and B-26, drilled in Elliot Road revealed a pavement structure made up of 2 inches of asphaltic concrete, 4 to 6 inches of old asphalt/RAP and/or 6 inches of aggregate base. Standard Penetration Test values generally range from 3 to 50+ blows per foot, generally increasing with depth. No groundwater was encountered during this investigation. Based on visual and tactile observation, the soils were in a 'dry' to 'moist' state at the time of investigation.

Laboratory testing indicates in-situ dry densities of the upper soils on the order of 115 pcf at about 16 percent moisture at the time of investigation. Liquid limits of the clays are in the 27 to 45 percent range with plasticity indices ranging from 7 to 28 percent. The sands are expected to be low to non-plastic The upper clayey soils exhibit volume increase due to wetting of 4 percent when re-compacted to moistures and densities normally expected during construction. An undisturbed sample displayed compression during increasing loading up to a maximum load of 2,200 psf and actually swelled slightly after inundation at 2,200 psf. Laboratory measured minimum resistivities range from 600 ohm-cm to 2,935 ohm-cm while soil pH ranged from 7.5 to 8.2. The results of agronomic testing and the associated reports are appended.

3.0 ANALYSIS AND RECOMMENDATIONS

3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are generally favorable for the support of the proposed structures on shallow foundations and for slab-on-grade construction subject to remedial earthwork. They also appear to be suitable for construction of the basins and channels to the intended depths and side slopes. The presence of cemented or very dense/hard soils may impede excavation progress within basin and channel areas and require the use of heavier equipment.

With respect to cast-in-place concrete pipe, sloughing within sandier zones may require removal and replacement or laying back of side slopes and result in concrete quantities higher than neat dimension calculations. Cemented soils may impede excavation progress and the ability to excavate 'neat' trenches. Allowance should be made for the presence of concrete within the existing channel (see B-3). Bedding should be selected per the requirements of the pipe materials used and the trench loading conditions.

Laboratory-measured, minimum soil resistivity measurements indicate a severe degree of corrosiveness. Suitable and adequate protection to buried metal pipe and/or increased wall thickness per the American Iron and Steel Institute Handbook of Steel Drainage & Highway Construction Products will be essential for long term performance. Suitable pipe wall thickness and corrosion protection should be selected per the trench/traffic load and lifetime requirements of the project. Subsurface concrete should use Type I or II cement, readily available and used in the area.

Ground water is not expected to be a factor in the design or construction of shallow foundations and underground utilities. Depending on the time of year, flow in the existing channel may have to be diverted. If the soils are still wet when construction begins, the exposed grade may be come unstable under excavating equipment. Additional time may be required to allow the soils to dry when exposed, or alternative methods such as chemical stabilization or rock fill may be required to stabilize the exposed grade.

The swell potential of the upper clayey soils is a concern. The potential is usually strong enough to cause differential movements of slabs-on-grade such as floors and sidewalks but not enough to cause damage to structures unless lightly loaded. As the consolidation test indicated, the clay soils swelled even when restrained with a 2,200 psf load and subjected to inundation. Accordingly, it will be critical to pay attention to providing **proper drainage to limit the potential for water infiltrating under slabs**. A minimum slope of at least 5 percent for a distance of 10 feet is recommended for unpaved landscaped areas. Typical recommendations to reduce the swell potential include reducing the compaction requirements and requiring higher moisture contents during pad preparation and/or requiring at least 12 inches of non-expansive material to be placed directly beneath the slabs-on-grade. It is recommended that this apply not only to building floor slabs but also to perimeter sidewalks contiguous to each structure. It may be possible to selectively stockpile the low to non-plastic silts and sands for use in this regard. Due to the variable nature of these deposits, the contractor should satisfy himself as the feasibility of such an undertaking.

For exterior slabs on grade, frequent jointing is recommended to control cracking and reduce tripping hazards should differential movement occur. It is also recommended to pin the landing slab to the building floor/stem wall. This will reduce the potential for the exterior slab lifting and blocking the operation of out-swinging doors. Pinning typically consists of 24 inch long No. 4 reinforcing steel dowels placed at 12 inch centers.

As an alternate to placing 12 inches of non-expansive import to complete the building pad, the native soils may be treated with chemical lime slurry to reduce the plasticity and swell potential to less than 1.5 percent. Commercial lime slurry is recommended to reduce the environmental concerns for blowing lime dust and to ensure proper hydration and mixing. The specified underslab aggregate base course should not be eliminated.

The above comments relating to swell and ways to reduce its potential also apply to the channel lining (sides and bottom).

There is some concern with respect to hydrostatic pressure build-up behind the liner during sudden high flow events and rapid draw down, or infiltration entering behind the lining from surface drainage. Accordingly, consideration may be given to geotextile or geocomposite drainage strips connected to weepholes through the lining just above the channel bottom. Weepholes through the channel bottom itself run the risk of becoming clogged with silt or debris over time, rendering them useless, unless they are suitably filtered and maintained. It is assumed that design and construction of the channel sides and bottom will be such that resistance to hydrostatic uplift of the base slab can be provided. While such drainage does have the potential for water entering the expansive soils under the lining, hydrostatic pressure could cause even greater damage. Proper moisture and density control during construction combined with non-expansive fill under the lining should minimize the potential for slab movement. With weep holes located on the side slopes, low flows and nuisance water would not be a constant infiltration factor.

In addition to recommendations for maximum allowable design bearing capacity, a recommended minimum design bearing pressure will also be provided in light of the results of compression testing, and using deeper footings to reduce the potential for moisture changes under the footings. Stem walls must be backfilled and properly compacted to reduce the potential for water infiltration. Interior floor slabs should be reinforced, especially ones proposed for rigid floor coverings, to reduce the potential for uncontrolled cracking.

Another option would be to support the structures on a post-tension slab-on-grade foundations. This raft type foundation would be allowed to move with the expanding subsoils. With this system, special site preparation would not be required beyond clearing and grubbing, and precompaction of the surface. The exterior foundation should be supported 18 inches below lowest finished exterior grade within 5 feet of the structure with interior foundation lines at minimum depth. If this option is selected, this office can provide preliminary soils design criteria based on the *Post Tension Institute Design and Construction of Post-Tensioned Slabs-on-Ground* recommendations. This type of foundation system is more flexible and may require special design and construction of the superstructure to allow for this flexibility.

3.2 Site Preparation

The entire area to be occupied by the proposed construction should be stripped of all vegetation, debris, rubble and obviously loose surface soils. Depending on the proposed grades, additional native soil should be removed as necessary to provide space for the 12 inches of non-expansive import under slabs on grade if this option is selected.

If grading plans require placing structural fill below footing bottom elevation, the exposed grade should be scarified to a depth of 8 inches, moisture-conditioned to optimum (±2 percent) and compacted to at least 95 percent of maximum dry density as determined by ASTM D-698. Pavement areas should be scarified, moisture-conditioned and compacted in a similar manner.

All cut areas and areas above footing bottom elevation that are to receive floor slab only fill and expose clayey soils (CL or SC classification) should be scarified 8 inches, moisture-conditioned to at least optimum to 3 percent above optimum, and uniformly compacted to at least 90 but not more than 95 percent of maximum dry density as determined by ASTM D-698. All other areas to receive slab-on-grade fill should be scarified to a depth of 8 inches, moisture-conditioned to optimum (±2 percent) and compacted to at least 95 percent of maximum dry density.

The silts and fine sands may be sensitive to excessive moisture content and could become unstable at elevated moisture content. Accordingly, it may be necessary to compact these soils on the dry side of optimum, especially in asphalt pavement areas. The reduced moisture content under slabs-on-grade should only be used upon approval of the engineer in the field.

3.3 Excavation And Temporary Cut Slopes

Excavation operations should be relatively straightforward using conventional equipment. The presence of cemented or very dense/hard soils may impede progress and could require the use f heavier equipment. All excavations must comply with current governmental regulations including the current OSHA Excavation and Trench Safety Standards. Side slopes for open-cut excavation in the sandy clays and clayey sands (CL or SC classification) should be cut back at 1:1 (horizontal to vertical). Side slopes within the silts and sands (SM, ML, SW/SP classification) should be cut back at 1.5:1. The slopes should be protected from erosion due to run-off or long term surcharge at the slope crest. Construction equipment, building materials, excavated soil and vehicular traffic should not be allowed within 10 feet or 1/3 the slope height, whichever is greater, from the top of slope. All cut slopes should be observed by the Soils Engineer during excavation. Adjustments to the recommended slopes may be necessary due to wet zones, loose strata and other conditions not observed in the borings. Localized shoring may also be required. Shotcrete or soil stabilizer on the slope face may be useful in preventing erosion due to run-off and/or drying of the slope.

3.4 Foundation Design

It is recommended that the structures be founded on shallow spread footings bearing on dense native soil, or properly compacted fill if dictated by grading plans, at a minimum depth of 24 inches below lowest, finished exterior grade within 5 feet of the structure. For structures in channel areas, the up stream and down stream edges should have turn-down cut off walls that extend at least 36 inches below the design scour and/or stream bed degradation elevation. If site preparation is carried out as set forth herein, a recommended maximum allowable bearing capacity of 2,500 psf can be utilized for design. This value may be increased by one-third as the allowable toe pressure for retaining walls. This should also be near the minimum design bearing pressure. Post-tensioned slab-on-grade foundations maybe designed based on an allowable bearing capacity of 500 psf. These bearing capacities refer to the total of all loads, dead and live, and are net pressures. They may be increased one-third for wind, seismic or other loads of short duration. All footing excavations should be level and cleaned of all loose or disturbed materials. **Positive drainage away from the proposed building must be maintained at all times**.

Continuous wall footings and isolated rectangular footings should be designed with minimum widths of 16 and 24 inches respectively, regardless of the resultant bearing pressure. Lightly loaded interior partitions (less than 800 plf) may be supported on reinforced thickened slab sections (minimum 12 inches of bearing width).

Estimated settlements under design loads are on the order of ½ to 1-inch, virtually all of which will occur during construction. Post-construction differential settlements will be negligible, under existing and compacted moisture contents. Additional localized settlements of the same magnitude could occur if native supporting soils were to experience a significant increase in moisture content. Positive drainage away from structures, and controlled routing of roof runoff **must** be provided to prevent ponding adjacent to perimeter walls. Planters requiring heavy watering should be considered with caution. Care should be taken in design and construction to insure that domestic and interior storm drain water is contained to prevent seepage.

Continuous footings and stem walls should be reinforced to distribute stresses arising from small differential movements, and long walls should be provided with control joints to accommodate these movements. Reinforcement and frequent control joints are suggested to allow slight movement and prevent minor floor slab cracking especially in floor areas to be covered with hard tile.

