REPORT ON GEOTECHNICAL INVESTIGATION

DESIGNATION: Payson University Deceleration Lane

LOCATION: MP 253 State Hwy 260
Payson, Arizona

CLIENT: Tetra Tech, Inc.

PROJECT NO: 160316SF

DATE: May 5, 2016

Registered Geologist
CERTIFICATE NO
50535
CLAY WARD
SPENCER
Date Signed 5/5/16
ARIZONA U.S.A.
Expires 03/31/19

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

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1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of a proposed deceleration lane at the entrance to a future university campus located along Highway 260, near Granite Dells Road, in Payson, Arizona.

Preliminary information calls for the construction of a deceleration lane on State Highway 260 near mile post 253 at the entrance of the proposed Payson University Campus. The exact configuration of the deceleration lane is still under design. Depending upon how the lane is configured with respect to the current traffic lanes will affect the overall amount of cut and fill that could occur. Exploration was conducted on both sides of the highway to account for multiple widening scenarios. Adjacent areas will be landscaped and may be utilized for storm water retention and disposal.

2.0 GENERAL SITE AND SOIL CONDITIONS

2.1 Site Conditions

State Highway 260 is bounded on the north by undeveloped land with cuts of up to 15 feet into predominantly to moderately decomposed granite along the northern shoulder. Along the southern shoulder, west of the proposed intersection, fills up to 15 feet were placed and the roadway is bordered by a drainage wash channel with undeveloped land beyond. The undeveloped land was covered with a moderate to dense growth of Ponderosa and Piñon Pines, Cedar, and dense Manzanita and Scrub Oak trees. Site drainage along the southern side of State Highway 260 is generally towards the southeast, with drainage on the north side of State Highway 260 generally to the north and west.

2.2 General Subsurface Conditions

Subsurface conditions at the site are fairly consistent. A thin layer of soil, 0-24 inches thick, consisting of silty sand with gravel overlays a granitic bedrock intrusion. Predominantly weathered granite outcrops were observed at the surface in several locations around the site. The granitic bedrock displays varying degrees of weathering, decreasing with depth. The upper decomposed to predominately decomposed granite exhibits soil characteristics of silty sands, sandy gravel and gravelly sand with subordinate amounts of cobbles, and granite boulders. The original rock fabric is present, however once excavated it exhibits soil properties. Moderately decomposed granite boulders were observed scattered about the site. Predominantly weathered granite was encountered between depths of 2.5 to 5.0 feet. Backhoe refusal was typically encountered within 6 to 12 inches of encountering the predominantly weathered granite. Standard Penetration Resistance Tests (SPT) values range from 28 to greater than 50 blows per foot (bpf) in the upper soils. Blow counts exceeding 50 bpf were typically encountered in the predominantly decomposed granite layer. Based on visual and tactile observation, the upper soils were in a dry to moist state at the time of investigation, typically below the plastic limit of the soil. Laboratory testing indicates liquid limits on the order of 21 percent with plasticity indices ranging from non-plastic to 2 percent.

No groundwater was encountered at the time of our investigation. However, it is not uncommon to have seasonally perched water that may be encountered at the soil/bedrock interface.

3.0 ANALYSIS AND RECOMMENDATIONS

3.1 Analysis

Analysis of the field and laboratory data indicates that subsoils at the site are suitable for support of the proposed paving. Although the amount of cut and fill is unknown at this time, this report herein assumes fills of less than 15 feet and cuts on the order of 10 to 15 feet. If fills greater than 15 feet and/or cuts greater than10 to 15 feet are required to reach finished grades, this office should be contacted for additional recommendations.

ADOT traffic information indicates a 2014 estimated AADT of 15,212 with a 2.3% Truck Factor evenly divided between single and combo trucks. ADOT models indicate an expected growth factor 1.6%. A traffic impact assessment performed by Southwest Traffic Engineering, LLC (April 1, 2016) indicates an expected growth factor of 2% and provided expected trips generated for the different phases of construction at the Payson University Campus. Using the 2% growth rate and combining the expected impacts of the proposed construction and existing traffic, a total ESAL amount of approximately 3.8 million was calculated for a 20 year period for through traffic along State Highway 260. Expected traffic exiting or entering the Payson University Campus over the same 20 year period, yielded an expected total ESAL amount of 1.4 million. Section 3.6 presents several structural sections with associated capacities for consideration depending on the anticipated traffic volumes. These sections assume using new imported aggregate base meeting ADOT Standard Specifications. When transitioning from existing roadways to new roadways, all new pavement sections should meet or exceed the thickness of the existing pavement or be graded accordingly to maintain drainage within the aggregate base.

