SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

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March 9, 2018

Edward Herman
Rio Bonito Ranch Home Owners Association
28814 North 150th Street
Scottsdale, AZ 85262

RE: Project No. 151924SF/180485SF
Rio Bonito Ranch
El Rancho Bonito Rd.
Cornville, AZ
Addendum No. 2 - Geotechnical Report Review

Dear Mr. Herman:

Speedie & Associates conducted a geotechnical investigation in 2005 for Majestic Development Company at the above referenced project. The previous report, Project No. 051924SF, dated December 29, 2005, Addendum No. 1, dated January 10, 2006 and an ADRE R4-28-A1203 Summary letter dated April 30, 2007 are attached. It is our understanding that the property was purchased by Rio Bonito Ranch HOA in 2009. The purpose of this addendum was to conduct a site visit, review the previous report and addenda, and provide any revised recommendations if necessary to update the report meeting our current engineering standards.

On March 5, 2018, a site visit was conducted by S&A Regional Manager, Clay W. Spencer, R.G. At the time of the site visit, no residential structures were present. The roadways were observed to be constructed as shown on the site plan attached to the 2007 ADRE letter. It also appears as though site utilities have been installed along with construction of the pond on the north side of Lots 25 and 26. Based on the maturity of the native vegetation present in the area identified as Zone B in the geotechnical investigation report, it does not appear that mass grading was performed other than the localized grading necessary for construction of the roadways and utility installation. Zone A is still covered with low-lying grasses as described in the 2005 report and irrigation equipment is still present. Although mass grading could have occurred 10+ years ago and this vegetation type reestablished, there were no telltale signs present that would suggest that this has occurred. Grading appears to have occurred for construction of the roadways, utilities and pond construction in Zone A.

Review of the geotechnical report and ADRE summary letter indicates that no changes are necessary to those two documents. However since 2006 when Addendum No. 1 was issued, our approach to developing the Post-Tension design parameters has changed. Provided that the building pads are properly prepared as indicated in Addendum No. 1, then the design parameters provided below may be used for design of the Post-Tension system. This includes proper moisture conditioning of the soil and maintaining the moisture contents specified in Addendum No. 1 until placement of concrete. If the moisture contents cannot be maintained, then the design parameters provided in Addendum No. 1 should be used for design.

P-T Slab Design Parameters – with Turndowns	
Edge Moisture Variation, e_m	Differential Movement, y_m
Edge Lift: 2.8 ft	Edge Lift: 0.09 in
Center Lift: 4.9 ft	Center Lift: 0.11 in

While on site, the condition of the roadway was observed to be in good to fair condition, but showing signs of oxidation, deterioration of the chip sealed surface and minor cracking. The pavement sections provided in the geotechnical report were based on a 20 year life with regular routine maintenance. The actual pavement section constructed is unknown. Since the subdivision was not developed, it is assumed that the roadways have not been subjected to the anticipated design loads. However, aging has occurred through natural oxidation of the surface and it does not appear that any maintenance has occurred. Since the asphalt has become brittle over the past 10 years, as the roadways are exposed to construction traffic, which is often times the worst offender in residential subdivisions, rapid deterioration of the pavement may occur. To help extend the life of the pavement, a surface seal should be considered prior to the roadways being subjected to construction traffic.

This addendum should be attached to the original geotechnical investigation and made a part thereof. All recommendations made in the referenced reports are still valid and considered updated with inclusion of this addendum.

Please give us a call if you have any questions or if we can be of further assistance.

Respectfully submitted,
SPEEDIE & ASSOCIATES

Registered Geologist
CERTIFICATE NO
50535
CLAY WARD SPENCER
Date Signed 3/9/18
ARIZONA U.S.A.
Expires 03/31/19

Clay W. Spencer, R.G.

Attachments:

Report on Geotechnical Investigation – Rio Bonito Ranch, Dated 12/29/2005
Addendum No. 1 for Rio Bonito Ranch, Dated 1/10/2006
ADRE R4-28-A1203 Summary for Rio Bonito Ranch, Dated 4/30/2007

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REPORT ON GEOTECHNICAL INVESTIGATION

Registered Professional Engineer (Civil)
CERTIFICATE NO
14388
GREGG ALAN CREASER
Date Signed 12-29-05
ARIZONA, U.S.A.

DESIGNATION: Rio Bonito Ranch

LOCATION: Verde Valley
Cornville, Arizona

CLIENT: Majestic Development Co.

PROJECT NO: 051924SF

DATE: December 29, 2005

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PHOENIX TUCSON FLAGSTAFF SHOW LOW

SPEEDIE AND ASSOCIATES
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Registered Professional Engineer (Civil)
Certificate No.
14388
GREGG ALAN CREASER
Date Signed 12/29/05
ARIZONA, U.S.A.

1.0 INTRODUCTION

This report presents the results of a subsoil investigation carried out at the site of a proposed Residential Development located in Verde Valley, in Cornville, Arizona.

Preliminary information calls for the construction of an approximate 85 acre, 32 lot, split subdivision, with associated infrastructure including a proposed man-made pond and paved roadways. Lots 1 through 11 are located along Swinging Bridge Lane and El Rancho Bonito Road on an upper plateau. Lots 12 through 32 are located below the degradated limestone cliff face and are nestled on a river terrace of a paleo-river channel from Oak Creek. Lots 12 through 32 are to be a gated private residential subdivision. Oak Creek is situated southwest of the upper and lower developments. There is also a perennial spring that bisects the upper and lower developments, and flows into Oak Creek. There are plans proposed to re-route the spring to flow into the man-made pond and then back into Oak Creek. It is assumed that structures will consist of single-family, one to two story, slab-on-grade wood framed and/or masonry structures. Structural loads are expected to be light to moderate and no special considerations regarding settlement tolerances are known at this time. Adjacent areas will be landscaped and/or paved to support moderate passenger and light truck traffic. Landscaped areas, including the proposed man-made lake, will be utilized for storm water retention and disposal.

2.0 GENERAL SITE AND SOIL CONDITIONS

2.1 Site Conditions

The irregular shaped site is approximately 85 acres in size and is bounded on the north by Swinging Bridge Lane, on the south by floodplain and inhabited residential structures, on the east by inhabited residential structures, and on the west by an inhabited ranch. At the time of the investigation the site was covered with Creosote bushes and Prickly Pear cacti in the upper portion of the development were lots 1-11 are located (Zone B). The lower portion of the development were lots 12-32 are located (designated as Zone A for this report) was formerly ranch grazing land and was covered in low-lying grasses and weeds. At the time of the investigation, there was evidence of previous development, including a gravel road cut into the degredated limestone cliff face leading from the upper lots to the lower lots and also irrigation pipes from prior ranchers' watering systems. Site drainage is generally towards the south-southwest.

2.2 General Subsurface Conditions

Subsoil conditions at the site are consistent, but are variable between the upper and lower lots depending on the topography. The low-lying lots have distinctly different engineering properties than that of the elevated lots. The rough boundaries of these zones are identified on the attached Test Pit Location Plan.

Within Zone A, the subsoil conditions are somewhat consistent, typically consisting of 2.5 to 4.5 feet of clayey sand. The underlain soils typically consist of sandy silt and sandy clay with subordinate amounts of gravel, river cobble, and occasional small boulders. Pocket Penetration Test values range from 1 to ≥4.5 tons per square foot (tsf) in the upper soils. Values of ≥4.5 tsf were typically encountered in the upper 6 feet identified as sandy clays and clayey sands. 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 in Zone A indicates liquid limits on the order of 23 to 30 with plasticity indices from 8 to 17. In-place densities of the upper soils is on the order of 97 pcf with moisture contents at 6 percent. Volume increase due to wetting of the upper soils is on the order of 5.4 percent when recompacted to moistures and densities normally expected during construction and confined to 100 psf. An undisturbed sample displayed a significant volume decrease of 8.1 percent due to inundation when subjected to 2000 psf.