3.5 Lateral Pressures

The following lateral pressure values may be utilized for the proposed construction:

Active Pressures	
Unrestrained Walls	35 pcf
Restrained Walls	60 pcf
Passive Pressures	
Continuous Footings	350 pcf
Spread Footings or Drilled Piers	400 pcf
Coefficient of Friction (w/ passive pressure)	0.35
Coefficient of Friction (w/out passive pressure)	0.45

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. Expansive native soils should not be used as retaining wall backfill, except as a surface seal to limit infiltration of storm/irrigation water. The expansive pressures could greatly increase active pressures.

3.6 Fill And Backfill

Native soils are considered suitable for use in general grading fills and as backfill but should **not** be used in the top foot of pad fill or as wall backfill. The top foot should be completed with an approved low or non-expansive soil, either approved imported common borrow, selectively stockpiled site-available materials or select granular soil. If select granular is used, the 4 inches of under slab A.B.C. may be included as part of the 12 inches. Otherwise, a full 12 inches of common borrow should be used in addition to the normal 4 inches of A.B.C.

If imported common fill for use in site grading is required, it should be examined by a Soils Engineer to ensure that it is of low swell potential and free of organic or otherwise deleterious material. In general, the fill should have 100 percent passing the 3-inch sieve and no more than 60 percent passing the 200 sieve. For the fine fraction (passing the 40 sieve), the liquid limit and plasticity index should not exceed 30 percent and 10 percent, respectively. It should exhibit less than 1.5 percent swell potential when compacted to 95 percent of maximum dry density (ASTM D-698) at a moisture content of 2 percent below optimum, confined under a 100 psf surcharge, and inundated.

Fill should be placed on subgrade which has been properly prepared and approved by a Soils Engineer. Fill must be wetted and thoroughly mixed to achieve optimum moisture content, ±2 percent (optimum to +3 percent for underslab fill). Fill should be placed in horizontal lifts of 8-inch thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 set forth as follows:

A.	Building Areas		
	1.	Below footing level	95
	2.	Below slabs-on-grade (non-expansive soils)	95
	3.	Below slabs-on-grade (expansive soils)	90-95 max
	Channel Bottom		
	1.	Below slabs-on-grade (non-expansive soils)	95
	2.	Below slabs-on-grade (expansive soils)	90-95 max
B.	Pavement Subgrade or Fill		95
C.	Utility Trench Backfill		
	1.	More than 2.0' below finish S/G	90
	2.	Within 2.0' of finish S/G	95
D.	Aggregate Base Course		
	1.	Below floor slabs	95
	2.	Below asphalt paving	100
E.	Landscape Areas		
	1.	Miscellaneous fill	90
	2.	Utility trench - more than 1.0' below F/G	85
	3.	Utility trench - within 1.0' of F/G	90

3.7 Utilities Installation

Trench excavations for utilities can be accomplished by conventional trenching equipment. Cemented soils may impede progress and could require the use of heavier equipment. See 'Analysis' and 'Excavation and Temporary Cut Slopes' sections above. Adequate precautions must be taken to protect workmen in accordance with all current governmental regulations.

Backfill of trenches may be carried out with native excavated material (<3 inches in diameter). This material should be moisture-conditioned, placed in 8-inch lifts and mechanically compacted. Water settling is not recommended. Compaction requirements are summarized in the "Fill And Backfill" section of this report.

3.8 Slabs-On-Grade

To facilitate fine grading operations and aid in concrete curing, a 4-inch thick layer of granular material conforming to the gradation for Aggregate Base Course (A.B.C.) as per M.A.G. Specification Section 702 should be utilized beneath the slab. Dried subgrade soils **must** be re-moistened prior to placing the A.B.C. if allowed to dry out, especially if native soils are used in the top 12 inches of the pad.

The native soils are capable of storing a significant moisture level which could increase the natural vapor drive through the slab. Accordingly, if moisture sensitive flooring and/or adhesive is planned, the use of a vapor barrier or low permeability concrete should be considered. Vapor barriers do increase the potential for slab curling and water entrapment under the slab. Accordingly, if a vapor barrier is used, additional precautions such as low slump concrete, frequent jointing and proper curing will be required to reduce curling potential and detailed to prevent the entrapment of outside water sources.

4.0 GENERAL

The scope of this investigation and report does not include regional considerations such as seismic activity and ground fissures resulting from subsidence due to groundwater withdrawal, nor any considerations of hazardous releases or toxic contamination of any type.

Our analysis of data and the recommendations presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific sample locations. Our work has been performed in accordance with generally accepted engineering principles and practice; this warranty is in lieu of all other warranties expressed or implied.

We recommend that a representative of the Soils Engineer observe and test the earthwork and foundation portions of this project to ensure compliance to project specifications and the field applicability of subsurface conditions which are the basis of the recommendations presented in this report. If any significant changes are made in the scope of work or type of construction that was assumed in this report, we must review such revised conditions to confirm our findings if the conclusions and recommendations presented herein are to apply.

Respectfully submitted,
SPEEDIE & ASSOCIATES, INC.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30524
PRABHAKAR
RUPAL
Date Signed 1.6.00
ARIZONA, U.S.A.

Prabhakar (Peter) Rupal, P.E.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 1.6.00
ARIZONA, U.S.A.

Gregg A. Creaser, P.E.

APPENDIX

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLANS

SOIL LEGEND

LOG OF TEST BORINGS

TABULATION OF TEST DATA

CONSOLIDATION TEST

MOISTURE-DENSITY RELATIONS

SWELL TEST DATA

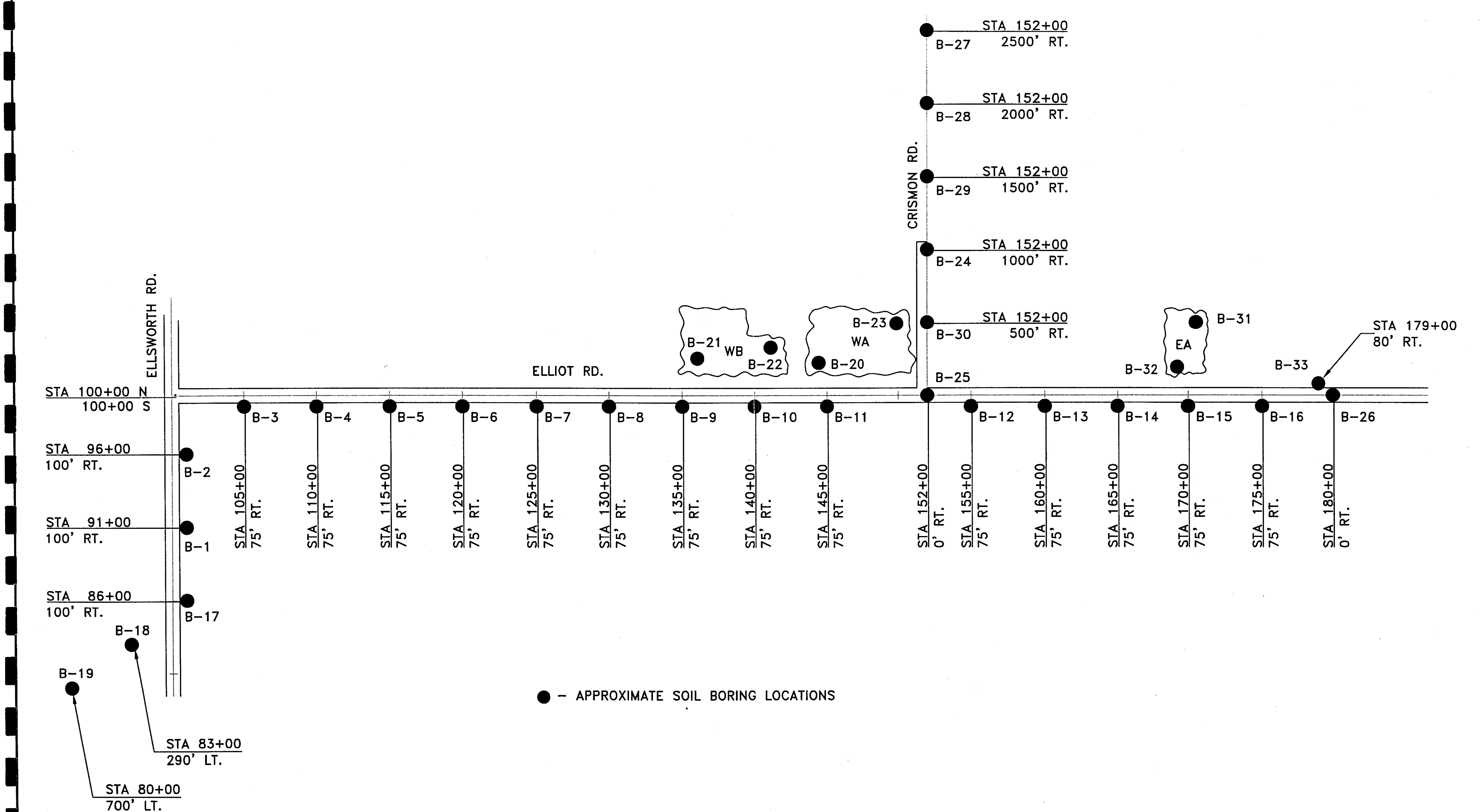
SOIL FERTILITY REPORT

RESISTIVITY & pH TEST DATA

FIELD AND LABORATORY INVESTIGATION

On June 17, 18 and December 13, 1999, soil test borings were drilled at the approximate locations shown on the attached Soil Boring Location Plan. All exploration work was carried out under the full-time supervision of our staff geologist, who recorded subsurface conditions and obtained samples for laboratory testing. The soil borings were advanced with a truck-mounted CME-55 drill rig utilizing 7-inch diameter hollow stem flight augers. Detailed information regarding the borings and samples obtained can be found on an individual Log of Test Boring prepared for each drilling location.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests, pH, resistivity and agronomic tests for classification and design parameters. Remolded swell tests were performed on samples compacted to densities and moisture contents expected during construction. Compression tests were performed on a selected ring sample in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.



SOIL BORING LOCATION PLAN

ELLIOT ROAD BASINS
ELLIOT & ELLSWORTH ROADS
MESA, ARIZONA

SPEEDIE AND ASSOCIATES
GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS

DR: JMM	CHK: PR	REV:	DATE: 7-28-99	Project No. 990509SA

SOIL LEGEND

SAMPLE DESIGNATION	DESCRIPTION	
AS	Auger Sample–	A grab sample taken directly from auger flights.
BS	Large Bulk Sample–	A grab sample taken directly from auger flights.
S	Spoon Sample–	Standard Penetration Test (ASTM D-1586) Driving a 2.0 inch outside diameter split spoon sampler into undisturbed soil for three successive 6-inch increments by means of a 140 lb. weight free falling through a distance of 30 inches. The cumulative number of blows for the final 12 inches of penetration is the Standard Penetration Resistance (N).
RS	Ring Sample–	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42 inside diameter, 1 inch long brass rings, into undisturbed soil for one 12 inch increment by the same means of the Spoon Sample. The blows required for the 12 inches of penetration are recorded.
LS	Liner Sample–	Standard Penetration Test driving a 2.0 inch outside diameter split spoon equipped with two 3 inch long, 3/8 inch inside diameter brass liners, separated by a 1 inch long spacer, into undisturbed soil by the same means of the spoon sample.
ST	Shelby Tube–	A 2.0 inch outside diameter thin-walled tube continuously pushed into undisturbed soil by a rapid motion, without impact or twisting (ASTM D-1587).
–	Continuous Penetration Resistance–	Driving a 2.0 inch outside diameter "Bullnose Penetrometer" continuously into undisturbed soil by the same means of the spoon sample. The blows for each successive 12 inch increment are recorded.

CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot *	Strength †	Sands & Gravels	Blows/Foot *
Very Soft	0-2	0-0.25	Very Loose	0-4
Soft	2-4	0.25-0.5	Loose	5-10
Firm	5-8	0.5-1.0	Medium Dense	11-30
Stiff	9-15	1-2	Dense	31-50
Very Stiff	16-30	2-4	Very Dense	> 50
Hard	> 30	> 4		

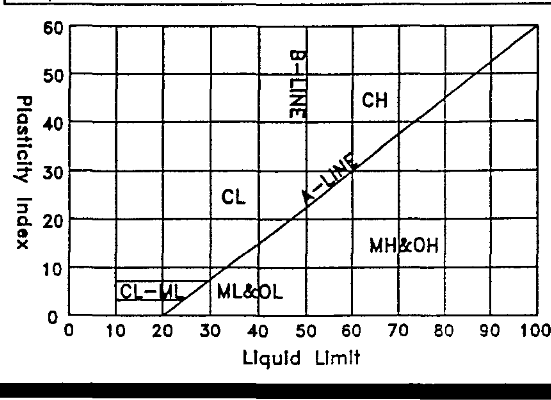
* Number of blows of a 140 lb hammer free falling 30 inches to drive a 2 inch O.D. split spoon sampler (ASTM D-1586)

† Unconfined compressive strength in tons/sq ft. Read from a pocket penetrometer.

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
Coarse Grained Soils More than 50% of material is larger than #200 sieve size	Gravel and Gravelly Soils	Clean Gravels		GW	Well Graded Gravels
				GP	Poorly Graded Gravels
	50% Coarse Fraction is > #4 Sieve Size	Gravels w/ Fines		GM	Silty Gravels
				GC	Clayey Gravels
	Sand and Sandy Soils	Clean Sands		SW	Well Graded Sands
				SP	Poorly Graded Sands
	50% Coarse Fraction is < #4 Sieve Size	Sands w/ Fines		SM	Silty Sand
				SC	Clayey Sand
Fine Grained Soils More than 50% of material is smaller than #200 sieve size	Silts and Clays Liquid Limit is less than 50%			ML	Inorganic Silts, Low P.I.
				CL	Inorganic Clays, Low P.I.
				OL	Organic Silts, High P.I.
	Silts and Clays Liquid Limit is greater than 50%			MH	Inorganic Silts, High P.I.
				CH	Inorganic Clays, High P.I.
				OH	Organic Clays, High P.I.
Highly Organic Soils				PT	Peat and Humus, Highly Organic

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size †	mm	Sieve Size †
Sands				
Fine	.075	#200	0.42	#40
Medium	0.42	#40	2.00	#10
Coarse	2.00	#10	4.76	#4
Gravels				
Fine	4.76	#4	191	3/4" °
Coarse	191	3/4" °	762	3" °
Cobbles	762	3" °	304.8	12" °
Boulders	304.8	12" °	914.4	36" °

† U.S. Standard   ° Clear Square Openings

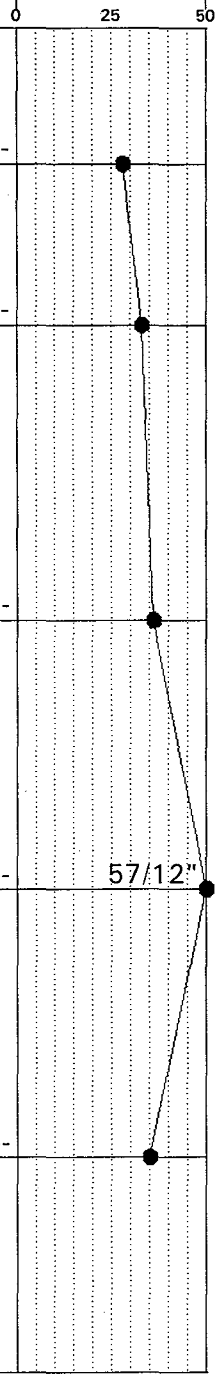


Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 3.5	Medium Dense Brown SILTY SAND (SM-Dry)
3.5 – 14.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation
14.0 – 18.0	Very Dense Reddish Brown SILTY SAND (SM-Dry) with Trace Gravel and Small Cobbles
18.0 – 21.0	Dense Brown WELL GRADED SAND (SW-Dry) with Trace Gravel
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
RS-2	5.5	--	--	
S-3	11.0	--	--	
S-4	16.0	--	--	57/12"
S-5	21.0	--	--	



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 1**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 7.0	Medium Dense Reddish Brown CLAYEY SAND (SC-Dry) with Weak Calcareous Cementation
7.0 – 13.0	Medium Dense Brown SILTY SAND (SM-Dry)
13.0 – 18.0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry)
18.0 – 21.0	Very Dense Reddish Brown WELL GRADED SAND (SW-Dry) with Clay
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
S-1	6.0	--	--	
BS-2	10.0	--	--	
S-3	11.0	--	--	
S-4	16.0	--	--	
S-5	21.0	--	--	51/12"

Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 2**

Elliot Road Basins

Elliot & Ellsworth Roads

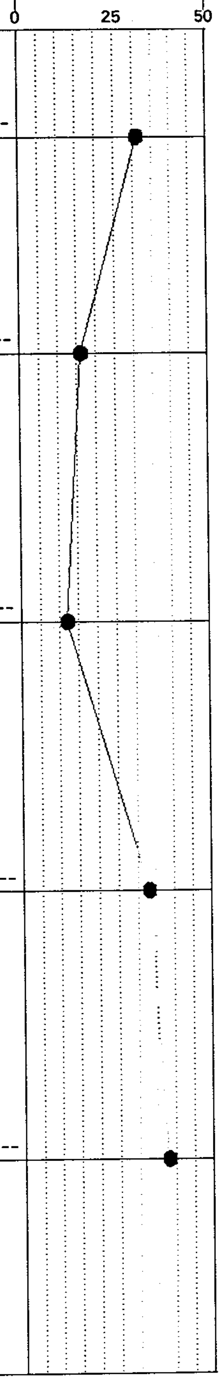
Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Layer depth	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 2.0	2 Feet of Brown SILTY FINE SAND (SP/SM-Dry) over 2 Inches of Concrete in Drainage Channel	2.0	RS-1	2.0	--	--
2.0 – 8.5	Reddish Brown SANDY CLAY (CL-Moist) Very Stiff Brown SANDY LEAN CLAY (CL-Dry to Moist) with Weak Calcareous Cementation	8.5	S-2	6.0	--	--
8.5 – 13.0	Medium Dense Brown CLAYEY SAND (SC-Dry to Moist) with Weak Calcareous Cementation	13.0	S-3	11.0	--	--
13.0 – 21.0	Hard Brown SANDY CLAY (CL-Moist) with Weak to Moderate Calcareous Cementation	21.0	S-4	16.0	--	--
			S-5	21.0	--	--
21.0	End of Boring					

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 3

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

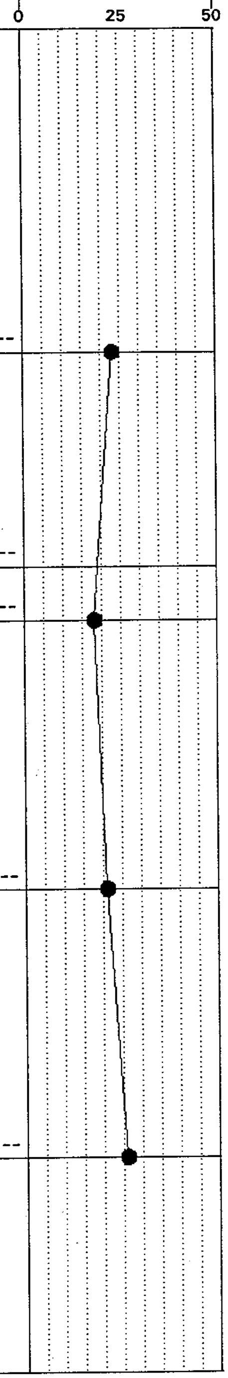
Rig Type: CME-95
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Visual Classification

Depth (feet)	Visual Classification
0 – 8.0	Medium Dense Brown SILTY SAND (SM-Dry) with Trace Gravel
8.0 – 18.0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry)
18.0 – 21.0	Very Stiff Brown SANDY CLAYEY SILT (CL/ML-Dry)
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
S-1	6.0	--	--
BS-2	10.0	--	--
S-3	11.0	--	--
S-4	16.0	--	--
S-5	21.0	--	--

Penetration Resistance Blows per Foot



Boring Date: 6-17-99
Field Engineer/Technician: M. Polsky
Driller: K. Heinrich
Contractor: Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 4

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

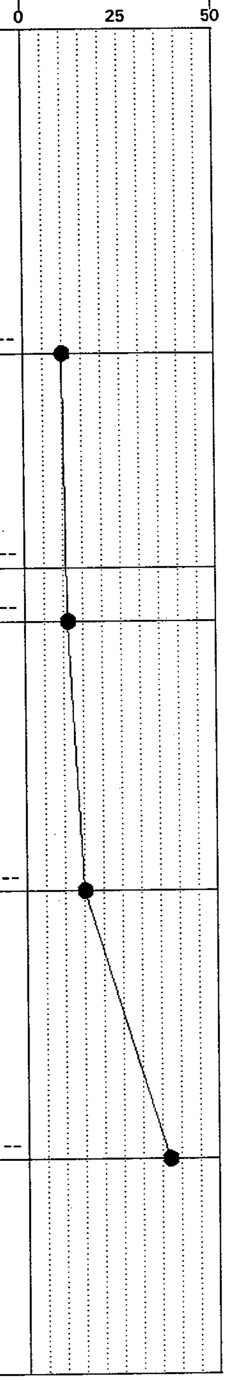
Project No.: 990509SA

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 8.0	Stiff Brown SANDY SILT (ML-Dry)	S-1	6.0	--	--
8.0 – 18.0	Medium Dense Brown SILTY FINE SAND (SP/SM-Dry)	BS-2	10.0	--	--
		S-3	11.0	--	--
	Medium Dense Brown SILTY SAND (SM-Dry)	S-4	16.0	--	--
18.0 – 21.0	Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation	S-5	21.0	--	--
21.0	End of Boring				