Heavy duty excavation equipment will be necessary for excavations into the predominantly/moderately weathered granite. Rock removal techniques may be required if competent rock is encountered. This may include, but not limited to, blasting, rock trenchers, and/or pneumatic rock hammering. The weathering process of granite can also produce large boulders or intact ‘core stones’. Core stones are a result of in-place weathering and represent material that has not been affected as much by the weathering process as the adjacent material. Core stones may impact excavation and require localized fragmentation via hydraulic hammers or blasting. The random surficial outcrops are a good example of core stones and may require intensified rock excavation techniques.

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. Any deleterious materials encountered during grading such as trees, tree stumps, and major root systems should be removed and grubbed.

The area for new pavement construction will require the complete removal of any existing asphalt surface and aggregate base to be replaced with a new structural section of asphalt surface on new aggregate base. This process will likely disturb the underlying subgrade. After removal of the existing asphalt and aggregate base, the subgrade will require fine grading and compaction prior to the placement of new ABC and asphalt. The subgrade should be compacted to at least 95 percent of maximum dry density per ASTM D-698. The subgrade should be proof rolled with a heavy rubber tired vehicle such as a loaded water truck to locate unstable areas.

Prior to placing structural fill, the prepared 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. Scarification of rock is not required.

3.3 Lateral Pressures

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

Active Pressure	
Unrestrained Walls	35 pcf
Restrained Walls	60 pcf
Passive Pressure	
Continuous Footings	300 pcf
Spread Footings or Drilled Piers	350 pcf
Coefficient of Friction *(With Passive Pressure)*	0.35
Coefficient of Friction *(Without Passive Pressure)*	0.45
Coefficient of Friction *(Clean Bedrock)*	0.65

All backfill must be compacted to not less than 95 percent (ASTM D-698) to mobilize these passive values at low strain. Expansive 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. The exposed rock cut must be cleaned of all loose debris by high pressure air or water to take advantage of the higher coefficient of friction given for clean bedrock.

3.4 Fill and Backfill

Native surface soils are suitable for use in general grading and engineered fills provided any cobble and boulder sized material is removed or broken down. Although not encountered during this investigation, expansive clays can occur through the weathering process of granite. If encountered, clay soils should not be used in the top three feet of fill or as retaining wall backfill. Oversized material (> 3 inches) should be removed or reduced in size. If import material is required for site grading, it should be of equal or better quality than the native soils used as the basis for design. In general it should meet the following criteria:

Table 3.4.1 – Import Specifications

Specification	Common
Passing 3″/75mm	100%
Passing #200/.075mm	≤15%
Liquid Limit	<20%
Plasticity Index	<8%
Swell[1]	<1.5

Notes:
1. 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. Granular fill (ASTM Classification GW, GP, SW, SP) can be placed on the dry side of optimum at the discretion of the geotechnical engineer on record.

Fill should be placed in horizontal lifts of 8-inch loose thickness (or as dictated by compaction equipment) and compacted to the percent of maximum dry density per ASTM D-698 as set forth below. Frozen material shall not be placed, nor shall fill be placed upon frozen grade.

A.	Pavement Subgrade or Fill < 5 feet below finished grade		95
	1.	Fills ≥ 5 feet below finished grade	98
B.	Utility Trench Backfill		
	1.	More than 2.0' below finish subgrade	95
	2.	Within 2.0' of finish subgrade (non-granular)	95
	3.	Within 2.0' of finish subgrade (granular)	100
C.	Aggregate Base Course		
	1.	Below asphalt paving	100
D.	Landscape Areas		
	1.	Miscellaneous fill	90
	2.	Utility trench - more than 1.0' below finish grade	85
	3.	Utility trench - within 1.0' of finish grade	90

3.5 Utilities Installation

Based on the investigation, the predominantly weathered granite was encountered as shallow as 1-2 feet below existing grade. Heavy excavation and/or rock excavation techniques, such as rock trenches or controlled blasting, will most likely be required for trenches excavated into the predominantly weathered granite. Trench walls will stand near-vertically for the short periods of time required to install utilities. If trenches are greater than shoulder-height, precautions must be taken to protect workmen in accordance with all current governmental regulations. All trench excavations and temporary slopes should meet OSHA requirements.