Within Zone B, the subsoil conditions are somewhat consistent, typically consisting of 1.0 to 3.5 feet sandy silty clay, sandy silt, and silty gravel with subordinate amounts of limestone gravel and cobble. Underlying these upper soils is a shelf of slightly weathered freshwater limestone of the Verde Formation. Penetration Test values of ≥4.5 tsf were encountered in the upper soils. Based on visual and tactile observation, the upper soils were in a 'dry' state at the time of investigation, typically below the plastic limit of the soil.

Laboratory testing in Zone B indicates liquid limits on the order of non-plastic (NP) to 20 with plasticity indices from NP to 6. Volume increase due to wetting of the upper soils is on the order of 1.8 percent when recompacted to moistures and densities normally expected during construction and confined to 100 psf. No undisturbed samples were taken by ring-sampling methods due to the presence of gravel, cobble, and shallow limestone bedrock.

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 generally favorable for support of the proposed residential structures on shallow spread footings subject to remedial earthwork. Remedial earthwork will depend on if the structure is located in Zone A or Zone B. Due to the limited number of test pits and the specific locations of the structures not being identified at the time of the investigation, the boundaries of these two zones may vary along with the soil types within the transition zones. During construction, a representative of the geotechnical engineer should be retained to determine which recommendations should be followed on a lot by lot basis as well as to verify all bearing media.

Excavation operations may be difficult in areas with the presence of cobbles, small boulders, and weathered bedrock, requiring the use of heavier equipment. In Zone B, rock removal techniques may be required for foundation excavations and will be required for deeper utility installations.

In Zone A, the swell potential of the clayey soils is of **significant** concern. The potential is strong enough to cause differential movements and damage to foundations, in addition to concrete slabs-on-grade. The differential movement is typically a result of post construction fluctuation in moisture contents. The use of the expansive clayey soils is **not** recommended for foundations, under slabs, or wall backfill. It is therefore recommended that foundations be placed entirely on a minimum of 2 feet of low-permeability non-expansive engineered fill at a depth of not less than 30 inches below lowest exterior grade. It is also recommended that the expansive clays be removed in their entirety within the entire building footprint extending 5 feet beyond the exterior wall. The depth of removal will vary, but based on the test pits it is anticipated that removal will be required to a depth of 2.5 to 4.5 feet. All bearing media must be verified during construction by a representative of the geotechnical engineer of record.

In Zone B, it is recommended to bear foundations directly upon the limestone bedrock at a depth of no less than 30 inches below lowest exterior grade. It is additionally recommended to remove enough surface clay soils to provide at least 12 inches on non-expansive fill under the entire footprint of the building.

Footings may have to be excavated into the bedrock depending upon finished grades and may be stepped. All bearing media must be verified during construction by a representative of the geotechnical engineer of record.

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 and/or causing a tripping hazard. Pinning typically consists of 24-inch long reinforcing steel dowels placed at 12-inch centers.

While no groundwater was encountered in this investigation, there is a high potential for water to be perched at the interface of the surface soils and underlying bedrock. And as noted above, there is a spring located on site. Foundation design and subsurface drainage will need to take into account this potential so that foundations do not intersect the water flow. It is recommended to use French drains or other means to direct flows around structure to prevent water from entering below.

Other options are available instead of removal of the expansive clay soils. These include the use of suspended floors (above a crawl space) or Post Tensioned (PT) slab on grade foundations. If PT slabs are desired, this office can provide additional design recommendations.

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. For Zone A, remove the expansive clay soils full depth, extending 5 feet beyond the building limits. For Zone b, removed sufficient clay soil to provide space for at least 12 inches of non-expansive fill under slabs on grade.

Prior to placing structural fill below footing bottom elevation, the existing 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 treated in a similar manner. Scarification of exposed bedrock is not required.

All cut areas and areas above footing bottom elevation that are to receive floor slab fill should be scarified 8 inches, moisture conditioned to at least optimum to 3 percent above optimum, and lightly but uniformly compacted to 88 to 92 percent of maximum dry density.

3.3 Foundation Design

If site preparation is carried out as set forth herein, the following safe allowable bearing capacities can be utilized for design:

Table 3.3.1 Foundation Design

Zones	Foundation Type	Bearing Medium	Bearing Depth (feet)	Allowable Bearing Capacity (psf)
A	Spread Footings	2.0' Engineered Fill[1]	2.5	2,500[1]
B	Spread Footings	Limestone Bedrock[2]	2.5	4,000[2]

Notes:

1. Bearing Depth refers to minimum depth below lowest finished exterior grade within 5' of structure. Footings to bear on minimum of 2.0' of engineered fill. The bearing media must be verified during construction.
2. Bearing Depth refers to minimum depth below lowest finished exterior grade. Footings should bear on undisturbed bedrock. Native soils should be completely removed to bedrock.

Although test pits were not advanced to 100 feet, based on the nature of the subsoils encountered in the borings and geology in the area, Soil Profile Type, S_c, (Table 16-J, 1997 UBC) or Site Class Definition, Class C (Table 1615.1.1, 2000 & 2003 IBC) may be used for design of the structures.

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 ¾ 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 should be provided to prevent ponding adjacent to perimeter walls. Caution must be used when considering planters requiring heavy watering. 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 control joints are suggested to allow slight movement and prevent minor floor slab cracking.

3.4 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 or Drilled Piers	300 pcf
Spread Footings or Drilled Piers	350 pcf
Coefficient of Friction	0.35
(With Passive Pressure)	
Coefficient of Friction	0.45
(Without Passive Pressure)	

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.

3.5 Fill and Backfill

Native soils are suitable for use in general grading fills provided they are not placed directly beneath building slabs. The upper native soils encountered in Zone A are **NOT** suitable for use as fill within building footprints or as wall backfill.

Imported common fill for use in site grading 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 not 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. **Clean Cinders are not acceptable beneath foundations. For fill placed beneath foundations, it should meet the above specifications in addition to containing at least 15 percent passing the 200 sieve.**

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)	88-92 max
	(Not recommended within 5 feet of pad elevation.)		
B.	Pavement Subgrade or Fill		95
C.	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
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 finish grade	85
	3.	Utility trench - within 1.0' of finish grade	90

3.6 Utilities Installation

Trench excavations for utilities can be accomplished by conventional trenching equipment in Zone A. However in Zone B, trench excavations will most likely require the use of heavier excavating equipment and/or rock removal techniques. Trench walls will stand near-vertical 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 safety regulations.

Backfill of trenches may be carried out with native excavated material. 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.

3.7 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.

The native clayey 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 should be considered. Vapor barriers do increase the potential for slab curling. Accordingly, if a vapor barrier is used, additional precautions such as low slump, frequent jointing and proper curing will be required to reduce this potential. Other option would include the use of low permeability concrete that can be provided by the concrete suppliers.

3.8 Asphalt Pavement

If earthwork in paved areas is carried out to finish subgrade elevation as set forth herein, the subgrade will provide adequate support for pavements.