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 5**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

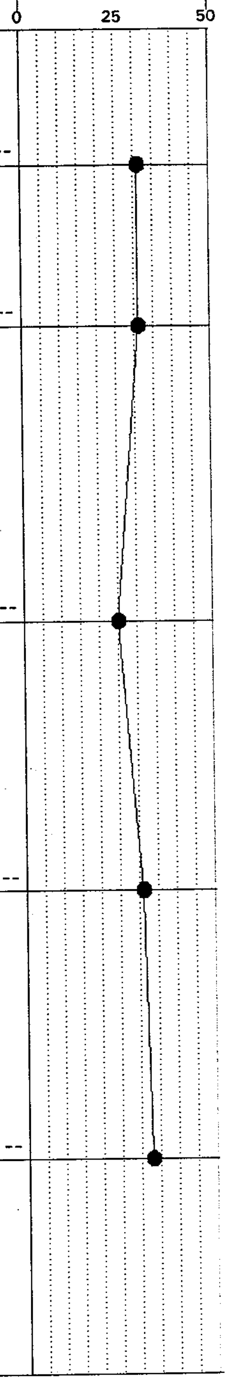
Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 8.5	Hard Brown SANDY SILT (ML-Dry); with Weak Calcareous Cementation (from about 5 ft)
8.5 – 13.0	Medium Dense Reddish Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation
13.0 – 21.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
S-1	2.5	--	--
RS-2	5.5	--	--
S-3	11.0	--	--
S-4	16.0	--	--
S-5	21.0	--	--

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 6**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: CME-95
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0 – 7.5	Hard Brown SANDY SILT (ML-Dry) with Moderate Calcareous Cementation	S-1	6.0	--	--	
7.5 – 21.0	Very Stiff to Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation	BS-2	10.0	--	--	
		S-3	11.0	--	--	
		S-4	16.0	--	--	52/12"
		S-5	21.0	--	--	67/12"
21.0	End of Boring					

Boring Date: 6-17-99
Field Engineer/Technician: M. Polsky
Driller: K. Heinrich
Contractor: Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B- 7

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

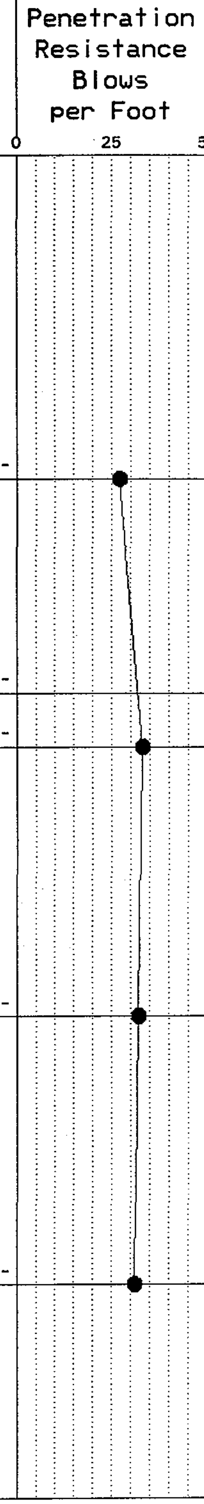
Project No.: 990509SA

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 18.0	Very Stiff to Hard Brown <u>SANDY LEAN CLAY</u> (CL-Dry)
15	with Moderate Calcareous Cementation
18.0 – 21.0	Dense Reddish Brown <u>CLAYEY SAND</u> (SC-Dry) with Little Gravel
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
S-1	6.0	--	--
BS-2	10.0	--	--
S-3	11.0	--	--
S-4	16.0	--	--
S-5	21.0	--	--



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 8**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

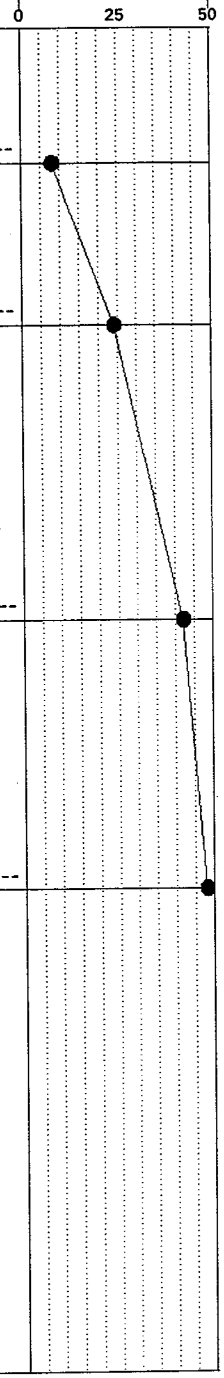
Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Graphic Log	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0		Firm to Very Stiff Brown SANDY LEAN CLAY (CL-Dry)				
			S-1	2.5	--	--
5			RS-2	5.5	--	--
10		Hard Brown SANDY CLAY (CL-Dry) with Moderate Calcareous Cementation				
			S-3	11.0	--	--
15						
16.0		End of Boring	S-4	16.0	--	--
20						
25						

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B- 9**

Elliot Road Basins

Elliot & Ellsworth Roads

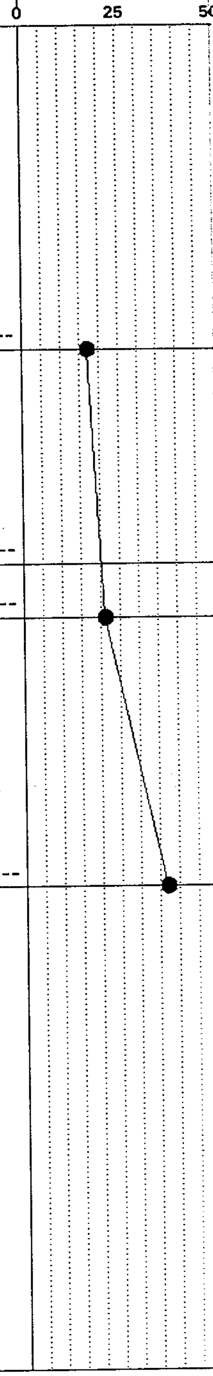
Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 6.5	Very Stiff Brown SANDY SILT (ML-Dry)	S-1	6.0	--	--
6.5 – 12.0	Medium Dense Reddish Brown CLAYEY SAND (SC-Dry)	BS-2	10.0	--	--
		S-3	11.0	--	--
12.0 – 16.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation	S-4	16.0	--	--
16.0	End of Boring				

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-10**

Elliot Road Basins

Elliot & Ellsworth Roads

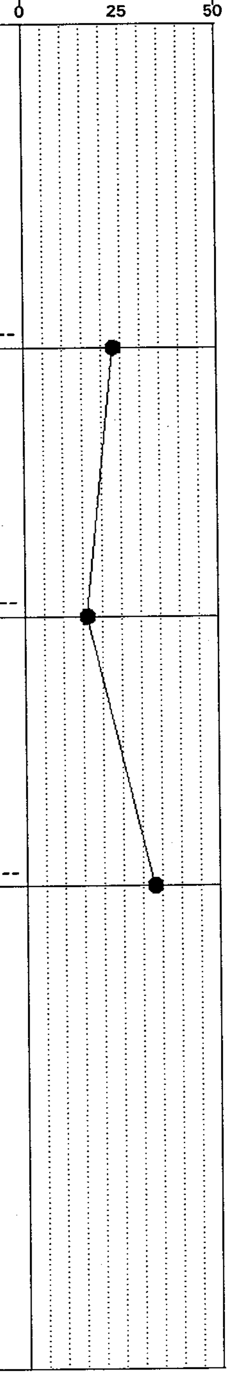
Mesa, Arizona

Project No.: **990509SA**

Rig Type:	CME-95
Boring Type:	Hollow Stem Auger
Surface Elevation:	N/A

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry)				
5		S-1	6.0	--	--
10		S-2	11.0	--	--
	Hard Brown SANDY CLAY (CL-Dry) with Moderate Calcareous Cementation				
15	16.0	S-3	16.0	--	--
	End of Boring				
20					
25					

Penetration Resistance Blows per Foot



Boring Date:	6-17-99
Field Engineer/Technician:	M. Polsky
Driller:	K. Heinrich
Contractor:	Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B-11

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

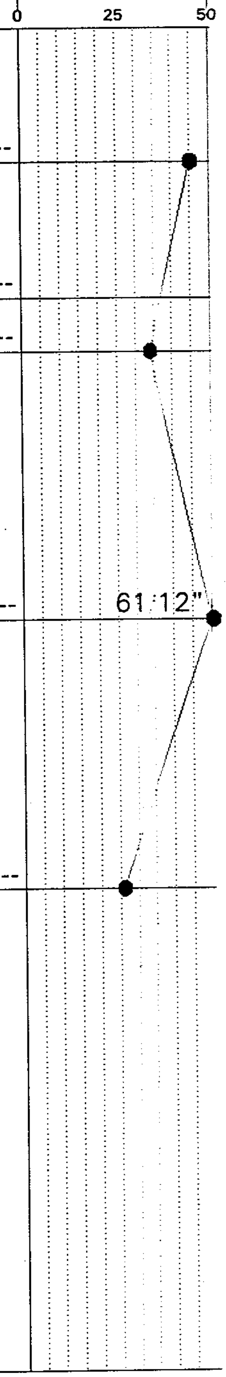
Project No.: 990509SA

Rig Type:	CME-95
Boring Type:	Hollow Stem Auger
Surface Elevation:	N/A

Visual Classification

Depth (feet)	Visual Classification
0 – 8.5	Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation
8.5 – 13.0	Very Dense Brown WELL GRADED SAND (SW-Dry)
13.0 – 16.0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation
16.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
BS-2	5.0	--	--	
S-3	6.0	--	--	
S-4	11.0	--	--	61:12"
S-5	16.0	--	--	



Boring Date:	6-17-99
Field Engineer/Technician:	M. Polsky
Driller:	K. Heinrich
Contractor:	Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B-12

Elliot Road Basins

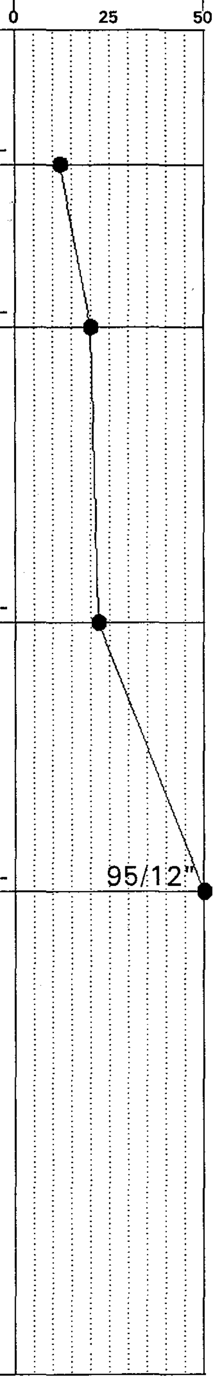
Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: 990509SA