Backfill of trenches may be carried out with native excavated material provided material greater than 8 inches is broken down or removed. Material used for backfill of trenches 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.

3.6 Asphalt Pavement

It must be noted that all new asphalt pavements will eventually crack. Cracking in asphalt pavement is typical and should be expected over the life of the pavement. In fact, it has been our experience that we are seeing the onset of earlier aging and block shrinkage cracking in the new asphalt binders that are available. These require routine maintenance to prevent accelerated deterioration. Accordingly, it is highly recommended to establish a maintenance program where the cracks are routinely filled as they appear beginning at about the second year of life. It is also recommended that surface fog seal coats be considered beginning at about year 5 and every 5 years after. This will help preserve the pavements, extending the service life.

If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements. The section capacity is reported as daily ESALs, Equivalent 18 kip Single Axle Loads. Typical heavy trucks impart 1.0 to 2.5 ESALs per truck depending on load. It takes approximately 1200 passenger cars to impart 1 ESAL. On college campuses, the worst offenders, construction traffic and bus traffic, are often overlooked. As mentioned earlier, this site is located at the entrance to a proposed college campus and near a school and accordingly, a primary source for early pavement deterioration will come from bus/construction traffic. Based on the existing structural section, it appears that the existing pavement should have provided for approximately 3,200 daily ESALs over a 20 year life. This assumes the entire thickness of the existing pavement section was constructed at once and that the existing section does not consist of multiple overlays. The age of the existing roadway and subsequent maintenance is unknown and it is therefore unknown if the pavement provided the anticipated life expectancy or not. Options B and C are presented as options for pavement sections that will provide service to through traffic along State Highway 260. Option B provides the minimum section to meet expected traffic volumes. Option C presents a thickened section that provides additional traffic capacity. Options D and E present options for pavement sections that will **only** provide service to traffic accessing the Payson University Campus through the deceleration/turning lanes. The designer/owner is ultimately responsible for choosing the appropriate section to meet the anticipated traffic volume and life expectancy.

Table 3.6.1 – Asphalt Pavement

Options	Daily/Total 18 kip ESALs	Flexible Pavement	
		AC	AB
A (Existing Pavement Section)(1)	3,228 / 25,753,500	7.5”	8.0”
B (Through Traffic Lanes, Rt 260)	527 / 3,845,000	5.0”	7.0”
C (Through Traffic Lanes, Rt 260)	1,355 / 9,891,500	6.0”	8.0”
D (Turning Traffic-Payson Univ.)	220 / 1,603,500	4.0”	7.0”
E (Turning Traffic-Payson Univ.)	212 / 1,549,500	4.25”	6.0”

1. ESAL capacity assumes the entire thickness of the existing pavement section was constructed at once and that the existing section does not consist of multiple overlays.
2. Designs are based on AASHTO design equations, lab R-values, and Arizona Department of Transportation (ADOT) correlated R-values.

Pavement Design Parameters:

Assume:	1.5 18 kip Equivalent Single Axle Load (ESAL)/Truck
Life:	20 years
Subgrade Soil Profile:	
% Passing No. 200 Sieve:	11% (avg)
Plasticity Index:	1 (avg)
R-value:	86.5 (per ADOT Tables)
M_R:	26,000 Max (per AASHTO formula)
Serviceability	
Initial	4.2
Final	2.8
Reliability:	**95%**
Standard Deviation	0.45
Structural Coefficients:	
Asphalt >4":	0.42
Aggregate Base:	0.12

These structural sections assume that all subgrades are prepared in accordance with the recommendations contained in the "Site Preparation" and "Fill and Backfill" sections of this report, and paving operations carried out in a proper manner. If pavement subgrade preparation is not carried out immediately prior to paving, the entire area should be proof-rolled at that time with a heavy pneumatic-tired roller to identify locally unstable areas for repair. Site drainage should be designed to ensure positive drainage of the base and sub base materials. Improper grading of sub base materials will drastically reduce the overall life of the pavement.