For Zones A and B, pavement areas to be used primarily for passenger traffic and parking, our experience in the area indicates that a minimum of 2.5 inches of asphalt over 8 inches of aggregate base course will provide satisfactory service. Heavy duty areas subject to more frequent truck traffic should be 4 inches of asphalt over 6 inches of base. This assumes 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 M.A.G. Section 702 Specifications. Asphalt concrete materials and mix design should conform to M.A.G. 710 (and any Town of Cornville/Yavapai County modifications) using the Marshall mix design criteria for low volume traffic and PG 64-22 for the asphalt grade. Reducing the air void content to 3 percent will aid in reducing thermal cracking typical in the area. It is recommended that a 12.5mm or 19.0mm mix designation be used for the pavements. While a 19.0mm 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 M.A.G. Section 321 and municipality standards. The asphalt supplier should be informed of the pavement use and required to provide a mix that will provide stability and be aesthetically acceptable. Some of the newer M.A.G. mixes are very coarse and could cause placing and finish problems. A mix design should be submitted for review to determine if it will be acceptable for the intended use.

For driveways supporting only passenger vehicle traffic, a minimum section of 5.0 inches of PCCP is recommended. Portland Cement Concrete Pavement (PCCP) must have a minimum 28-day flexural strength 550 psi (compressive strength of approximately 3,700 psi). It may be cast directly on the prepared subgrade with proper compaction (reduced) and the elevated moisture content as recommended in the report. Lacking an aggregate base course, attention must be paid to using low slump concrete and proper curing, especially on the thinner sections. No reinforcing is necessary. Joint design and spacing should be in accordance with ACI recommendations. Construction joints should contain dowels or to be tongue and grooved to provide load transfer. Tie bars are recommended on the joints adjacent to unsupported edges. Maximum joint spacing in feet should not exceed 2 to 3 times the thickness in inches. Joint sealing with a quality silicone sealer is recommended to prevent water from entering the subgrade allowing pumping and loss of support.

Proper subgrade preparation and joint sealing will reduce (but not eliminate) the potential for slab movements (thus cracking) on the expansive native soils. Frequent jointing will reduce uncontrolled cracking and increase the efficiency of aggregate interlock joint transfer.

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.

Shaun M. Kulish

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 12.29.05
ARIZONA, U.S.A.

Gregg A. Creaser, P.E.

SPEEDIE AND ASSOCIATES
Geotechnical • Environmental • Materials Engineers

APPENDIX

FIELD AND LABORATORY INVESTIGATION

SOIL BORING LOCATION PLAN

SOIL LEGEND

LOG OF TEST BORINGS

TABULATION OF TEST DATA

CONSOLIDATION TESTS

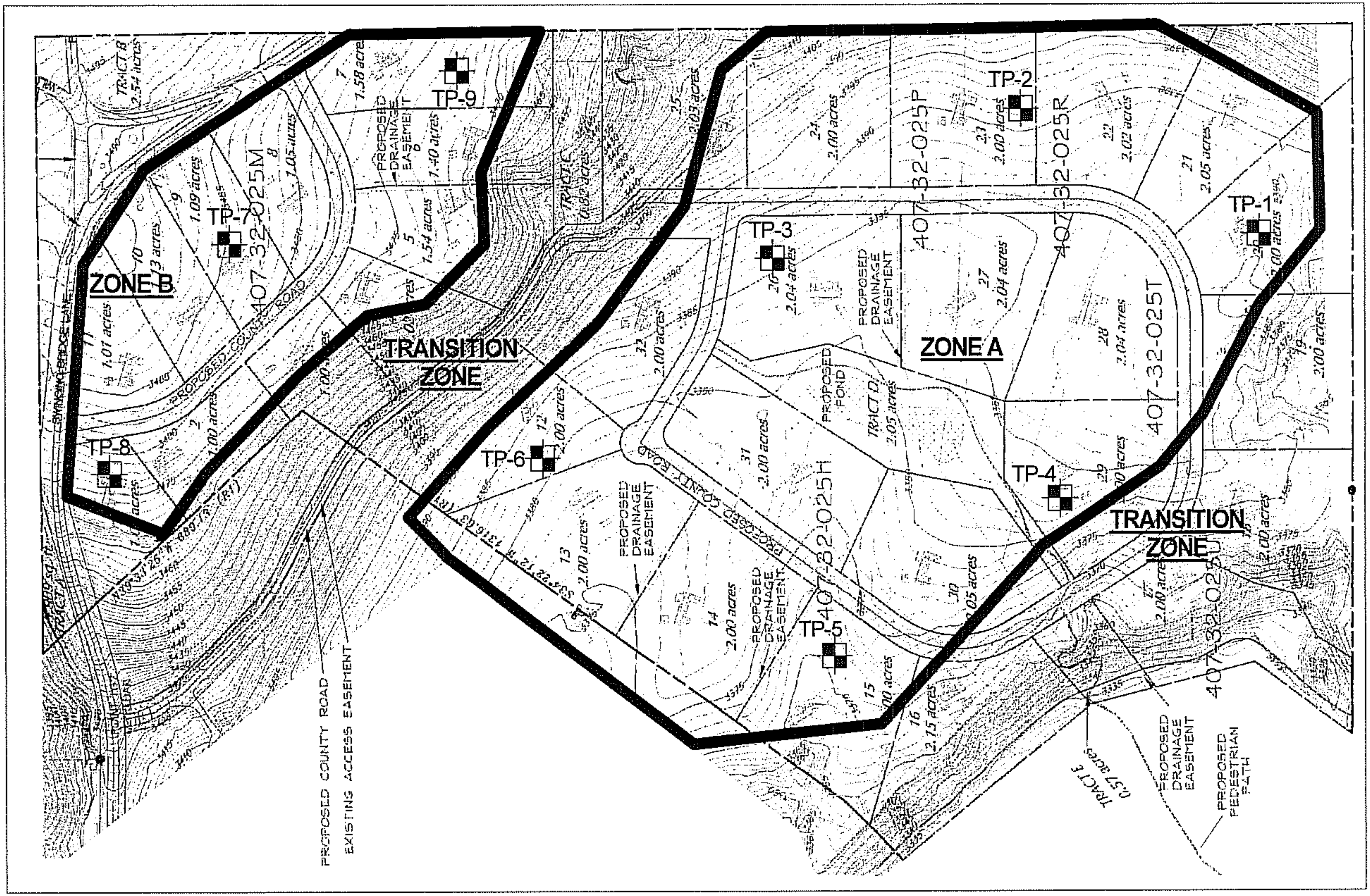
MOISTURE-DENSITY RELATIONS

SWELL TEST DATA

FIELD AND LABORATORY INVESTIGATION

On November 8, 2005, 9 structural test pits were excavated at the approximate locations shown on the attached Test Pit Location Plan. All exploration work was carried out under the full-time supervision of our geotechnical technician, who recorded subsurface conditions and obtained samples for laboratory testing. The borings were excavated with a rubber-tired Case 580D Extendahoe. Detailed information regarding the test pits and samples obtained can be found on an individual Log of Test Pits 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. Remolded swell tests were performed on samples compacted to densities and moisture contents expected during construction. Compression tests were performed on a selected ring samples in order to estimate settlements and determine effects of inundation. All field and laboratory data is presented in this appendix.