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
0	Medium Dense Brown WELL GRADED SAND (SW-Dry)					
		S-1	2.5	--	--	
5	Medium Dense Reddish Brown WELL GRADED SAND (SW/SC-Dry) with Clay	RS-2	5.5	--	--	
10		S-3	11.0	--	--	
13.0	Very Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation					
15						
16.0	End of Boring	S-4	16.0	--	--	95/12"
20						
25						



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-13**

Elliot Road Basins

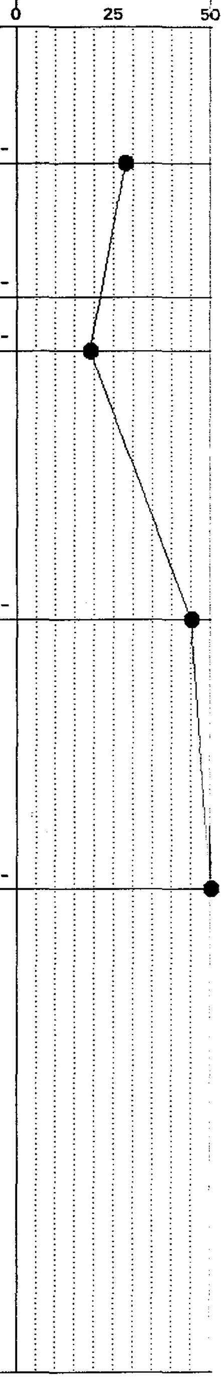
Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0	Stiff Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation				
		S-1	2.5	--	--
		BS-2	5.0	--	--
		S-3	6.0	--	--
8.5	Dense to Very Dense Light Brown CLAYEY SAND (SC-Dry) with Moderate to Strong Calcareous Cementation				
		S-4	11.0	--	--
16.0	End of Boring	S-5	16.0	--	--



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-14**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

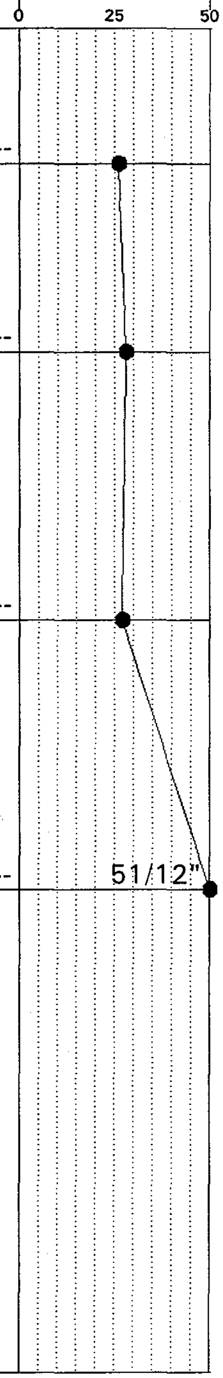
Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 8.0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry) with Weak Calcareous Cementation
8.0 – 16.0	Medium Dense to Very Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation
16.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
S-1	2.5	--	--
S-2	6.0	--	--
S-3	11.0	--	--
S-4	16.0	--	--

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-15**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

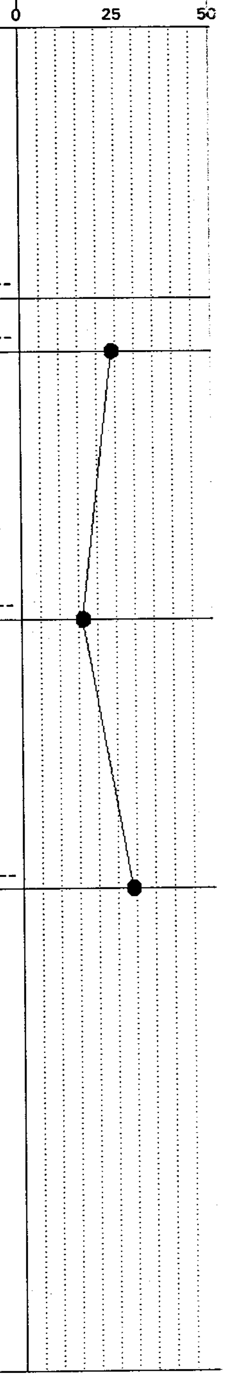
Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 2.5	Very Stiff Brown SANDY SILT (ML-Dry)				
2.5 – 16.0	Medium Dense Brown CLAYEY SAND (SC-Dry)	BS-1	5.0	--	--
		S-2	6.0	--	--
		S-3	11.0	--	--
		S-4	16.0	--	--
16.0	End of Boring				

Penetration Resistance Blows per Foot



Boring Date: **6-17-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-16**

Elliot Road Basins

Elliot & Ellsworth Roads

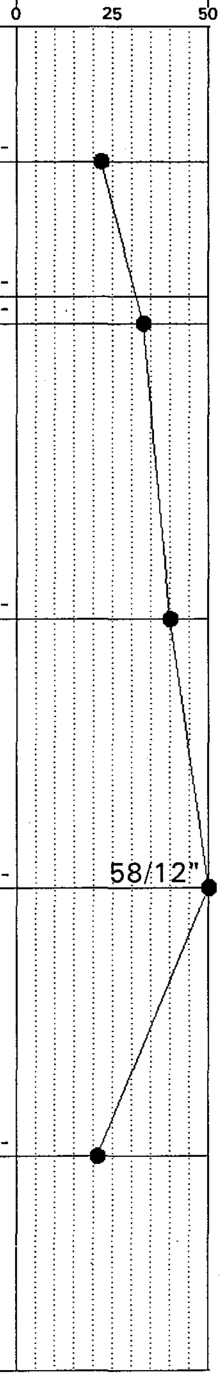
Mesa, Arizona

Project No.: **990509SA**

Rig Type:	CME-95
Boring Type:	Hollow Stem Auger
Surface Elevation:	N/A

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
0	Very Stiff Brown SANDY SILT (ML-Dry)					
		S-1	2.5	--	--	
3.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation					
		BS-2	5.0	--	--	
		RS-3	5.5	--	--	
		S-4	11.0	--	--	
		S-5	16.0	--	--	58/12"
21.0	End of Boring	S-6	21.0	--	--	



Boring Date:	6-18-99
Field Engineer/Technician:	M. Polsky
Driller:	K. Heinrich
Contractor:	Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B-17

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: 990509SA

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 3.5	Stiff Brown SANDY SILT (ML-Dry)
3.5 – 20.5	Hard Brown SANDY LEAN CLAY (CL-Dry) with Weak to Strong Calcareous Cementation
20.5	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
BS-2	5.0	--	--	
S-3	6.0	--	--	75/12"
S-4	11.0	--	--	
S-5	15.2	--	--	50/2"
S-6	20.5	--	--	50/6"

Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-18**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

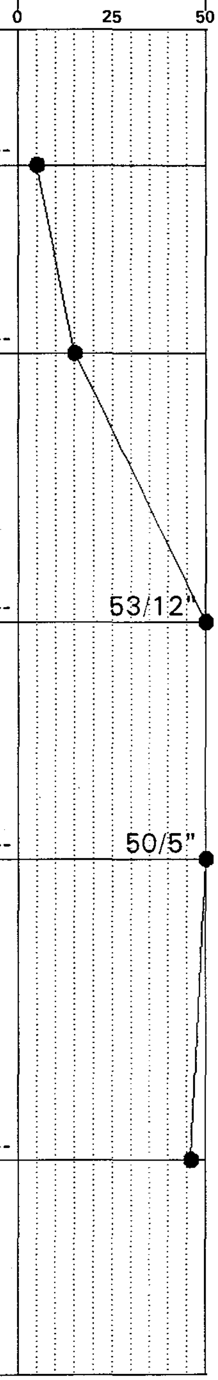
Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 3.5	Firm Brown SANDY SILT (ML-Dry)
3.5 – 8.0	Medium Dense Brown SILTY SAND (SM-Dry)
8.0 – 21.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
S-1	2.5	--	--
S-2	6.0	--	--
S-3	11.0	--	--
S-4	15.4	--	--
S-5	21.0	--	--

Penetration Resistance Blows per Foot



Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-19**

Elliot Road Basins

Elliot & Ellsworth Roads

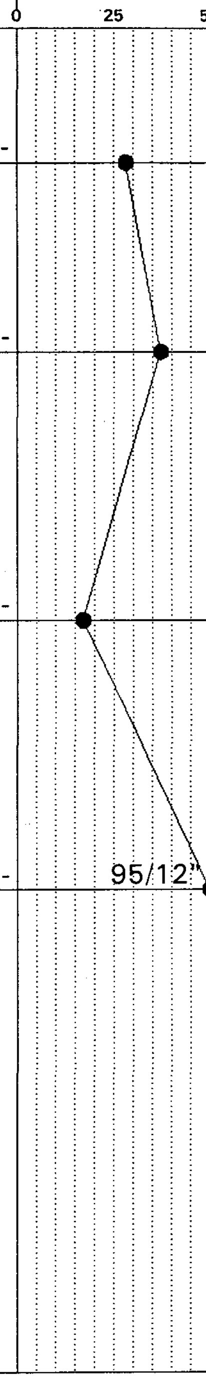
Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0	Very Stiff Brown SANDY LEAN CLAY (CL-Dry)				
		S-1	2.5	--	--
3.5	Dense to Medium Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation				
		S-2	6.0	--	--
		S-3	11.0	--	--
13.0	Hard Light Brown SANDY CLAY (CL-Dry) with Moderate to Strong Calcareous Cementation				
16.0	End of Boring	S-4	16.0	--	--

Penetration Resistance Blows per Foot



Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-20**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0–25–50)
0–3.0	Brown SILTY SAND (SM-Dry)					
3.0–14.9	Very Dense Brown CLAYEY SILTY SAND (SC/SM-Dry) with Moderate Calcareous Cementation	BS-1	5.0	--	--	
		S-2	6.0	--	--	51/12"
		S-3	10.4	--	--	50/5"
14.9		S-4	14.9	--	--	50/5"
14.9	End of Boring					

Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-21**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Brown SILTY SAND (SM-Dry) [0 to 3.0]

Very Dense Brown CLAYEY SAND (SC-Dry) with Moderate Calcareous Cementation [3.0 to 15.0]

End of Boring [15.0]

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
S-2	6.0	--	--	95/12"
S-3	11.0	--	--	66/12"
S-4	15.0	--	--	50/6"