Pavement base course material should be aggregate base per ADOT Specifications. Asphalt concrete materials and mix design should conform to ADOT Specifications and use PG 64-16 for the asphalt binder grade. Reducing the air void content to 3 percent will aid in reducing thermal cracking typical in the area. It is recommended that a ½ inch or ¾ inch mix designation be used for the pavements. While a ¾ inch mix may have a somewhat rougher texture, it offers more stability and resistance to scuffing, particularly in truck turning areas. Pavement installation should be carried out under applicable portions of ADOT Standard Specifications. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

3.7 Permanent Cut/Fill Slope Limitations

Care should be taken during excavation not to endanger nearby existing roadways and utilities, etc. Depending on proximity, existing structures (including utilities) may require shoring, bracing or underpinning to provide structural stability and protect personnel working in the excavation.

Generally, permanent cut or fill slopes should be no steeper than 2 horizontal to 1 vertical (2:1). Where particular conditions make it appropriate to vary from these slopes, these must be addressed on a case by case basis, either in this report or at special request directed to a representative of this office. Steeper cut slopes in stable rock may be possible (depending on geology), but are not very likely in soils. Determination of acceptable steeper slope ratios is predicated on a stability analysis of the specific geometry, determinations of soil and groundwater characteristics, structure setbacks, surcharge loads and slope stabilization.

Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified deeply or where the slope ratio of the original ground is steeper than 5 horizontal to 1 vertical (5:1), the bank shall be stepped or benched to remove all loose soils and to provide a level surface for placement of fill. Ground slopes which are flatter than 5 to 1 may require benching when considered necessary by a representative of this office. The benches should be cut wide enough to remove loose surface soils and allow proper compaction of fills. A minimum bench width of 8 feet is typically recommended for the first lift (toe) of any fill placed on a slope. This width may be reduced at the direction of the field engineer depending on the presence of loose soils, slope steepness, exposed rock and lift thickness. A keyway shall also be constructed at the toe of the slope. The key width shall be ½ times the height of the slope or at least 1½ times the width of the compaction equipment. The key bottom shall be sloped 2% toward the slope. The key shall be excavated into dense soil or rock formation to a minimum depth of 18 inches unless approved otherwise by the engineer.

Placement and obtaining compaction of fill adjacent to fill slopes may be very difficult. Depending on soil type and final slope configuration, it may be necessary to over-build the slope and cut back to the final configuration to obtain the required degree of compaction.

3.8 Soil Corrosion

For the upper soil units, soil resistivity (laboratory values of 24,220 to 28,770 Ω-cm) indicates the soils are less corrosive. The pH results (5.1 to 5.5) indicate the soils are considered severely corrosive to direct buried metal products. Soils usually have a pH range of 6-9. In this range, pH is generally not considered to be the dominant variable affecting corrosion rates. More acidic soils obviously represent a serious corrosion risk to common construction materials such as steel, cast iron and zinc coatings. Soil acidity is produced by mineral leaching, decomposition of acidic plants (for example coniferous tree needles), industrial wastes, acid rain and certain forms of micro-biological activity. The pH level can affect the solubility of corrosion products and also the nature of microbiological activity. Direct buried steel/aluminum products are not recommended. Proper pipe bedding material should be utilized. If steel products are to be placed directly into the native soil, (example: underground steel piping), it is recommended to use suitable pipe/structure wall thickness and corrosion protection per the trench/traffic load and lifetime requirements of the project. ADOT specifications apply.

Results of sulfate testing indicate a sulfate content of 3 to 4 ppm and a chloride content of 15 to 17 ppm, which is a negligible degree of exposure. Accordingly, either Type I or Type II cement, readily available and used in the area, may be used on this project.

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 Geotechnical 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.

Jeremy DeGeyter, E.I.T.

Registered Geologist
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Gregg A. Creaser, P.E.