— APPROXIMATE TEST PIT LOCATIONS

TEST PIT LOCATION PLAN

DR: SMK	CHK: CS	REV:	DATE: 11-15-05	PROJECT NO. 051924SF

Rio Bonito Ranch
Verde Valley
Cornville, Arizona

SPEEDIE AND ASSOCIATES
GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS
4025 E. HUNTINGTON, SUITE 140 FLAGSTAFF, ARIZONA 86004

TMPLT_2000.CAD 10/23/00

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 Reddish Brown CLAYEY SAND (SC-Dry) with Little Silt	3.5	BS-2	3.5	NT	NT	
		Hard Mottled White/Light-Reddish Brown SANDY SILT (ML-Dry) with Trace Gravel	4.8	RS-1				
5		Stiff to Very Stiff Light-Reddish Brown SANDY SILT (ML-Dry to Moist) with Trace Gravel	10.0	AS-3	10.0	NT	NT	
10		End of Test Pit						
15								

Equipment Type: **Case 580D Extendahoe**

Surface Elevation: **N/A**

Excavation Date: **11-8-05**

Field Engineer/Technician: **S. Kulish**

Excavator: **Z. Thomas**

Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

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

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Hard Reddish Brown SANDY CLAY (CL-Dry) with Trace Gravel		RS-1	4.0	5.6	97.4	
			4.3					
5		Hard Mottled White/Light-Reddish Brown SANDY SILT (ML-Dry) with Trace Gravel						
			5.5					
		Hard Light-Reddish Brown SANDY SILT (ML-Dry to Moist) with Trace Gravel		AS-2	10.0	NT	NT	
10		End of Test Pit	10.0					
15								

Excavation Date: **11-8-05**
Field Engineer/Technician: **S. Kulish**
Excavator: **Z. Thomas**
Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

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

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

TEST PIT 051924SF.GPJ GENGEO.GDT 12/16/05

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	Hard Light-Reddish Brown SANDY CLAY (CL-Dry to Moist) with Trace to Little Gravel and Little Silt		RS-1	3.5	NT	NT	
		4.5					
5	Hard Mottled White/Light-Reddish Brown SANDY SILT (ML-Dry to Moist) with Trace Gravel						
		6.0					
	Very Stiff to Hard Light-Reddish Brown SANDY SILT (ML-Moist) with Little Clay and Gravel	10.0	AS-2	10.0	NT	NT	
10	End of Test Pit						
15							

Equipment Type: **Case 580D Extendahoe**

Surface Elevation: **N/A**

Excavation Date: **11-8-05**

Field Engineer/Technician: **S. Kulish**

Excavator: **Z. Thomas**

Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

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

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Hard Reddish Brown <u>CLAYEY SAND</u> (SC-Dry to Moist) with Trace Gravel	4.0	RS-1	3.5	NT	NT	
5		Hard Mottled White/Light-Reddish Brown <u>SANDY SILT</u> (ML-Dry to Moist) with Trace Gravel and Clay	5.5					
		Very Stiff to Hard Light-Reddish Brown <u>SANDY SILT</u> (ML-Moist) with Trace Gravel and Clay	10.0	AS-2	10.0	NT	NT	
10		End of Test Pit						
15								

Excavation Date: **11-8-05**
Field Engineer/Technician: **S. Kulish**
Excavator: **Z. Thomas**
Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-4**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

TEST PIT 051924SF.GPJ GENGEO.GDT 12/16/05

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Hard Reddish Brown <u>CLAYEY SAND</u> (SC-Moist) with Little Gravel	2.5	AS-1	2.5	NT	NT	
		Hard Reddish Brown <u>SILTY SAND</u> (SM-Moist) with Gravel, 15-25% Cobble, and Trace Boulders up to 2.0'	6.0	AS-2	6.0	NT	NT	
5		Test Pit Refusal on Cobble						
10								
15								

Excavation Date: 11-8-05
Field Engineer/Technician: S. Kulish
Excavator: Z. Thomas
Contractor: Todds Excavation

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-5**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

Equipment Type: **Case 580D Extendahoe**

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	Hard Reddish Brown SANDY CLAY (CL-Dry to Moist) with Trace Gravel	2.5	AS-1	2.5	NT	NT	
	Hard Mottled White/Light-Reddish Brown SANDY SILT (ML-Dry to Moist) with Trace Gravel	3.5	RS-2	3.8	NT	NT	
5	Hard Light-Reddish Brown SANDY SILT (ML-Moist) with Trace Gravel and 1-5% Cobble	10.0					
10	End of Test Pit						
15							

Excavation Date: **11-8-05**

Field Engineer/Technician: **S. Kulish**

Excavator: **Z. Thomas**

Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-6**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

TEST PIT 051924SF.GPJ GENGEO.GDT 12/16/05

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Dense Light Brown SILTY GRAVEL (GM-Dry) with Sand, Little to Some Clay, 1-10% Cobble, and Trace Boulders up to 1.5'	1.3	AS-1	1.3	NT	NT	
		Test Pit Refusal on Limestone						
5								
10								
15								

Excavation Date: **11-8-05**
Field Engineer/Technician: **S. Kulish**
Excavator: **Z. Thomas**
Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-7**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Hard Light Brown SANDY SILT (ML-Dry) with Gravel and 10-20% Cobble	3.5	BS-1	3.5	NT	NT	
		Test Pit Refusal on Limestone						
5								
10								
15								

Excavation Date: **11-8-05**
Field Engineer/Technician: **S. Kulish**
Excavator: **Z. Thomas**
Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-8**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

TEST PIT 051924SF.GPJ GENGEO.GDT 12/16/05

Depth (feet)	Graphic Log	Equipment Type: Case 580D Extendahoe 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		Hard Light Brown <u>SANDY CLAY/SILTY CLAY</u> (CL-Dry) with Gravel and 10-20% Cobble	1.0	AS-1	1.0	NT	NT	
		Test Pit Refusal on Limestone						
5								
10								
15								

Excavation Date: **11-8-05**
Field Engineer/Technician: **S. Kulish**
Excavator: **Z. Thomas**
Contractor: **Todds Excavation**

Water Level

Depth	Hour	Date
Free Water was Not Encountered		

NT = Not Tested

SPEEDIE AND ASSOCIATES

Log of Test Pit Number: **TP-9**

Rio Bonito Ranch

Verde Valley

Cornville, Arizona

Project No.: **051924SF**

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			UNIFIED SOIL CLASSIFICATION	SPECIMEN DESCRIPTION
						#200 SIEVE	#40 SIEVE	#10 SIEVE	#4 SIEVE	3" SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
TP-1	BS-2	BULK	0.0 - 3.5	NT	NT	46	99	100	100	100	23	15	8	SC	CLAYEY SAND
TP-2	RS-1	RING	3.0 - 4.0	5.6	97.4	59	94	97	98	100	23	10	13	CL	SANDY LEAN CLAY
TP-3	RS-1	RING	2.5 - 3.5	NT	NT	68	95	98	100	100	24	9	15	CL	SANDY LEAN CLAY
TP-4	RS-1	RING	2.5 - 3.5	NT	NT	41	98	99	100	100	24	13	11	SC	CLAYEY SAND
TP-5	AS-1	AS	0.0 - 2.5	NT	NT	42	90	93	95	100	28	11	17	SC	CLAYEY SAND
TP-6	AS-1	AS	0.0 - 2.5	NT	NT	51	75	83	90	100	30	16	14	CL	SANDY LEAN CLAY
TP-7	AS-1	AS	0.0 - 1.3	NT	NT	34	51	57	62	100	NP	NP	NP	GM	SILTY GRAVEL with SAND
TP-8	BS-1	BULK	0.0 - 3.5	NT	NT	54	70	78	83	100	NP	NP	NP	ML	SANDY SILT with GRAVEL
TP-9	AS-1	AS	0.0 - 1.0	NT	NT	60	90	94	97	100	20	14	6	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.