Depth (feet): 0, 5, 10, 15, 20, 25

Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-22**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification
0 – 3.0	Brown SILTY SAND (SM-Dry)
3.0 – 8.5	Hard Brown SANDY CLAY (CL-Dry)
8.5 – 12.0	Dense Brown WELL GRADED CLAYEY SAND (SW/SC-Dry) with Weak to Moderate Calcareous Cementation
12.0 – 16.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate Calcareous Cementation
16.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
BS-1	5.0	--	--	
S-2	6.0	--	--	51/12"
S-3	11.0	--	--	
S-4	16.0	--	--	95/12"

Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-23**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0–25–50)
0 – 3.5	Medium Dense Brown SILTY SAND (SM-Dry)	S-1	2.5	--	--	
3.5 – 8.0	Medium Dense Brown WELL GRADED SAND (SW-Dry) with Trace Silt	S-2	6.0	--	--	
8.0 – 13.0	Very Stiff Brown SANDY SILT (ML-Dry)	S-3	11.0	--	--	
13.0 – 16.0	Hard Brown SANDY LEAN CLAY (CL-Dry) with Moderate to Strong Calcareous Cementation	S-4	16.0	--	--	95/12"
16.0	End of Boring					

Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-24**

Elliot Road Basins

Elliot & Ellsworth Roads

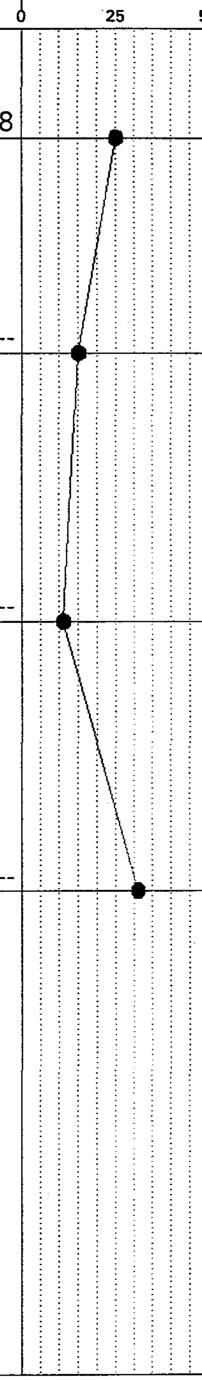
Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 1.0	2" Asphalt 4" Old Asphalt or RAP 6" ABC				
1.0 – 3.5	Very Stiff Brown SANDY LEAN CLAY (CL-Dry to Moist)	RS-1	2.0	15.6	114.8
3.5 – 13.0	Medium Dense Brown CLAYEY SAND (SC-Dry to Moist) with Moderate Calcareous Cementation	S-2	6.0	--	--
		S-3	11.0	--	--
13.0 – 16.0	Dense Brown WELL GRADED CLAYEY SAND (SC/SW-Dry)	S-4	16.0	--	--
16.0	End of Boring				

Penetration Resistance Blows per Foot



Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-25**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

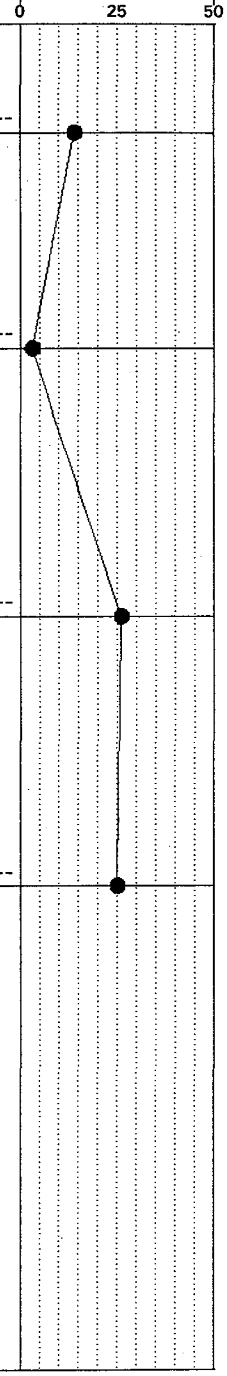
Project No.: **990509SA**

Rig Type: **CME-95**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)
0 – 0.5	2" Asphalt 4" RAP/ABC				
0.5	Stiff to Soft Brown SANDY LEAN CLAY (CL-Dry)	RS-1	2.0	--	--
		S-2	6.0	--	--
	Very Stiff Dark Brown SANDY LEAN CLAY (CL-Dry to Moist) with Moderate Calcareous Cementation	S-3	11.0	--	--
16.0	End of Boring	S-4	16.0	--	--

Penetration Resistance Blows per Foot



Boring Date: **6-18-99**
Field Engineer/Technician: **M. Polsky**
Driller: **K. Heinrich**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-26**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Graphic Log	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 – 25 – 50)
0		Very Dense Brown <u>SANDY CLAY</u> (CL-Moist)	RS-1	2.0	--	--	
5		Calcareous	S-2	6.0	--	--	50/6"
10			S-3	11.5	--	--	95/12"
12.5		End of Boring	S-4	12.5	--	--	50/5.5"
15							
20							
25							

Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-27**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
0 – 3.5	Hard Brown SILTY CLAY (CL-Dry) Calcareous	S-1	2.5	--	--	
3.5 – 8.0	Hard Brown SANDY CLAY (CL-Dry)	BS-4	5.0	--	--	
		RS-2	6.0	--	--	
8.0 – 12.5	Medium Dense Brown CLAYEY SAND (SC-Dry)					
12.5 – 13.5	Hard Brown SANDY SILT (ML-Dry) With Clay	S-3	13.5	--	--	58/12"
13.5	End of Boring					

Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-28**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: CME-55
Boring Type: Hollow Stem Auger
Surface Elevation: N/A

Visual Classification

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot (0 / 25 / 50)
0–13.0	Very Stiff to Hard Brown CLAY (CL-Dry to Moist) with Some Sand from 5 to 10 Feet	RS-1	2.0	--	--	
		S-2	6.5	--	--	
		S-3	11.5	--	--	
13.0		S-4	13.0	--	--	50/6"
	End of Boring					

Boring Date: 12-13-99
Field Engineer/Technician: T. Rheinschmidt
Driller: J. Carter
Contractor: Heber Mining Co.

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: B-29

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: 990509SA

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
0	Very Stiff to Hard Brown SILTY CLAY (CL-Dry) With Sand, Calcareous					
		S-1	2.5	--	--	
5		RS-2	6.0	--	--	
10		S-3	11.5	--	--	64/12"
15	15.5	S-4	15.5	--	--	50/5"
	End of Boring					
20						
25						

Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-30**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification	Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
0 – 13.5	Very Stiff to Hard Brown SILTY CLAY (CL-Dry) With Sand	RS-1	2.0	--	--	
		S-2	6.5	--	--	
		S-3	11.5	--	--	84/12"
13.5 – 16.5	Very Dense Brown SANDY SILT (ML-Dry)	S-4	16.5	--	--	56/12"
16.5	End of Boring					

Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-31**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet)	Visual Classification
0 – 8.0	Hard Brown SANDY CLAY (CL-Dry) With Silt; Calcareous (at 5)
8.0 – 13.0	Hard Brown SILTY CLAY (CL-Dry) With Sand, Calcareous
13.0 – 16.5	Very Dense Brown SILTY SAND (SM-Dry)
16.5	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
S-1	2.5	--	--	
BS-5	5.0	--	--	
RS-2	6.0	9.1	107.6	50/12"
S-3	11.5	--	--	52/12"
S-4	16.5	--	--	

Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-32**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

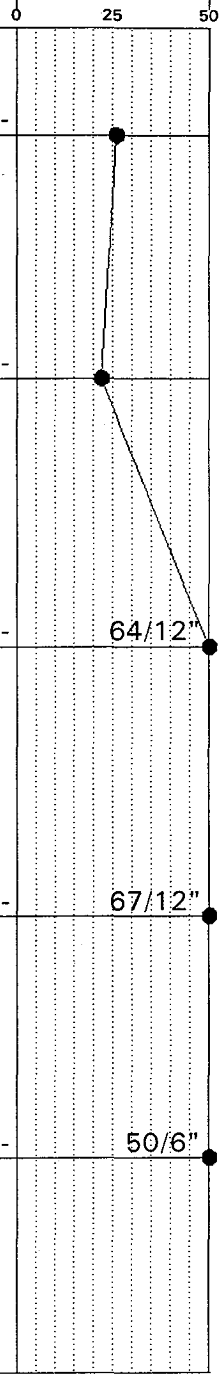
Project No.: **990509SA**

Rig Type: **CME-55**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth (feet) | Graphic Log | Visual Classification

Depth (feet)	Visual Classification
0 – 13.5	Very Stiff to Hard Brown SANDY CLAY (CL-Dry) With Silt
~10	Calcareous
13.5 – 20.5	Very Dense Brown SILTY SAND (SM-Dry) with Some Gravel
20.5 – 21.0	Hard Brown SILTY CLAY (CL-Moist)
21.0	End of Boring

Sample Number	Depth of Sample	Natural Water Content (%)	In-place Dry Density (P.C.F.)	Penetration Resistance Blows per Foot
RS-1	2.0	--	--	
S-2	6.5	--	--	
S-3	11.5	--	--	64/12"
S-4	16.5	--	--	67/12"
S-5	21.0	--	--	50/6"



Boring Date: **12-13-99**
Field Engineer/Technician: **T. Rheinschmidt**
Driller: **J. Carter**
Contractor: **Heber Mining Co.**

Water Level

Depth	Hour	Date
No Water		

SPEEDIE AND ASSOCIATES

Log of Test Boring Number: **B-33**

Elliot Road Basins

Elliot & Ellsworth Roads

Mesa, Arizona

Project No.: **990509SA**

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	DEPTH OF SAMPLE TIP	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
B- 2	S-1	SPT	6.0	--	--	49.6	72	91	95	100	33	16	17	SC	CLAYEY SAND
B- 4	S-3	SPT	11.0	--	--	71.6	98	100	100		27	20	7	CL	LEAN CLAY with SAND
B- 6	S-4	SPT	16.0	--	--	64.7	89	97	99	100	40	22	18	CL	SANDY LEAN CLAY
B- 8	S-5	SPT	21.0	--	--	14.8	29	58	81	100	30	21	9	SC	CLAYEY SAND with GRAVEL
B-10	S-3	SPT	11.0	--	--	26.3	44	85	97	100	27	16	11	SC	CLAYEY SAND
B-12	S-5	SPT	16.0	--	--	64.6	89	98	100	100	45	17	28	CL	SANDY LEAN CLAY
B-14	S-3	SPT	6.0	--	--	61.2	88	98	100	100	40	19	21	CL	SANDY LEAN CLAY
B-16	S-3	SPT	11.0	--	--	29.4	54	81	95	100	27	18	9	SC	CLAYEY SAND
B-17	BS-2	BS	5.0	--	--	63.0	88	98	100	100	30	18	12	CL	SANDY LEAN CLAY
B-19	S-3	SPT	11.0	--	--	57.6	79	95	100	100	37	19	18	CL	SANDY LEAN CLAY
B-22	S-2	SPT	6.0	--	--	46.7	68	90	98	100	34	19	15	SC	CLAYEY SAND
B-25	RS-1	RS	2.0	15.6	114.8	60.4	91	99	100		37	18	19	CL	SANDY LEAN CLAY
B-26	S-4	SPT	16.0	--	--	65.1	86	96	100	100	32	17	15	CL	SANDY LEAN CLAY

Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

Elliot Road Basins
Elliot & Ellsworth Roads
Mesa, Arizona
Project No. 990509SA

SPEEDIE AND ASSOCIATES

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	DEPTH OF SAMPLE TIP	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			pH	RESISTIVITY (Ohm-Centimeters)	UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX				
B-28	BS-4	BULK	5.0	--	--									7.9	1342		
B-29	RS-1	RS	2.0	--	--	85.0	97	100	100		36	19	17	--	--	CL	LEAN CLAY with SAND
B-32	BS-5	BULK	5.0	--	--	51.7	77	94	99	100	23	16	7	--	--	CL-ML	SANDY SILTY CLAY

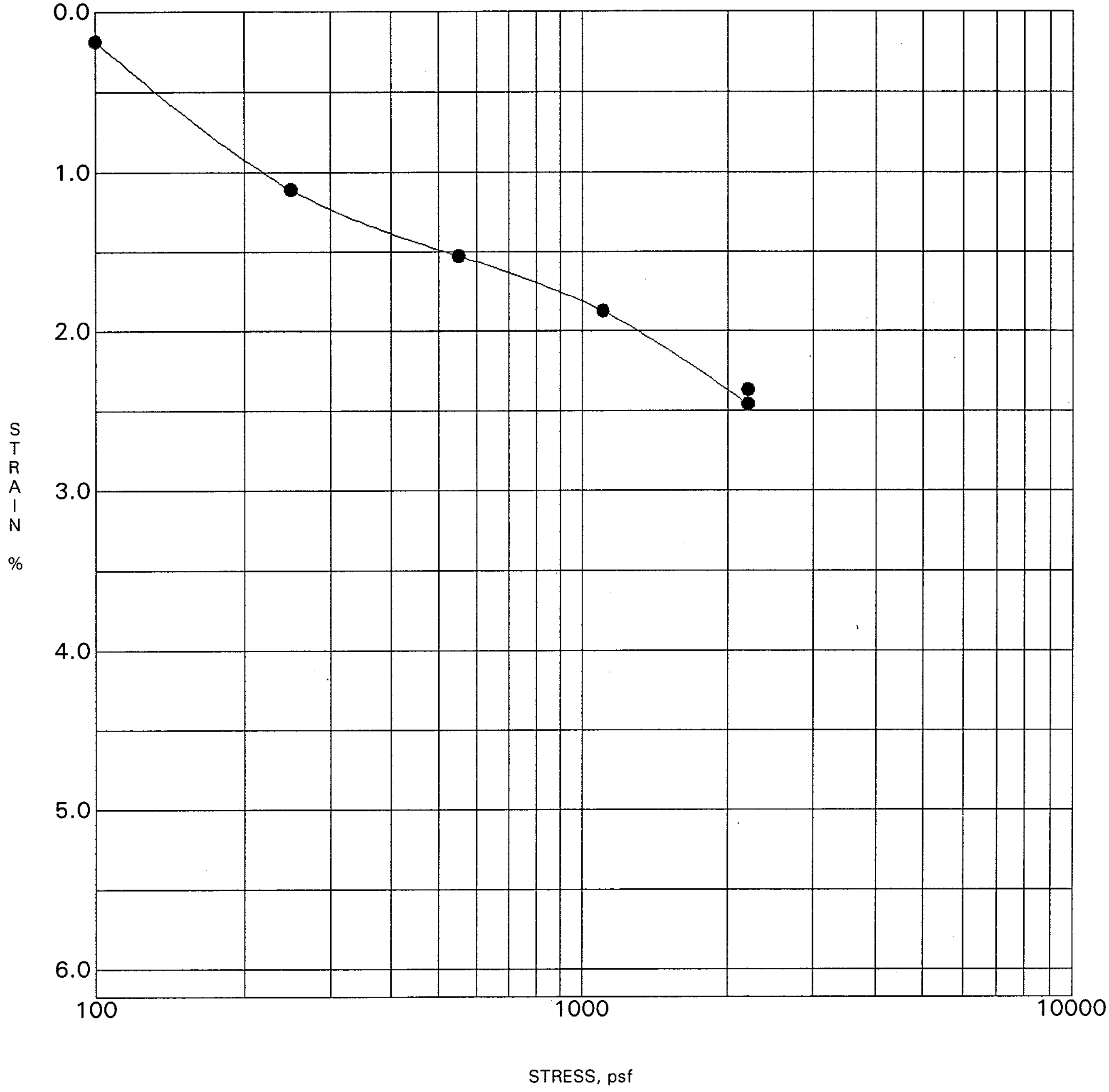
Sieve analysis results do not include material greater than 3". Refer to the actual boring logs for the possibility of cobble and boulder sized materials.

Sheet 1 of 1

Elliot Road Basins
Elliot & Ellsworth Roads
Mesa, Arizona
Project No. 990509SA

SPEEDIE AND ASSOCIATES

CONSOLIDATION TEST



BORING B-25

SAMPLE No. RS-1

Sample inundated at end of test at 2200 psf

PROJECT **Elliot Road Basins - Elliot & Ellsworth Roads**

JOB NO. **990509SA**

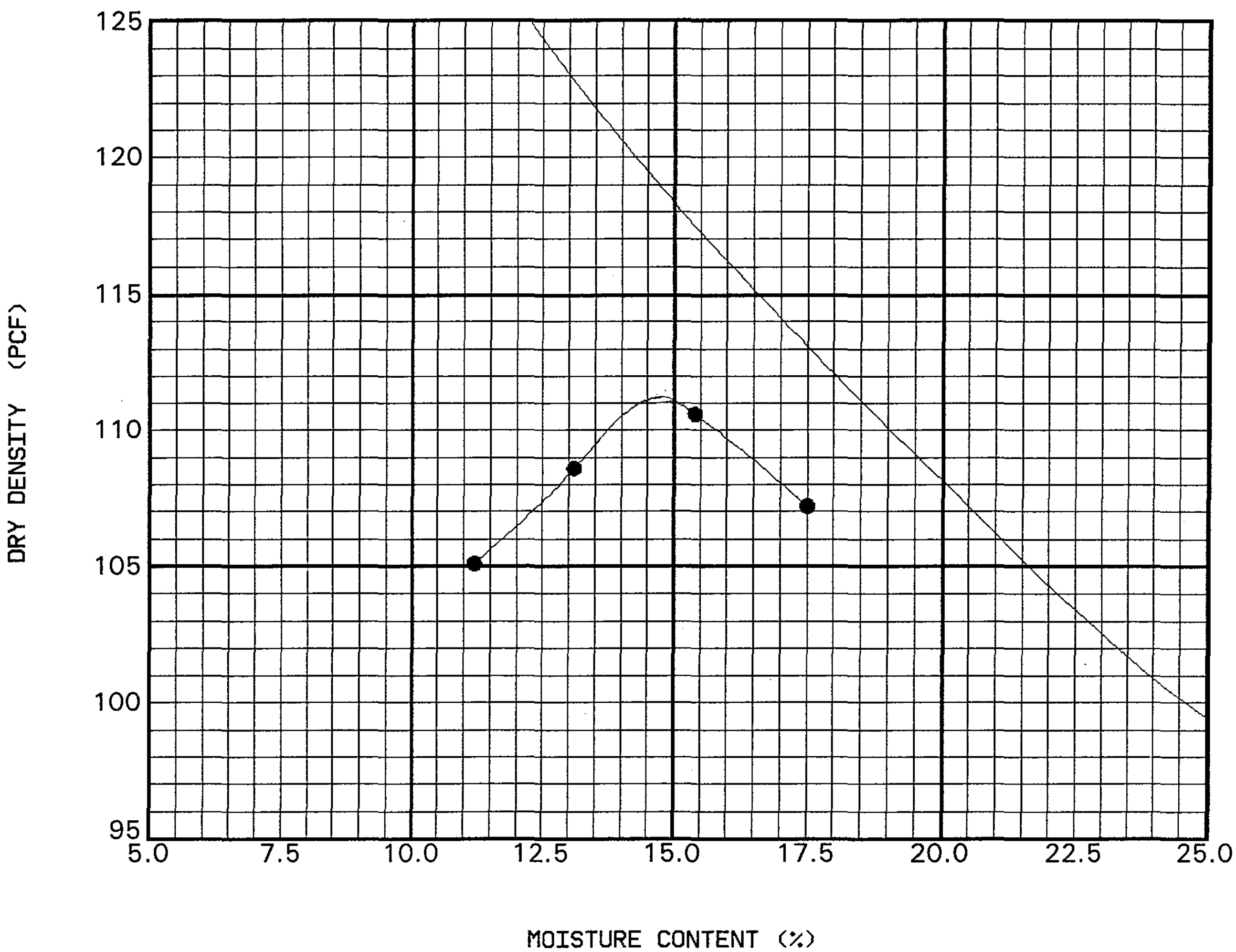
DATE **6/18/99**

SPEEDIE AND ASSOCIATES

MOISTURE-DENSITY RELATIONS

PROJECT: Elliot Road Basins
PROJECT NO.: 990509SA
LOCATION: Elliot & Ellsworth Roads
DATE: 6/18/99
BORING NO.: B-17
SAMPLE NO.: BS-2'
SAMPLE DEPTH: 5.00
METHOD OF COMPACTION: ASTM D698A
LIQUID LIMIT:
PLASTIC LIMIT:
PLASTICITY INDEX:
CLASSIFICATION:
ASTM SOIL DESCRIPTION:

MAXIMUM DRY DENSITY: 111.2 PCF
OPTIMUM MOISTURE CONTENT: 14.8 %



SPEEDIE AND ASSOCIATES

SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE (%)	PERCENT COMPACTION	INITIAL DEGREE of SATURATION (%)	FINAL DEGREE of SATURATION (%)	TOTAL SWELL (%)
B-17 BS-2	5.0	106.0	13.0	95.1	61.3	91.3	4.0

PERCENT COMPACTION BASED ON A MAXIMUM DRY DENSITY OF 111.2 pcf @ 14.8 % MOISTURE

Elliot Road Basins
Elliot & Ellsworth Roads
Mesa, Arizona
Project No. 990509SA

SPEEDIE AND ASSOCIATES

Laboratory Consultants, Ltd.

July 9, 1999

Speedie & Associates
11029 North 24th Avenue
Phoenix, Arizona 85029

RE: Soil samples, Laboratory #990985
Project: 990509SA

Dear Sir:

Based on the enclosed soil fertility reports, pH is slightly alkaline. This level is quite suitable for desert adapted species.