APPENDIX A

FIELD AND LABORATORY INVESTIGATION

SOIL BORING/TEST PIT LOCATION PLAN

SOIL LEGEND

ROCK TERMINOLGY

LOG OF TEST BORINGS

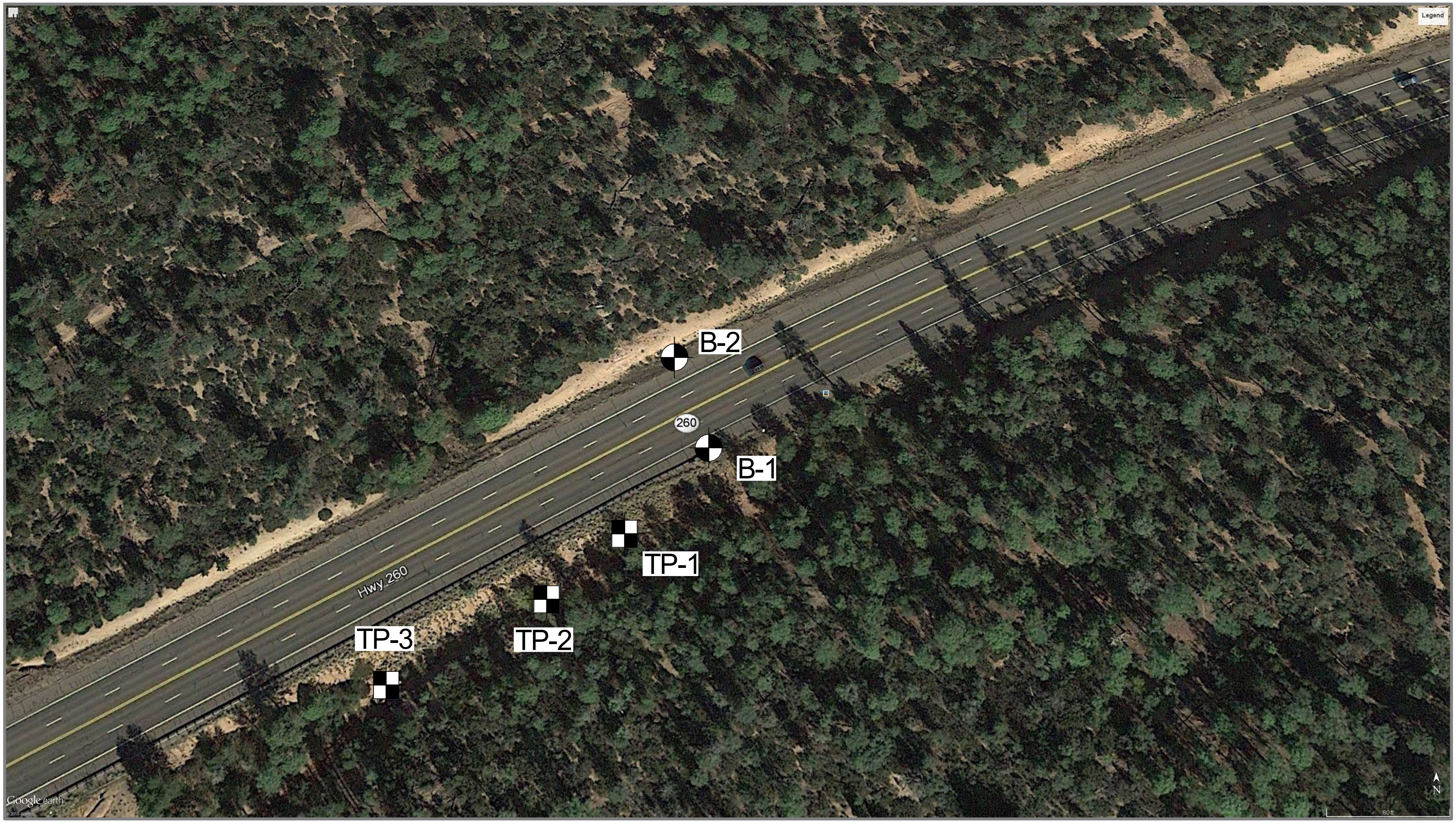
LOG OF TEST PITS

TABULATION OF TEST DATA

FIELD AND LABORATORY INVESTIGATION

On March 15th, 2016, 3 structural test pits and 2 structural borings (1 with rock coring) were excavated at the approximate locations shown on the attached Soil Boring/Test Pit Location Plan. All exploration work was carried out under the full-time supervision of our staff engineer, who recorded subsurface conditions and obtained samples for laboratory testing. The test pits were excavated with a Cat 420 E rubber-tired backhoe. Detailed information regarding the test pits and samples obtained can be found on an individual Log of Test Pit prepared for each location. The borings were excavated with a CME-75 drill rig utilizing 8-inch diameter hollow stem augers. Detailed information regarding the soil borings and samples obtained can be found on an individual Log of Test Boring prepared for each location.