NT=Not Tested

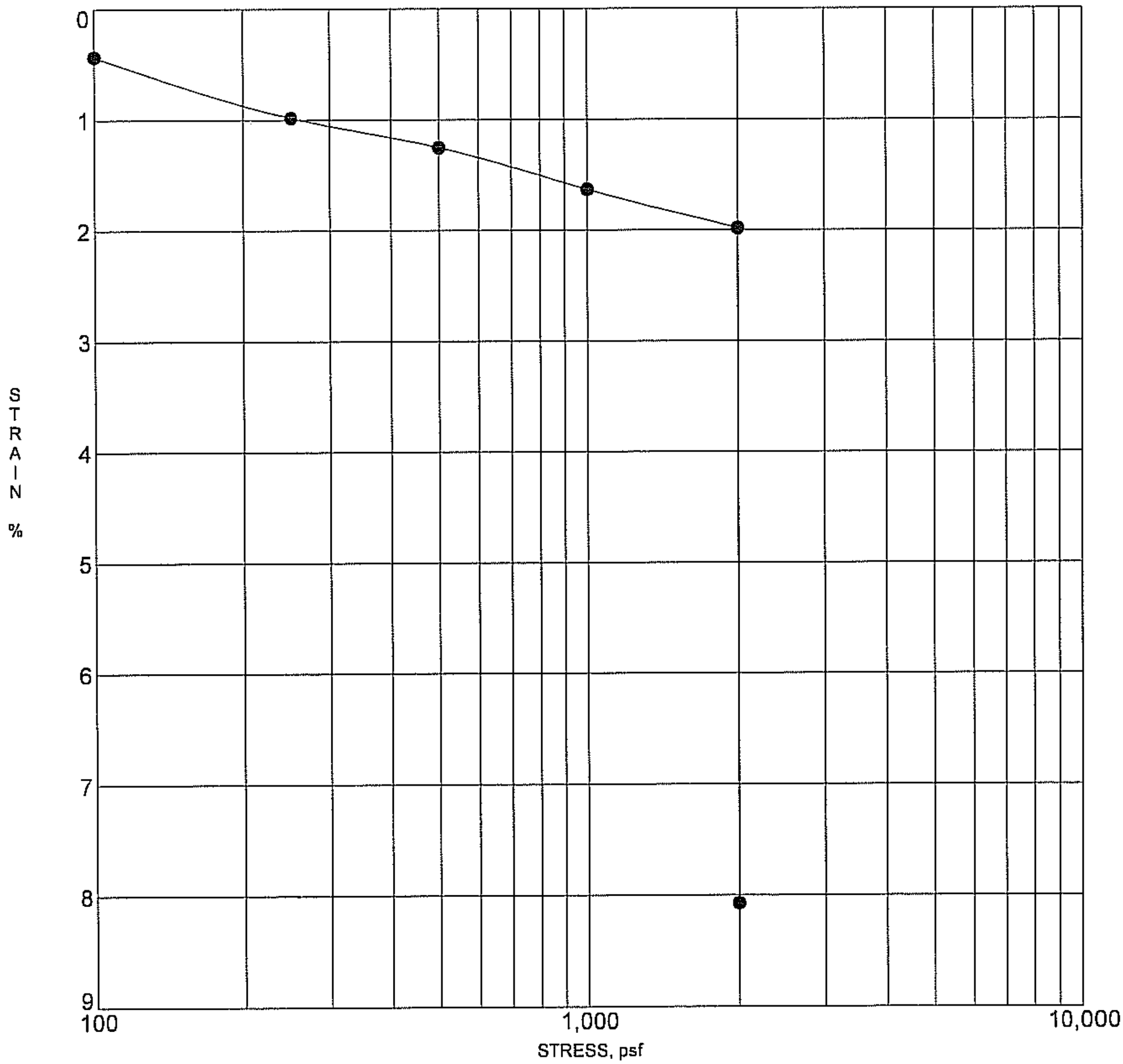
Sheet 1 of 1

Rio Bonito Ranch
Verde Valley
Cornville, Arizona
Project No. 051924SF

SPEEDIE AND ASSOCIATES

CONSOLIDATION TEST

PROJECT:	Rio Bonito Ranch			PROJECT NO.:	051924SF
LOCATION:	Verde Valley			DATE:	11/8/05
BORING NO.: TP-2	SAMPLE NO.: RS-1	SAMPLE DEPTH:	3 to 4	LABORATORY NO.:	V4273
LIQUID LIMIT:	23	PLASTIC LIMIT:	10	PLASTICITY INDEX:	13
CLASSIFICATION:	CL	ASTM SOIL DESCRIPTION:	SANDY LEAN CLAY		



Sample inundated at end of test at 2000 psf

SPEEDIE AND ASSOCIATES

GEOTECH CONSOLIDATION 051924SF.GPJ GENGEO.GDT 12/13/05

MOISTURE-DENSITY RELATIONS

PROJECT: Rio Bonito Ranch | PROJECT NO.: 051924SF

LOCATION: Verde Valley | DATE: 11/8/05

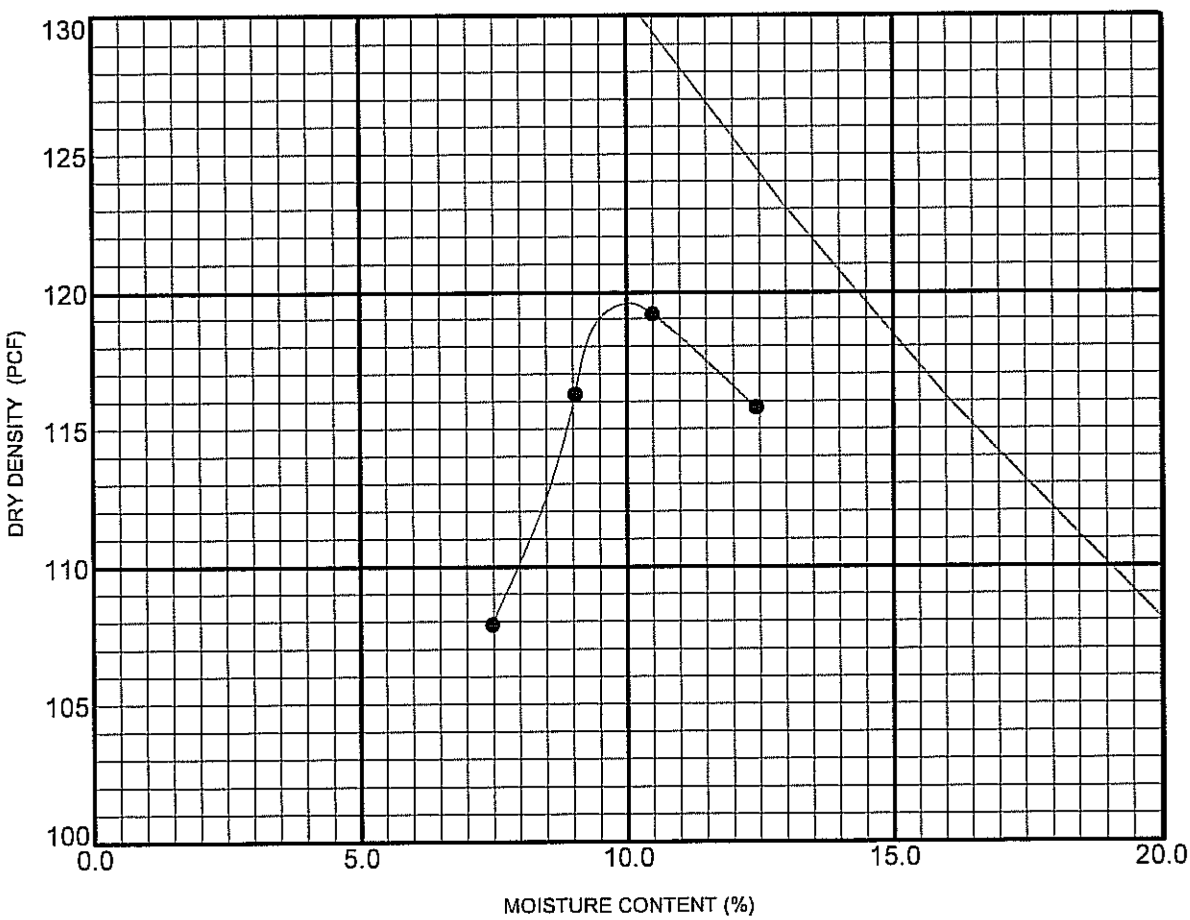
BORING NO.: TP-1 SAMPLE NO.: BS-2 SAMPLE DEPTH: 0 to 3.5 | LABORATORY NO.: V4271