Salinity (electrical conductivity) is low. No adverse effects due to salinity would be expected at this salinity level.

Exchangeable sodium percentage is within the acceptable range. Water permeability problems and/or foliar burn due to excess sodium will not occur.

The organic matter content of this soil is very low. An application of nitrogen stabilized mulch will increase water and nutrient holding capacity, and improve structure of the native soil.

Of the nutrients tested, nitrogen, phosphorus and zinc are low. These nutrients should be supplemented preplant.

Before planting, determine if any soil physical problems such as compaction or abrupt textural change are present. These conditions will restrict water and air movement through the root zone. If present, they should be resolved before installation of the irrigation system and plant material to provide an efficient, easily maintained growing medium.

On turf areas, apply 20 pounds ammonium phosphate (16-20-0) and 1 pound zinc sulfate per 1000 square feet, preplant. Incorporate these materials into the top 2 to 3 inches of soil. Organic matter is not cost effective on new turf. As the turf matures, organic matter will increase.

In planters, apply 25 pounds ammonium phosphate (16-20-0), 1 pound zinc sulfate and 5 cubic yards nitrogen stabilized mulch per 1000 square feet preplant. Incorporate these materials into the top 6 to 8 inches of soil.

For trees or shrubs under drip or bubbler irrigation, use a backfill mix consisting of 4 parts soil and 1 part nitrogen stabilized organic material. To this mix, add 0.5-pound ammonium phosphate (16-20-0) and 0.25-pound zinc sulfate per cubic yard of backfill.

JUL 17 1999

947 South 48th Street, Suite 127 Tempe, Arizona 85281 Phone (602) 858-1841 Fax (602) 858-0752

MEMBER ACIL

Speedie & Associates
Project: 990509SA
Laboratory #990985
Page 2

After plants are established maintain adequate available nitrogen levels. Apply fertilizer spikes or tablets to trees, shrubs or ground covers under drip or bubbler irrigation, according to label directions. To annuals and ground covers in beds, apply 1 pound actual nitrogen per 1000 square feet every 6 to 8 weeks during the active growing season. In turf areas, apply 1 pound nitrogen per 1000 square feet per month during active growing seasons. Water in nitrogen applications to incorporate.

Develop an irrigation schedule that applies heavy, infrequent waterings. This type of schedule promotes deep rooting, leaches salts, and allows root aeration.

If I can be of further assistance regarding this report, please call at your convenience.

Respectfully submitted,

Harry Owens
Laboratory Director
Certified Crop Advisor

SPEEDIE990985.doc

Laboratory Consultants, Ltd.

SOIL FERTILITY REPORT

SUBMITTED BY Speedie & Associates
ADDRESS: Accounts Payable
11029 N. 24th Avenue
Phoenix, Az 85029

GROWER: 990509SA
LAB NUMBER: 990967
SAMPLE NUMBER: 990967-01

SAMPLE MARKING	57091	CROP		DATE RECEIVED	6/28/99
		YIELD GOAL		DATE REPORTED	7/1/99

Lab Tests	Result	Level	Suggested Recommendations
pH, S.U.	7.3		
ELECTRICAL CONDUCTIVITY, mmhos/CM	1.7		
FREE LIME, --	YES		
ORGANIC MATTER, %	0.4		
NITRATE-N, PPM	26		
AVAILABLE NITROGEN, lbs/A	114		
BICARBONATE PHOSPHORUS, PPM	11		
EXCHANGEABLE POTASSIUM, PPM	328		
EXCHANGEABLE MAGNESIUM, PPM	503		
EXCHANGEABLE CALCIUM, PPM	3531		
EXCHANGEABLE SODIUM, PPM	103		
EXCHANGEABLE SODIUM PERCENTAGE, %	1.9		
COPPER, PPM	1.4		
IRON, PPM	15.3		
MANGANESE, PPM	9.3		
ZINC, PPM	0.4		
BORON, PPM	2.2		
SULFATE-SULFUR, PPM	25		

Soil Depth = 12 Inches

There were no problems with the analyses and all data met laboratory quality assurance specifications.

Analyst [signature]

Laboratory Consultants, Ltd.

SOIL FERTILITY REPORT

SUBMITTED BY	Speedie & Associates	GROWER:	990509SA
ADDRESS:	Accounts Payable 11029 N. 24th Avenue Phoenix, Az 85029	LAB NUMBER:	990985
		SAMPLE NUMBER:	990985-01

SAMPLE MARKING	57083	CROP		DATE RECEIVED	6/30/99
		YIELD GOAL		DATE REPORTED	7/6/99

Lab Tests	Result	Level	Suggested Recommendations
pH, S.U.	7.4		
ELECTRICAL CONDUCTIVITY, mmhos/CM	1.2		
FREE LIME, --	YES		
ORGANIC MATTER, %	0.5		
NITRATE-N, PPM	27		
AVAILABLE NITROGEN, lbs/A	123		
BICARBONATE PHOSPHORUS, PPM	11		
EXCHANGEABLE POTASSIUM, PPM	314		
EXCHANGEABLE MAGNESIUM, PPM	409		
EXCHANGEABLE CALCIUM, PPM	2829		
EXCHANGEABLE SODIUM, PPM	57		
EXCHANGEABLE SODIUM PERCENTAGE, %	1.3		
COPPER, PPM	1.3		
IRON, PPM	4.1		
MANGANESE, PPM	7.5		
ZINC, PPM	0.3		
BORON, PPM	1.3		
SULFATE-SULFUR, PPM	36		

Soil Depth = 12 Inches

There were no problems with the analyses and all data met laboratory quality assurance specifications.

RECEIVED
JUL 09 1999

Analyst D. Lodang

Laboratory Consultants, Ltd.

December 23, 1999

Speedie & Associates
Mr. John Kelley
11029 North 24th Avenue
Phoenix, Arizona 85029

RE: Soil sample, Laboratory #991690
Project: 990509SA

Dear Mr. Kelley:

Based on the enclosed soil fertility report, pH is slightly alkaline. While this level is acceptable for desert adapted species, a preplant sulfur application is advisable to improve nutrient availability.

Salinity (electrical conductivity) is high. Salts in this range will restrict germination and growth of salt sensitive species. Salinity should be reduced for optimum plant growth.

Exchangeable sodium percentage is within the acceptable range. Water permeability problems and/or foliar burn due to excess sodium will not occur.

The organic matter content of this soil is very low. A preplant organic matter application is advisable. Organic matter increases water and nutrient holding capacity, and improves structure of the native soil.

Of the nutrients tested, nitrogen, phosphorus and zinc were found to be deficient. These deficiencies should be corrected preplant.

Before planting, determine if any soil physical problems such as compaction or abrupt textural change are present. These conditions will restrict water and air movement through the root zone. If present, they should be resolved before installation of the irrigation system and plant material to provide an efficient, easily maintained growing medium.

To reduce salinity, apply a heavy irrigation at or before planting to leach excess salts down and out of the root zone. Repeat 3 to 4 times.

On turf areas, apply 10 pounds soil sulfur, 20 pounds ammonium phosphate and 1 pound zinc sulfate per 1000 square feet preplant. Incorporate these materials into the top 4 to 6 inches of soil. Organic matter is not cost effective in turf areas. As the turf matures, thatch will break down to increase soil organic matter.

In planters, apply 10 pounds soil sulfur, 25 pounds ammonium phosphate, 1 pound zinc sulfate and 5 cubic yards nitrogen stabilized mulch per 1000 square feet preplant. Incorporate these materials into the top 10 to 12 inches of native soil.

For trees or shrubs under drip or bubbler irrigation, use a backfill mix consisting of 4 parts soil and 1 part nitrogen stabilized organic material. To this mix, add 1 pound soil sulfur, 2 pounds ammonium phosphate (16-20-0) and 0.25-pound zinc sulfate per cubic yard of backfill mix.

947 South 48th Street, Suite 127 Tempe, Arizona 85281 Phone (480) 858-1841 Fax (480) 858-0752

Speedie & Associates
Project: 990509SA
Soil sample, Laboratory #991690
Page 2

After plants are established maintain adequate available nitrogen levels. For turf, apply 1 pound actual nitrogen per 1000 square feet per month during active growing seasons. In planters, apply 1 pound actual nitrogen per 1000 square feet every 6 to 8 weeks during active growing seasons. Apply high nitrogen fertilizer spikes or tablets to trees or shrubs under drip or bubbler irrigation, according to label directions.

Develop an irrigation schedule that applies heavy, infrequent waterings. This type of schedule promotes deep rooting, leaches salts, and allows root aeration.

If I can be of further assistance regarding this report, please call at your convenience.

Respectfully submitted,

Harry Owens
Laboratory Director
Certified Crop Advisor

Speedie991690.doc

Laboratory Consultants, Ltd.

SOIL FERTILITY REPORT

SUBMITTED BY:	Speedie & Associates	GROWER:	990509SA
ADDRESS:	Accounts Payable 11029 N. 24th Avenue Phoenix, Az 85029	LAB NUMBER:	991690
		SAMPLE NUMBER:	991690-01

SAMPLE MARKING	A3080	CROP		DATE RECEIVED	12/20/99
		YIELD GOAL		DATE REPORTED	12/22/99

Lab Tests	Result	Level	Suggested Recommendations
pH, S.U.	7.7		
ELECTRICAL CONDUCTIVITY. mmhos/CM	3.6		
FREE LIME, --	YES		
ORGANIC MATTER, %	0.3		
NITRATE-N, PPM	41		
AVAILABLE NITROGEN, lbs/A	163		
BICARBONATE PHOSPHORUS, PPM	9		
EXCHANGEABLE POTASSIUM, PPM	317		
EXCHANGEABLE MAGNESIUM, PPM	403		
EXCHANGEABLE CALCIUM, PPM	2773		
EXCHANGEABLE SODIUM, PPM	49		
EXCHANGEABLE SODIUM PERCENTAGE, %	1.2		
COPPER, PPM	1.1		
IRON, PPM	6.8		
MANGANESE, PPM	6.2		
ZINC, PPM	0.6		
BORON, PPM	1.6		
SULFATE-SULFUR, PPM	32		

Soil Depth = 12 Inches

There were no problems with the analyses and all data met laboratory quality assurance specifications.

Analyst

Laboratory Minimum Resistivity & pH

Sample	Minimum Resistivity (ohm-cm)	pH
B-2, 10'	734	7.7
B-4, 10'	1,001	7.8
B-5, 10'	2,068	7.5
B-7, 10'	867	7.5
B-8, 10'	1,534	8.0
B-10, 10'	600	8.1
B-12, 5'	2,935	7.9
B-14, 5'	1,734	8.2
B-16, 5'	1,534	7.6
B-18, 5'	1,934	7.9

* Also see Tabulation of Test Data, 2nd page