Laboratory testing consisted of moisture content, dry density, grain-size distribution and plasticity (Atterberg Limits) tests for classification and pavement design parameters. An R-value test was performed to obtain pavement design parameters. Resistivity, pH, sulfates, and chlorides testing was conducted to determine the potential corrosive properties of the soil. All field and laboratory data is presented in this appendix.



— APPROXIMATE SOIL BORING LOCATIONS

Drawing Courtesy of Google

SOIL BORING LOCATION PLAN

DR:JMD	CHK:AAR	REV:	DATE: 03-22-16	PROJECT NO. 160316SF

Payson University Deceleration Lane
MP 253 State Route 260
Payson, Arizona

SPEEDIE AND ASSOCIATES
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SOIL LEGEND

SAMPLE DESIGNATION	DESCRIPTION	
AS	**Auger Sample**	A grab sample taken directly from auger flights.
BS	**Large Bulk Sample**	A grab sample taken from auger spoils or from bucket of backhoe.
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.
RS	**Ring Sample**	Driving a 3.0 inch outside diameter spoon equipped with a series of 2.42-inch 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 3.0-inch outside diameter thin-walled tube continuously pushed into the 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.

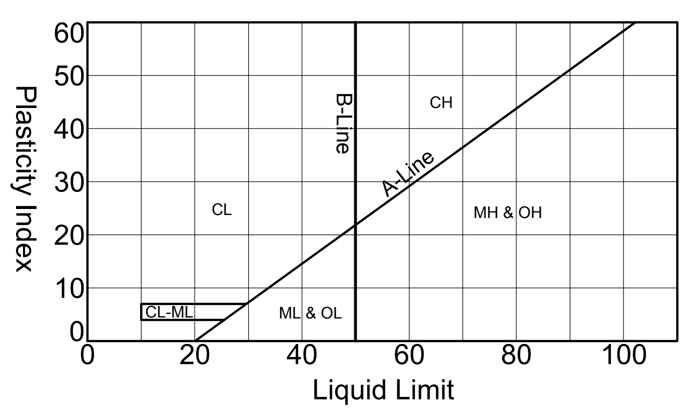
CONSISTENCY			RELATIVE DENSITY	
Clays & Silts	Blows/Foot	Strength (tons/sq ft)	Sands & Gravels	Blows/Foot
Very Soft	0 - 2	0 - 0.25	Very Loose	0 - 4
Soft	2 - 4	0.25 - 0.5	Loose	5 - 10
Firm	5 - 8	0.5 - 1.0	Medium Dense	11 - 30
Stiff	9 - 15	1 - 2	Dense	31 - 50
Very Stiff	16 - 30	2 - 4	Very Dense	> 50
Hard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

MAJOR DIVISIONS			SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS; MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS; MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS; MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS; MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL OR MODIFIED SYMBOLS MAY BE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS OR TO PROVIDE A BETTER GRAPHICAL PRESENTATION OF THE SOIL

MATERIAL SIZE	PARTICLE SIZE			
	Lower Limit		Upper Limit	
	mm	Sieve Size ◆	mm	Sieve Size ◆
SANDS				
Fine	0.075	#200	0.42	#40
Medium	0.420	#40	2.00	#10
Coarse	2.000	#10	4.75	#4
GRAVELS				
Fine	4.75	#4	19	0.75" ×
Coarse	19	0.75" ×	75	3" ×
COBBLES	75	3" ×	300	12" ×
BOULDERS	300	12" ×	900	36" ×

◆U.S. Standard ×Clear Square Openings



ROCK TERMINOLOGY

SCALE OF RELATIVE HARDNESS	
Term	Field Identification
Extremely Soft	Can be indented with difficulty by thumbnail. May be moldable or friable with finger pressure.
Very Soft	Crumbles under firm blows with point of a geology pick. Can be peeled by a pocketknife. Scratched with fingernail.
Soft	Can be peeled by a pocketknife with difficulty. Cannot be scratched with fingernail. Shallow indention made by firm blow of a geology pick.
Medium Hard	Can be scratched by knife or pick. Specimen can be fractured with a single firm blow of hammer/geology pick.
Hard	Can be scratched with knife or pick only with difficulty. Several hard hammer blows required to fracture specimen.
Very Hard	Cannot be scratched by knife or sharp pick. Specimen requires many blows of hammer to fracture or chip. Hammer rebounds after impact.