METHOD OF COMPACTION: D698A

LIQUID LIMIT: 23 PLASTIC LIMIT: 15 PLASTICITY INDEX: 8

CLASSIFICATION: SC ASTM SOIL DESCRIPTION: CLAYEY SAND

MAXIMUM DRY DENSITY: **119.8 PCF** OPTIMUM MOISTURE CONTENT: **10.0%**



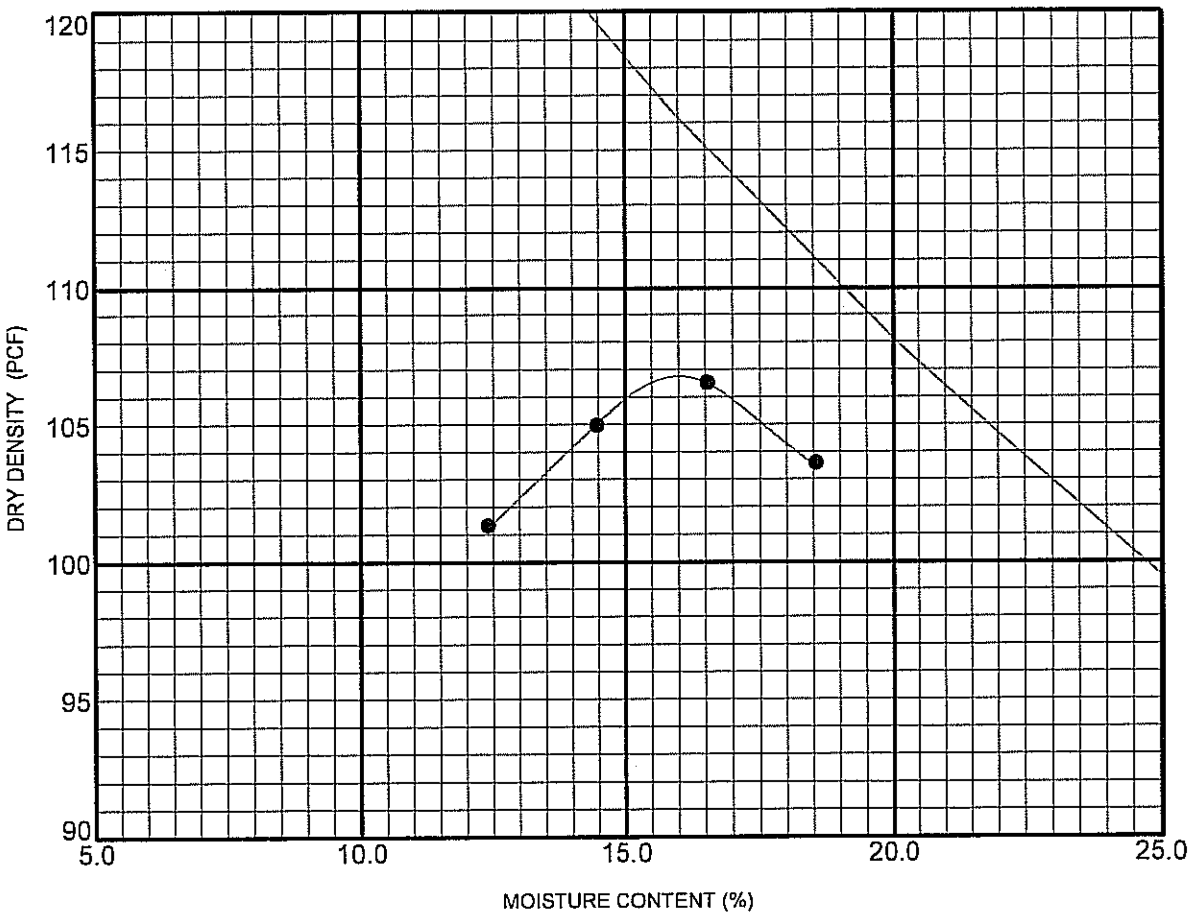
GEOTECH PROCTOR 051924SF.GPJ 12/13/05

SPEEDIE AND ASSOCIATES

MOISTURE-DENSITY RELATIONS

PROJECT: Rio Bonito Ranch
PROJECT NO.: 051924SF
LOCATION: Verde Valley
DATE: 11/8/05
BORING NO.: TP-8 SAMPLE NO.: BS-1 SAMPLE DEPTH: 0 to 3.5
LABORATORY NO.: V4284
METHOD OF COMPACTION: D698A
LIQUID LIMIT: NP PLASTIC LIMIT: NP PLASTICITY INDEX: NP
CLASSIFICATION: ML ASTM SOIL DESCRIPTION: SANDY SILT with GRAVEL

MAXIMUM DRY DENSITY: **106.7 PCF** OPTIMUM MOISTURE CONTENT: **16.0%**



SPEEDIE AND ASSOCIATES

SWELL TEST DATA

BORING or TEST PIT No.	SAMPLE DEPTH, ft	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)	REMOLDED DRY DENSITY (pcf)	INITIAL MOISTURE CONTENT (%)	PERCENT COMPACTION	FINAL MOISTURE CONTENT (%)	CONFINING LOAD (psf)	TOTAL SWELL (%)
TP-1, BS-2	3.5	119.8	10.0	115.1	7.5	96.0	16.9	100	5.4
TP-8, BS-1	3.5	106.7	16.0	101.9	14.2	95.5	22.4	100	1.8

Rio Bonito Ranch
Verde Valley
Cornville, Arizona
Project No. 051924SF

SPEEDIE AND ASSOCIATES

SWELL TEST 051924SF.GPJ GENGEO.GDT 12/13/05

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

January 10, 2006

Brian Carlson
Majestic Development Co.
2230 N. Ricke
Flagstaff, AZ 86004

RE: Addendum No. 1
Project No. 051924SF
Rio Bonito Ranch
El Rancho Bonito Rd.
Cornville, AZ

Dear Brian:

At your request, we have provided a PT-Slab option for the above referenced report. Based on the local geology, the field investigation performed, and the laboratory data, we have modeled a low to moderate swelling condition and have assumed the following design parameters based on the information available using VOLFLO 1.5 for the design of post tension slab on grade foundations.

Edge Moisture Variation, e_m		Differential Movement, y_m	
Edge Lift:	2.8 ft.	Edge Lift	1.0 in.
Center Lift	4.9 ft	Center Lift	0.5 in.