STRATIFICATION TERMS	
Term	Characteristics
Laminations	Thin beds (<½ inch)
Fissile	Tendency to break along laminations.
Parting	Tendency to break parallel to bedding, any scale.
Foliation	Non-depositional, e.g., segregation and layering of minerals in metamorphic rocks.

ROCK TERMINOLOGY

SCALE OF RELATIVE ROCK WEATHERING	
Term	Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 1 inch into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Predominantly Decomposed	Rock mass is more than 50% decomposed. Rock can be excavated with a geologists pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock fabric may be evident. May be reduced to soil with hand pressure.

JOINT AND BEDDING/FOLIATION SPACING TERMS		
Spacing	Joint Spacing Terms	Bedding/Foliation Spacing Terms
<2 in.	Very Close	Very Thin (Laminated)
2 in. to 1 ft.	Close	Thin
1 ft. to 3 ft.	Moderately Close	Medium
3 ft. to 10 ft.	Wide	Thick
>10 ft.	Very Wide	Very Thick (Massive)

GEOTECHNICAL SERVICES
EXPLORATION LOG

PROJECT NO.: 160316SF
DATE: 3-15-16
GEOL/TECH: J. DeGeyter
PROJECT NAME: Payson University Deceleration Lane
DRILLER: B. Anderson
LOCATION: MP 253 State Route 260
CONTRACTOR: Resilient Drilling
BORING NO.: B- 1
STATION: N/A
RIG TYPE: CME-75
ELEVATION: N/A

DEPTH IN FEET	NX CORING DATA %RECOVERY	%RQD	PENETRATION RESISTANCE BLOWS/12"	DRILLING DATA NOTES	AVERAGE RATE (Min/Ft)	VISUAL CLASSIFICATION & REMARKS
0.6						7.5 INCHES ASPHALT
1.3						8 INCHES AGGREGATE BASE
3			28			Medium Dense Reddish Brown SILTY SAND (SM-Moist) with Little Gravel (Decomposed Granite)
5.5						
6			88			Very Dense Reddish Brown PREDOMINANTLY DECOMPOSED GRANITE (SW/SM-Dry) Sand with Silt and Gravel
9.0				Red/Brown Drilling water	1.3	GRANITE Reddish Brown Moderately Weathered; Medium Hard; Medium Grained; Very Close Joints; Very Close Fractures;
11.5						GRANITE Reddish Brown Predominantly Decomposed; Soft; Medium Grained;
14	45	10			2.0	
15.0	0	0				

	Depth	Hour	Date
▽	*Free Water was Not Encountered*		
▼			

_SPEEDIE ROCK 160316SF.GPJ GENGEO.GDT 4/7/16

SPEEDIE AND ASSOCIATES

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 – 1.5	Loose Reddish Brown POORLY GRADED SAND (SP/SM-Dry to Moist) with Silt and Gravel (Decomposed Granite)					
1.5 – 15.0	Very Dense Reddish Brown PREDOMINANTLY DECOMPOSED GRANITE (SP/SM-Dry) Sand with Silt and Gravel	BS-1	5.0	NT	NT	
		S-2	5.4	NT	NT	50/5"
		S-3	10.3	NT	NT	50/4"
		S-4	15.3	NT	NT	50/3"

Rig Type: **CME-75**
Boring Type: **Hollow Stem Auger**
Surface Elevation: **N/A**

Depth scale: 0, 5, 10, 15, 20

Boring Date: **3-15-16**
Field Engineer/Technician: **J. DeGeyter**
Driller: **B. Anderson**
Contractor: **Resilient Drilling**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