Special site preparation will require clearing and grubbing the surface, and scarifying the exposed grade to a depth of 12 inches, moisture conditioning and re-compacting. To **reduce** (not eliminate) the swell potential beneath the slab, reduced compaction requirements (90-95%) and requiring higher moisture contents (optimum to +3) during pad preparation can be used. In general, the P-T Slab can be cast directly on the prepared subgrade. If a base material is used, such as sand, or other granular material, or other membrane, such as polyethylene sheeting, the structural design should take into account a proper slab-subgrade coefficient of friction value for the selected material. Most contractors prefer to have a granular material to aid in fine grading or concrete curing. Typically a minimum 2 to 4-inch layer of crushed rock is sufficient.

A Modulus of Subgrade Reaction, k, of 100 pci may be used for the design of slabs-on-grade. The PT Slab should be designed with 24 inch turn downs (for frost protection) below lowest finished exterior grade within 5 feet of the structure. With this embedment depth, an allowable bearing capacity of 1,250 psf may be utilized for design of PT Slabs.

Since we do not determine the slab thickness or if base material is to be used, our only requirement is that the specified 24 inches of embedment depth (for frost protection) from final grade, for exterior turndowns, is met. Any soils backfilled along the turndowns must be compacted to prevent erosion and a pathway for water migration.

Post-tensioned slabs-on-grade should be designed in accordance with the Post-Tensioning Institute guidelines "Design and Construction of Post-Tensioned Slabs-on-Grade", Second Edition. This type of foundation system is more flexible and may require special design and construction of the super-structure to allow for this flexibility.

As discussed in the report, exterior slabs-on-grade will require frequent jointing 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 and/or causing a tripping hazard. Pinning typically consists of 24-inch long reinforcing steel dowels placed at 12-inch centers.

Drainage must not be overlooked, it is paramount to provide 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. Roof drains must be directed to the pavement or storm drains. They should not be allowed to discharge into planters adjacent to the structure. Irrigated planters adjacent to the structures should be kept at a minimum and/or the use of low water use plants (xeriscape).

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

Respectfully submitted,
SPEEDIE & ASSOCIATES

REGISTERED GEOLOGIST
CERTIFICATE NO.
32166
TIMOTHY J.
RHEINSCHMIDT
Date Signed 1-10-06
ARIZONA, U.S.A.

Timothy J. Rheinschmidt, R.G.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
14388
GREGG ALAN
CREASER
Date Signed 1-10-06
ARIZONA, U.S.A.

Gregg A. Creaser, P.E.

SPEEDIE AND ASSOCIATES
Geotechnical ▪ Environmental ▪ Materials Engineers

Gregg A. Creaser, P.E.
Brett P. Creaser, P.E.
Donald L. Cornelison, P.E.
Steven A. Griess, P.E.
Keith R. Gravel, P.E.
Jason C. Wells, P.E.
Brian E. Lingnau, Ph.D., P.E.
Timothy J. Rheinschmidt, R.G.
Richard A. Schooler, R.G.
Todd B. Hanke, P.E.

April 30, 2007

Brian Carlson
Majestic Development Co.
2230 N. Ricke
Flagstaff, AZ 86004

RE: Project No. 051924SF - Rio Bonito Ranch
El Rancho Bonito Rd.
Cornville, Arizona
ADRE R4-28-A1203 Summary

Dear Mr. Carlson,

Speedie & Associates have issued a Report on Geotechnical Investigation, Project No. 051924SF, dated December 29, 2005 combined with Addendum No. 1 dated January 10, 2006 for the subject site. This Report presents the results of a subsurface soil investigation for the purpose of determining the engineering properties of the soils and to provide recommendations for the design of the foundations, site grading and paving. This letter presents a summary of that Report. Refer to the full report for more details. Note that the sitemap provided for the original report has been revised, including lot numbers and roadway infrastructure, and is included in this letter.

Construction is presumed to consist of an approximately 85 acre, 33 lot subdivision, with associated infrastructure including paved roadways. It is assumed that structures will consist of single-family, one to two story, slab-on-grade wood framed and/or masonry structures. Lots 1 through 5 and Lots 28 through 33 are located along Majestic Vista Lane and Bonito Ranch Loop are on an upper plateau. Lots 6 through 27, located along Bonito Ranch Loop, are below the degredated limestone cliff face and are nestled on a river terrace of a paleo-river channel from Oak Creek. The lots are to be a gated private residential subdivision. Oak Creek is situated southwest of the upper and lower developments. There is also an irrigation ditch that bisects the upper and lower developments, and flows into Oak Creek. This irrigation ditch will be used to provide irrigation water to Lots 6 through 27 and to provide water to the pond that will be used for fire protection. The subject site is not located in an area that is known for excessive ground subsidence or earth fissures due to groundwater withdrawal.

The site is bounded on the north by Swinging Bridge Lane, on the south by floodplain and inhabited residential structures, on the east by inhabited residential structures, and on the west by an inhabited ranch. At the time of the investigation the site was covered with Creosote bushes and Prickly Pear cacti in the upper portion of the development where Lots 1 through 5 and lots 28 through 33 are located (Zone B). The lower portion of the development where Lots 6 through 27 are located (designated as Zone A for the report) was formerly ranch grazing land and was covered in low-lying grasses and weeds. At the time of the investigation, there was evidence of previous development, including a gravel road cut into the degredated limestone cliff face leading from the upper lots to the lower lots and also irrigation pipes from prior ranchers' watering systems. Site drainage is generally towards the south-southwest.

The field investigation indicates the subsoil conditions at the site are consistent, but are variable between the upper and lower lots depending on the topography. The low-lying lots have distinctly different engineering properties than that of the elevated lots. The rough boundaries of these zones are identified on the Test Pit Location Plan presented in the original Geotechnical Investigation.

Within Zone A, the subsoil conditions are somewhat consistent, typically consisting of 2.5 to 4.5 feet of clayey sand. The underlain soils typically consist of sandy silt and sandy clay with subordinate amounts of gravel, river cobble, and occasional small boulders. Pocket Penetration Test values range from 1 to ≥4.5 tons per square foot (tsf) in the upper soils. Values of ≥4.5 tsf were typically encountered in the upper 6 feet identified as sandy clays and clayey sands. 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 in Zone A indicates liquid limits on the order of 23 to 30 percent with plasticity indices from 8 to 17 percent. In-place densities of the upper soils is on the order of 97 pcf with moisture contents at 6 percent. Volume increase due to wetting (swell potential) of the upper soils is on the order of 5.4 percent when re-compacted to moistures and densities normally expected during construction and confined to 100 psf. An undisturbed sample displayed a significant volume decrease of 8.1 percent due to inundation when subjected to 2000 psf.

Within Zone B, the subsoil conditions are somewhat consistent, typically consisting of 1.0 to 3.5 feet sandy silty clay, sandy silt, and silty gravel with subordinate amounts of limestone gravel and cobble. Underlying these upper soils is a shelf of slightly weathered freshwater limestone of the Verde Formation. Penetration Test values of ≥4.5 tsf were encountered in the upper soils. Based on visual and tactile observation, the upper soils were in a 'dry' state at the time of investigation, typically below the plastic limit of the soil. 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.

Laboratory testing in Zone B indicates liquid limits on the order of 20 percent with plasticity indices from non-plastic to 6 percent. Swell potential due to wetting of the upper soils is on the order of 1.8 percent when re-compacted to moistures and densities normally expected during construction and confined to 100 psf. No undisturbed samples were taken by ring-sampling methods due to the presence of gravel, cobble, and shallow limestone bedrock.