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

Payson University Deceleration Lane

MP 253 State Route 260

Payson, Arizona

Project No.: **160316SF**

_SPEEDIE 160316SF.GPJ GENGEO.GDT 4/22/16

Depth (feet)	Graphic Log	Equipment Type: Cat 420 E Backhoe Surface Elevation: N/A 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		Loose Reddish Brown SILTY SAND (SM-Dry to Moist) with Little Gravel (Decomposed Granite)					
		2.5					
		Very Dense Reddish Brown PREDOMINANTLY DECOMPOSED GRANITE (SW/SM-Dry to Moist) Sand with Silt and Gravel					
5		5.0	AS-1	5.0	NT	NT	
		Test Pit Refusal on Bedrock					
10							

Excavation Date: **3-15-16**
Field Engineer/Technician: **J. DeGeyter**
Excavator: **J. Vickers**
Contractor: **JNL Contractiing**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP- 1**

Payson University Deceleration Lane

MP 253 State Route 260

Payson, Arizona

Project No.: **160316SF**

TEST PIT 160316SF.GPJ GENGEO.GDT 4/22/16

Depth (feet)	Graphic Log	Equipment Type: **Cat 420 E Backhoe** Surface Elevation: **N/A** 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		Loose Reddish Brown SILTY SAND (SM-Dry to Moist) with Little Gravel (Decomposed Granite)	BS-1	3.0	NT	NT	
5		5.0 Very Dense Reddish Brown PREDOMINANTLY DECOMPOSED GRANITE (SW/SM-Dry to Moist) Sand with Silt and Gravel 6.0					
		Test Pit Refusal on Bedrock					
10							

Excavation Date: **3-15-16**
Field Engineer/Technician: **J. DeGeyter**
Excavator: **J. Vickers**
Contractor: **JNL Contractiing**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP- 2**

Payson University Deceleration Lane

MP 253 State Route 260

Payson, Arizona

Project No.: **160316SF**

TEST PIT 160316SF.GPJ GENGEO.GDT 4/7/16

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 – 2.0		Loose Reddish Brown SILTY SAND (SM-Dry to Moist) with Little Gravel					
2.0 – 3.0		Medium Dense Reddish Brown SILTY SAND (SM-Dry to Moist) with Little Gravel	AS-1	3.0	NT	NT	
3.0 – 6.0		Very Dense Reddish Brown PREDOMINANTLY DECOMPOSED GRANITE (SW/SM-Dry) Sand with Silt and Gravel					
6.0		Test Pit Refusal on Bedrock					

Equipment Type: **Cat 420 E Backhoe**

Surface Elevation: **N/A**

Excavation Date: **3-15-16**

Field Engineer/Technician: **J. DeGeyter**

Excavator: **J. Vickers**

Contractor: **JNL Contractiing**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP- 3**

Payson University Deceleration Lane

MP 253 State Route 260

Payson, Arizona

Project No.: **160316SF**

TEST PIT 160316SF.GPJ GENGEO.GDT 4/7/16

TABULATION OF TEST DATA

SOIL BORING or TEST PIT NUMBER	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE INTERVAL (ft)	NATURAL WATER CONTENT (Percent of Dry Weight)	IN-PLACE DRY DENSITY (Pounds Per Cubic Foot)	PARTICLE SIZE DISTRIBUTION (Percent Finer)					ATTERBERG LIMITS			R VALUE at 300 PSI	CORRELATED R VALUE	pH	RESISTIVITY (Ohm-Centimeters)	% SULFATE (SO4)	% CHOLRIDE (CL)	UNIFIED SOIL CLASSIFICATION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX							
B- 1	S-1	SPT	1.5 - 3.0	NT	NT	16	27	52	82	100	21	19	2	NT	73	NT	NT	NT	NT	SM
B- 2	BS-1	BULK	0.0 - 5.0	NT	NT	10	17	44	83	100	NP	NP	NP	86	87	5.5	24220	3	17	SP-SM
TP- 1	AS-1	AUGER	2.5 - 5.0	NT	NT	5	12	31	56	100	NP	NP	NP	NT	93	NT	NT	NT	NT	SW-SM
TP- 2	BS-1	BULK	0.0 - 3.0	NT	NT	13	24	54	85	100	NP	NP	NP	NT	83	5.1	28770	4	15	SM

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.

NT=Not Tested

Sheet 1 of 1

Payson University Deceleration Lane
MP 253 State Route 260
Payson, Arizona
Project No. 160316SF

SPEEDIE AND ASSOCIATES

TABOFLAB R-VALUE 160316SF.GPJ GENGEO.GDT 4/21/16