Based on the findings in our investigation, the subject site is suitable for the support of the proposed residential structures imposing relatively light foundation loads provided certain remedial actions are taken to improve the soils and the bearing soils are not subjected to water inundation.

In general, the soils encountered during the investigation consisted of high plasticity 'fat' clay, sandy clay, clayey sand, and limestone bedrock with subordinate amounts of gravel and cobble. Based on the soils encountered, construction of residential type structures on standard shallow foundation systems is typically subject to remedial earthwork or specialized foundation systems are recommended for areas with expansive soils.

This site has highly expansive soils within Zone A. The swell (expansion) potential of the high plasticity clays on site are typically strong enough to cause differential movements and damage to structures in addition to concrete slabs-on-grade such as floors and sidewalks. These differential movements are typically a result of post construction fluctuation in moisture contents. Preventing moisture changes under the foundations in addition to concrete slab-on-grades is critical to reducing potential movement. With residential construction, this is extremely difficult due to drainage and landscaping changes incorporated by the various homeowners. Potential homeowners **must** be made aware of the risks associated with the expansive soils on site and restrictions on grading and landscaping adjacent to foundation elements and concrete slabs. Typical recommendations when properly executed, will help reduce, but not necessarily eliminate the swell potential.

Typical recommendations include removal of the expansive soils and placement of several feet of non-expansive material beneath foundations and concrete slabs, or utilize suspended wood floor construction. Attention must be paid to **provide and maintain** proper drainage to limit the potential for water infiltrating under slabs and foundations. A minimum slope of at least 5 percent for a distance of 10 feet is recommended in unpaved landscaped areas. The lots should be uniformly graded away from the structures and drainage should not be allowed to discharge towards adjacent or proposed structures. Irrigation systems and planters requiring heavy watering should **not** be placed against the foundations. Roof drains should be installed and directed to discharge to either storm drains or the pavement, not unpaved planters adjacent to the structures. Based on the swell potential of the clayey soils, these recommendations alone on typical shallow spread footing and slab-on-grade construction may not be sufficient without significant structural damage occurring.

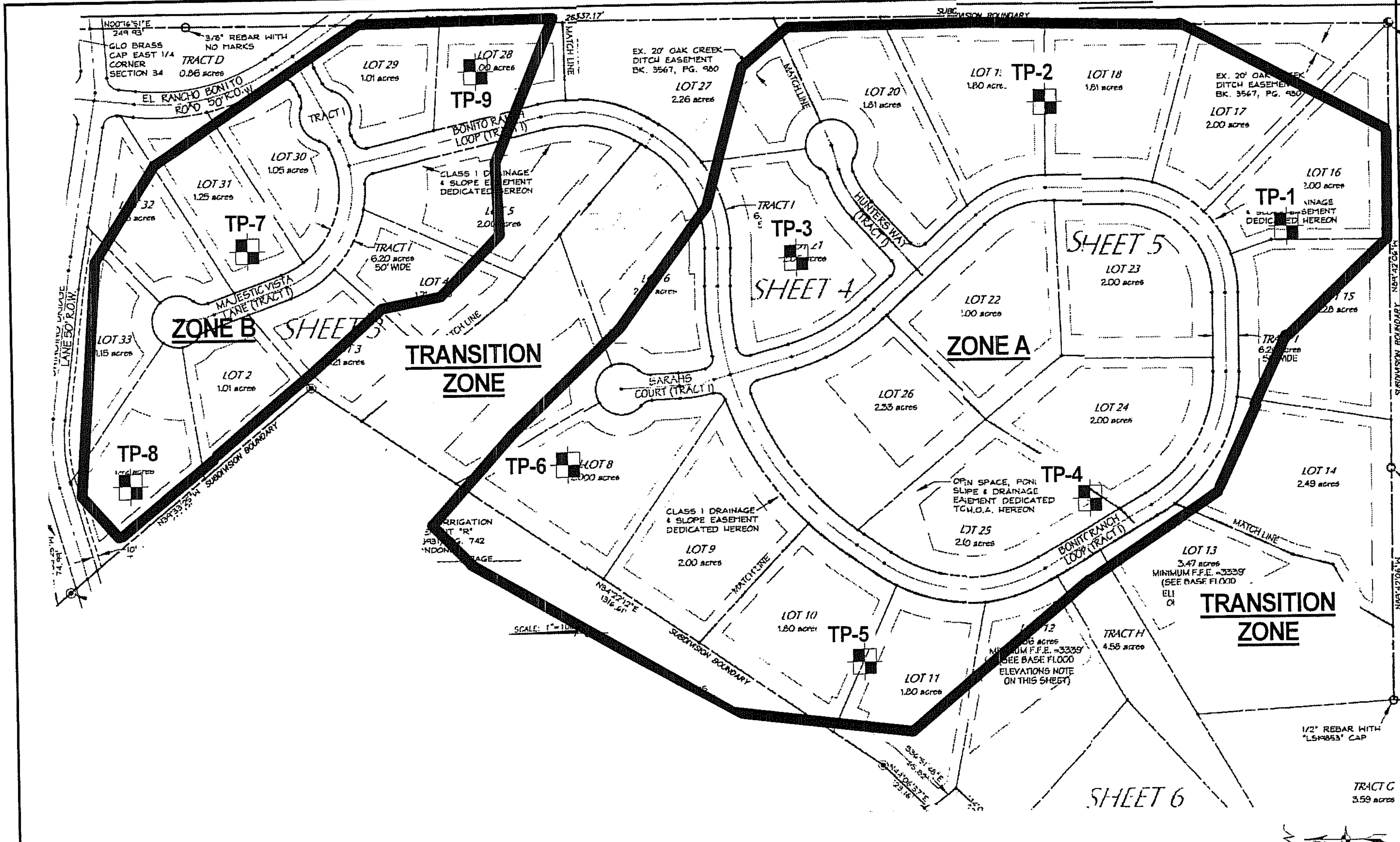
Remedial earthwork or specialized foundation systems can further reduce the potential for structural damage. Remedial earthwork beneath foundations typically consists of carrying the foundations to a depth in which moisture fluctuations are reduced, placing foundations directly on competent bedrock, or the construction of a barrier wall to prevent moisture infiltration. Specialized foundation systems include mat foundations or the use of a post-tension foundation/slab-on-grade system. Both of these foundation systems are designed to move with the expanding soils. Post tensioned slabs should be designed in accordance with the procedures given in the *Design and Construction of Post-Tensioned Slabs-on-Ground, by the Post Tensioning Institute*. This type of foundation system is more flexible and may require special design and construction of the superstructure and interior walls to allow for this flexibility.

Respectfully Submitted,
SPEEDIE & ASSOCIATES, INC.

Amanda G. Perkins, G.I.T.

Gregg A. Creaser, P.E.

Registered Professional Engineer (Civil)
Certificate No. 14388
GREGG ALAN CREASER
Date Signed 4.30.07
ARIZONA, U.S.A.



■ – APPROXIMATE TEST PIT LOCATIONS

Drawing Courtesy of Majestic Development Co.

TEST PIT LOCATION PLAN					Rio Bonito Ranch Verde Valley Cornville, Arizona
DR: SMK	CHK: CS	REV: AGP	DATE: 04-25-07	PROJECT NO. 051924SF	

SPEEDIE AND ASSOCIATES
GEOTECHNICAL/ENVIRONMENTAL/MATERIALS ENGINEERS
4025 E. HUNTINGTON, SUITE 140 FLAGSTAFF, ARIZONA 86004

TMPLT 2000.CAD 10/23/00